WORLD ECONOMIC FORUM

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Industry Agenda

Environmental Sustainability Principles for the Real Estate Industry

World Economic Forum Industry Agenda Council on the Future of Real Estate & Urbanization

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Foreword by the Industry Agenda Council

The World Economic Forum aims to develop a common set of environmental principles in partnership with the real estate industry. The goal of this effort is to ensure that the decision-making and operations of real estate firms place a high priority on becoming environmentally sustainable. Although there are a growing number of diverse environmental standards at the building level, at the company level as well as at the urban and national governmental level, the real estate industry lacks a uniform set of sustainability principles. Current initiatives often lack a wider context, a value proposition and a broader vision. In addition, there is fragmentation and confusion and a widespread belief that real estate lags behind other sectors in responding to environmental challenges.

The Forum recommends that real estate industry leaders commit to a set of sustainability principles and create a community around the diligent adoption of specific initiatives that serve these principles. This represents an opportunity to demonstrate leadership and to shape the agenda, rather than merely responding to regulatory and other external pressures.

The goal is to embody a wider sense of stewardship for the natural environment, consistent with the ethical and professional conduct of business. Moreover, a clear business and economic rationale for embedding environmental sustainability in firm-wide decisions, policies and strategies can result in long-term cost reduction, protected or even enhanced property values and, hence, improved risk-adjusted returns. There are opportunities to embrace new technology and innovation to meet environmental goals and enhance business performance.

The real estate sector should further ensure that all assets contribute to city-wide resilience efforts to minimize the impact of extreme weather events and to speed recovery. Activities should align with city-wide efforts to meet such goals. In particular, we recommend that corporate leadership focus on the following sustainability efforts as part of a commitment from the sector to contribute to meeting sustainable development goals and to the agenda set out in the agreements reached at the United Nations climate change summit in Paris in December 2015. These include reducing greenhouse gas emissions, implementing water/waste management, and reducing pollutants in the air, water and land.

To access the full report "Sustainability Principles for the Real Estate Industry", please go to:
http://www.weforum.org/content/future-real-estate-urbanization-2014-2016

Environmental sustainability principles for the real estate industry

Across the lifecycle of individual portfolios and as key business objectives, and as organizations committed to environmentally sustainable practices for the built environment, we will:

1. *Embed adherence to best-in-class sustainability standards in all aspects of our real estate operations, with board level responsibility for monitoring and disclosing our sustainability performance.*

2. *Ensure that our decisions contribute to improvements in environmental sustainability at the local and urban levels, working cooperatively with tenants, city governments, planners and other stakeholders in achieving our targets.*

3. *Commit to continuous improvement in the environmental performance of construction and development activities, our real estate operations and our asset management policies.*

4. *Track the environmental performance of our real estate assets and operations on a continuous basis, to assess our ecological footprint, and our exposure to risk from natural shocks, environmental regulation and the economic impacts of climate change.*

5. *Identify explicit targets for improving our environmental sustainability performance including specifically in our commitment to minimize emissions of greenhouse gases and to increasing our use of renewable resources.*

Introduction

This report has been produced by the World Economic Forum's Industry Agenda Council on the Future of Real Estate & Urbanization, which brought together a wide range of representatives from the real estate industry, as well as city governments and academia – all united in a common interest in the real estate industry and concern about the impacts of climate change and the environment on the future development of cities and the built environment.

Real estate is central to urban development, consumes physical resources and is a significant source of emissions. Equally, it is central to the goal of creating an environmentally sustainable future. We recognize the imperative to avoid dangerous climate change by limiting global average temperature rise to less than 2°C, and understand that the existing trend of the world's net greenhouse gas (GHG) emissions is not consistent with this ambition. We also acknowledge that the real estate sector is responsible for more than 20% of the world's carbon emissions and for other environmental impacts, including waste production, pollution, use of water and consumption of other natural resources.

Over the past few years, many companies in the sector have taken action to reduce the environmental impact of buildings. We will continue in our efforts to help support sustainable development. We will also play a part in lowering the current global emissions trajectory, supporting adaptation to climate change in cities, reducing pollution and damage to the natural environment, and promoting the principles of the circular economy where possible. We stand ready to work with our stakeholders to implement the UN Sustainable Development Goals and we will tailor our approach to local circumstances.

In this report we first set out as context the contribution of real estate to environmental issues and sustainability. By many metrics, the sector is a major contributor to global emissions and user of non-renewable resources. Despite substantial progress, for example with the growth of green building technologies, the sector lags behind other industries in responding to environmental challenges.

Next we survey evidence on the response of real estate organizations to the adoption of sustainability principles. While many firms have sustainability statements, these lack coherence and consistency. Many do not appear to be principles shaping an organization's policies and strategies, but rather are responsive and focus on measurement and reporting. Adopting a clear set of principles would help the sector to contribute to a more sustainable economy. However, the solutions adopted need to be feasible and valuable and there needs to be a clear business case for making those changes.

The fourth and fifth sections of the report focus on these issues. Finally, we set out our conclusions – a call for the industry to adopt a comprehensive and strategic set of principles to contribute to sustainable development in the built environment.

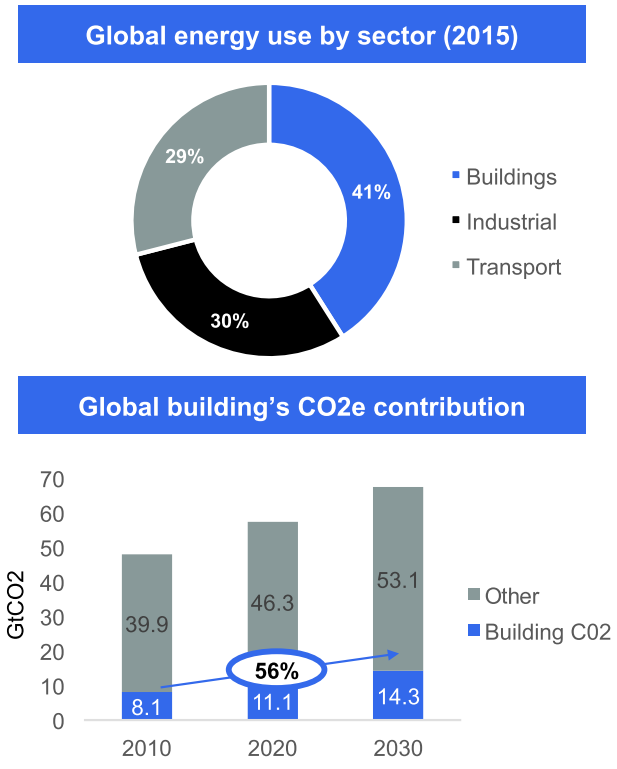
Real Estate and the Environment

The real estate sector uses more energy than any other sector and is a growing contributor to CO_2 emissions. Although measurement is complex, most estimates suggest that the real estate sector is the single most significant sectors in terms of CO2e[1] contributions.

- The sector consumes over 40% of global energy annually
- 20% of total global greenhouse gas emissions originate from buildings
- There is a projected 56% increase in building CO_2 emissions by 2030
- A 7% increase in proportionate share of global GHG emissions is expected by 2030
- Buildings use 40% of raw materials globally (3 billion tonnes annually)

Buildings also have a significant and growing impact on other environmental aspects. For example, by 2030 buildings are expected to use 12% of global fresh water, and generate 30% of total waste in the European Union.

Figure 1: Real estate's contribution to energy use and CO_2 emission



Source: Accenture (adapted from IPCC, USBC, EC)

Figure 2: Environmental impact and contribution of built form

Environmental impact	Share of buildings in total output/use
Raw material consumption[2]	30%
Solid waste generation[3,4]	25-40%
Potable water consumption[5]	12%
Water effluents[6]	20%

Source: JLL from cited material

Global socio-economic forces will make the environmental impact of real estate sector even more important in the future. By most projections, by 2030, the global population will exceed 8 billion and over 60% of the world's population (4.9 billion people) will be living in urban environments. This will lead to significant growth in the construction and real estate market:

- Global construction output will reach $15.5 trillion (3.9% CAGR) by 2030
- Investable real estate will reach US$69 trillion (60% growth from 2015)

The largest 750 cities (representing 61% of global GDP) will require:

- 260 million new homes
- 540 million m^2 of new office space
- 60 million new jobs in industry

Parties to the UN Climate Change Conference (COP21), which took place in Paris, France, in December 2015, agreed to a deal to keep global warming below 2°C and, ideally within 1.5°C. To stay under the 2°C threshold, the real estate sector requires more stringent targets. According to World Bank estimates, a 36% reduction in total CO_2 emissions in the real estate sector is required by 2030 in order to stay within the 2°C threshold. This translates into a 1.25% reduction in annual energy consumption and a 3% reduction in annual emissions. The goal of achieving carbon neutrality by 2050 will require new non-CO_2 emitting energy for the built environment.

