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White Paper

on

TALL BUILDINGS RECONSIDERED
Examining the Evidence of a Looming Urban Crisis

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TALL BUILDINGS RECONSIDERED:
Examining the Evidence of a Looming Urban Crisis

EXECUTIVE SUMMARY

At a time of unprecedented speed of construction of tall buildings around the world, evidence-based evaluations of their drawbacks as well as claimed advantages are remarkably infrequent (Ng, 2017). Given the potential for long-term impacts of unknown magnitude, this situation seems to warrant urgent remedy. As a contribution to that goal, this research summary looks specifically at negative impacts, which we find are under-reported. Specifically, we find significant negative impacts in the following categories:

1. ***Economic externalities.*** There is evidence that tall residential buildings with for-sale units are significantly more likely to fail economically over time. A hardly addressed but important issue is the built-in market failure in meeting the maintenance costs of towers – especially residential towers – with condominium type ownership. Contrary to intuition, the maintenance costs broadly rise with height, reaching prohibitive sums that many households will at some point not be able to afford. Towers are thus destined to faster deterioration, greater difficulties in upgrading to newly expected standards, and major, unaddressed economic and urban challenges when the time comes to replace these towers.There is also evidence that the higher cost of tall residential for-sale buildings can fuel gentrification and make surrounding housing less affordable (Lehrer and Wieditz 2009).

   There is also some evidence that tall buildings tend to suppress small-scale entrepreneurial activity by replacing older, smaller, more affordable commercial spaces with larger more expensive ones.

2. ***Social impacts.*** There is abundant cautionary research on the negative social impacts of residential tall buildings and their associated urban typologies, both for residentsand for adjacent communities. These include greater isolation and loneliness for some populations, greater rates of depression and even suicide, and suppression of street-based social interaction (particularly for tall buildings with garages for private automobiles).

3. ***Impacts on the natural environment.*** There is evidence that tall buildings do not contribute significantly to urban sustainability, and that arguments to that end are often greatly exaggerated. Evidence shows that many tall buildings with claims to sustainability have performed poorly on environmental criteria in actual post-occupancy evaluations. Tall buildings also have higher embodied energy and resources than lower building typologies, greater exposure to energy heat and loss, and higher negative impacts on access to natural daylight and passive heating by adjacent buildings.

4. ***Impacts on the human environment.*** There is ample research indicating that tall buildings have many negative impacts on the livability of their adjacent public and private spaces. These include shading effects, wind effects, loss of sky view, canyon effects (concentration

of pollutants at street level), and aesthetic effects for larger numbers of residents, which, when judged by residents to be negative, affect more residents negatively for taller buildings. This problem is compounded by evidence of a significant divergence between what professionals and non-professionals judge to be a proper and pleasing building design, which becomes more consequential for more residents when buildings are taller, and thus more conspicuous. There is also an inherent cognitive bias in any profession, which in the case of architecture and development, can have negative ramifications for laypersons' quality of life.

Background

In the last several decades, the number and height of tall buildings has greatly increased in many cities around the world. The benefits of these new buildings are widely discussed: symbols of civic identity, profitable engines of economic development, new homes and offices affording beautiful views, and accommodations for new urban growth in a more compact and (it is alleged) sustainable form.

Indeed, it has become a truism among many sustainability advocates that tall buildings are, by sheer virtue of the higher volume of building they provide per given footprint, paragons of sustainability. Some architects and other boosters now offer highly exuberant prescriptions for the building of many more "sustainable skyscrapers," often with fanciful designs and technological features. Some proponents advocate a wholesale move to super-dense "skyscraper cities," while others simply tout the green credentials of particular tall buildings, like London's Gherkin or Manhattan's New York Times Building.

These are strong claims, which should require strong evidence. In fact, troubling evidence points to many problems with tall buildings, on social, economic and even ecological grounds. Far from being paragons of sustainability, evidence indicates on the contrary that they are a highly problematic urban typology. At the very least, in light of this evidence, the burden should be on those who (for often understandable reasons of self-interest) are exuberant boosters of the type, to show that their negative impacts have been mitigated, and claims for their positive contributions have been fully substantiated. In particular, this should be a minimum prerequisite for any move to deregulate building height rules – which is indeed under way in a number of cities.

We must certainly acknowledge the numerous advantages and appealing qualities of tall buildings for their own residents (and to the developers' profit margin). They can afford wonderful views to residents, or at least they can when not blocked by other similar tall buildings. However, it seems clear that, given the pace of growth of tall buildings – in both number and height – a sober assessment of the evidence is long overdue.

Looking at the evidence

To be clear, the research does show that places like Manhattan and Vancouver, BC, perform well on ecological criteria: They conserve farmland and natural areas, they have relatively low energy use and emissions per person, and they have relatively efficient use of resources per person (notably in

things like buildings, pavement, etc.).

But how much of this is due to the presence of tall buildings? Is it possible that tall buildings are not a significant contributor in and of themselves?

More pointedly, does the research show that there significant negative impacts that we, as responsible practitioners, must bear in mind?

In a word, yes -- on both counts. One problem is that the current knowledge about the impacts of tower buildings is still rudimentary, especially regarding residential towers, and it is replete with unsupported assumptions about the ostensible benefits of tower buildings.

To be sure, there is a small but growing body of research on the benefits and drawbacks of tall buildings, and this research gives a decidedly mixed picture. This research shows that there are significant negative ecological and even economic impacts of tall buildings, as well as other negative factors, and the ecological benefits are not as great as is often assumed. We summarize some of this research below, and offer a sampling of citations.

Definition

First, for the purposes of this paper, we define a "tall" building as any building more than fifteen storeys. This is a somewhat arbitrary definition, since both positive and negative impacts of taller buildings increase with height, and there are many complex factors at play, including materials, engineering requirements, local building codes, view sheds, and other variable factors. Nor are the impacts continuous by height, but rather, they are influenced by a series of "tipping points" above which different materials, structural designs, lift and egress designs, and other changes are required. Nonetheless, there is a significant difference between a ten-storey building and a twenty-storey one, sufficient to draw a line of definition between them.

