SUSTAINABLE BUILDING FINANCE:
A PRACTICAL GUIDE TO PROJECT FINANCING IN EAST AFRICA

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EXECUTIVE SUMMARY

Promoting Energy Efficiency in Buildings in East Africa (EEBEA) is a 48-month project implemented by UN-Habitat in collaboration with UNEP and five East African countries (Kenya, Uganda, Rwanda, Burundi, and Tanzania). More information on the EEBEA can be found at http://www.eebea.org/. Its objective is to mainstream green measures into policies, codes, and development practices, and to avoid GHG emissions as a result of improved building and development practices.

In order to promote energy efficiency in building, the project includes 5 components, namely:

1. establishment of energy efficiency data and benchmarks in the building sector;
2. integration of energy efficient measures in the building codes, housing policies, and regulations;
3. awareness raising and capacity building in energy efficiency and green buildings;
4. appropriate financial framework for the implementation of energy efficiency and green design measures in buildings; and
5. provision of project-specific advice to development projects so as to improve environmental performance.

Finance has been identified among the most important barriers for the adoption of green building designs, and is the topic this guide seeks to address. The regional market presently does not provide adequate financial mechanisms and alternative lending products, i.e. green mortgages or preferential loans for sustainable, green and energy efficient buildings, and asset finance for integrated renewable energy networks. International experience with such products can inform how green property finance can develop in East Africa.

A practical guide to project financing in East Africa is based on the premise that green buildings typically carry higher upfront capital/buyer costs but lower ongoing/operational ones. As such, they offer financial value to lenders, owners, and occupiers; and societal value in reducing resource consumption, and carbon and other forms of pollution. Unlocking this value requires specialist energy efficiency, green building, and localised energy finance.

THE IMPORTANCE OF ENERGY EFFICIENCY AND GREEN BUILDINGS IN EAST AFRICA

Energy used in commercial and residential buildings accounts for a significant percentage of total national energy consumption across East Africa. It is estimated that 40% of the total electricity generated in the region is used in buildings alone, consuming more energy than the transport and industry sectors

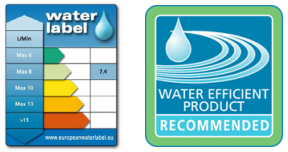
Inefficient design and construction using inadequate materials for the climate, combined with poor understanding of thermal comfort, passive building principles and energy conscious behaviour, has led to tremendous energy wastage and high electricity bills. Improved building designs (Figure 1) can create significant gains in energy performance and occupant comfort.

The significant building stock additions expected in East Africa in the coming decades make green design practices all the more critical, given the region's challenges in providing full access to modern energy services. High urbanisation rates and even higher projected rates of electricity demand (Figure 2) are outpacing capacity additions to national energy generation and distribution networks. Addressing this challenge needs to consider both the energy and resource consumption within buildings, and also how buildings are supplied with energy. Utilising low-carbon, on-site/local-area energy solutions that are affordable, installed and commissioned quickly, and scalable, can help address this demand growth and capacity constraint dilemma while accelerating the needed change toward renewable energy supply.

FIGURE 1 **IMPROVED BUILDING DESIGN**

Water efficiency

Water efficient appliances for showers, taps, toilets and other domestic appliances can reduce water consumption up to 60% and the investment can be back in less than a year:



Water efficient shower head save up to 60% of water

Water-efficient taps save up to 50% of usage

Dual-flush toilet save 60% of water used in toilets

Gray water recycling and reuse can cover 100% of water used for toilets, gardening and washing!

Water efficient washing machine save 60% of water

Water efficient dishwasher save 60% of water

Renewable energies

Hot water heating: save 50% to 80% of energy compared to conventional electric resistance water heaters

Solar Photovoltaic panels and Wind small turbine: produce your own electricity

Energy efficiency

Save more than half of your enegy bill for utilities

Central air conditioner: can reduce cost for cooling by 30% compared to Central AC from the 80s and 90s. Change your old air conditioner!

Ceiling fans: Energy Efficient ceiling fans combined with light are 50% more efficient

CFL light bulbs save 80% of electricity in lighting have 7 times longer live than conventional bulbs

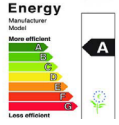
Energy Efficient Room Air Conditioner consume 50% less electricity compared to 80s and 90s models

LED save 88% of electricity in lighting and last 8 to 15 times more than conventional bulbs

Energy efficicent LCD TV using LED backlight system saves 29% to 60% of the electricity compared to those that don't and cathode rat TV sets

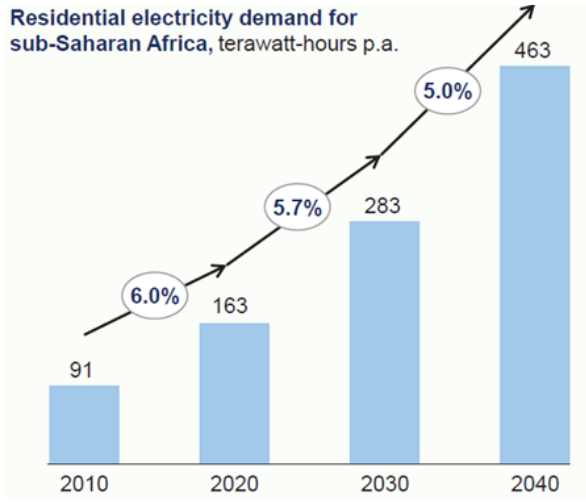
Energy efficient fridge saves 60% of electricity in cooling

Green mortgage is a housing finance scheme to encourage the design and construction of sustainable homes as well as the procurement of energy and resource efficient appliances. Save more on energy and water than the increase in the mortgage payment!



Source: *UN-Habitat, Sustainable Buildings in Tropical Countries*

FIGURE 2 **RESIDENTIAL ELECTRICITY DEMAND FOR SUSB-SAHARA AFRICA (TWH/YR)**



Source: *McKinsey and Company (2015). Brighter Africa: The growth potential of the sub-Saharan electricity sector*

THE IMPORTANCE OF GREEN FINANCE

Achieving the internationally agreed targets of the Paris Climate Accord and the Sustainable Development Goals requires a vast mobilisation of both public and private finance, some US$90 trillion over the next 15 years globally (UNEP 2016). Meeting the Sustainable Development Goals by 2030 presents a US$2.5 trillion global investment requirement in cities per annum (Business and Sustainable Development Commission 2016).

While at an early stage, there is a discernible trend across the continent and globally for shaping finance practices to sustainability objectives. East African banks and other investment sector participants should actively take part in this. Doing so can seed green building and localised energy finance practices in the region, positively shaping the built environment for generations to come.

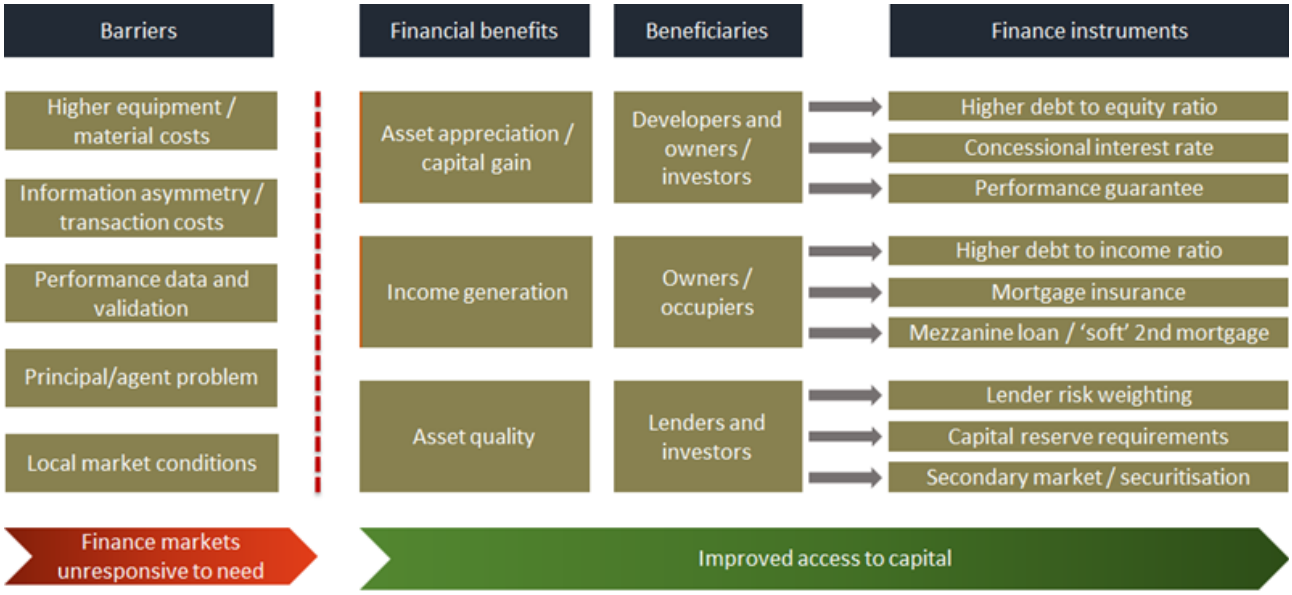
There are many barriers which prevent greater investment in green buildings and energy efficiency. They include higher costs; information asymmetries; performance data and validation; and the principal/agent problem. The characteristics of the East African property finance market - i.e., its high interest rates/cost of debt; housing affordability constraints from a mismatch between income levels and the production cost of formal housing; and low liquidity from shallow capital markets and modest amount of refinance products and activity in each country – add to these investment barriers. Any green finance products created will need to be tailored to these local conditions. Figure 3 summarises these barriers and potential finance instruments to address them.

While there are reasonable concerns that green buildings will be more costly to deliver and thus impact upfront affordability, the available evidence suggests only modest cost premiums to design and build green are needed. Meanwhile, the evidence base that green buildings create financial benefits in excess of costs is solid and growing.

Recommendation: green concessional construction finance

That green properties return higher values vis-à-vis comparable properties in the marketplace, and improve occupant/owner cashflow and satisfaction, they reduce both the likelihood of borrower default and the potential that foreclosed properties are liquidated at values below their debt liability. This is particularly relevant in the absence of a secondary market as primary lenders remain the long-term holder of the loan and security. These characteristics

FIGURE 3 **FINANCIAL BARRIERS AND AVENUES ON HOW TO OVERCOME THEM**



of green buildings shown in markets internationally can support the EAC region's banking sector in evaluating how modest adjustments to lending criteria and practices can result in more credit flows to green buildings.

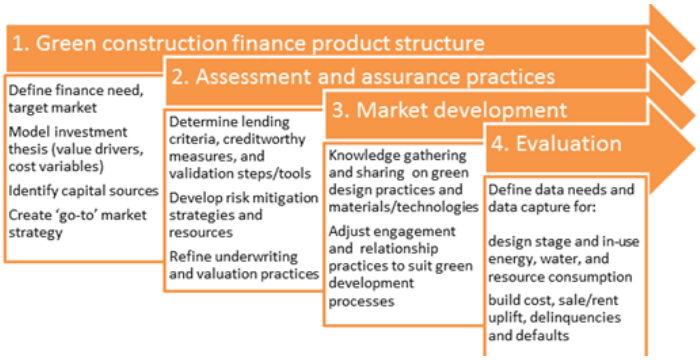
As a first step, it is recommended that a **green construction loan product** be developed whereby project debt is provided at concessional interest rates in order to balance out any increase in project capex compared to non-green buildings. The end-result should be that the price borne by the end-buyer is equal or very close to that of comparable non-green properties in the market.

Figure 4 outlines a process for bringing a green construction finance product to market. Equalising the cost of construction between green and standard properties will start to build the supply of green properties; create producer and consumer understanding and demand for green properties; and build the evidence base on green building benefits.

Having objective design and in-use assessment and performance data is foundational to making investment and lending decisions in green buildings. Fortunately, there are a range of existing tools in use internationally – many in development contexts similar to the EEBEA target countries – that can be applied here to support finance decisions. An objective of any green finance initiative should be to deepen the pool of data and performance indicators on energy performance and other green building attributes.

Though not a comprehensive list, Table 1 shows best practice and knowledge resources which may be drawn upon to develop this finance mechanism.

FIGURE 4 **PROCESS FOR BRINGING A GREEN CONSTRUCTION FINANCE PRODUCT TO MARKET**



Recommendation: localised energy asset development and finance

Integrating distributed energy systems within large master planned property projects can take advantage of remarkable cost reductions in renewable energy, storage, and demand management. Local area microgrids (Figure 5) can provide owner/occupier benefits through secure, lower-cost energy, and deliver wider network benefits. Yet uptake of integrated localised energy systems has been low.

The property finance and delivery sectors tend to be risk-averse toward new technologies and changes to tested design, financing, and construction pathways. A strategy to help overcome this aversion is for the property and the energy assets to be separated into parallel development tracks tied via power purchase and lease agreements. Localised energy delivery thus gets vested with specialists who bring their own expertise and financing to the project, allowing the lead property developer to focus solely on its core asset. For projects targeting lower-income buyers/residents, this may offer tangible development cost saving and affordability benefits as expenditure on site

TABLE 1 **EXAMPLES OF BEST PRACTICE AND KNOWLEDGE RESOURCES WHICH CAN BE ADOPTED**

PRODUCT & MARKET DEVELOPMENT ACTIVITIES	RESOURCES
1. Green construction finance product structure	• International green mortgage products (e.g., Mexico, South Africa, India, United States, etc.) • IFIs and national institutional investors • Green bond market
2. Assessment and assurance practices	• Green building tools (e.g., EDGE) • Performance guarantees and mortgage insurance (e.g., Brazil, Canada) • RICS (UK), Appraisal Institute (US) and RenoValue, ReValue (EU) green valuation checklists and knowledge tools
3. Market development	• EEBEA technical guidance documents and knowledge resources • National green building councils
4. Evaluation	• International energy and water audit protocols and post-occupancy evaluation methods • Loan and property performance tracking (e.g., Community Preservation Corporation and Enterprise – US, EU Energy Efficiency Re-finance pilot)

infrastructure is capitalised through a partner's long-term energy asset financing, rather than the lead developer's short-term construction debt. this approach is provided in Figure 7.

Figure 6 outlines a process to assess the commercial viability for localised energy systems (potentially bundled with other local utility services, e.g. water, wastewater, and data) within large-scale development plans. The emphasis is on whole networks rather than individual elements, i.e., rooftop solar panels on individual buildings. If only the latter is pursued, it could be done within a concessional construction loan as described above, with the property developer taking on delivery risk and recapturing the investment at the point of sale. Alternatively, the systems approach is premised on creating a **separate local energy/utility asset that can be financed and delivered by a dedicated delivery partner**. Doing so could create affordability gains, value uplift, resource and carbon savings, and wider network benefits greater than could be achieved on an individual elements basis.

For the East African market, the availability of finance resources, the economic return to the lead property developer, and the availability of delivery and operations partners for splitting the energy and property assets, needs to be assessed. The aim is to justify to property developers/ investors that localised energy asset finance and delivery is market-ready, the financial benefits for lead project sponsors can be realised, and that delivery and operations risks can be managed. This may require support from specialised capital and project preparation finance sources at the outset.

