

# **Overdue Urban Solutions: Smarter Houses and Buildings**

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## I. Overview

UPCEA is releasing a series of research papers examining four pillars of smart cities: Transportation; Infrastructure; Housing and Buildings; and Tourism and Entertainment. A smart city is typically defined as a city with digital technology embedded across all its functions. This paper addresses the future of urban housing and buildings.

U.S. citizens spend 87% of their lives indoors, according to the Environmental Protection Agency.<sup>1</sup> Coupling this statistic with continued mass migration to urban hubs means that the pressure to update buildings has never been greater. Houses and buildings shape important moments of our lives. We work in them, and we live in them. However, growing challenges such as the housing crisis and climate change means we need to reassess the designs of our buildings. Housing units, offices, hotels, airports, hospitals, etc., will need to be upgraded via technology.

Many tech giants have recently begun to move into existing smart housing and smart building markets. Google was founded in 1998, but the idea to make houses and buildings smarter dates as far back as the 1980s. Now, Internet of Things (IoT) technology will be able to translate those visions of smarter buildings into a reality. This paper presents brief overviews of five trends shaping the houses and buildings of the future: the current housing crisis; big tech firms entering the housing market; communal and open living spaces; smart buildings' profitability impact; and smart buildings' sustainability impact.

Key findings of the smart city housing and buildings report include:

- Converting 5% of Minneapolis' largest single-family lots into triplexes would create 6,200 new housing units; San Jose could create 15,000 new housing units in a similar fashion<sup>2</sup>
- Sidewalk Lab's (Google) Quayside Project in Toronto may lower the cost of living by 14%<sup>7</sup>
- The global smart home market is expected to be worth \$107 billion by 2020<sup>3</sup>
- The IoT smart building market may grow from \$6.3 billion in 2017 to over \$22 billion in 2026<sup>4</sup>
- Office buildings can save 18% of their energy use through smart technologies<sup>5</sup>
- 79% of employees would choose a job in a LEED-certified building over a non-LEED one<sup>6</sup>

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<sup>1</sup> <https://www.nature.com/articles/7500165>

<sup>2</sup> <https://www.nytimes.com/interactive/2019/06/18/upshot/cities-across-america-question-single-family-zoning.html>

<sup>3</sup> <https://www.cbsnews.com/news/inside-amazon-alexa-smart-home-partnership-with-homebuilder-lennar/>

<sup>4</sup> <https://www.i-scoop.eu/internet-of-things-guide/facility-management-iot-smart-buildings/>

<sup>5</sup> <https://aceee.org/blog/2017/12/smart-buildings-save-energy-and>

<sup>6</sup> <https://www.usgbc.org/articles/employees-are-happier-healthier-and-more-productive-leed-green-buildings>

## II. Introduction

The U.S. housing market is challenged by two problems. The first is that there are fewer and fewer homes available. Our nation is staring down a shortage of 7.3 million housing units. This shortage triggers the second problem: a lower supply means higher prices for the limited housing units that are available. Increasingly, the dwindling supply of housing units makes home ownership too expensive for many U.S. citizens. According to the Wall Street Journal, in 2017, home prices rose 6.2% – twice the increase in incomes and triple the increase in inflation.<sup>7</sup> Smart city enthusiasts see technology as a means to amend these housing problems.

Plans to innovate skyscrapers and other urban buildings adopt a different approach. Primarily, there are two incentives for investments in “intelligent buildings:” sustainable energy usage and long-term profitability. Many parts of a building such as its elevators, lights, heating/cooling systems, etc., can become interconnected through IoT technology. Consequently, the data that IoT-enabled buildings produce could be analyzed and eventually lead to more sustainable energy usage, cost-savings, and even revenue generation.

A snapshot of the United States’ housing crisis:

- The U.S. needs 4.6 million new apartments at all price points by 2030 or it will face a severe shortage; up to 11.7 million apartments may need renovations by 2030<sup>8</sup>
- New/existing housing affordability peaked in 2012 at 78% and dropped to 56% by 2018<sup>9</sup>

A snapshot of buildings excessive energy usage and ensuing government responses:

- Buildings account for 33% of the world’s greenhouse gases<sup>10</sup>
- In the U.S., buildings can account for 40% of the nation’s total energy usage; in large urban centers that figure can exceed 70%<sup>11</sup>
- The E.U. is requiring that all public buildings reduce their energy use by 25% by 2020<sup>11</sup>

In the short term, we’ve already seen smart technology enter the household and the office through virtual assistants such as Amazon’s Alexa. In the long-term the smart technology will be embedded into housing units from the beginning, potentially resolving many current problems.

