



WHITE PAPER

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- The 2020s is a decisive decade for global economy to reach decarbonization goal of limiting global temperature rise by 1.5C.
- Real Estate industry is facing time-sensitive challenges to decarbonize while investors and occupiers are making commitments for net-zero goals.

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Towards a Zero-Emission and Resilient Real Estate Industry: Global Outlook and Asia's Progress

The Intergovernmental Panel on Climate Change (IPCC) Special Report 6 released in August 2021 urged action to maintain a habitable planet for humankind. To avoid the most significant effects of climate breakdown, including limiting the global temperature rise by 1.5°C¹, GHG² emissions must be halved before 2030 and net-zero emissions must be achieved before 2050. The 2020 - 2030 is a decisive decade for global economy decarbonization³.

The real estate industry faces time-sensitive challenges to reduce carbon emissions, while investors and occupiers are making bold commitments at a fast pace, setting ambitious net-zero goals for 2030 or even sooner.

With this critical momentum, academics, scientists and regulators are working hard to calculate carbon externality and hold market players accountable through cost and business risk. Successful market transformation will require a combination of human capital and financial capital with novel solutions wrapped in innovative business models. In this white paper, we examine eight countries, European Union; North America, Australia, China, India, South Korea, Thailand and Singapore and their real estate market transition to net-zero emissions in three aspects: 1) Policy; 2) Capital markets; 3) Business innovation.

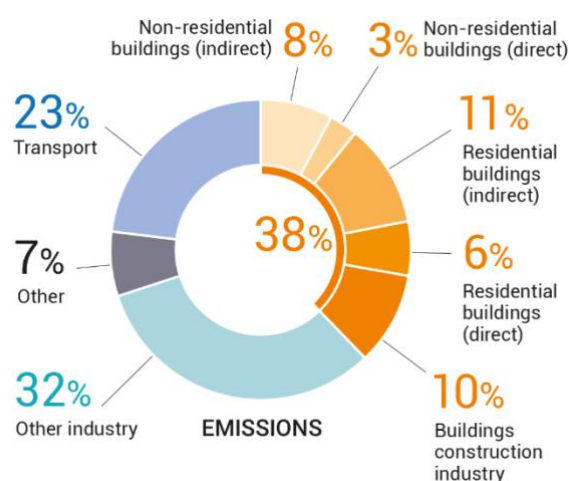
World political and business leaders are publicly committing their countries, cities, and companies to net-zero emissions and a 1.5°C target. The United Nations' Race-to-Zero campaign has mobilized a coalition of leading net-zero initiatives, representing 733 cities, 31 regions, 3,067 businesses, 173 of the biggest investors, and 622 higher education institutions⁴. The Net Zero Asset Managers initiative, launched in December 2020, aims to galvanize an international group of asset managers committed to supporting investments aligned with the goal of net-zero emissions by 2050 or sooner. As of Dec 2021, this initiative now encompasses 220 signatories globally, thus collectively holding USD \$57.4 trillion in assets under management. COP26, for the first time, had a specific focus on cities, regions and buildings. C40 is a network of mayors of nearly 100 cities collaborating to deliver the urgent actions needed to confront the climate crisis. C40 cities at the COP26 announced that more than 1,000 city and local governments around the world have joined the Cities Race to Zero, committing to limit the global temperature increase to 1.5°C⁵.

Buildings generate nearly 40% of annual global CO₂ emissions. Across real estate markets globally, building operations are responsible for 28% of total emissions annually, while building materials and construction (typically referred to as embodied carbon) are responsible for an additional 10% of total emissions annually⁶ (Diagram 1). The value of all the world's real estate assets reached \$326.5 trillion in 2020⁷. As the world's most significant store of wealth, real estate is more valuable than all other global equities and debt securities combined⁸. As extraordinary contributors to carbon emissions, real estate industry players in the construction, development, asset management and investment segments can play a substantial role in finding a solution. Decarbonizing real estate is key to achieving the net-zero economy. The World Green Building Council's Net Zero Carbon Buildings Commitment urges real estate businesses to reach net-zero carbon in operation for all assets under their direct control by 2030, and all buildings to be net-zero carbon in operation by 2050.

