Aligning Buildings with a Climate Compatible 2050:

Insights and developments from the Green Bond Market

Climate Bonds INITIATIVE

Climate Bonds Initiative

The building sector represents one of the largest contributors to climate change, both on a local and global level. The good news is that there is vast potential for cost-effective mitigation through proven demand reduction and energy efficiency technologies. Unfortunately, the current level of global investment in emissions efficiency in the buildings sector still falls far short of what is required to achieve mitigation goals for a 2°C scenario.

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Glossary

Base Building	A reporting standard covering the energy use and emissions under the control of the asset owner including HVAC, common space lighting, lifts/elevators, and core building services such as ventilation.
Baseline Emissions Intensity	The initiation year's emissions target derived from taking the top 15% of the cities emissions benchmark
Building Codes	Government regulations outline minimum structural, occupancy safety, and other performance requirements.
Carbon Budget	The maximum amount of carbon dioxide that a country, company, organization, or sector can produce over a particular period of time
Certifications Schemes	Ex. BREAMS, LEED, Green Globes, EDGE
Certified Climate Bond	A bond that is certified by the Climate Bonds Standard Board as meeting the requirements of the Climate Bonds Standard (both the parent standard and the appropriate sector specific eligibility criteria (as determined in accordance with the use of proceeds of the bond))
Climate Bond Certification	Allows the issuer to use the Climate Bond Certification Mark in relation to that bond. Climate Bond Certification is provided once the independent Climate Bonds Standard Board is satisfied the bond conforms with the Climate Bonds Standard
Climate Bonds Initiative (Climate Bonds)	An investor-focused not-for-profit organisation, promoting large-scale investments that will deliver a global low-carbon and climate resilient economy
Climate Bonds Standard (CBS)	A screening tool for investors and governments that allows them to identify green bonds where they can be confident that the funds are being used to deliver climate change solutions
Climate Bonds Standard Board (CBSB	A board of independent members that collectively represents $34 trillion of assets under management. The CBSB is responsible for approving i) Revisions to the Climate Bond Standard, including the adoption of additional sector Criteria, ii) Approved verifiers, and iii) Applications for Certification of a bond under the Climate Bonds Standard
Commercial Building	A building that is intended to generate a profit, either from capital gain or rental income. There are sub-categories of Commercial Buildings, including offices, shopping centres and hotels
Compliance Target	The decreasing year to year maximum carbon intensity making up the low -carbon trajectory. The term is used to describe the required emissions intensity of the portfolio or asset
Emissions	Total emissions produced on an annual basis (tonnes of CO2e)
Emissions Efficiency	Reductions in emissions required to provide products and services
Emissions Factor	Units of CO2e produced from the complete combustion of a given fuel. Ex. Emissions factor by fuel source (lbs CO2e/mBtu) Diesel fuel and heating oil: 161.3, Gasoline (without ethanol): 157.2, Propane: 139.0, Natural gas: 117.0
Emissions Impact	The impact of the release of associated CO2e emissions
Emissions Intensity	Emissions produced (CO2e) per built area (sq. ft. or m sq.)
Energy	Total energy used on an annual basis (kBtus or MJ).
Energy Conversion Efficiency	Useful energy out (MJ) per total embodied energy in (MJ). Used to measure a technology's fuel-energy utilization
Energy Efficiency (EE Energy Performance	Reduction in energy required to provide products and services
Certificate (EPC)	A ranking system used along-side the Environmental Impact Rating (EI) to rate a building's (asset's) level of achieved energy efficiency.

Energy Services	The application of useful energy to provide an end user need (illumination, thermal comfort, mobility, etc)
Energy Use Intensity (EUI)	Energy consumed (kBtus or MJ) per built area (sq ft. or m sq.)
Environmental Impact Rating (EI)	A ranking system used along-side the Energy Performance Certificate (EPC) to rate a building's (asset's) environmental impact
Equivalent Carbon Dioxide (CO2e)	The concentration of gases in a stock normalised to carbon dioxide gas. CO2e is used to describe the state of and/or carrying capacity of a stock or volume such as the atmosphere.
Final Energy	The energy transported and distributed to the point of retail for delivery to final users.
Post-occupancy performance evaluations	The process of evaluating a completed development to determine its achieved and in-use performance
Power	The dimension of power is energy divided by time. The SI unit of power is the watt (W), equal to one joule per second.
Primary Energy	The energy that is embodied in resources as they exist in nature: chemical energy embodied in fossil fuels (coal, oil, and natural gas) or biomass, the potential kinetic energy of water drawn from a reservoir, the electromagnetic energy of solar radiation, and the energy released in nuclear reactions.
Public Space and Neighbourhood	A space thermally unconditioned such as streets, parks, plazas, etc. designed for public use. Public buildings such as thermally conditioned transit buildings are not included in this category
Residential Building	A building that is used or suitable for use as a dwelling.
Secondary Energy	The energy that is embodied in fuels such as electricity, gasoline, jet fuel, or heating oil which serve as energy carriers for subsequent energy conversions or market transactions.
Scope	The operational boundaries in relation to indirect and direct GHG emissions.
Scope 1 Emissions	A reporting organization's direct GHG emissions. Ex. fuel combustion, company vehicles, fugitive emissions (refrigerants)
Scope 2 Emissions	A reporting organization's indirect GHG emissions associated with the generation of electricity, heating/cooling, or steam purchased for own consumption. Ex. purchased electricity, heat and steam
Scope 3 Emissions	A reporting organization's indirect GHG emissions other than those covered in scope 2. Ex. purchased goods and services, business travel, employee commuting, waste disposal, use of sold products, transportation and distribution (up- and downstream), investments, eased assets and franchises
Target missions Intensity	The 2050 emissions target derived from the 2-degree scenario building emissions decarbonisation requirement
Technical Working Group (TWG)	A group of key experts from academia, international agencies, industry and NGOs convened by the Climate Bonds Initiative. The TWG develops Sector-Specific Criteria - detailed technical criteria for the eligibility of projects and assets as well as guidance on the tracking of eligibility status during the term of the bond.
Useful Energy	The last measurable energy flow before the delivery of energy services.
Whole Building	A reporting standard covering the energy use and emissions of an entire building/ asset including occupant/tenant energy use.
Zero-Carbon Trajectory	The pathway derived from taking the initial baseline emissions intensity and target emissions intensity.

We are mobilising the $100 trillion bond market for climate change solutions

What is the Climate Bonds Initiative?

The Climate Bonds Initiative

The Climate Bonds Initiative is the only organisation in the world working solely to mobilize the largest capital market of all, the $100 trillion bond market, for climate change solutions.

Climate Bonds promote investment in projects and assets necessary for a rapid transition to a low-carbon and climate resilient economy. The strategy is to develop a large and liquid Green and Climate Bonds Market that will help drive down the cost of capital for climate projects in developed and emerging markets; to grow aggregation mechanisms for fragmented sectors; and to support governments seeking to tap debt capital markets.

Climate Bonds Standards & Certification Scheme

Investor demand for Green Bonds & Climate Bonds is strong, and will increase in line with the delivery of quality products into the market. However, investor concerns about the credibility of green labelling are also growing. Standards, assurance & certification are essential to improved confidence and transparency, and enabling strong growth in the market.

The Climate Bonds Standard and Certification Scheme is an easy-to-use screening tool that provides a clear signal to investors and intermediaries on the climate integrity of Certified Climate Bonds. Certification enable asset owners, portfolio managers and investors clarity around climate compatibility, a key step to ensuring continued investment towards a climate compatible development, fit for a 2050 future.

A key part of the Climate Bond Standard and Certification Scheme is the overarching 'Climate Bonds Standard' available at www.climatebonds.net/standards/standards-V2.1. This documents the common fund management and reporting requirements that any and all Certified Climate Bonds must meet, in addition to meeting the sector specific Criteria.

Also important is the complementary suite of sector-specific eligibility Criteria. Each set of Criteria establishes climate change benchmarks for that sector. They are used to screen assets and capital projects so that only those that have climate integrity, either through their contribution to climate mitigation, and/or to adaptation and resilience to climate change, will be certified. Where a bond encompasses a mixed portfolio of assets across a number of sectors, each sub-category of assets will be subject to the relevant sector-specific Criteria for those assets.

These Criteria are rooted in the climate science that lays out the rapid transmission pathways to limit global warming to no more than a 2D rise, ideally 1.5D. The Climate Bond Standard recognizes that small improvements will not be sufficient to meet the targets of the international community, step changes are needed. The Criteria are drafted through a multi-stakeholder engagement process, including Technical and Industry Working Groups, convened and managed by the Climate Bonds Initiative. The draft Criteria are subject to public consultation. Finally, they are reviewed and approved by the Climate Bonds Standard Board.

Criteria have already been developed for Solar, Wind, Geothermal, Land Based Transport, Water Infrastructure, and Buildings. Criteria are currently under development for Bioenergy, Hydropower, Marine Renewables, Forestry, Agriculture, Fisheries and Aquaculture and Waste Management.

To date, the Building Criteria under the Climate Bonds Standard have been used to certify 16 buildings related bonds to date, with a total value of approximately $3.8 bn.

Letter to Our Readers

As part of the Paris Agreement, the international community committed to limit the global average temperature to no more than 2-degree C above pre-industrial levels, and to pursue efforts to limit it to no more than 1.5-degree C above pre-industrial levels.

Rapidly reducing greenhouse gas emissions in the buildings sector will be critical in this, given it is estimated to account for approximately one-third of anthropogenic emissions globally at present.

To be successful, there needs to be a focus on total buildings emissions, not just improvements in energy efficiency. It is estimate that only about a third of emissions reduction potential can be achieved via energy efficiency. Another third can be achieved through changes in building materials, and a final third from energy switching. On this latter point, many buildings and real estate assets have on-site fuel generation. If these continue to be powered by 'dirty fuel', we will not sufficiently bring down emissions no matter now efficient the buildings become.

Strategies to deliver this decarbonisation need to be based on the latest climate science. Only this can provide the appropriate information on the scale and speed of decarbonisation needed. Only from this can appropriate performance targets can be set and tracked against to ensure we are on track as a global community, as a sector, and as an individual building regulator, owner or manager.

With this information:

- Building owners and managers of existing building stock can plan for sufficiently deep retrofits and renovations;
- Developers of new buildings stock can design and build in compliance with future climate needs;
- Regulators can embed 2-degree compatible emissions metrics and targets into the range of building codes, post-occupancy evaluation schemes and industry certification schemes that drive change in the market;
- Green finance providers can embed 2-degree compatible emissions metrics and targets into their investment and lending mandates. This includes green mortgage provides, investors in green buildings bonds and equity, and governments offering fiscal incentives and many other types and forms of financial support.

Delivering this transition will require deployment of capital – to retrofit the existing building stock and establish new builds with a low GHG footprint. Bonds have a long history of financing large infrastructure investments, and the US$ 100 trillion bond market can play a significant role in funding this rapid decarbonisation in the buildings sector.

The Climate Bonds Initiative is working to make that happen. We aim to ensure that money borrowed and invested via the bond market is diverted into green assets and projects and away from 'brown' assets and projects. Since the first labelled green bond issuances in 2007, the labelled green bond segment of the market has grown rapidly with US$80 billion of labelled green bonds issued in 2016, taking total labelled green bonds outstanding to US$135 billion. These bonds are in high demand, with investors ever increasing their green mandates and demand for green product.

However, for this market to continue to grow and grow fast, coherent and consistent science-based green definitions and benchmarks are critical. In the absence of these, investors raise concerns about 'greenwashing', where bond proceeds are allocated to buildings that have little or uncertain green or climate value. Clear and ambitious green definitions are required to ensure confidence in the market and boost efforts to finance a transition to a low carbon economy.

To address this, the Climate Bonds Initiative has established the Climate Bonds Standard and Certification Scheme, the only green bond certification scheme globally. It acts as a fair-trade like labelling scheme, where all bonds are assessed by an independent verifier against transparent and consistent green definitions and associated eligibility Criteria. These green definitions and eligibility Criteria screen for assets and projects which are sufficiently low carbon to be consistent with the rapid decarbonisation needed to meet the goals of the Paris Agreement – only these assets can be included in a Certified Climate Bond. Certification then sends a clear signal to the market (bond issuers, bond investors and market regulators) about the climate credentials of that bond. To date, eligibility Criteria have been established for Solar, Wind, Geothermal, Buildings, Transport, and Water Infrastructure assets. Work in ongoing to establish eligibility Criteria for Waste Management, Bioenergy, Hydropower, Marine Renewable Energy, Forestry, Agriculture and Fisheries assets.

These Buildings Criteria have been developed through consultation and collaboration with buildings experts around the world. They are clear, science-based criteria which can be used to identify which building assets and projects are 2-degree compatible.

They have been guided by the latest climate science and scenario modelling from key organisations such as the International Energy Association (IEA), which enabled a picture to be painted of the direction, and, critically, the speed of decarbonisation needed in the buildings sector at a global level. This picture could be improved by more clearly separating and differentiating between commercial and residential and industrial buildings and facilities, between new builds and the existing building stock, and between landlord and tenant loads, but it provides a solid starting point.

From this, the buildings experts developed a methodology to establish targets at a more local level, leveraging localized data sets to benchmark current performance and drawing from it net zero emissions trajectories that buildings should be compliant with if they can truly be viewed as supporting the rapid transition needed to hit the global warming limits embedded in the Paris Agreement.

As part of this process, existing building standards, codes, regulation and industry certification or rating schemes have:

- Been mined for emissions intensity performance data from which to derive localised decarbonisation trajectories,
- More broadly been assessed for their compatibility with these targets and trajectories.

Using these Criteria, US$3.8 billion of buildings related bonds have been assessed and certified globally, giving clear signals to investors and other interested parties that the assets and projects linked to those bonds are 'climate compatible'. This includes bonds (and buildings) in Australia, the Netherlands, France, India, the US and others. It includes bonds from property management companies, real estate investment trusts, from public entities with large building portfolios, and from commercial banks whose mortgage portfolios have been linked to eligible buildings. In this latter category, a range of financial instruments have been certified, including Residential Mortgage Backed Securities. And this pool of Certified Climate Bonds in the buildings sector is growing rapidly.

More broadly, as these Criteria are based on an assessment of the underling building asset, they can be used to assess a variety of green financial instruments, not just bonds. This can include project finance, equity in pure plays, asset backed securities etc. They can also be used to assess the 'climate compatibility' of investment plans and policy schemes – including countries building development plans and regulations, and property portfolio managers investment schedules. Are these directed at delivering assets that are compliant with these climate science-driven targets?

The challenge is that this work to translate the internationally agreed climate target into localized metrics for assessment of buildings globally is slow and arduous. The result is that it is not yet possible to monitor and assess the buildings sector as a whole to ensure that collectively, the industry is moving in the right direction and at the right speed to ensure the required rapid decarbonisation is achieved. In this situation, there is a very real danger that ongoing energy efficiency improvements in the building sector may not be sufficiently ambitious and therefore encourage complacency, when in fact the sector is not contributing as it needs to towards the rapid decarbonisation collectively needed.

The primary challenge here is the lack of the appropriate, reliable, easily accessible performance data from the buildings sector that is needed to 1) benchmark buildings in a particular location to establish appropriate decarbonsation targets, and 2) to enable a building owner or investor to determine whether an individual building or building portfolio meets that target.

Various market schemes and mechanisms exist in the building sector, that relate to the assets performance at different points in its lifecycle, and have varying requirements and methodologies relating to data collection. These include building codes, post-occupancy performance evaluations, and industry based performance schemes:

Some of these mechanisms provide a large and robust enough data set sufficiently focused on emissions. In those markets, it has been possible to establish appropriate net zero carbon trajectories.

For example, through the NABERs scheme and data in Australia and Local Law 84 in New York City, the Climate Bonds Initiative has been able to access a sufficiently robust dataset from which to set

appropriate zero carbon emissions trajectories in these locations. This has allowed portfolio managers to appropriately tag climate compatible assets with an increased degree of accuracy and precision, and bring them to market in a Certified Climate Bond.

In other locations, the Climate Bonds Initiative has been able to access similar data through institutions which collate it from their members on a voluntarily basis for the purposes of internal improvement and benchmarking amongst participants.

Both these efforts are enabling the first benchmarking of emissions intensity performance in European markets.

However, many building codes, evaluation and certification schemes do not provide a large and robust enough data set sufficiently focused on emissions to enable the establishment of establish appropriate net zero carbon trajectories, or even to assess the emissions performance of buildings that have been assessed or rated under those codes and schemes.

