

Building blocks for the low carbon economy

Managing climate risk in real estate investing



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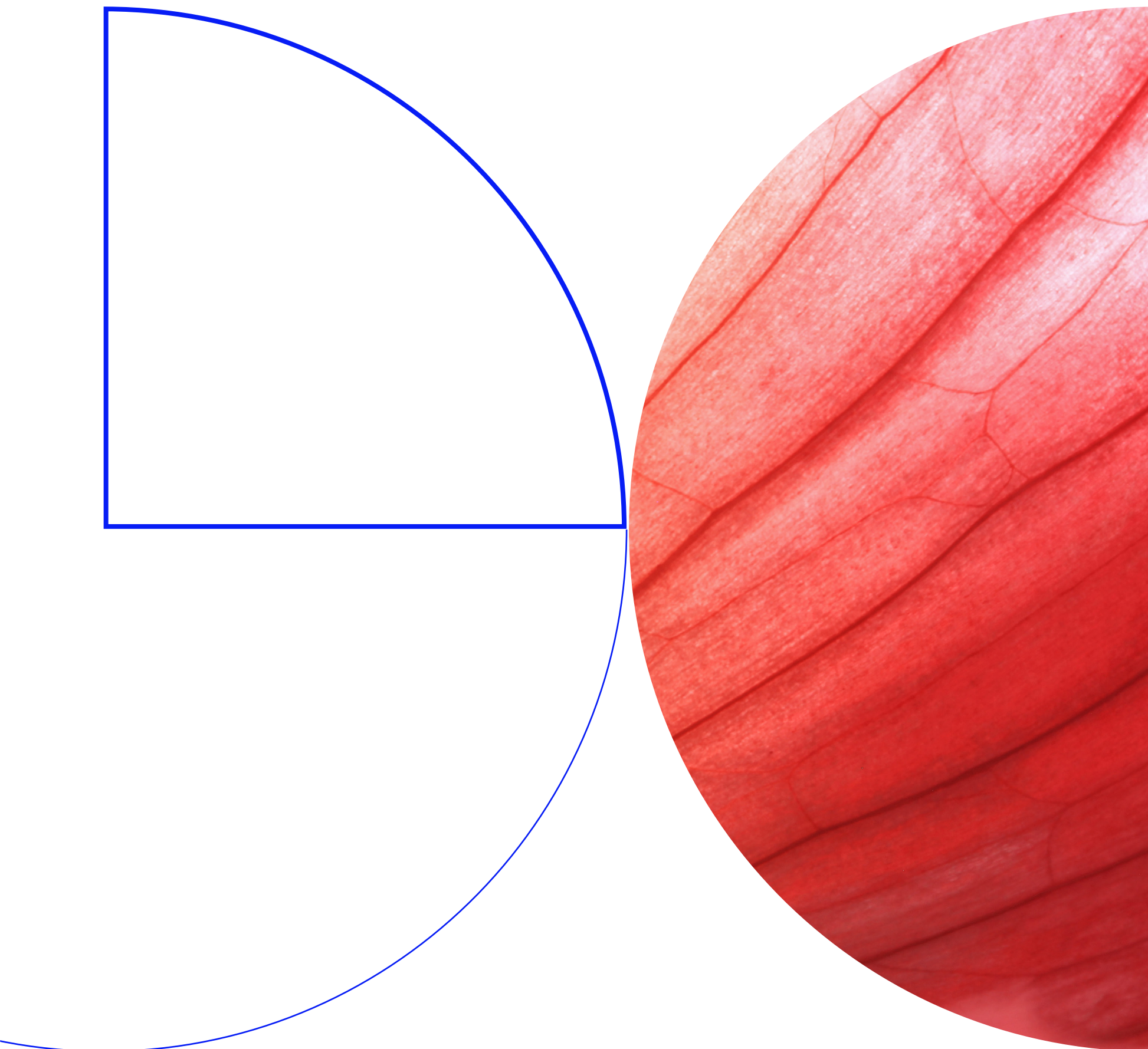




Contents

| | |
|------------------------------------------------------------------------------------------------------------------------|----|
| 01. Executive summary | 3 |
| 02. Section 1 Green real estate: Key building blocks for the low carbon economy | 7 |
| 03. Section 2 Tackling the gap in green real estate investment | 10 |
| 04. Appendix Putting green on the map: A geo-location approach to evaluating real estate sustainability performance | 15 |

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Executive summary

Climate change poses clear and material risks to real estate assets, with the potential to impact return profiles. This paper focuses on listed real estate, which historically has lacked appropriate tools to allow investors to assess their exposure to climate risk and to integrate it effectively in their investment strategies.

Helping to address this gap, the FTSE EPRA Nareit Green Indexes have been developed with data input from GeoPhy, a specialist data provider, and the European and North American real estate associations, EPRA and Nareit. These indexes provide a sustainability-focused extension to the FTSE EPRA Nareit Global Real Estate Index Series, a leading global series of listed real estate benchmarks which are tracked by over US\$340 billion in assets.¹

¹ Data as of December 31, 2017 as reported on April 2, 2018 by eVestment for institutional assets, Morningstar for retail mutual funds, insurance products, and ETFs, and additional passive assets directly collected by FTSE Russell. AUM data includes blended benchmarks and excludes futures and options. Passive assets directly collected by FTSE Russell have been removed from third party sources to prevent double counting. No assurances are given by FTSE Russell as to the accuracy of the data.

Solid ground for sustainable investing

Listed real estate offers investors fertile ground for index-based investment strategies that integrate sustainability concerns alongside financial considerations, due to a combination of:

- A. material exposure to both physical and regulatory climate risk driven by the long-lived, energy-intensive nature of the fixed assets that define the sector. According to UN estimates, buildings account for over half of global electricity usage and about 28% of global carbon emissions²
- B. strong alignment between financial appeal and sustainability credentials of assets, with studies linking better environmental performance to higher asset values, higher occupancy rates, higher rental yield and lower operating costs;³ and
- C. the availability of a range of well-understood, cost-effective options for greening buildings, ranging from better building design and materials to highefficiency heating, cooling and lighting.

Nonetheless, there have so far been limited implementation options available to investors to integrate climate and other sustainability concerns systematically in real estate - a sizeable asset class with an estimated US\$57 trillion in income - generating holdings.⁴

2 UN Environment, 'Towards a zero-emission, efficient, and resilient buildings and construction sector', 2017.

3 Eichholtz, Kok, and Quigley, 'The Economics of Green Building', *Review of Economics and Statistics*, 95(1), 2013, 50-63; Fuerst and McAllister, 'Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Values,' *Real Estate Economics*, 39(1), 2011, 45-69; Miller, Spivey, and Florance, 'Does Green Pay Off?', *Journal of Real Estate Portfolio Management*, 14(4), 2008, 385-400.

4 LaSalle Investment Management, 'The Real Estate Investment Universe in 2018'.

Building “bottom-up”, asset level data

A lack of comprehensive data is among the primary roadblocks. At the asset level, investors are faced with a hard-to-navigate array of competing green certification schemes with limited coverage. Among listed real estate companies, less than half disclose carbon emissions data for their portfolio;⁵ and only one in five is currently able to collect and disclose asset-level data for 100% of their holdings.⁶

To address this challenge, an alternative approach has been taken in the design of the FTSE EPRA Nareit Green Indexes. The sustainability performance of index constituents is assessed using data on the individual holdings in their property portfolios. Drawing on a geolocation database of over 15 million buildings from GeoPhy, circa 73,000 individual buildings with over 1 billion sq m of combined floor space are mapped. These cover real estate holdings for 93% of the constituents of the FTSE EPRA Nareit Developed Index (see appendix). This data is then matched with green certification data and provides the basis for detailed, building-by-building energy use and carbon modeling.

Expanding the toolbox: Introducing the FTSE EPRA Nareit Green Indexes

This data is aggregated to create portfolio level metrics that provide a timely, consistent and highly granular assessment of the sustainability performance of each index constituent across three key metrics: the share of green certification as a percentage of total net leasable area; and the average energy use and carbon emissions per square meter of net leasable area. The latter two are estimated using detailed building-by-building modeling, based on characteristics such as location, age, and refurbishments (see appendix).

These green certification and energy use metrics are applied to the index as ‘tilts’ to adjust the weights of constituents in the parent index, the FTSE EPRA Nareit Developed Index. This overweighting of more energy efficient constituents and green certification significantly improves the climate and sustainability characteristics of the index. Compared to the parent index, floor space with eligible green certification increases by 63%, while carbon emissions per dollar of revenue drop by 40%. The financial characteristics of the index change only modestly, with the green version outperforming the parent index by 1% p.a. and producing 2.3% tracking error p.a. in three year historical simulations (2015-18).

To meet a variety of investor preferences, an alternative version of the index is also offered, which focuses on limiting tracking error to the parent (0.72% p.a. in three year historical simulations, 2015-18), by minimizing active sector and country weights. This version also provides notable sustainability improvements, with green certification increasing by 24%, and a 22% reduction in carbon emissions per dollar of revenue.