FIGURE 5 **LOCAL AREA MICROGRIDS**

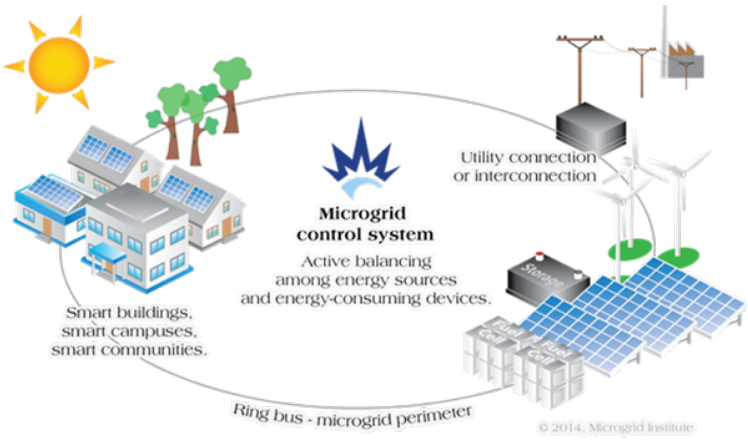


FIGURE 6 **PROCESS TO ASSESS THE COMMERCIAL VIABILITY FOR LOCALISED ENERGY SYSTEMS**

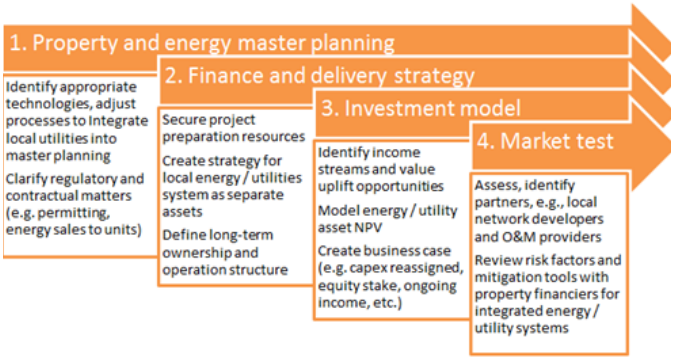
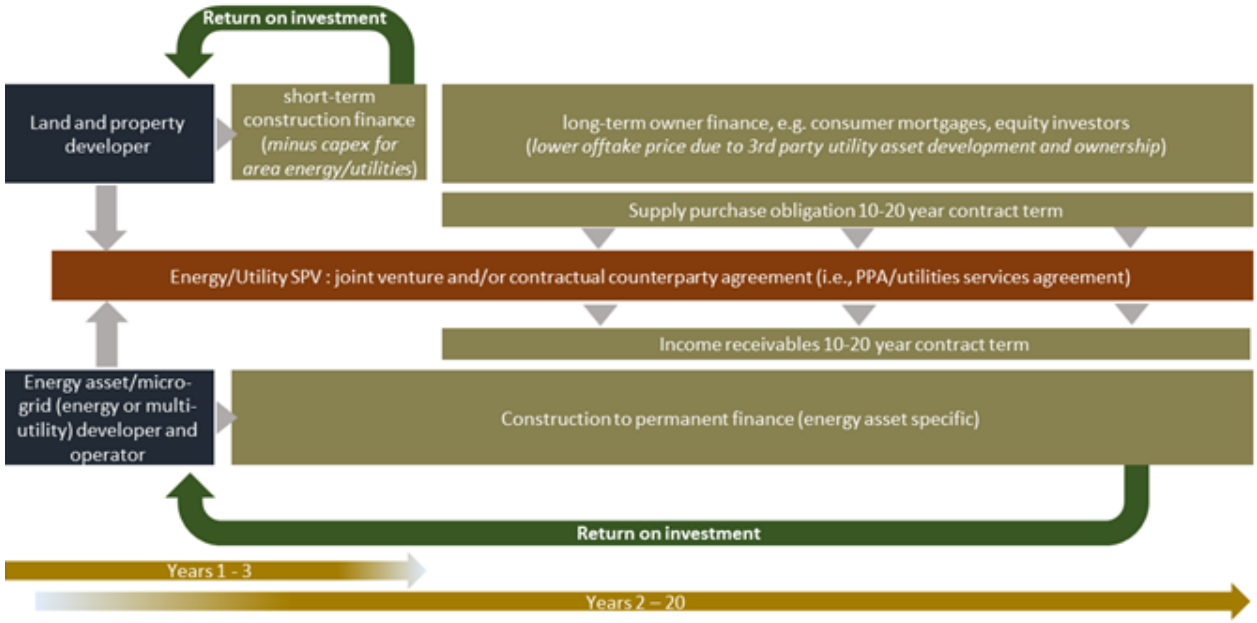


FIGURE 7 **BARRIERS AND POTENTIAL FINANCE INSTRUMENTS TO ADDRESS THEM**



Some best practice and knowledge resources which may be drawn upon to deliver this finance mechanism are provided in Table 2.

TABLE 2 **BEST PRACTICE AND KNOWLEDGE RECOURCES**

PRODUCT & MARKET DEVELOPMENT ACTIVITIES	RESOURCES
1. Property and energy master planning	• Technology and regulatory framework reviews (e.g., IRENA, REN 21, World Bank RISE 2016[1]) • EEBEA technical guidance documents and knowledge resources • International case studies (Europe, US, Japan)
2. Finance and delivery strategy	• Project preparation grants from IFIs or donors (e.g., Sustainable Energy for Africa, Renewable Energy Performance Platform/REPP, Green MiniGrid Facility)
3. Investment model	• National or regional examples of rural or industrial/large commercial energy generation systems and microgrids
4. Market tests	• National or regional renewable energy councils or industry associations • Specialist equity funds • Risk mitigation instruments (e.g., currency hedge, performance guarantees)

1 *International Renewable Energy Agency (IRENA); Renewable Energy Policy Network for the 21st Century (REN21); Regulatory Indicators for Sustainable Energy (RISE)*

01 INTRODUCTION

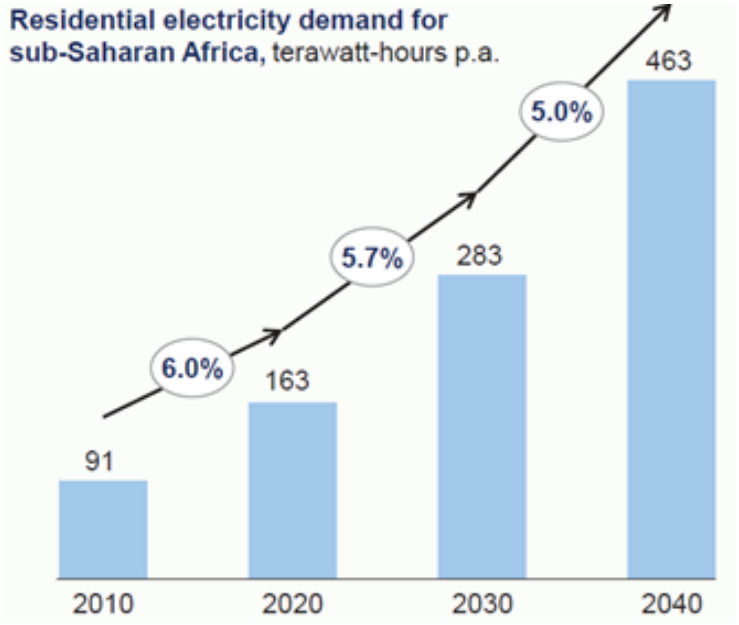
1.1 THE IMPORTANCE OF ENERGY EFFICIENCY AND GREEN BUILDINGS IN EAST AFRICA

Energy used in commercial and residential buildings accounts for a significant percentage of total national energy consumption across East Africa. It is estimated that 40% of the total electricity generated in the region is used in buildings alone, consuming more energy than the transport and industry sectors. Carbon emissions from the sector are of a similar order of magnitude.

The building sector encompasses a diverse set of end-use activities, which have different energy use implications. The amount of energy used for cooling, heating and lighting is directly related to the building design, building materials, the occupants' needs and behaviour, and the surrounding micro-climate. A majority of modern buildings in sub-Saharan Africa (mainly tropical climates) are replicas of buildings designed for the western world (cold and temperate climates) and do not account for the differences in climate. As a result, buildings are heavily reliant on artificial means for indoor comfort, i.e. cooling, heating and lighting. Inefficient design and construction using inadequate materials for the climate, combined with poor understanding of thermal comfort, passive building principles and energy conscious behaviour, has led to tremendous energy wastage and high electricity bills.

In addition to improving energy and resource consumption within buildings, consideration of how buildings are supplied with energy is also needed. While electricity access rates are higher in cities than overall national averages, full urban electrification from centralised energy sources remains elusive. Meanwhile, high urbanisation rates and even higher projected rates of electricity demand are outpacing capacity additions to national energy generation and distribution networks. Utilising low-carbon, on-site/local area energy solutions that are affordable, fast to erect and commission, and scalable, can help address this demand growth and capacity constraint dilemma, while accelerating the needed change toward renewable energy resources.

FIGURE 8 **SUB-SAHARAN AFRICAN RESIDENTIAL ELECTRICITY DEMAND GROWTH**



Source: *McKinsey and Company (2015). Brighter Africa: The growth potential of the sub-Saharan electricity sector*

1.2 THE IMPORTANCE OF GREEN FINANCE

The international community have clearly determined the need for significant carbon emission reductions and prioritisation of sustainable development, as evidenced by the Paris climate accord and 2030 Agenda for Sustainable Development, both agreed to in 2015. Achieving the goals established in these requires a vast mobilisation of both public and private finance, some US$90 trillion over the next 15 years globally (UNEP 2016).

In response, both private and public finance will need to be redirected on a significant scale. For sources of private investment capital, the opportunity to realise economic returns while simultaneously delivering carbon reduction and sustainable development gains is substantial. Meeting the Sustainable Development Goals, i.e., 17 goals for ending poverty and hunger, reducing inequality, and tackling urgent challenges such as climate change by 2030, presents a US$2.5 trillion global investment requirement in cities per annum (Business and Sustainable Development Commission 2016). In another estimate, shifting cities toward low-carbon energy supply, and efficient buildings, industrial operations, and transport/spatial uses, a cumulative US$17 trillion global stream of energy efficiency savings through could be generated 2050 (based on the NPV of net energy savings from an annual 2.5% rise in energy costs and 3% discount rate) (NCE, 2015).

Creating a finance system that enables and prioritises green and sustainable investments requires:

1. National strategies to embed sustainability into long-term road maps for financial reform
2. Financial technological innovation aligned with sustainable development
3. Public finance to pioneer new markets, rules and practices
4. Awareness raising so that policymakers and professionals are fully aware of sustainability imperatives and raise the quality of public debate
5. Common methods, tools, and standards for integrating sustainability into investment decisions and financial sector performance (UNEP, 2016a).

Across East and sub-Saharan Africa, examples can be found for each these five, though not yet comprehensively in any one country. Innovations such as M-Kopa (a renewable energy payment system focusing on rural households); national green growth policies in Rwanda and the Kenya Sustainable Finance Initiative (see Sections 8.4.1and 8.4.2); subnational government 'green bond' issuances in South Africa; and adoption of Equator Principles[2] at individual banks in South Africa, Nigeria, and Togo, are examples. There is an early stage yet discernible trend across the continent and globally for shaping finance practices and deploying instruments to deliver green results. East African banks other investment sector participants need to actively take part in this. Doing so can seed green building and localised energy finance practices which are much needed in the region.

1.3 THE EEBEA INITIATIVE

Promoting Energy Efficiency in Buildings in East Africa (EEBEA) is a 48-month project implemented by UN-Habitat in collaboration with UNEP and five East African countries (Kenya, Uganda, Rwanda, Burundi, and Tanzania). Funding has been provided by the Global Environment Facility (GEF). Its objective is to mainstream energy efficiency measures into housing policies, building codes and building practices in East Africa, and to avoid GHG emissions as a result of improved building and development practices. In order to promote energy efficiency in building, the project includes 5 components, namely:

1. establishment of energy efficiency data and benchmarks in the building sector;
2. integration of energy efficient measures in the building codes, housing policies, and regulations;
3. awareness raising and capacity building in energy efficiency and green buildings;
4. appropriate financial framework for the implementation of energy efficiency and green design measures in buildings; and
5. provision of project-specific advice to development projects so as to improve environmental performance.

More information on the EEBEA can be found at http://www.eebea.org/

1.4 OVERVIEW OF COMPONENT 4 – FINANCE

This manual is in support of Component 4 – Finance, within the overall EEBEA project. Its premise is that while green buildings typically carry higher upfront capital/buyer costs but lower ongoing/operational ones, they offer financial value to lenders, owners, and occupiers; and societal value in reducing resource consumption, and carbon and other forms of pollution. Unlocking this value

2 *A risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects.*

requires specialist energy efficiency and green building, and localised energy, finance.

Shifting markets so that green buildings are supplied by developers, demanded by consumers, and financed by lenders is a substantial effort. But so too is the opportunity: up to 70% of energy consumed in buildings can be saved through the adoption of passive building design, behaviour changes and the use of resource efficient appliances (UN-Habitat, 2013a).

Financial barriers have been identified among the most important barriers for the adoption of green building designs. The regional market presently does not provide adequate financial mechanisms and alternative lending products, i.e. in form of green mortgages or preferential loans for sustainable, green and energy efficient buildings, and including integration of renewable energy technologies.

This guide to sustainable property finance was developed to give finance sector participants a knowledge base and recommended steps/activities to initiate product and market development activities for green property and localised energy finance. Its focus is on new construction. It aims to bring information and raise awareness on the financial aspects of green building, e.g., what are the costs of green buildings in comparison to conventional buildings; what are returns on investments for green buildings; what is the impact of green building on the valuation of buildings; and so on. The need to mainstream these features into property development and finance, and push the boundaries of standard and 'stretch' practices for continuous ratcheting up of rigorous performance outcomes, is critical: roughly 75% of the buildings to be standing in East Africa by 2050 have yet to be built (UN-Habitat, 2013b).

1.5 STRUCTURE OF THE FINANCE GUIDE

The several chapters of the finance guide provide information on green building design principles and technologies; barriers and benefits of green buildings; strategies to integrate low-carbon distributed energy networks within large property master plans; preliminary green finance models; matching green finance to underwriting, valuation, and regulatory and risk practices; recommendations for new product development and potential sources of wholesale capital to meet the market need; a framework for building capacity and new product development; and an appendix with best practice case studies from a range of countries and development contexts.

The manual is based on extensive literature review of studies and papers on green building and distributed energy technology and value, and best practices observed elsewhere; and consultation with dozens of national stakeholders in Kenya, Rwanda, Tanzania, and Uganda[3] and other international consultees. The full list of stakeholders is provided as Appendix B. Most consultations took place during a two-week mission to East Africa in October, 2016. The manual is also the culmination of a process begun in September 2013 when an international conference was held in Nairobi, chaired by UN-Habitat, on financing green building in Africa. That conference successfully brought together the building industry with the finance sector in East Africa alongside international development banks with an interest in green building. It presented opportunities for financing energy efficient and green buildings in Africa, referencing recent initiatives and best practices; and brought attention to the business case opportunity for banks and financing institutions to develop green property finance products.

1.6 KEY MESSAGES

- The East African property finance market is characterised by its high interest rates/cost of debt; housing affordability challenges due to the mismatch between income levels and the production cost of formal housing; and low liquidity from shallow capital markets and modest amount of refinance products and activity in each country.