To address this, it is recommended that:

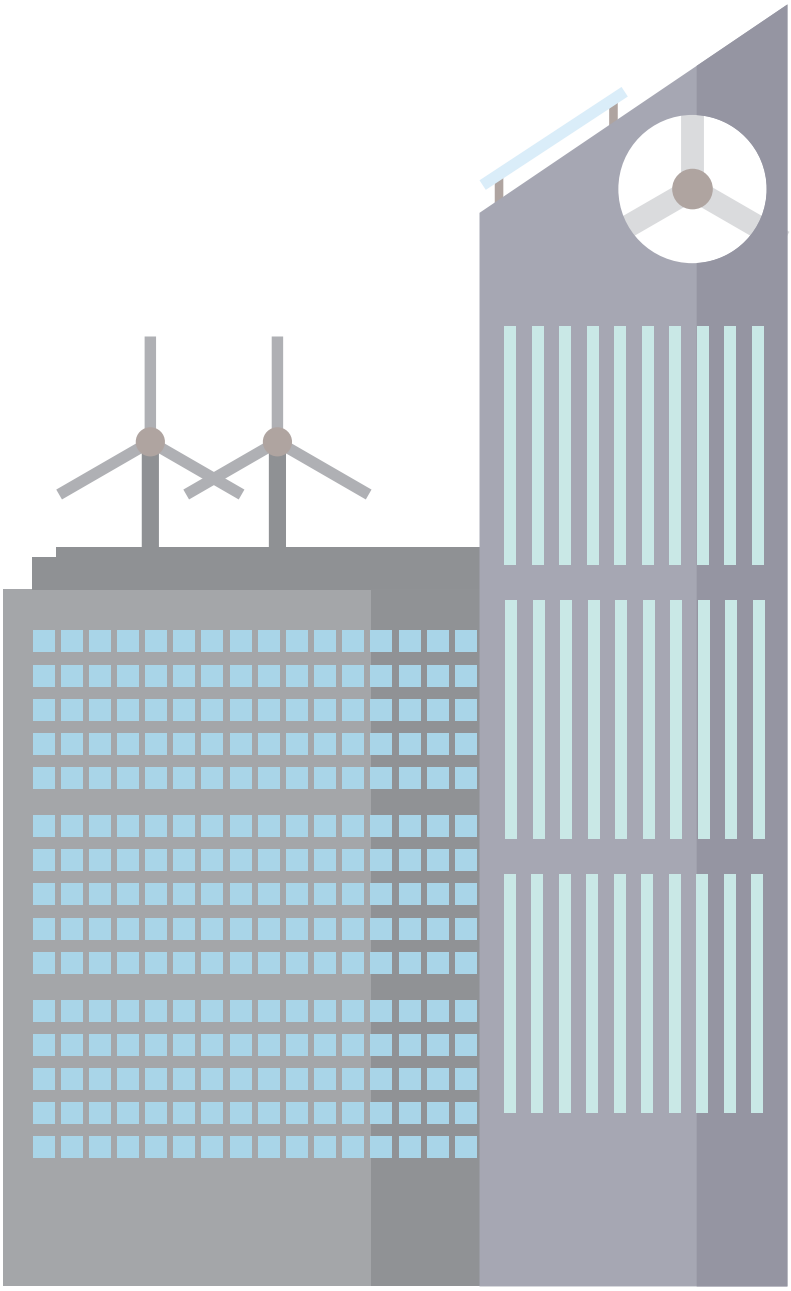
- There is a (re)focus on direct measurement of commercial and residential buildings emissions performance using full fuel cycle reporting standards (kgCO2 and kgCO2/m sq) – across all market mechanisms – building codes, post-occupancy performance evaluation and industry certification schemes.
- Where modelled reporting continues to be used, post-facto reviews and assessment is carried out to assess and establish the degree of correlation with emissions intensity performance, and modelling methodologies are revised as needed to favour design measures which are strongly correlated with emissions intensity.
- Operational (and modelled) assessment and reporting methodologies are standardised, over jurisdictions and time
- All holders of buildings performance data:
  a. Make every effort to make publicly available (at least on request) anonymized performance data in its raw, unadjusted form.
  b. Provide annual reporting on emissions intensity across their datasets, alongside information about the methodologies used

Energy and emissions intensity performance is appropriately weighted in the ratings of industry certification schemes. This will ensure awarded ranking will more accurately reflect and incentivise emissions performance.

Horizon 2020 & the Sustainable Energy Investment Metrics

Horizon 202 & the Sustainable Energy Investment Metrics (SEIM) Project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649982. This report was published in the context of the H2020 "Sustainable Energy Investment Metrics" project.
The project aims to develop a climate performance framework and associated investment products that measure the exposure of financial portfolios to the 2°C economy. The metrics, benchmarks, and tools will enable investors to align their portfolio with decarbonization roadmaps. The project runs from March 2015 to March 2018 and mobilizes over €2.5m in funding. Consortium members in the project include the 2° Investing Initiative, CIRED, WWF Germany, Kepler-Cheuvreux, Climate Bonds Initiative, Frankfurt School of Finance & Management, CDP, WWF European Policy Office and the University of Zurich.



The building sector in a climate compatible future

The Building Sector in a Climate Compatible Future

The building sector represents one of the largest contributors to climate change, both on a local and global level. The good news is that there is vast potential for cost-effective mitigation through proven demand reduction and energy efficiency technologies. Unfortunately, the current level of global investment in emissions efficiency in the buildings sector still falls far short of what is required to achieve mitigation goals for a 2°C scenario.

Growth projections for the buildings sector

Buildings meet a range of occupancy demands, providing everything from an individual's housing need to a business's commercial space. At present, there are over 400 billion square meters of gross floor area globally, three times as large as New York State. These buildings account for roughly 30% of global final and 40% of primary energy consumption, roughly equal to 135 EJ of final energy.

Looking forward, the IEA projects that current residential floor area will increase by 75%, from 200 billion square meters in 2015 to over 350 billion square meters by 2050. It projects a similar growth trend in non-residential floor area.

The need to decarbonise

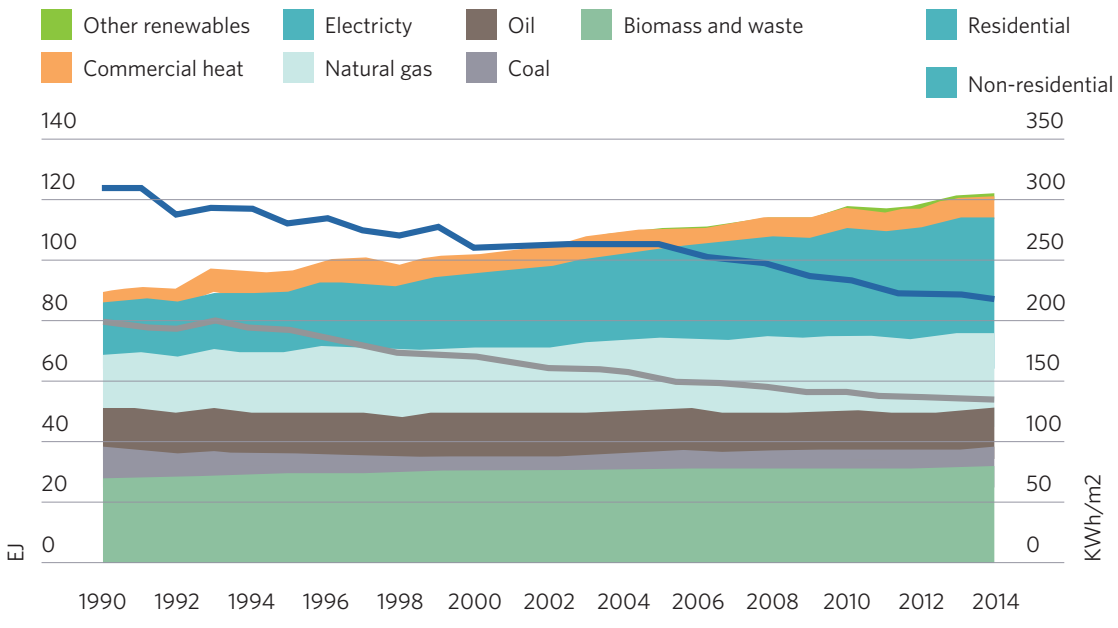
Existing buildings already account for 1/3 of the world's emissions, equating to roughly 11,915 MT CO2. In the absence of a demand-side energy transition in these existing buildings and in new buildings, global energy demand across this sector is likely to grow by 60% to 2050.

The world's existing building stock will represent roughly 2/3 of the global building stock in 2050. While energy use per floor area for residential and non-residential buildings is decreasing globally, year-on-year, the buildings sectors energy and fuel use continues to increase in-line with new construction and greater advances in energy efficiency are required (**see Figure 1**).

IEA and other major institutions are calling for a tripling in current retrofit rates, to 3% per year, in order to address the level of energy and emissions reductions required to stay within a 2-degree scenario. With roughly 1 to 2 investment cycles per building between now and 2050, a need for not only an

increase in the rate but also the scale of efficiency gains, known as deep retrofits, is critical to aligning the building sector with a climate compatible future. A similar story is apparent in new construction, with the IEA calling for all new construction to be zero emissions by 2025.

Figure 1: Global Building Sector Energy Consumption & Intensity by Sub-sector, 1990-2014



Source: Data sourced from IEA Energy Technology Perspective 2016

How might this be achieved

Whether new construction or existing buildings, all buildings are comprised of a combination of structural, mechanical, and operational strategies, together providing the building's end-use service and determining its energy demand. The delivery of these services currently depends on the on-site (direct) input of energy via a range of fuel types and off-site (indirect) grid electricity.

Globally, 35% of a buildings final energy consumption is met using on-site combustion of fossil fuels, with electricity accounting for roughly 1/3 or 29% and the remainder renewable energy. This mixed fuel composition can be associated with the underlying technologies used to provide everything from thermal conditioning to illumination with each building, and to a larger extend, building typologies having their own unique energy use profiles. Regionally, this composition varies substantial do to a range of local economic, cultural, and climatic factors. **Figure 2** illustrates the drivers of energy use across residential and non-residential buildings. Heating and cooling are particularly large energy users in non-residential buildings. In residential buildings, water heating and cooking services are also key drivers of energy use.

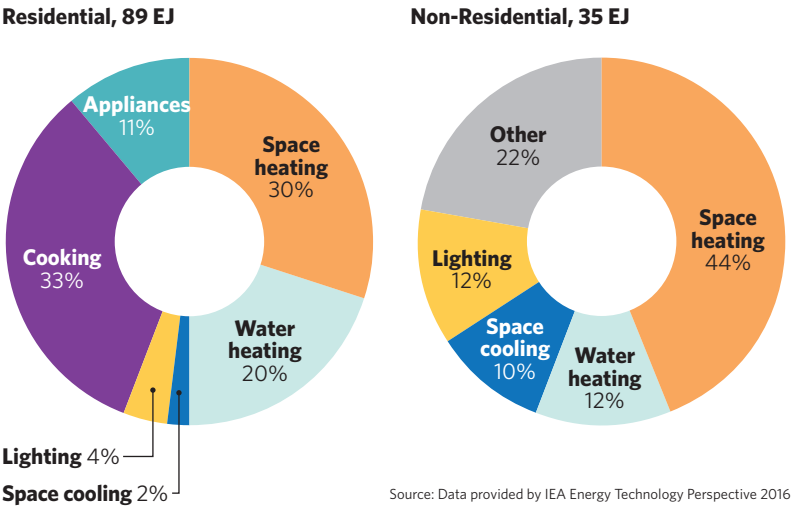
Decarbonisation strategies are required. **Figure 3** illustrates the relative potential of four key strategies: energy efficiency in new buildings, deep retrofits for energy efficiency in existing buildings, ensuring low GHG grids for indirect energy supply, and the use of low GHG materials in building materials. Of course, given the complexity of the energy demand, distributed nature of the assets, and disaggregated structure of the industry, in practice the relative importance of these decarbonisation strategies will be highly site or asset specific.

The need for early and rapid investment

2-degree warming scenarios allow for moderate levels of building sector emissions in year 2050, but all "Low Carbon" scenarios require early and rapid investment in decarbonsation. At present, 80% of existing buildings efficiency potential remains untapped globally.

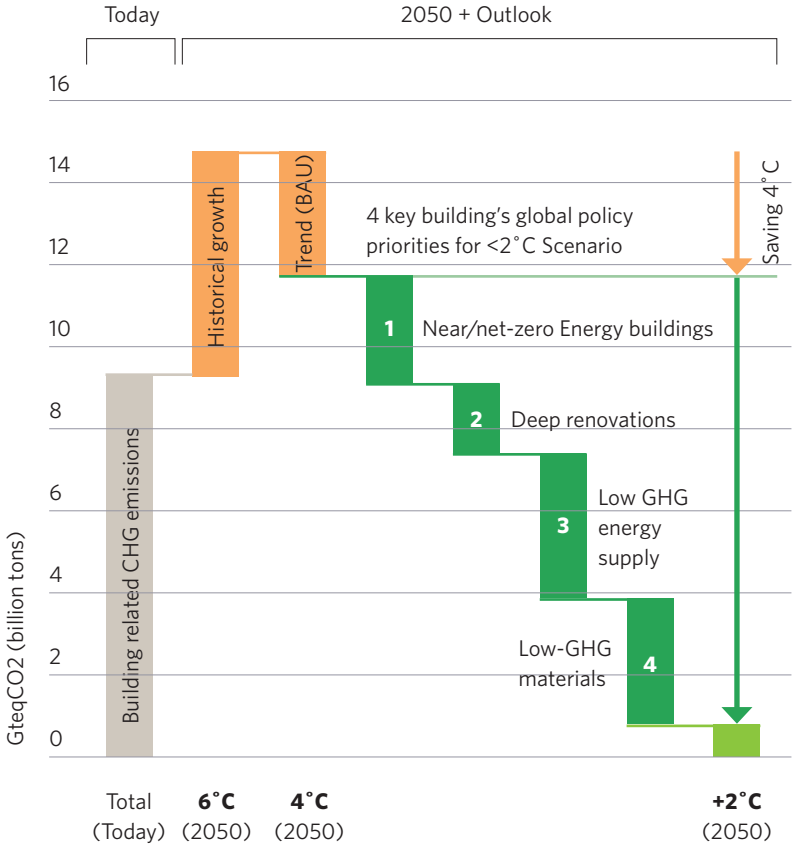
The windows to invest in the deep decarbonisation needed by 2050 within the building sector depend on the investment cycles within the sector. ~60% of energy reductions will come from heating and cooling interventions including in new or existing buildings. This being said, commercial heating and cooling applications have an investment lifecycle of 15 years

Figure 2: Residential & Non-residential Building Energy Use, 2013



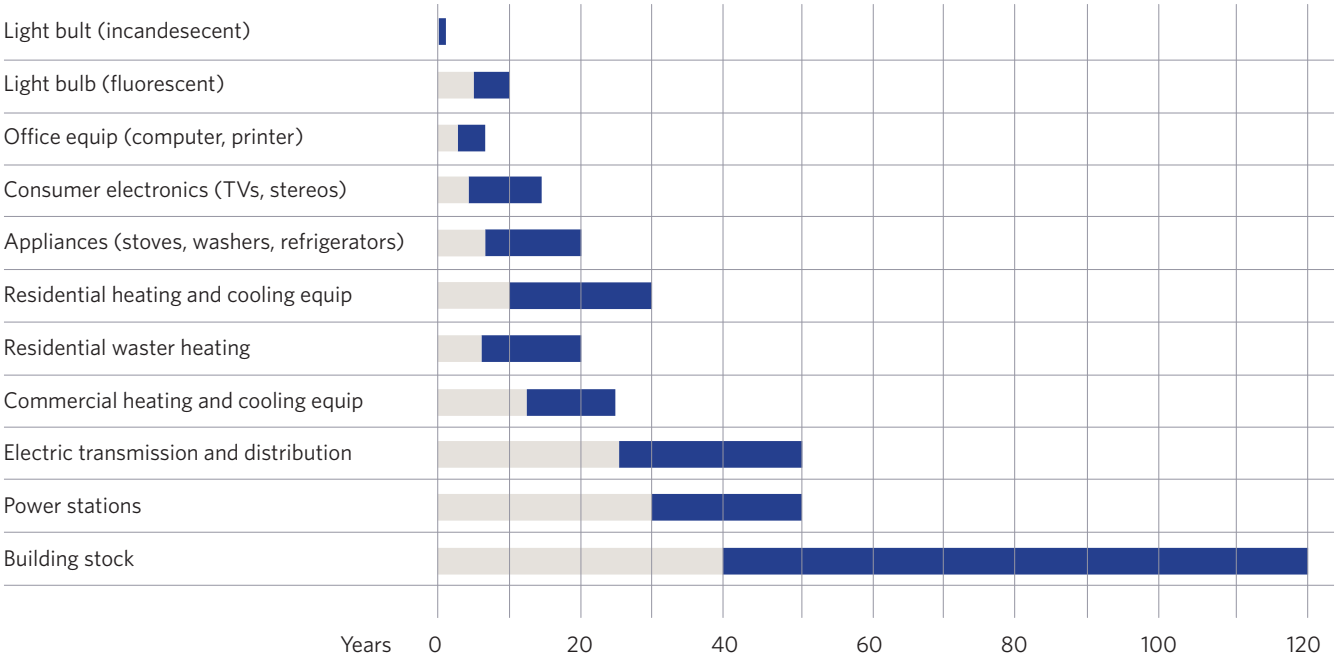
Source: Data provided by IEA Energy Technology Perspective 2016

Figure 3: Split of Global Building-related Emissions & Emissions Reduction Potential



Source: Chart provided by Energy Technology Perspective 2016

Figure 4: Typical Lifetimes for Energy Consuming Building Stock & Equipment



Note: Many building investment opportunities have limited opportunities between now and 2050, three decades away
Source: Data provided by UN Environment: Global Alliance for Building & Construction: Global Roadmap

meaning boilers will have 2-3 renovation opportunities by 2050. Likewise, building stock can last for generations with many buildings structures going renovated for decades with major components such as roof and thermal envelopes having only 1-2 renovation cycles in this same time period.

In this context, there is a need for early and rapid investment to prevent locking in carbon intensive investments. **Figure 4** compares the typical lifetime for energy consuming building stock and equipment. To put these figures into context, 2050 is three decades away.

