Urgent but Neglected: The Question of Consumption in a Rapidly Urbanizing World

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Cities are centers of innovation and wealth creation, and as such, are powerful drivers of human wellbeing and human civilization. Simply put, people seem to prefer the promises of urban life. This explains the massive and historic migration from rural to urban areas over the past century or more. Through this historic shift, we humans are driving our own evolution and becoming *homo urbanis*.

But cities, as traditionally designed and constructed, are also centers of consumption, pollution, inequality, and resource depletion. Modern cities are voracious centers of human activity that pull resources from around the globe, transform them into goods and services—which are often shared unequally--and spit out massive flows of waste that despoil the air, water and land surrounding cities.

In short, cities offer unprecedented opportunity, but in materials-intensive and polluting ways that cannot be sustained. If cities are to be made sustainable human habitat, they will need to learn to develop a much lighter materials footprint. A research agenda that embraces the questions identified in this document and that is focused on redesigned economies and a new ethic of consumption would be helpful in bringing about this material transformation.

The Modern World and the Problem of Consumption

More than half of humans live in cities today after a more than 5-fold increase in urban population between 1950 and 2014.[1] Today, some 80 million people are added to cities each year, implying that within a year, the world's cities together will add more than 15 Barcelonas to their population.[2] By 2020 34 megacities—those with a population of 10 million or more—will dot the world, and just ten years later the total will be 43.[3]

Even as cities add population, they are losing density, which means they are claiming more land per person. A study of 120 cities worldwide in 2010 documented a decline in density of 1.6 to 2.4 percent annually between 1900 and 2000, slightly faster than the 1.5 percent decline in density going back to 1800 (and based on a smaller set of 30 cities).[4] If this long-term trend continues, urban area could increase from just under 1 million km2 to more than 2.5 km2 by 2050, often eating up agricultural land.[5]

As cities continue their rapid growth in population and area, their environmental impacts grow as well. Indeed, the literature on sustainability documents in several ways the increase in environmental impact

at the national and international level. Because cities are major drivers of these trends, many of global and national environmental indicators reflect the impact of cities as well:

- The Ecological Footprint reveals that humanity today uses the equivalent of 1.6 Earths to provide the renewable resources used by humans and to absorb our waste. Thus it takes the Earth about a year and a half to regenerate the renewable resources that we use in a year.[6]
- Planetary Boundaries research demonstrates that on nine environmental fronts—climate change, biodiversity loss, land-system change, altered cycles of phosphorus and nitrogen, stratospheric ozone depletion, chemical pollution, ocean acidification, freshwater consumption, and atmospheric aerosol loading—the impact of human activities at the global level can be documented. Already, boundaries on the first four have been breached by human activities and are considered to be areas of high risk.[7]
- Species loss is documented regularly by the International Union for the Conservation of Nature. Their data show that 13 percent of birds, 25 percent of mammals, and 41 percent of amphibians are considered to be threatened with extinction.[8]
- Meeting basic needs for all people, within the constraints identified by the planetary boundary research, is possible.[9] But doing so at today's high levels of life satisfaction would require resource consumption at 2 to 6 times the sustainable level.

Common to these diverse studies is a high level of consumption by humans on average and a particularly high level among higher-income people. This suggests that one goal of urban development must be to reduce overall consumption. This is a huge challenge, because cities, the preferred human habitat, are themselves engines of consumption, and because poor cities often need to *increase* their consumption—of everything from food to infrastructure—if all citizens are to have an opportunity for dignified lives.

Consumption Trends in Cities

As concentrated centers of resource use and as home to a growing share of the human population, cities drive global consumption of energy and materials. Cities account for 60–80 percent of energy consumption, more than 75 percent of natural resource consumption, and 75 percent of the world's carbon emissions. [10] In 2017 the International Resource Panel, a project of the UN Environment Programme, released details of materials use in cities in a report entitled *The Weight of Cities*. It found that cities account for about 60 percent of total global 'domestic material consumption' (DMC)—a measure of the use of raw materials such as sand, gravel, iron ore, coal and wood.[11]

More important, intensive resource consumption is projected to continue, under business-as-usual policies and practices. If materials use increases faster than urban population growth, as is projected, consumption per urban resident could rise by about 40 percent by 2050 (from 10.1 tonnes per urban resident to 14.2 tonnes per urban resident). (See Table 1.)[12] The one-two punch of urban population growth and increased materials consumption per person results in more than a doubling of total resource use (from 40 billion tonnes in 2010 to almost 90 billion tonnes by 2050). [13] In a world in which

environmental and resource limits are already being surpassed, this projected increase in materials use—and its accompanying environmental impact—is very worrisome.