- These local market conditions are barriers to investment in green buildings, and the structure of green finance products will need to be tailored to them. The ability to effectively deploy commercial finance solutions in the EEBEA target countries, and structuring concessional or subsidised solutions for certain markets or interventions (to deliver both consumer and societal benefits), requires further investigation and sensitivity modelling.

- In addition to the above regional market characteristics, there are more general barriers to investing in green buildings and energy efficiency which include higher costs; information asymmetries; performance data and validation; and the principal/agent problem. International experience offers guidance to overcoming these.

- Given the high and rising cost of energy in Africa generally and the significant impact that lower energy expenditure can have on household financial security and business competitiveness, investments in building efficiency and cost-effective distributed energy are of great importance.

- While there are reasonable concerns that green buildings will be more costly to deliver and thus impact upfront affordability, the available evidence

3 *Burundi was excluded from the in-country consultations and therefore all general or specific references to the EEBEA target countries is restricted to the four countries listed.*

suggests only modest cost premiums to design and build green are needed. Meanwhile, the evidence base that green buildings create financial benefits in excess of costs is solid and growing. Finance instruments will need to be tailored to regional market conditions to unlock these benefits.

- The financial benefits from green buildings can be organised as those most relevant to

    1. developers and owners/investors (asset appreciation and higher capital gains);

    2. owners and occupiers (income generation from building efficiencies and rental income); and

    3. lenders and investors (improved asset quality).

- The persuasive evidence in support of these benefits is almost entirely from mature markets reports and studies. This is due to their longer track-records in green property and deeper data sets to draw from. As the market for green property grows in East Africa, similar benefits can be anticipated.

- Extending finance to properties that return higher values vis-à-vis comparable properties in the marketplace, and that improves occupant/owner cashflow and satisfaction, should reduce both the likelihood of borrower default and the potential that foreclosed properties are liquidated at values below their debt liability. This is particularly relevant in the absence of a secondary market as primary lenders remain the long-term holder of the loan and security.

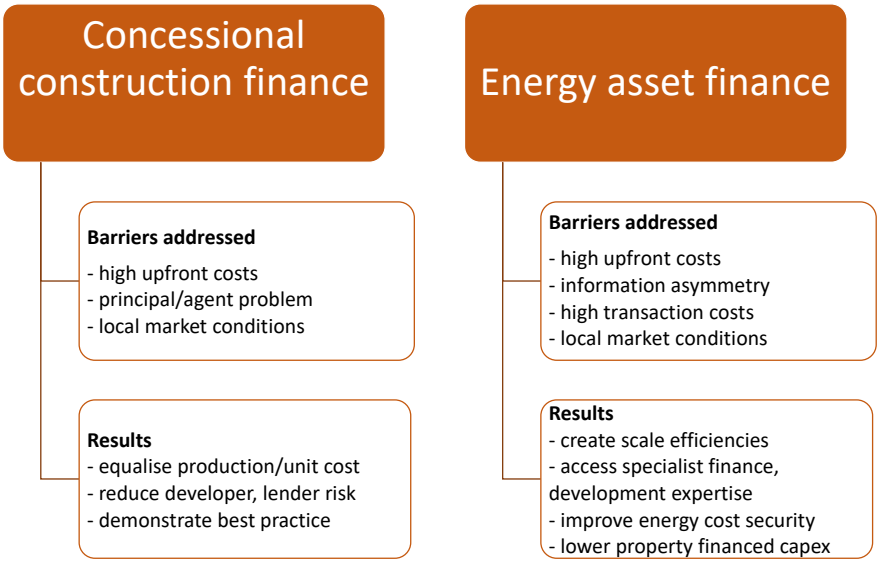
- Integrating distributed energy systems within large master planned property projects can take advantage of remarkable cost reductions in renewable energy, storage, and demand management technologies. Local area microgrids can provide owner/occupier benefits through secure and lower-cost energy supply, and deliver wider network benefits.

- Energy from photovoltaics can be provided at costs generally on par or perhaps lower than retail electricity rates right now. Battery storage will be cost neutral with diesel back-up in East Africa within a period of two to three years. For any large-scale property project entering into feasibility assessment and planning, to not include localised renewable supply and storage in project design and planning is to subject future occupants to higher than necessary energy costs.

- Uptake of integrated localised energy systems has been low. The property finance and delivery sectors tend to be risk-averse toward new technologies and changes to tested design, financing, and construction pathways. A strategy to help overcome this risk aversion is for the property and the energy assets to be separated into parallel development tracks tied via power purchase and lease agreements. Localised energy delivery thus gets vested with specialists who bring their own expertise and financing to the project, allowing the lead property developer to focus solely on its core asset. For projects targeting lower-income buyers/residents, this may offer tangible development cost saving and affordability benefits.

- Modelling undertaken for this guide shows that several green finance mechanisms can match

FIGURE 9 **RECOMMENDATIONS FOR NEW FINANCE PRODUCT DEVELOPMENT**



a range of development opportunities (project finance, retail mortgage finance, localised energy asset finance), though variables such as interest rates, level of equity contributions, loan tenors, and the amount and cost of energy used impact the product's efficacy and commercially viability. These will need to be carefully calibrated to the market.

- It is recommended that concessional construction project finance for green properties, and energy asset finance separated from the underlying property finance for large master planned projects, be the first focus for new green finance product development in the EEBEA target countries. This may require external specialised capital and project preparation finance sources at the outset (Figure 9).

- Developing these finance instruments can be informed by international best practices. Such new finance products for East Africa will be part of a growth trend internationally in green finance, in which commercial banks and investors are playing significant parts.

- Using objective design and in-use assessment and performance data is foundational to making investment and lending decisions in green buildings. There are a range of existing tools in use internationally – many in development contexts similar to the EEBEA target countries – that can be applied here. An objective of any green finance initiatives should be to deepen the pool of data and performance indicators on energy performance and other green building attributes.

- A range of market shaping and capacity building activities are needed to increase the supply and demand of green finance and green properties. The commercial finance and development sectors should be lead agents in this, but engagement of other stakeholders from the government, utility regulation, building design, energy technology, and specialist energy finance sectors is critical.

1.7 ACKNOWLEDGEMENTS

The following individuals at UN-Habitat must be thanked for the advice and effort in the in-country consultations and preparing this manual: Vincent Kitio, Chief, Urban Energy Unit; and his colleagues on the EEBEA project management and delivery team: Goodman Kazoora, Robert Sangori, Yves Sangwa, Fatma Mohamed, Solomon Kagogwe, and Sebastian Lange. The advice from the consultees listed in the appendix was invaluable and they also must be thanked for generously sharing their time and opinions.

Any errors or omissions in the document are attributable solely to the author.

02 EAST AFRICA PROPERTY AND FINANCE MARKET

The formal property finance/mortgage sector is growing across the East Africa region, though from a very low base. In general,

- interest rates/cost of debt is high;
- housing affordability is a significant challenge, with the only small percentages of national populations able to access the formal housing market due to the mismatch between income levels and the production cost of formal housing; and
- liquidity is low given the shallow capital markets in each country and modest amount of refinance products and activity.

Discussions with individual stakeholders in the region also suggest a level of consumers mistrust of financial products, and preference for short-term or no financing, are contributing factors to the small market size.

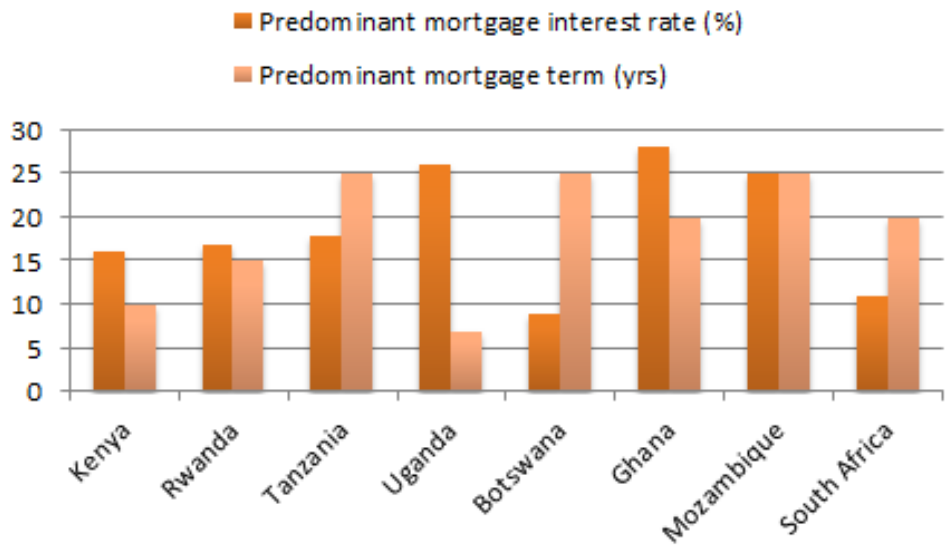
The outlook for the property and finance markets suggests continued incremental growth. Creating specialist finance solutions to facilitate uptake of green/energy efficient building development and sales, and low-carbon energy finance, can complement other efforts within the sector to bring new capital sources to market, improve portfolio quality, and increase the pool of potential borrowers.

The remainder of this section provides an overview of the market, including characteristics for property development and finance generally and some of the barriers to increased lending. There is also more specific commentary for the four EEBEA countries.

2.1 OVERVIEW

Mortgage rates are one factor that impacts access to finance and housing affordability. Figure 10 shows a snapshot of prevailing mortgage terms in the four EEBEA countries, as well as four comparator countries elsewhere on the continent. In the EAC, mortgage interest rates at a minimum of 15% are the norm, with tenors varying between countries.

FIGURE 10 **PREVAILING MORTGAGE INTEREST RATES AND TERM**



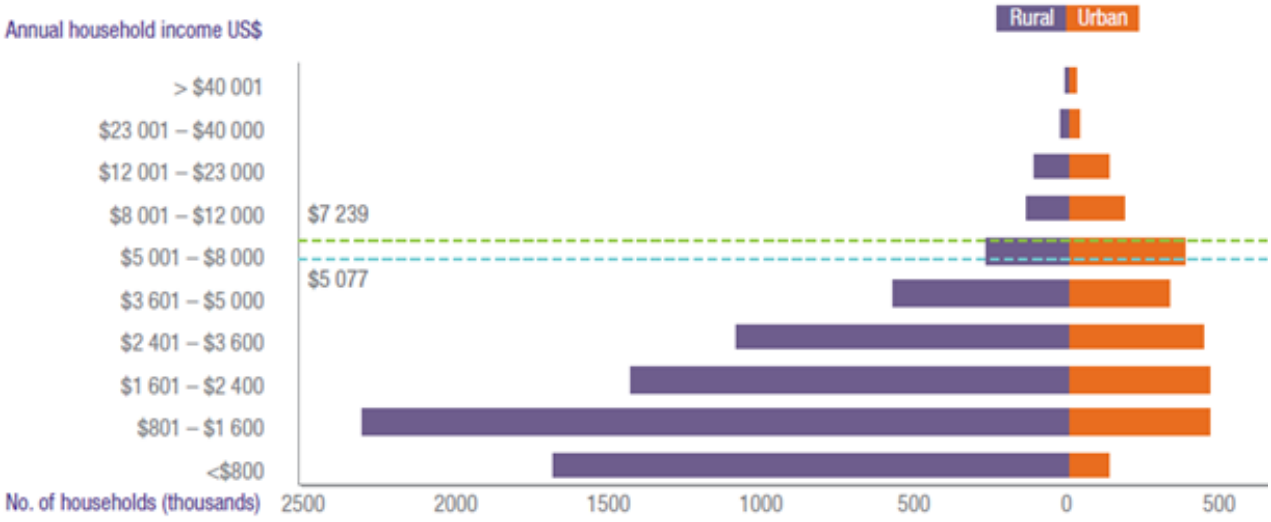
Source: *Based on: Centre for Affordable Housing Finance in Africa, Housing Finance in Africa 2016 Yearbook*

Interest rates at these levels makes housing finance prohibitive for a great number of prospective low- and middle-income buyers, given the interest payment burden over and above capital repayment for even low-cost production housing. Addressing the interest rate charged to consumers could help address the trade-off between the higher capital costs and reduced ongoing costs of green buildings (see Chapter 4 and 6 for further exploration of this).

Most low- and middle-income housing is either informal or self-build, which if financed is often through short-term unsecured consumer loans for projects built incrementally. Formal housing developers meanwhile struggle to create 'down-market' products to suit the income and credit parameters of significant segments of the population, the same segments of which tend to be absent from lenders' customer bases due to expensive credit. While the cost of formal production housing is high for many reasons not detailed in this manual (e.g., material sources and supply chains; building codes and standards; small-scale development entities and fractured markets; cost of land; land registration and regulatory matters; contract enforcement rights; etc.), this lack of purchasing and borrowing power results in most production housing built for the upper middle- and upper-income brackets of the market. Note, too, that incremental (self-build) housing - even if developed through formal land tenure and ownership – likely does not carry the same level of utility service and connection standards that larger-scale master planned projects do. Thus even if these larger projects are targeting the lower end of the market, the costs borne by these developers for services and utilities can put them at a cost disadvantage vis-à-vis self-build units. Separating property and utility assets into individual finance and delivery packages (explored further in Chapter 5) may help level this housing production cost disparity.

Figure 11 to 14 from the Centre for Affordable Housing Finance in Africa provide an indication of the gap between what the East Africa development market is producing in terms of low-cost housing, and what prospective buyers can afford based on their income levels and indicative borrowing costs/borrowing terms. The affordability calculations assume a 20-year mortgage at 15% interest, with a 25% debt to income ratio and no down payment. The cost listed is the lowest formal production home brought to market in 2015. Income data is also based on 2015 figures.