Leveraging the Green Bond Market

Identifying investment needs and potential sources of finance

The need to invest in climate action is widely recognized. Various agencies have estimated the amount of investment needed by sector and/or technology, released as investment roadmaps.

According to the World Economic Forum and the IEA's Energy Technology Perspective 2016, the global building sector requires 3,770 billion US$ between now and 2030. Compared to the current investment in the sector, estimated at 358 billion annually, this will require increasing yearly investment by 296 billion. **Figure 5** below shows the breakdown of investment need for the buildings and industry.

These investment roadmaps must be converted to financing roadmaps, that identify potential sources of investment finance and instruments, such as debt vs.

Figure 5: Building sector investments need by 2030 compared to business-as-usual

	Cumulative	Annual average
Business -as-usual	4,656	358
2-degree scenario	8,498	654
Incremental investment required	3,842	296

Note: IEA provides investment figures from 2010-2020 and 2020-2030. Total investment is calculated as the sum of the two period investments minus 7 years of the average annual investment. Annual investment is calculated by dividing the two investment periods by 20 years.
Source: World Economic Forum's Green Investment Report. http://reports.weforum.org/green-investing-2013/required-infrastructure-needs/#hide/fn-33 via Energy Technology Perspective 2017

equity, loan vs. bond, grant vs. concessional financing. **Figure 6** provides a conceptual overview of this.

Several agencies have begun to map these financing strategies for the global 2-degree transition. In 2016, the OECD produced its report 'Analysing Potential Bond Contributions in a Low-Carbon Transition'. This study built on IEA's investment roadmap (2014) and focused on the role of fixed income asset classes in financing the transition in 4 regions (US/EU/China/Japan) and 3 technologies/sectors (power, auto loans, buildings) from 2015-2035.

However, the development of investment and financing roadmaps is required at all levels, by a wide variety of stakeholders. This includes commercial real estate funds and organisations looking to finance their activities and assets. It includes governments looking to turn their National Development Strategies into investment plans and finance strategies. It includes a variety of public entities looking to finance their own activities and assets, and also support the private sector to do so via appropriate policy and fiscal support.

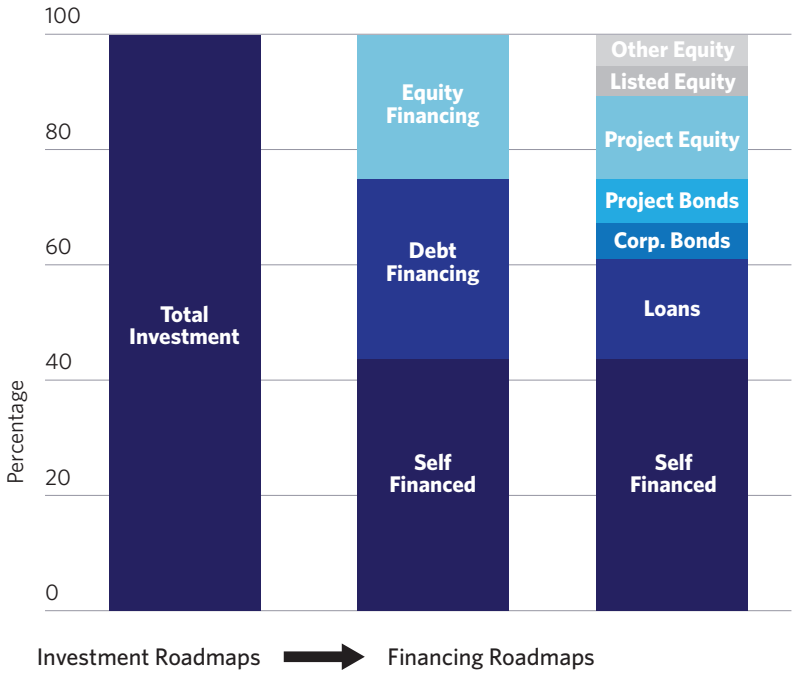
Progress on this front is variable, and it is yet to be seen the extent to which this investment need will be financed via which instruments. Today, the capacity of government to directly fund the transition to a low-carbon economy from current revenues is limite, but the world has deep capital resources. With some US$120 trillion of institutional funds under management, plus retail investor and corporate funds, adequate capital exists. Much of past development efforts was financed by the issuing of bonds – long-term debt repayable at pre-agreed rates, guaranteed by credit worthy institutions. The transition to a low-carbon economy presents capital with what is likely to become the largest commercial opportunity of our time: investing in clean energy and low-carbon infrastructure. What is already clear is that the bond market can and should play a critical role in this transition. This is most notable when looking at the current scale of green bond oversubscription. Without increased efforts to provide visibility on financing needs, issuers risk missing the opportunity to align assets under management with climate compatible scenarios and investors risk investing in incremental and unsustainable efforts.

Opportunities for institutional funds and the bond market

The appetite to invest that capital in green and climate solutions already exists. The owners and managers of a large portion of this capital – representing assets of some USD 60 trillion (half) – have made public statements about the need to address climate change and stand ready to invest in climate solutions – subject to meeting risk/yield requirements. Pension funds, for example, understand the importance of supporting the shift to a low-carbon economy, but also have to ensure secure returns for their members. Long-term bonds are well suited to both the financing of long-term return on investment energy projects and to providing pension funds with security and consistency of returns over a longer horizon. The challenge now is to construct opportunities for that capital that will allow investors to meet their obligations while funding the essential transformation. "To investors green bonds offer a stable, rated and liquid investment with long duration. To issuers, they could tap the USD100 trillion global institutional fixed income investor base." - Mark Carney, Governor of the Bank of England and FSB Chair.

A large and liquid green and climate bond market will help. The bond market itself currently has $100 trillion of loans outstanding. A new asset class of green and climate bonds can and should play a pivotal role in shifting capital, acting as a tool to close the gap between funding needs for a climate transition and investor demand to support and facilitate that transition. For investors, green and climate bonds will simply be investments in new fixed-interest opportunities, packaged for transparency on green impacts, and delivering secure, long-term returns at competitive levels of risk. (**Box 1** provides further clarification on the nature of green and climate bonds, vis-à-vis regular or vanilla bonds.) In this context, there is a vast opportunity to leverage the bond market to finance high-performing buildings and energy efficiency components for those buildings.

Figure 6: From investment to finance



Source: On the Road to 2C: From Climate Investment Roadmaps to Science-Based Financing Roadmaps

"To investors green bonds offer a stable, rated and liquid investment with long duration. To issuers, they could tap the USD100 trillion global institutional fixed income investor base."

Mark Carney, Governor of the Bank of England and FSB Chair.

Box 1: Climate Bonds and Green Bonds

Green bonds are issued by a public of private entity, who guarantees to repay the bond over a certain period of time, plus either a fixed or variable rate of return. This is identical to traditional bonds. They have however one distinguishing feature over traditional bonds: proceeds are earmarked for projects or assets with environmental benefits.

The idea of a climate bond is an extension of the green bond concept. The use of proceeds in a climate bond are earmarked for assets and projects with climate change benefits, either mitigation, adaptation and/ or climate resilience.

In reality, there is much overlap between green and climate labelled bonds. Many green bonds are used specifically to fund climate mitigation and adaptation assets and projects. As climate bonds move into climate resilience considerations, they are increasingly incorporating a range of traditional sustainability impacts.

The potential and growth of green and climate bonds

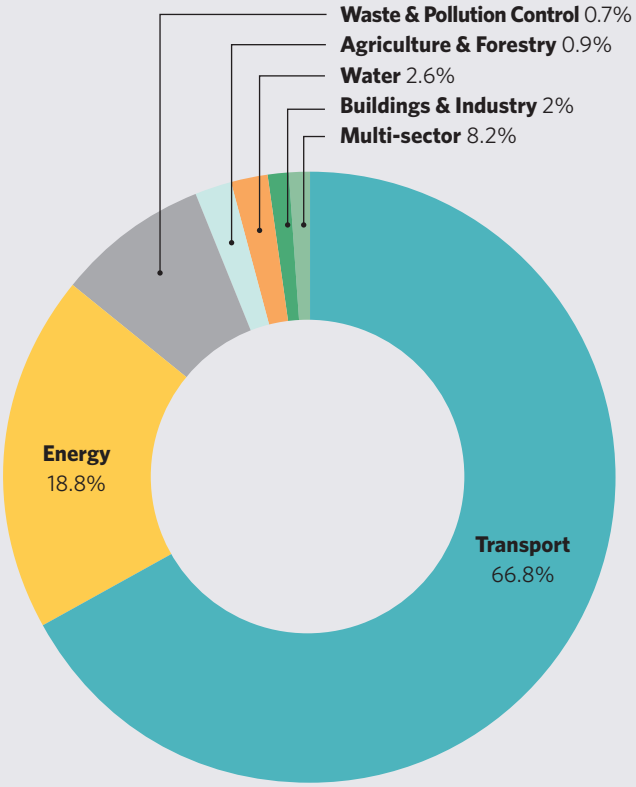
Climate-aligned bonds are bonds that are being used to finance low carbon and climate-resilient infrastructure. This includes labelled green or climate bonds with use of proceeds defined and labelled as green, as well as a larger universe of bonds financing climate-aligned assets that do not carry a green or climate label. Together, these make up the 'climate-aligned' bond universe.

Climate Bonds Initiative research estimates that there are $694bn of climate-aligned bonds outstanding. This is made up of approximately 3,590 bonds from 780 issuers across a number of sectors, including transport, energy, buildings & industry, water infrastructure, waste & pollution control and agriculture & forestry. This includes $118 bn of labelled green bonds, up from [$XX bn] (figure being revised) in 2015. **Figure 7** illustrates the split of these bonds across the climate themes.

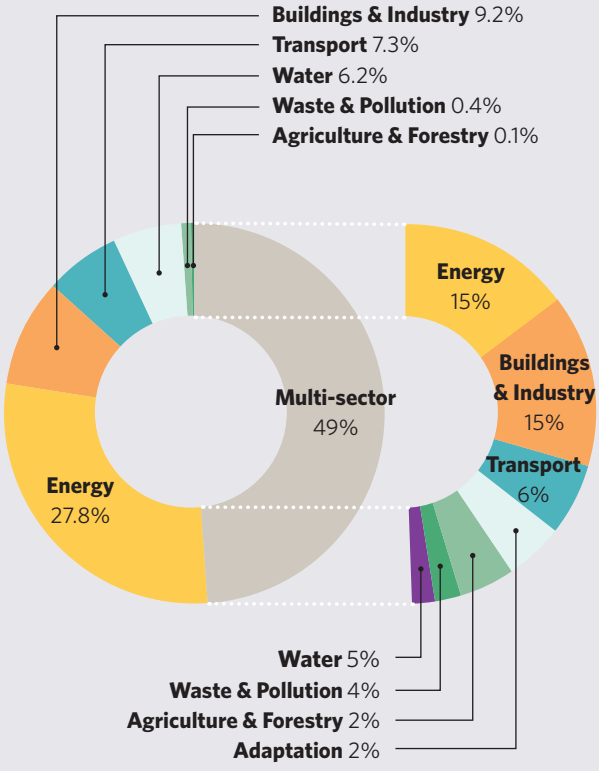
The private sector, including corporations and banks, now accounts for the majority of this issuance, growing from zero in 2010 to 66% of issuance in 2016. This is an important development given the role that the private sector will need to have in financing the low carbon economic transition.

Figure 7. The green bond market covers a wide range of sectors

Climate-aligned bonds



Green laballed bonds



Box 2: Certified Climate Bonds in the Building Sector

To date, Climate Bonds has certified 3.8 billion in bond issuances, covering both climate compliance commercial and residential assets. Issuers have ranged from private universities and large banks, to central financing authorities and agencies.

Issuers have various means to achieve certifications, including benchmarking against established commercial baselines, approved commercial and residential proxies such as Energy Performance Certificates, and through undergoing significant upgrades. Australia's ANZ Bank's 187 M USD issuance was the first to be certified using the commercial criteria. Others quickly followed, including; ABN AMRO, Netherlands with two Issuances totaling 895 M using the residential and commercial criteria, Axis Bank, India with 25 M USD bond issuance for commercial buildings using the LEED proxy, and New York State Housing Finance Agency's 233 M USD multi-family residential, using the Energy Star proxy. A number of others have since followed, including Westpac (Australia), Obvion (Netherlands), CDL Properties Limited (Singapore), Treasury Corporation of Victoria (Australia), Investa (Australia), and many others.

Green and climate bonds within the building sector

Within the buildings & industry theme, 67% of climate aligned bonds are linked to low carbon buildings, and 79% of labelled bonds. That is $XX bn (figure being revised) and $8.5bn respectively.

The buildings theme includes bonds issued by those with real estate portfolios (such as real-estate companies, property developers and real estate investment trusts), those with loans against property assets (such as banks with green mortgage portfolios) and those manufacturing products and technologies that improve energy efficiency in buildings (such as LED lighting, insulation etc). That said, in this analysis, the $8.5bn of labelled green bonds is an underestimate as it does not capture multi-sector bonds with an energy efficiency component to them. Over 94% of bonds in the multi-sector theme have an energy efficiency or low carbon component to them, although it is hard to estimate what is actually allocated on such projects. This includes, for example, World Bank green bonds where Buildings & industry projects include an energy efficient light bulb exchange scheme in Mexico.

Vasakronan issued the first corporate bond linked solely to low carbon buildings in 2013. They have continued to issue green bonds as others have joined the market, including Unibail-Rodamco, Europe's largest listed real-estate company, (and its subsidiary Rodamco Sverige) which is the largest issuer to date with $1.8bn currently outstanding. The French property developer Société Fonçière Lyonnaise was the second largest issuer. However, it is not just corporates that are issuing green buildings bonds. US Munis have more recently entered the market with bonds to improve the energy efficiency of academic institutions such as Massachusetts institute of Technology and University of Texas. Monash University in Australia has also issued green bonds, as has New York State Housing Agency.

It is notable that buildings & industry make up a relatively small share of the climate-aligned bond universe, at just 2%. But they make up an estimated 24% of labelled green bonds.

The building sector's low share within the climate-aligned bond market is understandable for a number of reasons. Firstly, bonds have traditionally been utilised for large infrastructure project due to the maturity of the technologies and the suitability of assets to bond financing. Aggregated pools of smaller, distributed assets characteristic of the building sector have often been financed using a range of debt instruments. Rail assets, for example, have been financed using bonds for decades (hence their large presence in the data), while relatively few bonds are issued by companies within the agriculture and forestry sector, or the building sector. Secondly, the ease of assessment and generalization of the sector's environmental credentials has made categorising rail as a 'low carbon asset' relatively straight-forward, while determining this for buildings is highly dependent on a range of market conditions and individual asset performance.

Conversely, this may explain why buildings & industry are relatively well represented in the labelled green bond universe. A labelled green or climate bond is essentially a signaling mechanism for investors, enabling the identification of climate-aligned investments with limited requirement for due diligence on the part of the investor. A green bond label therefore reduces friction in the market, facilitating growth in climate-aligned investments. Green bond indices have also greatly contributed to reducing friction by giving investors a means to evaluate performance and assess risk. Labelled Green Bond indices include: S&P Dow Jones, Solactive, Barclays MSCI and Bank of America Merrill Lynch.

The need for science based green definitions to grow this market

In the bond market specifically, coherent and consistent science-based green definitions and benchmarks are critical to boosting the market for green buildings bonds. In the absence of clear and widely accepted definitions around what are green buildings, investors will raise concerns about 'greenwashing'. Issuers will be unable to provide with a degree of certainty that bond proceeds are allocated to buildings meeting investors desires, let alone deliver the scale and speed of transition necessary for rapid decarbonisation. Under current conditions, issuers and investors may be under the impression that use of proceeds are going to adequately meeting sustainability objectives, while in fact, they may be adding little or uncertain environmental value. Relative, let alone absolute impact is unknown. Either of these outcomes would shake confidence in the market and hamper efforts to finance a transition to a low carbon economy. A need for clarify is a critical missing piece.

Outside the financial sector, a strong effort has been made for companies and other non-state actors to adopt "science-based" performance tracking and targets, under the logic that each institution should do its 'fair share' of global climate mitigation and

adaptation. These science-based metrics and targets should and can provide the critical context of "how much is enough" in terms of climate or low carbon performance, something that is often missing from regulations, policy and current financial institution performance tracking.

The Green Bond Principles (GBP), second opinions and the Climate Bonds Standard & Certification Scheme are tools to address greenwashing. The GBP were launched in 2014 by a group of banks to bring clarity to the processes and transparency associated with green bonds. The four voluntary principles primarily relate to the process of issuance, disclosure and reporting, while the questions of 'what is green' is addressed on a case-by-case basis by issuers and second opinion providers. **Box 2** provides additional information on building related Certified Climate Bonds.

The Climate Bonds Standard and Certification Scheme acts as a fair-trade like labelling scheme, where all bonds are assessed against transparent and consistent green definitions and criteria, and compliance with those criteria is assured by an approved verifier.

A key advantage of the Climate Bonds Standard & Certification Scheme is that it provides clear, science-based criteria on what is green, not just in the Buildings Sector, but across all sectors of a low-carbon, climate-resilient economy. The Climate Bonds Standard is aligned with the transparency and disclosure requirements of the GBP, but goes further in more precisely identifying the conditions under which building assets and projects can be determined to be 2-degree compatible, and how issuers can demonstrate compliance with these requirements in order to address both the "fair share" and "how much is enough" desire from issuers and investors. It is also applied consistently to all Certified Climate Bonds relating to buildings, removing subjectivity and inconsistency in the marketplace.