Progress made: Green buildings

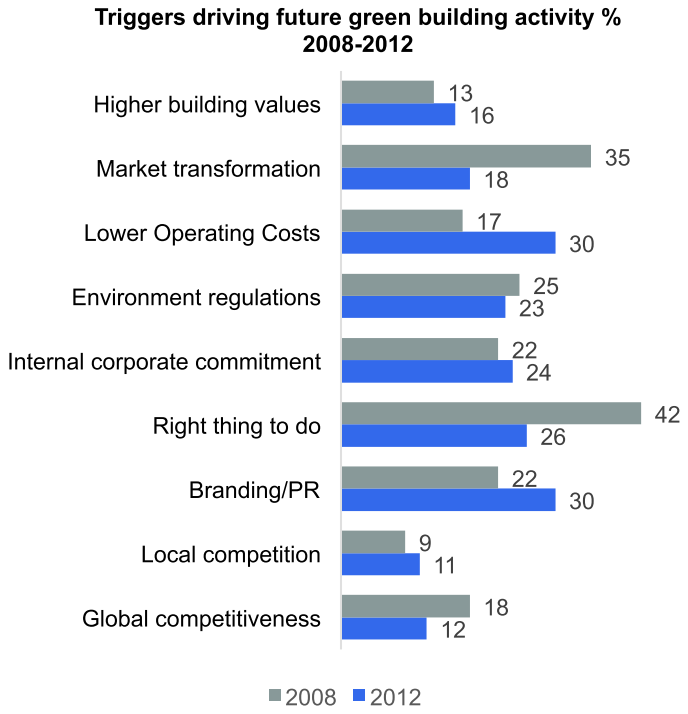
It would be wrong to suggest that the real estate industry has not acknowledged environmental sustainability in its decision-making. In development, there has been a significant shift towards the production of "more environmentally sustainable buildings. Currently, 40-48% of new commercial builds are "green", compared to only 2% in 2005. The percentage of new commercial build properties built green is expected to rise to ~55% in 2020 as new regulations on construction specifications are enforced. The carbon emissions saved by smart technology for new buildings[8] has been estimated at c.44 Mt CO_2e.

Of course, the majority of the world's real estate stock is already in existence, and it is harder to achieve environmental improvements. Nonetheless, there has been a parallel growth in retrofitting to produce greener properties:[9]

- 13% (293 Mt CO_2e) of total carbon emissions savings will come from retrofitted buildings
- 46% of commercial buildings to be covered by LED lighting by 2020
- 25% penetration of building management systems (BMS) for energy efficiency is expected by 2020

This uptake of green building activity is increasingly driven by commercial factors, as much as the idealism that dominated the early 2000s. As survey results show, client and market demand are important drivers, while lower operating costs and branding/PR are now the two biggest factors influencing green building investment decisions.

Figure 3: Green building drivers: Survey evidence



Source: World Green Building Trends Report, Smart Market Report, 2013

Regulation remains a key driving force for energy efficient building design, based on the strong correlation between the number of companies affected by green building regulations and the percentage of green building activity per country.

- 71% of projects valued at $50 million and over have LEED referenced in project specifications
- More than half of firms surveyed by the World Green Building Council reported that they were required by law to work towards and report on a building's sustainability performance
- Typically green building activities lag behind changing regulatory requirements

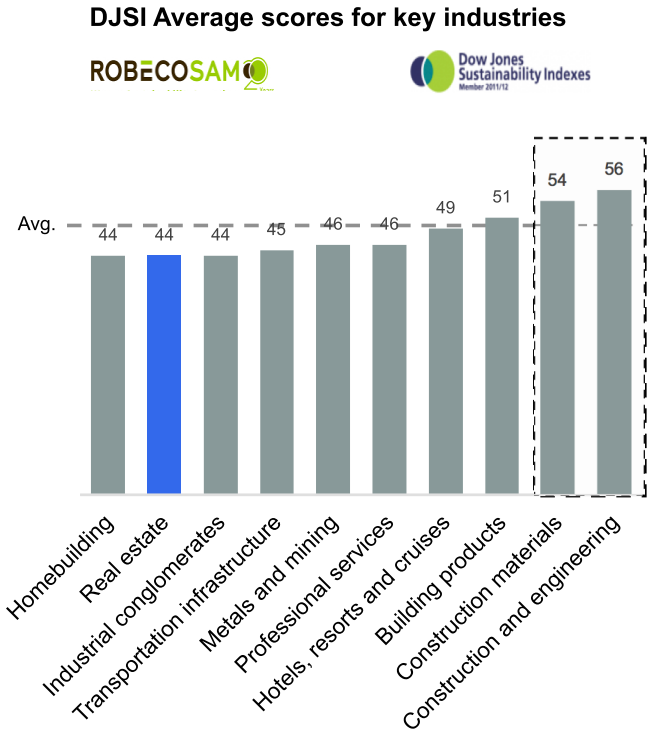
Management and reporting of environmental data in the sector has improved alongside overall performance. The GRESB (Global Real Estate Sustainability Benchmark) survey assesses the environmental, social and governance (ESG) performance of 707 property companies and private equity real estate funds that represent 61,000 assets and $2.3 trillion in asset value. Recent results show that:

- 288 out of 707 property companies and funds have long-term carbon reduction targets
- The average reduction target is a 21% decrease in carbon emissions over a period of 7 years[10]
- 37 companies and funds have reduction targets of 50%(or more), over an average period of 13 years
- Short-term reduction targets (for one year) are in place for 247 companies and funds, with an average reduction target of 7%
- However, 28% of the 707 property and companies and funds reporting to GRESB in 2015 did not provide data on the environmental performance of their real estate

The real estate sector underperforms

Within the real estate value chain, there are noticeable differences between sub-sectors which are at different levels of maturity in addressing their environmental and social impacts, reducing the overall effectiveness of the industry's sustainability efforts. However, the industry trails some industry peers such as construction and engineering or construction materials. From purchase and engineering to design to demolition, there is a lack of an integrated approach in making and managing buildings. This leads to disjointed sustainability outcomes.

Figure 4: Sector sustainability performance



Source: RobecoSAM, DJSI

To meet environmental targets, significant investment is required in both new building and retrofitting in both residential and non-residential segments of the real estate industry:

- Current levels are around $78 billion p.a.
- Annual spending required by 2030 is $130 billion

To achieve this requires ~4% of current annual construction investment by 2025 to unlock the remaining potential gains in environmental sustainability and contribute to limiting global warming to the targets agreed at the Paris climate change conference. If it is to deliver the magnitude of energy savings and GHG mitigation required to stay below 1.5%-2ºC warming, today's state of the art needs to become mainstream. There also needs to be renewed focus on developing countries:

- EU and North America have ~50% of current energy efficiency investment
- Developing countries with higher economic growth rates have significantly less energy efficiency investment

To what extent are those needs reflected in the strategic decision-making processes of real estate firms? Are sustainability principles embedded in the sector's market practices? The next section explores these questions.

A Survey of Existing Practice

Many firms and organizations have statements of environmental policy, sustainability targets or or commitments to reduce carbon emissions. What is the situation in the real estate sector? Are there coherent, common principles for achieving sustainable investment or development? Does the sector have a common view of what is needed to achieve sustainability? To investigate these issues, a targeted survey of existing principle initiatives in the real estate industry was conducted by Jones Lang LaSalle (JLL), their work complementing a data gathering exercise on urban sustainability policies conducted by research students at the National University of Singapore that focused more on government bodies and NGOs.[11] The aim was to focus on the quality and diversity of content, not the quantity of initiatives identified.

The challenge of defining a "sustainability principle" was a considerable one throughout the survey process. Occasionally, clear examples of schemes explicitly labelled as "sustainability principles" were identified that actually contained statements that conformed to our working definition of a principle.[12] However, many of the documents and web pages viewed tended to intermingle principles, assessment criteria, indicators and data on progress without a clear, overarching framework. Some schemes labelled "sustainability principles" might more accurately be described as lists of criteria or indicators. More often, sustainability programmes that did not use the word "principles" but rather policies, frameworks, commitments, goals, etc., and did not readily distinguish between principles and KPIs.

