Electrify

THE MOVEMENT TO ALL-ELECTRIC REAL ESTATE

Urban Land Institute
Greenprint

About ULI

The Urban Land Institute is a global, member-driven organization comprising more than 45,000 real estate and urban development professionals dedicated to advancing the Institute's mission of shaping the future of the built environment for transformative impact in communities worldwide. ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 80 countries. More information is available at uli.org. Follow ULI on Twitter, Facebook, LinkedIn, and Instagram.

About ULI Greenprint

The ULI Greenprint Center for Building Performance is a worldwide alliance of leading real estate owners, investors, and strategic partners committed to improving the environmental performance of the global real estate industry. Through measurement, benchmarking, knowledge sharing, and implementation of best practices, Greenprint and its members strive to reduce greenhouse gas emissions 50 percent by 2030 and achieve net-zero carbon operations by 2050. More information on ULI's Greenprint Center can be found at https://americas.uli.org/research/centers-initiatives/greenprint-center/.

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Introduction

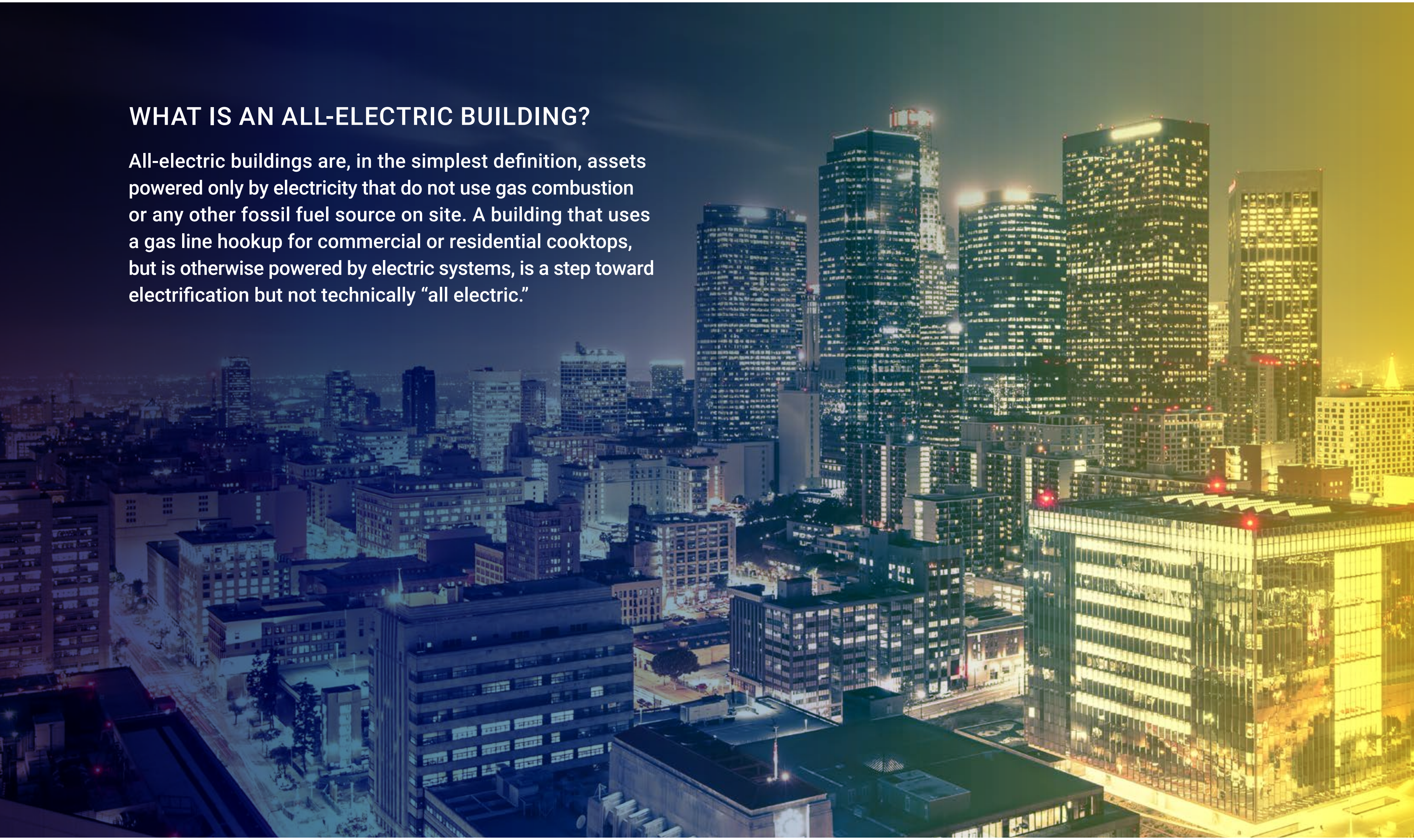
Across the built environment, the movement toward all-electric buildings is growing. Interest is being driven by emerging regulatory requirements, the technical and operational benefits of all-electric buildings, and a growing understanding of the negative long-term financial and environmental impact of buildings that run on fossil fuel combustion. Electrification across new and existing buildings is improving real estate's bottom line, future-proofing portfolios, attracting high-quality tenants, lowering building emissions, and improving the health of building occupants.

Research by the American Council for an Energy-Efficient Economy (ACEEE) shows that electrification could reduce site energy use of U.S. commercial building stock by 37 percent and greenhouse gas emissions by 44 percent.[1] The challenge is to do so cost-effectively, equitably, and responsibly to ensure a thriving and sustainable built environment. With new construction projects, developers can go all-electric for little net cost, whereas existing building retrofits require significant planning and coordination to pencil financially.

In addition, combusting fuel causes health problems by lowering indoor air quality for building occupants and polluting outdoor air, is increasingly expensive to build infrastructure for, and emits greenhouse gases including methane leaks during transmission.

For electrification to support climate change mitigation, it is critical to decarbonize both upstream energy production methods (moving away from fossil fuel–burning power plants and toward a renewable energy utility grid), and downstream end-user needs at the building level (installing electric building systems and encouraging high-efficiency design/operations).

Electrification is a key strategy for decarbonizing the building sector. This report shares the business case for electrifying commercial assets, showcases technologies that enable electric buildings, and outlines current opportunities and challenges for real estate owners and investors to make the all-electric commitment portfolio-wide.

