Compact spatial planning and transit-oriented development for climate change mitigation

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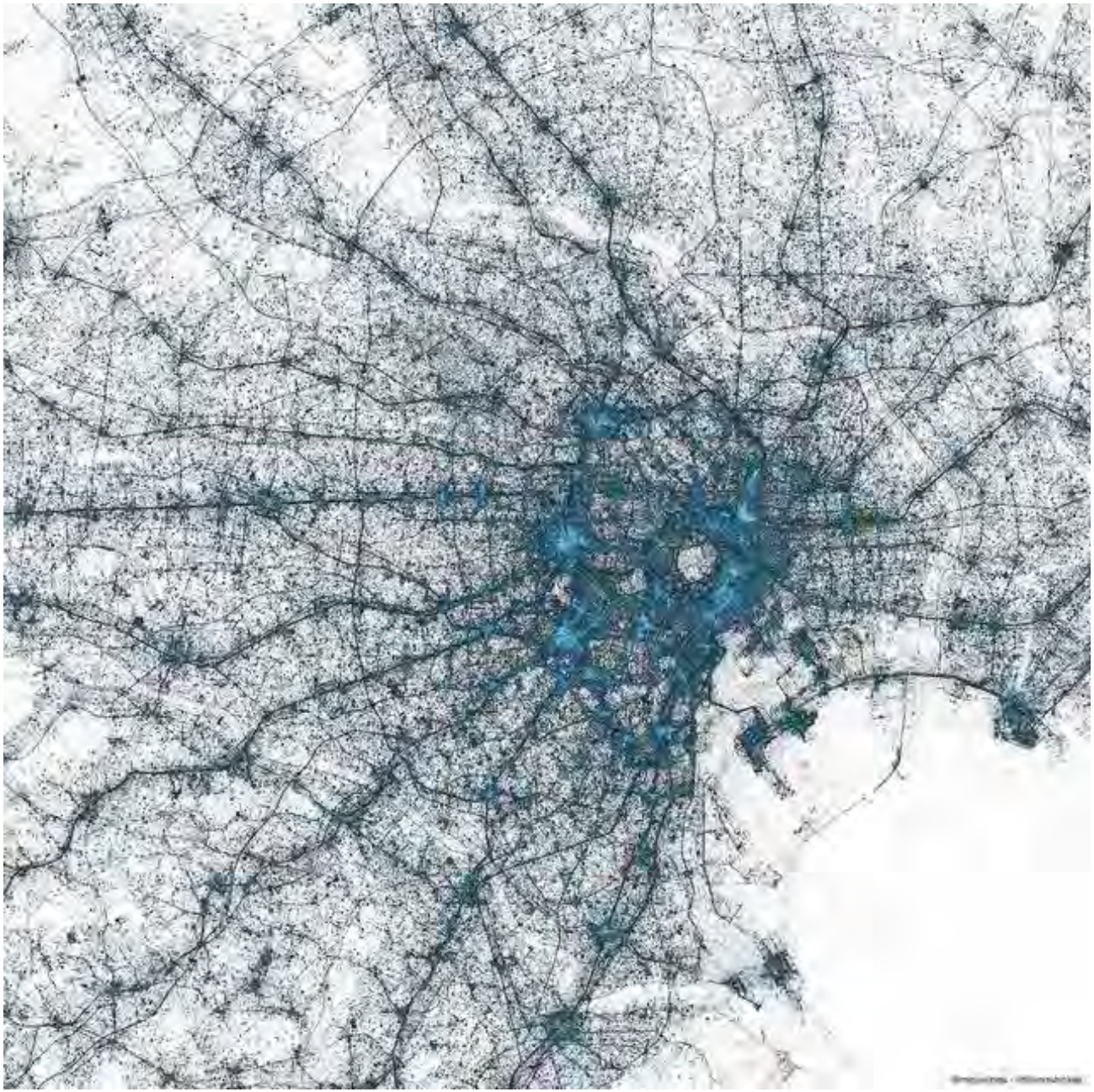
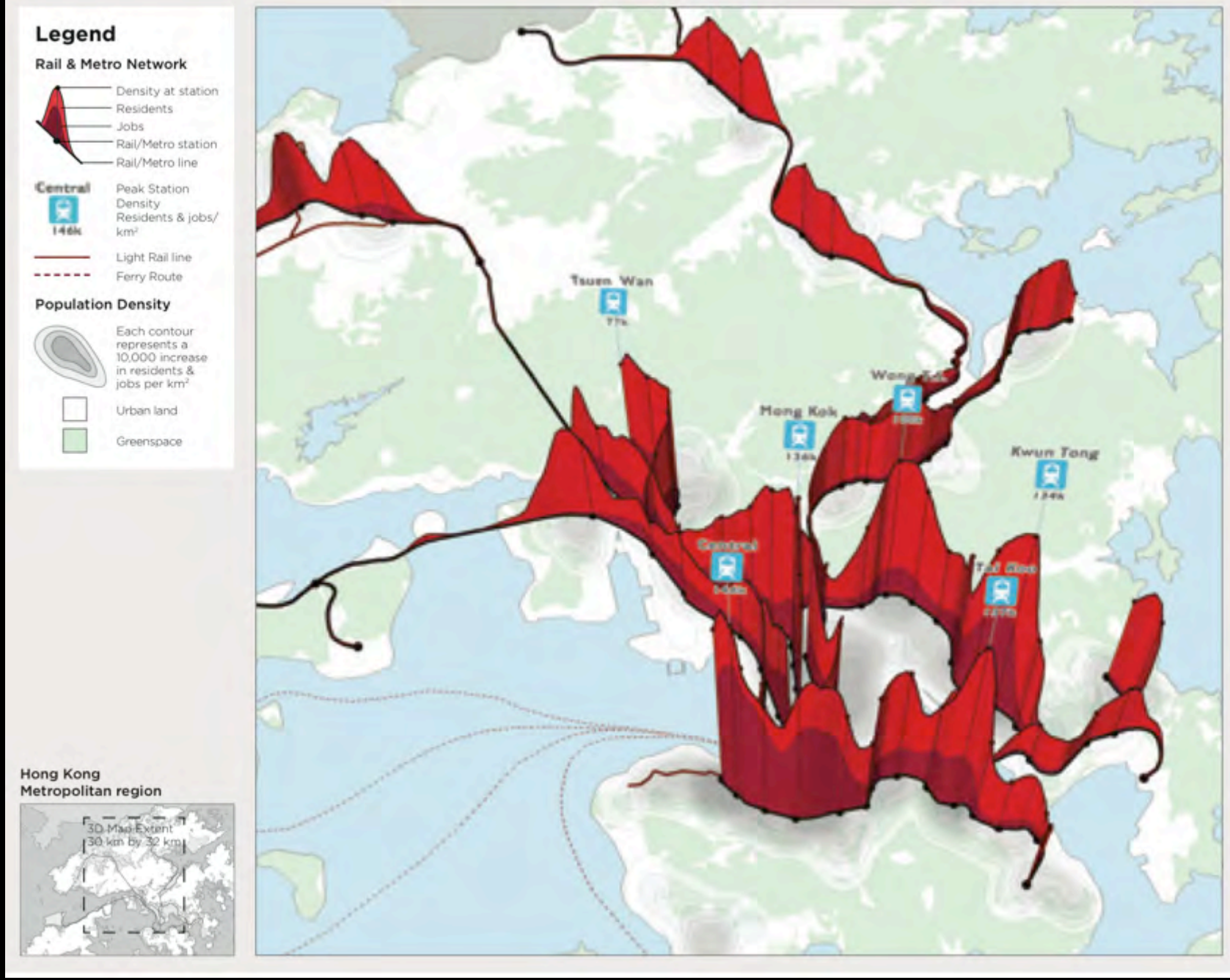
Compact spatial planning and transit-oriented development are policies to manage urban growth and shape urban densities (population and jobs) in an efficient way for delivering economic growth and social inclusiveness while mitigating climate change.

They rest on an integration of spatial and transportation planning and on concentrating densities along transit lines and around major transit nodes.

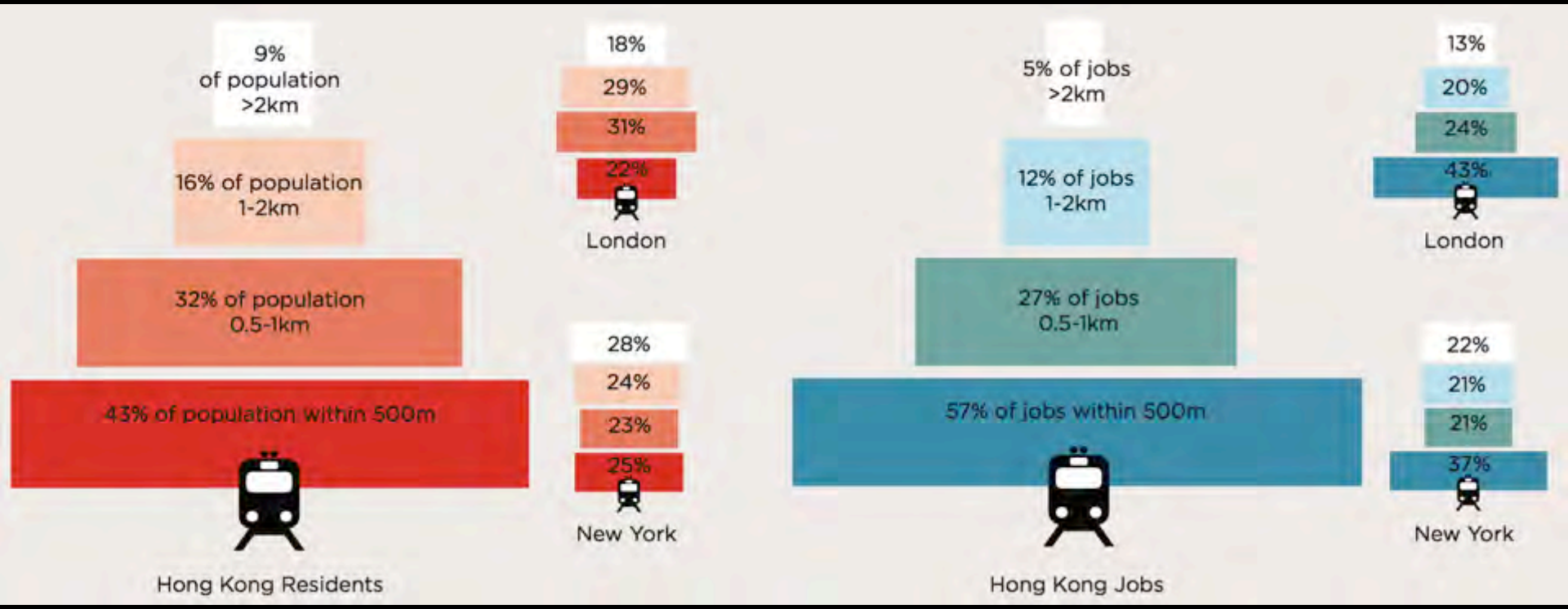
1. Which spatial development patterns best contribute to GHG emissions reductions, climate change mitigation, and economic growth?



Tokyo tweets map reveals that density of human activity and interaction is structured by transit lines and nodes



Hong Kong jobs and population densities are aligned with transit lines. Source: LSE Cities

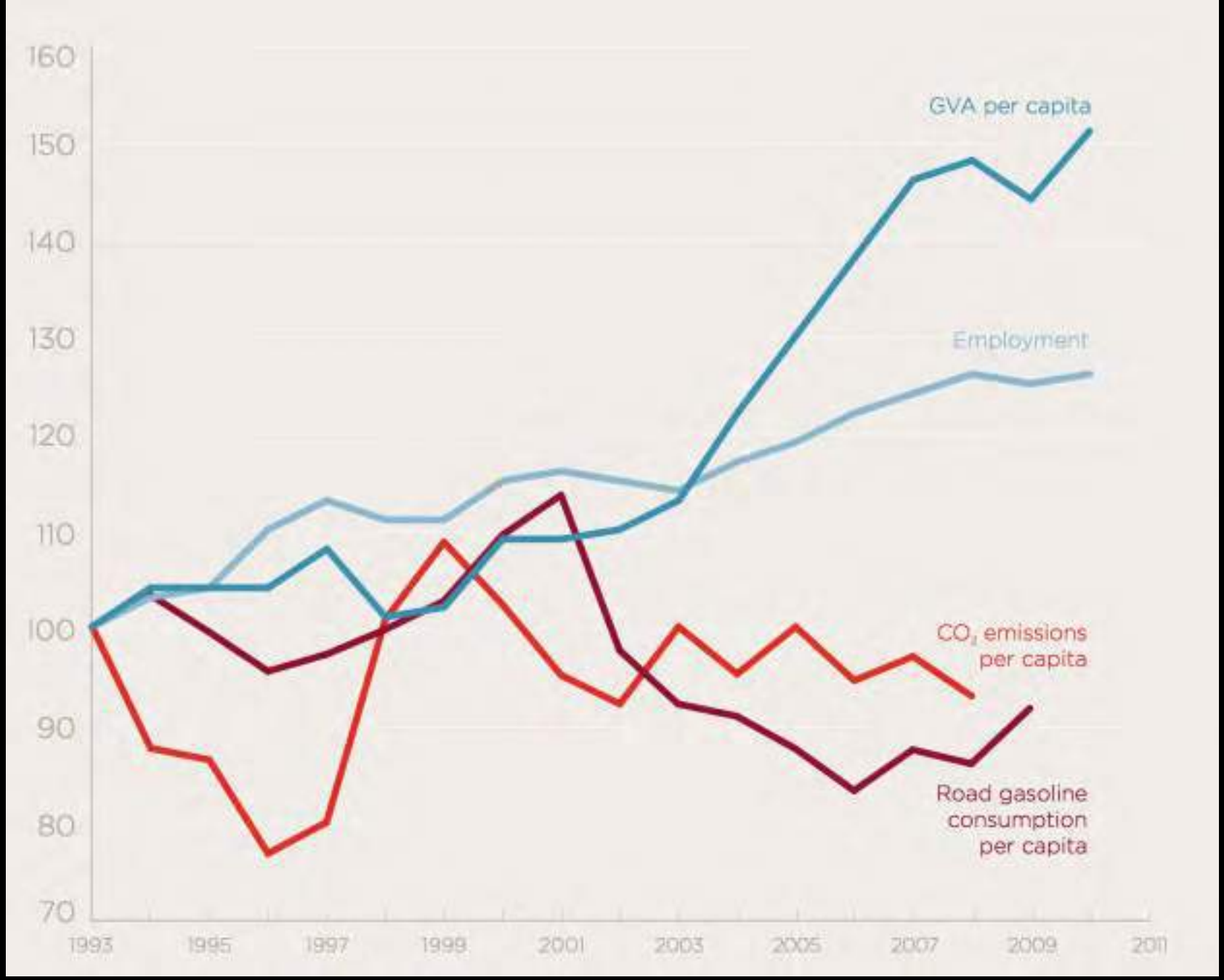


Pedestrian accessibility to rail and metro stations in Hong Kong. Source: LSE Cities

- As a result of Hong Kong's approach to integrating transport and land-use planning, 43% of the population (3 million people) live within 500m of an MTR station and 75% live within 1 km of a station . Public transport is used for 90% of all motorized journeys and the car ownership rate (56 per 1000 people) is lower than any other city of similar wealth (as a comparison, the average rate in OECD countries is 404 per 1000 people).

- The city's exceptionally high levels of residential density – averaging 21,900 people per km2 within the built-up area, 6,300 people per km2 across the entire territory and peaking at 123,300 people per km2 at North Point – has also created one of the most walkable cities in the world. 45% of trips are undertaken by foot.

- These transport patterns have resulted in very low transport-related energy use and carbon emissions. It is estimated that annual carbon emissions from passenger transport are 378 kg per person, compared with around 1000 kg in European cities and over 5,000 kg in Houston, USA.



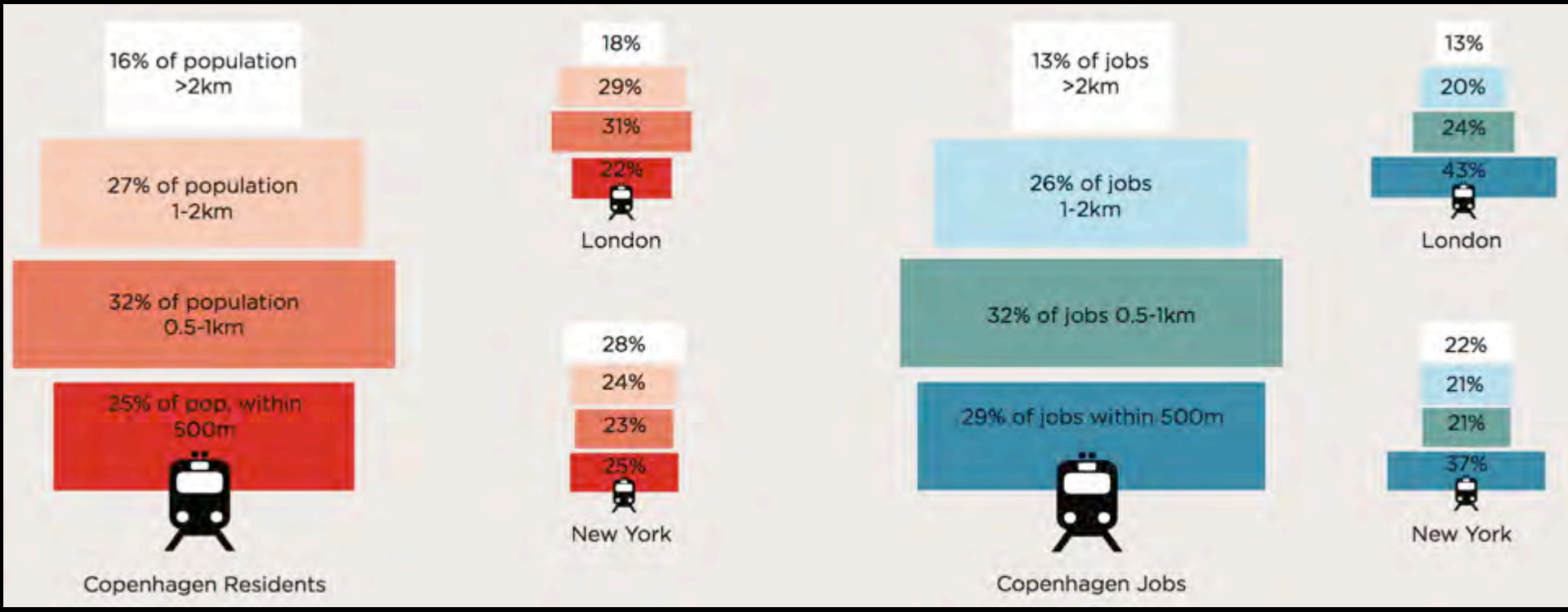
Green growth in Hong Kong. Source LSE Cities

- Hong Kong's efficient transport network creates various economic benefits for the city, including agglomeration, competitiveness, and cost-saving benefits. Thanks to its well-used and efficient public transport network, Hong Kong spends around 5% of GDP on motorized travel, compared with 12-14% in motorized cities such as Melbourne and Houston.

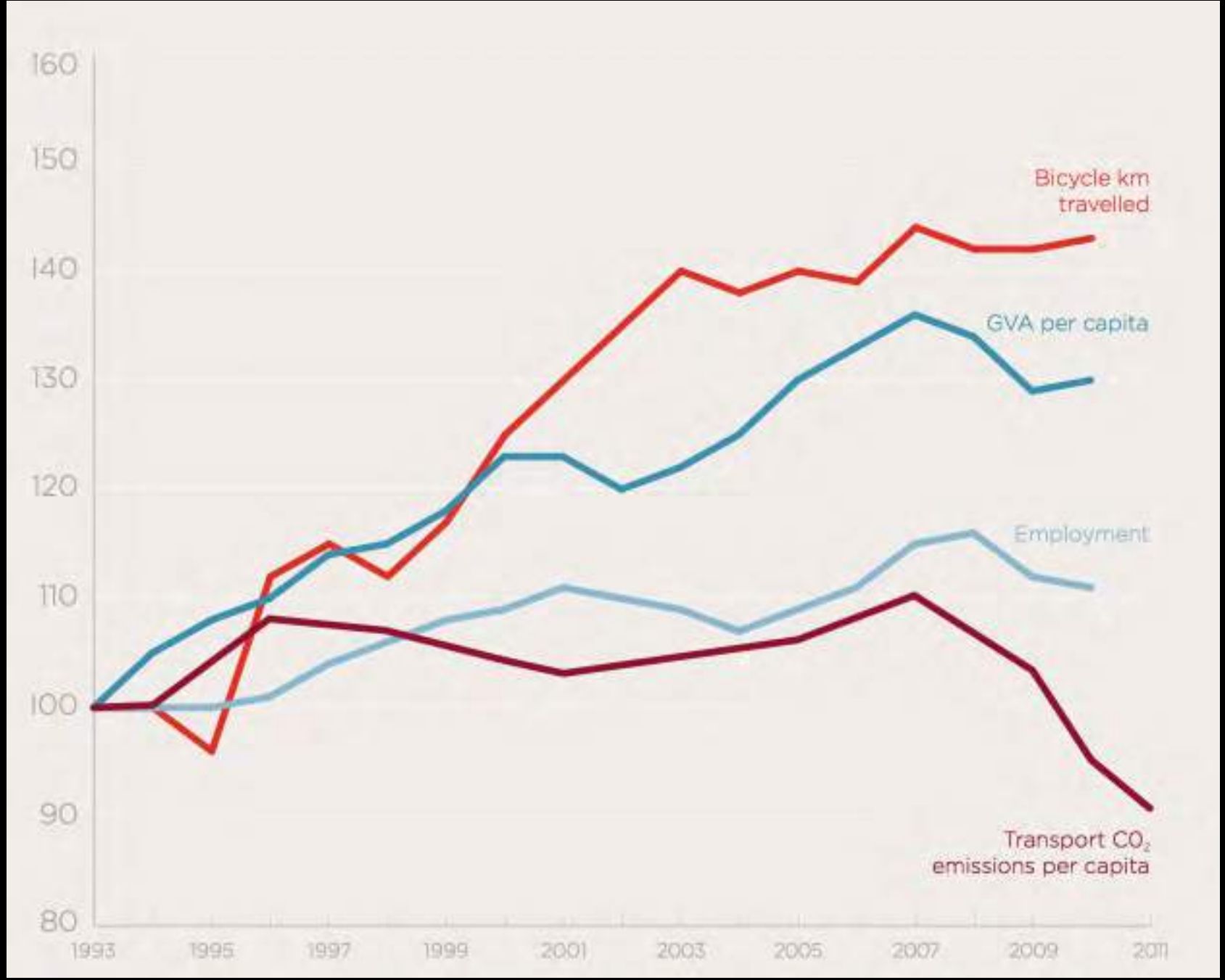
- The city's dense urban form and efficient transport system supports agglomeration economies, including access for firms to a large pool of skilled labor within easy commuting distance, and a high density of firms in the inner-city which improves networking opportunities and face-to-face interaction. The latter is known to be particularly important for service-sector industries, and assists Hong Kong in the goal of securing its position as a global financial hub.

- Hong Kong's integrated 'Rail plus Property' model allows the MTRC to operate as a profitable enterprise, resulting in cost savings for taxpayers from an unsubsidized public transport system. Despite receiving no subsidies, passenger fares are low by international standards and fare increases have been below inflation during the past five years. The MTRC calculates that direct financial benefits to the Hong Kong government resulting from the 'Rail plus Property' have totaled HK$210bn (US $27bn) since the establishment of the company in the 1970s. While the government provided initial investment funds for the first MTR lines, the value of the company (publicly listed in 2000) has since grown considerably and payments from developers for the land value premium resulting from the building of rail infrastructure have totaled almost HK$100bn (US$12.9bn).

Copenhagen jobs and population densities are aligned with transit lines. Source: LSE Cities

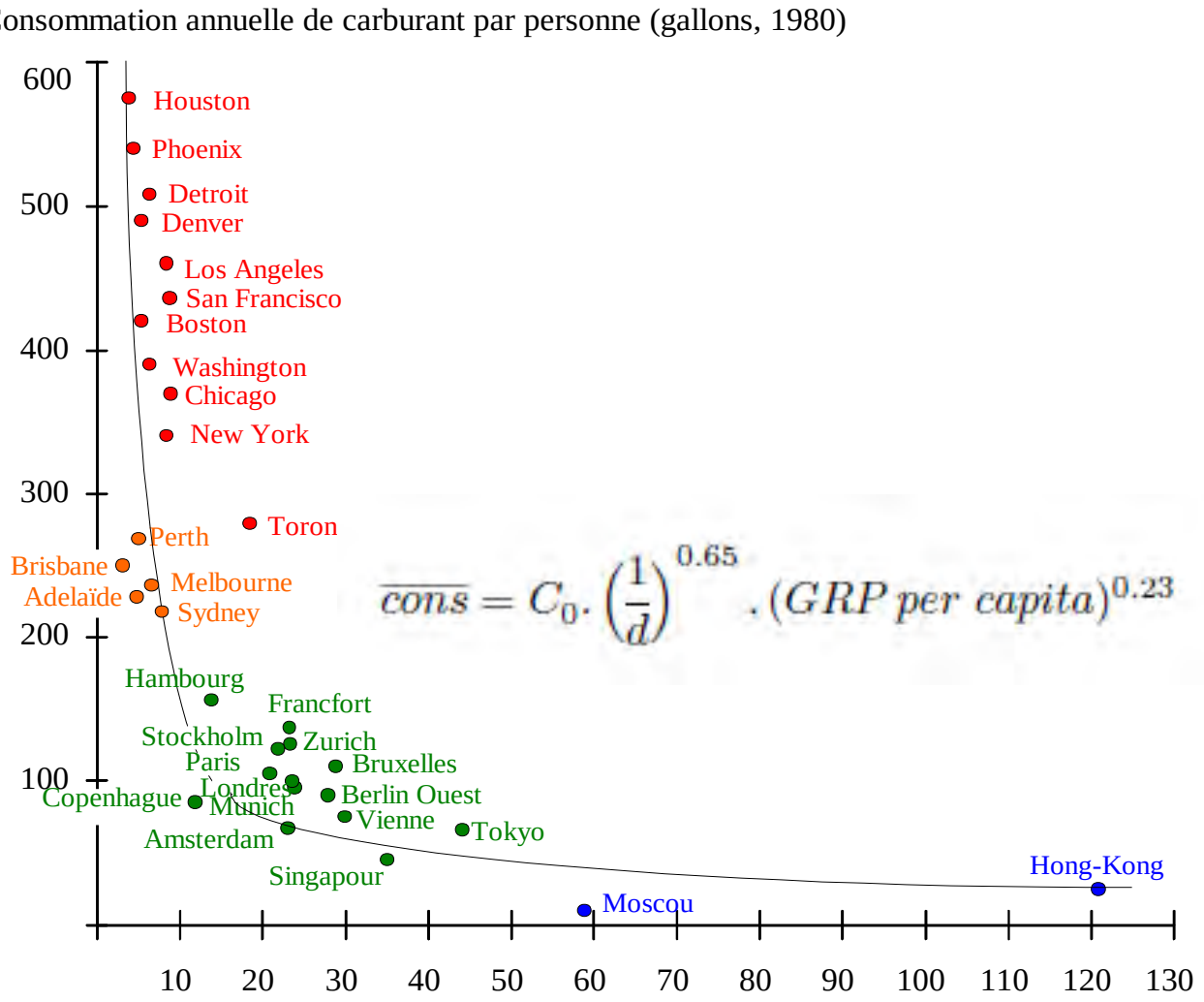


Pedestrian accessibility to rail and metro stations in Copenhagen. Source: LSE Cities



Green growth in Copenhagen. Source LSE Cities

2. What is the impact of compact spatial planning and TOD on transportation energy?



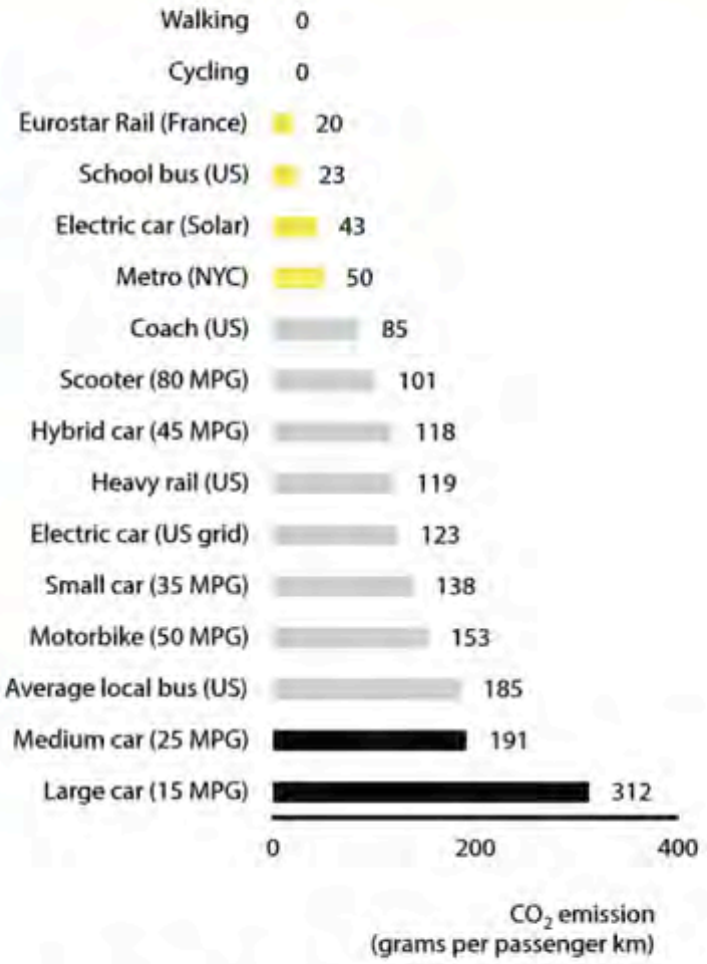
Données : Newmann et Kenworthy, 1989

Share of green transport modes and carbon emissions per capitacities

Cities	Share (%) of public transport, walking and cycling	CO_2 emissions (kg per capita per year)
Hong Kong	89%	378kg
Tokyo	68%	818kg
Berlin	61%	774kg
Paris	54%	950kg
London	50%	1,050kg
Madrid	49%	1,050kg
Montreal	26%	1,930kg
Houston	5%	5,690kg

Source: Bongardt et al 2013

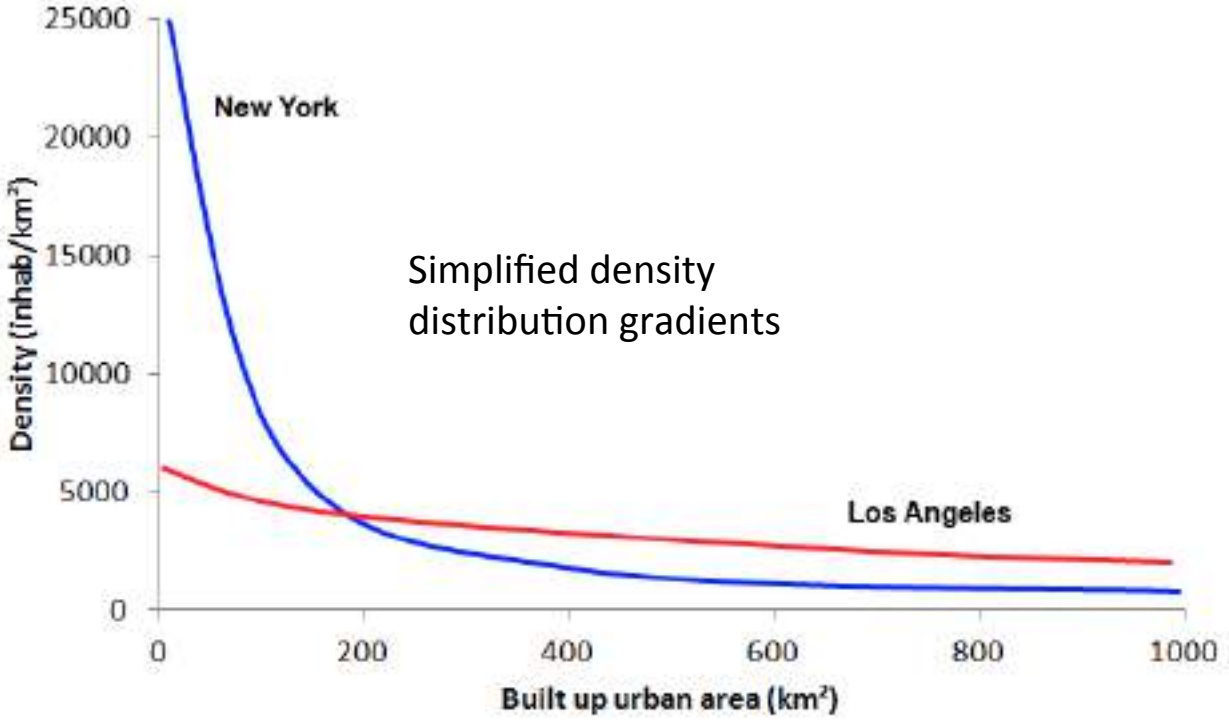
Emissions per passenger km by urban transport mode



Source: LSE Cities 2014 based on STF 2014

Average densities are not sufficient to explain energy intensities
Density distribution patterns matter