This document

The introduction frames the challenge of aligning with a 2-degree target set out by the Paris Climate Agreement and the current state of the bond market in addressing this target. In order to achieve this, continued effort on all fronts is needed, from measuring the climate impacts and estimating the investment costs, to leveraging the financial sectors and identifying climate compatibility on an asset level.

While others are actively working to measure climate impacts, estimate investment cost, and leverage the financial sector, identifying climate compatibility on an asset level has remained out of reach. In order to identify what is climate compatible, Climate Bonds has developed the Building Criteria, a framework in which to identify and certify those assets in-line with a climate compatible 2-degree scenario.

This report is the result of that work, including the goals & principles driving the criteria development, the application of these principles within the bond market, and the criteria revised to allow issues to identify assets under management compliant with a 2-degree world.

The remainder of this report describes in more detail the Buildings Criteria under the Climate Bonds Standard, specifically:

- The goal and principles of the Criteria (Chapter 2);
- Application of these principles (Chapter 3);
- The resulting eligibility Criteria for Buildings under the Climate Bonds Standard (Chapter 4);
- The challenges uncovered from the Criteria development process that can provide lessons for the buildings sector and its stakeholders (Chapter 5); and
- The wider application of these Criteria to other financial and building asset classes (Chapter 6).

Principles underpinning the performance metrics

SCOPE: Climate

The building sector currently accounts for 1/3 of the world's emissions, equating to roughly 11,915 MT CO2. A need to mobilise the bond market towards supporting a climate compatible building sector is critical to achieving global emission mitigation.

The Buildings Criteria of the Climate Bonds Standard aim to offer a robust and transparent method for investors and other market players to assess whether bonds issued to fund commercial buildings, residential buildings, public spaces, and building components deliver outcomes compatible with global climate change targets. That is, that the assets linked to those bonds:

- Have a low GHG footprint and/or significantly reduce emissions in line with the rapid decarbonisation required to meet the internationally agreed target of limiting warming to no more than 2D and ideally no more than 1.5D;
- Promote adaptation to climate change and facilitate increased climate resilience;
- Meet minimum disclosure requirements to raise the levels of transparency and disclosure.

Launched in 2014, the Criteria at present focus on climate change mitigation through emissions efficiency and energy efficiency. It is intended that they will be expanded to incorporate climate adaptation & resilience impacts in the near future.

SCOPE: Assets

The Buildings Criteria are made up of a number of complementary parts. These reflect appropriate groupings of assets in this sector, as green bonds are linked to eligible assets and use of proceeds. These are:

- Commercial Buildings, i.e. buildings that are intended to generate a profit, either from capital gain or rental income. There are sub-categories of Commercial Buildings, including but not limited to, offices, shopping centres and hotels.
- Residential Buildings, i.e. buildings that are used or suitable for use as a dwelling.
- Public Spaces, this includes projects and assets that are not specifically buildings related, but are part of the wider built environment, such as street lighting upgrade projects or residential block projects.

Criteria for assessing the climate credentials of energy efficiency components relating to buildings (e.g. LEDs, heating and cooling systems, insulation materials) are currently being developed. These are not addressed in this report.

PRINCIPLE: Compatibility with a 1.5 or 2-degree future

The Building Criteria relies on scientifically derived climate scenarios and associated transition roadmaps and carbon budgets in order to determine what level of performance required in and by the building sector. Working within this climate-science framework ensures not only that all actors and assets in the building sector play their part, but also that each part adds up to the necessary rate and volume of decarbonisation called for in the global carbon budget.

In this context, in 2013 when the Criteria were developed, it was determined that aiming for zero-carbon emissions across the buildings sector by mid-century would ensure a level of carbon mitigation necessary to stay below the 2-degree warming threshold. This rate of decarbonisation was first proposed by the Potsdam Institute and has since been expanded upon by many others including the IEA and the IPCC's in the World Energy Investment 2016 and Climate Change 2014 reports respectively. These later efforts continue to refine more specific targets by building typology (commercial, residential) and stage of investment (new construction, existing asset).

Therefore, the current Buildings Criteria aim to ensure that buildings related assets included in Certified Climate Bonds are compliant with emissions trajectories compatible with net zero carbon emissions by 2050. These trajectories represent the rapid decarbonisation paths required to ensure the 2D limit is held, and provide a structure for the improvement or transition pathways that need to be rolled out across the buildings sector. Importantly, they also recognize that zero net energy buildings are not currently technically feasible at scale at floor space ratios typical in urban centres.

In addition, these ambitious, but necessary target trajectories can also be used to identify performance gaps or target misalignment in existing mandatory or voluntary building codes.

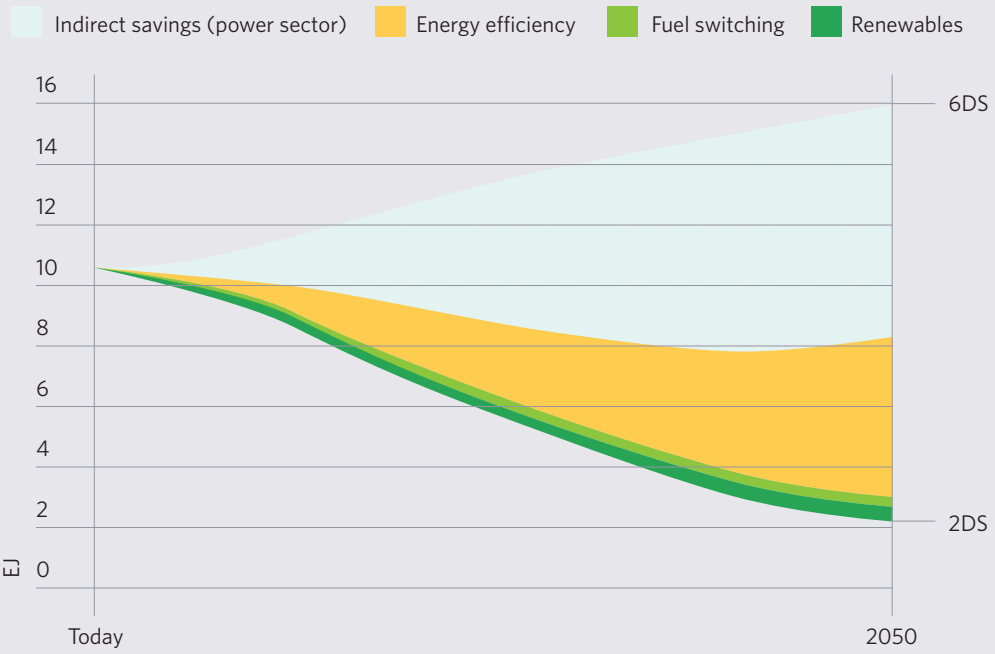
Of course, climate modelling and energy demand scenarios have continued to develop since 2014.

Box 3: Aligning with science derived rate of decarbonisation of the Building Sector

Most recently Climate Bond's climate science advisors, Potsdam Institute/Climate Analytics (Bill Hare) produced an internal Climate Action Tracker, a list of ten, short-term steps to reach the 1.5°C ambition. The Tracker found a more stringent requirement for 'net zero energy' needs to be applied to new buildings. Namely, that all new buildings should be fossil-free and near zero energy by 2025. The tracker also found a 90% reduction in energy intensity needs to be achieved in the refurbishment of the existing building stock;

"Scenarios with a likely – or very likely – chance of limiting warming to less than 2-degrees require a 70-80% reduction of direct emissions from the building sector by 2050 (Rogelj et al., 2015). For scenarios consistent with no more than 1.5 digress the required emissions reduction increase to 80-90% (Rogelj et al., 2015). Indirect emissions, primarily from electricity, are treated in the energy sector in these scenarios and also require full decarbonisation by mid-century."

The recent IEA Energy Intensity Potential report partially corroborates this rapid decarbonisation requirement (see Figure 6) while incorporating indirect emissions, primarily from electricity as a means of decarbonising the building sector by mid-century. As this work continues, it may be necessary to re-evaluate the Building Criteria to take into account these more stringent targets by building typology.



Note: On-site energy demand is composed of a range of upstream sources of both fuel and electricity generation technologies.
Figure provided by Climate Bonds Initiative.

The Climate Bonds Initiative continues to conduct assessments of developing building sector modelling in order to ensure future Criteria are in-line with the latest science. **Box 3** summarises recent developments in the climate science that will inform future updates to the Buildings Criteria.

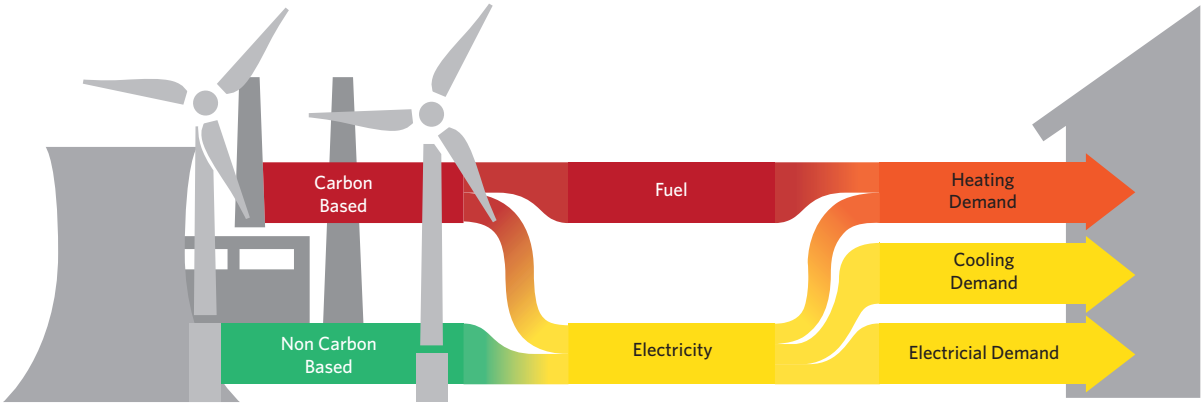
PRINCIPLE: Focus on emissions, not energy

There are currently efforts underway to track building performance including via; energy use (MW/year), EUI or energy use intensity (kWh/m sq/year), emissions produced (kgCO2e/year) and emissions intensity (kgCO2e/m sq/year).

However, measuring what matters remains a missing step in aligning the climate science and investment and financing roadmaps with asset owners and investors. The building sector has made progress institutionalising building performance by measuring energy use intensity (EUI). Some have gone so far as to measure both site and source EUI in order to track energy efficiency both at the site as well as across the entire energy supply chain (source). While increases in energy efficiency and therefore reductions in a buildings energy use intensity (EUI) can reduce emissions intensity of a building, EUI reduction does not take into account the underlying fuel's emission intensity going to supply the assets energy demand. **Figure 8** below highlights the integrated natural of emissions within an energy supply system.

The building sector's diverse use of direct and indirect fossil fuel, both on-site and offsite, requires a metric

Figure 8: Emissions embedded in energy and energy efficiency



Note: The useful energy demand of a building asset has in it, varying proportions of emissions dependent on the composition of the energy source and end-use technology instituted on-site. Source: From Climate Bonds Initiative Building Criteria

that allows cross comparison of assets from a holistic, climate impact perspective. The traditional energy use intensity (EUI) metric used by the industry is unable to measure climate impact effectively.

As energy is not all equal in regard to emissions, it is necessary to measure emissions directly to both account for high performers and identify assets ripe for improvement. A focus on emissions can also help uncover opportunities for fuel switching, where assets can improve their emissions intensity by say, moving from direct combustion for heat to indirect electricity from a decarbonised grids to run a heat pump. The current EUI metric does not reward this type of activity, which is critical to rapid decarbonisation in the building sector.

For this reason, the Climate Bond's Building Criteria's preferred unit of measurement is emissions, and more specifically emissions per square meter (emissions intensity). As the metric sends a strong signal to investors, asset owners and developers of building standards and codes that emission is the metric to measure.

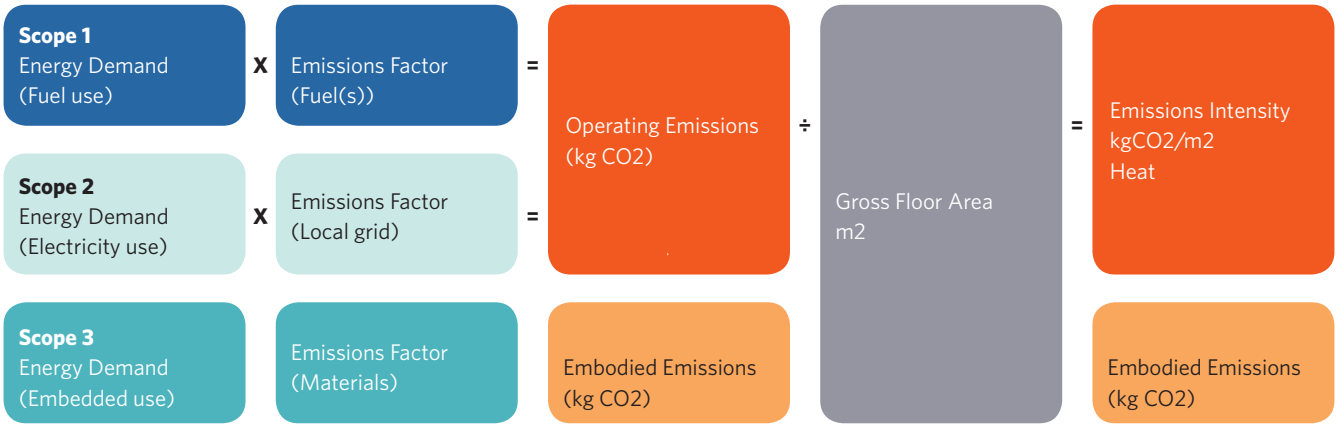
In practical terms, this includes the following scope of emissions, as defined in the Greenhouse Gas Protocol methodology.

Scope 1 - direct emission sources from buildings including the energy conversion-through-combustion of fossil fuels such as natural gas, fuel oil, biomass and in some cases coal on-site. Other types of direct emissions such as refrigerants are not currently required.

Scope 2 - indirect emissions sources from building including the energy conversion-through combustion of fossil fuels such as coal, oil and natural gas, AND/OR the emissions associated from non-fossil fuel such as nuclear and renewables (when substantial enough ie reservoir emissions from hydro) when providing electricity and/or district heating/cooling to the building.

Scope 3 – indirect emissions sources association with the sourcing, transmission and distribution of energy to the building. Other scope 3 emissions from transport, waste, and water are not currently incorporated.

Figure 9: Converting final energy demand to carbon dioxide equivalent emissions



Note: Scope 1 and 2 emissions accounting does not require life cycle assessment. Scope 3 emissions accounting require such as embedded emissions in building materials requires a life cycle assessment model to determine total embedded emissions. Building product labeling schemes are bringing these efforts to the market. Source: From Climate Bonds Initiative Building Criteria

2.5 PRINCIPLE: Focus on landlord, not tenant

In addition to considering the scope of emissions in which to account for, there are also boundaries within a given building asset. The two most common boundaries are the "Base Building" and "Whole Building".

- **Base Building** reporting includes only the emissions production typically under the control of the landlord or asset owner i.e. the heating, hot water, ventilation and air-conditioning of the whole building, light and power in common areas, and the lifts.
- **Whole Building** reporting includes both the emissions production under the control of the landlord (or asset owner) and the tenant, ie tenant lighting, office equipment, etc.

Benchmarking regulations and demand from investors for more transparent reporting is driving increased sub-metering of buildings, effectively delineating whole building reporting into base building and tenant energy and emissions. All forms of building performance benchmarking should be actively encouraged, including both base and whole building. Long-term, increased demand from tenants for high-performance buildings will require tenant level performance tracking and therefore, whole-building with sub-metering is ideal when considering future demand growth in this area.

That said, currently the Buildings Criteria focus on the emissions associated with energy use within the control of the landlord i.e. base building services also known as "core and shell."

The reasons for this are that:

- Light, power, and miscellaneous end-use energy demand within tenant spaces is outside the financial or management control of the building owner.
- Commercial buildings may experience a change in occupiers during the term of the bond.
- Driving down end-use energy demand at the tenant level also benefits from a direct return on investment for a tenant,
- These investments and energy reduction strategies are outside the control of the landlord who ultimately issues the bond.

Converting Energy use to Emissions

Converting energy use to emissions is a principle step in accurately accounting for an assets contribution to a climate compatible future. While policy and regulation efforts continue to bridge these two performance tracking metrics current efforts by issuers to identify climate compatible asset is still a challenge. While various methods for converting energy use to emissions exists, the Building Criteria require accounting by final energy use. This is in line with ISO 16745-1:2017. **Figure 9** above highlights the methodology use to account for differences in final energy demand and associated emissions (direct & indirect).