Compared to the parent index, floor space under green certification increases by 63%, while CO2 emissions per dollar of revenue drop by 40%.

⁵ FTSE Russell analysis, as of Q4 2017.

⁶ 2018 GRESB Real Estate Results.

FTSE EPRA Nareit Global Real Estate Index Series

Launched in 2009, the FTSE EPRA Nareit Global Real Estate Index Series is designed to represent the performance of eligible listed real estate stocks worldwide, including REITs and other companies involved in the ownership and development of income-producing real estate. It is the global market leader, tracked by over US\$340 billion of benchmarked assets.⁷ These indexes are calculated and overseen in partnership with the leading European and North American real estate associations, EPRA and Nareit.



⁷ Data as of December 31, 2017 as reported on April 2, 2018 by eVestment for institutional assets, Morningstar for retail mutual funds, insurance products, and ETFs, and additional passive assets directly collected by FTSE Russell. AUM data includes blended benchmarks and excludes futures and options. Passive assets directly collected by FTSE Russell have been removed from third party sources to prevent double counting. No assurances are given by FTSE Russell as to the accuracy of the data.

Section I

Green real estate: Key building blocks for the low carbon economy

The energy and resource-intensive nature of real estate...

Greening the real estate sector is a major challenge for the transition to a more sustainable, low carbon economy. Buildings account for some 28% of global carbon emissions,⁸ over 10% of potable water consumption,⁹ and over half of global electricity usage.¹⁰ Heating, cooling and lighting make up roughly 60% of energy usage in buildings; with appliances and other miscellaneous uses accounting for the remainder.¹¹

The rapid global expansion of the built environment adds to these pressures - the UN estimates that over the next 40 years, buildings with an area equivalent to Paris will be constructed every single week.¹² Construction already uses an estimated 3 billion tonnes of raw materials annually.¹³ It is the world's biggest consumer of steel and copper and the principal application for concrete – which, after water, is the second most consumed substance on earth.¹⁴ These resources in turn are often energy and carbon intensive to produce. For example, cement production alone accounts for 8% of global carbon emissions.¹⁵

8 UN Environment, 'Towards a zero-emission, efficient, and resilient buildings and construction sector', 2017, p. 16.

9 McGraw Hill Construction, 'Green Outlook', 2011, estimates 12% water consumption in buildings for the US.

10 International Energy Agency, 'Digitalization and Energy' 2017, p. 42.

11 Ibid.

12 UN Environment, 'Towards a zero-emission, efficient, and resilient buildings and construction sector', 2017.

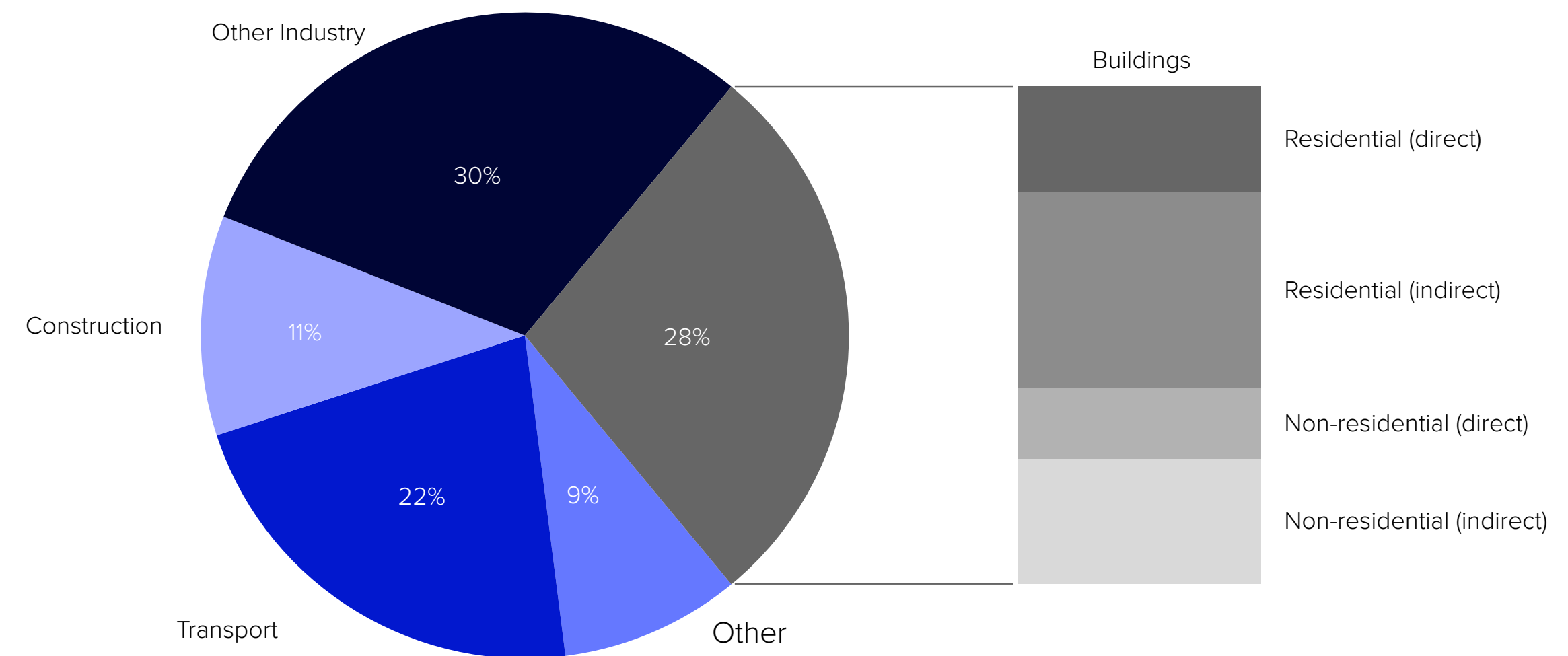
13 World Economic Forum, 'Environmental Sustainability Principles for the Real Estate Industry', 2016

14 Lehne and Preston, 'Making Concrete Change: Innovation in Low-carbon Cement and Concrete', June 2018.

15 Ibid.

16 UN Environment, 'Towards a zero-emission, efficient, and resilient buildings and construction sector', 2017.

Figure 1: Share of global energy-related CO2 emissions by sector, 2015



Source: UNEP, 2017.¹⁶

...creates risks for investors as the low carbon transition accelerates...

This makes real estate a key part of the economy for achieving ambitious global emission reduction targets, creating significant policy risk for investors in the sector. To keep global warming below 2 degrees as mandated by the Paris Agreement, the real estate sector will need to reduce total CO2 emissions by 36% by 2030, according to estimates from the World Bank.¹⁷

As policy makers seek ways to accelerate emission reductions, buildings with poor environmental performance face growing regulatory risks that could substantially reduce their asset value and liquidity. The UK has already outlawed the letting of residential or commercial buildings with F or G rated energy performance certificates (EPC),¹⁸ whilst the Netherlands plans to prohibit the use of office buildings with ratings below EPC label C by 2023.¹⁹ In California, recent legislation seeks to reduce the energy use in buildings by 20% by 2030 versus 2015.²⁰ Singapore currently requires newly developed properties to be certified, and aims to have 80% of its building stock (excluding logistics and industrial facilities) certified by 2030.²¹

...but also opportunities, with investment and sustainability objectives often aligned

Large-scale emission reductions pose a significant challenge for a sector that is defined by long-lived, energy-intensive fixed assets. However, in contrast to some other carbon intensive industries, the real estate sector benefits from a range of cost-effective, well-understood solutions to reduce energy use and achieve carbon savings.

Comprehensive decarbonization may require sweeping changes, including the redesigning of cities or deploying novel types of construction materials; but substantial sustainability improvements can be achieved through routine measures such as energy-efficient design or state-of-the-art insulation. For example, in one recent study, LEED office buildings had on average a 13% lower site energy use intensity, 11% lower electricity usage, and 16% lower water usage when compared to non-LEED certified office buildings.²² Existing buildings can achieve similar sustainability performance gains through retrofitting and refurbishing.²³ The latter is particularly relevant in mature economies, with UNEP estimating that for OECD countries, 65% of the total expected buildings stock in 2060 has already been built.²⁴

Meanwhile, real estate investors often have a vested interest in driving such environmental performance improvements, with sustainability concerns and investment objectives appearing particularly well aligned in the sector. Indeed, there is a growing body of evidence suggesting that strong sustainability performance contributes to better branding and higher asset values in the sector; with several recent studies tying greener buildings to higher occupancy rates, higher rental values and reductions in operating costs.²⁵

17 World Bank, as cited in World Economic Forum, 'Environmental Sustainability Principles for the Real Estate Industry', 2016.

18 UK Government's Minimum Energy Performance Standards (MEPS)

19 JLL, 'The upcoming EPC regulation for buildings in the Netherlands', June 2018.

20 California Energy Commission, 'Existing Buildings Energy Efficiency Action Plan'.

21 Singapore, *Code for Environmental Sustainability of Buildings*.

22 'USGBC, 'Do LEED Buildings Perform? Indeed They Do!', 2014.'