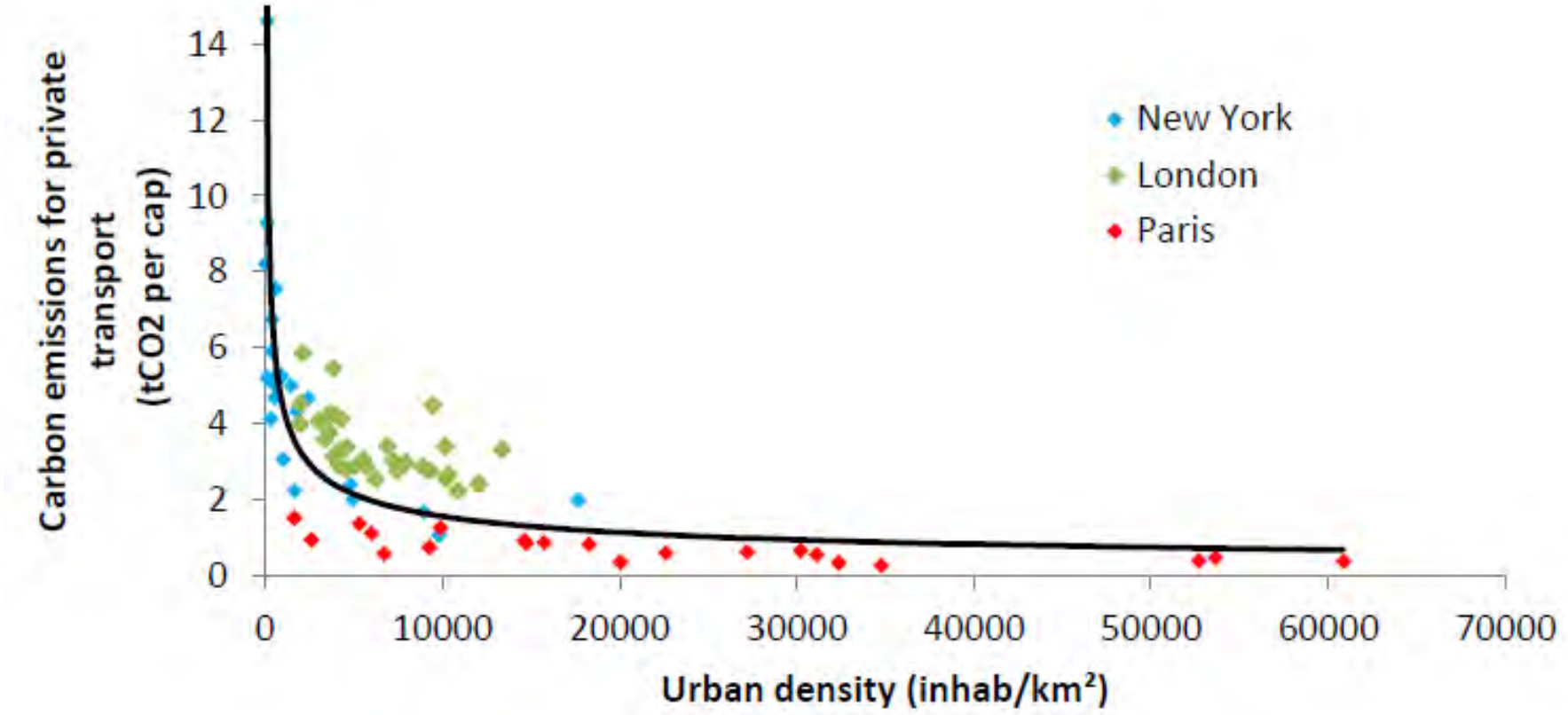
CITY	Population density (inhab/km²)	Private transport energy use (GJ/ cap/yr)	Total GHG (tCO2e/cap)
Los Angeles	2400	55	13
New York	1900	46	10.5



Simplified density distribution gradients

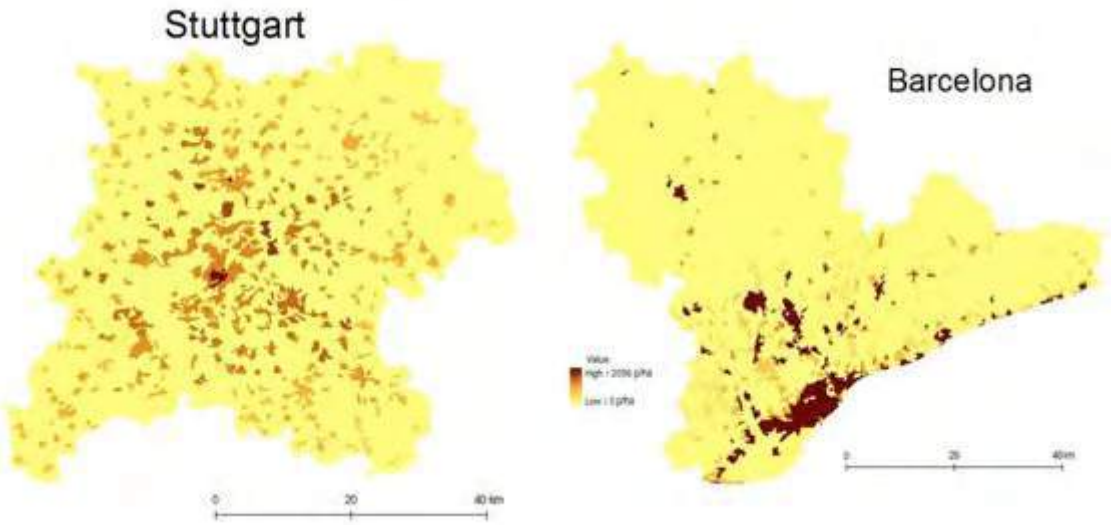
Source: Urban Morphology Institute

Intra urban emissions and densities are unevenly distributed within urban space



GHG Emissions and density in Paris (by IRIS) in NYC (by county) and in London (by borough)
Source: Loeiz Bourdic, Urban Morphology Institute

Entropy versus hierarchy



Stuttgart is an example of high entropy urban spatial structure: density is scattered homogeneously over the entire urban area.
Barcelona is an example of an urban area with a high hierarchy of density distribution.

Entropy and hierarchy are calculated using a grid of N 200x200m cells, each with a density Pi.
Resting upon this grid, entropy and hierarchy (alpha parameter) are calculated using the following formulas:

$$\text{Entropy} = \frac{\sum_{i=1}^{N} \frac{p_i}{P_N} \log\left(\frac{p_i}{P_N}\right)}{\log N}$$

Hierarchy $p_k = P_0 k^{-\alpha}$

Source: Urban Morphology Institute

What is the impact of density distribution of transport energy consumptions?

$$Energie = C_0\, PIB^{0.35}\, dens^{-0.14}\, hier^{-0.52} entrop^{0.86}$$

Multivariate analysis resting upon 34 European cities
(Data partially extracted from Le Néchet 2011)

4 factors impact on per capita transportation energy consumption:

- **GDP per capita** (elasticity 0,35)
- **Average density** (elasticity -0,14)
- **The entropy of the density distribution** (elasticity 0.86): The more homogenous the density distribution, the higher the energy consumption for transportation per capita.
- **The hierarchy of the density distribution** elasticity -0.52): The higher the hierarchy of the density distribution, the more efficient the urban structure, and the lower the energy consumption for transportation per capita.

$$Entropie = \frac{\sum_{i=1}^{N} \frac{p_i}{P_N} \log\left(\frac{p_i}{P_N}\right)}{\log N}$$

$$p_k = P_0 k^{-\alpha}$$

Source: Urban Morphology Institute

Impact of urban morphology on heating energy
Compactness and shape factor

Shape factor
$S/V^{2/3}$

In Haussmannian Paris
SH=9,32

Paris, 1968-1975
SH=13,8

Compactness
S/V

Size factor
$1/V^{1/3}$

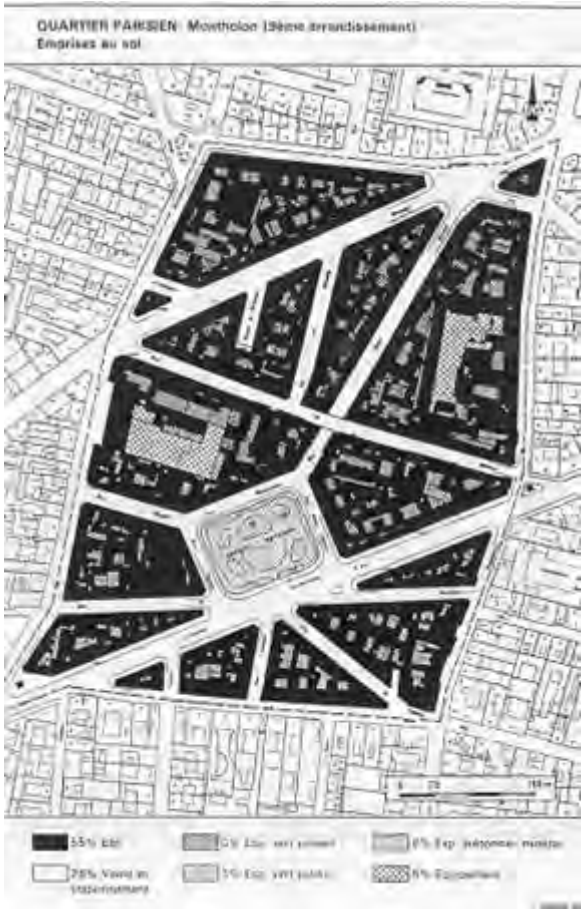
Source: Urban Morphology Institute

Compactness and passive volume ratio

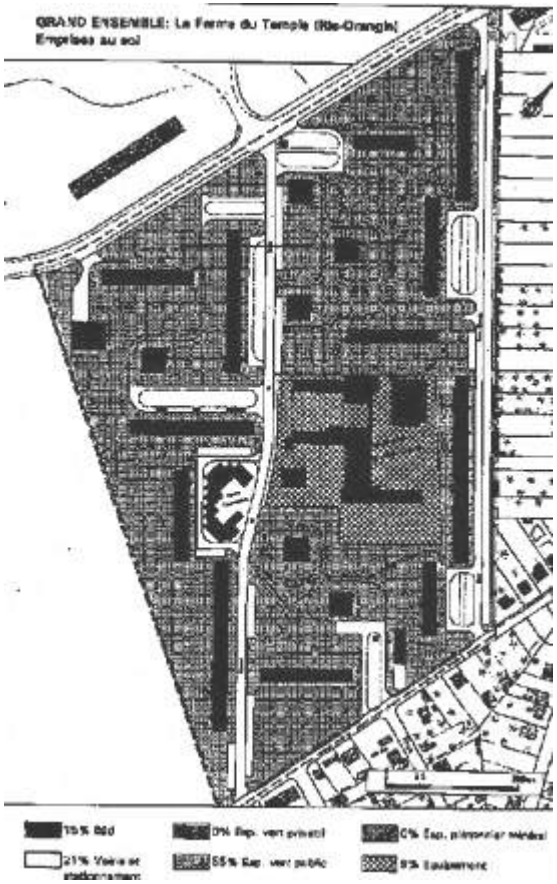
Climate variations: courtyard fabrics

Type of urban fabric	1 Block	Linear Buildings	9 blocks	1-level courtyard	2-levels courtyards	3-levels courtyards
S/V	0.08	0.12	0.13	0.10	0.12	0.19
Passive volume ratio	17 %	58 %	46 %	33 %	60%	100 %

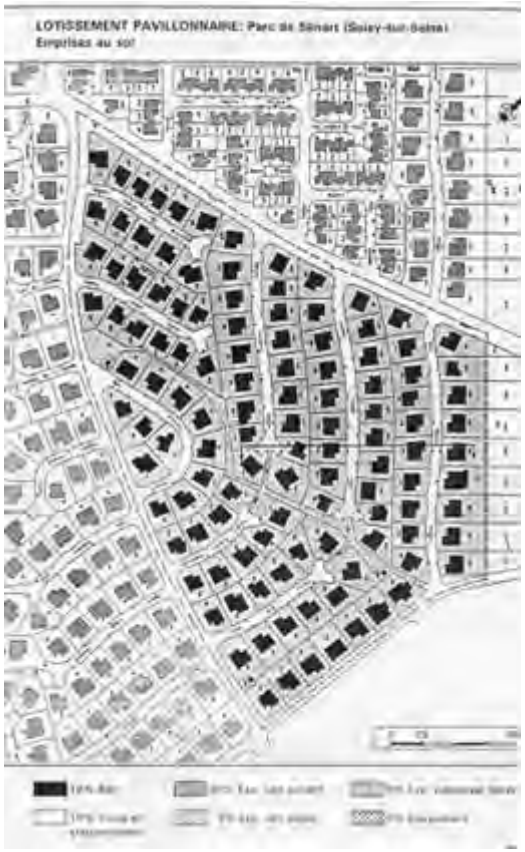
COURTYARDS/SLABS/DETACHED HOUSES



COS:4,5



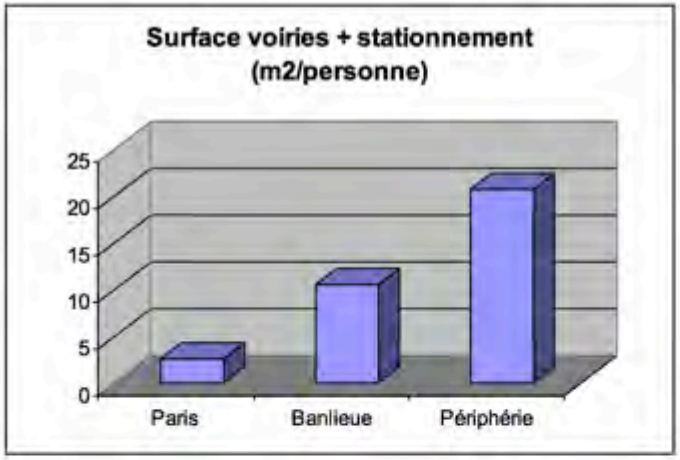
COS:1,25



COS: 0.5

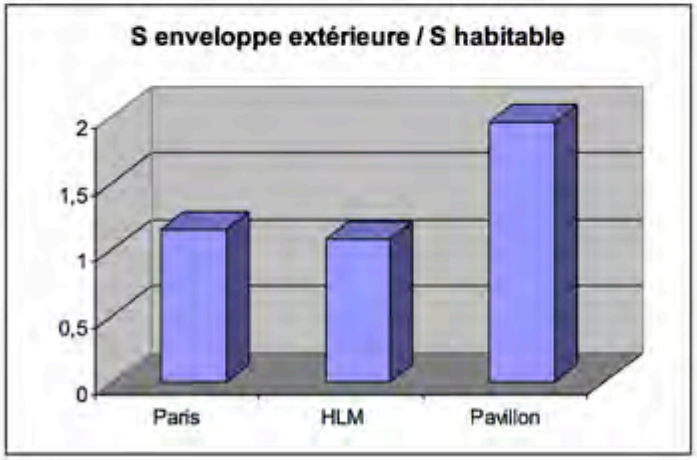
Source: JP Traisnel

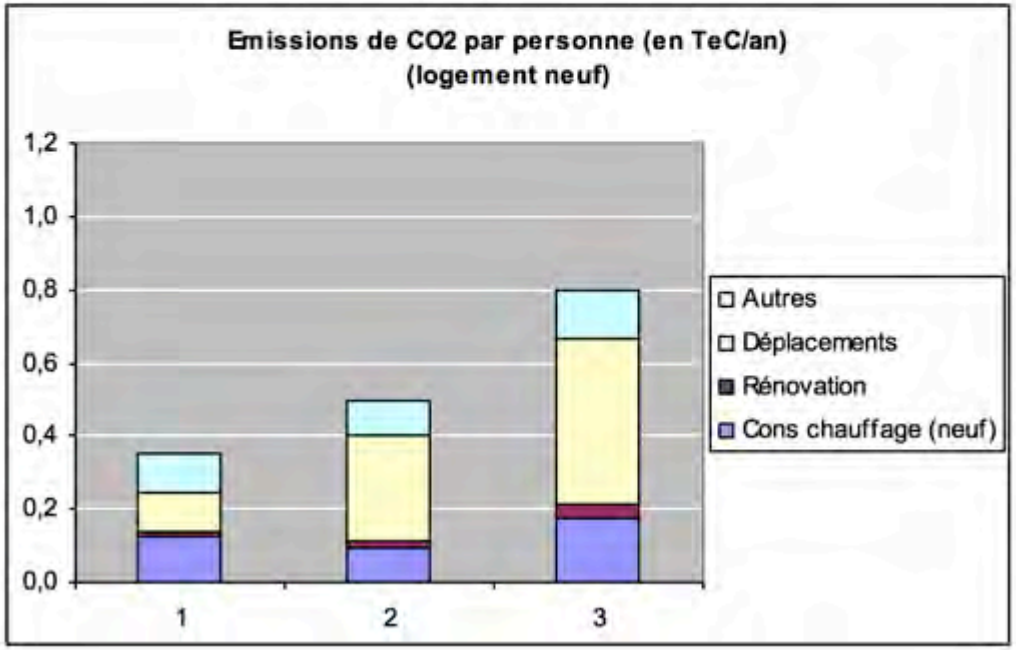
COURTYARDS/SLABS/DETACHED HOUSES
The transportation energy /heating energy impact



Région IdF:

1. Paris (immeuble urbain)
2. Banlieue (grand ensemble)
3. Périphérie (pavillonnaire)





Source: JP Traisnel

Traditional urban forms

Traditional urban forms

- A high urban built density,
- A good shape factor,
- A high cyclomatic number and low distance between intersections.
- Heating needs around 100 kWh/m²/yr

	FAR	Shape factor	Cyclomatic number 800 x 800m	Average distance between intersections (m)	Heating needs (kWh/m²/yr)
Barcelona (Barrio Gotico)	4,94	9,31	123	50	136,97
Toledo	2,98	8,44	121	40	91,18
Turin (quadrilatero Romano)	4,63	8,8	75	70	127,99

Source: Urban Morphology Institute

Extensions in the 19th century

XIXth century urban forms

Density, compacity and connectivity are high. These urban forms are the natural evolution of the previous forms. The heating needs slightly increase (from approx. 100 to 125 Kwh/m²/yr).

	FAR	Shape factor	Cyclomatic number 800 x 800 m	Average distance between intersections (m)	Heating needs (kWh/m²/yr)
New York (Manhattan)	4,77	8,76	27	150	113
Paris (Haussmann)	4,49	9,32	77	150	129,13
Turin (collective medium size buildings)	2,95	9,87	77	80	121,69

Source: Urban Morphology Institute

The upheaval of Modernism

The upheaval of modernism

In the last 60 years, modernist urbanism has produced two different types of urban forms:

- High rise, out of scale developments
- Low rise suburban neighborhood

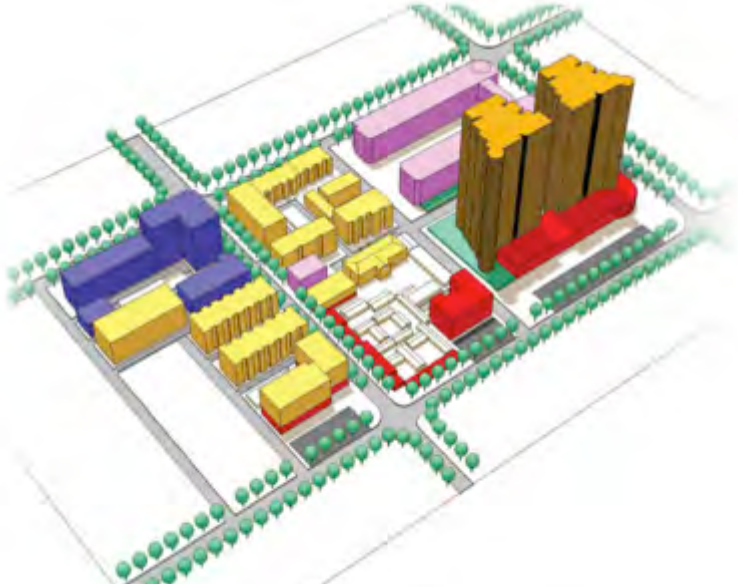
Both of them are not sustainable: they have poor connectivity, poor compactness and poor density. Heating needs increase tremendously: from approx. 125 to 200/300 kWh/m²/yr

	FAR	Shape factor	Cyclomatic number 800 x 800 m	Average distance between intersections (m)	Heating needs (kWh/m²/yr)
Brasilia	0,34	15,49	26	400	-
New York (sprawl)	0,4	11,35	19	200	350
Le Corbusier	3,57	19,66	4	400	140,88
Washington (sprawl)	0,41	11,98	4	300	203,34

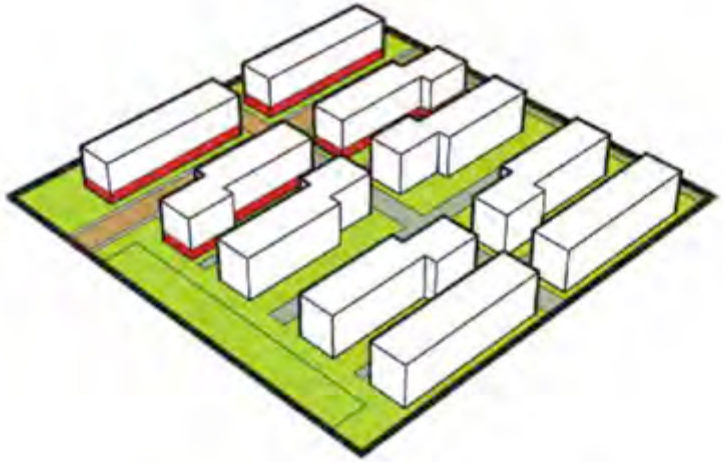
Source: Urban Morphology Institute

SUPERBLOCKS: ENERGY INTENSIVE URBAN FORMS

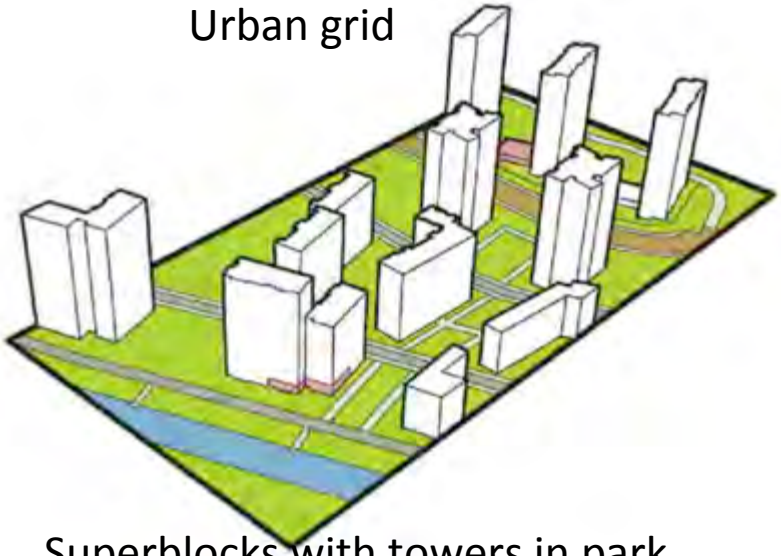
Traditional settlement



Urban grid

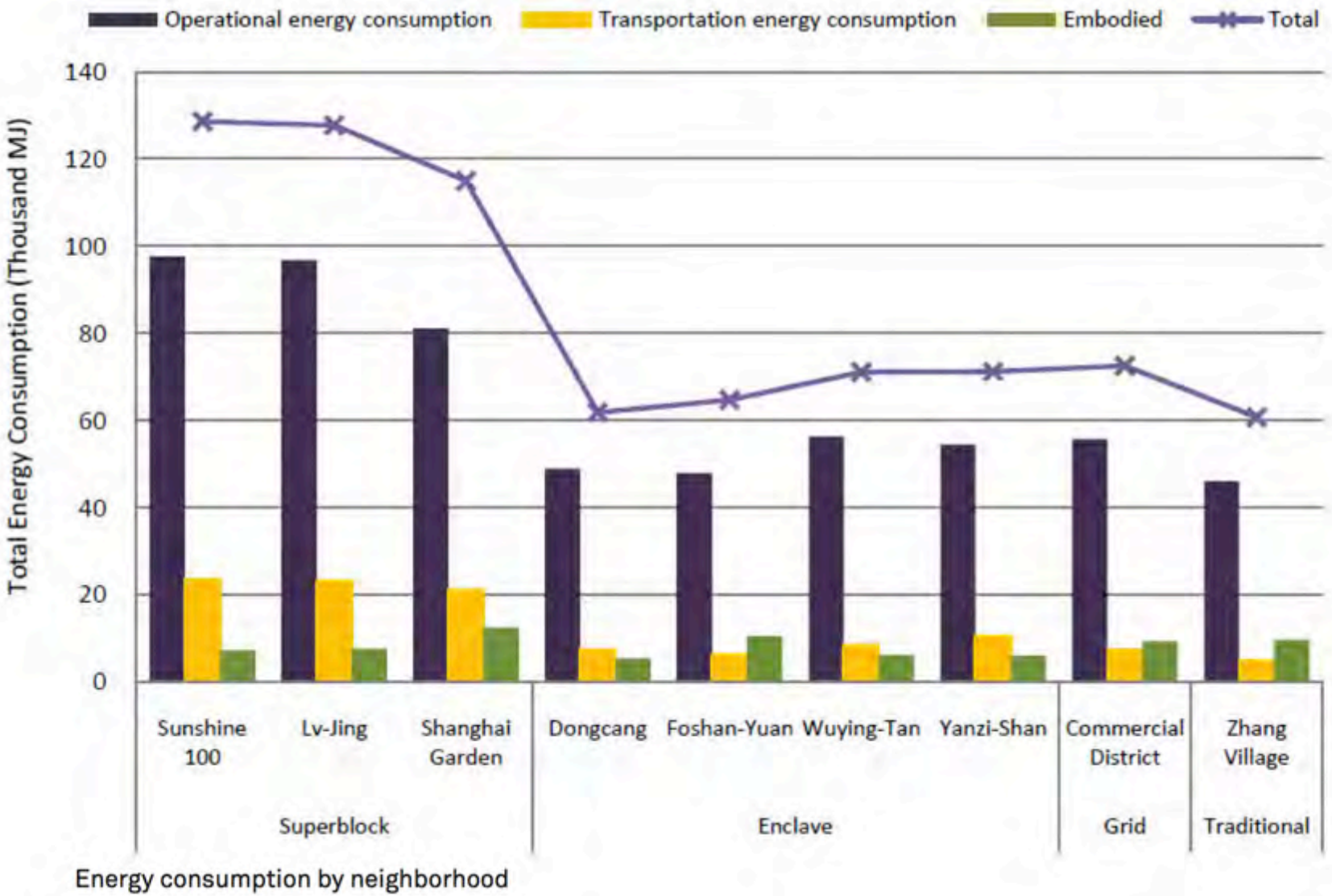


Enclave of low rise slabs



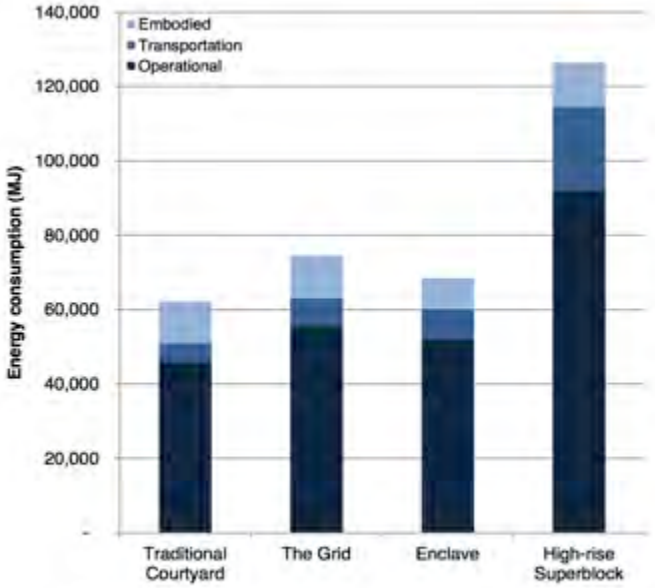
Superblocks with towers in park

4 urban forms in Jinan Source: MIT



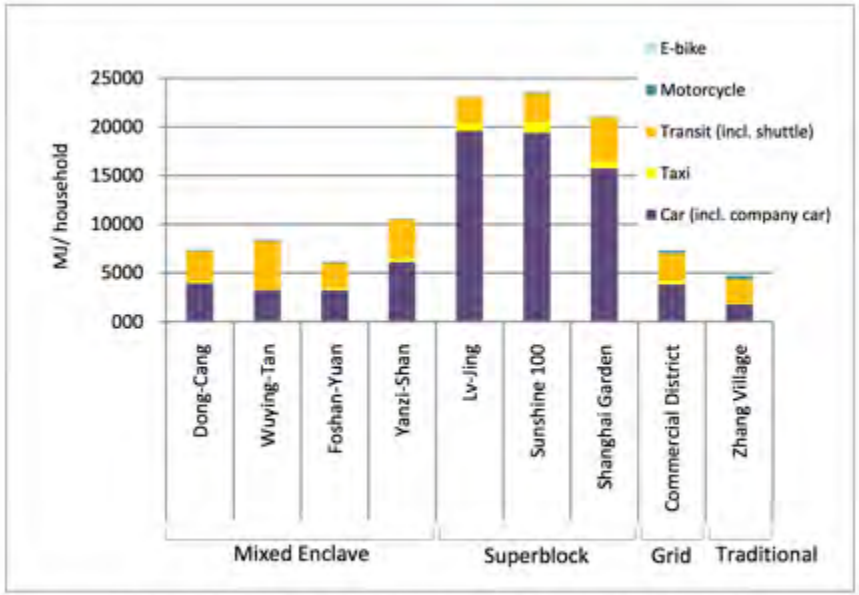
Energy consumption by neighborhood

Source: MIT

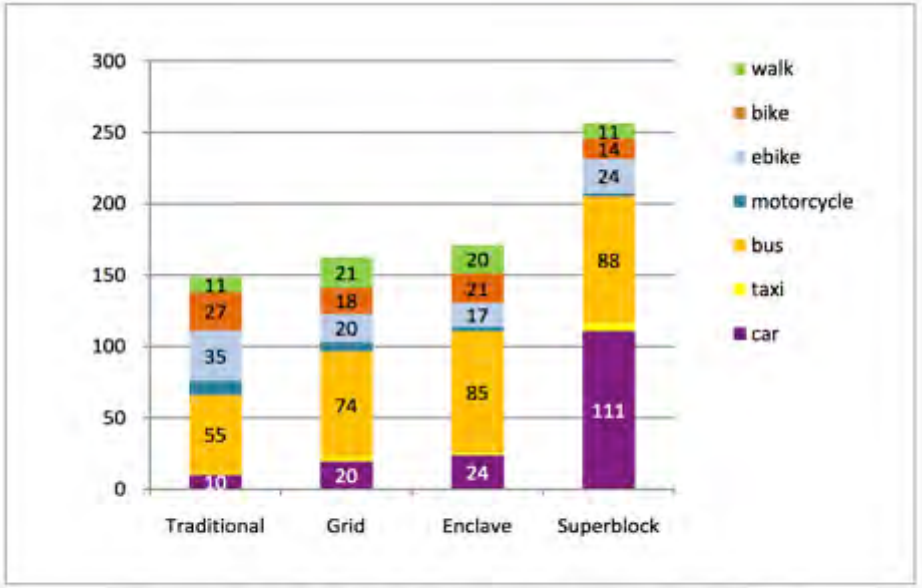


Energy consumption by prototype

Source: MIT (top)
and Energy Foundation (below)



Average household annual transportation energy consumption by development type.



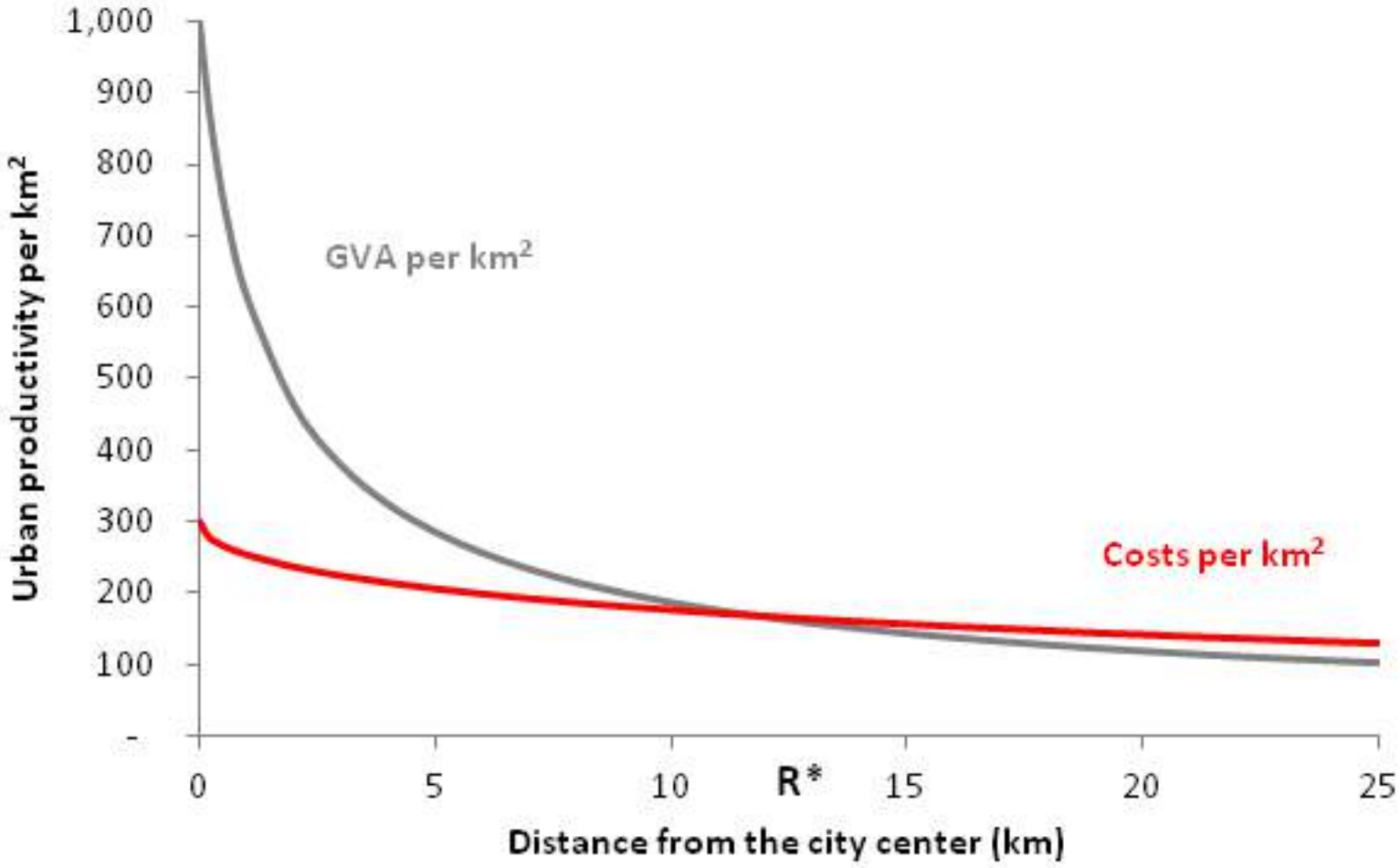
Average household weekly Travel Distance (km) across the four Neighborhood Typologies

3.What impact of compact development on urban costs?