By 2045, the world's urban population will increase by 1.5 times to 6 billion. Almost half a billion urban residents live in coastal areas, increasing their vulnerability to storm surges and sea level rise. In the 136 biggest coastal cities, there are 100 million people – or 20% of their population – and \$4.7 trillion in assets exposed to coastal floods⁹. Around 90% of urban expansion in developing countries is near hazard-prone areas and built through informal and unplanned settlements. City leaders must move quickly to plan for growth and provide the basic services, infrastructure, and affordable housing their expanding populations need.

To get the buildings sector on track to achieve net-zero carbon by 2050, all actors across the buildings value chain must increase their decarbonization actions and their impact by a factor of five¹⁰. The touchpoint of real estate business interacts with many parts of the economy, such as energy, technology, urban infrastructure, finance and investment. Net-zero buildings require systematic change in the economy. In 2019, electricity consumption in building operations represented nearly 55% of global electricity consumption. This underlines the importance of a triple strategy to aggressively reduce energy demands in the built environment while decarbonizing the power sector and reducing lifecycle carbon emissions¹¹.

Diagram 1: Global share of buildings and construction emissions, 2019



[2020 Global Status Report for Buildings and Construction](#). United Nations Environment Program (2020). Dec 16, 2020

Policy

Decarbonization policies are evolving rapidly. Jurisdictions in the EU, US and Canada continue to enact regulations to eliminate carbon emissions. Property owners and investors are facing greater pressure to act¹². In 2020, the EU passed its “Renovation Wave” regulations—requiring a 60% reduction of carbon emissions in buildings over the next decade, along with an 18% reduction in heating and cooling demands. Bloomberg New Energy Finance estimates that in Europe alone, this will cost more than \$3 trillion (Coker & Champion 2021). The European Renovation Wave, which followed policy precedents from Los Angeles’s 2019 Green New Deal and New York’s Local Law 97, pulled the real estate industry into the epicenter of climate change action. Global top cities in all eight countries described here represent the biggest commercial real estate markets in their countries. As such, these cities lead municipal level decarbonization regulations. They are Boston, New York City, Sydney, Melbourne, Seoul, Bangkok, Beijing, Chongqing, Singapore. Their regulation mechanisms are a combination of carrots (incentives) and sticks (mandates), from energy codes, penalties, and mandatory green certification, to tax credit/rebates, subsidies and zoning incentives.

As EU and North America capital markets have been moving from voluntary to statutory ESG reporting requirements, regulations are transitioning towards more stringent, performance based decarbonization mandates. On March 2022 US Securities and Exchange Commission (SEC) propose public companies disclose climate-related information in their registration statements and periodic reports 10-k. The most important requirements relate to carbon emissions and physical climate risk exposure. In addition to simply reporting these details, the SEC also expects companies to describe how they’re actively managing the associated risks. The new SEC mandate will have significant impacts for publicly traded REITs and knock-on effects for private real estate funds.

European regulation like SFDR(Sustainable Finance Disclosure Regulation), the EU Taxonomy, and US new SEC climate disclosure rules propel the world's two largest real estate markets (US and Europe) into a regulated ESG reality. The era of voluntary disclosures based on arbitrary standards and self-defined approaches will quickly fade away. Market participants will now look to a smaller, legally binding set of prescriptions about what to disclose, when and how. Those real estate firms that adopt outcome-based targets and are able to deliver comprehensive, bottom up, granular, real time, automated and transparent ESG reporting will be those most likely to secure the influx of institutional finance targeting sustainable assets, as capital markets move from voluntary to statutory ESG reporting requirements¹³. Inevitably, such firms which have clear data and PropTech strategies.

Capital Market

The Glasgow Financial Alliance for Net Zero (GFANZ) - a group of more than 450 organizations in the financial sector, including banks, fund managers and insurance companies - have pledged to move US\$130 trillion of funds under their control into investments where the recipient is committed to net-zero emissions by 2050. Many organizations are working to establish standards, action plans to implement the net-zero goals. The International Financial Reporting Standards (IFRS) Foundation announced a new International Sustainability Standards Board to develop globally consistent and harmonized climate and broader sustainability disclosure standards for the financial markets. This step has been welcomed by Finance Ministers from more than 50 countries and subsequently received support from the G7 to make climate disclosures mandatory and transparent. The number of ESG regulations has grown over the past decades as more and more governments require green reporting standards. Sustainable Finance Disclosure Regulation (SFDR) became effective on March 10, 2021 as the EU regulatory standard for sustainable investing. SFDR imposes mandatory ESG disclosure obligations for asset managers¹⁴. Starting from 2025, all fund managers in the UK will be required to adopt the Task Force on Climate-related Financial Disclosures (TCFD), a new international standard for reporting on climate risks. Canada is now considering enacting the standard as well¹⁵.