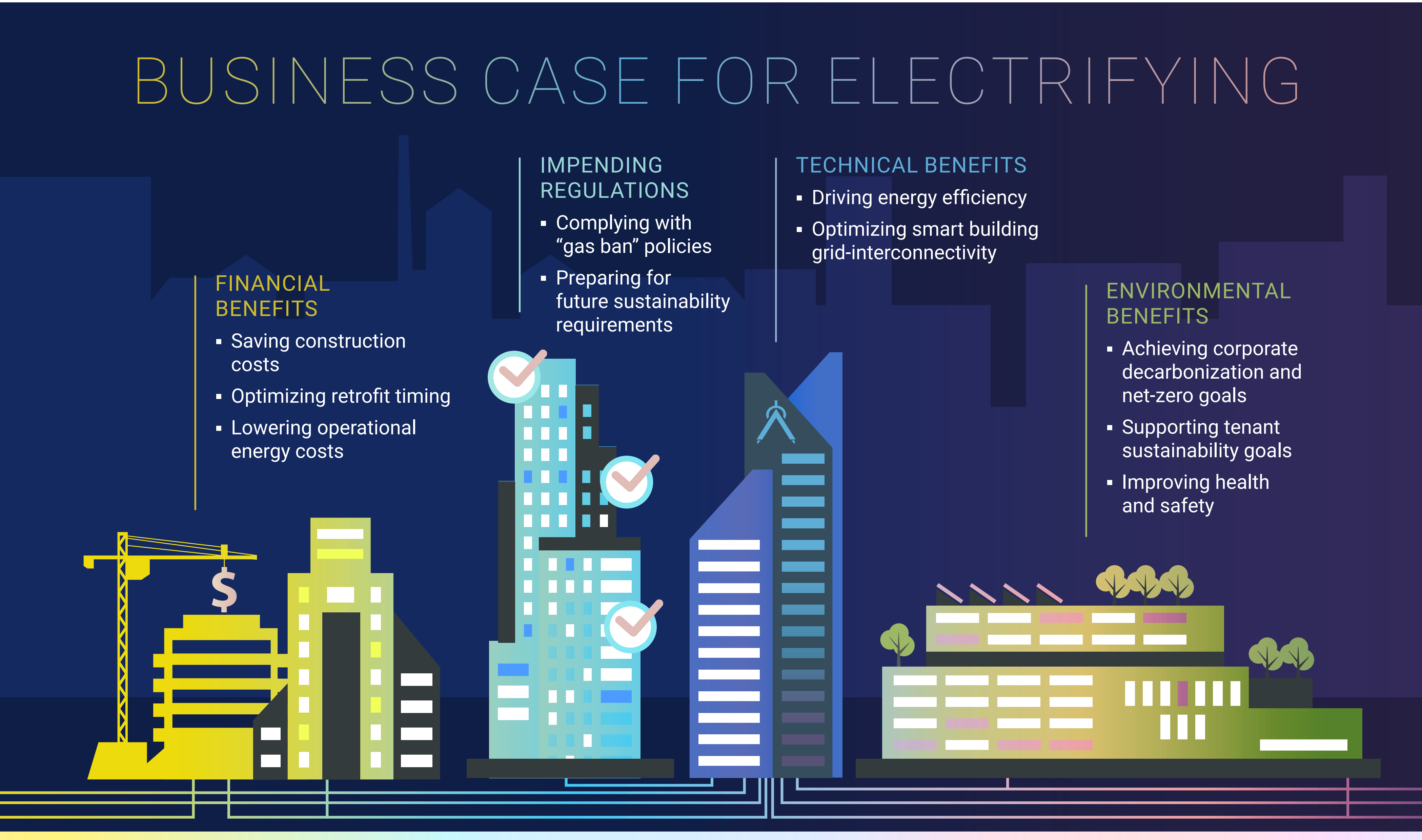


WHAT IS AN ALL-ELECTRIC BUILDING?

All-electric buildings are, in the simplest definition, assets powered only by electricity that do not use gas combustion or any other fossil fuel source on site. A building that uses a gas line hookup for commercial or residential cooktops, but is otherwise powered by electric systems, is a step toward electrification but not technically “all electric.”

The Business Case for Electrifying

The business case is clear for moving commercial real estate toward electrification and a decarbonized future: financial, technical, regulatory, and environmental. Although nuances exist depending on construction type (new or retrofit), asset classification, climate zone, and utility fuel source availability (i.e., natural gas, coal, electricity, or renewable energy), many of the benefits can be applied widely across commercial real estate.


BUSINESS CASE FOR ELECTRIFYING
FINANCIAL BENEFITS
▪ Saving construction costs
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▪ Complying with “gas ban” policies
▪ Preparing for future sustainability requirements
TECHNICAL BENEFITS
▪ Driving energy efficiency
▪ Optimizing smart building grid-interconnectivity
ENVIRONMENTAL BENEFITS
▪ Achieving corporate decarbonization and net-zero goals
▪ Supporting tenant sustainability goals
▪ Improving health and safety
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Financial Benefits

An all-electric building can provide significant cost savings both during development and operations. The opportunities to reap the financial benefits of switching to all-electric stem from reduced construction costs without having to run gas lines, optimized retrofit timing with equipment turnover, and lower long-term energy costs.

SAVING CONSTRUCTION COSTS

As with many other sustainability initiatives, the earlier the decision to go all electric, the more cost-effective the decision can be. Already some developers are reporting no net upfront costs when planning to go all electric from the start in new developments—not to mention avoiding the future cost risks of retrofitting to all electric later. While heat pumps, a key technology for all-electric buildings, cost more from a budget perspective, there are upfront cost savings by removing the need for gas infrastructure. According to the Building Decarbonization Coalition, gas distribution system expenditures continue to increase, tripling between 2009 and 2017 to $14.9 billion per year, which in turn affects the costs of construction. Multiple real estate firms have already proven it is possible to go all electric without sacrificing the bottom line.

- Maceo May Apartments in San Francisco is an example of highly efficient all-electric affordable housing targeting LEED (Leadership in Energy and Environmental Design) Platinum that was able to beat California's Title 24 code by 20 percent by using a high-efficiency system, and still save costs by avoiding gas line hookups. The savings allowed the design team to prioritize increased insulation, energy recovery ventilators, electric heat resistance, and a solar array.
- Kaiser Permanente's Santa Rosa, California, Medical Office Building is an all-electric project with a LEED Platinum rating and estimates saving $1 million in HVAC first-costs by using thermodynamically zoned heat pumps. This zoning is combined with electrochromic glazed glass and photovoltaic panels in the parking lot.

MITHUN

Rendering of Maceo May Apartments in San Francisco, designed by Mithun.

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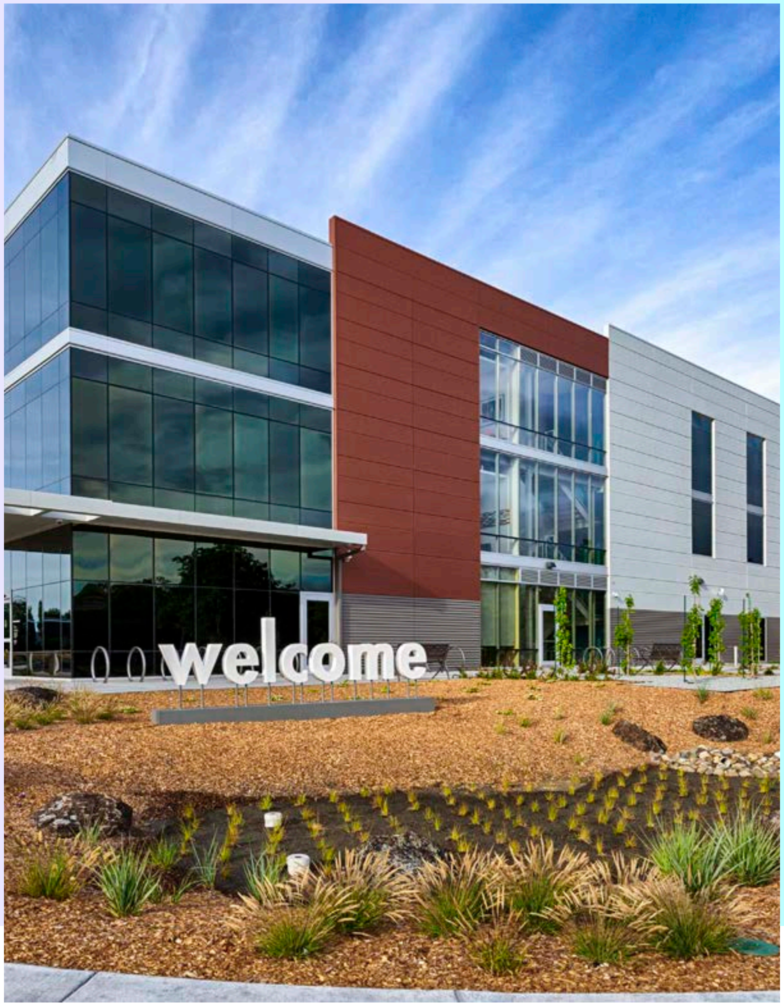


Kaiser Permanente's all-electric Medical Office Building in Santa Rosa, California.

- A study of the University of California's real estate portfolio found that all-electric buildings are comparable or slightly less expensive than combination gas and electric buildings when factoring in both capital costs and operational energy costs.[2] The average 20-year life-cycle cost for all-electric buildings compared to the gas and electric option is $1.23 per square foot (about 0.7 percent) lower for academic buildings, $5.28 per square foot (about 3.5 percent) lower for residential buildings, and $3.09 per square foot (about 0.8 percent) lower for laboratories. These total net present costs balance the upfront capital costs with the 20-year energy costs: all-electric academic and lab buildings are 1 to 1.5 percent costlier upfront, while spending 14 percent and 8 percent less on energy costs, respectively, over the 20-year life cycle. All-electric residential buildings cost 6 percent less in upfront capital costs; however, life-cycle energy spend is 16 percent higher.
- A Colorado office-focused study found that the upfront costs in new commercial buildings of all-electric heating and cooling are lower than similar systems powered by natural gas.[3] In addition, with modern air source heat pump efficiencies and time-of-use electric rates, the analysis found the operating costs of all-electric office buildings to be 8 percent lower than those of buildings with standard natural gas–fired equipment, with only a 1 percent increase in utility costs. Retrofitting an office building's gas-fired equipment at end of useful life with all-electric efficient replacements would result in only a 2 percent difference in initial costs.