GDP/km^2 decreases with spatial expansion

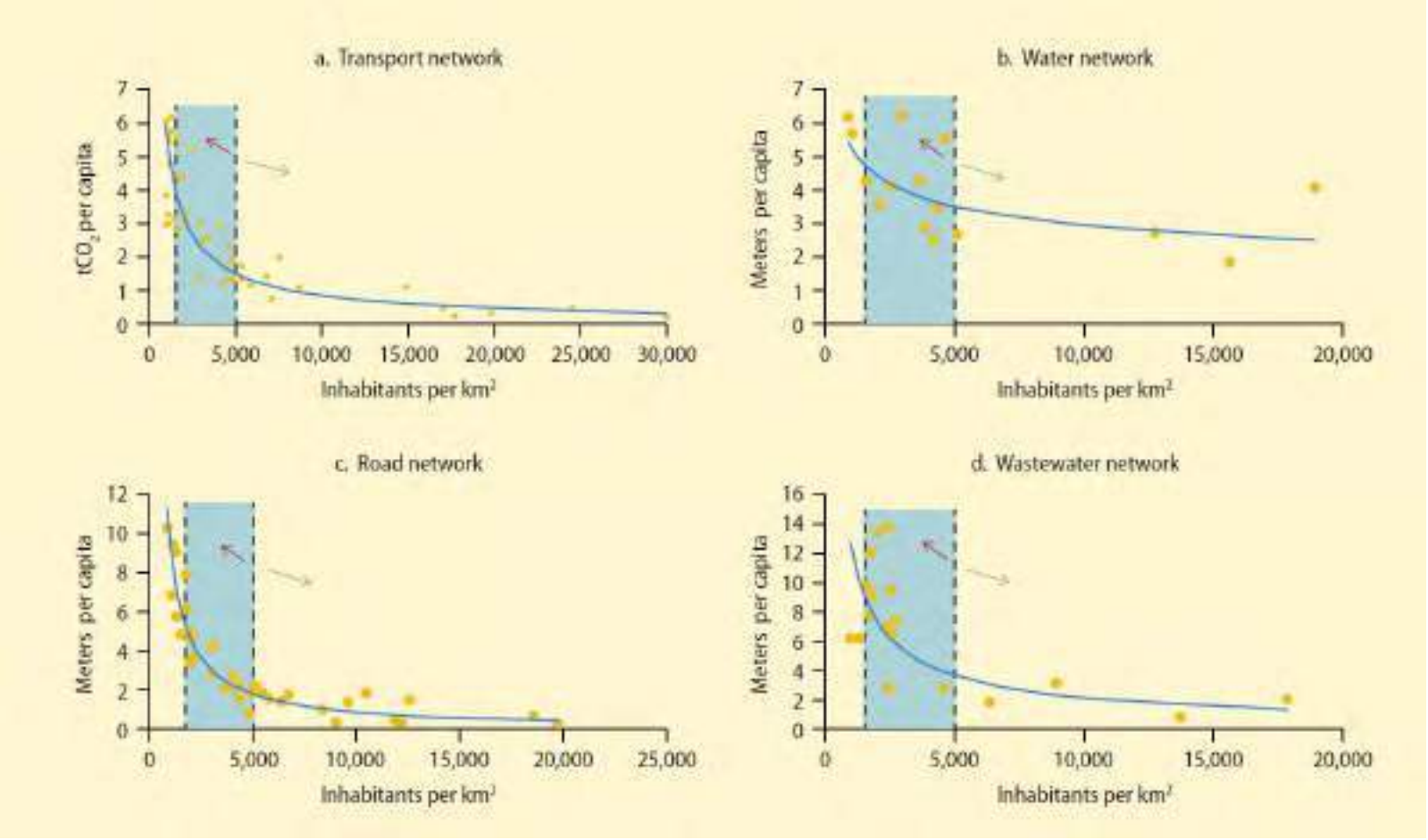
Infrastructure costs/km^2 and emissions increase with spatial expansion

The city costs more than it produces value at a threshold of about 500 km^2 (600 km^{2}size of Tokyo 23 wards and Seoul Special City with populations between 9 and 10 million)



Source: Bourdic 2015, Urban Morphology Institute.

Low density increases infrastructure costs, resource intensity of infrastructures per capita, energy consumption and carbon emissions



From Paris or Manhattan (≈20,000 inhab/km²) to an average density of 5,000 inhab/km²

- Road network investment cost per capita **is multiplied by 4**
- Water network investment cost per capita increases **+ 40%**
- Waste water network investment cost per capita **is multiplied by 3**
- Carbon emissions for transportation per capita **are multiplied by 2.5**

Source: Salat and Bourdic, World Bank 2014.

Capacity and Infrastructure costs of different transport systems

Transport Infrastructure	Capacity [pers/h/d]	Capital costs [US$/km]	Capital Costs/Capacity
Dual-lane highway	2,000	10m – 20m	5,000 - 10,000
Urban street (car use only)	800	2m – 5m	2,500 - 7,000
Bike path (2m)	3,500	100,000	30
Pedestrian walkway / pavement (2m)	4,500	100,000	20
Commuter Rail	20,000 – 40,000	40m – 80m	2,000
Metro Rail	20,000 – 70,000	40m – 350m	2,000 - 5,000
Light Rail	10,000 – 30,000	10m – 25m	800 - 1,000
Bus Rapid Transit	5,000 - 40,000	1m – 10m	200 – 250
Bus Lane	10,000	1m – 5m	300 – 500

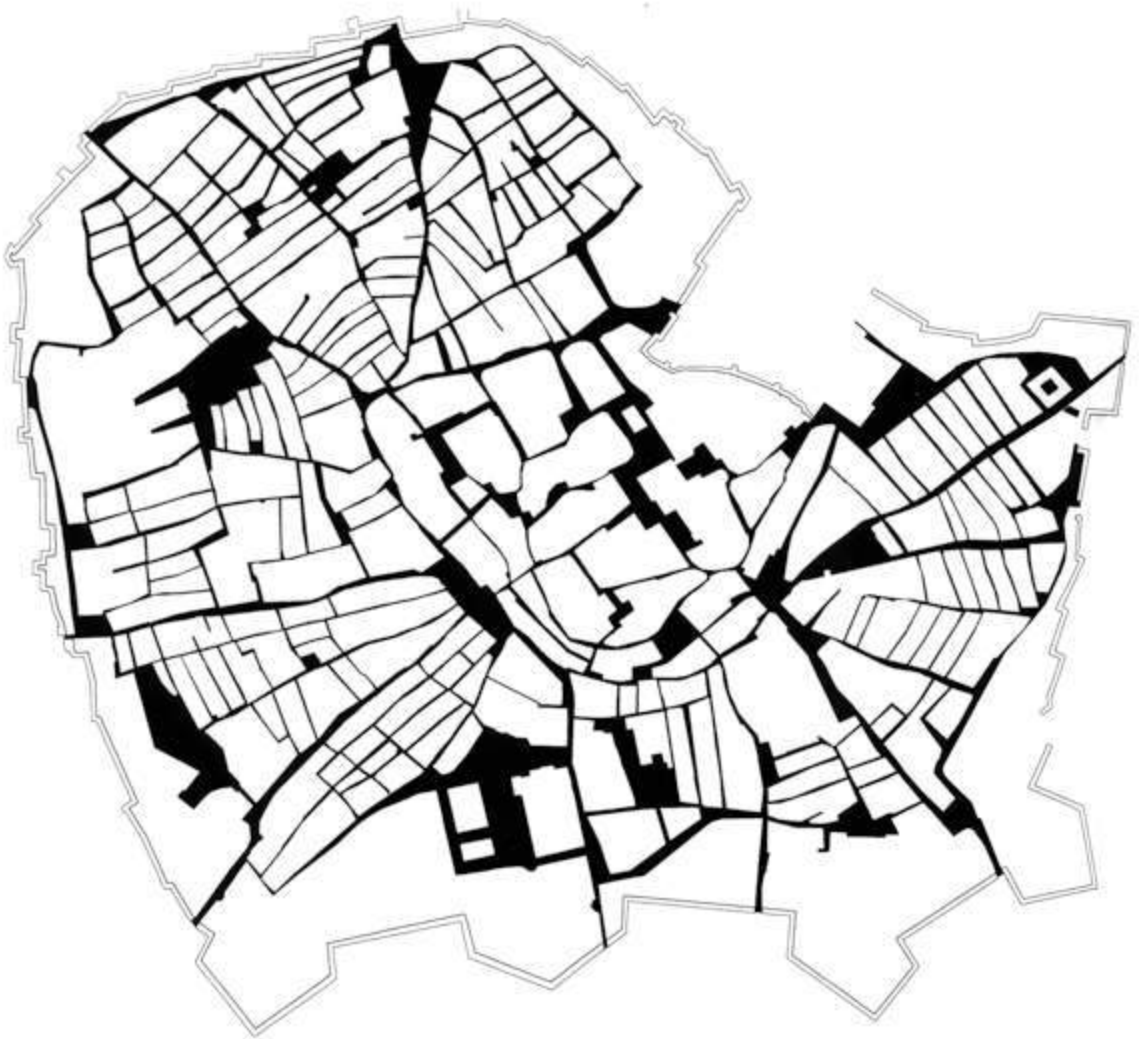
Source: Rode and Gipp 2001, Litman 2009, Wright 2002, Brilon 1994

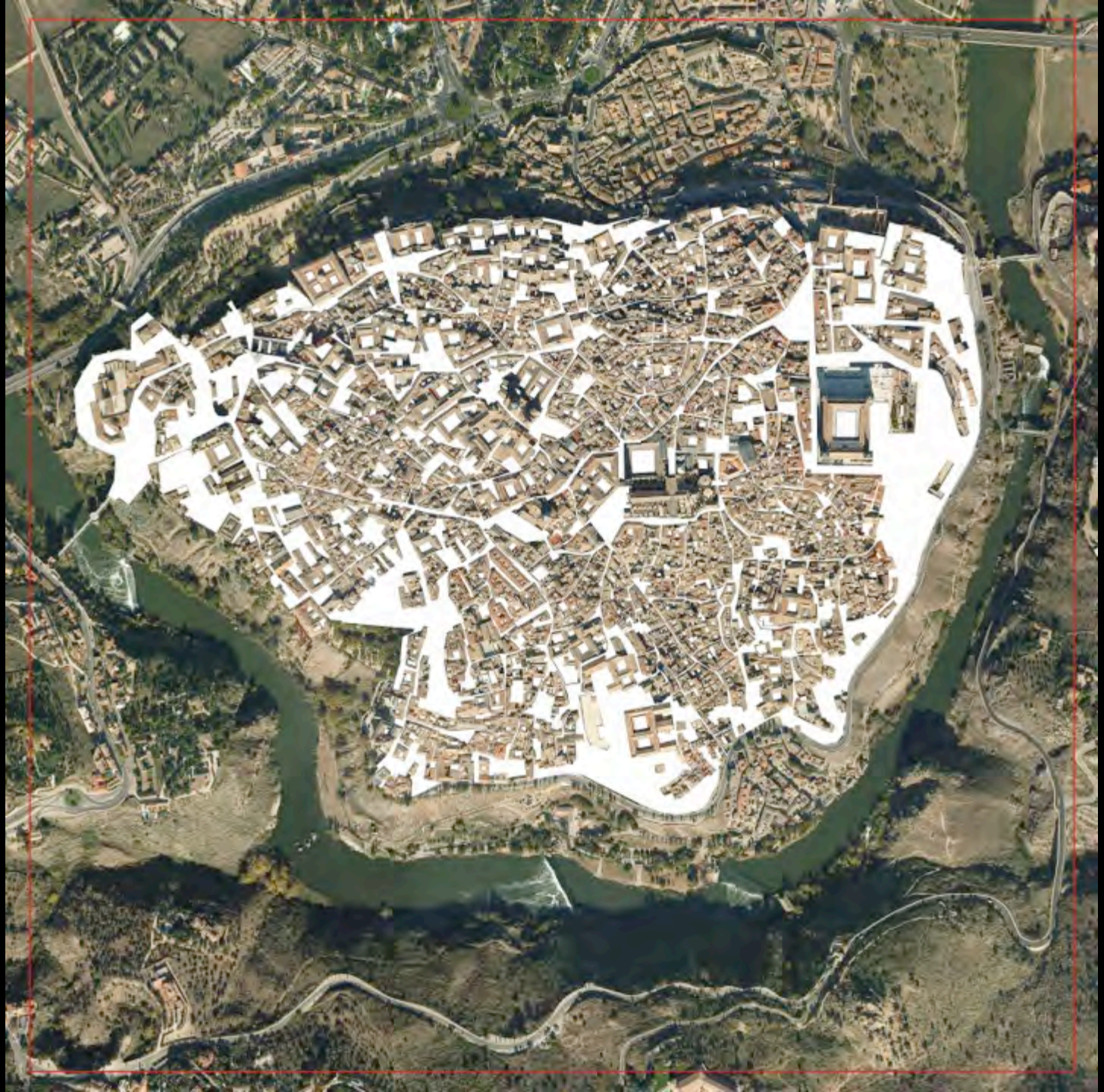
4.How to articulate densities (FAR, residents and jobs) and how to shape transit networks in order to achieve compact development through scales?

4.1. Networks and Spikes

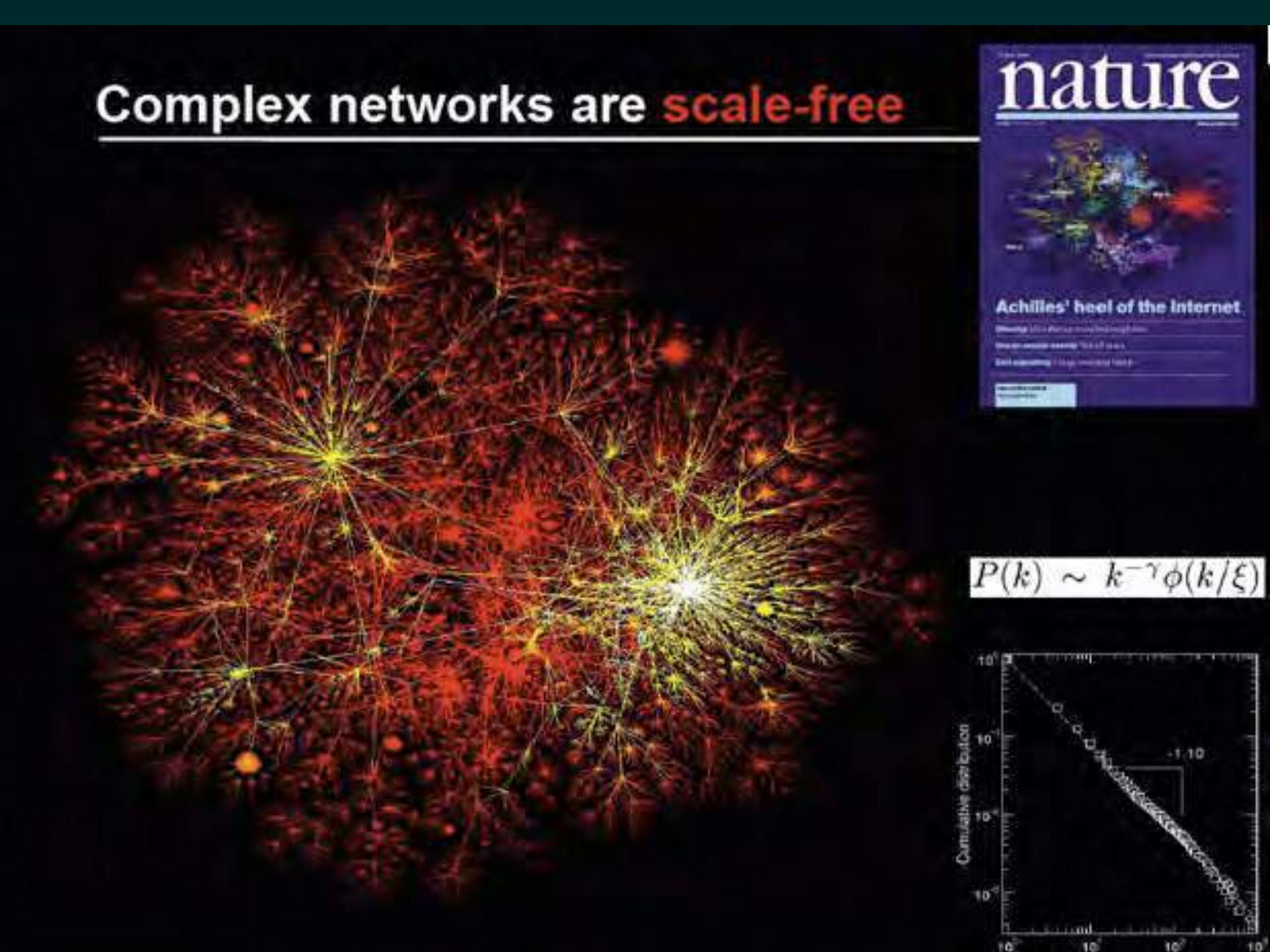
The urban world is Paretian both for network structures and for intra urban densities

Traditional network street patterns were multi connected at all scales. This increased their structural resilience.



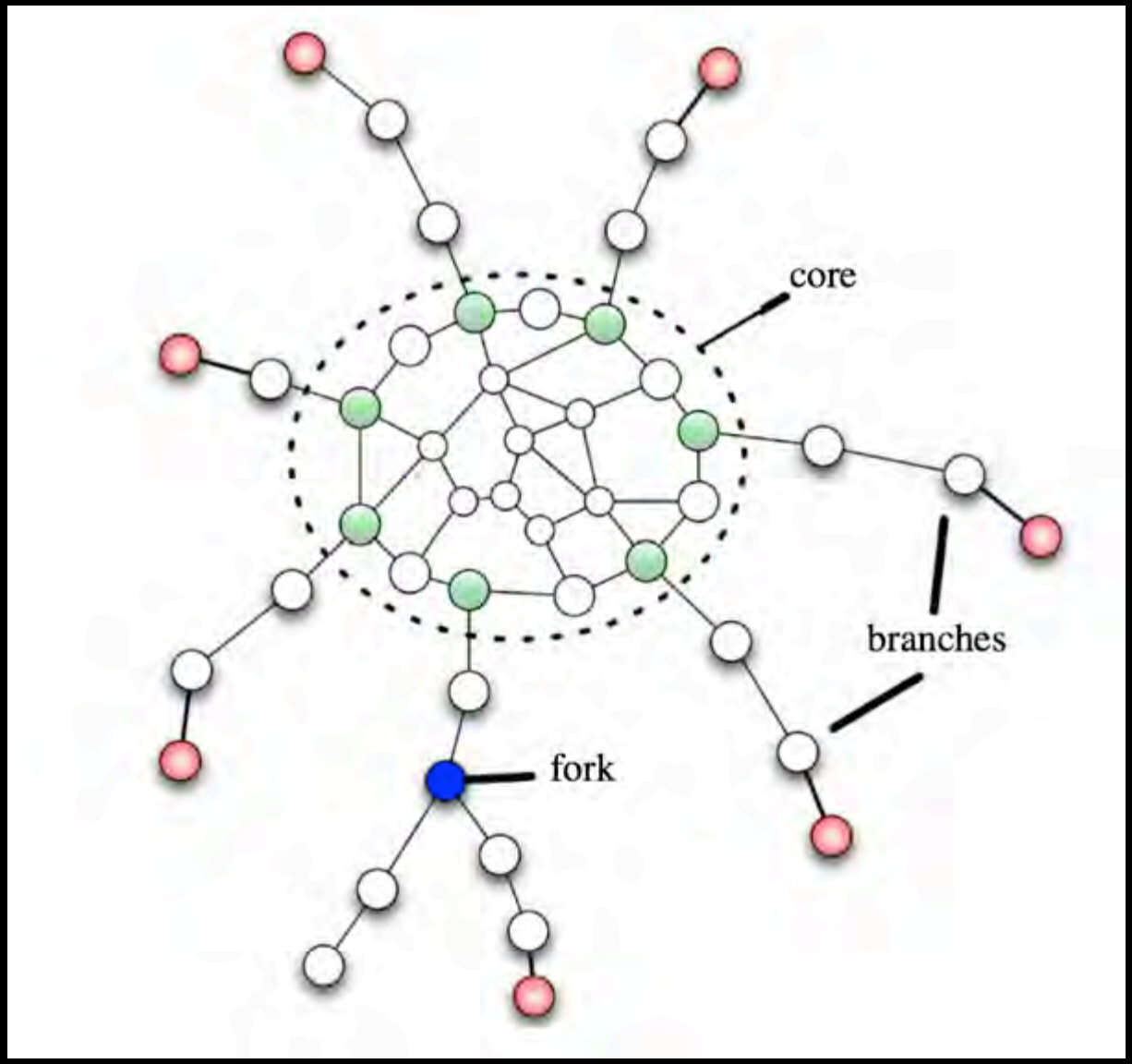


Complex networks are scale-free



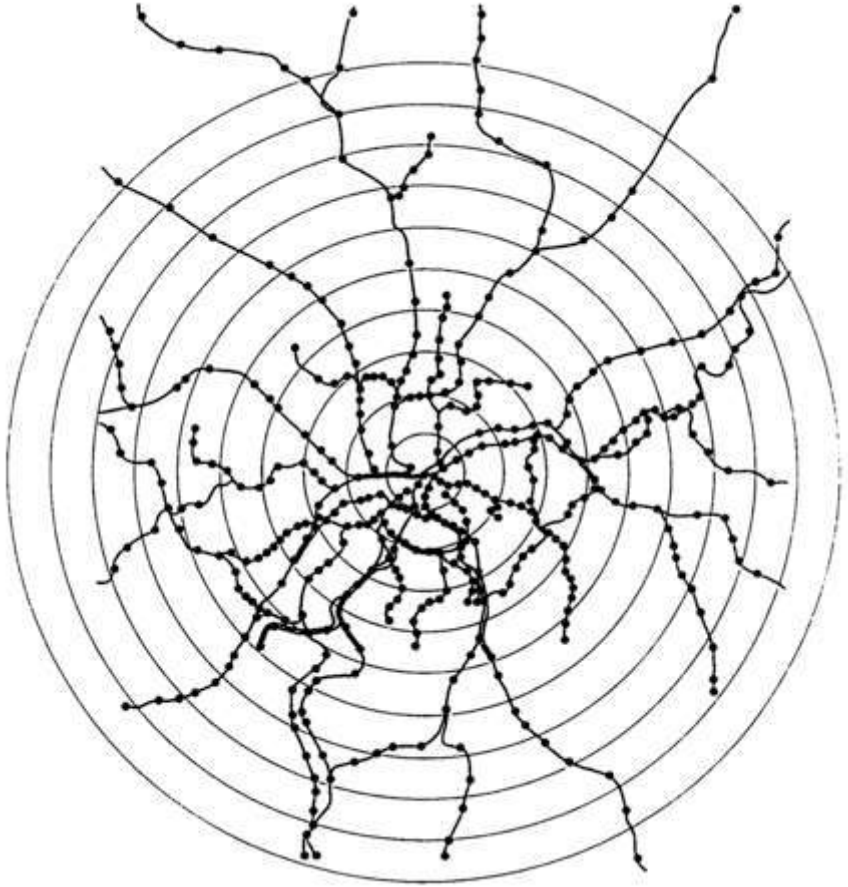
$$P(k) \sim k^{-\gamma}\phi(k/\xi)$$

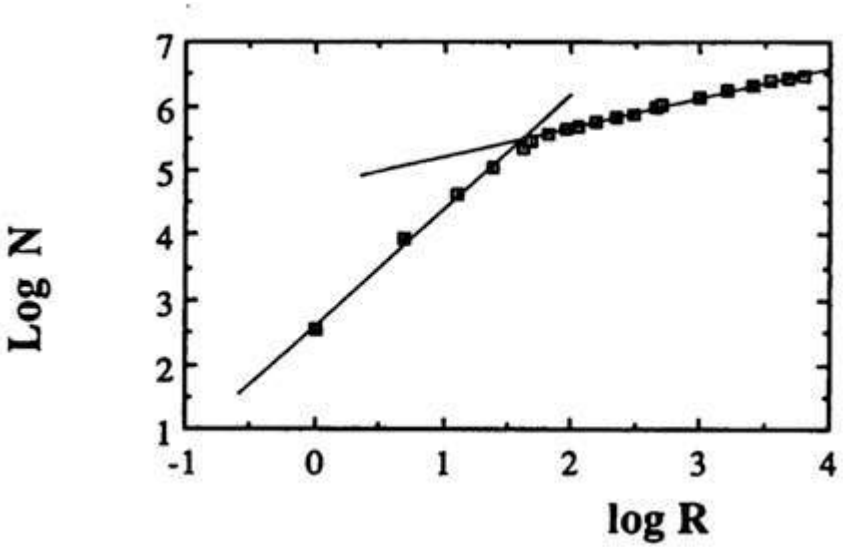
Subway networks converge towards a characteristic structure with a dense and interconnected core and with spokes



Source: QuantUrb, CASA

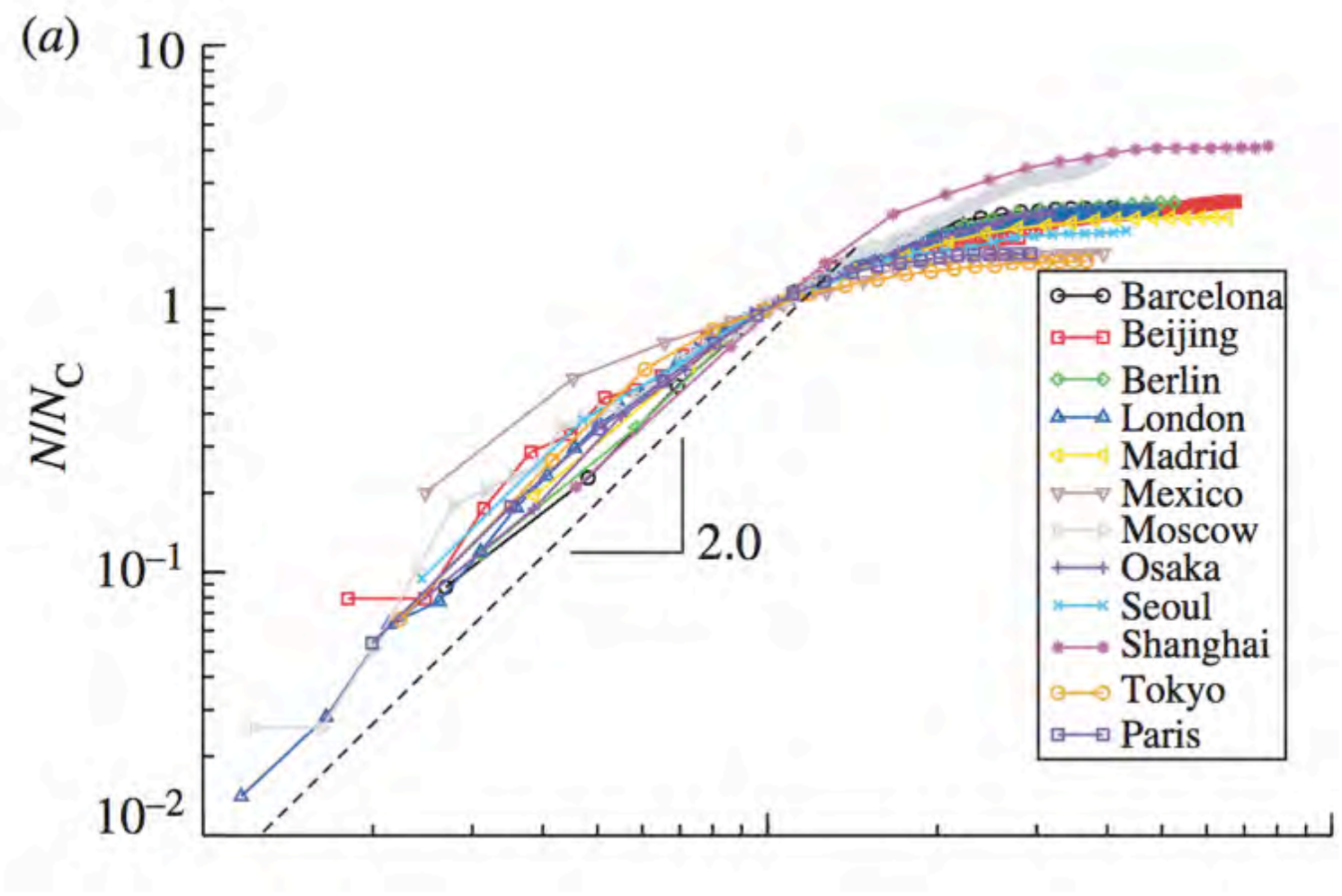
The core (R= 5.6 km in Paris) contains a constant density of stations while the density of stations outside the core decays rapidly with a decay exponent of minus 1.5 in Paris case





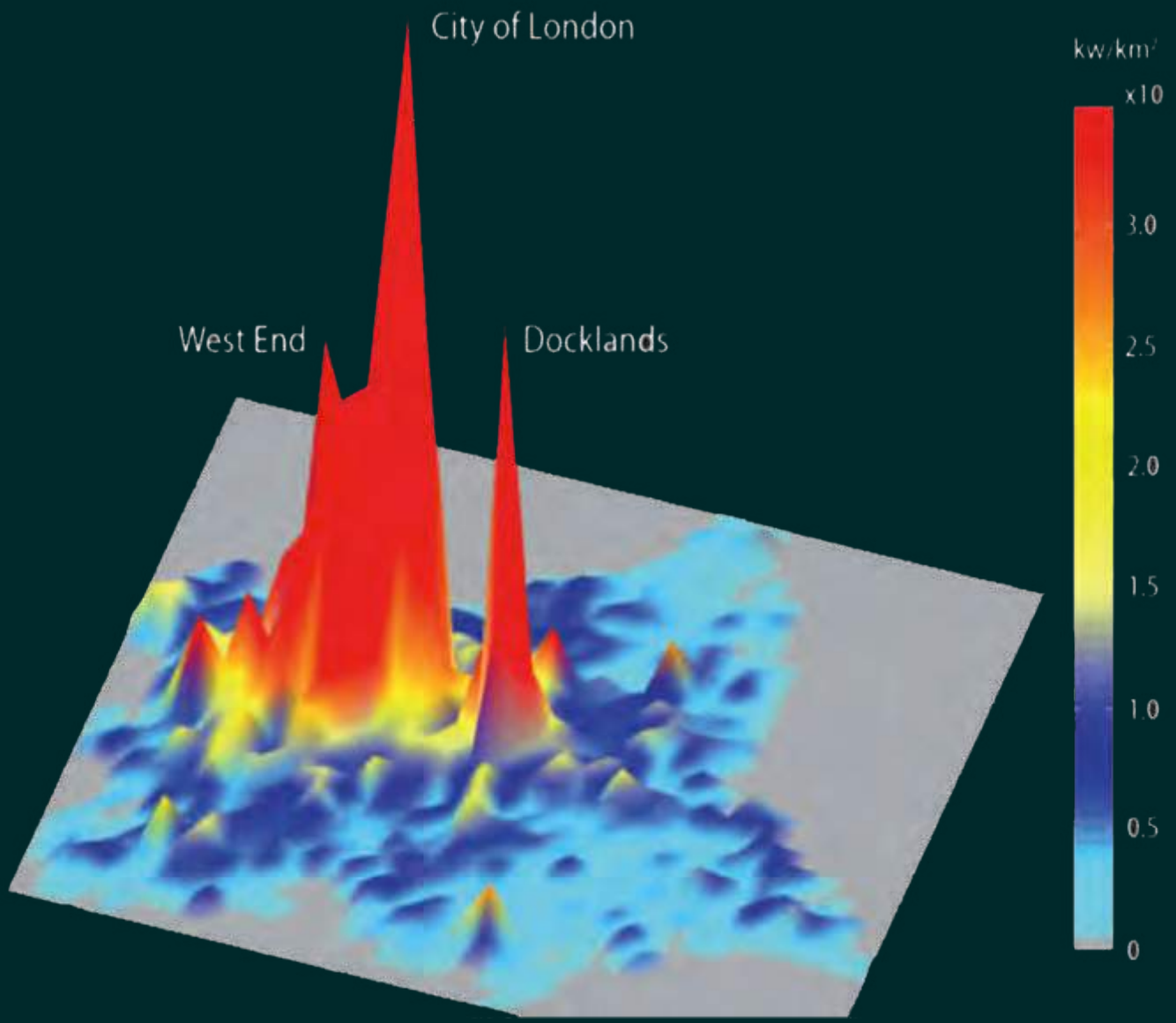
Source: Benguigui

This structural change in the density of stations and thus in transit accessibility levels characterizes most subway networks.