JLL's principle identification work built from existing work by the National University of Singapore, which identified sustainability documents earlier in the Council's research. That group of documents was reviewed to identify unique instances of sustainability principles or principle-like initiatives that pertain to real estate and places. Additionally, as the documents collected by NUS were almost exclusively from governmental bodies and NGOs, an additional survey was conducted to identify principle schemes from real estate companies – one of the target audiences of the Council's proposed principle initiative.

In both the review of NUS documents and the JLL survey of real estate companies:

- Principle schemes were identified if they had any concise, targeted list of statements driving the programme objectives or summarizing its essential characteristics regardless of whether that list was called principles, policy, framework, etc.
- Principle statements were not included if they were not applicable to real estate/urban issues or did not focus in significant part on sustainability.
- Sustainability programmes were not included if they did not have a list of principle or principle-like statements, regardless of how strong or accepted the programme.
- The identification process was limited by the public availability of organizations' sustainability strategies. Some organizations/companies surveyed for which no principles were found actually have principle or similar initiatives, but do not make that information publically available.

Figure 5 summarizes the number of principle initiatives identified and analysed.

Figure 5: Number and Percentage of principle initiatives

	Government/NGOs (NUS)	Real Estate Companies (JLL)	Total
Initiatives with "principle" in the title	6 / 9%	6 / 10%	12 / 10%
Principle and principle-like initiatives	13 / 19%	32 / 55%	45 / 36%
Full number of organizations surveyed	67 / 100%	58 / 100%	125 / 100%

Source: JLL Survey of Sustainability Statements, Q3 2015.

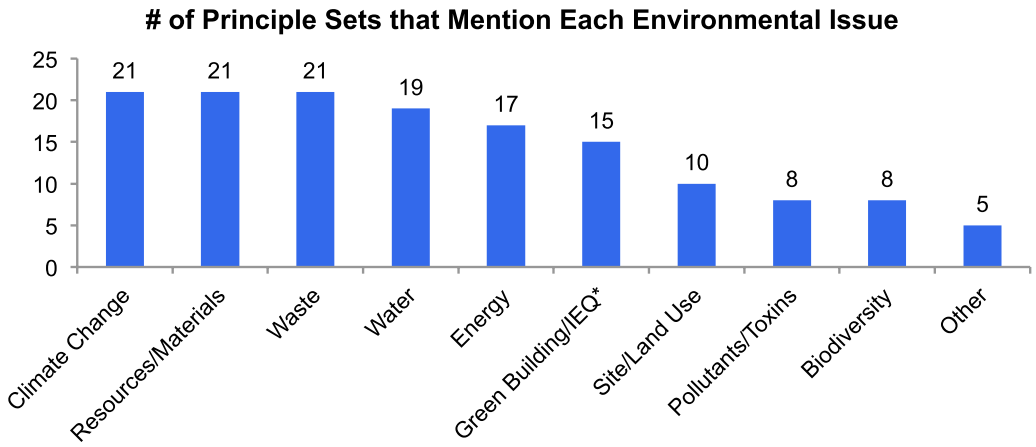
Statements of sustainability principles were largely retrieved from material publically available, typically on organizational websites. Several individuals working on sustainability issues for real estate companies identified by Industry Agenda Council Members were also contacted directly. Principle documents obtained through this method were included in the analysis, but they also led to conversations that revealed a number of recurring themes.

- A number of companies have extensive sustainability programmes in place, but do not have explicitly developed principles or principle-like initiatives. This finding was corroborated by web reviews of real estate companies with strong sustainability programmes. This gap in the development of such principles is an indicator that the Council-developed principles could prove useful for the industry.
- Several of the companies indicated that they were currently in the process of developing their own principles or policies – a potential indicator of growing interest in this area.
- Many companies indicated that they are already engaged in a number of other programmes with significant reporting requirements. The implication of this is that those companies might be less supportive of principle initiatives that involved new reporting requirements.

Below are out findings from analysis and examination of the principles identified in the surveys, which point to a number of common themes and issues:

- Companies with principle initiatives include investment managers, REITs, real estate service providers, investors and occupiers. Only one set of principles was from an occupier – we assume that more occupiers are guided by a set of principles, but that many such initiatives are internal, without publicly available documentation. Since the survey was targeted at the real estate sector, only one of the non-occupier companies with an initiative identified had significant business interests outside real estate.
- Government and NGO principle initiatives from the NUS list were from generally organizations focused on green buildings, programmes/goals for cities/governments/places, or corporate and real estate reporting.
- Almost half of the initiatives identified were from companies or organizations that operate across multiple continents. The ratio changed when we added several more single-country firms from Asia and LatAM.
- The median number of principle statements per initiative was six although there were some with as few as three and as many as 17 initiatives.
- While the principle identification was geared toward environmental sustainability principles, in line with the Council's stated goals, a number of sustainability principle or principle-like initiatives that take a triple-bottom-line or ESG approach to sustainability were identified, as well. These initiatives put an emphasis on social and environmental or social and governance concerns, in addition to environmental.
- Principles initiatives were roughly evenly mixed as to whether principle statements were organized around business issues (13), environmental/sustainability issues (12), or used both approaches (12). Companies were slightly more likely to have initiatives organized around business issues while the reverse was true for NGOs and Government organisations. However, both sets of organizations utilized both approaches.
  - An example of a principle statement focused on a business issue is this one from Oxford Properties: "*Innovation – We foster innovation in technology and building management practices aimed at higher levels of sustainability.*"
  - An example of a principle-like statement focused on an environmental/sustainability issue is this abbreviated one from DGNB: "*Life Cycle Assessment – Buildings generate emissions in all phases of their life cycle, from manufacture through use up to their end of life... The objective is therefore to reduce buildings' emissions throughout their entire life cycle as much as possible.*"

Figure 6: Wide Diversity of Environmental Issues Identified in the Survey



Source: JLL, LaSalle.
*IEQ = Indoor Environmental Quality. Some principle sets were about green building, so while underlying principles may not have mentioned green building, that does not indicate it is not given strong attention.

Figure 7: Number of principle initiatives identified

System	Full Name	Audience	Major Sustainability Issues	System for…
ULI – Greenprint	Urban Land Institute – Greenprint	Building owners/ operators/users	Climate change, energy, water, waste	Data collection, analysis, benchmarking and reporting
GRI – CRESS	Global Reporting Initiative – Construction and Real Estate Sector Supplement	Companies that invest in/develop/construct/ manage buildings or infrastructure	Economic, environment, labour, human rights, society, product responsibility	Sustainability reporting
UN PRI	United Nations – Principles for Responsible Investment	Institutional investors	Environmental, social, governance	Signed principles + reporting framework
GRESB	Global Real Estate Sustainability Benchmark	Institutional Investors	Energy, GHG, water, waste	Sustainability performance benchmarking
Energy Star – Portfolio Manager	Energy Star – Portfolio Manager	Building owners/ operators/ users	Energy, water, GHG	Tracking and benchmarking
CDP	Carbon Disclosure	Investors and companies (mostly)	Climate change, water, forests	Measurement and reporting
USGBC – LEED	US Green Building Council – Leadership in Energy and Environmental Design	Developers and building owner/ operators/users	Green building	Green building certification
BREEAM	Building Research Establishment Environmental Assessment Methodology	Developers and building owner/ operators/users	Green building	Green building certification
WBCSD – EEB	World Business Council for Sustainable Development – Energy Efficiency in Buildings	Large building portfolio owners/managers	Energy	Decision-making/ overcoming barriers to energy efficiency
ISO 14001 – Environmental Management	International Organization of Standardization 14001 – Environmental Management	Companies	[Varies]	Framework for development of environmental management systems

- The line between principles and criteria was often blurred in the initiatives identified.
- The scope of implementation plans for the identified initiatives varied widely. Some had none while others had none stated but likely had implementation guidance elsewhere. Some focused on assigning responsibility while others focused on programmes or reporting. Some utilized internal implementation/reporting systems while others utilized external systems. The very broad scope of these approaches makes it difficult to summarize the approaches used. However, a table of common/well-known existing global implementation and reporting systems appears below. A number of these are commonly used among the principle and principle-like initiatives surveyed.

In summary, while there has clearly been a move to more environmentally sustainable practices in real estate, many of the sustainability statements and policies identified did not make a clear distinction between the underlying principles relating to the activities of those organizations and the methods, measurement and monitoring that followed from general aims.