23 National Trust for Historic Preservation, 'The Greenest Building: Quantifying the Environmental Value of Building Reuse' 2011, p. iv.

24 UN Environment, 'Towards a zero-emission, efficient, and resilient buildings and construction sector', 2017, p. 8.

25 Eichholtz, Kok, and Quigley, 'The Economics of Green Building', *Review of Economics and Statistics*, 95(1), 2013, 50-63; Fuerst and McAllister, 'Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Values,' *Real Estate Economics*, 39(1), 2011, 45-69; Miller, Spivey, and Florance, 'Does Green Pay Off?', *Journal of Real Estate Portfolio Management*, 14(4), 2008, 385-400.

The real estate sector benefits from a range of cost-effective, well-understood solutions to reduce energy and achieve carbon savings.

Real estate: The world's largest asset class

Real estate is the world's largest asset class with an estimated value of US\$280 trillion in 2017 – more than the value of all bonds and equities combined.²⁶ However, only c. US\$57 trillion of this is income-producing real estate²⁷ that is tradeable between investors given significant owner occupation; particularly in residential real estate that makes up the lion-share of this asset class.

Rather than owning buildings directly, investors can also get exposure through real estate companies, of which over 2,200 with a combined market value of over US\$3.3 trillion are listed, worldwide.²⁸ These companies provide exposure to a portfolio of real assets; offering diversification and liquidity without requiring investor involvement in their management. Investors can identify assets within the real estate sector through indexes, such as the FTSE EPRA Nareit Global Real Estate Index Series.

While real estate still makes up only a relatively small part of overall allocations for most institutional investors, it has been steadily gaining importance as an alternative asset class. PwC estimates that real estate allocations have been growing at approximately twice the rate of global assets under management (AUM);²⁹ with studies suggesting that the asset class now accounts for anywhere between 1.5% and 5% of global funds assets.³⁰

Rather than owning buildings directly, investors can also get exposure through real estate companies, of which over 2,200 with a combined market value of over US\$3.3 trillion are listed, worldwide.

26 Savills World Research, 'The Future of Global Real Estate', 2018.

27 LaSalle Investment Management, 'The Real Estate Investment Universe in 2018'.

28 Nareit, as of October 25, 2018; 'EPRA Total Markets Table Q3 2018' (<https://www.reit.com/data-research/data/reits-numbers>).

29 Based on LSEG analysis of data within PwC, 'Asset & Wealth Management Revolution', 2017.

30 Andonov, Eichholtz, and Kok, 'Intermediated Investment Management in Private Markets: Evidence From Pension Fund Investments in Real Estate', 2014, p. 4.

Section 2

Tackling the gap in green real estate investment

In response to these challenges, investors, and large asset owners in particular, have begun to set increasingly ambitious sustainability targets across their asset allocations. Nonetheless, compared to other asset classes like equities and bonds, there are limited tools available today to help investors to systematically factor in climate and other sustainability concerns into large real estate investment portfolios.

A lack of data is a key roadblock to green real estate investing

A lack of comprehensive data to evaluate the sustainability performance of holdings has been among the primary roadblocks faced by investors attempting to integrate climate considerations more effectively into real estate investment strategies. Benchmarking initiatives and various green certification schemes have made critical contributions in stimulating better disclosure in the real estate sector. Despite an increased number of real estate companies disclosing on their sustainability performance, investment-grade data is still not widely available to investors.

At the individual property level, efforts have largely focused on the development of green certification schemes, which have expanded rapidly following their introduction in the 1990s in Europe and the US. A recent study estimates that almost 20% of office floor space across 10 developed markets in Australia, Canada and Europe is now certified as 'green', versus just 6.4% in 2007.³¹ LEED, the world's most widely used certification system, now reports certifying 2.4 million square feet of floor space per day, with more than 94,000 certified projects in 165 countries.³² BREEAM, another leading green certification scheme, reports having issued over half a million certificates across 79 countries.³³

The proliferation of large numbers of competing, mainly voluntary standards with limited coverage has, however, made it difficult to apply this data systematically as part of investment strategies.³⁴ These challenges are compounded at the portfolio level, especially where this involves comparisons across different types of real estate in multiple countries.

31 CBRE and Maastricht University, International Green Building Adoption Index, 2018.

32 LEED website, as of November 1, 2018 (<https://new.usgbc.org/leed>).

33 BREEAM website, as of November 1, 2018 (<https://www.breeam.com/>).

34 IPE Real Assets, 'The future of green building ratings', June 2018.

While real estate companies have made tangible progress with disclosing increasingly comprehensive, portfolio-level sustainability metrics, large coverage gaps remain. Market leaders now disclose third-party assured, portfolio-level data on carbon emissions; energy consumption; water consumption; waste generation; and green certified properties.³⁵ However, such data is still not available for many companies, with less than half of the largest 50 constituents of the FTSE EPRA Nareit Developed Index by market capitalization reporting carbon emissions.³⁶

Expanding the toolbox: A bottom-up, asset-by-asset approach

To address this challenge, FTSE Russell has taken an alternative approach, and assesses the sustainability performance of index constituents using data on the individual holdings in their property portfolios. Drawing on a geo-location database of over 15 million buildings from GeoPhy, over 73,000 individual buildings with over 1 billion sq m of combined floor space (excluding single-family rental homes) have been mapped. These cover real estate holdings for 93% of the constituents of the FTSE EPRA Nareit Developed Index (see appendix).

Matching this data with green certification data provides the basis for detailed, building-by-building energy use and carbon modeling. Information about a property's location and other specifications such as age, building type and size is combined with data on local energy markets to estimate expected energy use. To assess carbon intensity, this modeled energy use data is combined with the associated carbon intensity of the utility grid to create an approximation of carbon emissions.

This data is aggregated to create portfolio-level metrics that provide a timely, consistent and highly granular assessment of the sustainability performance of each index constituent across three key indicators:

1. Share of the total net leasable area covered by eligible green building certification³⁷
2. Average estimated energy use per square meter; and
3. Average estimated greenhouse gas emissions per square meter

Index reweighting proceeds only based on two of these metrics: green certification and estimated energy use data. The estimated carbon emissions are reported but are not actually used in the tilting process. A carbon metric might appear as an intuitive choice, but is heavily influenced by the energy mix of the country in which a specific asset is located. In practice, this would act as an unintended country reweighting and would increase exposure to countries with a low-carbon energy mix (e.g. France), at the expense of countries with higher carbon intensities (e.g. the US).

For similar reasons, energy use is normalized over floor space rather than alternatives such as revenue. This avoids overestimating the sustainability performance of assets in higher cost locations (e.g. San Francisco) versus lower cost locations (e.g. Berlin).

³⁵ Nareit, Leader in the Light Awards, 2018.

³⁶ FTSE Russell analysis, as of Q4 2017. A lack of standardized reporting also makes these disclosures hard to compare. In its 2018 Real Estate Assessment Results, GRESB found that only one in five companies is currently able to collect and disclose asset level data for 100% of their portfolio. Less than half of these disclosures were aligned with a standard, such as GRI or EPRA, and less than 30% provided third-party assurances.

³⁷ See the Appendix for a full list of eligible green certification schemes.

To assess the sustainability performance of index constituents, over 73,000 individual buildings with over 1 bn sq m of combined floor space are mapped.

The FTSE EPRA Nareit Green Indexes

These metrics are applied as 'tilts' using FTSE Russell's multi-factor approach³⁸ to develop two innovative, sustainability-focused alternatives to the FTSE EPRA Nareit Developed Index - part of the world's leading real estate index series tracked by over US\$340 billion in benchmarked assets. These green indexes adjust the weights of constituents to increase exposure to those with real estate portfolios, demonstrating strong sustainability performance characteristics and reducing exposure to those constituents with a less sustainable asset base.

This overweighting significantly improves the climate and sustainability characteristics of the indexes. For the FTSE EPRA Nareit Developed Green Focus Index, floor space under eligible green certification increases by 63%, while carbon emissions per dollar of revenue drop by 40%. The financial characteristics of the index changed only modestly, with the green version outperforming the parent index by 1% p.a. and producing 2.3% tracking error p.a. in three year historical simulations (2015-18).³⁹

To meet a variety of investor preferences, an alternative version is also offered - the FTSE EPRA Nareit Developed Green Index. This focuses on limiting tracking error to the parent (0.72% p.a. in three year historical simulations, 2015-18), by minimizing active sector and country exposure. This version also provides notable sustainability improvements, with green certification increasing by 24% and carbon emissions per dollar of revenue down 22% compared to the parent.⁴⁰

These indexes, and possible alternative configurations, can support investors in effectively integrating climate and sustainability concerns into their passive real estate investment portfolio. The multi-factor methodology creates flexibility to cater both for those willing to accept active sector or regional weights to maximize sustainability gains and those for whom sustainability goals must be incorporated within a tracking error budget.

