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U.S. GREEN BUILDING COUNCIL
USGBC

CARBON NEUTRALITY

SHIFTING TO NEUTRAL TO DRIVE REAL ESTATE SUSTAINABILITY IN CHINA

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CONTENTS

EXECUTIVE SUMMARY

Climate change today is the result of human-activity-induced greenhouse gas (GHG) emissions, and changes in global weather patterns.

Moving forward, it has been suggested that limiting warming to 1.5 °C (2.7 °F) would necessitate halving emissions by 2030, then achieving near-zero emissions by 2050. But whether this is achievable or not is currently a question up for debate.

According to the World Resources Institute (WRI), China can produce nearly US$1 trillion in net economic and social benefits in 2050 by adopting an ambitious net-zero climate plan.

Ahead, China's 14th Five Year Plan (FYP) looks set to build upon the environmental sustainability initiatives China has undertaken in the past. Strengthened climate and air pollution control measures will ensure the road ahead in the region will be healthier and cleaner as the country moves to carbon neutrality by 2060.

According to 'The 2020 Global Status Report for Buildings and Construction' report by the United Nations, while global building energy consumption in 2019 remained steady on an annual basis, energy-related carbon dioxide emissions increased to 9.95 Gt in 2019. When adding emissions from the building construction industry on top of operational emissions, the building sector was responsible for 38% of total global energy-related carbon dioxide emissions.

In order to reduce the amount of energy used by, and carbon emissions from, buildings in China, it will be important to take the next step and go carbon neutral.

Looking at whole building lifecycle carbon, the amount of energy and water used during a building's lifespan needs to be considered. When ruminating on this, many aspects about a building project have to be assessed, including:

- **The proposed use of the building;**
- **The proposed design of the building;**
- **The proposed building systems, plant and machinery used in the buildings;**
- **The extraction of the building materials;**

- The processing and manufacturing of the building materials;
- The transportation of the new building materials;
- The construction of the building;
- The operation, management and maintenance of the building;
- The re-use/disassembly of the building (if known);
- The transportation of the old building materials;
- The recycling of the old building materials, and;
- The landsite where the rest of the old building materials will be deposited.

Before building, operating and re-using/dismantling a building, it will be important to execute on the right whole-building lifecycle approach and to do this, the following elements will also need to be taken into consideration:

- Carbon offsetting;
- Carbon avoidance;
- Embodied carbon, and;
- Operational carbon.

Additionally, the COVID-19 outbreak has brought to the attention of investors, developers and landlords of commercial real estate space in China the importance of building health and safety, building wellness and wellbeing, and building environmental sustainability.

Much of the attention has also been brought about by a further push by authorities for environmentally sustainable development as well as by investment capital that is environmental, social and governance (ESG) principals-driven and/or environmental sustainability-driven, such as green financing capital. Given the 'green' development momentum of late, these drivers are increasingly going to become key influencers in the development and operational decision making of commercial building investors, developers and landlords in China.

In addition, more and more real estate developers and real estate fund companies have joined the Global Real Estate Sustainability Benchmark (GRESB). Some companies operating in China have been participating in the assessment for many years.

Green building in China is still continually developing and growing and alongside this development and growth, GRESB will be used more in the country for measuring the sustainability performance of real estate companies and real estate funds because:

- It incorporates a rounded methodology;
- It has a clear assessment goal;
- It is an international like-for-like standard that can be used in different jurisdictions across the globe, and;
- It is a standard that is continually evolving.

Finally, when considering optimal carbon neutrality solutions for commercial buildings, collective and early involvement of all professionals within the design team is essential.

INTRODUCTION

Failing to alleviate climate change could have negative consequences for the planet that we live on. Weather systems could be altered and whole ecosystems could change. If these occur, the knock-on effects will undoubtedly affect our everyday lives. As the understanding of what could happen grows so people around the globe are putting pressure on governments, businesses and themselves to take action, and one often-talked-about solution of late is going carbon neutral. In this report we will look at:

Climate change and the importance of going green

What China has done and is expected to do

How real estate can help

Taking the next step – Going carbon neutral

A whole lifecycle carbon reduction plan – A road map for real estate investors/ developers/landlords in China

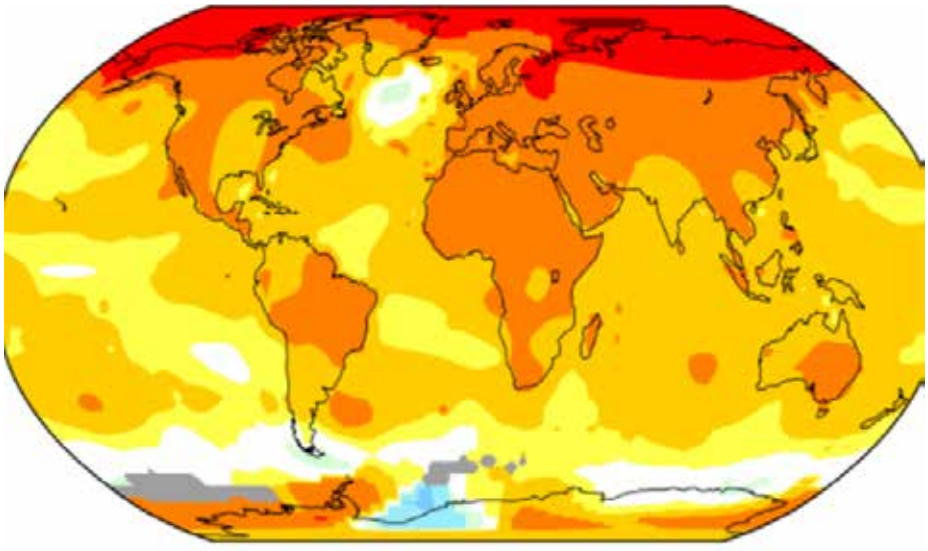
Other considerations and what's in it for real estate investors, developers and landlords

CLIMATE CHANGE AND THE IMPORTANCE OF GOING GREEN

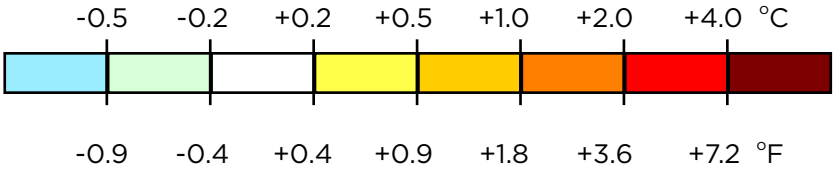
Climate change today is the result of human-activity-induced greenhouse gas (GHG) emissions, and changes in global weather patterns. Since midway through the last century, humanity has had an extraordinary bearing on Earth's climate and this influence has caused great change (Figure 1, Figure 2 and Figure 3).

Figure 1:

Global temperature change over the last 50 years



2011-2020 average vs 1951-1980 baseline



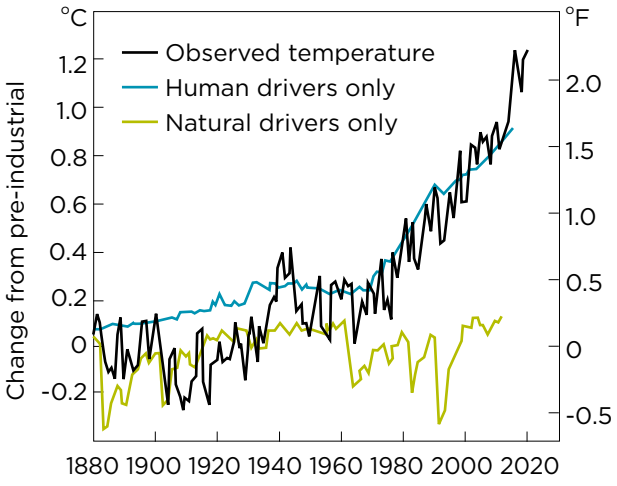
Source: NASA, Cushman & Wakefield Research

The foremost cause of warming is GHG emissions – 90% carbon dioxide and methane. The main source is fossil fuel burning for energy consumption, with additional inputs from agriculture, deforestation and industrial processing.

Subsequent temperature rise is leading to desertification, heat waves and wildfires. Intense evaporation is resulting in severe weather and storms. Temperature rise is also contributing to melting sea ice, permafrost and glaciers and rising sea levels. Additional warming will likely activate additional tipping points.

Figure 2:

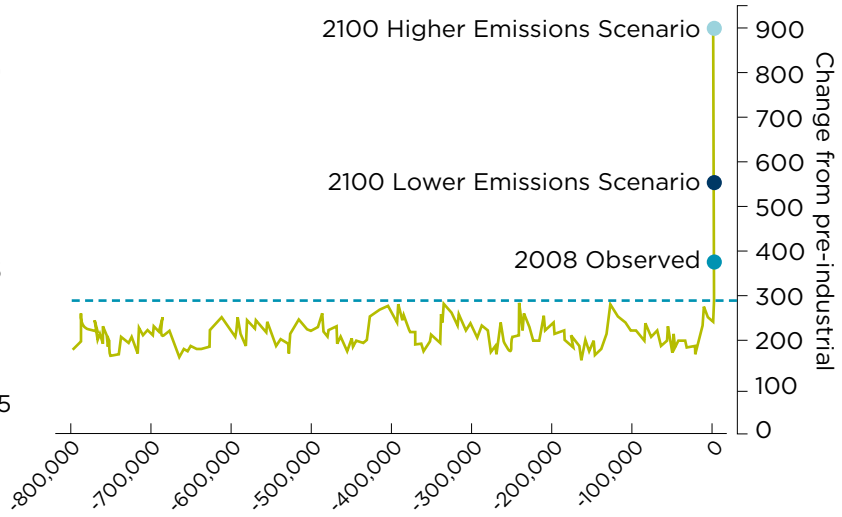
Global surface temperature (1880-2020)



Source: NASA, Cushman & Wakefield Research

Figure 3:

Carbon dioxide concentration over the last 800,000 years



Source: GlobalChange.gov, Cushman & Wakefield Research

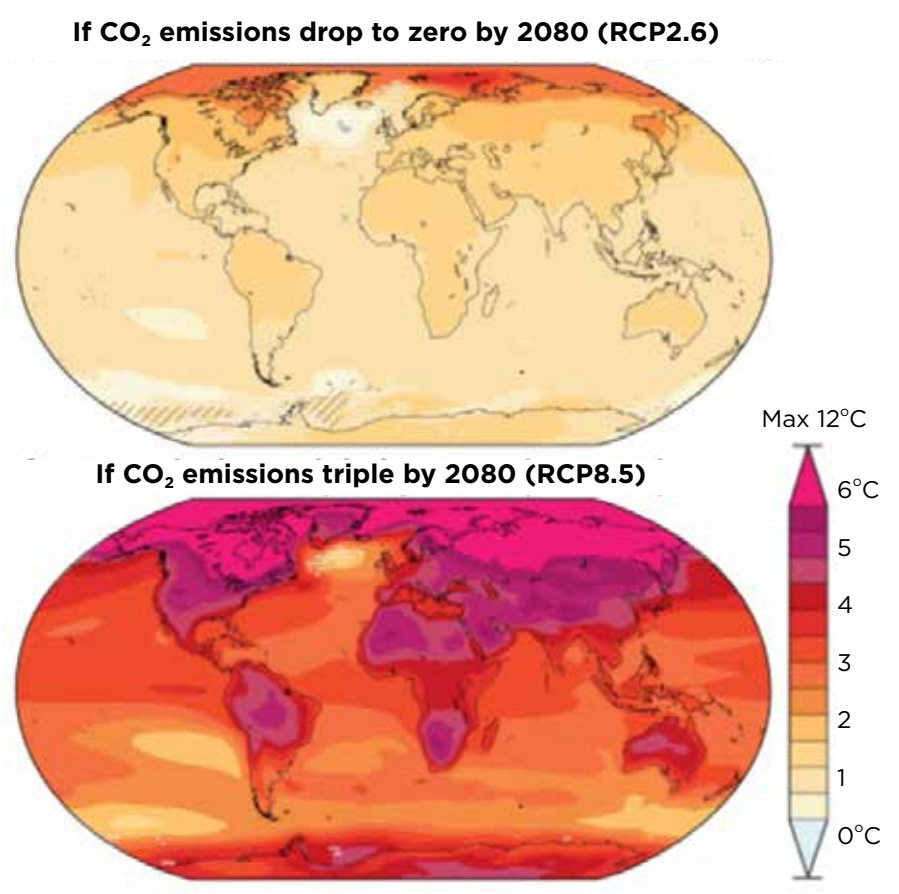
Impact on natural ecosystems and humanity is now evident, from coral depletion to mountain glacier retreat, and from reduced crop yields to climate change-induced migration.

Moving forward, it has been suggested that limiting warming to 1.5 °C (2.7 °F) would necessitate halving emissions by 2030, then achieving near-zero emissions by 2050. But whether this is achievable or not is currently a question up for debate (Figure 4).

Additional GHG emissions will cause a further increase in warming, a greater amount of climate change and a bigger change for ecosystems and people.

Figure 4:

Projected change in temperatures by 2080



Source: IPCC Fifth Assessment Report, Cushman & Wakefield Research

WHAT CHINA HAS DONE AND IS EXPECTED TO DO

According to the World Resources Institute (WRI), China can produce nearly US$1 trillion in net economic and social benefits in 2050 by adopting an ambitious net-zero climate plan. By pursuing such a plan, the resulting benefits will include:

- Cost savings related to fuel, operation and maintenance;
- The prevention of countless premature deaths, and;
- The reduction of carbon dioxide emissions.

Ahead, China's 14th Five Year Plan (FYP) looks set to build upon the environmental sustainability initiatives China has undertaken in the past. Strengthened climate and air pollution control measures will ensure the road ahead in the region will be healthier and cleaner as the country moves to carbon neutrality by 2060.

Leading the charge to carbon neutrality could be some of China's more developed economic regions, such as the Beijing-Tianjin-Hebei area, the Yangtze River Delta area and the Guangdong–Hong Kong–Macao Greater Bay Area. In these areas, new green initiatives, new green industries and new green jobs could be generated over the course of the next decade.

Targeted green deployment policy and action can take many forms, including:

- The promotion of renewable energy adoption and usage;
- The promotion of green industry;
- The promotion of green energy transportation;
- The promotion of carbon removal industry, and;
- The promotion of green construction and green real estate.

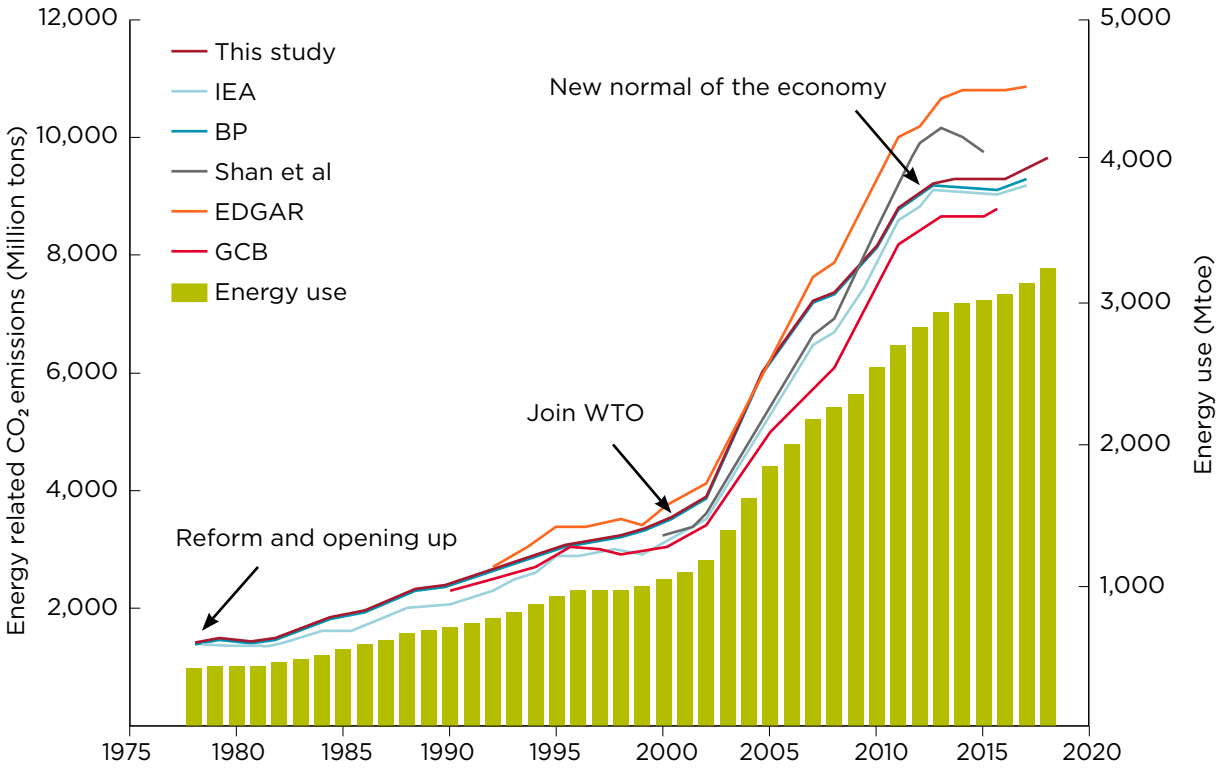
When looking at the past, China has experienced some profound changes including:

- Rapid economic growth;
- Extensive urbanisation, and;
- Poverty alleviation on a large scale.

However, many of the changes that China has experienced have come at an environmental cost, including greater natural resource-derived energy consumption, pollution and carbon dioxide emissions. According to the National Bureau of Statistics, China's total energy consumption in 2019 was 4.86 billion tons of coal equivalent, a growth of more than 700% when compared with 1980. What's more, according to the International Energy Association, in 2018, China's total energy-related carbon dioxide emissions reached 9.8 Gt, the largest in the world (Figure 5).

