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Article

Critical Connections: The Role of the Built Environment Sector in Delivering Green Cities and a Green Economy

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Abstract: The green agenda for cities and the economy in general is a major focus of global institutions and is increasingly a major national and urban priority. Core issues and best practice for built environment businesses were collated from published studies and used in a survey of Australian firms to see how committed they were to the green economy. The results show high awareness of the challenges and opportunities with 85% of firms having sustainability as an established agenda with senior management and over 20% of built environment firms deriving more than 50% of their sales from green products and services. This is much higher in design firms and is globally high. Whilst recognizing the scope for more engagement by industry in transitioning to a low carbon green economy, there is doubt within the built environment sector about how to create a business case for innovative green ventures and a lack of certainty or encouragement from government about how to proceed.

Keywords: green economy; built environment sector; eco-cities; sustainable urban development; green innovation; low carbon economy; socio-technical transition

1. Introduction

The 21st century's economy will be urban and green. The urban transition is advancing globally, albeit unsustainably [1,2]. The green economy transition is in its infancy. Yet, like other revolutionary socio-technical transitions before it, there are irrepressible sets of push and pull factors massing that can trigger transformative change. The push factors are those capable of delivering innovation. New technologies are among these as well as associated business strategies and practices and government policies and programs that all need to shift towards facilitating this new economy. The pull factors are also clear and relate, among others, to the challenge of creating sustainable and resilient built environments capable of functioning within the ecosystem limits of a single planet subject to climate change and forecast to be home to 9 billion people by 2050 [3,4].

This study represents a first attempt within Australia to explore the critical connections that exist between cities and the built environment industries that plan and manage them. Particular focus is on the extent to which these industries are operating in a manner that can deliver much needed sustainable regenerative urban development in the 21st century and contribute to the emergence of a green economy more broadly. It is based on a 2013 survey of 173 senior managers in both private and public sector built environment organizations with membership in national industry associations with acknowledged sustainability objectives.

Cities will be critical to sustainable urban development in the 21st century. A transition to sustainable urban development will, however, require a socio-technical transformation of a scale and complexity similar to that of the industrial revolution. The first created a factor of 20 fold increase in productivity. A green revolution will require a further increase by at least a factor of 4 or 5 which means that levels of wealth could double while cutting resource use by 50% or even 80% as suggested and illustrated by Von Weisacker *et al.* [5]. The second, post-industrial revolution is centered on sustainable development as initially articulated by the United Nations [6,7] and by much scholarship and public discussion over subsequent decades (see Figure 1). The graph depicts the volume of articles using the term “sustainability” that were published annually since the Brundtland Report using the search engine Factiva, an on-line tool that aggregates searchable content from over 10,000 licensed sources such as newspapers, journals, magazines, TV and radio transcripts and newswires worldwide, covering most languages.

Sustainability focuses on the need to ensure that human activities and the systems within which they operate (e.g., our human settlements and their populations) can continue into the future—within the earth's planetary boundaries [8].

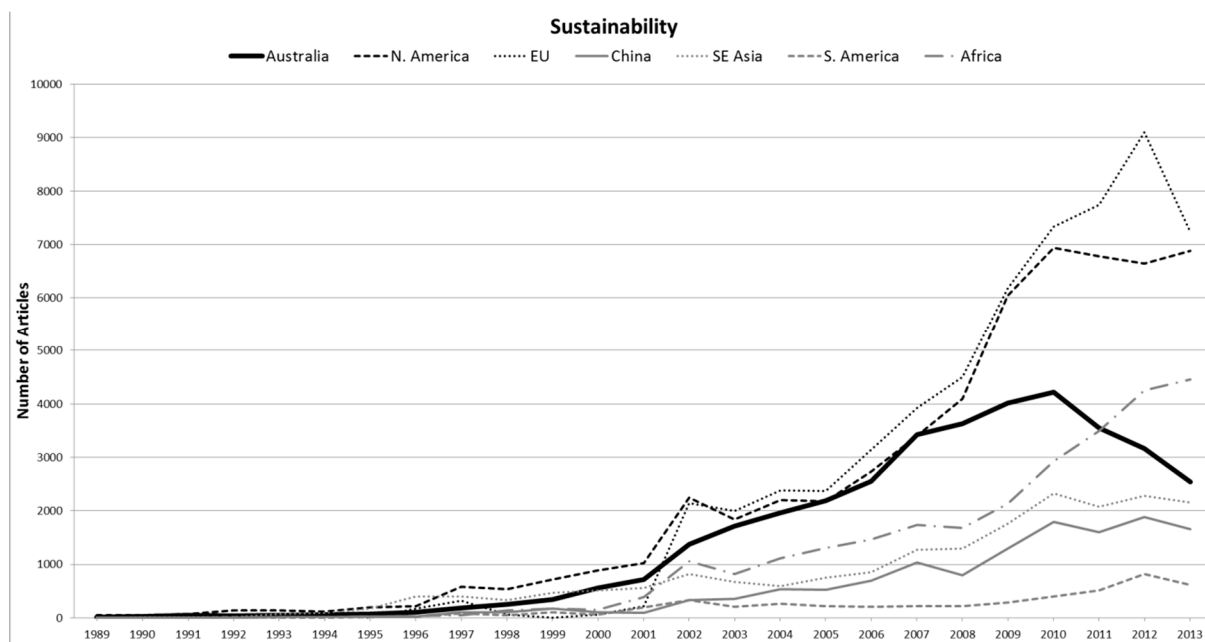


Figure 1. Trajectories of counts of the term “sustainability” in print. (Source: derived from [9] using key word “sustainability”.)

The progressively growing interest in the subject of sustainability, especially in those developed societies that have the human, social and financial capital to implement transformative change has somewhat stalled though they remain the main source of green products and services. The Global Financial Crisis in North America in 2007–2008 has had knock-on effects globally, with European governments in particular having additional sovereign risk challenges that diminished fiscal support for investment in innovative (longer term) sustainable production and consumption programs in favor of those deemed “shovel-ready” (and job-saving). During this period, many government departments with responsibility for metropolitan planning and development replaced “sustainability” with “livability” or “productivity” as their principal objective, given their clear economic connection to the attraction of international investment and skilled labor... both of which are highly mobile in the 21st century and focused on cities. Cities in North America, Australia and New Zealand and, to a lesser extent, Europe achieve their livability and productivity rankings as a result of their high levels of resource consumption and greenhouse gas emissions [1] though decoupling of wealth from fossil fuels is now progressing [10]. Cities in developing countries such as China are also aspiring to create more livable built environments as they rapidly urbanize with substantial ecological footprints in fast growing cities such as Beijing and Shanghai; however, they too are beginning to decouple like those in developed countries [10].

The principal global challenges are threefold. First, we live in a carbon constrained world which is witnessing increasing concentrations of greenhouse gases in the earth’s atmosphere capable of triggering climate change of a scale which could take centuries to reverse [11,12]. How we generate and consume energy is central to this issue. Second, we live in a resource constrained world where peak oil, water shortages, decline in agricultural land and loss of biodiversity are indications that our harvesting of the earth’s natural resources is now occurring at a rate which is exceeding replacement rate [13,14]. Our patterns of consumption of housing, travel, water and manufactured products are

central to this issue [15]. Population growth—forecast to reach nine billion by 2050—when coupled with per capita consumption defines the magnitude of the sustainability challenge. The task of transition from unsustainable levels of consumption is a challenge for the citizens of developed countries in North America, Western Europe and Australia that have ecological footprints three to four times the global average. Concerns about the environmental impacts of consumption have been registered in the OECD [16] with forecasts that consumption pressure is expected to intensify significantly by 2030. Forecasts have been advanced of major economic and social disruption or collapse associated with continued business as usual operations by industries, governments and communities [17] unless there is radical change. Third, we live in a world of increasingly concentrated populations, with the world's 9 billion-population forecast to be 70% urban by 2050, though this remains a question as to whether it helps or hinders the reduction in footprint [10].