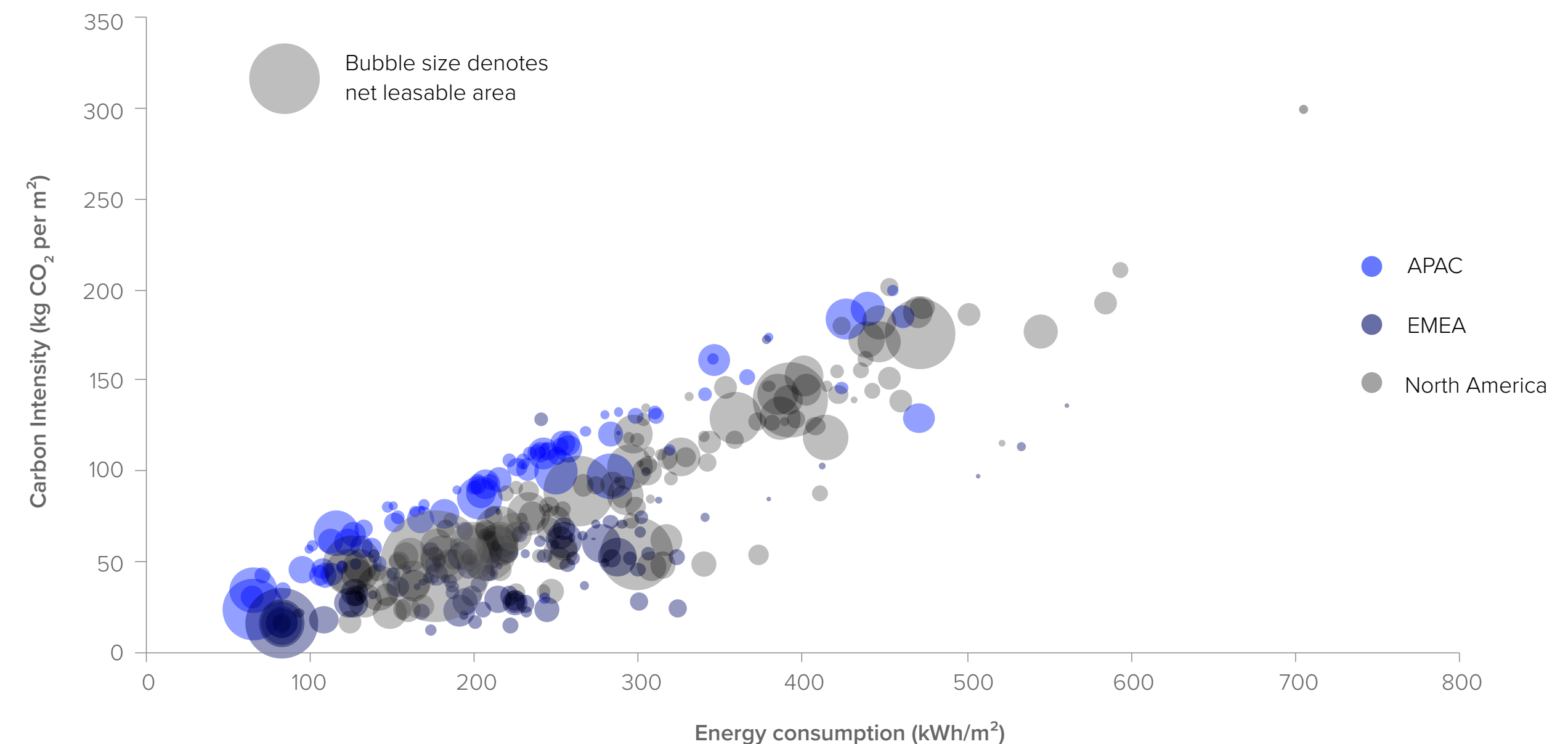
38 For more information, see FTSE Russell, 'Multi-factor indexes: The power of tilting', 2017 and FTSE Russell, 'Factor Exposure and Portfolio Concentration', 2017.

39 FTSE Russell, data as of September 25, 2018. Past performance is no guarantee of future results. Data for the FTSE EPRA Nareit Developed Green Focus Index is hypothetical, historical data. Please see the end for important legal disclosures.

40 FTSE Russell, data as of September 25, 2018. Past performance is no guarantee of future results. Data for the FTSE EPRA Nareit Developed Green Focus Index is hypothetical, historical data. Please see the end for important legal disclosures.



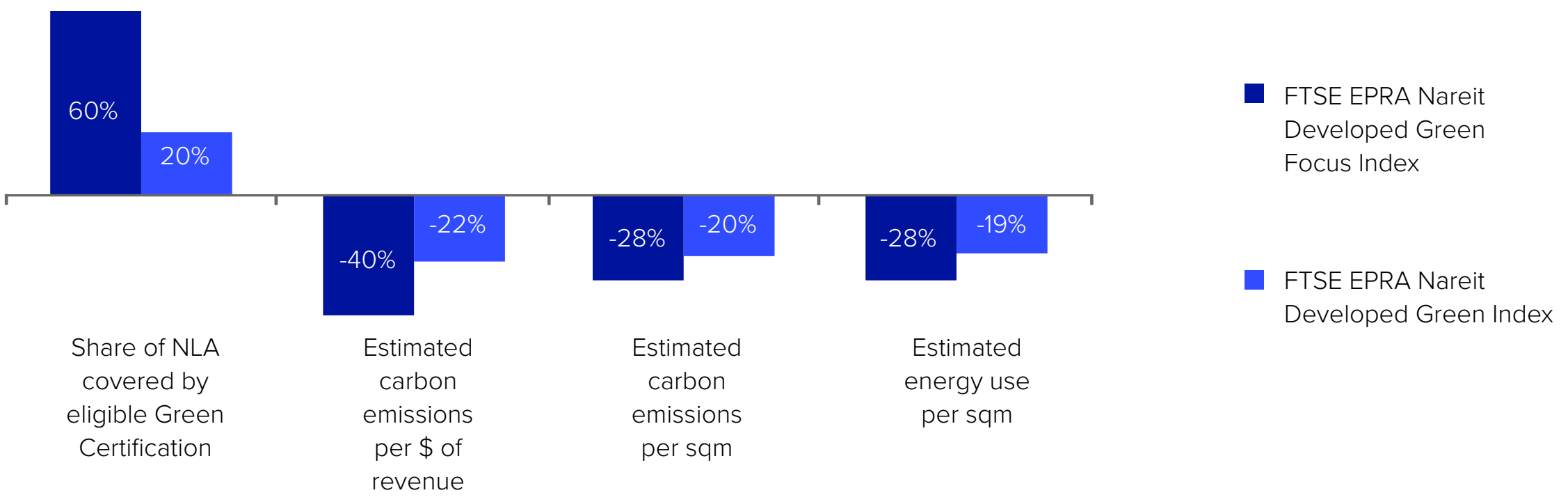
Figure 2: Estimated energy use and ghg emissions of ftse epra nareit developed green index constituents (2017)



Source: FTSE Russell analysis. Average of data for the period Q1-Q4 2017. EMEA denotes Developed Europe; APAC denotes both Developed APAC ex Japan and Japan.

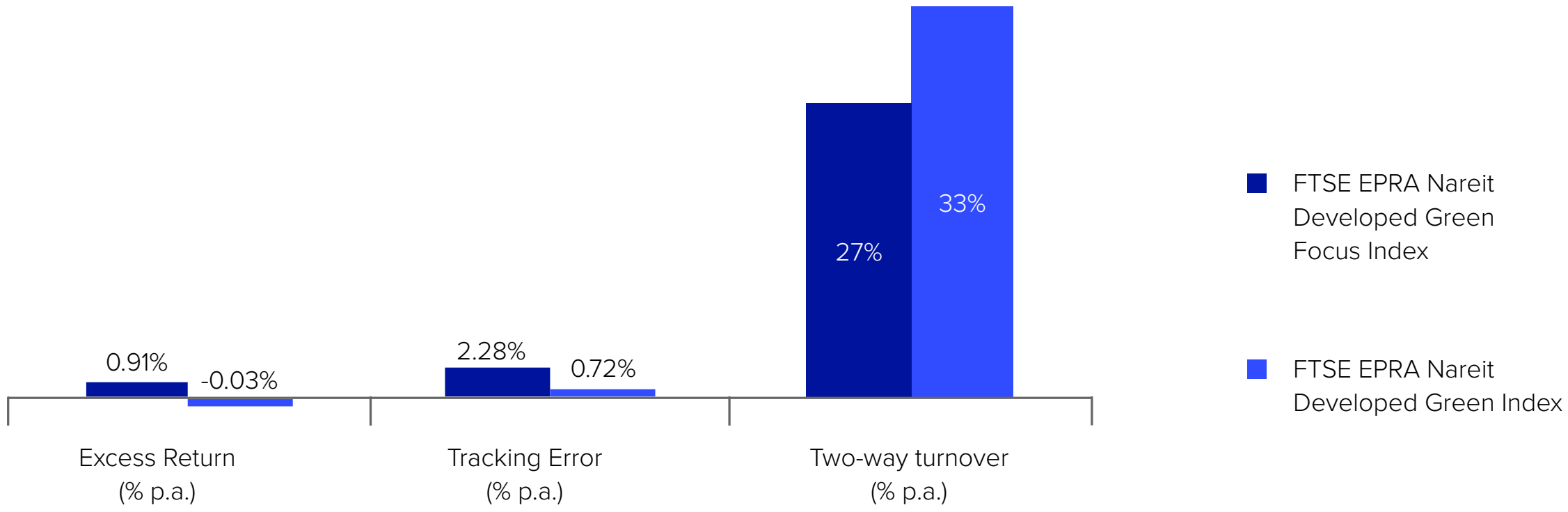
FTSE EPRA Nareit Green Indexes: Delivering material sustainability savings, whilst retaining a similar return profile to their benchmark

Figure 3: Index level sustainability performance vs. benchmark



Source: FTSE Russell analysis. Performance data from Sept 2015- 2018. Index weights as of September 25, 2018. Past performance is no guarantee of future results. Returns shown reflect hypothetical historical performance. Please see the end for important legal disclosures.

