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IRISH GREEN BUILDING COUNCIL

SUSTAINABILITY AND COMMERCIAL REAL ESTATE

A joint publication by –
AIB Real Estate Finance
The Irish Green Building Council (IGBC)

May 2022

Contents

Introduction

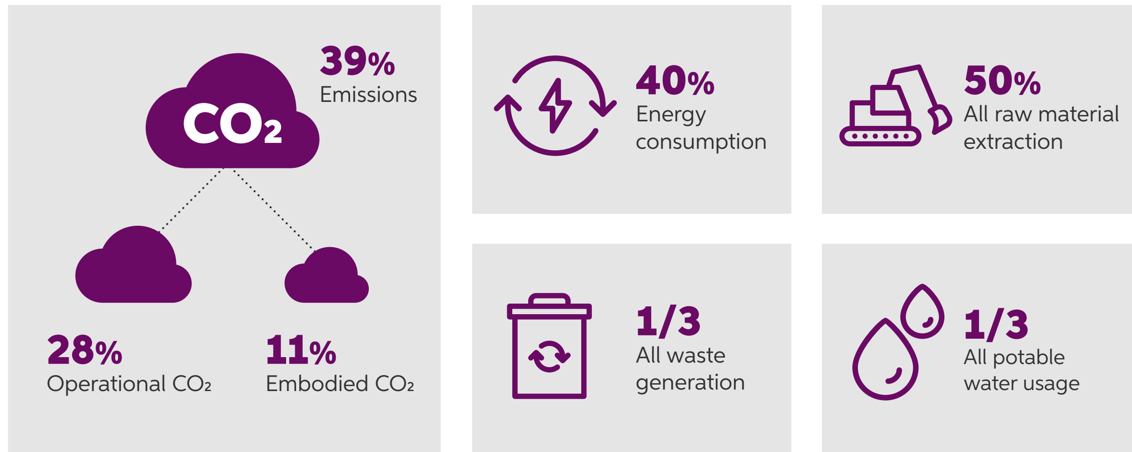
This briefing paper, Sustainability and Commercial Real Estate, is the result of a collaboration between the Irish Green Building Council and AIB, and it is the first in a series titled Sustainability, Finance and the Built Environment.

The purpose of this paper is to introduce key concepts to investors and developers, in the context of climate risk impacts on both the financial sector and the built environment.

We have 7 years left to cut carbon emissions by 50% and 27 years to get to net zero emissions. Globally, buildings and construction are responsible for 39% of all carbon dioxide (CO_2) emissions. Operational CO_2 from heating, cooling, and lighting buildings, accounts for 28% of CO_2 emissions with the remaining 11% coming from materials production, construction, refurbishments, and deconstruction – embodied CO_2.

Figure 1
Buildings and construction are responsible for 39% of emissions

Sources: European Commission, and SEAI, 2018



The amount of green-labelled bonds outstanding in Europe now exceeds €500 billion, with issuance growing by between 20% and 30% per year for several consecutive years. Equity and debt investor awareness and expectations with respect to climate change are increasing and are impacting on required returns for equity investors. Real estate locations and energy ratings are becoming an increasingly important consideration for investors. Evidence is also emerging on the 'green premium' or 'brown discount'.

This paper presents statistics on Ireland's non-domestic building stock, and on energy ratings and emissions by property type. It draws on local case studies of new and retrofitted buildings that are leading the way in net zero carbon targets.

The terms "nearly zero energy buildings" (NZEB) and "Building Energy Rating" (BER) are defined, and their relationship to each other is discussed briefly.
The BER calculation method and its implications for our understanding of the energy efficiency of a building is explained in relation to the issue of "performance gap", i.e. the difference between the predicted and actual energy performance of a building.

The paper stresses the importance of a whole life carbon approach, and how both operational carbon and embodied carbon should be accounted for when calculating the carbon impact of buildings. It also describes the energy hierarchy and life cycle analysis that constitute the key elements of net zero carbon buildings.

1

Global buildings energy consumption and emissions

Between 2010 and 2017 it is estimated that energy use in buildings grew steadily, achieving an annual average growth rate of 1.1% and accounting for 30% of global final energy consumption. This occurred despite the fact that the average energy use per square metre declined by nearly 25% over the 2000-2017 period. The improvement in energy intensity use was offset by the pace of growth of global commercial building floor space, which increased by 65% over the same period, reaching 240 billion m² in 2017 according to the International Energy Agency (IEA). The key drivers of the growth in global floor space over that period include:

- Expanding populations
- Increasing purchasing power in emerging economies, and
- Growing commercial activity.

These trends are likely to characterise the global economy over coming decades, and without direct action, the CO_2 emissions from building energy use in buildings could increase by between 100% and 200% by 2050, according to the Intergovernmental Panel on Climate Change (IPCC).

The World Green Building Council 2020 Global Status Report for Buildings and Construction estimated that buildings were responsible for approximately 35% of global energy consumption and approximately 39% of global emissions in 2019. In terms of energy consumption, the following is a breakdown of the key building sectors:

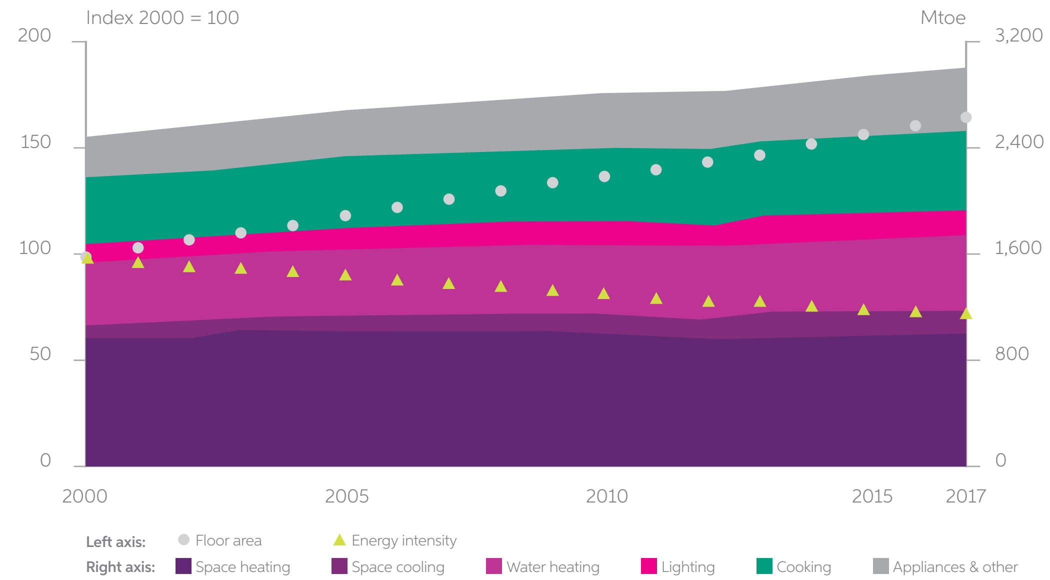
- Residential – approximately 63%
- Non-residential – approximately 23%
- Construction industry – approximately 14%.

In terms of emissions, the following is the relevant breakdown:

- Residential - approximately 45%
- Non-residential – approximately 29%
- Construction industry – approximately 26%.

However, the above numbers mask the relative level of intensity with respect to energy use and emissions. According to the IEA, commercial buildings account for approximately 50% of energy use and emit 200% more emissions than residential units. As the IEA states, this is due to the fact that; "[R]esidential buildings represent about 80% of global floor area, although they only account for around 60% of buildings-related CO_2 emissions." Consequently, while residential buildings will contribute significantly to the reduction in energy use and carbon emissions, there is an important onus on commercial real estate to improve on its energy use and emissions given its inherently higher levels of intensity.

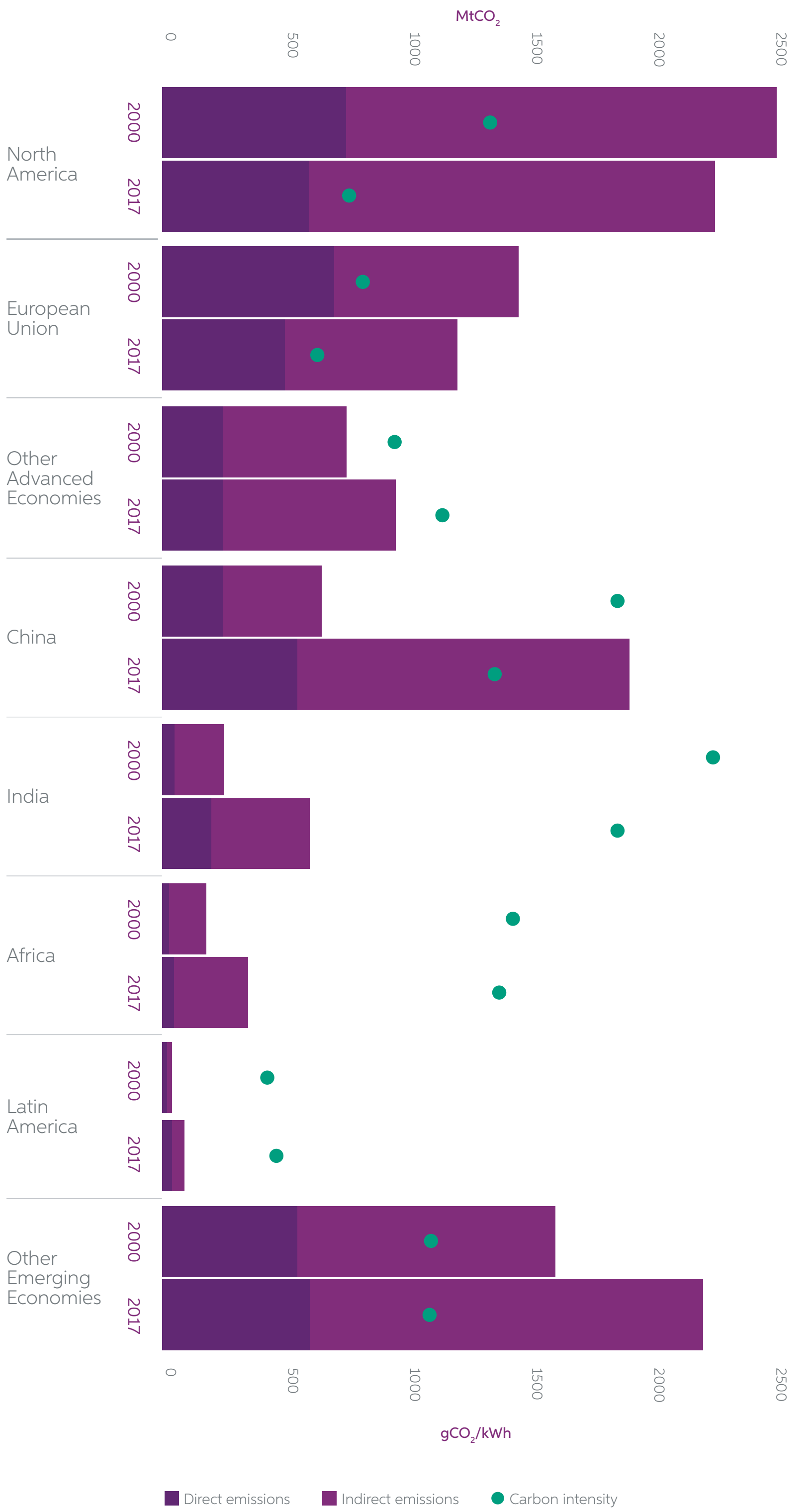
Figure 1.1
Global buildings sector energy use and intensity by end use, 2000–2017



From a geographic perspective, much of the increase in CO_2 emissions and carbon intensity has occurred in emerging economies. For example, in India, CO_2 emissions related to buildings more than doubled between 2000 and 2017, while indirect emissions nearly tripled, despite falling carbon intensities in electricity generation.

By contrast, indirect emissions from electricity generation and commercial heat use and carbon intensity fell in North America and the European Union (EU). This was due to low-carbon electricity generation and relatively stable electricity demand in recent years, and occurred despite increasing electrification of buildings.

Figure 1.2
Buildings-related CO_2 emissions and power sector carbon intensity by region, 2000–2017

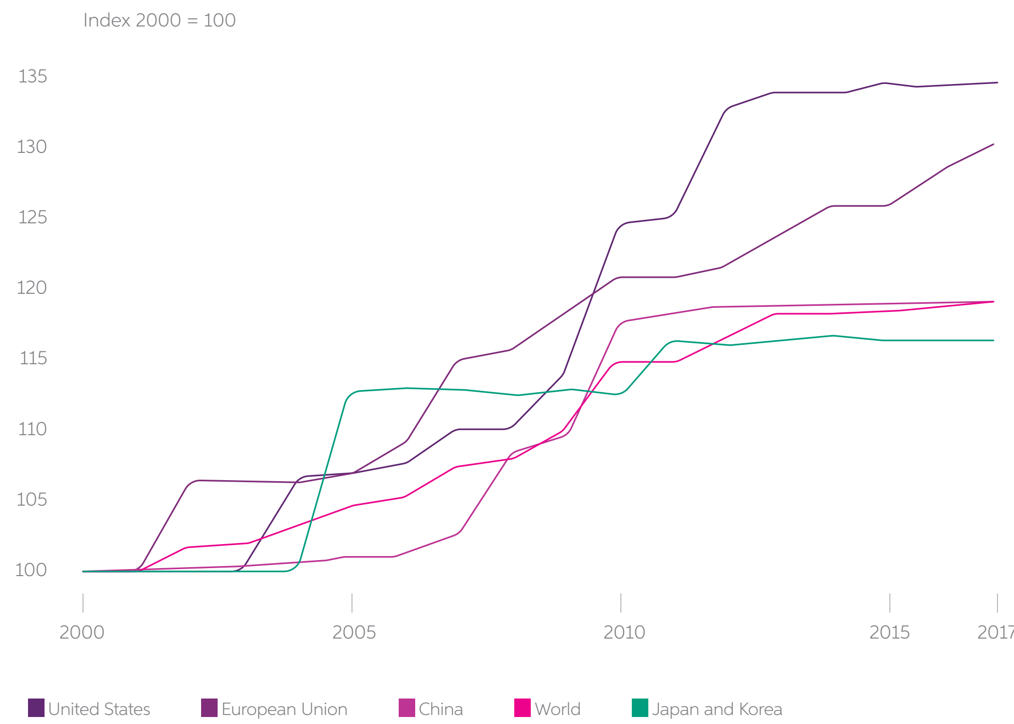


Notes: $MtCO_2$ = megatonnes of CO_2. Indirect CO_2 emissions result from upstream generation of electricity and heat used in building. Carbon intensities for the power sector represent the total grammes (g) of CO_2 emissions per kilowatt-hour (kWh) of electricity consumption.