The 21st century sustainability challenge will focus on cities, their future mode of development and redevelopment and their resilience to a mix of exogenous and endogenous forces now in play. In developed societies these have been recently catalogued [18]. The exogenous factors mirror those listed above: resource constraints (land, water, raw materials, oil); climate change (and its link to sea level rise and its impact on urban infrastructure; increased temperatures and changes to rainfall frequency and intensity—flooding in some locales, drought and heat extremes and megafires in others); bio-security (including pandemics) and financial uncertainty. The endogenous factors reflect the contemporary context and dynamics of each individual city: the quality of its existing buildings and infrastructure; its human and social capital and levels of social and spatial disadvantage; its governance structures; its urban environmental quality and the nature and trajectory of its economic base. In this context, a wide range of international, national and metropolitan studies of city performance continue to catalogue deficiencies across the spectrum of human settlement indicators associated with environmental quality and metabolism, economic productivity and competitiveness, liveability and social inclusion—all of which are inter-related dimensions that characterise the current state of sustainability of urban development [19].

A transition to sustainable urban development will require the emergence of a new form of (green) capitalism based on sustainability principles that embraces social and environmental as well as economic objectives capable of redressing this growing list of problems. The challenge confronting this transition is immense and is the topic of much contemporary debate [20]. To be successful, the urban sustainability transition will need to be closely integrated with and be a key driver of the emergence of a green economy. They are critically connected (see Figure 2) and represent the transition arena within which significant urban innovation is required. As current urban sustainability transition theory indicates; however, innovation capable of transformative change currently faces formidable challenges from well-established regimes that represent entrenched industrial, governance and consumer practices [1,21,22].

A range of (green) physical infrastructures are required to support urban living: transport, energy, water, waste, communications and buildings. The consensus is that the sustainability performance of each is currently poor, given that they all emerged in an era where there were few resource constraints and climate constraints. Next generation infrastructures and urban designs will need to demonstrate significantly greater eco-efficiency and resilience in their operation than those that they need to replace [23]. The demand for new urban infrastructures and green services represents the

trigger for a raft of innovative infrastructure technologies to move more widely into the urban marketplace [22]. In the energy sector, this relates primarily to renewable energy and the speed with which it can penetrate a currently dominant fossil fuel based regime. The resistance being faced in countries with significant fossil fuel endowments or dependencies is shaped by the threat to business and investors of holding the wrong assets. Recent divestment of fossil fuel stocks is a signal that green capitalism will also be based on creative destruction [24]. However, in this era increasingly centred on new technologies that out-perform existing technologies on sustainability criteria, there will need to be widespread acceptance of rapid change across all industry sectors.

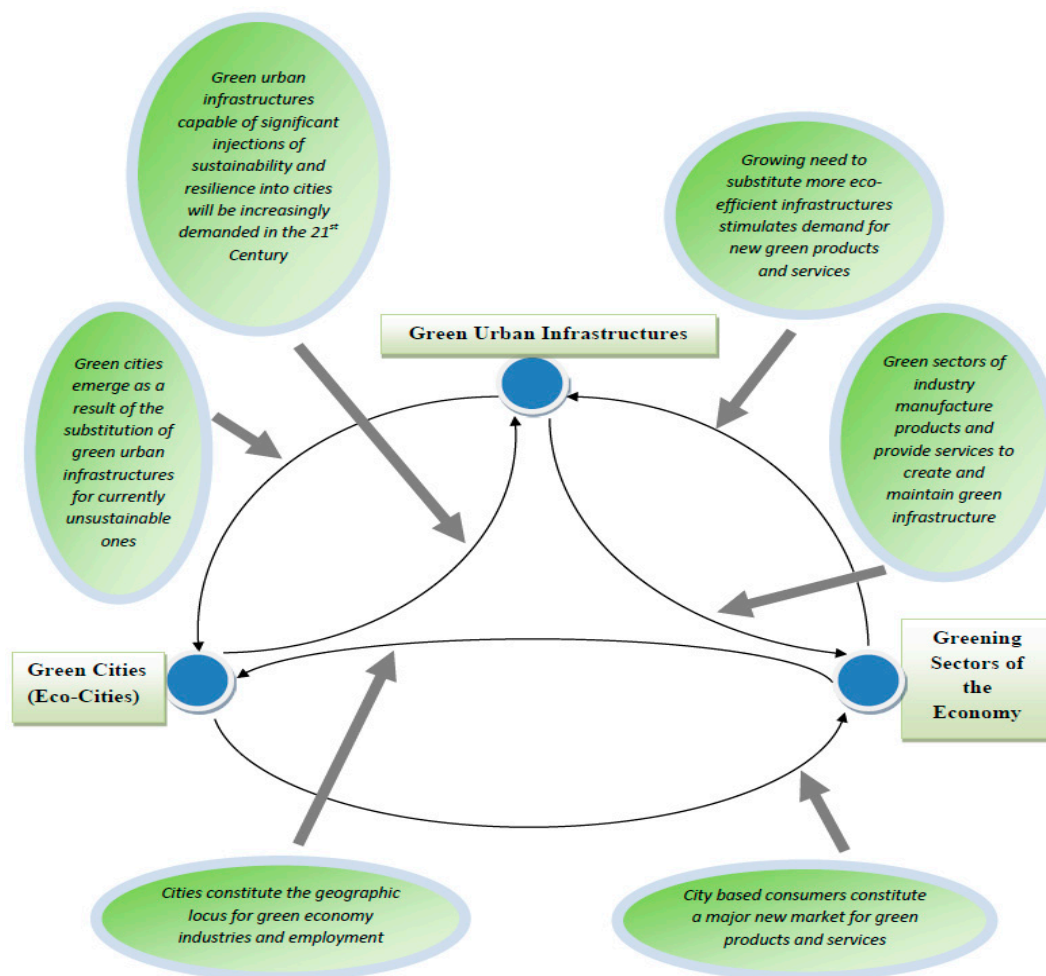


Figure 2. Critical connections: green economy, green urban infrastructure and green (eco) cities. Source: [22].

Figure 2 also indicates that cities will constitute a geographic locus for green industry location, given the innovative capacity agglomeration economies deliver to firms generally as well as providing the extensive customer base for new green products and services. It is this spatial convergence of supply and demand forces that will underpin the emergence of a green urbanism and the *eco-city* [25]. A common feature for the sustainability transition, irrespective of sector, will be the critical normative goals addressed: using resources more efficiently and reducing non-renewable resource consumption, reducing emissions and utilising wastes as resources, restoring environmental quality, enhancing human wellbeing, and developing better functioning cities. In all these arenas, governments have a

major role to play in setting performance benchmarks and targets for industry and community to achieve, given the challenges that are to be overcome that are beyond any previous era. Consumers are also central to this transition in terms of the signals they send to both industry and government that they are demanding more sustainable living environments (housing, transport/mobility, energy) and domestic products. At present, these demand signals are not strong [15,26] and as such represent a challenge (risk) for organisational strategies attempting to introduce more sustainable products and services to the market.

