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Global Trends in Data Capture and Management in Real Estate and Construction



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Report for Royal Institution of Chartered Surveyors

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Executive summary

Key decisions at all stages in the property life cycle – from financing, constructing and buying, to leasing and occupying assets – rely on the availability, accessibility and reliance of robust verifiable data. Such data is also crucial in the development of effective policy instruments and the ability to make compelling arguments for constructing energy efficient buildings.

Most market participants along the building value chain routinely gather data for various reasons. However, a substantial amount of this data is then either discarded, lost or forgotten or its format is not compatible with other databases and reporting requirements. In most cases, the data is not shared either. All this undermines the usefulness of the information for the organisation itself and for other stakeholders. This effectively means that baselines are potentially distorted, targets cannot be set and progress cannot be monitored, making reporting, benchmarking and comparison – and ultimately the achievement of climate targets – difficult.

We are in an age where Big Data is beginning to take hold in most sectors and where the rapidly ever-growing avalanche of data presents a real challenge to both policy-makers and stakeholders alike. And yet, at the same time a lack of data and information may be increasingly perceived as a tangible risk factor by those underwriting investment decisions. Against this background, this report analyses how building related data, including physical, performance and financial information, is currently captured and managed by key sector representatives. It also highlights the repercussions current data capture and management patterns can have for meeting countries' and organisations' energy saving and climate targets and commitments.

The findings presented in this report are based on a 2016 RICS-led global survey carried out amongst members of the Global Alliance for Buildings and Construction (GABC), of which RICS is a founding partner and their respective networks.

Given their importance for driving more widespread uptake and investment of energy efficiency measures in the built environment, the report focuses on the following stakeholders: governments and public authorities, the financing community, built environment and real estate professionals, developers and constructors, materials suppliers and occupiers and landlords.

The purpose of the survey was to investigate what type of data is collected by whom, where and for what reason and to examine data collection and use patterns. It also identified a series of key challenges in relation to better data capture and management, such as the lack of a central storage location, non-harmonised data collection formats and data reporting obligations, overall data availability and accessibility and data reliability. The analysis showed that in terms of effective data capture and subsequent management the sector still has some way to go. While there is an encouraging number of good practice examples and public and private initiatives, the overriding message of the survey findings is that the fragmentation and silo-thinking that the sector is known for also translates into the way it handles its data.

Finally, the report also provides guidance as to how some of the challenges identified may be potentially overcome and highlights the benefits and opportunities that arise from a more consistent and coherent approach to data and information collection and management for individual stakeholders.



About the GABC Working Group on Measurement, Data and Accountability

The GABC Working Group on Measurement, Data and Accountability represents one of five work streams set up by GABC members in April 2016:

1. Public Policy
2. Awareness and Education
3. Market Transformation
4. Finance
5. **Measurement, Data and Accountability**

The working group is co-chaired by the International Energy Agency (IEA), the government of Ukraine and RICS. Working group members include one GABC signatory country, one UN agency (UN Environment Finance Initiative) and representatives from relevant stakeholder organisations.

Thematic areas:

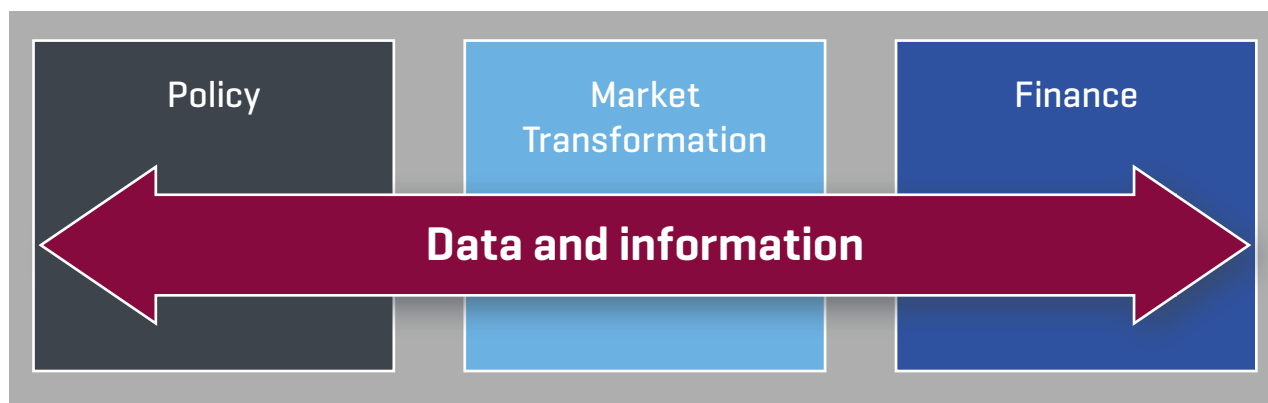
Measurement, Comparability, Accountability, Tracking, Reporting, Disclosure, Indicators & Targets

Goals:

- To raise awareness about the importance of Measurable, Reportable and Verifiable (MRV) data
- To promote data transparency, consistency and information exchange
- To provide guidance to enhance policy and track investments in the building sector
- To address compatibility of data formats
- To close information gaps and to support policy making and investment decision-making, and
- To facilitate the accessibility, transparency, understanding and comparability of energy usage through the development of international data, measurement and standards in the construction and real estate sector

Figure 1 illustrates the cross-cutting importance of measurement and data for policy making, financial and investment decisions and for successful market transformation towards resource efficient, low-carbon buildings.

Figure 1: WG5 thematic focus as a cross-cutting issue



2.0 The importance of systematic data capture and management

Who needs data and why?

Whether constructing, buying, leasing or occupying property assets, global investment decisions and effective policy instruments crucially depend on transparency and comparability. To gain the confidence of policy-makers, builders, developers, architects, investors and all building sector stakeholders, data must be holistic and appropriate. It must be available (and storable), compatible and credible (i.e. verifiable and transparent). As Figure 2 shows, the existence of robust data is also a key prerequisite for sector stakeholders to be able to develop policies, financial tools, new products and to underpin the overall business case for energy efficiency in buildings.

Most market participants along the building value chain routinely collect data, albeit for various reasons. Unfortunately, a substantial amount of this data is then either discarded or stored in an incompatible format or in another part of the organisation. Data not being documented properly is another very common issue – after some months nobody is able to find out what exact methodology was used in generating the data, often rendering the data or information effectively useless. Sadly, data and information sharing is also still the exception rather than the rule. All of this can potentially result in undermining the benefits the information might have had for the organisation itself and for other stakeholders. This, in addition to the challenges surrounding the lack

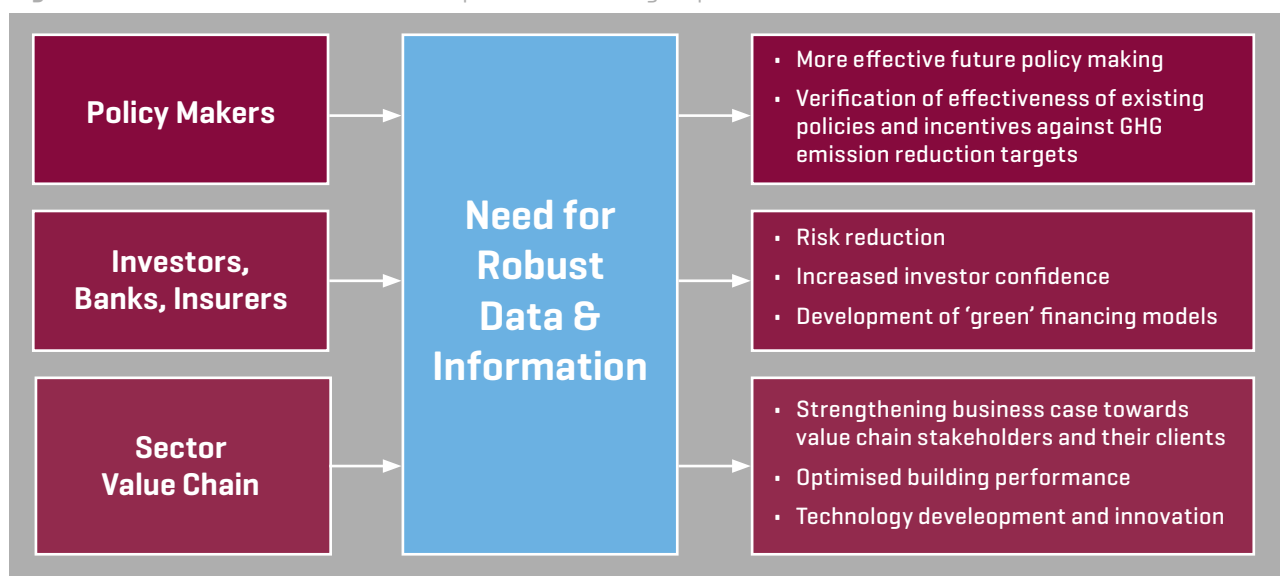
of harmonisation and standardisation in relation to data capture, means that targets cannot be set and progress cannot be monitored, making reporting, benchmarking and comparison difficult.

As feedback from round tables held with market participants in the framework of the IEE funded project RenoValue⁵ has demonstrated, the lack of solid and accessible data represents a key market barrier for upscaling energy efficiency financing and the development of associated products and tools. Data, or rather the lack of it, is also a recurring theme within the EU funded Energy Efficiency Mortgage Action Plan initiative, whether it be related to establishing ‘green value’ or energy efficiency and risk management.⁶

In an age of digitisation and automation, in which increasingly value is being attached to the data itself, the loss of information and the unsystematic way in which construction and real estate data is collected and managed can have serious repercussions, especially in relation to:

- Regulatory compliance
- Future competitiveness of the industry
- Effective planning
- Cost management
- Operation and maintenance
- Insurance
- Investment and financial decision-making

Figure 2: The crucial role of robust data per stakeholder group



⁵ Hartenberger, U. Lorenz, D., Antink, R., (editors), 2015, Divers for change, strengthening the role of valuation professionals in market transition, RenoValue Market Insights Report ⁶ See: EeMAP, 2017, Creating an Energy Efficient Mortgage for Europe, White Paper: Preliminary Recommendations, p. 13

3.0 About the Data Capture and Management Survey

Survey objectives

The GABC Data Capture and Management Survey represents a global review of:

... what type of real estate data is being collected

- ... where?
- ... by whom?
- ... how often?
- ... for what purpose?
- ... at which level of detail?

It also sought to identify:

- The current status quo with regard to building-related data capture and management across the core value chain community, including public authorities
- Key challenges in relation to more systematic data capture and management by stakeholders
- Implications of inadequacies in data capture and management, and
- Existing global initiatives regarding data capture and management

Dissemination and target groups

The Data Capture and Management Survey was launched ahead of COP22 in Marrakech and closed at the end of December 2016. It was disseminated to GABC members, their networks and at COP22.

The survey's main target groups were as follows:

- Governments and public authorities
- Representatives from the financing community (financial institutions, banks, investors, fund managers and insurers)
- Real estate advisory services providers and built environment professionals
- Developers and constructors
- Materials suppliers
- Occupiers, landlords and tenants

Survey structure

The survey consisted of 19 questions that covered:

- Type of organisation
- Geographical focus
- Physical, environmental performance and investment data collection habits
- Existence of tracking and reporting mechanisms in relation to environmental performance
- Frequency of data capture and use
- Existence of data quality assurance processes
- Data location and access
- Level of data detail
- Reason(s) for data collection
- Main challenges concerning systematic data collection and management
- Participation in data collection and tracking initiatives

Analysis

The survey received 99 responses across a range of organisation types with 94 stating their organisational name and 5 preferring to stay anonymous.

Due to the heterogeneous nature of the survey's target groups, response rates for individual questions slightly varied according to the relevance of the respective question to individual stakeholders. The actual response rate for individual questions is indicated in the graphs in chapter 4.

Response rates for most questions were well over 90 with most questions achieving response rates of over 95, thus showing a high level of stakeholder engagement and relevance of survey questions.

Given the survey's main target audience, i.e. government bodies and core value chain stakeholders, the authors have specifically focused their analysis on this group. To ensure rigor and meaningfulness of survey results, some respondent categories have been clustered, e.g. the category 'public authorities' includes responses from national and regional governments as well as city-level authorities.