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<sup>7</sup> <https://www.cbinsights.com/research/future-of-housing/#shortage>

<sup>8</sup> <https://www.naahq.org/news-publications/units/june-2017/article/united-states-needs-46-million-new-apartments-2030>

<sup>9</sup> <https://www.forbes.com/sites/brendarichardson/2019/01/31/americas-housing-affordability-crisis-only-getting-worse/#1221552f104b>

<sup>10</sup> <https://www.greenbiz.com/article/green-buildings-boost-health-productivity-and-value-investors>

<sup>11</sup> <https://www.theatlantic.com/sponsored/vmware-2017/building-smart-cities/1754/>

### III. The Housing Crisis and the Cities of the Future

The U.S. housing market is daunting. Rent costs are consuming gross incomes, construction is outdated and expensive, and restrictive zoning laws in many cities limit housing unit supply.

#### **Housing challenges are becoming more dire**

Housing costs continue to take larger shares of U.S. citizens' incomes. Half of all renters in the U.S. spend more than 30% of their gross income on rent.<sup>12</sup> Twenty-five percent of U.S. citizens are classified as "severely rent-burdened," meaning they pay over half their gross income on rent.<sup>7</sup>

Conditions surrounding home construction are not promising either. According to Sidewalk Labs (Alphabet) and McKinsey, the U.S. construction industry invests just 0.5% of annual construction value in R&D, compared to the 3.7% and 8.8% invested by the auto industry and computing and electronics, respectively. The construction industry has remained largely untouched by industrial or technological revolution. However, there is still hope that the industry will be ready for the expansion required by smart cities. Startups such as Katerra (which recently raised nearly \$1 billion in Series D funding) hopes it can revolutionize the construction industry. Among other differences from traditional firms, Katerra uses timber, which makes buildings 30% and 60% lighter than steel and concrete, respectively. Timber thereby reduces the cost of foundations, which could translate into lower housing unit prices.<sup>7</sup>

#### **Smart cities may usher the end of detached single-family zoning**

According to the New York Times, it is illegal to build anything other than a detached, single family home on approximately 75% of the residential land in U.S. cities. Critics of these U.S. zoning laws argue that such policies are driving the crisis in housing unit shortages and high prices.<sup>13</sup> If 5 percent of the largest single-family lots in Minneapolis converted to triplexes, that would create about 6,200 new units of housing, according to UrbanFootprint. If 10% of similar-sized lots in San Jose added a second unit, the city would gain 15,000 new homes.<sup>14</sup>

Minneapolis did not ignore those statistics. Last year, it voted to abolish single-family zoning, making it one of the only major U.S. cities to do so.<sup>15</sup> It is unclear if updating zoning laws will solve other housing crisis issues such price-outs or discrimination. Zoning likely will not be a silver bullet for these problems. Making urban spaces available to more people may be inevitable. The UN predicts that 68% of the world's population will live in cities by 2050.<sup>16</sup> Unless zoning laws are updated, more and more people will be heading towards a fixed and inadequate number of housing units.

<sup>12</sup> <https://themortgagereports.com/43368/half-of-renters-spend-more-than-30-of-their-income-on-rent>

<sup>13</sup> <https://www.sightline.org/upzoning/>

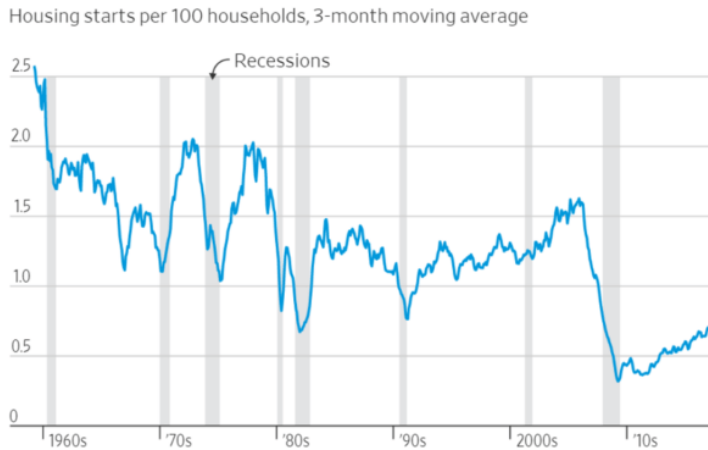
<sup>14</sup> <https://www.nytimes.com/interactive/2019/06/18/upshot/cities-across-america-question-single-family-zoning.html>