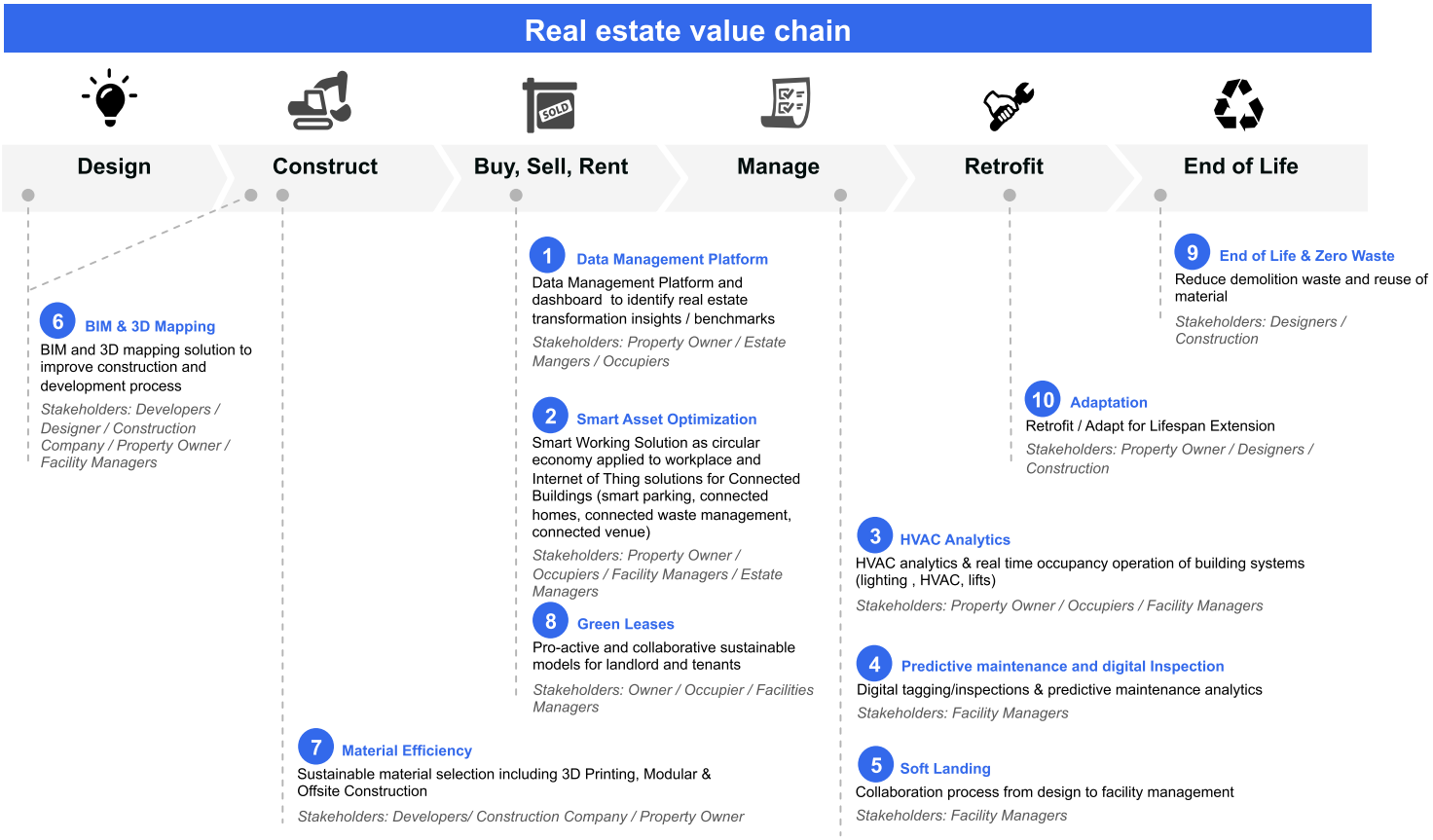
This confirmed our view that a simple but powerful and coherent set of *principles* for environmental sustainability in the real estate sector would be valuable in shaping the strategic decisions of real estate organisations in helping to meet the commitments from COP21 and the aim of creating a more sustainable economy.

Sustainable Solutions for Real Estate

City-scale actions by the real estate sector could decrease global GHG emissions by 3.7 Gt CO2e from a reference scenario in 2030 and by 8.0 Gt CO2e in 2050. This corresponds to roughly 6% of global business-as-usual GHG emissions in 2030, and 11% in 2050, without damaging bottom line profits. Similarly, improvements in space and water heating could reduce urban housing emissions by 1.1 Gt CO_2e annually in 2030 and by 2.0 Gt CO2e annually in 2050.[13]

This is achievable through application of existing proven technologies. Rapid introduction of low-energy appliances (including home electronics and kitchen equipment, among others) and lighting (especially LED lighting) reduce emissions even further, as does the increasing installation of solar PV technologies on building rooftops and facades. Figure 8 sets out 10 solutions from different stages of the value chain which are live and implemented. Further details and case studies are provided in Appendix I.

Figure 8: Ten environmental solutions along the value chain



Source: Accenture

Similar improvements in building energy are possible in urban commercial buildings. Since commercial buildings require greater use of appliances and lighting than in most residences, the abatement potential from these technologies is proportionally greater. The Council has identified examples of existing technologies that can be applied all through the real estate value chain to improve the performance of real estate organizations, protect them from environmental shocks and be part of the real estate sector's commitment to meeting global environmental commitments – a true business case for being part of the solution not part of the problem. We examine this further in the next section.

Environmental Sustainability: The Business Case

Investors in real estate assets whether they are owners acquiring, operating or refurbishing assets, developers constructing new or refurbishing existing assets, or occupiers operating or refurbishing assets, all have been interested in the relationship between financial and the environmental performance of real estate assets.
There is a growing body of evidence that new or existing buildings that can deliver superior environmental performance ("green buildings") can also deliver a range of tangible and intangible financial performance benefits to developers, investors, occupiers and other stakeholders. At the core of the business case for green buildings is improved returns and reduced risk as investors and occupiers can share a bundle of benefits such as direct cost savings, image improvements, increased liquidity and lettability, lower depreciation and reduced regulatory risk, among others. Even were there no premia at building level for environmentally sustainable real estate, there would still be an economic case for greener buildings, to reduce the wider economic costs of climate change, which will fall on business as well as government and wider society.

Although isolating the effects of environmental factors from other factors affecting values, operational costs, productivity, etc. is challenging, the vast majority of the empirical evidence suggests that green buildings attract rental and capital value premiums. Most studies have concentrated on environmental labelling (having an energy efficiency designation such as Energy Star, or a more wholistic green building certification such as LEED, BREEAM, Green Mark or other national equivalents) or on energy performance certificates, with analyses dominated by office and residential sectors. US-based analysis dominated early research, but there are now results available for a wide range of countries including Australia, Belgium, China, England, France, Germany, Ireland, Japan, Singapore and the US. Although results vary, there is broad consistency of findings:

- Substantial office market capital value premia (or lower cap rates) are found for properties with strong environmental labels and certification
- Residential prices tend to rise with improvements in energy performance certification
- Tenants appear willing to pay higher rents for energy efficient properties
- Occupancy rates are greater and the probability of lease renewals is higher for more energy efficient properties

Figure 9: Examples of studies of green premia [14]

Authors	Location/Sector	Green Label	Impact Found
Australian Bureau of Statistics (2007)	Australian residential	Energy Efficiency Rating	2-6% sales premia with energy rating, increasing with rating level
Miller et al. (2008)	US class A offices	LEED/Energy Star	No sales premium, 2-4% higher occupancy rate, 30% lower occupancy costs
Eichholtz et al. (2010)	US offices	LEED/Energy Star	3% rent premium; 19% sales premium
Fuerst & McAllister (2010)	US offices	LEED/Energy Star	3-5% rental premia, ~15% price premium, 1-3% higher occupancy rate
Brounen & Kok (2011)	Netherlands residential	EPC	3-10% price premium for ABC, 1-5% discount for EFG
Deng et al. (2011)	Singapore residential	Green Mark	3-6% price premium, rising to 14% for Platinum
Newell et al. (2011)	Australian offices	Green Star	1% rent premium, 2% price premium for highest rated, discounts for low rating
Wiley et al. (2011)	US class A offices	LEED/Energy Star	Occupancy rates 10-18% higher for labelled buildings
Hyland et al. (2013)	Irish residential	Energy Efficiency Rating	Sales premium 6-11% for A/B; rent premium 2-4% for A/B. Discounts for low rating
European Commission (2013)	Various countries, residential	Energy rating	Austria 4% per grade rent premium, 8%price premium; Belgium 3-5% price premium per 100pts; France 4% price premium per grade; Ireland 3% price premium per grade
Fuerst et al. (2013)	UK residential	EPC	Compared to lowest rating 6-14% premium, regional variations