Box 4: Impact of the grid mix on emissions and emissions reduction strategies

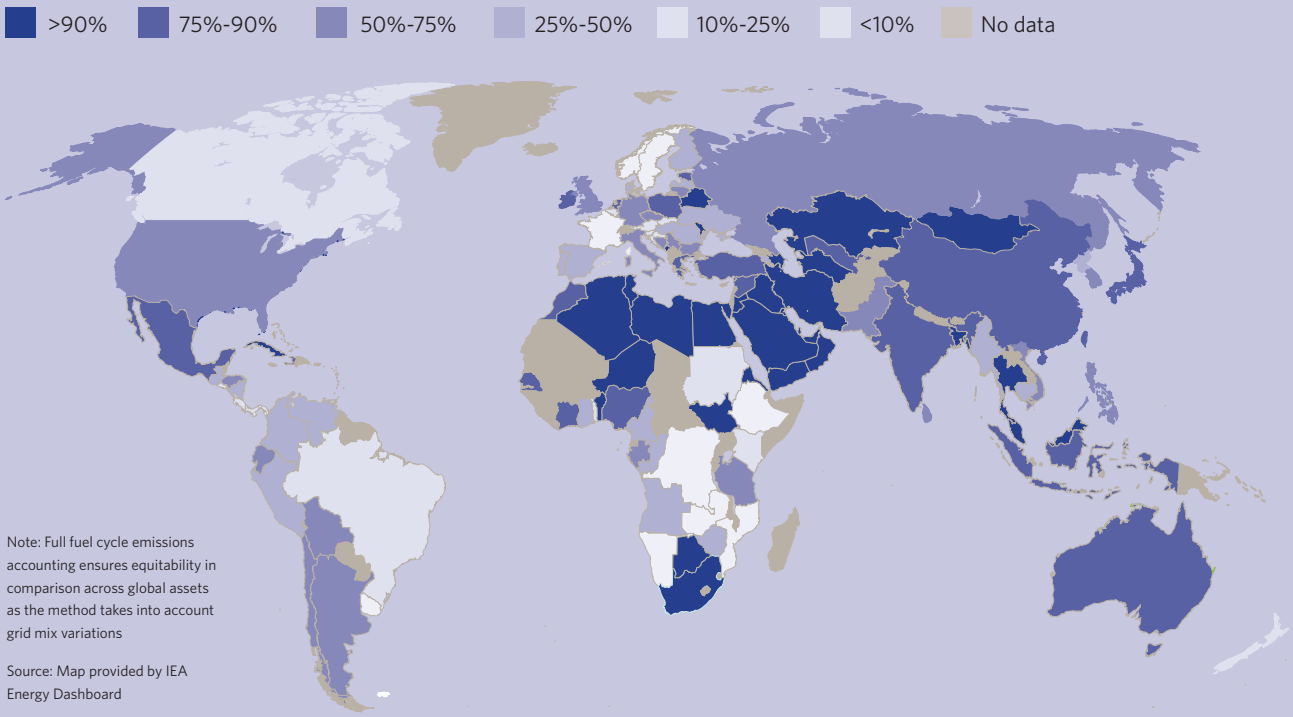
A building can have 3-4 times greater environmental impact if served from brown coal generated electricity versus electricity form gas fired combined cycle power plants. This in turn might influence the relative needs for fuel switching and energy efficiency, which may increase or decrease in any given location over time. Figure 10 highlights the varying share of fossil fuels in the grid mix across different countries.

Applying this accounting strategy to two different grids, both in similar climatic zones, the benefits become apparent. An electric heat pump to heat a home in a Nordic country, (low carbon grid at <10% fossil fuel) is highly climate compatible, whereas that same home in Poland (high carbon grid at 75-90%) may require increased thermal insulation and fuel switching from electric resistant heating to ground sourced radiant floor heating/cooling in order to achieve similar climate compatibility due to the higher scope 2 emissions from the grid in Poland.

Looking now at the fact that non-OECD use of electricity in buildings grew on average by 6% per year since 2010, a troubling scenario is revealed. "With OECD and non-OECD populations reaching, on average, 1.3 and 8 billion respectively in 2050, these per capita increases in energy demand mean that, on average, 60% more exajoules of decarbonised energy supply will be required in 2050 in addition to the decarbonisation of present-day energy supply." As non-OECD countries continue to promote electrification as a means of sustainable development, there is the potential for locking-in non-climate-compatible structural, mechanical, and operational strategies, energy efficiency aside.

Alternatively, direct tracking of emissions can help highlight the need to reduce direct emissions from buildings when grid mixes are relatively low-carbon. A report by the NRDC explores this relationship more closely, noting "emissions from California's residential and commercial buildings create roughly as much climate pollution as all of its in-state power plants, and the majority of this is from natural gas burned for space and water heating. Figure 12 shows that while fuels burned on-site account for 28 percent of U.S. emissions associated with building operations, the number is a whopping 41 percent in California.

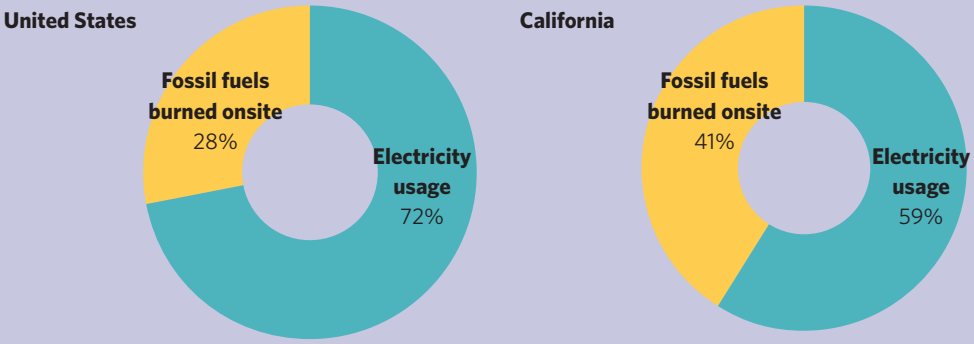
Figure 10: Share of Fossil Fuels in Electricity (%) (2014)[32]



Note: Full fuel cycle emissions accounting ensures equitability in comparison across global assets as the method takes into account grid mix variations

Source: Map provided by IEA Energy Dashboard

Figure 11: Sources of GHG Emissions from Residential and Commercial Buildings (California)



Note: On-site fossil fuel use accounts for a larger share of California's end-use emissions then electricity usage

Source: Energy Information Agency (EIA) 2014 and California Air Resources Board 2014 GHG Inventory. Information provided via the Natural Resource Defense Fund (NRDC)

Metrics, tools, and indicators for climate compatibility

Establishing zero carbon emission trajectories

As explained above, the overarching objective of the Buildings Criteria is to establish emissions trajectories compatible with net zero carbon emissions by 2050, so that only buildings performing within these trajectories would be eligible for inclusion in a Certified Climate Bond. Below are the principles used to establish the Building Criteria Emission Trajectory.

Net-zero-carbon trajectories are established by drawing a linear line between the emissions performance of the top 15% of the relevant market (residential, non-residential) 'today' and the net zero-carbon target for 2050. Notably, these trajectories are established on a city-by-city basis, rather than a single global trajectory. **Figure 12** illustrates this approach.

The simplicity of this approach enables rapid screening and meaningful monitoring and verification for assurance without transaction costs undermining any price benefit green bonds may offer. The Criteria has been designed with an ambition of a zero-carbon future in 2050 and offers a pathway to reach that outcome in a manner bespoke to each city's present circumstance. It aims to leverage the best data available to establish appropriate emission intensity baselines and offers an alternative pathway where lack of data prevents reliable market insight.

Why established on a city-by-city basis?

Figure 14 above highlights the range of final energy demand across regions broken down by end use service (ie, heating, cooling, lighting) and the required reductions determined by the IEA to meet a 2-degree scenario. The variability illustrated by region is indicative of a broader point: that there a variety of local characteristics that may influence emissions intensity in the buildings sector. These include:

- Local climate, such as daily and seasonal temperature and weather patterns which affect demand for lighting, heating and cooling etc
- Local grid mix and associated emissions intensity of off-site energy. Box 6 explores the impact of these factors in more detail.
- Local building characteristics that influence operational performance outcomes, such as the proportion of energy supplied on site and the fuel source for that energy.
- Local occupancy use patterns.

Setting zero carbon trajectories on a city-by-city basis therefore ensures that buildings in locations where higher levels of energy are needed to meet end-use need are not penalised. Instead, decarbonisation of energy as a means of achieving climate compatibility is incentivised.

Figure 12. Title of graph to go in this space

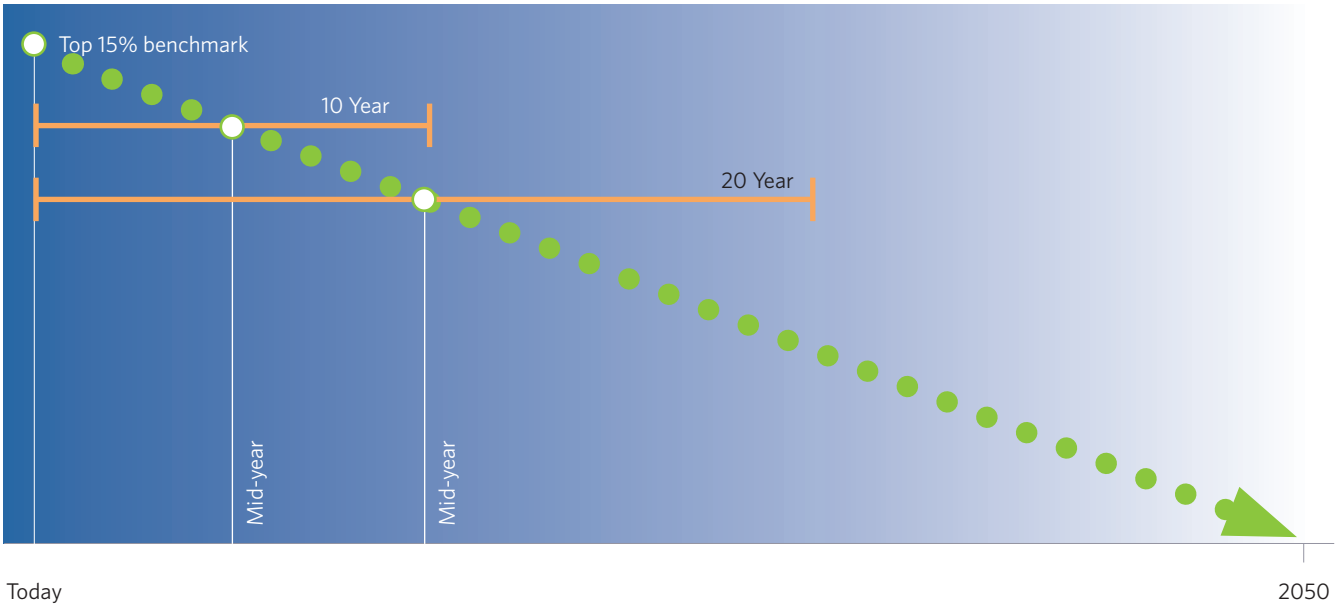
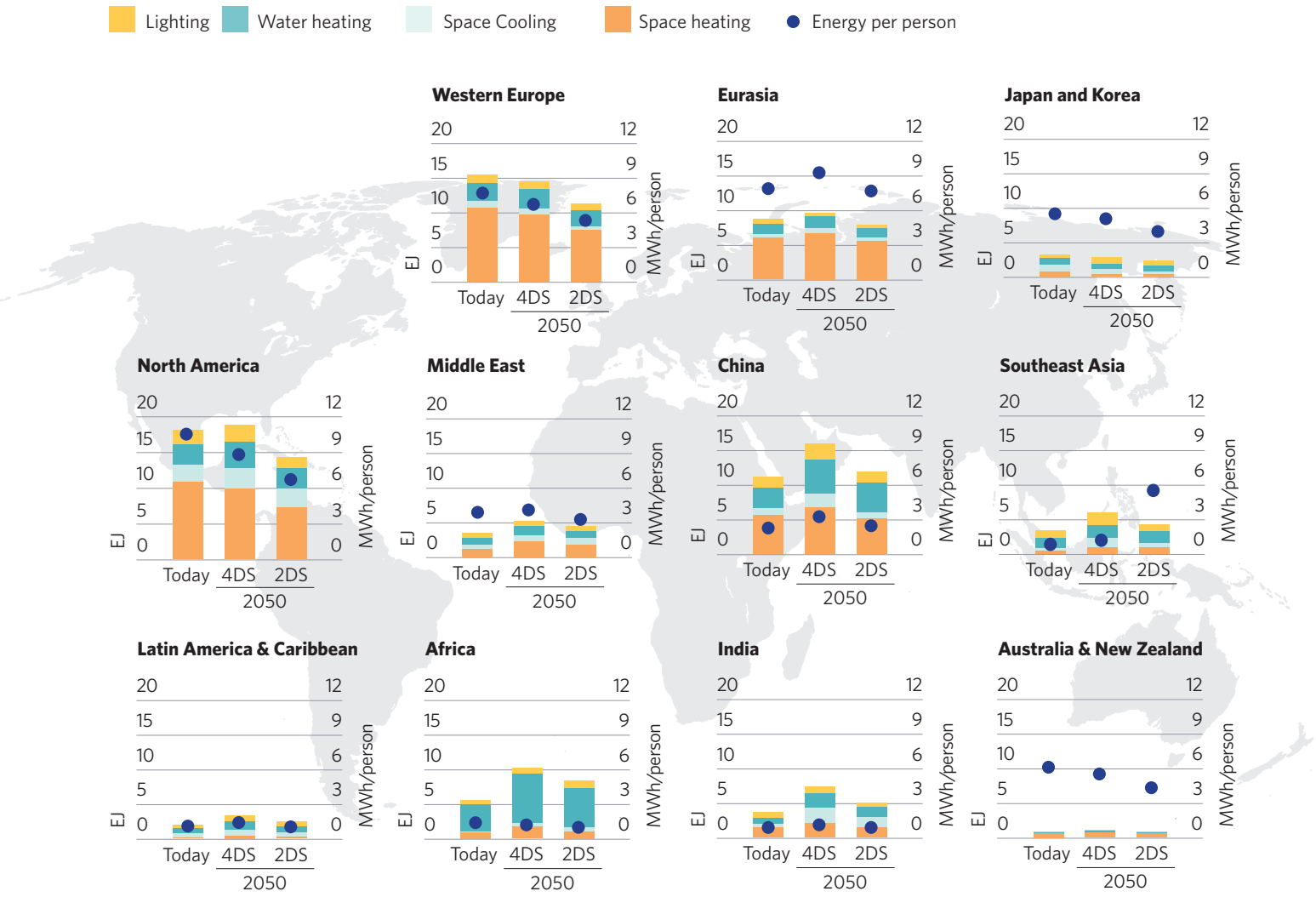


Figure 13: Building Sector Final Energy Demand in 2050



Source: Map provided by IEA Energy Dashboard

Why start the trajectory from the top 15% of the market

To ensure that Climate Bonds Certification achieves both significant scale and environmental impact, the starting emissions intensity is established by the performance level of the top 15 per cent of buildings in a city. The 15% was seen as the correct start position based a need to balance the following:

- Desire to establish high standards of performance - requires very strict performance standard
- Need to create some opportunity in the existing market – so that best performers can be identified and certified, so long as they continue to improve their performance in line with the declining emissions trajectory.
- Need to ensure that the resulting trajectories are aligned to the capacity of the market to deliver improved outcomes,

A market average approach was not adopted as this would arbitrarily permit 50% of the existing stock to qualify, and the Climate Bonds Standard would then not meet its objective of ensuring signaling of assets with are compatible with the Paris Agreement. An averaging across the market for the building stock, given the potential significant 'legacy' building stock that impacts the average and the focus on asset level rather than portfolio level (as in the 2°C portfolio tool from the 2° Investing initiative, which applies a market average), would have unduly skewed the eligibility of the building stock.

Why a linear trajectory

A linear trajectory puts in to place an early and rapid decarbonisation target. A concave trajectory would delay decarbonisation and risk not meeting the stringent demands of a 2-degree scenario. A convex trajectory, by requiring too rapid decarbonisation, may prevent the Building Criteria from gaining traction in the market and reaching significant scale and impact.

Recalibration

The "initial baseline emissions intensity" is established using available emissions intensity data of a representative sample of buildings by category (residential, non-residential) in a city. The sample

must be of sufficient size and cover a random sampling of assets in the market. Once set, it is not expected to be updated unless in exceptional circumstances.

The two key circumstances that warrant a recalibration of initial baseline emissions intensity are **(1)** when the size and quality of the underlying data set improves significantly and **(2)** when there is significant decarbonisation of the grid.

The Climate Bonds Initiative will undertake a review every 3 years to check for these two circumstances and whether they warrant a recalibration of initial baseline performance.

Expanding the pool of zero carbon trajectories via data Interpolation

The scarcity of reliable operational performance data for buildings in many parts of the world has been a significant limitation to establishing net zero emissions trajectories. Without this data, Climate Bonds Initiative is unable to determine overall market performance needed to establish low-carbon trajectories in most locations. This has led to Climate Bonds being unable to certify assets in many locations, and leaves investors with a lack of clarity of the climate performance of building assets in those locations. **Box 5** provides more information on this new methodology.

A New Way Forward

A process has been developed to allow estimation of the baselines needed where operational performance data for buildings of sufficient quality cannot be sourced for that location.

This means that Climate Bonds is now able to estimate market benchmarks with high confidence where the climate characteristics for that market are within the zones of climates associated with our established city baselines. In essence, established benchmarks can be interpolated to similar climate regions currently not covered by Climate Bonds – so long as the new location is within similar climatic zones regions as the established baselines.