OPTIMIZING RETROFIT TIMING

According to a 2020 ACEEE study, about 27 percent of existing U.S. commercial building floor space currently heated with fossil fuels could be electrified with a simple payback of less than 10 years.[4] Using this model, the addition of incentives, carbon pricing, and energy efficiency improvements would result in electrification of 60 percent of floor space, thus achieving a simple payback of less than 10 years. The best paybacks can be achieved in regions with limited need for space heating and in buildings with medium to high operating hours, such as health care, retail, and offices.

However, this 10-year payback period may not meet investment criteria for the three to 10 years of building ownership. To make electrification retrofits pencil, leading owners are undertaking significant planning and coordination to optimize the effort: bundling efficiency improvements with the equipment electrification, timing the renovations during tenant turnover/vacancies, and leveraging utility incentives to subsidize the project costs.

Good portfolio planning is essential for building owners aiming to retrofit equipment to all electric as each piece of equipment reaches its end of useful life. Along with the equipment swap-out, bundling additional energy efficiency measures in the project enables energy and cost-saving co-benefits. For example, heat pumps must be sized to the space, so the more efficient a space can be designed through active and passive measures, the smaller the heat pump will need to be. In a study of heat pump retrofits in London, undertaking energy efficiency measures alongside a heat pump retrofit reduces the demand for heat and lowers energy bills by 60 to 90 percent.

To help make retrofits more cost-effective, a growing number of utilities offer rebates or incentives for switching away from fossil fuel combustion equipment. In Massachusetts, Mass Save offers incentive programs targeting homeowners heating with oil or propane, encouraging them to switch to more efficient electric technologies like air-source heat pumps. The Sacramento Municipal Utility District offers incentives to support switching to cleaner, more efficient electric space heating, water heating, and cooking appliances.

LOWERING OPERATIONAL ENERGY COSTS

Given the uncertainty of rising gas costs and equipment replacements, electric buildings are more energy efficient and can lead to lower operating costs over the long term. According to a study, Sacramento customers in low-rise multifamily buildings that retrofit gas-burning furnaces and water heaters with electric air-source heat pumps and heat pump water heaters could see annual utility bill savings of $300.[5]

For tenants, lower energy costs are an important factor in selecting both work and living spaces. As building owners compete for tenants, those who are unable to deliver the most efficient and low-cost spaces will be at a disadvantage for signing new leases, securing lease renewals, and eventually selling the building.

Impending Regulations

Localities are starting to pass or propose local regulations that drive the real estate market into alignment with the city's climate goals, many of which envision an all-electric future for the built environment. The United States and countries around the globe have seen a rapid increase in local regulations that restrict or ban gas lines from new construction (table 1).

And even more cities are working on electrification strategies. For North American cities considering electrification, the Building Electrification Institute is helping 11 cities such as San Jose, California; Salt Lake City, Utah; and Boston, Massachusetts pilot strategies to scale up the electrification of building heating and cooling systems in a way that supports local market development, regional partnerships, and an equitable transition.

Even though a city or state may not currently have a "gas ban" in place or laws mitigating the use of fossil fuel combustion, many jurisdictions are moving steadily toward carbon emissions reduction goals, renewable energy targets, energy efficiency standards, and net-zero construction initiatives. Over time, these initiatives will all but preclude the use of fossil fuels in commercial real estate.

Responding to these policies and getting ahead of them can prove a useful strategy in a commercial real estate company's long-term planning: some developers have already started factoring in all-electric upgrades, rather than waiting until they are mandated by a locality or code. This includes considering the value of all-electric buildings in development pro formas, acquisitions and dispositions, and leasing decisions.

Although many cities are moving toward aggressive carbon legislation, some U.S. states have taken action in the opposite direction. Arizona, Tennessee, Oklahoma, and Louisiana all have laws in place that specifically prevent local governments from issuing electrification mandates or gas bans on buildings. Five states, including Texas, have proposed similar legislation with some level of support from utilities.

TABLE 1: SAMPLE OF U.S. ELECTRIFICATION POLICIES (AS OF SPRING 2021)

State	Jurisdiction	Policy
California	Alameda, Albany, Berkeley, Brisbane, Burlingame, Campbell, Carlsbad, Cupertino, Davis, East Palo Alto, Hayward, Healdsburg, Los Altos, Los Altos Hills, Los Gatos, Marin County, Menlo Park, Millbrae, Mill Valley, Milpitas, Morgan Hill, Mountain View, Oakland, Ojai, Pacifica, Palo Alto, Piedmont, Redwood City, Richmond, San Anselmo, San Francisco, San Jose, San Luis Obispo, San Mateo, San Mateo County, Santa Cruz, Santa Monica, Santa Rosa, Saratoga, Sunnyvale, Windsor	Building type covered, construction type (new construction vs. retrofit), and level of mandate vary slightly by jurisdiction. For example, San Francisco has passed multiple laws that ban natural gas use in all asset and construction types, whereas Oakland bans gas in new construction, both residential and commercial. For a complete and updated list, refer to the Building Decarbonization Coalition.
Colorado	Denver	Proposed ban eliminates gas in new residential and commercial construction over the next decade.
Maryland	Takoma Park	Goal to make Takoma Park fossil fuel free by 2045. The bill passed but is currently in debate on how to structure the mandate.
Massachusetts	Brookline	Ban on gas hookups in new construction. Passed, however the state attorney general then struck it down.
New York	New York City	Proposed ban stops fossil fuel connections in new construction by 2030.
Washington	Seattle	Gas ban in new construction.

Technical Benefits

According to the Rocky Mountain Institute (RMI), with the lower energy use and efficiency of all-electric building equipment, even burning natural gas in a power plant to supply electricity is more efficient than using a gas furnace.[6]

For owners and developers looking to incorporate electrification into their new and existing buildings, their buildings can gain value from electrification from the overall energy efficiency of electric technology and connectivity to the grid.

All-electric buildings are not a new concept for all asset types. For example, many data centers are already all electric. Data centers have low demand for heating so they do not have much need for fossil fuels (apart from the diesel generators for backup power). In addition, when reviewing their portfolio, some office building owners may be surprised to find that assets built decades ago are all electric because that was simply the trend of the time.

Heat pump technology.

DRIVING ENERGY EFFICIENCY

According to the New Buildings Institute's *Building Electrification Technology Roadmap*, per unit of energy, electricity is the more efficient energy choice.[7] Moreover, heat pumps are three to five times more efficient than standard gas or electric systems.

When deciding between a business-as-usual gas system or upgrading to all-electric equipment, key considerations include longevity of systems, cost of upgrades, operational and maintenance costs, fuel source, and fuel price volatility. Gas building systems tend to have a life expectancy of at least 10 years, with some warranties stretching up to 20 years or more. Over those 20 years, it is likely that base building heating and cooling systems will evolve significantly, in addition to the possibility that energy efficiency regulations, mandates forbidding fossil fuel combustion in buildings, and code upgrades will occur within that time span, potentially leaving newly installed gas systems obsolete. Selecting an all-electric building system also leads to lower maintenance costs because there is no on-site combustion, which developers report as a major benefit to property managers.

According to a U.K. Better Buildings Partnership case study, a seven-story class A office building in London owned by British Land facilitated an end-of-life replacement of the traditional boiler and chiller system to an air source heat pump system, which resulted in a one-year payback, £51,000 (US$72,000) a year in occupant savings, 40 percent reduction in tenant temperature complaints, 85 percent reduction in gas use, and 32 percent reduction in electric energy use. The air source heat pump option was selected as a replacement system rather than a more efficient boiler and chiller system because of the former's greater efficiency and cost savings over the life span of the equipment.[8]

OPTIMIZING GRID INTERCONNECTIVITY

All-electric buildings offer an opportunity to future-proof by integrating smart building features and technologies in communication with the electric utility grid. Tying in distributed energy resources such as on-site solar, battery storage and electric vehicle charging, communicating with the utility grid to support demand response, and actively managing peak loads are all strategies electric buildings can incorporate to further reduce energy costs and optimize efficiencies.

Given the current economics of cheaper natural gas and more expensive electricity, buildings can optimize energy use and costs by flexing peak loads with demand management and grid-interactive, efficient building strategies and technologies. These efforts can lead to co-optimization of cost reduction and carbon emission reductions by aligning loads based on when the utility grid is more renewable. A sophisticated building automation system can actively manage these electric loads.

