CHAPTER 5

Green Buildings Value Chain in South Africa

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ABSTRACT

The green building approach differs from the conventional approach in that all the linkages in the value chain must systemically consider sustainability matters in the entire lifecycle of the building process. Ideally, the processes of construction, occupation and renovation or demolition of such buildings should be low in water and energy input and consumption as well as generate limited waste, both directly and indirectly. The processes should further be capable of offering user satisfaction during occupation and ease of demolition or renovation after use. Given the relative novelty of green building in South Africa, this chapter explores the nature and dynamics of inputs, goods and services linkages in the green building value chain of the country. The premise of the study is that value is created when high rent earning supply linkages are first localised and then where applicable, exported.

INTRODUCTION

Managing the negative impacts of anthropogenic activities on the environment, expressed most worryingly through the climate change phenomenon, is arguably the greatest challenge to the global quest for the improved and universal social, environmental and economic well-being of all citizens. The adverse impacts of climate change manifesting as increased severity and frequency of extreme weather events that, *inter alia*, include floods, increased temperatures, and droughts – are now difficult to deny. The world is reacting to these events and their effect through actions that fall into two broad categories of climate change mitigation on one hand and climate change adaptation on the other. The former category pertains to actions

that seek to retard and/or limit greenhouse gas (GHG) emissions. The GHG emissions drive global warming, which leads to climate change. The latter category relates to activities of learning to live with the adverse impacts of climate change, either by reacting or anticipating these impacts and acting to reduce their hostile effects.

By its nature, this book is predominantly resident in the mitigation realm. This implies that this chapter focuses on how the built environment (buildings in particular) can mitigate global warming and ultimately climate change. This is because buildings are direct and indirect contributors of GHG emissions. Estimates show that buildings are responsible for a fifth of energy-related GHG emissions and nearly one-third of black carbon emissions globally.[1] On average, buildings including their construction, operations and demolitions or renovations consume nearly 15 per cent of the world's fresh water resources and 40 per cent of the world's energy. They also emit 23 to 40 per cent of the world's GHG emissions.[2]

Activities in the building sector in South Africa account for up to 23 per cent of the country's GHG emissions.[3] Urbanisation and modernisation efforts in many developing countries mean that GHG emissions from buildings will increase, particularly if the traditional construction, occupation and renovation or demolition approaches of these structures are not reoriented towards sustainable practices. Green building emerges as a plausible and viable measure of mitigating significant impacts of the building stock on the environment, society and the economy.

The essence of green building is employing carbon neutral or less carbon intensive approaches along the same path. Discourse in the space has grown from being merely conceptual to practice. The concept is now a global trend whose implementation, triggers, pace and challenges vary broadly within and across countries, regions and continents. In the not so distant future, it may be inconceivable to risk pursuing a construction project without measured levels of established sustainable building practices throughout the construction value chain.[4] South Africa is anticipating this future in both the practice and policy space as a number of public and private buildings have been certified green in the country.[5]

However, there is limited evidence of a systematic determination of 'greenness' of the construction value chain in South Africa. This chapter, therefore, addresses this by examining green practices and products in the construction industry of the country. It also identifies the nature and the dynamics around green practices and products within the green building value chain, posing the questions:

i. What is the nature of backward linkages into and out of the green building value chain in South Africa?
ii. What are the determinants of backward linkages into and out of the green building value chain in South Africa?

The two questions are unpacked in a descriptive and exploratory research approach lodged within the value chain framework. The research gathered both primary and secondary data. Primary data gathering involved in-depth key informant interviews, observations and an online survey, engaging occupants of selected green buildings in South Africa, as indicated in Chapter 1. The key informants were construction industry professionals that included architects, construction engineers and sustainability experts serving the construction industry.

Identified key manufacturers of construction material that were invited to participate in the study declined the invitation. Consequently, electronic and other publications from some of the targeted firms serve as important data sources. In addition, some consulting engineering firms and construction firms also informed the research on developments among these manufacturing firms, for example developments in the paint and timber industries. Public and private sector policy documents and other relevant publications were also valuable sources of secondary data.