3.3. Alternatives in Practice

Establishing emissions trajectories on a city-by-city basis requires robust buildings data for each city. This is often challenging to obtain. This is discussed further in Chapter 5: Challenges.

With this in mind, the Climate Bonds Initiative has established alternative methods to determine whether an asset or portfolio is on a climate compatible zero carbon trajectory, in instances where emissions trajectories cannot be reliably established for a given building type and location.

Currently, supports two alternative methods to determine whether a building asset or portfolio is on a climate compatible zero carbon trajectory;

- Market Accepted Proxies
- Significant Improvement from current performance

Alternative 1: Incorporating Market Accepted Proxies

Globally, markets have begun to adopt a range of various building design, construction or performance schemes. They range from voluntary and mandatory national schemes such as Energy Star in the US and Energy Performance Certificates in the EU to voluntary industry standards such as BREEAM and LEED. Many of these are well established in the market but aimed at difference audiences such as developers.

As an interim solution, in markets where data challenges have meant that zero carbon trajectories cannot yet be established, the Climate Bonds Initiative looks to leverage these codes or schemes as proxies to demonstrate the necessary level of performance of the buildings assets in question.

Specifically, the Climate Bonds Initiative has established a framework to evaluate the compatibility of these schemes and standards with the climate targets embedded in the Paris Agreement and the associated buildings emissions targets for Certified Climate Bonds as described above. With this framework, the suitability of any given scheme or code can be assessed, and those that are compatible with delivering the emissions outcomes required can be adopted as a potential performance proxy. Any building appropriately rated under that approved proxy is hence deemed climate-compatible and is eligible for certification under the Climate Bonds Standard. Importantly, as proxies are meant to serve as an interim solution until data becomes available to establish a local zero carbon trajectories, a limit is placed on the term of bonds that can be certified via a proxy. This ensures that green finance is not 'locking in' buildings that are not sufficiently low carbon over the longer term.

Appendix 2a gives this assessment framework for building schemes or codes. It is standardized to

Box 5: Interpolating Existing Data Establish Zero Carbon Trajectories

The method: The method for estimation relies upon strong correlations being observed between the established city baselines and three characteristics of climate that impact upon a buildings energy demands and resulting operational carbon footprint. The three characteristics used are high wet bulb temperatures, high dry bulb temperatures and low dry bulb temperatures. These influence latent cooling, sensible cooling and heating energy demands respectively. By determining the correlation between existing city baselines and each of these characteristics we are able to estimate baselines for new locations from knowledge of only the local weather characteristics and the underlying carbon intensity of the local fuel supply.

The data: Weather characteristics are derived from analysis of hourly annual weather data representative of a typical year for the target location. Such weather data is widely available and typically used by dynamic thermal modelling software for the purposes of predicting a buildings energy performance. Carbon intensity information is established from the best available local source. It is usual for this to be the same information that is required to be used for organisational greenhouse gas reporting in the location.

Confidence in the results: When estimating new benchmarks for similar economies and climates, i.e. offices in developed city markets within the bounds of climate covering the established benchmarks, this method is able to predict the market benchmark within an expected accuracy range of +/- 10%. The accuracy of the prediction reduces when the weather characteristics are outside the bounds of climates covered by the established benchmarks.

A sense check of the results: The ability to produce estimates of this accuracy is initially surprising as the method does not require any knowledge of the age of building, density or other non-climate related characteristics that could impact a buildings energy performance. This is explained by the market baseline approach of the Climate Bond Standard for zero carbon buildings. As the baseline is established for the whole of market, typically a city, the influence of any building specific aspects that might overtly influence performance outcomes is moderated by the diversity of built form in any given market. Additionally, as the baselines are representative of the 15th percentile of carbon performance, they are identifying the best performers in the market, which are expected to be of a similar level of technical sophistication.

Scope of this methodology: As noted above, we have high confidence in the results where the weather characteristics are inside the bounds of the climates covered by the established benchmarks. The accuracy of the prediction reduces when the weather characteristics are outside the bounds of climates covered the established benchmarks and accuracy deteriorates proportionally with climatic deviation. For this reason, it is proposed that this method of interpolation is used only across similar climates, which are within 20% of the bounds of the established benchmarks.

Specifically, based on an initial analysis of climate characteristics, it is anticipated the baselines can be able to set for the following cities from the World Major 150 largest cities by GDP: **Tokyo, Los Angeles, London, Paris, Mexico City, Buenos Aires, Seoul, Madrid, Detroit, Istanbul, Seattle, Beijing, San Diego, Barcelona, Denver, Rome, Milan, Pusan, Bogotá, Baltimore, St Louis, Johannesburg, Lisbon, Cleveland, Portland, Vienna, Vancouver, Cape Town, Pittsburgh, Tianjin, Dublin, Birmingham, Manchester, Berlin, Ankara, Lyon, Turin, Munich, Algiers, Naples, Curitiba, Leeds, East Rand, Medellin, Izmir, Auckland, Zurich, Amsterdam, Prague, Rotterdam, Brussels, Chengdu, Budapest, Xian, Casablanca, Taegu, Cologne**

The analysis shows that the following cities fall within a 20% climate bounds tolerance are able to be estimated with reasonable tolerance: Osaka/ Kobe, Shanghai, Atlanta, Toronto, Guadalajara, Fukuoka, Athens, Porto Alegre, Warsaw, Hamburg, Shenyang, Copenhagen, Krakow

Further work: The baselines established from operation performance data is limited to temperate climates. To extend the Buildings Criteria further, there is a need to establish more baselines in tropical and cold climates. Only when enough baselines are established from primary data representative of these climate will correlations be able to be established to estimate for more locations.

prevent unfair treatment across given performance standards as well as ensure reliability and cross comparison on all Certified Climate Bonds and the underlying building assets.

The framework allows for two methods of assessment and are dependent of whether a city specific baseline has been established.

- Benchmarking against local market emissions performance **Box 6**
- Benchmarking against proportion of total ratings/ labels awarded **Box 7**

For a list of accepted proxies to date see **Figure 14** below. This includes a range of schemes, performance standards, and building codes, some national, some international.

As is understandable, international building codes, regulations, and performance schemes do not all require the same methods and metrics. Based on experience to date, building codes, standards or schemes that are based on operational performance measures are preferred and those that measure only hypothetical performance abstractions or only the potential of a design is avoided. For additional details on component vs. operation measures, see Section 5: Challenges

Where a proxy is supported as best available in the local market but has known weaknesses when assessed against the ambition to provided operation greenhouse gas reductions, those weaknesses are acknowledged. This provides necessary transparency are to the quality of the bond metric and also help avoid reinforcing reliance upon tools and techniques that are not able to fully meet the requirements a rapid path to decarbonisation.

Figure 14: Approved Proxies to Date

Reviewed Scheme	Proxy Established
International	
LEED – Global Commercial (Method II)	●
Edge – Global Commercial and residential - developing countries only (Method I)	●
Local	
EPC Netherlands – Commercial (Method I)	●
Environmental Impact (EI) Netherlands – Significant Upgrade (Method I)	●
EPC England & Wales - Residential	●
EPC – Sweden Commercial (Method ?)	●
BASIX selected Australian state - Residential	○
NatHERS selected Australian states – Residential	●
Title 24 United States, California – Residential	●

Source: Climate Bonds Initiative

Recalibration

Market accepted proxies, while having the benefit of increased adoption, are stationary benchmarks that undergo updating and replacement over time. The performance dictates of these proxies also only meet compliance with the zero-carbon trajectory over a limited period of time due to the declining nature of the trajectory.

In order to account for these two scenarios (outdating and no long compliance) the established proxies are earmarked for review after a set period of time (expiration date), in this case, either a new proxy becomes available or the existing one has undergone updating and compliance is maintained. While arduous, this ensures only market proxies determined to be promoting a climate compatible building sector are accepted. Standardised assessment methodologies have been established to streamline this process. As additional baselines trajectories for cities are established, the building criteria will be less reliant on this sunsetting principle.

Alternative 2: Financing upgrade activity

This option has been included to allow financing of upgrade activity across a range of different asset types that might be included in a bond, such as street lighting programmes and other public space renovations, or finance incentive schemes such PACE or ESCO. This option also captures buildings that may not be able to be refurbished to meet the zero-carbon trajectory hurdle due to constraints such as heritage and historic protection orders. Significant improvements in emissions intensity has been shown to achieve similar emissions reductions called for in the low-carbon trajectory.

Box 6: Method 1: Benchmarking against local market emissions performance

Under Method 1, where an emissions baseline and zero carbon trajectory has been established using available market performance data, a proxy can be established by comparing its achieved performance against this benchmark.

For example, Energy Performance Certificate (EPC) data has been made publicly available for the whole of England and Wales. Using this data set, which includes emissions intensity kgCO2e/meter square for 67%* of residential buildings in England and Wales that have received an EPC, the Climate Bonds Initiative has been able to determine emissions intensity benchmark (top 15% of the market) and the zero-carbon trajectory. This year-on-year decreasing baseline was then used to determine which EPC ratings (A through F) meet this performance threshold, creating both a zero-carbon emissions pathway and market accessible compliance proxy.

Identify relevant building code or performance scheme

Access emissions intensity data for whole of locally certified assets

Determine the emissions performance level of the top 15% of buildings rated under the proxy dataset

Benchmark the building code or performance scheme against local market in order to account for localized conditions, ie climate, grid mix, etc.

Evaluate proxy efficacy over time to determine for how long the proxy remains within compliance of a decreasing zero carbon trajectory.

For additional information on the assessment of these EPCs and the justification for their adoption as a proxy indicator of performance under the Climate Bonds Standard, see Appendix 1

*Estimate was achieved by taking 96% of total EPC in England and Wales (17,316,000 between 2008 and June 2017 of which 16,623,360 are residential, possible duplicate entries not removed) divided by total residential housing stock (24,709,000 in 2017) in England (23,209,000 in 2017) plus Wales (1,400,000 in 2017).

Box 7: Method 2: Benchmarking against proportion of total ratings/labels awarded

Under Method 2, where an emissions baseline and zero carbon trajectory cannot be established using available market performance data, a proxy can be established by taking the top performers (15%) under an established rating or labeling scheme. This method is only used in lieu of an established baseline or representative dataset.

The following steps for Method 2 are summarized below;

Identify rating or label scheme

Access emissions intensity data for whole of locally certified assets

Determine 15th percentile of those assets which achieved certification under the labeling or rating scheme

Benchmark scheme categories (A through F, 1 to 100) against scheme's overall performance to determine which categories are representative of the top 15%

For additional information on the assessment the ratings/labeling schemes and the justification for their adoption as a proxy indicator of performance under the Climate Bonds Standard, see Appendix 1

*Estimate was achieved by taking 96% of total EPC in England and Wales (17,316,000 between 2008 and June 2017 of which 16,623,360 are residential, possible duplicate entries not removed) divided by total residential housing stock (24,709,000 in 2017) in England (23,209,000 in 2017) plus Wales (1,400,000 in 2017).

In order to ensure a path to compliance exist for the entire buildings sector, therefore, a significant improvement pathway has been determined as an alternative hurdle rate for eligibility for certification under the Climate Bond Standard.

This significant improvement is defined as a 30-50% improvement from current emissions performance. The exact percentage depends on the term of the bond, i.e. how long green finance is being locked up for. For a 5-year bond, a 30% improvement is required. For a 20-year bond, a 50% improvement is required. With a linear sliding scale between these two points. 30% was established as the minimum expectation for GHG reduction from an upgrade based on building components only, with no interruption to the buildings lifecycle. 50% was established as a reasonable reduction for the repositioning of a building that would requirement full refurbishment of plant and envelope. These bookends then set against the short and long-term targets expected of bond issuance.

Recalibration

Later analysis by the IEA and others to determine the amount of decarbonisation needed for existing buildings has since determined that an 80-90% reduction in emission is required between today and 2050. While the Building Criteria has accounted for this more stringent decarbonisation requirement using various mechanisms such as length of bond tenor and other conservative assumption making throughout various data assessment methodologies, this is likely to be revised during future technical working group criteria development. Tenor length partially overcomes this discrepancy as in theory, assets will have to undergo assessment 2 to 3 times between today and 2050 to remain in a certified bond.

Asset pools to which these should be applied

A number of assets are often included within a portfolio linked to a bond. To gain traction in the market, the Climate Bond Standard must minimize transaction costs for issuers and make it as easy as possible for them to demonstrate compliance with the Criteria.

Therefore, to uphold the level of stringency required to ensure assets and portfolios are indeed aligned with zero carbon trajectories, it is necessary to determine in what circumstances the Criteria could be applied and assessed at the portfolio level, as opposed to separately for each asset within the portfolio. The approach taken on this is as follows:

Method 1: Portfolio Aggregation

Where emissions intensity baselines are well established, properties across a portfolio compliant with the Climate Bonds trajectory OR Climate Bonds approved proxy (building code, energy labelling scheme or rating tool) can be measured by their collective emissions intensity. Those portfolios (pooled assets) that meet a Climate Bonds approved compliance pathway are certified as a whole, known as the Full Aggregation or "area weighted approach."

Method 2: Individual Asset Verification

Where emission intensity baselines are not established, properties compliant with a Climate Bonds approved proxy (building code, energy labelling scheme or rating tool) must be compliant in its own right and only assets that meet the proxy requirements can be pulled into a Certified Climate Bond. This is do to the fact that certifying proxies assume an increase level of risk over an zero-carbon trajectory approach.

Staying Up-to-Date

The Criteria as they now stand represent a strong first step forward for establishing clear signals and metrics to demonstrate what is required for buildings related assets to be compliant with 2-degree global warming pathways. However, the world is ever changing, and therefore these Criteria and underlying zero carbon trajectories, the approved proxies and the significant emissions improvements targets established will be subject to regular review as new information becomes available and increased demand form the market grows. Climate Bonds is continuing to see interest by issuers in many other areas related to the building sector.

In particular, possible future developments might include;

a. Major revisions on transition pathways (see Zero-Carbon Trajectories – Recalibration)

b. Establishing different zero carbon trajectories for new versus existing buildings

c. Expansion into other building typologies (i.e. other building asset classes we are likely to see entering the green bond market)

d. Revision to upgrade compliance pathway (see Significant Upgrade – Recalibration)

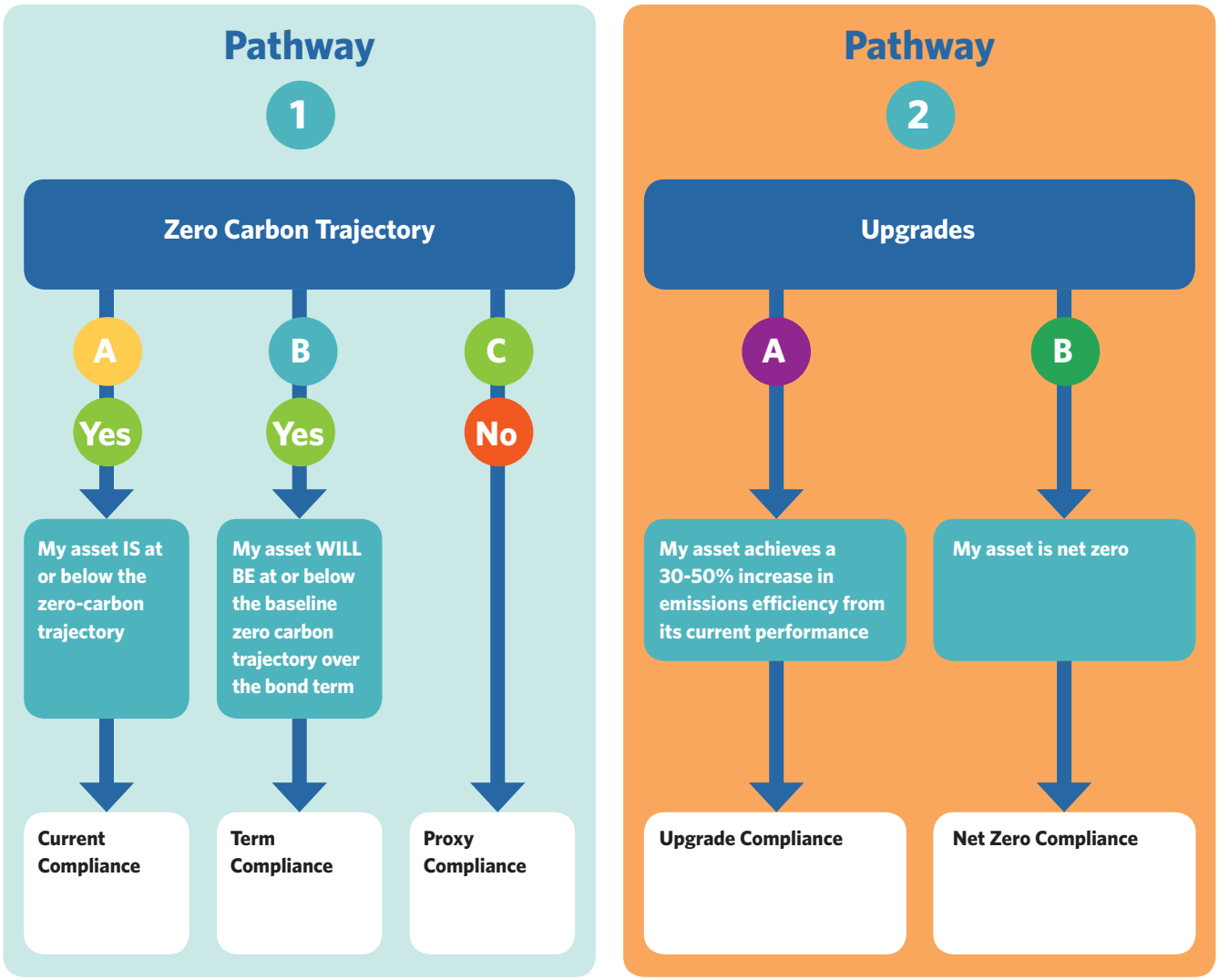
e. Continued establishment of market accepted proxies (see Market Proxies – Recalibration)

Standards for financing with a 2-degree world

There are, in essence, two pathways to eligibility for inclusion of buildings in a Certified Climate Bond. These are:

- **Pathway 1:** Compliance with the zero carbon emissions targets: Assets or portfolio MEETS or WILL MEET the zero emissions trajectory or already meets the requirements of an approved proxy, OR
- **Pathway 2:** Upgrades: HAS or WILL achieve a significant improvement in emissions efficiency against an asset/portfolio relative baseline

The diagram below illustrates these eligibility pathways. More information on each pathway is provided in the following sections.