"[P]olicy actions to encourage and enforce improved energy performance of buildings and end-use equipment are a critical element to put the buildings sector on a clean energy path. Existing, new and announced policies only covered around 38% of energy use in buildings in 2017, representing only half of CO_2 emissions from the sector. While energy efficiency policies have expanded rapidly since the early 2000s, when they accounted for less than 20% of buildings sector energy consumption, annual improvements in mandatory policy coverage only grew 2-3% in recent years (compared with 5-8% previously). Overall stringency improvements (i.e. increase in the relative strength of the policies over time) also diminished in recent years"

(IEA, 2018a)

Figure 1.3
Stringency improvement



According to the IEA, it is evident that significant progress has been made in many advanced economies with regard to policies governing CO_2 emissions from buildings. However, emerging economies tend to lag behind in this respect.

However, a continued focus on reducing carbon emissions from the built environment, irrespective of location, will be required in order to meet the challenging 2030 and 2050 energy targets.

2

Climate targets and their impact on the built environment

Global targets

Signatories to the Paris Agreement in 2015 pledged to keep temperature increases to between 1.5C and 2C. However, the report from the Intergovernmental Panel on Climate Change (IPCC) states that going above 1.5C will significantly worsen the risks of drought, floods, and extreme temperatures.

In 2015, United Nations (UN) Member States adopted the 2030 Agenda for Sustainable Development ("Transforming our World"). The focus of the 2030 Agenda is the 17 Sustainable Development Goals (SDGs). These are a collection of 17 interlinked global goals designed to be a "blueprint to achieve a better and more sustainable future for all".

EU targets

The European Climate Law writes into law the goal set out in the European Green Deal for Europe to become climate neutral by 2050. The law also sets the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared with 1990 levels.

EU INITIATIVES	FEATURES/PROPOSAL	TIMELINE	REMARKS
ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE (EPBD)	• Setting objectives for energy performance of buildings • Likely introduction of mandatory performance standards • Introducing means to control MS strategies and progress • Mandating measurement of whole life carbon	Proposed revision published in Q4 2021	• Regulatory boost for deep energy-efficient renovations • Regulatory boost for net zero build
EU TAXONOMY	• A classification system, establishing a list of environmentally sustainable economic activities • Activities classified according to criteria of making substantive contribution to climate change mitigation, do no significant harm and maintaining minimum safeguards	Phased out over 2021. Some articles passed in July 2021	• Targets investment in sustainable activities and hence expected to influence flow of capital • Incentivise companies (including real estate) to invest in sustainable and mitigative measures like renovation as well as investments in energy efficiency to attract capital
ENERGY EFFICIENCY DIRECTIVE	• Energy efficiency improvement target raised from 32.5%. By 2030 Vs. 2005 to 36% for Final Energy • MS' Savings obligations would roughly double on average	Agreement targeted in Q4 2021	• Annual obligation to renovate 3% of public building floor area • Efficiency requirements incl. in all public procurement
RENEWABLE ENERGY DIRECTIVE	• 32% minimum share of renewables increased to 38-40% by 2030 • Indicative target: 49% renewables use in buildings by 2030	Agreement targeted in Q4 2022	• Electrifying and renewables integration in buildings boosted • Clearer rules around district heating (less fossil fuels)
ENERGY TAXATION DIRECTIVE	• Revising minimum tax rates for energy products • Reducing MS' ability to create exemptions • Reviewing fiscal incentives to favour sustainable solutions	Agreement targeted in Q4 2022	• Electrification further incentivised • Possibly less MS' support for industrials' energy bills • Benefitting: alternative energy production incl. hydrogen
EMISSIONS TRADING DIRECTIVE	• Allowance cap means a 60% reduction in emissions by 2030 for industrials vs. the total 55% target for the EU • Tightened rules and progressive removal of free allowances to align with the CBAM	Agreement targeted in Q4 2021	• Carbon costs likely increasing: inflationary pressure in building • Inclusion of buildings in a specific ETS
CARBON BORDER ADJUSMENT MECHANISM	• Taxing imports according to their carbon content in order to guarantee a level playing field with EU producers • Incentivising trading partners to implement carbon pricing mechanisms	Agreement targeted in 2022	• Further incentive to decarbonise carbon-intensive processes • Import threat relatively limited in building products (local activity, service component)
CONSTRUCTION PRODUCTS REGULATION	• Framework to monitor and reduce life-cycle emissions of building products - step towards more circular economy • Reviewing material recovery targets for construction & demolition waste	2024	• Construction value chain to reorganise to meet circular economy targets • Circular long-life solutions in construction to gain market shares structurally

Initiatives

To achieve the goals set at EU and national levels, several initiatives targeting the built environment have been launched and are summarised in Table 2.

Table 2
EU initiatives to help the built environment on the sustainability journey

A Renovation Wave for Europe	In October 2020, the EU launched 'A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives' under the auspices of the European Green Deal. According to the European Commission, "[M]ore than 220 million building units, representing 85% of the EU's building stock, were built before 2001. 85-95% of the buildings that exist today will still be standing in 2050. Today, only 1% of the EU's existing building stock undergoes some level of renovation each year. However, very rarely, renovation works address energy performance of buildings. The weighted annual energy renovation rate is low, at some 1%. Across the EU, deep renovations that reduce energy consumption by at least 60% are carried out in only 0.2% of the building stock per year, and in some regions, energy renovation rates are virtually absent." The aim of the strategy is to markedly increase the level of renovation carried out in the EU, supported by significant investment.
Circular Economy Action Plan	The EU's new Circular Economy Action Plan, published in 2020 acknowledges that scaling up the circular economy from front-runners to mainstream economic players will make a decisive contribution to achieving climate neutrality by 2050. It opens the door to exploring setting whole life carbon targets for the building sector, addressing the issue of embodied carbon, and integrating whole life carbon assessment into green public procurement and sustainable finance policy.
Level(s) – European framework for sustainable buildings	Launched in October 2020, Level(s) – European framework for sustainable buildings has been developed as a detailed reporting framework to improve the sustainability of buildings from the life cycle perspective, including the transition towards circular economy models. It encourages life cycle thinking and supports users from design stage through to operation and occupation of a building.

Irish targets

The Climate Action and Low Carbon Development (Amendment) Act 2021 enshrines in law the objective of reaching carbon neutrality by 2050 and of reducing greenhouse gas (GHG) emissions by 51% by 2030.

The impact on the built environment in Ireland

The Climate Action Plan (2019), the Programme for Government (2020), and Ireland's Long-Term Renovation Strategy (2020) include a number of targets that relate specifically to reducing CO_2 emissions associated with operational energy use in Ireland. These include:

- Retrofitting 500,000 homes to a BER B2 by 2030.
- Installing 600,000 heat pumps in residential buildings by 2030 (200,000 in new buildings – 400,000 in existing buildings),
- Retrofitting at least one-third of commercial premises to a BER of B by 2030.
- Installing 25,000 heat pumps in commercial buildings by 2030,
- All public sector buildings and one-third of commercial buildings will be retrofitted to a BER of B by 2030. While no milestones have been formally set for 2040 and 2050, it is expected that an indicative milestone of two-thirds of commercial buildings retrofitted to a BER of B will be reached by 2040. The corresponding date for retrofitting of all commercial buildings to a BER of B is 2050.

The overall objective is to reduce CO_2 equivalent emissions from the built environment by between 40% and 45% relative to 2030 projections.

However, regulations are confined to the fixed loads (such as heating, hot water production, fixed lighting, fixed pumps, and ventilation), and do not cover plug loads for equipment brought into a building by the occupiers. Such equipment includes dishwashers, fridges, coffee-makers, and computers. Current regulations only deal with operational energy during the use phase of the building, but for the first time ever, the Climate Action Plan (2021) includes action to address embodied carbon emissions.

The requirement for nearly zero energy building in the Irish Building Regulations

The European Energy Performance of Buildings Directive (EPBD) recast 2010/31/EU set out a requirement for all new buildings to be nearly zero energy buildings (NZEB) by 31 December 2020 and all buildings acquired by public bodies by 31 December 2018.

The nearly zero energy building is defined in the EPBD as follows:

> "Nearly-zero energy building that has a very high energy performance and in which the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby."

The requirements are interpreted by each EU member state and are implemented through the building regulations in each country. In order for new building construction to comply with the NZEB requirements of the European Energy Performance of Buildings Directive (EPBD) recast 2010/31/EU the Irish Government issued the revised Building Regulations Part L – Conservation of Fuel and Energy – Buildings other than Dwellings (2017) – and the accompanying Technical Guidance (non-residential buildings) and Technical Guidance Document L – Conservation of Fuel and Energy – Dwellings (2019) (residential).

Building Energy Rating, Energy Performance Coefficient, and methodology

In order to fulfil the requirements of the EPBD, Ireland has introduced:

- **Building Energy Ratings (BER)**; to benchmark the building energy performance of all building stock, new or old. Valid for 10 years, a BER must be provided on building completion, renovation, sale, or lease.
- **Energy Performance Coefficient (EPC)**; a minimum energy performance target for new buildings and renovations to demonstrate compliance with Part L of the Building regulations 2017.

Non-Domestic Energy Assessment Procedure (NEAP)

The Non-Domestic Energy Assessment Procedure (NEAP) is Ireland's official methodology for calculating a BER or EPC for non-domestic buildings, using the Simplified Building Energy Model (SBEM), or by other approved software packages. Under NEAP, three different versions of the building are calculated. As follows.

- **The 'actual building'**
  The building as constructed; is verified via 'as-built' documentation and site inspection.
- **The 'notional building'**
  This is a hypothetical alternate version of the actual building using the same orientation and geometry. Default building fabric and systems applied to create the notional building are used to determine the BER.
- **The 'reference building'**
  This is a hypothetical alternate version of the actual building using the same orientation and geometry. Default building fabric, systems and renewable energy applied to create the reference building are used to determine compliance with part L of the building regulations 2017.

BER

The BER is determined by the actual building's performance being divided by the performance of the notional building. A BER of 1.5, indicating that the actual building energy use is 1.5 times that of the notional building energy use would correlate to a 'D2' energy band.

EPC

The EPC is determined by the actual building's performance being divided by the performance of the reference building. As the Maximum Permitted Energy Performance Coefficient (MPEPC) is 1.0, the actual building must meet or exceed the performance of the reference building.

Performance gap

While EPCs and BERs calculate potential operational emissions from buildings, these are essentially theoretical, and do not necessarily reflect the actual energy use in a building. The latter can vary from the theoretical based on the various appliances and equipment (plug loads) used in a building, and on the occupant behaviours. The 'performance gap' is the difference between the estimated energy use and the actual operational energy use recorded post occupancy. Closing this gap is critical to ensuring that clients get the standard of building they pay for, and that carbon emission targets are achieved.

What is the relationship between NZEB and BER?

There is no relationship between NZEB and BER as the BER is still calculated via separate methodolog. However, it has been found that a typical commercial building complying with Part L of the Building Regulations 2017 (NZEB performance) will typically achieve a high A3 to low A2 BER.

3

Ireland's non-domestic building stock and associated BER ratings

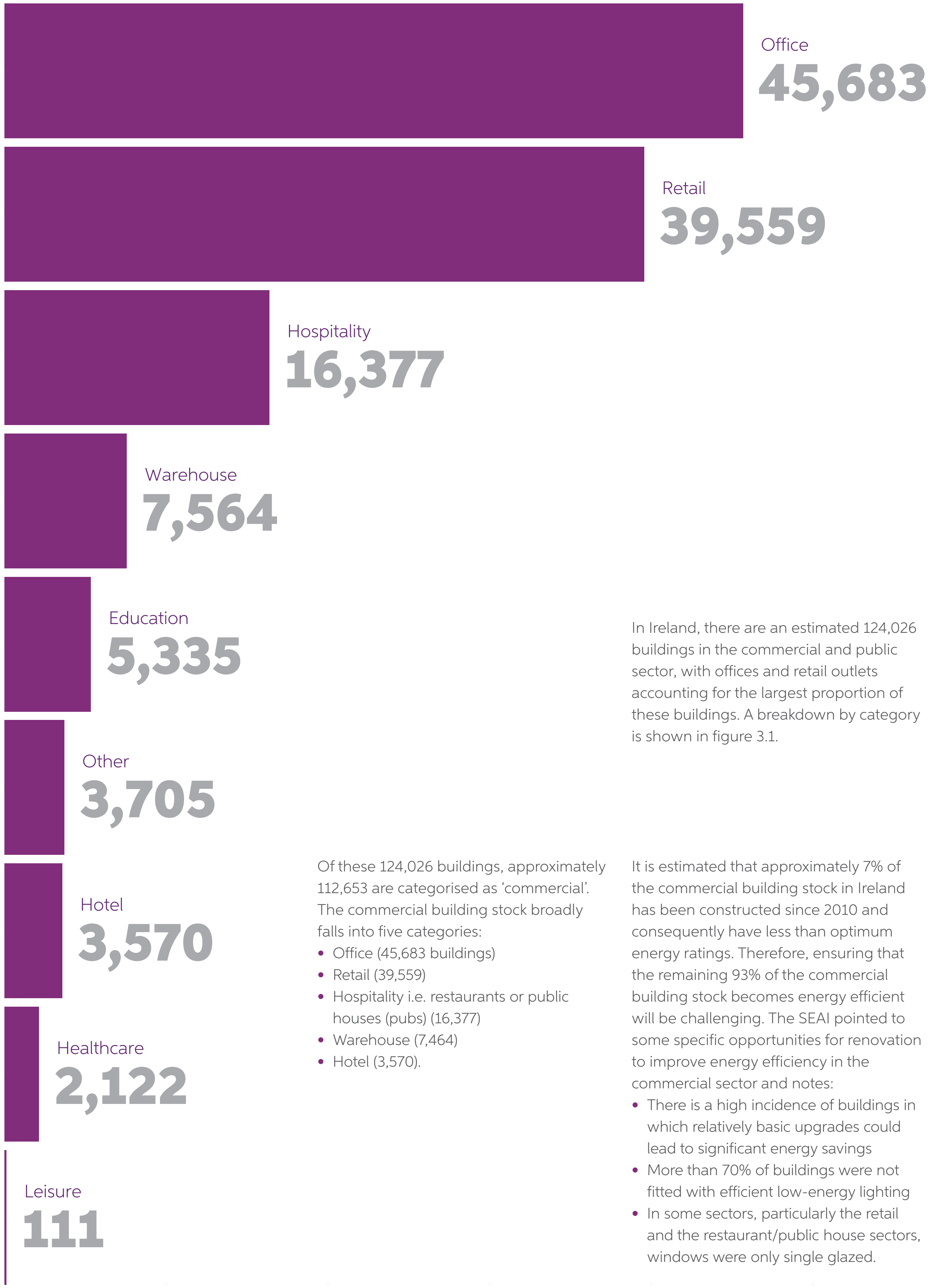


Figure 3.1 Commercial and public sector – building categories

Source: CSO

In Ireland, there are an estimated 124,026 buildings in the commercial and public sector, with offices and retail outlets accounting for the largest proportion of these buildings. A breakdown by category is shown in figure 3.1.

