CITIES AND THE FUTURE OF CONSUMPTION

A RESEARCH AGENDA

TODAY'S AGENDA

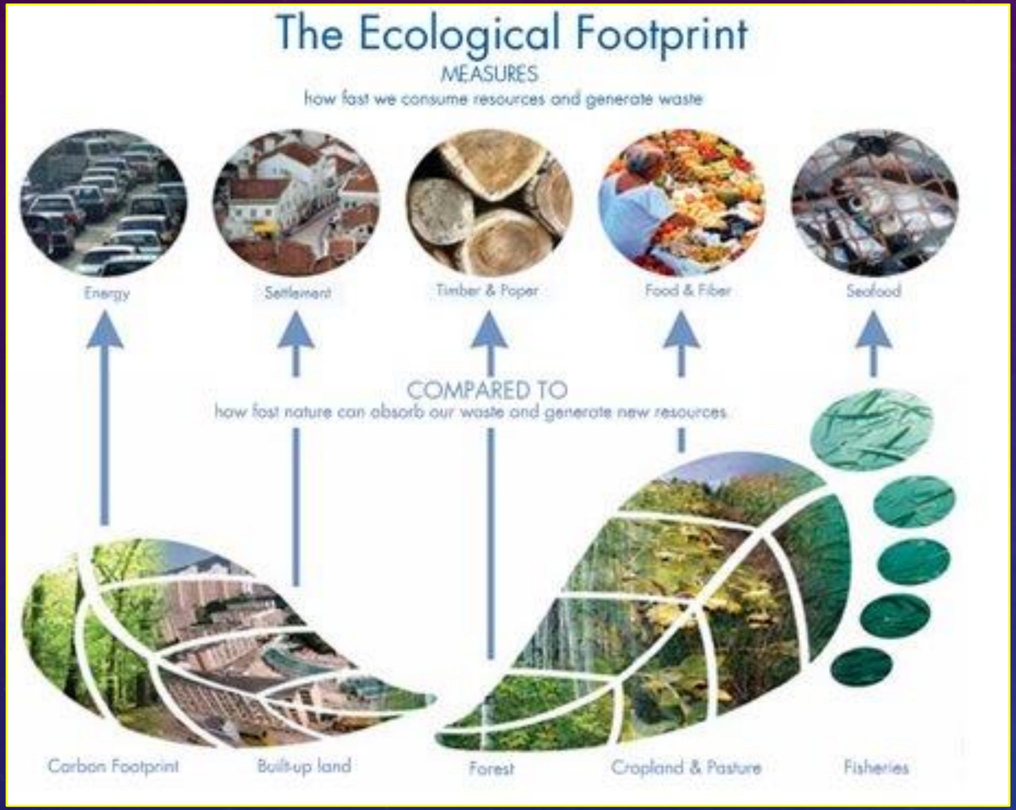
- The Modern World and the Problem of Consumption
- Consumption Trends in Cities
- Good response: Efficiency
- Better response: System Re-Design
- Needed response: Sufficiency
- Sustainable Cities Are Less Consumptive Cities

I. THE MODERN WORLD AND THE PROBLEM OF CONSUMPTION

AN URBAN WORLD

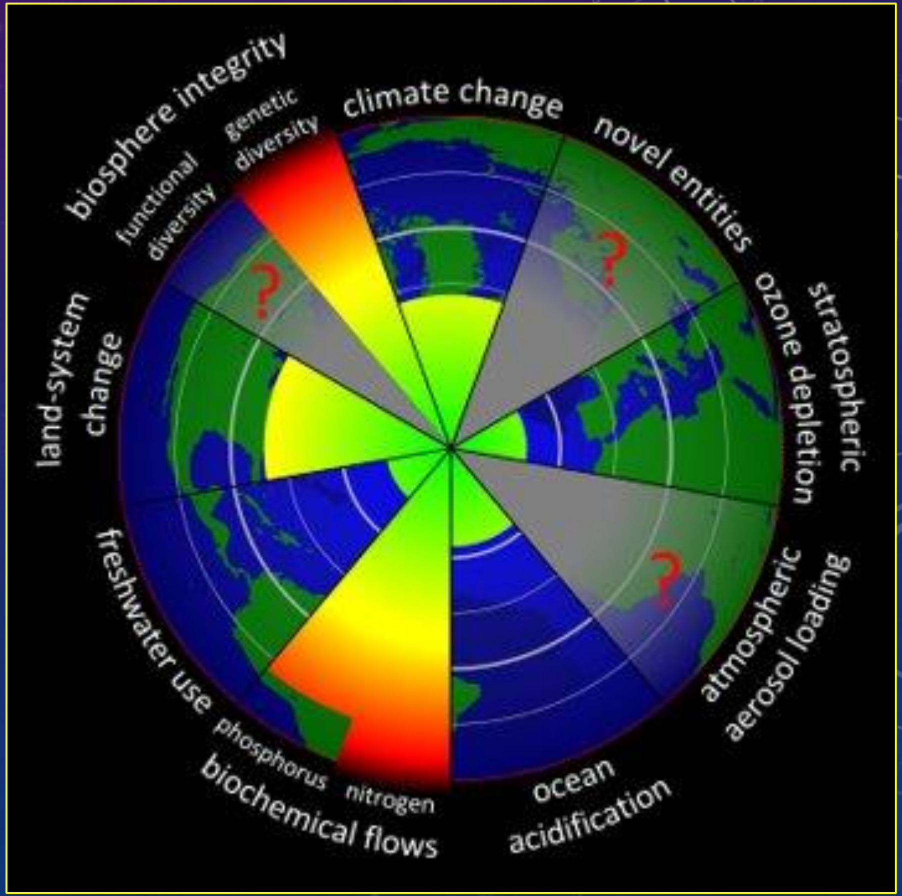
- The World: 55 percent urban today, up 5-fold between 1950 and 2014
- 79 million people—~15 more Barcelonas—added to cities each year
- Number of “megacities”—cities of 10 million or more—grew more than 15-fold, from 2 in 1950 to 29 in 2015

LITERATURE OF LIMITS

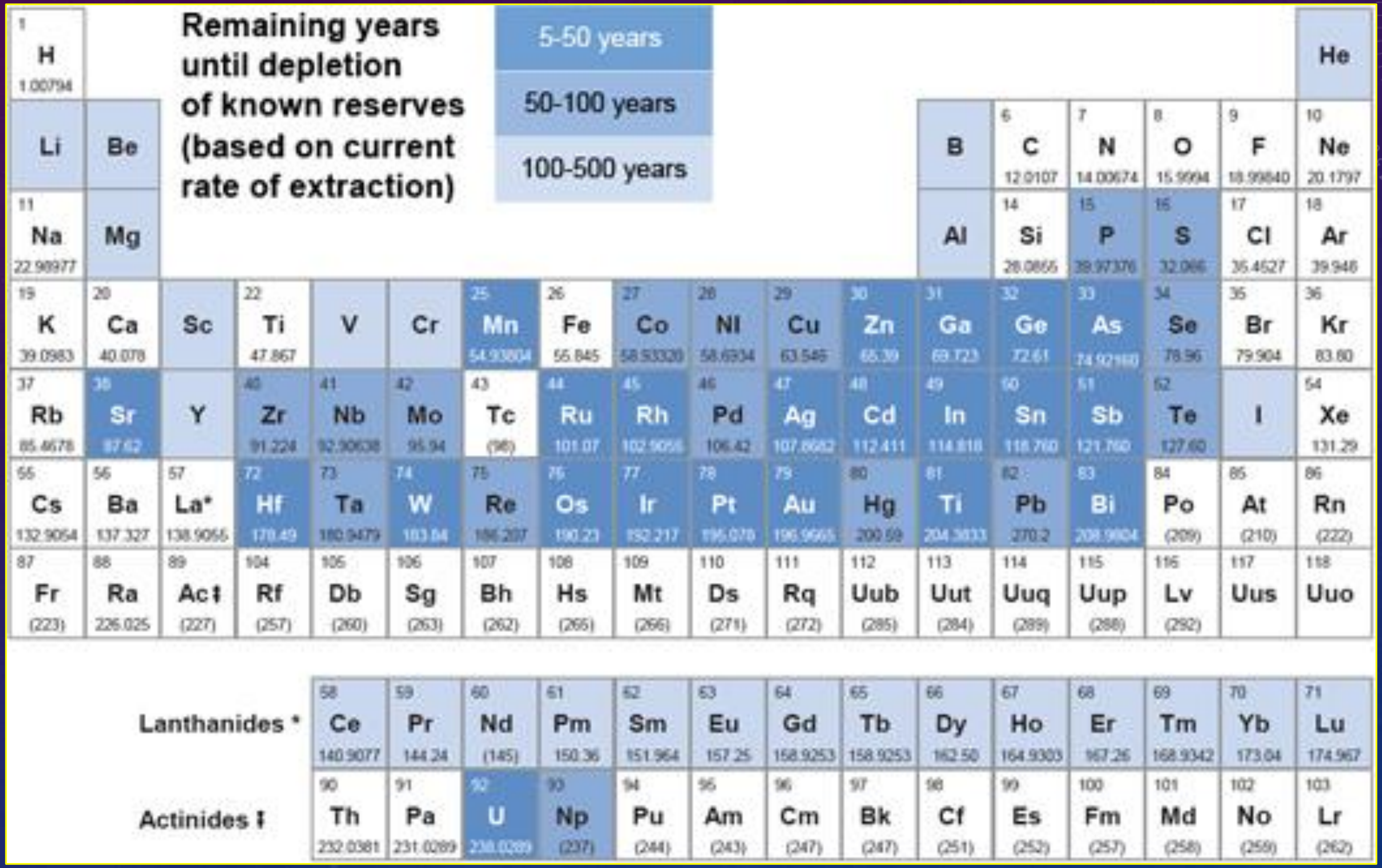


Ecological Footprint—Humans use the equivalent of 1.6 Earths to provide resources and absorb wastes.