Source: QuantUrb, CASA

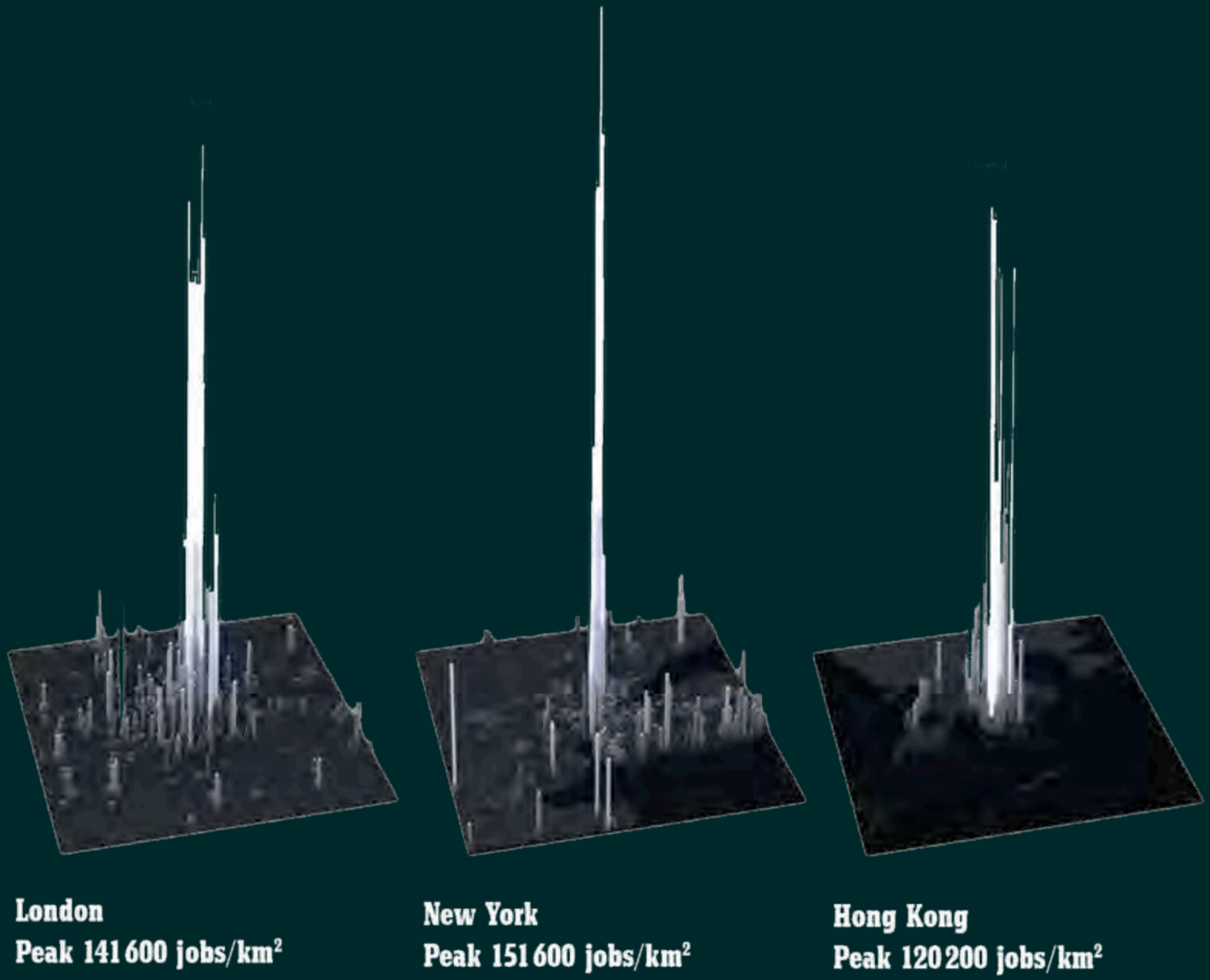
Transit network centralities and differences in accessibility + agglomeration economies concentrate densities in spikes at intra urban scale



Urban energy density per unit of land in London

Residential densities in London, New York, Hong Kong

Source: LSE Cities, LSE London



Jobs densities in London, New York, Hong Kong. Source: LSE Cities

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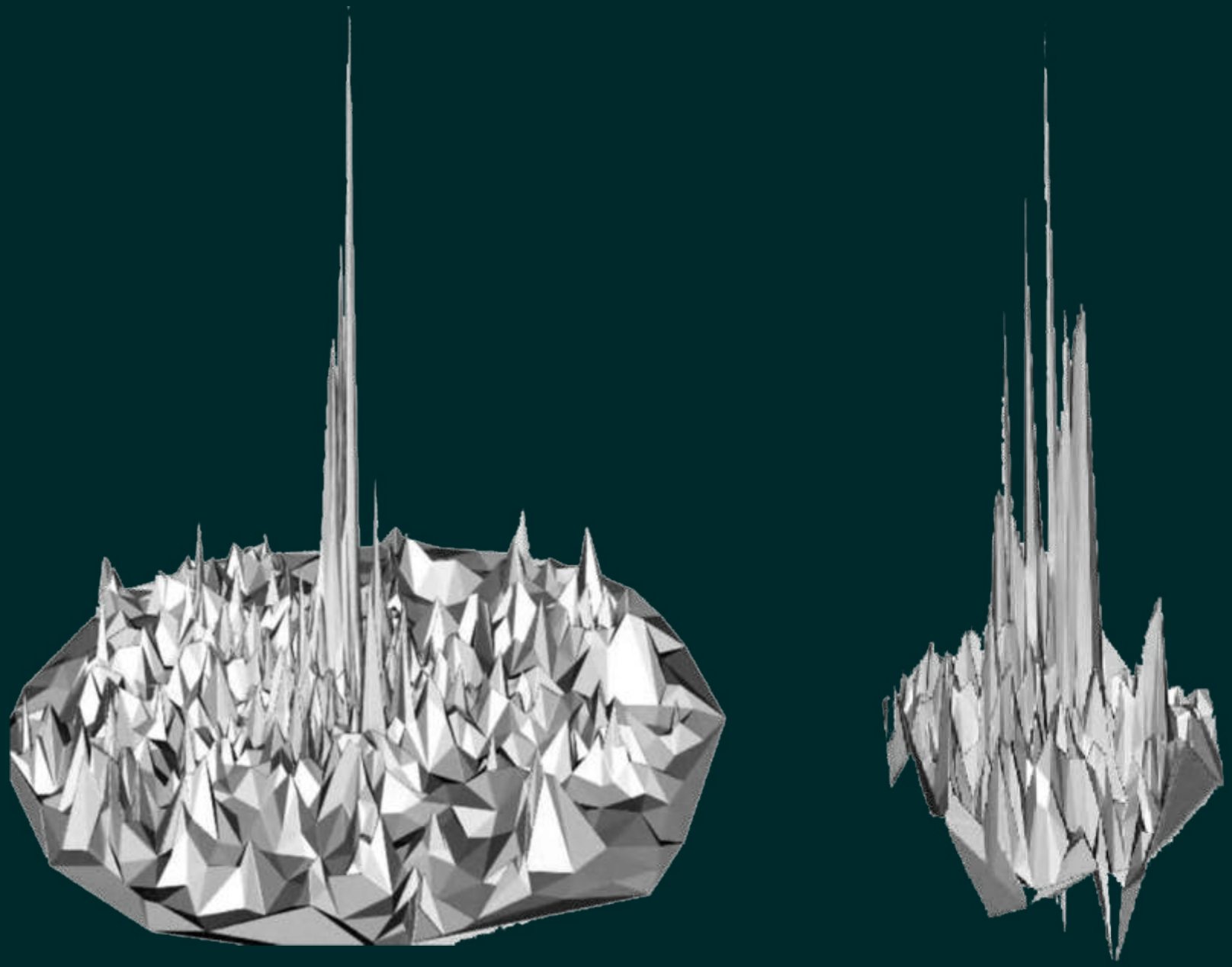
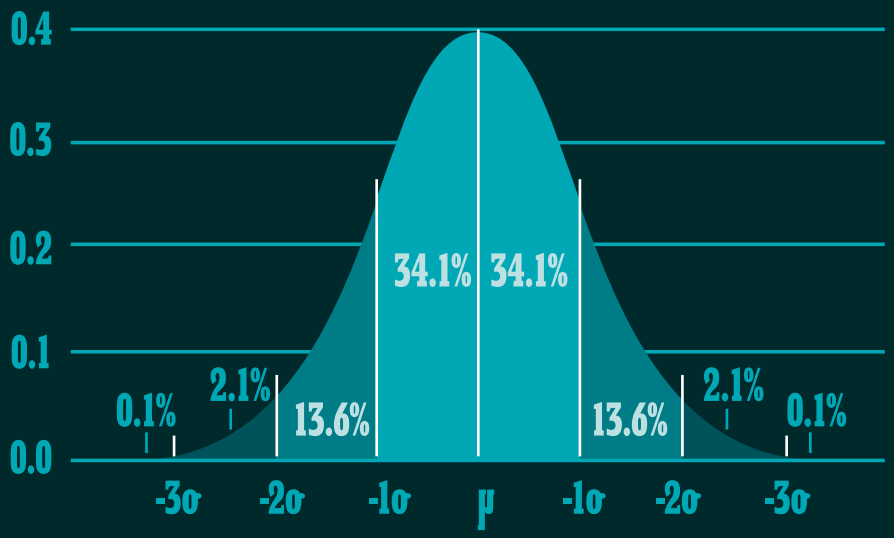


Rents in London. Source: Robin Morphet, CASA, UCL London.

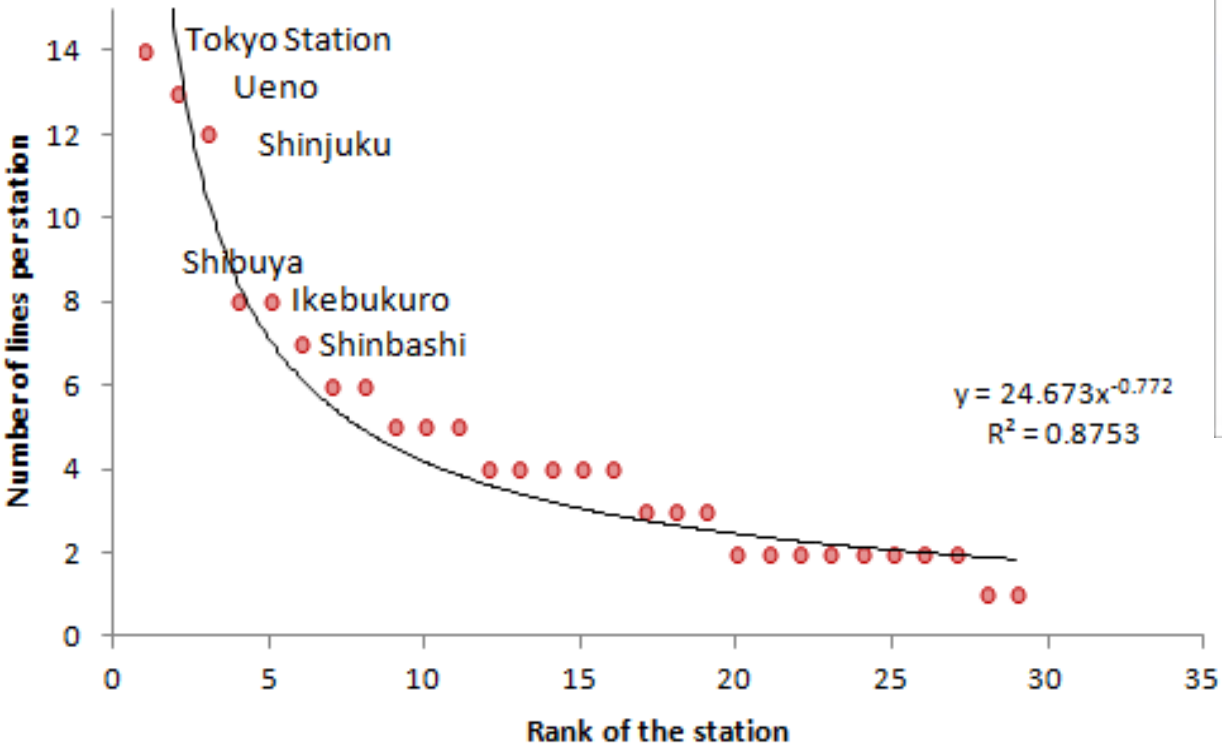


$$freq_i = \frac{A}{l_i^{\varepsilon}}$$

The urban world is not Gaussian (top). It is Paretian (bottom) and follows inverse power laws

4.2. Case Studies: Tokyo, Seoul, London, New York

Tokyo economic engine is concentrated along the high spikes of connectivity and economic density of Yamanote line



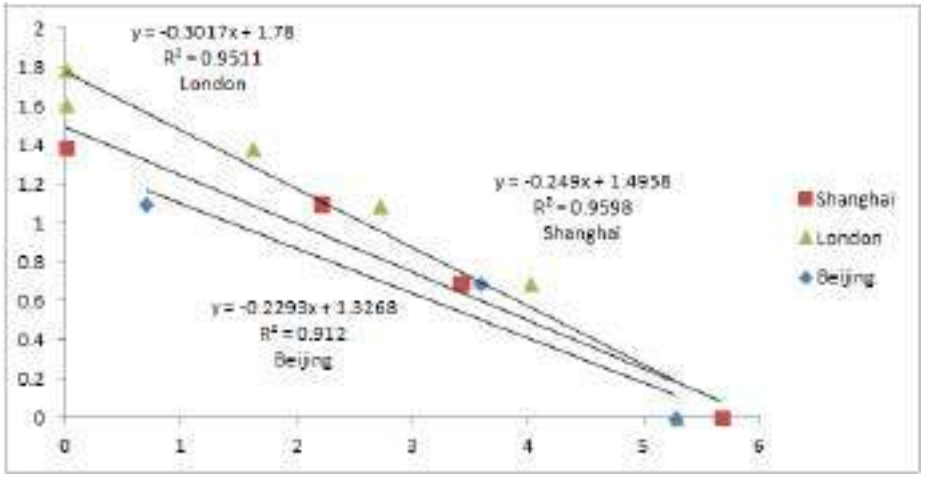
Source: Urban Morphology Institute

URBAN CHINA ISSUE: FLAT NETWORK HIERARCHY LEADS TO LOW NODE VALUE

Beijing subway map

Shanghai subway map

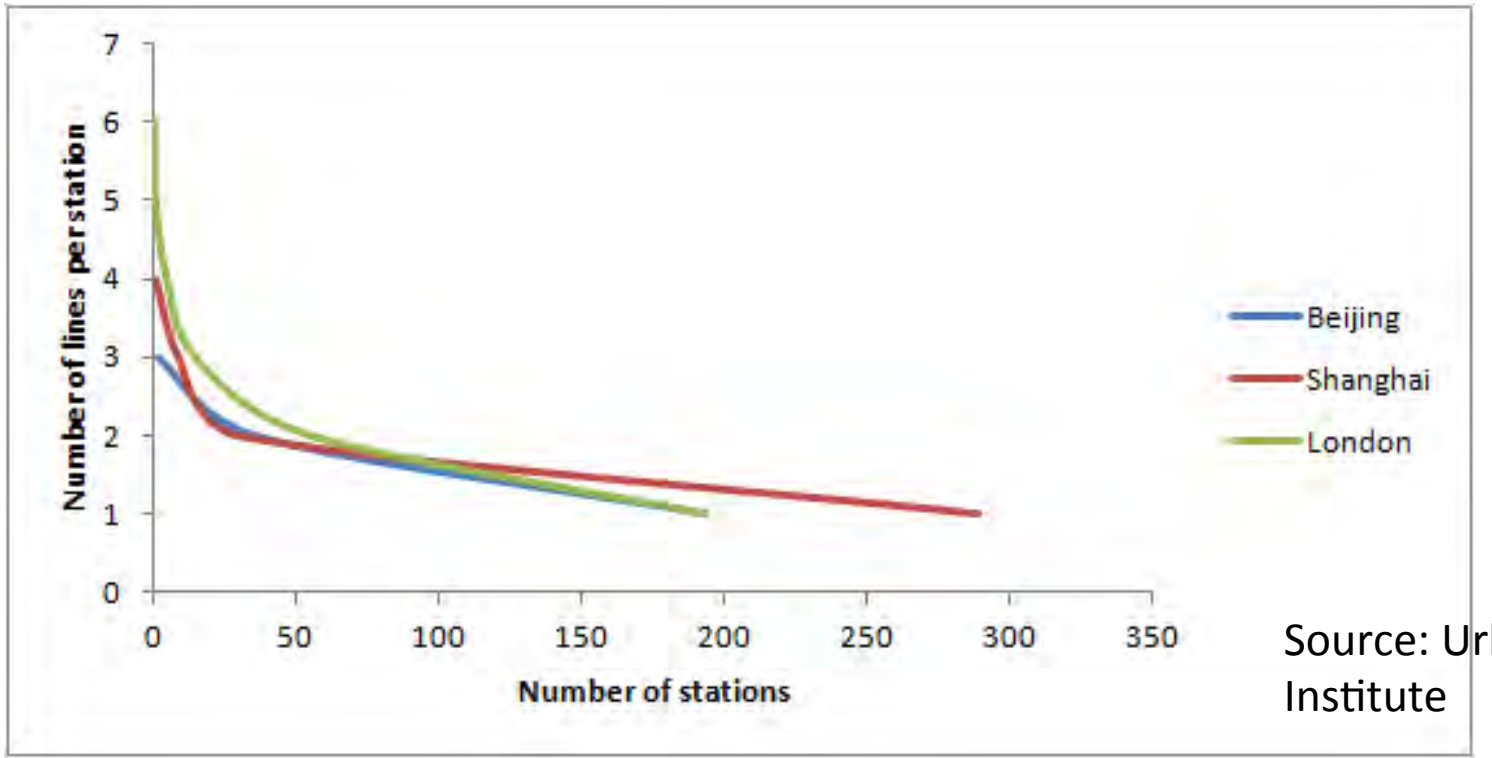
URBAN CHINA ISSUE: FLAT NETWORK HIERARCHY LEADS TO LOW NODE VALUE



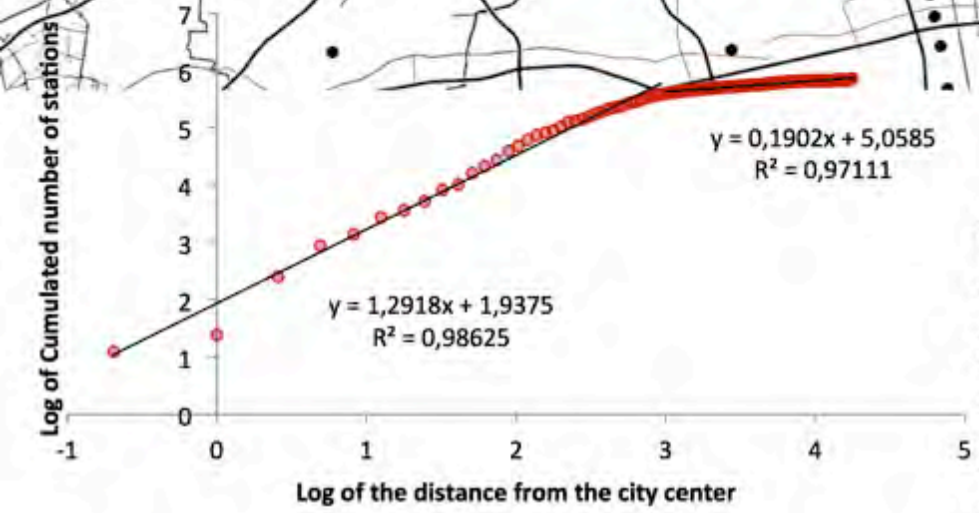
Beijing network hierarchy is flat and lacks hubs

Shanghai is in an intermediary situation with a steeper hierarchy than Beijing but flatter than London and a very thick right tail of low degree centrality stations

Due to this network lack of hierarchical structure there is much less opportunity to capture high land values in Shanghai and Beijing than in London and to articulate density accordingly



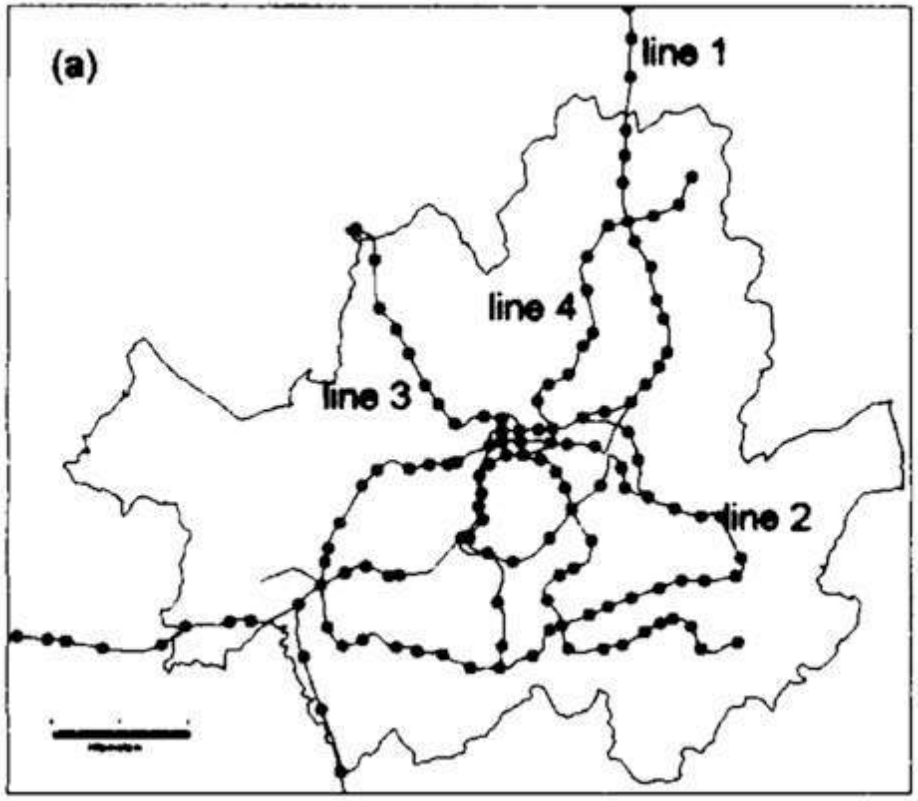
Source: Urban Morphology Institute

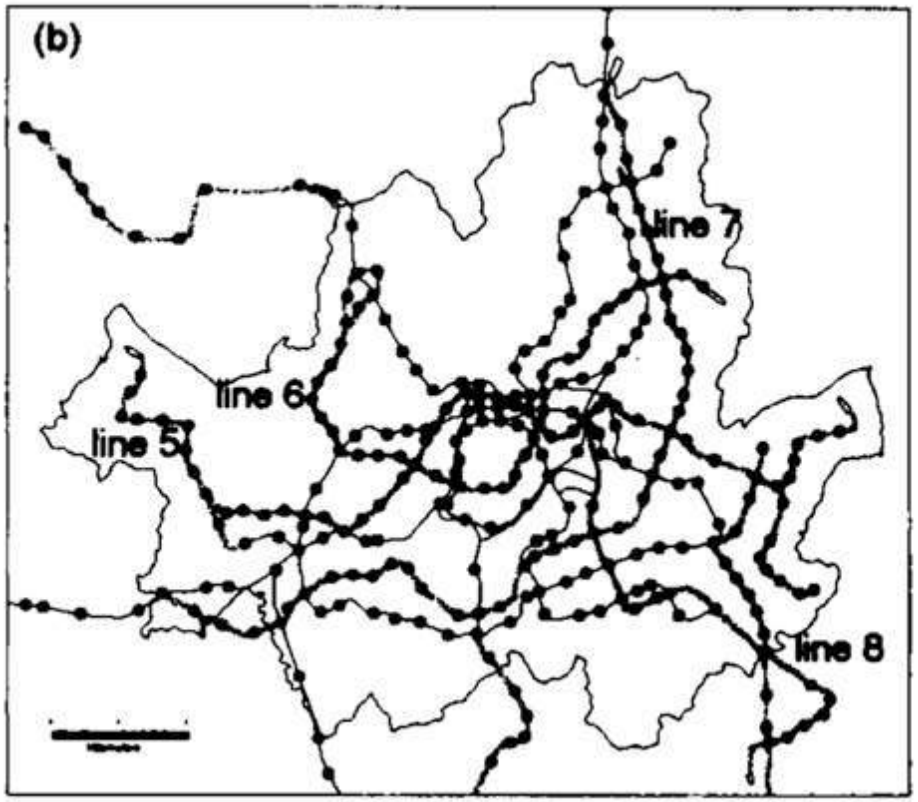


Shanghai subway network structure impacts on accessibility with a key difference between 2 regimes with a change at R= 20 km (density of connectivity decays with exponents -0.7/-1.8)

Source: Urban Morphology Institute

Seoul transformation in accessibility with the subway extension has reshaped the urban form

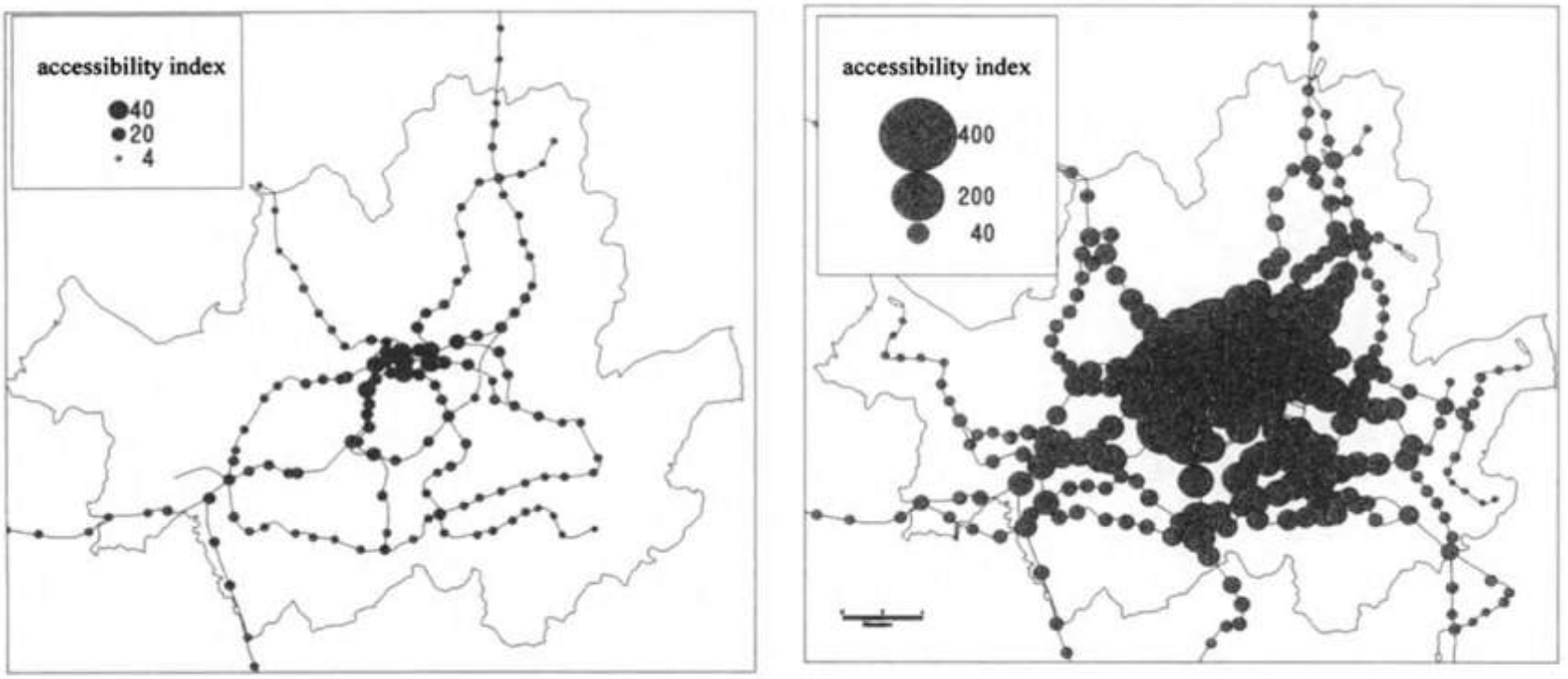




1st phase

2nd phase

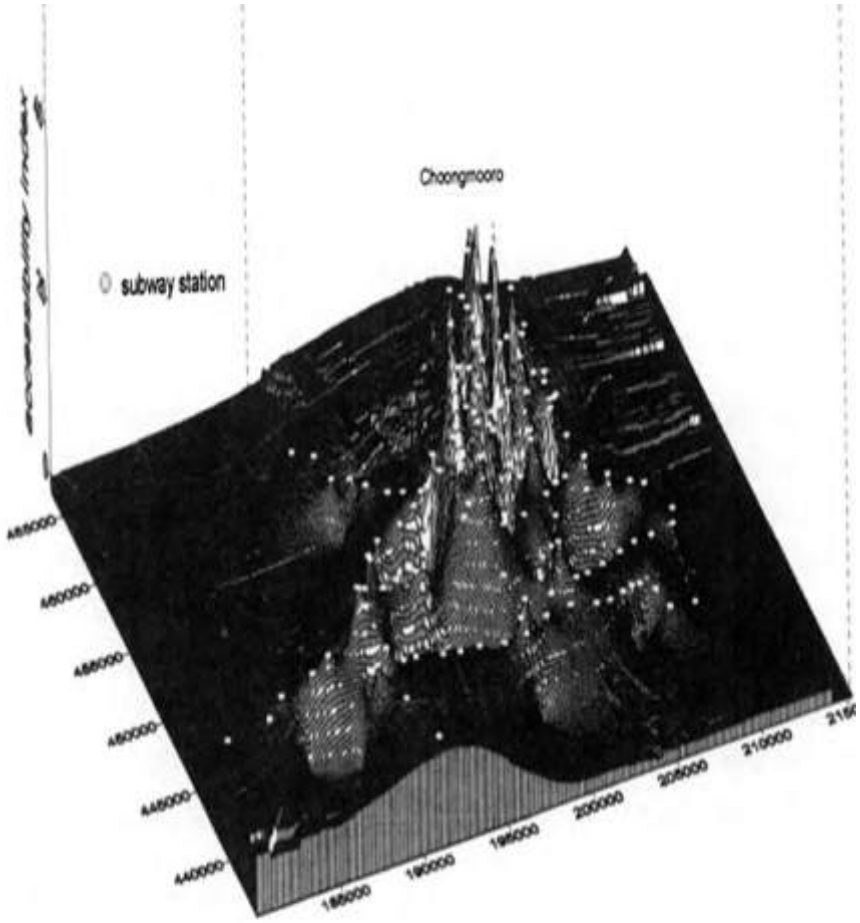
Increase in accessibility between first and second phase



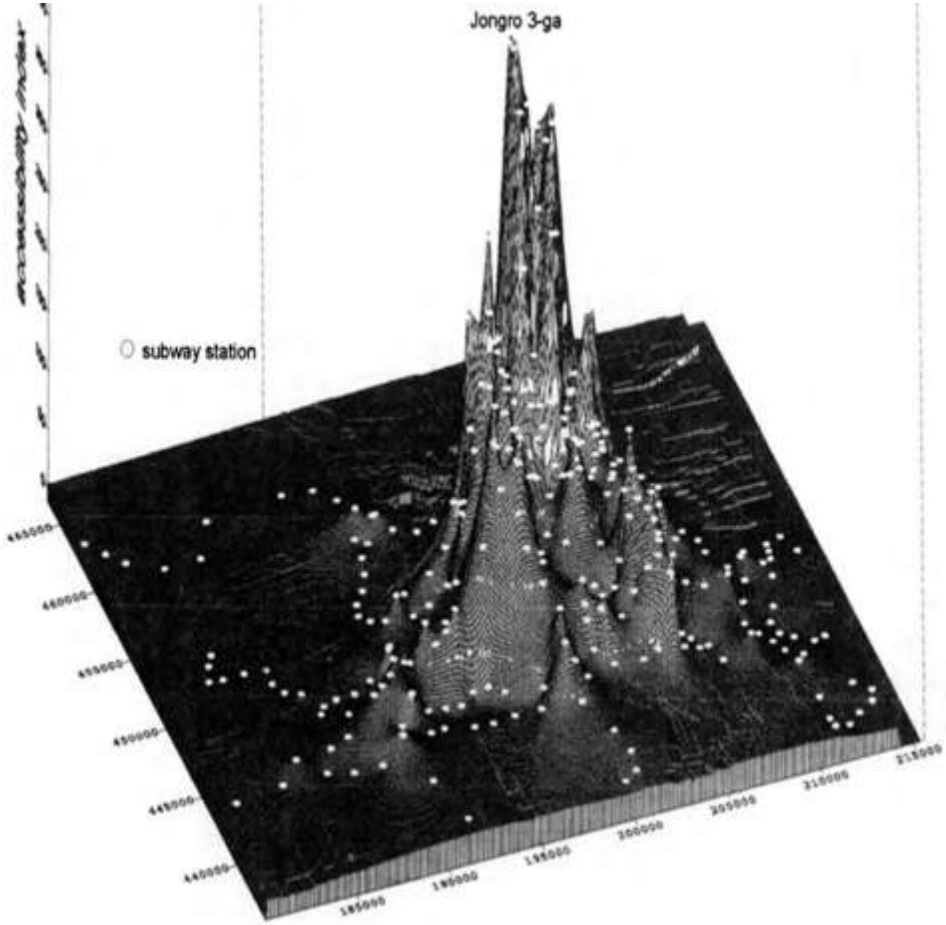
Spatial Patterns of Nodal Accessibility (a) in the First Phase and (b) in the Second Phase