Table 1. Domestic Materials Consumption in 2010, and projected to 2050

	Urban Materials Consumption (tonnes per year)	**Urban Domestic Materials Consumption (tonnes per person per year)**	**Increase in DMC (percent)**
2010	40 billion	10	--
2050	90 billion	14	40

Source: See endnote[14]

Materials use tends to be concentrated in a few key sectors, especially transport, housing, and food. Those three sectors, along with household furnishings, account for 86 percent of materials used in European economies and for 89 percent of greenhouse gas emissions.[15] (Table 2.) Although the data is for the EU as a whole, the patterns are likely similar for cities, given Europe's heavy level of urbanization. The concentration of resource and environmental impact in these four sectors offers policymakers a set of ripe targets for lightening urban footprints.

Table 2. Share of total material use and share of total GHG emissions in Europe, by consumption sector

	Materials use %	**GHGs %**
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, and routine maintenance	16.6	11.6
Subtotal	**85.8**	**88.5**
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**

Source: European Environment Agency[16]

Cities, as centers of industry and commerce, are engines of affluence that further drive consumption. Indeed, some 3.2 billion people, not quite half of the human family, were estimated to belong to the global middle class in 2016, with an additional 140 million people joining this club each year. [17] At this rate of growth, about 2 percent annually, the ranks of the middle class would double by 2050, with most of this growth taking place in cities. [18]

Even as affluence has brought more comfortable and opportunity-filled lives to masses of people, it is also a large driver of environmental impact—a dynamic that has been true for millennia. Research examining the relative roles of population and affluence in generating environmental impact suggest that prior to the scientific advances of the Enlightenment, population growth and increased affluence were equally responsible for environmental impacts such as deforestation, species loss, and water pollution. But after 1500, affluence has generated about 3 times more environmental impact than population growth, making the growth in the global middle class a serious concern, despite delivering better lives for billions.[19] (See Table 3.)

Table 3. The Relative Importance of Population and Affluence as Drivers of Degradation

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

Source: Fischer-Kowalski, et al.[20]

The historical data reveal another worrisome reality. Technological advance since 1500 is estimated to have increased environmental impact by 1.5 times—for example, as powerful fishing trawler fleets harvest massive fish takes from the oceans, huge digging machines and trucks lop off mountaintops to access metals and minerals, and rapacious logging equipment fell vast swaths of forested areas. [21] Policymakers and the public today often point to technological advance as an important tool for solving today's global environmental crises. But the historical data suggest that at a minimum, technology must be evaluated critically because of its very real potential to worsen environmental damage.

The need to curb materials and energy use in cities may be urgent, but so is another imperative: to boost opportunity and the quality of life for billions of poor people. The rapid expansion of opportunity experienced by China and other Asian nations in the past three decades has lifted hundreds of millions of people out of poverty, yet many hundreds of millions more have yet to be helped. Continuing to develop these countries will require huge investments. The Asian Development Bank estimates that developing Asia will need to invest $26 trillion between 2016 and 2030--$1.7 trillion per year--in order to maintain economic growth, rid itself of poverty, and deal with climate change.[22] This spells a huge increase in materials and energy use for the future.

Given these challenges, the IRP estimates that DMC in the range of 6-8 tonnes per capita per year will be needed to create more sustainable cities. This compares to roughly 10 tonnes per capita today and is roughly half the 8-17 tonnes per capita projected for 2050. In the face of needed *increases* in living standards for billions of people in developing countries, this materials reduction challenge is huge. How might we achieve this?

For further investigation

What kinds of consumption tend to rise the most, and the least, when people move to cities?

To what extent do urban populations consume renewable materials? Nonrenewable materials?

What role does greater urban density play in reducing urban materials consumption?

Common Response: Efficiency

A civilization accustomed to ever-more technological progress might expect that advances in efficiency are the way to green cities in the future. After all, resource efficiency is widely regarded as an advantage for a wide range of constituencies, from businesses to environmentalists: it is surely best to achieve economic outcomes with fewer resources rather than more. But this seeming common sense may carry an important caveat, because of a dynamic called the rebound effect.