4.0 Survey findings

4.1 Organisational breakdown of survey responses

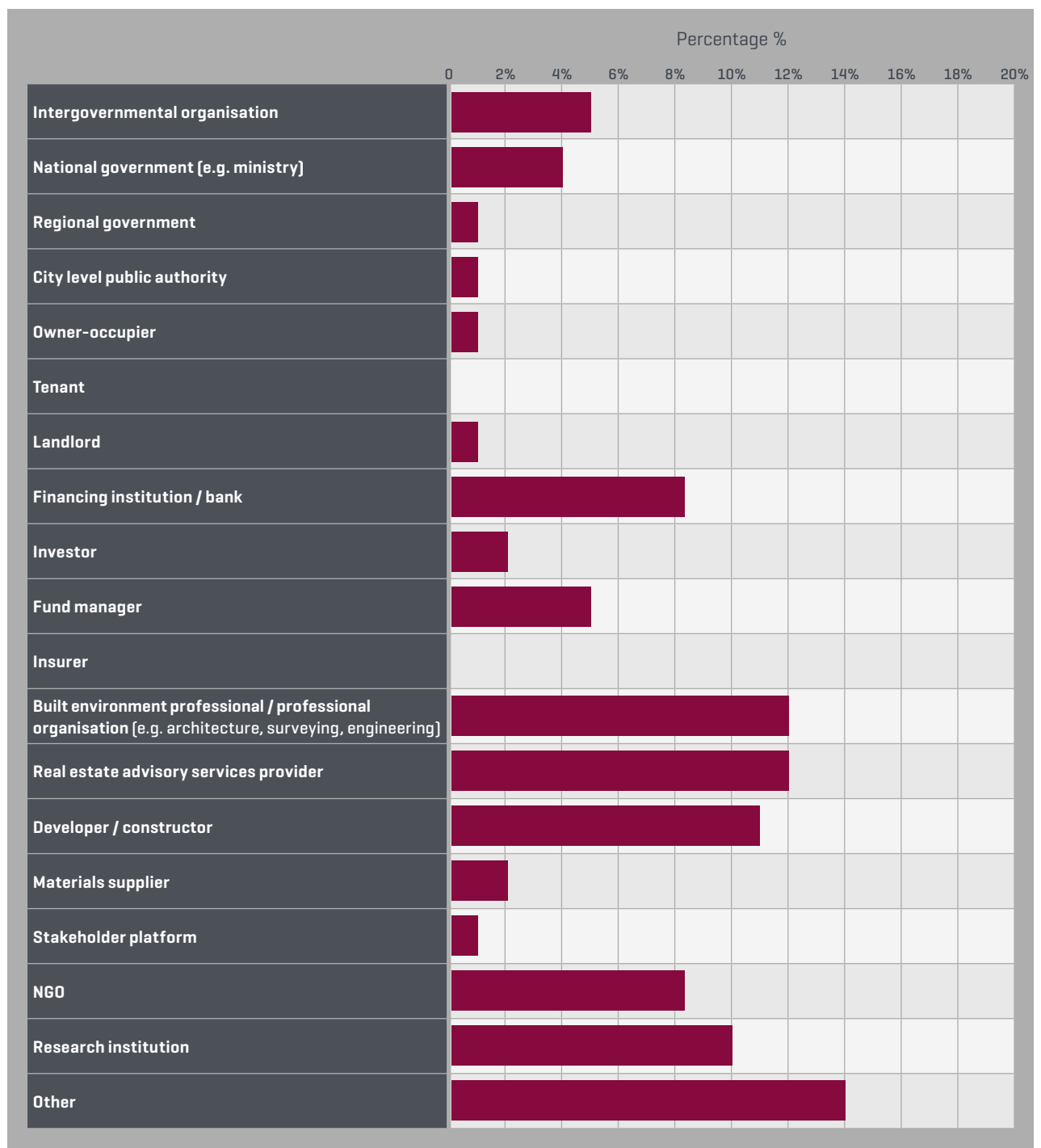
Response rates between different types of organisations greatly varied (see Figure 3). The majority of responses came from the stakeholder categories 'built environment professional / professional organisation' (12), 'real estate advisory services provider' (12), and 'developer / constructor' (11), followed by the categories 'research institution' (10), 'financing institution / bank' (10) and 'NGO' (8). There was also reasonable representation from the groups 'Intergovernmental organisations' (5), 'fund manager' (5) and 'national government' (4) but limited feedback from the 'materials supply' (2), 'investor' (2) and real estate use side, such as 'owners' (1), 'landlords' (1) and no responses from the 'tenant' and 'insurer' categories. Additional stakeholder categories not listed as survey option included 'consultancy', 'IT R&D', 'utility' and 'foundation'.

Looking at the organisational response breakdown, the low response rates from real estate users and the complete lack of responses from the insurance sector are particularly striking. The low response rate from the former because users are in fact a proportionally much larger and broader sectoral group and the lack of responses from the latter because, like financing institutions, insurance companies should have a very keen interest in minimising risk resulting from a lack of information and transparency.

The low response rate from the user community also mirrors experience from previous projects. Real estate users are traditionally more challenging to engage through whole life cycle sectoral initiatives. They are occupying and using buildings as offices, retail outlets, hotels, warehouses, etc. but most of them typically do not actually regard themselves as part of the sectoral value chain as their core business activities are not focused on real estate.⁷

The lack of responses from insurers and re-insurers may be due to the fact that this group has only recently been identified as potentially important players in the buildings and climate change debate. Climate resilience of buildings achieved through implementation of sustainability measures can help to reduce risks and associated costs from increasingly occurring extreme weather events that can heavily impact the viability and insurability of a built asset. Therefore, more efforts need to be undertaken to engage insurers and re-insurers as it should be in their interest to either collect reliable data themselves or to have access to it. Alongside financing institutions, they also have a key role in strengthening the business case for sustainable buildings, e.g. by giving preferential insurance premium conditions for climate resilient sustainable buildings.

⁷ See: RICS / UN Global Compact, 2015, Advancing Responsible Business Practices in Land, Construction and Real Estate Use and Investment, London

Figure 3: Breakdown of total response rate per target organisation type (98 respondents)

4.2 Geographical breakdown

Figure 3 below reflects the geographical breakdown of survey responses. A sizeable proportion of organisations responding to this question are operating globally (30%). In terms of regional representation, most organisations were either from Europe or considered Europe as the main hub of their activities (38%), followed by Asia (33%), North America (13%), Australia (10%), Middle East and Africa (8%) and Central and South America (4%). That organisations from Europe engage on a survey on buildings and climate change and related data capture and management does not come as a surprise as Europe has long been perceived as a leader in both the development of regulatory frameworks and innovative technologies. In addition, a significant number of GABC members and their networks are based in Europe which is also the region where the Alliance was originally founded. The relatively high response rate from Asia can be attributed to the fact that the GABC had organised a regional workshop that helped to raise awareness about the survey only two months prior to its launch.

4.3 Type of building data collected

One of the key objectives of the survey was to identify who collects what type of data. Depending on their core organisational focus, different value chain stakeholders have different data needs, which is one of the main reasons why data capture and management patterns

greatly vary (see Tables 1 and 2 below). It also explains existing challenges regarding harmonisation and standardisation with regard to data capture.

For a more in-depth analysis in relation to what type of data is being collected by which survey respondent group category, respondents have been grouped into the two clusters below.

Cluster 1: Core value chain stakeholders with direct impact on decision-making

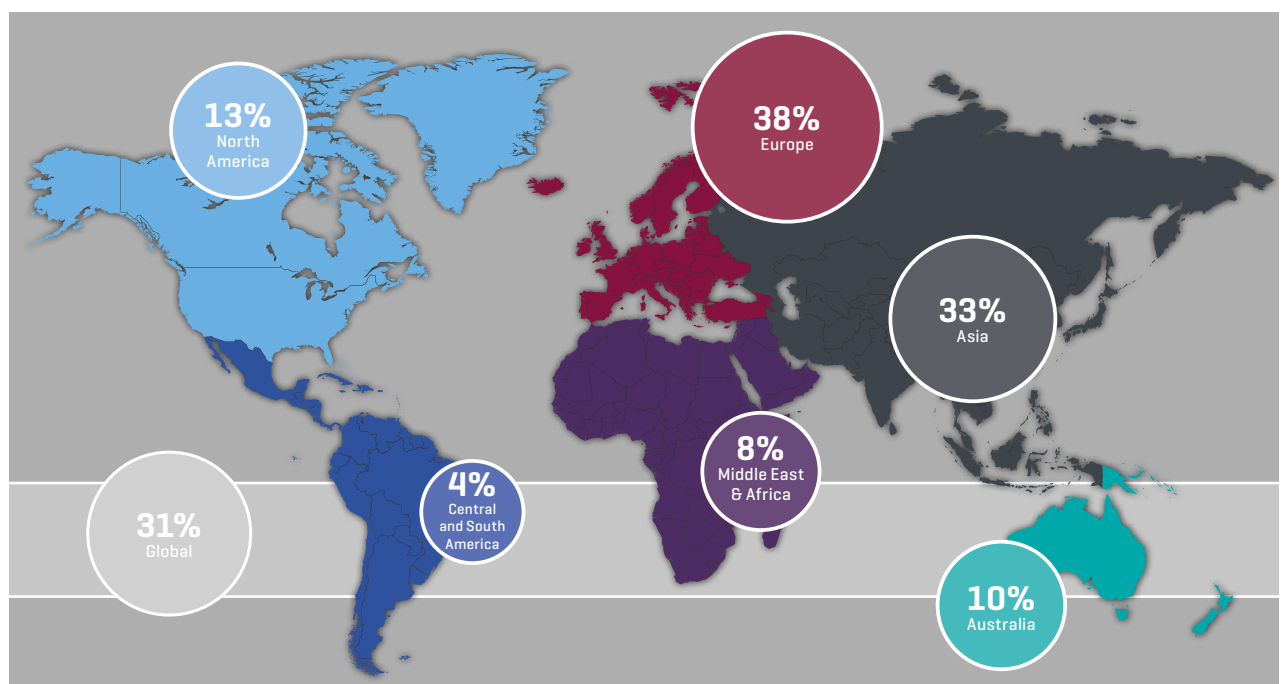
- Public authorities
- Finance and investment (financing institutions, banks, investors, fund managers)
- Built environment professionals / real estate services providers
- Developers and constructors
- Owners and tenants
- Material suppliers

Cluster 2: Supporting value chain stakeholders with indirect impact on decision-making

- NGOs
- Research institutions
- Stakeholder platforms
- Intergovernmental organisations

For an overview of data collected by Cluster 2, see Tables A2 and A3 in the Annex.

Figure 3: Geographical breakdown of organisations' responses [97 responses]



4.3.1 What type of data is being collected?

Table 1 summarises survey participants' responses in terms of the type of data collected in three different categories.

- 1. Category 1:** Physical building characteristics data and information
- 2. Category 2:** Environmental building performance characteristics data and information
- 3. Category 3:** Real estate transaction and investment data and information

In category 1, the piece of information with the overall highest relevance to all core value chain stakeholders, i.e. those in Cluster 1, is the building's floor area. Floor area data is followed by construction data and then information in relation to the quantity of buildings. Very little data is collected on embodied carbon and building demolition.

In category 2, most information is collected on energy consumption of new and existing buildings, followed by water consumption and data on the efficiency of systems and equipment. Even the level of data with regard to

building resilience scored reasonably high across all core value chain stakeholder groups with the exception of real estate advisory services providers and financing institutions / banks.

In category 3, transaction data ranks highest but only amongst certain stakeholder groups, such as financing institutions / banks, investors, fund managers and real estate advisory services providers and to a much lesser extent amongst developers / constructors and owner-occupiers and built environment professionals and not at all amongst public authorities and materials suppliers. In second place is energy efficiency investment data which appears to be of special interest for materials suppliers and fund managers but not for owner-occupiers and investors and only of marginal importance for financing institutions / banks. Curiously, while respondents from the group of public authorities stated that they were not collecting real estate transaction data, some do, however, collect this type of data when linked to building performance data, a data category which otherwise seems to be only of real interest to investors.

A more detailed analysis can be found in Table 2.

Table 1: Summary of data categories collected by Cluster 1 survey participants

Organisation type	Categories of data collected
Financing institutions / banks, investors and fund managers	Within this respondent group, fund managers are collecting most data across all 3 data categories, followed by investors and then financing institutions / banks who are mainly interested in high level category 1 data, energy consumption information and transaction data but to a much lesser extent in construction and technical data.
Built environment professionals and real estate advisory services providers	Both stakeholder groups display very similar collection patterns with a stronger focus on category 1 technical data by built environment professionals and more priority given to category 3 data by real estate advisory services providers.
Developers / constructors	This group scores reasonably high across categories 1 and 2 but less so for category 3 data.
Public authorities	Like the group of developers / constructors, public authorities collect a solid amount of data in categories 1 and 2 but data collection in category 3 is very limited.
Owner-occupiers / landlords	This group scores reasonably high across categories 1 and 2 but less so for category 3 data.
Materials suppliers	Suppliers are also strongest in categories 1 and 2 but score also highest on the collection of energy efficiency investment data.