The second phase has intensified the core accessibility and created a second potential core

Closeness centrality from one station to all the others

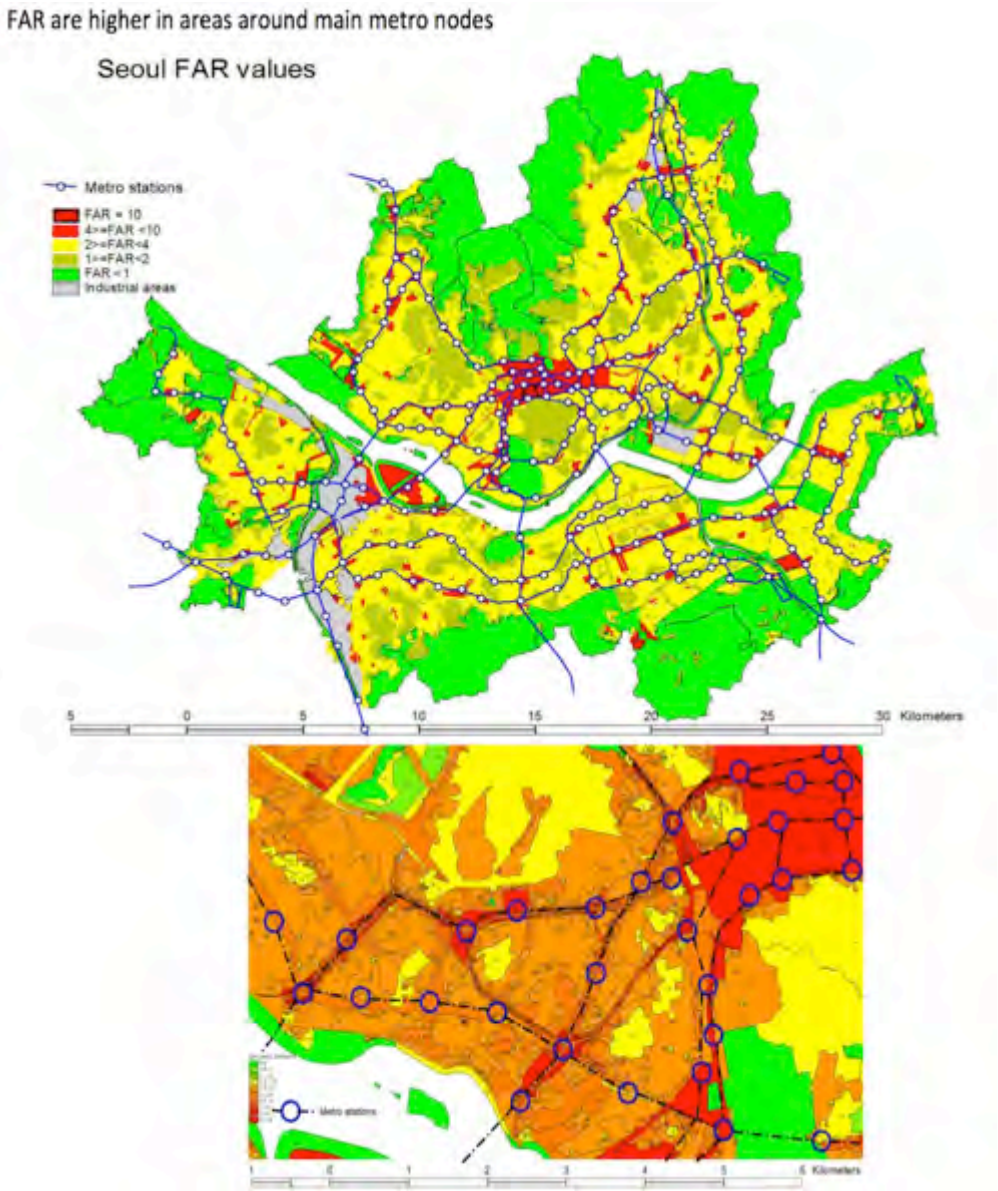


Spatial Pattern of the Accessibility Grid Surfaces in the First Phase



Spatial Pattern of the Accessibility Grid Surfaces in the Second Phase

FAR policies matches closeness centrality with high FAR variations



Land use policies match closeness centrality

High closeness centrality

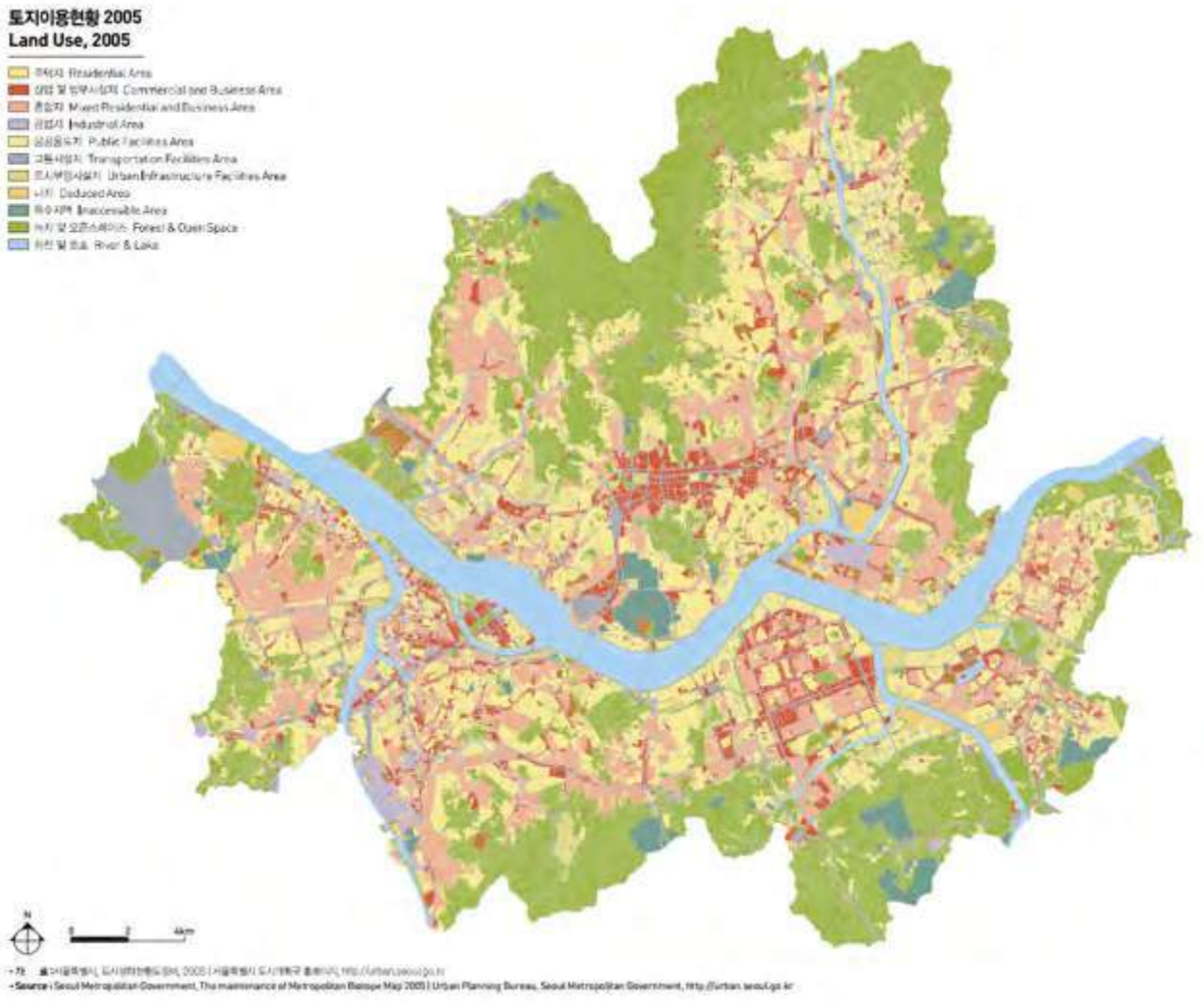
Business

Medium closeness centrality

Mixed use

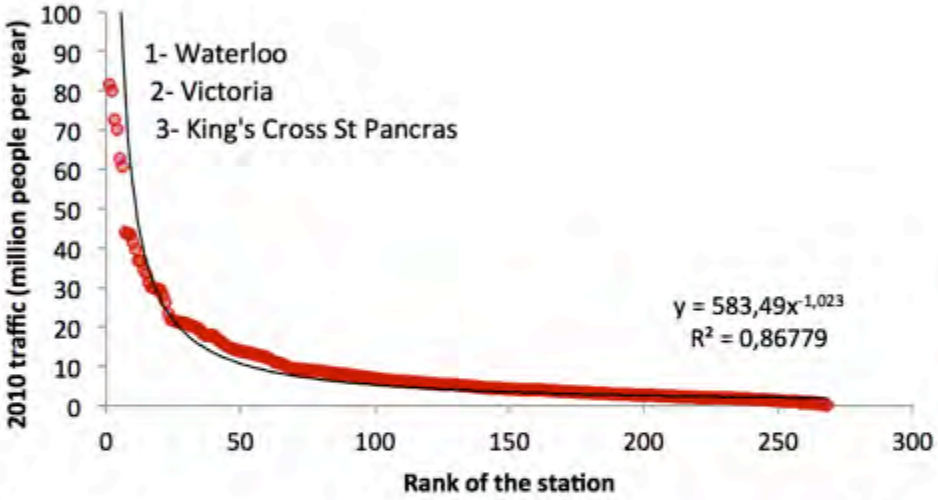
Low closeness centrality

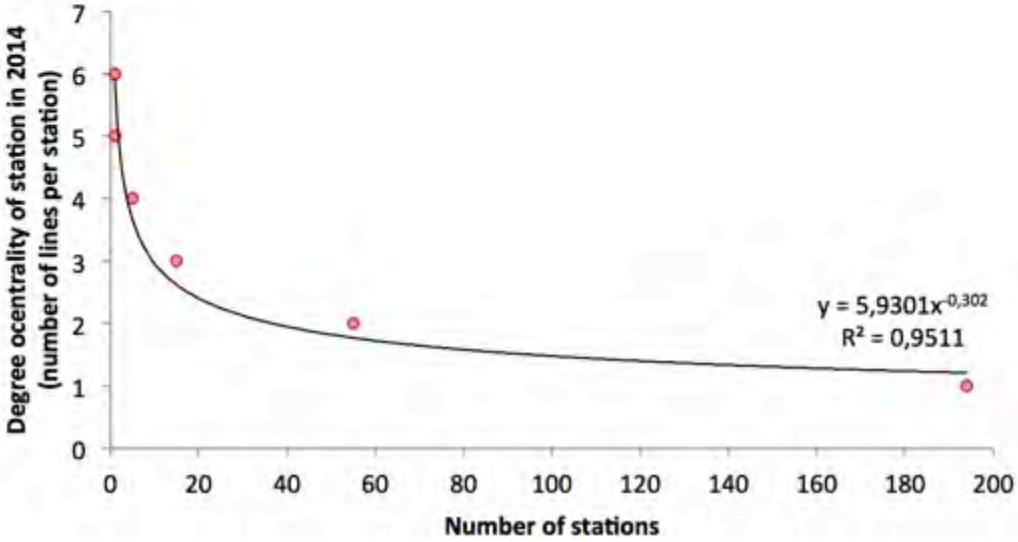
Residential



London subway network radiates from Circle line

Hubbing in London

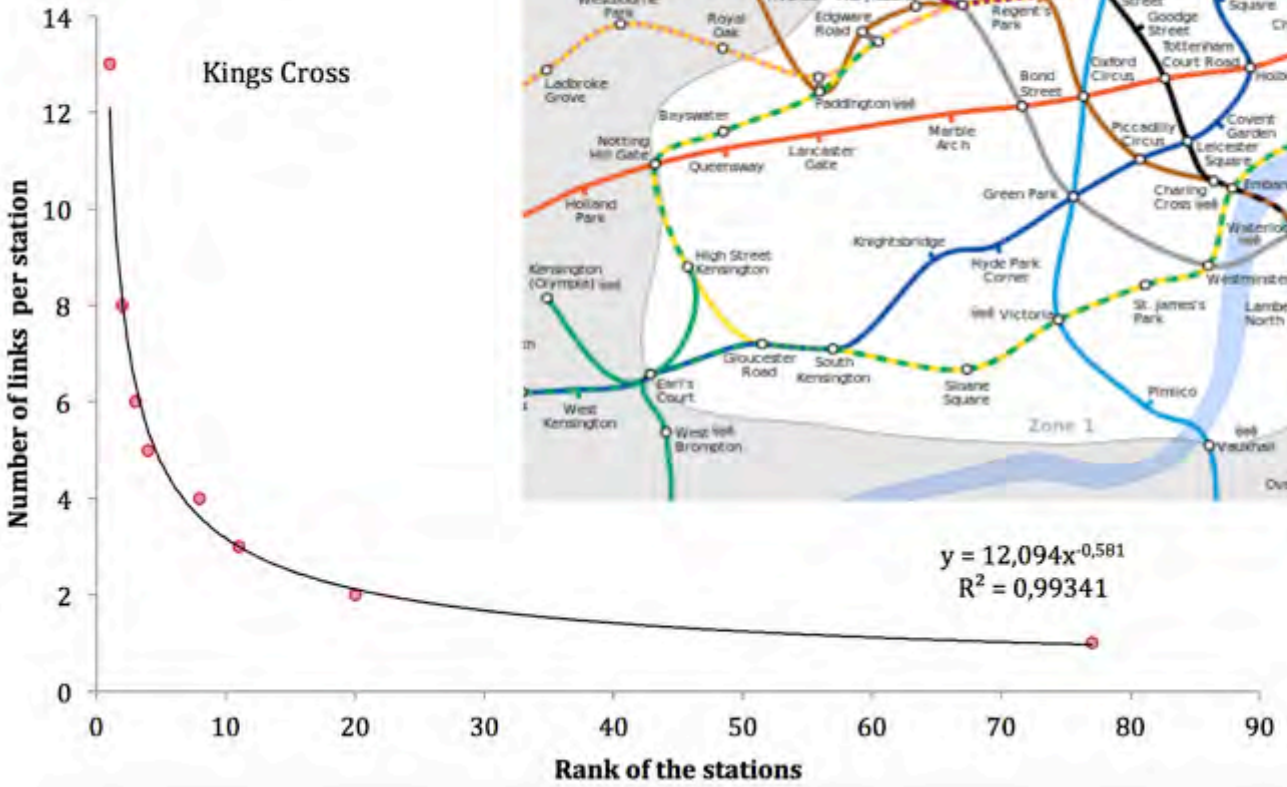




Source: Urban Morphology Institute

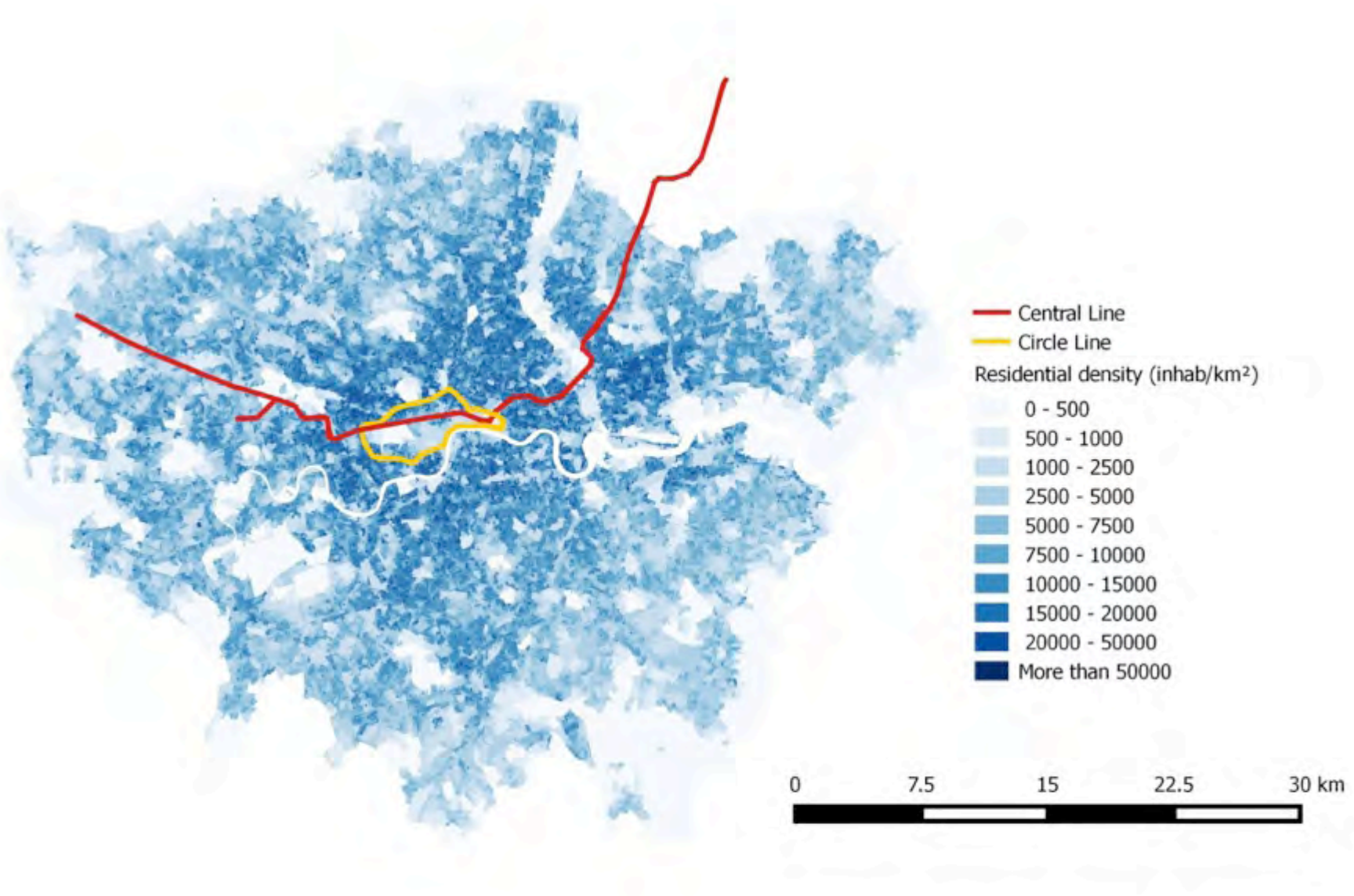
Compact polycentricity in London

Circle Line encompasses 33km² and links the economic cores of London



Source: Urban Morphology Institute

Residential density in Greater London

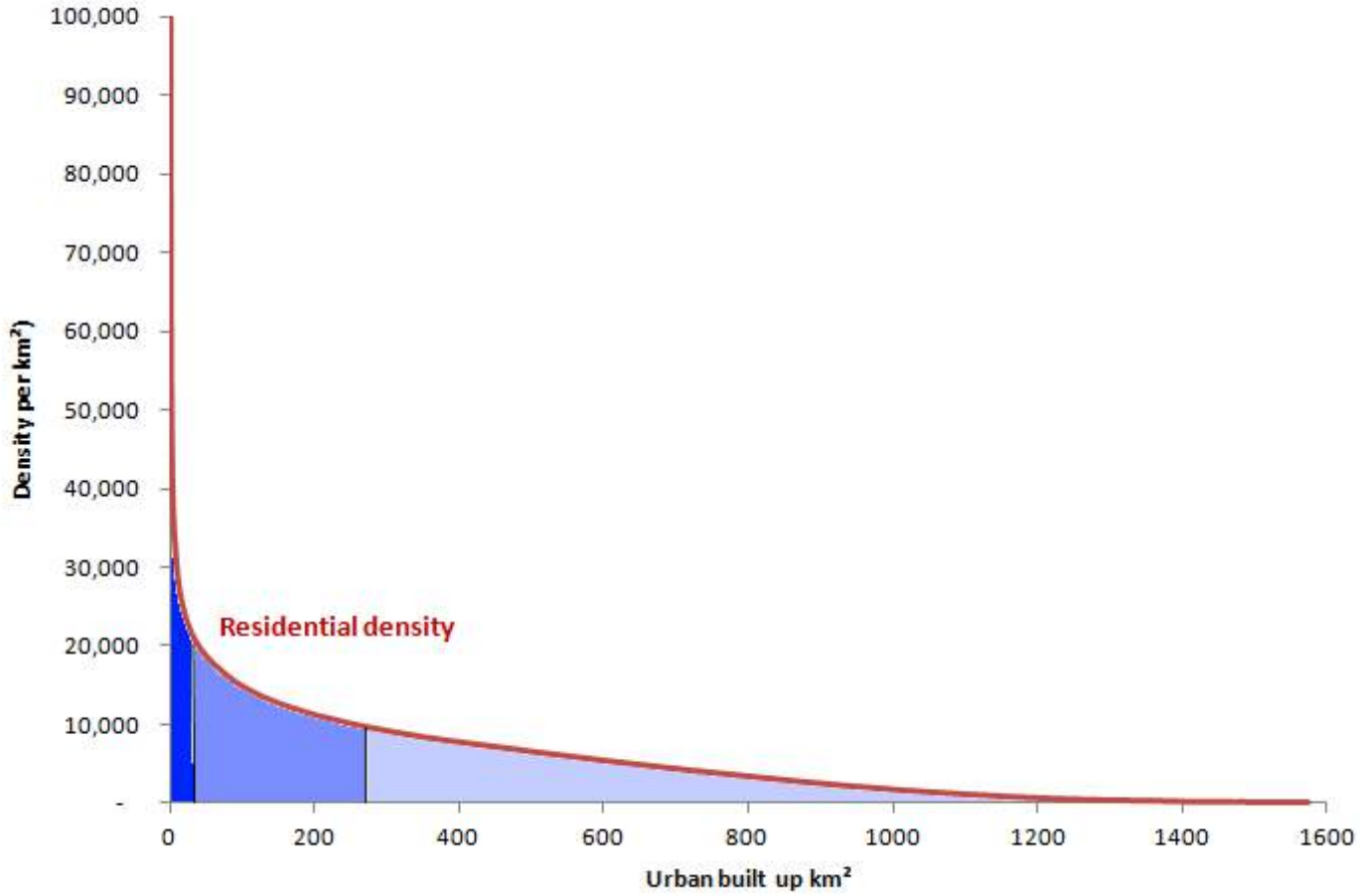


Source: Urban Morphology Institute

Residential density in Inner and Central London

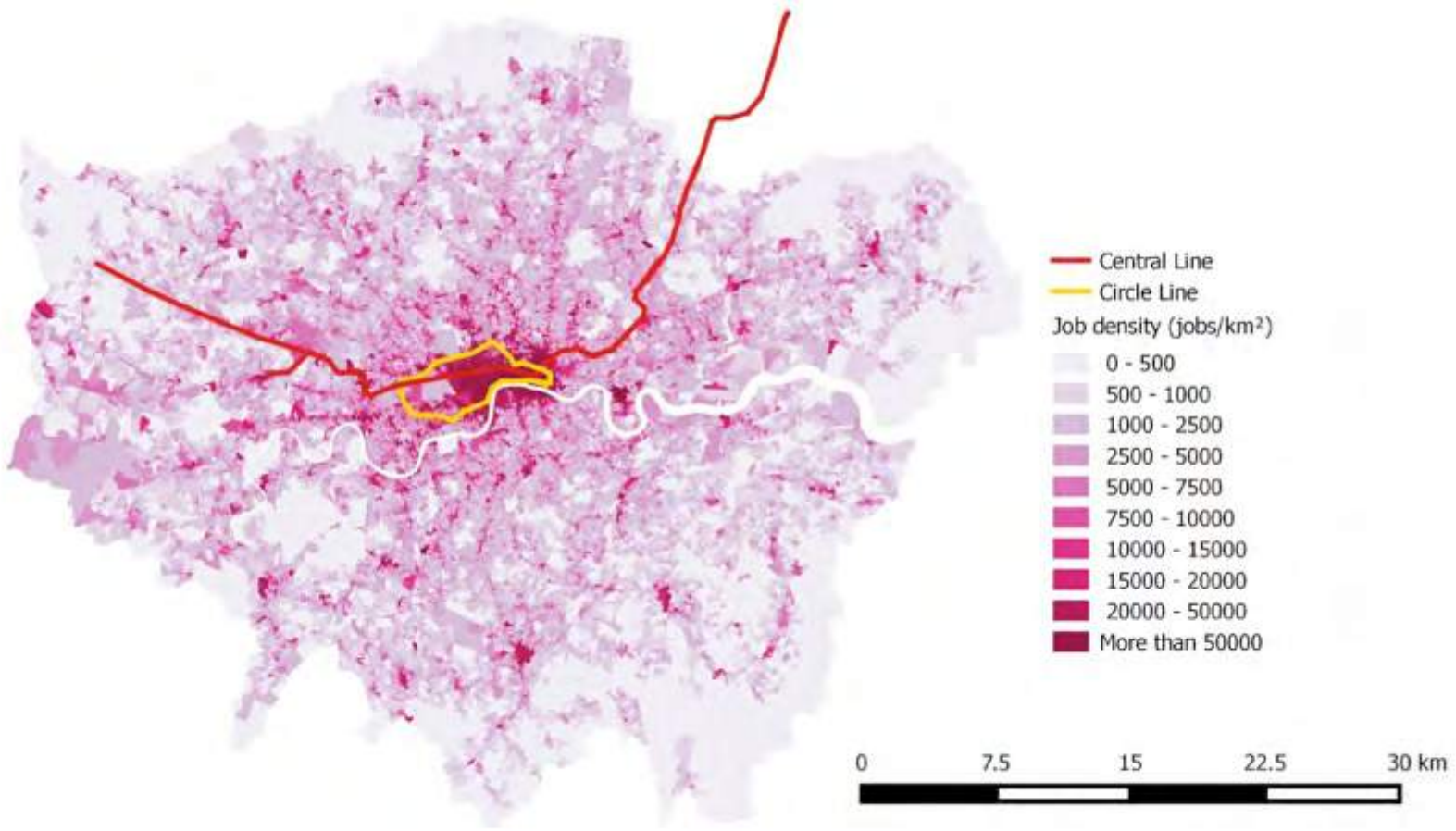
Source: Urban Morphology Institute

London population distribution is Paretian with a hierarchy coefficient of - 0.5
Half of the population lives in Outer London



Source:Urban Morphology Institute (2015)

Jobs density in Greater London is articulated by transit lines and nodes

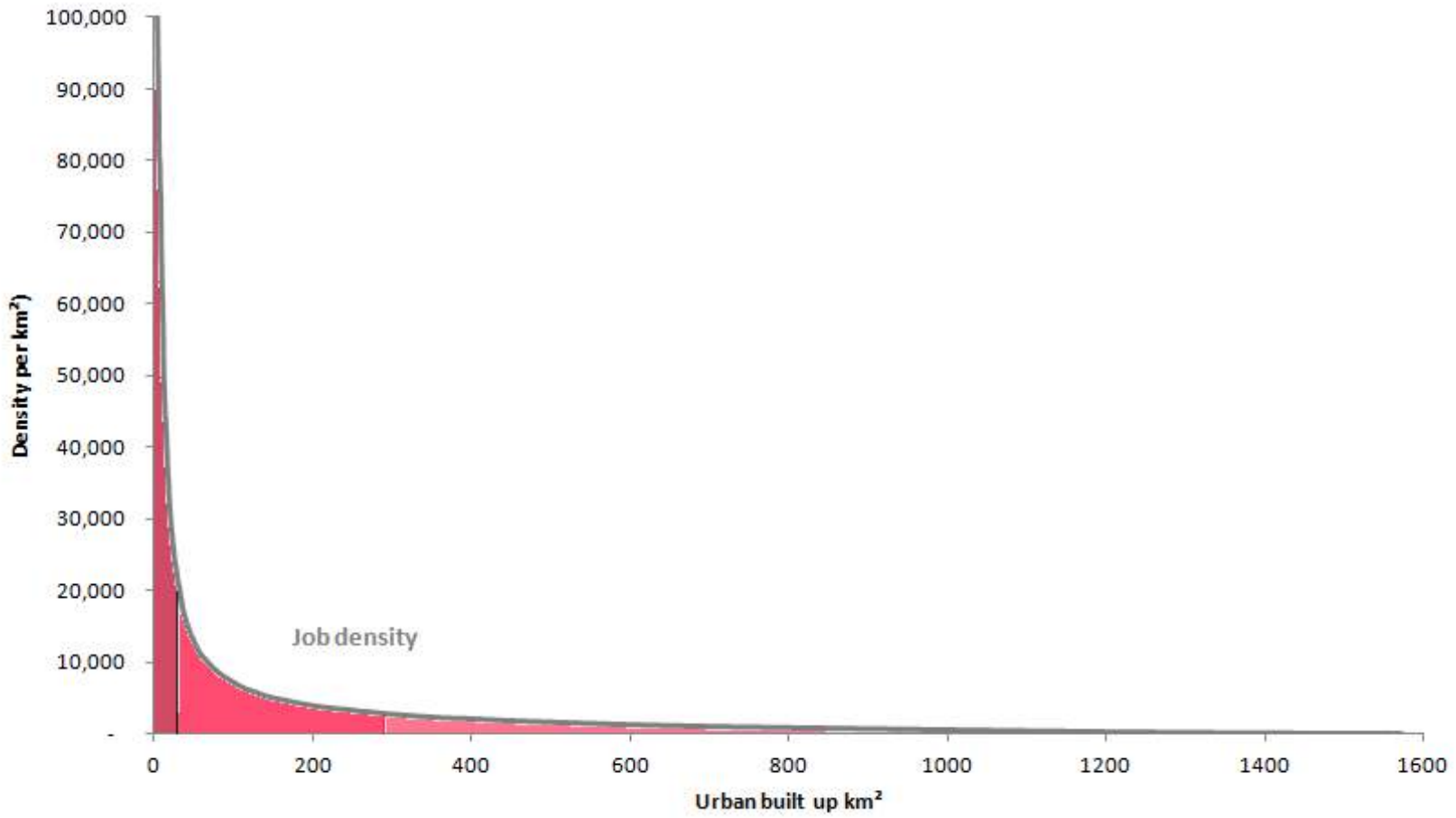


Source: Urban Morphology Institute

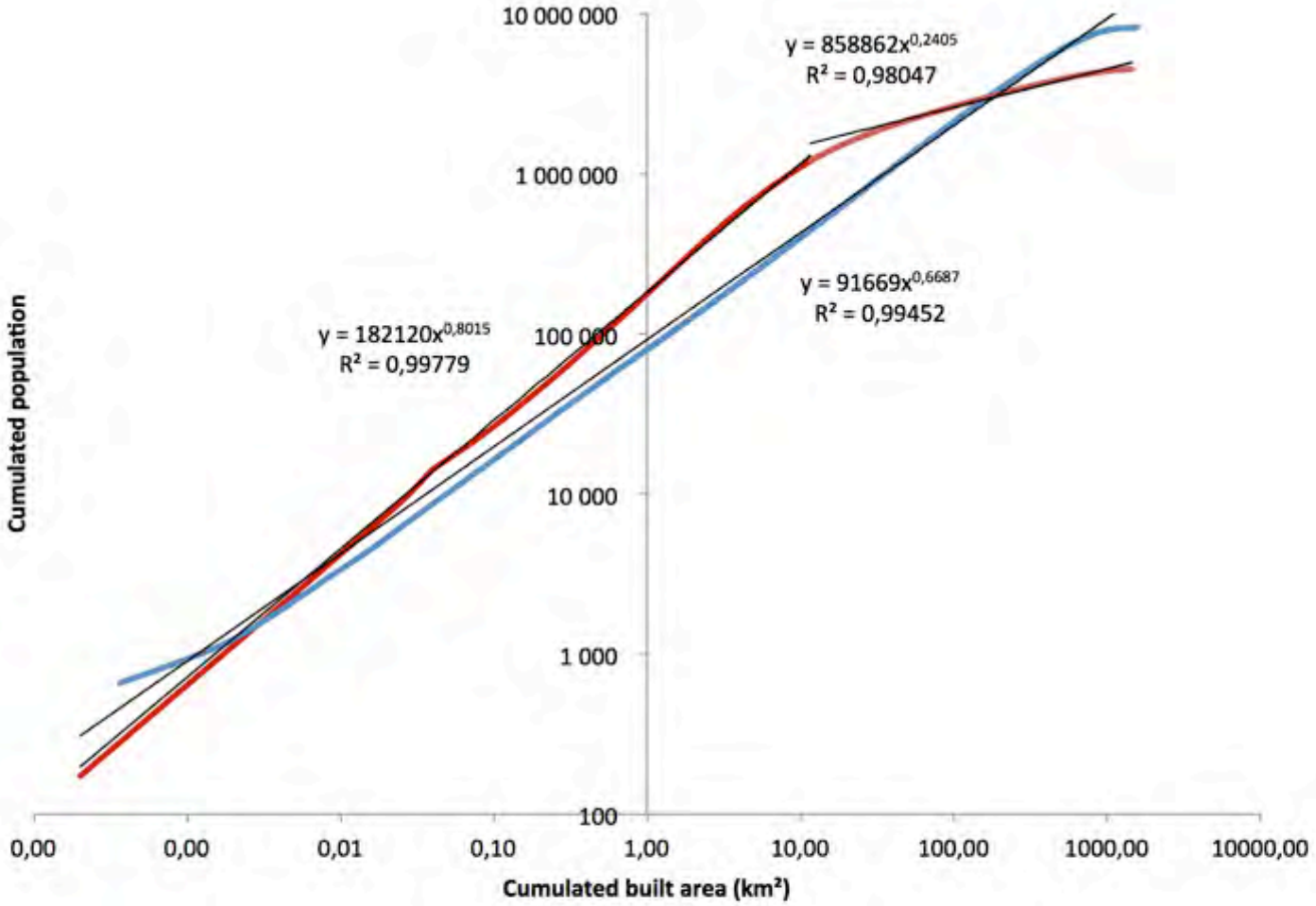
Jobs density is highly concentrated in central London

Source: Urban Morphology Institute

London jobs distribution is Paretian with a hierarchy coefficient of - 1, which reflects a very strong concentration of economic densities fostering agglomeration economies that are an engine of growth, productivity, and urban competitiveness



Source:Urban Morphology Institute (2015)



Allometric relationship for residential (blue) and job (red) spatial distribution in Greater London. Output areas are ranked by density (residential or jobs). The cumulated population of the N most populated output areas is plotted versus the cumulated area of the N output areas.