Figure 5:

Annual energy-related carbon dioxide emissions and energy use in China (1975-2020)

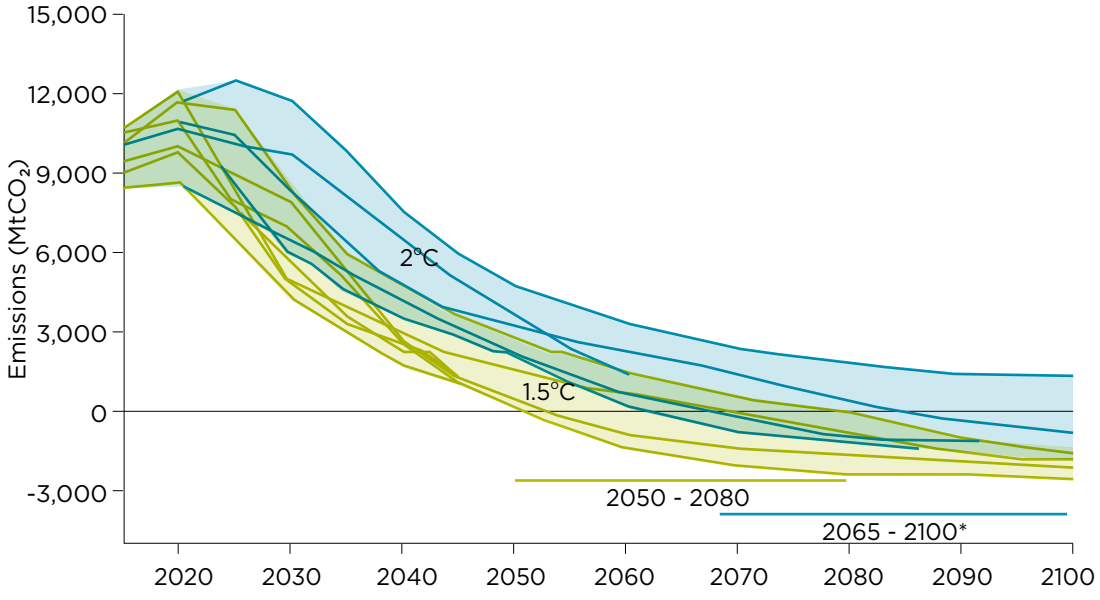


Source: PNAS, Cushman & Wakefield Research

Looking to the future, to fulfil its 2060 carbon neutral goal, China will look to adopt and implement more robust sustainable and low-carbon emission plans in the mid- to long-term, and looking to China's recent environmental sustainability track record, this can be achievable (Figure 6).

Figure 6:

China's carbon dioxide emissions for 1.5 degrees centigrade and 2.0 degrees centigrade scenarios from selected models (2020-2100)

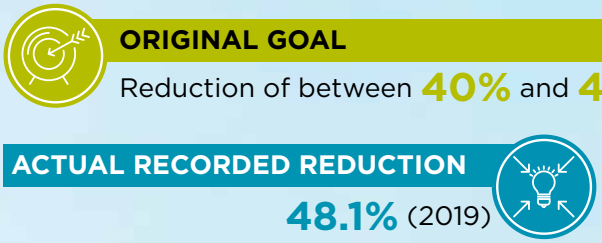


Source: NRDC, Cushman & Wakefield Research

In 2009, China projected that by 2020, carbon dioxide emissions per unit of GDP will be lessened by between 40% and 45% when compared with 2005. In 2015, China further suggested that carbon dioxide emissions would top out around 2030 and that carbon intensity would drop by between 60% and 65% when compared with 2005. When looking at recorded data, China's carbon intensity actually decreased by 48.1% in 2019 when compared with 2005, surpassing the original 2020 goal ahead of time (Figure 7).

Figure 7:

China's carbon intensity goal (2020)



Source: UNCC, Cushman & Wakefield Research

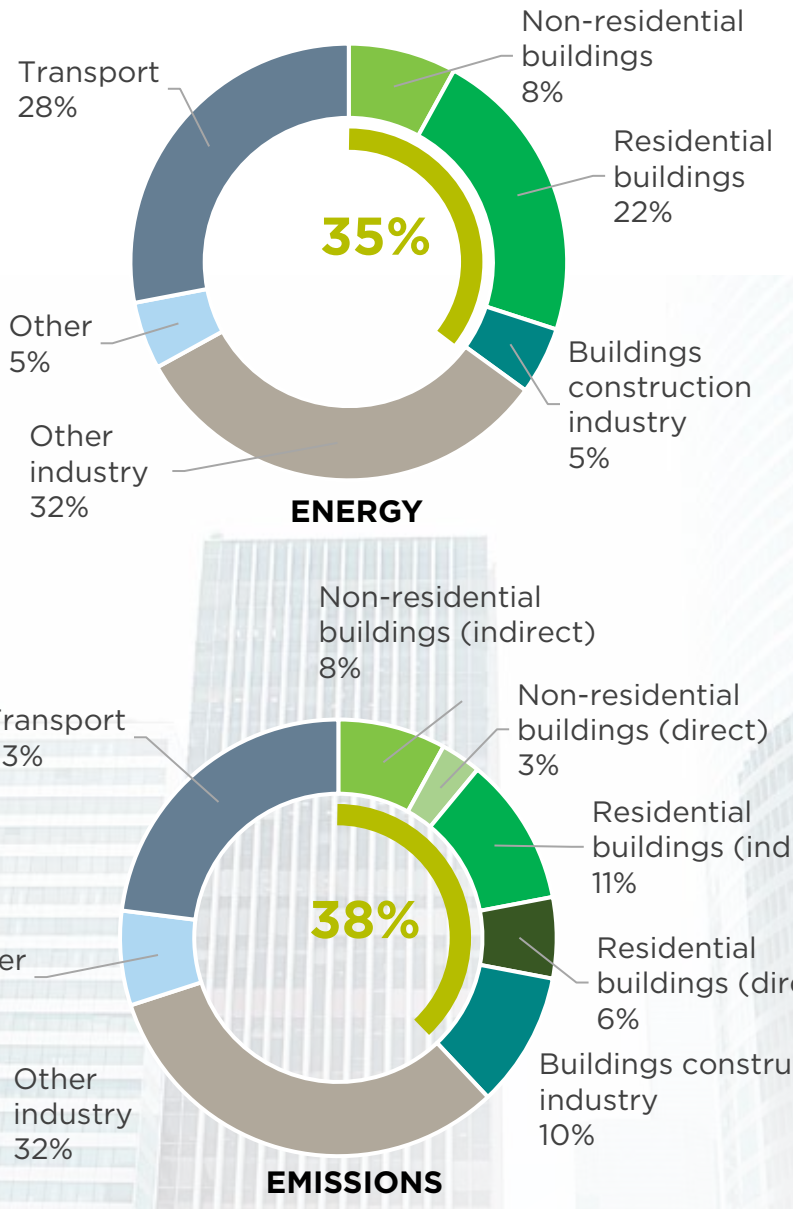
HOW REAL ESTATE CAN HELP

According to 'The 2020 Global Status Report for Buildings and Construction' report by the United Nations, while global building energy consumption in 2019 remained steady on an annual basis, energy-related carbon dioxide emissions increased to 9.95 Gt in 2019. When adding emissions from the building construction industry on top of operational emissions, the building sector was responsible for 38% of total global energy-related carbon dioxide emissions (Figure 8).

Figure 8:

Global industry energy consumption and energy-related carbon dioxide emissions (2019)

Source: IEA, UN, Cushman & Wakefield Research



Given this sizable contribution to energy consumption and energy-related carbon dioxide emissions, there is much that real estate can do to cut related totals and to ensure the general global environment remains on a sustainable footing.

Real estate in China also has a big part to play in this goal. Estimates suggest around 50% of the world's construction will take place in China during the next 10 years. The country already builds around two billion sq m of new floorspace each year and if this amount was built on a single storey basis, the footprint would be 1.3 times the size of London.

Over the years, China's economic growth considerably amplified the energy use by the built environment in the country. According to the BBC's Future Planet Series, from 2001 to 2016, the primary energy consumption in China's building sector more than doubled to around a billion tons of coal. What's more, the carbon cost of building construction, including the raw materials and energy utilised throughout the supply chain, contributes to around a fifth of China's carbon emissions.

In order to reduce the amount of energy used by, and carbon emissions from, buildings in China, it will be important to take the next step and go carbon neutral.

TAKING THE NEXT STEP – GOING CARBON NEUTRAL

Via best-practice design and choice of materials used, efficient buildings with low energy and water use can be visualised and built. Energy demand can be lessened by augmenting the building volume and positioning, by means of vigilant design of the building envelope and by stipulating energy/water-efficient building services and controls.

Moreover, by setting up a carbon budget, a real estate investor, developer or landlord in China can better make sure that carbon neutrality remains central to all undertaken projects. The objective is to minimise emissions from materials and energy throughout the lifecycle of every building and to equalise all emissions with climate-positive schemes.

According to White Arkitekter, six steps to take to work towards carbon neutrality include:

- **Outline a well-defined target;**
- **Concur on a carbon budget and follow through throughout the project;**
- **Make use of what is already there;**
- **Curtail the use of materials and energy demand;**
- **Select materials and energy sources that have a low climate impact, and;**
- **Offset the remaining emissions.**

We also think water demand and sources should be taken into consideration as well.

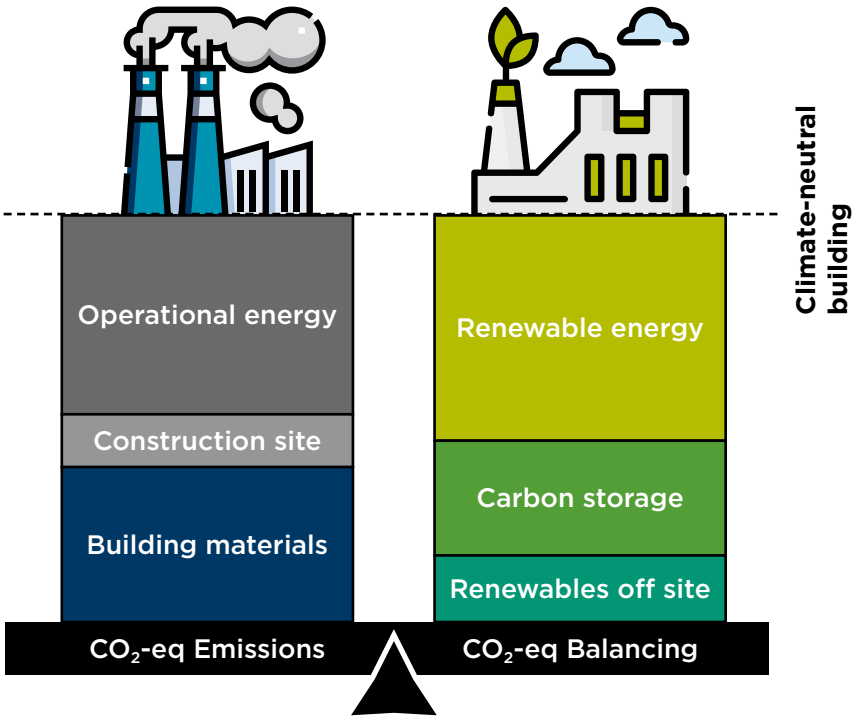
All existing buildings have a carbon footprint and this footprint includes:

- **The carbon generated by the building materials used within the building's internal and external fabric;**
- **The carbon used in the building's construction;**
- **The carbon used in the overall operation of the building, and;**
- **The carbon used in the dismantling or renovation of the building (if known).**

When thinking of going carbon neutral, it is important to find a balance between the carbon used and a carbon compensating green initiative to be implemented. A carbon balance calculation is a useful tool for reducing the climate impact of a building throughout its lifecycle (Figure 9).

Figure 9:

Finding a balance for a climate neutral building



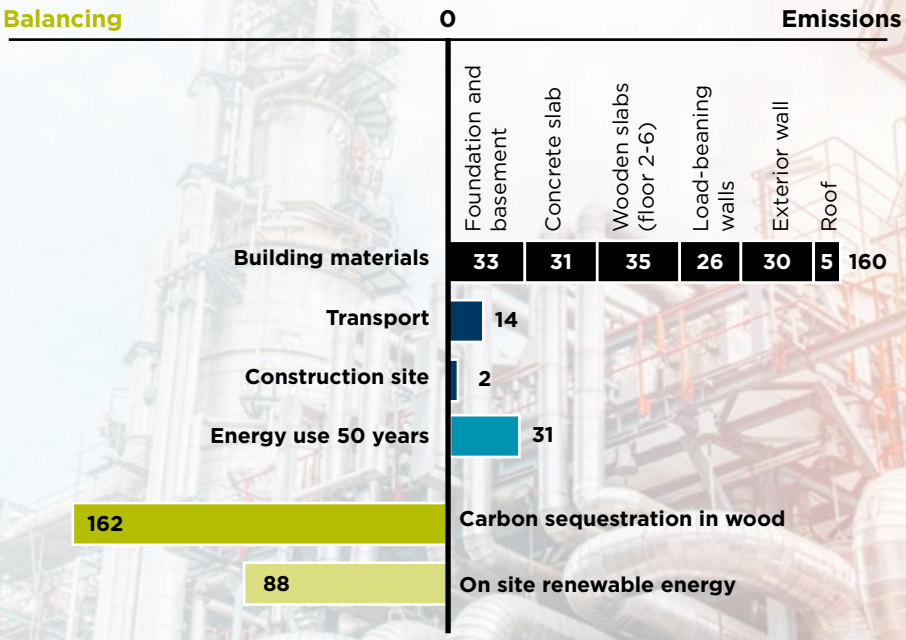
Source: White Arkitekter, Cushman & Wakefield Research

Going one step further, in 2022, the Swedish Board of Housing, Building and Planning is expected to introduce "Carbon Declarations". For building projects in Sweden, the emissions that transpire during the extraction and manufacturing of building materials and products, as well as emissions arising during the construction phase, must be reported. From here, the next step will be reporting on the emissions from energy use during the building operational stage as well as the climate-balancing approaches embraced (Figure 10).

Figure 10:

An example of a building 'carbon declaration'

Heated floor area **12,000 m²** | Total no. of floors **6** | Area solar cells **1,100 m²**



SUMMARY

Total emissions
207 kg CO_2-eq

Total balancing
-250 kg CO_2-eq

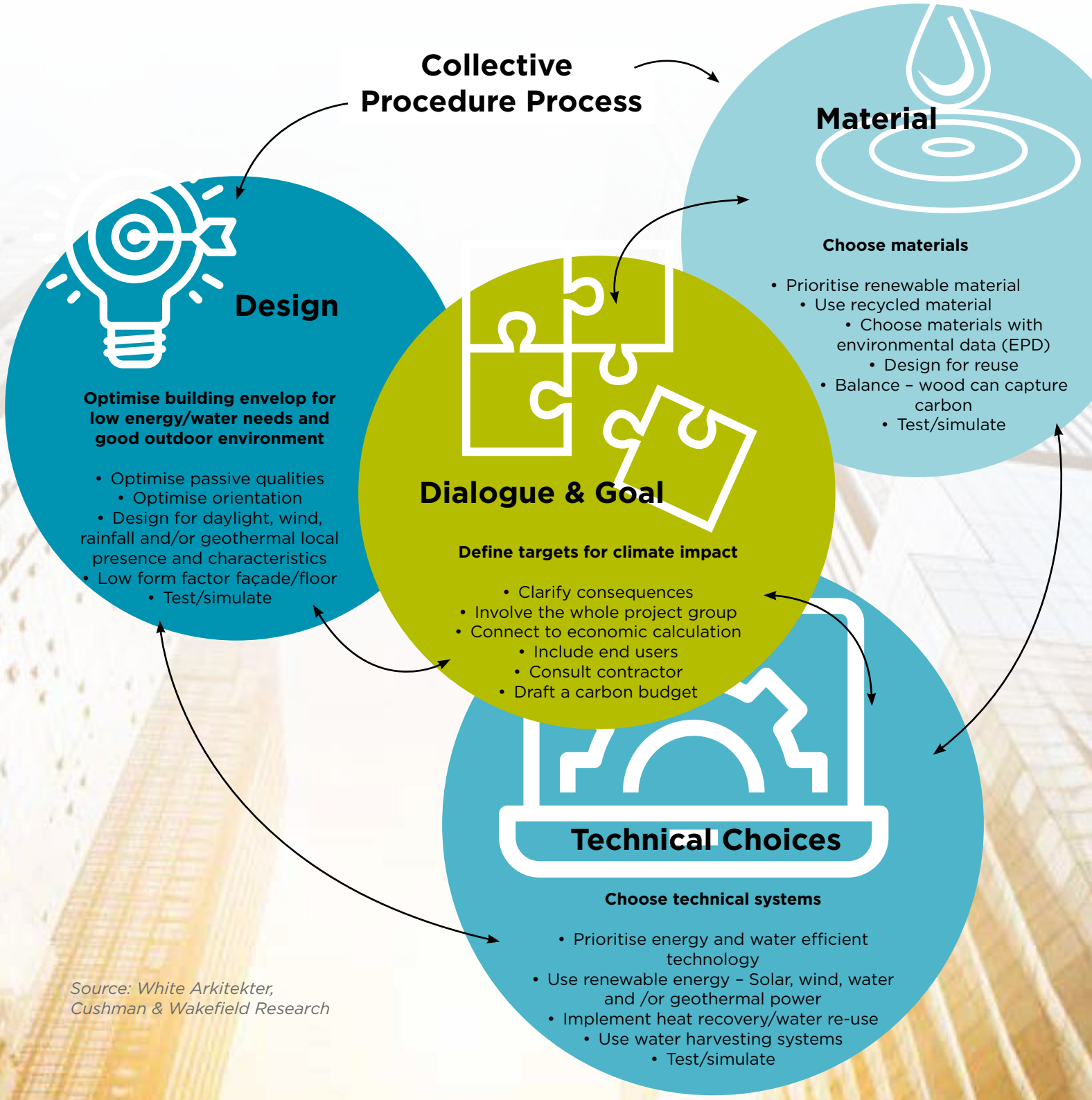
Summary climate impact
-43 kg CO_2-eq

Source: White Arkitekter, Cushman & Wakefield Research

To better realise carbon balance and carbon neutrality in a building, collaboration is also needed across all partaking parties, as well as an unremitting follow-up throughout the whole project. Therefore, it is essential that a joined-up, collective procedure process is adopted for each project (Figure 11).