Table 2: Type of building data and information collected by core value chain stakeholders with direct impact on decision-making [Cluster 1]

	Financing institutions/banks ⁽⁸⁾	Investors ⁽²⁾	Fund managers ⁽⁹⁾	Built environment professionals ⁽¹²⁾	Real estate advisors ⁽¹²⁾	Developers/constructors ⁽¹²⁾	Public authorities ⁽⁶⁾	Owner-occupiers/landlords ⁽²⁾	Materials suppliers ⁽²⁾
Physical building characteristics data and information									
Quantity of buildings	■ ■ ■ ■	■ ■	■ ■ ■ ■	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■	■ ■
Age of building stock	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■	■ ■	■	■ ■ ■ ■	■ ■	■ ■
Floor area	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■ ■	■ ■
Building construction data	■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■
Building renovation data	■	■ ■ ■ ■	■ ■ ■ ■	■	■ ■	■ ■	■ ■ ■ ■	■ ■	■ ■ ■ ■ ■
Building demolition data	✕	■ ■	✕	✕	✕	■	■ ■	✕	■ ■
Quantity of systems and equipment in building	■ ■	■ ■ ■ ■	■ ■ ■ ■	■	■	■ ■	■ ■	■ ■ ■ ■ ■	■ ■
Building embodied carbon	■ ■	■ ■	✕	■	✕	■	■ ■	✕	■ ■
Environmental building performance characteristics data and information									
Carbon emissions	■ ■	■ ■	■ ■ ■ ■	■	■ ■	■ ■	■ ■	■ ■	■ ■ ■ ■ ■
Energy consumption (new)	■ ■ ■ ■	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■ ■
Energy consumption (existing)	■ ■ ■ ■	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■
Water consumption	■ ■	✕	■ ■ ■ ■	■ ■	■ ■	■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■
Waste during use	■	✕	■ ■ ■ ■	■	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	✕
Efficiency of systems and equipment	■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	✕	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■
Building resilience	■	■ ■	■ ■ ■ ■	■ ■	✕	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■
Real estate transaction and investment data and information									
Real estate transaction data	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■	■ ■ ■ ■	■ ■	✕	■ ■	✕
Real estate transaction cost data	■	■ ■	■ ■ ■ ■	■	■ ■	■ ■	✕	✕	✕
Real estate transaction data linked to building performance data	■	■ ■ ■ ■	■ ■	■	■	■	■ ■	✕	✕
Energy efficiency investment data	■	✕	■ ■ ■ ■	■ ■	■ ■	■ ■	■ ■	✕	■ ■ ■ ■ ■

Percentage of respondents collecting data: ■ 1-25% ■ ■ 26%-50% ■ ■ ■ 51-75% ■ ■ ■ ■ 76-100% ✕ no data captured

[In total: 96 responses for physical building characteristics data; 98 responses for environmental performance characteristics data; 95 responses for real estate transaction and investment data].

Table 3 below lists additional types of data collected by selected survey representatives from the core value chain stakeholder group in Cluster 1, i.e. types of data not included within the scope of the survey.

Table 3: Additional data collected by core value chain stakeholders

Organisation type	Physical building characteristics data	Environmental performance characteristics data	Real estate transaction and investment data
Public authorities	Types of systems		
Financing institutions / banks	- Quality of construction - Builders' references and record to date	- Certificate information in relation to clients in the commercial property finance domain - Environmental clearance data obtained for projects of more than 20,000m²	
Fund managers		Refrigerant loss data	
Real estate advisory services providers		- Renewable energy consumption - Green building certificate data - Energy Performance Certificates	
Developers / constructors	Distance from main transport hub	Utility data – energy, water, waste	
Materials suppliers		- Energy consumption per m² of building envelope - Energy need for heating & cooling	



4.4 Reasons for data collection

Table 4 shows the main reasons for data collection within the group of core value chain stakeholders with direct impact on successful market transformation. The top two reasons set in blue denote drivers with the highest response rates.

When summarised, the main drivers for data collection are as follows:

- Data is supporting policy decision-making and policy tools
- Data is informing and underpinning investment decision-making
- Data is helping with and underpinning strategic business decision-making, and
- Data is supporting risk management and due diligence.

Table 4: Main reasons for data collection by core value chain stakeholder group [97 responses]

Public authorities	Support of policy decision-making & policy tools
	Research
	Reporting obligations
	Market transparency
	Investment decision-making
	Risk management and due diligence
	Building maintenance
Owner-occupiers / landlords	Investment decision-making
	Strategic business decision-making
	Reporting obligations
	Support of policy decision-making and policy tools
	Risk management and due diligence
	Use of data for commercial purposes
	Research
Financing institutions, investors and fund managers	Investment decision-making
	Risk management and due diligence
	Support of policy decision-making and policy tools
	Strategic business decision-making
	Reporting obligations
	Building maintenance
	Market transparency
	Use of data for commercial purposes
	Market competitiveness
	Research
	Other reasons stated: building efficiency, cost comparison
Built environment professionals and real estate advisory services providers	Research
	Market competitiveness
	Risk management and due diligence
	Support of policy decision-making and policy tools
	Reporting obligations
	Investment decision-making
	Building maintenance
	Strategic business decision-making
	Use of data for commercial purposes
	Market transparency
	Other reasons stated: for clients, consultancy for valuation, development of load profiles [through BIM]
Developers / constructors	Risk management and due diligence
	Strategic business decision-making
	Market competitiveness
	Investment decision-making
	Building maintenance
	Support of policy decision-making and policy tools
	Research
	Market transparency
	Commercial value of data
	Reporting obligations
Material suppliers	Support of policy decision-making and policy tools
	Investment decision-making
	Building maintenance
	Commercial value of data
	Market competitiveness

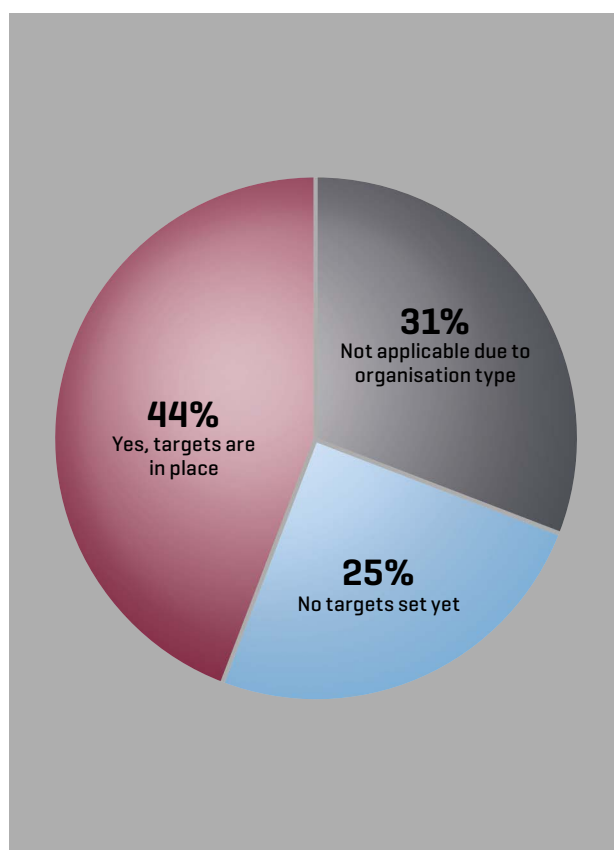
4.5 Setting and tracking of carbon targets and reporting

Target setting

An essential prerequisite for CO₂ reduction within the sector is the setting of appropriate, verifiable, quantitative and qualitative targets.⁸

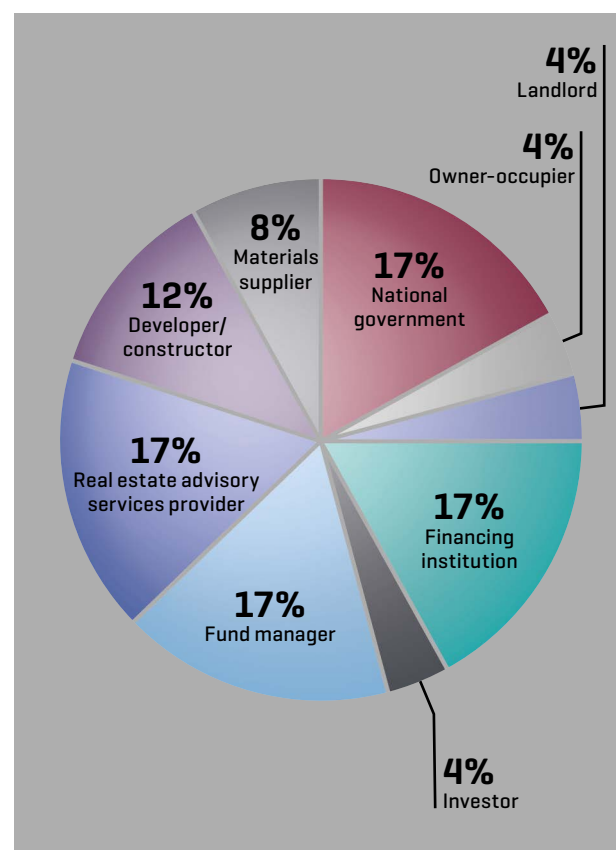
Out of 97 responding organisations who provided feedback, almost half (44%) have set carbon targets (see Figure 5).

Figure 5: Proportion of respondents already setting carbon targets [97 responses]



Taking a closer look at the organisational breakdown of the 43 organisations setting targets, 24 fell into Cluster 1, i.e. core value chain stakeholders. Figure 6 illustrates the organisational breakdown of these 24 core value chain stakeholders. Carbon targets are predominantly set by fund managers, real estate advisory services providers, financial institutions and national governments, followed by developers and constructors and materials suppliers and finally investors, owner-occupiers and landlords.

Figure 6: Setting of carbon targets: organisational breakdown of core value chain stakeholders in Cluster 1 [24 responses]



⁸ See: UN Environment Programme Finance Initiative, 2016, Sustainable Real Estate Investment – Implementing the Paris Agreement: An Action Framework, Geneva, p. 18

Table 5: Overview of target setting and reporting amongst Cluster 1 survey respondents

Organisation type	Target setting only	Target setting and reporting
Public authorities	2	1
Financing institution		3
Investor		1
Fund manager	1	3
Built environment professional		
Real estate advisory services provider	1	3
Developer / constructor		2
Owner - occupier	1	
Landlord		1
Materials supplier	1	1

Tracking and reporting

According to a 2014 report by the Property Working Group within the UN Environment Finance Initiative (UNEP FI)⁹, sustainability reporting should fulfil three functions:

1. Enable and trigger internal processes for improving an organisation's sustainability performance
2. Provide a basis for internal as well as external benchmarking, and
3. Provide a meaningful evidence base for informed decision-making among investors, stakeholders and the wider public.

Table 5 shows that most core value chain stakeholders in Cluster 1 who set targets also report against these targets. This is particularly the case with financing institutions, real estate advisory services providers and fund managers. As Table 1 above has shown, fund managers are the stakeholder group with the highest collection rates across most data collection categories and it seems reasonable to assume that the high level of data collection within this group could be driven by reporting obligations.

Table 6 provides a list of examples of targets set within the core value chain stakeholder group (Cluster 1). Most target dates follow political time goals, e.g. 2020 and 2030. This pattern also applies to the level of ambition which more or less represents policy goals. This is particularly true for value chain stakeholders who predominantly operate in Europe – a clear indicator that a policy framework can act as a strong driver for ambitious target setting by value chain stakeholders.

Targets fall into the following categories:

- Absolute energy consumption or CO₂ reduction targets with fixed dates or incremental reduction target(s) against baseline year or consumption / CO₂ emissions levels
- Number of built assets with energy / green / sustainability label / rating by a certain target date
- Number of assets built to either government or industry standard by a certain target date
- CO₂ emissions reduction targets for construction materials

⁹ See: UN Environment Programme Finance Initiative, 2014, Sustainability Metrics, Translation and impact on property investment and management, Geneva, p.17