The attractiveness of the value chain approach is the two theoretical constructs embedded in the framework. First, the approach permits the mapping of the flow of goods and services up and down the chain, and between different chains. This is important in tracking the flow of goods and services, distinguishing between locally produced and imports in the value chain. Second, value chains' analytical structures provide insights into the determinants of income distribution and the identification of effective policy levers that can be manipulated to gain desired outcomes. In this case, one outcome is how the South African construction industry could increase the depth and breadth of backward linkages in the green building value chain for both local use and exports. This carries important economic development and growth outcomes for the country.

Subsequent to this introduction, the rest of the chapter comprises four sections that follow this sequence; the next section, comprising two sub-sections discusses the theoretical concepts underpinning the research followed by a section that presents, analyses and discusses the research findings. The final section draws the theoretical and practice conclusions and recommendations.

THE GREEN BUILDING THEORY

Green buildings encompass both a structure and the application of processes that are environmentally accountable and resource efficient throughout a building's lifecycle.[6] Also known as green construction or sustainable building, this approach covers all direct and indirect construction work from planning to design, construction, operation, maintenance, renovation and demolition. This is important because the palpable climate change concerns and the drive towards energy efficiency call for the built environment to consider new approaches in the designing of new buildings and the remodelling of existing ones. The green construction movement targets changing the way the construction industry understands and deals with the architecture or design, construction, use and decommissioning of buildings. It focuses on four chief areas: (i) site development, (ii) energy efficiency, (iii) indoor air quality, and (iv) construction material selection and minimisation.[7] This emphasis seeks to implement the reduce-conserve-recycle ecological guidelines throughout the lifecycle of a building.[8]

The consideration of a site for the construction of a green building has to ensure that the building is geographically oriented to maximise the desired solar access as well as shading and wind patterns. This is important for reducing energy consumption for heating, cooling and lighting. Equally important is that the construction process has to present minimal impact to the natural environment. This involves minimal disturbance of flora and fauna through practices such as retaining the original vegetation, and where permitted, even allowing some of the fauna to continue living within the built environment.

The ultimate measure of a green building is its energy efficiency, because energy constitutes a significant cost of a building, particularly during its occupancy. In the United States of America (US), this cost averages 30 per cent of the cost of operation. The energy use applies to heating, cooling and lighting functions, all of which are indispensable for a comfortable occupation. However, this energy consumption and ultimately the related costs are reducible by using active and passive measures. Active measures include using energy active technologies such as energy efficient light bulbs as well as energy efficient office or home equipment. Energy saving practices such as switching off electrical equipment that is not in use and insulating buildings to minimise heat losses or gains are also part of active measures. Passive measures include constructing a building that can exploit heat, light and wind through the orientation of the building and the materials used in its construction.

Within the ambits of the two aforementioned considerations, it is important to ensure that green buildings present conditions that deliver comfortable occupancy. Air quality concerning temperature, humidity, scent and the amount of particulate matter are important in this regard. This consideration has given rise to the concept of living architecture in the construction industry.[9] The basis of the concept is the knowledge of ecosystem services such as water purification offered by wetlands and the vegetation, as carbon sinks. Living architecture incorporates these functions in buildings so that they too can be sites of catching, storing and purifying water and air among other ecological functions.[10] While site selection, preparation, energy efficiencies and the living architecture concepts are important, it remains critical to ensure that all materials (including their production) used in constructing green buildings are themselves 'green'. This dictates that these materials be produced through an environmentally friendly process and be renewable and/or recyclable.[11] Such materials include bricks, cement, sand, other aggregate materials, paint, roofing and the fittings that are necessary to provide comfortable occupancy.

With such a wide variety of issues to consider, countries have developed framework setting standards, thus, ratings for green buildings. These standards serve as a measure of the best practice in sustainable design and management and seek to assess the environmental performance of buildings. Examples of such standards include the Building Research Establishment Environmental Assessment Method (BREEAM) of the United Kingdom (UK),[12] the Leadership in Energy and Environmental Design (LEED) of the US,[13] and the Green Star standard used in Australia[14] as discussed in depth earlier in Chapter 4. As the oldest standard, BREEAM initially focused on the construction phase of new buildings. However, it now covers the entire lifecycle of the building from design to in-use and retrofitting, like the majority of contemporary standards.[15] Interestingly, the Australian Green Star seems to be the most followed assessment tool in that countries such as South Africa and New Zealand have adopted it with some modification to meet local realities. Despite some differences, the core focus of the different standards mainly on water and energy remains similar worldwide.

