Contents

Introduction

"Moreover, modern housing provides certain minimum amenities for every dwelling: cross-ventilation, for one thing; sunlight, quiet, and a pleasant outlook from every window."

—Catherine Bauer, *Modern Housing*

Nearly ninety years after housing advocate Catherine Bauer penned that line in *Modern Housing*, I have begun to think it may have been one of the most prescient in her book. The way housing and neighborhoods are built in the United States today is a radical departure, one where dwellings often do not have sunlight, are not quiet, do not have pleasant outlooks, and do not have the ability to cross-ventilate. This departure begins with something as simple and mundane as requirements for multiple stairs and a corridor connecting them, a requirement rarely found for most urban housing the world over. It ends with new districts oriented around transit with little affordable housing, poorly planned urban realms that are incredibly autocentric in the very types of places they shouldn't be. The disparity in resulting outcomes could not be more significant. Our regulations result in housing that is less livable, less climate adaptive, and less family-friendly, and with a much lower quality of life.

As a practicing architect, I never considered that our building and planning codes could be detrimental to addressing the very things I have been focused on from a personal and professional standpoint: livable cities, building decarbonization, and climate adaptation. After numerous years researching building codes and their effects on buildings, and spending a few years working in Germany, I believe that we could vastly improve the way buildings and neighborhoods are planned in the United States and Canada to be more livable and adaptive to a changing climate by rethinking how we plan and regulate our buildings to be thinner and more family friendly. I believe that our own processes and approaches leave little opportunity to achieve the types of neighborhoods that planners, politicians, and architects flock

to when abroad. But I am hopeful this book can provide an insight into the potential that development approaches and models found outside the United States, such as ecodistricts, can offer.

The United Nations predicts that nearly 70 percent of the global population will live in cities and urbanized areas in 2050. In my own city, Seattle, a recent Microsoft report stated we had a housing deficit of 194,000 homes. Recent estimates from Freddie Mac showed a national housing shortage of 3.8 million homes. We have growing housing affordability crises across nearly all economic spectra. In 2023, Canada had its first year with a population increase exceeding one million residents, and its population is expected to double in less than twenty-five years. That is an incredible amount of housing that needs to be built. How and where it will be built will have a sizable effect on carbon emissions. Will we choose to build dense, livable, low-carbon ecodistricts? Or will we see massive amounts of carbon lock-in with continued patterns of unsustainable sprawl?

Many of the topics in recent housing discourse—office-to-residential conversions, micro units, windowless bedrooms, missing middle housing—are largely a reaction to a century of incredibly poor building and land use regulation, including exclusionary zoning that banned all forms of collective housing. With the rise in postpandemic work from home, office-to-residential conversions are being explored as a way to correct decades of a poor mix of uses in downtown cores. However, because of cheap energy and a lack of daylighting requirements, modern office buildings have incredibly deep floor plates, making it difficult to get functional apartments and incredibly expensive to rehabilitate them. Windowless bedrooms are a function of a building code in much of the United States that allows them (although many countries, and cities such as New York and San Francisco do not), yielding deep, bowling-lane-shaped single-aspect dwellings that have windows on only one side. Micro units are a means of getting more dwellings that are slightly less expensive to rent in buildings that are significantly larger in virtually any metric (e.g., floor area, density, volume) than in peer countries. Much of the land area of US cities is filled with detached houses, a function of a century of exclusionary zoning.

That lack of flexibility, of poor foresight, can be found in numerous aspects of US and Canadian cities. In sprawling suburbs where development patterns and street layouts severely constrain walkability or mobility. In poorly zoned neighborhoods that do not have much, if any, economic and social mix of residents. In transit-oriented density (TOD) that is incredibly autocentric, loud, and offering a poorer quality of life than it should.

Aerial photo of Sonnwendviertel in Vienna, a 77-acre car-light ecodistrict planned for 13,000 residents and 20,000 jobs. (Credit: Christian Fürthner)

Over the last decade, I have been grappling with a number of questions about how urban environments can be transformed to be more inclusive and affordable and to do so in a way that offers a high quality of life while being adaptive to a changing climate. In this search, I have come to realize that there are underlying aspects to *how* we plan, dictated by codes and standards and affecting myriad issues in unseen ways. Part of my work at Larch Lab has been to highlight what these differences are, working with legislators, housing advocates, architects, and planners to advocate for changes to allow for better buildings. Our current paradigm not only affects the *types* of housing we can build but the *quality* of that housing. During a presentation in New Zealand, a colleague commented that even if one were to visit new urban districts in other countries, such as Vauban or Vienna's Sonnwendviertel, it would be really difficult to get a sense of how interconnected things are because the underlying codes are not readily grasped. They compared this with visiting Ghent, Belgium, which has seen a dramatic mobility transition, and seeing or understanding the dimensions and configurations of transformed streets or bicycle lanes. It is virtually impossible to experience

the Circulation Plan that redirects traffic around the city center and induces the use of more sustainable modes of transportation.

In a sense, this book is intended as a way of seeing how these things are all connected: climate adaptation, buildings, livable neighborhoods, decarbonization, sustainable mobility, public health, and quality of life. Of understanding and overcoming how our own regulations and processes can prevent and stifle the very places the planning profession, developers, and politicians claim they want to create. It captures the answers to many of the fundamental questions that I have asked over the many years of working on creating more livable, affordable, low-carbon cities.

What would it be like to live in a car-light or car-free neighborhood? Why does American TOD look nothing like European TOD? What could climate adaptive neighborhoods look like? What if we had more options for housing beyond the binary of rented apartments and owned houses and townhomes? Can neighborhoods become carbon sinks?

This book will help clarify how the processes, regulations, and prioritization of public health and quality of life work together to create livable, low-carbon communities. It is divided into four sections: planning the ecodistrict, quality of life and public health, climate adaptation and nature, and building decarbonization. This manual is intended for both new and existing neighborhood retrofits and building-level construction. I bring together a number of topics to show that not only is it possible to build better housing and neighborhoods, but it is imperative. We can build better housing. We can build up community. We can build places able to withstand the worsening effects of climate change. We can provide affordable housing in urban areas for families and workers. We can make space for jobs. As cities pivot postpandemic to address both systemic housing shortages and a worsening climate crisis, scale and flexibility will become paramount to addressing both of these issues simultaneously. But we cannot wait; it is time to deliver.

CHAPTER 1

The Compact, Climate Adaptive Ecodistrict

"We must shift our thinking away from short-term gain toward long-term investment and sustainability, and always have the next generations in mind with every decision we make."

—Deb Haaland, Secretary, US Department of Interior

We, as a species, have to learn to think differently.

The ongoing and devastating events of the polycrisis[1] are interwoven and interconnected in frightening ways: the lingering effects of COVID, a worsening affordable housing shortage, a social isolation and loneliness crisis,[2] climate change, and more. The postwar patterns of development in the United States, with sprawl being omnipresent among them, have in many ways exacerbated these crises.