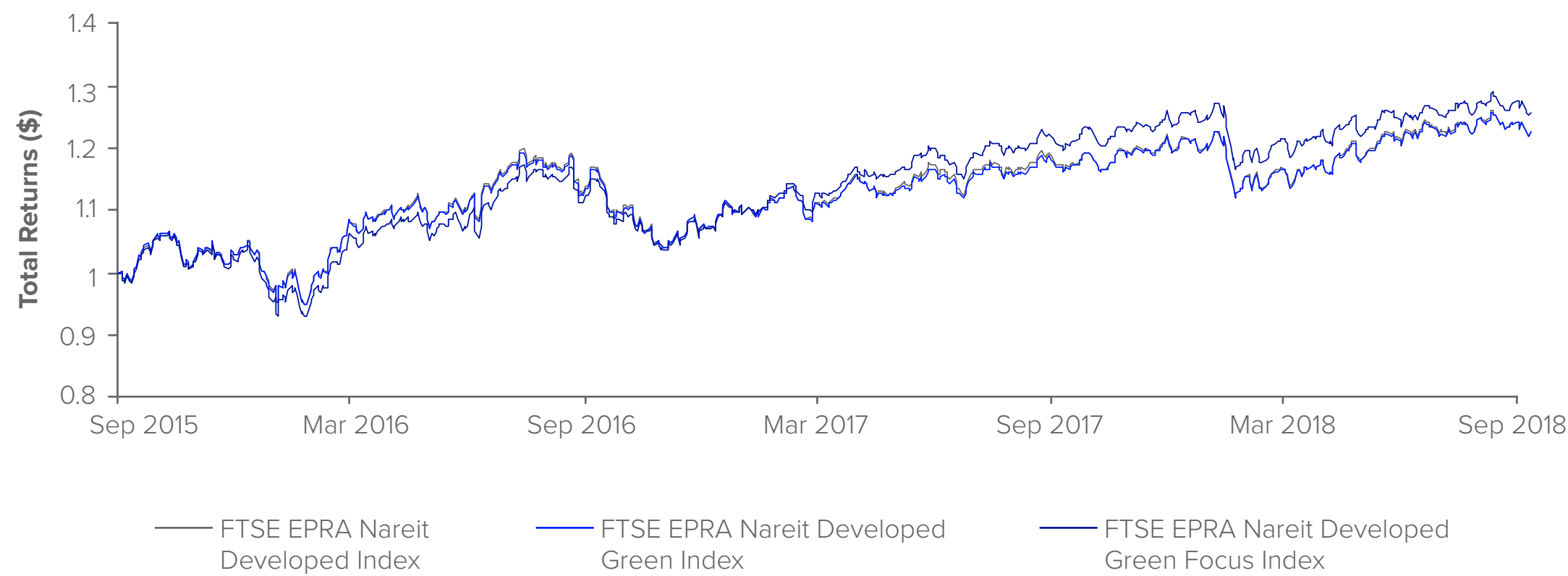
Figure 4: Index level financial performance vs. benchmark



Over a 3-year simulation period, the Green Focus Index achieves +91 bps p.a. relative performance

With lower tracking error, Green Index largely maintains sector and region weight vs. the benchmark

Figure 5: Total returns for the Green Index and Green Focus Index vs. benchmark



Source: FTSE Russell analysis. Performance data from Sept 2015- 2018. Index weights as of September 25, 2018. Past performance is no guarantee of future results. Returns shown reflect hypothetical historical performance. Please see the end for important legal disclosures.

Figure 6: Industry weights

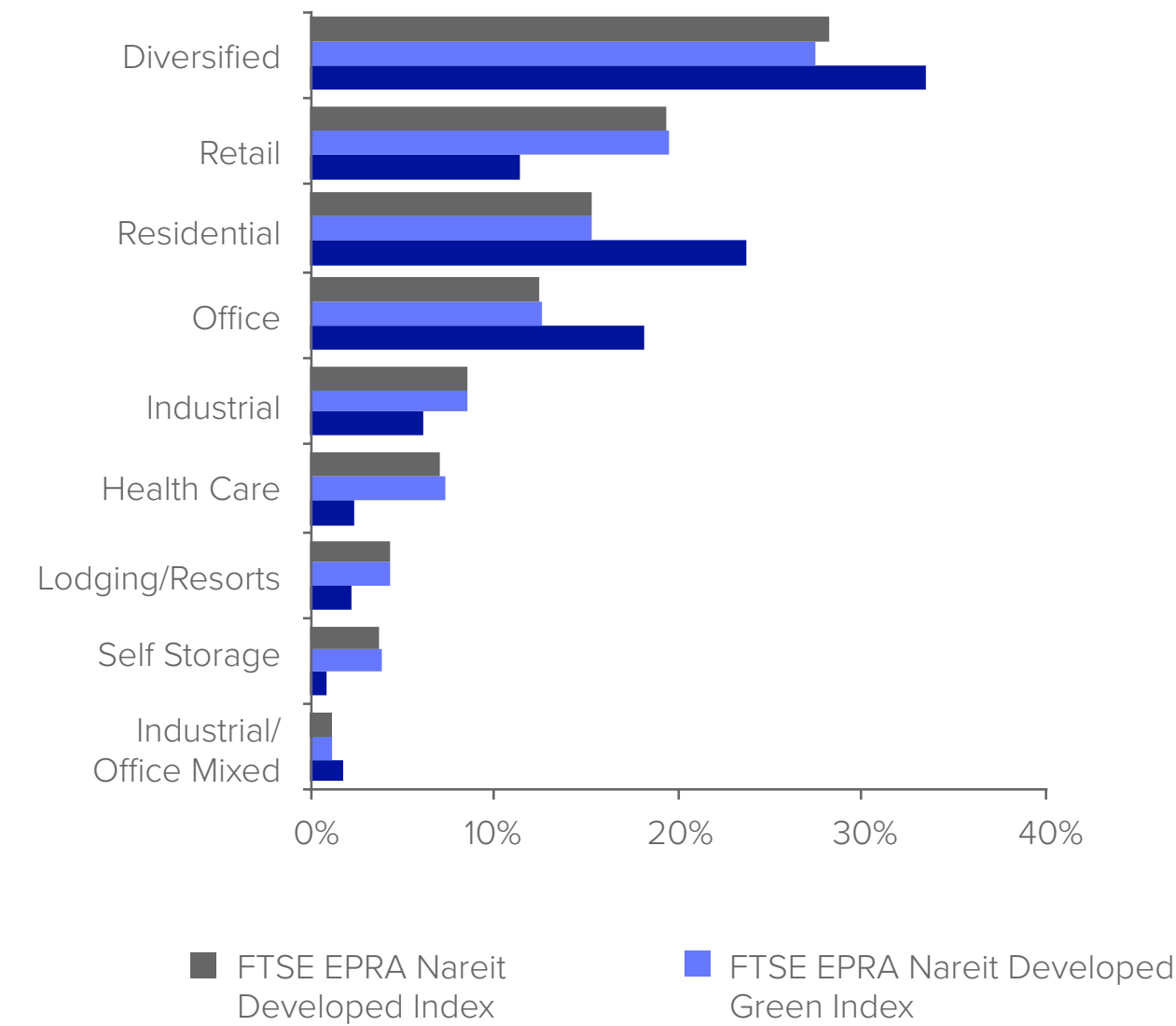
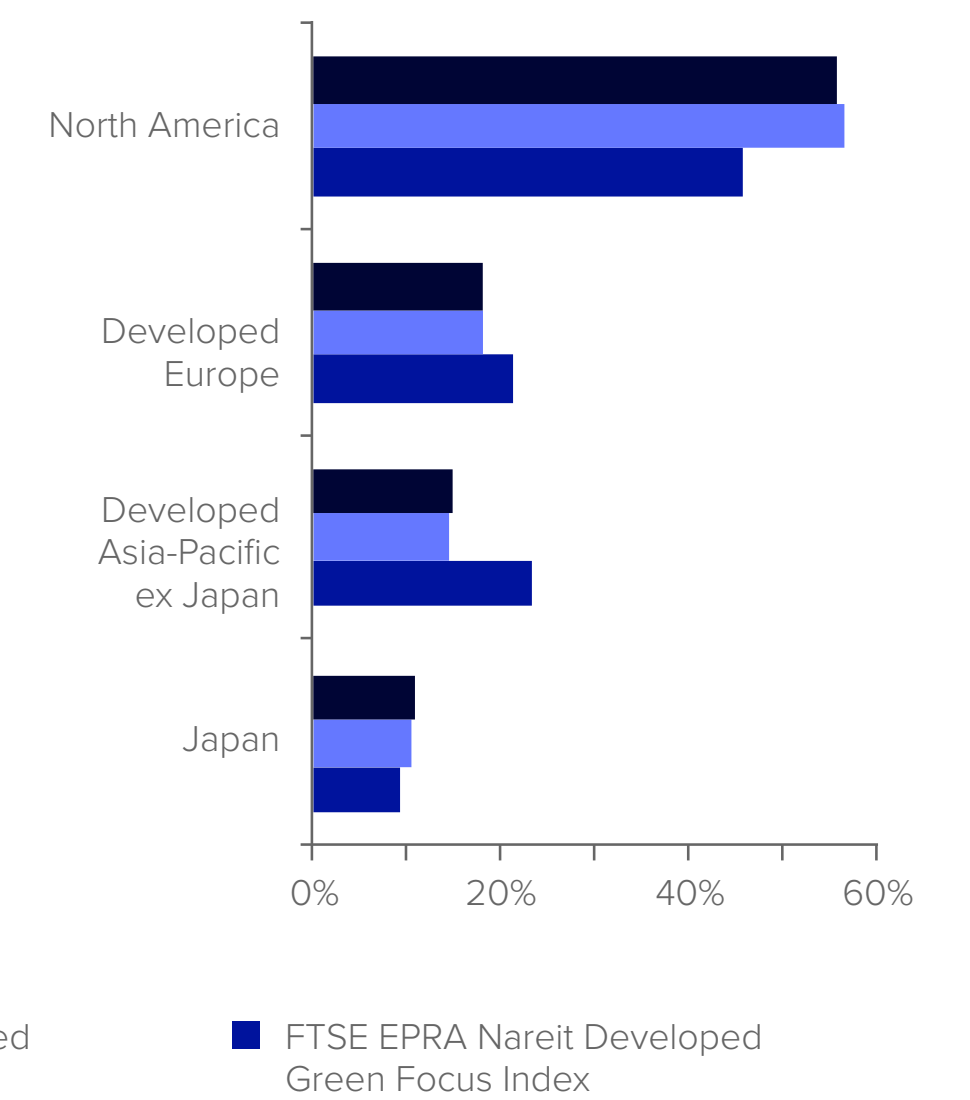