The full range of activities necessary for bringing a product or service (a green building in this case) from conception through different phases of production (involving a combination of physical transformation and the input of various producer services) to delivery to final consumers, and final disposal after use, describes a value chain.[16] This value chain is more than a descriptive construct that merely provides a heuristic framework of how goods and services flow between actors in the chain. Instead, value chain theorisation provides an analytical structure, which avails important

insights into the determinants of income realised by the different actors in a chain and ultimately between countries. These insights can inform plausible policy and practice levers for firms to realise greater returns from activities in their chain. Governments similarly can help firms and consequently nations realise the same. Two theoretical constructs: governance and rents, are important in this research. The following sub-section outlines these two constructs.

VALUE CHAIN GOVERNANCE AND RENTS

The construction industry plays a significant role in advancing (sustainable) economic development and growth by availing physical, social and commercial infrastructure. It is also a source of direct and indirect employment creation through inter-sectoral linkages between construction and other sectors.[17] The inter-sectoral linkages are particularly important when they involve the manufacturing of goods for both domestic and export markets. This is because a strong manufacturing industry is the essence of economic development.

Activities within a value chain are not random. Instead, they exhibit a division of labour in which some firms appear to be in charge, dictating what other organisations do and how they should do it within the chain. Power asymmetry is at the core of the ability to dictate terms to other parties. This power asymmetry means that value chains are subject to governance in which powerful actors within a chain often take charge of the inter-firm relationship, i.e. the division of labour and activities within a chain.[18] The importance of these powerful players is that they ultimately determine the integration of components into the design of the final products and the quality standards that determine this integration. Broadly, there are three types of governance in a value chain: (i) legislative governance, judicial governance and (iii) executive governance.[19]

Legislative governance refers to defining rules that determine the integration into a chain. Such rules may include conforming to standards like good manufacturing practice (GMP) followed by the pharmaceutical industry, the hazard analysis and critical control point (HACCP) in the food processing industry, and green building codes such as BREEAM and LEED. Judicial governance pertains to auditing and confirming if the actors in a chain conform to the set standards. Noting that some actors in a chain may not have capacity and capabilities to perform to the requirements of the chain, executive governance serves to assist value chain participants in meeting these operating rules. Actions under this governance mode include

handling the various subordinate links in the value chain through directly or indirectly assisting some suppliers to attain the prescribed quality standards. A key component in the three types of governance is the ability to sanction the deviant players in the chain and reward those who conform to the defined standards. Sanctions may include financial penalties for non-conformance and exclusion from a chain as either a component supplier or serving the final market. Rewards may be through less stringent audits.[20]

Within this realm of these three governance modes, Gereffi[21] distinguished two categories of chains. He referred to one category as the producer-driven chains. Such chains are characteristic of the capital and technology-intensive industries like heavy mining and lifting equipment, industrial machinery, aircraft and computers. In such chains, the world's strategic producers command vital technologies. As a result, these producers coordinate the various links in the chain.[22] Typically, such producers are multinational corporations. The other category is the buyer-driven chains dominated by large retailers, marketers and branded manufacturers. These actors are responsible for establishing dispersed production networks in a variety of exporting countries, typically located in developing countries. Industries in buyer-driven chains are those that are labour intensive, like in manufacturing. Examples include industries in apparel, footwear, furniture and toys.[23]

Irrespective of the type of chain, all the actors in it (either as firms, regions or countries) seek to ensure that their integration into the chain yields high and sustainable returns. In principle, they all strive to avoid activities that lead to immiserising growth characterised by an overall increase in economic activity, but a decline in the returns from this activity.[24] In theory, all firms, regions and countries seek to retain their exclusive ability to earn high and sustainable returns, which forms the basis of the rent concept within which there are different types. This research focused on economic rents, with a particular interest on Schumpeterian rents. Such rents originate from newly invented products or services that permit suppliers and/or producers to charge considerably above their costs of production for their goods or services. Except in a monopoly, the ability to charge considerably above the costs of production does not last eternally. This is because other players may replicate this innovation and in the process, erode the ability to earn super profits. A new ability to earn super profits is availed by additional innovations. The repeating cycle of innovations earning super profits and the subsequent erosion of such competitive advantages is the basis of the Schumpeterian motor. However, not all economic rents accrue based on innovations; others accrue because of access to scarce natural resources

such as mineral deposits, good weather and fertile arable lands. In addition, parties not in the value chain provide other rents in some instances: for example, governments whose public policies provide an environment that makes it easier for firms to construct economic rents through providing better access to human skills, infrastructure and efficient financial intermediation compared to competing countries.[25]

A lesson from this discussion is that South Africa and indeed other countries seeking to entrench green practices in their construction industries must aim to produce unique green products and services for the industry. This serves two objectives. First, such products and services ensure a systemic greening of the industry because rents can be created along the entire chain. Second, these avail high returns to the developers of products and services, particularly those traded in both the global and local markets that are hard to copy, and more important, if they become an absolute necessity in the green construction process. This chapter explores how South Africa is doing on this front.