Stanley Jevons in 1865 argued that efficiency can backfire and create greater consumption, not less. Focused on coal use, he wrote that increased efficiency leads to a lower price, which stimulates greater consumption. This boomerang effect can more than offset the gains from efficiency, Jevons wrote--a controversial claim because it is difficult to test empirically.[23] A 2015 study concludes that while the Jevons effect is difficult to demonstrate at the micro level—for example, that increases in the efficiency of steel production lead to increases in steel consumption—the relationship at the macro level is clearer. The study demonstrated that for several nations and for Europe, greater energy efficiency at the national level correlated with greater energy consumption,[24] controlling for population, urbanization, and other variables that influence total consumption, thus seeming to confirm the effect.

For further investigation:

How real is the rebound effect? Does it manifest differently with different kinds of consumption? How can it be effectively resisted?

How can measures to dampen the rebound effect, such as eco-taxes, avoid dampening incentives to innovate?

If this analysis is correct, it carries sobering consequences. Researchers at Sandia National Laboratories in the United States, studying the effect of increased efficiency in the lighting sector, noted that efficiency gains in moving from using candles, wood, and oil 300 years ago to electric lights today was accompanied by approximately a 100,000-fold increase in consumption.[25] They predict that more-efficient LED and other forms of solid-state lighting could increase consumption another 10-fold in just two decades. And they note that demand could continue to increase, given that indoor spaces are typically lit at just ten percent of outdoor light on a cloudy day.

Even if the Jevons effect cannot be proved or if its impact is not as great as some claim, it may be short-sighted to place too much confidence in efficiency gains to shepherd this civilization to sustainability. Nevertheless, if measures to counter the rebound effect of greater efficiency—through eco-taxes, for example—can be put into place, many opportunities for greater efficiency still exist. In addition to responses such as smart grids and energy-efficient buildings, more complex cross-sector solutions promise great efficiency gains as well, such as using waste heat from industry in district heating systems, tapping industrial wastes for use in construction, and reusing wastewater in urban systems.[26]

Better response: System Re-Design

A different approach to curbing consumption moves beyond efficiency gains in individual products or processes to build circular economies, in which entire economic processes are rethought to essentially write waste out of the economic picture, at least in theory. In this ambitious vision, materials are seen as "nutrients" that are used carefully and minimally, and that can circulate repeatedly across the cycle of production, use, and reclamation. These nutrients are of two types: biological nutrients, the wood, food waste, and other organic materials that can be composted and returned to soils; and technical nutrients, the industrial materials such as metals or minerals that can be reused or recycled.

For further investigation:

What real material savings can be expected with a circular economy? Which circular economy strategies offer the greatest materials savings?

Because circular economies often involve 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?

The Ellen MacArthur Foundation, which studies the circular economy concept, estimates that in Europe, adoption of circular economy principles could produce €1.8 trillion per year of net economic benefit by 2030.[27] It estimates that the building sector could cut construction costs in half by using industrial and modular processes, and that transportation costs could be lowered by 75 percent through systemic use of car-sharing, autonomous driving, and electric vehicles. And it observes that cities may be well positioned to advance the circularity model because materials are concentrated in urban areas, which reduces the distance materials must travel in their circular flows.

Circular economy initiatives involve much more than materials recycling. Providers rethink the entire purpose of production and consumption, exploring how they might provide the utility a consumer seeks, with minimal materials consumption. The solution may involve products made of materials that are easily

recyclable. It may involve replacing only worn materials, such as worn carpet tiles, while leaving the rest of the product in place, greatly reducing the materials load of providing attractive flooring. It may involve making products reusable, as with used copiers that are refurbished and returned to the market. It may involve replacing a good, such as a car, with a service such as car-sharing, which provides the personal transport people sometimes need while spreading the materials used across many consumers. Table 4 gives a sense of the myriad ways that a circular economy might be pursued.

Table 4. Strategies for Building a Circular Economy

Stage of Economic Activity	Initiatives to Reduce Materials Use
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 manufacturing 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

Source: Kalmykova[28]

The magnitude of reductions in construction costs projected by the Ellen MacArthur Foundation are in the ballpark of the 50 percent reduction in materials use that UNEP says is needed to create sustainable cities and could make the circular economy strategy a promising one. But what if the claims are too optimistic? What if envisioned reductions for buildings cannot be replicated in other sectors of the urban economy? What if reductions lower the price of materials, and as Jevons predicted, encourage greater consumption? And what if the needed 50 percent reduction in materials consumption, cited by UNEP as a global average, implies that reductions must be even greater in the cities in wealthy countries? On any number of levels, circular economies, while surely a promising idea, may not be sufficient to reduce global materials consumption to sustainable levels.