Three common types

Where tall buildings do exist in these cities, they often fall disproportionately into two categories. They are usually either single-use or limited mixed-use office buildings, or they are residential towers inhabited primarily by upper-income families. A third type of building is the public housing project created by government. Since these structures are rarely above fifteen storeys, we will not focus on that type in this paper.

However, it is worth noting that many of the taller (but below fifteen storeys) buildings that house the poor have an unhappy history. There is extensive research on their dysfunctions, calling into question their social suitability for families, their impact on children, their psychological impacts, their relation to their open spaces and propensity for crime, and other social issues. Moreover, in most cases these are not simply correctable design defects, but inherent problems stemming from isolation from the ground, lack of eyes on the street, and other attributes of taller buildings. These problems are clearly present and even exacerbated when residential buildings are above fifteen storeys.

Office buildings, a common type of tall building within city centres, by definition don't by themselves increase residential density, but depend for many of their claimed benefits on their location and the pattern of commuting. If they are confined to largely single-use office districts whose employees empty out in the evening, decamping to remote residential enclaves, then this is clearly not much of an ecological benefit.

A. Economic and legal impacts

1. The illusion of internal economic efficiency masks the real cost of long-term maintenance of towers.

Contrary to conventional wisdom, tall buildings often entail *higher* rather than lower maintenance costs per unit, despite the large number of owners; the taller, the more complex, although not quite in a linear relationship (for details see Alterman 2010). A further problem is related to the structural attributes of tower buildings, which operate like complex, closed machines that are not amenable to structural changes. Unlike regular buildings, in towers it will not be possible to grant additional development rights in the future (incentive zoning) to finance the necessary updating costs. Tower buildings are less amenable to structural modifications, so there is a greater danger that their relative value will eventually diminish, causing them to lose their position in the housing market, and thus to deteriorate faster than smaller apartment buildings. In addition to current expenditures for routine maintenance, comparatively larger investments are required for periodic repair and replacement of expensive machinery, large scale upgrading and renovation of the whole building and so on, than applies to regular buildings.

The problem of financing maintenance is much more severe in residential towers (almost always in condominium ownership) than in office towers. These edifices have built-in susceptibility to market failure in their decision structure. The large number of households in a tower along with the high absolute costs of maintenance are breeding ground for "free riders". This means, that even if the monthly payment is not met by a few households, the elevator is likely to continue to run and the stairs cleaned for many months before the "free rider" effect leads to organizational or economic collapse. Especially challenging would be the higher periodic investments needed for upgrading the technologies, or Any initial socially based understanding among the original owners is likely to erode over time, as apartments change hands or are rented out, and as the costs rise due to building deterioration. As the time range expands, and higher investments are needed for renovation, it becomes increasingly likely that many of the original owners will have moved out. An 'intergenerational' problem then arises, whereby upon sale, each owner has an interest in passing on the onus of financing maintenance to the new purchasers. When this happens on the large scale of a residential tower, the effect on deterioration is inevitable.

2. The legal frameworks differ across countries, but their impacts are barely researched.

Since residential towers are almost always in condominium ownership (called strata in Pacific countries), there is a special legal structure that determines or guides decision making and the mutual obligations of the apartment ownership; However, the differences in the legal structures are

not socio-economically neutral. The decision-making rules may have direct or indirect implications for participation, social inclusion or exclusions. Furthermore: various legal requirements in the law to prevent payment defaults along with the legal powers of the condominium association could have major impacts on the costs of maintenance and thus on the future of the buildings' good functioning. The different legal formats can also impact the socio-economic composition of the ownership and reinforce the inherent exclusionary attributes of towers.

Condominium laws differ from country to country. There is no published large-scale comparative research on a wide span of countries' laws and practices and their urban impacts in practice. There are however a few published papers on one or a few countries. Harris (2011) analyzes British Columbia. Alterman's 2010 paper compares Florida and Israel, and Garfunkel's paper (2017) presents part of the findings of a larger research project in-progress by Alterman and Garfunkel encompassing four countries.

Alterman's comparison of Florida and Israel reports on two legal regimes which may represent the two extremes on the range of condominiums laws: In Florida the law is very sophisticated in its attempt to assure funding for long-term maintenance of condominiums. It grants the condominium association a draconic legal right - to take over any apartments if the owner has not paid the monthly fees for more than a month! The Association can then sell the apartment, deduct what is owed, and give the rest to the owner. In addition, the law requires that apartment buyers put aside a heft fund for future repairs, to be managed by the association. These drastic rules come hand in hand with scores of pagers of legal caveats and rules placed both on the developer and on the buyers. To meet these legal and financial requirements, buyers would need to hire a slate of legal and economic experts, thus raising the costs of apartment purchase. These are exclusionary factors built into the legal requirements. (Despite all these protections many condominiums did not survive the 2008-9 crisis when the condo associations found themselves with too many defaulted apartments and a weak market).

At the other extreme is the Israeli "thin "law, which is typical of many other countries as well. It has the minimal elements necessary to run a condominium, and has served the country well for 70 years – a country where the vast majority of urban residents live in condominiums (spanning most price levels). However, the simply condo laws are not geared to assure the long-term maintenance of tower buildings. With scores and hundreds of owners the social fabric that could work with 10-20 owner is silenced. The absolute maintenance costs, as noted, are also much higher. Although the law does not require hiring of building-management corporations, towers have not practical choice but to do so. The entrance of maintenance companies changes the entire decision-making structure, adding third players in the game, with many unanticipated repercussions. Research on these repercussions is still embryonic. The Israel Ministry of Justice is currently considering legal changes, but these are not likely to tackle the inherent costs of maintenance – probably even exacerbating the problem.

3. The claims that tall buildings provide a stimulus for economic development are weak.

Another issue that should be considered is the relation of real estate development, and tall building development specifically, to the economic development strategy of a city. Indeed, tall buildings are

often linked to economic development and the growth of jobs by many proponents. Some advocates of tall buildings, like Harvard economist Edward Glaeser, favor a kind of "supply-side" development strategy using real estate development to create jobs, and to lure wealthy people into the city to generate additional economic opportunities for others.