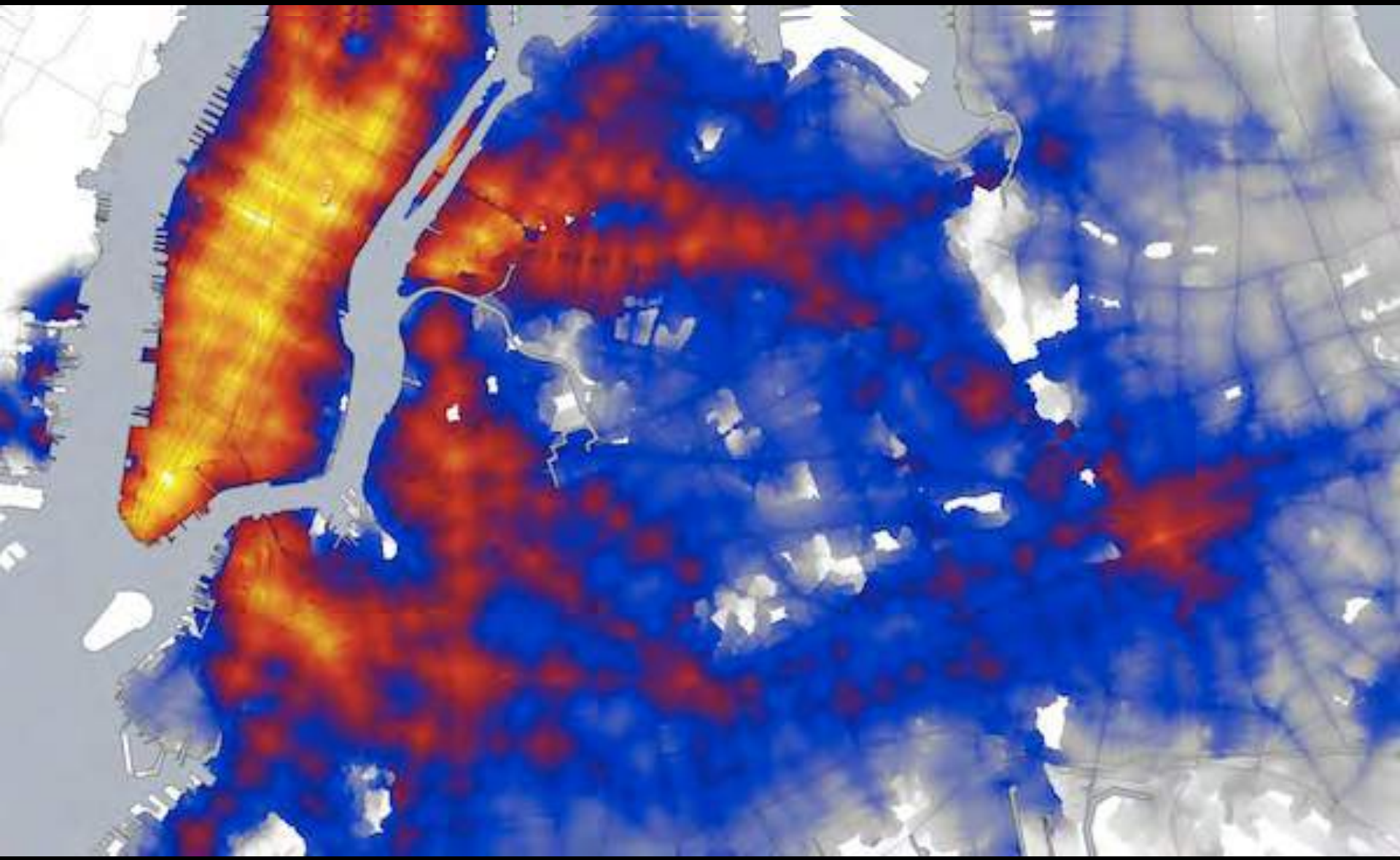
The allometric behavior of the residential population is infralinear with an exponent of 0.66.

The allometric behavior of the job distribution is infralinear with an exponent of 0.8 within the 12 most populated km² in terms of jobs, and then with an exponent of 0.24 in the rest of the city.

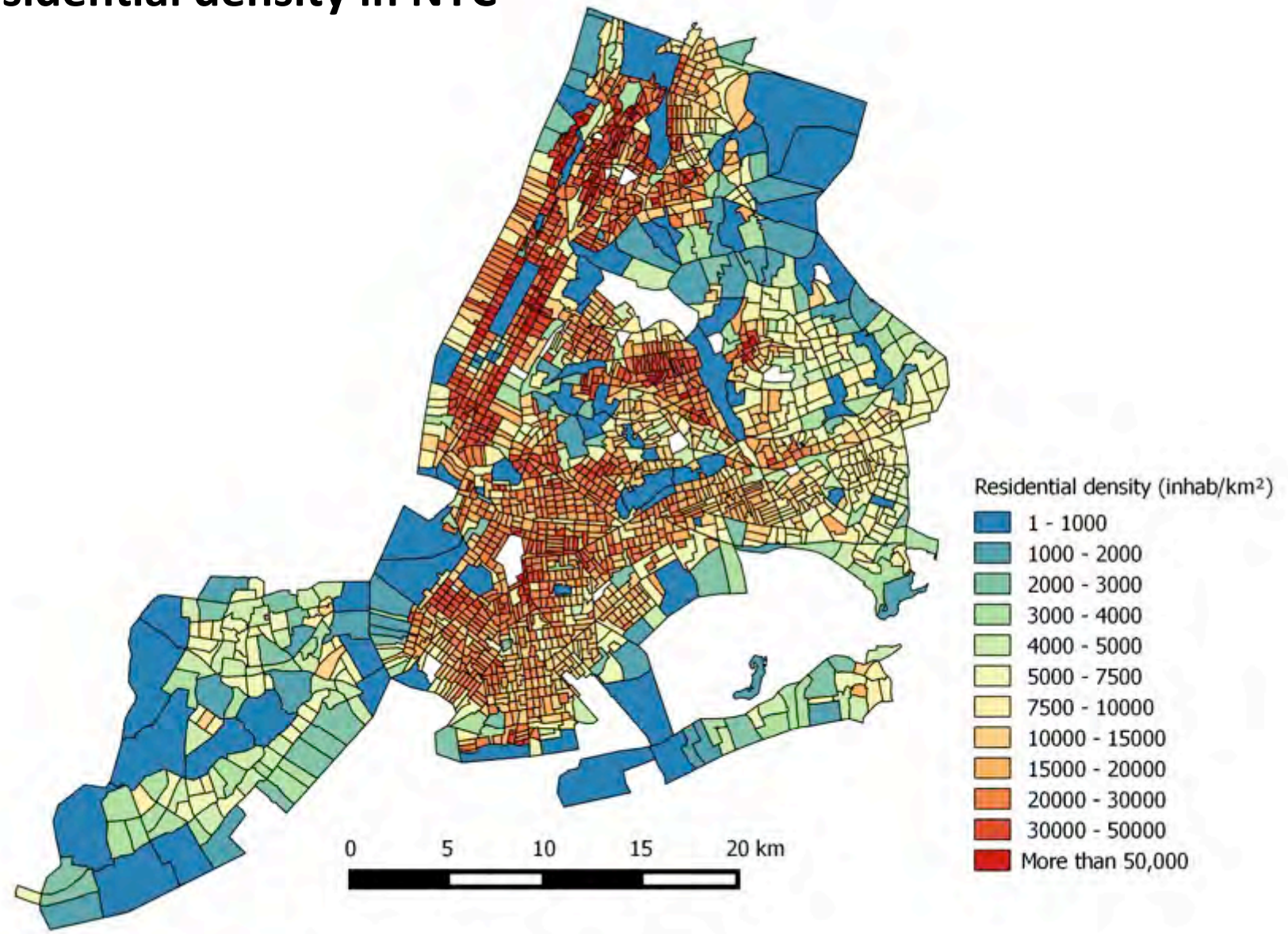
London economic spatial hierarchy is spiky

- 8.5 % of UK GDP on 1 square mile (2.9 km)
- 29 % of Inner London office space is in the square mile of the City of London (in less than 1% of Inner London area) with jobs densities of 155,000 per km^2
- 40% of London jobs are centrally located in 32 km^2 (2% of Greater London area)
- 75% of Greater London jobs are in Inner London (20% of Greater London)

The 30min transit area from high job concentrations defines the high intensity development area in NYC



Residential density in NYC

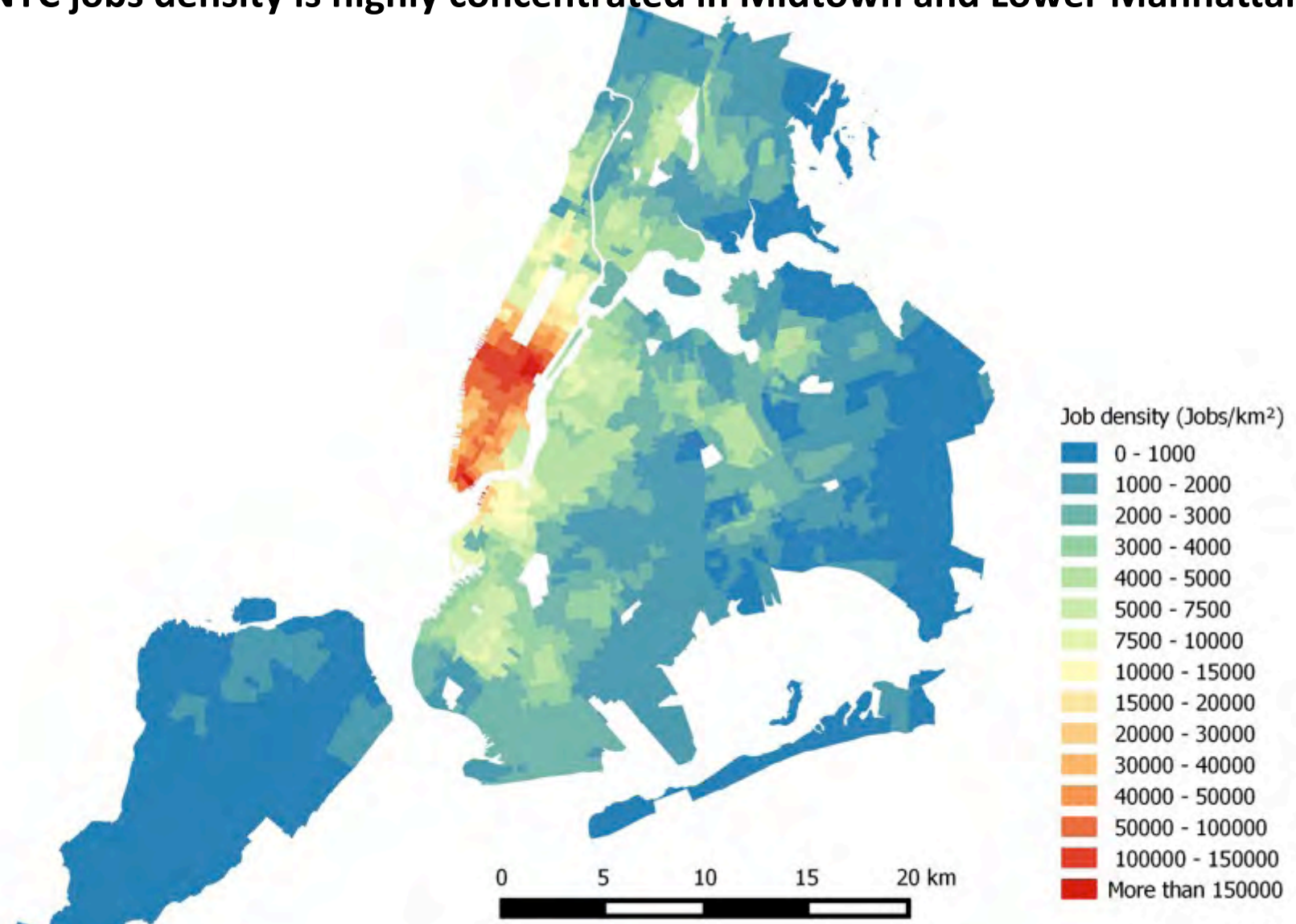


Source: Working paper UMCSII, Urban Morphology Institute ©

NYC Population density

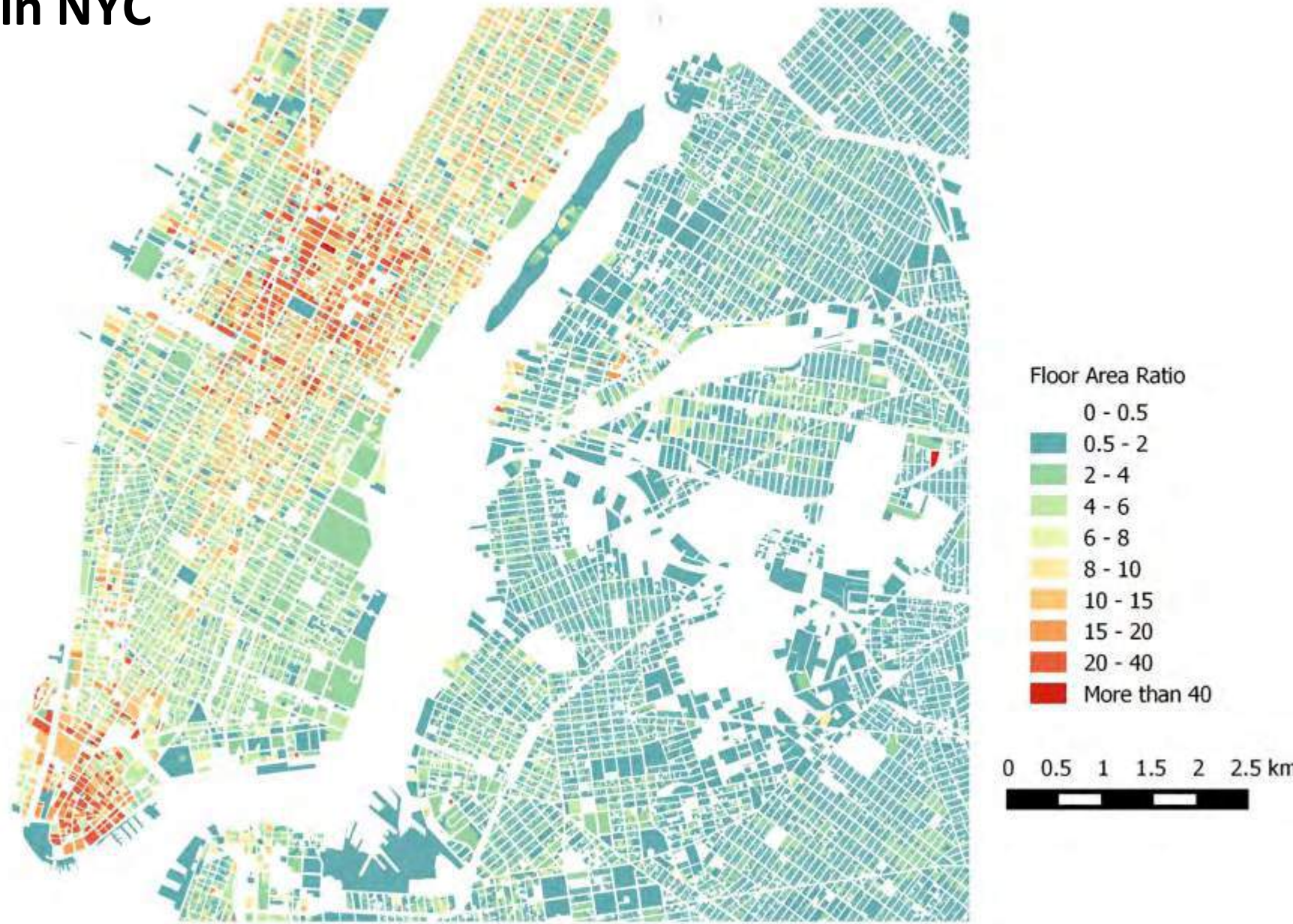
Source: Working paper UMCSII, Urban Morphology Institute ©

NYC jobs density is highly concentrated in Midtown and Lower Manhattan



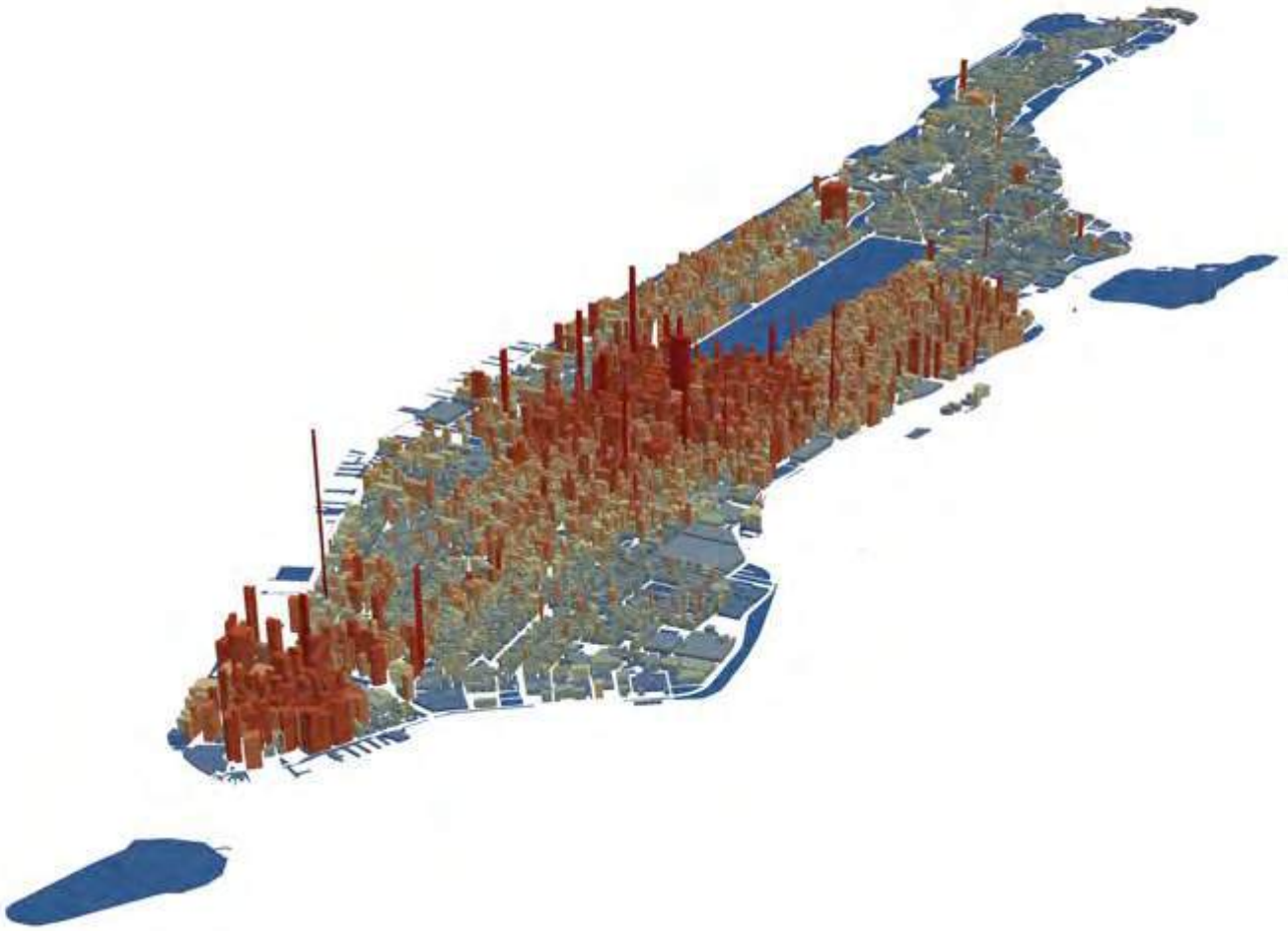
Source: Working paper UMCSII, Urban Morphology Institute ©

FAR in NYC



Source: Working paper UMCSII, Urban Morphology Institute ©

FAR in NYC



Source: Working paper UMCSII, Urban Morphology Institute ©

Office FAR in NYC

Source: Working paper UMCSII, Urban Morphology Institute ©

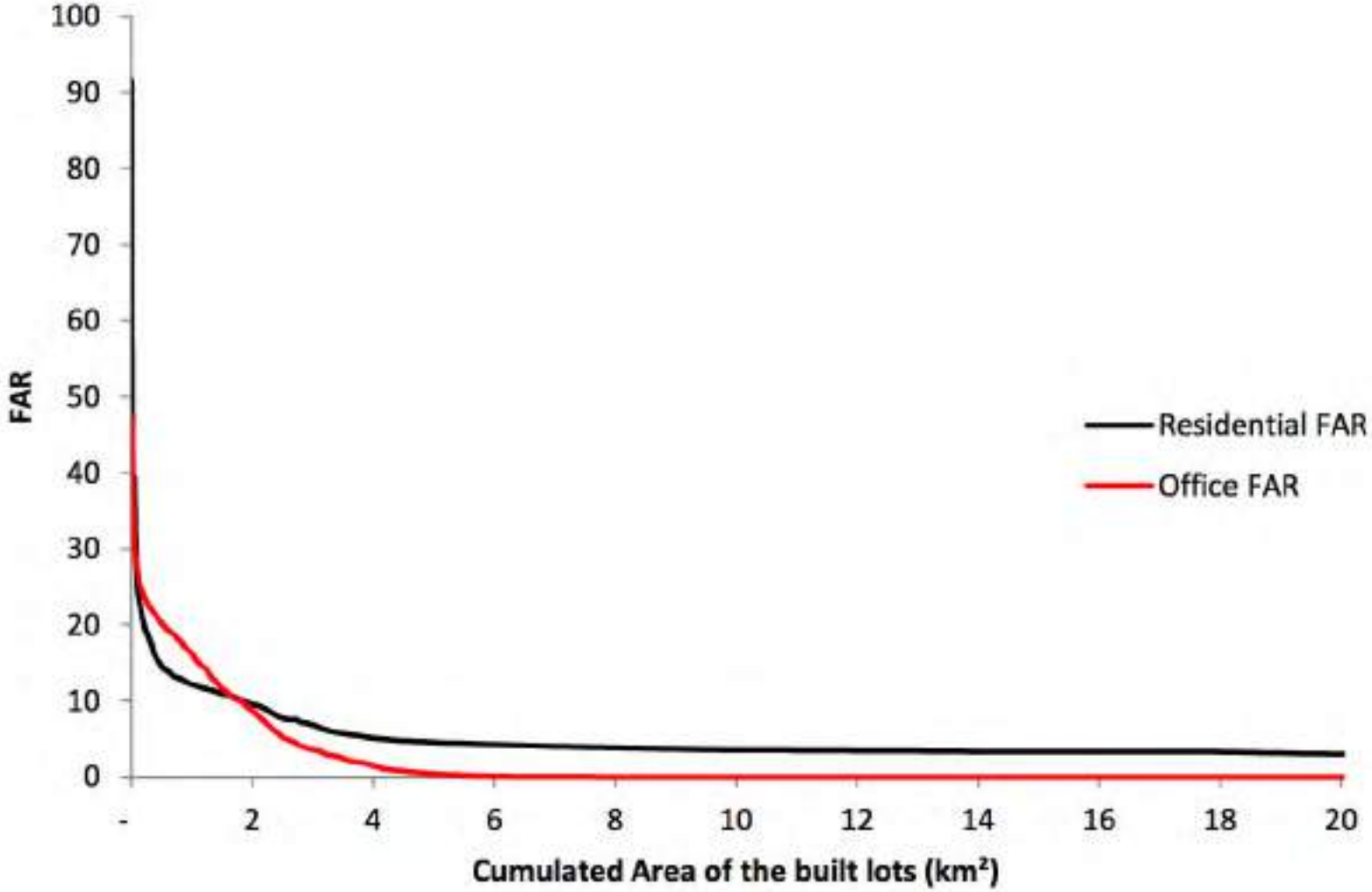
Manhattan

- 40 %

of NY REGION OFFICE SPACE IS IN MIDTOWN

- 60 %

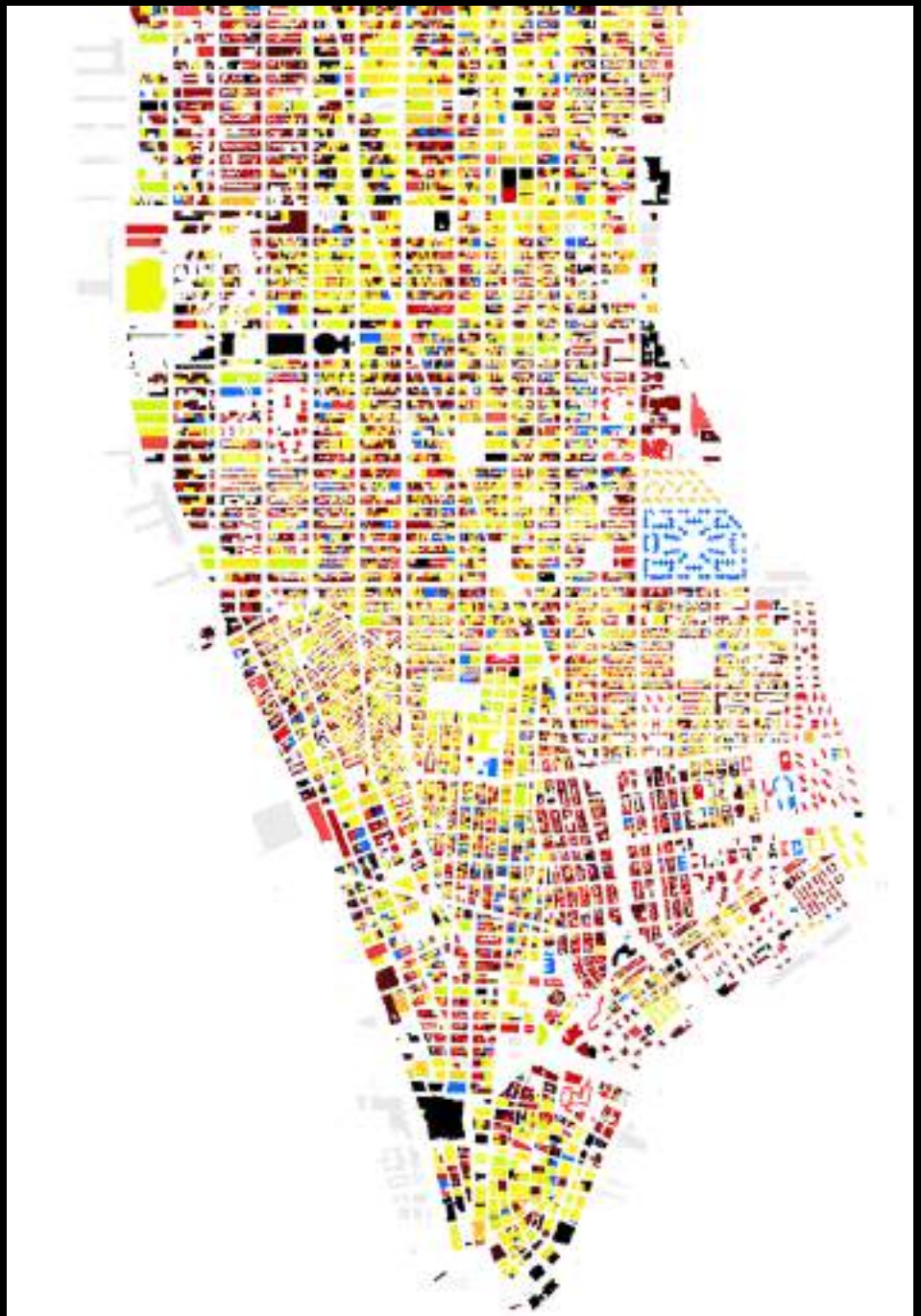
of NY REGION OFFICE SPACE IS IN MIDTOWN +LOWER MANHATTAN



Rank size distribution of floor area ratios (office and residential) for Manhattan. Residential: R^2=0.88, scaling exponent 0.53. Office: R^2=0.66, scaling exponent 1.7.

Manhattan

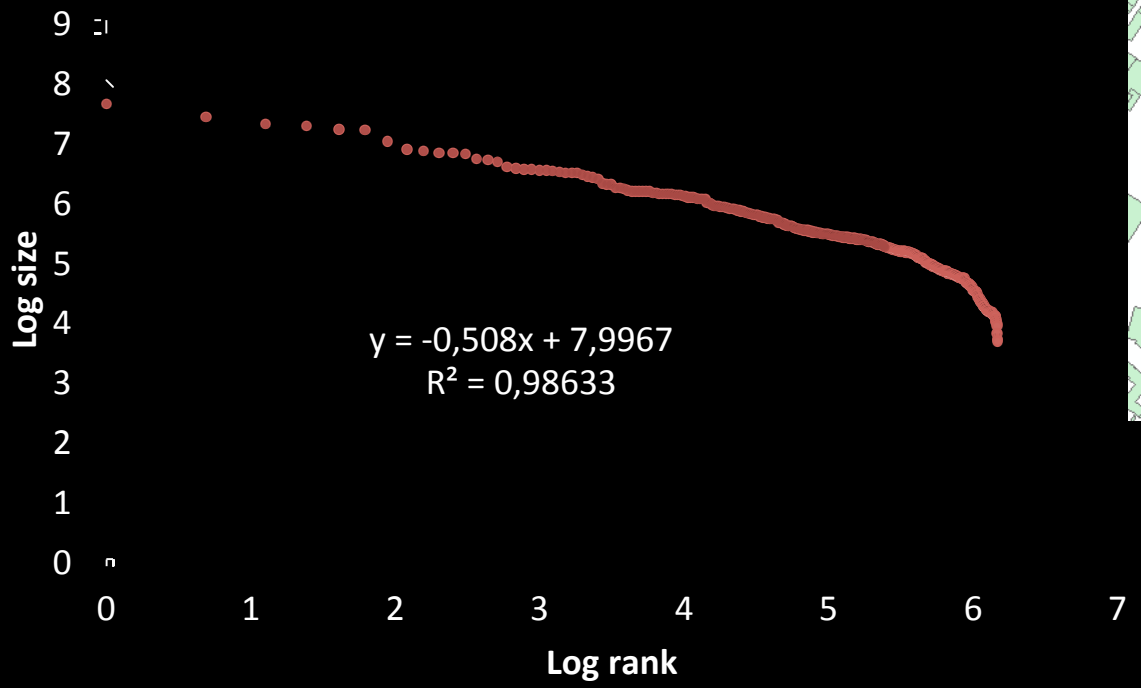
A highly heterogeneous urban landscape within an apparently homogeneous Euclidean grid



Highly adaptive platting follows a mathematical regularity characteristic of scale free complex systems: Frequency of sizes follows an inverse power law

Wall Street's plot area scaling coefficient is similar to Paris reflecting the European origin of this part of the city (New Amsterdam) and its longer evolution The largest plot is 2000 m2.

New York City
Wall Street

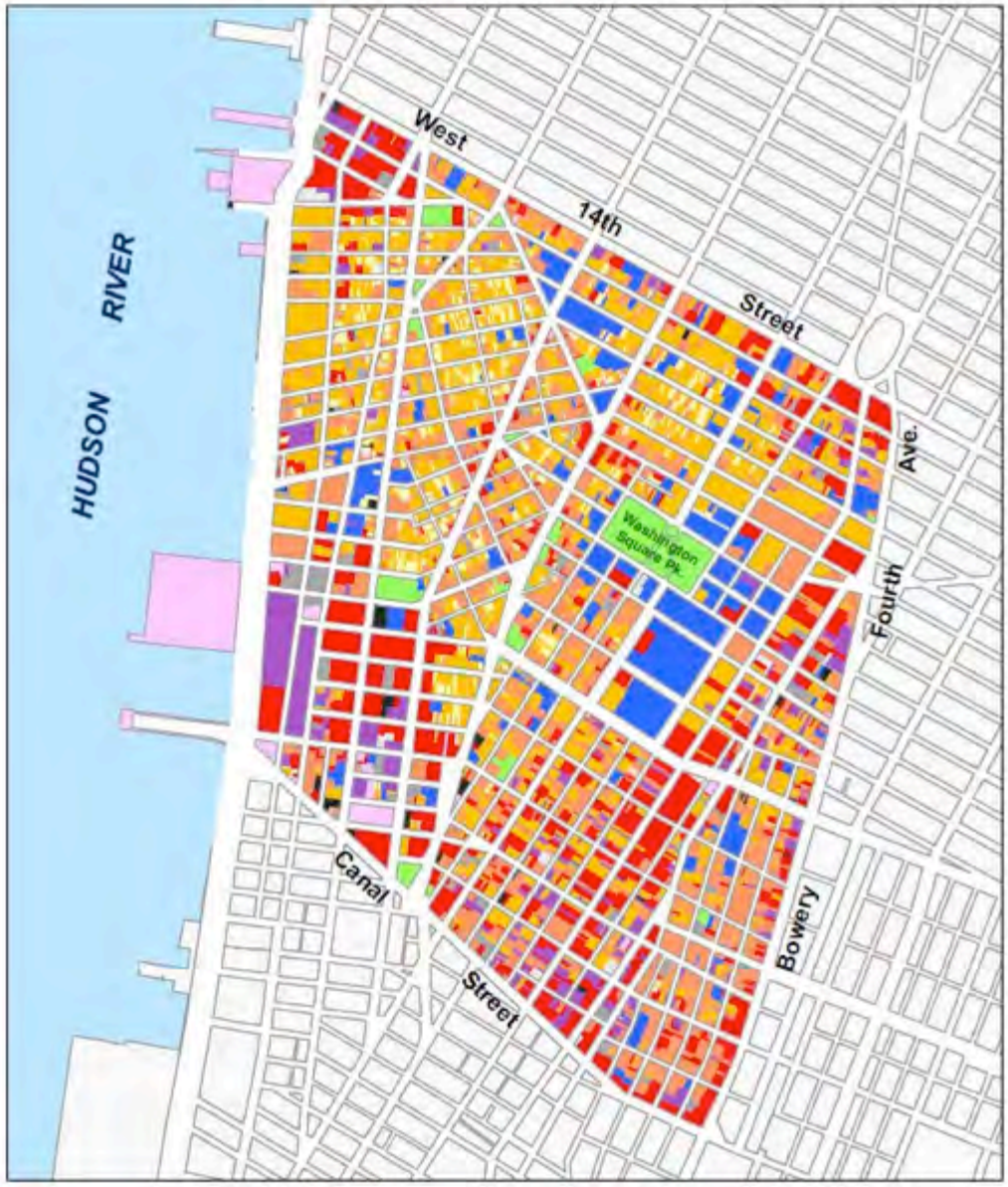


Source: Working paper UMCSII, Urban Morphology Institute

Fine grain diversity

- Fine grain diversity refers to mixed use at the neighborhood and block scale:
  - At the neighborhood scale, it refers to a “smart” mix of residential buildings, offices, shops, and urban amenities.
  - At the block and building scale, mixed use consists of developing small-scale business spaces for offices, workshops, and studios on the ground floor of residential blocks and home-working premises.
- A number of studies of single-use zoning show strong tendencies for residents to travel longer overall distances and to carry out a higher proportion of their travel in private vehicles than residents who live in mixed land use areas in cities. Single-use zoning is a low resilience urban development, because it is highly dependent to individual cars and fossil fuel energy
- Fine grain mixed-use development shortens journeys and promotes transit/walking/cycling and adaptive re-use of buildings. As such it widely contributes to urban resilience.