Figure 7: Regional weights



APPENDIX

Putting green on the map: A geo-location approach to evaluating real estate sustainability performance

The FTSE EPRA Nareit Green Indexes are underpinned by a consistent, granular dataset developed by GeoPhy that assesses the sustainability performance of individual buildings. Drawing from a range of sources, this dataset uses a geolocation approach to identify the individual real estate assets in each index constituents' portfolio. In the first quarter of 2018, this dataset provided coverage of 93% of index constituents, up from 85% in the first quarter of 2015.

Geolocation data is then enriched with building characteristics data, drawn from various sources and mapped to green certifications data. Building specific data is finally combined with information on local energy use, energy mix and grid carbon intensity data to model a property's individual energy usage and carbon footprint.

Building an asset-level picture of a real estate portfolio

An asset-level profile of each constituent's real estate portfolio is constructed from a range of public sources (such as annual reports, 10-K and 10-Q filings), and enriched with building attributes and financial features (see appendix A for an overview of the individual characteristics and data sources). This provides coverage of 312 constituents of the FTSE EPRA Nareit Developed Index for the first quarter of 2018, with a total of 73,713 assets (excluding single-family rental homes), covering over 1 billion square meters of net leasable area.⁴¹

The building attributes data is derived from a variety of sources – in particular county tax records and national land registries – and focuses on basic attributes, such as building name, address, property type, building size (area/units), number of floors, year of construction, year of renovation and the presence of building amenities, such as on-site retail and food & beverage facilities. In cases where multiple sources of data are available for a single property, different inputs are triangulated into a single observation. Where available, financial metrics, such as net operating income, rent roll, past sales transactions and ownership structure are also sourced.

⁴¹ GeoPhy analysis.

Assessing data quality

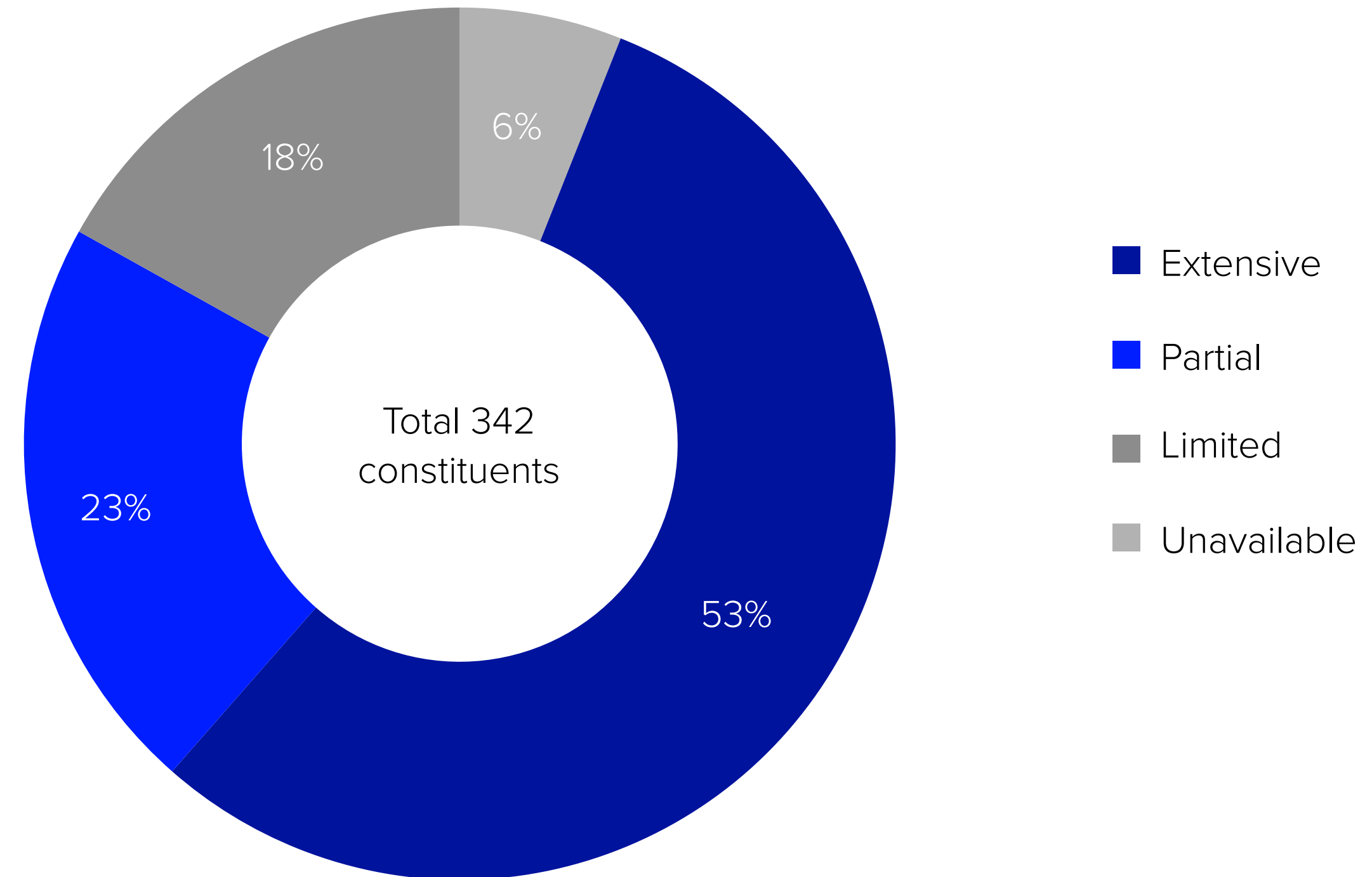
The level of detail that is available on asset-level holdings differs across individual constituents. To reflect this variation in asset-level data, the quality of disclosures is classified for each constituent as extensive, partial, or limited. Typically “extensive” disclosure consists of property level reporting in official reports (e.g. 10-K or similar). “Partial” disclosure indicates incomplete disclosure, whilst companies with “limited” disclosure generally only report at a portfolio level. A small number of constituents, such as some single-family property companies, do not disclose any details about the location and characteristics of the asset in their portfolio (see figure 8).