FIGURE 11 **KENYA HOUSING AFFORDABILITY INDICATORS**



- - - - Average income needed for the cheapest newly built house by a formal developer (US$15,085)

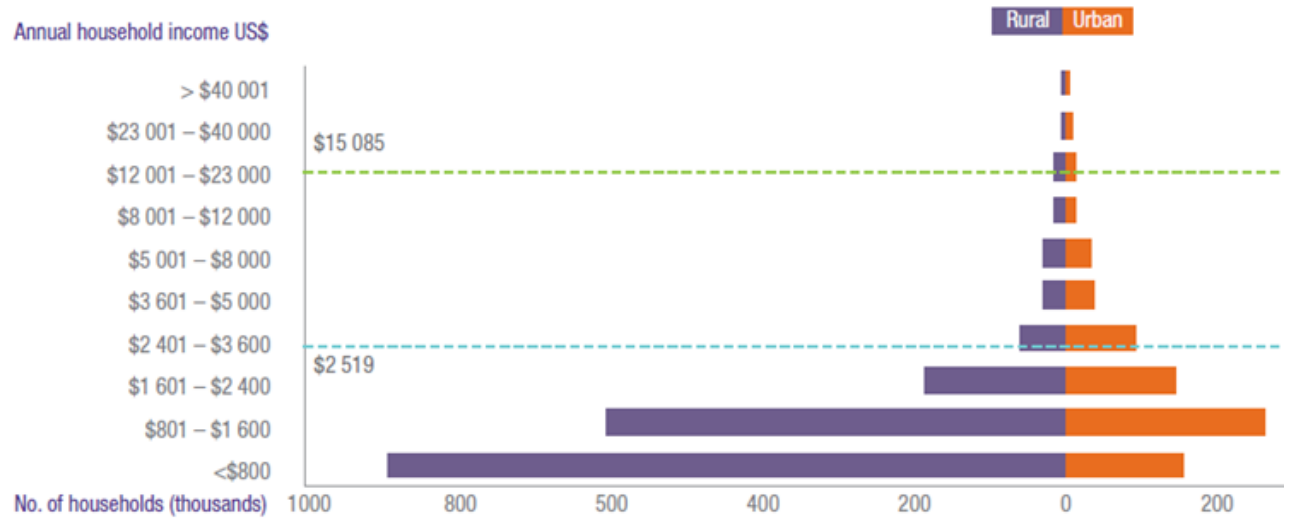
- - - - Average annual urban household income (US$5,007)

- lowest cost formally produced house: US$15,753

- percentage of urban households that can afford this unit: 29.4%

Source: *Centre for Affordable Housing Finance in Africa, Housing Finance in Africa 2016 Yearbook*

FIGURE 12 **RWANDA HOUSING AFFORDABILITY INDICATORS**



- - - - Average income needed for the cheapest newly built house by a formal developer (US$ 15,085)

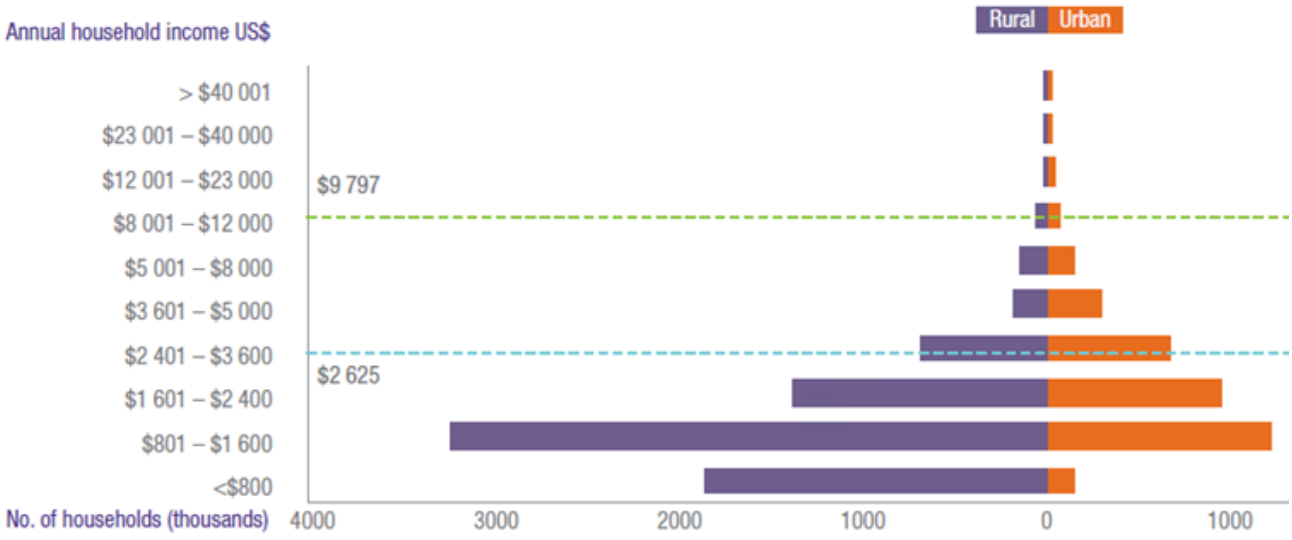
- - - - Average annual urban household income (US$2,519)

- lowest cost formally produced house: US$38,000

- percentage of urban households that can afford this unit: 2.7%

Source: *Centre for Affordable Housing Finance in Africa, Housing Finance in Africa 2016 Yearbook*

FIGURE 13 **TANZANIA HOUSING AFFORDABILITY INDICATORS**



- - - - Average income needed for the cheapest newly built house by a formal developer (US$ 9,797)

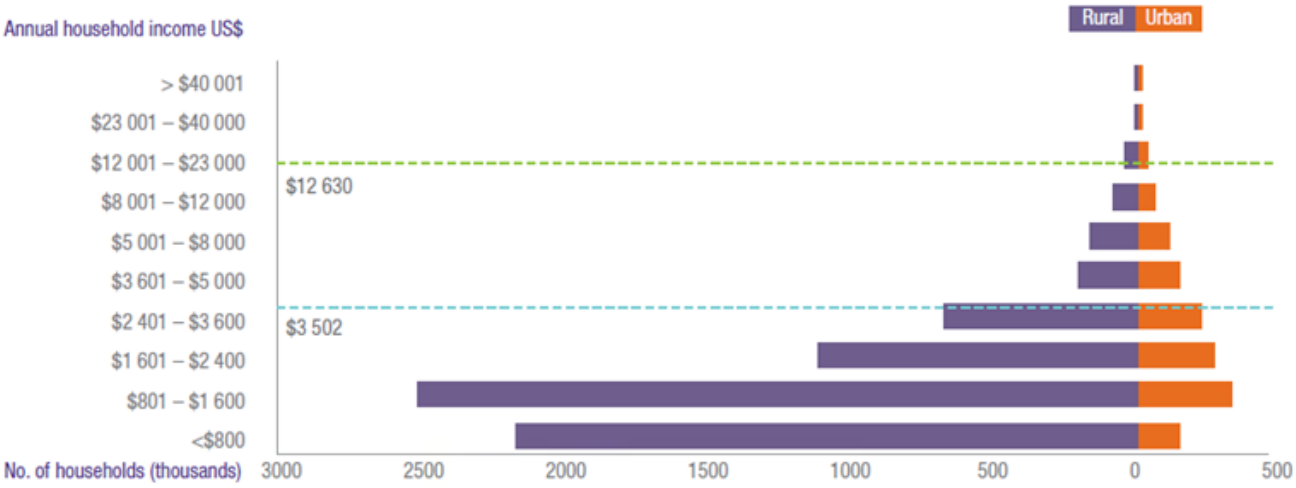
- - - - Average annual urban household income (US$2,625)

- lowest cost formally produced house: US$19,801

- percentage of urban households that can afford this unit: 3.2%

Source: *Centre for Affordable Housing Finance in Africa, Housing Finance in Africa 2016 Yearbook*

FIGURE 14 **UGANDA HOUSING AFFORDABILITY INDICATORS**



- - - - Average income needed for the cheapest newly built house by a formal developer (US$ 12,630)

- - - - Average annual urban household income (US$3,502)

- lowest cost formally produced house: US$30,000

- percentage of urban households that can afford this unit: 3.5%

Source: *Centre for Affordable Housing Finance in Africa, Housing Finance in Africa 2016 Yearbook*

The above figures highlight the challenge of addressing affordability and access to finance while simultaneously creating new finance mechanisms specifically for the development and purchase of green properties. Where there is a risk of increasing the cost of the production housing through a green cost premium, there is a corresponding risk that affordability will be negatively impacted. Sufficient international experience does show, however, that the goals of green and affordability can be compatible (see Chapter 4 and the case study appendices).

Another feature of the East African market is that most mortgage finance is based on short-term deposits. There is a general lack of market liquidity and lack of access to long-term, lower cost wholesale finance due to immaturity in the capital markets. This liquidity mismatch (short-term deposits to fund long-tenor consumer mortgages) creates institutional risk which holds back the development of the property finance market (Mutero, 2014). While the region does feature some larger finance institutions that have issued corporate bonds so as to raise longer-term debt; an emerging proto-secondary mortgage market in Tanzania; and REIT legislation enacted and early-stage REIT market activity, there is substantial room for growth in terms of access to long-term wholesale capital and liquidity instruments. Liquidity instruments specific to green property finance such as green bonds or green mortgage backed securities may be part of the response to these needs.

Due to the above market constraints there is the lack of longer-term developer finance, e.g., structured loans that roll from construction to permanent take-out, including longer amortising commercial mortgages with shorter-term interim refinance triggers. Virtually all construction debt is fully retired at the point of completion and sale, reducing the timeframes in which investments can be amortised and gains realised. This can impact the appetite to invest in green technologies with longer payback periods. Chapter 5 (Localised energy systems and microgrids) presents a strategy for distributed energy financing to overcome this.

2.2 KENYA[4]

Kenya has the most advanced property market in the region and high levels of investment in large-scale projects, including significant inflows of private equity. Its governmental/parastatal development actors remain major players in the housing sector - though perhaps are comparatively less influential than in other countries as a result of the deeper pool of private developers. There are a broad range of institutional finance sources as a result of its well-developed pension, insurance, and mutual fund sector that can play a role in property finance, e.g., as investors in banks or through pension-backed loans. HF Group and KCB are amongst Kenya's large banks that have issued corporate debt in recent years. HF Group has

4 *The country-level commentary is supported by reports from the Center for Affordable Housing Finance in Africa (2015 and 2016 yearbooks) and from individual in-country stakeholder discussions, unless otherwise noted.*

also drawn from an IFC term loan, a portion of which was structured to support project finance for green property development (IFC 2013). The results to date have been modest, though it has created a learning experience on institutional preparedness for green property finance[5].

Property registration and titling difficulties, and land scarcity, are frequently cited constraints to property development and finance. The strong prevalence of adjustable rate mortgages coupled with high interest rates has created affordability and non-performing loan difficulties for buyers and lenders, respectively. This may change, however, due to restrictions on rates charged. The Kenyan government has recently instituted interest rate capping that all commercial banks are bound to. As a result, loans are set at 4 points above the central bank rate (mortgages are presently at 15%). Depending on the point of view, industry participants see rate capping as a barrier or opportunity for new 'green' product development.

- As a barrier, the fact that all products / projects are based on the same interest rate means that risk variables have been minimised in pricing decisions. As a result, banks may be less willing to lend to projects or create products seen as less safe.

- As an opportunity, the fact that banks cannot differentiate themselves to customers on the basis of interest rates means that new products such as green finance can be a tool to retain and attract business.

Institutions such as the Kenya Bankers Association, Kenya Green Building Society, and Kenya Property Developers Association provide effective non-governmental support for influencing green building, development, and finance practices. The Sustainable Finance Initiative of the Kenya Bankers Association has established high-level principals and is providing capacity building within the banking sector to increase finance flows in support of sustainable development (see Chapter 8 for further information).

2.3 RWANDA

Rwanda has a fast growing property market and high levels of financial inclusion. Mortgage laws were amended in 2011 that helped move the market toward longer-term, higher LTV loans (World Bank 2012). National-level policy setting that prioritises 'green growth' has contributed to Rwanda's regional leadership in establishing green building policies and codes (Government of Rwanda 2011). The City of Kigali has additionally been progressive in its long-term planning and marketing to attract investment and development, and demonstrates strong property sector governance (titling, registration, etc.). Some concerns have emerged of a property bubble in Kigali at a time when property prices are rising against macro trends of a depreciating franc against the dollar and increased imports (Africa Property News 2016)

Notable government-backed institutions that presently or potentially play a market-shaping role in green property finance and development include:

- The Development Bank of Rwanda (BRD)which can bring finance to the market at preferential terms from their lower cost of funds than is typically available to commercial banks in Rwanda. It plays a major role in the real estate development market through project finance as well as direct development activities.

- The Rwanda Housing Authority, established in 2010, which implements government housing and urbanisation policies. It recently signed an MoU with Singapore Building and Construction Authority to promote the development of green buildings and cities in Rwanda.

- FONERWA (Rwanda Green Fund), which is capitalised through government and donor grants and certified to access financing from the international Green Climate Fund. It on-lends concessional finance for projects that meet certain green technological and cost-benefits standards. BRD are presently certified as an on-lender.

2.4 TANZANIA

Tanzania is home to more than 50 commercial banks and the sector generally reports good profitability. There are several Islamic-only finance institutions, and all major commercial banks have Islamic windows. However it has the smallest mortgage market in the region. One factor in this is the lack of land titles. Data from the Bank of Tanzania suggests that 75% of land is not surveyed in Dar es Salaam. Many in the sector also expect a slowdown in the Dar es Salaam market and softening of property values based on the national government's decision so move many its functions and facilities from Dar to Dodoma.

5 *Formal reporting on the outcomes of this term loan arrangement has not been completed. In outline, the mechanism was structured so that HF offered a construction finance interest rate rebate if certain green design/performance features were met by developers taking the loan. Uptake was subsequently low as risk was retained by the property developer (the rebate was retroactive); and the rebate level insufficient to compel developers to make design/ technology changes in support of green design principles given the unclear costs and returns.*

Banks tend to be more risk averse toward property finance at present as a result.

On the development side, government institutions and parastatal developers are the main drivers of the market. This includes one closed-end REIT, the Watsumishi Housing Company, which is capitalised by public sector institutions. Launched in 2015 with a primary mandate to deliver low-cost public sector worker housing, it was the first fully fledged REIT established in the region. Another noteworthy developer is the National Housing Corporation (NHC), a corporatised government agency. It works across several income levels and property types: its higher-end projects are in fact a means to subsidise affordable housing units. NHC is expected to generate a profit for their equity shareholder (the national government), and utilise commercial bank finance in its development work. Several of their projects have been Green Mark[6] certified or assessed.

Tanzania is also the only country in the region with a liquidity facility (an early stage secondary market). The Tanzania Mortgage Refinance Corporation was launched with support from the IFC/World Bank. It has played a significant role in improving general market liquidity and efficiency in the sector. As of 30 June 2015, 21 lenders were offering a mortgage product (from only two in 2011). Tenors have been increasing so that 15 to 20 year terms are the norm, and rates have decreased since the TMRC was launched. It is structured to purchase loans on a full recourse basis from primary mortgage lenders, or to extend wholesale 'pre-finance' on an overcollateralised basis for mortgages pledged to the facility. Presently capitalised with IFC funds and capital stakes from several Tanzanian banks, it expects to issue bonds to raise additional wholesale finance in the near future.

2.5 UGANDA

The housing and commercial property finance sector is at its early stages of growth. Five Ugandan banks dominate the mortgage market, with nearly half of the market claimed by one lender. Overall, a lack of long-term capital is hampering the market. The National Social Security Foundation (NSSF) appears to be the only investor with long-term capital at play. Uganda does have REIT legislation enacted which is hoped will have an effect on the high cost of capital. However, there is no evidence of an active market yet.

The private developer market in Uganda is also quite small. There are very few developers capable of delivering more than 100-200 units per year. It has been suggested that the country's small property developers (i.e., those delivering circa 20 units per year) do have a significant importance in aggregate but their impact is hard to track.

As is the case elsewhere in the region, affordability is a major consideration. Developers with innovative production techniques and materials have sought to enter the market with models showing significantly lower delivery costs, but consumer preferences and building code differences have conspired to block these projects from being executed. A small number of condominium developers who are new to the market have developed lower cost housing (60 – 180 million Ugandan Shillings range/US$16,500 – 49,500, whereas average low-cost housing is considered to be around 200 million/US$55,000)[7]. It is believed that the ability to spread land costs to more units has been a contributing factor in lowering their unit prices.

National Housing and Construction Company (NHC), a government-backed developer, is presently piloting a new approach to on-site sewage treatment at one of its present development projects (Namungoona). It relies on a decentralised plant, installed and managed on a long-term service agreement by an outside vendor. There are lower capital costs for NHC for site infrastructure as a result, and lower ongoing costs paid by residents.