To be sure, there is strong evidence that real estate development can serve as a spur to economic growth. Cities like Phoenix, Las Vegas and Atlanta have explicitly used suburban real estate development in exactly that way. Arguably the economic development of the American middle class was fueled in part by suburban real estate development, along with the growth in automobiles and household goods. The question now is what is the quality of this economic growth, and how sustainable is the model?

There is some evidence that real estate development per se is a short-lived contributor to a regional economy, and that it can also produce unintended negative consequences. Vancouver, for example, experienced explosive growth of tall buildings beginning in the 1990s, and the surging wealth in the city also contributed to its high cost of living. The city is now in the midst of a broad civic debate about the wisdom of tall buildings, with many people expressing misgivings – a debate that is not typically acknowledged in proponents' arguments.

There is a strong alternative argument about the dynamics of cities, most famously articulated by the urbanist Jane Jacobs. She argued for a diverse city, with diverse uses, and diverse building ages and costs. In such a city, she argued, there are opportunities for entrepreneurship at a range of economc price points and "rungs of the ladder." The problem with the supply-side model may be that it focuses too much on one end of the economic spectrum, and it thereby exacerbates inequality and the under-performance of some sectors of the economy. Jacobs' "slow burn" approach, while it may not produce the quantity of riches for some sectors that the urban supply-side model does, nonetheless produces a steadier, more sustainable form of urban growth – and one most likely to preserve a city's livability, which is also a key economic asset.

B. Resource and ecological impacts

1. The claims for benefits from density are not supported by the evidence.

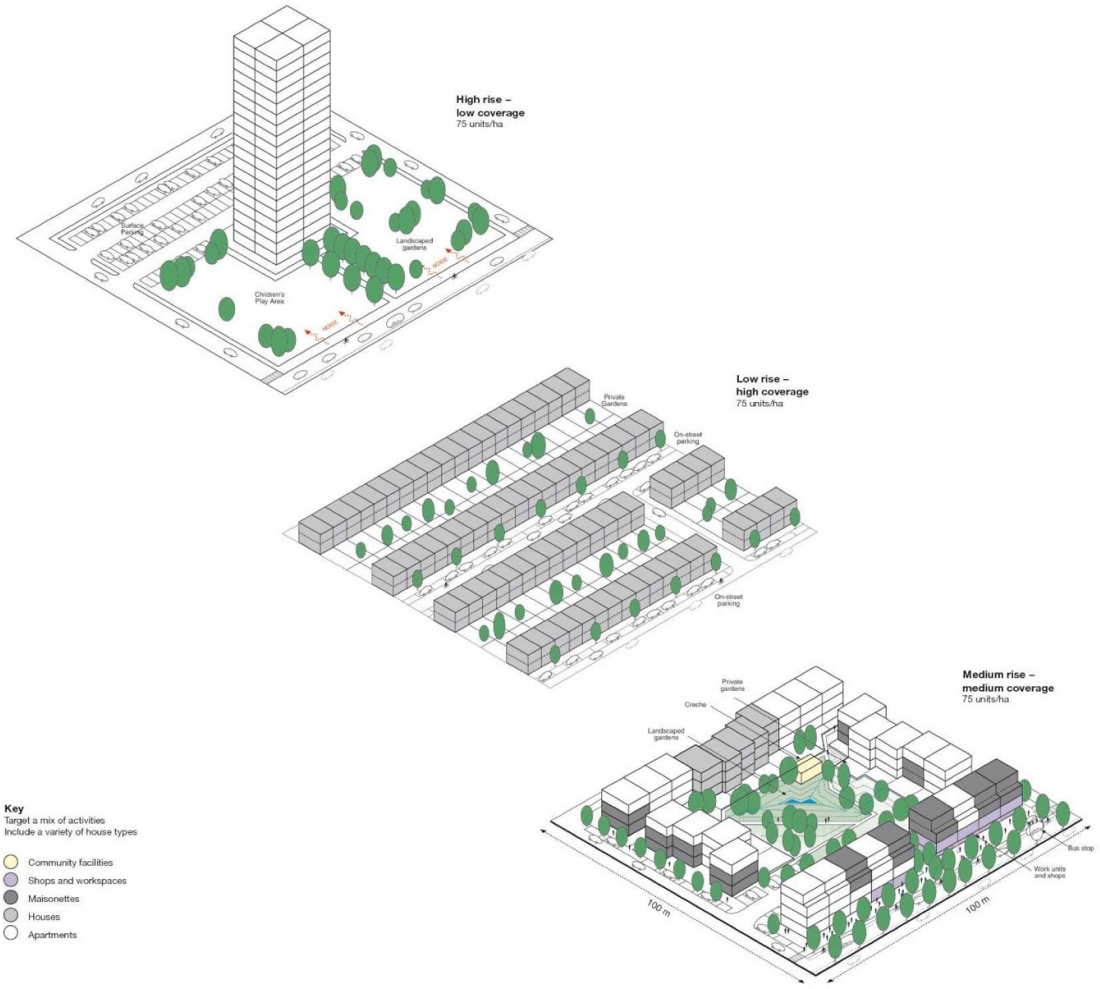
One of the most common arguments for the benefits of tall buildings is that they create dense settlement patterns that are inherently beneficial in reducing energy, resource consumption and emissions. A related argument is that the denser form of tall buildings reduces sprawl.

But as a recent UK House of Commons report concluded, "The proposition that tall buildings are necessary to prevent suburban sprawl is impossible to sustain. They do not necessarily achieve higher densities than mid or low-rise development and in some cases are a less-efficient use of space than alternatives."

Often cities like New York and Vancouver are cited as stellar examples of dense ecologically superior cities with tall buildings. It's usually assumed that it's the tall buildings in these cities that give them the edge.

As noted earlier, these cities are indeed very positive when it comes to carbon and other ecological metrics. But it's often overlooked that tall buildings are only a fraction of all structures in these places, with the bulk of neighborhoods consisting of rowhouses, low-rise apartment buildings, and other much lower structures. They get their low-carbon advantages not only from density per se, but from an optimum distribution of daily amenities, walkability and access to transit, and other efficiencies of urban form.