Planetary Boundaries—of the nine, 3 are breached and considered to pose high risk; 2 face uncertain risk.

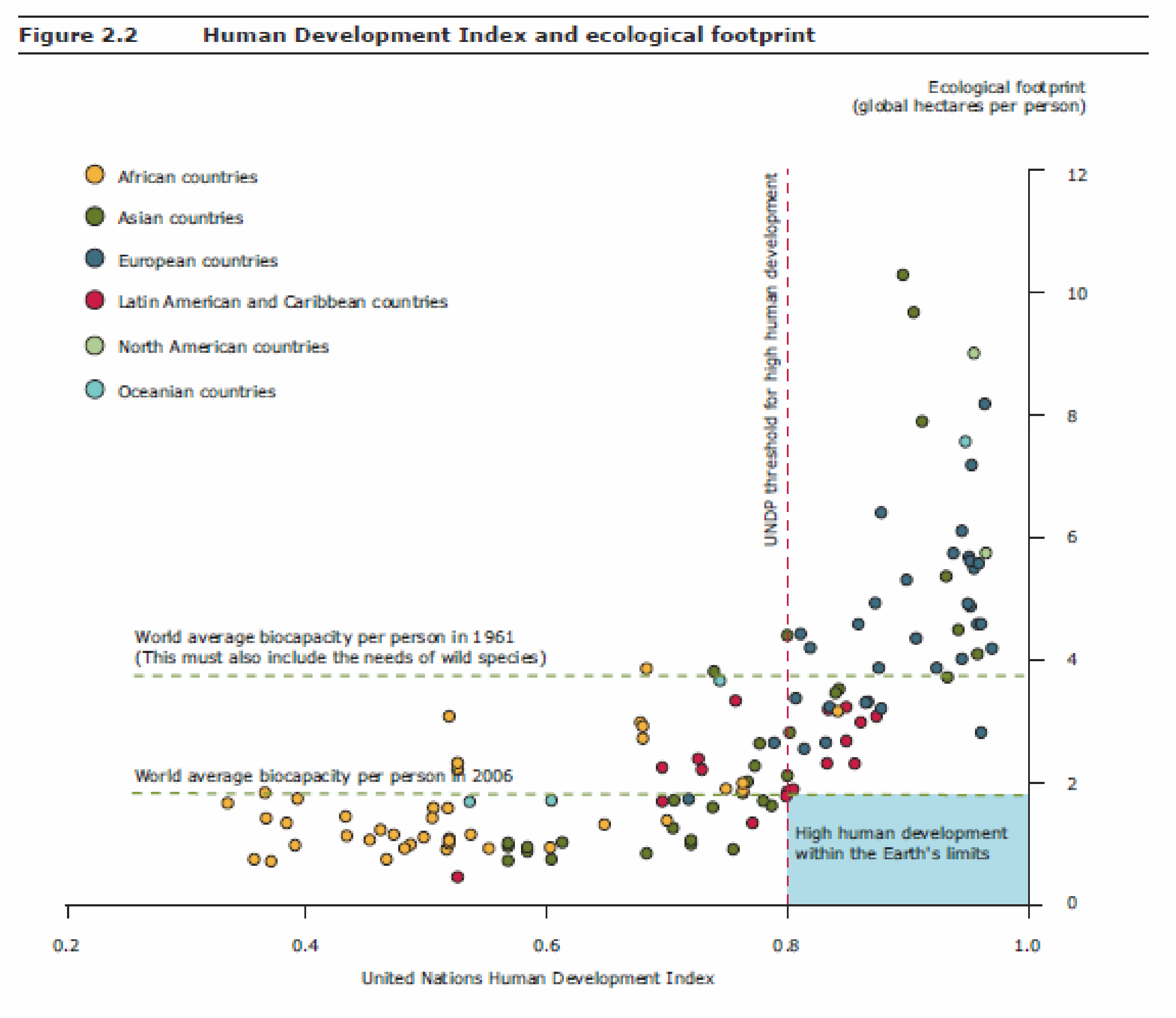


WARNINGS OF SCARCITY?



Darker = worse, depletion coming sooner

GOOD LIFE FOR ALL, WITHIN ENVIRONMENTAL LIMITS?

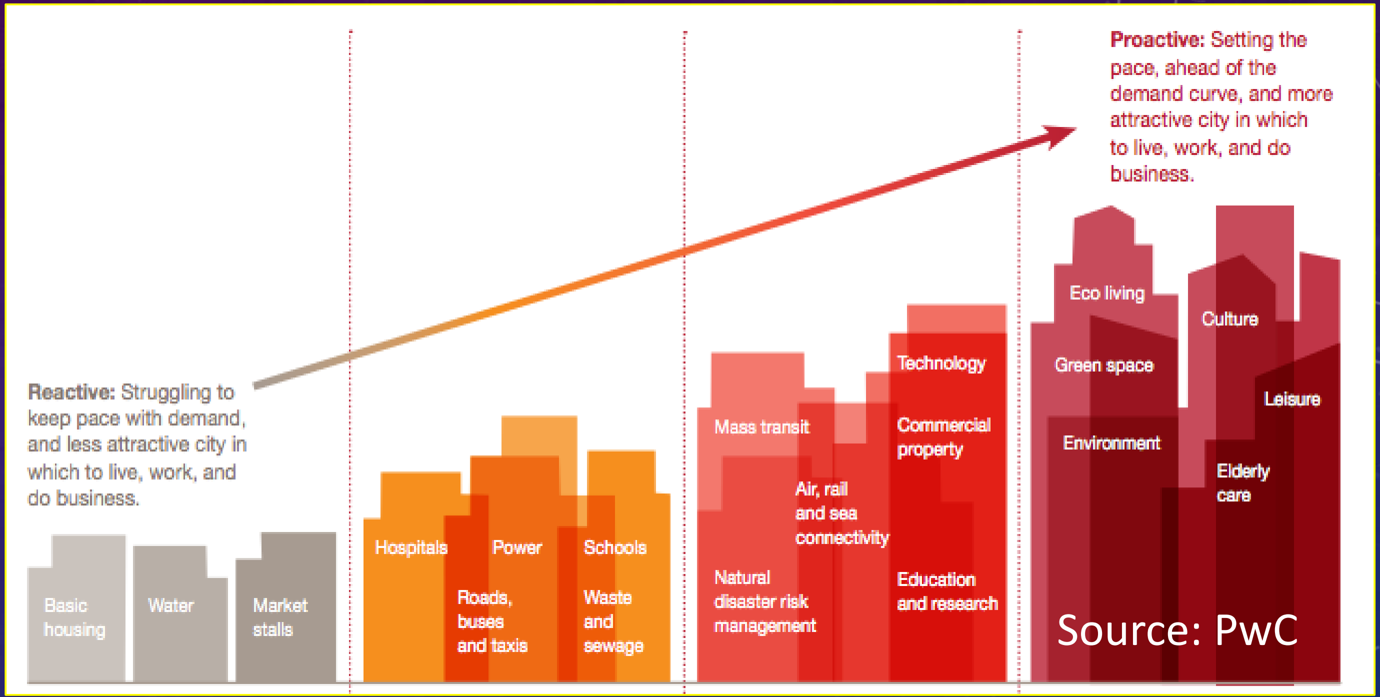


Source: Global Footprint Network

QUESTIONS FOR FURTHER RESEARCH

- What kinds of consumption tend to rise the most, and the least, when people move to cities?
- To what extent can consumption in cities be shifted from nonrenewable materials to renewable ones?
- What role does greater urban density play in reducing urban materials consumption?

II. CONSUMPTION TRENDS IN CITIES



CITIES ARE CENTERS OF RESOURCE USE

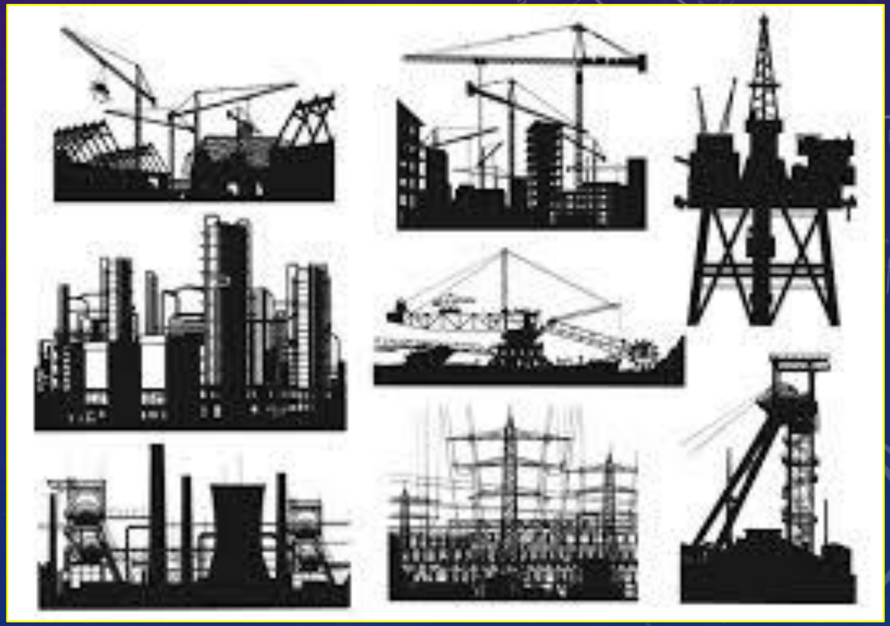
- Cities account for
  - 60–80 percent of energy consumption
  - more than 75 percent of natural resource consumption
  - 75 percent of the world’s carbon emissions
- More affluence
  - 3.2 billion people in the global middle class in 2016.
  - Soon a majority will live in middle-class or rich households.
  - 140 million join the middle class annually; could rise to 170 million within five years.