In the next section, we attempt a sketch of some of the dimensions of a green economy as it begins to emerge. We then proceed to explore the directions that Australia's built environment industries are taking as reflected in senior management's thinking about their company's sustainability practices and green growth strategies. They are critical to a green economy transition. The manner in which they assess the strengths, weaknesses, opportunities and threats in their operating environment (see Figure 3)—with particular reference to the current and likely future practices of governments and consumers—will influence the rate at which they are likely to innovate and explore new areas for products and services. The results from a survey of built environment firms undertaken by the authors constitute a marker in assessing the progress towards a green economy and green cities in Australia and internationally.

2. Critical Connections

2.1. Green Economy

At a broad conceptual level, a green economy can be defined as one that is sensitive to and not destructive of the environment. It involves a transition from the current model of development that continues to give primacy to economic decisions in isolation and assumes that environmental problems and externalities can be solved or accommodated if the economy is sound. It is based on an integration of ecological thinking and innovation into all social and economic planning by government and industry from the beginning, not after the issues have been framed. It involves recognition that the macro-economy is part of a larger natural ecosystem and resource base, which has capacity constraints that will be severely tested in this century [2,27]. It involves what some authors (e.g., [28]) have termed eco-positive development, where focus is on making positive contributions to the public realm and ecological base in contrast to the present approach of merely attempting to minimise the negatives associated with economic development and city building. Others have termed it restorative or regenerative development [29,30]. We are currently at some distance from embracing this paradigm, though it remains the kind of long-term goal needed to transform our cities.

To date, the most influential advocates for a green economy have been from international agencies such as the United Nations and OECD that are seeking to establish a new global platform for sustainable development. These global policy agendas (e.g., [31–36]) are presented as a backdrop against which more specific national policy agendas are emerging. The Green Growth agenda has been pursued by many emerging nations e.g., Vietnam, Indonesia, China *etc.* following the lead of Korea [37]. A number of initiatives, such as those out of Asia (e.g., [34,35,37]) are focusing on projects capable of delivering blueprints for low carbon green growth at a national scale. Since the era

of sustainability strategies developed out of the Rio process, the focus of most Western countries (e.g., USA), has centred more on green energy and green jobs, driven by national interests related to energy security and creating new industries capable of generating new jobs in an era of slow growth. Europe has led the world in green economy strategies through a range of initiatives developed through the EU (again, see Figure 1) [38].

The academic literature in this area has attracted a range of authors from a variety of disciplines, each of whom view the green economy through different sets of lenses [39–44]. Titles on the green economy are being written from a diverse range of perspectives, e.g., economic [45], from an industry location and employment perspective [46], from an education and training perspective [47] and from a broad societal governance perspective. Milani [48] suggests that the green economy will emerge from the bottom up, through public opinion and new social movements. The role of business is explored in various ways: Brown [49] puts the responsibility for bringing about the transition to an eco-economy almost exclusively into the hands of the state (via the three principle levers available to governments: regulation, subsidies/incentives and pricing/taxing instruments); while Hatfield-Dodds *et.al.* [50] argue that both government and industry have a role, especially considering that the business sector is beginning to emerge as a central player in strategic thinking and planning about sustainability. MIT [51] shows who are the leaders in this transition. These are issues that will be explored via an industry survey that follows in the *Greening Business* section.

The emergence of green business rankings [52] (which quantify the ecological footprints, policies and reputations of the US top 500 and Global top 100 businesses) and Clean Tech indexes [53] among others are following in the wake of the earlier and broader-based corporate sustainability (triple bottom line-based) rankings of companies e.g., Dow Jones Sustainability Index; Australian Sustainable Asset Management Index (see [54,55]). The former group (green rankings) are indicative of the changes beginning to enter all industry sectors that will shine a spotlight on corporate environmental performance. In addition, how businesses in the built environment sector in Australia are attempting to measure the performance of their organisations beyond profit and shareholder value dimensions is examined in the following section.

In its narrowest sense, the green economy has been seen to revolve primarily around energy and the transition from fossil fuels to renewables [56,57]. This is sometimes referred to as the “de-coupling” agenda where GDP and GHG are decoupled—wealth grows and footprint declines [10,56]. In its broader sense, it can be seen to embrace all major sectors of the economy creating opportunities for innovations that enable achievement of green goals relevant to industries within those sectors [47] as well as being found in green industrial clusters [58]. In fact the emerging concepts of the green economy cross over the different sectors and are not easily separated under these older classification systems. Some examples are provided in Table 1.

It is clear that there have been major opportunities in all industry sectors for some time to create greener products and services—that are demonstrably superior in performance to those currently in the marketplace. Transition is a socio-technical process, however [1] where multiple barriers exist to the diffusion of a more eco-efficient product. In the auto industry, for example, strategies for transitioning to hybrid and electric vehicle manufacturing would have been on corporate radar screens for decades, but given the power of the entrenched ICE (internal combustion engine) and fossil fuel industries, and an absence of drivers from governments and customers, triggers for change have lagged. Table 1

outlines the key concepts for business that need to be the focus of their agenda if they are to contribute to competitive, productive and liveable cities in the next major economic wave of innovation related to sustainable development. The green goals used in this table were provided to businesses in Australia as the basis of a survey to ascertain their commitment to the green economy, thus helping to define the meaning of “green” to these businesses.

Table 1. Greening the economy: key sectors and green goals.

Industry Sectors	Green Goals Associated with Sector
Manufacturing	Cradle-to-cradle manufacture; closed loop production; industrial ecology clusters; circular economy; green materials manufacture
Energy Utilities	Renewables; distributed (local) generation; energy efficiency; smart grid
Water Utilities	Integrated (stormwater, wastewater) systems; water sensitive urban design; city as catchment
Waste	Reduction, reuse, recycling, and materials reforming; eco-industrial development; closed loop planning
Property and Construction	Smart, green building design; virtual design and construction; constructed as designed; life cycle analysis entrenched together with Building Information Modelling ; green supply chain; design for deconstruction
Trade (Retail/Wholesale)	Zero waste (packaging, food <i>etc.</i>); carbon management; carbon neutral products
Transport	Hybrid, electric, hydrogen vehicles; land use-transport integration; active transport; extensive public transport
Finance and Property	Green accounting; urban retrofitting; building accreditation; green loans; green bonds
Services	Zero waste; reduced consumption, carbon management; e-services
Government	Green procurement; de-coupling policies; sector-specific decarbonising schemes; eco-efficient regulation; green performance targets for own operations as well as industry and population; product labelling (declarations), standards, rating

2.2. Surveying the Greening of Business

Nations and firms are increasingly aware of the need to be ahead of or at least in touch with the next new wave of innovation [59] and are seeking to identify what will give rise to the new areas of innovation. For a major societal transformation to occur—such as to a green economy—there needs to be an associated critical mass of new and emerging enabling technologies capable of being linked to a clearly recognised and pressing need in the marketplace—in this instance, the “wicked” challenges of 21st century sustainable development (economic, social and environmental). Earlier socio-technical and economic transitions can be seen to have conferred significant first mover advantages to those firms, regions and nations that have been adept at nurturing the development and implementation of innovative technologies, e.g., Detroit and the auto industry; Silicon Valley’s role in the information technology revolution; and the more diverse but locally significant spatial clusters in the biotechnology industry [60]. The emergence of green industrial clusters has been identified by Davies [58]. Advantages also accrue to those organisations capable of “sudden catch-up” [59], that is, adopting and adapting the new technology products or processes to current business operations. Slow catch-up (laggards) is to be

avoided—by firms as well as governments. Indeed, the window of opportunity for transitioning to a green economy and a more sustainable society—without major social and economic upheaval—is seen to be narrowing [5,14,50,61].