Figure One. Density and tall buildings are not synonymous. A drawing by Sir Richard Rogers shows the same density in three completely different urban typologies. From the Urban Task Force, 1999.



From an urban sustainability perspective, it is not just density, but the efficient placement of people and their activities, that is important. A dense downtown, far away from a dense bedroom community, may actually be worse, from a carbon point of view, than a less dense mix of the two.

Furthermore, research shows that the benefits of density are not linear, but taper off as density increases. In other words, there is an optimum density, above which the negative effects of density start to increase over the positive ones. That "sweet spot" seems to be in the neighborhood of about

50 people per acre. Many cities around the world achieve this density without tall buildings, while creating a very appealing, livable environment (e.g., Paris and London, as well as the aforementioned parts of New York, Vancouver et al.).

2. There is other cautionary evidence about the negative ecological consequences of tall buildings.

Research literature documents the following problems:

1. Increasingly high embodied energy of steel and concrete per floor area, with increasing height, requiring more resources and energy per unit of useable floor space.
2. Relatively inefficient floorplates due to additional egress requirements (e.g. multiple stairs).
3. Less efficient ratios of common walls and ceilings to exposed walls/ceilings (compared to a more low-rise, "boxier" multi-family form — as in, say, central Paris).
4. Significantly higher exterior exposure to wind and sun, with higher resulting heat gain/loss.
5. Challenges of operable windows and ventilation effects above about 30 stories.
6. Diseconomies of vertical construction systems, resulting in higher cost per usable area (not necessarily offset by other economies — these must be examined carefully).
7. Limitations in insulation and solar gain of typical lightweight curtain wall assemblies (there are efforts to address this, but many are unproven).
8. Challenge of maintenance and repair (in some cases these require high energy and cost).

3. Evidence from post-occupancy research on environmental performance is not encouraging.

When actually measured in post-occupancy assessments, many tall buildings have proven far less sustainable than their proponents have claimed. In some notorious cases they've actually performed worse than much older buildings with no such claims. A 2009 New York Times article, "Some buildings not living up to green label," documented the extensive problems with several noted sustainability icons. Among other reasons for this failing, the Times pointed to the widespread use of expansive curtain-wall glass assemblies and a failure to account for increased user consumption of energy.

Partly in response to the bad press, the City of New York instituted a new law requiring disclosure of actual performance for many buildings. That led to reports of even more poor-performing sustainability icons. Another Times article, "City's Law Tracking Energy Use Yields Some Surprises," noted that the gleaming new 7 World Trade Center, LEED Gold-certified, scored just 74 on the Energy Star rating — one point below the minimum 75 for "high-efficiency buildings" under the national rating system. That modest rating doesn't even factor in the significant embodied

energy in the new materials of 7 World Trade Center.

Things got even worse in 2010 with a lawsuit ["$100 Million Class Action Filed Against LEED and USGBC"] against the US Green Building Council, developers of the LEED certification system (Leadership in Energy and Environmental Design). The plaintiffs in the lawsuit alleged that the USGBC engaged in "deceptive trade practices, false advertising and anti-trust" by promoting the LEED system, and argued that because the LEED system does not live up to predicted and advertised energy savings, the USGBC actually defrauded municipalities and private entities. The suit was ultimately dismissed, but in its wake the website Treehugger and others predicted, based on the evidence uncovered, that "there will be more of this kind of litigation."

This is a paradoxical outcome. How can the desire to increase sustainability actually result in its opposite? One problem with many sustainability approaches is that they don't question the underlying building type. Instead they only add new "greener" components, such as more efficient mechanical systems and better wall insulation. But this "bolt-on" conception of sustainability, even when partially successful, has the drawback of leaving underlying forms, and the structural system that generates them, intact. The result is too often the familiar "law of unintended consequences." What's gained in one area is lost elsewhere as the result of other unanticipated interactions.

For example, adding more efficient active energy systems tends to reduce the amount of energy used, and therefore lowers its overall cost. But, in turn, that lower cost tends to make tenants less careful with their energy use — a phenomenon known as "Jevons' Paradox." Increasing efficiency lowers cost, and increases demand — in turn increasing the rate of consumption, and wiping out the initial savings. The lesson is that we can't deal with energy consumption in isolation. We have to look at the concept of energy more broadly, including embodied energy and other factors.

There are often other unintended consequences. A notable case is London's sustainability-hyped "Gherkin" (Foster & Partners, 2003), where the building's open-floor ventilation system was compromised when security-conscious tenants created glass separations. Operable windows whose required specifications had been lowered because of the natural ventilation feature actually began to fall from the building, and had to be permanently closed. The ambitious goal of a more sophisticated natural ventilation system paradoxically resulted in even worse ventilation. (See also Capeluto et al 2003).

4. Life-cycle costs and energy retrofitting affect towers' role in emissions

The life-cycle costs of constructing towers in various specific geographic contexts are also not factored into the cost calculations by developers or consumers. These too are worthy of more research.

Because most older buildings are low or mid-rise, there is little research on environmental retrofitting of towers, especially not on residential towers. The global agenda is increasingly focusing on zero-energy consumption and on installing renewable energies in building, and standards and technologies are in flux. For example, new solar energy technologies to paste on windows and walls, will soon be economically viable . Tower buildings consume much energy, but

also offer a lot of potential window and wall surface areas . But towers, especially condominium towers, are likely to prove recalcitrant. The legal framework and the already high costs of maintenance (without counting in energy) are likely to make such retrofitting difficult. Towers might not be good friends of the climate-change agenda.

5. No building is an island

Another major problem with green building programs happens when they treat buildings in isolation from their urban contexts. In one infamous example [“Driving to Green Buildings”], the Chesapeake Bay Foundation moved its headquarters to the world’s first certified LEED-Platinum building — but the move took them from an older building in the city of Annapolis, Maryland to a new building in the suburbs, requiring new embodied energy and resources. The added employee travel alone — what’s known as “transportation energy intensity” — more than erased the energy gains of the new building.