POPULATION, AFFLUENCE, TECHNOLOGY OVER HISTORY

Period	Increase in Environmental Impact	Of Which
1CE to 1500CE	5-fold	Population and Affluence were roughly equally responsible
1500 to present	10-fold	Affluence responsible for about 3 times more impact than population growth. Technology increased impact by 1.5 times

UNEP ON MATERIALS USE

- BAU urban resource growth:
  - 40 billion tonnes in 2010
  - nearly 90 billion by 2050
- Per capita: 8–17 tonnes per year by 2050
- UNEP proposes 6–8 tonnes as sustainable goal – **reduction of roughly 50 percent**.
- Resource consumption should be a central policy focus



DOMESTIC MATERIAL CONTENT

	Urban material use (tonnes per year)	DMC/urban citizen (tonnes per year)	Increase in DMC/urban citizen (percent)
2010	40 billion	10	--
2050	90 billion	14	40

INFRASTRUCTURE NEEDS IN ASIA

- Between 2016 and 2030: $26 trillion

- $1.7 trillion per year

- $1.7 trillion: more than double the $750 billion ADB estimated in 2009.

MORE WASTE TO COME

- World Bank: waste levels will increase 69 percent by 2025 over 2012 levels.
- Peak in global waste:
  - under BAU conditions, not before 2100.
  - with more aggressive policies, around 2075.

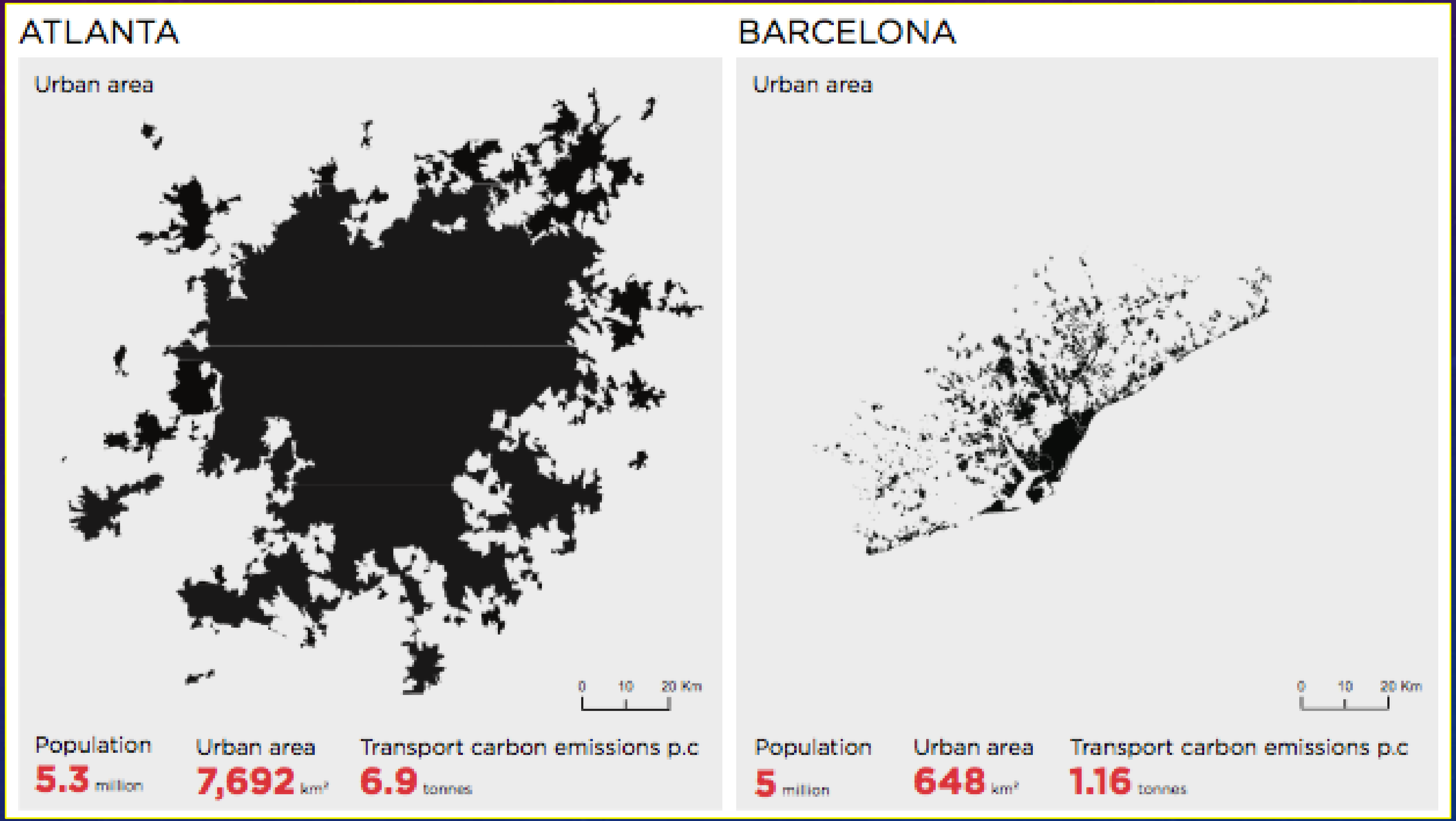
SHARE OF TOTAL MATERIALS USE, SHARE OF TOTAL GHG EMISSIONS, BY CONSUMPTION SECTOR

	Share of Materials Use (%)	Share of GHG emissions (%)
Less Intensive Sectors		
Restaurants and Hotels	5.7	4.1
Recreation and Culture	2.1	1.8
Miscellaneous Goods and Services	1.8	1.7
Clothing and Footwear	1.8	1.6
Health	1.5	1.3
Communications	0.8	0.7
Tobacco and Narcotics	0.4	0.2
Education	0.2	0.2
Subtotal	**14.3**	**11.5**
More Intensive Sectors		
Housing, water, electricity, gas, and other fuels	19.3	35.2
Transport	21.7	24.5
Food and non-alcoholic beverages	28.2	17.2
Furnishings, household equipment, routine maintenance	16.6	11.6
Subtotal	**85.8**	**88.5**

CITIES ARE DECREASING IN DENSITY

	Projected Increase by 2030	
	Built-up Area (%)	Population (%)
Developing country cities	200	100
Industrial country cities	150	20

LAND USE: PROBLEMATIC V. SMART



III. STANDARD RESPONSE TO HIGH CONSUMPTION: GREATER EFFICIENCY

GREAT HOPE FROM GREATER EFFICIENCY

- UNEP--Resource-efficient infrastructure:
  - 24-47% reduction in consumption of water, energy, land and metals by 2050.
- Strategic intensification:
  - additional 3-12% reduction in the transportation, commercial buildings and heating/cooling sectors.
- Total increased resource efficiencies: 36- 54 %

TECHNOLOGY CONTINUES TO DRIVE EFFICIENCY

- **'Internet of everything'.** Everything could be connected, from ships and buildings to cows, crops, and heating and lighting systems.
- Creates tracking efficiency.
- Example: Boulevard in Nice, France, has 100s of sensors that capture data, feed it to a wifi system. Helps the city to
  - improve traffic flow
  - lower pollution
  - potentially save 20 to 80 % in electricity by adjusting street lights for pedestrian and traffic flows, and for changing weather conditions.

NEW MANUFACTURING TECHNOLOGIES

- Can advance circular business models, at lower cost.
- For example, 3D printing
  - reduces waste in the manufacturing process
  - Reduces the need for inventories by moving from make-to-stock systems to make-to-order ones
  - used in the rework of spare parts, extending the life of many products.

TECHNOLOGIES TO REDUCE WASTE

- Technologies for biowaste
  - reverse treatment technologies These include anaerobic digestion, cultivating waste-eating microbes and algae in biofactories, filtering proteins out of wastewater from breweries
  - enable dramatic improvements in the way value is extracted from today's biological waste streams.
- Multiple waste streams
  - Combine CO2, heat, waste water, nutrients into advanced agro-manufacturing systems.
- Make CO2 a revenue source
  - Liquid fuel from bioenergy and CO2, polymers using CO2 as a carbon source, decarbonization of cement production
- New packaging technologies
  - fully compostable mycelium-based packaging extend food life and minimize packaging waste
- Reclaimed polyester from textiles
  - Up to 99.9% of the polyester and available cellulose could be captured and returned as resources.