The capital markets in India, China, Thailand, and South Korea are still in a nascent state compared to the EU, US and Canada. There is little demand for sustainability in real estate investment from domestic capital market investors; however, the trend is catching up. Investors in these Asian markets are gradually warming up to ESG standards. Funding for energy efficiency in the real estate market is primarily driven by government-owned entities and several global financing institutions. A few leading private institutions also have offerings in this segment but their impact has been very limited. Data transparency is also a critical issue in the Asian capital markets in India, China, Thailand, South Korea and Singapore. As one example, although the Thai SEC has stipulated the "One Report" disclosure standard, critics see issues of greenwashing among market participants that use the disclosure as a means of branding rather than taking concrete measures with validated data and performance on emissions and ESG performance.

In China, India, and Thailand, a few green bonds have been successfully issued by infrastructure companies, but no financial products specifically aim to fund net-zero building investments. In India, while several financial institutions have issued green bonds to provide lending for green projects, there has been no specific bond issuance by a real estate developer or by public authorities that earmark the proceeds towards green buildings. China is the second-largest green bond issuer globally. In 2018, China's internationally aligned green bond issuance reached USD 31.2 billion, accounting for 18% of global volume. These funds invest primarily in green transportation, renewable energy, and clean energy, with only 9% allocated to the building and construction sector. Although green bonds support lower financing costs; however, extra costs to borrowers are incurred during the process, such as certification expenditures. More green debt instructions and focusing on the building and construction sector and streamlined process is needed.

In China, South Korea, Thailand and Singapore, the national Emissions Trading Schemes (ETS) is considered one of the key financial instruments to achieve emissions targets. Singapore is the first Southeast Asian country to implement carbon pricing. The Carbon Pricing Act of 2019 encouraged emissions reductions in all sectors and helped the country transition to a low-carbon economy. In China, the national carbon trading market is under development, commercial banks will likely explore a series of financial products and services related to carbon emission reduction indicators and carbon emission quotas. On 1 January 2015, South Korea implemented a nationwide emissions trading scheme, the Korea Emissions Trading System¹⁶ in 2015 which was the second-largest energy trading market at that time after EU ETS. Thailand has also initiated efforts to establish domestic carbon market mechanisms. Thailand Carbon Neutral Network (TCNN) promote cooperation among government organizations, private sectors, and local communities by creating demands for carbon credit in line with the Thailand Voluntary Emission Reduction Program (T-VER) standards¹⁷.

Business Innovation

The EU, US and Canada markets see a booming business case for net-zero buildings. To date, there have been 136 verified and 547 emerging zero energy (ZE) projects in North America, representing over 62.7 million square feet of real estate, a number that has more than doubled in size since 2015. While ZE projects have expanded rapidly to almost every state in the U.S. and every province in Canada, they are largely concentrated in California and the Northeastern United States. Over the past two years, the greatest growth in ZE projects was seen in California, Oregon, New York, and Massachusetts. Publicly- and privately-owned ZE projects have grown at a similar pace, with the public sector continuously leading the market. Government offices, libraries, schools, and universities still account for a large portion of the ZE project list. In EU, US and Canada markets, net-zero energy new construction is becoming mainstream especially in the jurisdictions of Massachusetts; New York City, New York; Austin, Texas, Vancouver, British Columbia; and Toronto, Ontario. In those markets, new net-zero buildings enjoy strong government incentives and can be built with little incremental up-front costs.

As opportunities emerge, there are also challenges. One challenge has been to develop a ZE building in a dense urban context. It is hard for buildings over six stories to generate sufficient electricity onsite from solar photovoltaics to fully offset their energy usage, no matter how energy efficient. Another challenge is to develop ZE buildings for laboratories, hospitals, data centers, and other high-energy use types. In those situations, building owners must purchase additional renewable energy offsite to reach carbon neutrality.