WHAT IS GOING ON?

Three major issues emerge from the construction industry in South Africa:

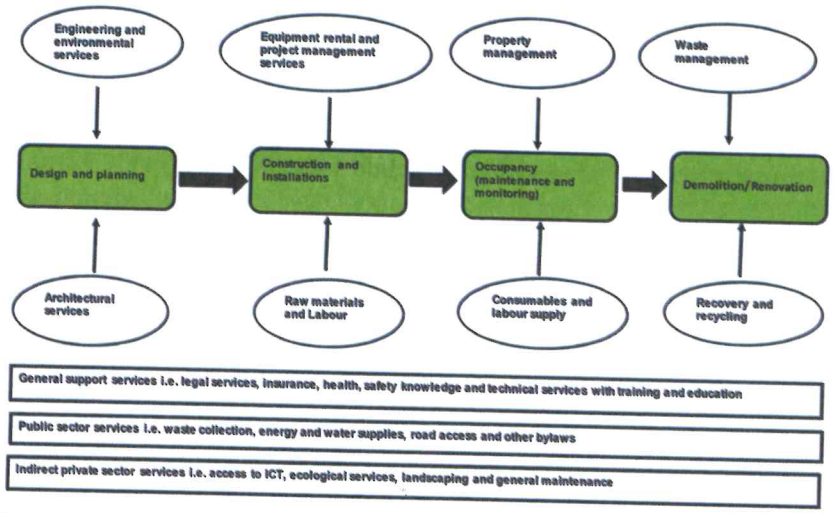
i. Broadly, the construction industry in South Africa is aware of standards and benefits of green construction
ii. Consumers are driving the demand for green building in South Africa
iii. The design, physical construction and operational side of the building value chain show greater readiness and ability to engage and deliver on the green construction and buildings compared to the materials supply side

GREEN BUILDING IN SOUTH AFRICA

The generic construction sector value chain covers on and off-site construction activities that include architectural and engineering consultancy services, construction site preparation, the maintenance of a building and the demolition or renovation of a building. It further covers raw material supply and the manufacture of construction materials and products, a range of knowledge-intensive services provided by private enterprises and public knowledge organisations, the 'user phase' and the eventual renovation or demolition.[26] A green construction value chain is similar to the generic form

with the difference being the consideration of sustainability issues in the former. Figure 5.1 shows a construction value chain.

Figure 5.1: A Simplified Value Chain of the Construction Industry



Source: Authors

The genesis of construction and, to an extent, renovation, is the conceptualisation or envisioning of the desired building. Building owners, tenants, architects and engineers are the key players at this stage. The terrain in the construction sector in South Africa shows an industry that is aware of the need for green practices. This research identified 37 green buildings in Gauteng Province, most of them concentrated in Pretoria and Johannesburg. This number comprises new buildings covering both the public and the private sector.

An emerging trend in the design and planning sub-chain of the construction value chain is the shift in the drivers of green building – from a push by architects suggesting the merits of green buildings to a pull by clients demanding that their new buildings be green. This means that the value chain has shifted from being predominantly supplier driven to being largely buyer driven. A number of factors are driving this trend and two major factors are prominent in this regard. The first major factor is experiencing green building either visually or by being in one. All interviewed architects and sustainability consultants affirmed this, stating that:

> Institutional clients are demanding sustainable architecture for their new buildings, either because they have seen one elsewhere, or have been in one and they now know about it and its advantages and want it too.

The architects further added that:

> We find our design processes changing in order [to] meet the Green Building Council of South Africa's Green Star standards as demanded by the client.