<sup>15</sup> <https://www.bloomberg.com/opinion/articles/2018-12-14/single-family-zoning-is-an-urban-dinosaur>

<sup>16</sup> <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>

Figure 1 details new starts of housing in the U.S. over the past six decades. Housing supply simply has not kept up with demand. The U.S. faces a shortage of 7.3 million units that could continue for years.<sup>7</sup>

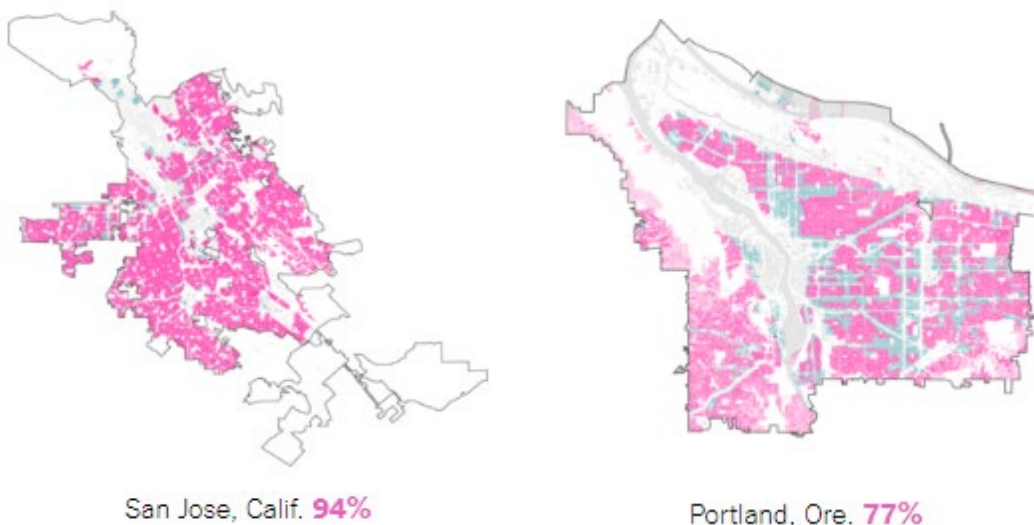
**Figure 1: Graphing the National Housing Shortage**



Sources: CBI Insights | The Wall Street Journal | Federal Reserve Bank of Kansas City

Figure 2 shows zoning heat maps for San Jose, CA and Portland, OR housing units. Detached single-family units are signified in purple and each map has a corresponding percentage for these units. Other housing units are depicted in blue.

**Figure 2: Housing Unit Heat Maps for San Jose and Portland**



Source: The New York Times

## **IV. Big Tech Enters the Housing Market**

In much the same way that Amazon thought it could do retail better than traditional brick and mortar firms, various big tech firms think they can upset and disrupt traditional housing and real estate markets. For some firms, new housing business models can be sustained by working within the current system. For others, issues such as poor residential zoning and outdated urban designs that were built to accommodate cars mean that the planning must begin from scratch.

### **Tech companies are tackling rentals and building their own housing units**

Speaking of Amazon, the firm has recently entered the housing market. It has partnered with the home construction company Lennar to install Alexa technology into the fabric of new homes. In these homes, Alexa is there from the beginning. Homeowners can walk through the halls, asking Alexa to turn off the lights, turn on the TV, and even do some cleaning.<sup>17</sup>

Tech firms are also designing communities. Facebook has released its vision for Willow Village, a plan to build residential housing units for its employees and the broader community. The social media giant's real estate experiment will be in Menlo Park, just outside Palo Alto, CA. Willow Village will have an office complex, retail stores, hotels, parks, open spaces, and a town square. In total, it could employ 8,000.<sup>18</sup> If Facebook is able to execute this project successfully, it could become a model for future arrangements where employers have a stake in their employees housing and communities.