What if cities prioritized climate adaptive neighborhoods with abundant affordable housing, open space, and people-centered places, offering a high quality of life, with good jobs and the ability to adapt to a changing climate? Neighborhoods focused on high-quality living, with the daily amenities that can be accessed without cars? Places that are lush with gardens, courtyards, playgrounds? Districts that are multigenerational, child friendly, and even quiet? In many European and Asian cities these are exactly the types of places being developed. Cervero and Sullivan call this green transit-oriented development (TOD),[3] but I prefer the term *ecodistricts*, short for *ecologically oriented districts*. Ecodistricts offer the possibility of broadly addressing the polycrisis: neighborhoods of respite and adaptation to a changing climate. Places that are community oriented and social, to blunt the effects of the social isolation crisis. Places where a broad mix of housing types and tenures allows for a broad mix of residents, addressing the growing housing crises affecting our cities. The Organisation for Economic Co-operation and Development defines the eco-neighborhood as "an urban neighbourhood

designed to have minimal environmental impact by achieving sustainable resource management of energy, water and waste; dense and mixed-use development; and less automobile dependency supported by public transport systems, walking and biking."[4]

The eco-city and eco-neighborhood concepts have been a growing global phenomenon, with several realized and planned projects since the 2000s.[5] There is abundant potential for these types of places to be built and retrofitted in US and Canadian cities and suburbs, learning from the exemplary districts happening around the world.

Freiburg's Vauban and Malmö's Bo01 are oft-cited examples. In Freiburg, I saw what is possible in redeveloping brownfields into socially mixed, ecologically focused urban districts. Brownfield development is critical, because cities already have ample room to develop, repair, and reconnect without building new cities in greenfields disconnected from existing infrastructure. Hamburg might have the best motto to highlight this approach: "Mehr Stadt in der Stadt" ("More city within the city"). They have designated 80 percent of new development to be located in the city, rather than in greenfields outside the existing built-up area.[6]

France requires ecological urban development primarily on brownfields with its ÉcoQuartier (Écologique, "ecological," and *Quartier*, "district") label, which passed into law in 2012. The French Ministry of Ecological Transition defines an ÉcoQuartier as "a development project that integrates the issues and principles of the city and sustainable territories."[7] The ÉcoQuartier label is used in numerous cities and villages across France, across a variety of scales, from a hundred homes all the way up to several thousand. Proximity and diversity of functions, participatory planning, and social inclusion are all central to the label's scoring.

There has been a push for ecodistricts in the United States, with the Portland-based nonprofit EcoDistricts that developed the Protocols, a program designed for "a new model of urban regeneration to empower just, resilient, sustainable neighborhoods for all."[8] The organization was founded to bring best practices to the neighborhood and district scales with a focus on equity, resilience, and climate protection. It has focused largely on the incremental regeneration of existing urban neighborhoods, in contrast to Europe, which tends to focus on new or redeveloped neighborhoods. Rehabilitating existing neighborhoods to be more climate adaptive and equitable is significantly more difficult, and although it is not the focus of this book, it is incredibly important. Seattle's Capitol Hill Ecodistrict was the first certified ecodistrict in that Pacific Northwest,[9] which had largely been achieved in an existing dense, vibrant neighborhood. In 2021, EcoDistricts was incorporated into the Partnership for Southern Equity, with the program renamed Just Communities.[10]

Small-Scale Urban Development

Aurora Avenue, a state highway bisecting Seattle, with development capacity for nearly 100,000 homes. (Credit: Michael Eliason)

There is a lack of granularity in US development today that is found in the historical patterns of development. Blocks in historic neighborhoods contain multiple different parcels, often with different owners. As those blocks are redeveloped and reintensified, small-scale projects are no longer possible, and parcel assemblage is required. Small-scale urban development in

the United States is really limited to buildings of three stories or less. As described in Chapter 6, this is primarily due to building codes, planning codes, and finance regimes that in effect require significantly larger and deeper buildings. However, this is not the case for new development in many other countries, as their planning allows for small, fine-grained development that can be used in both new and historic neighborhoods. One city that does this really well is Freiburg.

Although this book focuses on larger developments, these concepts and strategies can be used in smaller ones as well.

Currently, Freiburg is planning a new ecodistrict on the periphery of the city, called Dietenbach. Dietenbach is split into separate quarters, each containing several semipermeable perimeter blocks. The city is specifically aiming for *staedtebaulichen Kleinteiligkeit*, or small-scale urban development at the block level. The city is doing this for a number of reasons but primarily "in order to generate varied and lively building structures, which also enable mixture of different uses & have a high degree of adaptability to future structural changes." They are specifically aiming to avoid the banality of large post-war estates or contemporary development, in order to allow a more mixed, vibrant, and varied streetscape.[11]

Top left: Courtyard path through a semi-permeable perimeter block in Freiburg's Rieselfeld district. (Credit: Payton Chung)

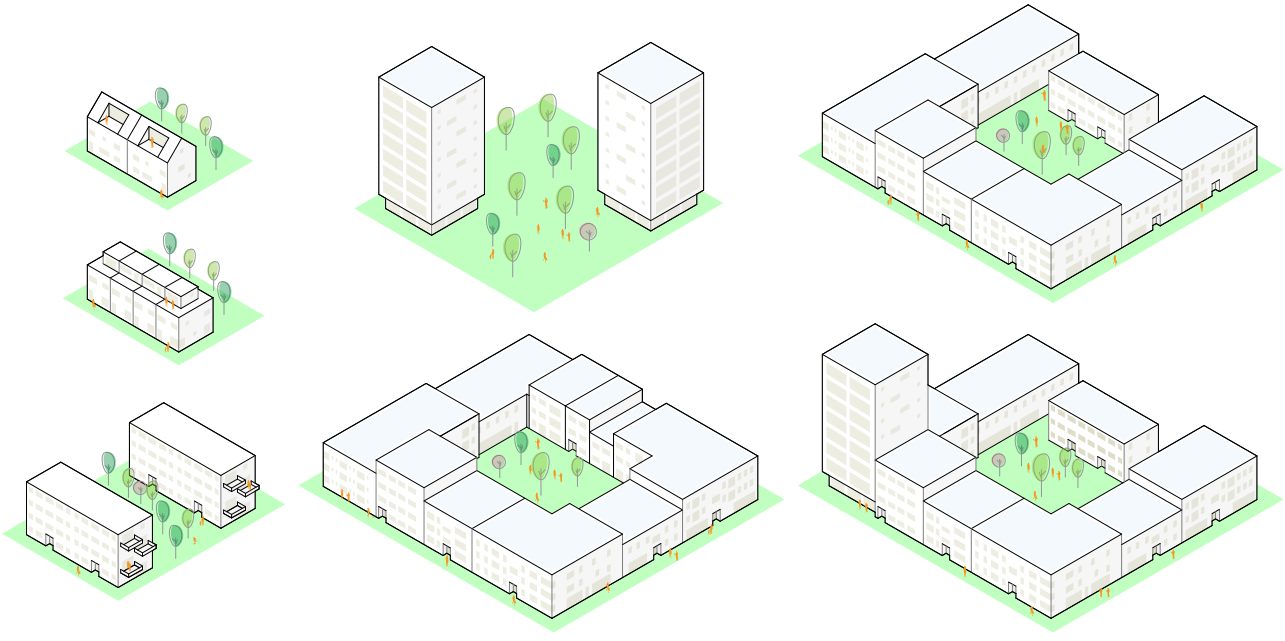
Left: Aerial photo of Freiburg's Rieselfeld district, showing how thin buildings allow for massive private and semi-public courtyards. (Credit: Volker Jung)