The contractors and architects stated that some of their clients were, in fact, committing resources in the form of in-house and external design consultants to develop their ideas and communicate these to architects. They further added that:

> Such clients are specific, they know what they want and as such, we have to design to their specification as far as possible. They are willing to pay to facilitate the delivery of their designs. We work with them and try to deliver what they want but at times, some of the designs may be beyond the current engineering capability of contractors in South Africa. In such cases, we work with the client to deliver what is practical and possible.

This is a clear indication that it is not only the developers and building owners who are interested in green buildings. The tenants of rented buildings, corporate tenants, property funders and investors specifically are increasingly demanding buildings certified as 'green'. Given the shift to a buyer-driven value chain, architects are gradually losing designer rents that were associated with the novelty of early and rare green building design expertise in the country.

Two factors have given rise to the shift in the green building value chain from being producer driven to buyer driven. First is the set of perceived and real pecuniary and environmental benefits that are derived from green buildings. The pecuniary benefits are the financial savings realised from energy efficiency associated with the occupancy of such buildings. This is becoming important against the backdrop of escalating electricity costs in South Africa. This happens against a decline in consumption due to an increase in the use of energy-efficient domestic and industrial electric appliances and machinery. In addition, the supply capacity of electricity is under constraint. In this scenario, energy-efficient buildings could, in principle, avail some electricity to other sectors. Second, increased environmental awareness has also driven present and potential owners of buildings to ensure that their assets demonstrate their contribution to environmental

management, where climate change management is prominent. For government, such an action is an indication of a political will to tackle the environmental management challenge.

The second major factor relates to the status of being an owner or occupier of a building rated and certified as being green. Both the government and the private sector firms have to manage their reputations as responsible corporate citizens: Building green, to an extent, enhances such a reputation. The Green Building Council of South Africa (GBCSA) is the 'greenness' certifying body in the country. The council has developed a suite of green building rating tools that avails a means for the standard of measurement for green buildings in South Africa, as discussed in Chapter 4. The practices and materials that apply to the rating system are not yet legislated by the state. Instead, they are voluntary and are usually above the minimum state legislated requirements.[27] The GBCSA plays the legislative governance role in the green building value chain of South Africa, where it has adopted and modified the Australian Green Star protocol. By 2017, the council had certified 250 commercial properties as being green. The government has also assisted the endeavours of the council and the green construction cause by legislating SANS2004 and SAN10400 XA as basic energy standards that aim to provide energy-saving practices in all construction projects.

To facilitate the greening of the construction industry, there have been attempts to ensure that the entire value chain is green. The genesis of this endeavour is arguably an awareness of green construction and its benefits. As stated earlier, this awareness is growing in South Africa. A further step in this process is seeking to define the parameters. Architects play an important role in this respect and South Africa has embarked on a programme to train architects. In designing these buildings, architects consider issues such as location, which is important in two regards. First, a building has to be located where it can have maximum possible sunlight. This helps in both illuminating the building and in temperature control due to exposure to direct sunshine. Both these considerations are important as they limit the energy consumption of a particular building. In South Africa, buildings seek to face north for maximum exposure to both sunshine and sunlight. A distinguishing feature of buildings that assist in this regard is that they have big windows to allow as much light as possible, and in the process, the need for artificial illumination is minimised. The second important consideration is the availability of complementary infrastructure and services. In this regard, the location of the building seeks to ensure that it is accessible by public transport, provides bicycle parking space, and has ample space for the dropping and picking up of building occupants who share transport with others from within and outside that building.

Designing and planning arrangements are turned into action when the physical building is constructed. The construction process and its outcome deliver a building whose level of greenness can be determined.

CONSTRUCTION AND INSTALLATION: GREEN CONSTRUCTION INPUT GOODS AND SERVICES IN SOUTH AFRICA

The process of erecting a building and installing all the necessary features to a stage where it is ready for occupancy employs a number of direct and indirect goods and services. The final green rating of a building is dependent on the greenness of the input goods and services as well as the final features that deliver comfortable occupancy. This means that these input goods and services need greening to deliver a systemically green building industry in South Africa. Table 1 shows the state of these supplies in South Africa.