The theory of resilience points to the nature of the problem. Systems may appear to be well engineered within their original defined parameters — but they will inevitably interact with many other systems, often in an unpredictable and non-linear way. We look towards a more “robust” design methodology, combining redundant (“network”) and diverse approaches, working across many scales, and ensuring fine-grained adaptivity of design elements. Though these criteria may sound abstract, they’re exactly the sorts of characteristics achieved with so-called “passive” design approaches.

Passive buildings allow the users to adjust and adapt to climactic conditions — say, by opening or closing windows or blinds, and getting natural light and air. (Capeluto and Shaviv 2001). These designs can be far more accurate in adjusting to circumstances at a much finer grain of structure. They feature diverse systems that do more than one thing — like the walls that hold up the building and also accumulate heat through thermal mass. They have networks of spaces that can be reconfigured easily, even converted to entirely new uses, with relatively inexpensive modifications (unlike the “open-plan” typology, which has never delivered on expectations). They are all-around, multi-purpose buildings that aren’t narrowly designed to one fashionable look or specialized user. And perhaps most crucially, they don’t stand apart from context and urban fabric, but work together with other scales of the city, to achieve benefits at both larger and smaller scales.

6. Older, shorter buildings often perform surprisingly well.

Many older buildings (prior to the age of cheap energy) took exactly this “passive” approach, simply because they had no alternative. In an era when energy was relatively expensive (or simply not available) and transportation was difficult, buildings were naturally more clustered together in urban centers. Their shape and orientation exploited natural daylight, and typically featured smaller, well-positioned windows and load-bearing walls with higher thermal mass. The simple, robust shapes of these buildings allowed almost endless configurations. In fact, many of the most in-demand urban buildings today are actually adaptive reuse projects of much older buildings.

The results of this passive approach are reflected in good energy performance. While New York’s 7

World Trade Center actually scored below the city's minimum rating of 75 out of 100, older buildings in the city that had been retrofitted with the same efficient heating, cooling, and lighting technologies fared much better: the Empire State Building scored a rating of 80, the Chrysler Building scored 84.

But age alone is clearly not a criterion of success. The 1963 MetLife/PanAm building (Walter Gropius & Pietro Belluschi), now a half-century old, scored a dismal 39. Another mid-century icon, the Lever House (Skidmore, Owings & Merrill, 1952), scored 20. The worst performer of all was Ludwig Mies Van der Rohe's iconic Seagram building, built in 1958. Its score was an astonishingly low 3.

What's the problem with these buildings? As the earlier New York Times article noted, they have extensive curtain-wall assemblies, large window areas and other limitations. On a fundamental level, as we can now begin to see from resilience theory, they lack many crucial resilient advantages of older building types. There may be something inherent in the building type itself that is non-resilient. The form language itself could be an innate problem — something that, according to systems thinking, no mere bolt-on "green" additions can fix.

7. Perhaps it's time to re-assess "Oil-interval" architecture?

Architectural critic Peter Buchanan, writing recently in the UK magazine, The Architectural Review, placed the blame for these failures squarely at the feet of the Modernist design model itself, and called for a "big rethink" about many of its unquestioned assumptions ["The Big Rethink: Farewell To Modernism — And Modernity Too"]. Modernism is inherently unsustainable, he argued, because it evolved in the beginning of the era of abundant and cheap fossil fuels. This cheap energy powered the weekend commute to the early Modernist villas, and kept their large open spaces warm, in spite of large expanses of glass and thin wall sections. Petrochemicals created their complex sealants and fueled the production of their exotic extrusions. "Modern architecture is thus an energy-profligate, petrochemical architecture, only possible when fossil fuels are abundant and affordable", he said. "Like the sprawling cities it spawned, it belongs to that waning era historians are already calling 'the oil interval'."

C. Social and health impacts

1. In addition to ecological and economic impacts, the research literature also paints a rather damning picture of social impacts, for both residents and those around them.

1. Psychological effects on residents, especially children. After surveying the literature, Gifford (2007) concludes that "the literature suggests that high-rises are less satisfactory than other housing forms for most people, that they are not optimal for children, that social relations are more impersonal and helping behavior is less than in other housing forms, that crime and fear of crime are greater, and that they may independently account for some suicides."

2. Social effects, particularly at the street. Tall buildings can function in effect as "vertical

gated communities," failing to activate longer stretches of streets with ground-level doors and windows. (We discuss this problem in more detail below.) This problem is exacerbated with tall buildings that have their own internal garages, through which residents may enter and depart without ever setting foot in the public realm.

3. Shading of other buildings and public spaces. This has obvious impacts on degree of sunlight and skyview, and impacts on those who are using the public realm.

4. Ground wind effects. Some of these effects can become quite strong (e.g the so-called "Venturi effect") which can make public spaces unpleasant. The proverbial "windswept tower plaza" seems to be more than a stereotype.

5. Heat island effects. Tall buildings clustered together are known to trap air and heat it, placing increased demand on cooling equipment in warm climates, and making adjacent public spaces less habitable.

6. "Canyon effects". Similarly to heat island effects, canyon effects can trap pollutants, reducing air quality at the street and in public spaces.

7. Psychological impacts for pedestrians and nearby residents. This is a more difficult area to evaluate and depends greatly on the aesthetics of a particular building. However, there is research to show that a design that is (or comes to be) experienced as ugly by adjoining residents can significantly degrade their experience of the public realm and quality of place.