The mechanisms that generate such benefits are difficult to analyse formally. In terms of rental income, some of the factors include:

- Tenants are likely to pay higher rents if their energy costs are lower over the period of their occupation (assuming they are directly responsible for utility costs), lower costs increasing profitability[15]
- Tenants and investors obtain branding and marketing benefits from investing in or occupying green buildings
- Talents are more attracted to work for an eco-friendly company (e.g. 80% of young professionals in the US are interested in securing a job that has a positive impact on the environment), green buildings acting as a signal of eco-friendliness
- Worker satisfaction has been found to be higher and staff turnover lower in environmentally friendly and healthy workplaces, another source of increasing productivity
- Regulation and environmental policy decisions by corporate occupiers reduce the demand for less sustainable property (in many countries, government occupiers are required to procure energy efficient buildings, for example)

Higher rental income (and reduced loss of income from vacancy) should be capitalized into investment property prices. Similarly, energy cost savings will encourage owner occupiers (whether commercial or residential) to pay higher prices. For investors, acquiring more environmentally sustainable buildings should reduce risk, the lower risk premium reducing cap rates:

- Green buildings are less vulnerable to changes in government environmental regulation[16]
- Green buildings are less vulnerable to institutional investors moving to environmentally sustainable investment policies
- Environmentally sustainable buildings may be more resilient to climate shocks, energy price shocks and similar
- The income stream from environmentally sustainable properties is less vulnerable to the growth of green procurement policies by corporate occupiers and residential tenants.

Firms adopting more environmentally sustainable strategies have benefitted from first mover advantages and can benefit from both technological change and behavioural shifts. Further benefits include:

- Access to creditors offering green loans at preferential rates
- Access to equity capital from green funds and ethical investment funds
- Beneficial effects on equity prices for listed firms
- Reduced risk of community and political opposition to projects, limiting potential delays and additional costs
- Ability to recruit and retain best staff attracted to organisations committed to environmentally sustainable policies

While there is growing evidence of these benefits and, as noted above, construction of green buildings has accelerated rapidly, there seems to be a reluctance to embrace fully environmentally sustainable development practices. In part, this may relate to difficulties in adopting new and unfamiliar production technologies (allied to concerns that those technologies might pose issues for valuers and appraisers). However, a key issue is perceptions about the cost of producing environmentally sustainable buildings and the extent to which that cost is fully recouped in increases in capital values. The common misaligned incentives problem in leasing can also be an issue in existing buildings. Tenants may be unwilling to invest in improving the environmental performance of buildings where a significant proportion of the financial returns may flow to the owner and vice versa.

In terms of financial costs, the evidence suggests that green buildings cost only ~2-9% more than conventional ones to construct, although perception of the cost premium is much higher, at 13-18%. In addition, costs are expected to decrease further over the coming years due to scale and advanced technological improvements (as is evident, for example, in the falling price and rising reliability of photovoltaic panels). Given the size of rental and capital value premia identified, this suggests that an environmentally sustainable focus would significantly enhance projects' profitability margins. Furthermore, the future costs of mitigating poor environmental standards in construction may be considerable, both for developers holding assets and for investors acquiring new assets with poor environmental qualities.

Similar principles apply to consideration of risk and return at portfolio level. Investors can enhance risk adjusted returns by ensuring that their portfolio of real estate assets both benefits from higher rental income and lower void periods, but also is protected from environmental risks. An environmentally sustainable portfolio can attract capital from the widest range of potential investors and is better protected from regulatory change, jumps in energy prices (e.g. from carbon taxes), environmental shocks and shifts in tenant and investor behaviour and decision-making.

The business case for more environmentally sustainable decisions extends beyond the building to include the location of activity. Development of, and investment in, real estate in more environmentally sustainable and resilient cities (whether that is due to their physical attributes or to the policy decisions of city managers and governors) are likely to prove more profitable in the long term. This should not be a passive process: the real estate sector can contribute to a more sustainable built environment by working cooperatively with other organizations committed to sustainable solutions and by encouraging greener development policies – in its own best interests.

There are strong and plausible reasons to expect a range of tangible benefits such as higher rents and sale prices, lower operating costs, increased occupancy rates, higher liquidity, increased productivity, lower depreciation, tax benefits, etc. and intangible benefits such as image and branding, future proofing to, in turn, produce financial benefits for investors in and occupiers of real estate assets with superior environmental performance. More evidence is emerging to support these expectations. However, it is also to be expected that willingness to pay for these benefits associated with enhanced environmental performance will vary over time, among different market segments as well as between buildings as energy costs, energy consumption, investor and occupier preferences and economic structure also vary over time and between markets. As a result, the evidence on the business case for green buildings should continue to evolve and should, in turn, be updated.

Towards a More Sustainable Real Estate Sector

This report has shown that:

- The real estate sector is a major contributor to GHG emissions and to consumption of non-renewable resources
- The real estate sector lags behind other sectors and industries in responding to the challenges of environmental sustainability
- There is a clear business case for adopting more sustainable practices in the built environment, improving returns and ameliorating risks at the building, portfolio and city levels
- There is a lack of coherence and consistency in the responses to environmental challenges with many organizations having no policies, or adopting policies that focus on measurement and monitoring rather than strategic decision-making.

Although there are a growing number of environmental standards at the building, company, and urban and national governmental levels, the real estate industry lacks a single set of sustainability principles. Current initiatives often lack a wider context, a value proposition and a broader vision. In addition, there is fragmentation and confusion and a widespread belief that real estate lags behind other sectors in responding to environmental challenges.

The World Economic Forum recommends that real estate industry leaders commit to a set of sustainability strategies and create a community around the diligent adoption of specific initiatives that serve these principles. This represents an opportunity to demonstrate leadership and to shape the agenda, rather than merely responding to regulatory and other external pressures.

The goal is to embody a wider sense of stewardship for the natural environment, consistent with the ethical and professional conduct of business. Moreover, a clear business and economic rationale for embedding environmental sustainability in firm-wide decisions, policies and strategies, can result in improved risk-adjusted returns, long-run cost reduction and enhanced property values. There are opportunities to embrace new technology and innovation to meet environmental goals and enhance business performance.

The sector should further ensure that all assets contribute to city-wide resilience efforts to minimize the impact of extreme weather events and to speed recovery. Activities should align with city-wide efforts to meet such goals.
In addition, corporate leadership sustainability efforts should focus on reducing greenhouse gas emissions, implementing water/waste management, and reducing pollutants in air, water and land (surface and underground) as part of a commitment from the sector to contribute to meeting sustainable development goals and to contribute to the agenda set out in the agreements reached at the United Nations climate change summit.

Environmental sustainability principles for the real estate industry

Across the lifecycle of individual portfolios and as key business objectives, and as organizations committed to environmentally sustainable practices for the built environment, we will:

1. *Embed adherence to best in class sustainability standards in all aspects of our real estate operations, with board level responsibility for monitoring and disclosing our sustainability performance.*

2. *Ensure that our decisions contribute to improvements in environmental sustainability at the local and urban levels, working cooperatively with tenants, city governments, planners and other stakeholders in achieving our targets.*

3. *Commit to continuous improvement in the environmental performance of construction and development activities, our real estate operations and our asset management policies.*

4. *Track the environmental performance of our real estate assets and operations on a continuous basis, to assess our ecological footprint, and our exposure to risk from natural shocks, environmental regulation and the economic impacts of climate change.*

5. *Identify explicit targets for improving our environmental sustainability performance including specifically in our commitment to minimize emissions of greenhouse gases and to increasing our use of renewable resources.*

Appendix I: Examples of Environmental Initiatives in the Built Environment[17]

Solution 1: Data Management Platform

What is it?
A digital dashboard that is user friendly and mobile accessible, that tracks key performance indicators (KPIs) – for example energy use, water usage, waste disposal, space utilization, greenhouse gas (GHG) emissions together with asset data such as rent, lease detail, head counts, etc. It also tracks the costs associated with each KPI and support to identify scenario for portfolio optimisation.