Environmental Benefits

All-electric equipment contributes to the overall environmental performance of an asset, both for carbon emissions reductions and for health and safety of the space.

LENDLEASE

Aerial view of LendLease's 30 Van Ness.

ACHIEVING CORPORATE DECARBONIZATION AND NET-ZERO GOALS

A building cannot meet the strictest definition of net zero until it is all electric and powered by renewable energy. As such, prioritizing energy efficiency and electrification of assets are critical steps toward achieving net-zero energy goals. With more and more city, real estate, and end-user goals centering on net zero, forward-thinking commercial real estate owners and investors are including electrification in broader environmental, social, and governance (ESG) business plans.

According to a study by the Rocky Mountain Institute, multiple U.S. states have analyzed the pathway to achieve their climate goals (including 80 and 100 percent renewable by 2030) and found electrification to be the most cost-effective and lower-risk option.[9]

"In order to achieve the necessary emissions cuts in the stubborn buildings sector, a broad swath of research concludes the same thing: the lowest-cost pathway to eliminate direct emissions from commercial and residential buildings is to electrify."

Rocky Mountain Institute, "Building Electrification: A Key to a Safe Climate Future" (2020)

JBG SMITH

JBG SMITH's North Potomac Yard in Alexandria, Virginia.

Real estate companies such as JBG SMITH understand the importance of electrifying assets and adapting to evolving ESG targets. "The sitewide Environmental Sustainability Master Plan for North Potomac Yard enables sustainability to be woven seamlessly into the fabric of placemaking. The plan presents carbon-neutral buildings by 2030 with a focus on electrification, which complements our corporate goals," notes Bailey Edelson, senior vice president of development, specifically about JBG's North Potomac Yard development in Alexandria, Virginia.

Although most companies start electrifying single assets and responding to tenant ESG needs on an ad hoc basis, firms such as JBG SMITH understand the importance of incorporating decarbonization into a portfolio-wide strategy. "Throughout this past year, JBG SMITH has been crafting our strategy toward a carbon-neutral portfolio. At Potomac Yard, where we are working alongside Virginia Tech on their Innovation Campus, the Environmental Sustainability Master Plan takes a sitewide approach which provides a quicker path to decarbonization and brings us closer to achieving our future corporate goals," elaborates Kim Pexton, JBG's vice president of sustainability.

PROJECT PROFILE

30 VAN NESS

San Francisco, California | **Lendlease**

LENDLEASE

30 Van Ness in San Francisco.

Lendlease's 30 Van Ness is its first all-electric mixed-used development in the United States, and the decision to be all electric was made long before San Francisco passed a citywide no-gas policy for new construction. With 250,000 square feet of commercial office space, 330 condominiums (of which 25 percent will be affordable housing), 4,000 square feet of retail space, and a 5,000-square-foot public assembly space, the asset manager considered a variety of energy users when outlining the design.

"All-electric buildings are critical to achieving Lendlease's targets to be net zero carbon by 2025 in Scopes 1 and 2 and absolute zero by 2040. We're delivering our first all-electric mixed-use development at 30 Van Ness in San Francisco and committed to be net zero carbon in operation. This not only addresses our ambition to be a 1.5-degree Celsius aligned company, but it makes commercial sense in a market where commitments for zero carbon are shared by tenants and end users," explains Arden Hearing, executive general manager, development, West Coast, at Lendlease.

LENDLEASE

Rendering of 30 Van Ness glass facade.

LENDLEASE

Entrance to offices at 30 Van Ness.

Lendlease's motivation behind the "net-zero-ready" project was threefold: 1) alignment to prospective tenant aspirations for next-generation office space, 2) environmental considerations and corporate ESG goals, and 3) the desire to be an innovative leader in the space. To move toward net-zero-carbon operations over the long term, Lendlease understands the need to address the overall efficiency and electrification of base building systems and occupant energy use simultaneously. This will ensure the asset eventually meets stringent carbon emissions reduction goals that will help not only the city's climate goals but also those of the building's residents and businesses.

Lendlease is putting these goals into action at 30 Van Ness. Features of the LEED Platinum, WELL Silver building include electrochromic energy efficient glass, induction cooktops in most residential units, electric vehicle charging stations, over 300 bike parking spaces, an electric variable airflow volume system with 100 percent outside air capability, MERV 15 filters, and touch-free access systems. The absence of gas systems and cooktops in the building will increase the overall health and air quality of the building because of the absence of combustion burning.

Understanding that amenities such as induction cooktops and the lack of gas systems may lead to questions and hesitation from potential tenants and residents, Lendlease has built out a detailed marketing and education plan. The company's education and awareness-raising campaigns will help explain the energy savings of induction cooktops and benefits of the absence of gas systems.

SUPPORTING TENANT SUSTAINABILITY GOALS

Real estate owners are starting to recognize that all-electric buildings can be a beneficial marketing point to tenants who are seeking to reduce their carbon footprints. An increasing number of corporate tenants are keen to occupy space that helps achieve their own sustainability goals and provides a healthier and lower-cost space.

Tech companies like Google and Salesforce have participated in San Francisco's Zero Emission Buildings Taskforce as tenants, communicating their interest in prioritizing leasing in decarbonized buildings.[10] Microsoft's corporate campus redevelopment in Redmond, Washington, will be all electric, eliminating the use of fossil fuels within its buildings for daily operations including powering and heating as part of its goal to be carbon negative by 2030.[11] Adobe is adding a new, 18-story all-electric tower to its campus in San Jose, California, to reduce greenhouse gas emissions and demonstrate the company's commitment to power its operations with 100 percent renewable energy by 2035.[12]

Rendering of Adobe's all-electric tower in San Jose, California.

IMPROVING HEALTH AND SAFETY

Beyond the carbon reduction benefits of electric assets, additional benefits exist in improving health and safety of building occupants. The burning of natural gas poses health concerns and negatively affects indoor air quality. In addition, aging natural gas infrastructure or ruptures from earthquakes have caused fires or explosions in cities such as San Francisco.

Multiple studies have demonstrated the potential health impacts of gas combustion appliances. RMI's 2020 report "Health Effects from Gas Stove Pollution" indicates that gas stoves can emit elevated indoor nitrogen dioxide levels that exceed air quality indoor guidelines and outdoor standards.[13] Another study by the Lawrence Berkeley National Laboratory in 2014 showed that cooking with gas exposes approximately 55 to 75 percent of California homes to carbon dioxide and nitrogen dioxide pollutant levels that would exceed ambient air standards outdoors in a typical winter week.[14] Children are particularly susceptible to this pollution. A meta-analysis of health impacts of nitrogen dioxide from natural-gas cooktops found a 42 percent increased risk of childhood asthma.[15] This is especially pertinent in multifamily buildings and commercial kitchens with gas stoves.

Electric appliances provide an answer to tenants, residents, and consumers, who are increasingly demanding health and wellness features in the buildings where they work and live. Although gas stoves in residential units are a primary concern, any commercial asset that uses fossil fuel combustion—such as restaurant staff cooking at a gas stove or facility managers working in a boiler room—risks exposing occupants to dangerously high indoor air pollutants. Installing induction cooktops reduces indoor pollution, increases cooking efficiency, meets environmental goals, and can be a selling point to many potential residents interested in sustainability.

Further health and well-being benefits of all-electric buildings are that the higher-performance electric HVAC technology results in better indoor comfort. BlocPower, a New York City–based technology firm specializing in environmentally conscious retrofits, is working to renovate small multifamily properties with heat pump technology to meet energy and financial goals. The company touts "no more tenant complaints" as a benefit of modern (electric heat pump) heating and cooling because tenants can control their own comfort, airflow is quiet, and filters deliver healthy, purified air.

PROJECT PROFILE

ELECTRIC PASS LODGE

Aspen/Snowmass, Colorado | **East West Partners**

EASTWEST PARTNERS

North facade of Electric Pass Lodge in Snowmass, Colorado.