2. Vertical gated communities?

Residential towers – almost inevitably in condominium ownership - have a built-in capacity to take on aspects of gated communities, whether intentionally or not. Towers must be self-contained in controlling vertical traffic. They have expensive machinery that must be maintained and thus, as noted, must charge significant maintenance costs. Towers have many housing units, and therefore must have an effective decision-making mechanism that is unlikely to be in a "town meeting" format. The inevitable anonymity and the physical inability to see who comes in and out, increased issues of security. Gated communities thrive on the perception of need for security (Atkinson & Blandy, 2005; Blandy 2011). Tower condominiums invest sizable resources in technologies such as key fobs, CCTV and reception desks. This, in turn, serves to support claims that tower condominiums, as urban enclaves, act as a source for urban fragmentation (Warner, 2011; Webster and Glastz, 2006)

Thus, even if tower condominiums don't exercise overt selection of owners based on income, lifestyle, number of children etc., they do become "vertical gated communities" to some extent. Gatedness limits interaction and social capital across socio-economic groups (Margalit 2009). Moreover, like horizontal gated communities, they bottle up the activity of residents that might otherwise help to enliven the public realm. Lastly, there is the simple and rather embarrassing fact that when it comes to residential density, you can't count people more than once: if wealthy tower residents have two or three homes, then their residential population count has to be divided between

these. This fact alone reduces the conventional density count of some higher-end residential tower neighborhoods (like those in Vancouver) significantly.

2. Additional evidence from research on the divergence between architects' and laypersons' aesthetic judgments

A basic question about any building is its contribution to the public realm, and to the aesthetic qualities that are most valued by citizens. This comes down to the even deeper question, "for whom do we build?" Do we build only for our own buyers, or for our own professional community? Or do we need to take into account, in a democracy, the preferences of others whose experience of our buildings in within the public realm? If so, what are those preferences, and how do they align, or diverge, from those of professionals?

In the case of tall buildings, this question takes on much greater importance. A six-story building that is disliked by non-architect residents might be a problem for the neighborhood, but a sixty-story building that is disdained by non-architect residents (and possibly visitors too) becomes a problem for the entire city.

Here the research is also quite cautionary (see Appendix II for citations). In a widely cited survey of other research, psychologist Robert Gifford and his colleagues reported that "architects did not merely disagree with laypersons about the aesthetic qualities of buildings, they were unable to predict how laypersons would assess buildings, even when they were explicitly asked to do so." The researchers pointed to previous studies showing cognitive differences in the two populations: "Evidence that certain cognitive properties are related to building preference has already been found."

The researchers stressed that architects did not simply disagree aesthetically with non-architects: they literally *could not see* the difference between their own aesthetic preferences and those of non-architects. "It would seem that many architects do not know, from a lay viewpoint, what a delightful building looks like. If we are ever to have more delightful buildings in the eyes of the vast majority of the population who are not architects, this conundrum needs study and solutions."

Of course, every profession has its own biases and cognitive limitations, and it's unfair to suggest that architects are unique. Every profession is a bit like the proverbial "carpenter with a hammer, for whom every problem looks like a nail." We see the world through the lens of our own training and experience, and sometimes our specialized concerns become detached from the concerns – perhaps even the common sense – of our own clientele.

In social psychology, this well-known problem is described by what is known as "Construal Level Theory." The more removed we are from the concrete experience of, say, how buildings affect real people in ordinary life, the more we must construe our work and its goals in abstraction – and the more remote those "construals" can become from human beings and their needs. Of course the same is true for planners, developers, business owners or anyone else working in the built environment.

But in the case of architects, the research is helping to explain a particularly consequential way of seeing the world. It seems that, where most people see objects in context, architects as a group (and, we should add, their art-connoisseurs and media boosters) tend to focus on objects in isolation from their contexts. Where most people look for characteristics that help buildings to fit in and to increase the overall appeal of their surroundings, architects seem to focus narrowly on the attributes of buildings that make them stand out: their novelty, their abstract artistic properties, their dramatic (even sometimes bizarre) contrast.

Some researchers have concluded that this peculiar way of seeing comes from architects' unique studio education. Students must stand out in a highly competitive environment, and they do so by winning praise for the clever novelty of the art-objects they produce. In the abstracted world of studio culture, those objects are usually very far removed indeed from their real-world contexts – as anyone who has taught studio, like me, can readily observe.

But of course, this training turns out to be useful preparation for the role that architects must too often play in the modern development process: they must "brand" their buildings, their clients and themselves as attention-getting novelties, the better to compete as commodities with others.
This focus on the design of novel art-objects is a historically exceptional development. Up to the 20th century, architecture was by necessity a close adaptive response to its human and natural context. On that concrete foundation, architecture explored its more abstract expressions.

As the urbanist Jane Jacobs pointed out, this is a healthy relationship between life and art: namely, life serves as the foundation upon which the art is an enrichment of meanings. But as Jacobs warned, when this relationship is confused – when abstract art seeks to supplant concrete life – the results are very bad for life, and probably bad for art too.

But as Jacobs also observed, this is precisely what professionals allowed to happen – even encouraged to happen – in the 20th century. The marketing allure of their fine art was used to rationalize, even glamorize, a toxic industrialization of the built environment. The results of this malpractice are evident today in ugly, dysfunctional cities and towns all around the globe.

Of course many architects blame others for this degradation of settlements: developers, engineers, or the non-architects who design a large percentage of structures. But architects occupy a singular leadership position, whether by action or inaction. It is architects whose influential ideas about cities and buildings profoundly shape what others can do in the built environment – perhaps by deeming certain kinds of designs "fashionable" or "edgy" – or conversely, "reactionary" or "inauthentic."

Historically, it was also architects who helped to shape the most beautiful, enduring, well-loved cities, towns and buildings of human history. As we enter a time of unprecedented urbanization – on track to produce more urban fabric in the next five decades than in the previous 10,000 years – it is architects who now have an urgent responsibility to lead a humane, sustainable form of settlement for the future.

But the new research findings make it clear that this will require some major soul-searching.

Outmoded ideologies and practices must be fundamentally reassessed. The distorted conception of architecture as fine-art novelty, in dramatic contrast with its context – with its environment, and with its history – must be reformed. In its place we require an architecture of life – one responsive to human need, and to the patterns of nature and history.

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APPENDIX I:
RELEVANT EXAMPLES FROM RESEARCH ON TALL BUILDING IMPACTS

Guedi Capeluto, Abraham Yezioro, Daniel Gat and Edna Shaviv (2003). "Energy, Economics and Architecture." Proceedings of the Eighth International IBPSA Conference, Eindhoven, NL August 11-14, 2003.