Needed Response: Sufficiency

Technical responses to overconsumption may not be enough to bring about the needed changes in materials use. Fortunately, another approach to the problem, rooted in human psychology, may be useful in reframing the problem and in suggesting solutions. Rather than asking “How can economies provide what people want in an environmentally sound way?” this approach to a redesigned economy reframes the issue: “What do people need to have satisfying lives, within safe environmental boundaries?” Note

the subtle shift: instead of assuming that ever-greater (and clean) consumption is the goal, it questions the very notion of expanded consumption as a path to human happiness. It uses a "hierarchy of needs" framework, as outlined by Abraham Maslow and other thinkers, as a rough guide for fundamental questions of economic design.[29]

Maslow's hierarchy consists of five levels, ranging from basic needs, such as food, shelter and safety, through higher-level needs, including love, esteem, and the capacity to achieve one's potential. (See Table 5.) Other analysts have refined the model over the time, but the basic design serves the purpose here of re-thinking urban consumption.

Table 5. Maslow's Hierarchy of Needs

Level	Description
Physiological Needs	Food, air, water, sleep, and other survival needs
Safety Needs	Protection from "wild animals, extremes of temperature, criminals, assault and murder, tyranny"
Love needs	"The need for love, affection, and belongingness"
Esteem needs	"… a stable, firmly based, (usually) high evaluation of themselves, for self-respect..and for the esteem of others."
Self-actualization needs	"self-fulfillment, namely…to become everything that one is capable of becoming"

Source: Maslow[30]

The needs hierarchy appears to be associated with different levels of materials use as well: the most basic needs have the highest materials consumption, while the highest needs carry the lowest materials base (although high-level needs presume sufficient access to basic needs). (See Table 6.) The table raises an intriguing possibility: can consumption be shifted, to some degree, away from materials-intensive goods such as large homes and cars, toward activities with low levels of materials intensity, such as engaging in recreational, cultural, or educational pursuits? Space for such a shift would seem to exist given high levels of spending in wealthy countries on housing, cars, furniture, and other basic needs.

Indeed, if urbanites too often pursue love, esteem, and self-actualization by overspending on physiological and safety needs (as advertisements often encourages), might they be happier shifting consumption away from excessive or environmentally harmful materials-intensive needs in favor of higher level needs? Such a shift would be environmentally beneficial, but it might arguably be preferred by individuals as well, given people's fundamental need for connection (see below), which is associated with Maslow's higher-level needs.

Table 6. Share of total material use, and possible Maslow Level, by consumption sector

	Materials use as share of all materials use (%)	Possible Maslow Level
More Intensive Activities		

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

Source: European Environment Agency and author[31]

Several insights into the psychology of consumption suggest, at the conceptual level, how such a shift might be made. Researchers note, for example, that humans tend to misread their happiness needs, often overvaluing extrinsic motivators (material things such as housing or possessions) and undervaluing intrinsic motivators (activities that help us to feel connected, competent, or autonomous, such as sports, hobbies or relationship building). Extrinsic needs might be thought of as concrete nouns—which, by definition, are material in nature—while intrinsic motivators are often activities, or verbs. An important feature of extrinsic motivators is that they are relatively fixed—the car I drive today has not changed since I drove it yesterday. We easily become accustomed to these goods and quickly tire of them, leading to a desire to seek even more.

Intrinsic motivators, however, are ever-changing—tennis today is different from tennis last week, because of changes in opponent, weather, or even improvement in my own skills. This variability tends to keep humans interested and engaged. Would a policy focus of providing a variety of intrinsic motivators—more concerts, sports opportunities, dance classes, and adult education—along with discouragement of overconsumption of extrinsic motivators, perhaps a tax on a second car or on housing size above a certain threshold—make people happier while reducing environmental impact?

Interestingly, city design can advance or erode people's happiness. The 2013 book *Happy City* cited two considerations that are important for urban design.[32] The first is how well cities encourage relationship

building—the higher-level needs in Maslow's hierarchy that are too often an afterthought in urban design. For example, car-centered cities are known to isolate people from one another, whether because sprawling development requires heavy levels of car use that keep people from walking, biking, and interacting, or because homes are often located far from work, making commuting a time-consuming and draining chore that dampens or kills the inclination to be socially involved. Greater density of development that puts people close to their work, makes walking, biking, and public transport workable commuting options, and encourages neighborly interaction increases the connections that bring happiness to people.