Table 5.1: Green and Non-green Supplies in the Construction Industry of South Africa

Item	Green	Not green
Design	X	
Cement	X	X
Steel	X	X
Construction steel		X
Brick	X	X
Sand		X
Quarry		X
Paint	X	X
Piping fresh water	X	
Piping grey water	X	
Tubing (electrical)	X	
Plumbing pipes	X	
Washing basin	X	
Water taps	X	
Geysers	X	
Other water heaters/boilers		X

Electrical cables	X	
Window frames		X
Wind panes		X
Ceiling		X
Lights	X	
Other electrical fittings	X	
Carpets		X
Floor and wall tiles		X
Ground covers, i.e. tarmac or paving		X
Waste collection/disposal	X	X
Other		
Timber	X	X
Roofing material	X	

Source: Authors

The table shows a manufacturing industry that is not systemically green. Industry players acknowledge this and state that the greening of supplies (both goods and services) is a process that will take time. They also state that there is a need for addressing legislation and policy ambiguities for a 'fair' green rating. For example, one player stated that the laws and policies were not clear on the treatment of the overburden that earth produced when excavating to anchor the foundation of a building. Traditional practices were that this overburden is used to cover municipal waste landfills or in road construction. However, at the time of this research, construction firms stated that national lawmakers were considering laws that view the overburden of earth and rock material from construction sites as waste material and that construction firms have to pay for its disposal, even in landfill sites. Construction firms viewed such measures as being punitive.

An important feature of this study was the reluctance of the input goods and services industries (except architects and construction engineers) to participate in the study. This could be an indication of an industry that is aware that it is not systemically green. To counter this reluctance, the research examined the websites of major construction inputs suppliers to determine their work towards greening their supplies. Most notable in this space are cement, bricks, paint and engineered timber manufacturers. Concerning cement, two large producers in South Africa, Lafarge and AfriSam (South Africa) (Pty) Ltd, claim to be continually greening their products.

Cement is a major construction industry ingredient used to produce concrete that is critical for the strength of virtually all buildings. It is also a binder that sets, hardens and adheres to other materials (bricks and steel), holding them together. The production of cement is energy intensive, involving the heating of limestone and other clay-like materials in a kiln at 1 400°C and then grinding them to form clinker.[28] Mixing this clinker with gypsum produces cement.

The production of cement accounts for approximately five per cent of the global GHG emissions. The heating of limestone (calcium carbonate, in essence) is responsible for almost half of the GHG emissions of the cement production process. Consequently, the focus of climate change management in the industry is targeting this step. Actions in that direction include improving the efficiencies of the heating process and seeking alternatives to limestone as an ingredient of cement production. For example, one of South Africa's large cement producing firms, Lafarge, states that it is producing green cement using siliceous fly ash from ash resources to reduce the amount of clinker in its products and as a performance enhancer in cement and concrete formulations.[29]

Closely linked to cement is the production of bricks. The Clay Brick Association of Southern Africa is in a three-year project (starting in the year 2017), the Energy Efficient Clay Brick Project (EECB), that aims to reduce the carbon footprint of the industry through an industry-wide Life Cycle Assessment (LCA) of clay brick products.[30] This approach seeks to ensure that there are overall decreases in carbon intensities in all areas of the lifecycle, including in areas normally regarded as being cleaner in the brick production processes. Inevitably, there is a major focus on the kilning of bricks. Outside this project, the Clay Brick Association of Southern Africa reports improvements around kilning with improved kiln designs at Worcester Brick in the Western Cape reducing their coal use from 129 grams of coal per kg of fired bricks to 66 grams.[31] Systemic improvements that may result from inside and outside the Energy Efficient Clay Brick Project will definitely reduce the carbon intensity of South African bricks. While the brick association is engaged with its LCA projects, an alternative brick manufacturing group is emerging. Such bricks are made from waste material such as concrete and rubble from demolition and construction sites respectively. A construction engineer stated that this stream was helping with the disposal of some construction industry waste. However, the challenge is that bricks from this source are not certified by the South African Bureau of Standards (SABS) and, therefore, cannot be used in the formal construction industry. Further, the bricks are relatively expensive and thus it may not be cost effective to buy these bricks, despite the environmental benefit of

their production being from recycled materials. Plausible solutions to this dilemma include attaining an SABS tag for the bricks and increasing the scale of their production to decrease unit cost.