Of these 124,026 buildings, approximately 112,653 are categorised as 'commercial'. The commercial building stock broadly falls into five categories:

- Office (45,683 buildings)
- Retail (39,559)
- Hospitality i.e. restaurants or public houses (pubs) (16,377)
- Warehouse (7,464)
- Hotel (3,570).

It is estimated that approximately 7% of the commercial building stock in Ireland has been constructed since 2010 and consequently have less than optimum energy ratings. Therefore, ensuring that the remaining 93% of the commercial building stock becomes energy efficient will be challenging. The SEAI pointed to some specific opportunities for renovation to improve energy efficiency in the commercial sector and notes:

- There is a high incidence of buildings in which relatively basic upgrades could lead to significant energy savings
- More than 70% of buildings were not fitted with efficient low-energy lighting
- In some sectors, particularly the retail and the restaurant/public house sectors, windows were only single glazed.

Energy ratings of non-domestic buildings in Ireland

The stock of energy-efficient non-domestic real estate buildings in Ireland is low, with approximately 10% of such buildings having a BER B3 or higher. An analysis of BER data from the Central Statistics Office (CSO) shows that of all the BER audits conducted for non-domestic buildings in Ireland between 2009 and 2021, a G rating accounts for the largest number at close to 8%, while an A rating accounts for just over 1%. The majority of non-domestic buildings audited in the 2009–2021 time period had a BER rating of either C or D.

Figure 3.2
Number of BER audits conducted by grade (non-domestic) 2009–2021

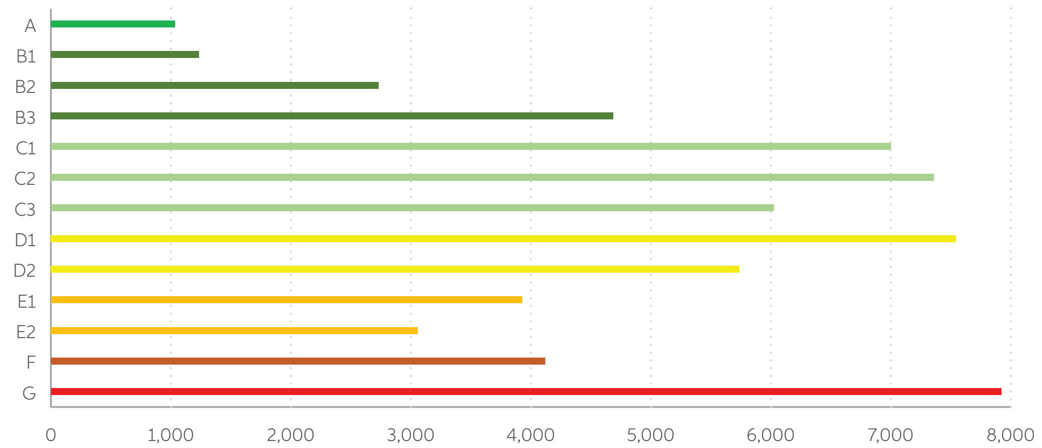
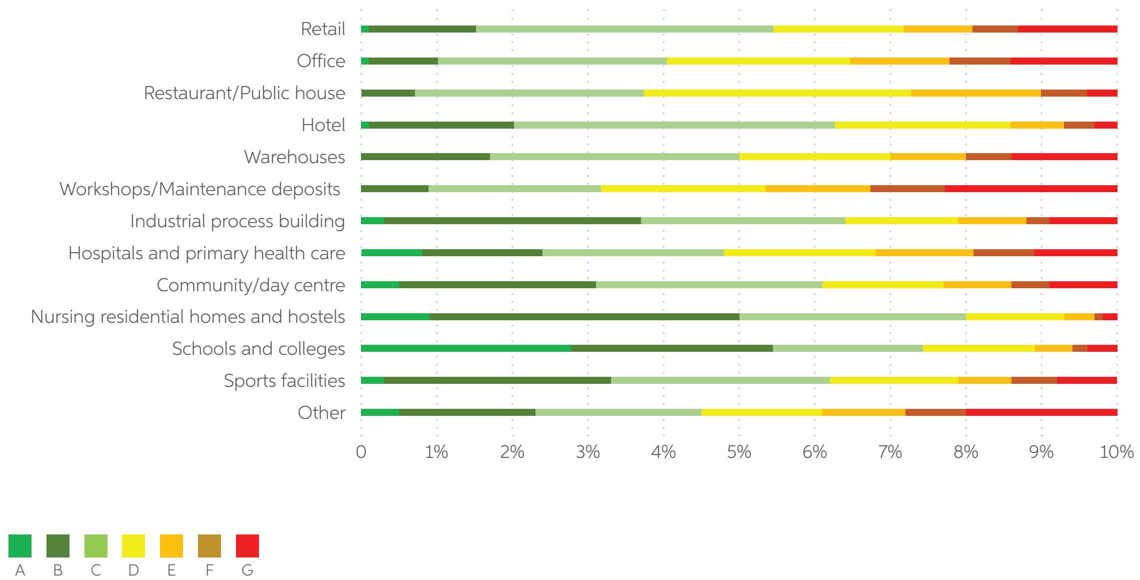


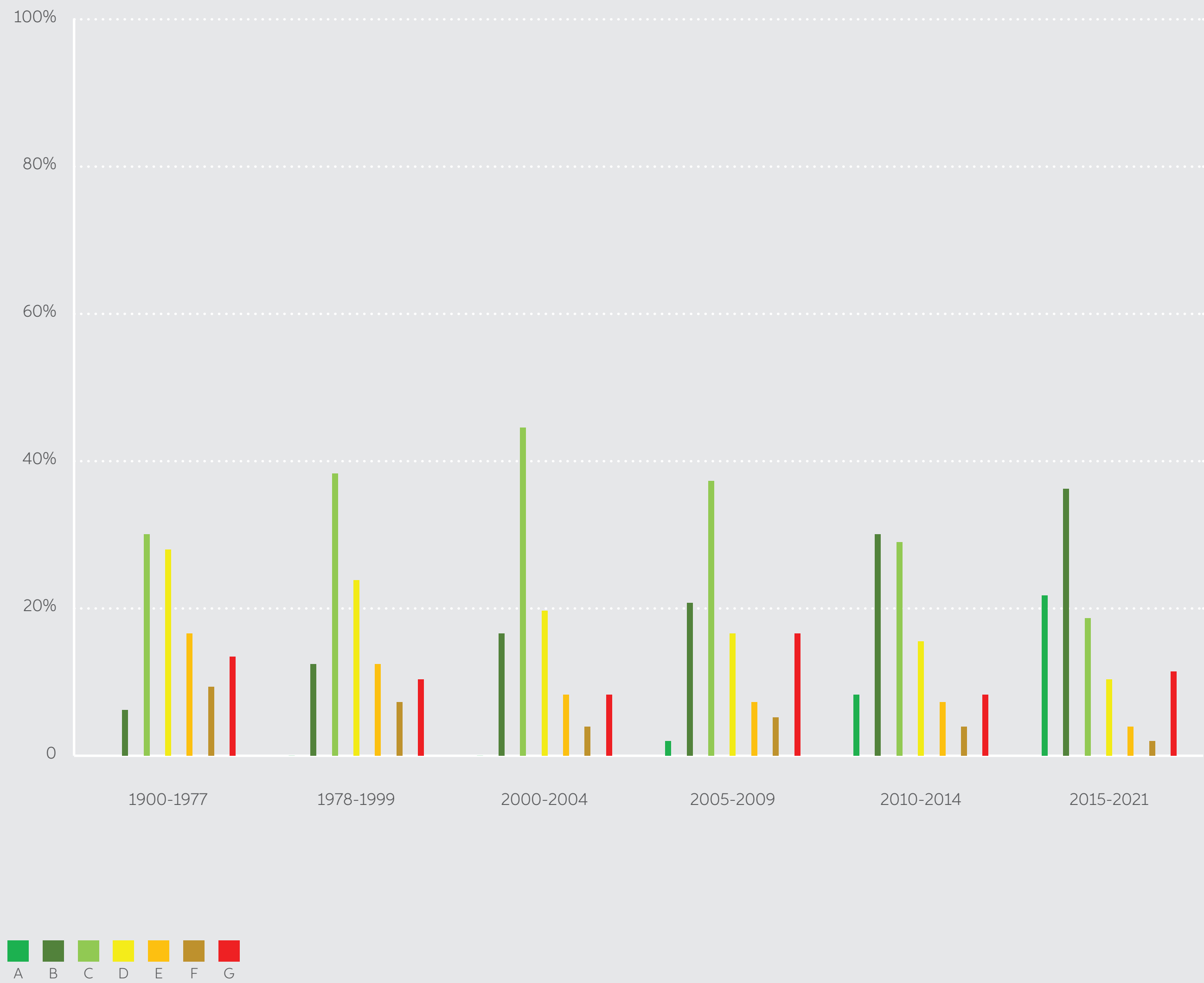
Figure 3.3
BER audits conducted by type of building (non-domestic) 2009–2021
Source:CSO



When broken down by type of non-domestic building, the CSO data show that schools and colleges are the most energy efficient, with 28% of such buildings rated A, as illustrated in *Figure 3.3*. This is followed by 'Nursing homes and hostels', 9% of which had a BER A, and 'Hospitals and primary care' which had an A rated share of 8%. The least energy-efficient buildings were 'Restaurants/Public houses', 'Warehouses', and Workshops/maintenance depots, none of which had a BER of A.

Figure 3.4 shows the change in BER trends by period of construction. No building built prior to 2005 had a BER of A, and just 16% of buildings built between 2000 and 2004 achieved a B rating. On a more positive note, recent years have seen an increase in the number of energy-efficient buildings. While only 8% of non-domestic buildings constructed between 2010 and 2014 were rated A, this percentage increased to 21% for those that were constructed in the 2015 to 2021 period.

Figure 3.4
BER audits by period of construction (non-domestic)
Source:CSO



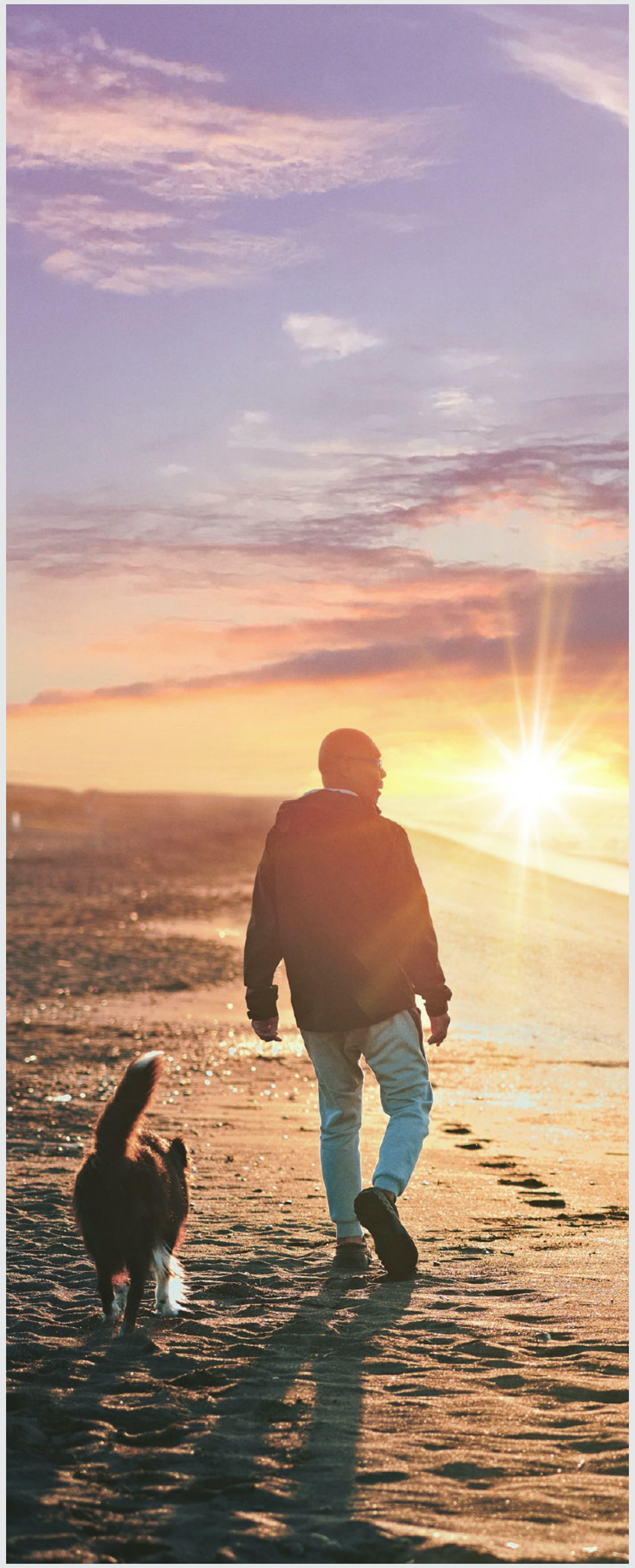
4 Net Zero Carbon

What is net zero?