For further investigation

Can the materials load in cities for each of level of Maslow's hierarchy be precisely measured? How much lower is materials use associated with higher level needs?

What policies might actively shift people's consumption preferences away from overconsumption of basic needs and toward the fulfillment of belonging, esteem, and self-actualization needs?

In addition, cities can be designed for social interaction beyond home and work. Placemaking—the use of public spaces creatively to bring people together--has become a popular way to do this. These spaces can be plazas and parks, of course, but also street parking that is converted to benches and tables for eating, space beneath freeways that is used for basketball courts, or adaptation of spaces, as with the conversion of an elevated railway in New York into the High Line Park.

The experience with placemaking raises the question of public versus private consumption. Public infrastructure can require fewer materials per person than private consumption—a public swimming pool, for example, requires less cement, fencing, restroom and changing space and amenities per person served than if everyone had a pool in their back yard. Yet private consumption sometimes pushes out public consumption. General Motors, for example, promoted the private automobile in US cities in the 20th century, to the detriment of public transport. Personal water bottles may sideline public drinking fountains.[33]

A second way that the built environment in cities can advance the happiness of its citizens is through strategic provision of green space. These are not necessarily huge parks, but can be community gardens, median plantings, green roofs, forested area, and green stormwater infrastructure. What seems to matter in creating effective green space is not so much the extent of green areas overall, but their distribution and connectedness. Timothy Beatley, a professor at the University of Virginia, offers guidelines for a green city that give a sense of how a green city would look and feel:

- 100% of city population living 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 semi-wild 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[34]

For further Investigation:

What kinds of urban design best promote the social, economic, transportation, and other connections necessary for advancing the development of all urban citizens, with the least materials load?

To what degree does private consumption "crowd out" possibilities for public investment?

For what private consumption choices are public alternatives most easily offered, and what are the materials savings of each alternative?

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?

Green spaces are documented to help people to feel happy in a city and can support general psychological health. They are also good for physical health. Pleasant outdoor spaces attract citizens, offering them fresh air and space for exercise—sports, running, cycling, and walking—all of which can help to curb the incidence of obesity that afflicts a growing number of cities. Researchers at the Universidad Autónoma de Barcelona are leading an effort to document the effects of different kinds of green spaces on human health, which might help city planners to understand how to build an infrastructure of green spaces that provides a range of ecosystem services while improving the psychological and physical health of citizens.

Reducing consumption in cities may require development of a sufficiency ethic, a sense among citizens that once a city can meet survival and safety needs, and offer ample opportunities for connectedness that builds relationships, esteem, and offers people the opportunity to become their fullest selves, that greater material consumption per person is not necessary. An ethic of sufficiency can be related to public consumption: once people understand the value of consuming leisure with fellow citizens in a plaza, for example, the desire to visit the mall regularly might recede. It is also something that could be promoted

by leaders in ethics and faith communities, who often have the moral credibility to make such an argument.

Sustainable Cities Are Less Consumptive Cities

Recall that the International Resource Panel of the United Nations has called for reducing urban Domestic Materials Consumption roughly in half, from the 8 to17 tonnes per capita per year projected for 2050 to roughly 6–8 tonnes per capita per. This implies a reduction in materials use of some 44 billion tonnes by 2050, a huge sum.[35]

Achieving such an ambitious goal will require creative thinking on a number of fronts. Certainly all of the approaches described above—greater efficiency, circular economy, and sufficiency, will play a role. But the impact of each, and their relative importance, is unclear, and call out for greater research. To assist city policymakers to tackle the challenge of materials consumption, solid research will be needed to ground decisionmaking. The questions identified in this document are only a starting point.

Answers to these questions could lead to policies designed to curb consumption while offering greater satisfaction to citizens. These policies, in turn, could help make cities truly sustainable and livable human habitat. Such a development would make the evolution of humans into *homo urbanis* a true advance for our species this century.

For further investigation

What policies or initiatives are successful in persuading consumers that they would be happier by consuming less?

How much more materials-intensive are extrinsic than intrinsic motivators?

How might public policy help people to identify and value intrinsic over extrinsic motivators?

What responsibility does advertising bear in creating unnecessary and unhealthy demand? How might this advertising be curbed?

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