Climate change is always top of mind for those who live and work in mountain resorts where robust, predictable snowfall and manageable wildfire seasons are critical for local economies and quality of life. With its latest project, Electric Pass Lodge, East West is taking its approach to sustainability to the next level with a stringent eye on ongoing carbon emissions. Electric Pass Lodge includes 52 ski-in/ ski-out condominium residences in the heart of Snowmass Base Village in Snowmass, Colorado, that are all electric, ultra-efficient, and 100 percent powered by renewable energy. This focus on environmental sustainability is blended with amenities promoting health and wellness. A zoning-required village pool facility, powered by natural gas, is being constructed adjacent to and concurrent with Electric Pass Lodge.

East West has pushed the sustainability of Electric Pass Lodge to the forefront of its branding and marketing of the luxury for-sale residences, as opposed to a “check-the-box” type afterthought. Andy Gunion, Roaring Fork Valley managing partner for East West Partners, explains why this was an important distinction for the company: “If you own a home at a ski resort, you’re inherently invested in the preservation of snow. Nobody wants their ski home to contribute to climate change, but the reality is that most do—either through the burning of natural gas in the home itself or by receiving electricity generated from fossil fuel sources. With Electric Pass Lodge, we’re thrilled to offer buyers beautifully designed, high-performing, healthy residences that come with the peace of mind that when you turn up your heat, you’re not melting precious snow.”

EASTWEST PARTNERS

Rendering of interior condominium units at Electric Pass Lodge. Kitchens include highly efficient induction cooktops.

Project Architect 4240, along with sustainability engineer Integral, took a holistic approach to the design of the building's envelope and mechanical technologies as one unified system. The 100,000-square-foot building will include heat recovery systems, earth tubes, passive cooling, passive heating, and efficient lighting. Specifically, the project features the following elements:

- Triple-pane, operable windows with a fenestration ratio designed to balance energy conservation with solar gain and daylighting. While the entire Snowmass Base Village project is a LEED Neighborhood Development, Electric Pass Lodge will pursue LEED Gold certification.
- Solar photovoltaic panels on the roof will be combined with off-site renewable electricity provided by local utility cooperative Holy Cross Energy, through its PuRE program.
- Earth tube technology, which is tubing buried beneath the ground that absorbs heat/cold from the soil and conditions the air moving through the tubes, will be used in conjunction with heat recovery ventilators to precool (or preheat) a continual flow of fresh air circulating through each individual residence.
- Within the two- and three-bedroom residences themselves, state-of-the-art induction cooktops will be installed alongside electric water-vapor fireplaces with heat generators, ensuring residents do not miss out on the luxuries and comforts of traditional gas-powered mountain homes.
- The absence of any gas burning in the residences, the use of non-VOC-emitting materials, and the continual fresh-air circulation system that is isolated by residence puts the focus on indoor air quality.

Technologies That Enable an Electric Building

In commercial buildings, most fuel combustion is used for space heating, followed by water heating. Today's market offers off-the-shelf technology solutions to develop or retrofit all-electric buildings.

Table 2 outlines all-electric alternatives to commonly used fuel-combusting technologies. Some of the technologies described in the table have only recently gained popularity, but a number of them have been used by various industries for years. While this list is not exhaustive, it is a good starting point when considering all-electric building technologies.

It is important to note that electric replacement technologies are only a portion of the electrification and decarbonization pathway. All-electric buildings should incorporate efficient building design and technologies like those in table 3 to create the highest-performing building and most compelling financial business case.

TABLE 2: THIS FOR THAT: ELECTRIC TECHNOLOGIES TO REPLACE CONVENTIONAL GAS OPTIONS

Conventional gas option	All-electric alternatives
Gas boiler for space heating	**Heat pump (air source, water source, or ground source)** Instead of burning fuel to create heat, heat pumps use electricity to move heat from one place to another in ways that would not naturally occur. For example, a refrigerator is a heat pump; it takes heat out of the inside (even though it is cool) and pumps it to the outside (the typically warmer kitchen). Heat pumps are highly efficient, even in cold temperatures, because one unit of electric energy can “create” three to five units of heat simply by moving it from one place to another. Some heat pumps pull heat from outside air (air source), some from a water loop (water source), and some from the ground (ground source, commonly though incorrectly referred to as geothermal).
	Electric resistance boiler Electric resistance heating is efficient, with each unit of electric energy converted to one unit of heat, but not as efficient as heat pumps.[16] This technology is most compelling in dry climates with either hot or mixed temperatures.
Gas boiler for domestic hot water	**Heat pump water heater** Similar to heat pumps for space heating, heat pump water heaters use electricity to move heat from one place to another. While a standalone water heat pump can be purchased, they can also be combined with space heat pumps.
	Solar thermal water heater Solar water heaters capture solar energy and use it to heat water. Solar water heaters can be active, using pumps to circulate water, and passive, which do not.
Gas stove	**Electric induction cooktop** Instead of a gas heating element, induction cooktops directly heat cookware through magnetic induction. Induction cooktops boil water faster, cool down immediately upon removing a pot or pan, and cook food evenly and efficiently.

TABLE 3: EXAMPLE TECHNOLOGIES AND STRATEGIES IN ELECTRIC BUILDINGS

Technology	Description
Variable refrigerant flow (VRF)	VRF consists of an outdoor unit and multiple indoor units, all connecting for a central air conditioning system. In these systems, refrigerant is circulated through a series of pipes throughout the building to an evaporator.
Energy recovery ventilator (ERV) and heat recovery ventilator (HRV)	ERV/HRV do not provide fresh air and they cannot heat or cool on their own. Instead, they essentially preheat or precool so that the HVAC system has less work to do. These systems harvest energy from exhausted air to preheat/precool, reducing the amount of overall energy needed.
Passive heating and cooling (building envelope)	These strategies include improvements such as window glazing, insulation, thermal breaks, and air tightness. Upgrading these elements allows mechanical systems to be downsized, saving capital expenses and freeing up rentable square feet. These passive systems are low maintenance, improve tenant comfort, and provide critical resilience during energy outages, because the building can remain comfortable and occupiable for longer.
Grid-interactive optimization	This technology envisages a building with smart technologies that enable it to use distributed energy resource strategies and communicate with the utility in a demand/response mechanism. This interactivity optimizes the relationship with the electric grid while still accounting for occupant comfort and needs.
Battery storage	Buildings can use electric battery storage to save energy produced on site instead of sending it back to the utility grid. Batteries can dramatically reduce peak energy costs and improve carbon performance by charging during low-carbon times and discharging during high-carbon times.
Solar panels	Photovoltaic cells are grouped into panels to absorb the sun’s radiation, creating electricity while releasing no greenhouse gas emissions. Electricity from these panels can be used on site or stored in batteries, powering the building with clean energy and reducing the need to draw from the local power grid.

Challenges to Building Electrification

With the realities of today's markets, electrification of all commercial buildings does not yet make business sense. Barriers include conflicting building codes for new developments, building retrofit logistics, upfront equipment costs, social equity concerns, occupant preferences, and utility infrastructure. Real estate firms face a handful of challenges as they move to electrify; however, many companies and stakeholders are already identifying strategies to overcome these hurdles.

Conflicting Building Codes

California leads the way on all-electric building policies, with over 30 cities and counties requiring or encouraging all-electric new construction. However, the state's current building energy code is murky as to whether an all-electric building will meet code. Title 24, or the Building Energy Efficiency Standard, helps ensure energy efficiency and cost-effectiveness for building occupants. Updated every three years, the most recent round in 2019 allows all-electric single-family homes and low-rise residential designs to be given equal standing with natural gas; they will have their own baseline for compliance. Due to a lack of updated computer modeling availability for all-electric building designs, this could increase penalties for all-electric high-rise multifamily and office properties.[17] This has led some developers in California to design all-electric new developments that they can only hope meet code. Better alignment between policy, code, and incentives is necessary to build the business case and drive market uptake.

San Francisco skyline.

Building Retrofit Logistics

Retrofitting an existing building to be all electric is complicated and costly. When retrofitting a building, real estate owners and investors should consider the life expectancy of space heating and cooling equipment, physical footprint of equipment, and weather and climate-related concerns.

TIMING THE RETROFIT

The life cycle of building technology systems can make the logistics of electric replacements a challenge. Most space heating and cooling systems have long life cycles of 10 to 30 years. Instead of replacing all gas systems across a portfolio at once, building owners are instead slowly upgrading systems in an evolving manner as each technology reaches its end of useful life.

In addition, even if timing aligns for replacing systems, tenant lease terms may affect what work can realistically be done and when. It can be challenging to sync the investments for electrical equipment upgrades with the needs and demand for efficiency and sustainability. Leveraging tenant and resident turnover is optimal when possible, but many upgrades are planned on a longer-term timeline and implemented as lease renewal or equipment failure allows.