Applicability

Single building	*Poor.* Solution not applicable for single buildings
Development /city	*Good.* Estimates new development impact on existing infrastructure and better estimate actions. Also provides data to utilities and government to optimize urban systems
Portfolio	*Excellent.* Portfolio transformation insights driven by data from different sources are usually not comparable. Easy access to building performance and improvement tracking

Key benefits

Value for property owners
- Avoid asset depreciation and critical expenditure by forecasting risks
- Optimize energy efficiency investments
- Identify achievable sustainability targets and improve corporate sustainability reporting performance

Value for estate manager
- Improve the understanding of building performance for the acquisition process and reduce risks
- Increase revenue and reduce void period due to increase of sustainability conscious corporate demand

Case studies

AEW Capital Management
AEW currently manages nearly $30 billion of real estate assets in their North American portfolio and sought to reorganize their property data all together in one location. The integration of a portion of EW's portfolio into a digital platform allowed them to submit for two of AEW's US investment funds to GRESB in 2015, reduce energy and water consumption as well as improved waste diversion and ENERGY STAR scores.

Netherlands' Central Government Real Estate Agency (CGI)
CGI provides a modern platform for optimal real estate management for a complete overview of real estate. The platform allowed CGI to enable optimal management of buildings and properties, and enables planning ahead to save costs and resources.

Microsoft
Microsoft's adoption of a single software platform to automating energy and sustainability data collection to support CDP reporting and informing efficiency and cost-saving decisions by providing a wide range of environmental performance analytics such as benchmarking, forecasting and marginal abatement cost analysis tools.

Solution 2: Smart Asset Optimization

What is it?
Smart working is an unconventional organizational model characterized by more flexibility and autonomy in the choice of spaces, locations and working hours that result in a reduction of energy consumption, an optimization of space utilization and reduced environmental impact for employee commuting. Workplace sharing solutions are enabled by digital technologies such as smart booking, smart parking, mobile apps and a collaborative Internet of Things (IoT) platform for resource sharing.

Applicability

Single building	*Good.* Good cost and carbon reduction for new HQ applications. Reduced impact for existing buildings if consider in isolation
Development /city	*Excellent.* Higher carbon emission reduction due to possible implementation of solution such as smart parking, smart waste management and smart retail
Portfolio	*Excellent.* Smart working applied to corporate portfolio could reduce by 40% CO_2 Emission including employee commuting

Key benefits

Value for property owners
– Reduced void rates
– Asset consolidation

Value for estate manager
– Revenue growth from alternative services

Value for occupier:
– Improve productivity by 20%
– Reduction in energy consumption by 25%
– Reduce in operating cost and physical space by 30%

Case studies

Vodafone
By implementing better ways of working at their UK headquarters, Vodafone achieved a 20% improvement in productivity, cost savings of £40.7 million and carbon reductions of 617 tonnes of CO2 over the last five years. The mobile working policy in the Netherlands led to an estimated 25% cut in emissions from employee commuting.

UniCredit
The "Piani Città" project, launched in 2010, included the main European locations of the group and is a great challenge to implement a sustainable rationalization, based on smart working models and asset consolidation with a target of reduction of approximately 50.000 tonnes of CO_2 per year.

City of Chicago
Investment in open superfast broadband infrastructure, community engagement, as well as technology innovation, are all part of the Chicago's aspiration to create the "City-as-a-Platform" where products and services can be built on city owned resources.

Solution 3: HVAC Analytics and Occupancy Adaptation

What is it?
Points data (such as supply and return air temperature) is collected with high frequency from heating, ventilation and air conditioning equipment, and analysed against a bank of building physics and mechanical engineering algorithms to find operational efficiencies. These efficiencies can be checked against design values with speed and accuracy to enable fast changes, enabling agile and sustainable operations in small buildings and entire campuses. Operations can then be altered to live occupancy monitoring sensors – ensuring that only occupied zones utilise the benefits.

Applicability

Single building	*Excellent.* A simple Building Management System (BMS) or gateway device needed – better for buildings above 10,000m^2
Development /city	*Good.* Development/cities scale integrations possible, but ownership of actions unclear
Portfolio	*Excellent.* More complex data infrastructure needed, but analytics can be employed from equipment to portfolio level

Key benefits

Value for property owners
– 10-25% reduction in energy consumption and spend
– 15-20% reduction in carbon emissions
– Improved occupant comfort

Value for estate manager
– 10-25% reduction in energy consumption and spend
– 15-20% reduction in carbon emissions
– Powerful tool for BMS logic

Value for occupier
– Improved comfort levels
– Predictive comfort adaptation
– Enhanced sustainability culture

Case studies

Leading technology company
Employed HVAC analytics across a 2.5 million square foot campus in India, saving 10% on energy consumption despite high technology load.

National utility company
Integrated equipment connected to their BMS with HVAC analytics; achieved 19% saving in energy spend in one year.

Facilities management company
Integrated the heating, ventilation and air conditioning equipment of a client site, achieving a 15% reduction in energy spend in 18 months.

Large shopping mall
Connected shared and individual retailer HVAC equipment through central system, running analytics to realize energy consumption reductions of 10-15% annually.

Solution 4: Digital Inspections and Predictive Maintenance

What is it?
Digital inspections and asset tagging allows for paperless, rapid and accurate insights to the current maintenance state of a property. Aggregated portfolio level data allows for optimum resource buying, use and replacement. Combined with analytics, this data, in conjunction with HVAC performance data can be used to provide predictive maintenance for equipment, preventing catastrophic failure and efficient running.

Applicability

Single building	*Excellent.* A simple Building Management System (BMS) or gateway device needed – better for buildings above 10,000m^2. Building to have assets tagged
Development /city	*Good.* Development/cities scale integrations possible, but ownership of actions unclear
Portfolio	*Excellent.* More complex data infrastructure needed, but analytics can be employed from equipment to portfolio level. Provides powerful economies of scale

Key benefits

Value for property owners
- 10-25% decrease in maintenance
- Reduced carbon emissions from inefficient operation, including reduced need for replacement equipment, reduced embodied carbon
- Reduced risk of catastrophic failure and extended lifespan of equipment
- Reduced waste from replacement parts and more efficient use of time

Case studies

American private healthcare chain
A key operational risk mitigation tool that ensures the equipment protecting life does not fail. It allows for more informed facility scheduling and maintenance.

International hotel chain
Use of predictive maintenance analytics across all rooms in several hotels. The hotel chain reports that they save 5% in maintenance from the insights generated by the analytics.

University
A notable university claims to have saved 10%-15% in the first six months of employing predictive maintenance equipment.

Solution 5: Soft Landing

What is it?
Soft landings is a process for graduated handover of a new or refurbished building, where a period of professional aftercare by the project team is a client requirement, planned for and carried out from project inception onwards and for up to three years post-completion. Soft landings require clients to appoint designers and constructors to stay involved with their new building beyond practical completion and into the critical initial period of occupation. This will assist building managers during the first months of operation, help fine-tune and de-bug the systems.

Applicability

Single building	*Excellent.* High value for maintaining high sustainability performance across the building lifecycle
Development /city	*Good.* Effective for campus or multi-function development with complex centralized systems
Portfolio	*N/A*

Key benefits

Value for property owners:
- Maintain Sustainability Design Performance and enable O&M Sustainability Certification (ex. LEED)

Value for estate manager
- Better understanding of building operation and sustainability targets
- Reduced risk to manage complex new technologies

Value for occupier
- Improved occupiers comfort
- Reduced risk of disruption for late integration requirements

Case studies

London Borough of Southwark
The Private Finance Initiative (PFI) schools project for Southwark is a major schools rebuilding programme, part of Building Schools for the Future (BSF). The school was able to achieve the strong carbon emission target of 27kg CO_2/m^2 and introduce effective procedure by early involvement of IT and catering expertise.

Estover College, Plymouth
Early involvement of ICT expertise resulted in avoidance of late attempts at integration that could cause difficulties with servicing, energy use, comfort conditioning and daylighting.

Keynsham Town Hall
The brief for this new office includes achieving an A-rated Display Energy Certificate (DEC). The soft landings approach delivered a high-performance building.

Solution 6: BIM and 3D Mapping

What is it?
Building Information Modelling (BIM) is a process used to design, construct and manage a construction project. BIM models are a digital representation of projects allowing various stakeholders to share, access and analysis data-rich information. BIM can integrate sustainability issues within the lifecycle of a project. It can help streamline the delivery process by identifying materials used and where they are sourced from and ensure the reduction of embedded carbon. It can reduce site waste and reduce energy costs. BIM contributes to an improvement in the quality of output. Laser scanning and 3D mapping allows existing built environment data to be incorporated into a BIM model.[18]

Applicability

Single building	*Excellent.* Allows designer to predict energy efficiency and embodied carbon and adjust design as necessary
Development /city	*Good.* 3D mapping and laser scanning allows BIM models to tap into a wider developments and check local infrastructure capabilities
Portfolio	*Good.* More complex and vast data sets needed; however, portfolio level data provides high-level benchmarking insights

Key benefits

Value for property owners:
- Meet certification requirements (BREEAM, LEED)
- Cost appraisal of building materials
- 3D mapping mitigates unforeseen site risks

Value for estate manager
- Ongoing data analysis of a project
- Efficient and effective building maintenance

Value for designer
- Enhances efficiency and improves productivity
- Collaborative approach across disciplines improves communication
- BIM clash detection mitigates risks
- Advanced modelling

Case studies

Leading European broadcaster
Use of BIM for a leading broadcaster allowed their new building to reduce energy consumption by 67% through BIM design iterations versus traditional design methods.