Also, closely linked to the production of cement and brick is steel, which is an important input to the construction industry. Combined with cement in concrete or in the brickwork, steel provides strength to a building. This industry has made limited progress in greening its production process. Currently (2018/2019), the industry is more concerned with its economic viability, which is under threat from cheaper imports mainly from China, and trade barriers as suggested by the US under the Donald Trump Administration. Nevertheless, the industry through the Southern Africa Stainless Steel Development Association (SASSDA)[32] recognises the role of steel in the green construction value chain. A player in the industry acknowledges the importance of sustainability in the industry but emphasises that the current national, international economic and trade conditions were limiting the scope for local innovations on the sustainability front. The same respondent added that the cost of energy would eventually add impetus to the need for innovations around energy efficiency and that climate change induced droughts would do the same concerning water efficiency.

Another industry that has begun its green journey is that of engineered timber, whose uses include structural applications such as roof trusses and finishings like solid hardwood floors. Traditionally, this timber is preserved with formaldehyde and other organics that have been linked to eye, nose and throat irritation as well as cancer.[33] The GBCSA confirmed that at the time of this study, local engineered timber production had started producing timber with less volatile organic compounds (VOC), albeit at a premium: the producers are earning a rent. However, this production was limited with the imports currently addressing local demand.

The issue of imported materials and services for the construction industry carries interesting nuances. The first is that while an imported product may be green, its journey from its source to a construction site in South Africa imparts a heavy carbon content to that product. A consulting engineer stated:

> If wooden roof trusses are imported from New Zealand, they may have no VOCs and be harvested in a sustainable way and certified as such. However, by the time they reach Cape Town or Johannesburg they are carbon loaded due to their transportation that is fossil fuel dependent.

This and other related points indicate a need for locally produced or, at worst, regionally (i.e. SADC) produced imports. Early innovators in the

manufacture of green construction goods and services stand a chance of supplying these goods at a premium to a clientele that is increasingly becoming environmentally conscious. Importantly, the local, regional and continental production of these goods and services presents an industrialisation route that is the desire of almost all African economies. While rents that accrue to early innovators may not last in perpetuity, the erosion of these rents may be countered by additional innovations. More importantly, such innovations are better than being excluded from the construction value chain should the demand for such products become an absolute or dominant necessity for construction in South Africa and beyond.

While cement, steel and bricks are important for the structural integrity of a building, there are other fittings that enhance the sustainability of a building simultaneously with delivering on the aesthetics, both making a building functional and also delivering an enjoyable occupancy. Critical for a functional green building are energy and water efficiency concerns. Energy efficiency is delivered through two means: (i) avoiding the use of electricity and, (ii) using efficient electricity appliances. The former largely pertains to lighting. A typical feature of many green buildings, especially those designed *de novo*, is their large glass exterior walls that allow natural light in during the day. This eliminates the use of artificial lighting. Among the energy efficient electricity consuming equipment, a significant contributor has to be in the production of light bulbs. The production of energy efficient lights is now routine in South Africa. The country produces a wide variety of international brand energy efficient bulbs, commonly called light-emitting diodes (LEDs), that have replaced relatively energy intensive incandescent light bulbs. LED brands produced and/or found in South Africa include Eurolux, Eveready and Philips, among others. In addition, South Africa has access to a range of energy equipment that includes computers, printers and refrigerators from international brands such as Samsung, Defy, Dell and Whirlpool.

On the other hand, it is disappointing that with all the proliferation of solar powered green buildings in South Africa, there is a paucity of manufacturers of panels, inverters and other related equipment, despite solar energy becoming popular in commercial and household energy applications. Shopping malls such as the Clearwater Mall in Roodepoort, Johannesburg, and the Grove Mall in Pretoria partly exploit solar energy. As green building increases both in quantity and quality, solar energy for lighting and water heating is likely to become a necessity for a high green rating. Under such conditions, it may be prudent and indeed profitable to have a local (nationally and regionally) solar technology supply base. Although South African businesses have not quite caught up on the trend of producing

solar technologies, a nascent industry is focusing on producing this equipment. Most notable in this space is the Chinese company Jinko Solar, the fourth-largest solar photovoltaic (PV) manufacturer in the world, which in 2014 unveiled an R80-million solar PV module manufacturing plant in Cape Town.[34] The local production of solar technologies could lower the purchasing costs that most of the responding business owners noted were a barrier to exploiting solar energy in their buildings. Essentially, this could also give rise to other manufacturing and service linkages that create jobs and increase the country's tax and export bases.