The term 'net zero' means achieving a balance between the carbon emitted into the atmosphere and the carbon removed from it. The balance – or net zero – will happen when the amount of carbon we add to the atmosphere is no more than the amount removed. To reach net zero, emissions from homes, transport, agriculture, and industry will need to be cut. In other words, these sectors will have to reduce the amount of carbon they put into the atmosphere. More information can be found at: https://energysavingtrust.org.uk/what-is-net-zero-and-how-can-we-get-there/

Net zero in the context of the built environment

Net zero does not only mean CO_2 emissions while a building is in use. While the majority of CO_2 emissions occur when people use buildings (through heating, lighting and use of appliances), significant emissions are also created before the building is occupied, for example, during the manufacturing of building materials.



FURTHER READING:

Introduction to the Net Zero Carbon Guide by Max Fordham can be found at: https://www.netzerocarbonguide.co.uk/guide#where-to-start

WATCH:

Should you always retrofit? Available at: https://www.youtube.com/watch?v=XIntpMWGpk4

Life cycle of a building

CO_2 emissions or carbon emissions occur at every stage of the life cycle of a building.

The life cycle stages of a building are:

- Product – extraction of raw materials and manufacturing of products
- Construction of the building
- Use of the building, and maintenance and repair
- End of Life – deconstruction, demolition, waste processing and disposal of the building.

Figure 4.1 shows the carbon emissions at each stage of the life cycle of a building. Operational carbon - the emissions that occur during the 'Use' stage of a building's life cycle as a result of heating, cooling, and lighting – are usually the most significant, particularly in older buildings where fewer energy-saving strategies are deployed.

Other phases of the life cycle of a building also produce carbon emissions that need to be accounted for. The carbon emissions that are created during the 'Product', 'Construction', and 'End of Life' stages are known as 'embodied carbon'. Embodied bodied carbon also includes emissions arising in the 'Use' stage, during the maintenance, repair and replacement of sections of a building.

Whole life carbon

Whole life carbon (WLC) = embodied carbon + operational carbon

A whole life carbon approach involves measuring both the embodied and operational carbon using data on the embodied carbon of building materials drawn from the proposed design, and data on the operational carbon of energy use drawn from energy modelling. The European standard EN 15978: 2011 is the assessment framework that divides the four life cycle stages into 16 modules, from phases A1 to C4 with:

- A1 to A3 phase – Product stage
- A4 to A5 phase – Construction stage
- B1 to B7 phase – Use stage
- C1 to C4 phase – End of Life stage

Figure 4.1 provides a more detailed exposition of each phase and stage.

Figure 4.1

Together, embodied carbon and operational carbon constitute the concept of whole life carbon (WLC)

EMBODIED

STAGE: UP-FRONT

Raw materials	Transport	Design and Manufacturing	Construction
Production of steel, cement, aluminium, glass and plastic account for c.23% of a building's carbon footprint	Transporting to building sites produces GHG emissions	Initial design influences lifetime carbon emissions	Construction makes up 30% of the UK's total waste generation
Possible solutions:			
Use alternative low carbon materials	Use electric vehicles	Conduct life cycle assessments	Use recycled materials where possible and net zero construction methods

STAGE IN-USE

Maintenance	Repair	Refurbishment	Replacement
Keep buildings up-to-date to minimise energy intensity		It is often more energy intensive to demolish and rebuild a building than to retrofit an existing one	
Possible solutions:			
Ensure buildings are up-to-date with energy efficient methods		Use recycled materials where possible and improved construction techniques	

STAGE: END-OF-LIFE

De-construction / Demolition	Transport	Waste Processing	Disposal
Demolition releases GHG and produces waste	Removing debris from demolition sites can produce GHG emissions	Processing waste produces GHG emissions	Transporting materials to landfill releases GHG emissions
Possible solutions:			
Demolition should be last resort	Use electric vehicles	Ensure waste is processed in carbon neutral way	Reuse and recycle as much material as possible, with disposal the last resort

OPERATIONAL

STAGE IN-USE

Heating and Cooling	Energy	Appliances and Cooking	Smart Technology
Largest proportion of operational carbon	Building energy demand will rise with increased use of appliances	Appliances used in buildings can be energy intensive	Excessive energy demand at peak times can cause issues for the GHG
Possible solutions:			
Replace gas boilers with low-carbon alternatives	Use renewable energy	Install appliances with high energy efficiency ratings	Install smart metres to track energy usage and make use of off-peak electricity

The EN 15978 framework helps design teams to measure the carbon emitted for each material they specify. It outlines the calculation method to assess the environmental performance of a building and gives the means for reporting and communication of the outcome of the assessment. The standard is applicable to new and existing buildings and refurbishment projects.

Figure 4.2
EN 15978 Reporting Modules
Source: Reproduced from Potrc Obrecht, T., Kunič, R., Jordan, S. and, Legat, A. (2019). Roles of the reference service life (RSL) of buildings and the RSL of building components in the environmental impacts of buildings. IOP Conference Series: Earth and Environmental Science.

BUILDING ASSESSMENT INFORMATION

BUILDING LIFE CYCLE INFORMATION															SUPPLEMENTARY INFORMATION BEYOND THE BUILDING LIFE CYCLE
A1-2 PHASE			A4-5 PHASE		B1-7 PHASE					C1-4 PHASE					D
Product stage			Construction process stage		USE stage					End of life stage					
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4		
Raw material supply	Transport	Manufacturing	Transport	Construction - Installation process	Use	Maintenance	Repair	Refurbishment	Replacement	Deconstruction demolition	Transport	Waste processing	Disposal		Benefits and loads beyond the system boundary Reuse Recovery Recycle
					B6	Operational energy use									
					B7	Operational water use									

Embodied Carbon   Operational Carbon

Life cycle analysis

In order to quantify embodied carbon, design teams use the standard EN 15978 framework to draw on the background data of each material in a building design to build up an inventory based on the emissions involved in the production processes of the materials. These background data are drawn from Environmental Product Declarations [EPDs] or generic studies of each material.

What is a net zero energy building?

A net zero energy building is one that seeks to minimise emissions as much as possible across all life cycle stages, and then offset the remaining balance through the supply of renewable energy to the grid and/or participation in recognised offsetting schemes that meet the Gold Standard. (More information can be found at: https://www.goldstandard.org/). For more information on the Verified Carbon Standard, go to (https://verra.org/project/vcs-program/). Using the EN 15978 framework helps us to address questions such as:

1. Where can embodied carbon be reduced?
2. What effects might this have on operational carbon?
3. Can renewable energy supply be introduced?
4. What is the final figure that needs to be offset?

The scope of a whole life carbon study must include phases A1 - 5 as the production of materials and the construction process are significant contributors to the WLC of any project.

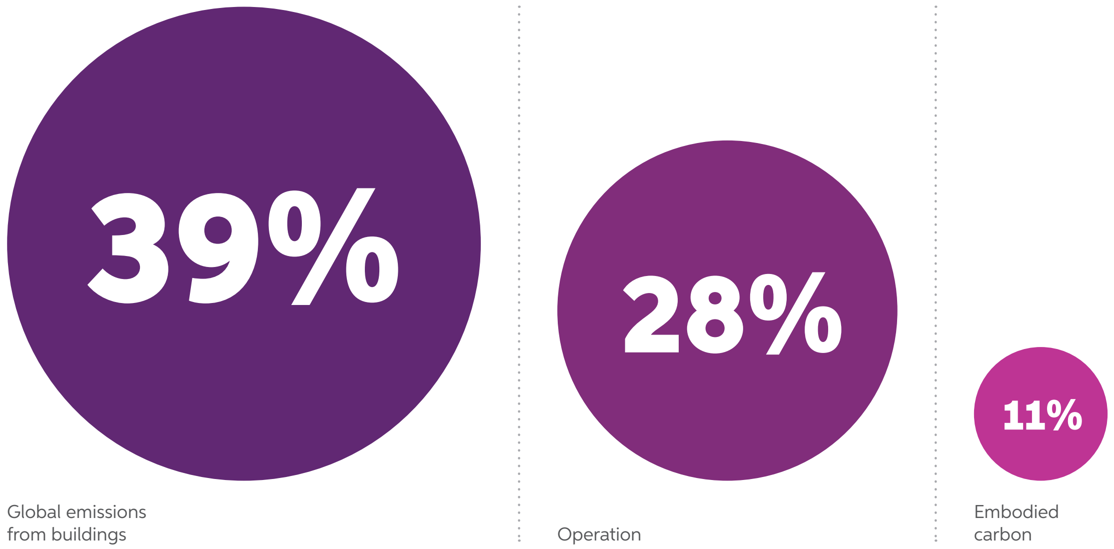
Offsets

When an investor has taken the four questions above into account and has reduced WLC as much as possible, before calculating the remaining WLC that cannot be designed out, they can then develop a plan to offset the remaining emissions. For example, they could buy carbon credits by long-term investment in carbon sinks such as reforestation programmes that will sequester carbon in the long term.

Importance of embodied carbon

As shown in figure 4.3, buildings and construction are responsible for 39% of all carbon emissions globally. Around 11% of all emissions are embodied carbon; in other words emissions resulting from the manufacturing of materials and construction of buildings. The operational carbon of a building resulting from heating, cooling, and lighting the building has traditionally accounted for the largest carbon footprints, currently standing at 28% globally. As our energy supply decarbonises and buildings are designed to operate more efficiently, the carbon cost of heating and cooling reduces, thus increasing the relative importance of other phases in the life cycle, known collectively as embodied carbon.

Figure 4.3
Breakdown of operational and embodied carbon
Source: WGBC



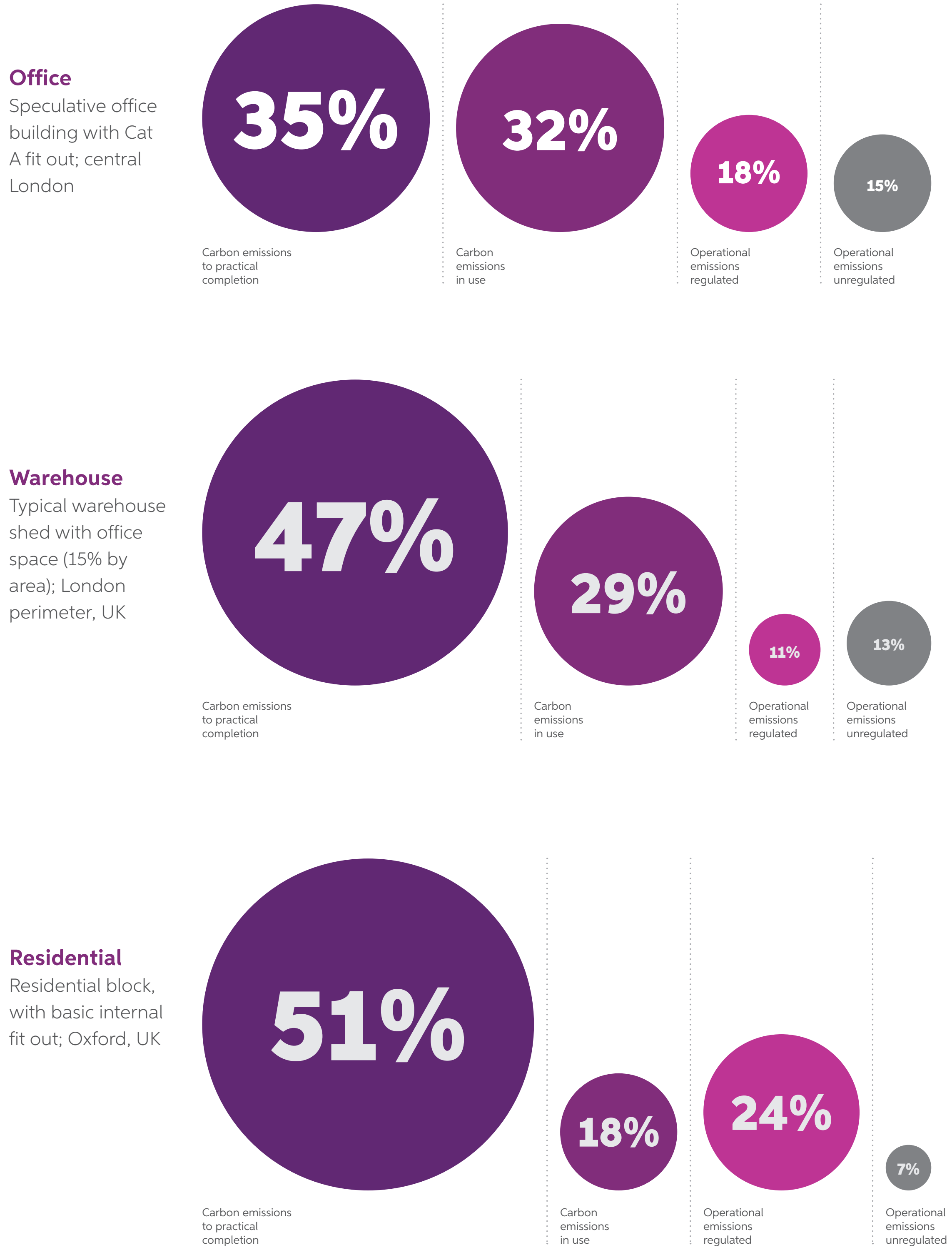
Breakdown of whole life carbon emissions by building type

Figure 4.4 presents typical breakdowns of whole life carbon emissions for a speculative office building, a typical warehouse building with office space, and a residential block. It shows the relative weight of operational and embodied carbon. The whole life figures illustrated have been calculated in line with the modular structure of the EN 15978 framework, and they account for all components making up the finished building, and covering a cradle to grave scope ([modules A1 – C4].

In the example of the speculative office building, 35% of emissions have already been released into the atmosphere during phases A1 – A5. Another 32% emissions are released in phases B1 – B5 when parts of the building are used, maintained, repaired, refurbished, and replaced. For the operational carbon emissions, 15% is released from unregulated use, such as appliances and machines that need to be plugged in to electrical sockets, and 18% is from regulated use , i.e. heating, cooling, lighting, and hot water.