Right: Historic pattern of development in Landshut, Germany, reflecting small scale walkable urbanism (Credit: Michael Eliason)

Building on the experience of previous neighborhoods, proposed regulations in Dietenbach would induce a diverse and mixed district, even at the block level. Blocks would be composed of different-sized parcels, generally a minimum of eight, although several would have more. In order to ensure a broad variety of housing types and tenures, each block would contain four of six different housing types on the Development Framework Plan. These housing types are attached small-plexes, four-plexes with stacked flats, small apartment buildings of five to eight dwellings, medium apartment buildings

Regulations that allow small scale urban development allow for a greater economic and social mix at the block level, versus one or two massive buildings as is typical in the US. (Credit: Michael Eliason/ Larch Lab)

with ten to twenty dwellings, and large apartments of more than thirty dwellings. This typological and ownership mix would ensure a broad economic and social mix of residents, rare in US development. Developers would also be limited to a maximum of forty dwellings per block, on at most two parcels per block.[12] This would enable a broad diversity of tenure at the block level, as well as housing including apartments, condos, social housing, cooperatives, and Baugruppen (German for "building group," self-developed urban housing similar to cohousing). Instead of a development trying to look like several smaller ones through modulation or a messy material mix, the development would be separate buildings. This is exactly as we used to build in US cities but forgot along the way.

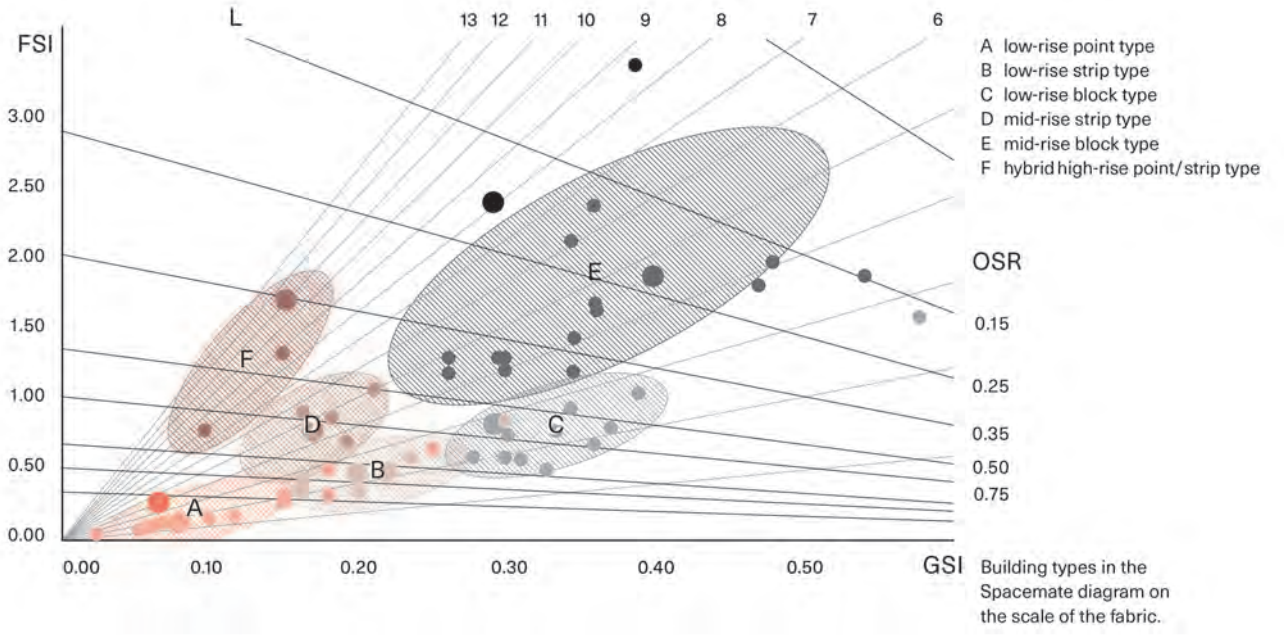


Building regulations play a strong role in the production and variety of building forms including semi-detached houses, rowhouses, slab buildings (zeilenbauten), perimeter blocks, point towers (punkthaeuser), or hybrids of these. (Credit: Michael Eliason/Larch Lab)

On Form

Ecodistricts come in a variety of scales, from small settlements of a few acres with a hundred homes to massive projects such as Dietenbach or Hamburg's Oberbillwerder, planning for 7,000 homes on 292 acres. The urban form can range from almost pastoral to incredibly dense, with towers and midrise buildings spanning for blocks, up to a half mile from a transit station.

Pound for pound, the midrise building of four to eight stories is one of the most effective and appropriate for compact, walkable development. An analysis by the City of Berlin found that buildings containing five stories, including an inhabited attic, had virtually the same residential density as buildings greater than ten stories.



Building types in the Spacemate diagram on the scale of the fabric.

The form of development at the block level also plays a role in urban character, density, and climate adaptability. The dense urban perimeter blocks found in the historic cores of cities such as Paris, Vienna, and Amsterdam allow for an incredible amount of density without much height. Alternatively, the urban form of Hong Kong or Singapore's towers allows for a significant amount of density over very little land but may not be the most resilient, as climate-change-induced events such as wildfires or heat events result in power outages that prevent elevator usage. US land use codes generally only look at floor area ratio (FAR), the ratio of the allowed building area on a given site divided by the site area. There are numerous other issues that can be considered, such as lot coverage (the percentage of lot occupied by building).

When it comes to urban form, there are several options, although in the United States they tend to not play a role in urban planning. These are detached buildings, rowhouses, slab buildings, perimeter blocks, and towers in the park—and then there are hybrids combining aspects of these. The urban housing types all have a different character to them, but the perimeter block is one with the most character. It also provides for much more open space, density, and interesting opportunities for mixed-use urbanity.

Spacemate is a visualization tool for understanding the relationships between density, open space, and urban form developed by Meta Berghauser Pont and Per Haupt that looks at FAR, lot coverage, the number of floors, the

The Spacemate is a matrix designed to help visualize the connections between open space, Floor Area Ratio (FSI), and building height (L) at the block level. Midrise blocks stand out as the superfruit of walkable urbanism, allowing for optimal levels of proximity, open space, and density. (Credit: Meta Burghauser Pont)