### **Tech companies are building the smart city itself**

Housing and community construction are not enough for some big tech companies. Some want to build entire houses or cities. Sidewalk Labs, an Alphabet (parent company of Google) firm, is one such tech company. It won an RFD from Toronto to design the city's waterfront and dubbed this ambitious project "Quayside." By embedding technology into the city from the beginning, creating a "digital layer" and new zoning laws, Google thinks it can lower the cost of living by 14%.<sup>7</sup>

This project is certainly the most ambitious smart city vision for a tech company. The rest of the world may get to adopt a "wait and see" approach as Google negotiates issues such as data governance, community engagement, and income inequality in its miniature smart city.

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<sup>17</sup> <https://www.cbsnews.com/news/inside-amazon-alexa-smart-home-partnership-with-homebuilder-lennar/>

<sup>18</sup> <https://www.mercurynews.com/2019/02/08/facebook-unveils-new-vision-for-big-willow-village-complex-in-menlo-park/>

Figure 3 depicts an ad for Amazon and Lennar’s new smart homes. These homes are available across 15 U.S. cities and the partners are already planning for expansion. The global smart home market is expected to be worth \$107 billion by 2023.<sup>19</sup>

**Figure 3: Advertisement for Amazon and Lennar’s New Digitally Connected Homes**



Source: CBI Insights

Figure 4 shows computer generated images of Facebook’s Willow Village project. The 59-acre, first phase of the project will be completed by 2021 and will include 1,500 apartments, 225 of which will be priced below the market rate.<sup>7</sup>

**Figure 4: What Facebook’s Willow Village May Look Like**



Source: The Mercury News

<sup>19</sup> <https://www.cbsnews.com/news/inside-amazon-alexa-smart-home-partnership-with-homebuilder-lennar/>

## V. Communal and Open Living Spaces

Millennials and Generation Z are fueling a revolution in the way people live together in apartments. That revolution is the communal or open living space model which has the potential to disrupt the market and drive down housing unit prices. In this model, multiple people share the apartment's common spaces but have their own rooms. Units are typically furnished, leases are shorter, and repair services are handled through an app. Reportedly, the number of co-living spaces will triple to over 10,000 units over the next few years.<sup>20</sup>

### **Millennials and Generation Z are rethinking the American Dream**

For many years, the American Dream has at least partially been about owning your own land and owning your own home. Now, factors such as exorbitant housing unit prices, rising student debt, and different mindsets on whom to live with (i.e., family vs. strangers) are creating a trend towards open and communal living spaces. Younger generations are more comfortable living with strangers. Given that Generation Z has shared an apartment with more strangers than Millennials have (43% compared to 31%), it seems likely that later generations will continue to push this trend forward.<sup>21</sup>

### **Tech startups that are capitalizing on this new trend**

Because of the success of WeWork, its apartment-based sibling WeLive is perhaps the most famous startup that uses a co-living rental model. Other startup firms such as Starcity, Hubhaus, and Common have also entered the co-living market. Starcity, a strong player in the market, operates similarly to WeLive. Apartment units are either leased or outright purchased and then rented to multiple people or families. Each group gets their own bedroom and pays a flat fee that covers rent, Wi-Fi, and utilities. Starcity operates 36 units, has 8,000 people on its waiting list, and has raised \$18.6 million to date.<sup>7</sup> With need for more efficient living space utilization in cities, this kind of model may be exactly what smart cities will need. Under these models, more people can easily live in a housing unit relative to the traditional leasing system.

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<sup>20</sup> <http://www.cushmanwakefield.com/en/research-and-insight/2019/coliving-report>

<sup>21</sup> <https://www.usatoday.com/story/money/2019/07/26/gen-z-co-living-blurs-line-between-residential-and-hotel-living/1812863001/>



Figure 5 details a brief overview of Starcity, a rising co-living company. These kinds of firms and their business models may become core to future smart cities.

**Figure 5: The Rise of Starcity**

 Starcity pushes co-living as a way to repurpose space

Starcity is an example of a company in the growing coliving space. The San Francisco-based startup is a graduate of Y Combinator and has raised \$18.6M to date, most recently via a \$16.4M Series A from Alrai Capital, Bullpen Capital, Invest AG, and Y Combinator.



Source: CBI Insights

Figure 6 gives an overview of co-living startup Common, which is unique among its peers. It partners with landlords themselves to help manage the property and find tenants, rather than build its own housing units or completely manage rented units.