6 *A green building assessment and rating system developed in Singapore.*

7 *These figures are anecdotal. If correct on the low end (60 million Ugandan Shillings), this is considerably lower than the 2015 low cost production housing figure as stated by Centre for Affordable Housing Finance in Africa as shown in the graphic in Section 2.1.*

03 GREEN BUILDING DESIGN AND TECHNOLOGY

The sections below provide a brief overview of design strategies and technologies appropriate to the East African market. More detailed information on these subjects can be found at the EEBEA website in the "Awareness Raising and Capacity Building" and "Digital Library" content sections. In particular, a detailed technical manual has been completed by the EEBEA that is being used for professional training and skills development throughout the region: Sustainable Building Design for Tropical Climates: Principles and Applications for Eastern Africa.

3.1 INTEGRATED DESIGN

There is no single, strict definition of what constitutes a green building. In general, a building can be classified as green if it has the following attributes:

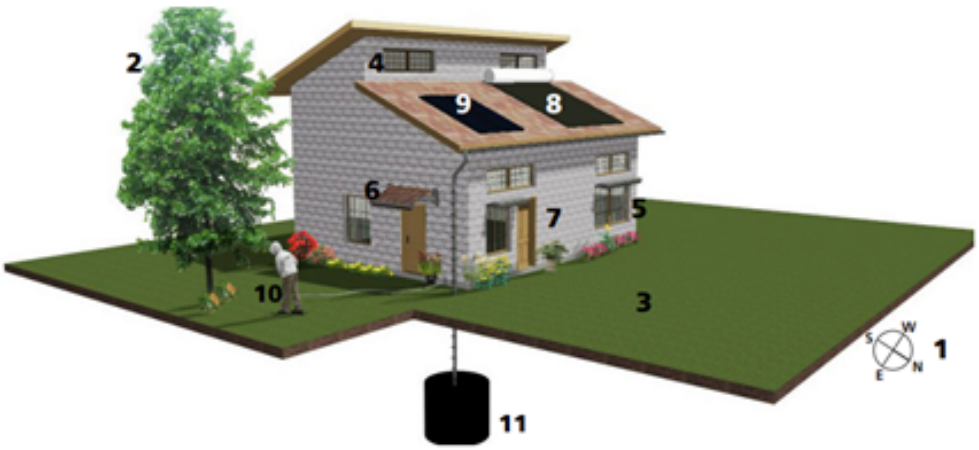
- Energy, water-, and material resource-efficient
- Low in embodied energy/carbon and embodied water
- Improve occupant comfort and well-being through healthy indoor air quality, stable ambient temperatures, use of natural daylight, and presence of exterior views
- Improve onsite ecology and minimise offsite pollution impacts during operation
- Use of low-carbon on-site energy generation and demand management systems

There are many green building rating and assessment tools used in the region and globally that create a form of green design and measurement standardisation[8]. Measures and labels for green buildings can be tied to investment decisions by lenders and buyers of properties.

The East African Community is characterised by five different climates, according to the Köppen classification, ranging from the tropical rainforest to the desert climate. Sustainable architecture must take into account this climatic diversity for its impact on thermal comfort, energy consumption and building materials. The prevailing region's climate characteristics means that there are extensive opportunities to minimise space conditioning and artificial lighting needs through passive design solutions which

8 *Examples include: BREEAM (UK and international); LEED (US and international); Green Star (Australia, with local versions in place in Kenya and South Africa); Green Mark (Singapore and international); Energy Star (US); Minergie (Switzerland); HQE (France and international); and more. See Chapter 7 for more details.*

FIGURE 15 **EXAMPLES OF INTEGRATED GREEN BUILDING STRATEGIES**



KEY

1. Orientation
2. Vegetation
3. Permeable area
4. Natural vertical ventilation
5. Natural lighting
6. Overhang for shading
7. Local building materials
8. Solar Water Heaters (SWH)
9. Solar Home System (SHS)
10. Waste water reuse
11. Rain water collection

Source: *Urban Energy Technical Note 01: Guidelines for Green Building Design (UN-Habitat, with the support of GEF and UNEP) See file for full reference guide including step by step green decision processes.*

TABLE 3 **EXAMPLE OF CLIMATE SPECIFIC PASSIVE DESIGN GUIDELINES**

KAMPALA, UGANDA **Lake region climatic zone**	**DODOMA, TANZANIA** **Semi-arid / Savannah climate zone**
• Buildings should favour good natural ventilation • Protection of all openings from direct and / or indirect solar radiation • Orientation along the east-west axis for maximum sun control • Major windows should be oriented on North and South facing walls as they receive less solar radiation • Use of medium weight materials is recommended as night temperatures often fall below the comfort zone • Roofs should be well ventilated and made of lightweight materials with low thermal capacity and high reflectivity • Light colour finishes are desirable to reflect solar radiation • Passive solar heating in the colder season	• Orientation with long axis running east-west to provide effective shading • Major windows should be oriented on North and South facing walls as they receive less solar radiation • Compact buildings to reduce the façades exposed to solar radiation • Use of medium to heavy weight materials with high thermal mass • Well ventilated and high reflective roofs of high thermal mass • Ventilation should be limited during day time, when the air is hot but allow for good natural night ventilation • Protection of all openings from direct and / or indirect solar radiation • Evaporative cooling in the hottest days is recommended

Based on: Urban Energy Technical Note 02: Climate and Architecture (UN-Habitat, with the support of GEF and UNEP), and includes guidelines for additional EAC cities.

very often are cost-neutral. In fact, the influence of passive design far exceeds that of active systems and needs to be prioritised as the most cost-effective and resource-efficient approach to improved environmental performance of the built environment.

Different passive design, mechanical and electrical systems and technology, and material choices influence building performance. Optimising environmental performance results from how these work together and complement one another to meet building performance criteria (Figure 15). Table 3 above shows the passive design guidelines for Lake Region and Savannah climates zones.

There are a range of regionally relevant design guides and resources available from UN-Habitat on passive design and active technologies to assist designers and developers in minimising resource use and consumption in buildings. See http://eebea.org/?q=all-documents for more details.

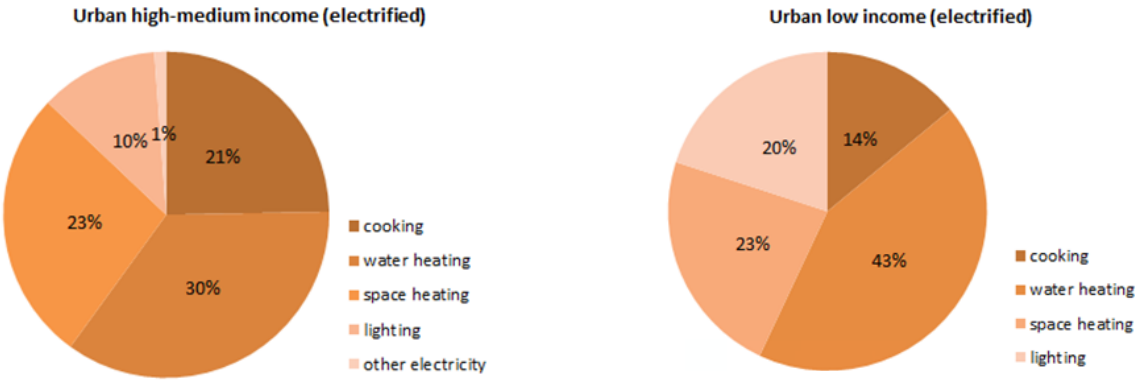
3.2 ENERGY EFFICIENCY

Countless studies on energy use in buildings demonstrate the vast opportunities to cost effectively design in and retrofit for energy efficiency in heating, cooling, ventilation, lighting, and appliance equipment and systems. In addition, coordinating the operation of the systems through the use of building management systems (sensors, analytics, and controls) help optimize equipment use and can greatly reduce energy demand. These advanced systems are more widely utilised in large commercial and multi-family residential buildings, but trends (particularly in mature property markets) are making the use of these technologies more common in individual homes and small commercial buildings. These include 'smart' thermostats, light sensors, predictive controls for appliances and systems, and remote monitoring.

Regional data on energy demand and consumption for specific building types and systems/uses within buildings is shallow though improving through activities of the EEBEA[9]. Energy and water audits were recently undertaken for more than 1,000 buildings in Kenya, Tanzania, and Uganda. The audits captured data on mean residential electrical (kwh/m^2 of floor area per annum) and water consumption (litres per capita per annum) for each country, grouped for climate region and income. This study, and others that from the continent that can serve as a proxy for the region, are instructive for assessing the in use consumption patterns and interventions can have the greatest cost-benefit impact.

9 *UN-Habitat. Assessment of Energy and Resource Consumption in Buildings in East Africa: A Case Study of Sample Buildings, Benchmarking and Evaluation of Energy Saving Potentials. Principal authors, Zeltia G. Blanco & Kennedy Muzee, forthcoming*

FIGURE 16 **HOUSEHOLD ENERGY CONSUMPTION PATTERNS, SOUTH AFRICA**



Based on: South African Report on Greenhouse Gas Emission Reduction Potentials from Buildings - A Discussion Document (UNEP Sustainable Buildings Initiative)

The UNEP study of South African building energy consumption suggests that interventions in the areas listed below could result in energy efficiencies in new buildings of around 40% to 50% in the commercial sector and around 30% to 40% in the residential sector, compared to business as usual. Similarly, the EEBEA energy and water audits study models a series of ideal buildings (incorporating appropriate active and passive design strategies for the region's five climatic zones), varied by income level, and shows a range of potential savings from typical practices.

Technologies such as solar water heating, which can offer a 50-80% energy reduction from electric water heating, and efficient lighting such as compact fluorescent (CFL) and light-emitting diode (LED) lamps, are two examples of significant saving potential. LED lamps use 70% to 80% less energy than incandescent counterparts and last 15 times as long. Commercial and multi-family residential buildings can also make use of lighting sensors and controls tied to occupancy and daylighting levels.

Passive design strategies and systems that influence energy efficiency include the use of efficient glazing (e.g., low-e coatings, which primarily slow the rate of infrared radiation through glass/glazing unit assemblies – either to keep heat in the building or unwanted heat out); selective use of glazing on east/west facades to minimise solar heat gain and on north/south facades to maximise daylight penetration; and external shades and louvers to block or allow seasonal solar heat gain.

3.3 DISTRIBUTED LOW-CARBON ENERGY

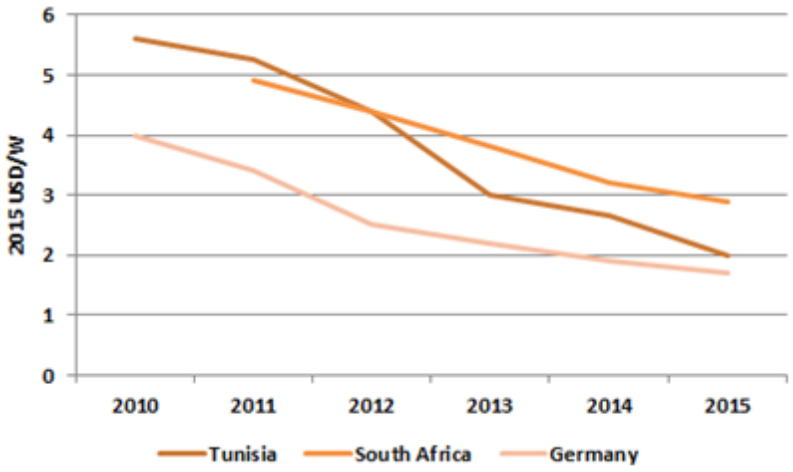
A range of on-site/localised energy generation and storage technologies are available and increasingly cost-effective at multiple scales, i.e., building, master planned estate/development, and district. As a result, it is possible for developments to offset anywhere from a small portion to their entire energy needs that otherwise are drawn from grid-based utilities. Appropriate technologies include solar electric (photovoltaic or PV) panels and systems, solar hot water, ground and air source heat pumps, biomass boilers, and modern bioenergy cookstoves.

TABLE 4 **PASSIVE DESIGN GUIDELINES**

ENERGY EFFICIENCY OPPORTUNITIES	
COMMERCIAL SECTOR	**RESIDENTIAL SECTOR**
• HVAC variable speed drives	• solar water heating
• thermal design	• geyser blankets
• energy efficient lighting	• efficiencies in space heating
• solar water heating and heat pumps	• energy efficient lighting
• energy efficient appliances	• behavioural changes
• behavioural changes	

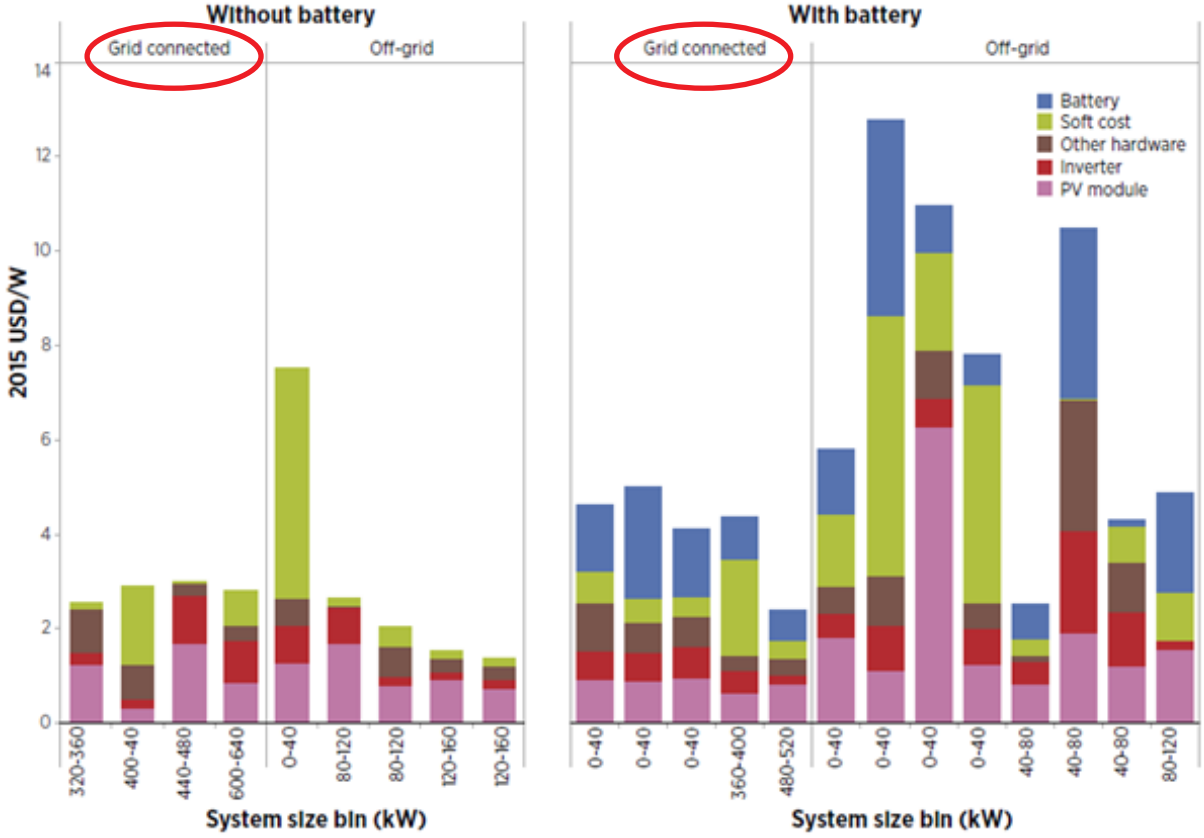
Based on: South African Report on Greenhouse Gas Emission Reduction Potentials from Buildings - A Discussion Document (UNEP Sustainable Buildings Initiative)

FIGURE 17 **COMPARISON OF AVERAGE TOTAL INSTALLED COST OF RESIDENTIAL SOLAR PV SYSTEMS, 2010-2015**



Based on: IRENA - Solar PV in Africa: Costs and Markets (2016)

FIGURE 18 **AFRICAN SOLAR PV MICROGRIDS COST BREAKDOWN (INSTALLED BETWEEN 2011-15)**



Source: *IRENA - Solar PV in Africa: Costs and Markets (2016)*

As shown in Figure 17, photovoltaic (PV) and battery costs have been falling precipitously, largely a result of scaling capacity. Trends over the past 15 years show that every time PV infrastructure (i.e. production and installed capacity) doubles, prices drop by 22%. And this trend may be accelerating. The result has been a globalised compound annual growth rate for PV of 43% since 2010 (Seba 2014). Absolute PV costs in Africa are dropping at a lagging pace vis-a-vis more mature markets, as would be expected due to the deeper pool of suppliers, installers, finance sources, and service providers in the latter countries. However, high and rising energy costs, excellent solar irradiation levels, and energy reliability considerations often makes PV energy more cost-effective for African consumers even in spite of the present higher average installed costs.