At a macro-economic level, new classes of employment and local economic development are associated with the development of new “engines” of an economy. The attraction of green industries and green jobs is high on the radar screens of governments in many developed and major developing countries—seeking new employment opportunities for economies that have experienced a global recession and have growing populations seeking work [62]. Global trade and national balance of payments is also a significant driver. Even authoritarian governments like the Gulf States and China are implementing green economy strategies. Friedman [63,64] (p. 11), reports on a three sentence summary of China’s modern economic history provided to him by C.H. Tung, the first Chief Executive of Hong Kong: “China was asleep during the industrial revolution. She was just waking during the information technology revolution. She intends to participate fully in the green revolution”. China has led all nations in the level of investment made in green industries during and after the 2008–2009 global financial crisis [65,66]. In Australia, the federal government from 2007 to 2013 was committed to a range of green economy initiatives including Infrastructure Australia that ensured all infrastructure decisions included commitments to decarbonising the economy and the Clean Energy Package of policies that included a carbon tax and facilitation of renewable energy. The election of a conservative neo-liberal federal government in September 2013 led to a major retreat in public policy and expenditure on most fronts related to climate change (e.g., renewable energy targets were reduced) and the environment. Continued lack of bipartisan agreement in these areas in Australia creates uncertainty and risk for business planning and investment in green industry. This stands in marked contrast to Britain’s three main political parties who made a joint commitment at the beginning of 2015 to cut greenhouse gas emissions by 80% (compared to 1990 levels) by 2050. Nevertheless at a state and local level there are many initiatives being taken to assist the development of the green economy in Australia, e.g., a low carbon procurement model is being developed in the state of New South Wales [67].

At a micro-economic level, determining sustainability’s strategic worth to companies continues to be an area of increasing focus among leaders of business and is of continued interest to the research community [51,68–70]. From a survey of literature in this area, an attempt was made by the authors to create a “map” of the strategic and operational issues and indicators that could be seen to define the state of progress in an organisation’s transition to adoption of sustainability principles and practices to their operations. The key elements of this “map” are found in Figure 3.

These Elements relate to:

- (1) An organisation’s current and expected future *operating environment* (what transition theorists term “*the landscape*”). Included here are the (external) threats and opportunities as well as the (internal) strengths and weaknesses of the firm as reflected in the current company “profile”... the traditional SWOT factors.
- (2) Whether the corporate strategies of the private sector organisations are beginning to catalogue and target new market opportunities connected with emerging environmental challenges; whether sustainability issues are a permanent fixture on the agenda of senior managers; whether the firm’s business model has changed as a result of issues surrounding sustainability;

establishing the level of difficulty management has in evaluating the business case for sustainability; whether the firm’s green services or products can make a net positive contribution to the prosperity of the firm; establishing where “niche innovation” is possible and how can it be financed?

- (3) Whether organisations demonstrate sustainable performance of their own operations; e.g., is the ecological footprint of their operations shrinking? And is employee productivity, health and well-being being enhanced? Is there regular monitoring and reporting?
- (4) Areas where government can assist business in creating an environment conducive to low carbon green growth. Conditions conducive to longer term planning and investment need to be created by governments where firms can have a measure of confidence that by more aggressively pursuing green strategies they will not unduly raise the risk of being exposed to a sudden change of public policy. Post-2013, Australia’s federal political parties have shown a diminished vision and a lack of bipartisanship in relation to green economy thinking and planning, and have instead provided only short-term programs linked to electoral cycles that seem to demand policies that are friendly to voters and established (fossil fuel based) industries. This is not conducive to creating an environment for transitioning to green growth.

Sustainable Organisations

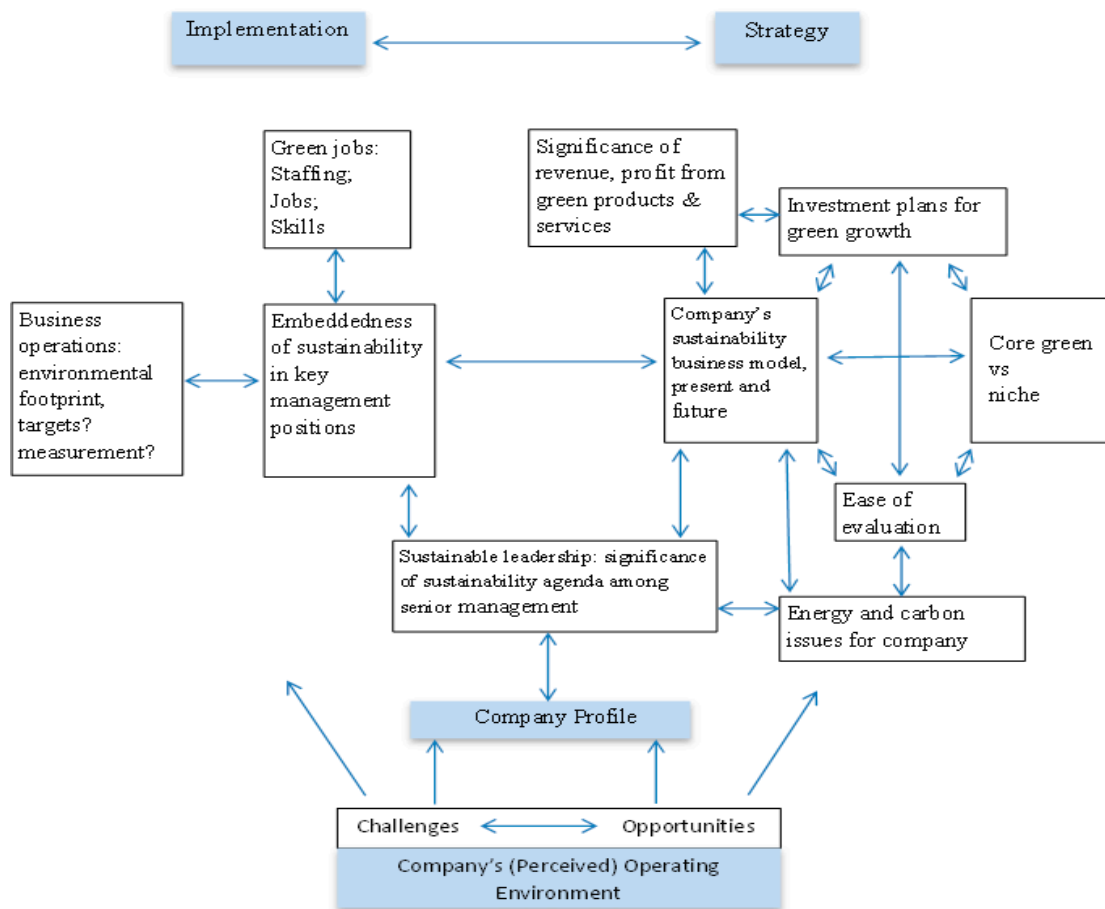


Figure 3. Facets of a sustainable organization.