Figure 4.4
Examples of total whole life carbon emissions breakdown for new buildings

Source: © RICS; Sturgis Carbon Profiling



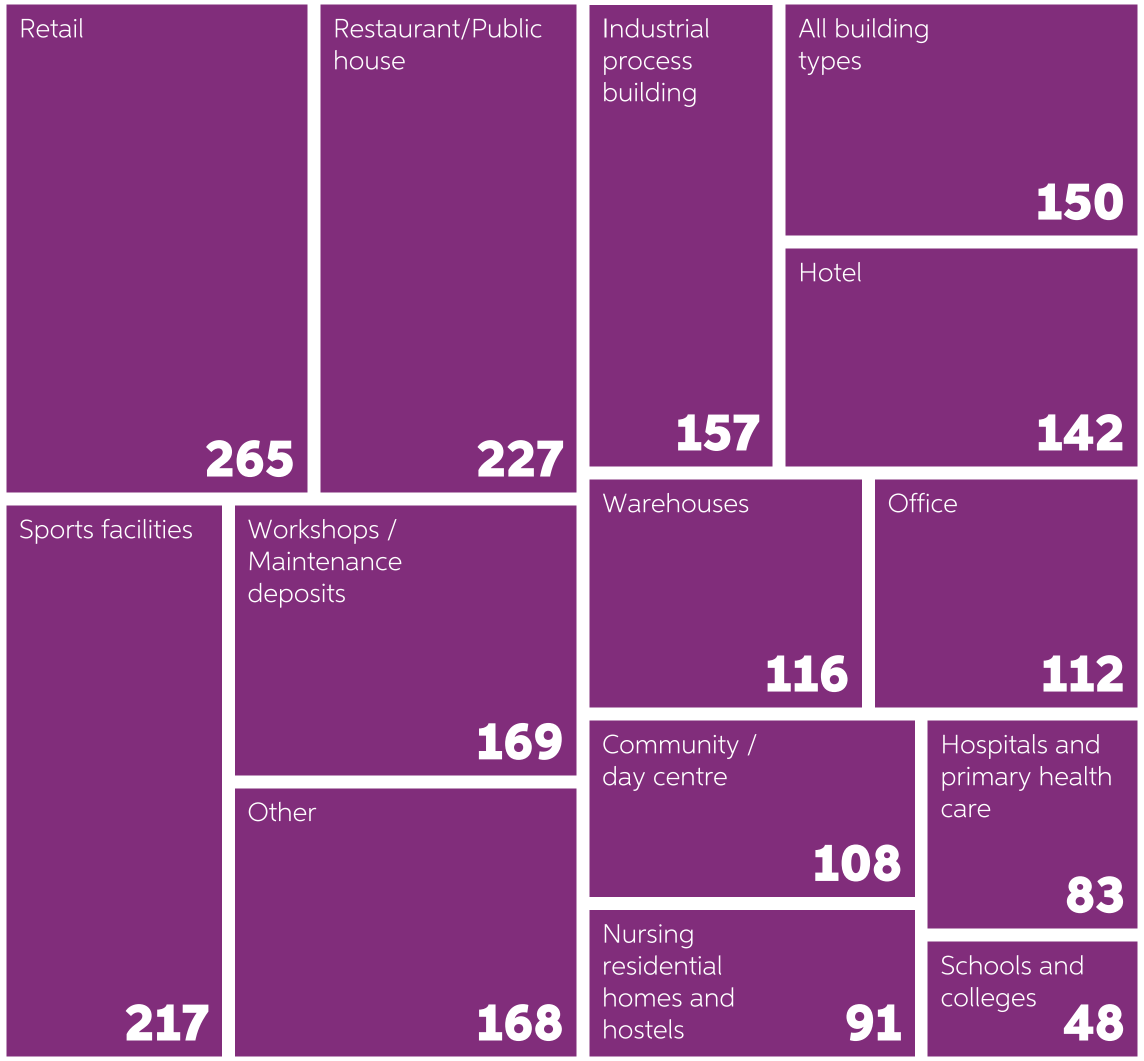
In each of these studies, a grid decarbonisation factor has been applied to future emissions due to electricity consumption over the life of the building, both embodied and operational. This effectively means the assessment has assumed the electricity usage in the future will be lower and lower carbon as the grid decreases, further emphasising the need to also consider the embodied carbon of materials used at the start of the lifecycle which cannot benefit from future decarbonisation of the grid

Emissions by property type in Ireland

Looking at CO_2 emissions by type of building, figure 4.5 shows that retail buildings were by far the biggest contributors, with 265 kg/CO_2/m²/year emitted. In contrast, schools and colleges had carbon emissions of less than 50 kg/CO_2/m²/year over 2009 – 2021 period.

As shown in figure 4.5, the Irish non-domestic building stock will require significant improvements in terms of its energy efficiency, and consequently ratings, in order to meet the energy efficiency targets set by the Government.

Figure 4.5
Average CO_2 emissions by type of building (non-domestic) 2009–2021, by kg/ CO_2 /m2/year
Source: CSO



Nearly zero energy buildings and net zero carbon buildings – significant differences

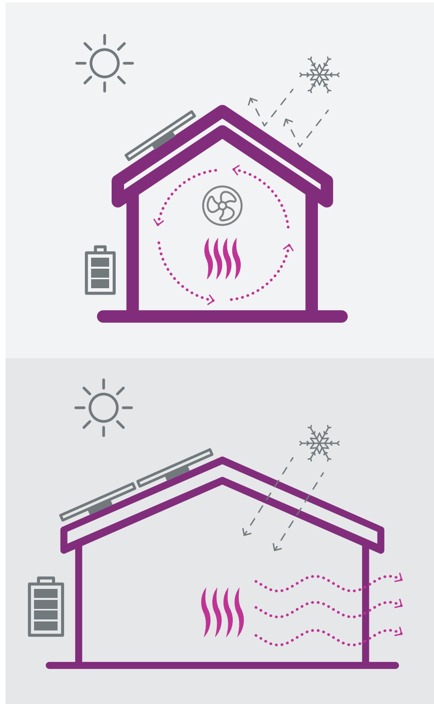
There is a major difference between net zero carbon buildings and nearly zero energy buildings (NZEB). First, NZEB is based on a theoretical benchmark, whereas net zero carbon is based on actual measurement. Secondly, the methodology used to define NZEB outlined above means that buildings can still comply despite poor design, and they can have quite a high fossil fuel load, with only 20% of the regulated energy met with renewables.

Net zero carbon buildings, on the other hand, should be designed for maximum energy efficiency. They should also be fossil fuel free and they should meet all operational energy needs, including unregulated loads on-site or off-site. In addition, they should measure and reduce as far as possible the embodied carbon associated with their construction, and they should offset the balance. The key differences are summarised in Table 4.1

Table 4.1
Nearly-zero energy building versus net zero carbon building

NEARLY ZERO ENERGY BUILDING (NZEB)	NET ZERO CARBON BUILDING
Based on theoretical benchmark Measures operational carbon theoretically	Based on actual measurement Measures operational and embodied carbon
May be poorly designed with high fossil fuel load – only 20% of regulated energy needs to be met with renewables	Designed for maximum energy efficiency, fossil fuel free. All operational energy needs must be met from on-site or off-site renewable energy sources
No measurement of embodied carbon or need for offset	Must measure and reduce the embodied carbon associated with construction, and offset the balance
Mandatory in building regulations	Not in building regulations yet

Figure 4.6
Both homes have the same BER rating however the one on the top is more sustainable as it has a more compact design, has a fabric first approach with better insulation due to good air tightness and mechanical ventilation.



NZEB in Ireland – the cost optimality method

The implementation of NZEB through building regulations in Ireland was based on the cost optimality method, meaning that the regulations were based on what was considered cost optimal across the life of the building, not necessarily what is considered 'nearly zero'. Depending on the building type, 'nearly zero 'can still result in quite high energy use.

The EPBD also requires member states to review the regulations every 5 years. This means that Ireland is expected to review and revise Part L of the Building Regulations 2017 for the period 2022–2023.

How can the carbon performance of buildings be improved?

5

The best time to improve the carbon performance of a building is at the planning stage. The potential for achieving net zero carbon is greatest for new builds and deep retrofits. Once decisions have been made and locked in, it becomes more difficult and more expensive to revise them. However existing buildings can typically achieve moderate improvements in their carbon performance without carrying out major works.

New builds and deep retrofits

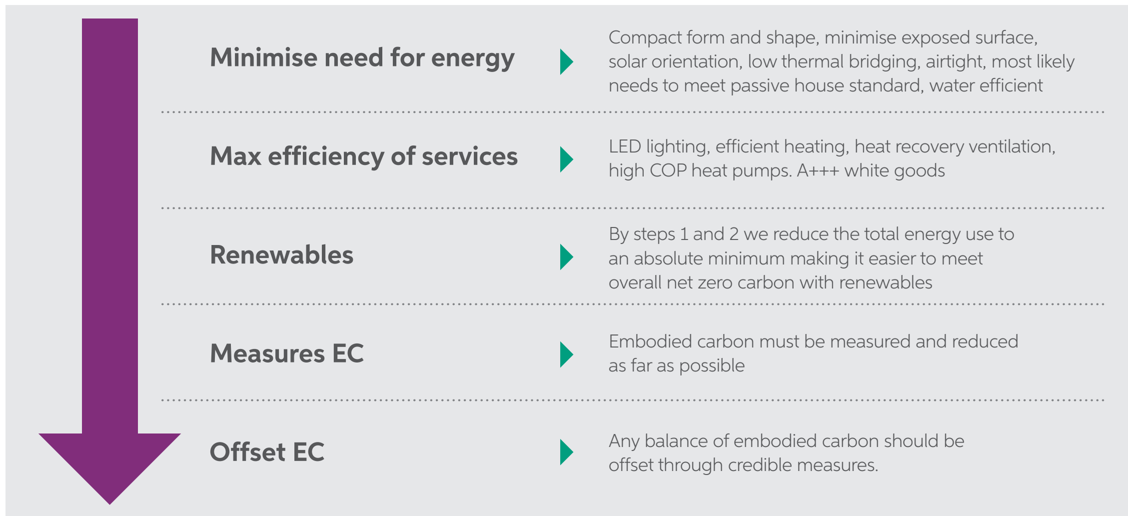
- **Life Cycle Analysis**
  Any building owner who is serious about maximising the carbon performance of a new build or deep retrofit should use life cycle analysis (LCA) to guide the project from the early design stage. While this process was previously quite labour intensive, due to the detailed information required, in recent years a number of companies have developed software and services that greatly streamline the process.

- **Energy strategy**
  An energy strategy is formulated in the early design stage of every project. The goal of the energy strategy is to meet the mandatory requirements of Part L of the Building Regulations 2017. Projects should use the LCA to explore options that exceed the mandatory performance to deliver greater carbon performance over the building's whole life cycle. With carbon performance requirements due to be constantly tightened in the future, investors need to think long term about their projects, and not just think about what is mandatory at the time of construction. Using LCA for long-term planning will be critical to future-proofing buildings and property portfolios.

  Figure 5.1 is indicative of the hierarchy applied to the development of the energy strategy for a new building.

- **Soft landings**
  Generally, the majority of new buildings do not perform as efficiently as they were designed to. The difference between post-occupancy operational energy use and design stage estimations is called the 'performance gap', which is often considerable. Upon practical completion, there is typically a clear handover from the design/construction team to the facility management (FM) team. 'Soft landings' is a framework developed by the Building Services Research and Information Association (BSRIA) that can be adopted to ensure a smoother transition from construction to fully operational occupation, and also to ensure that operational performance is optimised via extended aftercare and post-occupancy evaluation (POE) for 2- 3 years after handover.

Figure 5.1
Energy strategy hierarchy



Existing buildings:

- **Behavioural change**
  A building's carbon performance can very often be improved with some simple behavioural changes by the building's users. This will not improve its BER, but it will deliver real-life energy savings.

- **BER advisory report**
  As part of every BER assessment the BER assessor provides an advisory report to accompany the BER certificate. The advisory report is tailored to the assessed building, listing key measures that could reduce the building's energy use and subsequent carbon emissions. While not very detailed, this report nonetheless serves to point building owners/managers in the right direction in terms of required upgrade works.

- **Energy monitoring**
  If you cannot measure it, you cannot manage it. A considerable proportion of older commercial building stock has no Building Management System (BMS) and little or no sub-metering. As a result, facility management teams are unable to identify and target potential energy savings. Bespoke energy management equipment and services are widely available, and typically guarantee energy savings.

- **Lighting**
  In older commercial buildings, particularly retail and office buildings heating and refrigeration account for the largest energy use. However, lighting can typically achieve the most energy reduction for the least capital expenditure. This can be achieved via upgrading lighting (T8 fluorescent, T5 fluorescent light-emitting diodes (LED).

LEED certification and whole building energy modelling

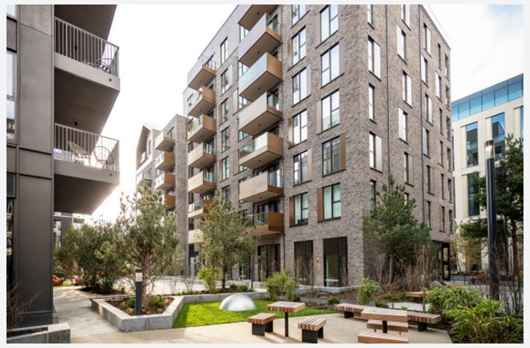
Where building owners/managers are pursuing LEED (Leadership in Energy and Environmental Design) certification, developed by the U.S. Green Building Council (USGBC), whole building energy modelling is required. This LEED energy modelling must be carried out in line with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Performance Rating Method (PRM). This is an extremely detailed Dynamic Simulation Modelling (DSM) process, where all final energy uses (i.e. regulated and unregulated loads) are accounted for as accurately as possible. While the LEED energy modelling can be carried out with standard assumptions applied, the more detailed information the building owner, or end user, can provide about expected operational usage, the more accurate the LEED energy modelling will be. As this is often a relatively expensive aspect of LEED certification, owners should strive to engage in the LEED energy modelling process in order to derive the maximum benefit from it.