Figure 11:

An example of a collective procedure process for a carbon neutral building project



Source: White Arkitekter, Cushman & Wakefield Research

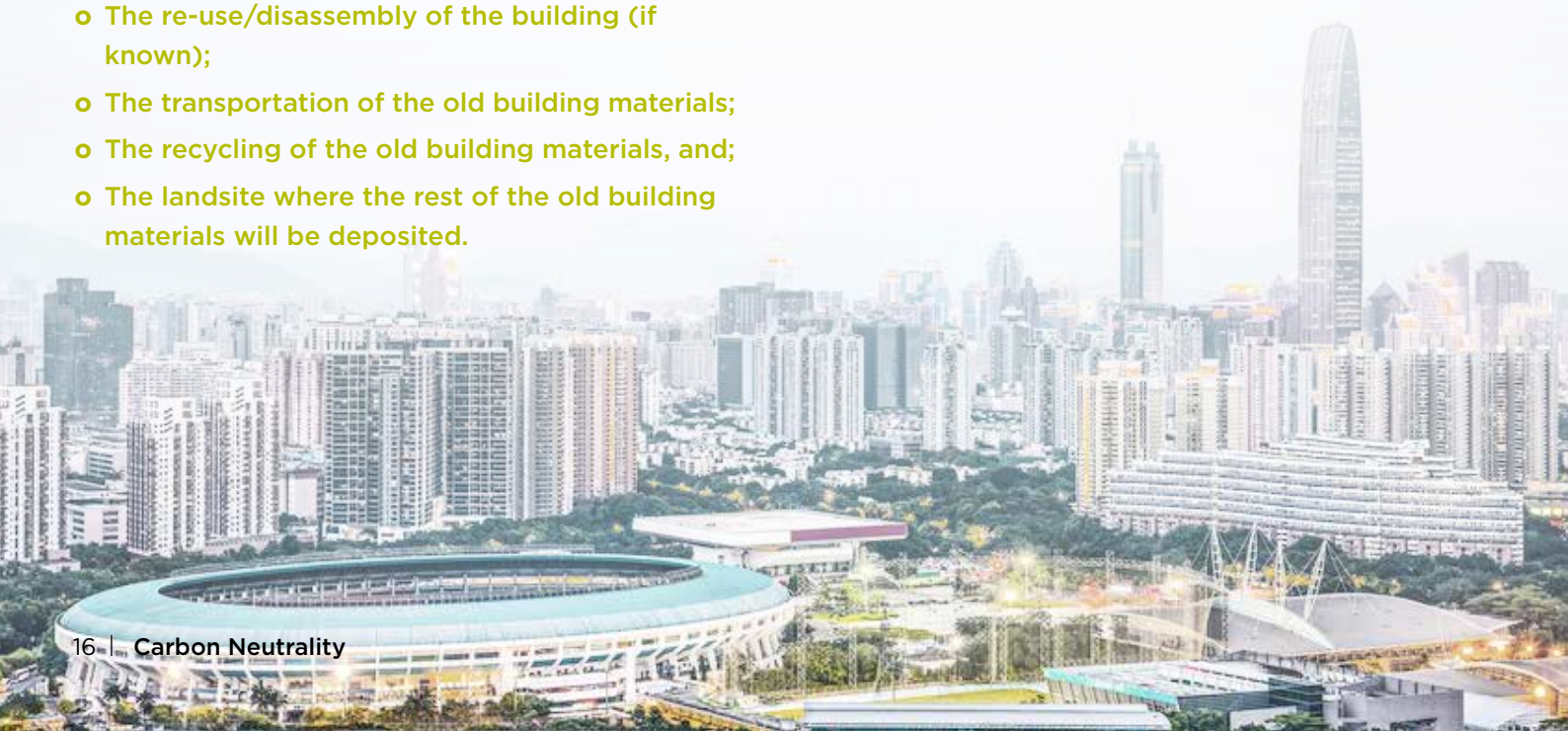
A WHOLE LIFECYCLE CARBON REDUCTION PLAN – A ROAD MAP FOR REAL ESTATE INVESTORS/DEVELOPERS/ LANDLORDS IN CHINA

Looking at whole building lifecycle carbon, the amount of energy and water used during a building's lifespan needs to be considered. When ruminating on this, many aspects about a building project have to be assessed, including:

- The proposed use of the building;
- The proposed design of the building;
- The proposed building systems, plant and machinery used in the buildings;
- The extraction of the building materials;
- The processing and manufacturing of the building materials;
- The transportation of the new building materials;
- The construction of the building;
- The operation, management and maintenance of the building;
- The re-use/disassembly of the building (if known);
- The transportation of the old building materials;
- The recycling of the old building materials, and;
- The landsite where the rest of the old building materials will be deposited.

Before building, operating and re-using/ dismantling a building, it will be important to execute on the right whole building lifecycle approach and to do this, the following elements will also need to be taken into consideration:

- Carbon offsetting;
- Carbon avoidance;
- Embodied carbon, and;
- Operational carbon (Figure 12).



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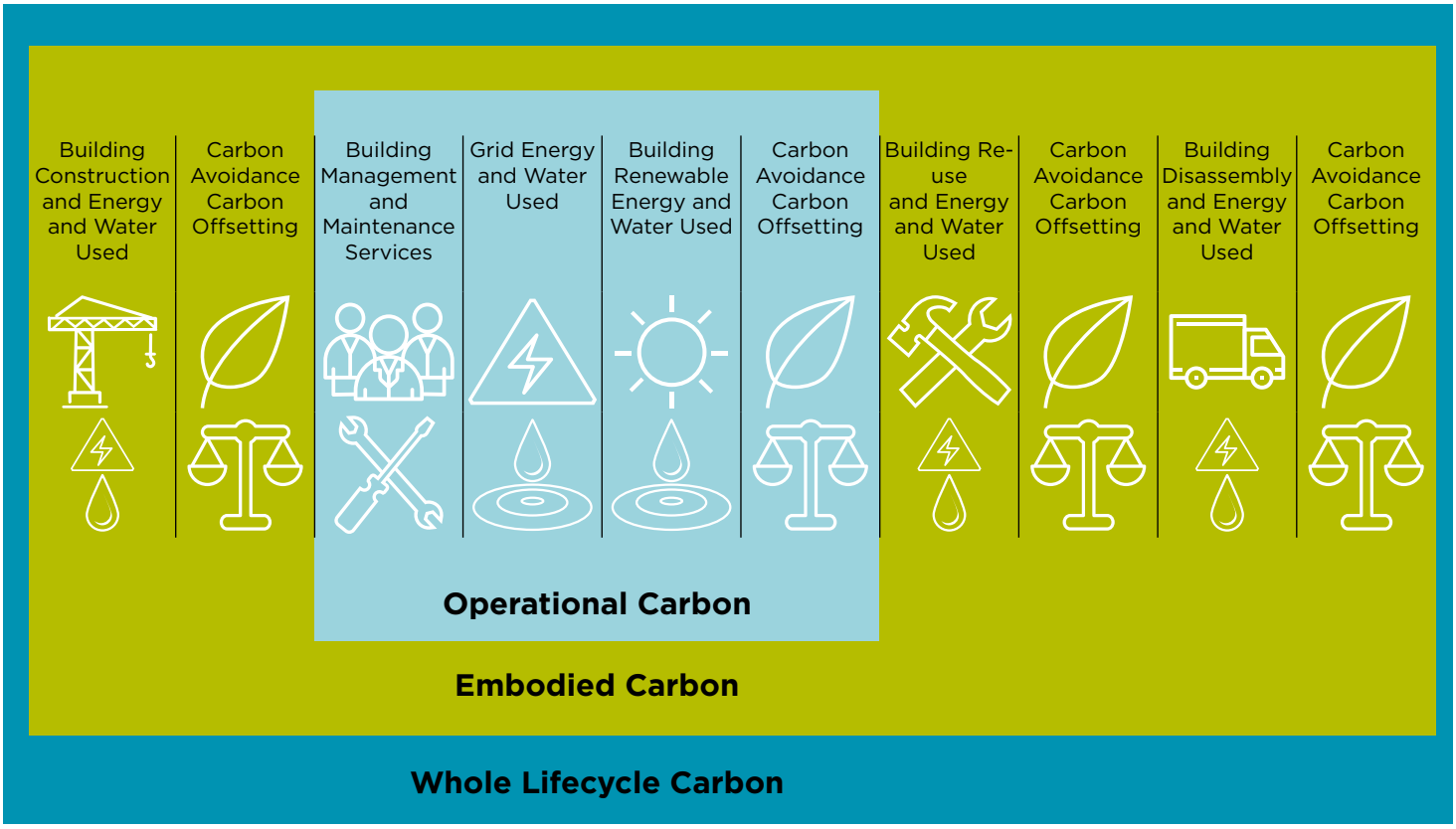
An example of a collective procedure process for a carbon neutral building project



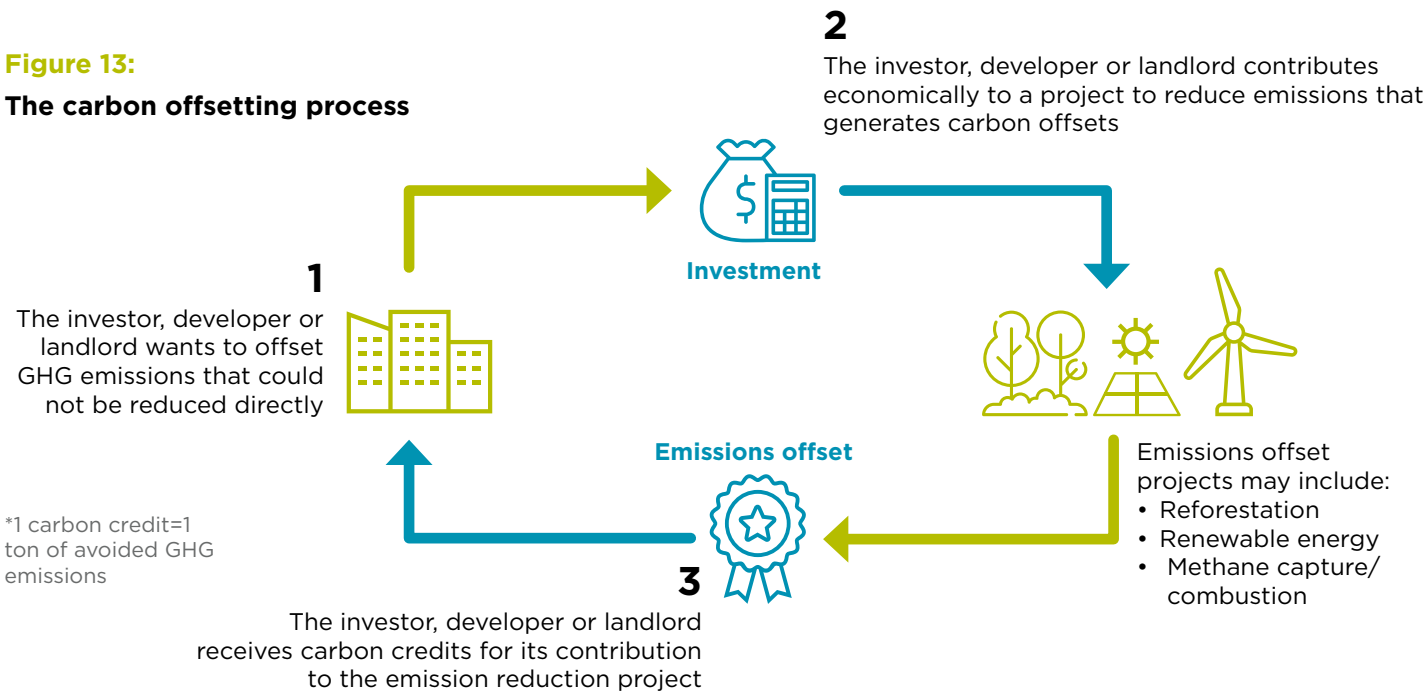
Source: Cushman & Wakefield Research

CARBON OFFSETTING

Carbon offsetting can allow real estate investors, developers and landlords in China to construct and operate a real estate project in a location without that particular project being necessarily green in any way. In this case, carbon offsets (certificates that represent the reduction of one metric ton of carbon dioxide emissions) can be bought by the investor, developer or landlord to fund a green carbon offset project. What's more, this green carbon offset project could be in a completely different part of the country. By purchasing carbon offset certificates, the GHG emission impact on the environment from an investor's, developer's or landlord's own project can be lessened. Moreover, if emissions for the real estate project are actually impossible to reduce, the investor, developer or landlord can use offsetting funds to help reduce emissions elsewhere in another location (Figure 13).

Figure 13:

The carbon offsetting process



Source: igbc.ie, Cushman & Wakefield Research

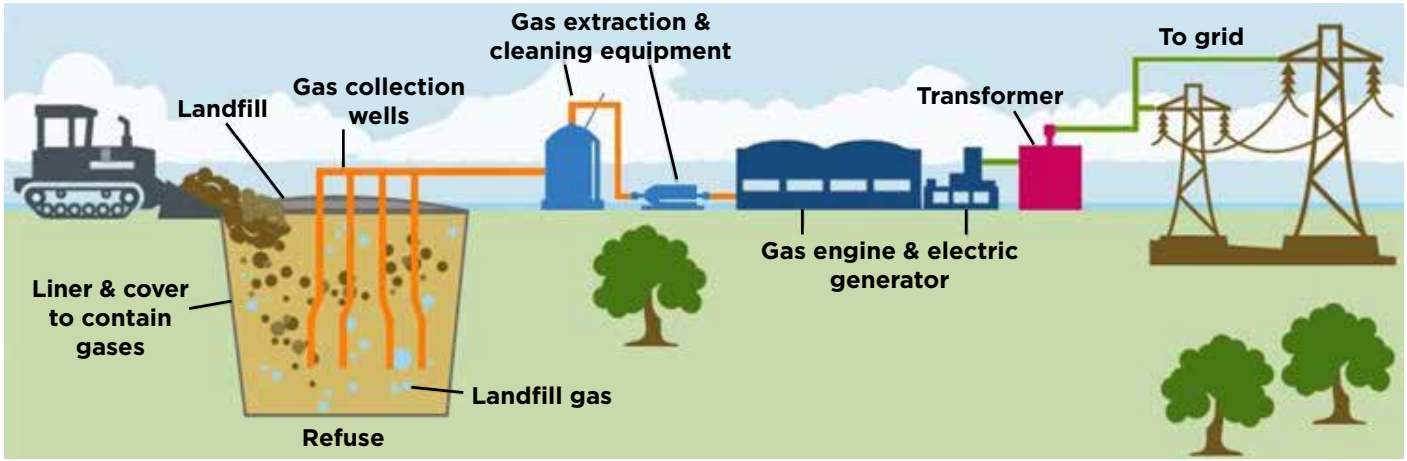
There are generally three ways in which carbon offsetting can go about reducing emissions and they are:

1. By producing renewable energy. One example of this is a wind power carbon offset project;
2. By sequestering GHGs to prevent their release into the atmosphere. One example of this is a forestry carbon offset project, and;
3. By seizing and extinguishing GHGs that would normally be released into the atmosphere. One example of this is methane gas capture at a landfill carbon offset project.

There are also some carbon offset projects that entail more than one of these activities at any one time. For example, gas capture carbon offset projects at landfills can prevent the release of methane gas into the atmosphere. At the same time, these same landfill carbon offset projects can also be used to generate electricity that would normally be generated by burning fossil fuels, by burning off the captured methane (Figure 14).

Figure 14:

An example of a renewable electricity generating gas capture landfill carbon offset project



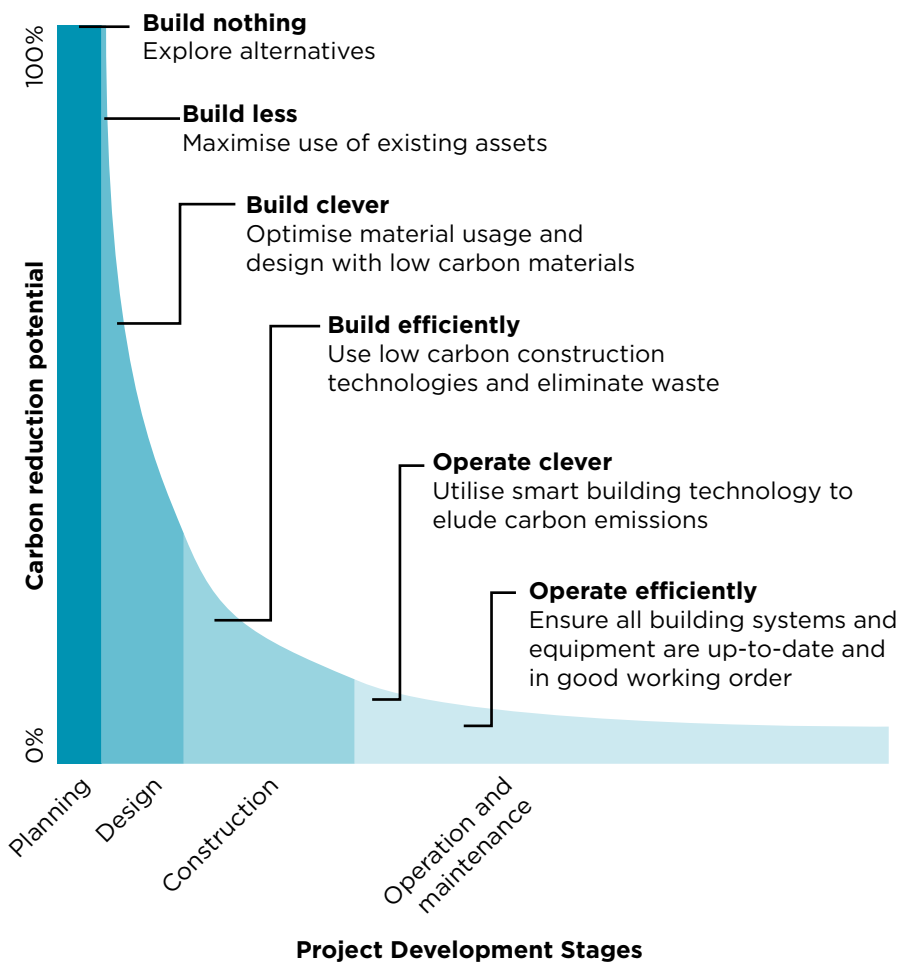
Source: ENSO Plastics, Cushman & Wakefield Research

CARBON AVOIDANCE

For real estate investors, developers and landlords, carbon avoidance is about:

- Building nothing;
- Building less;
- Building clever;
- Building efficiently;
- Operating clever, and/or;
- Operating efficiently (Figure 15).