Data from the International Renewable Energy Agency on smaller-scale renewable energy technology costs in Africa show a promising opportunity to improve affordability and reliability of energy services through small-scale and localised solutions and systems. Figure 18 is based on data from 33 microgrid installations in Africa, a combination of grid-connected and off-grid systems. The grid-connected systems (i.e., those best suited for large-scale property development projects seeking commercial finance) are highlighted.

With the downward trend in battery costs projected three to five years forward mirroring the sharp declines seen in PV module costs since 2010, grid-connected microgrids with battery back-up could become a more common feature of large-scale development projects.

3.4 WATER EFFICIENCY

There are wide variances in household, institutional and commercial water consumption, depending on the location, age of the facilities and fixtures, heating/cooling requirements (e.g., use of evaporative cooling systems), landscaping, and affluence of the population. Low-flow water fixtures and dual flush toilets are commonly available and generally carry only a low cost premium (if at all). Efficient showerheads create energy savings due to reduced water heating in addition to the water savings achieved.

In addition to specifying water efficient fixtures, green building approaches can vary the water source utilised for various end-uses. For example:

- Treated blackwater (e.g. sewage effluent) or greywater (e.g., water from sinks and showers) can be used for landscape irrigation using building- to district-scale treatment. Note that relying on treated blackwater requires appropriate irrigation protocols to direct water to root systems and avoid dispersive spraying.

- Treated greywater or stormwater (run-off from roofs or impermeable surfaces) can be used for toilet flushing, and for evaporative cooling.

- Stormwater can be used for clothes washing, or with appropriate treatment, potable water.

Considering ways to utilise these sources helps preserve limited groundwater or mains water. Using these non-potable supplies requires attention to factors such as health and safety regulations and local accepted practices; the availability of technologies and human resources to manage high- or low-technology approaches; and consumer attitudes.

For the co-benefits of minimising water demand and providing resources that can improve local bio-dynamics, dry sanitation may also be considered. Dry sanitation is a modern adaptation of managing excreta without the use of water, and therefore without generating sewage. It implies: a) waterless toilets; b) the on-site treatment of excreta; and c) the production of a safe and effective soil amendment (Cordova 2001). Dry sanitation is more common in rural areas that lack networked infrastructure and where the treated wastes can be easily utilised by local farmers. However, successful urban and peri-urban examples do exist. An EU funded applied research programme, Resource-Oriented Sanitation concepts for peri-urban areas in Africa (ROSA), conducted from late 2006 to early 2010, undertook pilot projects in four cities in East Africa: Arba Minch (Ethiopia), Nakuru (Kenya), Arusha (Tanzania), and Kitgum (Uganda). Installations in Arusha included systems at eight households and at two primary schools (one to serve the school's 500 students, and the second for 56 staff)[10]. And in a dry sanitation pilot in Awassa, Ethiopia, a 42-unit/multi-storey housing development with 210 residents produced a 65% investment and operational cost savings over conventional wet system designs (Oldenburg et. al.2009).

3.5 LOCAL, LOW-EMBODIED ENERGY MATERIALS

The embodied energy of a product is a function of how much energy it takes to manufacture and transport a material or piece of equipment to a building; the energy it consumes during the life of the building; and the energy required for disposal. The assessment scale can vary depending on the boundaries drawn, and calculating embodied energy and carbon is a complex and data-intensive exercise. Protocols for doing so are available from the International Standards Organisation (e.g., ISO 14040). Embodied water of materials is an emerging metric for the assessing the environmental impact of buildings, largely led by academic researchers at this stage.

Common brick and cement block materials used for construction in Africa may be produced locally or regionally, but tend to have high embodied energy and are often thicker (more material intensive) than is required for the application. A recent study on opportunities to build low-cost green housing in Nairobi suggested that most structures are overspecified and that roofing and walling materials are unnecessarily heavy. Optimised building specification and improved site management alone can save in excess of 20% of lifecycle carbon (Kalra and Bonner 2012). Compressed Earth or Stabilised Soil Blocks, for example, constitute a highly viable alternative to conventional cement blocks. These are made from a mixture of soil, cement and water, and is hydraulically compressed (often at the worksite) to form an interlocking block. Their thermal insulation is equivalent to 10 times

10 *Further details can be viewed at: http://rosa.boku.ac.at/index.php?option=com_frontpage&Itemid=1*

that of cement blocks, significantly reducing heating and cooling costs (UNCTAD 2015).

A wide range of other lightweight, structurally sound, and superior insulating materials are widely used internationally and available (or potentially so) in the region. Examples include:

- Aerated autoclaved concrete (AAC) blocks, which are similar in function and construction to conventional concrete masonry blocks but are much lower in weight and material volume. AAC blocks are 80% air and 20% raw material, and only 15% of the material is Portland cement.

- Insulated concrete forms (ICFs), which are stay-in-place framework blocks made of rigid foam board insulation with hollow interior voids that are filled with concrete (and reinforcement bar depending on the building requirement). They offer excellent insulation and air tightness, quick construction, and overall material efficiency.

- Hollow core slabs that reduce the amount of concrete and steel in floors and decking by creating space or air voids in place of solid material. Significant thermal mass remains while reducing material volume by 20% or more.

- Structural insulated panels (SIPs) are a stressed skin sandwich of rigid insulation bonded between two wood fibre facings. Some make substantial use of bio-based materials, such as panels that use straw bales for the insulation layer or agricultural fibreboard for the facings. Exterior cladding can be part of the SIP assembly (Navigant 2013).

There are many natural or bio-based materials suited to African building typologies and that can be manufactured from specifically grown and harvested local materials or waste streams. This includes grasses and fibres such as wool, cotton, bamboo, jute, and hemp that are used in flooring, insulation, wall covering, or furniture fabrics. Waste products such as recycled cellulose or fabric for insulation, straw for straw-bale or adobe construction, and wheat or rice straw for compressed board products can also utilized in the production of building materials[11]. A significant advantage of bio-based products is the fact that they can act as a carbon store. Organising material production from fast-regenerating resources, such as agricultural products, softwoods, and grasses can also help rebuild stressed but easily replenishable material stocks.

11 One local example is Strawtec, based in Kigali, which produces wall systems with a core made from compressed agricultural straw fibres. See www.strawtec.com for more details.

EASTGATE CENTRE, MICK PEARCE AND ARUP, HARRARE, ZIMBABWE

Source: *https://www.pinterest.com/pin/240450067576426881/*

PLASTIC INSULATED FORMWORK BUILDING SYSTEM IN SOUTH AFRICA

Source: *https://www.designother90.org/solution/plastic-formwork-system/*

HABITAT RESEARCH AND DEVELOPMENT CENTRE - LIBRARY EXTERIOR - SOUTH FACING ENTRANCE TO LIBRARY (LEFT) AND VIEW OF LIBRARY AND MULTI-PURPOSE ROOM (RIGHT) FROM CONFERENCE CENTRE. COOLING TOWERS AND SOLAR PANELS ARE VISIBLE

Source: *https://archnet.org/sites/7093/media_contents/83628*

04 VALUE OF GREEN BUILDINGS – BARRIERS, BENEFITS, AND FINANCE INSTRUMENTS

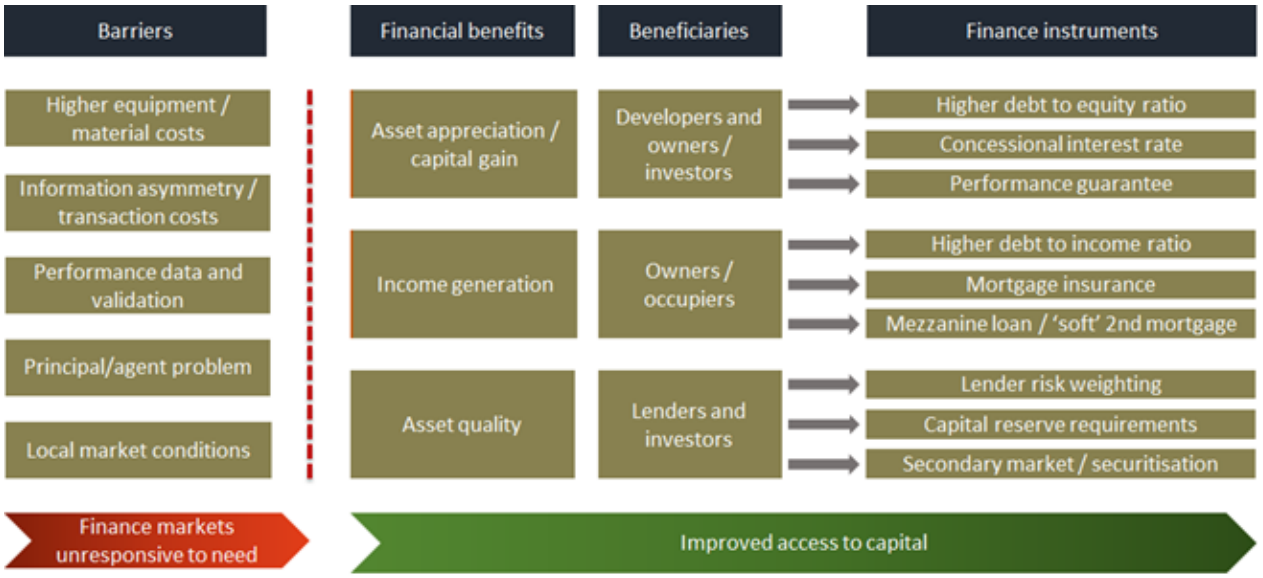
Green buildings can create many benefits to their developers, owners, and occupants such as improved financial returns and occupant comfort and wellbeing. Not all values are easily quantified, derived in the short-term, nor realised equitably (that is, there may be a gap between who pays and who benefits). Understanding the typical cost premiums for delivering these benefits and how to overcome them, which parties benefit, and the timeframe in which those benefits accrue is a challenge for the property development and finance sectors. Fortunately, finance instruments can play a role in rationalising these temporal, cost and value capture, and agency difficulties. Evidence from academic and case study literature, and applied examples of dedicated finance instruments for green property development and retrofits internationally, can be used to build the case for action and to support financial product development in East Africa.

This chapter will overview the barriers to green/energy efficiency building development; the benefits from green properties; and relevant finance instruments that can remove the barriers and increase finance flows so as to unlock the inherent financial value of green buildings and energy efficiency. These elements are summarised in Figure 19. A table at the end of the chapter maps these finance instruments against the barriers.

As the emphasis of the EEBEA initiative is on integrating green design and energy efficiency into new construction rather than retrofits, this chapter will focus principally on new property finance and development[12]. Where evidence and application of green building (particularly energy efficiency) retrofits is offered, it will serve as illustrative to what is possible through targeted finance mechanisms. Some information will also be presented on energy efficiency upgrades at the time of property sale or refinance, thus linked to mortgage underwriting rather

12 *Generally, green mortgages for new properties are referred to as Energy Efficiency Mortgages (EEM), and refinance/retrofit products labelled as Energy Improvement Mortgages (EIM).*

FIGURE 19 **UNLOCKING VALUE AND IMPROVING CAPITAL FLOWS FOR GREEN PROPERTY FINANCE**



Source: *Authors*

than extending credit for discrete energy efficiency retrofit works. This is similarly a secondary focus of the EEBEA initiative due to the minimal mortgage refinancing seen in the target country markets. Again, such refinance products offer an illustrative example of how green instruments can unlock investment opportunities. Mortgage refinance tied to energy efficiency retrofits could be a potential area for product development as the property finance market matures[13].

4.1 BARRIERS TO GREEN PROPERTY DEVELOPMENT AND RETROFITS

The first four barriers presented below are general inhibitors to a well-functioning market for financing green and energy efficient properties. These are grouped as:

- Higher equipment and materials costs (capex)
- Information asymmetries and transaction costs
- Performance data and validation
- Principal/agent problem

These are somewhat universal and applicable to the EAC region. A last barrier – local market conditions - is meant to highlight the marked differences between the four target countries and experience elsewhere, that is, mature market/higher income countries where most of the evidence base on barriers (and benefits) is drawn from. It is essential that finance solutions be calibrated to these local conditions.

4.1.1 HIGHER EQUIPMENT AND MATERIAL COSTS

Where there is a cost premium for developing green properties, it derives from a combination of hard costs (project capex) and soft costs (the process and project management elements of a project budget). Separating the two is inexact and rarely done in the literature. The majority of the cost premium, however, will be attributed to project capex which is the focus here[14], with soft costs discussed in section 4.1.2 below. It is important to note that the available evidence suggests only modest cost premiums are needed to design and build green high performance buildings.

As described in Chapter 3.1, many green design/ building features are cost-neutral. Employing passive design principles does not require additional technologies or hardware, and could even reduce capital spend on heating and cooling equipment. However, where products or technologies are more resource efficient than 'standard' specifications (e.g., low-flow water fixtures, low energy consuming lighting or HVAC equipment, low embodied carbon materials), cost premiums are typical. This is largely due to differences in market volumes and reliance on imported products for the more efficient substitutes. The variance thus is the incremental cost between the standard and the premium item, e.g., an incandescent light bulb versus an LED. Other green building elements clearly bring additional costs for technologies that fall outside of standard practice, for example, greywater diversion systems, advanced building sensors and controls, or on-site renewable energy generation.