Manhattan Community District 2



0 0.15 0.3
Miles

Source: MapPLUTO™ Release 11v1

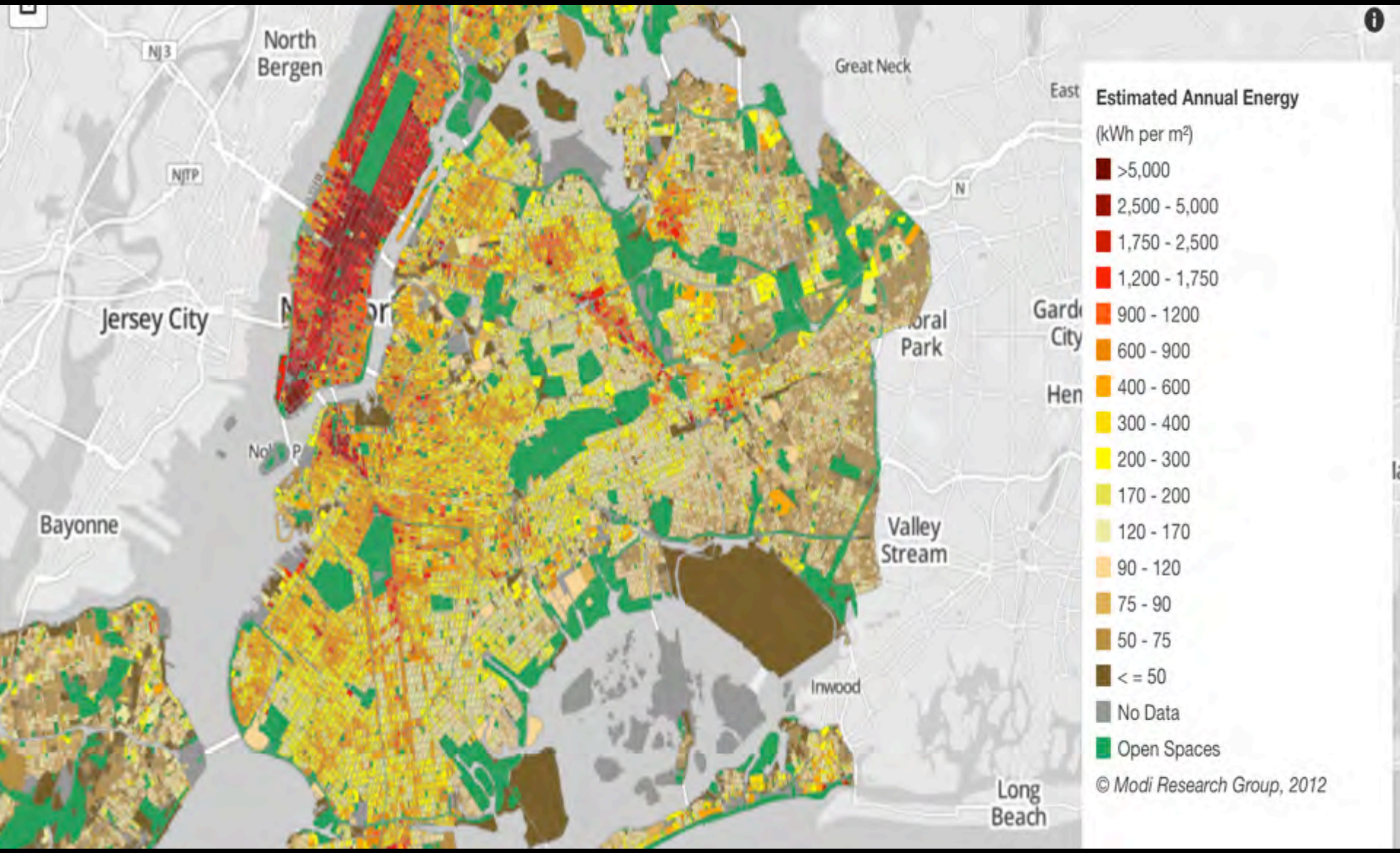
Residential Land Uses

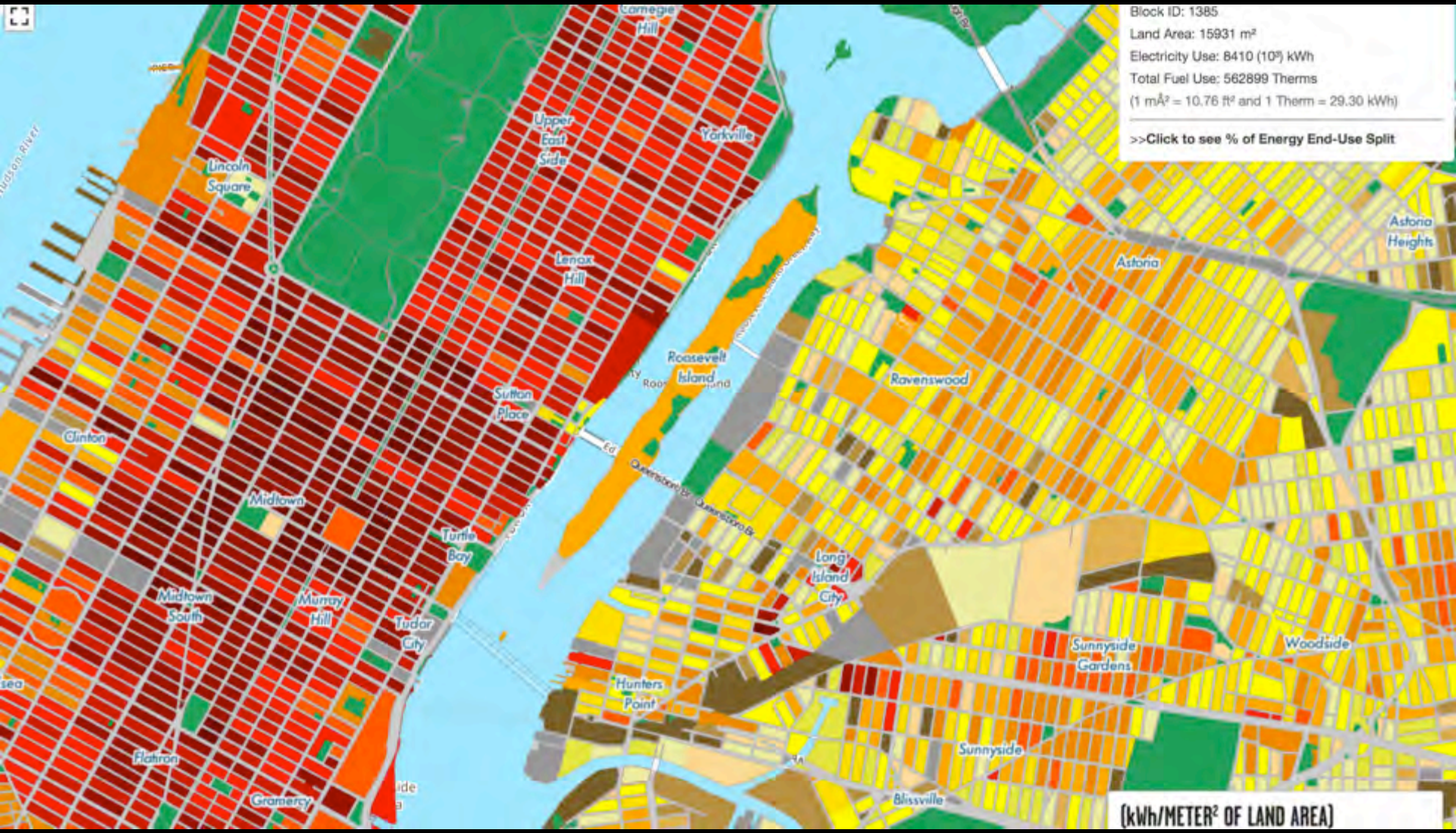
- One & Two Family Buildings
- Multi-Family Buildings
- Mixed Residential and Commercial Buildings

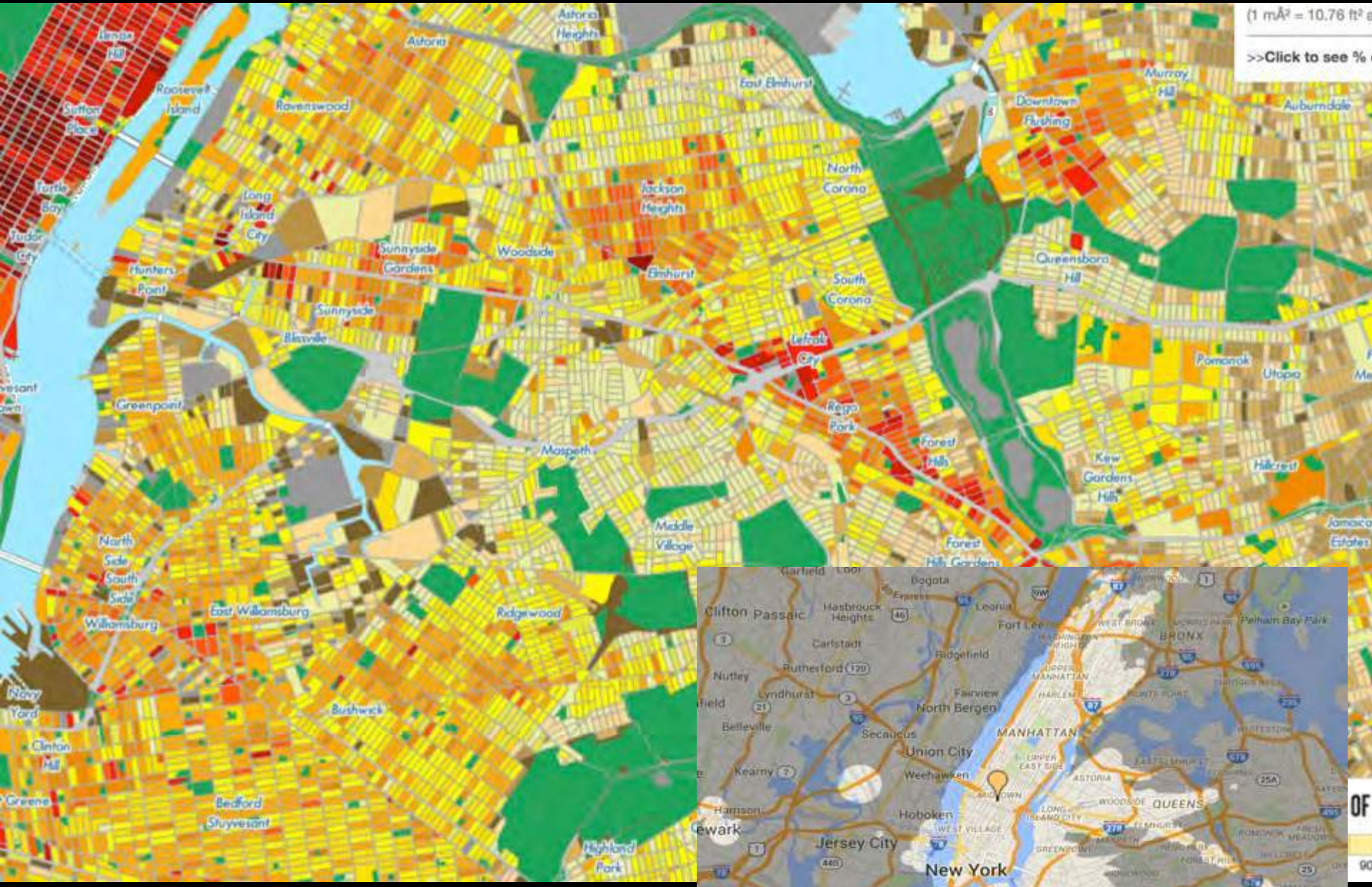
Non-Residential Land Uses

- Commercial / Office Buildings
- Industrial / Manufacturing
- Open Space and Outdoor Recreation
- Public Facilities and Institutions
- Transportation and Utility
- Parking Facilities
- Vacant Land
- All Others or No Data

Manhattan energy density map shows a high diversity at all scales




Block ID: 1385
Land Area: 15931 m²
Electricity Use: 8410 (10³) kWh
Total Fuel Use: 562899 Therms
(1 m² = 10.76 ft² and 1 Therm = 29.30 kWh)
>>Click to see % of Energy End-Use Split
Carnegie Hill
Upper East Side
Yorkville
Lincoln Square
Lenox Hill
Roosevelt Island
Sutton Place
Astoria
Astoria Heights
Ravenswood
Clinton
Midtown
Turtle Bay
Midtown South
Murray Hill
Tudor City
Long Island City
Sunnyside Gardens
Woodside
Hunters Point
Sunnyside
Blissville
Flatiron
Gramercy
(kWh/METER² OF LAND AREA)

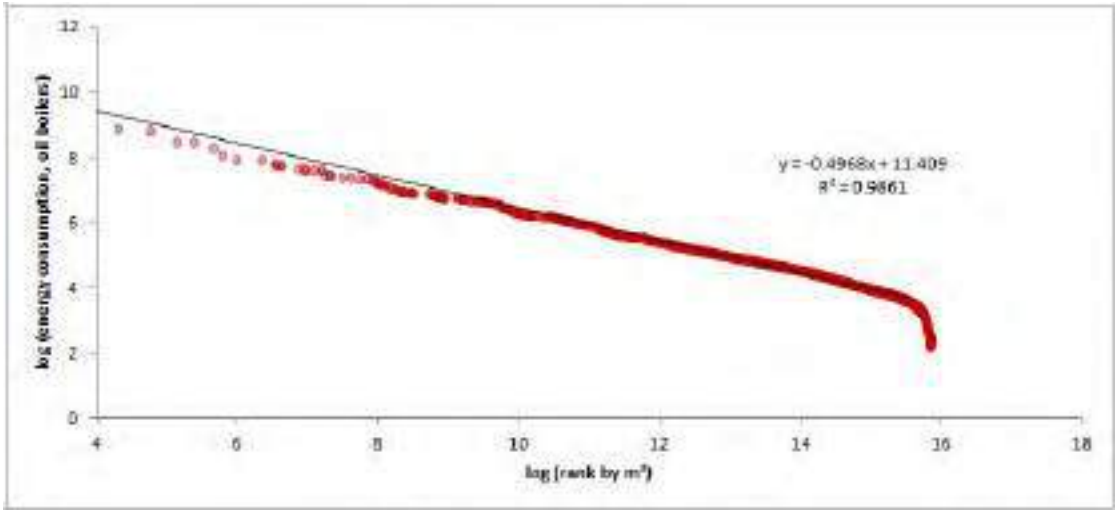


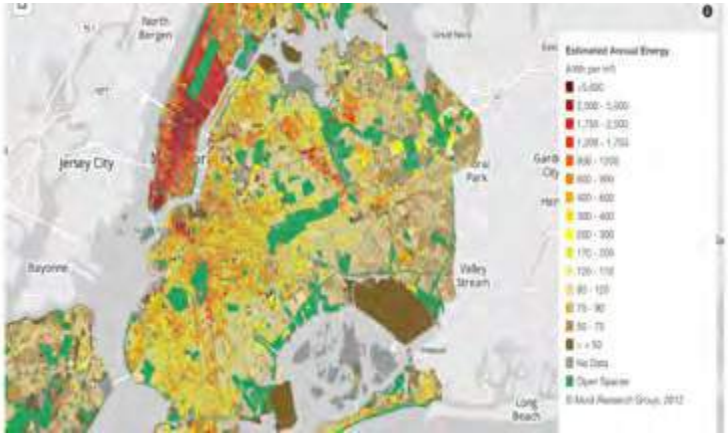
Intensity of development matches accessibility to core jobs

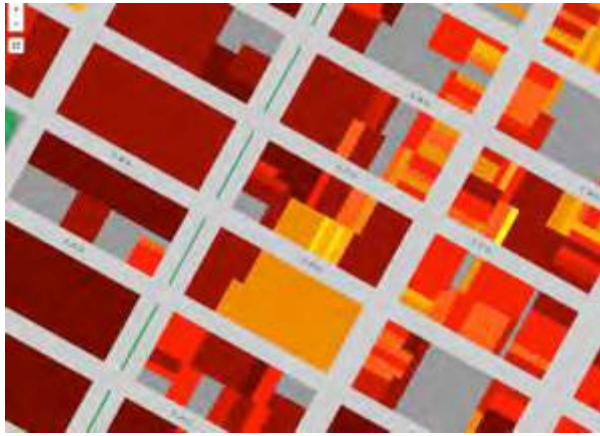

Building Floor Area: 21449 m²
Lot Electricity Use: 1375 (10⁵) kWh
Lot Total Fuel Use: 199490 Therms
(1 m² = 10.76 ft² and 1 Therm = 29.30 kWh)
Estimated Annual Energy End-Use Split %
16.1%
3%
18.7%
62.3%
Rego Park
Forest Hills
Grand Cent Pkwy S/ W
(kWh/METER² OF LAND AREA)
N/A
<=50
75
90
120
170
200
300
400


Estimated Lot Level Annual Energy Consumption
Lot Address: 266 WEST 25 STREET
Lot Land Area: 284 m²
Building Floor Area: 1083 m²
Lot Electricity Use: 96 (10³) kWh
Lot Total Fuel Use: 7667 Therms
(1 m² = 10.76 ft² and 1 Therm = 29.30 kWh)
>>Click to see % of Energy End-Use Split
Flatiron
Gramercy

In a city shaped by market forces like New York, energy density at tax lot level (in kWh/m² of land), which is a good proxy of the intensity of land development, varies more than 100-fold and follows an inverse power law







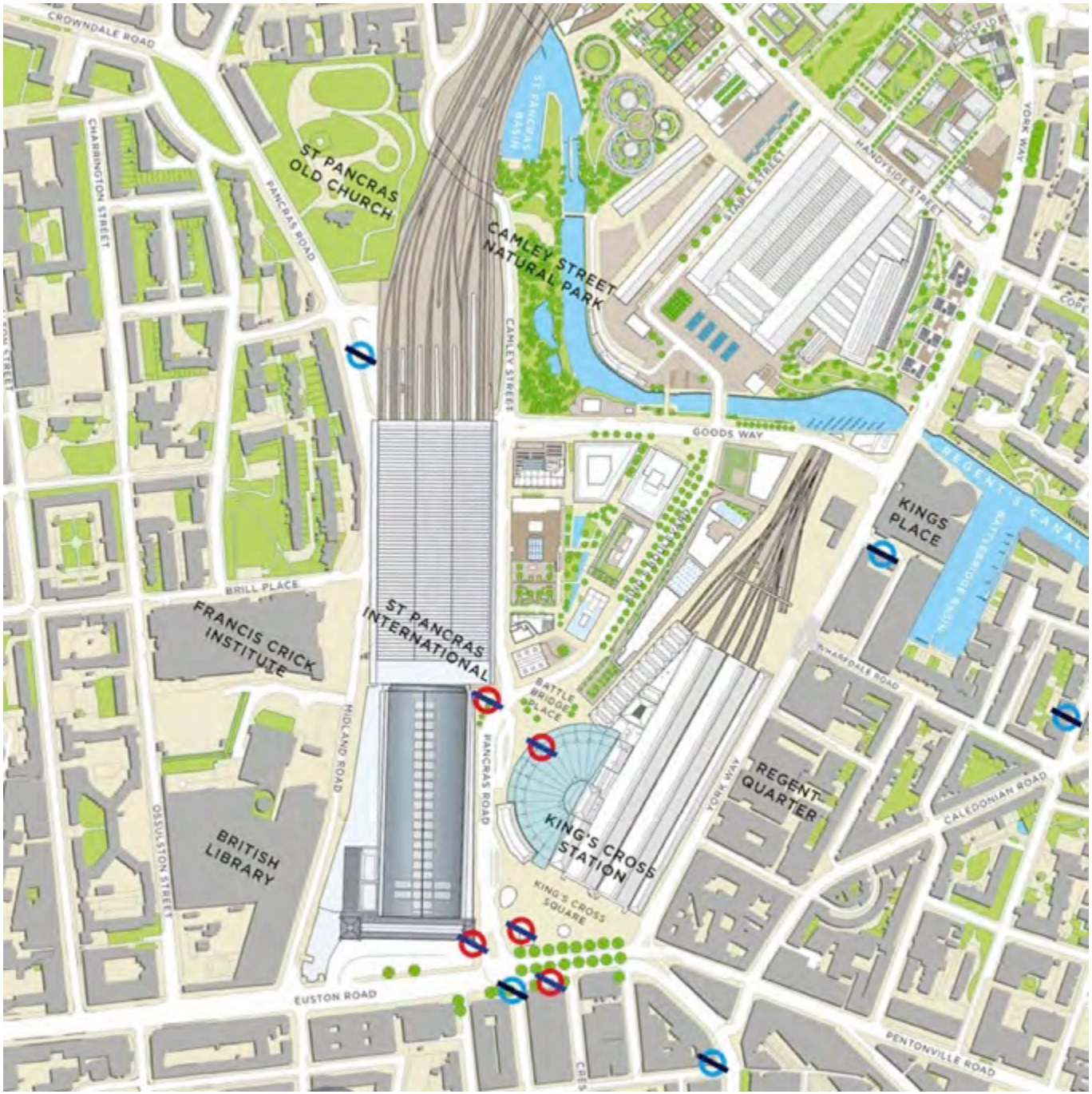
Data Source:
Spatial distribution of urban building energy consumption by end use. B. Howard, L. Parshall, J. Thompson, S. Hammer, J. Dickinson, V. Modi

5. How to address simultaneously challenges to urban quality of life, housing affordability, and urban competitiveness?

Case Studies from London and New York

到2020年，约有5万人将在国王十字车站区域学习、生活和工作

King's Cross in the core of London is a major interchange station, at the scale of the city, of UK, and of Europe. King's Cross is a 6 subway lines hub. King's Cross Central combines 2 major train stations (International high speed Eurostar and domestic). Passengers can reach the center of Paris in 2hrs 15, Brussels in 1hr 51 and Lille in 1hr 20. These destinations will be joined by Amsterdam, Cologne and Frankfurt via Deutsche Bahn's high speed ICE. This transport hub is expected to support 63 million passengers a year from 2020.



KING'S CROSS CENTRAL EXAMPLE

国王十字车站范例

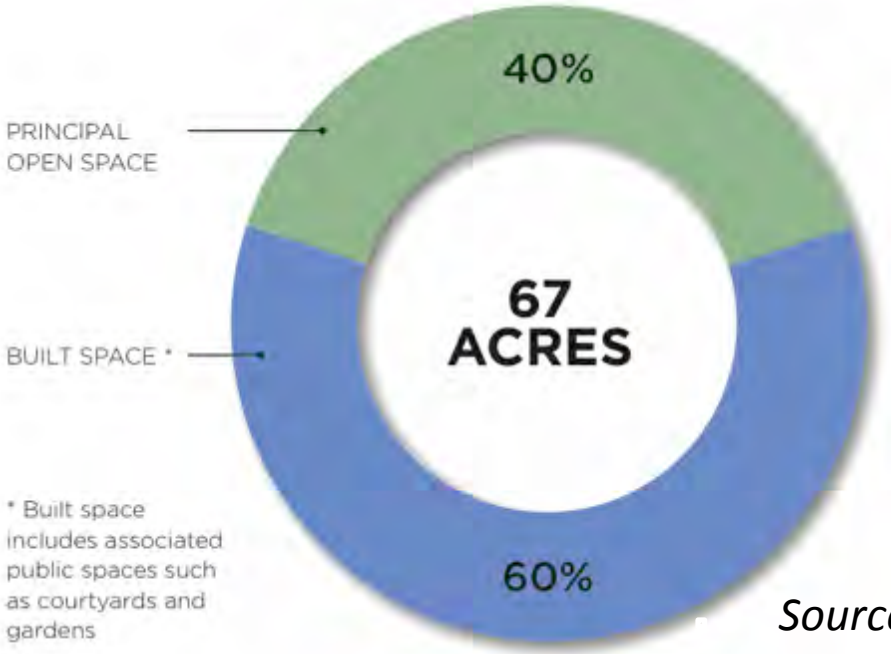
CREATING HIGH PLACE VALUE IN A NODE OF UNIVERSAL CONNECIVITY

HIGH DENSITY (173,000 JOBS + PEOPLE/KM^2 IN A SERIES OF OPEN PARKS) WITH A FAR OF 4.6

Source: Argent

King's Cross Central
250 million £ investment in
20 new streets and 10 new public spaces have leveraged
2.2 billion £ of private investment

国王十字车站
对2.5条街道和10个新建公共场所，投资20亿英镑



Source: Argent

Public realm公共区域

2 Billion £ (21 Billion RMB) already spent in local transport infrastructure and public realm)
20亿英镑（210亿人民币）用于当地交通基础设施和公共区域建设
A third of the site (10 ha) dedicated to new public streets and open spaces
三分之一的场地（10公顷）用于建新的公共线路与开放空间
20 major streets created 建设20条主要街道
10 new public spaces 10个公共空间
Including 5 major squares totalling 3.2 ha 包括3.2公顷的5大广场

London King's Cross Central伦敦国王十字车站

Mixed use 混合用途

5000 students (Granary Complex) 5000名学生（谷仓型大楼）

650 student's housing rooms 650间学生宿舍

50 new buildings 50栋新建筑

Residential buildings (2000 homes including affordable homes)

住宅建筑（2000户，包括经济适用住房）

Office buildings (One Pancras Square) 办公建筑（一处潘克拉斯广场）

A concentration of high tech economy

高技术经济中心

Google new UK headquarters is a low-rise building longer (330 m) than the Shard skyscraper is tall.

谷歌的英国新总部是一所低层建筑，其高度（330米）大于Shard摩天大楼。

Google has spent about 650 million £ (RMB 6.8 Billion) to buy and develop a 1 ha site. The finished development will be worth up to 1 billion £ (RMB 10.5 billion) . Google presence is expected to draw other technology companies to King's Cross - especially small start-ups - and help bump up rents.

谷歌耗费约6.5亿英镑（68亿人民币）购买并开发一块1公顷土地。完工后价值将升值至10亿英镑（105亿人民币）。谷歌进驻将吸引其他技术公司进驻英王十字中心 – 尤其是小型创业公司—并可帮助提升租金。

Value creation创造价值

50 new and restored buildings and structures 50所新建及修复建筑和设施

GOOGLE UK headquarter 1 Billion £ per ha 谷歌英国总部每公顷10亿

Source: Argent

New York region by 2025: 440,000 new jobs requiring 12 million m² of new space

Hudson Yards Project:

- 22 ha
- 2.5 million m² of new office space
- 13,500 new housing units, inc 4,000 affordable units
- 110,000 m² of new retail space
- 220,000 m² of new hotels

Market value is created by a high spike of economic density (20% of NY jobs growth by 2050)

Source: Hudson Yards website

Market value is fostered by place value high quality public space and small Manhattan blocks
at pedestrian level
with the High Line
with an investment of 600 million $ in public realm and landscaping

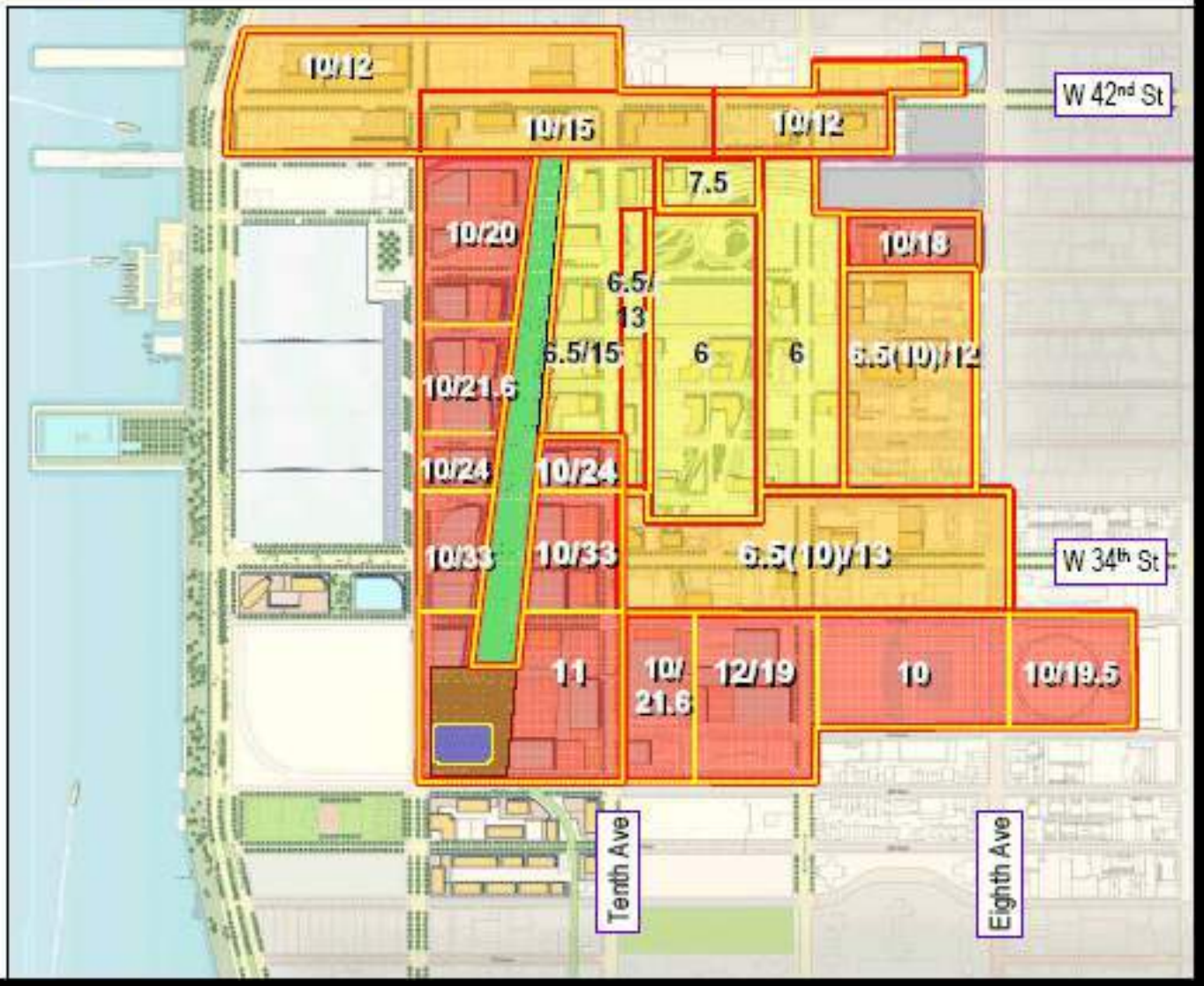
Source: Hudson Yards website

Market value is fostered by high place value (mixed use)