In Australia, market demand and competition have created a virtuous reinforcement circle to drive change in the private sector. Many private sector players are already ahead of the game and are willing to go down the net-zero path before policy mandates require them to. In the EU, US, Canada and Australia markets, more and more companies are outpacing policymakers in their sustainability ambitions and actions.

Achieving a zero-carbon building for existing buildings requires changes to the operations of and/or retrofitting; for new buildings, it requires new construction methods, with embodied carbon across all building uses/types. Across the globe, in the earlier green building movement, we saw that the public building segment (also known as MUSH - municipal, university, school and hospital) had the greatest number of early adopters and pioneers in building sustainability. This segment consists of long-term owner occupiers. As a result, it's easier for them to work out financial structures for long-term investments. Commercial real estate, on the other hand, has extra challenges, including meeting short-term return targets, different lease structures, split incentives, etc. In China, India, South Korea, Thailand, and Singapore, few private developer-led net-zero commercial real estate projects exist. Almost all net-zero buildings are funded by the public sector, such as governments or universities, with exemplary projects currently underway in China, India and South Korea.

Leading real estate firms across the globe are investing capital into the technology (i.e. PropTech) solution, such as IOT, AI, Digital Twins to advance energy efficiency, ESG goals and decarbonization. When the real estate industry transition into a low-carbon emission paradigm, environment sustainability expertise, technology and data skills, will become as important as real estate skills and capital-market skills. Any firm that tries to decouple those skills will not only face severe consequences from regulators, but also significant barriers to fulfilling the ESG goals of future investors and raising the capital.

Challenges and Opportunities

In 2017, the United Nations Environment Program estimated that the global building floor area is expected to double by 2060, adding more than 230 billion m² to the planet in new buildings construction¹⁸. Asia is driving the global urban development boom. By 2025, more than half of the world's urban population— 2.5 billion people—will live in Asia. In India, 70% of the commercial and high-rise residential buildings that will exist in 2030 are yet to be built in the next 10 years¹⁹. China, the largest building construction market in the world with up to 2 billion square meters constructed annually, will account for nearly 50% of new construction globally in the coming decade²⁰. South Korea is proposing new city

development across its nation, bringing large-scale infrastructure and real estate development outside the existing city center.

Asia will also be a big part of the net-zero solution. In COP26, several Asia economies formally committed to a net-zero economy: 2070 (India), 2065 (Thailand), 2060 (China), 2050 (South Korea). Real estate owners, operators, and developers will continue to see opportunities in innovative financial mechanisms that can advance net-zero new construction and net-zero building retrofitting. The first financial lever is ESG mandate from equity capital. Second is the green financing mechanism from debt investors. Thirdly, carbon credits are one powerful tool to offset the emissions from buildings. Reliable carbon measurement technology and procedures may provide a foundation to launch building decarbonization credits for building sector players. As a result of rapid urbanization, population growth and infrastructure needs, China's estimated climate-smart business investment potential will be \$15 trillion by 2030²¹. This includes \$773 billion in new renewable energy, \$12.9 trillion for low-carbon buildings. This creates significant opportunities for generating renewable energy, improving green buildings, and building sustainable cities.

According to the Global Alliance for Buildings and Construction, to achieve the global decarbonization target, net-zero energy and carbon-neutral buildings must become the primary form of new building construction across all economies by 2050. This means prioritizing performance-based, mandatory building energy codes. It also means collective action by all actors along the real estate industry value chain to reduce the demand for material and lower embodied carbon and to adopt nature-based solutions that enhance building resilience. PropTech startups across China, India, South Korea, and Thailand primarily offer brokerage and transaction-based services, with little focus on real estate sustainability. Future opportunities in sustainability-focused PropTech will unfold as the region's real estate industry transitions towards zero-emission buildings.