2.2.1. Survey Population

In order to explore these issues, an on-line survey was undertaken of senior executives and managers belonging to organisations in the built environment sector in Australia who were members of either the Green Building Council of Australia (GBCA), Infrastructure Partnerships Australia (IPA), Infrastructure Sustainability Council of Australia (ISCA) or Engineers Australia (EA; more specifically, members of the Environmental College and the Society of Sustainability and Environmental Engineers)—all with knowledge of corporate strategy and performance of their respective organisations. The four industry associations who collaborated in this survey by facilitating contact with the relevant executives and managers also have established reputations for their progressive attitudes to corporate sustainability reporting. A total of 173 completed questionnaires were obtained from the national survey, undertaken in mid 2013: 85% from private sector firms and 15% from public sector agencies. Of the total respondents, 30% operated in a single state, 26% in multiple states, 12% in all seven states, 11% in Australia and the Pacific and 21% in Australia and globally. Ninety percent were headquartered in the capital cities (60% Sydney and Melbourne). Responses were received from organisations across the size spectrum, with 40% from SMEs (fewer than 50 employees), 17%, 50–200, 19%, 200–1000, 17%, 1000–10,000 and 6%, over 10,000. Questionnaires developed for this survey are presented in Newton and Newman (2013). As the built environment sector is represented by a wide spectrum of private sector firms, it was decided to aggregate responses for analysis and reporting purposes into three groups: design (38% of total), building product manufacturers and construction (37%); and property services (25%). Depending upon the topic under analysis, responses will be presented as an analysis of the total sample, private *versus* public sector or comparison of responses by the three private sector groupings. The findings are presented in relation to the set of topics for investigation outlined in the previous section.

2.2.2. Business Perceptions of Operating Environment and Key Challenges

A formidable set of challenges with implications for built environment sustainability and resilience are now confronting all societies and their economies as outlined above. Private sector firms as well as public sector organisations have been confronted with the task of establishing management strategies and making investments that can advance their operations and at the same time contribute net positive benefits to the regions in which they operate. The manner in which the organisations responding to this survey have rated the challenges are instructive (see Table 2).

Table 2. Rating of challenge to the company in the next five years (private firms only).

Area of Challenge	Level of Challenge (%)					
	1 (Low)	2	3 (Moderate)	4	5 (Major)	Not Applicable
Technological (<i>n</i> = 156)						
Acquiring and/or adapting new low carbon technology	18.6	12.2	40.4	13.5	5.8	9.6
Limited Australian R&D capacity	18.6	16.0	21.8	16.0	13.5	14.1
Identifying emerging new technology and assessing relevance to business	10.3	14.7	41.0	22.4	10.3	1.3

Table 2. Cont.

Area of Challenge	Level of Challenge (%)					
	1 (Low)	2	3 (Moderate)	4	5 (Major)	Not Applicable
Market Related (n = 156)						
Responding to changing market conditions	7.7	11.5	28.8	28.8	19.9	3.2
Increasing competition in Australian markets	8.3	12.2	16.7	30.8	23.7	8.3
Increasing competition in global market	14.1	9.0	22.4	24.4	12.8	17.3
International trade barriers to export of products and services	28.8	11.5	17.9	4.5	3.2	34.0
Whether customers are willing to pay a premium for green products, services	6.4	10.3	26.9	23.7	31.4	1.3
Competitors increasing commitment to sustainability, green products/services faster than expected	18.6	17.3	31.4	17.9	5.1	9.6
Government Related (n = 156)						
Addressing impact of government regulations, standards etc./maintaining “licence to operate” on our business	9.6	16.7	30.8	20.5	15.4	7.1
Lack of certainty regarding government policies/legislation	5.8	10.3	28.8	20.5	30.8	3.8
Financial (n = 156)						
Taxation policy (e.g., carbon tax, corporate tax etc.)	14.7	21.2	33.3	18.6	7.7	4.5
Global financial uncertainties	5.8	12.8	32.1	28.8	16.0	4.5
Cost of capital, borrowing	14.7	23.7	30.8	15.4	7.7	7.7
Access to capital	14.7	22.4	29.5	11.5	13.5	8.3
Growing revenue	5.1	10.9	28.2	35.9	15.4	4.5
Staff Related (n = 153)						
Acquiring necessary skills/competing for new talent	6.5	13.7	37.3	24.2	16.3	2.0
Shortage of skilled labour	15.7	19.0	35.3	17.6	10.5	2.0
Attracting talented people	9.8	21.6	27.5	26.8	13.1	1.3
Retaining and motivating existing employees	7.2	23.5	35.3	24.2	7.8	2.0
Business Operations (n = 153)						
Reducing costs and increasing efficiencies	3.3	11.1	31.4	33.3	20.9	0.0
Innovating to achieve competitive differentiation	5.9	8.5	26.8	38.6	15.7	4.6
Responding effectively to threats and opportunities of sustainability	5.9	15.0	36.6	29.4	11.1	2.0
Increasing operating speed and adaptability	2.6	17.6	32.0	30.7	13.1	3.9
Responding effectively to disruption of our business model	5.9	24.2	33.3	24.2	7.2	5.2
Stricter requirements from partners along the value chain	11.8	25.0	29.6	16.4	3.9	13.2
Externalities (n = 153)						
Climate change adaptation (increasing temperature, sea level, rainfall, variability etc.) challenges for your company	26.8	22.9	21.6	13.7	5.2	9.8
Shortage (high cost) of material inputs to company operations	21.6	22.2	22.2	13.1	3.9	17.0

In line with previously published studies in this area [71], we found that while 88% of companies indicated that sustainability is permanently on their agenda (see following section; Table 3), when this issue is placed in the context of the large number of challenges that business needs to manage, it is rated down the scale of importance. Responding effectively to threats and opportunities of sustainability to their business are seen by 40% as a significant challenge (category 4 and 5 responses), but green competition is only identified by 23% as such. Green technology is seen as something that can be acquired relatively easily. Resource constraints and carbon constraints are rated as significant by less than 20% of companies. The big challenge is understanding “whether customers are willing to pay a premium for green products and services”. Sixty percent of respondents indicate that uncertainty in this area is the key issue. Uncertainty rates high as a key challenge in other areas as well: global financial markets (45%) and consistency of government (over 50%). Uncertainty in these three areas ranks with issues of increased competition in the Australian market (54%), the challenges of growing revenue (51%) and being innovative (54%) as the key targets on the radar screens of senior management in the built environment industry.

2.2.3. Management and Sustainability

The survey findings suggest that issues relating to sustainability and carbon reduction are now a permanent and core fixture on the agenda of built environment’s top management for over 40% of surveyed organisations, with a higher representation among private sector companies (see Table 3).

Table 3. Sustainability as an agenda item with senior management. (Source: derived from Author survey; [51].)

	Private <i>n</i> = 128	Public <i>n</i> = 21	Total <i>n</i> = 149	MIT 2010	MIT 2011	Design <i>n</i> = 48	Mfg&Con <i>n</i> = 47	Serv <i>n</i> = 33
Already a permanent fixture and core strategic consideration	43.0	38.1	42.3	24.0	28.0	60.4	31.9	33.3
On the agenda permanently, but not core	42.2	47.6	43.0	38.0	42.0	31.3	48.9	48.5
Temporarily on the agenda, but not core	12.5	14.3	12.8	22.0	19.0	6.3	17.0	15.2
Excluded from agenda, because viewed as a passing fad	0.0	0.0	0.0	4.0	2.0	0.0	0.0	0.0
Never considered for the agenda	2.3	0.0	2.0	8.0	8.0	2.1	2.1	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Although the sample size of public organisations represented in this survey is small, there are several topics where important differences appear to be emerging that the authors considered should be reported (albeit with the above qualification). Most tables, however, are restricted to reporting private sector responses. When these responses are segmented according to the major categories of built environment industry it is clear that the design firms are significantly further advanced in recognising the strategic importance of incorporating sustainability objectives in their business models for competing for urban development projects. This is an area where new knowledge is emerging capable of being added to other longer established dimensions of design innovation that can now make a major contribution to achieving more eco-efficient outcomes on construction projects. International

comparisons suggest that Australian companies have elevated sustainability to a higher level of corporate concern than their overseas counterparts [51] (a possible reflection of their membership of those industry associations collaborating in the survey that have strong environmental objectives).