The paint industry is another sector that has made strides in greening its supplies. Paint manufacturers in South Africa include firms like Dulux, Plascon and the Paint Doctor. The GBCSA states that paint production in South Africa has started going green with a limited but growing production of green paints. Such paints are characterised by being lead-free, carrying low VOCs levels, and being produced through water and energy efficient processes. Most notable as confirmed by the GBSA are paint suppliers that even supply (on hire) water efficient paint brushes washing water technologies, and hardware that eliminates the washing of paint brushes in sewerage and storm water drains. For example, the Dulux Trade Environmental Wash System and the Dulux Trade Paint Solidifier are innovations that facilitate sustainable waste paint management. The wash system minimises the risk of waste paint entering the water system, and the solidifier serves to avert the disposal of paint containers in landfills.[35] Such technologies and hardware are said to be in short supply in South Africa, meaning that its suppliers can charge a premium, which is unavoidable, particularly if a building owner insists on such to facilitate the attainment of specified (or even higher than targeted) green rating standards for a completed building.

In addition to the supply of input goods, the green construction process also employs a number of services. An important service input in the construction industry is that of sustainability consultants. This profession is growing. These consultants avail their expertise to the industry throughout the building lifecycle from the genesis marked by the initial conception stage of the building to the end marked by the demolition/renovation stage. One example of the role of such services is that of landscaping around the building. Often the aim is to retain as much as possible of the original flora and fauna. In such cases, sustainability consultants advise about the local use of the overburden earth moved during excavations made for construction, the planting and maintenance of the most suited indigenous flora and fauna, and minimal disturbances of other features such as rocks and topography.

An important finding of this study is that GBCSA does not yet have a portal of green local goods and services suppliers. This database could contain environmental and technical characteristics of all building materials and services and be accessible to anyone who wants to assess the environmental sustainability of products and services. The council acknowledges that this is not helping to grow the customer base of the 'early' local entrants into the green construction input goods and services. However, the GBCSA is looking into establishing such a database. In our view, this is an executive governance role of the council that is long overdue. This assertion is made despite the difficulties the council identified in coming up with such a database. The associated difficulties relate to definitions of products and the setting of standards that determine incorporation into the database, among others. Our view is that it may be difficult but it is not impossible and the GBCSA acknowledges this and is working on the modalities of this database. What is encouraging is that despite these and other deficits, the construction of green buildings continues to grow. For example, GBCSA states that since its launch in 2007, it took six years to certify the first 100 buildings in the country, but that it took less than a year and half to certify 100 more buildings to reach 200 certified buildings in September 2016.[36] Indeed, green buildings have become highly visible in South Africa and leading firms with an international footprint lead visibly with such buildings.

OCCUPANCY AND DEMOLITION/RENOVATION

An important issue in green building is the systemic use of features that have been designed and/or installed to deliver sustainability. A green construction consultant indicated that it is important to ensure that occupants of such buildings are aware of these green features, as well as how and when they work.

The first step to this end is ensuring that the occupants are aware that they are in a green building. A survey of 259 commercial green buildings in South Africa showed that 97 per cent of the occupants were aware that they were occupying green buildings. However, despite this awareness, 'not green' practices were taking place in these buildings. The most notable concern was around the maintenance of comfortable temperature in these buildings. There were concerns that the buildings were either too cold or too hot, depending on the season. Cold, in particular, resulted in energy intensive interventions in which some occupants used electric heaters to keep warm. This created 'warm islands' that interrupted, if not confused, the set automatic response interventions and the operators that were meant

to maintain these systems. A possible intervention could be adjusting the set temperature, i.e. elevating the desired temperature setting from 21°C to 25°C that is considered comfortable by many in Africa. In addition, it is necessary to inform occupants fully about the features of these buildings, so that they are aware of how and when these operate. This is likely to enhance the operation efficiencies of such buildings.

Since the green building drive is relatively new in South Africa, there have been no demolition or renovation experiences. However, it is worthy to note that the design of the buildings and the materials used in the construction are anticipating future renovations and demolitions. For example, the facade of the five-star Green Star-rated Portside Building in Cape Town is designed to be disassembled and re-erected on another site when this building is either demolished or renovated in the future.[37]

CONCLUSION

Transition towards green products and services is an inevitable component of the sustainable development drive. The construction industry

Notably, there is recognition of the need for energy efficient building systems and practices by both government and the private sector. This can be delivered when there is concerted, coherent (as much as possible), and substantial international, financial and technical support.

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