6

Refurbishment costs and opportunities

Case studies

Dublin Landings, commercial offices and apartments with new public realm space
Source: Ballymore



Location
North Wall Quay, Dublin 1

Project partners
Ballymore/Oxley

Architect
Arrow/RKD

Mechanical and electrical engineer
Homan O'Brien

Civil and structural engineers
O'Connor Sutton and Cronin

Building type
Mixed-use development – commercial, residential, & retail

Size
Over 100,000 m^2 of development in a land area of 2.35 hectares

Status
Completed June 2021

Certification and rating
A minimum BER of A3 was achieved on the apartments.
Commercial Building achieved -LEED Platinum

DUBLIN LANDINGS

Thirteen new buildings, mixed-use development

Project overview

Dublin Landings is mixed-use development comprising more than 100,000 m2, and the first campus development in Ireland to achieve LEED Platinum certification on all five commercial buildings within this new urban quarter. A high level of prefabrication minimized waste throughout the process. High-quality public realm space connects the development to the river Liffey.

Highlights:

- Excellent rating on water efficiency, with low flow and efficient sanitary ware
- Very good indoor air quality
- Maximised diversion of waste from landfill
- High level of prefabrication, thus reducing waste at the source
- High-quality public realm space created

Approaches used:

Operational energy: All five commercial buildings in Dublin Landings achieved very high scores on energy performance, with an A3 BER. A minimum BER A3 was achieved on the 298 apartments.

Embodied carbon: The buildings have a very low material waste, with a focus on prefabrication.

Sustainable location: Less than a 5-minute walk from quality bus corridors, Luas, and Dublin Bikes parking stand. 15-minute walk to Connolly Station Ireland's busiest transportation hub.

Water: Specification and design of low flow and efficient sanitary ware. Rainwater harvesting is utilised in the commercial buildings for toilet flushing, reducing consumption by 50%

Waste: Prefabrication on facades and primary M&E elements were utilised, reducing waste on site.

Indoor air quality: Commercial Buildings meet LEED VOC requirements for excellent indoor air quality.

Heating and cooling: To meet NZEB requirements, high efficiency heat pump chillers generate cooling to the commercial buildings, with a Combined Heat and Power (CHP) plant and back up gas fired boilers providing heat and hot water. Hot water and heating to the residential units is delivered by CHP and a mechanically ventilated heat recovery system.

Biodiversity: Native planting strategy encourages birds and insects that are common in the area.

More information can be found at:
www.ballymoregroup.com/project/detail/dublin-landings

TROPICAL FRUIT WAREHOUSE DUBLIN

Location
Dublin Docklands

Building owner and developer
IPUT Real Estate Dublin

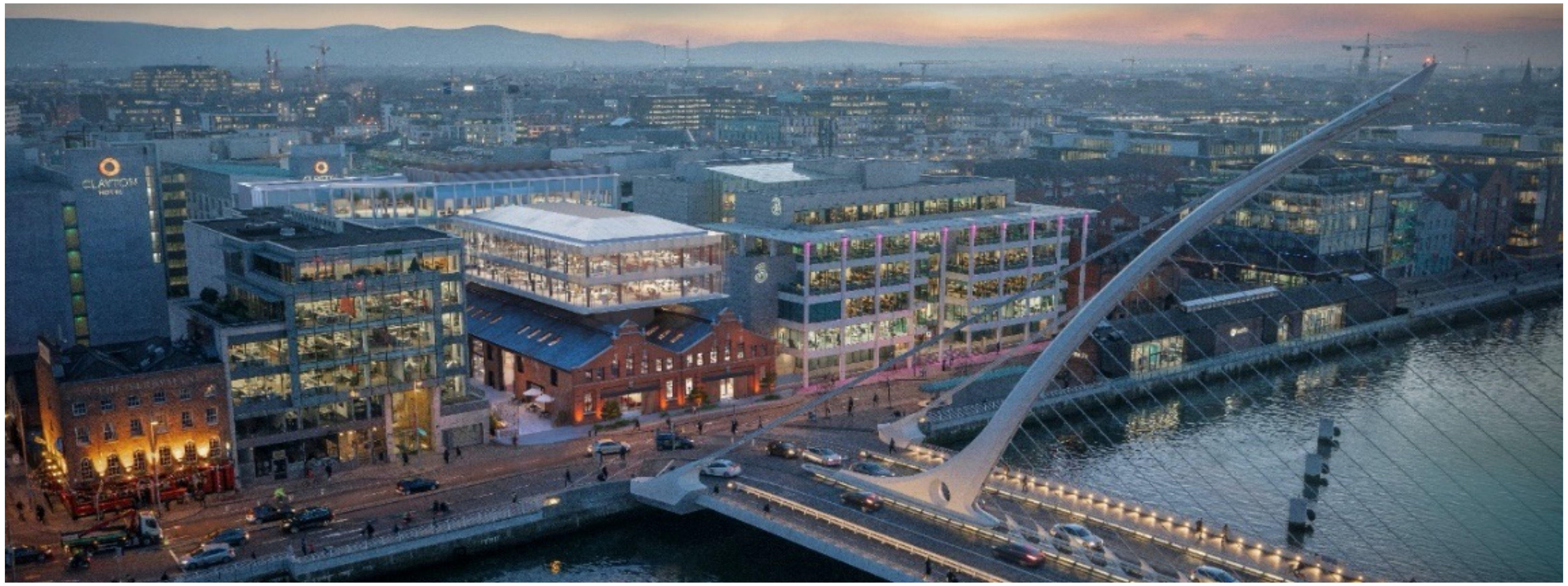
Key design team and contractors
Henry J. Lyons Architects, OCSC, KSN, Torque, PJ Hegarty

Building type
Office

Size
80,000 sq ft

Status
Due for completion June 2022

Certification and rating
LEED Platinum (targeted)
WELL Pre-certified (achieved)
Wired Score Platinum (targeted)
BER A3 (targeted)



Tropical Fruit Warehouse, Sir John Rogerson's Quay

Project overview

The Tropical Fruit Warehouse is a Grade A commercial office building that blends the original warehouse features with contemporary architecture and a highly energy-efficient design. A landscaped link connects the riverfront and Whitaker Square to create flexible, social spaces designed to facilitate events and performances; this is bookended by an artist's studio and café space. The original warehouse built in 1892 has been restored, with the development of a seven-storey building at the rear and a two-storey glazed office space cantilevered over the warehouse and onto the River Liffey.

Highlights

- Restoration and reuse of existing warehouse features dating back to 1892
- On track to achieve LEED Platinum certification
- First of IPUT's buildings designed to avoid the use of fossil fuels.

Approaches used

Operational energy: Targeting an energy use intensity of 97.7 kWh/m2/year and an A3 BER. The energy use intensity includes a total final consumption of 48.55 kWh/m2/year, with the additional allowance for the carbon intensity of the Irish electrical grid.

Embodied carbon: Restoring and incorporating original features into the new development has helped to reduce embodied carbon emissions. The project is currently achieving 748 kg CO_2e/m^2 embodied carbon emissions during the product and construction stages of the building life cycle.

Assessment of whole life carbon: Our whole life carbon assessment was completed with One Click LCA software and is in accordance with EN 15978:2011. In addition, it follows the RICS Guidelines of Whole Life Cycle Carbon Assessment for the Built Environment (2017) where necessary.

Materials: Original features of the historic warehouse were reused and repurposed where possible; such features included exposed brick, timber trusses, stone walls, and slates from the roof. In addition, in order to maintain the character of the building, materials salvaged from other projects were used where shortages occurred.

Sustainable location: The development's central location promotes active travel. The Tropical Fruit Warehouse is less than 5 minute walk from a quality bus corridor and the Luas red and green lines, and within an 8-minute walk of the DART and rail station.

Heating and cooling: An all-electric strategy of air source heat pumps will be used to heat and cool the building. The building will be powered by 100% renewable electricity.

Future-proofing: Infrastructure has been installed in the building to connect to the future Dublin District Heating Network. Using waste to generate heat helps to extend circular thinking including better use of materials, and better use of energy, water, and waste.

More information can be found at:
www.tropicalfruitwarehouse.com

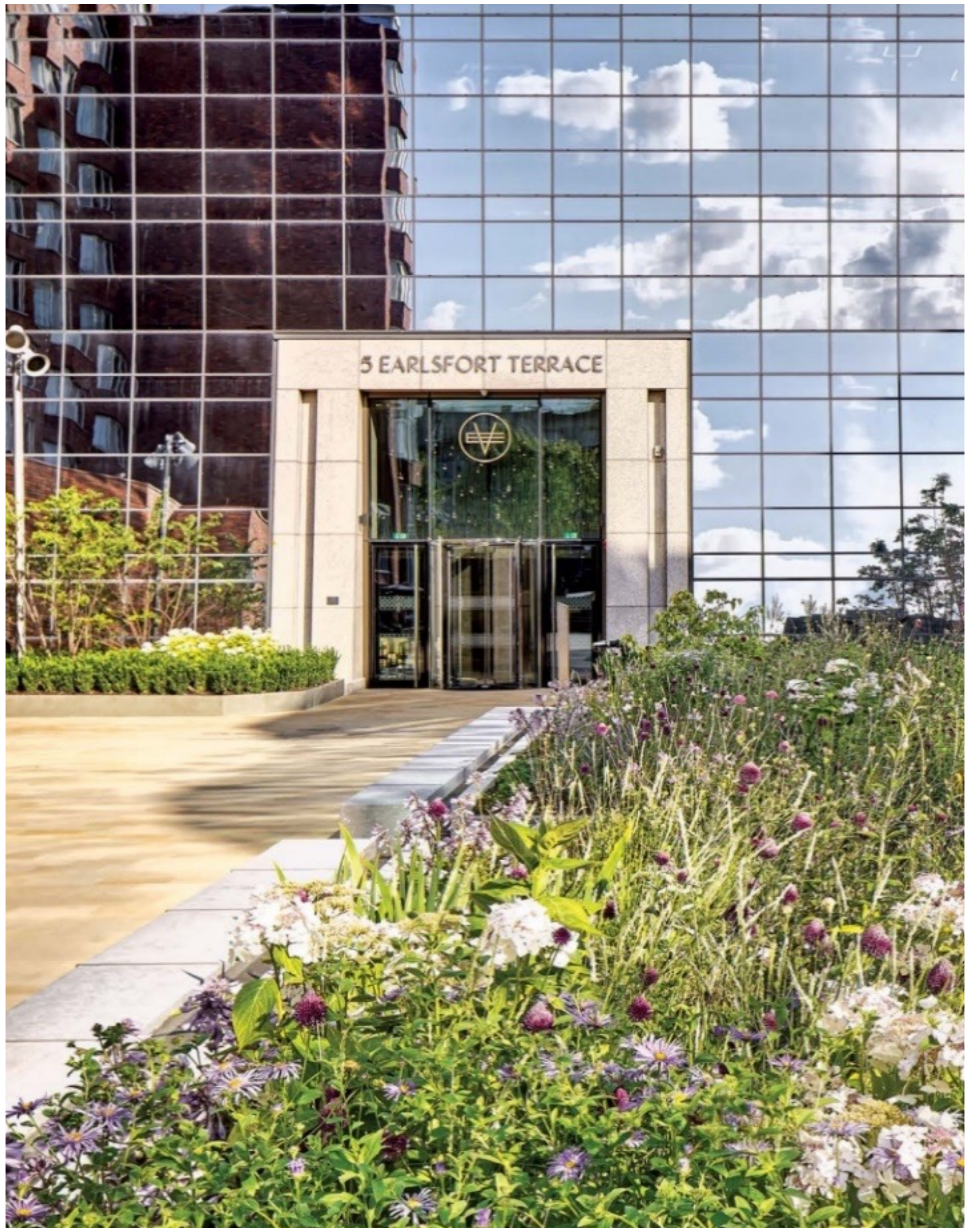


Figure 5.3
Earlsfort Terrace Dublin

5 EARLSFORT TERRACE DUBLIN

Project overview

5 Earlsfort Terrace is a major refurbishment of a multi-let office building with two new floors. It has been refurbished to a Grade A office building with excellent place making credentials which is accessed through a landscaped courtyard area.

Highlights

- Improved operational performance through IPUT's proactive building management approach and engagement with multiple occupiers
- Created Earlsfort Gardens, an urban courtyard designed by Robert Townshend
- Reduction of 46% in potable water use
- Photovoltaic (PV) panels on the roof, generating 10,000 kWh electricity each year.

Location
5 Earlsfort Terrace Dublin

Building owner
IPUT Real Estate Dublin/Cashel Fund PLC

Key design team and contractors
BKD Architects, Metec Consulting Engineers, Cronin Sutton Consulting, Maurice Johnson & Partners, Meehan Green

Building type
Office

Size
5,000 m2

Status
Refurbishment completed in 2018

Certification and rating
LEED Platinum V4
BER A3
Wired Score Platinum

Approaches used

Operational energy: The building's energy performance is monitored on a floor-by-floor basis by smart metering technology. These data inform the level of intervention needed to meet IPUT's net zero carbon commitment by 2030.

Increasing renewables: PV solar array was installed on the roof, generating 10,000 kWh on-site electricity each year, which helps to meet the building's energy needs and reduce carbon emissions.

Embodied carbon: Refurbishment of the existing building helped to reduce embodied carbon emissions from civil and structural works.

Occupier engagement: A green committee was established, and they organize the building management team and occupants to drive sustainability initiatives. This process of regular engagement helps to share information, generate ideas, and encourage positive behavioral change.

Net zero carbon commitment: 5 Earlsfort Terrace forms part of IPUT's scope of the World Green Building Council's Net Zero Carbon Buildings Commitment.

Sustainable location: Seventy bicycle parking spaces have been installed. In addition, shower and locker facilities have been installed to encourage active travel. The building is 5 minute walk from a quality bus corridor, the St Stephen's Green and Harcourt Street Luas stops, and a Dublin Bikes parking stand.

Investing in the public realm: IPUT developed Earlsfort Gardens, a courtyard with urban landscaping and a reflective water feature that acts as an additional well-being amenity for the building occupiers and neighbors.

Water: 46% reduction in potable water use by providing water-efficient sanitary ware.

Heating and cooling: The installation of solar control glazing further enhances the performance of the building.

WREN URBAN NEST HOTEL

Figure 5.4
Wren Urban Nest

Project overview

Wren Urban Nest is a 137-bedroom, nine-storey hotel, with a green roof. It is the first hotel in Ireland to comply with the World Green Building Council's operational net zero carbon definition, without needing to buy carbon offsets. Constructed in an urban infill site measuring 40 x 14 meters, it has improved the public realm and security of the surrounding street. The site previously accommodated a two-storey nightclub.