For 52% of private sector firms and 38% of public organisations, sustainability is being embedded within *all* facets of their operations, and there remains only a very small percentage where sustainability has not been addressed at all (Table 4).

Table 4. Extent of sustainability penetration throughout organization.

	Private <i>n</i> = 124	Public <i>n</i> = 21	Total <i>n</i> = 145	Design	Mfg&Con	Services
Sustainability is being embedded within all aspects of my organization's operations	51.6	38.1	49.7	62.2	48.9	40.6
My organization addresses sustainability as a separate, delineated activity	41.9	57.1	44.1	33.3	48.9	43.8
Sustainability has not been addressed in my organization	6.5	4.8	6.2	4.4	2.1	15.6
Total	100.0	100.0	100.0	100.0	100.0	100.0

Not unexpectedly, perhaps, the design firms are further advanced in ensuring wide penetration of sustainability thinking and processes compared to manufacturing and construction firms and property services firms: 62%, 49% and 41% respectively. As design represents that phase of a project where innovation potential is highest, with capacity to eventually impact all parts of a building or construction project, it can be expected that sustainability outcomes will become more and more mainstreamed into built environment products and processes in future.

It is evident that a significant proportion of built environment organisation's business models have changed as a result of issues surrounding sustainability and low carbon development (Table 5).

Table 5. Whether organizations' business models have changed as a result of issues surrounding sustainability and future low carbon development. (Source: derived from Authors survey; [71].)

	Private <i>n</i> = 129	Public <i>n</i> = 21	Total <i>n</i> = 150	Design	Mfg&Const	Services	MIT 2011
Yes	45.7	42.9	45.3	47.9	55.3	29.4	46.0
No	50.4	42.9	49.3	47.9	40.4	67.6	40.0
I do not know	3.9	14.3	5.3	4.2	4.3	3.9	14.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

A higher percentage of private sector organisations have effected some change, compared to public sector organisations. A comparison of the three built environment industry segments reveals that manufacturing and construction firms appear to have made more change to their business models and property services least, reflecting the higher exposure to global competition by the former (and larger) firms. Design firms may be (inadvisably) resting on their leadership in sustainability thinking that has characterised this segment of industry to date. In addition, they were found to be not as environmentally progressive when it came to monitoring their own day to day activities (e.g., water

and energy use, waste generation). Taken overall, the percentages associated with changed business models are closely aligned to published studies of international organisations.

Part of the reason for lack of a higher level of progress in embedding sustainability more deeply and effectively within private sector organisations is the level of difficulty they expressed in evaluating the business case (see Table 6).

Table 6. Level of difficulty expressed in evaluating the business case for sustainability related strategies (private sector).

Issue	Level of Difficulty (%)					Average Score
	Not	2	Moderately	4	Very	
Establishing financial incentives for considering sustainability	7.3	15.3	23.4	34.7	19.4	3.44
Predicting customer response to sustainability strategies	2.4	19.4	29.8	37.1	11.3	3.35
Quantifying intangible effects of sustainability strategies (e.g., brand reputation, employee hiring, retention and productivity)	7.3	21.8	21.8	31.5	17.7	3.31
Capturing comprehensive metrics about sustainability impact of operations	6.5	18.5	35.5	26.6	12.9	3.21
Lack of model/framework for incorporating sustainability in business cases	10.5	18.5	27.4	31.5	12.1	3.16
Uncertainty about future carbon pricing	13.7	14.5	35.5	18.5	17.7	3.12
Opposition from executives or influential individuals	12.1	22.6	25.8	23.4	16.1	3.09
Evaluating competing priorities	4.8	27.4	37.1	26.6	4.0	2.98
Quantifying sustainability-related risks	8.1	24.2	39.5	19.4	8.9	2.97

Note: $n = 124$.

All issues listed have a level of difficulty associated with their execution. Those heading the list involve: the challenge of resolving uncertainties surrounding customer response and incentives; predicting customer response to sustainability strategies; and quantifying intangible effects of sustainability strategies (“reputation” being the principal attribute often referred to here; McKinsey, 2014 [70]). An analysis across the three built environment business segments revealed that the property services firms had above average (>3.0 score) difficulty with all nine aspects of the business case, compared to only three for design and seven for manufacturing and construction.

2.2.4. In-House Sustainability

Results of the survey suggest that the private sector is more alert to green business strategies and opportunities external to the firm than the green credentials of its own internal operations. It is in relation to in-house sustainability management and measurement that the public sector currently has the lead (see Table 7).

Across the three built environment industry segments, some important differences emerged. Design firms were ahead in relation to sustainability strategies involving committees, dedicated managers, defined indicators and procurement, but the manufacturing and construction firms were ahead in relation to the routine measurement of the environmental performance of the organisation (a number of

which would relate to their licence to operate). A major gap (in the order of 20%–30%) common to all three segments related to the variation in measurement of energy (cost-related) compared to CO₂ emissions (environment-related), a reflection of the absence of targets or sanctions that currently impact business operations in any tangible way.

Table 7. In-house sustainability indicators (percent of responses indicating “present”).

Indicator	Private <i>n</i> = 124	Public <i>n</i> = 21	Total <i>n</i> = 145	Design	Mfg&Con	Services
A formal sustainability policy/strategy	75.0	85.7	76.6	80.0	72.3	71.9
A senior sustainability manager role	47.6	52.4	48.3	55.6	38.3	50.0
Sustainability Board or committee	33.1	52.4	35.9	35.6	27.7	37.5
Key sustainability performance indicators (such as feature in the Annual Report or its equivalent)	38.7	71.4	43.4	44.4	34.0	37.5
A sustainability-oriented procurement strategy	46.8	57.1	48.3	53.3	46.8	37.5
Routine measurement of the following:						
Energy used	74.2	95.2	77.2	71.1	78.7	71.9
CO ₂ emissions generated	49.2	81.0	53.8	53.3	48.9	43.8
Water used	54.0	95.2	60.0	48.9	63.8	46.9
Other emissions to air (SO ₂ , NO ₂ etc.)	16.9	9.5	15.9	4.4	31.9	12.5
Liquid waste	29.8	19.0	28.3	11.1	42.6	37.5
Solid waste	45.2	76.2	49.7	31.1	59.6	43.8

2.3. Measuring the Green Economy

A UNEP [32] (p. 454) report on the green economy has suggested that green industries are dominated by service industries and tend to be concentrated in the largest consumer markets. There is, however, an absence of research that attempts to measure how businesses are performing in this respect. In this study we attempt to measure the significance of green business to an industry sector by the proportion of an organisation’s incomes that are derived from providing green products or services to meet current needs in the marketplace (Table 8).