**Figure 6: Overview of Common**

ADULT DORMS



**Total Funding**  
\$65M

Common offers flexible shared housing connecting vetted members to private rooms in furnished properties.

**SELECT INVESTOR(S)**

Maveron, Norwest Venture Partners, 8VC



Source: CBI Insights

## VI. Smart Buildings and Profitability

Smart buildings have strong business justifications. They will be able to improve profitability by reducing costs and increasing revenue. The former will be achieved through better facility management and the latter through the creation of new services. Both profit boosts will be a result of IoT technology becoming a fabric of building designs. The IoT market for intelligent buildings was \$6.3 billion in 2017. It is projected to exceed \$22 billion by 2026.<sup>22</sup>

### **Cost savings through more efficient operations**

Buildings can achieve significant cost savings through interconnected technology investments. Occupancy sensors and smart thermostats can automatically adjust rooms' air conditioning or heating based on need. Lighting systems could be dimmed or turned off if a room or an entire floor is not in use. Smart outlets can also reduce the energy consumption of office equipment.<sup>23</sup>

A report from the American Council for an Energy-Efficient Economy (ACEEE) concluded that the average office building can save 18% of its whole building energy use through smart technologies. Additionally, retail stores and hospitals could save an average of 14% and hotels an average of 8%.<sup>24</sup>

### **Revenue generation through business intelligence**

Smart buildings will be able to generate revenue through external and internal means. Externally, IoT data can be monetized, and businesses can sell their intelligent buildings' data to the firms that are able to derive insights from it. Internally, IoT data can lead to improved business intelligence and thereby new services.<sup>25</sup>

With respect to new services specifically, Kroger, the nation's largest supermarket chain, tested an IoT "intelligent shelf" system in 2018. The shelves are linked with their stores' Point of Sale (POS) systems. The POS payment information is then used to create data-driven ads, display coupons, and update prices (which have digital signage instead of paper). Kroger has seen sales rise from 5,000 promotional tests of these smart tech shelves and is expanding the technology to additional store locations.<sup>25</sup> Such technologies have also been found to improve employee morale by allowing them to focus on higher order tasks.<sup>26</sup>

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<sup>22</sup> <https://www.i-scoop.eu/internet-of-things-guide/facility-management-iot-smart-buildings/>

<sup>23</sup> <https://www.smartbuildingtec.com/2018/01/22/smart-buildings-save-18-of-energy-cost/>

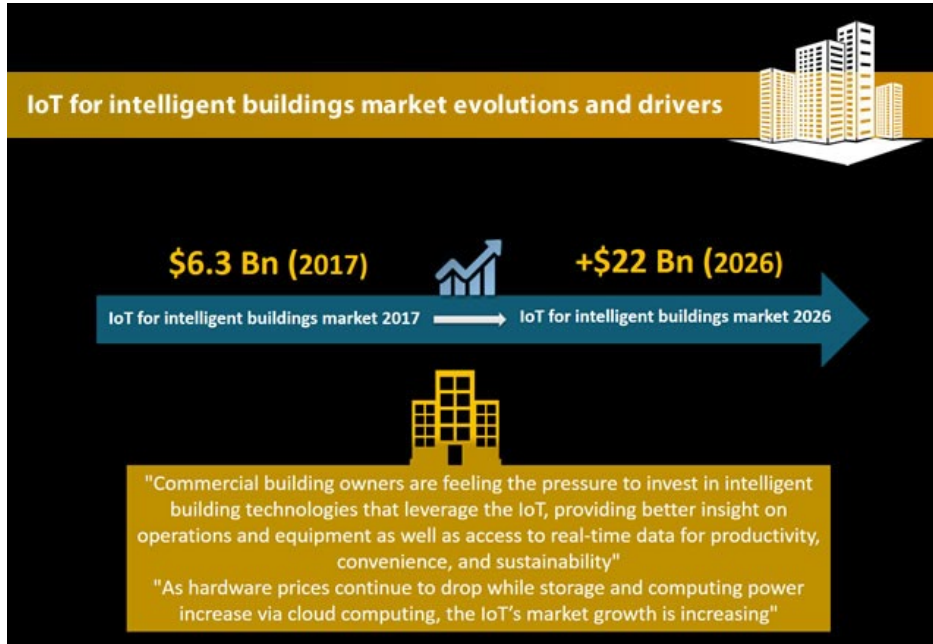
<sup>24</sup> <https://aceee.org/blog/2017/12/smart-buildings-save-energy-and>