Figure 15:
Carbon avoidance potential for real estate



Source: igbc.ie, Cushman & Wakefield Research

1.

Building nothing is what it is. Here the construction site/potential construction site remains undisturbed and in its natural state with both the underground carbon and the above ground carbon also remaining in a constant state of naturalness. In this case – at 100% – the potential for GHG emission reduction is the most out of all carbon avoidance strategies.

2.

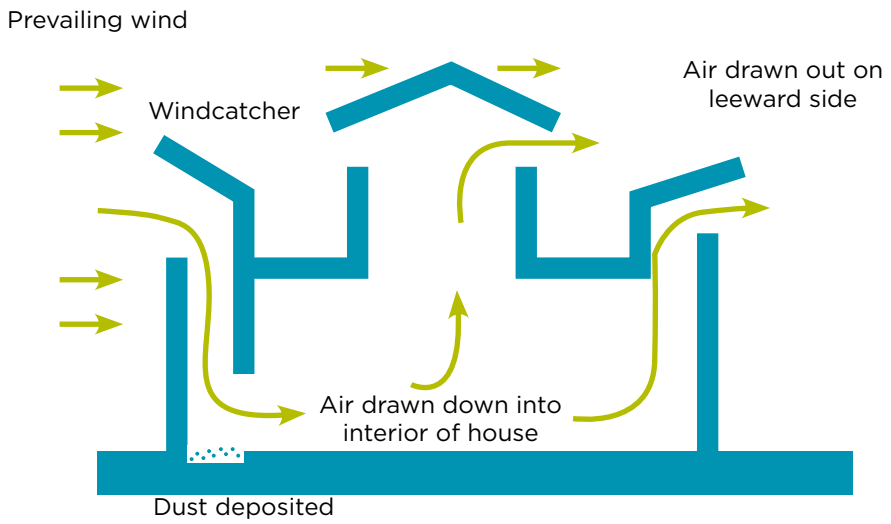
Building less means looking at and closely assessing your existing assets. For real estate investors, developers and landlords in China, this means rather than commencing on a new build project, it might be worthwhile examining any existing projects, (with the help of a professional property consultant if needed), and trying to seek out situations where gains in performance can be made, such as building occupancy rates. By ramping up the performance in existing assets, there then might not be a need to build a new project with all the extra carbon emissions entailed.

3.

Building clever is related to the use of low carbon materials and low carbon friendly design to cut down and avoid carbon emissions. For example, instead of using typical building cement, real estate investors, developers and landlords in China could use carbon friendly blended cement or, on the design side, build in a low energy intensity floor and roofing system into the project (Figure 16).

Figure 16:

An example of a traditional Malqaf natural air conditioning system

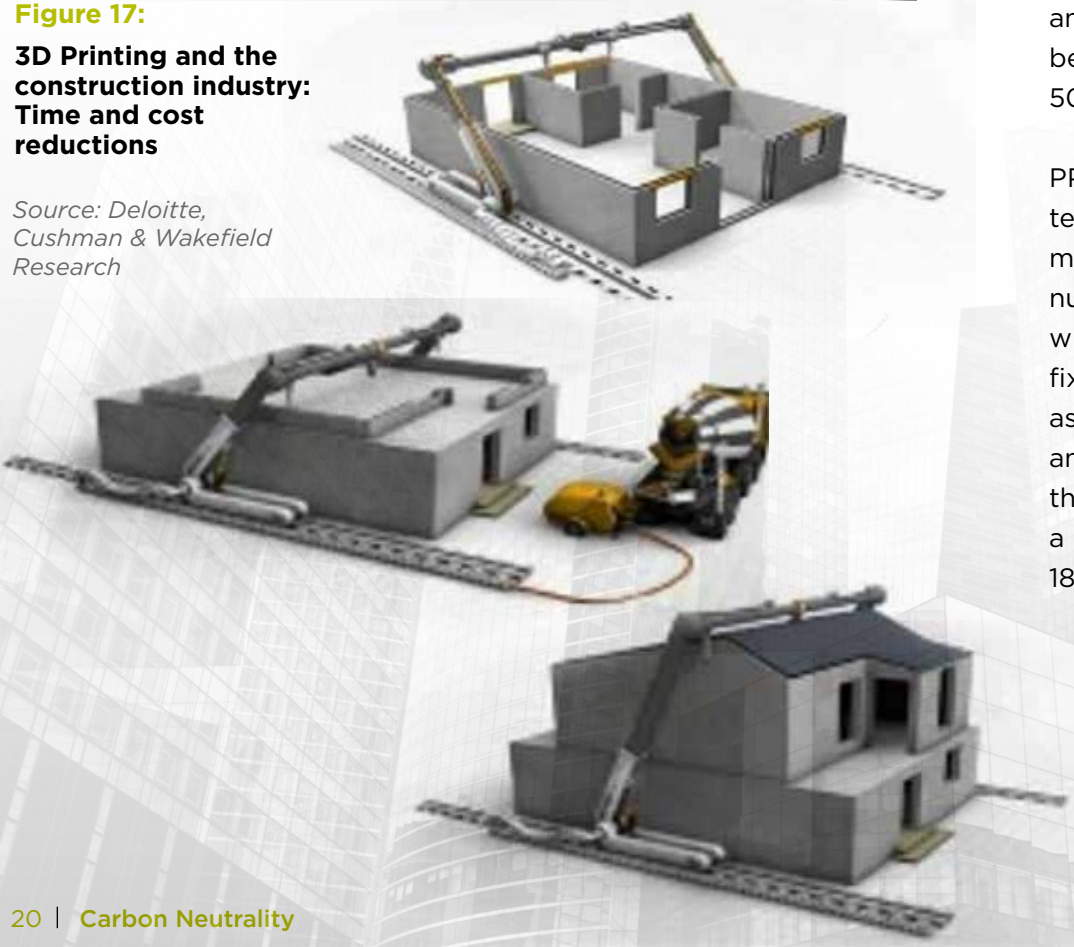


Source: Tunza Eco-generation, Cushman & Wakefield Research

Figure 17:

3D Printing and the construction industry: Time and cost reductions

Source: Deloitte, Cushman & Wakefield Research



4.

Building efficiently

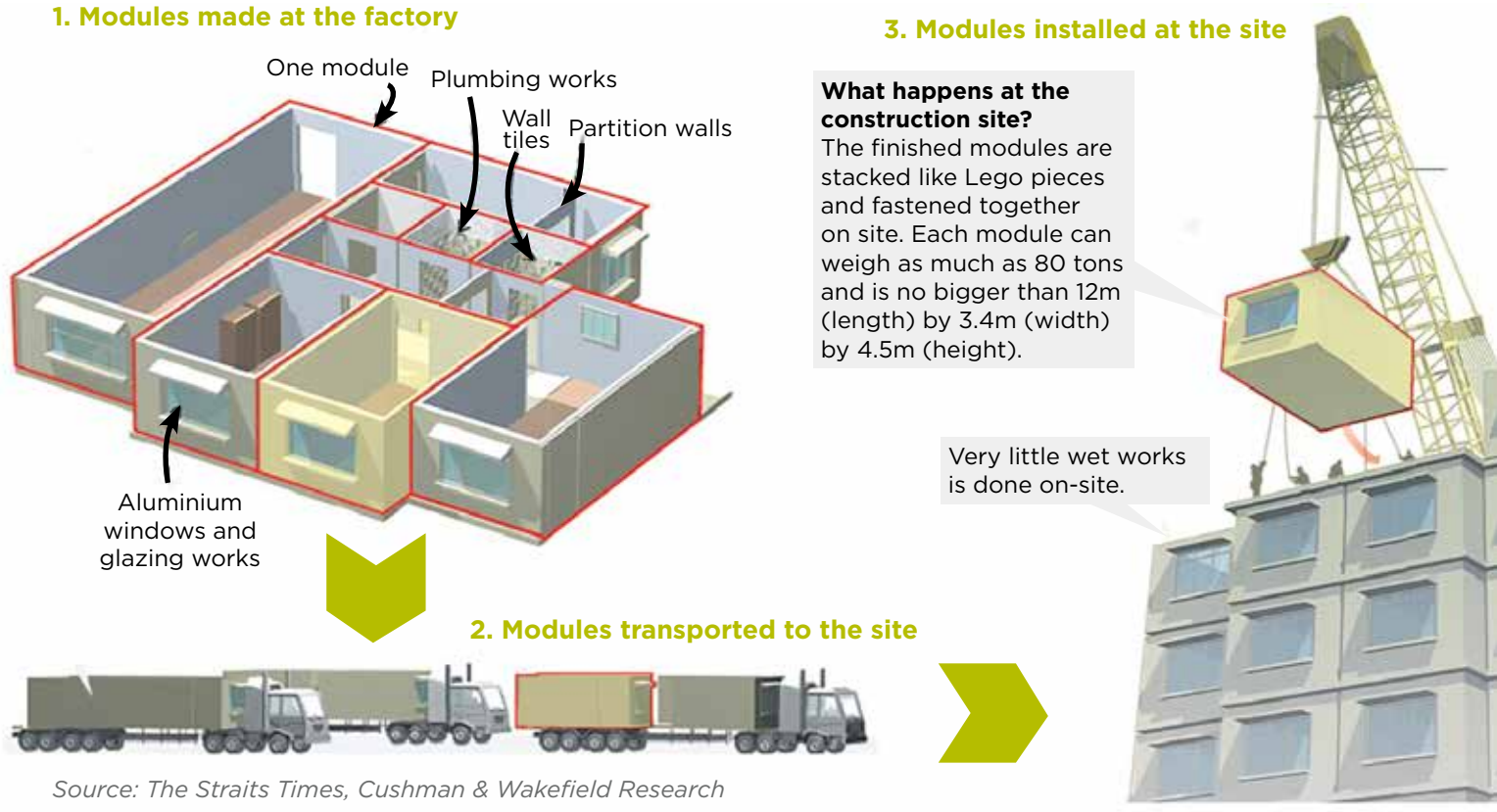
really is all about utilising low carbon construction technologies to eliminate waste and avoid unnecessary carbon emissions. Two examples are the use of 3D printing and Prefabricated Prefinished Volumetric Construction (PPVC).

3D printing, which prints material layer by layer, can be utilised for speedier, cost effective, efficient, high quality as well as customised construction. In fact, where the process has already been used in Dubai and China, construction times have been lowered by between 50% and 70% and construction costs (due to decrease in labour and material wastage) have been reduced by between 50% to 80% (Figure 17).

PPVC is a construction technique whereby modules made up of a number of units complete with interior finishing, fixtures and fittings are assembled at the factory and are then transported to the site for installation on a unit-by-unit basis (Figure 18).

Figure 18:

PPVC construction process



Source: The Straits Times, Cushman & Wakefield Research

Although it may be challenging to adopt this new technology, and costly too, for those investors, developers and landlords in China who are used to certain methods of construction, PPVC generally allows for more uniform and better-quality construction. By building components off-site, the quality control is high. Once complete, units are brought onto the construction site and are stacked on top of one another, which requires less manual labour and allows for less air, water and noise pollution. The time it takes to stack units is also less than constructing each building section and component on site.

5.

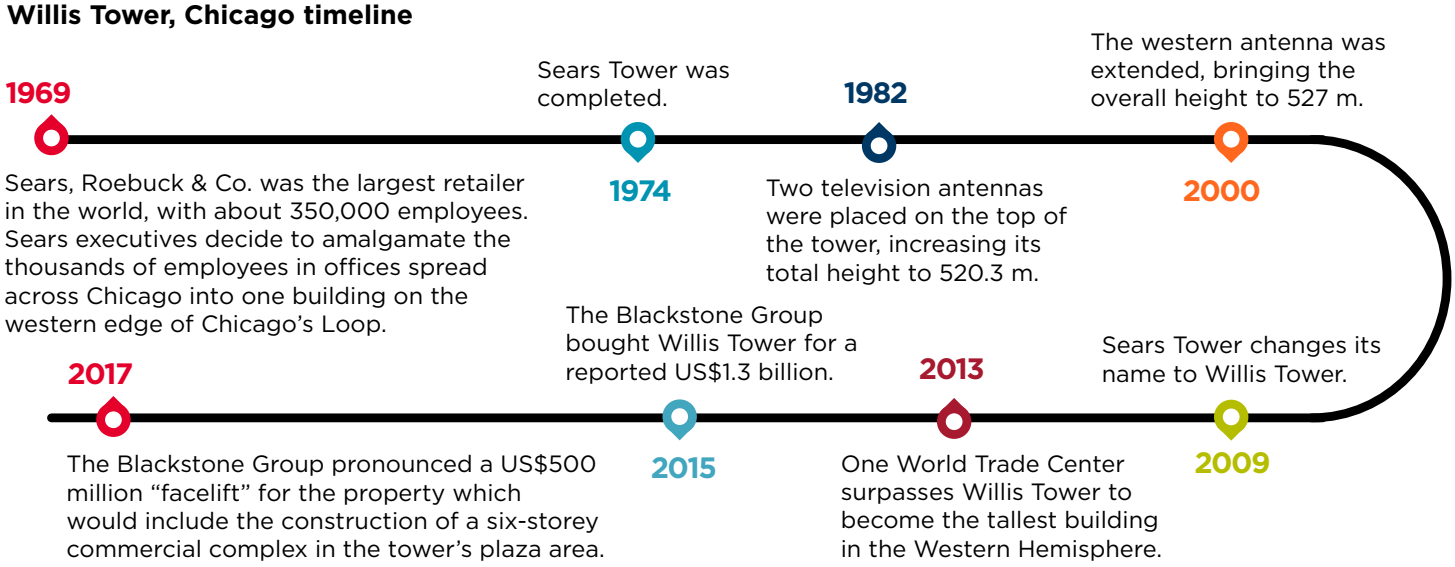
Operating clever entails the implementation and operation of smart building technology that helps to reduce energy and water usage and avoid carbon emissions during the building's operational lifespan. If required, this work can be done by a professional property consultant. Installed smart energy use and water use meters are able to detect demand variations in real time and alter the amount of electricity and water use accordingly.

6.

Operating efficiently is the next step from operating clever. Once all the building smart meters and systems, plant and machinery are installed and operating, it will be important for an investor, developer or landlord in China to make sure, (with the help of a professional property/facilities management consultant if needed), that this equipment remains relevant, up-to-date and in good working order at all times. It will also be important that the building's property management staff thoroughly understand the workings and how to operate all the systems and equipment at any one time. By ensuring this, carbon emissions arising from inefficient building systems and equipment can be avoided. One building that is now undertaking an extensive building plant and machinery refitment programme is Willis Tower in Chicago. Once fully completed the building hopes to run on 100% renewable energy (Figure 19 and Case study 1 in Appendix 1).

Figure 19:

Willis Tower, Chicago timeline



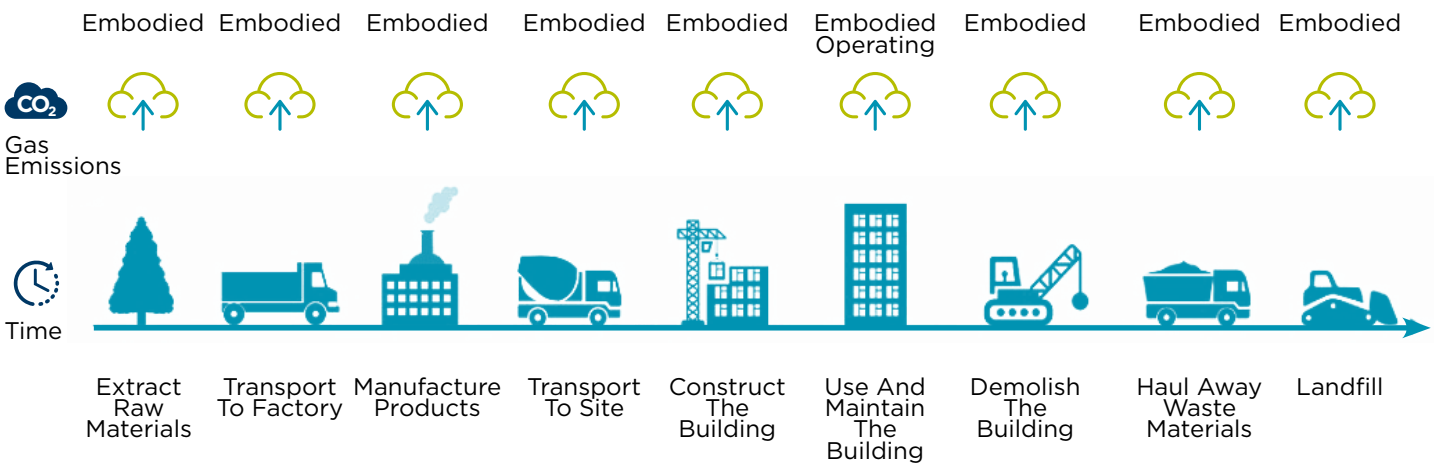
Source: Cushman & Wakefield Research

EMBODIED CARBON

Embodied carbon relates to emissions linked with a number of activities associated with a building's lifecycle, such as the extraction of raw materials, the transportation of raw materials to the factory, product manufacturing, the transportation of products to the site, building construction, use and maintenance of the building, building refurbishment/building demolition, the transportation of waste materials from the site and the storing of the waste material at a landfill (Figure 20).