Table 8. Proportion of organizations’ income derived from providing green products or services to meet sustainability needs in the market place.

Proportion	Private <i>n</i> = 145	Public <i>n</i> = 26	Total <i>n</i> = 171	Design	Mfg&Con	Services
100%	11.0	0.0	9.4	19.6	7.1	5.3
50%–99%	11.0	3.8	9.9	7.8	16.1	7.9
10%–49%	24.1	3.8	21.1	27.5	21.4	23.7
Less than 10%	40.7	42.3	40.9	39.2	41.1	42.1
None	13.1	50.0	18.7	5.9	14.3	21.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

For built environment organisations in the public sector, over 90% derive either less than 10% or no income from this source. In contrast, 22% of private sector firms are currently securing more than half of their income from green products and services; but there appears to be considerable scope for

growth with over half currently having little or no involvement. Of those organisations deriving some income from green business, the distribution between products and services is in line with UNEP [32] findings (see Table 9).

Table 9. Approximate proportion of “green income” due to green services as opposed to green products (%).

Proportion	Private <i>n</i> = 123	Public <i>n</i> = 13	Total <i>n</i> = 136	Design	Mfg&Con	Services
More than 90% services/10% products	52.0	61.5	52.9	85.4	13.3	56.7
70% services/30% products	2.4	0.0	2.2	0.0	6.7	0.0
50% services/50% products	6.5	7.7	6.6	2.1	11.1	6.7
30% services/70% products	10.6	7.7	10.3	4.2	20.0	6.7
Less than 10% services/90% products	28.5	23.1	27.9	8.3	48.9	30.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

According to these findings, 52% of private sector firms receive more than 90% of their income from services (*vs.* 62% in the public sector). Across the three built environment industry segments, there is greater contrast: design firms derive over 85% of their green income from services, while for manufacturing and construction firms approximately half is from green products, reflecting a greater *diversification* of green business for this group (*i.e.*, adding a service function to traditional product activity). This is also the case for property services.

When we cross-classify these two measures of green business activity for private sector firms (Table 10), we find that they are at varying stages of developing lines of business in these areas.

Table 10. Measuring green business activity in the built environment sector (private sector only).

Proportion of Total Income Derived from Green Lines of Business	Proportion of Firm Income from Services <i>Versus</i> Products			Total
	Mostly Products (>50%)	Roughly 50:50% Products and Services	Mostly Services (>50%)	
100%	3.3	0.0	9.8	13.0
50%–99%	4.9	3.3	4.9	13.0
10%–49%	10.6	0.8	16.3	27.6
<10%	20.3	2.4	23.6	46.3
None	0.0	0.0	0.0	0.0
Total	39.0	6.5	54.5	100.0

Note: *n* = 123.

The study found that only 13% of companies derive all their revenue from either green products or services, with a further 13% receiving at least half from this area of business. Green services have a larger share of firm income but not by a large margin. The challenge is for the 46% of built environment businesses that currently have less than 10% of their sales in green products and services to be actively looking for such opportunities.

2.4. Locating Green Opportunities by the Private Sector

When built environment organisations were probed as to where they saw major opportunities (Table 11) for delivering green products or services in the built environment sector, most of the responses to this open-ended question did not identify new or cutting edge areas.

Table 11. Targets for green business as identified by built environment industries.

General
Providing green services, products, technologies in response to increased awareness and demand—to meet changing customer needs; wherever possible at a cost point that increases market interest (**)
New Products and Technologies to Drive Business Opportunities
Alternative (renewable, low carbon) energy sources, distributed generation (***)
Natural/hybrid ventilation systems; adiabatic cooling, solar shading (*)
Low energy lighting
Improved energy metering, monitoring, energy management systems, energy efficiency (EE)
Low VOC products, enhanced IEQ
Recycling of C&D waste/less waste (*)
Paperless operations—requires less storage/floorspace
New Services
Sustainability consulting
Resource minimization consulting
Carbon and/or sustainability rating and profiling of buildings, infrastructures, precincts
Financial packages/options for clean energy/EE
LCI/LCA assessment of products
Climate change planning and design
Centers of expertise aligned to needs of low carbon economy
Design
Design leadership; companies should challenge themselves to find new eco-efficient solutions; have a belief that they <i>can</i> derive green designs at competitive cost; “find ways to produce cost effective sustainable dwellings that produce a competitive edge for the company” (**)
Utilize GBCA products in design (***)
Sustainable precinct design (*)
Design to prescribed as well as increased levels of sustainability
Construction
Energy efficient retrofits (***)
Facility Management
Optimal building operating performance
Building with lower life cycle costs
Leadership
Be seen as a market leader in promoting sustainable built environment technologies (**)
Demonstrate credentials/points of difference with competitors
Educating Clients
Educating clients about longer term benefits of green design, green technology as a means of growing business (**)

(*) represents similar comment by more than one respondent; (**) by at least three; (***) by five or more.

They represent incremental rather than the more innovative step change advances which are considered necessary for any transformative urban sustainability transition (see [1] for a wider discussion on the three horizons of urban technology innovation). They were mostly in areas where the level of risk/uncertainty had diminished as a result of a sufficient number of successful implementations over the past 10 to 15 years, which established the viability, and attractiveness of the particular green product or service. Responses to another open-ended question “What needs to change to create opportunities for low carbon green growth” revealed that there are a clearly defined set of persistent and significant barriers that are a challenge to innovation in this sector (see Table 12) and to the emergence of a green economy and eco-efficient cities.

Table 12. What needs to change to create opportunities for business in relation to low carbon living and low carbon green growth.

Government
Clarity, continuity, and commitment of governments (all levels) on direction for low carbon green growth in order for business to adopt sustainability business model
Increase government regulations and audits
Energy/carbon legislative change that is appropriate and effective
Green standards and certification for products and services; life cycle product performance declarations need to be mandatory
Application to life cycle assessment to all aspects of government—drive a whole of life approach
Green procurement
Industry
Locate and increase pools of investment capital to match company’s sustainability goals
Once large corporations change their business models, they represent a major opportunity/driver for smaller consulting companies
Demonstration of connection between sustainable built environment and financial sustainability of organisation
Increasing global demand for new green products and services
Attitudes of company executives
Public
A cultural shift towards a greener way of life opens up a multitude of opportunities for new products and services
Increased education of consumers regarding carbon footprints of their behaviour/lifestyle

There are several areas where governments need to begin talking to their built environment industries and businesses and general public more generally about how they can create critical connections for a more sustainable and productive future.

3. The Carbon Challenge

As discussed earlier, in its narrowest sense, the green economy has been seen to revolve primarily around energy and the transition from fossil fuels to renewables. The Australian Labor government (2007–2013) introduced its Clean Energy Strategy in July 2011 containing a number of measures to reduce the nation’s greenhouse gas emissions, including a carbon tax. In September 2013, there was a change of (federal) government to a conservative Liberal/National coalition that has subsequently repealed the carbon tax, abolished many of the climate-related agencies and programs, reduced the

national renewable energy target and has introduced a “direct action” program in an attempt to mitigate growth in CO₂ emissions (many commentators see this as being less effective compared to a price on carbon, with an inadequate budget and untested processes for project assessment and delivery). This watering down of a national commitment to carbon reduction continues to cause local uncertainty (a major concern in the business sector revealed in this and other studies [72]) as well as international friction in the lead up to the UN Climate Change meeting in Paris in December 2015.