PURSUE EFFICIENCY

	Evaluate the Potential of
Infrastructure for cross-sector efficiency	Waste heat from industry in district energy systems; industrial waste materials in construction, such as fly-ash bricks; reuse of wastewater in urban systems
Resource-efficient urban components	Car sharing, electric vehicles, efficient energy, efficient waste and water systems, smart grids, cycle paths, energy-efficient buildings, new heating, cooling and lighting technology, etc.
Efficiency offsets	Surcharges to avoid rebound effect

BUT… BEWARE THE REBOUND EFFECT

- Efficiency doesn’t necessarily mean conservation
- Britain: 100,000 x more energy for lighting than in 1700, despite increases in efficiency. Better technology stimulated demand
- Jeff Tsao, Sandia National Laboratories:
  - solid-state lighting, three times more efficient
  - could increase consumption of light by 10x by 2030.

ENERGY EFFICIENCY AND CONSUMPTION IN THE US

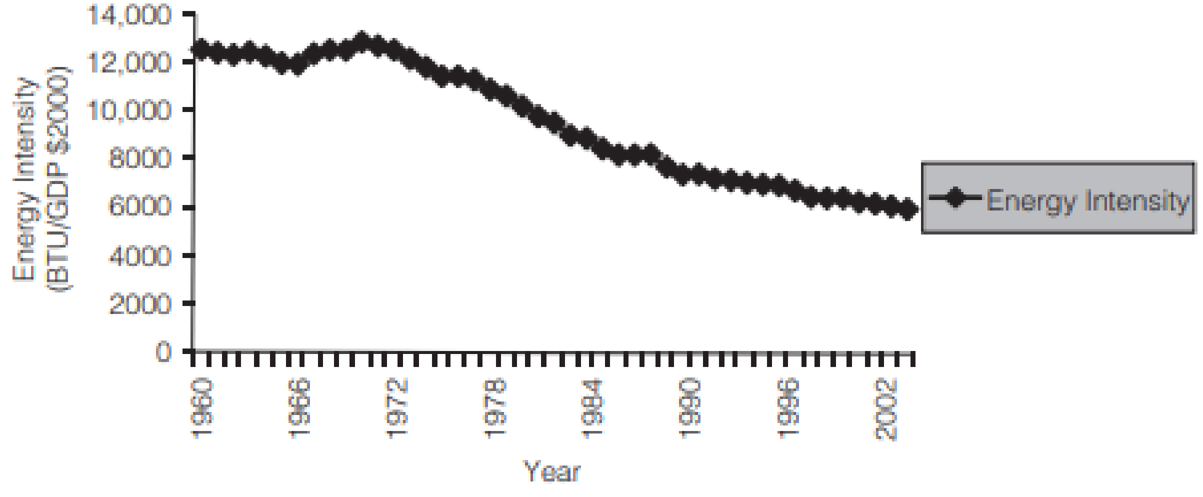


Figure 4.2 *Energy intensity in the US, 1960–2004*

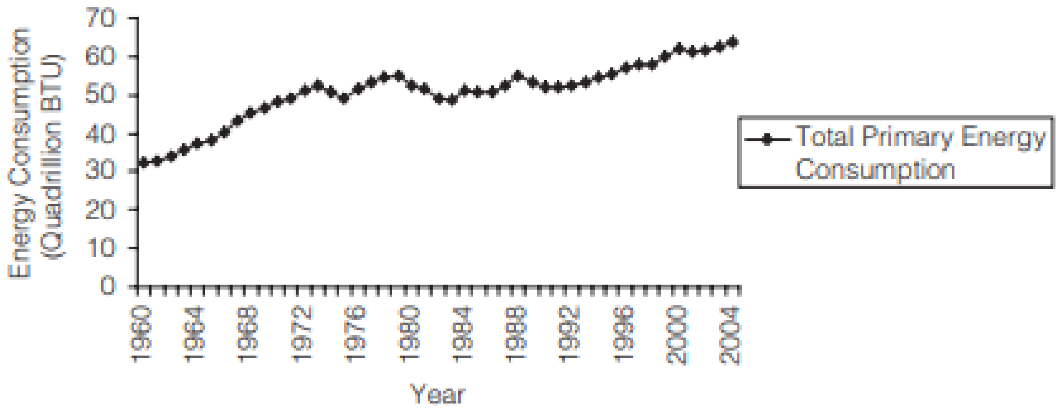
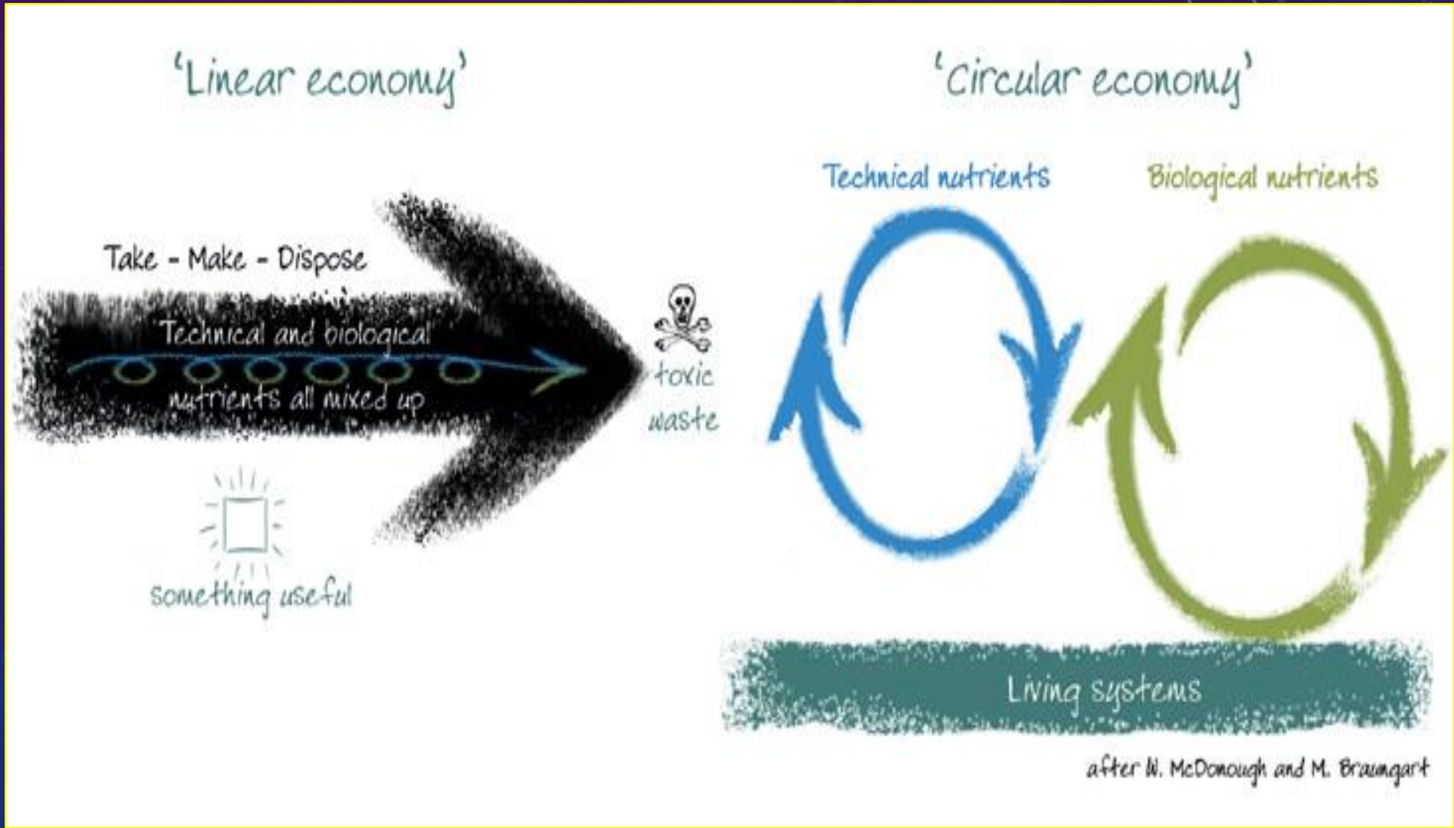