Source: Hudson Yards website

HUDSON YARDS

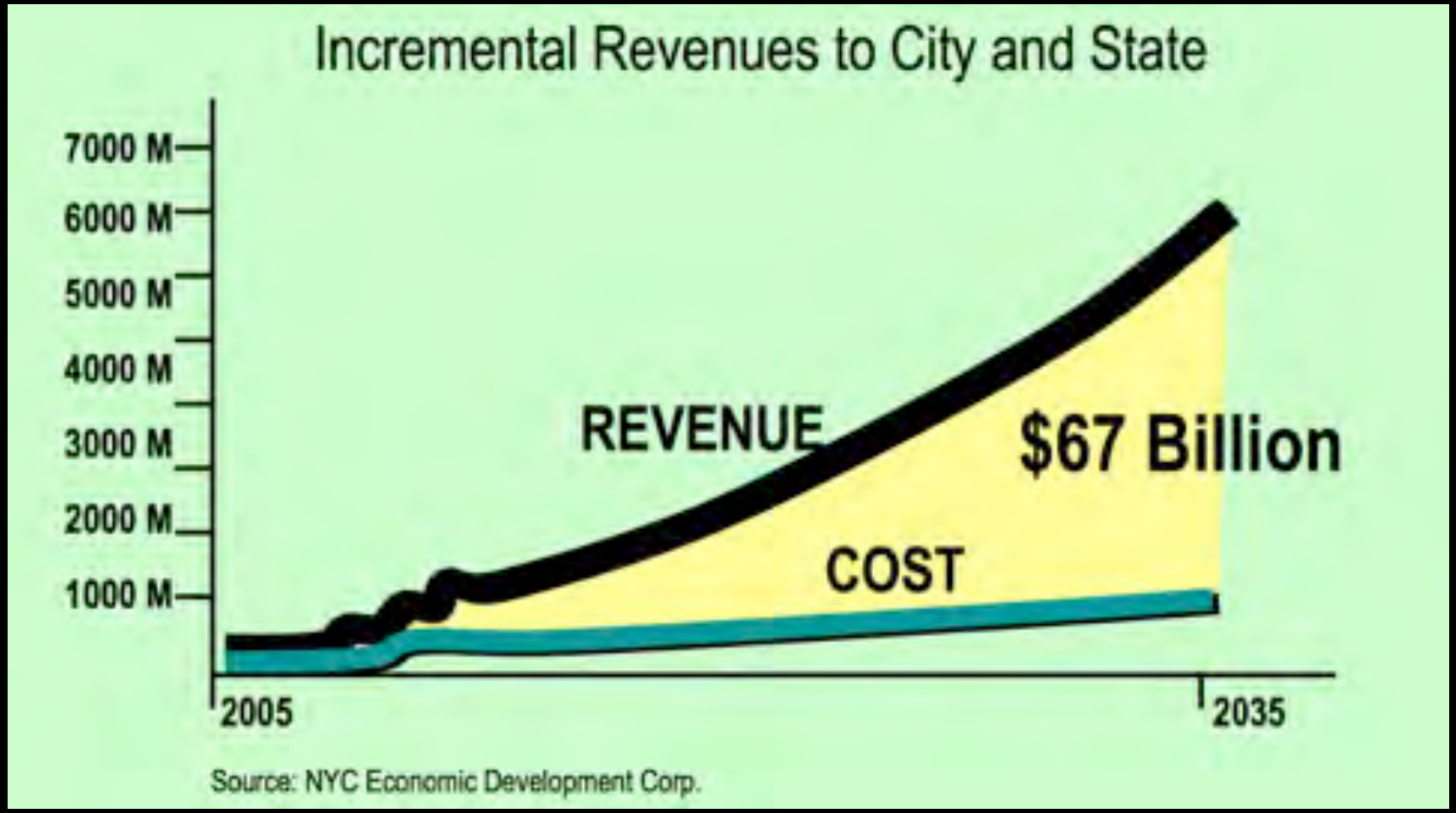
Adopted Zoning-
Base/ Maximum FARs



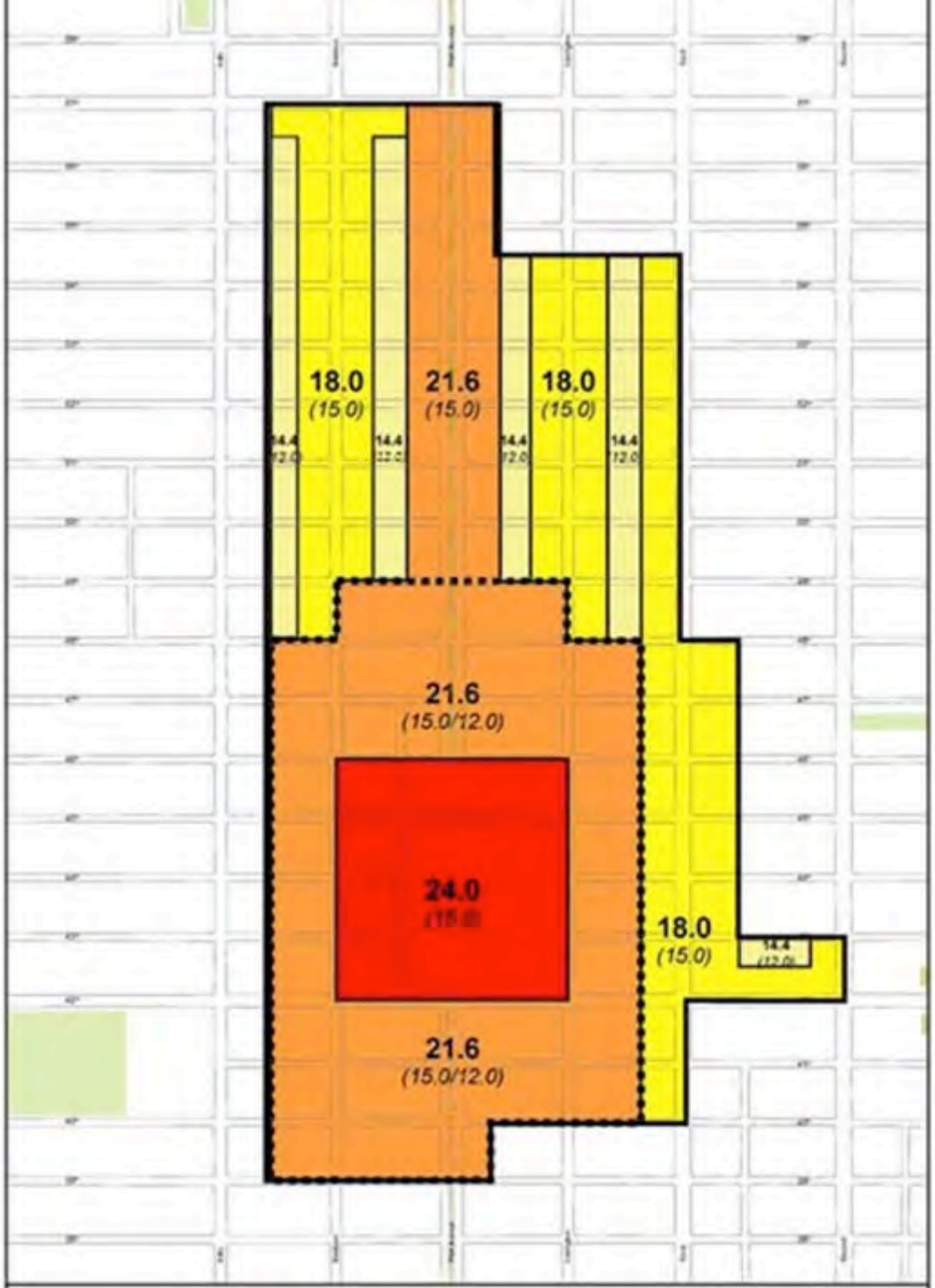
Land Use

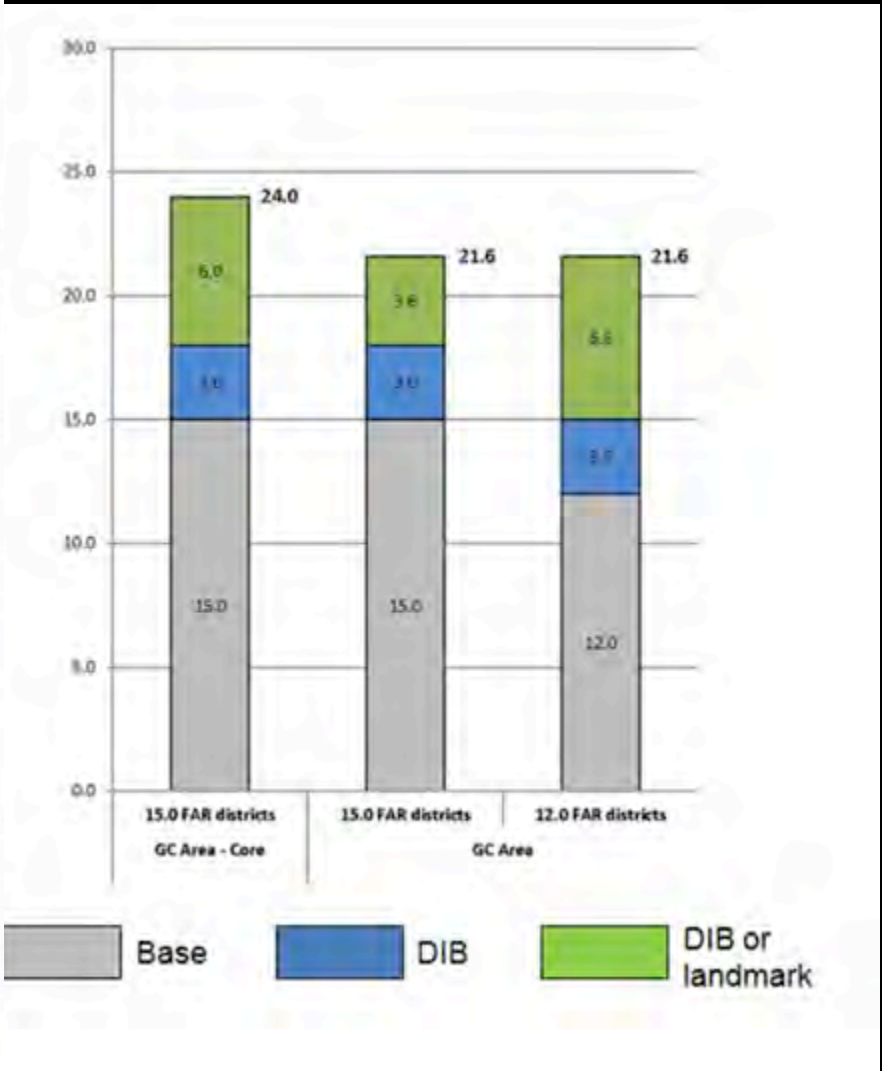
- predominantly residential
- mixed use
- predominantly commercial
- open space
- institutional

Source: NYC Department of Planning

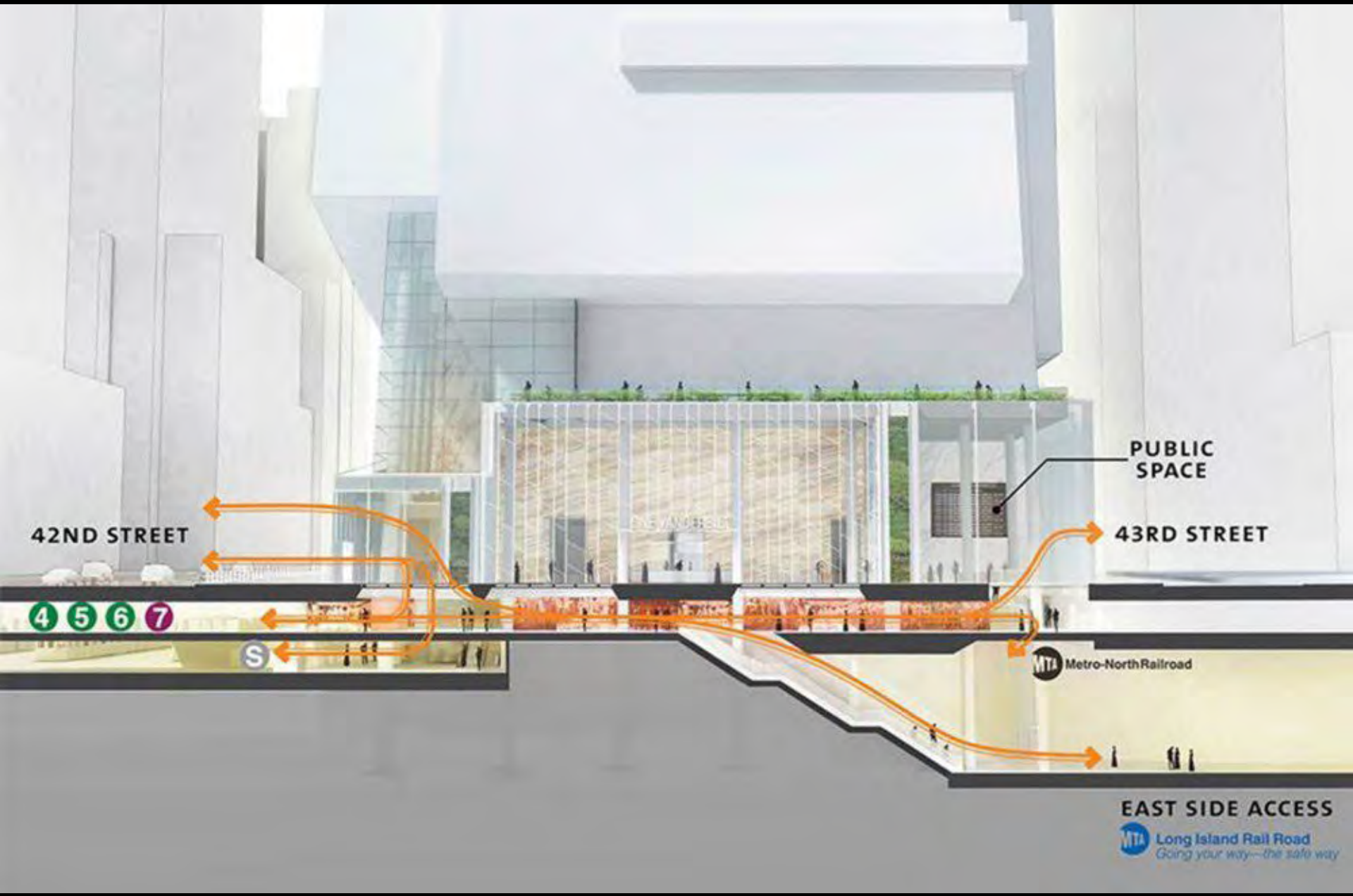

Incremental Revenues to City and State
7000 M
6000 M
5000 M
4000 M
3000 M
2000 M
1000 M
REVENUE
$67 Billion
COST
2005
2035
Source: NYC Economic Development Corp.

Midtown rezoning





Source: NYC Department of Planning


PUBLIC SPACE
42ND STREET
43RD STREET
4 5 6 7
S
Metro-North Railroad
EAST SIDE ACCESS
Long Island Rail Road
Going your way—the safe way

Source: KPF

Source: KPF

Source: KPF

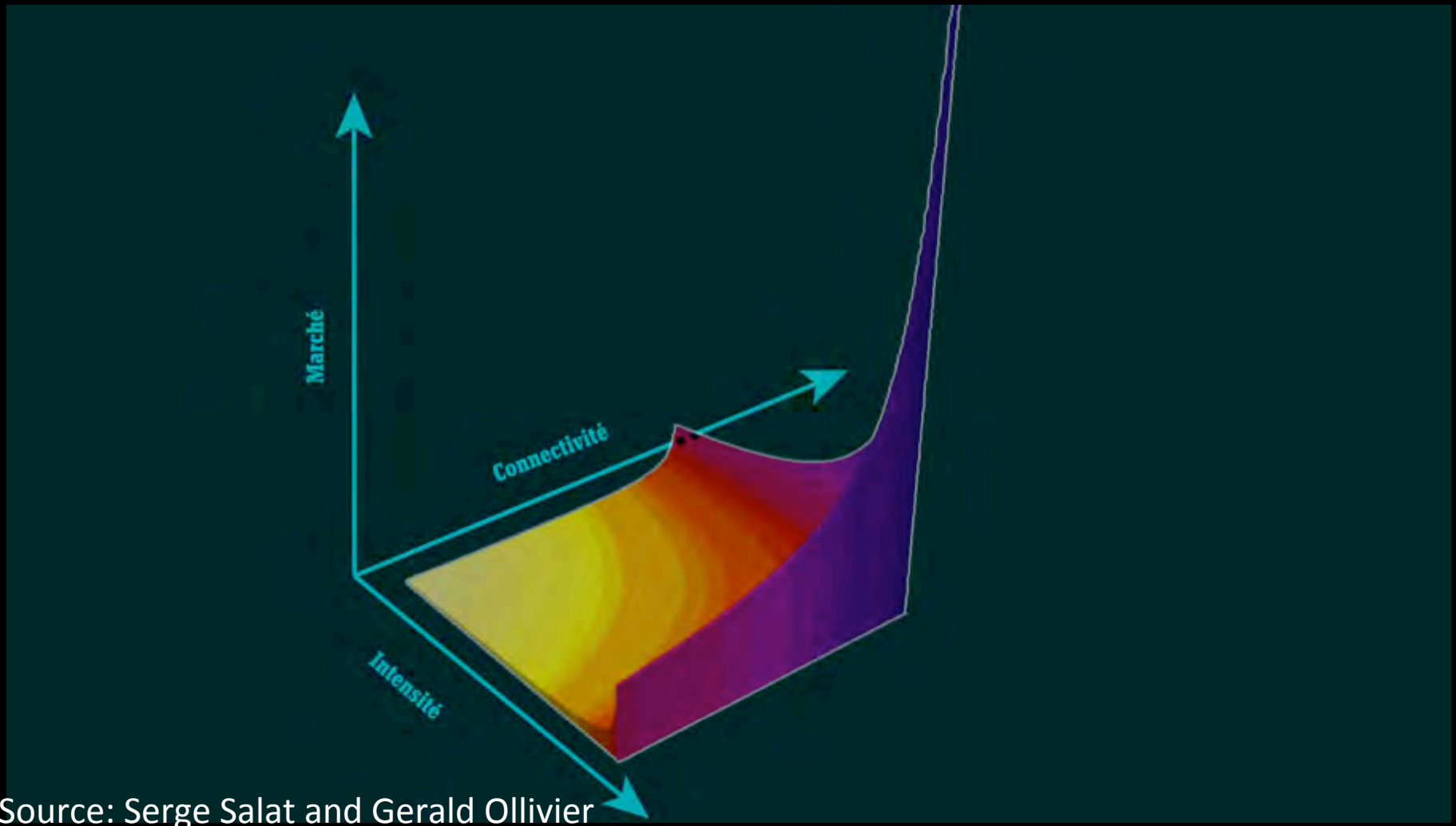
Source: KPF

Source: KPF

6. The 3 V Framework

Guiding local authorities and planners to prioritize TOD investment with a set of indicators addressing connectivity and accessibility, urban design and planning at local scale (street patterns, high quality urban fabric, mix use) as well as economic levers to create market value through the integration of urban form and transportation.

The alignment of high node value and high place value creates the highest peaks of market value and the highest spikes of value capture potential



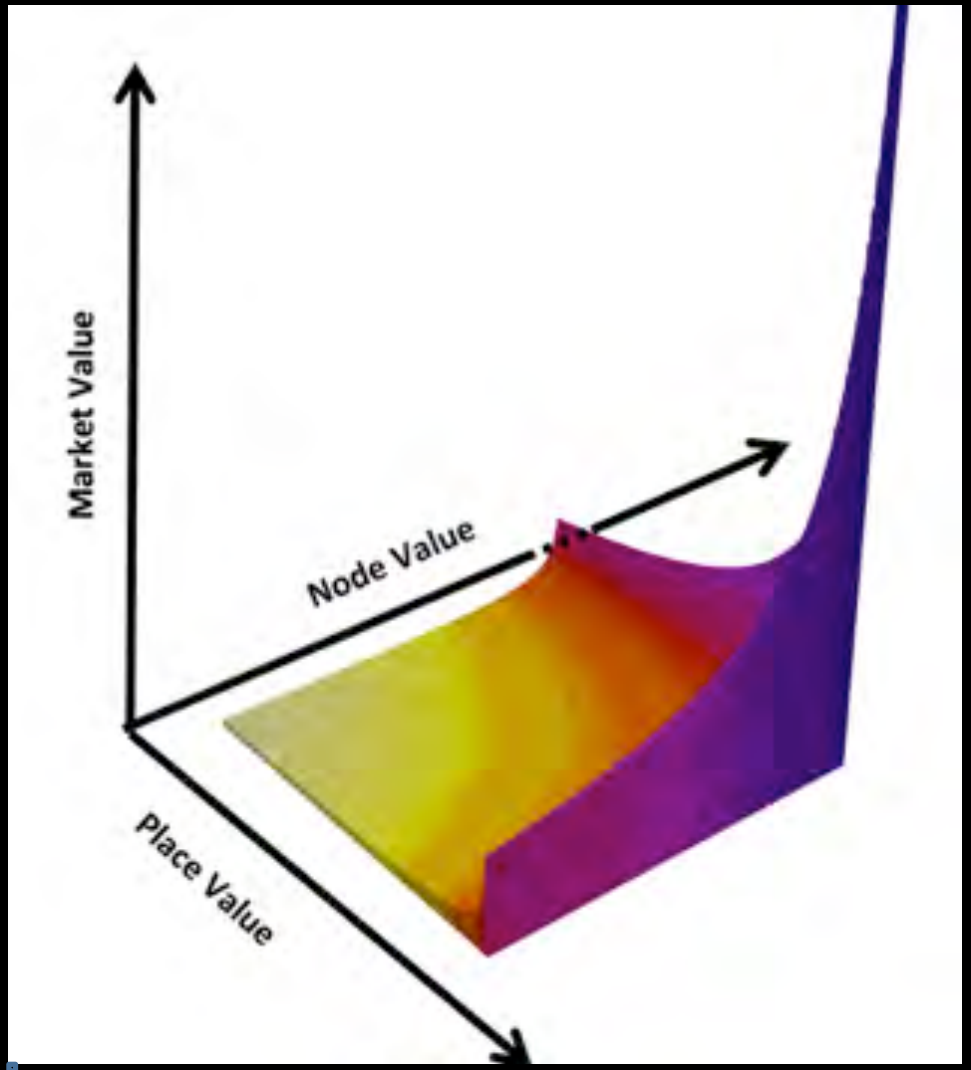
Source: Serge Salat and Gerald Ollivier
Urban Morphology Institute and World Bank

The “3V Framework”
“3V框架”

- Node Value based on its location in the network
- 节点价值—基于网络中的位置

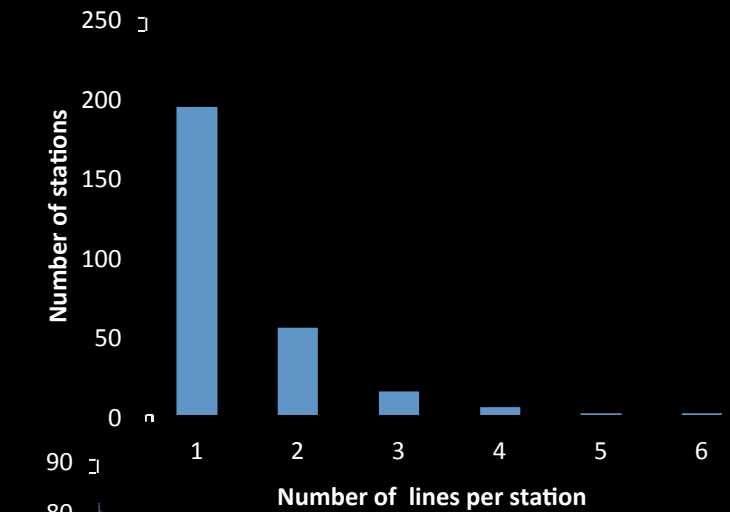
- Place Value based on its urban qualities
- 场所价值—基于城市空间质量

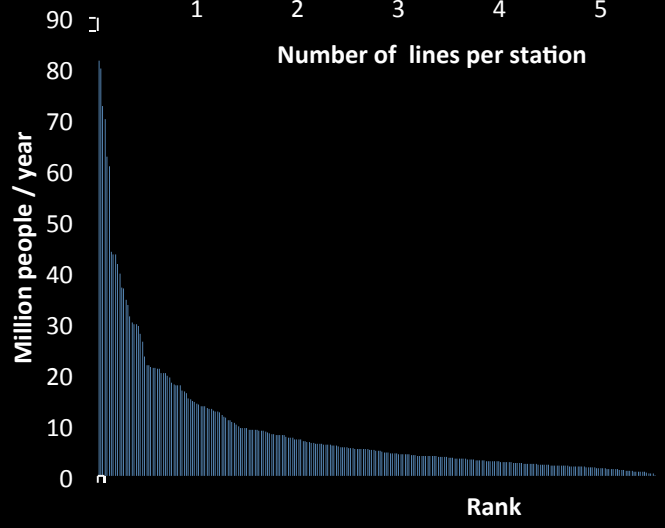
- Market Value, based on its economic potential
- 市场价值—基于经济潜力



The 3V Framework

Node Value (London Tube)
节点价值（伦敦地铁）

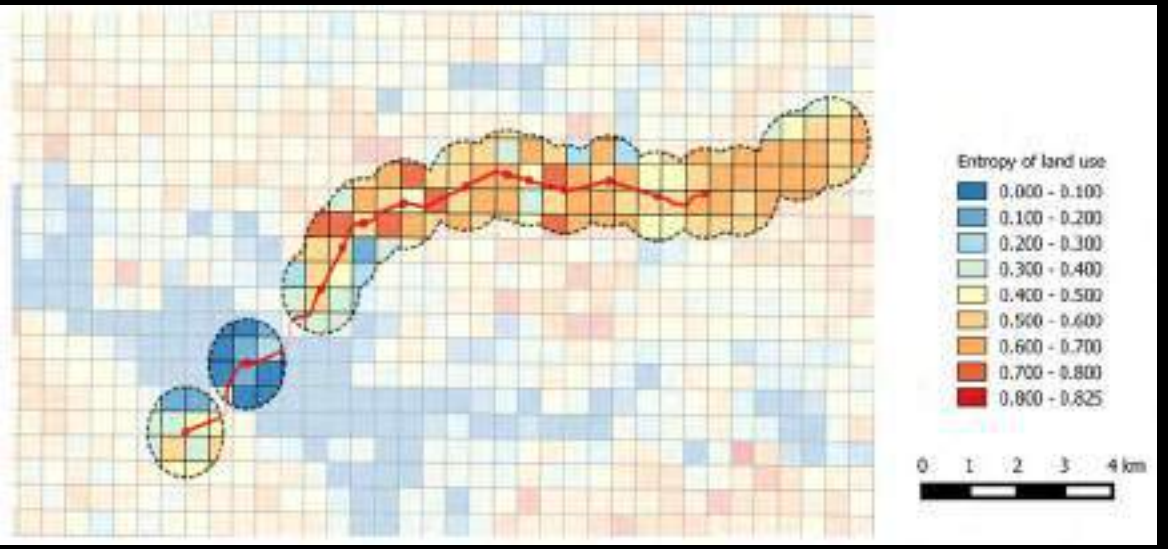




- Hub, Interchange, Single station
- 枢纽、换乘、单一站点
- Diversity of connectivity
- 多样的连接性
- Node Accessibility/Centrality
- 节点可达性/集中性
- Intensity of node activity
- 节点活动的密集性

Source: Urban Morphology Institute

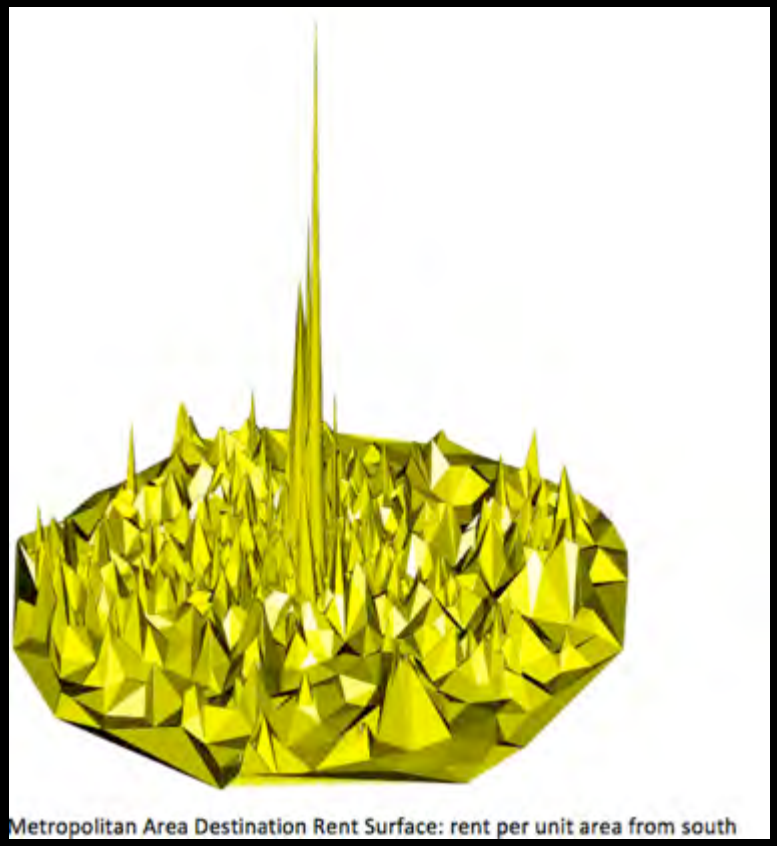
Place Value
场所价值



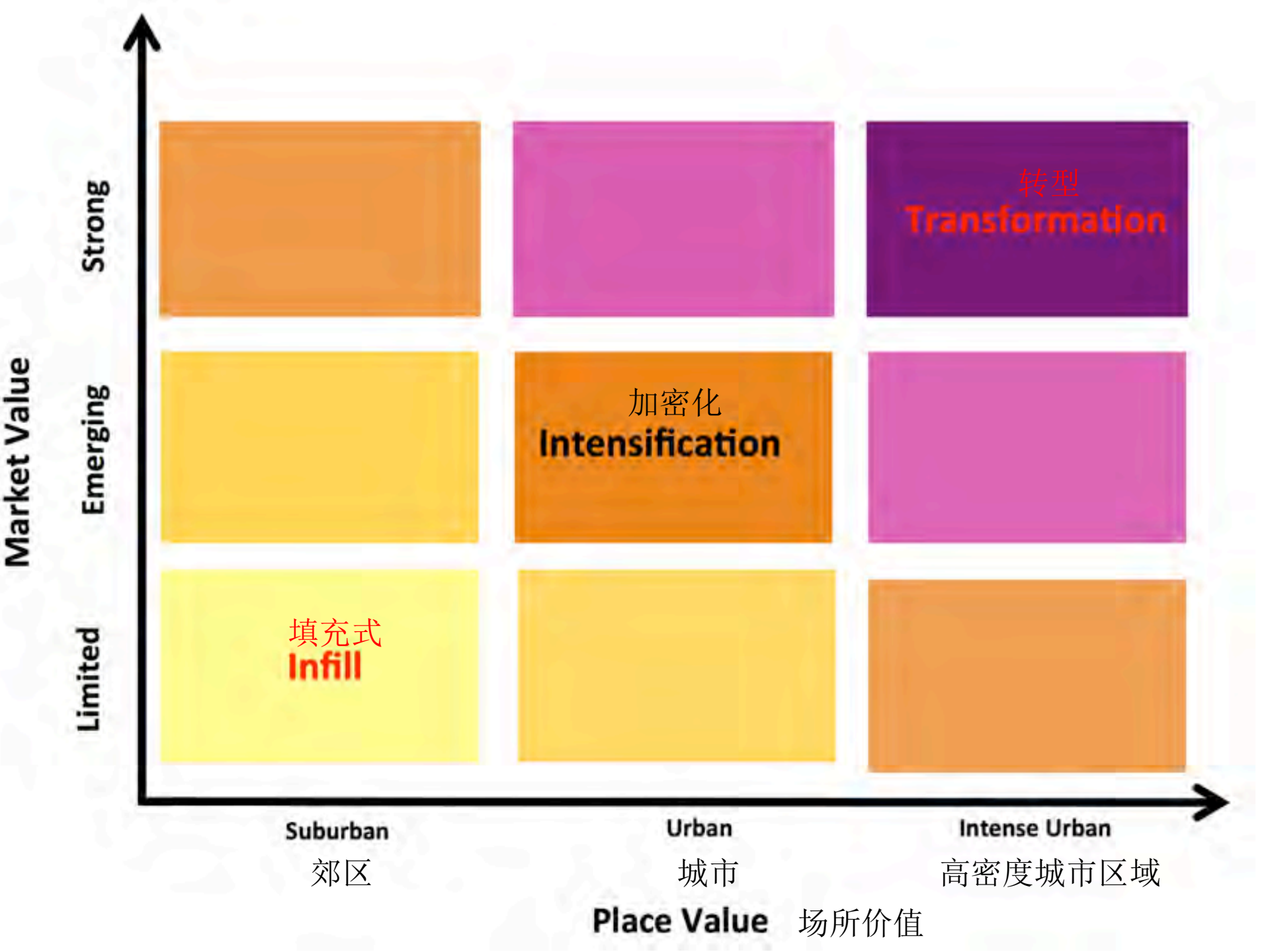
- Mix of land uses
- 土地混合使用
- Density of social infrastructure
- 社会基础设施密度
- Compactness
- 紧凑性
- Physical form and street patterns
- 空间形式和街道形态
- Walkability and bikability
- 步行及自行车友好

Source: Urban Morphology Institute

Market Value
市场价值


Metropolitan Area Destination Rent Surface: rent per unit area from south

- Economic attractiveness for developers (job densities/ accessibility; People density)
- 对开发商的经济吸引（就业密度/可达性，人口密度）
- Land and real estate opportunities (FAR/unbuilt land)
- 土地和房地产机会（容积率/未建成地）
- Market prices and activity
- 市场价格和活动
- Land shortage at city level
- 城市层面的土地短缺


Market Value
Strong
Emerging
Limited
转型
Transformation
加密化
Intensification
填充式
Infill
Suburban
郊区
Urban
城市
Intense Urban
高密度城市区域
Place Value
场所价值

Urban morphology, spatial planning, and spatial economics have significant implications for climate change mitigation, infrastructure costs, social inclusiveness and economic competitiveness of cities.

The articulation of density in a “spiky” geography of growth connected by dense networks reduces developments costs, creates more wealth, inclusiveness and competitiveness, and contributes to climate change mitigation and to a significant increase of structural resilience.

Thank you
谢谢

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