<sup>25</sup> <https://www.forbes.com/sites/barbarathau/2018/02/07/how-target-kroger-and-design-within-reach-are-tapping-tech-to-improve-your-shopping-trip/#6d16fc102d75>

<sup>26</sup> <https://www.bizjournals.com/phoenix/news/2018/03/20/how-smart-buildings-can-save-and-make-your.html>

Figure 7 provides further reasoning behind the growth for intelligent buildings. High prices are commonly the strongest barrier to businesses adopting new technologies. Now, as prices continue to decrease, more businesses are willing to invest in smart building solutions.

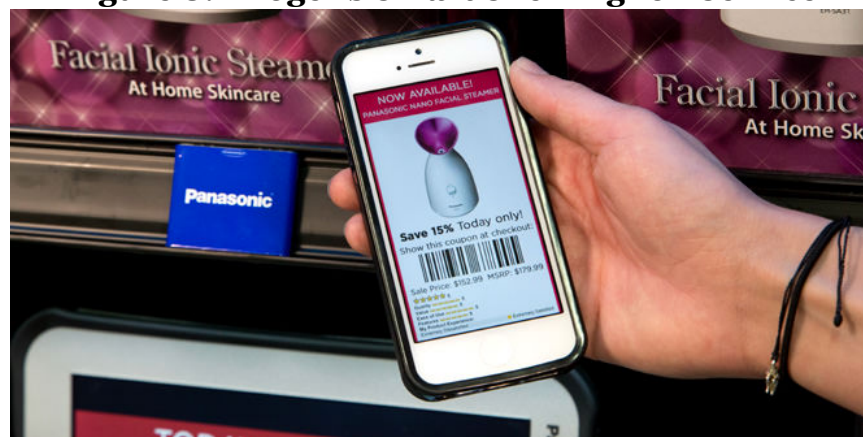
**Figure 7: Intelligent Building Growth Drivers**



Source: Navigant Research

Figure 8 shows how smart technologies can be used in retail. Customers can receive personalized coupons, get directions to items on their shopping lists, and receive relevant product recommendations. Supply chains can also be optimized. For example, if inventories are too high, promotional offers can be offered automatically, saving hours of labor costs.<sup>27</sup>

**Figure 8: Kroger's Smart Shelving IoT Service**



Source: RetailWire

<sup>27</sup> <https://www.retailwire.com/discussion/will-smart-shelves-ever-be-smart-enough-for-kroger-and-other-retailers/>

## VII. Smart Buildings and Sustainability

One of the many challenges smart cities will have is the looming threat of climate change. Businesses and governments will have to do their part, and there will be strong incentives for both to help make cities cleaner and to improve work environments.

### **Sustainability will be a feature of smart cities**

Businesses are finding that climate change is not an issue that they can ignore. In fact, climate change activism can be a good opportunity for forward-thinking businesses. By connecting 30,000 sensor-connected pieces of equipment across 125 buildings, Microsoft was able to cut energy usage at its headquarters by 20%.<sup>28</sup> The public sector has not lagged far behind.

For example, Copenhagen, Denmark plans on being carbon net neutral by 2025. Its population of approximately 630,000 hopes to serve as an example to the rest of the world's cities. Previously, the city had decreased its greenhouse gas emissions by 42% by moving away from fossil fuels. Now, Copenhagen is trying convert necessary city functions into forms of sustainability, namely, how it uses its garbage. All cities need to dispose of their trash, but Copenhagen does not want to waste the energy of this process. It burns unrecyclable trash in specialized incinerators that will help alleviate the heating needs of the city's buildings.<sup>29</sup>

### **Sustainable buildings enjoy a labor advantage**

According to Medium.com, the dual interpretations of the word "green," either profits on the one hand or sustainability on the other, are being reconsidered. Progressively, those seemingly disparate "green" interpretations are considered intertwined, not mutually exclusive. For example, there is an intersection of profitability and sustainability in terms of talent acquisition and employee productivity.<sup>30</sup> Seventy-nine percent of employees reported that they would choose a job in a Leadership in Energy and Environmental Design (LEED)-certified building over a non-LEED building.<sup>31</sup>