Figure 4.1 *Energy consumption in the US, 1960–2004*

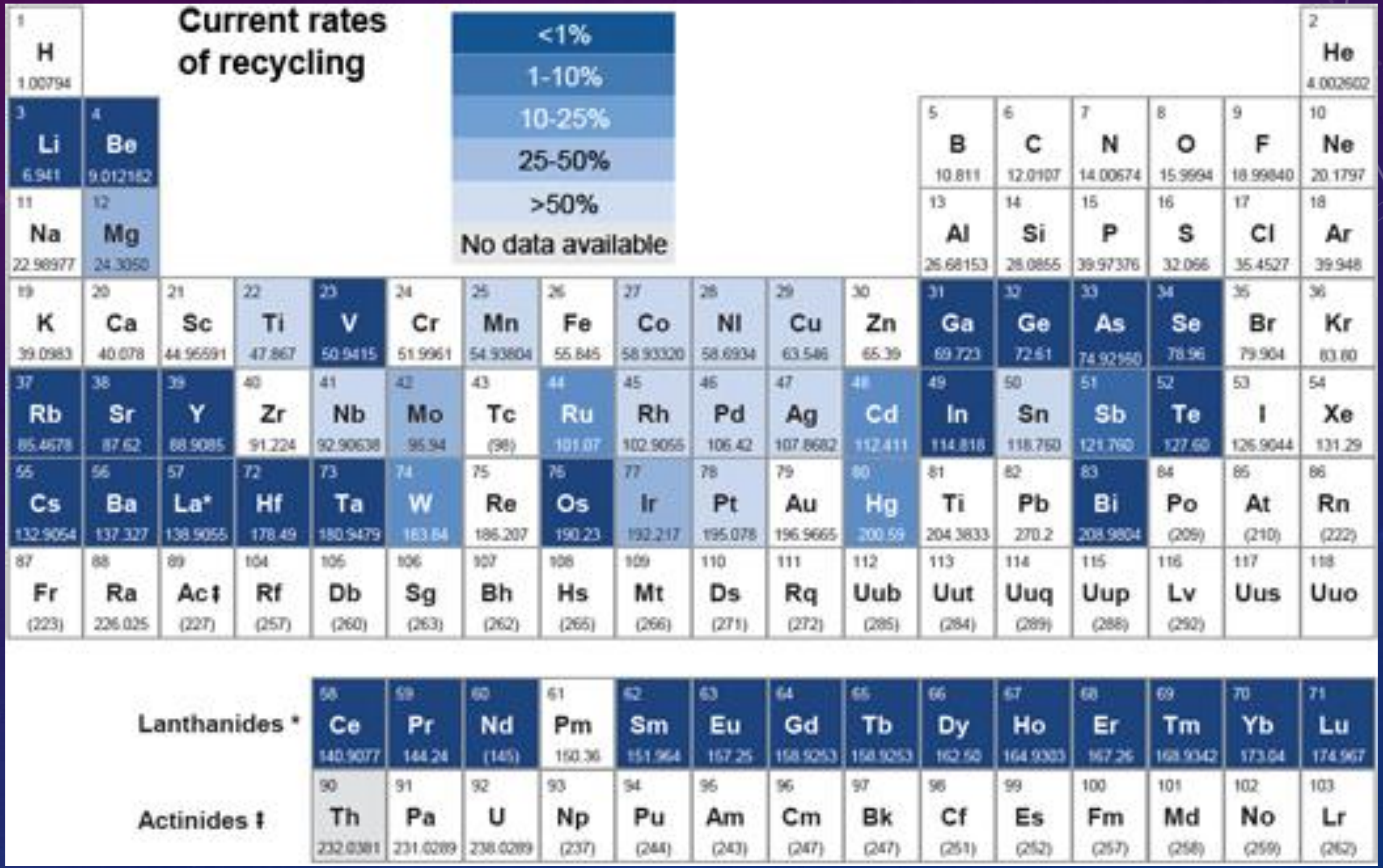
QUESTIONS FOR FURTHER RESEARCH

- **How real is the rebound effect? Does it manifest differently with different kinds of consumption? How can it be effectively resisted?**
- **If eco-taxes are used to offset the price reductions created by greater efficiency, what incentive do producers have to adopt efficiency measures?**

IV. BETTER RESPONSE TO HIGH LEVELS OF CONSUMPTION: SYSTEM RE-DESIGN

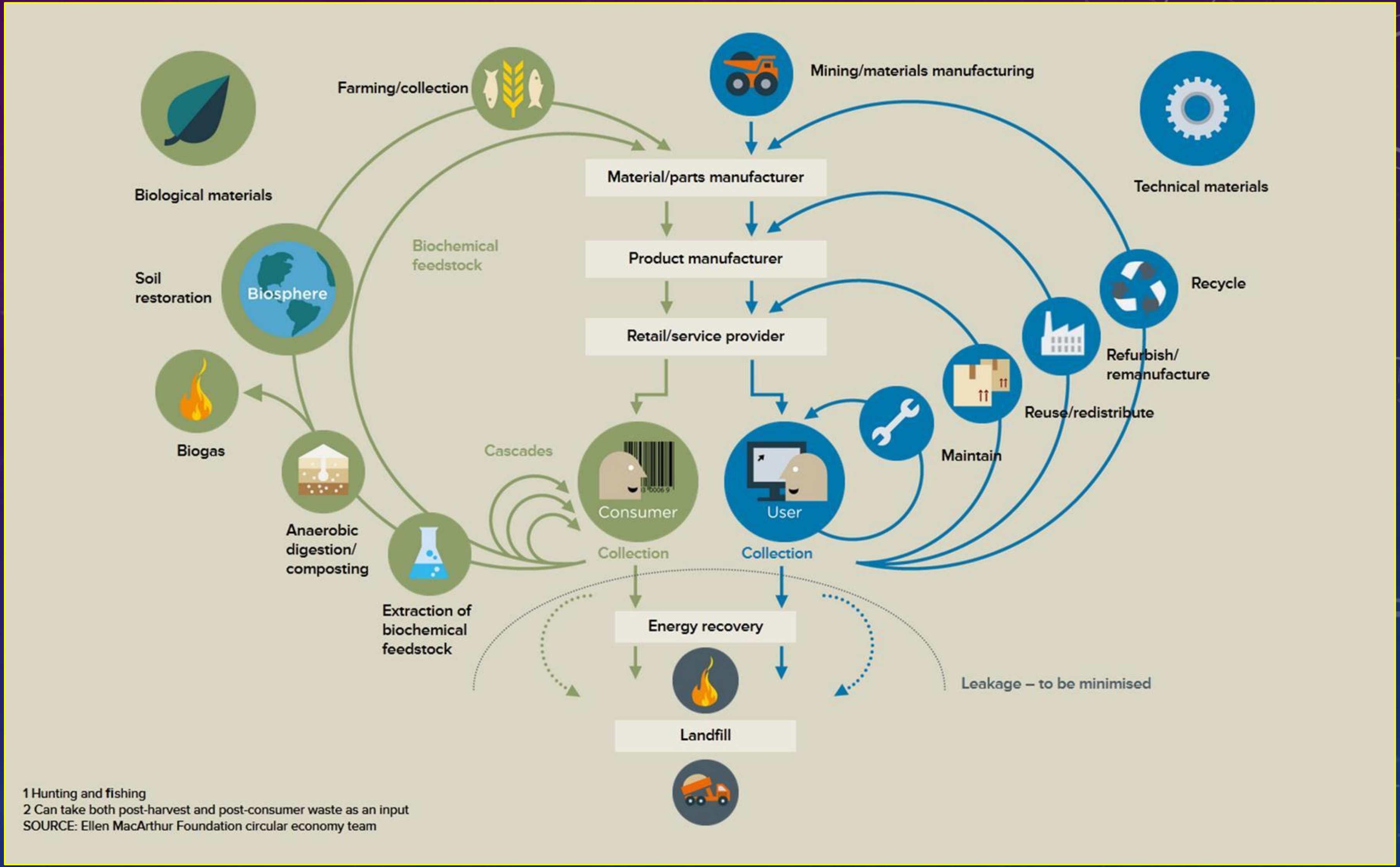


RATES OF RECYCLING



(Darker = worse, lower rates of recycling)

CIRCULAR ECONOMY



WHAT POTENTIAL FOR CIRCULAR ECONOMY?

- "Finding growth within: A new framework for Europe" says
  - Circular economy: net economic gain of €1.8 trillion per year by 2030.
  - Building sector could cut construction costs in half with industrial and modular processes.
  - Car sharing, autonomous driving, electric vehicles, and better materials could lower the cost of driving by 75 percent.

CIRCULAR FLOWS: HOW?

	Evaluate the Potential Of
Materials Sourcing	Green procurement, tax on virgin materials, life-cycle assessment of products, materials substitution
Design	Design for disassembly, for recycling, modularity, customization
Manufacturing	Material productivity, energy efficiency, transparent mfg processes
Distribution and Sales	Optimized packaging design, product resale
Consumption and Use	Sharing, product-as-service, product labeling, dematerialization
Collection and Disposal	EPR, efficient collection systems, incentives for recycling
Recycling and Recovery	Use of by-products, materials recovery, industrial symbiosis
Remanufacture	Refurbishment/remanufacture, repair, upgrading
Circular Inputs	Bio-based materials that can be reprocessed