The Economist Intelligence Unit (EIU) undertook a survey [73] of 130 Australia-based senior executives prior to the introduction of the carbon tax in Australia. The present survey was undertaken several months after its introduction, which should have provided organisations with an opportunity to begin to gauge its impact on their operations. The two surveys reveal similar percentages in relation to whether organisations overall have a strategy in place for reducing their carbon footprint (see Table 13). Overall, more than 30% are still lacking such a strategy, with a higher proportion in the private sector.

Table 13. Organization has a strategy in place for reducing its carbon. (Source: derived from author survey and Economist Intelligence Unit (EIU) (2011) [73].)

	Private <i>n</i> = 90	Public <i>n</i> = 17	Total <i>n</i> = 107	EIU <i>n</i> = 131	Design	Mfg&Con	Services
No	35.8	14.3	32.6	30.0	34.1	28.3	50.0
Yes	64.2	85.7	67.4	70.0	65.9	71.7	50.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Governments currently have a lead role in establishing policies, regulations, pricing and incentives for the green economy. Recent announcements by international scientific groups (IPCC, 2014 [11] as well as financial institutions World Bank, 2012 [74]) all point to a likely “4° world” by the end of this century unless significant greenhouse gas mitigation occurs (e.g., ~80% reductions on 1990 CO₂ levels by 2050). There are multiple pathways that have been advanced to decarbonise the built environment [10,72,75] as well as the economy and society more generally. A list of these, based on EIU, 2011 [73], was incorporated in this survey. The results from private sector respondents are listed in Table 14.

Table 14. Preferred government action on carbon reduction (%).

	Yes	No
Provide subsidies for clean technology investments by companies	87.4	12.6
Establish incentives for corporate behaviour that leads to low carbon business operations	87.4	12.6
Provision of information on sustainable practices for companies	87.4	12.6
Introduce a performance standard/label for all energy generation technologies	85.7	14.3
Provision of education on green practices for consumers	85.7	14.3
Establishment of national carbon emission reduction goals	84.0	16.0
Subsidies for clean technology usage by consumers	82.4	17.6
Establishment of environmental reporting standards for business	72.3	27.7
Link to an international carbon pricing scheme	67.2	32.8
Introduce carbon labelling for all manufactured products	62.2	37.8
Carbon cap and trade scheme	55.5	44.5

Table 14. *Cont.*

	Yes	No
Current federal government carbon pricing scheme	52.1	47.9
Establishment of penalties for lack of carbon efficiency compliance by companies	50.4	49.6
Corporate tax on carbon footprint of business operations	43.7	56.3
Consumer/sales tax on carbon footprint of goods/services consumed	39.5	60.5
Establishment of penalties for lack of carbon efficiency compliance by consumers	34.5	65.5
None of the above—government can help most by doing nothing and letting the market come up with solutions	9.2	90.8

Government was clearly endorsed as having a role to play (over 90% of industry respondents in favour), but, from this point, on the directions for intervention varied. The highest proportions of “no” votes by companies were reserved for any imposition of carbon taxes on goods and services consumed as well as consumer-centred compliance, suggesting that more decisive action was required higher up the supply chain. Here, corporate taxes or company carbon compliance charges were among the least favoured actions for governments to take. Incentives and subsidies were clearly favoured over taxes for both consumers and producers. There was strong support for introduction of a performance label for all energy generation technologies as well as incentives for the introduction of clean technologies, both targeting the front end of the energy supply chain—and indicative of “direct action”. National carbon emission reduction goals were endorsed by 84% of business, part of the search for certainty on the part of business and a clear signal to government that more consistency is required.

4. Conclusions

The emergent new low carbon green economy is shaping as the next competitive advantage for industry. This study and the survey on which it is based has demonstrated that in the built environment area, Australian business and government are gearing up for this challenge. There are signs that Australian business is highly aware of the issues and has structured itself to prepare, perhaps even more so than their international counterparts, based on the results of global surveys [51,69]. However, the transition is not yet as market-oriented as it could be as many businesses are still waiting to see if consumers will pay a premium for going green; meanwhile, they are doing normal business.

The research revealed that private sector firms are at varying stages of developing green lines of business. The study found that only 13% of companies derive all their revenue from green products or services, with a further 13% receiving at least half from this area of business. Green services have a larger share, but not by a large margin. The challenge is for the 46% of built environment businesses that currently have less than 10% of their sales in green products and services to be actively looking for such opportunities. The significant scope for increasing green revenue is tempered by the high level of uncertainty surrounding a firm’s understanding of what customers are willing to pay for green products and services (55% of respondents—“uncertain”). The challenges of competition, growing revenue and being innovative—among several other traditional business metrics—clearly outranked sustainability issues around the management table when put in the full context of contemporary business operations.

These challenges notwithstanding, sustainability is a permanent agenda item with senior management in 85% of both private sector and public sector organisations responding to the survey (43% of private sector firms have sustainability as a permanent and core agenda item compared to 38% in public sector). The private sector appears more alert to sustainability/low carbon agenda issues than the public sector, possibly because they are more exposed externally to the “front line” of the economy. They are embedding sustainability within all aspects of their organisation’s operations to a greater extent than the public sector (51.6% to 38.1%).

For in-house sustainability and measurement practices, public sector organisations are currently in the lead in terms of having a formal sustainability policy, sustainability manager, sustainability board/committee, reportable sustainability indicators and a sustainability-oriented procurement strategy. Public sector organisations also had higher levels of routine measurement of energy, water and CO₂ emissions; the exceptions were with noxious emissions, where there has been mandated reporting for such waste discharges for some time by state environmental protection authorities.

Approximately half of the organisations are yet to change their business model in response to sustainability/low carbon development issues. A primary reason for this is the level of difficulty reported to be associated with evaluating “green” business cases. A comparable percentage indicates that sustainability is yet to be embodied within all facets of operations.

The opportunities identified for green business development within the built environment sector were weak and not representative of the range that currently exist in the marketplace, let alone those that are emerging opportunities. Most of the opportunities identified could be classed as “mature”, reflecting the lack of leading edge “green” innovation currently represented in most urban development projects in Australia.

Two-thirds of organisations surveyed had a strategy in place for reducing their carbon footprint (similar to results from the EIU survey a year earlier). Ninety percent of respondents indicated that government has a lead role to play in encouraging carbon reduction; although there was significant variability in response as to where government intervention should occur. Most favoured areas were subsidies, incentives, information and education. Least favoured were taxes, either on business or consumers.

This survey has demonstrated that, in the built environment area, Australian business and government are gearing up for the green economy challenge. There are signs that Australian business is highly aware of the issues and has structured itself to prepare, perhaps even more so than businesses in other countries, based on the results of global surveys. But the transition is not yet as market-oriented as it could be since many businesses are still waiting to see if consumers will go green and whether governments can offer more consistent policy direction in this area. Meanwhile, they are conducting business as usual. Publicly funded organisations appear to be less market-aware than business but are demonstrating green economy approaches and outcomes at a high level of commitment. Tipping points in all the critical transition arenas are yet to be reached to enable a more rapid shift to a green economy. If Australia is to be a strong global competitor in the green economy and cities are to be core to this transition, then awareness and commitment will need to increase across the board in private and public sector built environment industries—and among consumers. National governments, in particular, need to take a leadership position and then stay the course.

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Author Contributions

Both authors contributed to the design of the research, the questionnaire and the write-up. The on-line survey, data cleaning and tabulation was undertaken by the CATI Unit at Swinburne University of Technology. Both authors have read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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