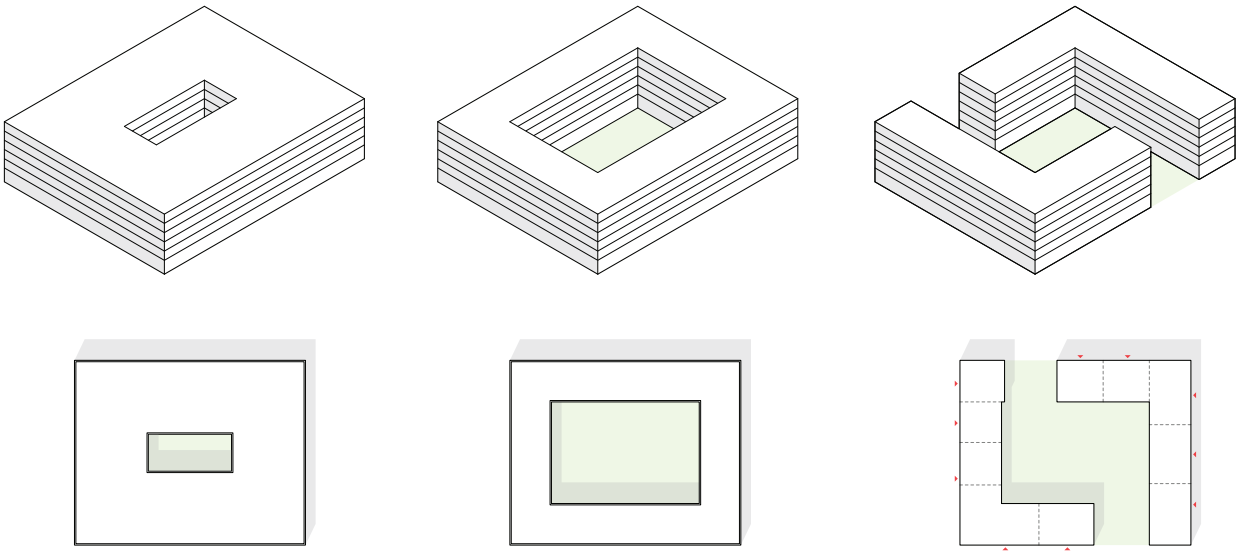


Diagram comparing amount of open or green space the typical US perimeter block with an 80-foot-deep double loaded corridor (left), a closed European style perimeter block with a 45-foot-deep floor plate (middle), and a semi-permeable perimeter block with varied building depths up to 45 feet (right). (Credit: Michael Eliason/Larch Lab)

amount of open space at ground level, and network effects.[13] When I first saw this diagram in 2009, I could not get my head around why perimeter blocks and super blocks scored so much better than high rises, and then it hit me: It was the compactness *paired* with open space. It took me a few more years to realize that the increase in open space was directly related to thinner buildings, with more stories than typical in the United States, but this was just part of the picture. The key was figuring out what enabled the buildings to be thinner in the first place; as described in Chapter 5, this key is point access blocks.

The perimeter block composed of thin and tall buildings is ideally situated for compact urban development. It allows for a high degree of livability, dwellings with views and daylight on multiple sides, family-sized homes, and larger courtyards to congregate in and mitigate urban heat islands and stormwater. The perimeter block allows more dwellings to have good solar access while allowing for moderate levels of privacy. It orients buildings to the street and quieter courtyard, as opposed to neighbors a few feet away. It has better daylight exposure than most other urban types as well.[14] Because of its compact nature, it also tends to have a lower heating demand than other building forms, which tends to decrease with building height.[15]

More restricted airflow is a noted negative effect, but a solution to this that I rather like is the semipermeable perimeter block. A semipermeable perimeter block includes gaps that increase daylight, airflow, and views. Airflow is going to become a larger issue in dealing with overheating from climate change, so allowing for some level of permeability will be increasingly important.

Height is often a point of contention in development in US cities. The four- to eight-story block structure allows for a wide variety of housing and tenure types and an optimal level of density for walkability. However, mixing in the occasional taller building or tower can help balance out more density and provide accent points within the district. Variability in height not only is visually interesting but allows for increased views and daylight over conventional perimeter blocks.[16] It is also something better achieved with small-scale urban development, as opposed to massive block-sized projects. Skyscrapers in the mix can also work, but when it comes to climate adaptability and resilience and issues of embodied carbon, they score low on these metrics.

Toward Compact, Integrated Ecodistricts

The integrally planned ecodistrict will have an abundance of open and green space, future-oriented mobility, and climate adaptation measures to allow a good life in economically and socially mixed neighborhoods. In aiming for livable, low-carbon districts, it is imperative that the whole is greater than the sum of its parts, and the parts are arranged through a climate lens. Livability is related not only to climate adaptation but to public health and quality of life. The ecodistrict should offer a quality of life as high as, if not higher than, that found in detached houses. Canadian urban planner Brent Toderian notes that cities should "be unashamed to have a consistently high urban design standard."[17] These are fundamentally human-scaled places, with a good mix of uses and necessities of life within reach. Cities that adopt these measures will set an example that urban expansion and contraction can be livable, sustainable, and more affordable than today's inequitable status quo. The opportunities in the compact, climate adaptive ecodistrict are numerous and include the following:

- a functional mix of uses, community spaces, schools, shops, grocery stores, cafes, restaurants, and other amenities needed for daily life (Chapters 6, 9, and 10);
- the productive city, including space for work such as office spaces, workshops, co-working spaces, and even space for industry (Chapter 3);
- energy efficiency, carbon emission accounting, energy flows, and water flows to enable efficient, low-carbon living (Chapters 4, 15, 16, and 18);
- space for living and working in places that are more adaptable to the extreme and unpredictable weather events associated with climate change (Chapters 5, 15 and 17);
- more future-proof and flexible ways of building, with new low-carbon

technologies that result in better, more durable, and more livable homes (Chapters 18, 19, and 20);

- a broad array of housing, for more inclusivity and affordability, with new forms of living (Chapters 9, 11 and 12);
- car-light living encouraged by the prioritization of sustainable mobility and a high-quality public realm (Chapters 8 and 10);
- better public health outcomes, due to reductions in air and noise pollution (Chapter 13);
- innovative, inclusive, and future-oriented forms of co-participation and planning procedures (Chapters 6 and 7).

Pivoting toward the future of sustainable urban development, cities need to prioritize livable, climate adaptive places offering car-light and car-free living, affordable housing, and much more access to green and open space. The chapters in this book highlight several themes that must be prioritized to make these places a reality. Although this book is intended for compact urban development, the concepts and ideas found within are just as applicable to suburban districts, as well as individual buildings, both new and adapted. Architects, planners, developers, owners, institutions, insurers, and politicians must start thinking about how climate in the future will affect their buildings and how their portfolios can be rapidly adapted to these drastic changes. Our buildings were designed for a climate that no longer exists; the impacts will range from incredibly uncomfortable to increasingly deadly. The sooner we come to terms with this, the sooner we might begin to pivot toward a better and more sustainable future.