Regional evidence on the green building cost premium is sparse and mostly anecdotal, due to the fact that there are very few such buildings in the EEBEA countries. A representative of the Kenya Green Building Society (KGBS) indicates that for the handful of 'green certified' Kenyan projects (i.e., LEED, Green Star), capital costs have been between 0-3% above non-certified projects[15]. The National Housing Corporation of Tanzania (NHC) have utilised the Singaporean green rating tool, Green Mark, on some of its projects and indicate that doing so has been cost-neutral. Elsewhere on the continent, the Green Building Council of South Africa (GBCSA) advises that the South African property industry can expect cost premiums of a new commercial green building to be between 3% - 10%. Costs on individual Johannesburg projects have shown that very low premiums are possible:

- the construction value of 40 on Oak, a 4 Star rated Green Star SA residential development, was affected by less than 1%, and
- the capital cost premium to green the Absa Towers West office building (5 Star rated Green Star SA office building) is reported to be less than 2%, including the costs related to the Green Star SA certification. (Cruikshanks, undated).

Most evidence on cost differentials comes from mature markets, mainly the US, UK, Australia, Singapore, France, and Germany. They feature green certification rating tools that have been in use for a decade or more, which are important for clarifying standards and requirements, measuring outcomes, and driving down costs through continual industry 'learning by doing.'

13 *Given the transaction costs with refinancing, the trigger to do so will likely be reasons other than to fund energy efficiency improvements. Refinance events where green retrofits could be added to the borrowing include property resales, refinancing balloon payments, or other property upgrades coincidental with an equity release. See the Appendix section of this manual for a review of a refinance product in the US from the secondary mortgage company Fannie Mae.*

14 *The information cited does not attempt to disaggregate hard and soft costs unless explicitly done so by the referenced author/source.*

15 *KGBS suggest that no specific sales premiums have resulted from the green certification to date. Such a value uplift is apparent in more mature markets – see the Benefits section of this chapter for more detail.*

The World Green Building Council prepared a global review of the evidence for green building premiums and found that actual design and construction costs have been documented to be in the range of -0.42 to 12.5% from a baseline of code-compliance, with the high premium value corresponding to a zero carbon building project (WGBC 2013)[16]. For the majority of certified green buildings, the added cost, if any, typically is less than 4%. In China, the Ministry of Housing and Urban–Rural Development, in a 2010 survey of all green-labelled dwelling buildings, concluded an average added green cost of 4.1% over the typical price of a newly-built housing unit in the same year (Qiu, 2012, as referenced by Deng, Y. and Wu, J, 2014).The WGBC report referenced above also assessed practitioner attitudes and perceptions, finding that they are out of line with the evidence. Many industry professionals are reported as operating under the general assumption that building green increases design and construction cost by approximately 10-20% (with estimates as high as 29%) compared to the cost of conventional code compliant buildings.

4.1.2 INFORMATION ASYMMETRY AND TRANSACTION COSTS

This barrier relates to gaps in understanding the:

- opportunity and benefits to energy efficiency and green buildings, and the means to execute projects (i.e., a network of suitable delivery partners); and
- costs linked to creating a business case/project team buy-in, designing the solution, and executing the idea.

In simplest terms, most actors in the property design, development, and finance chain lack substantial technical and administrative skills on green design and certification; the sets of valued peer and business counterparty relationships with specialists in the sector; and actual experience on green property projects. Added to this is the uncertainty on future energy prices and difficulty in effectively modelling cost effectiveness based on a range of known and unknown factors. This creates a level of inertia that makes consideration and execution of alternative solutions out of reach for most projects, and generally unattractive to lenders concerned about risk exposure to properties and loans not considered mainstream. Overcoming this inertia requires organisational expenditure by developers, borrowers, and lenders – whether it is internal time and resource allocation, or contracting for external advice and skills.

On a project level, costs to address the information asymmetries and the added transaction elements to execute a green project may include:

- materials or mechanical/electrical product and materials research by design teams;
- energy modelling and additional design engineering work;
- specialist design and/or project management review;
- value engineering assessment by lenders;
- more rigorous construction and post-construction commissioning; and
- costs to register and assess buildings with green rating certification systems or organisations.

Fortunately, a study green premium for the design and delivery of eight similar buildings in the US state of Colorado (two of the eight were green certified through the LEED rating system) concluded that while some soft costs are unavoidable (e.g., fees for LEED certification with the US Green Building Council), the total soft costs for the green versus non-green buildings was immaterial in a range of typical projects (Figure 20).

Reducing information asymmetries and transaction costs is partly the goal of EEBEA thematic areas 3) Awareness Raising and Capacity Building and 5) Pilot Projects.

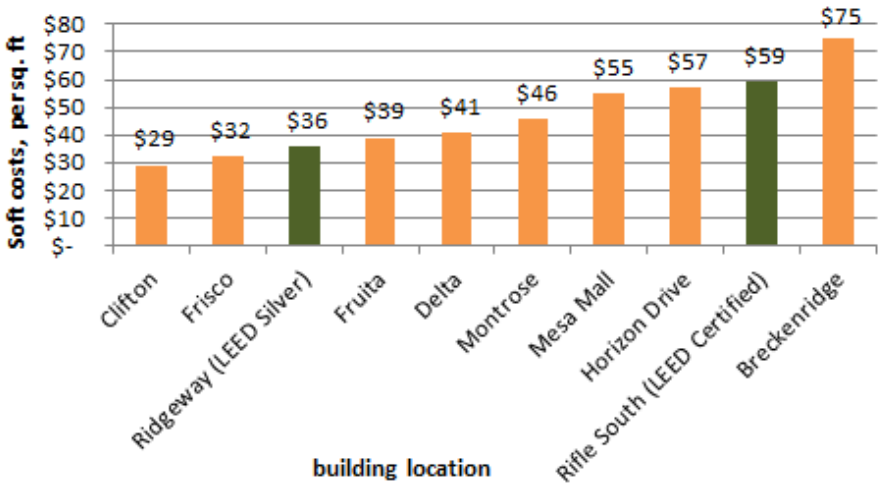
4.1.3 PERFORMANCE DATA AND VALIDATION

Many investments in energy efficiency and in green buildings (retrofits, particularly, but new construction as well) are based on the assumption that in-operation cost reductions will result from upgrades or investments in more efficient equipment and design features. (See Section 4.2.2 for findings on improved energy performance.) In energy efficiency retrofits, standard practice is to establish an energy baseline from the equipment age and type, building use and operation profile, and actual energy consumption data. With this baseline, comparisons can be made to similar properties and systems to discern performance gaps, and engineering investigations made to determine causes of poor performance and actions to ameliorate. Before and after savings can be clearly tracked and measured, against which finance decisions may be based.

For new properties, discerning an appropriate consumption baseline from which energy savings can be estimated is difficult. Energy modelling may be used during project design, particularly for commercial or multi-

16 *Cost data have been taken from a wide variety of building types, including offices, homes, schools, warehouses, banks, supermarkets, health centres, community facilities, academic buildings, and public buildings, based on studies published between 2000 and 2012. Buildings are from the United States, United Kingdom, Australia, Singapore, and Israel.*

FIGURE 20 **SOFT COSTS PER SQUARE FOOT (ADJUSTED FOR LOCATION AND TIME OF CONSTRUCTION (2011 DOLLARS)), LEED VERSUS NON-LEED CERTIFIED PROJECTS**



Based on: Mapp, Nobe, Dunbar (2011): The Cost of LEED—An Analysis of the Construction Costs of LEED and Non-LEED Banks. JOSRE, Vol 3, No 1 – 2011.

residential properties, to generate estimates[17]. Engineering professionals treat these findings as guides with wide tolerances, with factors such as product substitution, workmanship, commissioning (or lack thereof) during construction and handover, and the inherent difficulties of translating design options to real world performance, all contribute to common variances between design and measured performance[18]. Moreover, consumption figures between residential properties due to individual occupant behaviours show wider ranges than is typically the case in commercial properties where usage patterns track closer to a norm. Even in countries where residential building energy ratings are generated off of extensive data sets for actual performance of similar buildings (e.g., US and Australia), the ratings are relative performance indicators to other properties, not absolute measures of future consumption.

At issue is the level of energy and therefore cost savings that can be assumed to support the level of project finance required during design and construction, should capital costs be higher than the norm and need to be repaid out of ongoing operational savings or, indirectly, higher sales prices. Anecdotal evidence suggests a high level of conservatism is warranted when assessing predicted energy efficiency gains from which finance decisions are based. In other words, the lender may assume that only a portion of the modelled savings will actually materialise and can be used as a source of repayment for any debt incurred to create the savings.

17 *Performance modelling may also be used for buildings in operation where actual data is lacking or cannot be assembled from all parties – for example, in multi-tenanted buildings were several parties have control over energy consumption. Modelling is also used in certain jurisdictions within the EU to assign performance labels to existing properties, similar to A-F energy ratings found on appliances.*

18 *Based on concerns about the 'performance gap' between modelled and actual energy consumption, an academic and NGO-led initiative in the UK is aggregating anonymised building and energy data from properties across the UK to highlight and assess these differences. See http://www.carbonbuzz.org/ for more detail.*

Data availability on in-use performance and a deep data pool is critical. Such data sets are frequently unavailable or substandard throughout the world, but particularly so in emerging markets[19]. This lack of data heightens the risk of under or overvaluing energy efficiency improvements. Performance guarantees may be part of the solution to this barrier (further discussed in Section 4.3.3).

4.1.4 PRINCIPAL/AGENT PROBLEM

The principal/agent problem (also known as split incentive) arises where the party that invests in energy efficiency or green premium does not secure the benefits in terms of lower utility bills or higher sale income. This is most common in landlord/tenant situations where the primary benefits will accrue to the occupant in terms of lower occupancy costs, rather than the building owner who may be unable to charge higher rental rates to compensate for the investment. A different split incentive problem often arises with homeowners who, if uncertain of their long-term plans to remain at the property, forgo efficiency investments if they perceive the payback period to be anything but very short term and lack confidence that they can recoup the investment at the point of sale to the new owner.

Evidence that green properties deliver higher value to owners should help overcome the principal/agent barrier. Yet it remains as a significant drag on the motivation to invest. One study on the value of green property in Singapore shows that principal/agent issues remain even when developers secured a green premium for Green Mark rated residential buildings. 18,224 transactions from 62 GM-rated housing complexes were assessed and showed that the green premium was about 10% at the resale stage, compared to about 4% during the presale stage. This implies that while developers pay for

19 *EEBEA thematic area 1) Energy Efficiency Data and Benchmarks is working to address this barrier, with an energy and water audit report from buildings in Kenya, Tanzania, and Uganda forthcoming.*

almost all of the additional costs of energy efficiency during construction they only share part of the benefits associated with such green investments (Deng and Wu, 2014). The fact that higher premiums are found at resale does demonstrate, however, the role of in-use energy/environmental performance data for creating the uplift.

The structure of most commercial and residential tenant leases in the four EEBEA target countries offers little or no incentive for owners/developers to invest in energy efficiency. Common area energy usage is billed as a service charge to tenants on a pro-rata share of space leased, but energy consumption for common services is very low[20]. Meanwhile energy used in individual spaces is sub-metered, or apportioned and paid directly by the tenant. As such, tenants would realise the savings from energy efficiency but do not directly bear any of the capital cost for creating those savings where there is no evidence of rental premiums for green buildings.

4.1.5 LOCAL MARKET CONDITIONS

This last barrier has been added to highlight some particular challenges to capitalising and capturing the value of green property and energy efficiency in the EEBEA countries, namely:

- the very high cost of capital, and
- low energy usage amongst large segments of the population.

As will be described in Section 4.2 - Financial Benefits below, there is solid evidence that green and energy efficient buildings offer improved value across a number of measures including sales and rental premiums and reduced energy costs. There is extensive literature showing investments that reduce energy expenditure are financially sound and generate attractive rates of return. Key variables that create this cost-effectiveness are a) the cost of capital (or its related discount rate if assessing on a net present value basis); b) the unit cost of energy and expectations of future costs; and c) the volume of energy consumed. These variables are significantly different from high to low/middle income country markets, and most of this evidence is based on findings from mature markets. Therefore measuring assumed or realised value needs careful assessment.

The high cost of finance both for construction and for end-mortgages pressures developers to keep costs low. This affects the capacity to absorb soft costs such as professional skills to design/integrate green features, and hard cost premia for green materials and resource-efficient fixtures and technologies. More so, interest rate sensitivity affects the long-term capitalisation of green features if higher debt is required, for example for borrowers who are equity constrained. This makes the clarity and sensitivity of the financial value proposition for green design/efficiency so critical.

A study on energy efficiency investments for low-cost housing in South Africa demonstrates the point[21]. Interventions for the building shell (thermal interventions e.g., ceiling, roof insulation, partitioning, appropriate window size and wall insulation), and more efficient space heating, lighting, and water heating (e.g., CFL and SWHs) were modelled for a 30m^2 unit. Two variations were presented: one using 8% as the social discount rate (consistent with government guidelines at the time for evaluating infrastructure projects); and a consumer discount rate of 30%, reflective of low-income households who have more immediate time value of money considerations and less access to capital and/or access only to very high cost capital. All interventions were considered over 50 years, based on the standard economic life of a low-cost house, with future replacement costs within the 50 year timeframe included if needed. It found that virtually all interventions have a positive NPV using the social discount rate, but that only a minority of the interventions have a positive NPV when a 30% discount rate is applied (Winkler et al 2002). Based on this finding, the study investigated what capital subsidy would be required to make energy efficiency attractive to poor households at this high discount rate. It concluded the subsidy needs to only lower the discount rate - not cover the full incremental cost of the energy efficiency capital investment. On these terms, it is very modest - around R1 000[22] at the time of writing.

Energy consumption will be a factor in the level of the investment that is financially beneficial. Higher income households clearly have higher energy expenditures in whole numbers than low income households (though not as percentage of income or household expenditure). This allows for more 'headroom' in the incremental capital costs to move from standard to green/efficient products and materials. The following figures, drawn from a study in the United States published in 2011, demonstrates the effect. It shows the maximum cost-effective energy efficiency investment for householders varied by income level, assuming a 15-year measure life, 5% discount rate, and energy cost increases in line with those seen between 2005 and 2010.

The elasticity between poverty level of energy expenditure is likely to be greater in the EAC than shown above. Lower income households can be expected to consume energy at far lower levels relative to in-country higher income peers meaning efficiency investments will take longer to amortise, other factors remaining equal.

20 *Retail malls may offer an exception as they are likely to have high common area energy demands which could be serviced through on-site energy and/or reduced through energy efficiency. Landlords could generate a return on the 'efficiency spread' between energy charges from their supplier and service charges to tenants where these are comparable to other less efficient spaces.*

21 *It is somewhat dated (2002), but unfortunately there is a lack of literature from Africa on this subject.*

22 *Based on 2002 costs. At present day exchange rates, this equals US$75.*

TABLE 5 **MAXIMUM COST-EFFECTIVE ENERGY EFFICIENCY INVESTMENT, BY INCOME LEVEL (MINNESOTA, US)**

	POVERTY LEVEL			
(All figures US$)	<200%	201-300%	301-400%	>400%
2005 avg. annual energy cost	1,750	1,894	1,987	2,271
2010 avg. annual energy cost	1,911	2,069	2,170	2,480
Present value of 25% energy savings	5,551	6,008	6,303	7,204
Present value of 40% energy savings	8,882	9,613	10,085	11,526

Based on: Office of Energy Security, Minnesota Department of Commerce (2011). Financing Energy Improvements - Insights on Best Practices to Engage Consumers and Marry Dollars with Demand.