Figure 20:

Building related embodied carbon activities

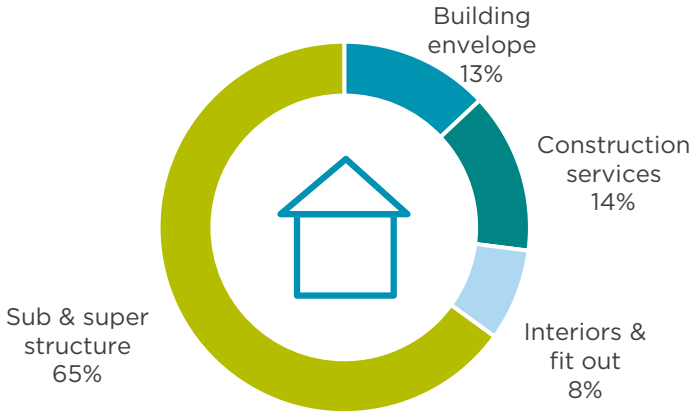


Source: buildpass.co.uk, Cushman & Wakefield Research

As for which related component of a typical building and its construction carries the most embodied carbon on average, according to Hoare Lea, at 65%, the sub- and super-structure are responsible for the greatest amount. On the flip side, interiors and fit out are responsible for the least amount of embodied carbon, at 8% (Figure 21).

Figure 21:

Building and its construction – Related embodied carbon amounts



Source: Hoare Lea, Cushman & Wakefield Research

Looking to the near future in China, embodied carbon and its reduction will become a top priority for real estate investors, developers and landlords in China. The good news is that reductions can be achieved in so many ways and some of them include:

1 **Limit the use of carbon-intensive materials –** Materials, such as aluminium, plastics, and foam insulation, use needs to be carefully considered, given their significant carbon footprint.

2 **Select lower carbon substitutes –** Wood instead of steel and concrete, or a wood floor instead of a vinyl floor. If these can be achieved, then the building's embodied carbon will be lessened. A list of carbon alternatives can be found in the Environmental Product Declarations.

3 **Pick carbon sequestering materials –** Wood, straw or hemp insulation come to mind, with straw and hemp, for example, being annually renewable.

4 **Use lightweight materials –** When relating two internal wall profiles frequently used in Brazil, Saint Gobain discovered that the lighter weight system bore a multitude of environmental benefits. By using the lighter drywall system rather than the traditional wall, a 63% decrease in global warming potential, a 49% reduction in primary energy use, an 80% drop in wall system weight, and a 36% saving in freshwater amount usage was achieved (Figure 22).

Figure 22:

Use lightweight materials

1m² For 1 m^2 of partitions walls, using drywall systems instead of traditional systems **would save**:

63% reduction in global warming potentials (kg CO_2 equiv/FU)

49% reduction is primary energy use (MJ/ FU)

80% reduction in wall system weight (kg/ FU)

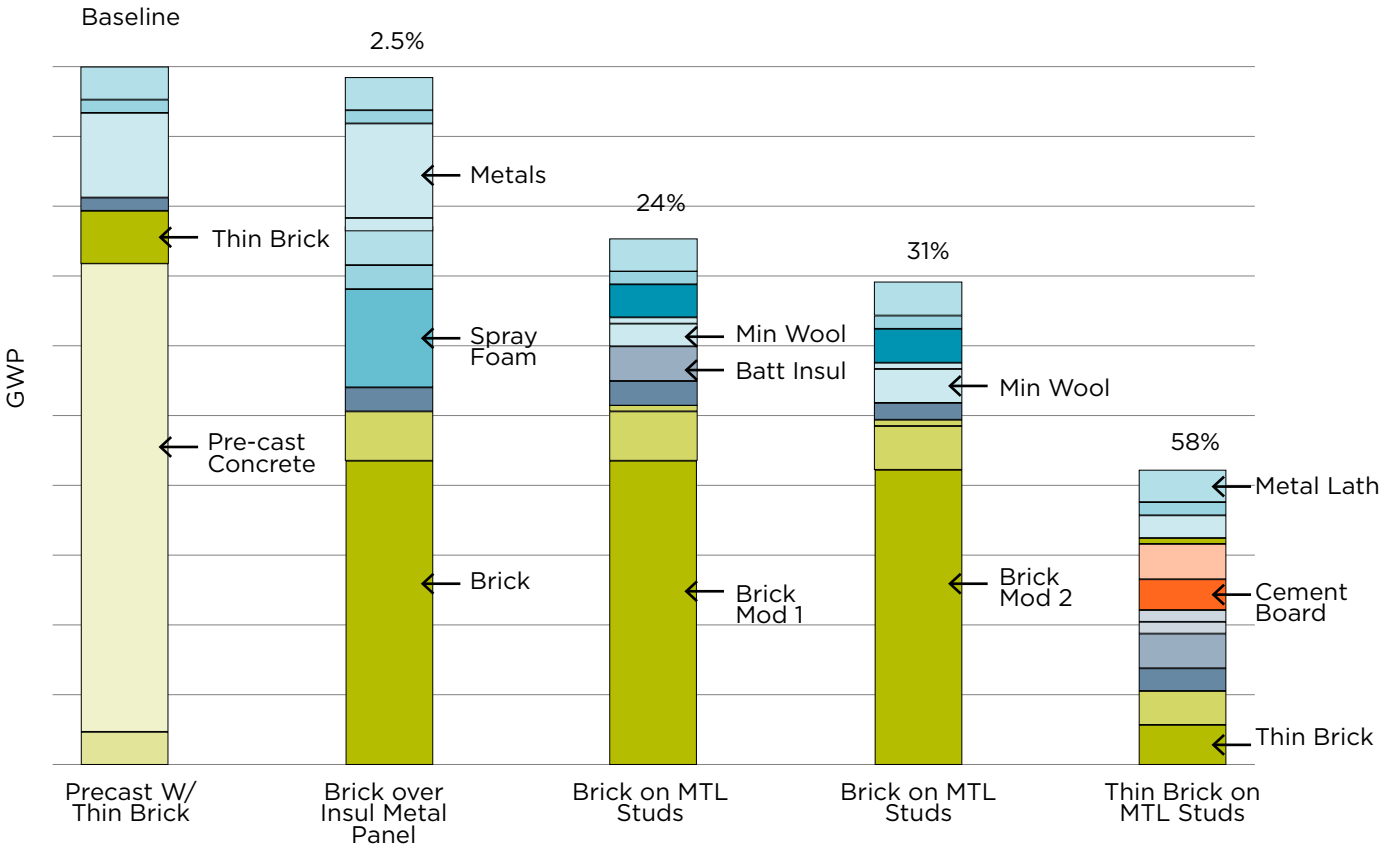
36% reduction in fresh water usage (L/ FU)

Source: Saint Gobain, Cushman & Wakefield Research

5 **Optimise structural efficiency and minimise high embodied-carbon-use materials –** Embodied carbon for the most part is incorporated in the structure. By using the latest construction and building engineering techniques as well as renewable material framing methods and efficient structural sections and slabs, minimum high embodied carbon materials need to be used and construction and building engineering efficiency can be realised. What's more, architect Brad Benke examined the impact of brick façade systems and revealed that five functionally similar wall types had very dissimilar impacts. Thin brick on metal studs, seen at the far right of the Figure 23 below, lessened embodied carbon by 58% when evaluated against a baseline wall system (the thin brick with precast concrete wall system).

Figure 23:

The impact of brick façade systems on embodied carbon



Source: LMN Architects, Cushman & Wakefield Research

6 **Use less finished materials –** In this situation, structural materials could be used as a finish. For example, having polished concrete slabs as finished flooring means embodied carbon from carpet or vinyl flooring need not be considered. Unfinished ceilings are a further possible source of embodied carbon savings.

7 **Cut down on material wastage –** Consider conventional sizes for regular materials, such as 4x8 plywood, 12-foot gypsum boards, 2-foot increments for wood framing, and pre-cut structural members and when looking to use these particular materials, design the building to accommodate these sizes.

8 **Buildings and material recycling –** Relevant to the concept of full building lifecycle is the disposal or reuse of materials after the useful life of a building. The 'take, make, and waste' model will no longer be a viable business model for commercial real estate going forward, considering the increasing importance placed by the general public, by governments and by business, on sustainability and sustainable development. A building following the parameters of the circular economy will expend fewer resources over its lifecycle because it is designed to be resource efficient, adaptable and long-lasting. Whenever possible, investors and developers in China should look to retrieve materials like brick, metals, concrete or wood. These re-used materials usually have a much lower embodied carbon footprint than newly manufactured materials, since the carbon to manufacture them has already been expended.

OPERATIONAL CARBON

Operational carbon is more or less the collective carbon dioxide emissions produced for a building to run throughout its operational lifecycle (Figure 24).

Emissions stem from a variety of building operational activities, including regulated heating, cooling, ventilation and lighting of the building, and unregulated appliance use and small power plug loads, such as IT (Figure 25).

Figure 24:

Net zero operational carbon

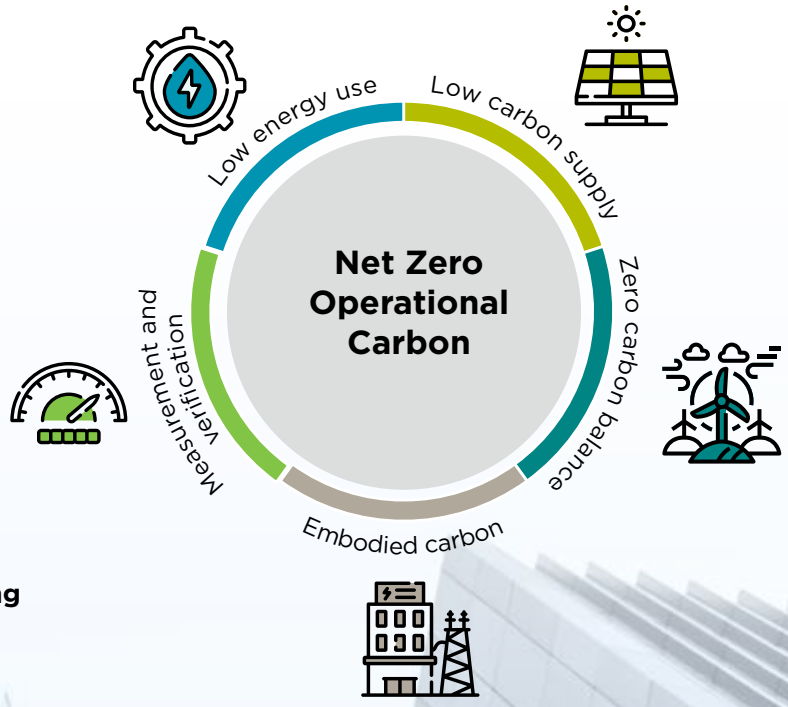
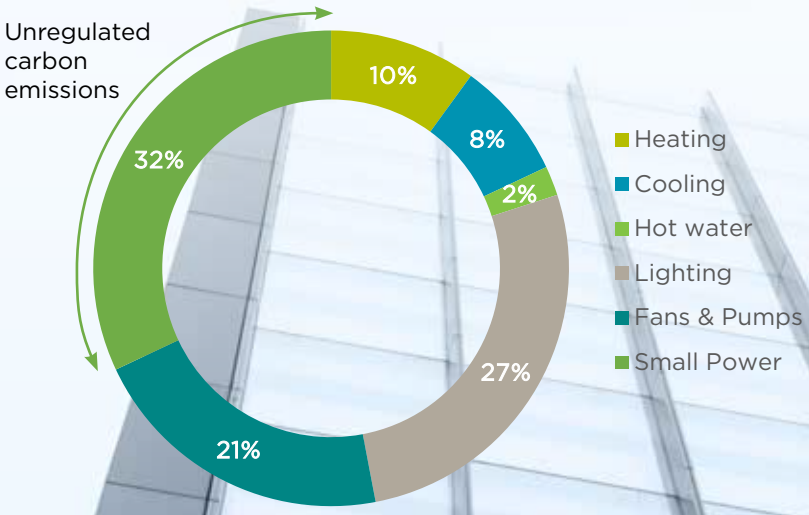


Figure 25:

Operational carbon emissions (by energy use) for a typical city centre office building



Source: steelconstruction.info, Cushman & Wakefield Research

Energy efficiency measures and systems which concern the heating/cooling equilibrium of buildings can be challenging to augment. This is because the amount of yearly carbon emissions from space heating and cooling are often quite analogous. As a result, energy efficiency measures and systems which lessen fabric heat loss or elevate solar gain will lessen the emissions from space heating, but also amplify those from cooling. Correspondingly, measures and systems which elevate heat loss or lessen solar gain will amplify the emissions from space heating but decrease those from cooling. The net effect can be rather small.

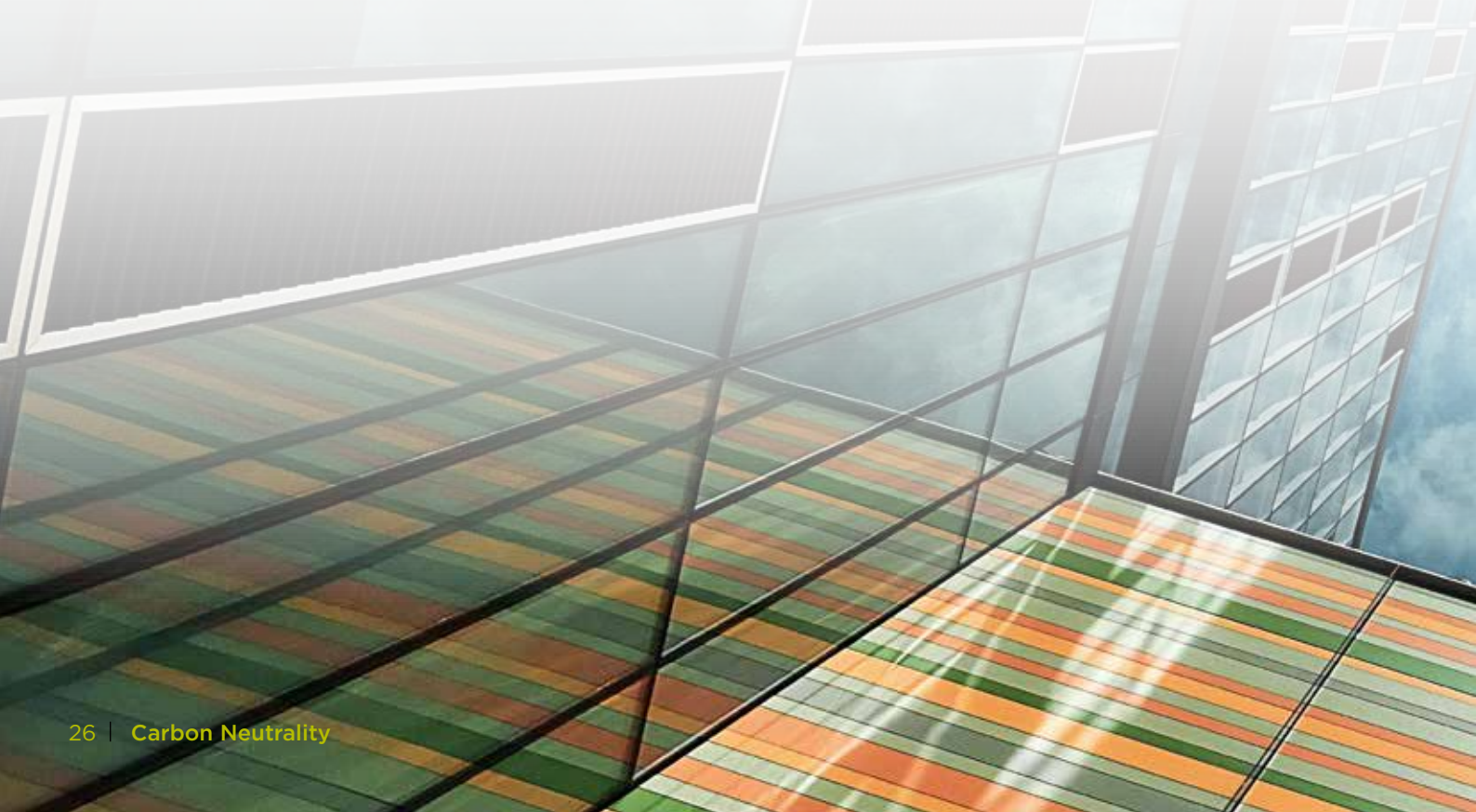
Having said this, there are a number of energy efficiency concepts, measures and systems which commercial building investors, developers and landlords in China can employ and a few of them are listed in Table 1 below:

Table 1:

Examples of energy efficiency concepts, measures and systems which can be employed by commercial buildings

Category	Description of measure
Air tightness	Improved air tightness
Thermal bridging	Enhanced thermal bridging
Improved envelope thermal insulation	Roof
	Ground floor
	External walls
Glazing	Optimised glazed area (windows and/or rooflights)
	Improved thermal performance of glazing
	Optimised building orientation
	Solar shading, e.g. Louvers, brise soleil
	Solar control glass
Heating cooling & ventilation efficiencies	Improved boiler seasonal efficiency
	Improve cooling efficiency (SEER)
	Improved Specific Fan Power
	Heat recovery
Lighting	Improved lighting efficiency
	Occupancy sensing lighting controls
	Daylight dimming lighting controls
Miscellaneous	Green roof
	Passive/active chilled beams
	Radiant heated/chilled ceiling slabs
	Mixed mode ventilation
	Water cooled/heated slabs

Source: steelconstruction.info, Cushman & Wakefield Research



Moving one step further, low and zero carbon (LZC) technologies can also be considered and implemented for commercial buildings in China. These technologies (as highlighted in Table 2 below) can be defined as systems which satisfy building energy demands with either no carbon emissions, or carbon emissions which are pointedly lower than those emissions produced by conventional technologies.

When successfully applied, a combination of energy efficiency measures and systems and LZC technologies can result in a significant energy performance improvement of a commercial building, with operational energy being a fraction of that for typical traditionally operated commercial buildings (Figure 26).