4.1. Pathway 1: Zero Carbon Trajectory:

Bond issuers have three options to establish this:

Option A

Current Compliance: Emissions intensity of the building **MEETS** the appropriate compliance target for buildings in that city.

Option B

Term Compliance: Emissions intensity of the building **WILL MEET** the appropriate compliance target for buildings in that city over term of bond.

Option C

Compliance via Proxy: Emissions efficiency of the building **MEETS** the appropriate Climate Bonds Initiative's emissions intensity proxy for buildings in that category. Option C is only appropriate if Options A & B are not available.

The key strength of the Criteria is how emissions efficiency requirements are calibrated to local market conditions, taking into account differences in climate zones, prevailing market practices and inherent greenhouse intensities of the fuel supply.

Option A and B, while inherently simplistic, still remains out of reach for some cities and for some building types where the data simply does not exist in any reliable form. In such markets, existing instruments such as building standards, codes, and rating schemes will be leveraged as proxies for the top 15 per cent of buildings. This alternative approach is referred to as **Option C**.

In markets where all options are available, **Option A and B** will be the preferred approach. As **Option C** is meant to serve as an interim solution until data becomes available, a limit is placed on the term of bonds certified against this option (maximum 6 years).

Option A

Current Compliance: Meets Appropriate Compliance Target for Buildings in that Location

The emissions intensity of a building must meet the appropriate compliance target for its building type in the city in which it is located.

Additional Details

The compliance target an issuer has to satisfy is determined by the "zero carbon trajectory" set by connecting the "initial baseline emissions intensity" with the "target emissions intensity" for 2050.

The compliance target is expressed on an annual basis in kgCO2e per square meter terms. For instance, the compliance target for Sydney offices may be 78.2 kgCO2e /sqm per annum for a 10-year bond issued in 2015.

Portfolio application requirements

An issuer seeking certification will most likely have a portfolio of buildings covering different building types in different cities. The performance target that the issuer on a portfolio basis will have to satisfy is a weighted average of the different targets of building types and cities in the pool.

This weighted average will be calculated based on area, which Climate Bods has established as the most appropriate denominator for most building types including offices. Where a different denominator is applied, the weighted average will be calculated based on that alternate denomination. This approach of aggregating buildings in a bond portfolio is known as the Full Aggregation Method. It is applied when emissions intensity data for buildings in a city are available to establish emissions intensity trajectories.

In the absence of emissions intensity data, issuers should apply the individual asset verification method

Pre-issuance requirements

[text]

Post-issuance requirements

Post issuance, the issuer must monitor and report emissions intensity at a portfolio level on an annual basis. Annual reporting must apply a well-established methodology (e.g. Carbon Reduction Commitment in the UK and National Greenhouse and Energy Reporting in Australia) and be supported by an independent auditor's sign off with respect to the process and record keeping. Climate Bonds will also initiate spot audits and request issuers to provide raw data on all buildings in their portfolio to verify that portfolio performance is in line with performance targets.

Ongoing monitoring, reporting and verification are critical to ensure transparency and assurance that performance ambitions are met. The approach to monitoring and verification has been designed to be sufficiently light-touch to ensure that ongoing costs are kept to an absolute minimum.

If an issuer underperforms and this is attributed to unusual climate conditions for that year, a climate-correction mechanism may be applied to adjust the performance target. Climate Bonds will then assess the issuer's portfolio performance against this adjusted target. Climate Bonds advises that the climate-correction mechanism apply the methodology adopted by Energy Star in the US or the Department for Business, Energy & Industrial Strategy in the UK.

Option B:

Term Compliance: Will Achieve Equivalent Performance Appropriate Performance Target for Buildings in that Location Over the Bond Term

The emissions intensity of a building must meet the appropriate compliance target for its building type in the city in which it is located.

Additional Details

A building that does not qualify for certification under **Option A** can qualify for certification under **Option C** as long as there is a commitment to improvements in emissions intensity such that the building's average emissions intensity over the bond term is equivalent to the compliance target under **Option A**.

Details on benchmarking the portfolio and measuring required emissions efficiency improvements to achieve compliance can be found in "**Appendix 2: Term Compliance Methodology – Box 4**"

Portfolio application requirements

Full Aggregation

Pre-issuance requirements

As Term Compliance assumes a level of performance uncertainty, it is important that issuers seeking Climate Bonds certification provide additional detail and assurance that proceeds will go to achieving the desired emissions intensity compliance. This involves providing;

- Current portfolio emission intensity
- Proposed Use of Proceeds and associated projected increases in emission efficiency
- Detailed monitoring and evaluation methodology

Post-issuance requirements

As term compliance requires the promise of future compliance with the low-carbon trajectory, post issuance is used to verify the Use of Proceeds have gone to the appropriate efforts AND the efforts have brought the portfolio into compliance.

Option C

Proxy Compliance: Achieves Climate Bonds-Approved Proxy

The emissions intensity of a building must meet the appropriate compliance target for its building type in the city in which it is located.

Additional Details

Issuers seeking to apply other instruments will need to perform similar statistical analysis on their proposed proxies to demonstrate to Climate Bonds the ability of proxies to position buildings in the top 15 per cent. Climate Bonds encourages issuers to propose alternative proxies and have established guidance for issuers wishing to undertake the statistical work (**See Appendix X**). Climate Bonds will also undertake its own efforts to establish proxies for priority investment markets. The most up-to-date list of Climate Bonds-approved proxies is available on the website.

Limitations on bond term

As **Option C** is meant to serve as an interim solution until emissions intensity data becomes available, a limit is placed on the term of bonds certified against this option. The bond term is capped at 6 years.

Portfolio application requirements

To be certified against Option C, each building in the issuer's portfolio must satisfy the Climate Bonds-approved proxy following the Individual Asset Verification

Pre Issuance Requirements

[text]

Post-issuance requirements

The issuer must monitor and report emissions intensity at a building level on an annual basis.

4.2. Pathway 2: Upgrades

Bond issuers have three options to establish this:

Option A
Upgrade Compliance:
Emissions intensity of the building SIGNIFICANTLY IMPROVES from current or previous state.

Option B
Net Zero Compliance:
Emissions intensity of the building IS net zero according to Climate Bonds definition

Condition 2 allows the certification of projects that seek improvement in emissions efficiency through the application of energy efficiency and emissions efficiency measures and technologies that relate to the built environment (e.g. Insulation, LED lights, heat pumps, micro combined heat and power, renewable micro-generation, etc.)

The Upgrades pathway was established in order to certify high performance projects that, in theory, bring a building into compliance with the low-carbon trajectory due to their substantial gains in energy and emissions efficiency.

The methodology is agnostic to types of energy efficiency measures and technologies. As long as the measures and technologies to be applied in the project lead to the required improvement in emissions efficiency, the project is eligible for certification.

The methodology however requires that a contract or agreement already be in place with a contractor to undertake the emission efficiency work.

Option A

Significant Enhancement

Certification requirement

Projects where a contract or agreement is already in place with a contractor must achieve a minimum 30-50% improvement in emissions efficiency against the existing asset's emissions intensity through the application of energy efficiency measures and technologies that relate to the built environment.

* The required level of improvement in emissions efficiency depends on the bond term.

Additional Details

A minimum improvement in emissions efficiency of 50% is required for bond terms of 30 years and 30% for bond terms of 5 years.

Between 5 years and 30 years, the minimum improvement required is derived based on the linear trajectory between 30% for 5 years and 50% for 30 years.

For bond terms below 5 years, the minimum improvement is equivalent to that required for 5-year bonds (30%).

These requirements are depicted in Appendix 3 - Box 5

Issuers must be able to quantify to Climate Bonds the emission efficiency improvement of the upgrades.

Portfolio application requirements

Such an issuer with multiple projects can aggregate them into one portfolio and it is the aggregated portfolio that must satisfy the required minimum improvement in emissions efficiency rather than each project included in the pool having to comply in its own right.

Aggregation would be similar to the Full Aggregation Method except the denominator for aggregation would be either the total value of financing or the total carbon savings (in absolute terms not percentage terms) to be achieved.

Post-issuance requirements

There is no additional monitoring, reporting and verification requirements on top of those required by the performance contracts or upgrade agreements. For commercial buildings, Climate Bonds requires issuers to provide annual reporting in accordance with the terms of the contracts or agreements. For residential buildings, Climate Bonds does not require annual reporting.

Option B

Net Zero

Certification requirement

Be net zero carbon such that on-site energy use is equivalent to or less than the renewable energy generated on-site. The building can be connected and use the grid as long as on-site energy use is equivalent to or less than the renewable energy generated on-site. [Note: There are varying definitions of Zero Energy/Carbon Buildings. The definition that aligns with Climate Bonds's focus on energy consumption-related emissions is "Net Zero Energy Emissions", where a building produces at least as much emissions-free renewable energy as it uses from emissions-producing energy sources.].

Any renewable energy generated that is not used on-site must be exported to the grid or stored. Any renewable energy certificates related to renewable energy generated on-site must be retired and must not be sold to other parties.

* The required level of improvement in emissions efficiency depends on the bond term.

Additional Details

On-site energy consumption only relates to the parts of a building that an owner has operational control over, consistent with the existing Commercial Buildings Criteria. Climate Bonds adopts the Greenhouse Gas Protocol's definition of operational control: "...has the full authority to introduce and implement its operating policies at the operation". Two example building types are provided below for guidance.

- An office building owner will generally be responsible for "base building" energy consumption relating to heating, ventilation and air conditioning; lifts and escalators; car park lights and ventilation; common area light and power; exterior lighting and signage. Base building consumption excludes energy end uses controlled by the tenant including lighting within tenant areas; tenant power; tenant supplementary cooling; tenant data facilities.
- A hotel building owner will generally be responsible for "whole building" energy consumption, covering the entire scope of energy end uses in a building.

Portfolio application requirements

Such an issuer with multiple projects can aggregate them into one portfolio and it is the aggregated portfolio that must satisfy the required minimum improvement in emissions efficiency rather than each project included in the pool having to comply in its own right.

Post-issuance requirements

For existing buildings, the issuer will need to provide evidence that the building's operational performance is net zero carbon. This may be done through third-party certifications such as the Living Building Challenge Petal Certification's Energy Petal.

For new buildings, the issuer will need to provide technical consultant reports, design documents or similar documentation to demonstrate that the building post-construction will deliver net zero carbon.

Ongoing reporting requirements

Issuers will need to demonstrate evidence on an annual basis that the building continues to be net zero carbon.

If the building misses the net zero carbon target by a small amount and this is attributed to unusual climate conditions for that year, a climate-correction mechanism may be applied to adjust the target. Climate Bonds will then assess the building's performance against this adjusted target. The climate-correction mechanism will apply the methodology adopted by Energy Star in the US or the Department for Business, Energy & Industrial Strategy in the UK. (This mechanism is already included in the existing Buildings Criteria.)

Challenges to application of criteria

The purpose of Climate Bonds Certification is to signal to the market which bonds (and underlying assets and investments) are compatible with limiting global warming to 2 degrees. This signal provides issuers with guidance on what level of performance their assets should deliver, and provides investors with guidance as to what their investment in a Certified Climate Bond is supporting in climate terms.

As described above, there is a simple metric (emissions intensity or gCO2e/m2) that can be used as the foundation of this signal.

However, there are still major hurdles to overcome to establish these zero carbon trajectories (or proxy indicators) using this simple metric. These hurdles mean that it is not yet possible to monitor and assess the buildings sector as a whole to ensure that collectively, the industry is moving in the right direction and at the right speed to ensure the required rapid decarbonisation is achieved. There is a very real danger that ongoing energy efficiency improvements in the building sector may not be sufficiently ambitious and therefore encourage complacency, when in fact the sector is not contributing as it needs to towards the rapid decarbonisation collectively needed.

This may stem from the fact that various market schemes and mechanisms exist in the building sector, that relate to the assets performance at different points in its lifecycle, and have varying requirements and methodologies relating to data collection. These include building codes, post-occupancy performance evaluations, and industry based performance schemes:

- **Building Codes:** Requirements set by national and local building departments dictating minimum construction requirements including fire safety, occupancy density, energy performance requirements, often in the form of individual component requirements. E.g. insulation must have value of R-20. These requirements go into effect during new construction and major renovations. Example: California's Title 24 and ASHRAE 90.1,
- **Post-occupancy Performance Evaluations (or rating systems):** Requirements set during first occupancy or point of sale that dictate post occupancy performance reporting, including energy use, itemization of building characteristics, and potential emissions reporting. Example: Energy performance certificates (EPC), Energy Star, NABERS,
- **Industry Base Certification Schemes:** Voluntary requirements used to help asset owners distinguish their building from others in the market, often in order to increase lease and/or rental value, real-estate value or brand image. These schemes often incorporate both additions to local codes, and regulations over performance reporting. Example: LEED, BREEAM and EDGE certification schemes.

All three types of market mechanisms are potential sources of information or data to establish a zero-carbon trajectory for any given location, or failing that, a proxy indicator for top performers in the market in respect of emissions intensity.

For this reason, the Climate Bonds Initiative has, and continues to, investigate these schemes and mechanisms, to see which are robust enough to use to establish a zero-carbon trajectory and/ or an emissions intensity proxy. This process has identified a number of shortcomings with the majority of existing schemes. The most significant of these are:

- Across these schemes there is a paucity of actual emissions performance data that is sufficiently large and methodologically robust enough from which to derive a representative zero carbon trajectory. While efforts have been made to bring increased levels of standardization to the industry, most notably through ISO 16745 building emissions reporting methodology, and ASHRAE 90.1 Energy Standards, at present, there is little standardization in evidence.
- When then investigating whether these schemes can be used to establish a proxy to identify the top performers in the market, in many cases, good performance against a code, rating system or scheme does not correlate with high performance outcomes in terms of emissions intensity. This is a serious challenge, not just in respect of signals in the market, but more fundamentally, it indicates that the direction that the industry is travelling is not necessarily well-aligned with meeting rapid decarbonisation goals.

These issues are explored further below, with recommendation to address.

5.1. Building codes

Building codes have traditionally relied on a component based approach to implementing demand side management. That is, they focus on regulating individual building components such as minimum levels of insulation, use of double pane windows, etc. Many of them do not currently set minimum energy performance requirements for the "as-built" condition,

and they do not require post-occupancy reporting of energy use or associated emissions productions.

While the regulation of these individual components, should in theory achieve increased level of energy performance and reduced emissions, post implementation analysis of these building codes shows weak correlation between code compliance and a low emissions intensity. This is due to the fact that building components are only as good as their weakest link. For example, the insulation in a wall section may be rated above market standards, but other construction conditions work in tandem to determine the performance of the wall section and subsequently the building as a whole such as thermal breaks, fenestrations, etc.

Building codes have also posed challenging as both baseline data sources and proxies as they have been tranditionally used as a "push" based regulatory policy, wherein very low performing assets in the market are "pushed" into a market average condition.

As "high performance" codes continue to be developed, as in the case of California building code, Title 24, there will be increased opportunity to use these market mechanisms as performance proxies, ultimately helping the issuer identify climate aligned assets.

5.2. Post-occupancy performance evaluations (or rating schemes)

Many countries and cities have begun requiring mandatory reporting of energy and emissions performance for commercial buildings, most notably NABERs is Australia and Local Law 84 in New York City. in the European Union, the European Commission has set guidelines for country level environmental performance certificates (EPCs), requiring an energy audit and energy and emissions benchmarking during the point-of-sale.

Where these evaluations are extensive enough and based on robust methodologies, they can provide sufficiently large and reliable data sets to determine actual emissions performance across the local market.

For example, through the NABERs scheme and data in Australia and Local Law 84 in New York City, the Climate Bonds Initiative has been able to access a sufficiently robust dataset from which to set appropriate zero carbon emissions trajectories in these locations. This has allowed portfolio managers to appropriately tag climate compatible assets with an increased degree of accuracy and precision, and bring them to market in a Certified Climate Bond.

For other locations, the Climate Bonds Initiative has been able to access similar data through institutions which collate it from these members on a voluntarily basis for the purposes of internal improvement and benchmarking amongst participants. This is enabling the first benchmarking of emissions intensity performance in European markets.