Highlights

- The building runs on renewable electricity purchased from the national grid, and because it does not use fossil fuels it does not generate any local pollution. The hotel's commitment to zero carbon is followed through by the chefs, who work in a zero-carbon kitchen that is not reliant on gas for cooking; the chefs also source local organic produce.
- Wren Urban Nest achieved an A3 BER, and a Renewable Energy Ratio (RER) four times better than the NZEB requirement.
- The hotel uses an advanced HVAC system which in the summer months recovers and transfers heat to the hot water supply and captures normally rejected heat from the cooling process.

Approaches used

Operational energy: Wren Urban Nest has achieved an A3 BER, and Renewable Energy Ratio (RER) that is four times better than the NZEB requirement.
Every element of the hotel design was carefully considered in order to minimise operational energy. This included the angled glazing on the west façade, which reduces peak solar gain in the afternoon by reducing the surface area of glazing exposed to the sun to 50% at any given time. Other examples include the adoption of an advanced BMS (Building Management System) and sub-metering strategy, LED lighting throughout, absence detection and dimming controls on lighting, and VDA's Micromaster smart room control system.

The rooms have an automatic system to control blinds to reduce solar gain, to setback room temperature, and to turn off non-essential room loads if a room is unoccupied. Guests can control their room environment, such as temperature, air conditioning levels, blinds, and lighting, all of which are monitored in order to ensure energy efficiency. The building generates heating and hot water energy renewably and runs on renewable electricity purchased from the national grid. In addition, because it does not use fossil fuels it does not generate any local pollution.

Embodied carbon: BDP's approach was to 'build less, build cleverly and build efficiently' for the maximum embodied carbon reduction. The typical hotel room size of 21 m2 was reduced to a mix of 9.5 m2 and 12 m2. This decision alone reduced the embodied carbon per guest room to 50% of what a typical hotel would use.

Assessment of whole life carbon:
Assessment of whole life carbon has been ongoing with BDP Consultants and is currently being undertaken to allow the team to measure and understand the final embodied carbon associated with the build, in order to use it as a benchmark for future hotel projects. This is being undertaken in compliance with BS EN 15978, and the final result is due in August 2022 to align with the 1 year of operation and energy use.

Materials: Specification and procurement of responsibly sourced construction products and materials with a low environmental impact over the full life cycle of the building was implemented, and environmentally conscious decisions such as exposed concrete soffits and walls were followed through to reduce the carbon impact of the building. Where appropriate, a GGBS substitute was used within the concrete and the following areas had exposed concrete finishes in order to minimise material use.

Sustainable location: Less than 5 minutes' walk from quality bus corridors, the St Stephen's Green Luas stop, and a Dublin Bikes parking stand.

Water: The hotel's water demand is approximately 60% lower than that of a typical hotel building due to the careful specification and design of sanitary ware. In addition, all rainwater is captured and attenuated, thus reducing the load on the public mains.

Waste: The hotel has committed to not using any single-use plastics. All wash-hand basins in the bedrooms have a drinkable cold water supply, so that guests do not need to use plastic bottles. To further improve the guest experience, hydration stations have been placed in the corridor of each floor, delivering free chilled drinking water for refilling the Irish branded water cartons that are provided to guests. All waste streams from the operation of the hotel are separated for recycling. In addition, the kitchen has signed up to the "Too Good to Go" initiative via a community app that allows local people to purchase food to go at cheaper prices directly from the kitchen rather than letting it go to waste or spoil.

Heating and cooling: Rather than reject the heat from the cooling process, the air source heat pumps transfer it to heating pipework for use in the AHU or east façade that is in heating mode during winter. To maximise the transfer and capture of heat in summer, when there is no heating load, the energy is transferred to the hot water supply for showers and wash-hand basins. A water-to-water heat pump is used to boost the 45 oC heating medium to 65 oC for domestic hot water, thus ensuring that there is no risk of Legionella contamination.

Biodiversity: The green roof above the plant room, coupled with the native planting in the reception area, contribute to a significant improvement in ecological value, when compared with the original two-storey low ecological value building.
More information can be found at:
www.bdp.com/en/locations/ireland/news/wren-hotel-dublin/www.wrenhotel.ie

Location
St Andrews Lane
Dublin City Centre

Project partners
BDP Architects, BDP Mechanical and Electrical Engineers, BDP Civil and Structural Engineers, BDP Acoustics, MGM Partnership, Mitchell McDermott Construction Consultants, 21 Spaces Interior Designers, Jensen Hughes Fire Engineering Consultancy, Property Concepts, OLM Consultancy, Brock McClure Consultants, Duggan Brothers, Alpha Mechanical Services Contractors, Alfa Electrical Limited

Building type
Hotel

Size
3450 m²
137 rooms

Status
Completed October 2020
Opened August 2021

7 | Offset

What is an offset?

A carbon offset is a reduction in emissions of CO_2 or other GHGs made in order to compensate for emissions made elsewhere. Offsets can be traded in the form of credits that typically represent one metric ton of CO_2 equivalent emission reductions (or enhanced carbon sequestration).

Figure 7.1
Steps to achieving a Net Zero Carbon Building

1. ESTABLISH NET ZERO CARBON SCOPE*

1.1 Net zero carbon **CONSTRUCTION**

1.2 Net zero carbon **OPERATIONAL ENERGY**

2. REDUCE CONSTRUCTION IMPACTS

2.1 A whole life carbon assessment should be undertaken and disclosed for all construction projects to drive carbon reductions

2.2 The embodied carbon impacts from the product and construction stages should be measured and offset at practical completion

3. REDUCE OPERATIONAL ENERGY USE

3.1 Reductions in energy demand and consumption should be prioritised over all other measures

3.2 In-use energy consumption should be calculated and publicly disclosed on an annual basis

4. INCREASE RENEWABLE ENERGY SUPPLY

4.1 On-site renewable energy source should be prioritised

4.2 Off-site renewables should demonstrate additionality

5. OFFSET ANY REMAINING CARBON

5.1 Any remaining carbon should be offset using a recognised offsetting framework

5.2 The amount of offsets used should be publicly disclosed

D New buildings and major refurbishments targeting net zero carbon for construction should be designed to achieve net zero carbon for operational energy by considering these principles

*Please also note a further scope for net zero whole life carbon (1.3) will be developed in the future.

Debates around offsetting and offset trading

The main criticism of offsetting and offset trading is the perception that it does not encourage behavioural change, as it can be perceived as a tool to pay for the impacts of unsustainable behaviours while continuing business as usual. In other words, wealthier actors can continue high-carbon lifestyles and simply 'pay for the damage'.

Offsetting as a final step in a hierarchy of actions

While it is recognised that having no carbon impact in the world today is virtually impossible, this is not the purpose of offsetting. Offsetting should be viewed within a hierarchy of actions, and only used when all of the preceding actions have been pursued to the maximum degree possible. Within the built environment, Figure 7.1 shows how offsetting only comes into play after all carbon-reduction strategies in construction and operation, including the provision of renewable energy, have been explored. Offsetting should be used only as the final step in a zero-carbon strategy to bring the balance of emissions back to zero.

Risks associated with offset schemes

There are other well-known risks associated with current offset schemes: improper carbon accounting, re-release of stored carbon, negative unintended impacts on humans or ecosystems, and greenwashing. It is important to ensure that any offsetting is done using best practices to ensure equitable and long-lasting outcomes. For more information, see the International Carbon Reduction & Offsets Alliance (ICROA) definitions on international best practice and list of endorsed independent standards including the Gold Standard and the Verified Carbon Standard.

Offsetting

For construction, offsets should match all carbon impacts up to practical completion, including all emissions incurred during the production, delivery and use of building materials. For operational energy, offsets are calculated annually and should match the carbon impacts of the primary energy use of the building.

Offset as a last resort

Why offset? It is important to stress that offsetting is a last resort that should be considered only after all efforts to reduce emissions have been explored to the maximum. Science tells us it can help, but only as the small final balancing of the scales in a process that first requires every effort to reduce emissions.

Figure 7.2

Carbon offset principles

PRINCIPLE	DEFINITION	SOURCE
1. Real	All emission reductions and removals and the project activities that generate them are to be proven to have actually taken place. Carbon credits must only have been issued from the project after the emissions reduction has taken place.	Adapted from: ICROA, SEI & GHG Institute
2. Avoid leakage	The project must demonstrate that is has accounted for the indirect effects of the project on emissions, otherwise known as "leakage". Leakage is when the carbon saving made at a project location/time increases emissions elsewhere. An assessment must be made of any effects from the project whether upstream or downstream.	Adapted from: UK Gov, SEI & GHG Institute
3. Measureable	All emission reductions and removals are to be quantifiable using recognised measurement tools against a credible emissions baseline. The project must seek to avoid overestimation of emission reductions through adjustments for uncertainty and leakage.	Adapted from: ICROA, SEI & GHG Institute
4. Performance	Carbon credits are to represent permanent emission reductions and removals. Where projects carry a risk of reversibility, at minimum, adequate safeguards are to be in place to ensure that the risk is minimised and that, should any reversal occur, a mechanism is in place that guarantees the reductions or removals are replaced and compensated.	ICROA
5. Additional	Projects must demonstrate that (1) the project could not take place without the carbon finance from selling credits and (2) project-based emission reductions or removals are additional to what would have occurred if the project had not been carried out.	ICROA, UK Gov
6. Independently verified	The project must receive independent verification. The verifier must be an accredited and recognised independent third party. Purchasers of credits should also ensure that robust, independent validation and verification procedures were in place to check projects were implemented according to the methodology and subsequently monitored to ensure that emission reductions were properly measured.	UK Gov
7. Unique	No more than one carbon credit can be associated with a single emission reduction of removal of one (1) metric ton of carbon dioxide equivalent (CO_2e). A publicly-available registry must be used to register, track and permanently retire credits on behalf of the organisations/consumer to avoid double counting or double selling. Projects must not be double counted against another policy or mandatory targets.	ICROA, UK Gov
8. Avoid social and environmental harms	For a project to produce high quality offset credits, it should not significantly contribute to social and environmental harms.	SEI & GHG Institute

Further reading: The Oxford Principles for Net Zero Aligned Carbon Offsetting. This is available at www.smithschool.ox.ac.uk/publications/reports/Oxford-Offsetting-Principles-2020.pdf

Sustainability and climate risk and the likely channels to impact the value of commercial real estate assets

8

The ESG / energy ratings of Commercial Real Estate (CRE) properties, the physical impacts of climate change, and the transition to the low-carbon economy of the future will affect real estate values in the years ahead. For real estate investors, this poses a complex set of investment risks and opportunities that need to be anticipated, evaluated, and addressed.

The impact of climate change and the requirements for sustainable buildings will mainly impact the valuation of real estate assets in three main ways:

1. Cash flow
2. Yields- that is, via the capitalisation / discount rates
3. Financing – both debt and equity

Cash flow

Occupier demand will have a direct impact on rents and voids, which will have a direct impact on the level of cash flow a CRE asset can produce. It appears very likely that occupiers will become increasingly discerning about properties. In the coming years it is expected that occupiers will have an increased preference for sustainable and low-carbon buildings. As these market shifts continue, low-carbon buildings have the potential to command lower void rates, higher rents, and improved operating profit, with capital values and liquidity being enhanced as a result. According to commercial real estate services company JLL, analysis of the leasing velocity of 120 schemes completed in the London market between 2013 and 2017 shows that the schemes which have a higher BREEAM rating tend to show a higher pace of leasing and have lower void rates at 12 months and 24 months after completion.

Furthermore, lower-rated buildings will probably incur increased operating costs and capital costs in order to improve the energy rating of the building. However, a key issue here is around the economic payback of such investments. Those making such investments will probably require an increased differential yield and attainable rent levels in order to justify a capital expenditure that is likely to be significantly higher than that which pertains today. We would expect increased demarcation in pricing and rents between highly rated buildings and lower-rated buildings over time.

Yields – capitalisation / discount rates

The risk premiums associated with CRE assets are likely to change significantly over time, depending on the sustainability rating of the property and its likely exposure to the risk of climate change. The yield/capitalisation rates of property incorporate this risk premium and are for the most part determined by perceptions of risk, such as risk of vacancies and expected property cash flows, including rental growth. However, determining the appropriate risk premium to compensate for climate risk and sustainability will not be straightforward. According to the Bank for International Settlements, "'[c]limate risk drivers have a number of features that makes their evolution highly uncertain.