The business case does not stop at talent acquisition. Overall, workforce health, wellness, and productivity are stronger in greener work environments because these issues have never been more important to employees. More than 90% of employees in LEED-certified green buildings say they are satisfied with their jobs.<sup>31</sup> Green-certified buildings with health and wellness features also see reduced employee absenteeism and a workforce that feels more productive and healthier.<sup>32</sup> A Harvard study concluded that the cognitive scores of employees in green office buildings was 61% higher than their peers in conventional offices.<sup>33</sup>

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<sup>28</sup> <https://azure.microsoft.com/en-us/blog/how-smart-buildings-can-help-combat-climate-change/>

<sup>29</sup> <https://www.nytimes.com/2019/03/25/climate/copenhagen-climate-change.html>

<sup>30</sup> <https://medium.com/thebeamagazine/how-come-green-buildings-attract-engage-and-retain-talent-5857585b3d98>

<sup>31</sup> <https://www.usgbc.org/articles/employees-are-happier-healthier-and-more-productive-leed-green-buildings>

<sup>32</sup> <https://www.worldgbc.org/news-media/doing-right-planet-and-people-business-case-health-and-wellbeing-green-building>

<sup>33</sup> <https://green.harvard.edu/tools-resources/research-highlight/impact-green-buildings-cognitive-function>

Figure 9 shows the Edge, Amsterdam’s crown jewel in sustainability technology smart building. Its entire southern wall and roof are covered in solar panels; it uses 70% less energy than the traditional office building. According to British sustainability rating agency BREEAM, the Edge is the greenest building in the world, scoring 98.4%, the highest score ever awarded.<sup>34</sup>

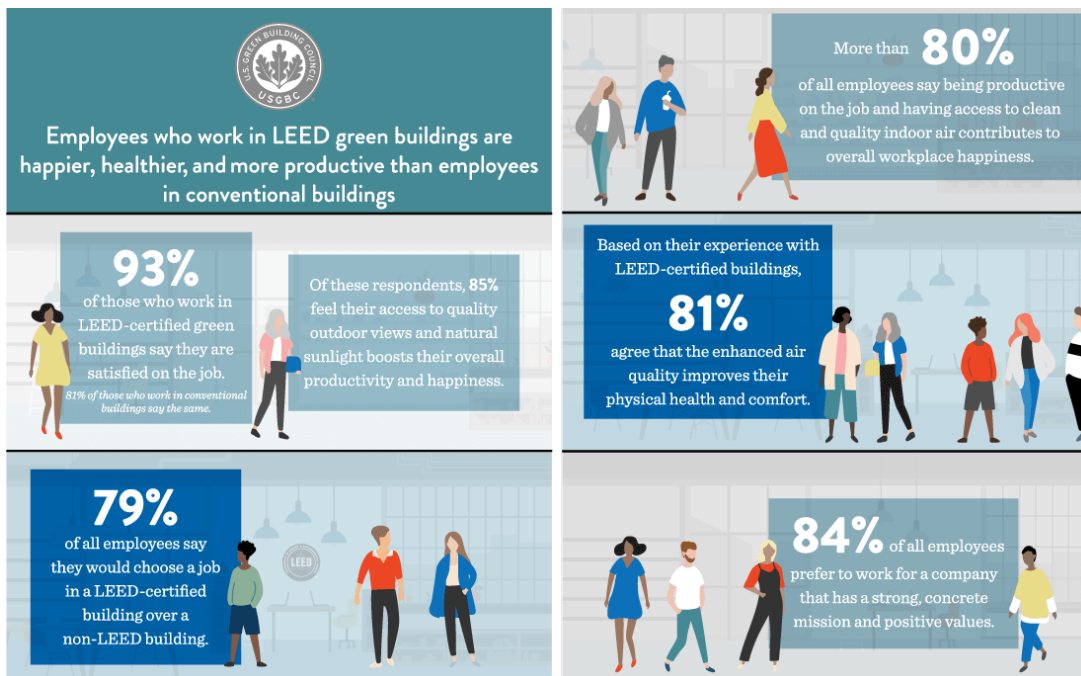
**Figure 9: The Edge, the Smartest Building in the World**



Source: Bloomberg | Photographer: Ronald Tilleman

Figure 10 provides more information on LEED-certified buildings’ effect on employees; 32,500 commercial buildings are LEED-certified. Certification has continued to grow for nearly 20 years.<sup>35</sup>

**Figure 10 : Effects of LEED Green Buildings on Employees**



Source: The U.S. Green Building Council

<sup>34</sup> <https://www.bloomberg.com/features/2015-the-edge-the-worlds-greenest-building/>

<sup>35</sup> <https://www.usgbc.org/articles/leed-numbers-16-years-steady-growth>

## VIII. The Impact on Higher Education

Smart housing and buildings will create jobs, increase safety, and change how we work. Some of these changes have already materialized in parts of the world and will soon spread elsewhere.