Morgan Creek Ventures, a small-scale Colorado-based development firm, started renovating a 2003 LEED Platinum building in 2020 to meet all-electric standards. Andy Bush, principal and founder of Morgan Creek Ventures, explains, “The hardest thing I find about renovation is what I think of as the ‘full building syndrome.’ It’s easier to renovate an empty building by changing out windows and converting it to all electric. But to change the heating and cooling system from a gas system to an all-electric system in a full building is much more difficult, and we have to be careful about that in light of mandated energy codes to avoid unintended consequences.” Despite the possible challenges, the firm is committed to overcoming the all-electric retrofit challenge and continues to integrate it as a core strategy moving forward.

MORGAN CREEK VENTURES

A 2003 LEED Platinum all-electric retrofit in Boulder, Colorado, by Morgan Creek Ventures.

LEVI PLAZA

San Francisco, California | **Jamestown**

JAMESTOWN, L.P.

Aerial view of Levi Plaza in San Francisco.

Jamestown LP set a goal of portfolio-wide net-zero-carbon operations by 2050. Physically, this requires eliminating the use of fossil fuels, which is concentrated in the use of natural gas to power assets' HVAC systems. Levi Plaza is one property in Jamestown's portfolio supporting efforts to achieve this larger goal, with building electrification being a key part of the solution. Over a four-year period, Levi Plaza will eliminate on-site use of fossil fuels by replacing boilers with electric heat pumps, generate solar electricity on site, and purchase 100 percent carbon-free electricity from the grid. These efforts position the property to be the first existing, large-scale commercial campus in San Francisco to reach net zero carbon.

Located in the Port of San Francisco along the Embarcadero seawall, the six-building campus has plans for renovation with a heightened focus on electrification, energy efficiency, resilience, and sustainability. Understanding the benefit of being an early adopter, Jamestown is strategically renovating the buildings to be all electric over a period to align with lease renewals and fit-outs—before being forced to do so by local legislation.

To electrify the building, Jamestown is engaging all stakeholders in the redevelopment process, from the construction manager to building tenants to the city of San Francisco's green buildings coordinator. The company sees itself as not just an operator, but as a full partner with tenants, working together to ensure spaces are sustainable, healthy, and inclusive.

The campus will provide a new level of resilience in a location subject to the dual risk of seismic events and sea-level rise. Jamestown is investing in resilience and hardening measures such as relocating critical equipment and increased waterproofing, especially considering studies that found that electrical infrastructure has only a one-week downtime after a 7.9-magnitude earthquake, whereas gas infrastructure has a six-month average downtime.

JAMESTOWN, L.P.

Local residents using Levi Plaza.

Renovation work across the Levi Plaza campus will be phased from 2021 to 2024 in conjunction with periods of major vacancy or tenant turnover at each building, beginning with 1160 Battery East and 1255 Battery:

- The HVAC central plant equipment at each building (currently powered by natural gas) will be replaced with all-electric systems.
- A photovoltaic system will be installed on building rooftops, starting with 1160 Battery West. This will completely power the fourth floor of the building, making it effectively a "net zero energy" space.
- A new dewatering system will be installed around the 1160 Battery buildings to protect against water intrusion.

"Levi Plaza is a great example of Jamestown's holistic approach to net-zero-carbon operations by 2050," says Becca Rushin, Jamestown's vice president of sustainability and social responsibility. "After reaching our 20 percent energy and greenhouse gas emissions goal early, we knew net zero was the next level and where the market was headed. Incorporating all-electric assets, like Levi Plaza, into our portfolio not only allows us to better collaborate with our tenants and help them achieve internal environmental goals, it also aids in moving the real estate sector writ large toward more decarbonization—something we feel is a critical need."

ENSURING ENOUGH SPACE

Another factor to consider is the physical footprint of each piece of equipment when upgrading from gas to electric building systems. On a one-to-one ratio, some electric systems are larger than their gas counterparts. For example, not all gas systems have dual space heating and cooling functions, whereas many electric systems do. Some gas systems may need to be paired with chillers, or potentially piping.

Although some reconfiguration of a central plant may be necessary when switching from gas to electric systems, footprint alone need not be the sole determining factor in a decision. It is necessary to view the entire network of base building systems as interconnected instead of as a one-to-one comparison.

CONSIDERING THE CLIMATE

Cold-weather climates pose additional technology hurdles. For example, heat pump systems may perform less efficiently in extreme cold temperatures since they function by transferring outdoor air inside. The technology has improved drastically in recent years to overcome the temperature hurdle, but in some areas this may still pose a concern. Typically, the systems work best in temperatures above 40 degrees Fahrenheit, but building owners can use certain strategies to protect the equipment, such as partially or fully enclosing parts of the system.

The Northeast Energy Efficiency Partnership keeps a list of cold climate air source heat pump (ccASHP) systems that meet the latest version of the ccASHP specification, considering temperatures as low as 5 degrees Fahrenheit. However, research now shows that heat pumps can heat homes down to −12 degrees Fahrenheit, and the state of Maine has even adopted a target to install 100,000 heat pumps by 2025, showing confidence in the technology.[18]

According to a 2019 Oak Ridge National Laboratory study, climate scenarios such as excessively high or low ambient temperatures, drought, flood, and high winds can negatively affect electric generation, transmission and distribution, and end use.[19] In the past, all-electric technologies such as heat pumps did not function in subfreezing temperatures, but today’s models are increasingly more resilient. Ultimately, real estate owners in extreme cold environments may need to consider whether a heat pump is the best technology for their asset.

Upfront Costs

Even for those with the financial means, the upfront and incremental costs of electric equipment—compared to like-for-like gas-fueled replacements—can deter owners from upgrading. Once the base building is completed in a new development, changes like a switch to all-electric equipment can become challenging and expensive. However, isolating the increased upfront costs from decreased operating expenses, decreased routine maintenance costs, and unknown future regulation implications is short-sighted. Long-term benefits of investments in electrification, whether during new construction or building retrofit, reap positive returns.

One example of companies overcoming this challenge to help small building owners afford all-electric technology is BlocPower's heat pump retrofit business. It uses a leasing model that requires no money down and no loan. Instead, low and predictable monthly payments are utilized while eliminating oil delivery, bills, and maintenance costs.

"Demand for mixed-fuel buildings could decrease because tenants are looking to reduce their carbon footprints. If so, this could place us at technology risk because transitioning to a lower-carbon, all-electric building through retrofitting an existing mixed-fuel building is difficult. This is because the current technology that enables switching from gas to electric heating is not yet cost-effective."

Kilroy Realty Corporation, 2019 Sustainability Report

Solar panels installed on the roof of a large industrial building or warehouse.

Social Equity Concerns

Low-income communities of color disproportionately suffer the health, environmental, and economic effects of fossil fuel use. These communities can benefit from electrification through healthier indoor air quality, lower energy costs from energy-efficient systems, and creation of new jobs. However, because of the upfront costs of retrofitting existing assets to all electric, targeted investment and empowered communities are needed to support an equitable transition.

> **"While building electrification has promising benefits for residents and for the state, it must be pursued equitably—ensuring that environmental and social justice communities can benefit, rather than being left with polluting and increasingly expensive gas appliances. It will require intentional policymaking and a planned transition for environmental and social justice communities to gain access to the major benefits of electrification, including cleaner air, healthier homes, good jobs and empowered workers, and greater access to affordable clean energy and energy efficiency to reduce monthly energy bills."**

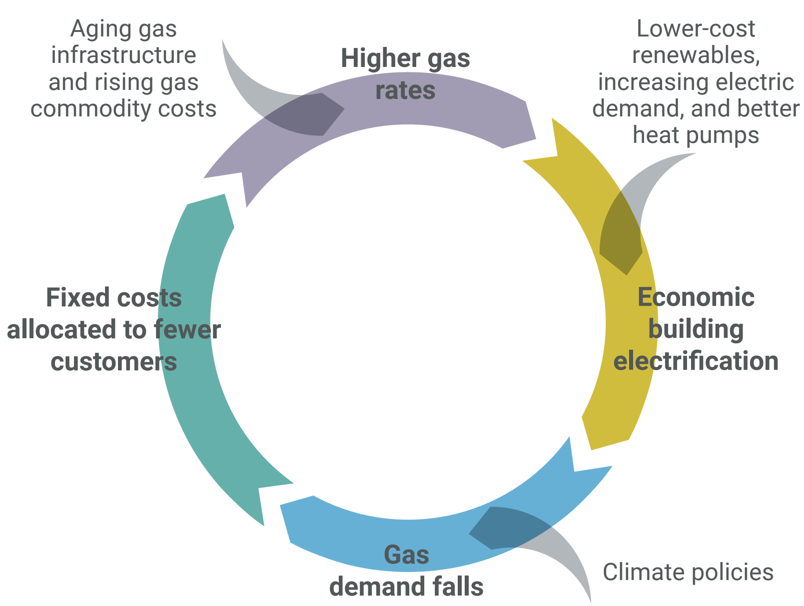
Greenlining Institute, Equitable Building Electrification (2019)

Electrification on display in Times Square, New York City.