These include the following:

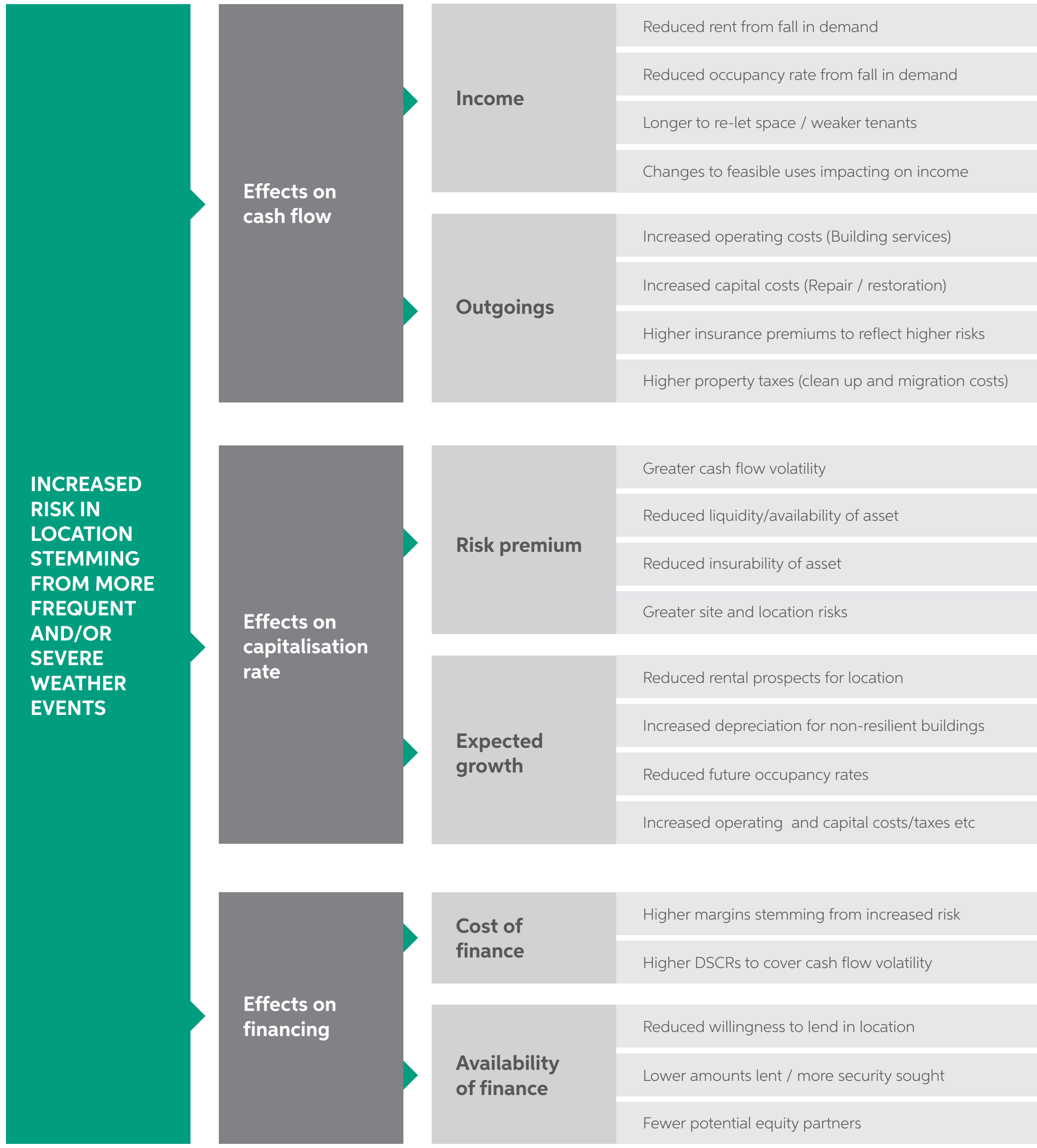
- Climate-related changes, and the speed with which they are evolving, are unprecedented in human history to such an extent that very little reliance can be placed upon historical experience to assess their magnitude or to identify patterns. This gives rise to a high level of uncertainty when attempting to assess the magnitude and timing of climate risk drivers;
- Climate risk drivers are also likely to be subject to non-linearities (i.e. tipping points) that exacerbate uncertainty; and
- The impacts of physical and transition climate risk drivers are geographically diverse. Given the characteristics above, assessments of climate risks must account for elevated levels of uncertainty, even while there is no uncertainty that climate change is under way.

This uncertainty arises from, but is not limited to, assumptions around future emissions pathways and the impact that these have on physical hazards, interactions between natural systems, future paths of policy, technological advances, and consumer and market sentiment."'

Financing – debt and equity

Equity and debt investor awareness and expectations with respect to climate change are increasing, which is starting to impact on required returns for equity investors and interest margins for debt providers. It also impacts on the availability of finance, as location and energy ratings are becoming ever more important considerations.
It is notable the degree of development of green financing instruments globally over recent years. According to the European Central Bank (ECB), "[a] prominent development in recent years with implications for climate-related risk is the growth of green finance and ESG investing. In particular, the amount of green labelled bonds outstanding in Europe now exceeds €500 billion, with issuance growing by 20-30% per year for several consecutive years. Market intelligence also suggests that there is currently strong appetite for other green finance instruments, such as green securitisations. Similarly, European funds with an ESG mandate have experienced very strong momentum, with assets up by 170% since 2015."

Figure 8.1
Anticipated effects on commercial real estate asset performance of increased exposure to climate risk
Source: de Wilde and Coley (2011)



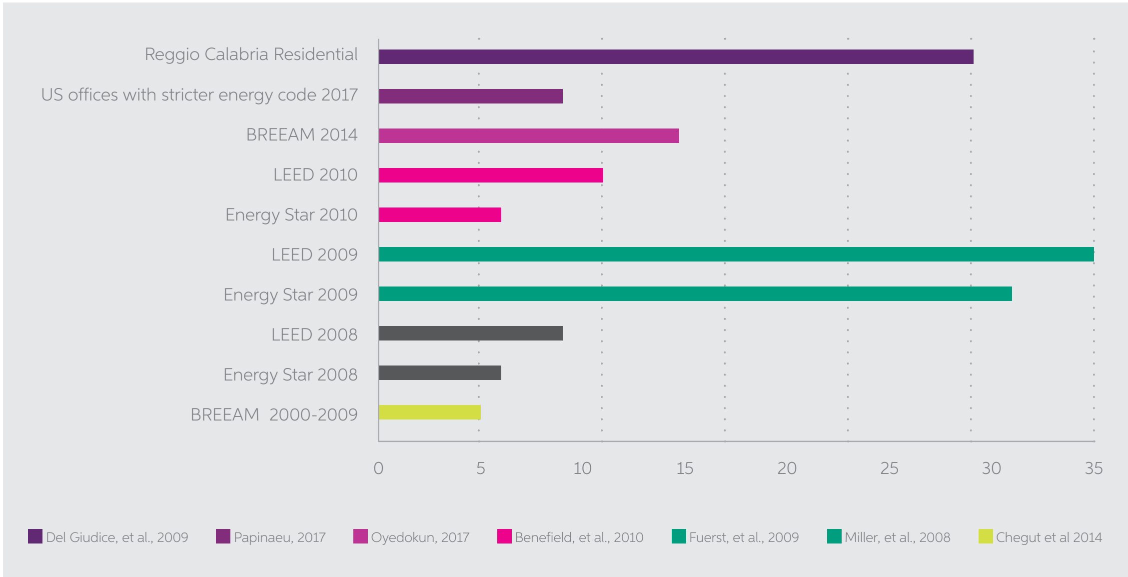
Green premium or brown discount – evidence emerging

There is now a broad and growing consensus that there is a meaningful (probably 10% or more) price premium for office buildings with strong green ratings (allowing for their other characteristics).

According to PMAs (Property Market Analysis) UK Survey of Investor Preferences, 92% of respondents stated that a green rating now affects value (up from 60-70% a year ago), with an average estimated premium of around 5%. PMA analysis of around 100 major City of London investment deals over the past 3 years shows a price premium for offices BREEAM rated as 'Excellent' or 'Outstanding' of around 17% over the rest of the market, normalised for other factors (e.g. age, location, date of sale). Similar analysis of 63 deals in Frankfurt suggests a premium of around 19% for buildings with LEED Platinum or Gold rating.

A number of academic studies have found evidence of a green premium in CRE assets, but the actual quantum of the premium is uncertain and ranges from 5% to 30%, as shown in Figure 8.2.

Figure 8.2
Sales Premiums (percent)
Source: Measuring the mythical: Quantifying the green premium in real estate, Aviva Investors, July 2021



According to Aviva, this green premium, "reflects the higher rents paid by tenants for more energy-efficient properties. The correlation between more energy-efficient buildings and higher rents has also been found to exist across different continents."

Conclusion

The impact of the COVID-19 pandemic is likely to accelerate the demand from occupiers for not only energy-efficient buildings but also buildings that meet key sustainability criteria. Consequently, it is likely that there will be increased demarcation in pricing between buildings that can meet these requirements and those that fall short, and this will result in the green premium becoming more widely established and possibly more pronounced.

Carbon sequestration
Trees and forests remove CO_2 from the atmosphere through photosynthesis to carbon, and store carbon in the form of wood and vegetation – a process referred to as 'carbon sequestration'. Trees are generally about 20% carbon by weight. In addition, the overall biomass of forests also acts as a 'carbon sink'.

According to studies reported by the Food and Agriculture Organization of the United Nations (FAO), forests store enormous amounts of carbon. The world's forests and forest soils currently store more than 1 trillion tonnes of carbon, twice the amount floating free in the atmosphere. Destruction of forests through deforestation or fire adds billions of tonnes of carbon into the atmosphere each year.

More information can be found at: https://www.un.org/en/chronicle/article/forests-and-climate-change-complex-problem-integrated-solution

Carbon dioxide (CO_2)
Carbon dioxide (CO_2) is the most commonly produced greenhouse gas. In the built environment, it is created and released during combustion of fossil fuels to create heat for warming space and water, and for industrial processes that require high temperatures such as steel and cement production. Another significant source of CO_2 in the built environment is the chemical reactions necessary for the production of cement, which release further CO_2 alongside that required for heat.

Carbon neutral
Carbon neutral means that any CO_2 released into the atmosphere from a company's activities is balanced by an equivalent amount being removed.

To become carbon neutral, companies can reduce their carbon emissions to net zero or balance their emissions through offsetting and the purchase of carbon credits. As it is virtually impossible to generate zero carbon emissions in today's society, offsetting is recognised as an alternative approach to carbon neutrality.

More information can be found at: https://plana.earth/academy/what-is-difference-between-carbon-neutral-net-zero-climate-positive/

Offset
Offsets are payments made in order to receive credit for a certified unit of emission reduction or removal carried out by another actor.

One ton of carbon offset represents the reduction of one ton of CO2 or its equivalent in other greenhouse gases.

Carbon offset projects reduce the emission of greenhouse gases in the short term or long term. Common project types are renewable energy, such as wind farms, biomass energy, or preserving forests. Others include energy efficiency projects, the destruction of industrial pollutants or agricultural byproducts, the destruction of landfill methane, LULUCF (land use, land-use change, and forestry), REDD (reducing emissions from deforestation and forest degradation).

Source: MDPI paper 'Carbon Emission Reduction – Carbon tax Carbon Trading and Carbon offset' published on 23 November 2020.

Greenhouse gas
Greenhouse gas (GHG) refers to any gases released into the atmosphere that have a warming effect. The most significant are CO_2, methane, nitrous oxide and some fluorocarbons.

More information can be found at: https://www.readingma.gov/climate-advisory-committee/faq/what-are-the-greenhouse-effect-and-greenhouse-gases

Carbon neutrality
Carbon neutrality refers to the theoretical balancing of GHG emissions into the atmosphere on the one hand with the capture and sequestration of the same amount of carbon on the other hand. This should result in no net change in the composition of the atmosphere.

Net zero carbon building
The World Green Building Council defines a net-carbon building as one that is highly efficient with all remaining energy from on-site/or off-site renewable sources. This means that the amount of carbon emissions associated with a building's usage and construction stages (up to practical completion) must be equal zero or negative. Net carbon status can be achieved using offsets or the export of on-site renewable energy, e.g. exporting surplus unused energy back to the grid. A net zero carbon measures the operational and embodied carbon. It is designed for maximum energy efficiency, and is fossil fuel free. All operational energy needs must be met from on-site or off-site renewable energy sources and the building's operators must measure and reduce the embodied carbon associated with construction and offset the balance. The Irish Building Regulations 2017 do not cover net zero carbon buildings.

Carbon footprint
Carbon footprint refers to the total GHG emissions caused by an individual, organisation or community. A carbon footprint can be measured in multiple ways, but for businesses this usually means measuring all direct and indirect

Glossary

emissions from operations, known as scope 1 and scope 2, plus all material emissions arising indirectly from the supply chain – scope 3.

NEAP
The Non-Domestic Energy Assessment Procedure (NEAP) is Ireland's official methodology for calculating building energy use for non-domestic buildings. This methodology must be used for determining compliance with Part L of the Building Regulations 2017 and for carrying out BER assessments.

DEAP
The Domestic Energy Assessment Procedure (DEAP) is Ireland's official methodology for calculating building energy use for domestic buildings. This methodology must be used for determining compliance with Part L of the Building Regulations 2017 and for carrying out BER assessments.

Part L
Technical Guidance Document L – Conservation of Fuel and Energy typically referred to simply as 'Part L' Technical guidance documents (TGDs) are published to accompany each part of the Building Regulations indicating how the requirements of that part can be achieved in practice. Adherence to the approach outlined in this TGD is regarded as evidence of compliance with the requirements of Part L of the Building Regulations 2017.

Two versions of TGD Part L exist; for 'Dwellings' and 'Buildings other than Dwellings'.

NZEB
The EPBD required all new buildings from 2021 (public buildings from 2019) to be nearly zero energy buildings (NZEB). This is defined as a building that has a very high energy performance (as determined in accordance with Annex I), and in which the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

In Ireland, this requirement was introduced into the updated Part L of the Building Regulations 2017, whereby Part L compliance requires all new buildings to meet or exceed NZEB performance.

BER
A Building Energy Rating (BER) is an 'asset rating' system which was introduced as part of the EPBD. BERs benchmark the energy performance of all building stock, new or old. Valid for 10 years, a BER is required upon building completion, renovation, sale or lease.

Regulated energy
Regulated energy is building energy consumption resulting from the specification of controlled, fixed building services and fittings, including space heating and cooling, hot water, ventilation, fans, pumps and lighting. Such energy uses are inherent in the design of a building and are covered in Part L of the Building Regulations 2017.

Unregulated energy
Unregulated energy is the energy used by tenants and owners for non-fixed equipment such as laptops, coffee machines, white goods and other electrical equipment not required for the operation of the building.

Primary energy
Primary energy includes the raw fuels that are used for transformation processes such as electricity generation and oil refining accounting for the energy that is consumed and/or lost in transformation, transmission and distribution processes. It is calculated by applying conversion factors, which vary by fuel type, to the final energy values. Latest primary energy conversion factors for Ireland can be found here.

Final energy
Final energy includes the energy used directly by the end user, i.e. energy consumption as denoted in energy bills is deemed to be final energy. Final energy does not include energy lost during transformation processes such as electricity generation.

Life cycle stages
Refer to the table below

BUILDING ASSESSMENT INFORMATION

BUILDING LIFE CYCLE INFORMATION														SUPPLEMENTARY INFORMATION BEYOND THE BUILDING LIFE CYCLE
A1-2 PHASE			A4-5 PHASE		B1-7 PHASE					C1-4 PHASE				D
Product stage			Construction process stage		USE stage					End of life stage				
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	
Raw material supply	Transport	Manufacturing	Transport	Construction - Installation process	Use	Maintenance	Repair	Refurbishment	Replacement	Deconstruction demolition	Transport	Waste processing	Disposal	Benefits and loads beyond the system boundary Reuse Recovery Recycle
					B6	Operational energy use								
					B7	Operational water use								

Embodied Carbon · Operational Carbon

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