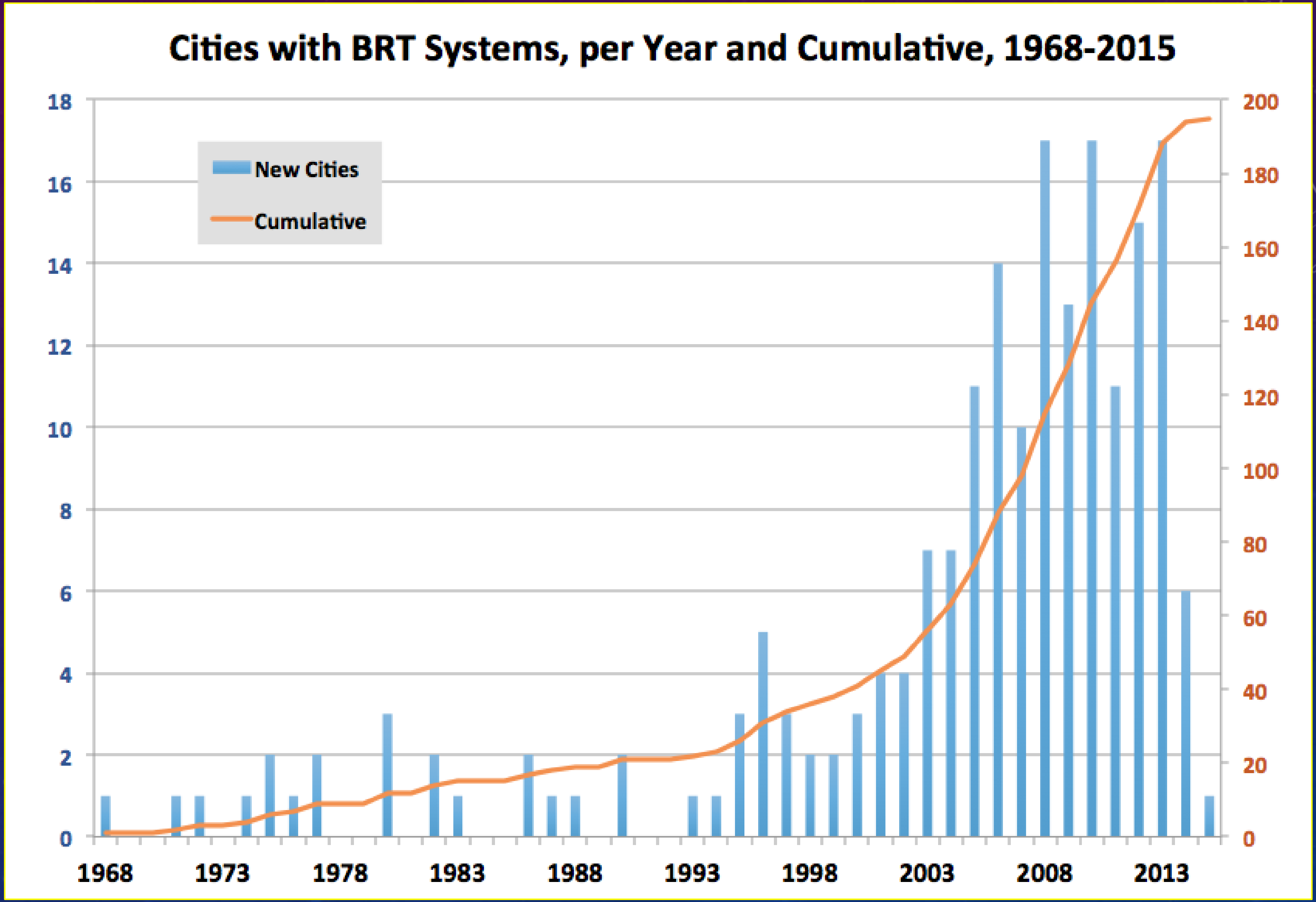
REMANUFACTURING AT RENAULT

- Renault plant re-engineers mechanical parts, from water pumps to whole engines.
- Sells these at 50 to 70% of original price, with a one-year warranty.
- Reductions of 80% for energy, 88% for water and 77% for waste from remanufacturing rather than making new components.

CAR-SHARING

- More than 1,000 cities in over 30 countries.
- 1995—15,000 car sharers globally
- 2014—4.9 million
- 2020: Navigant Research projects 12 million car sharers.

CHANGE IS POSSIBLE!



CONGESTION FEE SYSTEM

- Stockholm in 2007 and Gothenburg in 2013. In both cases:
  - 20% decrease in the number of car trips in the city center
  - 5% increase in trips on public transport

LUGNT PÅ KLARASTRANDSLEDEN. Lugnt på Essingeleden. Lugnt i kollektivtrafiken. Ingen visste i går

QUESTIONS FOR FURTHER RESEARCH

- What real material savings can be expected with a circular economy? Which circular economy strategies offer the greatest materials savings?
- Because circular economies imply increased levels of efficiency, is the rebound effect a concern when implementing circular economy strategies?
- What sorts of incentives and policies are required to build circular economies? How might these be financed, especially in low-income cities?

V. NEEDED RESPONSE TO HIGH LEVELS OF CONSUMPTION: SUFFICIENCY

A NEW QUESTION: WHAT DO PEOPLE NEED?

- Maslow's Hierarchy

CONSUMPTION MOTIVATORS

- Extrinsic
  - material things such as housing or possessions
  - Typically overvalued
  - Static--We easily become accustomed, then quickly dissatisfied and want more.
  - Competition with Peers
- Intrinsic
  - activities that help us to feel connected, competent, or autonomous, such as sports, hobbies, reading
  - Dynamic--ever changing—experiences are always different, which keeps me interested and engaged.

SHARE OF TOTAL MATERIALS USE, AND MASLOW LEVEL, BY CONSUMPTION SECTOR

	Materials use %	Primary Maslow Level
Less Intensive Sectors		
Restaurants and Hotels	5.7	Belonging
Recreation and Culture	2.1	Belonging
Miscellaneous Goods and Services	1.8	--
Clothing and Footwear	1.8	Esteem
Health	1.5	Safety
Communications	0.8	Belonging
Tobacco and Narcotics	0.4	--
Education	0.2	Esteem/Actualization
Subtotal	**14.3**	
More Intensive Sectors		
Housing, water, electricity, gas, and other fuels	19.3	Physiological/Safety
Transport	21.7	Safety?
Food and non-alcoholic beverages	28.2	Physiological
Furnishings, household equipment, routine maintenance	16.6	Safety/Esteem?
Subtotal	**85.8**	

QUESTIONS FOR FURTHER RESEARCH

- What is the materials load for each of level of Maslow’s hierarchy? How much lower is materials use associated with higher level needs?
- What policies might actively shift people’s consumption preferences away from excessive meeting of physiological and safety needs and toward the fulfillment of belonging, esteem, and transcendence needs?

CREATING CONNECTIONS

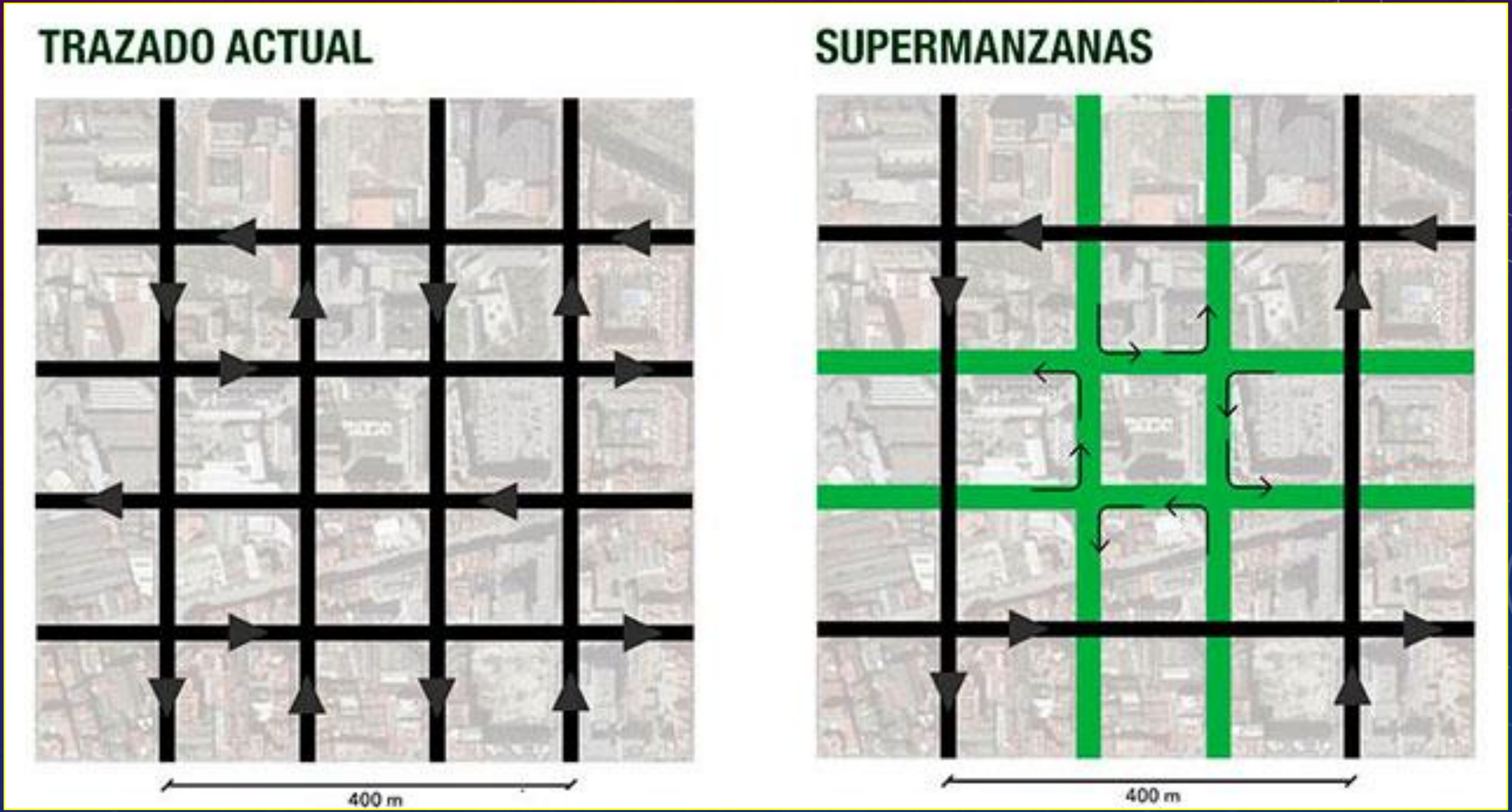
- Connection: a higher-level Maslow need!
- Important paths to connection:
  - Better physical layouts
  - More exposure to green areas
- Trade connection for material consumption?