In urbanized regions such as the EU, US, and Canada, opportunities are focused on accelerating action on building retrofits; developing and implementing decarbonization strategies for refurbishment and retrofits; increasing renovation rates and depth; and encouraging investment. The market transformation at scale can only be achieved when private sector players have both incentives and capability. The emerging private sector net-zero buildings signal that older assets and new building decarbonization can be financially feasible. Market leaders have already validated the value proposition of decarbonization investment via green premiums and competitive advantage. Investors are creating social and financial returns with sustainability. However, for in-between assets, decarbonization will require that perfectly functioning assets be retired and then replaced with something more efficient, a goal that may not be financially feasible. A 2020 McKinsey Europe report highlighted that 80% of all required retrofits do not yield financial benefit. Spending on energy efficient buildings increased in 2019, the first time since 2016, with investments in energy efficient buildings across global markets increasing to USD \$152 billion. However, this remains a miniscule proportion of the USD \$5.8 trillion spent in the buildings and construction sector²². The speed of change lags behind overall building construction investment.

Profit of decarbonizing the building sector is not enough to drive change at scale. The real issue is to spur faster and more scalable action. The decarbonization of buildings must rapidly increase in scale and pace to stay on track of the Paris Agreement goal. To support the decarbonization of new and existing buildings, effective policies and regulations are being launched across jurisdictions in the US and the EU to cover the entire building life cycle, including the design, development, operation and decommissioning stages, and also to act beyond site boundaries through neighborhood planning and renewable energy development. To accelerate action, greater collaboration is required across a range of stakeholders, including policy makers, urban planners, architects, construction companies, material suppliers, utility companies, developers and investors.

Highlights of the eight country chapters:

Europe

- The European Green Deal 2019 laid out a concrete strategy for reducing the greenhouse gas emissions by at least 55% by 2030 from the 1990 levels. The European Commission formulated and passed the Climate Law 2021 which included a legally binding target of net-zero greenhouse gas emissions by 2050.
- Individual countries, guided by the Paris Agreement mandate as well as the European Union directives and other legislation, are formulating policies to achieve specific goals. The UK, France, Germany and the Scandinavian nations are at the forefront of enabling legislation and implementing programs and funds for the net-zero real estate sector, with the goal of reaching the EU target. The UK has announced that from April 2020 onwards, all privately-rented homes in England and Wales which are required to have an Energy Performance Certificate must have EPC band E as minimum energy performance rating unless a valid exemption has been secured. Wales launched the Optimized Retrofit Programme with £20 million budget and a novel 'whole-building approach' towards decarbonization of homes and social housing
- 94% of real estate entities (institutional investors, listed property companies, non-listed real estate fund management companies) have defined an ESG policy for their real estate investments. 48% use the GRESB. The main drivers of ESG policies are investor demand, the opportunity to mitigate short- and medium-term risks, and the potential to increase asset value.
- Europe is at the forefront of ensuring the adoption of ESG regulations into business decisions in the commercial real Estate sector. Projects have been undertaken to achieve net-zero targets. For example, Aviva Investors announced plans to reach net-zero emissions across its £47.3 billion real estate platform over the next 20 years. Hines European Core Fund (HECF) is another market leader in ESG at the global level. In the River Green Finance deal, Goldman Sachs Group Inc's unit promoted the first-ever European green commercial mortgage-backed securities deal, structured around a €196.2 million loan for an office property in a Paris suburb.

North America

- The policy goal of the United States and Canada is to reach net-zero emissions economy by 2050. In Canada, many major cities like Vancouver and Toronto, as well as provinces such as Quebec, Newfoundland, and Labrador have pledged to decarbonize. In the United States, 23 out of 50 states have created emission-reduction targets and 12 have developed carbon-pricing guidelines, with concentrations in California and the Northeastern United States.
- Approximately 76 percent of American investors have already adopted or are considering adopting ESG criteria. The value of ESG in real estate includes enhanced returns, risk management, and compliance with ESG regulations. The United States, led by the government-backed mortgage giant Fannie Mae, is the largest source of green bonds in the world. There are 21 green banks across the United States. These financing vehicles have generated \$1.69 billion in 2020 to reach \$7 billion in cumulative green bank investment, growing at their fastest pace in years.
- In recent years, more than a dozen real estate companies, including office REIT, Boston Properties; industrial REIT, Prologis; data center REIT, Equinix Inc.; real estate services, Colliers International Group Inc., etc., have made net-zero pledges and aligned their sustainability strategies with the objective of achieving net-zero emissions by 2050.
- Emerging PropTech sectors are catalyzing the transition to net-zero buildings. These include: energy-as-a-service; building management and automation; heating and cooling technologies; advanced building materials; distributed energy solutions; carbon reporting; smart façades and windows; and lighting technologies.
- A 2019 RMI report finds the cost increase to build a zero-energy or zero-energy-ready home is modest—far less than consumers, builders, and policymakers realize—and highlights methods builders and policymakers can use to drive increased market penetration. Costs are expected to continue to decline over time as this market matures.²³ Federal tax credits and other local incentives are available in both Canada and the United States to offset the cost for energy saving features. Massachusetts is a national leader in affordable zero-energy buildings. Zero-energy buildings being built in Massachusetts bear zero additional up-front costs given today’s incentive structure.