RISING GAS TRANSMISSION AND DISTRIBUTION COSTS

As the natural gas system faces costly maintenance needs and increasing costs to operate aging infrastructure, rising transmission and distribution costs are passed down to consumers. Those remaining on the gas grid will share the rising burden of transmission and distribution costs. For example, Southern California Gas and Pacific Gas and Electric utility companies have already requested a 30 and 15 percent rate increase, respectively, by 2022.

RISING GAS COSTS LEAD TO DOWNWARD SPIRAL OF GAS SYSTEM



Social equity impacts as more customers move away from gas fuel sources. (Visual re-created with permission from Panama Bartholomy, Building Decarbonization Coalition.)

Rising gas costs could create a serious social equity divide as affluent consumers switch their building systems over to all electric, leaving behind the lower-income communities to bear the burden of these gas infrastructure costs. It exacerbates an already inequitable system and burdens lower-income households with higher gas bills as they are unable to afford or prioritize upgrades to all electric. Furthermore, with rising utility costs, these households risk falling deeper into debt and economic hardship in the long term but lack housing alternatives because those in their price range also operate on gas systems.

INCREASING ELECTRICITY COSTS

In the current market, electricity costs more than natural gas. This raises another equity concern for situations in which owners may decide a building should be all electric, but the occupants pay the utility bills. This is especially felt in multifamily properties where residents pay the electric bill, but the natural gas bill is often covered by the landlord.

"When assets are converted to all electric, the burden of the increased electricity usage falls onto the residents. While this isn't a reason to avoid going all electric, it brings up social and racial inequities that need to be addressed," explains Abhishek Dash, vice president of engineering management at BlocPower. In theory, a landlord could reduce a unit's rental rates based on the eliminated master gas bill, but that may not happen in practice.

PROJECT PROFILE

THE TYLER

East Haven, Connecticut | **WinnCompanies**

WINNCOMPANIES

Rendering of The Tyler in East Haven, Connecticut.

WinnCompanies recently completed the acquisition rehab of the 100-year-old East Haven High School building in East Haven, Connecticut. After sitting closed and vacant for over 30 years, the building underwent a $31.7 million historic adaptive use, creating 70 new high-efficiency mixed-income housing units for seniors 55 years of age and older.

The project, now called the Tyler, was the outcome of a successful public/private partnership between WinnCompanies and the city of East Haven, along with the Connecticut Housing Finance Authority. With a combination of federal and state historic tax credits and low-income housing tax credits, among other sources, including a grant from the utility-funded EnergizeCT initiative, the 104,000-square-foot four-story brick building was transformed between 2019 and 2020. The Tyler's 70 units and community amenity spaces are available to a range of residents, including formerly homeless individuals and households with incomes between 30 and 80 percent of area median income, as well as nonrestricted market-rate rentals. The Tyler is currently 85 percent occupied, including a number of residents who attended the original East Haven High School.

WinnCompanies views historic adaptive use and high-performance design as two critical components in meeting global carbon emissions reductions while creating new housing and economic development opportunities. The Tyler was designed and built in accordance with the Passive House Institute's EnerPHit program, which it accomplished by selecting and installing the following measures:

- A VRF system for heating and cooling;
- High-efficiency balanced ventilation with energy recovery;
- Comprehensive exterior envelope insulation and air sealing;
- Energy Star appliances and LED lighting; and
- A 90-kilowatt solar array.

The reuse of the building's existing materials, including brick, concrete, and wood, further contributes to the project's positive environmental goals through the avoidance of 18,000 metric tons of greenhouse gas emissions, or the project's embodied energy value. While these upgrades have helped the project meet environmental standards, the use of electric heating, rather than more traditional gas systems, has presented challenges during operations, from higher-than-expected operating costs caused by electricity pricing to resident comfort and training concerns related to lower temperature setpoints and thermostat controls.

"Historic adaptive reuse projects, such as the Tyler, are solving for two crises at once—a severe affordable housing shortage and climate change. While new development and curbing emissions are often competing goals, it is critical to identify and pursue the crossroads of the two in order to create and preserve healthy, sustainable communities. To achieve these goals, we need greater innovation from builders and manufacturers and the financial resources these types of projects require," explains Christina McPike, WinnCompanies' director of energy and sustainability.

WINNCOMPANIES

Solar array at The Tyler.

Occupant Preference

Many owners and developers are concerned about tenant and resident pushback on new electric appliances when they are more comfortable and familiar with traditional gas alternatives; this is particularly true for stoves. Some commercial restaurant tenants go so far as refusing to rent spaces without gas hookups. This causes many developers to either scrap plans for an all-electric building if they aim to attract certain restaurant tenants, or to install special gas lines only for the first-floor restaurant tenants. This can pose challenges when leasing or selling spaces. However, this situation is quickly changing. *Consumer Reports* in 2020 showed that six of the top eight ranges were electric, with the top two being induction stoves.

Major redevelopments like Brookfield's Pier 70 Building 12 in San Francisco are finding a way to appease retail tenants in the near term while planning for the long term. Alyse Falconer, associate principal at Point Energy Innovations, explains: "Alongside Brookfield Properties, we sought a highly sustainable structure and one which eliminates the use of fossil fuels and emission from on-site combustion at the HVAC and plumbing level. The only gas line in the building is in case tenants within Market Hall want to use gas-fired cooking ranges, but it's only a matter of time before the entire food service industry embraces and becomes comfortable with induction cooking."

To account for this inevitability in the future, Point Energy Innovations ensured that the electrical service was upsized to a point that it could maintain, and encourage, those Market Hall restaurant tenants to choose all electric more quickly. "On other projects, gas lines have been eliminated entirely, which can be a substantial cost saving, depending on project size. Even utility companies like Southern California Edison and Pacific Gas and Electric have Foodservice Technology Centers which embrace and showcase all-electric cooking appliances and options for chefs to use, in order to reduce the use of gas for cooking," adds Falconer.

EASTWEST PARTNERS

Rendering of Electric Pass Lodge in Snowmass, Colorado.

Induction cooktops have not only a high level of energy efficiency, but they also remedy the slow cooking times many consumers and chefs alike find with noninduction electric alternatives. Induction cooktops also offer health and safety benefits not found in either gas or electric cooktops because they cool down as soon as a pan is removed from the cooktop.

While earlier versions of induction cooktops required special pots and pans, newer models are compatible with cast iron, stainless steel, and all-clad pots and pans. Even so, Morgan Creek Ventures is one developer committed to all-induction models in its multifamily developments; Morgan Creek addresses occupant uncertainty about the technology by giving away pots and pans as a move-in gift to each new resident.

Notable Michelin-starred chefs like Thomas Keller are opting for induction cooktops in restaurants such as the French Laundry and Per Se because of their ability to cook and heat food evenly and quickly. Large food and beverage corporations like Nestlé are also getting on board: their entire test kitchen headquarters is all electric with induction stoves. And while induction cooktops might be relatively new to multifamily buildings and certain upscale restaurants, industries such as cruise lines, hospitality, and fast-casual dining have been using them for years to efficiently produce food for hundreds and even thousands of people.

Nonetheless, widespread education and awareness are still a critical step in getting more chefs, residents, and tenants to understand the benefits of switching to all electric. To help educate consumers and the industry, many nongovernmental organizations and companies already have campaigns underway. For example, the Building Decarbonization Coalition's The Switch Is On campaign[20] is helping educate and inform consumers on the alternatives to gas cooktops, and the Food Service Technology Center offers energy efficiency expertise and analysis on kitchen equipment such as induction cooktops.[21]

Electric induction cooktop.