Table 2:

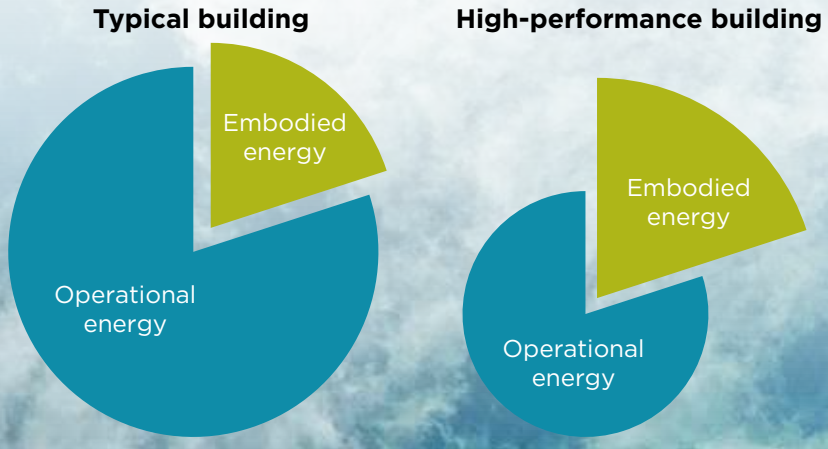
Overview of current LZC technologies which can be used in commercial buildings

Category	Technology
Wind	Building mounted (1 to 6kW turbine)
	Large offsite turbine up to 5MW
	On-site ground-mounted turbine (20 to 330kW)
Solar	Solar thermal hot water (STHW)
	Photovoltaics
Heat pumps	Open-loop ground source heat pump - Single or reverse cycle
	Closed-loop ground source heat pump - Single or reverse cycle
	Air source heat pump - Single ore reverse cycle
Biomass boilers	Biomass heating
Combined Heat & Power CHP	Large biomass CHP
	Fuel cell CHP
	Gas-fired CHP
	Anaerobic digestion CHP
Combined Cooling Heat & Power CCHP	Biomass CCHP
	Fuel cell CCHP
	Gas-fired CCHP
	Anaerobic digestion CCHP
Waste	Energy from waste
	Waste process heat
Miscellaneous	Refrigeration heat recovery system

Source: steelconstruction.info, Cushman & Wakefield Research

Figure 26:

Buildings: Total lifetime energy use



Source: BSA Embodied Carbon in Buildings Conference 2019, Cushman & Wakefield Research

OTHER CONSIDERATIONS AND WHAT'S IN IT FOR REAL ESTATE INVESTORS, DEVELOPERS AND LANDLORDS

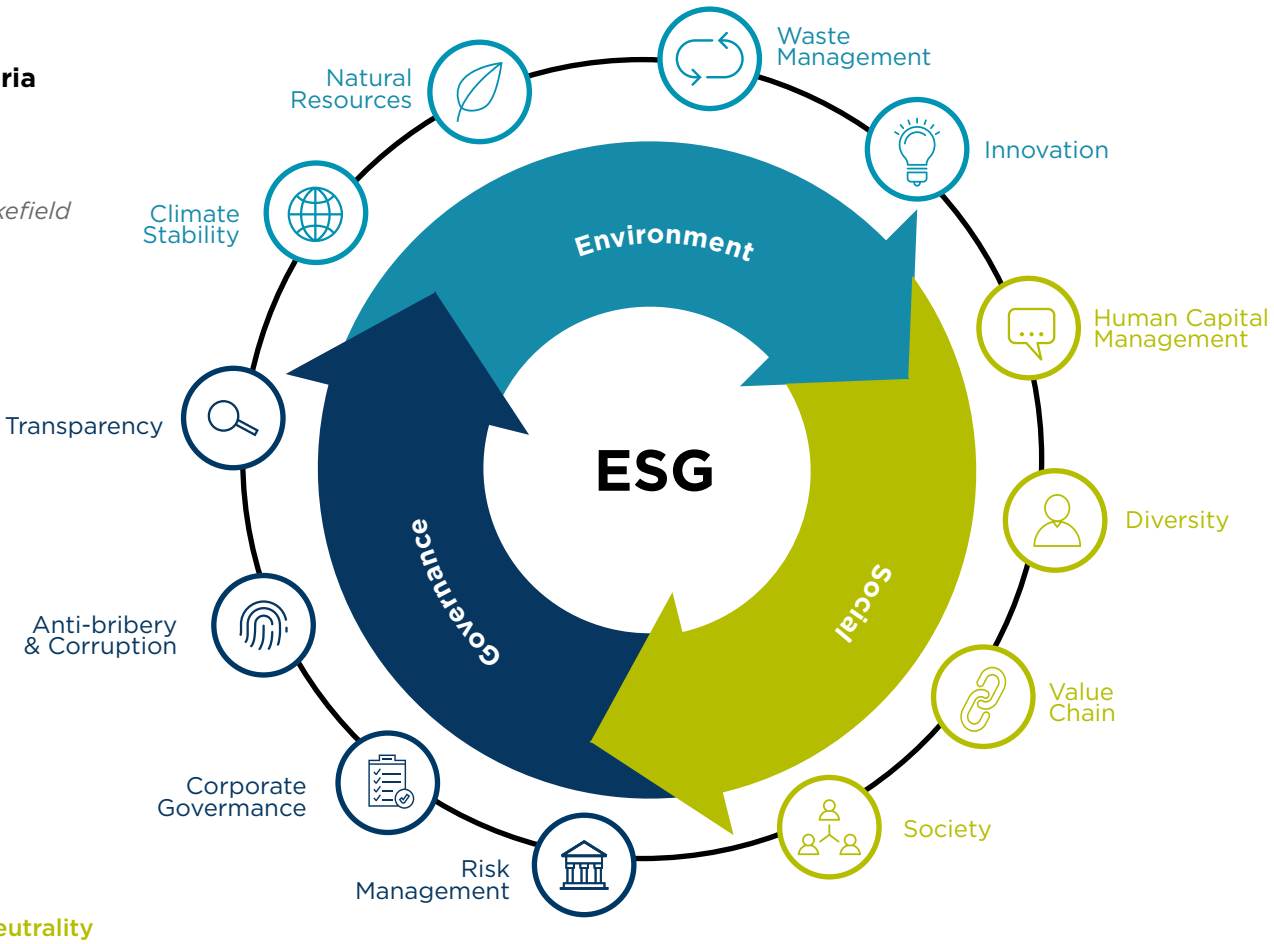
The COVID-19 outbreak has brought to the attention of investors, developers and landlords of commercial real estate space in China the importance of building health and safety, building wellness and wellbeing, and building environmental sustainability.

Much of the attention has also been brought about by a further push by authorities for environmentally sustainable development as well as by investment capital that is environmental, social and governance (ESG) principals-driven and/or environmental sustainability-driven, such as green financing capital. Given the 'green' development momentum of late, these drivers are increasingly going to become key influencers in the development and operational decision making of commercial building investors, developers and landlords in China (Figure 27).

Figure 27:

Selected criteria behind ESG

Source: BWFA, Cushman & Wakefield Research



Many of these sustainability-related initiatives were started well before the COVID-19 outbreak. For example, in 2006, former UN Secretary-General Kofi Annan officially launched the "Principles for Responsible Investment (PRI)." By the end of 2019, a total of 2,808 investment institutions around the world had signed the principles of responsible investment, and the total assets under management exceeded US$90 trillion (Figure 28).

Figure 28:

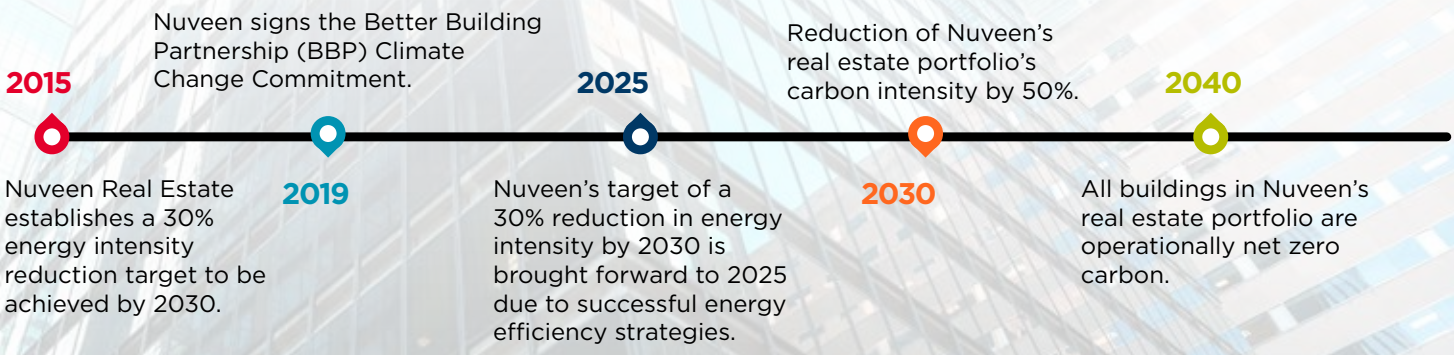
Principles for Responsible Investment (PRI) – The six principles

Source: PRI, Cushman & Wakefield Research

Commercial building investors, developers and landlords in China have to now understand the fact that over time, responsible investment principles and ESG investment have become more and more popular with capital, and this has also prompted investors and developers to transition from simply developing green buildings to making sustainable strategies the top business priority in accordance with the requirements of the capital market, and one property investor which has proactively moved in this direction of late is Nuveen (Figure 29 and Case study 2 in Appendix 1).

Figure 29:

Nuveen's Real Estate Portfolio, Global timeline



Source: Cushman & Wakefield Research

What's more, in 2019, the Hong Kong Stock Exchange began to gradually tighten its environmental, social, and governance information disclosure policies. All issuers now not only need to publish ESG reports, but they must also comply with stricter reporting guidelines. This will have a profound impact on mainland and Hong Kong developers listed on the Hong Kong Stock Exchange because they must strengthen their efforts in green building and sustainable development to avoid falling behind their peers.

In addition, more and more real estate developers and real estate fund companies have joined the Global Real Estate Sustainability Benchmark (GRESB). Companies operating in China, like Swire Properties, New World Development, China Resources Group, Sino-Ocean Group, and CITIC Capital have all been participating in the assessment for many years. (For more information on what some companies have done as well as their thinking in terms of carbon neutrality, please see Appendix 2).

Green building in China is still continually developing and growing and alongside this development and growth, GRESB will be used more in the country for measuring the sustainability performance of real estate companies and real estate funds because:

- **It incorporates a rounded methodology;**
- **It has a clear assessment goal;**
- **It is an international like-for-like standard that can be used in different jurisdictions across the globe, and;**
- **It is a standard that is continually evolving (Figure 30).**

Figure 30:

GRESB criteria and score example

Source: GRESB, Cushman & Wakefield Research

So what's in it for commercial building investors, developers and landlords in China? Well, there are many benefits, but one important advantage that should be pointed out is market performance. Environmentally friendly commercial buildings often enjoy higher rentals and augmented market pricing. They are also often more resilient to any market downturns as they are still the location of choice for many occupiers.

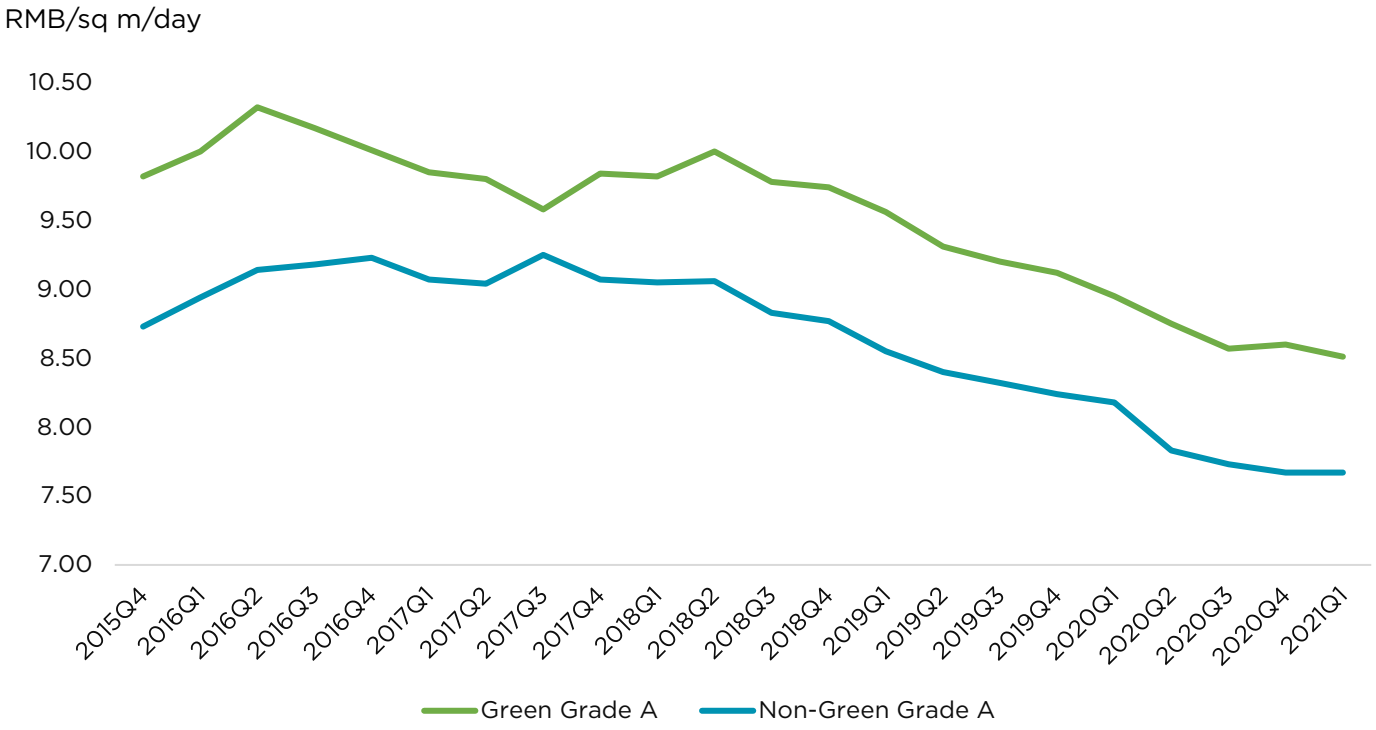
With users demanding this space and willing to pay for it, it is also not surprising to find that rental and capital value premiums enjoyed by green commercial building owners are and will be strong. But how much stronger are they now when compared to non-green commercial buildings? To find out, one test case we can use is the Shanghai Grade A office market.

By the end of Q1 2021, the Shanghai Grade A office market had a total stock of 13.77 million sq m. Out of this, green certified Grade A office buildings made up 8.01 million sq m, or 58.2% of total stock – with a significant number of office buildings in this basket being LEED certified. In terms of timeline development, notably, the city's green Grade A office stock dramatically rose 2.4-fold from 2015 to Q1 2020. Moreover, most future office projects in Shanghai are planned to be green.

When we examine recent quarterly average citywide rental comparisons between green and non-green Grade A offices in Shanghai, we can clearly see that green Grade A office rentals perform better than non-green Grade A offices (Figure 31).

Figure 31:

Shanghai green Grade A office and non-green Grade A office rental (Q4 2015-Q1 2021)



Source: Cushman & Wakefield Research

When we look at the last quarter (Q1 2021) in particular, we can see the average citywide rental for office projects with a green certification in Shanghai was RMB8.51 per sq m per day, or a whole 11% higher than that for non-green Grade A office buildings.

What's more, over the long term, the higher rental premiums enjoyed by green Grade A office landlords in Shanghai can amount to a substantial amount of total rental income over and above what a similar spec non-green Grade A building in the same location could achieve. In this example, we selected a Grade A office with LEED certification and a non-green Grade A office within the same area in Shanghai's Pudong New Area. The average rental for the selected non-green Grade A office was RMB8.5 per sq m per day, while the average rental for the selected green Grade A office building was RMB10.5 per sq m per day (Table 3).

Using a hypothetical five-year hold period and a total building GFA of 30,000 sq m, we can then calculate that a landlord of a green Grade A office would be able to receive a gain of RMB109,500,000 over a similar spec Grade A office building in the same location during the same time period.

Finally, stronger user demand, solid user profiles and higher rentals also have a positive effect on the capital values enjoyed by green commercial buildings.

Table 3:

Shanghai green Grade A office vs Shanghai non-green Grade A office (Q1 2021)

Case: Green	Case: Non-Green
RMB10.5/sq m/day x 365 days x 30,000 sq m x 5 years **= RMB574,875,000**	RMB8.5/sq m/day x 365 days x 30,000 sq m x 5 years **= RMB465,375,000**

= RMB574,875,000 – RMB465,375,000 = **RMB109,500,000**

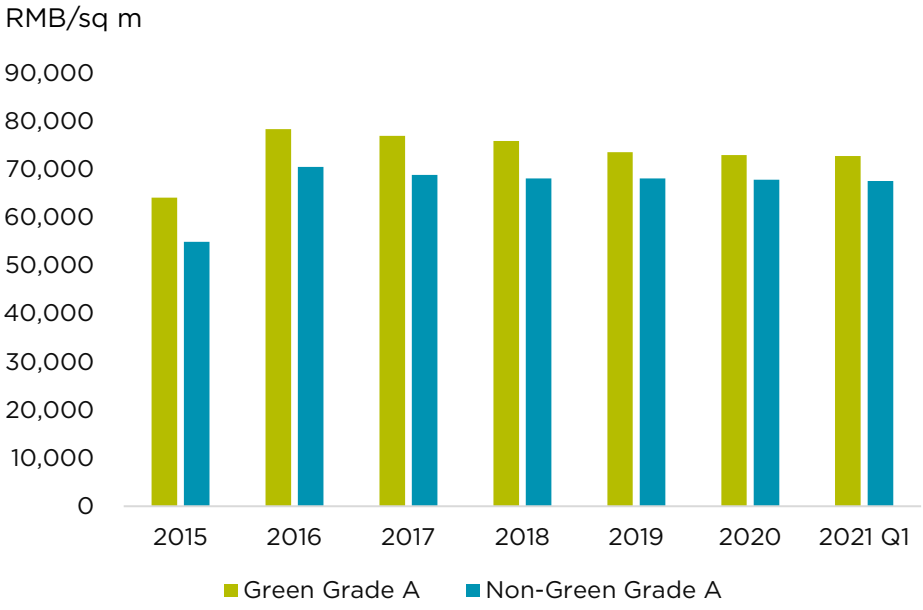
Source: Cushman & Wakefield Research

Using the Shanghai Grade A office again as an example, we can see that over the past four and a quarter years on average, green Grade A offices in the city have registered a higher capital value when compared to non-green Grade A offices.