Australia

- At COP26, Australia released the Long-term Emissions Reduction Plan to reach net-zero carbon emissions by 2050. At the forefront of the public sector initiatives are local municipalities such as the City of Sydney or City of Melbourne, both of which have the highest degree of control through Local Environmental Plans that guide land use and management. The Commercial Building Disclosure (CBD) Program requires that landlords or agents obtain a Building Energy Efficiency Certificate (BEEC) before any commercial building goes on the market for sale, lease or sublease.

- ESG investing is on a strong upward trajectory, with investment in environmentally sustainable properties showing substantial growth. Investors and portfolio owners are starting to adhere to more stringent green strategies with many equity investors in the real estate sector; in particular, the Australian Stock Exchange (ASX) listed real estate developers and owners to recognize the value of investing in sustainability, with many investors committing to net zero.
- Lenders within the Australian debt market are recognizing the value of incorporating ESG criteria in their lending decisions as this can lead to cheaper wholesale funding through the issuance of green bonds. Such investments mitigate risk given that the value of sustainable loan collateral is more resilient and of higher value. Furthermore, green investments help lenders achieve internal ESG targets within their own organizations. There is however a shortage of sustainable financing in the Australian market. This shortage may be attributable to issuers not knowing what assets qualify.
- According to the latest Global Real Estate Sustainability Benchmark (GSREB), the Australia and New Zealand real estate market is the world's greenest, with Australia topping the GSREB rankings for an 11th consecutive year. Much of its' success can be attributed to the private sector already being ahead of the game as they recognized the value of sustainability early on and were willing to pursue net-zero goals before these elements the public sector push.
- As a growing market with strong competition and high demand, the real estate sector has responded in new and innovative ways through the development and implementation of newer technologies with a focus on sustainability. Examples include the use of digital twins, cross-laminated timber, glue-laminated timber, green walls, heliostats, trigeneration and district cooling plants.
- There is a growing interest in the use of timber in building construction to tackle the issue of embodied carbon. The commercialization of timber as a key resource for achieving net-zero carbon buildings can be accelerated especially for high rise construction

China

- In 2021, China's State Council issued the "Action Plan for Carbon Dioxide Peaking Before 2030", which proposed to accelerate updates to the energy efficiency of buildings, municipal infrastructures, and other standards to improve energy savings and carbon reduction requirements. According to the Action Plan, by 2025, green building standards will be fully implemented in new buildings in urban areas.²⁴ Since 2010, China's central government has carried out 87 low carbon pilots, comprising 81 cities and six provinces. More than 60 of these pilots have committed to peak carbon emissions before 2025. Beijing has stated it will maintain a steady decline in carbon emissions after peaking in 2021–25. Various provinces and cities have also rolled out measures and regulations to attain decarbonization goals.

- China has gradually required listed companies to disclose ESG information. However, quantitative information appears insufficient in most real estate companies' ESG reports: only 31% of them released an independent ESG report, with only 3.36% of the ESG reports have been assured by an independent third-party auditor.
- China is the second-largest green-bond issuer globally. In 2018, China's green-bond issuance reached US\$31.2 billion, accounting for 18% of global volume. However, only 9% is allocated to the building and construction sector. Green bonds show less flexibility than conventional corporate bonds and require greater building specifications, reducing the number of potential issuers. Ample opportunity remains for Chinese real estate companies to issue green bonds to achieve green development targets.
- China is implementing significant policies to address climate change, including restricting coal consumption. The cumulative investment potential for the construction of new green buildings in China may be around \$13 trillion by 2030. As carbon reduction is mostly driven by the public sector, China's current exemplary net-zero building projects are primarily public buildings, with minimal engagement by high-quality private developers. Market leader firms include Hang Lung Properties, Link REIT, and Swire Properties. Mainland real estate companies are gradually focusing on reducing carbon emissions, while still in search of action plan and pathway.