CONNECTION: A FUNCTION OF DENSITY

CITY	DENSITY (PEOPLE PER KM^2)
ATLANTA	636
LONDON	5,900
TOKYO, SINGAPORE	9,000+
SHANGHAI, SEOUL	20,000+
HONG KONG, MUMBAI, HO CHI MINH CITY	30,000+

WHICH IS MOST CONNECTED?

THE EXAMPLE OF BARCELONA

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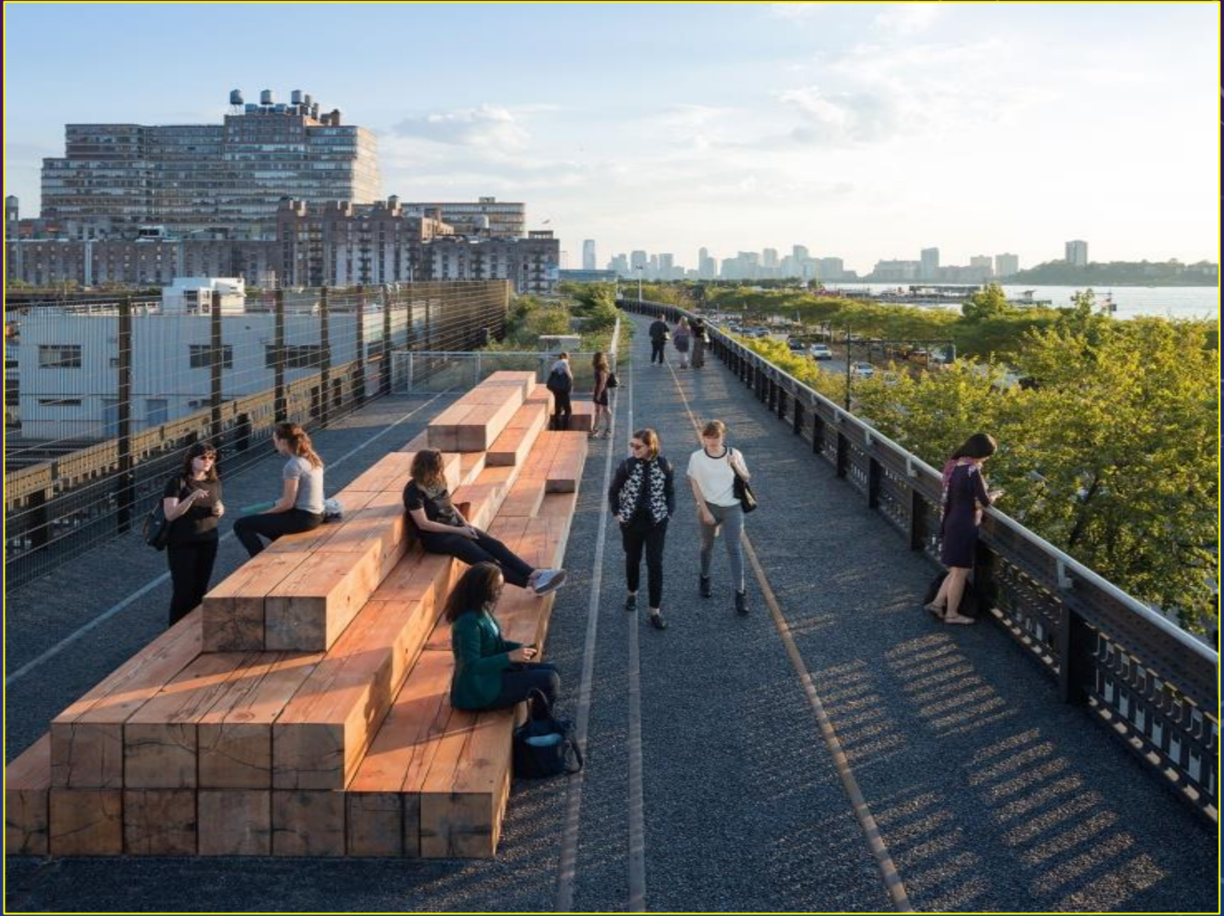
“PLACEMAKING”



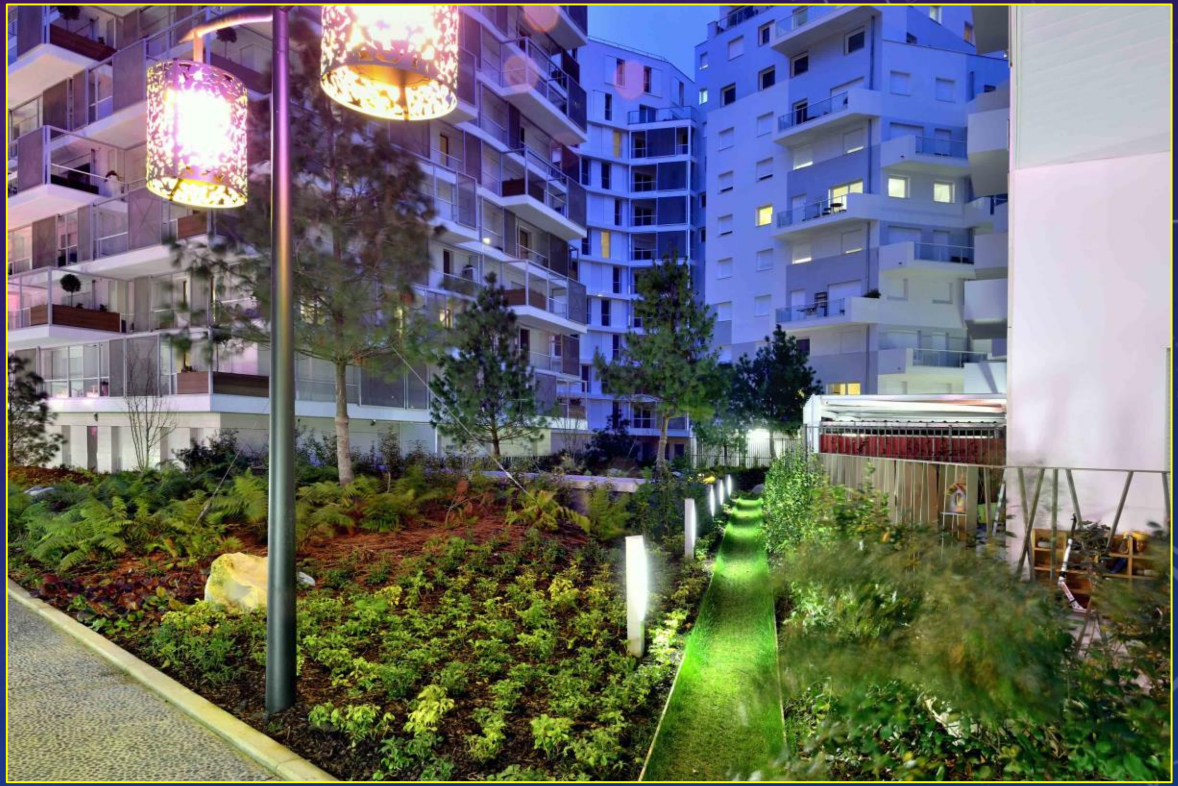
URBAN BIODIVERSITY


CGU

GREEN INFRASTRUCTURE

BEATLEY'S INDICATORS OF BIOPHILIC INFRASTRUCTURE

- 100% of city population lives within 100 meters of a park or green space.
- Continuous green corridors from the city center to the periphery
- 10% of the urban area in a wild or semiwild state
- 40 percent forest cover (less in the core, more near the periphery)
- 1 Green feature (green roof, gardens, trees, etc.) per 1000 inhabitants (minimum of one per block)
- 1.6 km of trails for every 1000 personas
- 1 community garden for every 2,500 inhabitants