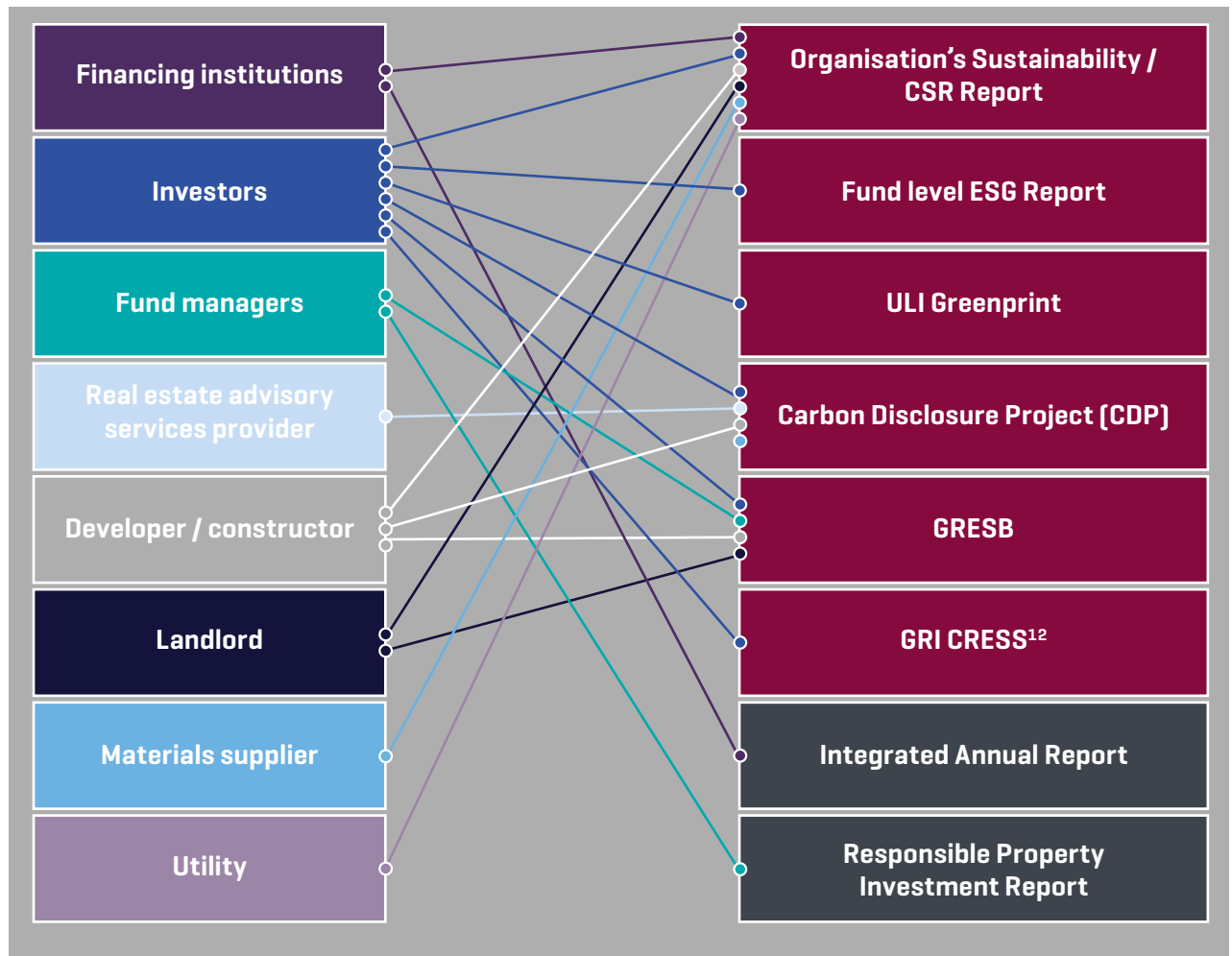
Table 6: Examples of targets set by organisations within core value chain stakeholder group

National governments Public sector building targets: Green Mark Platinum for all new developments: 30% energy savings minimum; Green Mark Gold Plus for existing buildings >10,000m² AC Floor Area by 2020; Green Mark Gold for all buildings >5,000m² GFA by 2020 (including schools); Ministry level >15% energy reduction, 5% water efficiency index reduction and waste reduction targets. [Government – Singapore]	Materials suppliers 75% reduction by 2040 of CO₂ emissions from own tertiary buildings [Materials supplier – France] 40% reduction in net specific CO₂ emission per ton of materials by 2030, compared to 1990 [Materials supplier – Switzerland]	Landlord 30% absolute reduction by 2020 using 2010 as a baseline year [Landlord – Hong Kong] 10% reduction of building related greenhouse gas emissions per corporate office employee by the end of 2017, using 2012 as baseline [Real estate consultant – USA]
30% reduction in energy use intensity of buildings by 2030 relative to 2010 level [Government – USA]	Fund managers 3% reduction in energy intensity per year, 4% reduction in carbon intensity per year. [Fund manager – USA]	Developers / constructors 80% of newly build detached houses to meet Zero Energy House [ZEH] government regulated standard by 2020 [Developer / constructor – Japan] 22% reduction by 2030 and 25% by 2030 vs baseline year 2007 based on 2012/13 baseline [Developer – Singapore]
12% reduction in energy use by 2020 and 15% by 2030 [19% in residential sector and 10% in tertiary sector] [Government – Morocco]	Investors 20% global reduction in energy use by 2020/21 based on 2012/13 baseline. [Real estate investor – UK] Absolute tCO₂ and relative tCO₂/m² carbon emission reduction of 20% by 2020 compared to 2006. [Real estate investor – UK]	
Financing institutions / banks 20% carbon reduction by 2020 vs 2014 [Bank – France] 38% reduction by 2030 [Bank – France]		

Figure 7 provides an overview of the main reporting mechanisms used by individual non-government core value chain stakeholder groups. Most stakeholders report progress against their targets via the organisation's Sustainability / CSR report, followed by participation in the Global Real Estate Sustainability Benchmark (GRESB)¹⁰ and the Carbon Disclosure Project (CDP).¹¹

At this point, only a few survey respondents have adopted an integrated reporting approach via a combined financial and sustainability / CSR report.

Figure 7: Reporting mechanisms used by core value chain survey respondents



10 See: <https://gresb.com/> 11 See: <https://www.cdp.net> 12 Global Reporting Initiative Construction and Real Estate Supplement – see: <https://www.globalreporting.org/resource/library/G3-1-English-Construction-and-Real-Estate-Sector-Supplement-Summary-Documents.pdf>

4.6 Data collection and management

Data access and storage

Figure 8 clearly shows that while data may be available, with 51% of all respondents stating that their data is kept in private databases and only 17% being in the public domain, a large proportion of information is not actually accessible for policy-makers and research institutions.

Looking at the 'no access' category, this is predominantly made up of the following core value chain stakeholder categories (in order of total number of responses received):

1. Financing institutions / banks
2. Real estate advisory services providers
3. Investors
4. Fund managers

Open data access is mainly practised by intergovernmental organisations and public authorities at national and regional government level.

Use of data management systems

Almost half of all survey respondents are using some form of building information and data management system (see Figure 9).

Core value chain stakeholders with a particularly high level of use of such systems are (in order of total responses received):

1. Real estate advisory services providers
2. Developers / constructors
3. Fund managers
4. Financing institutions / banks

Figure 8: Overview of survey respondents' data access practices [96 responses]

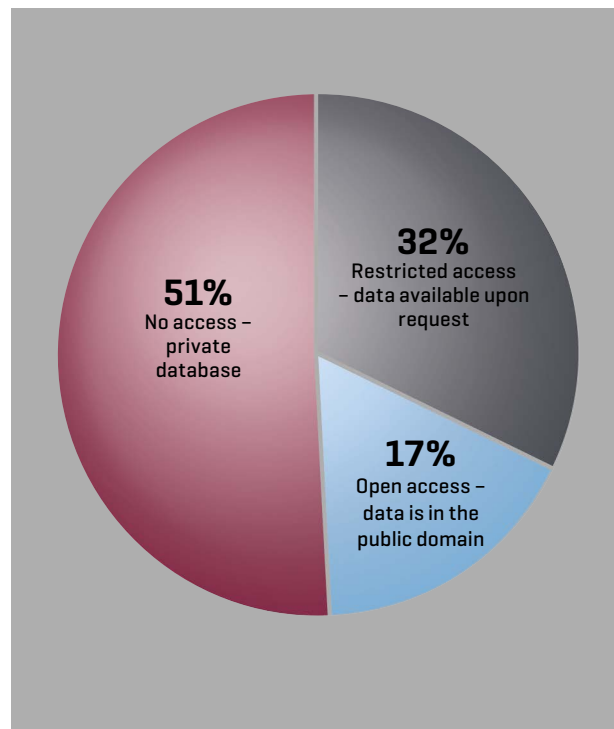
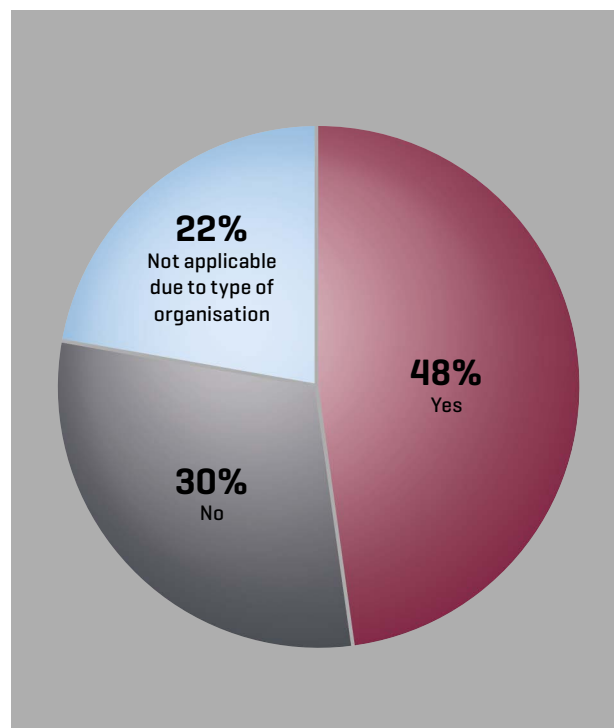


Figure 9: Level of use of building information and data management systems amongst respondents [93 responses]



Data collection and use routines

Data collection and use routines vary greatly amongst the core value chain stakeholder group. They are primarily determined by individual stakeholder profiles and respective data and information needs and reporting requirements.

As Figure 10 shows, an encouraging 25% of respondents are collecting data in real time. In terms of stakeholder profile, it seems that real time data collection is of particular interest for built environment professionals, fund managers and developers and constructors.

More than half of all responding organisations update their data at least once a year.

Most of the organisations stating a three-month data collection cycle are developers / constructors and real estate advisory services providers, the latter most likely valuers carrying out statutory valuations for commercial buildings.

Not all data seems to be collected with the same time intervals. Not only does the organisational profile of the data collector seem to be a determining factor for collection routines but also for the type of data collected as well as the

data collection method. Anything that can be automatised is often available in high resolution. Everything which requires manual labor, is not. Some information is updated in near real time while other data are collected monthly and some only on an annual basis. Moreover, data collection routines also seem to depend on the building type and existing building equipment and deployment of technology such as smart meters. In relation to energy consumption data, the frequency of data collection also appears to be influenced by the level of control the individual stakeholder has over energy consumption, e.g. where a landlord has only minimal control, energy data is typically collected annually.

While a significant number of responding organisations are systematically collecting data at regular intervals, there are also more ad hoc approaches whereby data is collected and updated on an as need basis, for example on a project by project basis or only covering a limited time-period as buildings are being developed or renovated.

When comparing collection and use (see Figure 11), the percentage of organisations using their data within a one year cycle is roughly the same. In other words, the data that is being collected is actually used by the organisation. In about a third of cases this happens daily.

Figure 10: Frequency of data collection
[94 responses]

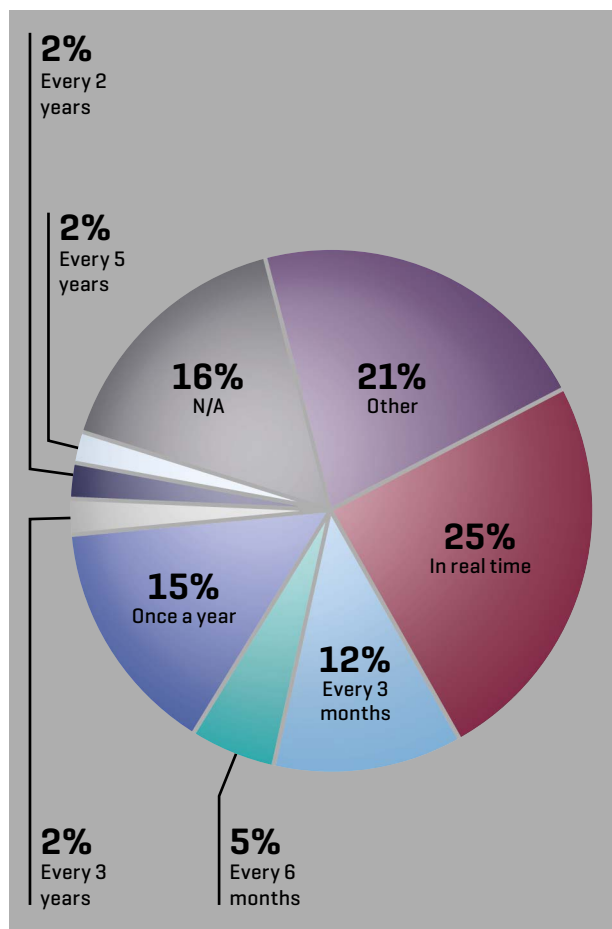
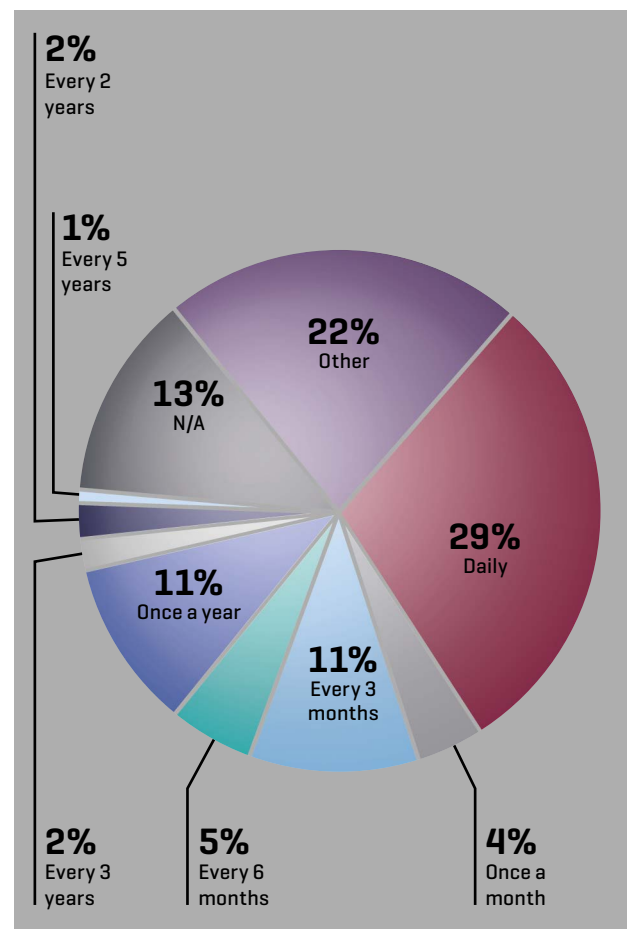