India

- With the recent net-zero commitment by the Indian government at COP26, the fine print for net-zero buildings is still awaited and is expected to be rolled out over the course of the next few years. Current policies focus on net-zero energy buildings through energy conservation and the use of renewable energy. The Energy Conservation Building Code 2017 governs compulsory and optional energy-saving measures during the design, construction, and operation of commercial buildings. Green building and net-zero energy building ratings have been emerging across the country.
- Equity financing options for green and net-zero buildings are limited. Venture capital is available through the Bureau of Energy Efficiency and capital subsidies are available through the Indian Renewable Energy Development Authority. There are few investments by the International Finance Corporations in equity of Banks for onward lending for green real estate projects. Debt financing is available primarily from government institutions and public sector banks with early interest by some private banks. The recent emergence of REITs and green bonds suggests the possibility of future growth. The Reserve Bank of India is likely to issue licenses for Green Banks in the near future.
- Business innovation in net-zero buildings is primarily dominated by government-sponsored projects. Examples include Indira Paryavaran Bhawan, New Delhi, and the Indian Institute of Technology, Jodhpur. Early interest has been exhibited by private players such as Godrej Group and Infosys. These buildings are financed through internal company accruals. Developers such as

Godrej Properties, DLF, Lodha Group, etc. have voluntarily disclosed their ESG initiatives in their annual ESG reports. Godrej Properties is the leading developer with a GRESB score of 95/100.

- Despite having a significant number of proptechs, there is a limited presence of proptechs addressing construction and property management sustainability and net-zero buildings.
- The real estate sector will require a huge infusion of capital over the next decade in order to achieve growth in green bonds, green banks, and sustainability-focused REITs. The capital requirement is high for both developers as well as proptechs. There is great potential for collaboration with local players in terms of technology and capital.

Thailand

- Climate change is currently addressed at the highest policy level under the National Strategy, and a plethora of regulations, acts and plans have been promulgated by the Thai government. Thailand has a large network of governmental bodies that focus on its climate change issues; energy consumption in the building sector is one of the key elements of the bigger picture. The Bangkok Climate Change Master Plan specifically aims to reduce GHG, including many FAR incentives and tax rebates for green-certified real estate projects.
- While the Thai SEC has stipulated some renewed reporting standards, Thailand lacks pragmatic financial instruments and sophisticated financial markets to support the development of green buildings. Thailand is, however, on track to establish carbon pricing, trading and offsetting scheme, as well as environmental taxation.
- Two private real estate developers and construction material manufacturers have taken the UNFCCC Race to Zero campaign pledge: Charoen Pokphand Group and Siam Cement. Several real estate firms, including Central Group, AWC, LPN, and Pruksa Real Estate have taken initiatives to reduce the carbon footprints of their projects.
- There're many exemplary projects, new and retrofitted, that demonstrate Thailand's endeavor toward sustainable urbanization, but they're by and large focused on green-certified buildings. Thailand currently has no net-zero buildings. Thailand, and especially Bangkok, is highly vulnerable to climate change impacts. But its real estate sector has not yet focused on adapting to climate change. Electricity consumption in the building sector almost doubled in the past decade, becoming the most rapidly increasing sector in terms of electricity consumption. Few case studies suggest Thailand's real estate sector is adapting to climate change except flood-prone areas.
- Proptech startups in Thailand are mainly centered around brokerage and transaction-based services, with little focus on real estate sustainability. Thailand also lags in terms of real estate climate-tech (i.e., solar energy and geothermal harvesting, next-gen building materials and novel construction methods, technologies to enhance existing buildings' resilience to climate change). Future investment opportunities lie in green building construction/management, and also nascent

renewable energy applications in real estate. Further research is needed regarding the development and market acceptance of green technology.