CHAPTER 2

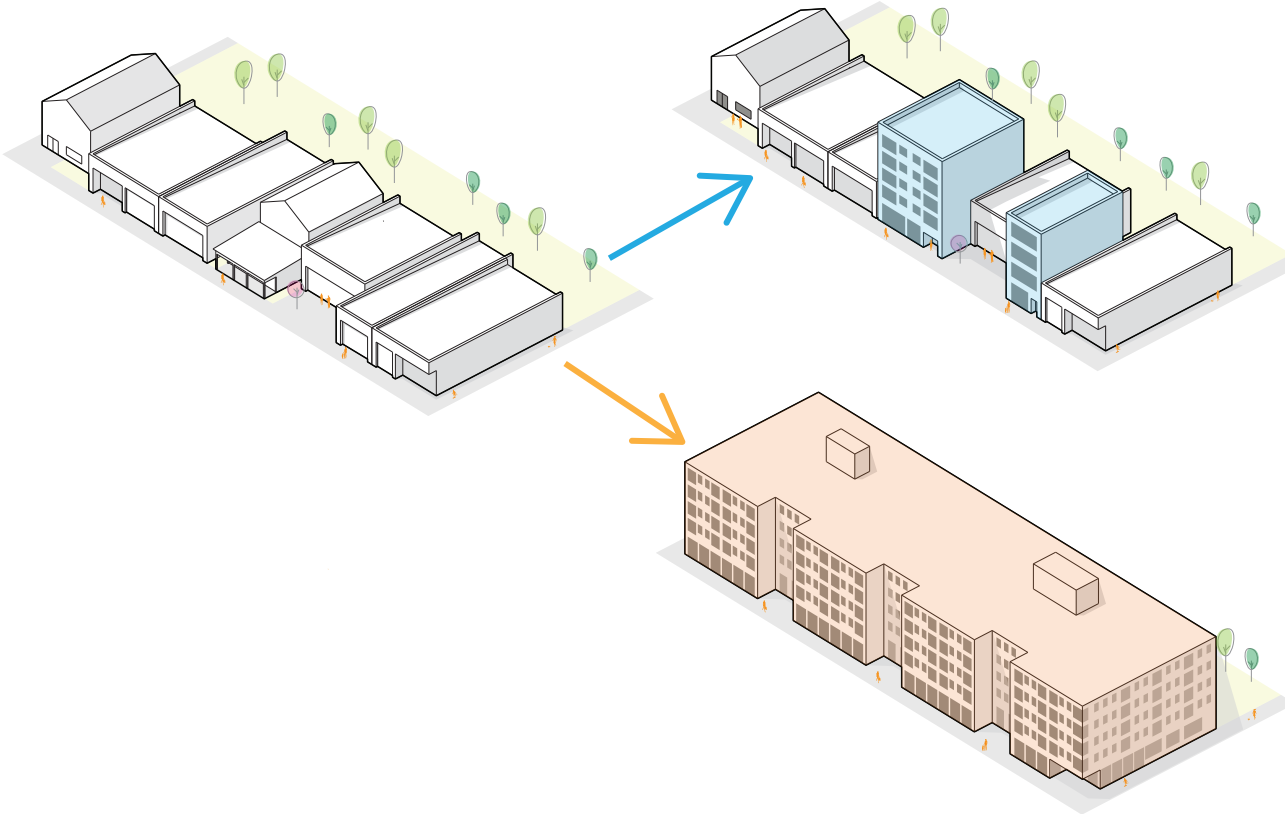
Rethinking Urban Development in the United States

There are effectively two patterns of dense urban development in North American cities, and although both may slightly reduce carbon emissions, neither offers livable, green places. The first is reintensification of areas already zoned for commerce and multifamily housing. Often, this entails upzoning, or increasing the allowed intensity of development, on sites that largely already have existing housing or businesses. These repeated cycles of upzoning induce a sort of urban cannibalism, destroying the very places that give a neighborhood a soul, identity, and character. Because of modern building and planning regulations, those existing buildings are replaced with significantly larger ones that often take up much or all of a block. These rezoned areas typically are found along major arterials and highways, which are also some of the most toxic places found in cities.[1]

The detrimental effects of this type of development could be lessened if planners and politicians would allow moderate levels of density far off the arterials. Although there is significant demand for walkable neighborhoods like those found in historic US neighborhoods or places such as Mexico City, Tokyo, or Berlin, limiting walkable density to narrow swaths of the city rather than broad areas curtails the character found in those types of neighborhoods. It also ensures that the amenities associated with walkable neighborhoods are largely accessible only to those who can afford to live in or near them. The challenge is that this unhealthy pattern of reintensification on arterials occurs because cities restrict new multifamily housing and urban development in most urban areas. The land area of nearly every US city is overwhelmingly zoned for detached houses.[2] This is slowly changing, as cities and states have realized the existing paradigm is no longer tenable and work to preempt their decades-old codes and processes. The entire west coast has effectively eliminated exclusionary zoning, at least in name, and is slowly adding new forms of housing including missing middle housing. As defined by Opticos Design's Daniel Parolek, missing middle housing is small-scale housing types, from one to three stories, that are compatible with detached single-family homes, such as duplexes, triplexes, rowhouses,

In Seattle, as in most of the United States, dense multifamily development including transit-oriented development (TOD) is largely relegated along noisy and polluted arterials and highways, resulting in low levels of walkability in poor-quality places. (Credit: Luke Gardner)

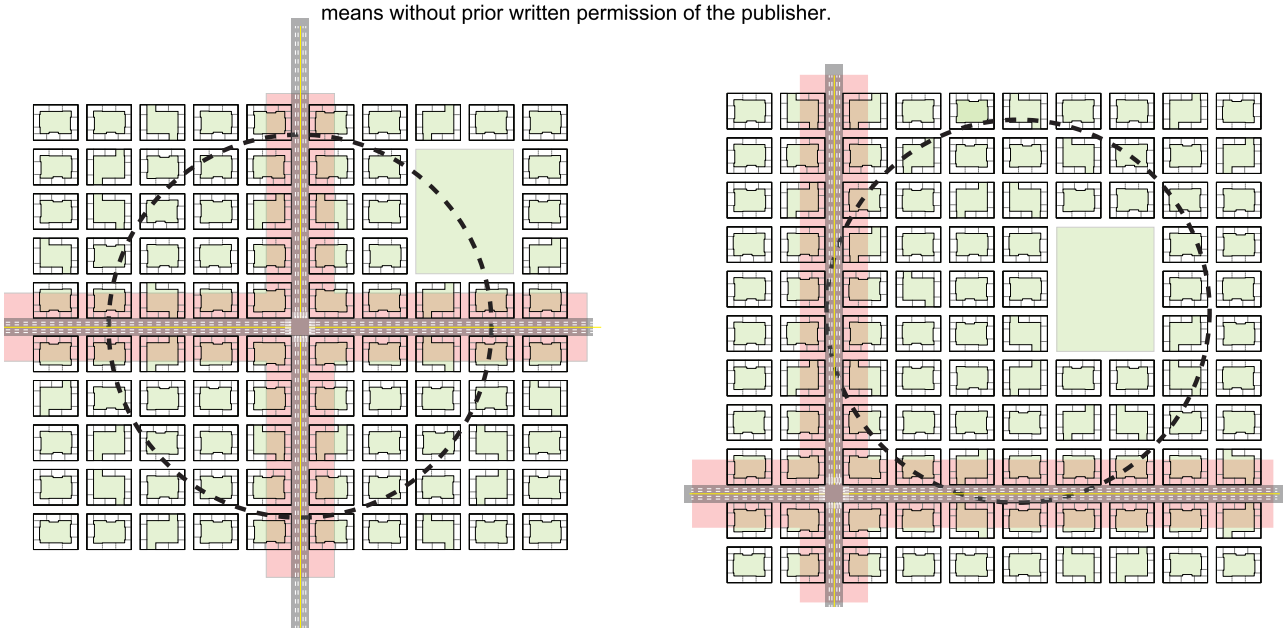
garden court apartments, and live–work buildings.[3] These forms of housing are missing, as they were zoned out of existence for most residentially zoned urban land starting in the 1920s and 1930s.