Figure 11: Frequency of use of collected data
[95 responses]

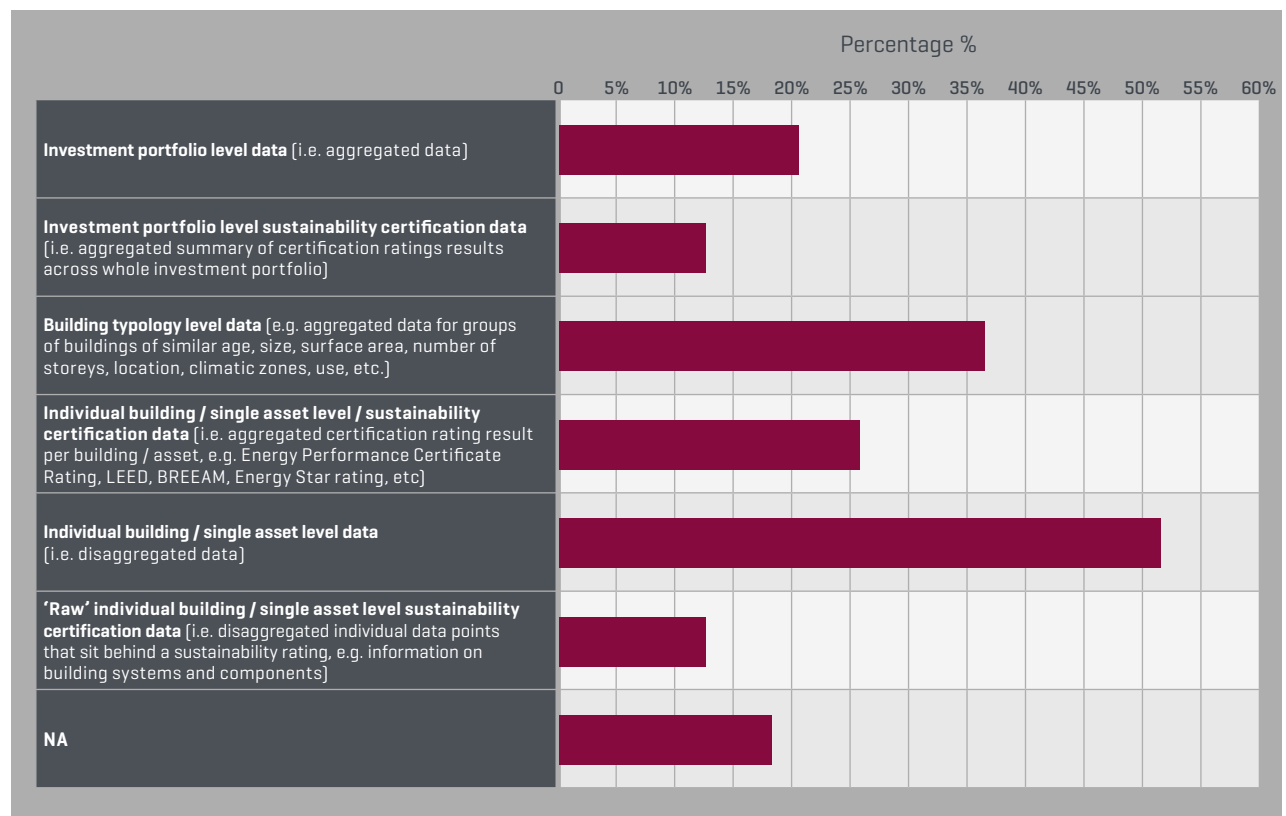


As with data collection, data use patterns also depend on several factors. Some data sets are used once a year but some more specific details are monitored and used on a more frequent basis. Use patterns are often determined by the very purpose of why the data was collected in the first place and who the information is for. Within the same organisation there can be different use cycles. For example, an investor may be collecting data and then be sending this information to all property managers monthly. Quarterly more detailed assessment reports are compiled and shared with property managers and fund managers. All information is then collated annually for regulatory and external reporting.

4.7 Level of detail of data and information collected

Figure 12 below illustrates the level of detail of data and information collected by survey respondents. Most data collected falls into the disaggregated single asset / individual building category, followed by building typology data, i.e. aggregated data for buildings of similar age, size, surface area, number of floors, location, climatic zone, etc. and single asset individual / single asset level (aggregated) sustainability certification data. Single asset level sustainability certification data is only collected by 13% of stakeholders (see bar in Figure 12).

Figure 12: Level of detail of data collected [94 responses]



4.8 Data and data source quality assurance and validation

In relation to successful data capture and management, key aspects are:

- Data availability
- Data access
- Quality and reliability of the data
- Transparency of data generation method

Even if data is available and accessible, if it is not trustworthy and robust, it is of little value and its use will only distort policy-making, tracking of progress and reporting. At worst, the use of doubtful data or from a doubtful source can lead to risky financial decision-making.

All the more surprising that, while 41% of respondents stated that they are checking the quality of the collected and then subsequently used data and information, 38% have no quality assurance procedures in place according whatsoever (see Figure 13).

Comments received from survey participants suggest that internal quality assurance processes are more prevalent than external procedures, i.e. third party verification. Some stakeholders seem to be applying hybrid approaches with the data management systems used by respondents already checking the validity of the data upon entry of the data through an inbuilt software functionality. Internal quality assurance processes are often coupled with subsequent benchmarking against external publicly available data and information.

The choice of external quality assurance greatly depends on the type of organisation. Those with reporting obligations, such as financing institutions and investors tend to have more rigorous quality assurance procedures by external auditors or quality assurance bodies in place. These include ISO (mainly 14001 and 50001), ULI's Greenprint Centre, EDGE auditor¹³, dedicated government bodies, accountancy / consultancy firms and in some rarer cases research institutions and universities.

The trustworthiness of the data source should be as important as the data itself. With 60% of respondents verifying the data source, survey responses confirm that validating the data source seems to be even more important than checking the actual data (see Figure 14).

As with other aspects of data collection and management, there does not seem a 'one fits all' approach to data source validation. Again, the type of data collected appears to play a significant role. On non-critical data, some organisations are more reactive than proactive regarding the data source. Some data sources are inherently trusted, such as government department data.

Figure 13: Prevalence of data quality assurance amongst survey respondents [93 responses]

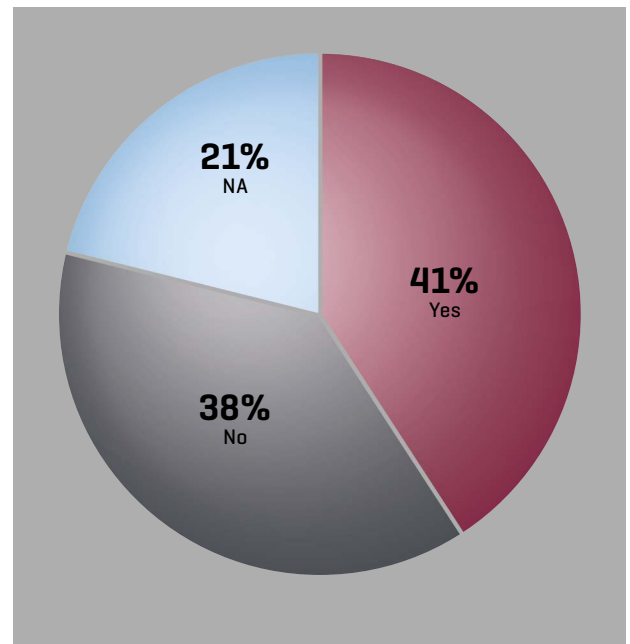
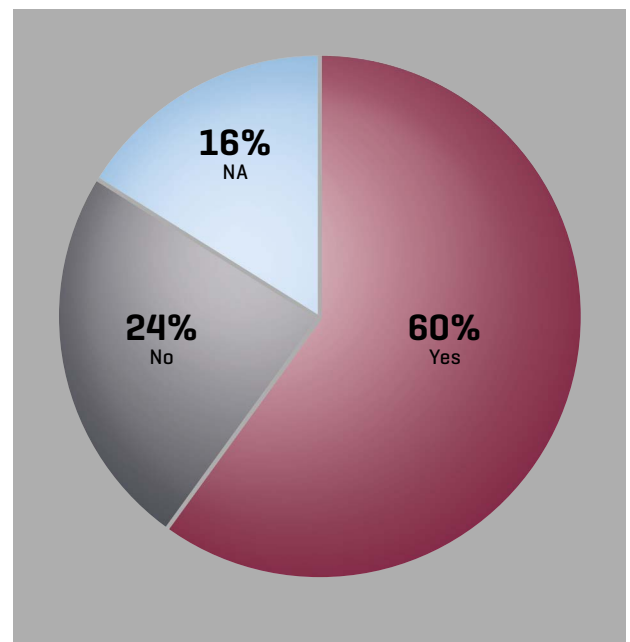


Figure 14: Percentage of responding organisations verifying the source of the data they are using [93 responses]



¹³ See: <https://www.edgebuildings.com/technical/auditors-corner/>

The box below provides insight into how individual responding organisations are validating their data sources.

How are survey respondents assessing the reliability and trustworthiness of their data and information sources?

Through a network of data providers that are appointed by country head contacts who are responsible for data accuracy at the local level

Real estate advisory services provider

Through contact with owners and market intelligence

Real estate advisory services provider

Through the use of multiple databases for validation within organisation's research department

Real estate advisory services provider

Through 2-level internal source auditing

Real estate advisory services provider

Through regular calibration of technology used for data collection

Built environment professional

Through contractors and sub-contractors

Owner

Through source validation part of third party auditing and due diligence procedures

Investor

Through reliance on property managers to provide reliable data and to check anomalies

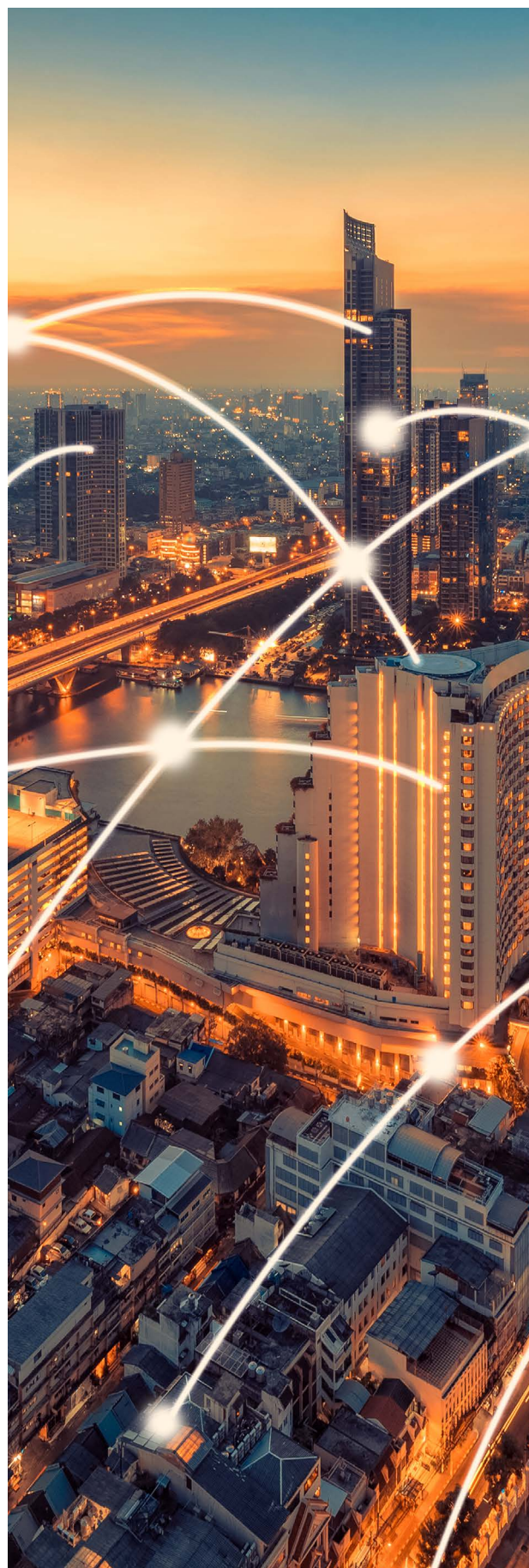
Fund manager

Through external auditors

Developer / constructor

Through internal source verification processes

Government



4.9 Participation in data capture and management initiatives

Partly due to ever more stringent energy efficiency and CO₂ emission reduction regulation coupled with an increasing growth in both mandatory and voluntary sustainability reporting and partly due to the desire for more market transparency, over the past few years, there has been a steady rise in the number of data capture and management initiatives.