### **Labor growth**

Higher education institutions have an opportunity to refine their degree and nondegree offerings. Unsurprisingly, the construction and engineering industries will see the greatest benefit from smart city housing and buildings. From 2019 to 2024, the North American construction industry is expected to grow at a compound annual growth rate (CAGR) of 4.2%. Ongoing infrastructure investments in smart city projects is driving this growth.<sup>36</sup> In 2018, there were 471,800 construction managers and this will grow by 10% over the next 10 years.<sup>37</sup> The number of civil and architectural engineering jobs will rise by 6% over the same period.<sup>38</sup> These occupations may also see greater specialization within their respective degree category.

There will also be ancillary job growth. Engineering and construction firms will likely need third-party assistance with the IoT technology and data analytics that smarter construction will require, resulting in technology sector growth as well.<sup>39</sup> Sensor maintenance and training around diagnostics and repair may also result.

Urban planning and community development professions are likely to grow as new buildings replace old ones and transportation shifts to more eco-friendly modes. Urban and community planners will be needed to redesign communities that were once frequented by automobile traffic or parking to more community friendly.

Retail planners will also focus in smaller footprint stores. The logistics of retail delivery will also be a factor in smart housing and buildings, as more products will be “just-in-time” as storage options will become a premium. Consumers will no longer order in bulk and therefore be more dependent on more precise delivery of product or the convenience of a walk-in purchase. As a result, higher education may see greater opportunities educating more in planning or supply chain logistics.

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<sup>36</sup> <https://www.mordorintelligence.com/industry-reports/north-america-construction-market-growth-trends-and-forecast-2019-2024>

<sup>37</sup> <https://www.bls.gov/ooh/management/mobile/construction-managers.htm>

<sup>38</sup> <https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm>

<sup>39</sup> <https://constructech.com/the-rise-of-smart-cities-and-the-impact-on-construction/>

### **Smarter safety**

STEM degrees are likely to grow as new products enter the smart home and building marketplace. Smart housing and buildings are not just about novelty and sustainability. They also give us new ways to protect ourselves and our assets. IoT temperature sensors inside of buildings can detect and prevent problems such as a data center overheating. The same principle applies to smart homes as well. IoT sensors will be integrated with water lines, meaning that water damage such as from freezing or leaking pipes can be detected.<sup>40</sup> However, given the data and internet-intensive nature of smart cities, the degree of cybersecurity will likely define how safe smart cities are. Cybersecurity issues will continue to be a challenge and growth of cybersecurity professionals is expected which in turn will likely fuel noncredit training opportunities.

Some industries may also grow or shift in focus, such as within the legal community. As smart houses and buildings expand, new issues will emerge including privacy and liability.

### **How will smart buildings change how people work?**

Today, people with technology like Amazon Alexa inside their homes are connected from the moment they wake up. They can ask for a weather report and their schedule, turn off the lights, and more. Soon, we will be equally as connected from the moment we set foot in the workplace. For example, the Edge in Amsterdam centralizes many work functions in one app.

The app recognizes when workers arrive, guiding them to an open parking space. The app also knows workers' schedules, so it directs them to the workspace they will need, whether that means a conference room for a group call or a solitary desk because the worker has no meetings. The app even saves temperature and outdoor lighting preferences and automatically updates the workspace based off that information.<sup>34</sup>

As a result, technology will improve to help workers better engage remotely. These technologies will also be applied to how students learn, thus improving distance learning technologies. It is likely that smart city technology will lessen the need to come into the workplace and thus reduce traffic. The same technologies may replace some traditional classroom dependent educational offerings.

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<sup>40</sup> <https://www.iotworldtoday.com/2019/09/26/smart-building-technology-to-keep-people-and-assets-safe/>