Building regulations affect development or redevelopment patterns. The US requirement for two or more stairs leads to significantly larger buildings (orange) than in places where point access blocks (blue) and small-scale urban development are allowed. (Credit: Michael Eliason/Larch Lab)

The second development pattern, which has seen an increase in numerous US and Canadian cities, is transit-oriented development (TOD). In 1993, planner Peter Calthorpe coined the term, writing, "The TOD concept is simple: moderate and high-density housing, along with complementary public uses, jobs, retail and services, are concentrated in mixed-use developments at strategic points along the regional transit system."[4] TOD has become a common planning approach in the United States, with the Center for Neighborhood Technology noting there are currently over 6,000 TOD locations built or in planning.[5]

Although TOD in the United States is usually adjacent to transit and may even be walkable, it generally has not prioritized climate adaptive communities to the degree needed. However, this is starting to change, as cities realize that there is demand for places that offer a high quality of life and push the boundaries beyond today's unsustainable status quo. Park space is surprisingly limited in TOD. Most TOD does not have a high level of affordable housing and therefore lacks a broad social and economic mix of residents.



Locating ecodistricts or TOD adjacent to or off arterials, instead of centering on them, allows for higher-quality neighborhoods where fewer residents or businesses are exposed to high levels of air and noise pollution. (Credit: Michael Eliason/Larch Lab)

High-quality public spaces are rare, generally limited to retail-oriented places. There is an opportunity to rethink how existing urban brownfields can be redeveloped to be climate adaptive, affordable ecodistricts with a mix of uses and housing types.

Reassessing Automobility

The goal of TOD should be to facilitate day-to-day living without the need for cars, to allow for high-quality low-carbon living with radical reductions in car usage and associated public health issues. Unfortunately, TOD is still incredibly autocentric, with abundant on- and off-street parking, wide streets, and massive buildings. Research has shown that although TOD reduces vehicle usage rates by as much as 35 percent,[6] it still tends to be overparked, with a 2020 Stark-Portage Area Computer Consortium report noting, "The 'over-parking' of projects near transit probably plays a large part in explaining why some TODs in the U.S. have failed to meet expectations for transit ridership gains and congestion reductions."[7] A recently announced mixed-use TOD project in the suburbs of Salt Lake City, Utah, with a projected 7,400 homes and space for 30,000 jobs, claimed it was aiming for a "15 Minute City." This same district will have space for an eye-popping 40,800 parking spaces.[8] In addition, TOD that is not as walkable and pedestrian oriented as it could be is noted for a decrease in car ownership but an *increase* in ride-hailing,[9] potentially negating the effects of reduced ownership.

Cities sometimes limit TOD to as little as one block off loud, dangerous arterials, which isn't conducive to walkable, livable environments. Open space often feels like an afterthought. "Complete Streets," where road space

is given for all modes while prioritizing none, instead of prioritizing sustainable mobility, are quite frequently implemented.

TOD is not normally designed for families, and even schools may not be walkable from or within a station area. Even if the district is designed for them, children can find it difficult to access parks or playgrounds without having to cross one or more streets. Building codes and development financing result in few family-sized homes. Affordable housing is often relegated to a handful of token projects and rarely to the percentage found near transit in other countries.

Freiburg's Rieselfeld is centered on a tram line with adequate bike connections and traffic-calmed streets, allowing for a much quieter district than TOD focused on arterials. (Credit: Payton Chung)

Quality of Life

The United Nations Weight of Cities report recommends cities to "develop appealing mixed-use and socially mixed inner-city neighbourhoods: These should be attractive and therefore remove the incentive to invest in the urbanization of the suburbs, focusing development instead around high-access 'nodes' of the transport network."[10] In the years that I have been researching ecodistricts and TOD, discussions oriented around the social mix, appealing

Courtyards that offer space for living, as in Stockholm's Hammarby Sjöstad, seem a much better option than parking. (Credit: Alex Linthicum)

places, and a high quality of life are far more prevalent in Europe. The outcomes tend to reflect that focus as well. Part of this difference is related to US building and planning codes that result in less livable buildings. These codes, paired with our construction practices, result in multifamily housing that offers a significantly worse quality of life than single-family houses, whereas this is not necessarily the case in other countries.

In Germany, "Wie wollen wir im Morgen leben?" ("How do we want to live together tomorrow?") is a constant refrain heard around neighborhood development. Co-creation was rooted in the ecodistrict of Vauban's planning and realization. Districts are planned to shield traffic noise, as opposed to being centered on highways or arterials. There is a much broader diversity in housing tenure and type, allowing for a much better economic and social mix of residents. European districts tend to be laden with space for community, nature, and culture. High-quality urban planning is almost always a central focus, and there is significant demand and potential for these same kinds of places in the United States.

Centering Climate Adaptation

Climate change will affect cities and districts in ways they haven't imagined and at intensities far greater than they probably have planned for. A decade ago, seasonal wildfire smoke was not an issue to mitigate. The intensity of cloudbursts and flooding is increasing at almost unbelievable rates. The sealing of surfaces in TOD is incredibly high compared with ecodistricts, in part due to the prioritization of automobiles over people, makes them much more vulnerable to intense heat and rain events. Yet climate adaptive planning in TOD is rarely incorporated to the degree it needs to be.