Utility Infrastructure

In some regions, building owners and developers are concerned that the incremental increased electricity demand from all-electric buildings is more than the electric grid infrastructure can supply. This is further challenged by the anticipated increase in electric vehicles plugging into these buildings.

Utility infrastructure.

The electric utility grid can be taxed in a number of both short- and long-term ways. An increase in demand, such as during a heat wave or cold snap, could overly tax the grid in ways for which it is not prepared. Large-scale building electrification would convert the electric system to a winter-peaking system, which is a further challenge since renewable energy is less available in the winter.

In other cases, occupant-requested building amenities such as electric vehicle (EV) charging stations can have a heavy impact on the grid if both the utility and developer have not coordinated in bringing the building and charging stations online. And as more developers move to get ahead of pending local electrification regulations, they may deliver a higher percentage of all-electric assets, thus taxing the grid more quickly than it can handle. Some utilities have already denied developers' requests for extra EV charging stations because of the challenged infrastructure of the nearest substation.

The solution will require partnerships between real estate and utilities. Real estate owners and developers can also address the stress on the electric grid by improving energy efficiency and grid interactivity at the building level to reduce or shift the overall demand on the system.

FEBRUARY 2021: AN UNEXPECTED WINTER STORM

A lived example of grid reliability and infrastructure concerns occurred in February 2021 in Texas. The state was slammed with a rare winter storm that dumped feet of snow, paralyzed the local utility grid, shuttered power plants, and left millions of Texans without running water and power in below-freezing temperatures for days. For those with power, electricity prices skyrocketed around 75 times higher than usual to $9 per kilowatt-hour, leading some customers on market-rate plans to receive huge energy bills.[22] While numerous state officials first blamed renewable wind turbine failures, a lack of grid winterization affected all energy sources, including solar, nuclear, coal, and natural gas.

This storm was heralded as a "100-year storm," but climate change–related catastrophic natural disasters such as this are increasing in frequency across the United States. The situation in Texas was unique because the state's utility grid is deregulated, largely powered by natural gas, and not winterized to shield it from extreme temperatures and weather. Although the situation in Texas was caused by a combination of rare events, potential exists for a similar scenario in other states. Resiliency and security of the utility grid are as much a sustainability issue as a national security one.

Conclusion: Market Adoption in the Future

The future of an all-electric building sector is not a near-term possibility but is a long-term possibility that real estate owners and developers should begin planning for. Although widespread adoption of all-electric assets is not anticipated for at least five to 10 years, the gears are already in motion. The movement toward electrification and away from fossil fuel combustion in buildings is well underway, and savvy real estate owners and developers have already begun factoring this into their bottom line and strategizing about how it may affect business as usual.

Full electrification and ultimately decarbonization of the commercial real estate sector in an equitable manner will require collaboration among cities, the real estate industry, utilities, service providers, and building occupants.

Cities can pilot new electrification technologies in their own portfolios, provide policies and incentives for all-electric buildings, and develop a workforce capable of designing and managing these systems. Owners and developers can calculate and begin to build in the costs to move new and existing buildings away from fossil fuel combusting systems and invest in deep energy retrofits to reduce their demand on the grid. Infrastructure stakeholders and utility providers can address electricity generation, develop and incentivize renewable electricity sources, and ensure grid preparedness for increased building and electric vehicle demand. Service providers can educate their clients on industry trends and the business case for going all electric. Tenants and residents can educate themselves on gas alternatives, such as induction stoves, rather than avoiding them due to lack of awareness.

As indicated by the number of cities and local jurisdictions already passing some form of a no-gas building construction mandate, developers are rapidly having to meet increasingly stringent energy codes and building policies. In addition, the financial, technical, and environmental business case is becoming clearer and more compelling. Owners, developers, and investors who ignore the growing trend risk premature obsolescence of their assets and face growing operating and capital expenses as the rest of the market moves away from fossil fuels. Now is the time for real estate to consider its strategy for an all-electric future.

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Resources

The following resources and references can help real estate firms as the move to all-electric assets picks up.

Building Decarbonization Coalition

A nonprofit dedicated solely to decarbonizing the built environment, providing real estate with resources and tools, and analyzing the health and social equity benefits of going all electric.

Building Electrification Technology Roadmap, New Buildings Institute and Building Decarbonization Coalition

An in-depth look into technologies moving the market toward decarbonization and electrification in California. The roadmap covers both residential and commercial assets.

Cold Climate Air Source Heat Pump List, Northeast Energy Efficiency Partnership

Product list of air source heat pump systems that meet the latest version of the ccASHP specification.

Electrification of Commercial and Residential Buildings, Group14 Engineering, PBC for Community Energy Inc.

An evaluation of the system options, economics, and strategies to achieve electrification of buildings.

Equitable Building Electrification: A Framework for Powering Resilient Communities, Greenlining Institute

A holistic analysis of the social equity and health concerns caused by natural gas, and the disparities exacerbated by income, race, and geographic region. Also offers a pathway and framework for equitable electrification of real estate.

"Gas Stoves: Health and Air Quality Impacts and Solutions," Rocky Mountain Institute

An analysis of the risks and health impacts of cooking with gas and a dive into suggested alternatives and solutions.

Regulatory Solutions for Building Decarbonization, Rocky Mountain Institute

Tools and strategies for cities and states looking to decarbonize or introduce gas bans and electrification mandates.

UC Carbon Neutral New Building Cost Study, Point Energy Innovations

2017 study that compares the capital and operating costs for the University of California's developments of new buildings with gas-based heating systems to all-electric-based systems.

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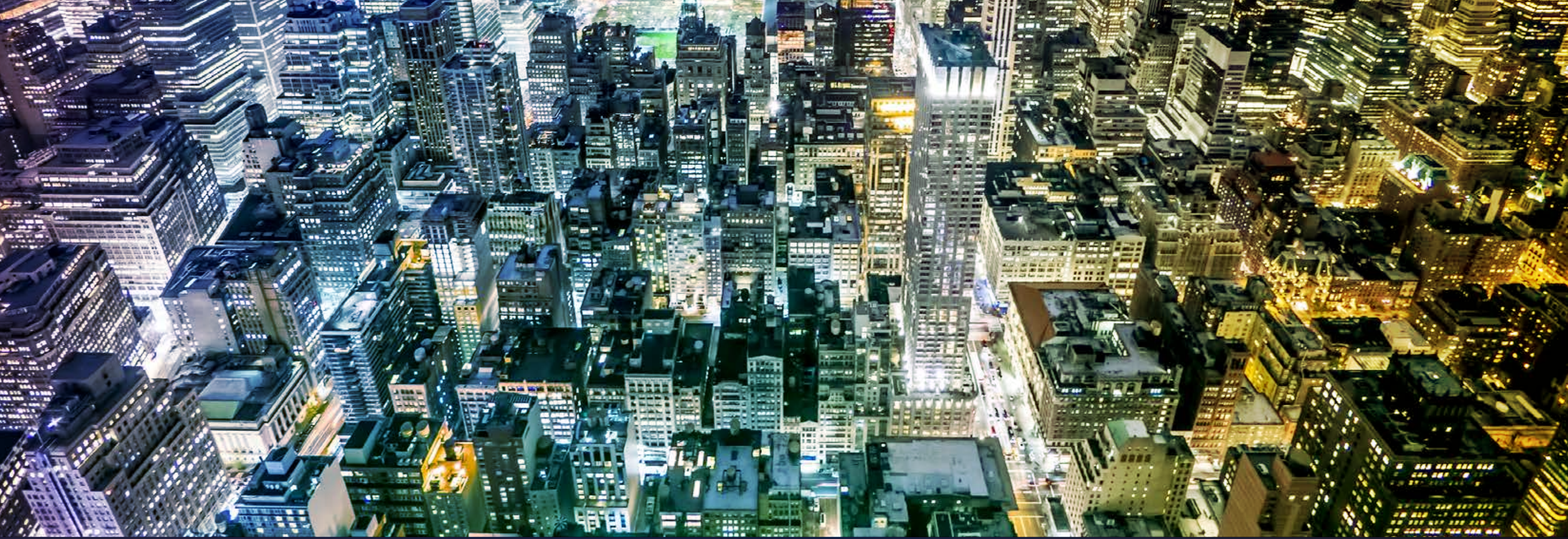

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