City of Chicago
Used subterranean 3D modelling to understand the infrastructure capacity for new developments, making strategic one-time decisions for developments.

HOK, architectural service practice
Attributes a 25% operating energy consumption reduction to their schemes as a result of employing BIUM design.

Solution 7: Material Efficiency

What is it?
Construction waste can be minimized by optimizing structural components using advanced computer modelling techniques. Additive manufacturing (3D printing) ensures that only required material is used, with zero wastage. Modular and offsite construction ensure safe, controlled environments, where fewer mistakes are made leading to less material wastage and H&S incidents. Modular design delivers efficiency-of-scale benefits, allowing construction methods to be optimized to reduce waste. Furthermore, choosing materials on the basis of sustainability (e.g. timber structural elements rather than steel) can reduce embodied carbon in the design phase.

Applicability

Single building	*Excellent.* Material efficiency initiatives help reduce cost and time of construction while enhancing environmental sustainability
Development /city	*Good.* Advanced material efficiency technologies enables cities to adapt and retrofit insulation
Portfolio	*Excellent.* Modular, offsite construction enables large building projects to be constructed rapidly and efficiently, reducing material waste

Key benefits

Value for property owners
- Reduced labour costs
- Components printed to order on site, minimizing waste generation

Value for estate manager
- Reduce on site health and safety risks by replacing on site jobs with off-site manufacturing
- Faster and more accurate manufacturing

Value for designer:
- Increased potential for complex design solutions that can be manufactured with relative ease and low costs
- Reduction in embodied carbon; selection of correct materials

Case studies

Yingchuang
A Chinese construction firm that 3D prints 10 houses in 24 hours.

Leading engineering and architecture practice
Arup produced a steel component prototype, with relative low cost compared to traditional manufacturing methods. The node was complex in design and made from maraging steel.

Eurocode 5
Has seen some changes in recent years to make the design of timber elements easier and more robust.

Structurally optimized elements
Additive manufacturing allows for custom web optimisations for specific loading cases without the need to alter manufacturing processes, reducing material wastage and manufacturing input energy.

Solution 8: Green Lease

What is it?
A green lease is a lease which has additional provisions set out within it whereby the landlord and the tenant undertake specific responsibilities/obligations with regards to the sustainable operation of a property. This could include energy efficiency measures, waste reduction/management and water efficiency. "Green clauses" can be included which relate to all aspects of the supply, maintenance and operational use of the building as well as social and ethical considerations.

Applicability

Single building	*Excellent.* Improves environmental footprint, maintenance of asset, alignment of interest between landlord and tenant
Development /city	*Medium.* Coordination issues but improves city's footprint
Portfolio	*Excellent.* Improved environmental KPIs and CSR benefits for landlord, alignment of interests protects cash flow, reduced downside regulatory risk

Key benefits

Value for property owners
- Increased ability to recoup the cost of energy and water efficiency investments
- Retain asset value due to improved building operation and maintenance

Value for occupier
- Facilitate saving sharing models from energy efficiency investments
- Improve the working relationship with the landlord
- Support corporate sustainability objectives

Case studies

British Land: 10 Exchange Square
At 10 Exchange Square, British Land brought together all parties involved in the building to work collaboratively on sustainability. Between 2000 and 2012, this collaborative approach saved 1,530 tonnes of CO_2, diverted over 220 tonnes of waste from landfill and saved £23,000 on occupiers energy and water bills.

Grosvenor: 40 Grosvenor Street
40 Grosvenor Place is a 230,000-square-foot office building developed by Grosvenor and Mountcity. Grosvenor installed an extensive AMR system saving 3676,600 on energy bills and has cut CO_2 emission by 17,650 tonnes.

Hermes: Prospect House
At Prospect House, Hermes Real Estate worked with the occupier, NBC Universal, and management agent, Jones Lang LaSalle, to implement sustainable technologies as part of its Responsible Property Management Programme. In 2008, it resulted in 15% reduction in annual CO_2 emissions, 18% cut in water use and zero waste sent directly to landfill.

Solution 9: End of Life and Zero Waste Construction

What is it?
Building design should consider ways in which construction has zero wastage (through intelligent modelling, quantity survey and scheduling, or even through simple designs). It should also consider how buildings can be demolished/dismantled in a way that the elements and their embodied carbon can be re-employed in another building, providing ample opportunity to improve the sustainable performance of the real estate sector.[19]

Applicability

Single building	*Good.* Reduced embodied carbon and possibility to easily adapt in the future
Development /city	*Good.* Developments upgraded over time allow for constant re-use of important elements, creating a long-term sustainable culture
Portfolio	*Good.* Ability to select elements across the portfolio as buildings change, adapting to new contexts including complex geographical boundaries

Key benefits

Value for property developers
- Enhanced lifespans of materials
- Reduced embodied carbon when future of elements considered

– Easy to implement designs

Value for designers/construction firms
– Easy to implement designs
– Flexible designs for a variety of uses
– Quality and legible structures and systems

Value for retrofitters
– Issue of wastage from previous building dealt with
– Simple designs allow for reduced wastage and easy of demolition

Case studies

Leading building design company
A leading building design company has developed their European campus with long uninterrupted spans, so that the structural elements can be re-used for different buildings in the future.

London Olympics 2012
The Crown Stadium was designed for deconstruction, enabling the steel to be shipped to Rio for the next Olympic Games.

Strategies for end-of-life and zero-waste construction
Strategies include large-span structural elements, friction joints, large flexible internal layouts, passive ventilation systems, and structurally simple and legible design

Solution 10: Retrofit and Adaptation for Life-Span Extension

What is it?
By modifying existing buildings for changes in usage or climate, the lifespan of a building can be extended. By re-using a building, the embodied carbon can be maintained. Furthermore, changes should include some energy efficiency measures to enhance the operating carbon output. Typically, buildings have a lifespan of 50-80 years before being demolished and replaced. By changing the internal layouts and improving the envelope, significant changes can be made without the need for new structure.[20]

Applicability

Single building	*Excellent.* Allows for localized changes that help to hold the value of the property, preventing demolition and re-build
Development /city	*Excellent.* Maintains existing infrastructure and improves existing stock, reducing energy demands and other local pressures
Portfolio	*Excellent.* Reduces risk of down-time during reconstruction; enhances energy efficiency and improves performance across whole portfolio

Key benefits

Value for property owners
– Extended building lifespan (+10-40 years)
– Improved occupant satisfaction

Value for constructors
– Buildings have greater value due to extended lifespan
– Reduced embodied carbon across projects

Value for designers
– Flexible design strategies
– Longevity of materials and structural arrangement
– Improved occupant satisfaction

Case studies

Interventions for adaptation to climate change may include:

– Function re-arrangement to allow for sacrificial basement with increased flooding
– Adding solar shades to reduce internal solar gains and associated temperature increases
– Cavity wall insulation to prevent heat loss
– Moving any internal drainage to the exterior of the building to help with heavy and rapid rainfall
– Installation of rain water harvest equipment for brown water usage

British university teaching space
A world top 100 university recently finished a multi-million pound refurbishment of their architecture and landscape teaching space to remove internal partitions, enhancing natural light and increasing collaboration across the studio spaces. Replacement windows for the highly glazed façade have improved the energy efficiency by 20%. This has extended the life-span of the 1950s tower to at least 2050.

Appendix II: Principles and Implementation Assessment Tools

A complete system of principles usually consists of the principles themselves and a set of assessment tools that help their implementation and the tracking of progress. Industry Agenda Council on the Future of Real Estate & Urbanization discussions were framed by a four-tier system that helped clarify the distinction between these levels:[21]

1. Principles
A useful working definition of "principle" can be drawn both from dictionary definitions and from standards that are incorporating principles. Based on such sources,[22] a principle could be defined as: *An essential rule or behaviour followed to achieve a desired outcome or an essential characteristic of a system.*

It is this level which is addressed in the World Economic Forum's Environmental Sustainability Principles for the Real Estate Industry.