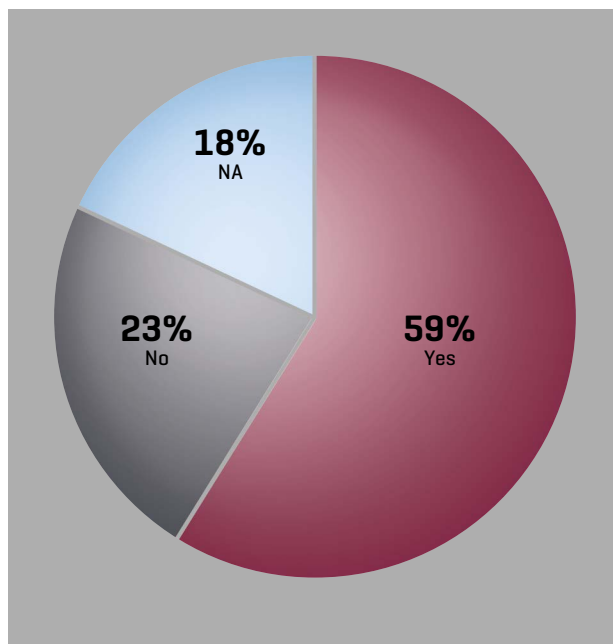
As Figure 15 illustrates, almost 60% of responding organisations are involved in data capture and management initiatives.

Essentially, there are two different types of initiatives:

1. Initiatives organised by stakeholder platforms with the objective of improving overall data availability within the sector. These are typically led by intergovernmental organisations, NGOs, research institutions, etc. and tend to adopt an open data access approach (examples: DEEP, EU Building Observatory, etc.)
2. Commercially driven initiatives that award a ranking based on the data submitted (examples: GRESB, ULI Green Footprint, etc.)

For an overview of global, regional and national initiatives in the area of measurement, data capture and management see Table A4 in the Annex.

Figure 15: Percentage of respondents participating in a data capture and management initiative [96 responses]



4.10 Challenges

As part of the survey, respondents were asked to rank the importance of the challenges facing organisations regarding the collection and management of building related data from a set of options on a scale from 1 (not important) to 8 (very important). The list below reflects the ranking of challenges according to the answers given by survey respondents:

1. **Storage** – no centralised storage location – data scattered over many departments
2. **Reporting** – too many different, non-harmonised reporting obligations
3. **Availability** – data not available or only partially available
4. **Collection** – no standardised data collection format
5. **Accessibility** – data not accessible
6. **Quality** – lack of data and / or data source reliability

The list above clearly indicates that the most significant challenges for all stakeholders is the lack of a centralised data storage location. In many cases, data is scattered across departments (silo-effect), making it difficult to access, trace and track. Linked to this is the proliferation of too many different, non-harmonised data collection and reporting obligations (key challenge 2) that also hinder the development of a standardised data collection format / template (key challenge 4) which would facilitate quicker, more cost-effective internal processes.

These challenges are corroborated by a 2017 report by the RICS Investment Risk Forum on Perspectives on Global Real Estate Investment¹⁴ that also confirms that data availability is of particular significance for financing institutions, investors and asset managers.

Particularly striking is the fact that while Figure 13 showed that 38% of all respondents have no data quality assurance system in place, data quality was only ranked in 6th place, i.e. overall trust levels in the reliability of the data collected and used seems to be surprisingly high.

¹⁴ See: https://wbef.rics.org/globalassets/markets--geopolitics/downloads/perspectives_on_risk_investment_insights_091017_rt.pdf

5.0 Implications of survey results

The survey findings have brought up a number of issues that currently hamper a more effective data collection and management approach along the value chain. This chapter provides a critical reflection of the current status quo based on survey findings and subsequent implications for stakeholders.

The data silo proliferation

It is a widely known and accepted fact that the built environment sector value chain is very complex and fragmented in its approaches and outlook. Individual stakeholders operating at different stages of the sectoral life cycle often have very different interests and priorities and typically tend to think and act in silos.¹⁵

As Table 1 above is illustrating, this also holds true for the type of data collected by different stakeholders. While all respondents are collecting a reasonable amount of environmental performance data (which was to be expected given the nature of the way the survey was disseminated and the survey respondents' profiles), data collection patterns vary more distinctly in categories 1 (physical building characteristics data and information) and 3 (real estate transaction and investment data and information).

As survey responses have shown, whole life cycle thinking – covering physical and environmental performance characteristics data as well as real estate transaction and investment data – is weakest amongst respondents from financing institutions / banks and public authorities. Public authorities are collecting category 1 data, i.e. physical building characteristics data and information but very little in category 3, i.e. real estate transaction and investment data and information. The opposite is the case with respondents from the group of financing institutions / banks. At the moment, banks and financing institutions are only collecting very limited category 1 physical building characteristics data which may be due to their perception that the data is too technical, therefore irrelevant and hence not valuable. However, with this type of data directly impacting energy performance, from a financing institution's / bank's point of view, this can have serious implications for risk assessment and due diligence procedures when awarding financing. It also means that by not collecting this type of data in-house, this group must rely on external sources to provide it. This is not only costly as the data must be recreated again and again but third party data sourcing also raises concerns about the actual reliability of the data.

The data value appreciation inadequacy

Even if data and information is being gathered, the most significant challenge identified by survey respondents is that building data and information is not held in one central location but is scattered over many departments that may not always see the 'bigger picture' value of the information they are holding.

This critical issue was already highlighted by a 2013 UN Environment Finance Initiative survey among international real estate organisations: "Some data collection takes place without systematic coordination. Some data are lurking in a range of different corporate departments without the facility to share data, creating a data silo effect. This not only hinders the exploitation of the added value of sustainability-related information but also impedes a more profound understanding of the relevance of this data/information for investment and management processes. Consequently, there is a potential stalemate situation."¹⁶

The data linkage dilemma

A vital aspect of the business case for energy efficiency investments is the building's potentially increased value which can be expressed either through direct higher yields upon sale and rental, i.e. through the so-called 'green value' sale or rental premium or through indirect monetary benefits, such as quicker turn-around times, the ability to secure more high-profile tenants, a reduced risk of longer void periods, obsolescence or of so-called 'brown discounts'.¹⁷

As demonstrated by survey responses, efforts to systematically link real estate transaction data with environmental performance data are limited, and yet, not establishing this link is the single most important obstacle to creating the empirical evidence base needed to successfully strengthening the business case for large-scale financing at the level of financing institutions / banks but equally at the end-user level.

The failure to systematically link environmental performance data with transaction data creates a vicious circle: stakeholders will not be able to see the evidence of potentially existing value premiums or 'brown discounts' and will therefore also not appreciate the value of physical building data and its implications for real estate risk assessment, investment and management either. Therefore, the stalemate situation mentioned above continues to persist.

¹⁵ See: RICS / UN Global Compact, 2015, Advancing Responsible Business Practices in Land, Construction and Real Estate Use and Investment, London, p.20

¹⁶ See: UN Environment Programme Finance Initiative, 2014, Sustainability Metrics – Translation and Impact on Property Investment and Management, Executive Summary, Geneva, p. 8 ¹⁷ See: Hartenberger, U. Lorenz, D., Antink, R., (editors), 2015, Divers for change, strengthening the role of valuation professionals in market transition, RenoValue Market Insights Report, p. 9

The information flow disruption

Survey findings have shown that at present, systematic data capture and management along a building's life cycle is more an exception than a rule. In addition, data and information is not adequately transferred from one life cycle stakeholder to the next. With each transaction, the flow of information is disrupted. To date, there is no universal, standardised system or protocol in place that would easily facilitate access, storage, update and transfer of building-related data and information in a standardised format along the value chain.¹⁸

The accessibility challenge

Only 17% of respondents stated that their data was in the public domain. This group mainly consisted of intergovernmental organisations and public authorities at national and regional government level. This obviously raises concerns about overall market transparency. While others may be willing to share their data, they may simply not be aware of where they can put their data, i.e. they are not aware of public databases or registries. Given the need for transparency and information exchange between professionals, their clients and assessors as well as the need for the long-term management of this information, data sharing and open data access in the public domain may seem to be the most obvious solution. While a general transparency obligation for building owners might be seen as a necessary course of action from a public interest perspective in certain cases, for example to evaluate the effectiveness of policy measures and government financed subsidies and incentives¹⁹, open access is riddled with several challenges, such as data protection, competitiveness, confidentiality, etc. The most challenging question is who should have the responsibility of holding all the – often sensitive and private – information. Hence, the responsibility for holding and maintaining, and in the case of a sale also for transferring and updating, building-related information should be with the building owner. Even if at present, the building owner may not use the information, he/she or a prospective owner may well do so in the future.

The benchmarking and comparison gap

While it is encouraging to see that most of those stakeholders in Cluster 1, i.e. core value chain stakeholders with direct impact on decision-making are setting targets and are also reporting against these targets, the question arises what the actual value of this reporting is for benchmarking purposes. Some complex benchmarking efforts are effective and have high accuracy with the right data entry by qualified professionals. From a business perspective, however, with most reporting tools requiring different data collection – often with varying priorities – as well as using different templates, a meaningful benchmarking and comparison of targets and progress across organisations and countries can be very difficult.

When discussing the merits of sophisticated benchmarking of energy performance data, it is important to take a step back and look at the comparability of other, seemingly more basic data. All attempts to benchmark more complex data and information and progress is led ad absurdum if the market is not even able to compare the most basic data such as floor area, which is the piece of information with the overall highest relevance to all core value chain stakeholders according to the findings of this survey (see Table 2, Section 4.3). To calculate floor area and other indicators, though, assessment systems and corresponding national industry standards do not always follow a universally agreed measurement system, i.e. making it difficult to compare²⁰. There are manifold definitions of what is counted as floor area – even within single countries and there is very little consensus on how to define floor area or subsequently what energy loads are to be included and excluded from building assessment. These uncertainties can compromise the accuracy and effectiveness of energy performance calculations and can potentially jeopardise the benchmarking and comparability of many building performance aspects.

A very tangible risk is that without the right baseline measurement, national energy saving targets may not be achieved in practice and reporting may become distorted. In a 2015 report by the International Energy Agency (IEA)²¹, the Building Energy Efficiency Taskgroup called for common energy metrics and highlighted the intrinsic link between energy use in buildings and floor area and the problems of variability in floor area data for the purposes of measuring energy consumption.

¹⁸ However, at local government and city level, the carbonn© Climate registry is already capturing data at local government level and it should be explored whether this could potentially be adapted to other stakeholders' needs. – see: www.carbonn.org ¹⁹ See: Lützkendorf, T. and Lorenz, D., Capturing sustainability-related information for property valuation, in: Building Research & Information, (2011) 39(3), 256–273 ²⁰ See: International Property Measurement Coalition: <https://ipmhc.org/> ²¹ OECD/IEA, 2015, Building Energy Performance Metrics, Supporting Energy Efficiency Progress in Major Economies, Paris, p. 12

6.0 Concluding remarks

Capitalising on the benefits of construction and real estate data and information

As the analysis of the survey and the implications of the results have illustrated, key challenges for the sector and its core stakeholders are to collect, organise, aggregate and interpret valuable (but often underrated) data and information so that it can be integrated into policy and core business and decision-making processes.

A more systematic and coherent approach to data capture and management by organisations will significantly support more informed public policy-making and investment and management practices. In addition, it will help organisations to protect the value of their assets and comply with their fiduciary duties and will provide the basis for identifying innovation needs for the building sector to achieve the 2050 targets.

The benefit for businesses is an improved understanding of the impact of building performance on asset and portfolio value. Furthermore, it also enables organisations to understand and assess the impact of sustainability-related activities at the building level on corporate value. Even more benefits arise when several corporate functions and methods of property investment and management organisations rely on similar data and information.