In Q1 2021, the average citywide capital value for non-green Grade A office buildings reached RMB67,689 per sq m, while the figure of green Grade A office buildings achieved RMB72,874 per sq m, a 7.7% difference (Figure 32).

Figure 32:

Shanghai green Grade A office and non-green Grade A office capital value (2015-Q1 2021)



Source: Cushman & Wakefield Research

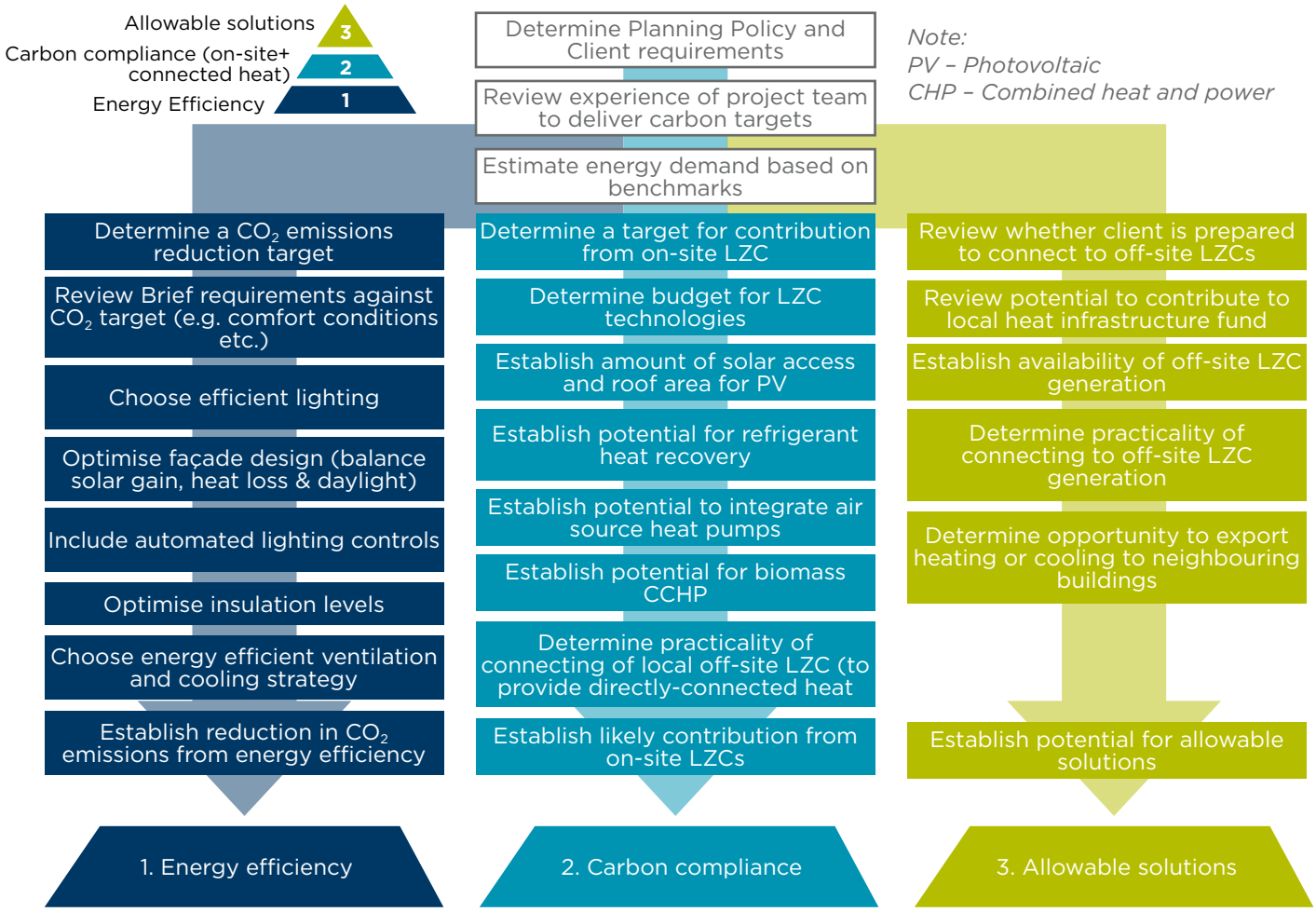
FINAL THOUGHTS

When considering optimal carbon neutrality solutions for commercial buildings, collective and early involvement of all professionals within the design team is essential. The flowchart below provides direction on how to cultivate cost-effective solutions for carbon neutral buildings, and in this case, office buildings in particular (Figure 33).

Finally, for real estate around the world, including property in China, to play its part in reducing carbon emissions and natural resource usage in the future, carbon offsetting, carbon avoidance, embodied carbon and operational carbon must all be considered to approach decarbonisation holistically and create a world that is more sustainable.

Figure 33:

An example flowchart for delivering carbon neutral operational carbon office buildings



Source: steelconstruction.info, Cushman & Wakefield Research

APPENDIX 1

CASE STUDY 1

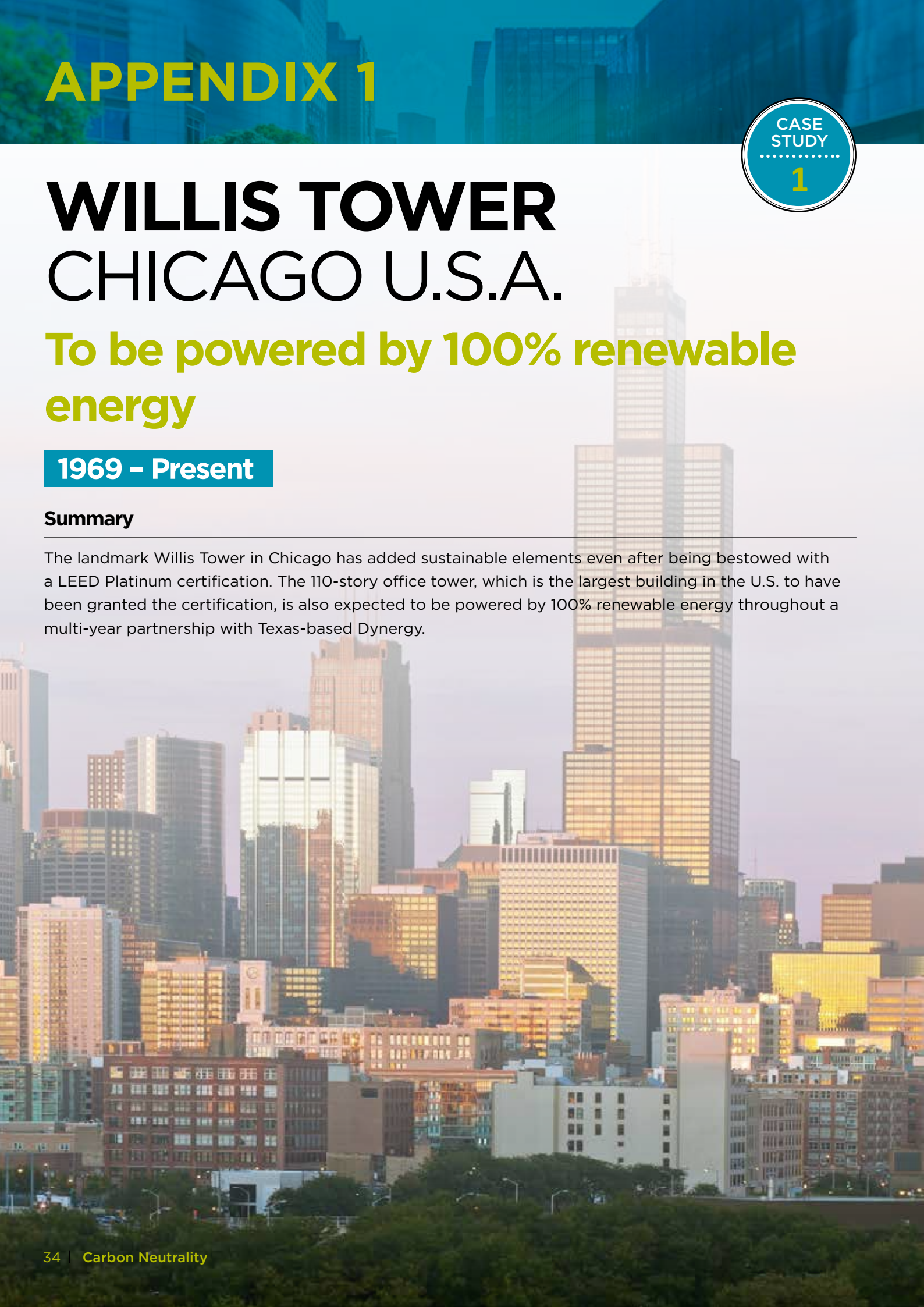
WILLIS TOWER
CHICAGO U.S.A.

To be powered by 100% renewable energy

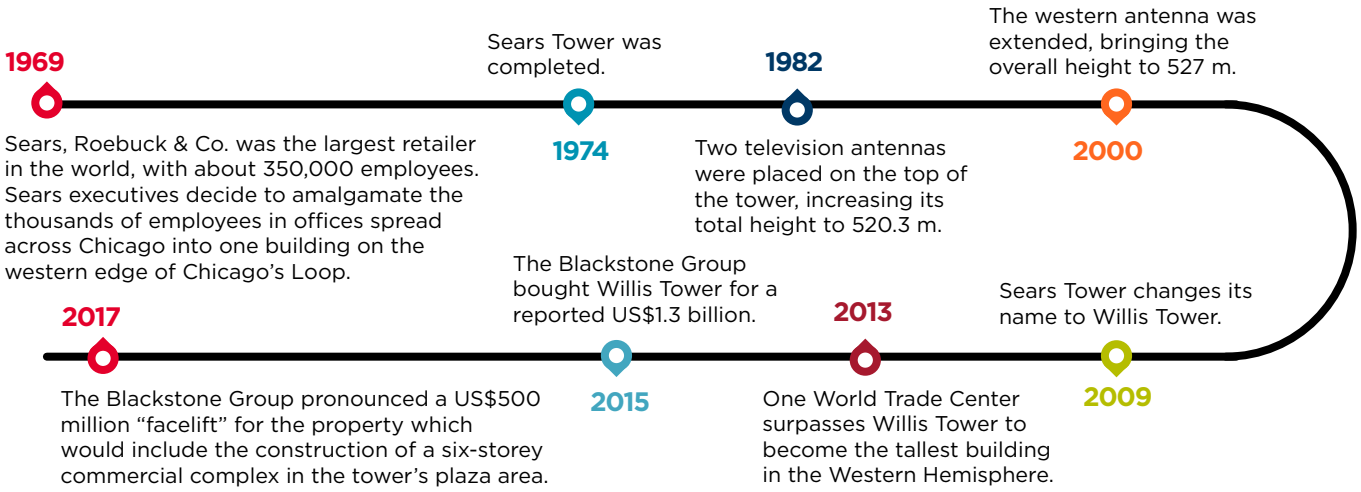
1969 – Present

Summary

The landmark Willis Tower in Chicago has added sustainable elements even after being bestowed with a LEED Platinum certification. The 110-story office tower, which is the largest building in the U.S. to have been granted the certification, is also expected to be powered by 100% renewable energy throughout a multi-year partnership with Texas-based Dynergy.



Timeline of major events/milestones reached:



Overview:

- Willis Tower is undertaking widespread upgrading and infrastructure retrofitting.
- These changes include retrofitting the HVAC system, installing motion sensors, placing lighting control panels in tenant areas, and converting to LED fixtures.
- A thorough improvement of the building's automation system is anticipated to offer improved temperature control, HVAC sequencing, and energy monitoring.
- Plans call for updating chillers, retrofitting cooling towers, and supplanting obsolete variable frequency drives with new ones that can interconnect with the building automation system.
- The tower also plans to be 100% powered by renewable energy in the future.

Impact:

- Willis Tower has become the largest office building to be granted the Energy Star certification.
- This means it uses an average 35% less energy than a standard building.
- This has helped Willis Tower to secure efficiencies, reduce operating costs, and enjoy higher net rentals.
- It has also added value by actually helping to raise building occupancy.

How it is being done:

- Some retrofit projects in Willis Tower can take six months, while others are scheduled to take up to six years.
- So far, Willis Tower has retrofitted a 4,800-ton chiller and a 1,400-ton chiller.
- The three remaining chillers are slated to be retrofitted over the next three years.
- Willis Tower is also undertaking a modernisation of its lift system and this specific project is expected to be completed in five years' time.

Results:

- The chiller retrofit helped Willis Tower realise electric savings from .9 watts a ton to .6 watts per ton.
- By supplanting the cooling tower media, gear boxes, fan blades, and VFDs, this facilitated the provision of cooler water to the chiller plant.
- Willis Tower anticipates 20% to 30% in cost savings from all these collective improvements.

Key takeaways:

- Willis Tower is embarking on comprehensive programme of upgrading and infrastructure retrofitting.
- Willis Tower foresees 20% to 30% in cost savings from all these combined enhancements.
- The tower also intends to be 100% powered by renewable energy in the future.

CASE STUDY 2

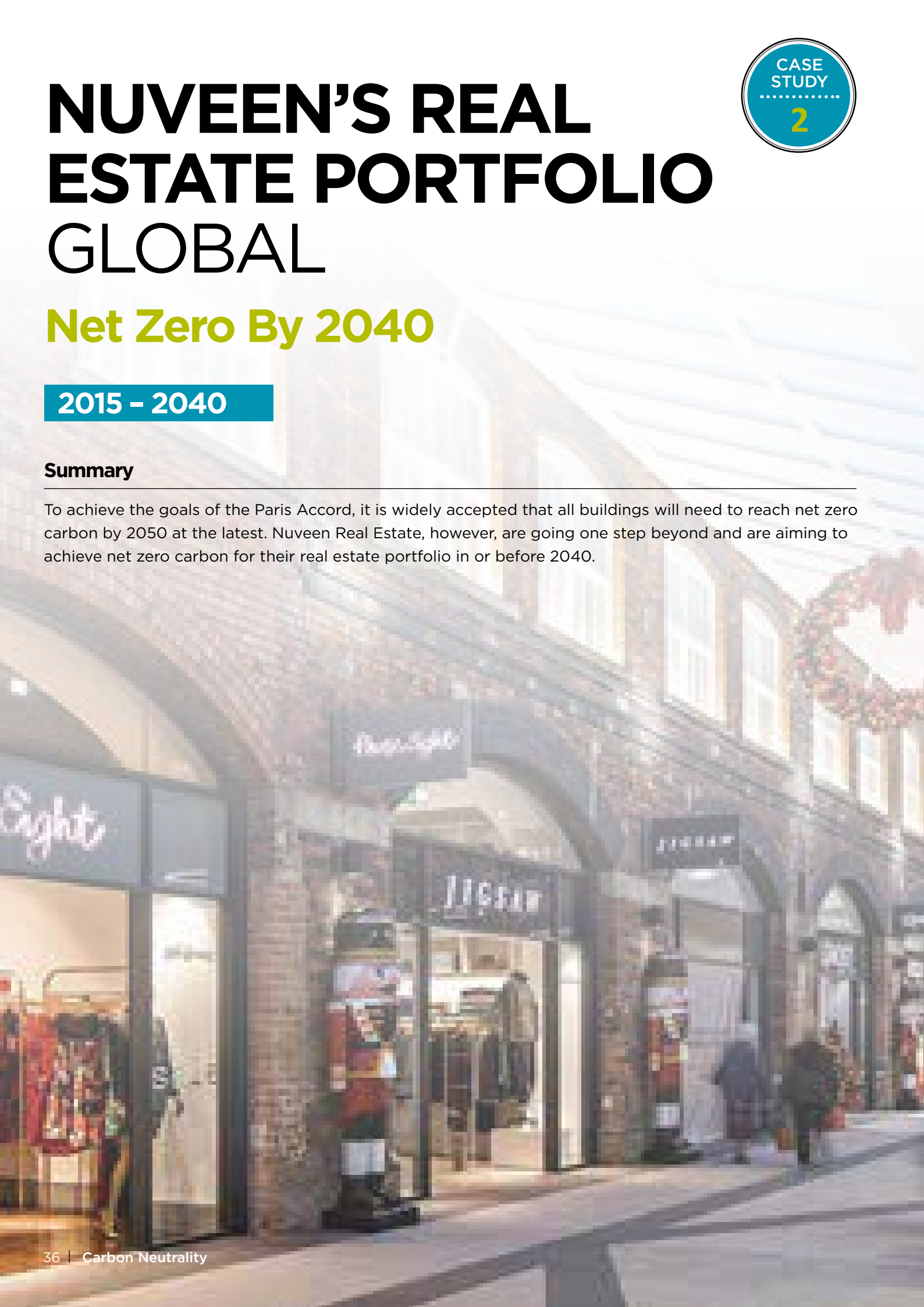
NUVEEN'S REAL ESTATE PORTFOLIO GLOBAL

Net Zero By 2040

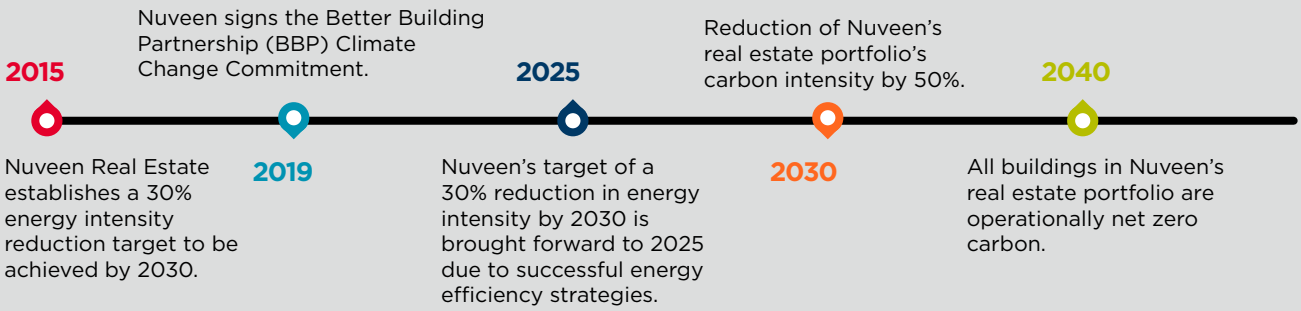
2015 – 2040

Summary

To achieve the goals of the Paris Accord, it is widely accepted that all buildings will need to reach net zero carbon by 2050 at the latest. Nuveen Real Estate, however, are going one step beyond and are aiming to achieve net zero carbon for their real estate portfolio in or before 2040.