2. Implementation assessment tools
Many existing environmental standards, general sets of sustainability principles or policy initiatives assess the fulfilment of the principles based on a set of related criteria, indicators and, sometimes, even more granular verifiers (specific data points). The UN Food and Agriculture Organisation (FAO) published a useful description on how these tools apply to sustainable forest management: *Criteria and indicators, which are neutral assessment tools for monitoring trends, provide a means to measure, assess, monitor and demonstrate progress towards achieving the sustainability of forests in a given country or in a specified forest area, over a period of time.*[23]

3. The PCIV Architecture
To provide a framework that structures principles (P), fulfilment criteria (C), indicators (I) and verification (V) data into a logical architecture, a so-called PCIV hierarchy has been used in a number of environmental standards, such as the FAO, the Forest Stewardship Council (FSC) or the Marine Stewardship Council standard.[24] In addition to the broad definition of what constitutes a principle, the following summary descriptions are based on the previously mentioned FAO publication on sustainable forest management:

- *Criterion:* A distinguishing element or set of conditions or processes by which a characteristic or management measure is judged
- *Indicator:* A quantitative or qualitative variable which can be measured or described and which when observed periodically demonstrates trends
- *Verifier:* Data or information that enhances the specificity or the ease of assessment of an indicator. Verifiers add meaning and precision to an indicator.

The following two tables provide a generic outline of the PCIV architecture and an applied example, based on the US LEED green building certification scheme:

PCIV architecture and potential levels of granularity

P	C	I	V
Principle 1			
	Criterion 1.1		
		Indicator 1.1.1	
			Verifier 1.1.1.1
			Verifier 1.1.1.2
	Criterion 1.2		
		Indicator 1.2.1	
			Verifier 1.2.1.1
			Verifier 1.2.1.2

The LEED green building certification scheme was created to certify the implementation of two major stages in the building life cycle: building design and construction, and building operations and management. In this example, the design and construction of green buildings principle can be seen as the high-level formulation of one of a set of environmentally sustainable buildings principles. The PCIV framework applies as follows to the LEED green building certification scheme:

PCIV architecture applied to the LEED for New Construction v2009 green building scheme (extracts)

Principle	Criterion	Indicator	Verifier
1. New Construction of green buildings			
	1.1 Sustainable Site selection		
		1.1.1 Rainwater Design	
			1.1.1.1 Quantity Control: 25% decrease in Volume
			1.1.1.2 Quality Control: Stormwater Mgt plan treating runoff from 90% of annual rainfall
		1.1.2 Brownfield Redevelopment	
			1.1.2.1 Develop contaminated site according to Phase II Env. Site Assessment
	1.2 Water Efficiency management		
		1.2.1 Water Use Reduction	
			1.2.1.1 Percentage Reduction (%)
		1.2.2 Water Efficient Landscaping	
			1.2.2.1 Reduce potable water consumption by 50%

As we can see from the above example, the successful implementation of the principle of "new construction of green buildings" can be assessed with the help of specific criteria, indicators and verifiers.

Looking at the past 20 years of environmental and broader sustainability initiatives, one can distinguish two phases, according to 2013 World Economic Forum "Designing for Action: Principles of Effective Sustainability Measurement" report:

- The decade following the 1992 UN Earth Summit in Rio de Janeiro that generated high-level but "relatively well-developed" sustainability science, related concepts and "some fairly mature implementation pathways" with tools and frameworks
- The second decade after the Rio Summit with an emerging next-generation sustainability science where many of the limitations of the earlier science constructs are being addressed. However, the science is still maturing and the implementation pathways are in the early stages.

It is worth noting that in each of the two phases, the original principles were formulated by a group of committed stakeholders and the development of implementation tracking and reporting tools, processes and more detailed governance structures followed in a second phase:

- The UN Global Compact of 10 Principles was launched in 2000 through the joint effort of UN agencies, businesses, labour groups and civil society. The Communication on Progress policy was introduced in 2004.[25]
- The launch of the six Principles for Responsible Investment (PRI) in 2006 by UN agencies and an international network of investors were followed by the PRI Initiative's call for communication on progress by its signatories in 2008.[26] In 2012, a revised framework was published[27] and an assessment process was introduced helping participants analyse how their organisations scored and how they compared to their peers.

Endnotes

[1] CO_2e measures both carbon dioxide and other greenhouse gases measured in terms of their equivalent CO_2 impact on warming.

[2] UNEPFI SBCI's Financial & Sustainability Metrics Report, 2008, http://www.unepfi.org/fileadmin/documents/metrics_report_01.pdf.

[3] GRI CRESS G4, https://www.globalreporting.org/resourcelibrary/GRI-G4-Construction-and-Real-Estate-Sector-Disclosures.pdf .

[4] UNEP 10-year framework programme website, http://www.unep.org/10yfp/Programmes/ProgrammeConsultationandCurrentStatus/Sustainablebuildingsandconstruction/tabid/106268/Default.aspx.

[5] Ibid.

[6] Based on US buildings impact analysis, "Scoping US Buildings Inventory Flows and Environmental Impacts in Life Cycle Assessment" by Levin, H., 1995.

[7] Data relates to 2010, which is the latest available year for a global sector analysis, as published in IPCC AR5, 2014.

[8] That is the construction of smart commercial buildings (new-builds), which integrate BMS, high efficiency HVAC, new insulation material, LED lighting, optimal design for natural air circulation and heat convection, green roofs (where appropriate) and other embedded LCT. This makes the key assumption that the applicable market grows at the average CAGR observed in 2005-2008.

[9] Installing smart building technologies to reduce energy consumption includes: micro combined heat and power units (micro-CHP), next generation LED lighting, high efficiency HVAC cooling and heating systems, and integrated building management systems (BMS) for lighting, heating, cooling control and automation. The calculation basis is the average number of retrofitted applications per building; it again assumes that the market grows at the average 2005-2008 CAGR.

[10] Some of these are, of course, in progress, with reductions already achieved.

[11] This section draws extensively on JLL's white paper report on sustainability principles. We are grateful for the use of this material. The views expressed here are those of the Industry Agenda Council and should not be taken as representing the views held by Jones Lang LaSalle.

[12] We define principles as "*essential rules or behaviours followed to achieve a desired outcome or an essential characteristic of a system.*" This is described more fully in Appendix II, which makes a clear distinction between a principle and the levels of criteria, targets and monitoring that deal with the implementation of that principle – the "PCIV hierarchy" (Principles, Criteria, Indicators, Verifiers).

[13] Stockholm Environment Institute/Accenture

[14] With acknowledgements to McAllister, P. (2012) Studies of Price Effects of Eco-Labels in Real Estate Markets, University of Reading, http://www.henley.reading.ac.uk/web/FILES/REP/Eco_labels.pdf

[15] Estimates suggest that operating costs in green builds are lower for green buildings (~8% for renovated buildings and ~14% for new ones) due to energy and water costs reductions, enhanced refurbishment and increased materials durability and longevity.

[16] As a stark example, implementation of provisions in the UK Energy Act will render buildings with an Energy Performance Certficiate (EPC) of "F" or "G" unlettable from 2018, facing owners with loss of income and the need to retrofit or redevelop the properties to comply with the new regulations.

[17] Much of the material here was developed by Accenture Strategy. The contribution is acknowledged, but the views expressed here should not be taken as representing those of Accenture.

[18] Source: HM Government, Arup, Accenture project delivery experience

[19] Source: Pelsmakers, 2012, The Environmental Design Pocketbook (RIBA), Kwok *et al.*

[20] Source: Pelsmakers, *op cit.*, Town and Country Planning Association.

[21] We are grateful to Franz Jenowein, Director of Sustainabilty Research at Jones Lang La Salle and LaSalle Investment Management for their work in clarifying and codifying these distinctions and for conducting the survey of real estate principles summarized on pages 9 - 11.

[22] See Oxford Dictionaries and page 7, FSC Principles and Criteria for Forest Stewardship, FSC, 2015.

[23] Criteria and Indicators for Assessing the Sustainability of Forest Management: Conservation of Biological Diversity and Genetic Variation, FAO, 2002, http://www.fao.org/docrep/005/ac649e/ac649e03.htm#bm03.

[24] Marine Stewardship Council Fishery Standard – Principles and Criteria for Sustainable Fishing, 2010.

[25] UN GC website, https://www.unglobalcompact.org/docs/communication_on_progress/Intro_to_COP.pdf.

[26] Ibid.

[27] UN PRI website, http://www.unpri.org/wp-content/uploads/2013-14_PRI_RF_overviewandguidance.pdf.

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