Additionally gathered - or now accessible - building-related data and information can be utilised several times and in manifold contexts to support business processes and corporate functions. Better data can also enable improved ability to sell energy efficiency products and services. This multiplicity of potential use suggests that the benefits of improving data capture and management may very well outweigh the required implementation efforts.²²

More and better quality building data helps financing institutions, banks and investors and their advisors gain more information on risk profiles, to adapt their risk management strategies accordingly and to develop financial instruments, such as so-called 'green mortgages'²³ that can stimulate demand for nZEBs.

For banks and financing institutions, an important consideration for data capture might be the link between bank/financier action to establish better, more regular and granular asset investigation and data capture (at time of transaction and then ongoing when in portfolio) and owner/borrower interest in the data.

If a green premium can be established and validated by data collection and analysis, lenders could also potentially offer an additional 'product / service' differentiation to customers (data capture and aggregation as part of underwriting and servicing that is available to borrowers) rather than merely a 'pricing' differentiation (interest rate concession on the loan). When the borrower seeks to capitalise on the environmental gain at point of refinancing or sale, he / she will have data to support that gain as partly provided or made accessible by the lender. In other words, instead of thinking of the lender's data capture solely in risk terms (asset security, capital reserves), it can be considered as one element of the customer facing value it offers.

From a public authority perspective, improved data and information first and foremost supports better regulations. It also underpins financial policies and incentive schemes such as the provisioning of tax incentives, subsidies and grants (e.g. for energy efficiency measures). In these cases, public authorities could take measures to ensure that building owners enable public access to information which has been used to qualify for such preferential treatment.²⁴

A transparency obligation for building owners enables an evidence-based public policy and/or monitoring of public strategies and instruments, such as the effectiveness of Energy Performance Certificates in Europe or any other policy tool targeted at increasing the uptake of energy efficiency of built assets.

None of the above represents entirely new insights. The issue of data capture and management has been at the centre of discussion within the construction and real estate market for years and it remains a critical issue for the sector. One of the aims of this report was to investigate the current status quo vis-a-vis data capture and management trends amongst core value chain stakeholders. The findings that came out of the survey have shown that the problems of insufficient data capture and management as well as inadequate information-sharing persist, both at public authority and business level.

²² Examples from the Urban Land Institute's Greenprint Center 2016 Greenprint Performance Report clearly show the benefits organisations can reap from data collection and analysis. See: <http://uli.org/wp-content/uploads/ULI-Documents/GreenprintPerformanceReportVol7.pdf> ²³ European Commission, 2017, Financing a Sustainable European Economy, Interim Report by the High-Level Expert Group on Sustainable Finance ²⁴ The 2017 edition ULI Greenprint Performance Report lists a series of examples from the United States that show that legislative data disclosure and benchmarking requirements can positively impact energy consumption figures. According to the ULI report, one important ingredient of successfully implementing disclosure and benchmarking policies is to stress the cost-saving potential of data collection and disclosure to relevant stakeholders, such as facility managers. Available at <https://americas.uli.org/research/centers-initiatives/greenprint-center/>

It is beyond the scope of this report to provide detailed, best practice examples and technical guidance for data capture and management within organisations. Building on the key challenges identified through the survey, this will form part of the Global Alliance's Working Group 5 forthcoming work programme. Additional recommendations and practical examples on how to address data capture and management barriers have been put forward through the UN publications listed below.

The way forward – finding the right ingredients

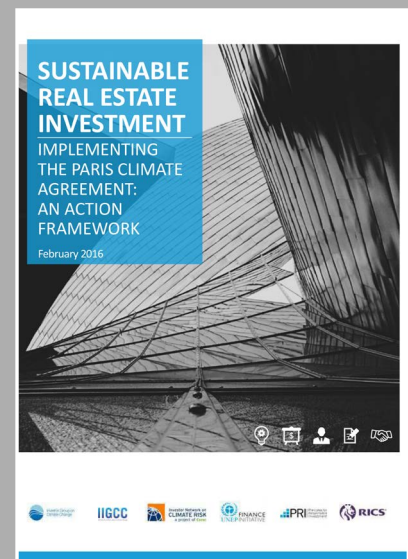
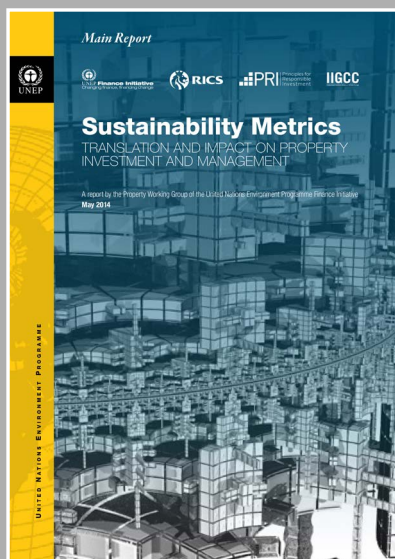
There are however a number of potential practical solutions and approaches that can help to improve the current data and information deadlock.

The issue of harmonisation and standardisation is and remains one of the major tasks of for the sector and related policy-making in the future. With the introduction of International Property Measurement Standards²⁵ and International Construction Measurement Standards²⁶, an important step has been taken to work towards harmonised measurement.

Linking buildings' physical and performance characteristics with transaction data in a combined data database will help to track financial performance of energy efficient buildings and / or energy efficiency features at single building and portfolio. This will help to identify the value of specific indicators and address several of the challenges mentioned above.

In addition, a so-called 'building passport' or 'building log-file', i.e. a data container into which all construction and/or renovation and building maintenance data can be entered and which stays with the building throughout its life cycle would be another useful tool that could enable better information flow and accessibility.

As Table A1 in the Annex demonstrates, there is now a promising number of dedicated initiatives and projects at the national and international level²⁷, however, as the survey findings illustrate, more efforts need to be made to raise awareness about the importance of data collection and management amongst all sector participants, including real estate users.



²⁵ See: <https://ipmsc.org/standards/> ²⁶ See <https://icms-coalition.org/>

²⁷ The IEA EBC Annex 70 Energy Epidemiology at University College London and the EU Building Observatory are two examples of initiatives dedicated to improving the data for buildings and as Table A1 in the ANNEX shows, there are many organisations working on this worldwide.

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Annex A1

Members of the Global Alliance for Buildings and Construction (GABC)

Status September 2017²⁶

GABC Member Category	Individual GABC Members
Countries/ministries/ national agencies	Argentine Republic; Republic of Armenia; Republic of Austria; Federative Republic of Brazil; Republic of Cameroon; Canada; Republic of Finland; French Republic; Federal Republic of Germany; Ivory Coast; Japan; United Mexican States; Mongolia; Kingdom of Morocco; New Zealand; Kingdom of Norway; Russian Federation; Republic of Senegal; Republic of Singapore; Kingdom of Sweden; Kingdom of Thailand; Republic of Tunisia; Ukraine; United Arab Emirates; United States of America; Socialist Republic of Vietnam
Sub-national states/ provinces/cities	Capital City of Warsaw; City of Dubai; City of Vancouver; Mexico City; Province of Ontario; State of California; Tokyo Metropolis
Civil society/non-profit	10-Year Framework of Programmes on Sustainable Consumption and Production Patterns – Sustainable Buildings and Construction Programme (10YFP SBC); Architects' Council of Europe (ACE); Architecture 2030; Autodesk; Brazilian Sustainable Construction Council (CBCS); Climate-KIC; Climate Technology Centre and Network (CTCN); Construction 21; Confederation of International Contractors Association (CICA); Cooperative Research Council for Low Carbon Living (CRCLC); Copenhagen Centre on Energy Efficiency (C2E2); Centre for Renewable Energy and Energy Efficiency (ECREEE); ENERGIES 2050; Energy Cities – Local Authorities in Energy Transition; Federation Française du Bâtiment (FFB); Fibrenergie; French Development Agency (Agence Française de Développement – AFD); The French Environment & Energy Management Agency (Agence de l'Environnement et de la Maîtrise de l'Énergie – ADEME); European Construction Industry Federation (FIEC); Global Buildings Performance Network (GBPN); The Global Environment Facility (GEF); Global District Energy in Cities Initiative; Housing Europe; Housing and Urban Development Ltd.; ICLEI – Local Governments for Sustainability; Institut de la Francophonie pour le Développement Durable (IFDD); International Initiative for a Sustainable Built Environment (iISBE); International Partnership for Energy Efficiency Cooperation (IPEEC); Internal Urban Development Association (INTA); International Passive House Association (IPHA); International Union of Architects (UIA); Investor Confidence Project (ICP); Nubian Vault Association (Association la Voûte Nubienne – AVN); R20 Regions of Climate Action; Réseau Habitat et Francophonie (RHF); Royal Institution of Chartered Surveyors (RICS); Sustainable Energy for All (SEforALL); Swiss contact; The Energy and Resources Institute (TERI); Global Forum on Human Settlements (GFHS); The Prince of Wales's Corporate Leaders Group; Urban Land Institute (ULI); World Business Council for Sustainable Development (WBCSD); World Green Building Council (WorldGBC); US Green Building Council (USGBC); World Resources Institute (WRI); Centre Scientifique et Technique du Bâtiment (CSTB); Royal Institute of British Architects (RIBA); Buildings Performance Institute Europe (BPIE); EuroAce; Renovate Europe; Plan Bâtiment Durable
International organisations/ agencies	International Energy Agency (IEA); The International Finance Corporation (IFC); The International Renewable Energy Agency (IRENA); United Nations Environment Programme (UN Environment), including United Nations Environment Programme Finance Initiative (UN Environment FI); United Nations Human Settlements Programme (UN-Habitat); World Bank / ESMAP
Private sector	Broad Group; Consolidated Contractors Company; Danfoss; Green Building Council South Africa; LafargeHolcim; Saint-Gobain; Sekisui House; Suez Environment; Thermaflex; International B.V.; US Green Building Council; Velux; Veolia

²⁶ A regularly updated list of GABC members is available at: www.globalabc.org/about-gabc/member

Annex A2

Members of GABC Working Group 5 on Measurement, Data and Accountability

WG 5 member organisation [* co-chair]	Location	Name	First name	Position
SAEE Ukraine State Agency on Energy Efficiency and Energy Saving of Ukraine *	Ukraine	TOMLIAK	Kyryl	Advisor to chairman
IEA * International Energy Agency	France	DEAN	Brian	Programme Officer Energy Efficiency Unit
RICS * Royal Institution of Chartered Surveyors	Belgium	HARTENBERGER	Ursula	Global Head of Sustainability
RICS * Royal Institution of Chartered Surveyors	United Kingdom	ERIKSSON	Clare	Director of Global Research & Policy
ICLEI	Germany	BADINO	Miriam	Senior Project Officer – Low Carbon City Team
C2E2 Copenhagen Centre on Energy Efficiency	Denmark	PETRICHENKO	Ksenia	Researcher
CSTB Centre Scientifique et Technique du Bâtiment	France	MESUREUR	Bruno	Director of Standardization, Marketing and International Affairs
Global Forum on Human Settlements	US	HE	Sabrina	Director of Public Affairs Department
Climate-KIC	Sweden	OSTERMEYER	York	Assistant Professor, Division of Building Technology, Research Group Building Physics, Chalmers University
CRCLCL Cooperative Research Council for Low Carbon Living	Australia	PRASAD	Deo	CEO
ICP Investor Confidence Project	USA	BARTHOLOMY	Panama	Director of the EDF Investor Confidence Project Europe
UNEP FI	France	DEGEN	Annie	Special Advisor Long Term Finance
UNEP FI UN Environment Finance Initiative	Switzerland	ULTERINO	Matthew	Consultant
ULI Urban Land Institute	USA	GURFEL	Helen	Executive Director, ULI Greenprint Center
WGBC World Green Building Council	UK	WILLS	Terri	CEO