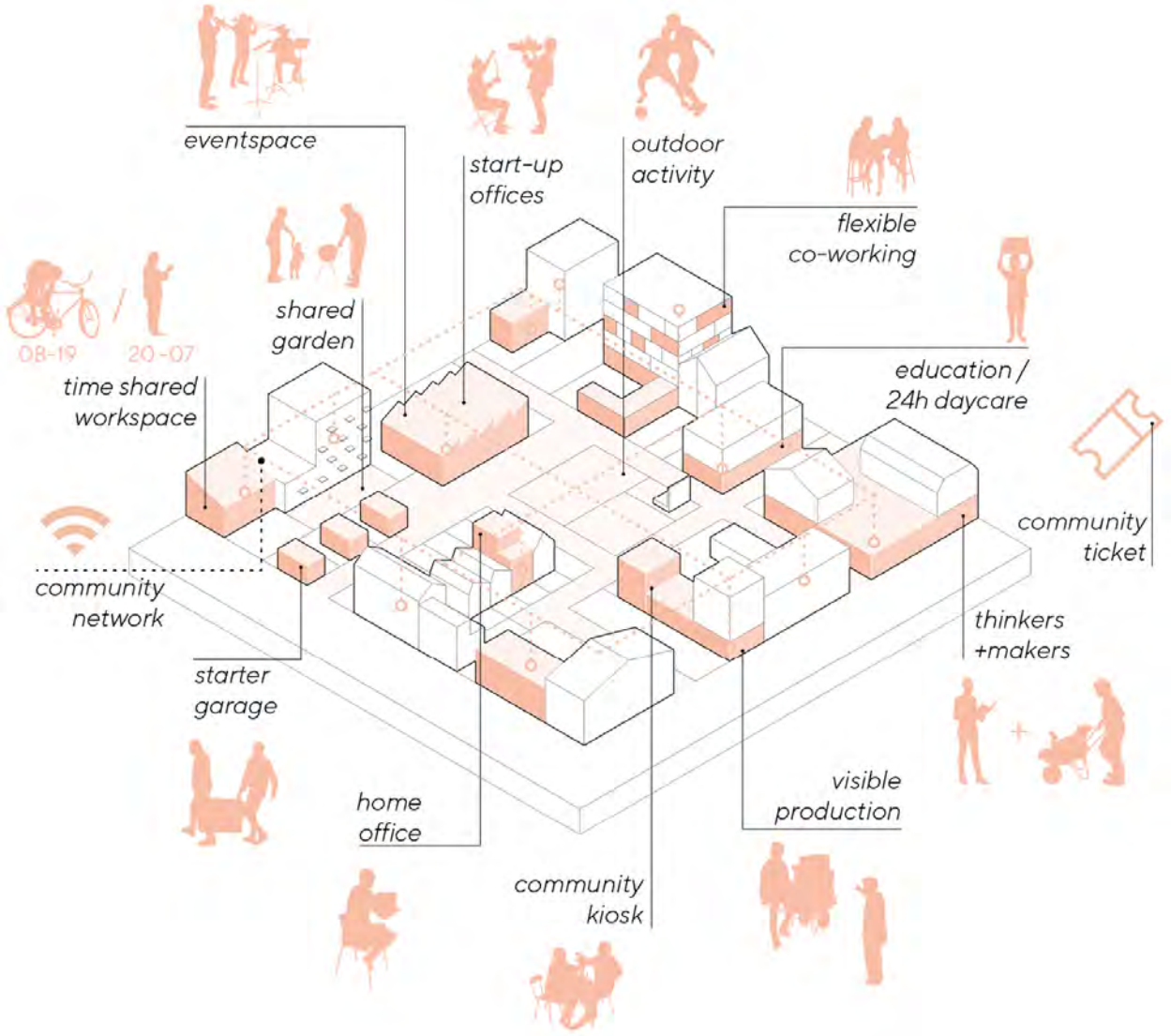
In the context of the 1980s and 1990s, as suburban sprawl was starting to hit the physical limits of continual expansion, TOD may have been an adequate approach. Adding moderate- to high-density neighborhoods near transit is a genuinely smart policy that has taken years of work to overcome a status quo resistant to change. The Institute for Transportation & Development Policy states that TOD is "a critical solution to the unsustainable, car-dependent, and transit-poor urban sprawl that has characterized the growth of cities around the world over the last century. It also contrasts with transit-adjacent development that fails to foster the strong walking and cycling environment needed to complement and actively support the use of public transit."[11] Both transit-adjacent and transit-oriented development *should* be those things! However, in looking at TOD today, through the lens of the polycrisis, it becomes rather clear that the planning of TOD needs a swift and substantial update.

How cities develop will play a major role in whether or not climate goals can be met, with the Intergovernmental Panel on Climate Change Working Group III report noting, "for rapidly growing and emerging urban areas, there is the opportunity to avoid carbon lock-in by focusing on urban form that promotes low-carbon infrastructure and enables low-impact behaviour facilitated by co-located medium to high densities of jobs and housing, walkability, and transit-oriented development."[12] Carbon lock-in occurs when "long-lived, energy and carbon-intensive assets persist, often for decades, and lock out more efficient, lower-carbon alternatives."[13] The path TOD is on in the United States will lock in much more carbon emissions that it should. Ecodistricts offer an opportunity to reverse this unsustainable trend by incorporating dense, climate adaptive neighborhoods with low-carbon technologies where getting groceries or taking the kids to school doesn't require a car, even for larger families.

Seattle's urban planning limits development to as little as a block, or even half a block, off an arterial and immediately falls to detached houses. Not only does this drastically reduce housing options, but it also reduces walkability by focusing it on less enjoyable streets. This is a stark contrast to many European cities, where midrise density exists several blocks off main roads. (Credit: Michael Eliason)

PART I

Planning the Ecodistrict



CHAPTER 3

The Productive District

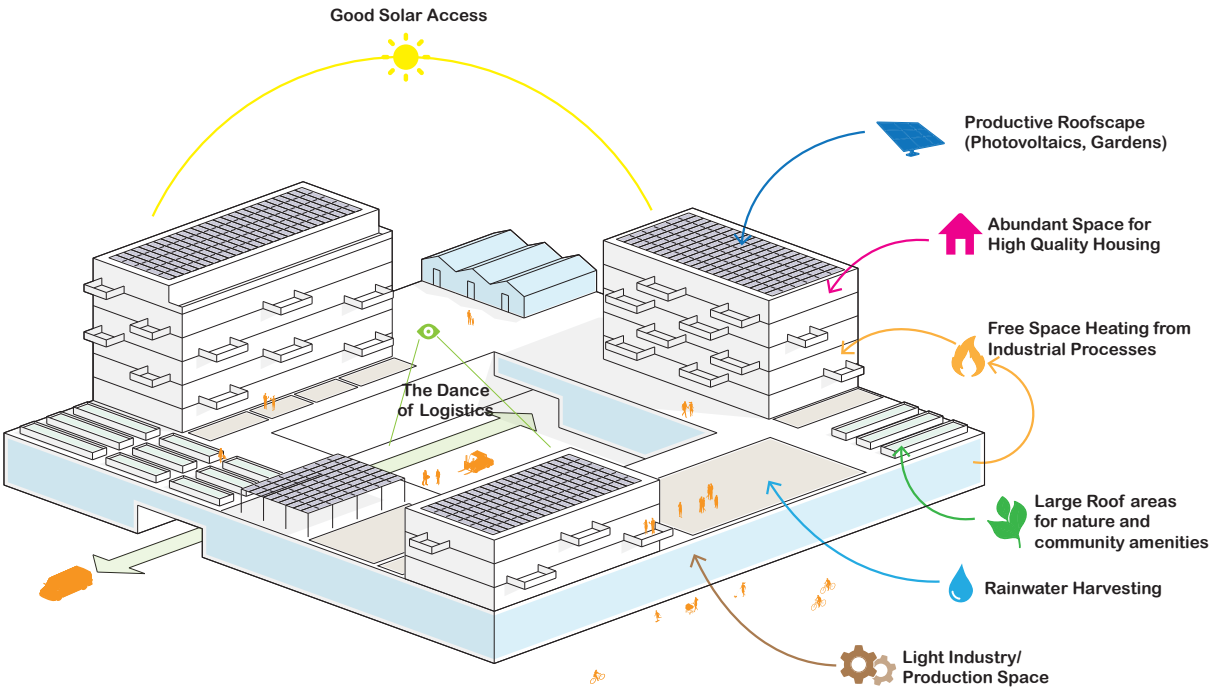
Transitioning away from the monofunctional district, one that is primarily residential or commercial, to a productive mixed-use district with diverse functions is central to the success of car-light and low-carbon ecodistricts. Production in the district can also be used as a means of balancing energy flows for processes to achieve fossil-fuel-free and net zero energy buildings and districts (addressed in Chapter 4).