Excerpt:

"Very often, high rise buildings are proposed as a means of achieving high urban density. However, t**all buildings may cause environmental problems like high wind velocities in open spaces around them, as well as extended shadows over nearby houses and open spaces** (HELIOS, 1999, 2000). Moreover, the construction cost of high-rise buildings is steep (Tan, 1999, Gat, 1995). **When all these factors are taken into account it is not a priori clear that the desired high urban density can be achieved by tall buildings along with an acceptable solution to the above mentioned environmental problems. Recent studies have shown that a reasonable density may be achieved with six stories high buildings while preserving the solar rights of neighboring buildings, as well as open spaces among them** (Capeluto and Shaviv, 2001)."

Citations given above:

Shaviv, Yezioro and Capeluto. (1999) The Influence of High-Rise Buildings on their Energy Consumption and Urban Shading. HELIOS Ltd., 1999.

Tan W. (1999). "Construction Costs and Building Height." Construction Management and Economics, Vol. 17, pp. 129-132.

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Capeluto I.G., Shaviv E. (2001). "On the Use of Solar Volume for Determining the Urban Fabric." Solar Energy Journal, Vol. 70, No. 3, Elsevier Science Ltd., pp. 275-280.

G.J. Treloar, R. Fay, B. Ilozor, P.E.D. Love (2001). "An Analysis of the Embodied Energy of Office Buildings by Height." *Facilities,* 2001 Volume: 19 Issue: 5/6 Page: 204 - 214 ISSN: 0263-2772 DOI: 10.1108/02632770110387797 Publisher: MCB UP Ltd

Abstract:

"Aims to compare the energy embodied in office buildings varying in height from a few storeys to over 50 storeys. The energy embodied in substructure, superstructure and finishes elements was investigated for five Melbourne office buildings of the following heights: 3, 7, 15, 42 and 52 storeys. **The two high-rise buildings have approximately 60 percent more energy embodied per unit gross floor area (GFA) in their materials than the low-rise buildings.** While building height was found to dictate the amount of energy embodied in the "structure group" elements (upper floors, columns, internal walls, external walls and staircases), other elements such as substructure, roof, windows and finishes seemed uninfluenced."

Excerpt from conclusion:

"Alternatives to tall buildings should be sought, but where unavoidable, measures to reduce the size of the building, reduce the intensity of material usage (especially energy intensive and

nonrenewable materials) and to minimise wastage should be fully explored."

Gifford, Robert (2007). “The Consequences of Living in High-Rise Buildings.” Architectural Science Review 02/2007; 50(1):2-17. DOI: 10.3763/asre.2007.5002

Abstract:

A full account of architectural science must include empirical findings about the social and psychological influences that buildings have on their occupants. Tall residential buildings can have a myriad of such effects. This review summarizes the results of research on the influences of high-rise buildings on residents' experiences of the building, satisfaction, preferences, social behavior, crime and fear of crime, children, mental health and suicide. Most conclusions are tempered by moderating factors, including residential socioeconomic status, neighborhood quality, parenting, gender, stage of life, indoor density, and the ability to choose a housing form. However, moderators aside, **the literature suggests that high-rises are less satisfactory than other housing forms for most people, that they are not optimal for children, that social relations are more impersonal and helping behavior is less than in other housing forms, that crime and fear of crime are greater, and that they may independently account for some suicides**.

Kunze, J. (2005) “The Revival of High-rise Living in the UK and Issues of Cost and Revenue in Relation to Height.” Masters thesis, UCL (University College London).

Abstract:

"The following report explores the recent revival of tall residential buildings in the UK as well as issues of costs and revenues for such projects. The first part of the paper focuses on the background and the preconditions of the revival. The history of tall residential buildings and its impact on the image of highrise living is explored as well as some of the debate that surrounds the topic. However, the vast amount of related social, urban design and environmental issues are not part of the analysis. The phenomenon of the revival is described in numbers of completed buildings and with examples of built and proposed projects. Characteristics like the new type of occupiers and the provision of affordable housing are highlighted. The second part of the report and the main part of the research focus on the economic drivers behind tall residential developments. The issues of building costs and sales prices in relation to height are explored and values are gathered in several interviews with professionals. The findings are analysed and applied in a series of model calculations for developments with heights from 5-50 storeys. It seems that the disadvantages of building high are not balanced out by a premium in sales prices for height. **The evidence found suggests that the economics of tall residential buildings change dramatically above 20 storeys.** This corresponds with the height of structures that were built in recent years. However, the paper concludes that the data available was not sufficient to establish robust quantitative relationships between residential developments of different heights and that it is necessary for the benefit of all that more research on this topic is made publicly available."

Buchanan Peter (2007). “The Tower: An Anachronism Awaiting Rebirth?”
Harvard Design Magazine: "New Skyscrapers in Megacities on a Warming Globe"
Number 26, Spring/Summer 2007

Excerpt:

"Is the tall building an anachronism? Does it, like sprawling suburbia and out-of-town shopping malls, seem doomed to belong only to what is increasingly referred to as "the oil interval," that now fading and historically brief moment when easily extracted oil was abundant and cheap? The answer is probably "Yes"....

" ... What kind of city nurtures [today's] very different workforce that is in touch with and wants to live in accord with its deeper values? Ask people how they believe they should really live; the clearer they become about this, the more obvious it is that such a lifestyle is very difficult in the contemporary city. Do we want to live in a city of glistening towers, of spectacle and the restless excitement that fuels and is fuelled by excessive consumption? Or would we prefer a mid-rise city with a more finely grained, more intricately rich and varied urban fabric offering choice, contrast, respite, and surprise - a convivial city where community has a chance of being reestablished? **Sustainability requires not only that we lessen our ecological impacts, but also that we create the urban and cultural frameworks in which we can attain full humanity, in contact with self, others, and nature. This might be the real reason that the tower seems an anachronism.** There may be a few clusters of green towers here and there, but their presence might be limited in the compact and convivial cities of the future."