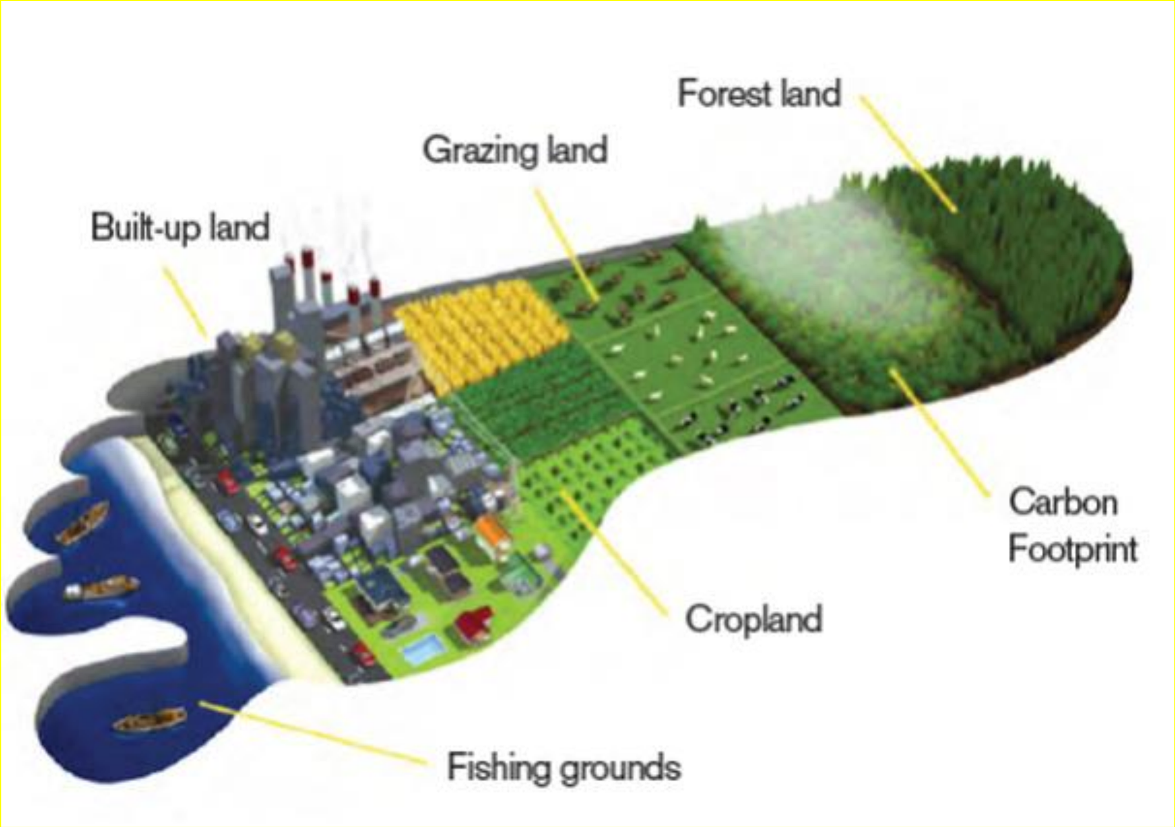
QUESTIONS FOR FURTHER STUDY

- How does design and provision of public space affect consumption choices among urban citizens?
- What kinds of urban design reduce material consumption per person while promoting connections of all kinds--social, economic, transport, and communications?
- How much green area does a city need, in what sizes, and with what pattern of distribution?
- How do different kinds of green spaces affect human health, and what are the implications for policy?

IV. TOWARD A LESS CONSUMPTIVE CITY

THE MATERIALS GOAL

- Instead of 8-17 tonnes per capita projected for 2050, IRP calls for 6-8 tonnes per capita.
- Need strategies for a 50 percent reduction in DMC in the world's cities.
- UNEP: a four- to ten-fold increase in resource productivity could allow us to urbanize in a way that
  - creates wealth
  - eliminates poverty
  - reduces the pressure exerted on the planet.

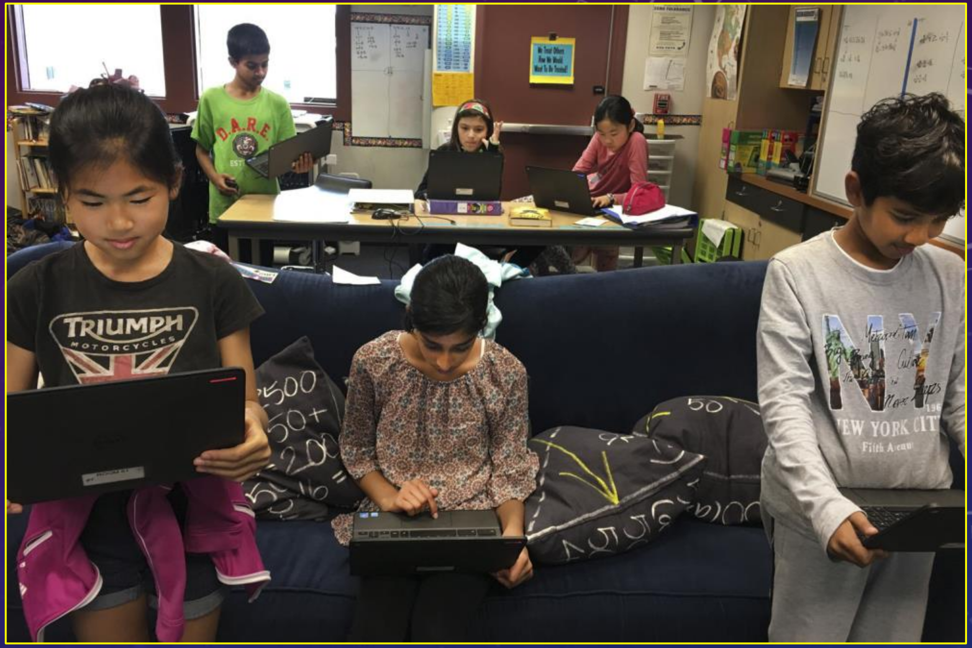


BUT ARE EFFICIENCY, TECHNOLOGY, AND CIRCULARITY ENOUGH?

- "Take-back" policies in Sweden have increased recycling rates to:
  - 75% for glass, 90% for paper, 68% for metal
- But consumption and waste generation continue to rise
  - Why? Increases in income, new consumer electronics, desire for larger living spaces
- Problem: Policies do not address demand reduction directly.
- **In high consumption societies, we are unlikely to recycle our way out of the rise in consumption—need to limit consumer demand.**

EDUCATION

- More schools offer media literacy, often to combat fake news
- Schools teach environmental ed
- Why not teach simple living?
- *The richest life possible with the fewest things!*



FAITH

- Powerful source of ethics
- But underused for sustainability

ADVERTISING

- “Peas Please” campaign in UK promotes a fund to advance advertising for vegetables

- Advertising:
  Not selling a product
  It’s selling Happiness

- Which brings us to:

THE VISION

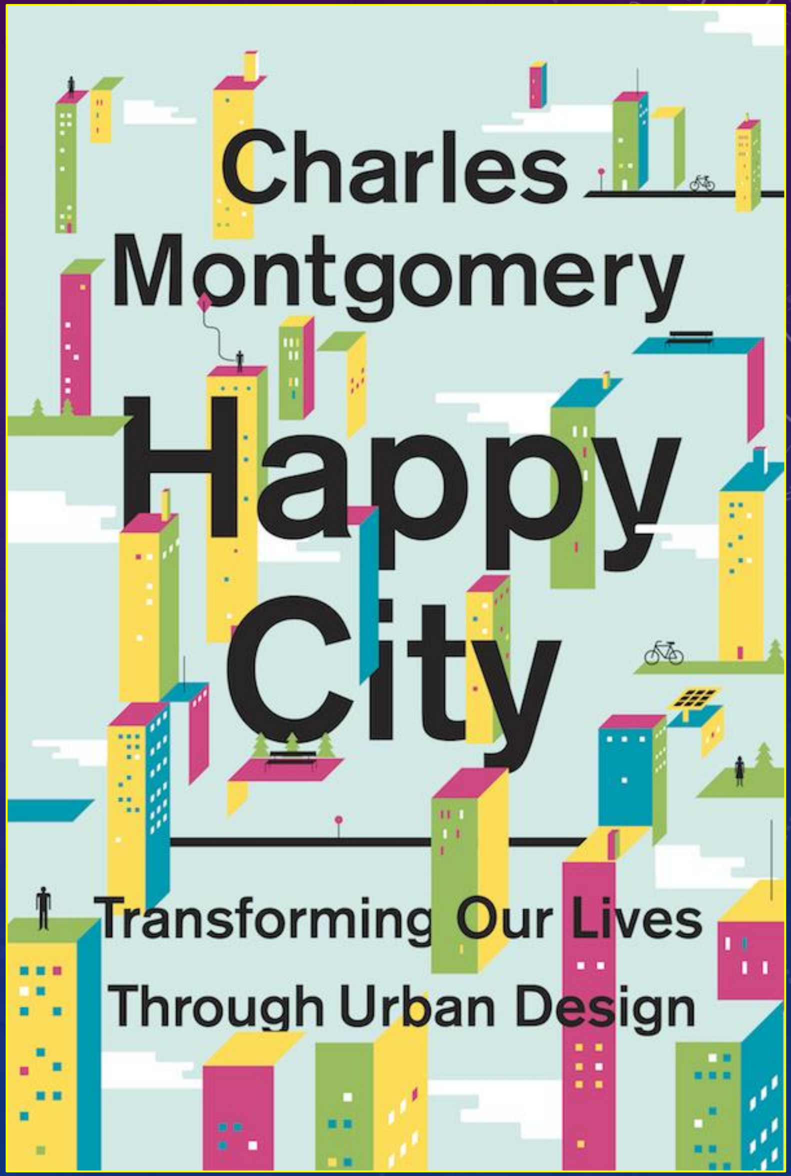
"The sustainable city has got to promise more happiness than the status quo.

It has got to be healthier, higher in status, more fun, and more resilient than the dispersed city.

It has got to lure us closer together rather than pushing us apart.

It has got to reward people for making efficient choices when they move around.

It has got to be a city of hedonic satisfaction, of distilled joys that do not cost the world."



A DIFFERENT MODEL

New urban consumption model may need to be cultural and social, not just technical.

Happiness and quality of life should count for as much as GDP and the stock market.

- Promotes a new understanding of happiness, based on strengthened relationships
- Values sufficiency
- Redesigns infrastructure and policies to promote connection and sufficiency

Thank You!

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