Manufacturing and production used to be present in the center of the city, and most of the areas currently zoned exclusively for industrial uses in US cities at one point allowed housing and other uses. Intensive mixing of residential and light or nonpolluting industrial uses can be a means of regenerating neighborhoods or districts. The productive city is related to the living milieu, to garage culture, and to vertical urban factories. It is an opportunity to introduce urbanity to existing or obsolete industrial areas. Importantly, as seen in places like Brussels, cities can support productive spaces through innovative leasing, mixed use zoning and microzoning, and prioritization of industry in mixed and residential areas. The productive city can also support a mix of social classes by bringing blue-collar jobs into the city and neighborhoods,[1] in contrast to the economic segregation that is increasingly becoming the norm.

This mixing of uses can take place at the district and even building scale, with hybridized buildings mixing housing and production. There are also opportunities for alternative forms of living, including affordable cluster apartments, workforce housing, and worker cooperatives. The close proximity of residential and light manufacturing does not have to be oppositional; rather, compatible uses can allow for synergies where residents are willing to put up with productive processes and possible noise or other urban nuisances, in exchange for benefits such as free heating, energy production, or large rooftop amenity spaces.

The productive city includes space for a variety of types of production and employment, coexisting with other uses such as dwellings. Even at the block scale, there is ample opportunity for mixing uses and proximity. (Credit: Marc Rieser)

Production can include energy, food and food processes, recycling centers, urban agriculture, and small-scale craft production. Advances in manufacturing



technology (also known as Industry 4.0) have made small-scale manufacturing possible for more people and resulted in a process that is less intrusive, making it easier to mix uses. It is a process that allows for quieter production, less intensive and less polluting production, the incorporation of robotics, and value-added or additive manufacturing. Industry 4.0 could allow industrial and residential uses, which were historically completely incompatible, to have a multitude of synergies while ensuring compatibility in urban districts. According to McKinsey, Industry 4.0 is "the current era of connectivity, advanced analytics, automation, and advanced manufacturing technology that has been transforming global business for years. This wave of change in the manufacturing sector began in the mid-2010s and holds significant potential for operations and the future of production."[2]

The Productive City as Policy Tool

The European Union recognizes that industry and manufacturing are drivers of innovation, research, and productivity—and are largely co-located in metropolitan areas. At the city level, the New Leipzig Charter incorporates the concept of the productive city in order to meet climate goals and prioritize just and sustainable urban development, stating,

> The transformative power of cities is based on a diversified economy which provides jobs while ensuring a sound financial base for sustainable urban development. Cities as attractive, innovative and

The productive city not only brings production back into the city but also allows interesting synergies to coexist between housing and production, such as free heating for residents, ample space for roof gardens, and diverse housing types. (Credit: Michael Eliason/ Larch Lab)

> competitive business locations need a skilled workforce, social, technical and logistical infrastructure as well as affordable and accessible space. Ensuring these preconditions, including a favourable innovative environment as well as opportunities for local and regional production should be integral to urban planning.[3]

Vienna has formally adopted the Produktive Stadt (productive city) in its 2025 Stadtentwicklungsplanung (Urban Development Plan).[4] The city views the integration and mixing of industry and housing as necessary for the long-term success of Vienna and attempts to foster new forms of mixing for more sustainable urban development. The city has also been a frontrunner on vertical factories, co-locating several different manufacturing processes in one structure, such as woodmaking, pharmaceuticals, or food production. These can be incorporated in numerous low-rise and midrise facilities being built around the city.[5]

Brussels has adopted the concept of the productive city in its spatial planning and urban governance policies. Brussels chief architect Kristiaan Borret states,

> It isn't about bringing the steel industry back to the city centre. We should also avoid the romantic fantasy of a return of preindustrial crafts. We are in the century of the "Millennials", and creative industries are highly fashionable. From artisanal fabrication of jewelry to bicycle design, fablabs and even micro-breweries, this type of industry is certainly welcome in town, but there are others too. There has to be room for ordinary occupations, such as repair and renovation companies, materials suppliers and the proverbial plumber. There will always be a need for plumbers in the city![6]

The concept, according to Borret, is that as cities redevelop postindustrial brownfields, there are spaces for housing, spaces for jobs, and spaces for the "productive economy, manufacturing, maintenance and repair jobs, food supply . . . being pushed out of the city."[7] The city has spent years researching and implementing the concept and is a frontrunner on new hybrid typologies.

Vertical and Flatted Factories

In many US cities, planning departments have resisted allowing different uses on industrial lands or even maker spaces in residential or commercial areas. Cities are recognizing that these are beneficial, and projects are slowly starting to sprout, such as the NewLab at Brooklyn's Navy Yard, a co-working space for makers.[8] Many cities also have a shortage of industrial space, with

industrial lands being hemmed in by housing, offices, or geography. One approach to solving this problem is to intensify industrial lands with multistory projects such as flatted factories. These solutions are not new, and in fact vertical factories have been around for a hundred years. However, many land use codes are not designed to allow innovation or intensification in these areas, leaving a lot of competition for little land, which can ironically lead to gentrification in industrial lands. Cities such as Seattle are trying to get ahead of this and to stem the tide of creeping sprawl of self-storage, with revisions to its comprehensive plans allowing taller and more intensive technology hubs and flatted factories on industrial lands.[9]

Flatted factories are multistory factories or light industrial buildings. They typically share cargo elevators and allow numerous manufacturers to be located in midrise and even high-rise buildings. They are very common in dense cities such as Hong Kong and Singapore and can be leased or bought like a condo. According to the City of London, maker spaces have "an impact not only on their sector but also on local communities. They rely on local suppliers, work with or for people in the area, are involved in training, apprenticeships and job creation. Some workshops have memberships or affiliations in the thousands and have fostered numerous businesses."[10]

One approach to dealing with the shortage of industrial lands is to allow light manufacturing to occur outside land zoned for industry. In 2014, the six-story York Street Industrial Building opened in Portland, Oregon. It was the first vertical factory built in Portland in more than sixty years. The project accommodates dozens of small tenants, and the leasable area is flexible. The project has a number of small-scale producers in the building, including brewers and furniture makers, and logistics is handled through a combination of elevators for people and elevators for moving freight.[11]

Urban production is especially reliant on sustainable logistics to reduce its carbon footprint. Last mile delivery is increasingly vital, and solutions toward e-mobility and carless delivery are necessary to achieve sustainability goals. This will also require rethinking delivery systems, distribution hubs, and other approaches to facilitate the interaction between trucks and cargo bikes or, as noted in Chapter 8, other urban-friendly e-logistics.[12]

There are also opportunities for logistics to become a spectacle where people can watch processes and movement of goods play out, to highlight the inflows and outflows of production. It is also an opportunity to experiment and prioritize sustainable forms of logistics while keeping large freight vehicles out of the pedestrian-friendly core of the district.

In Tokyo, the juxtaposition of production, logistics, housing, and retail all colliding on compact people-oriented streets is incredible. (Credit: Michael Eliason)

(continued...)