South Korea

- There are robust policy frameworks on both the national level and in big cities in South Korea. The Paris Agreement is a transition point in the country's policy setting. After the Paris Agreement, policies were enacted more frequently and goals became stricter and more ambitious. Key policies include: Korean New Deal and The 2050 Carbon Neutral Strategy of The Republic of Korea.
- South Korea implemented the Zero Energy Building (ZEB) Standard in 2017. According to the Mandatory ZEB Implementation Roadmap, ZEB will become a compulsory certification for new public buildings in 2020. By 2030, all new buildings with a total floor area of more than 5380 sqf will comply with the zero energy building code. A limited number of ZEB certifications were implemented before it became a mandatory standard. The mandatory ZEB certification will substantially affect the development of the Korean real estate market.
- Established in 2019, The Smart City Act regulated city development and provided a sandbox for developers to try out new technologies for green city development. It is another driving force to accomplish city-level emissions reduction through infrastructure improvement, energy monitoring and management through technologies and building regulations.
- While sustainability is always a philosophy embraced by big developers, ESG is a new concept. Few developers have established ESG strategies. This is likely to change as capital market investors are actively adopting ESG in their investment strategies. Other finance mechanisms have been promoted by the government to advance real estate sustainability. These include green debts, the emission trading system, and the Green Growth Trust Fund.
- Zero energy projects are mostly driven by the government. Government-owned developers play an important role in developing pilot projects. Private developers are actively pursuing zero energy developments, but the overall number is limited. One public sector led new city examples are the zero-energy city development known as OCEANIX City. The city of Busan, UN-Habitat and OCEANIX have partnered to build the world's first sustainable floating city prototype off the coast of Busan. OCEANIX City will house 10,000 residents across 75 hectares and is poised to become the world's first resilient and sustainable floating community.
- South Korea has leading information technologies but its proptechs in energy and sustainable development sectors are still limited. ICT technologies and infrastructure bring zero-energy sector innovation opportunities. New public-private cooperation will accelerate the implementation of zero energy policies as well as investment in sustainable material, construction, supply chain, new and renewable energy.

Singapore

- Singapore published a Long-Term Low Emissions Development Strategy in April 2020, with the goal of halving emissions from their peak in 2030 to 30 Mt CO₂e by 2050. Singapore is the first Southeast Asian country to implement carbon pricing. In the Singapore Green Plan's Greener Infrastructure and Buildings, Singapore agrees to:
 - 2025 targets:
 - Reduce energy consumption of desalination process from current 3.5kWh/m³ to 2kWh/m³
 - Integrate waste and used water treatment facility to be 100% energy self-sufficient (Tuas Nexus)
 - 2030 targets:
 - Green 80% of Singapore's buildings (by gross floor area) by 2030
 - Ensure 80% of new buildings (by gross floor area) to be super low energy buildings from 2030
 - Build best-in-class green buildings to see an 80% improvement in energy efficiency (over 2005 levels) by 2030
- The Monetary Authority of Singapore (MAS) announced in 2021 that it will spend US\$1.8 billion (about S\$2.4 billion) in climate-related investment opportunities. Singapore Budget 202 will issue green bonds for S\$19 billion worth of infrastructure projects, bolstering the nation's ambitions to transition to a low-carbon economy and become a leading green finance hub in Asia and beyond.
- Singapore is taking action in three main areas in order to counteract greenwashing and, as a result, improve the credibility of the green finance sector. From 2023, the Singapore Exchange (SGX) proposes that obligatory climate reporting be implemented in (i) financial, (ii) agriculture, food and forest products, and (iii) energy sectors. From FY 2024, the (iv) materials and buildings and (v) transportation sectors must follow suit.
- In 2017, SGX began voluntarily recommending the Task Force on Climate-related Financial Disclosures (TCFD) framework for sustainability reporting. SGX is the first Asian exchange to propose enforcing climate disclosures in accordance with the TCFD recommendations.
- So far, Singapore has only two zero-energy buildings. One was developed by the National University of Singapore and the other is Keppel Bay Tower by Keppel Land. It's Singapore's first Green Mark Platinum (zero energy) commercial building. Keppel Land took advantage of a BCA grant to test five new and emerging energy-efficient technologies in Keppel Bay Tower. These technologies aim to significantly reduce the building's energy consumption and improve its energy efficiency by 20% compared to other BCA Green Mark Platinum buildings. Keppel Bay Tower was certified as a Green Mark Platinum (zero energy) skyscraper by the Building and Construction Authority (BCA) in 2020. It is Singapore's first commercial building to receive this honor.

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