Annex A2

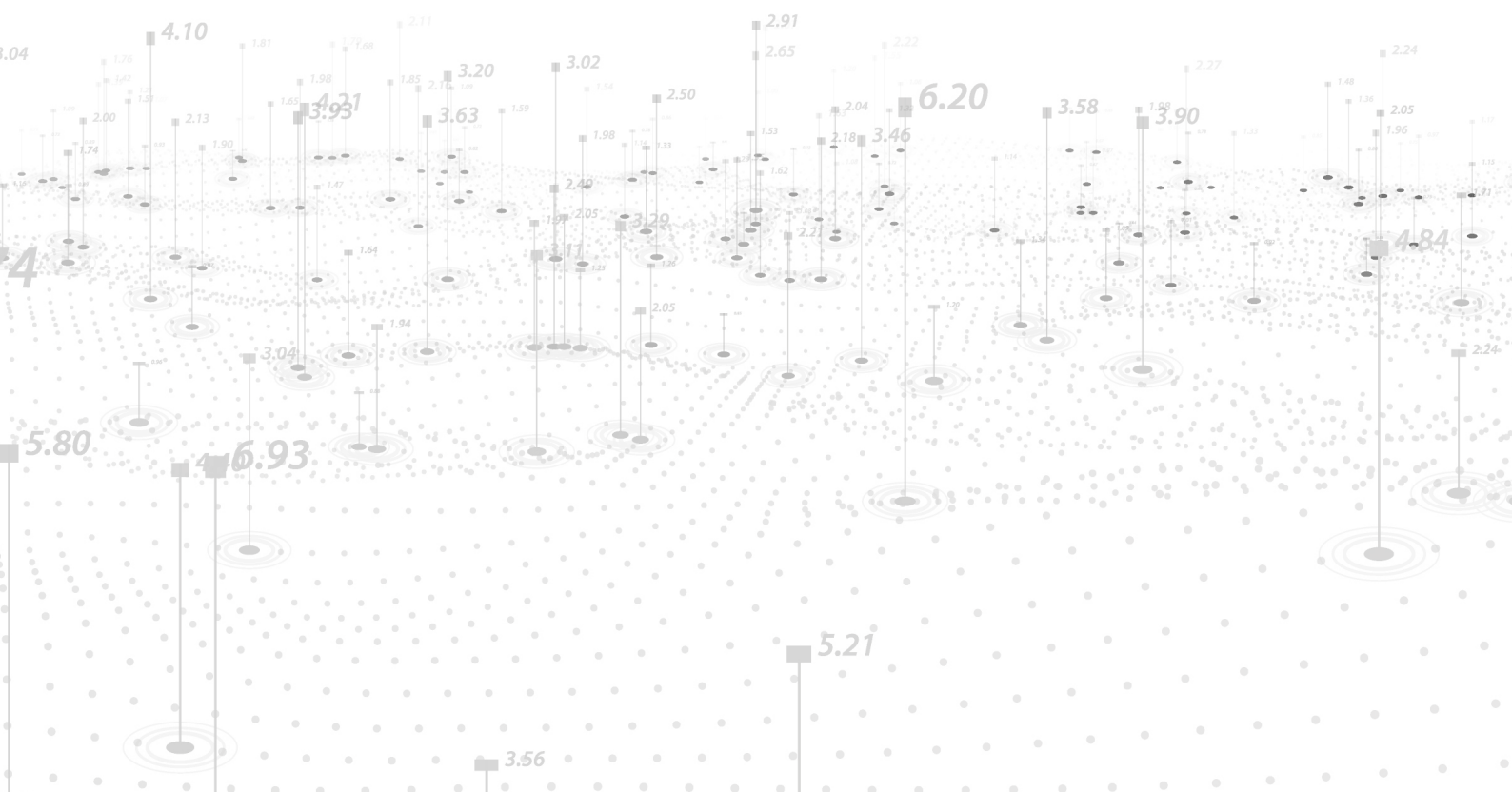
Data capture patterns per data category by supporting value chain stakeholders with indirect impact on financial decision-making (Cluster 2)



Annex A3

Additional data and information captured by respondents from the group of supporting value chain stakeholders

Physical building characteristics data	Environmental performance building characteristics data	Real estate transaction and investment data
Cost of construction	LCA based data	Asset value data
Quality of fit-out and furnishings	Indoor temperature, humidity and VOC levels	Data regarding decision-making for carbon reduction investments
Level of disrepair	Data regarding all ISO 14000 compatible environmental indicators	
Data on non-destructive testing	Data from post-occupancy evaluations	
Information about local, traditional building culture	Expected peak loads for new gas and electricity services	
Safety / accidents data on construction sites		
Number of parking lot spaces / swimming pools		



Annex A4

Overview of global measurement, data capture and management initiatives, projects and tools

Status November 2017

Initiative / Project / Tool	Led by	Geographical relevance	Short summary	Website
IEA and World Bank Global Tracking Framework	International Energy Agency (IEA) / World Bank	Global	An initial system for regular global reporting based on indicators that are both technically rigorous and feasible to compute from current global energy databases, and that offer scope for progressive improvement over time.	https://www.iea.org/publications/freepublications/publication/Global_Tracking_Framework.pdf
Energy Efficiency Indicators: Fundamentals on Statistics	International Energy Agency (IEA)	Global	Provides a solid methodological basis for both improving the resolution of the national energy balances that characterise where energy is consumed in each country and obtaining complementary information on the physical outputs associated with energy consumption in each sector.	https://www.iea.org/publications/freepublications/publication/energy-efficiency-indicators-fundamentals-on-statistics---.html
Energy Efficiency Indicators: Essentials for Policy Making	International Energy Agency (IEA)	Global	Provides a solid methodological basis for policy makers for both improving the resolution of the national energy balances that characterise where energy is consumed in each country and obtaining complementary information on the physical outputs associated with energy consumption in each sector.	http://www.iea.org/publications/freepublications/publication/energy-efficiency-indicators-essentials-for-policy-making.html
Energy Efficiency Indicators Statistics: Country Practices Database	International Energy Agency (IEA)	Global	A supplement to the publication Energy Efficiency Indicators: Fundamentals on Statistics, this database presents practices on collection of data for developing efficiency indicators from a variety of OECD Members and non-Members. Practices are searchable by country and territory, sector, methodology and type of available documentation.	https://www.iea.org/eeindicatorsmanual/
Energy in Buildings and Communities (EBC) Annex 70 – Building Energy Epidemiology: Analysis of real building energy use at scale	International Energy Agency (IEA)	Global	Annex 70 is focussing on identifying, reviewing, evaluating and producing leading edge methods for studying and modelling the building stock including: data collection techniques on energy use, building features and occupant features, and building morphology; analysis of smart meter energy data, building systems, and user behaviour; and modelling energy demand among sub-national and national building stocks.	https://energyepidemiology.org/

Initiative / Project / Tool	Led by	Geographical relevance	Short summary	Website
EBC Annex 72 Assessing Life Cycle Related Environmental Impacts Caused by Buildings	International Energy Agency (IEA)	Global	The project is researching harmonization issues arising when applying life cycle assessment (LCA) approaches on buildings. It functions as a platform to exchange experiences and knowledge within partner countries and to foster the application of LCA on buildings in countries with yet little experience. Deliverables will include national LCA databases used in the construction sector, including standardised characterisation of all relevant LCA databases.	http://www.iea-ebc.org/projects/ongoing-projects/ebc-annex-72/
ICLEI – Local Governments for Sustainability's carbons Climate Registry (cCR)	ICLEI	Global	A reporting platform to support local and subnational governments towards MRV climate action to help improve data collection, comparability and sharing of municipal building energy data and methodologies.	http://carbons.org/
Global Real Estate Sustainability Benchmark	GRESB	Global	A framework to collect and compare key ESG indicators and related performance metrics across global real estate and infrastructure portfolios.	https://www.gresb.com/
Green Building Market Intelligence	International Financing Cooperation (IFC)	Global	The 30 individual country reports include the following information: market growth projections through to 2025 (residential and commercial), total market size potential until 2025, analysis of climate policies for green buildings, market players currently building green.	https://www.edgebuildings.com/
International Property Measurement Standards	International Property Measurement Standards Coalition	Global	A set of international standards that will enable different classes of buildings to be measured on a transparent basis, promoting market efficiency through greater confidence between investors and occupiers by providing consistent property measurements for transactions and valuations.	https://ipmsc.org/standards/
RICS Property Measurement	RICS	Global	This document reflects the first IPMS standard (IPMS: Office Buildings) and will be updated over time to comply with other IPMS standards, including residential, industrial and retail, as they are published.	http://www.rics.org/uk/knowledge/professional-guidance/professional-statements/rics-property-measurement-1st-edition/

Initiative / Project / Tool	Led by	Geographical relevance	Short summary	Website
Level(s)	European Commission	European Union	The aim of Level[s] is to develop a common framework that is open source in the sense that it should be possible to use it: 1) directly by building professionals and their clients to prioritise their focus for making environmental improvements, as well as; 2) indirectly by assessment and certification schemes to ensure that their criteria reflect priority areas of focus for resource efficiency at a European level and to assure the comparability of data and results.	http://susproc.jrc.ec.europa.eu/Efficient_Buildings/
De-risking EE Investment Platform (DEEP)	Energy Efficiency Financing Institutions Group	European Union	DEEP is an open-source initiative to up-scale energy efficiency investments in Europe through the improved sharing and transparent analysis of existing projects in Buildings and Industry. Initially DEEP contains data for over 7,800 building and industry projects.	http://eefig.eu/index.php/deep
ZEB2020	IEE EU funded project	European Union	The EU IEE project ZEB2020 aimed to deliver recommendations and strategies that accelerate the market uptake of nZEBs while having a deep understanding of local contexts, in form of data-tool and nZEB tracker.	http://zebra2020.eu/
EU Building Stock Observatory	EU Commission (DG Energy)	European Union	The EU Building Stock Observatory monitors the energy performance of buildings across Europe.	http://ec.europa.eu/energy/en/eu-buildings-database
ENTRANZE	IEE EU funded project	European Union	As part of the ENTRANZE project, an interactive user-friendly data mapping tool was developed. It contains an in-depth description of the characteristics of buildings and related energy systems in EU-28 and Serbia. It provides data on the thermal quality, size, age, type, ownership structure of buildings, on the heating and cooling systems and on the energy consumption by end-use.	http://www.entranze.eu/tools/interactive-data-tool
ExcEED: European Energy Efficient building district Database	Horizon 2020 EU funded project	European Union	The scope of ExcEED is to create a European database for measured and qualitative data on beyond the state-of-the-art buildings and districts. Key performance indicators (KPIs) will be developed to quantify and benchmark the energy efficiency and the environmental quality at building and district level.	http://www.exceedproject.eu/

Initiative / Project / Tool	Led by	Geographical relevance	Short summary	Website
Energy Efficient Data Portal Initiative (EeDaPP)	Horizon 2020 EU funded project	European Union	The EeDaPP Project intends to deliver large-scale, granular technical and financial data related to energy efficient mortgages by way of a standardised data protocol to be accessed through a common, centralised portal. Three key outputs will be: the definition of specific reporting criteria for the gathering of data on energy efficient mortgages; the design and delivery of the standardised protocol for the gathering, processing and disclosing of such data, and the design of a centralised portal; the analysis of data gathered to further integrate 'green value' in property valuation and substantiate the correlation between energy efficiency and risk.	https://hypo.org/emf/
iNSPiRe	FP7 EU funded project	European Union	iNSPiRe is a 4-year project that will tackle the problem of high-energy consumption by producing systemic renovation kits. Simulation data from three iNSPiRe case study test buildings and case studies will be used to build a database that will serve professionals in the engineering and architectural sectors as well as local authorities and decision makers to inform them of the most efficient and cost effective means of the deep renovation of buildings.	http://inspirefp7.eu/retrofit-solutions-database/
Building Technologies Accelerator (BTA) Building Market Briefs	Climate-KIC	Europe	BTA Building Market Briefs will generate pan-European data and market reports aiming to encourage low-carbon innovation and adoption in the building sector.	http://bta.climate-kic.org/news/bta-building-market-briefs-co-creation-workshop-in-paris/
BBP (Better Buildings Partnership)	Collaboration of leading commercial property owners	United Kingdom	A set of data gathering tools and benchmarks that enable property owners to compare assets, set targets and report on progress.	http://www.betterbuildingspartnership.co.uk/our-priorities/measuring-reporting
BEDES (Building Energy Design Exchange Specification)	Department of Energy Buildings Technology Office	USA	A data dictionary that enables smooth data flow between various tools / databases.	https://energy.gov/eere/buildings/bedes-background
BPD (Building Performance Database)	Department of Energy Buildings Technology Office	USA	An online database that presents anonymised information on building performance and asset characteristics.	https://energy.gov/eere/buildings/frequently-asked-questions-about-building-performance-database

An abstract background featuring a grid of small dots. Overlaid on this are numerous vertical lines of varying heights, each topped with a numerical value. The values range from small numbers like 1.23 to large ones like 12.12. Some lines are accompanied by concentric circles at their base, resembling ripples in water. The overall aesthetic is clean and modern, with a focus on data visualization and geometric patterns.





Confidence through professional standards

RICS promotes and enforces the highest professional qualifications and standards in the development and management of land, real estate, construction and infrastructure. Our name promises the consistent delivery of standards – bringing confidence to the markets we serve.

We accredit 125,000 professionals and any individual or firm registered with RICS is subject to our quality assurance. Their expertise covers property, asset valuation and real estate management; the costing and leadership of construction projects; the development of infrastructure; and the management of natural resources, such as mining, farms and woodland. From environmental assessments and building controls to negotiating land rights in an emerging economy; if our professionals are involved the same standards and ethics apply.

We believe that standards underpin effective markets. With up to seventy per cent of the world's wealth bound up in land and real estate, our sector is vital to economic development, helping to support stable, sustainable investment and growth around the globe.

With offices covering the major political and financial centres of the world, our market presence means we are ideally placed to influence policy and embed professional standards. We work at a cross-governmental level, delivering international standards that will support a safe and vibrant marketplace in land, real estate, construction and infrastructure, for the benefit of all.

We are proud of our reputation and we guard it fiercely, so clients who work with an RICS professional can have confidence in the quality and ethics of the services they receive.

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