Bowker, G. E., D. Heist, S. G. Perry, L. Brixey, R. S. Thompson and R. W. Wiener (2006). "The Influence of a Tall Building on Street-Canyon Flow in an Urban Neighborhood. U.S. EPA Office of Research and Development, National Exposure Research Lab. Presented at 28th NATO/CCMS International Technical Meeting, Leipzig, Germany, May, 2006.

Mead, M. Nathaniel (2008). "Canyons Up the Pollution Ante" Environmental Health Perspectives, July 2008; Vol. 116, No. 7, p. A28.

Excerpt:

" … a new study focuses on how traffic emissions are dispersed within urban street canyons -- **streets that are lined with tall buildings on both sides. Within these domains, large quantities of pollutants are released near the ground from motor vehicle exhaust, then trapped and concentrated within the canyon walls.** Urban street canyons also tend to contain a lot of people, potentially making these areas high-risk zones for big cities. … population exposure to traffic pollutants in New York's urban street canyons can be up to 1,000 times higher than exposure to a similar amount of emissions in other urban settings."

House of Commons (2001). "Tall buildings: Report and Proceedings of the House of Commons Transport, Local Government and the Regions Committee." Sixteenth report of Session 2001-02. London, UK Stationery Office, 4 September 2002, HC 482-I

Excerpt:

"The main reason that the Committee held an inquiry into tall buildings was to identify the contribution which they can make to the urban renaissance. We found that contribution to be very limited. **The proposition that tall buildings are necessary to prevent suburban sprawl is impossible to sustain. They do not necessarily achieve higher densities than mid or low-rise development and in some cases are a less-efficient use of space than alternatives.** They have, for the most part, the advantages and disadvantages of other high density buildings. They can be energy-efficient, they can be part of mixed-use schemes and they can encourage the use of public

transport where there is spare capacity, but so can other types of high density developments. Tall buildings are more often about power, prestige, status and aesthetics than efficient development."

APPENDIX II:

RELEVANT EXAMPLES FROM RESEARCH ON DIVERGENCE OF ARCHITECTS' AND LAYPERSONS' AESTHETIC JUDGMENT

Brown, G., & Gifford, R. (2001). Architects predict lay evaluations of large contemporary buildings: whose conceptual properties?. Journal of Environmental Psychology, 21(1), 93-99.

Abstract

Evidence suggests that architects as a group cannot predict the public's aesthetic evaluations of architecture. In this study, practicing architects predicted laypersons' responses to large contemporary building, and again these predictions were poorly correlated with ratings by laypersons, although some architects' predictions were better than others, and architects were able to predict accurately that lay ratings in general would be more favourable than their own. To understand why most architects are unable to predict reactions to particular buildings, the architects' predictions were analysed in relation to their own and lay ratings of the buildings' conceptual properties. **The results suggest that architects are unable to exchange their own criteria for conceptual properties for those of laypersons when they predict public evaluations, which leads to self-anchored, inaccurate predictions.** This was supported by showing that the best-predicting architects related their evaluations to buildings' conceptual properties in a manner similar to that of the laypersons. Implications for design are suggested.

Ghomeshi, M., Nikpour, M., & Jusan, M. M. (2012). Evaluation of Conceptual Properties by Layperson in Residential Façade Designs. Arts and Design Studies, 3, 13-17.

Abstract

When it comes to aesthetic evaluation of a design, architects and non-architects differ from each other. This study demonstrates how aesthetic evaluation of buildings could be predicted. These predictions are important for architects as they can be used to find the users preferences and expectations of the design. Preference is considered to involve conceptual evaluation about whether the design is liked or disliked. In environmental preference, this type of conceptual evaluation might be conscious or unconscious. The aim of this study is to identify the essential conceptual properties that are related to aesthetic evaluation of façade designs using qualitative methodology. As a result it can be concluded that not all the conceptual properties are related to aesthetic evaluation of the design. Some conceptual properties are not important from the eye of non-architects and some are highly important. Findings of this research could help architects to understand the perception of non-architects.

Hubbard, P. (1984). Diverging evaluations of the built environment: Planners versus the public. The urban experience: A people–environment perspective, 125-133.

Hubbard, P. (1996). Conflicting interpretations of architecture: an empirical investigation. Journal of Environmental Psychology, 16(2), 75-92.

Abstract

The idea that environmental preferences are not solely determined by the characteristics of individuals, but instead are socially constituted, has fundamentally challenged many traditional

psychological analyses of landscape preference and meaning. In this paper, an attempt is made to suggest that the two interpretations are by no means incompatible, and that there is a growing need for an environmental psychology that recognizes the importance of both individual and social factors. Drawing on traditions within European social psychology, this paper demonstrates how the quantitative analysis of social representations can be used to identify both differences and commonalities in peoples' interpretations of architecture. Specifically, **this study reports on one segment of a larger empirical study investigating differences in architectural interpretation between planners, planning students and public respondents.** These interpretations were examined using multiple sorting techniques, with respondents asked to sort 15 examples of contemporary architecture according to their own criteria. INDSCAL analysis of this data facilitated the recognition of a shared conceptualization of these architectural stimuli, but also demonstrated a number of important inter-group and inter-individual differences in architectural interpretation, which were evident as variations from this common conceptualization. The paper concludes by discussing the implications of this study for research in environmental psychology, particularly stressing the need to consider notions of power and ideology.

Trope, Y., Liberman, N., & Wakslak, C. (2007). “Construal levels and psychological distance: Effects on representation, prediction, evaluation, and behavior.” *Journal of Consumer Psychology:* the official journal of the Society for Consumer Psychology, 17(2), 83.

APPENDIX III

RELEVANT EXMPLES FROM RESEARCH ON ECONOMIC DEVELOPMENT, REAL ESTATE AND URBAN FORM

Jacobs, J. (1961). *The Death and Life of Great American Cities.* New York: Random House.

Jacobs, J. (1970) *The Economy of Cities.* New York: Vintage Press.

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., & Shleifer, A. (1991). *Growth in Cities* (No. w3787). National Bureau of Economic Research.

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(TBC)