In cases where there are disclosure gaps, a high-quality hybrid view of the assets owned by each company is constructed. For example, where address data is missing, other data about a building (for example, tenant information, nearby buildings) is manually retrieved. In addition, a building address can be approximated if information is available on street, city, or region. In the case of missing building net-leasable area (i.e. size), this can be estimated in several ways:

1. Where area per building is not provided at an asset-level, but total portfolio area is documented (total footprint or total per property type), the total area is divided by the number of buildings in a portfolio.
2. Where there is no total area disclosed, but information on the number of units is available, average size per unit (from additional sources) is used to calculate area.
3. Where there is no disclosure on the number of units and total area of a building, but information is provided on other buildings in the portfolio, data can be extrapolated using advanced imputation methods.



Figure 8: As of Q1 2018, data coverage is provided for 93% of constituents of the FTSE EPRA Nareit Developed Index



Source: FTSE Russell.

Layering in sustainability: Green certifications

To add sustainability attributes to this asset-level dataset, existing eligible green certifications are mapped to the individual properties using GIS (Geographic Information System) mapping. Geocodes are generated based on addresses and building names, and compared to the list of certified buildings obtained directly from green certification schemes. This procedure is fully automated, with manual checks on non-perfect matches (i.e. buildings that are very close to each other, but not exactly at the same location).

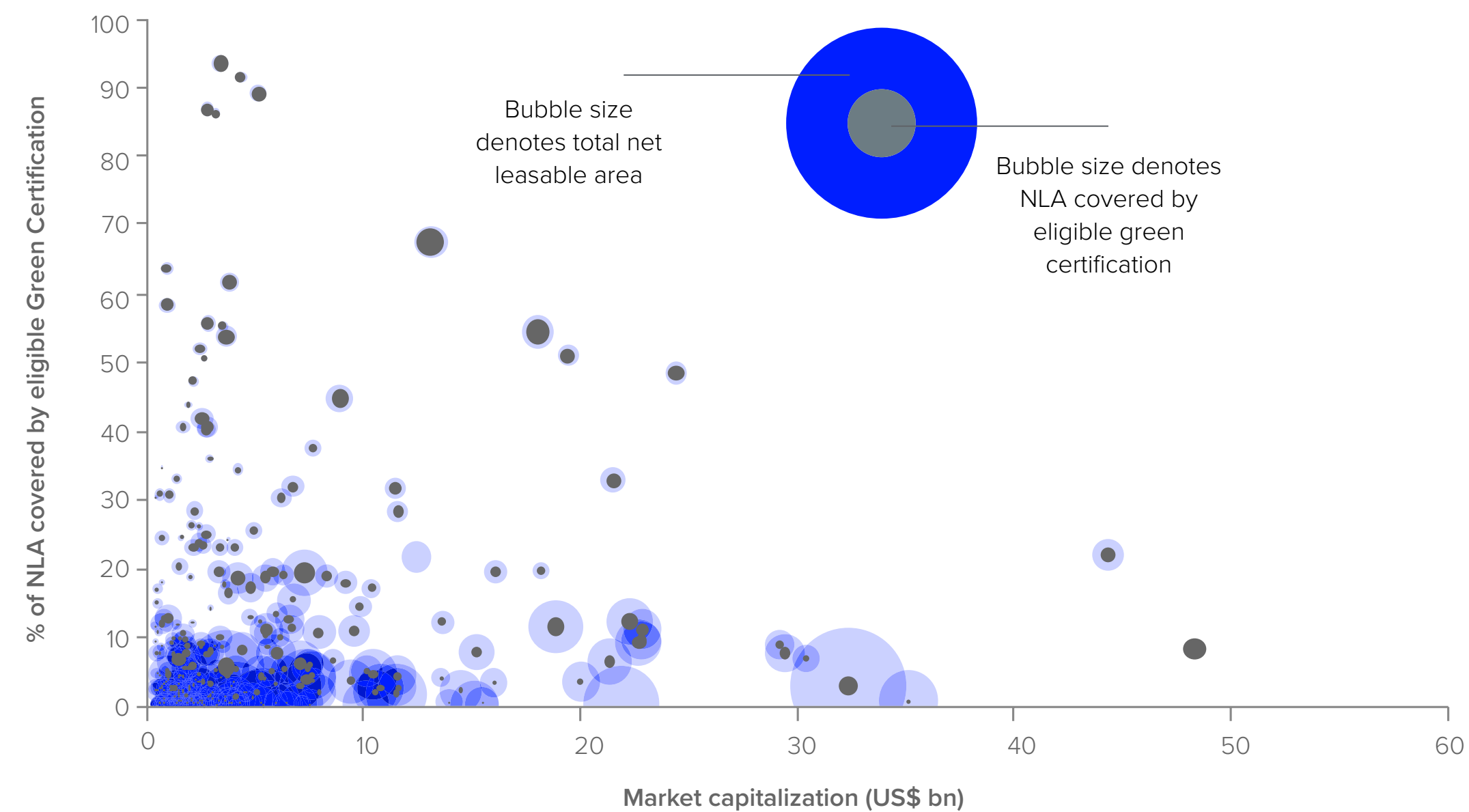
Among the many green certification schemes available, this mapping only considers green certification schemes that demonstrate a transparent, balanced and robust methodology (see appendix B for a comprehensive list of eligible certification schemes). This narrows the global list of certification schemes down to 25 eligible schemes. Given the data limitations and lack of comparability, the index methodology makes no additional distinction between different types of eligible certifications, certification level or date.

Green certifications are considered as eligible based on the following criteria:

- A list of certified assets is publicly available
- Transparency about how the sustainability performance of assets is evaluated, including a publicly available methodology documentation
- The scheme covers at least three sustainability-related indicators (i.e. a scheme that focuses on just energy or water performance is not included in the dataset)
- At least one of the criteria is focused on energy performance, as this indicator is typically considered most material to real estate investors and lenders
- A robust certification procedure, including a formal credentialization and data validation process (schemes relying on self-certification of assets are, for example, not considered).



Figure 9: Share of NLA with green certification for FTSE EPRA Nareit Developed Index constituents



Source: FTSE Russell. Average of data for the period Q1-Q4 2017.

The number of certificates in a real estate portfolio is assessed and aggregated across the portfolio both by number of buildings as well as by total square footage. In the first quarter of 2018, 72% of constituents in the FTSE EPRA Nareit Developed Index had at least one green-certified asset in their portfolio, with an average of 12.7% of NLA within these portfolios covered by an eligible green certification.

Layering in sustainability: Modeling energy performance

In a next step, individual building specifications and a range of information about local markets are used to estimate the energy efficiency of a building. The building type, building size and other key characteristics (e.g. year of construction and relative energy performance) are combined with location data to estimate baseline expected energy use in kWh/sq m. This distinguishes between thermal demand (heating and cooling) and electricity demand (e.g. lighting, building services). Property specifications also determine adjustments to this baseline to estimate energy use for a building that is “in use” or “vacant”.

The model is continuously calibrated through incorporating actual energy consumption data, which is publicly disclosed in some cases or provided via agreements with energy utility or real estate companies in several locations.

When total energy consumption for each asset is aggregated to a portfolio level, the average energy use intensity (in kWh/sq m) of the constituents of the FTSE EPRA Nareit Developed Index in the first quarter of 2018 was 260 kWh/sq m.⁴² Where publicly reported data is available, this is compared to modeled energy consumption data for listed property companies in 2017. The resulting correlation is 0.87, providing an indication of the consistency and accuracy of the modeled data, suggesting that the model provides a meaningful method to approximate energy use.

Modeling carbon intensity

To assess the carbon footprint for each asset, modeled energy consumption data is combined with national (and where available sub-national data) on the carbon intensity of the grid, to produce scope 1 and 2 emissions estimates for each asset. The modeling includes carbon intensities for electricity as well as for thermal energy, which can vary depending on the local energy mix.

Statistics on the local and national energy mix and their respective carbon intensity are sourced from national statistics offices and international bodies (such as the International Energy Agency and IPCC). This process uses the GHG Protocol as managed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). Note that the model currently omits Scope 3, which includes indirect emissions such as embedded carbon in materials, transport-related activities and other indirect sources.

When aggregated to the portfolio level, the carbon model provides an assessment of a constituent’s carbon intensity. In 2018, the average carbon emission intensity of the index was 77.8 kg CO₂ per sq m. This asset-level carbon model produces estimates that are closely correlated with disclosed carbon emissions at the portfolio level (raw correlation is 0.91). As with the energy model, modeled carbon emissions draw on comparable disclosed figures to continuously increase the accuracy of the data set.

⁴² GeoPhy analysis.