Timeline of major events/milestones reached:



Overview:

- The environmental impact of climate change and the shift to a low-carbon economy is expected to shape Nuveen's real estate portfolio values in the future.
- With this transition comes a multifaceted array of investment risks and opportunities for Nuveen's properties around the world.
- These risks and opportunities need to be foreseen, assessed and tackled by Nuveen before deleterious value adjustments wear away at portfolio financial performance.
- This has to be carried out in advance to make sure that any value growth from first-mover advantage is secured by Nuveen.
- Today, Nuveen has advanced an approach to examine their real estate assets under management globally, which considers local and asset-specific situations and conditions.

Impact:

- The switch to a low-carbon economy will have a bearing on investment performance.
- Nuveen's net zero by 2040 approach to their global portfolio is essential for their clients' investments and their fiduciary duty.
- By adopting this approach, Nuveen will not only be able to cope with transition risks more effectually, but will also allow Nuveen to reveal the value arbitrage that Nuveen anticipates from net zero carbon buildings.

How it was done:

- By affording pellucid information and data to investors on the advancement towards net zero carbon.
- By adopting a method that permits Nuveen to set forth on the journey to net zero carbon throughout all regions of the globe.
- By flexibly adapting to various market circumstances and partialities.
- By collaborating with foremost operating partners, developers and consultants to attain the ambition.
- By making sure that all Nuveen investment mavens obtain continuous climate risk investment training.
- By embracing reporting and certification paradigms for realising net zero carbon in the real estate sector.

Results:

Here we have picked out two properties from Nuveen's global portfolio; one office and one retail property, with demonstratable results:

Swindon Outlet Mall, Swindon, UK

- Optimised technology to produce significant energy and carbon diminution at minimal cost.
- Recurrent remote monitoring of energy use at Swindon examining over 8 million energy data points.
- A 36% energy use saving achieved and nearly £500k savings to tenants delivered.

183, Clarence Street, Sydney, Australia

- The building is aiming for 5 Star NABERS and 5 Star Green Star ratings.
- Establishing an energy use intensity goal at the start of the design process led to the provision of an exceedingly energy efficient and low-carbon building.

Key takeaways:

- The move to a low-carbon economy will have a sizeable impact on real estate value in the future.
- It is fundamental that investment decision making is well-versed by an extensive knowledge of these matters so that real estate sustainability can be promoted, and value protected.
- One of the soundest ways to bring about this is for assorted professionals to come together and work as a single and organised unit.

APPENDIX 2

Arup
Dr. Vincent Cheng. Director of Sustainability

Q1. Does Arup have a net zero target for the company?

Arup has committed to achieving net zero emissions across its entire operations by 2030, covering everything from the energy used in offices to goods and services purchased. To achieve this, the firm has set a target to reduce its Scope 1, 2 and 3 global greenhouse gas (GHG) emissions by 30% within the next five years from a 2018 baseline.

The target, validated by the Science Based Target Initiative (SBTi), has been classified as ambitious as it exceeds the minimum requirements for keeping global temperature rise under 1.5°C. In addition, Arup is also committing to purchasing Gold Standard certified offsets for all domestic and international flights and to compensate for other residual hard to de-carbonise emissions with high quality, certified GHG removal from 2030.

We have taken these steps to consolidate our efforts to reduce the impact of our operations around the world. But the greatest difference we can make is through the advice and solutions we offer our clients and communities – from helping city leaders take practical steps to meeting the Paris Agreement, to working with property developers to understand how digital technology can reduce their resource consumption.

Q2. Many cities around the world, including Tokyo and New York, have pledged to be net zero by 2050; can you describe what a net zero city will look like?

Net zero or carbon neutrality of a city is a multi-faceted and multi-dimensional problem. The city is a functioning living system comprising many components – buildings, infrastructure and transportation. A zero-carbon city is a manifestation of a total transformation of these systems away from carbon emissions activity. This is exemplified by the universal adoption of zero carbon buildings. Due to their immense effect on carbon emissions, buildings account for a substantial total of carbon emissions. Carbon neutrality of buildings is pivotal to the success of the movement, but to build climate resilience we must scale up net-zero beyond buildings to cities and communities incorporating the underpinned infrastructure. This requires an integrated and collaborative approach. For example, Arup is working with The Resilience Shift and the Global Resilient Cities Network to enhance the resilience of cities and communities to the increasing shocks and stresses resulting from climate change, including drought, water scarcity and food supply disruption.

Adrian Smith + Gordon Gill Architecture
Weiwei Luo
Director of Chinese Operations, Adrian Smith + Gordon Gill (AS+GG) Architecture

Q1. Does AS+GG incorporate net zero planning for its own operations?

For our own operation, we are about to release our 2025 sustainability plan that will require us to be net zero for our Scope 1 and Scope 2 carbon emissions* by 2030 in line with our design commitment. As we lease only one floor in a mid-rise, we are very limited in terms of energy saving upgrades that we can make and due to the building being considered a heritage building, we are not allowed to put solar film on the glazing, change the

shades or alter the internal ceiling lighting. Nevertheless, we have implemented a number of measures including developing a carbon offsetting strategy, moving our processing to offsite cloud-based server, working with our staff and building management on daylight and lighting control optimization, using energy saving IT equipment, etc.

** Scope 1 emissions = direct emissions from combustion of fossil fuel; Scope 2 emissions = indirect emissions from electricity production.*

Q2. Can you share with us why embodied carbon matters in Net Zero building?

Zero emission through a building's whole lifecycle, which means including the embodied carbon resulting from building construction and demolition, is a critical part of the 'Net Zero Building' definition. If we are to keep global average temperature rise to less than 1.5 degrees centigrade, then the emissions from producing steel, concrete, glass, aluminium, insulation, etc., all of which happen during construction, is the most important consideration. We estimate that over a 60-year period the embodied carbon emissions of a LEED platinum building can account for between 50-80% of its carbon emissions (depending on the climate zone and electricity grid carbon intensity). Consequently, a lot of the research we do is focussed on reducing embodied carbon – through a combination of design optimisation (using less materials) and materials specification (using materials that emit less CO2 during manufacturing).

Influencing clients to support reducing embodied carbon is actually easier than persuading them to support reducing operational carbon emissions. From a cost perspective, any savings, through reducing the quantities of materials (which obviously also reduces total embodied carbon), directly benefit the developer through reducing construction costs. Operational energy savings, on the other hand, may have an additional capital cost, which is paid for by the developer, that leads to operational savings that benefit the tenant, not the developer. Typically, there is not a significant cost increase associated with specifying materials that have a lower carbon footprint. The only potential concern, that may well be very true for China, is that the selection of materials that have Environmental Product Declarations (EPDs), which are the reports that state the Global Warming Potential (embodied carbon), as well as other environmental impact factors, may be limited. Although with LEED awarding a generous number of points for undertaking lifecycle analysis and selecting materials with EPDs, the number of products available that have EPDs is increasing exponentially.

Q3. Heard about your impressive plan with LinkedIn on its carbon negative buildings. Would you share with us what are Carbon Negative buildings? How can we achieve carbon negative buildings?

A carbon negative building is a building that, over a defined period of time, captures or saves more carbon than it emits. To do this we need to consider the entire design from a lifecycle perspective; a good example is adding more insulation to a building in a mild climate… perhaps it will slightly improve energy performance and therefore, most likely reduce carbon emissions. However, the saved operational emissions may never pay off the carbon emissions from manufacturing, transporting and installing the insulation. The key aims in designing a carbon negative building are to reduce material used, to use material with lower or negative embodied carbon – for example some wood products or concrete made with aggregate that has been manufactured using captured CO2 and waste material. Then, the building needs to be carbon negative in operations such that the carbon savings can offset the embodied carbon. Renewable electricity production, storage and intelligent grid management are critical.

Dow Chemical Pacific
Sammy Hui, Business Development Leader, Buildings & Construction

Q1. Does Dow have a net zero target for the company?

Dow's sustainability strategies focus on two closely linked issues: reducing carbon emissions and eliminating plastic waste. By 2030, Dow will reduce its net carbon emissions by 5 million metric tons versus its 2020 baseline (a 15% reduction). By 2050, Dow intends to be carbon neutral (Scopes 1+2+3 plus product benefits).

Q2. Dow initiated the Carbon Challenge across the building sector with the U.S. Green Building Council (USGBC) in 2019; how does that campaign connect carbon neutrality?

Dow and the USGBC announced a Carbon Challenge in 2019 that looks to address the increasing built environment growth by encouraging reductions in the operational carbon footprint of buildings. Carbon emission in the buildings sector was still an area that didn't get enough attention back then. We believe science and collaboration play a key role in solving some of our world's largest challenges. Partnering with an organisation like USGBC can help advocate the 'carbon concept' among building managers. Carbon innovation needs wider adoption of locally relevant solutions for a successful transition to a more sustainable society. The Carbon Challenge has helped identify and recognise best practices and learnings from top performing buildings that can help inform new construction in the region.

Q3. Why does Dow have a carbon partnership program?

The key driver is collaborating to create sustainable building solutions for meeting the increasing demand of government regulations and initiatives. High performance building solutions from Dow deliver the advanced silicone technology innovation and product advancement necessary to help create a high-performance building: one that is energy-efficient, cost-effective, safe, flexible, aesthetically pleasing, and, most importantly, sustainable. But to ensure material science is deployed, we need to work with stakeholders along the value chain to make it happen. Architects, engineers, investors and real estate developers need to recognise that reducing carbon from the buildings sector is essential in combating climate change, and that there are solutions available.

Johnson Controls
Duanning Ma, North Asia Director, Digital Solutions

Q1. Does Johnson Controls have a net zero target for the company?

Yes. In January 2021, Johnson Controls unveiled sustainability commitments, further showing our dedication to protect and preserve the environment. They include:

- Achieving net-zero carbon emissions by 2040, ten years ahead of the Paris Agreement;
- Setting science-based targets consistent with the most ambitious 1.5°C Intergovernmental Panel on Climate Change (IPCC) scenario, including reduction in our operational emissions by 55% and customers' emissions by 16% by 2030;
- Investing 75% of new product development R&D into climate-related innovation, and;
- Reaching 100% renewable electricity usage globally by 2040.

Q2. How will building technology play a role for real estate to achieve carbon neutrality?

Architecture is more than just the reinforced concrete. It should be seen as a dynamic place where experience and value can be created. Instead of only considering single construction equipment, reporting in stages, verifying the sustainability results, as well as leveraging the digital tools, will serve as an evolving brain to help landlords of buildings and top executives of corporations to conduct real-time management of sustainable operations. Through the digital platform, we can not only consider the relationship between the systems in the overall building, but we must also develop detailed sustainable solutions for every floor, piece of equipment, enterprise, team, and individual user of the building, to achieve daily sustainable management upgrading. Consequently, continuous optimisation of the building experience and long-term sustainable value outputs are becoming possible.

Sinobo Group
Wang Lei, Head of Project Design, Chongli Taizicheng Resort

Q1. What does the carbon neutrality goal for 2060 mean for Sinobo?

Achieving carbon neutrality is part of China's long-term economic and social reform. It may lead to systemic changes in the technological structure, the industrial structure and even the whole development mode not seen since the industrial revolution. It is both a challenge and an opportunity. In recent years, Sinobo Group has been shifting from a traditional real estate industry business model to building a new consumption business model, thus helping to boost the development of the new economy. Sinobo Group is committed to building a resource aggregation platform with culture and sports as the core content. With the exponential growth of the size of a project, Sinobo Group needs to take into consideration many factors, such as elaborate green buildings, the ecological environment, transportation and human flow in the whole region, and realise the integration and upgrading of all kinds of resources and professions, so as to hit the target of carbon neutrality while taking into consideration all aspects and factors. On the road to achieving carbon neutrality, Sinobo Group is willing to take the lead by implanting more green concepts and increasing renewable energy in design, construction management and operation, and promoting carbon neutrality in all aspects of building materials, equipment, construction, operation and building system design. In the future, Sinobo Group will implement the concept of carbon neutrality in every step of business development and shoulder the due social responsibilities.

Q2. What carbon reduction measures are Sinobo currently applying?

In May 2018, the consortium led by Sinobo Group won the bid for the development of Chongli Taizicheng Resort, the key cooperation project in Hebei Province. Sinobo was responsible for the investment, construction and future operation of the project. As a key service guarantee project for the Beijing 2022 Winter Olympic Games, the design, construction and operation of Chongli Taizicheng Resort took into consideration sustainability and made it a top priority. In terms of carbon reduction, the resort mainly implements the concept of sustainability from the following aspects:

In terms of the structure, a large number of buildings in Chongli Taizicheng Resort use a steel structure. Compared with a traditional concrete structure, steel is recyclable and renewable and has the advantages of light weight, energy saving and water saving, so it reduces carbon emissions from the construction source. From a systematic point of view, Chongli Taizicheng Resort will make full use of the local abundant renewable energy (wind energy and solar energy), not only for lighting, but also for cooling and heating, thus greatly optimising the energy structure of the town. In addition, in terms of water and electricity savings, Chongli Taizicheng Resort will use efficient and energy-saving lighting fixtures, heating and air conditioning equipment to control the energy consumption required by building operations to a relatively low level. The greywater system will be rationally used for outdoor landscape irrigation and indoor cleaning. Also, a selection of water-saving faucets and sanitaryware will be used for resource conservation. From the perspective of building materials, Chongli Taizicheng Resort mostly uses materials excavated on site and local stone materials, adopts assembly-type construction, pays attention to the balance of earth works, and minimises the impact of construction on the environment.

In terms of low-carbon transportation, Sinobo Group has made great efforts to build a green slow traffic system for the town and introduced tram lines using clean energy. Visitors will be able to achieve "carbon-free travel" in the town through the pedestrian and bicycle paths above the ground, underground 'warm streets' and trams. In addition, the project will make good use of local plants and topography for landscape design, creating green valleys and clear streams among the mountains, and "restoring clear waters and green mountains" to the greatest extent.

The project is applying for China's Three Star Green Building certification and LEED for Cities and Communities certification.

Kerry Properties Limited (KPL)
General viewpoint

Q1. Can you share with us KPL's sustainability vision? Do you have a carbon neutral goal or are you planning to do so?

Sustainability has been an integral part of the business and strategy of KPL. We have arrived at our Vision 2030 strategy which encompasses quantifiable key performance indicators with alignment of six of the United Nations Sustainable Goals over four major areas: People Health and Wellness, Value Chain, Environmental Stewardship, and Community Wellness. With sustainability embedded in our Group's DNA, and increasingly incorporated into our policies and guidelines, our operations will continue to progress ever more sustainably.

The low-carbon city concept is the cornerstone for tackling global climate change. With this belief in mind, we set an ambitious carbon intensity reduction target of 30% for Hong Kong operations and 10% for the mainland operations by 2020, with the base year being 2011 and 2015, respectively. Through meticulous planning, and various systems and equipment upgrades, we successfully achieved these targets ahead of schedule. As of 2020, we can proudly report that 36% and 53% carbon intensity reductions have been achieved in Hong Kong and on the mainland.

Advancing in the decarbonisation journey, we have taken big steps to ensure continuous improvements in carbon reduction. Feasibility studies on the SBTi targeting at checking the global temperature increase by 1.5 degrees Celsius were conducted. Apart from our Scope 1 and 2 emissions, we are contemplating action plans to engage our partners along the value chain and reduce Scope 3 emission altogether. We hope a challenging, yet meaningful target will lead us a step closer to a carbon neutral operation.

Q2. It was mentioned in KPL's sustainability report that KPL have been conducting climate risk analysis. What is climate risk analysis? Why does it matter to KPL's business?

It is beyond doubt that climate change is shaping the world we are living in. To better prepare for the unprecedented risks, climate risk assessment is a tool to help us identify potential risks, prioritise resource use, and devise adaptation plans.

Climate risk assessment takes into consideration the likelihood, impacts, and the adaptive capability of a business towards the physical risks and transition risks brought by climate anomalies. Physical risks refer to the acute (e.g., floods) and chronic (e.g., sea level rises) risks driven by changing climate patterns; while transition risks are associated with tightened control over local policies and regulations and shifts in market trends. All the aforementioned risks ultimately have an impact on the expenses, revenue, assets, and liabilities of a company. From a property developer perspective, through detailed analysis and modelling, mitigation measures for existing buildings and adaptive design for future development can be implemented.

KPL has adopted various measures to turn the risks into opportunities. We piloted the Climate Risks and Vulnerability Assessment as early as 2018 at Hong Kong Kerry Centre. The existing controls and management regimes were subsequently reviewed to mitigate the risks identified. Tapping into the potential of the assessment, it was extended to seven properties in our operations. As the way forward, we aim at completing the assessment in 100% of our investment properties as targeted in our Vision 2030.

To enhance our disclosures and respond to investors' concerns over climate risks, we referenced the Task Force on Climate-Related Financial Disclosures ("TCFD") to articulate the implications of and our responses towards climate-related financial impacts in our Sustainability Report 2020.

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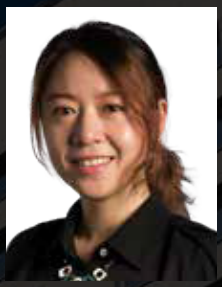

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