However, practically speaking, too few post-occupancy performance evaluations exist which:

- Are sufficiently well adopted to ensure a large data set; and
- Are appropriately targeted on the key metric of emissions intensity performance; and

Are methodologically robust enough to have confidence in emissions intensity data where it is reported; and

- Make this data on emissions intensity performance publicly visible and accessible.

Rather, it is often the case that:

- They do not focus on environmental metrics, but financial metrics such as lease rates and land value. This is particularly true of residential buildings, where reporting on full fuel cycle emissions and energy use are not yet as common. This is most likely due to the cost of measuring and reporting incurred by the homeowner and or the sheer size of the residential sector; or
- They do focus on environmental/ resource performance, they do not measure operational performance directly, instead relying on a component based approach (modeled reporting) which does not link to actual performance. For example, a building will get points for having double pane windows, or having shown proof of renovating the building thermal insulation; or
- They do measure energy use but do not convert this to emissions; or
- They do measure or estimate emissions performance, but using non-standardised reporting methodologies between different building types, and variations in requirements based of reporting date, effecting both the precision of reporting on individual assets between one measure and the next and accuracy of measure vs. actual performance.

- They do measure emissions performance via a robust and stable methodology (e.g. through energy bills), but do not directly use this to determine the resulting the asset rating (which means the rating itself cannot be used as an indicator of relative emissions intensity.)
- Inaccessible due to strict privacy concerns stemming from reputational risk of publicly highlighting poor performing assets

For example, Energy Performance Certificates (EPCs) and equivalent rating schemes outside of Europe have played a major role in Climate Bond's efforts to establish zero carbon trajectories or high-performance proxies. Even with this continued public release of performance data, several challenges have been encountered.

Commercial and residential EPCs require the measurement OR estimation of energy use intensity, most often reported as kWh/meter sq./annum. Specific requirements and methodologies is determined by each country, as a result, country-specific EPCs cover different scopes, some tracking energy use and others tracking building components and theoretical energy efficiency rates. Only a select few EPCs and other performance schemes reviews by Climate Bonds have collected emissions data, the required metric used in the Building Criteria. Depending on the type of building and transaction type at point of sale (new lease, resale, etc), schemes can require either an operational proxy of design proxy.

England and Wales' energy performance certificates (EPC) programme, requires reporting annual energy use, energy use intensity (kWh/sq m/year) and emissions intensity. The challenge when using this data set was determining whether the data set is robust enough to use to determine a zero emissions trajectory. Residential EPC data for England and Wales is composed of data points collected using different methodologies depending on when the data was collected, with the more recently adopted methodology offering much more reliable figures. In order to account for this Climate Bonds had to identify those assets within the dataset measured under the older assessment methodology and ensure that these data points were not distorting the derived zero carbon emissions trajectory.

Sweden's EPC programme only tracks energy use intensity and not emissions intensity. Therefore, although EPC datasets have been fruitful for establishing zero carbon trajectories for the UK residential sector, it is more challenging to use the Swedish data as a foundation for setting appropriate residential zero carbon trajectories in Sweden.

More broadly, this variation across Europe makes it significantly more time consuming and challenging to establish zero carbon trajectories across Europe – lessons cannot be read from country-to-country. In each country, the assessment process must start from scratch to fully understand what the data represents and ensure it is used appropriately.

That said, as evidenced, post-occupancy performance evaluations can be a very useful tool to assess and track emissions performance. What is needed is the promotion of direct tracking of energy and emissions data in a clear and standardised way.

5.3. Industry Certification Schemes

With voluntary performance certificates, it can be difficult to assess the correlation between their rating and emissions performance. In terms of their scope and methodologies, they have adopted many of the same approaches and methodologies as the post-occupancy performance evaluation systems and so are subject to many of the same limitations as identified above. This is most likely due to the fact that these are private schemes are looking to balance market uptake and climate objectives and must make compromises in order to meet current market abilities.

These certifications are often designed around performance tiers, ie certified, silver, gold, platinum as in the case of LEED. These tiers are awarded based on points based systems or multi-criteria decision analysis weighting. While emissions metrics relevant to Climate Bonds are often included, their weight does not correlate with awarded rating. This means, those assets awarded high marks could have achieved this via a range of pathways not relevant to Climate Bonds or emissions / decarbonisation targets more broadly. While the tiers are awarded based on incentivising meaning sustainability outcomes, this more holistic view of sustainability weakens their ability to award climate specific performance.

In addition, the programmes have undergone rapid development in the last several years and certification data has only recently begun to be released for public review. Preliminary assessments of these performance certifications have uncovered weak correlation between awarded certification and emissions performance.

That said, industry based performance certifications have do show promise in their ability to correlate certification with emissions performance. This is most likely due to that the fact that newer versions are beginning to take into account both building regulations and post occupancy direct energy and emissions reporting. Future growth in this area may open up opportunities for Climate Bonds to expand their list of accepted proxies.

Recommendations to policy makers, regulators, and other buildings' data owners or aggregators

Climate Bonds has found that energy and emissions data reporting varies across building codes, post occupancy performance evaluations, and industry certification schemes.

As mentioned above, they generally follow two reporting strategies, operational reporting (direct), and modeled reporting (indirect), with the following characteristics:

- Operational Reporting: stringency is assessed against annual performance, but alignment to carbon efficiency impacts may be limited; and
- Modeled Reporting: stringency is assessed against design measures, relying on a series of assumptions, such as theoretical impact of installing double pane windows, over actually impact on energy consumption, and not operational performance, and therefore they do not always have a good correlation to actual performance.

To increase the availability of appropriate performance data in the buildings sector, the following recommendations are made to policy makers, regulators, and data owners.

To ensure the right metrics are measured and reported on and that these are robust:

- Commercial and residential buildings emissions performance should ideally be directly measured using full fuel cycle reporting standards (kgCO2 and kgCO2/m sq), If gathering data on energy use, ensure relevant data on fuel type and appropriate emissions conversion factors are gathered alongside this.
- New avenues to access this data should be explored. For example, can relationships be established with utility companies to access actual energy and fuel mix data?
- Where modelled reporting continues to be used,

  Post-facto reviews and assessment should be carried out to assess and establish the degree of correlation with emissions intensity performance

  Modelling methodologies should be revised as needed to favour design measures which are strongly correlated with emissions intensity.
- Standardise operational (and modelled) reporting, over jurisdictions and time

To ensure data is widely available:

- Building codes incorporate both minimum energy performance standards (MEPS) and an emissions equivalent into local code. This will ensure both new construction and major renovations incorporate direct operational performance into their buildings.
- All data holders (across buildings codes, post-occupancy performance evaluation and industry certification schemes):

  Make every effort to make publicly available (at least on request) anonymized performance data in its raw, unadjusted form.

  Provide annual reporting on emissions intensity across their datasets, alongside information about the methodologies used
- Industry certification schemes appropriately weight energy and emissions intensity performance in their multi-criteria decision-making approach. This will ensure awarded ranking will more accurately reflect and incentivise emissions performance.

Wide Application of this Work

6.1. Applications to bonds issued by building owners

As described above, these Buildings Criteria focus on the emissions intensity of a building. They can therefore be used to assess the climate-compatibility of an individual building or a portfolio of buildings.

This includes dedicated real estate entities, public and private, such as property developers and property managers who might issue a bond against their real estate portfolio.

In line with this thinking, a number of green bonds have been issued by the real estate sector and the issuers have certified those bonds under the Climate Bond Standard, using compliance with these Buildings Criteria as a means to demonstrate their green credentials to investors.

From the private sector, this includes two bonds from Investa Office Fund in Australia in April 2017 with a total value of US$ 188m, and also in April 2017, a US$ 71m bond from CDL Properties Ltd in Singapore. All of these bonds were issued for a portfolio of commercial buildings. In the public arena, since November 2016, New York State Housing has issued four Certified Climate Bond with a total value of US$ 233m linked to its portfolio of low carbon affordable housing.

However, it also includes any other organization in any sector who owns eligible property that they may wish to put into a green bond. For example, in July 2016, the Treasury Corporation of Victoria (Australia) issued a Certified Climate Bond which included low carbon buildings in its portfolio of assets, alongside wind, solar and low carbon transport assets. Similarly, in December 2016, Monash University in Australia issued a Certified Climate Bond which included low carbon buildings as part of a wider portfolio of assets.

6.2. Applications to bonds issued by the financial sector (securitization & covered bonds)

The Buildings Criteria can also be used to assess the climate compatibility of a range of financial instruments linked to those assets. One clear example here is a portfolio of 'green mortgages'. These could be classified as 'climate-compatible' under these Criteria if the buildings that the mortgages or loans were offered against met the Buildings Criteria, i.e. if the underlying building asset is climate compatible, so are the loans to them.

This opens up another pool of potential green bonds connected to low carbon buildings - those linked to portfolios of mortgages on eligible green buildings.

Securitisation is a financial tool for the aggregation of multiple small-scale loans. It has potential to be widely adopted as a vehicle for pooling low carbon and climate-resilient assets into green investible deals.

Loans for small-scale low carbon assets and projects, such as energy efficiency upgrades, rooftop solar PV and mortgages on low carbon residential buildings, which on their own are too small to gain access to the bond market, can be aggregated and securitised into larger pools to access institutional investor capital. This process gives banks and other primary lenders an opportunity to refinance existing loan portfolios and recycle capital to create a fresh portfolio of green loans.

As an example in practice, Dutch mortgage provider Obvion NV (a subsidiary of Rabobank) issued the first green Residential Mortgage Backed Security, under the Climate Bonds Standard. The "Green Storm" bond, issued in June 2016, for EUR 500m (USD 557m), was backed by a pool of residential mortgages on energy efficient homes as well as houses that had been refurbished to improve energy performance. To demonstrate that these homes met the requirements of the Buildings Criteria, the Climate Bonds Initiative reviewed the Dutch energy performance labels for private homes, approving them as an appropriate proxy for demonstration of compliance with the principles of the Buildings Criteria as outlined in this document.

Dutch mortgage provider, Obvion NV, a subsidiary of Rabobank, issued the first green RMBS (Residential Mortgage Backed Security) in June 2016 called Green Storm. The assets backing the "Green Storm" bond are a mix of energy efficient homes, as well as houses that have been refurbished to improve energy performance.

Since then, in July 2017, Obvion have issued a second RMBS for a further US$ 667m which again was certified under the Buildings Criteria of the Climate Bonds Standard, and there is strong appetite from other banks in a variety of jurisdictions to do likewise, aggregating their mortgages into a portfolio that can be linked to a green bond.

This market will be further strengthened through the work of those like the European Mortgage Federation and European Covered Bond Council, who have launched an Energy Efficient Mortgage Initiative to develop a standardised energy efficient mortgage

based on preferential rates. The idea being explored is that energy efficiency measures give borrowers more disposable income, improving their credit profile, and make properties more valuable. Such a 'green mortgage' product is a prime contender for inclusion in a portfolio for a green or Certified Climate Bond.

Further, covered bonds are an area of burgeoning interest in the financial sector. A covered bond is a bank issued bond with recourse to a cover pool of assets and to the bank. It offers extra security than conventional bank bonds because if the bank goes into insolvency the bondholder has priority recourse to a protected pool of assets – the cover pool.

Berlin Hyp provides commercial real estate financing services in Germany. It issued the a green "Pfrandbrief" (a covered bond particular to German legislation) in 2016. The cover pool was made up of real estate mortgages to buildings that had internationally-recognised certifications. Like RMBS, the Buildings Criteria can be used to assess and certify such a bond – it would be eligible so long as those internationally-recognised certifications were approved as appropriate proxies for demonstration of compliance with the principles of the Buildings Criteria as outlined in this document.

6.3. Applications to equity

Where an organization is a "pure play", i.e. its business is dedicated to real estate or linked financial services, the Buildings Criteria can be used to assess the green credentials of that entity as a whole.

In simplistic terms, the balance sheet of the pure play is full of potentially qualifying assets. An assessment can be made for each of those assets as to whether it meets the requirements of the Buildings Criteria. If all assets meet the requirements of the Criteria, an effective argument can be made that that entity, and therefore any equity investment, is 'climate-compatible'.

If only a portion of the assets meet the Criteria, then a judgement call needs to be made as to whether enough of the assets meet the Criteria to deem the entity itself, and any equity investment, 'climate compatible'.

The Climate Bonds Initiative does not itself make such an assessment, as it focusses on assets only linked to green bonds. But we note that the Buildings Criteria could be used as the first step in this assessment and judgement process.

6.4.Applications to other financial instruments and tools

It is worth noting that as the Buildings Criteria are climate-science driven and focus on the underlying building related asset, they can be applied to guide and screen a range of climate finance and policy decisions.

They could, for example, equally be used to assess not just green bonds, but also green project finance and other debt instruments. Equally, they could be used to assess fiscal support measures such as tax breaks or subsidies. In each case, the key question would be: is the financial support targeted at assets and activities compatible with the zero carbon emissions trajectories established under the Buildings Criteria of the Climate Bonds Standards.

More broadly, they can be used to assess public policy mechanisms and building codes – are these focused on promoting and supporting the development of a buildings sector compliant with the zero carbon trajectories laid out in the Buildings Criteria? Are they then compatible with the Paris Agreement goals?

Likewise, they can inform the extent to which any industry driven evaluation schemes are consistent and compatible with the Paris Agreement – are they focused on reducing emissions to the levels outlined in the Buildings Criteria, and do they appropriate recognize those buildings portfolios and financial service providers that are compatible with these goals?

6.5. Final word

These Buildings Criteria are intended to screen and identify buildings and related financial products that are compatible with the climate targets committed to by the international community through the Paris Agreement. Their focus at the underlying asset level enables their application in a wide variety of financial and policy related contexts.

The Criteria will need to be, and will be, continually reviewed and revised to ensure they reflect the latest climate science and developments in the buildings sector.

What is critical is to ensure that there is consensus around these targets – only this will ensure that they are consistently embedded globally and across the financial, industrial and policy realms.

This needs to be a collaborative exercise. We welcome all engagement to improve, expand and embed these targets.

Appendices

Technical Working Group Members

The Technical Working Group (TWG) is a group of technical and industry experts in the buildings sector, who have been convened by CBI to develop the necessary and appropriate Criteria for the Low Carbon Buildings sector. Having established and launched the Low Carbon Buildings Criteria in 2014, the TWG now focuses its efforts on refining and expanding the Criteria to increase its ease of use as well as its application by bond issuers globally.

List of TWG members for first draft of Criteria:

Asari Efiong, Principal Product Development Manager, Climate Change, European Bank of Reconstruction and Development

Bart Adams, Principal Consultant, DNV Environmental Services

Ché Wall, Director, Flux Consultants

Hilary Elliott, Operations Manager, Centre for Carbon Measurement, National Physical Laboratory UK

Chris Pyke, Vice-President Research, U.S. Green Building Council

Jonathan Pressman, Vice-President, Environmental Markets Markit

Robert Tromop, Sustainable Buildings, International Energy Agency (IEA)

Matthew Deegan, Consultant, Balmain Developments

Niall McCarthy, Executive Director, Eureka Funds Management

Oliver Rapf, Executive Director, Buildings Performance Institute Europe

Peter Sweatman, Chief Executive, Climate Strategy & Partners

Thomas Boermans, Unit Manager (Buildings), Ecofys

Matters Kopp, Head of Low Carbon Business and Finance Sector, WWF

Bettina Medway, Deputy Treasurer, California State Treasurer's Office

Brian Rice, Investment Manager, CalSTRS

Kirsten Spalding, California Director, Investor Network on Climate Risk, CERES

Nigel Topping, Chief Innovation Officer, Carbon Disclosure Project

Simon Brooker, Clean Energy Finance Corporation

Jacob Holcomb, Ecofys

Yamina Saheb, Senior Scientific and Policy Officer, European Commission

Peter Margruber, Siemens

Tooraj Arvajeh, Senior Consultant, Arup

List of TWG members as of 20 Aug 2017:

Ché Wall, Director, Flux Co & Founding Chair, World Green Building Council

Jorge Chapa, Executive Director Market Transformation, Australia Green Building Council

Oliver Rapf, Executive Director, Buildings Performance Institute Europe

Peter Sweatman, Chief Executive, Climate Strategy & Partners

Simon Brooker, Executive Director, Better Buildings Partnership

Christopher Botten (Chris), Programme Manager, Better Buildings Partnership

Panama Bartholomy, Director, Environmental Defense Fund - Investor Confidence Project

John Dulac, Energy Analyst, International Energy Agency

Johannes Kreissig, DNGB (German Green Buildings Council & Thinkstep)

Annie Degen, UNEP FI property group

Lois Moulas, CEO, Observatoire de l'Immobilier Durable

Paolo Zancanella, Officer, European Commission

Teun van den Dries, Founder & CEO, Geophy

Prashant Kapoor, Principal Industry Specialist, IFC

Tatiana Bosteels, Head of Responsible Investment, Hermes

Alan Yates, Technical Director, Sustainability, BRE Group

Robert Cohen, Technical Director, Verco

Alex Rathmell, Director, EEVS Insight

Luis Castanheira, Technical Director, Environmental Defense Fund – Investor Confidence Project

Alexander Hadzhiivanov, Associate Director, Sustainable Resource Investments, Energy Efficiency & Climate Change

Appendix 1: Zero Caron Trajectory Methodology
(See appendices document for additional information)

Appendix 2: High Performance Proxies Methodology
(See appendices document for additional information)

Appendix 3: Term Compliance Methodology
(See appendices document for additional information)

Appendix 4: Significant Upgrade Methodology
(See appendices document for additional information)

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