Appendix A: Detailed list of data sources

Input / definitions include:

| Data | Details | Source |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Location | Building address, latitude and longitude | Company reports/country and county tax records |
| Property Type | Office, retail, industrial, residential, healthcare, education, convention, hospitality, leisure, cultural, parking | Company reports/country and county tax records |
| Size | NFA (net/leasable floor area), in m ² GFA (gross floor area as ratio of NFA), in m ² | Company reports/country and county tax records |
| Electrical energy use | kWh/m ² | National statistics offices, utilities data |
| Baseline electrical energy | Average per asset type, size and location, by year | National statistics offices, utilities data |
| Thermal energy use | kWh/m ² | National statistics offices, utilities data |
| Baseline thermal energy | Average per asset type, size and location, by year | National statistics offices, utilities data |
| Energy carbon intensity | kg CO ₂ e/kWh | IPCC, International Energy Agency (IEA) |
| Building carbon intensity | kg CO ₂ e/m ² | GeoPhy Energy/Carbon Model |
| Heating/cooling days | Number of heating and cooling days including temperature range | NASA |
| Electricity sources | Nuclear, coal, natural gas, oil, nuclear, geothermal, biomass, hydro, solar PV, concentrated solar, wind power | International Energy Agency (IEA), National statistics offices |
| Electricity source mix | Relative weight of different sources per country/state per year | International Energy Agency (IEA), National statistics offices |
| Thermal energy sources | Coal, natural gas, oil, wood, peat, geothermal, biomass, solar | International Energy Agency (IEA), National statistics offices |
| Thermal energy source mix | Relative weight of different sources per country/state per year | International Energy Agency (IEA), National statistics offices |
| Building vacancy | Physical vacancy | Company reports/country and county tax records |
| Year of construction | Year when construction was finished | |
| Year of renovation | Most recent major renovation/overhaul of building technical installations | Company reports/country and county tax records |
| Reporting year | Setting for building specifications, energy baseline, energy mix | GeoPhy Energy/Carbon Model |

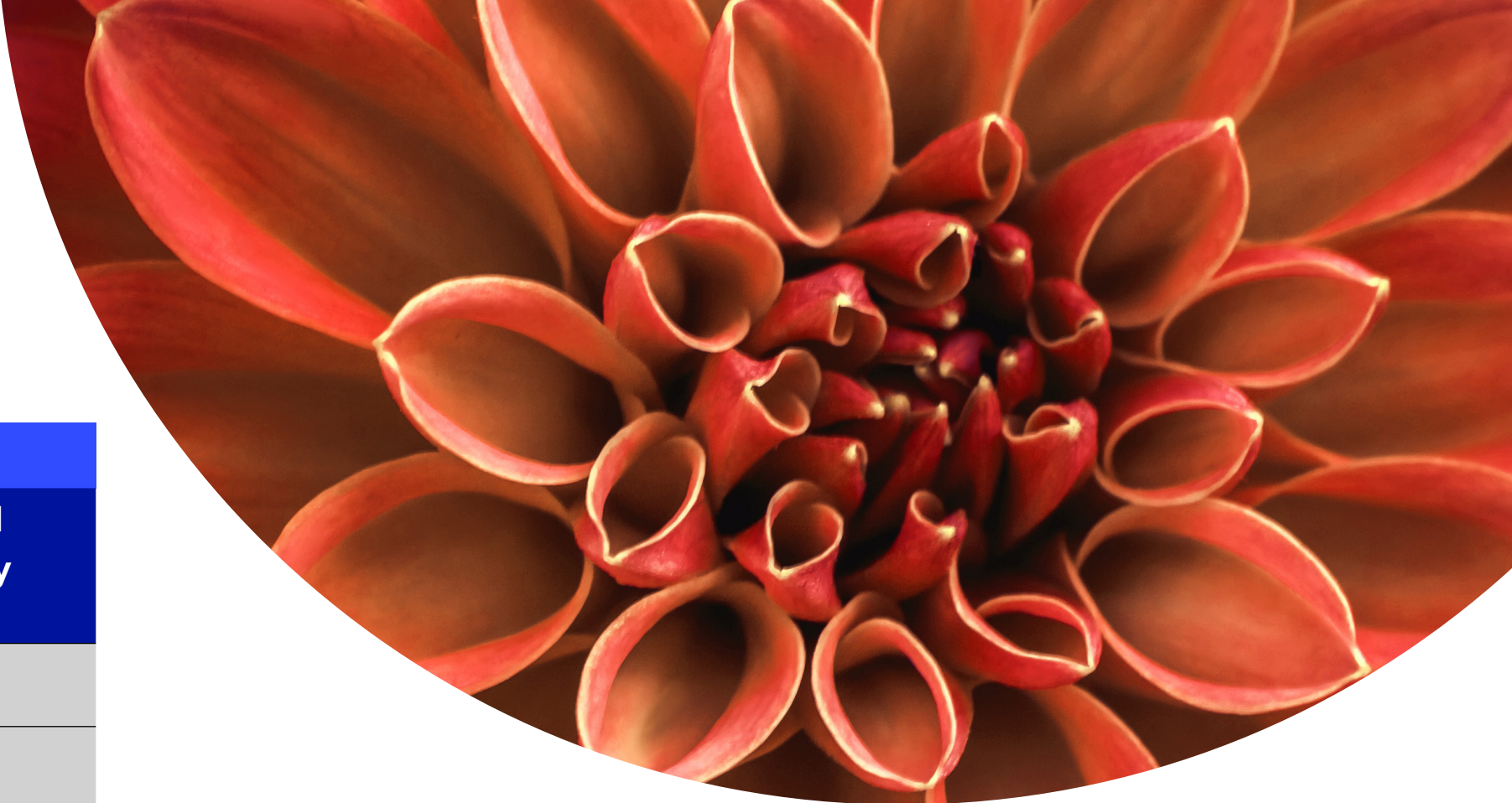


Appendix B: Green building certificates

Green Certification schemes are assessed against five eligibility criteria based on publicly available information. They must meet all five criteria to be included (dark shaded schemes).

| Green Certification Scheme | Eligibility Criteria | | | | |
|--------------------------------------------|----------------------------------------------|--------------------------------------|---------------------------------|--------------------------------|-----------------------------------------------|
| | Transparent methodology (publicly available) | 3+ sustainability-related indicators | 1+ energy performance indicator | Robust certification procedure | List of certified assets (publicly available) |
| Arge TQ | ● | ● | ● | ● | ● |
| Austin Energy Green Building Rating System | ● | ● | ● | ● | ● |
| BOMA 360 | ● | ● | ● | ● | ● |
| BOMA BEST | ● | ● | ● | ● | ● |
| BREEAM | ● | ● | ● | ● | ● |
| Build it Green/Greenpoint Rated | ● | ● | ● | ● | ● |
| Built Green | ● | ● | | ● | ● |
| CASBEE | ● | ● | ● | ● | ● |
| Certified Green Restaurant | ● | ● | ● | ● | ● |
| Certified Rental Building Program (CRBP) | | | | | ● |
| CHPS | ● | ● | ● | ● | ● |
| CasaClima | | | ● | | |
| DBJ Green Building Certification | | | | | ● |
| DGNB | ● | ● | ● | ● | ● |
| Eco-Schools | | | | | |
| Energy Labelling of Buildings: EU | ● | | ● | | |
| Energy Star | ● | | ● | ● | ● |
| Florida Green Building Certification | ● | ● | ● | ● | ● |
| GPR Gebouw | ● | ● | ● | ● | ● |
| Green Globes | ● | ● | ● | ● | ● |
| Green Key Eco-Rating Program | | | | | |
| Green Mark | ● | ● | ● | ● | ● |





| Green Certification Scheme | Eligibility Criteria | | | | |
|----------------------------------------------|----------------------------------------------|--------------------------------------|---------------------------------|--------------------------------|-----------------------------------------------|
| | Transparent methodology (publicly available) | 3+ sustainability-related indicators | 1+ energy performance indicator | Robust certification procedure | List of certified assets (publicly available) |
| Greenship | ● | ● | ● | ● | ● |
| Green Star | ● | ● | ● | ● | ● |
| Green Star NZ | ● | ● | ● | ● | ● |
| Green Star SA | ● | ● | ● | ● | ● |
| HQE | ● | ● | ● | ● | |
| IREM Certified Sustainable Property | ● | ● | ● | ● | ● |
| LEED for Building Design and Construction | ● | ● | ● | ● | ● |
| LEED for Building Operations and Maintenance | ● | ● | ● | ● | ● |
| LEED for Homes Design and Construction | ● | ● | ● | ● | ● |
| LEED for Interior Design and Construction | ● | ● | ● | ● | ● |
| Living Building Challenge | | ● | ● | | ● |
| Miljöbyggnad | ● | ● | ● | ● | ● |
| Minergie | ● | | ● | | ● |
| NABERS | ● | | ● | ● | ● |
| NABERS NZ | ● | | ● | ● | ● |
| NAHB Green | ● | ● | ● | | |
| Passivhaus | ● | | ● | | ● |
| SKA Rating | ● | ● | ● | ● | ● |
| Svanen | ● | ● | | ● | ● |
| Toronto Green Standard | ● | ● | ● | | ● |
| TripAdvisor Green Leaders | | | | | ● |
| Verde | | | | | |

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