None of this is presented to suggest that pursuing energy efficiency and other benefits of green design to individual consumers is inadvisable. **Given the high and rising cost of energy in Africa generally and the significant impact that lower energy expenditure can have on household financial security and business competitiveness, efficiency investments are of great importance. But the particular market conditions must be kept in mind**. The ability to effectively deploy commercial finance solutions in the EEBEA target countries, and the potential need for concessional or subsidised solutions for certain markets or interventions (to deliver both consumer and societal benefits), requires a level of investigation and sensitivity modelling that is presently underdeveloped.

4.2 FINANCIAL BENEFITS

The benefits from green properties and building energy efficiency can be grouped as:

- **asset appreciation and capital gains,**
- **income generation, and**
- **asset quality**

The benefits have different value to different agents and stakeholders in the property sector: developers and owners/investors, owners and occupiers, and lenders.

For developers and owners/investors, additional benefits that may be realised from green buildings include

- improved tenant retention and reduced vacancies,
- shorter letting-up periods,
- brand and marketing advantages,
- mitigation against future regulatory impacts,
- higher net operating income (NOI) (a function of higher rents and lower utility and/or maintenance costs),
- income from on-site energy generation,
- lower capitalisation rates, and
- sale price premiums.

For owner and occupiers of buildings (residential and commercial), general benefits include

- utility savings and potential energy generation income,
- improved indoor air quality with attendant health and productivity benefits,
- lower maintenance costs, and
- above average asset appreciation.

Tenants can also reap the same utility saving and health and productivity rewards from occupying green buildings. Commercial tenants can also use occupancy of green buildings in brand and marketing, particularly related to corporate social responsibility (CSR).

For lenders, the benefits can include lower risk of borrower default and product differentiation to increase market share.

The evidence for the benefits is based on reports and studies almost entirely from mature markets, principally Europe and North America. This is still a young field of study and separating out benefits attributed only to green and efficiency from other property features has methodological challenges. However, **the overall case for benefits in excess of costs is compelling**.

4.2.1 ASSET APPRECIATION/CAPITAL GAINS

The first parameter that can be assessed from the literature is whether developers of properties or subsequent owners or investors see sale price premiums as a result of green building or energy performance metrics. Typically, the metric is the whether the property has a green certification or part of an rating programme/system common in that market, for example Green Star, ENERGY STAR, NABERS, Green Mark, etc[23]. These studies investigate the value of future returns (a function of implied energy savings and other indirect positive green building attributes) compared or in addition to the explicit day-to-day cost savings.

Table 6 summarises some of the main sources of evidence that **green and efficient properties have higher asset values relative to 'standard' properties through which developers and owner/investors extract value**.

23 *Green building certification schemes can measure performance either in design intent, at pre-construction, or at post-construction or post-occupancy. Some are energy only, whereas others measure environmental performance across multiple impact categories such energy, water, materials, ecology, and so forth, yielding a single performance score in aggregate across all categories. This manual does not go into detail on the different assessment tools (though additional detail can be found in Chapter 7). What is meaningful is the fact that the labels/ratings allow for market differentiation.*

4.2.2 INCOME GENERATION

The income generation benefits of green and energy efficient buildings is a reflection of

- utility and other outgoings/operating cost savings due to a property's energy and water efficiency, demand management, and energy generation features; and
- higher rents and lower vacancies in tenanted properties.

The **day-to-day savings realised by occupiers (owner or tenants) can be treated, from a lender's perspective, as income suitable for debt service vis-à-vis other comparable properties where net costs are higher**. How best to measure and verify this income, and whether a portion of the income potential should be discounted in repayment ability calculations, is subject to some debate and requires careful consideration. Note, however, that for buildings featuring on-site energy generation, energy yields/cost of producing energy is predictable and measured benefits highly reliable.

The evidence base that well-designed and managed buildings reduce costs is solid. A summary of some of the key literature sources are provided in Table 7.

TABLE 6 **SUMMARY OF LITERATURE REVIEW, HIGHER ASSET VALUES OF GREEN PROPERTY**

STUDY REFERENCE AND NAME	LOCATION AND MARKET	SUMMARY OF FINDINGS
Aydin et al. (2016) Capitalization of Energy Efficiency in the Housing Market	Netherlands, residential market	This study assembles a very large data set by examining sales prices post the 1973-74 oil crisis which had the effect of a) generating consumer awareness of energy costs and efficiency benefits, and b) spurring policy action on building energy codes for successively more stringent performance requirements. It finds that a 10% increase in energy efficiency leads to an increase in the transaction price of about 2.2% for an average home. Somewhat contrary to expectations, the authors find that energy efficiency capitalisation is not significantly affected when information asymmetry is reduced through the presence of an energy performance certificate (EPC). The presumption is that the market is otherwise pricing energy performance, cautioning on the need for costly certification programs.
Phillbrick et al (2016) Moving the Market: Energy Cost Disclosure in Residential Real Estate Listings	United States, residential market	In 2013, Chicago became the first US municipality to enable listing agents to disclose residential energy costs in single-family home sale listings. Preliminary analysis shows that homes disclosing energy costs sold at a higher percentage of the asking price than those that did not disclose energy costs at the time of listing.

STUDY REFERENCE AND NAME	LOCATION AND MARKET	SUMMARY OF FINDINGS
Northwest Energy Efficiency Alliance (2015) Market Valuation of Energy Efficient and Green Certified Northwest Homes	United States (Oregon, Washington, Idaho), residential market	This is a market assessment of newly built certified homes in seven specific metro areas in three states. It uses a statistical methodology based on a comparable sales approach drawn from observed sales prices and other listing and transaction characteristics. Four of the seven geographic areas show premiums ranging from 2.8% to 8.0%; the three others are slightly positive but statistically insignificant. The study also suggests that premiums are higher in flat or depreciating markets rather than strongly appreciating ones[24]. It also follows up 117 properties from a single subdivision assessed in a similar 2009 study that showed an initial sales premium. There were 10 resale transactions in the intervening period and the result indicated that the value premium persisted over time.
Copenhagen Economics (2015) Danish house prices and the effects of energy standards: Econometric approach	Denmark, residential market	In Denmark, reporting a home energy rating (A-G scale) is mandatory when selling a house. The study assesses whether buyers' willingness to pay for higher energy standards relates to the value of the future energy savings. Three different types of statistical models were applied to data on all 300,000 single family homes sold from 2006 to 2014. Using the expected energy consumption of houses in each energy label (A-to-G) as well as the average energy price, the authors could calculate the expected yearly energy savings in kr. per sq. m. For a 100 sq. m. house, a price premium of 149,000 kr. (US$21,000) for every 10 MWh in yearly energy savings was found (i.e., the difference in average energy consumption between a E-labelled and B-labelled house). The authors note that when moving from a B to A rating, the estimated price difference is not statistically significant. The value premiums achieved are below the author's theoretical expectations, perhaps indicating that market barriers remain.
Hoen et al (2015) Selling Into the Sun: Price Premium Analysis of a Multi-State Dataset of Solar Homes	United States, residential market	This study focuses specifically on solar PV. It analyses over 21,000 home sales, 4,000 of which contained PV systems in eight states from 1999 to 2013. It shows home buyers have been willing to pay more for a property with PV across a variety of states, housing and PV markets, and home types – on average, a 0.92% increase in value for each kW of PV installed over the average price of a non-PV home.
Kahn and Kok (2014) The capitalization of green labels in the California housing market	United States (California), residential market	The paper looks at the effect of energy efficiency and green features on consumer choice, using a hedonic pricing analysis of all single-family home sales in California from 2007 to 2012 and concludes green labelled homes transact at a small premium. Adding an incremental value of 2.1% for a certified dwelling (the most conservative estimate) to an average non-labelled transaction price of US$400,000 generates some US$8,400.This is compared against the estimated cost to reach a modelled efficiency level of 15% and 35% above California's 2008 energy code (between US$1,600 and US$10,000). Thus on average the value exceeds the input cost for the developer. The paper also models the 'income generating' aspect of a green home (discussed in the next section), and finds a simple payback period of 12 years to repay the investment through energy savings. The authors conclude that based on this length of payback, some homeowners seem to attribute non-financial utility to a green label, explaining part of the premium paid for green homes.

24 *Lenders can consider this as an asset quality 'hedge', which will be explored further in this chapter.*

STUDY REFERENCE AND NAME	LOCATION AND MARKET	SUMMARY OF FINDINGS
WGBC (2013) The Business Case for Green Building: A Review of the Costs and Benefits for Developers, Investors and Occupants	Singapore, residential and commercial market	A summary of data from Singapore on Green Mark certification shows that the highest level, Platinum, gives a noticeable increase in sale price premiums when compared to Green Mark certified level (27.7% and 13%, respectively). Analysis also found that Green Mark Gold/Gold plus properties do not follow the trend and actually show smaller sale price premiums (9.6%) than that of Green Mark certified buildings. This may indicate a lack of knowledge by the market as to the difference between the various levels of certification. If so, developers will see better returns at the highest and lowest levels than the intermediate - at least until market awareness increases.
UK DECC (2013) Final Project Report: An investigation of the effect of EPC ratings on house prices	United Kingdom, residential market	An evaluation of sales premiums resulting from a home's Energy Performance Certificate (EPC) (A-G scale), from a 300,000 home data set across England between 1995 and 2011. Using Hedonic regression modelling, UK average premiums are found to be 14% (A-B), 10% (C), 8% (D), 7% (E), and 6% (F) (all increases are against a base EPC rating of G).
Eichholtz et al (2011) The Economics of Green Building	United States, office market	The study uses a sample of 21,000 rental and 6,000 sale buildings. Those with green ratings in 2009 commanded higher rental rates and occupancy rates, and transaction prices that are substantially higher (i.e., 13%) than those of otherwise identical office buildings, after distinguishing among contractual arrangements for the provision of services and utilities, and after controlling explicitly for the quality and the specific location of the buildings. The rental and sales premiums are not strictly comparable but the results suggest that the risk-lowering features of green property (stable tenancies, hedge against future regulations or energy price increases, etc.) are of greater value to investors than additional present property income via higher rents. The timing of the study (2011) finds no evidence that tenant demand for green space weakened during the global recession. Note, too, that tenants of green buildings seem to be indifferent between the types of rental contract, though the economic benefits of a green rating come through somewhat stronger for buildings with a "triple net" lease suggesting tenants prefer incurring utility costs separately..
Brounan and Kok (2010) On the Economics of Energy Labels in the Housing Market	Netherlands, residential market	The authors reviewed a data set of 31,000 homes sold between 2008 and 2009 that had high/above average energy performance rating (i.e., an A, B, or C rating of the EU Energy Performance Certificate protocol). Labelled homes sold for an average premium of 3.7%, over non-labelled homes. "A" rated homes sold for a 10.2% premium, while "D" labelled homes (below the "green" threshold) sold for an average of 5.1% less than non-labelled homes.
Australian Dept. of Water, Environment, Heritage and the Arts (2008) Energy Efficiency Rating and House Price in the ACT	Australia, Australia Capital Territory, residential market	Approximately 5,000 homes were reviewed that had received an energy efficiency rating under the Australian Energy Efficiency Rating (EER) system (a 10-point rating scale of 1 to 5 stars at 0.5 star increments). 2,385 homes garnered an average price premium of 1.23% for each 0.5 EER star in 2005, and 2,719 homes sold for a 1.9% premium for each 0.5 EER star in 2006.
Fuerst and McAllister (2009) New Evidence on the Green Building Rent and Price Premium	United States, office market	Using a data set of nearly 1,300 ENERGY STAR rating buildings and 626 LEED green certified buildings and controlling for specific submarkets, the study shows rental premiums of 6% and 5% for LEED Gold and ENERGY STAR certification, respectively, and sales premiums of 35% and 31% respectively.
Bond and Devine (2016) Certification Matters: Is Green Talk Cheap Talk	United States, multifamily residential market	The study examines the evidence for rental rate premiums associated with green certified real estate, specifically the rental rates achieved by green multifamily properties – a property type considered a gap in the existing evidence base. The authors find an approximate 8.9 % rental rate premium associated with LEED apartments.
US EPA and DOE (2016) Cost & Savings Estimates ENERGY STAR Certified Homes, Version 3.1	United states, residential market	The report summarises the annual purchased energy volumes and costs for a selection of baseline and ENERGY STAR certified homes with different climate and HVAC variables; and the resulting monthly purchased energy savings, monthly mortgage upgrade cost for ENERGY STAR homes, and net cash flow. The monthly mortgage upgrade cost was calculated assuming a 30-year fixed mortgage with a 5.0% interest rate, and purchased energy costs using a national average rate. Energy savings ranged from 19%-25%, and net monthly cash flow (savings over added mortgage costs) from US$23-$51

TABLE 7 **SUMMARY OF LITERATURE REVIEW, INCOME GENERATION POTENTIAL OF GREEN PROPERTY)**

STUDY REFERENCE AND NAME	LOCATION AND MARKET	SUMMARY OF FINDINGS
Devine and Kok (2015) Green Certification and Building Performance: Implications for Tangibles and Intangibles	North America, commercial market	The study looks at 300 commercial real estate assets in US and Canada, and firstly corroborates earlier findings on rental and sales premium for Green labelled buildings between 2004 and 2013. It adds findings on "intangible" tenant satisfaction, lease renewal rates, and utility consumption data. Reported levels of increased tenant satisfaction range between 4% and 20% depending on green label; and likelihood of lease renewal are significantly higher and rent concessions lower – 7% average rent concessions in green buildings versus 11% in non-green. Utility consumption data was mixed: water consumption was lower for all labels; energy use was lower is some certified properties but higher in others.
Jasimin and Ali (2014) The Impact of Sustainability on the Value of Commercial Office Buildings in Malaysia : Russian-Doll Model Approach	Malaysia, office market	A study of commercial office buildings in Malaysia shows that differences in rental rates between green and non-green buildings are rather small. The authors suggest the difference is more to supply and demand factors within the specific location rather than green features.
Moore et al (2014) Cost efficient low-emission housing: implications for household cash-flows in Melbourne	Australia (Melbourne), residential market	This research shows net-negative costs for housing designed to an extremely high performance target – a zero emission home. Delivering such a house exacted an additional capital cost of $25,637, or an extra yearly mortgage repayment of $2,117 at an interest rate of 7.89% across 25 years. Energy efficiency cost savings of $1,547 a year were calculated, leaving a gap of $570/year in additional mortgage repayments (all figures $ AUD).
McGrath (2013) The effects of eco-certification on office properties: a cap rates-based analysis	United States, multifamily residential market	An analysis of 52 affordable housing developments (28% of which were rehabs) with a total of 3,677 dwelling units from across the United States that were built using either the 2005 or the 2008 versions of the Enterprise Green Communities Criteria found that the 20-year lifetime utility savings exceed the cost (a circa 2% premium). The value of energy efficiency/generation was modelled using a 6% discount rate and year 1 energy prices (no future escalation). The median simple payback with all measures is 8.9 years; excluding renewable energy and special systems, such as ground source, thermal mass, etc., the median payback period drops to 3.4 years.
Zalejska-Jonsson et al (2012) Low-energy versus conventional residential buildings: cost and profit	Europe, residential market	The paper studies whether increased investment costs of green buildings is profitable via the reduction in operating costs, based on data obtained by surveys and personal interviews. Sentiment was that low energy buildings were sound investments. Using respondent cost premium indicators (the large majority stated a premium of less than 10%), the author's model shows that if extra investment costs exceed 6% (with assumptions on energy prices) the potential energy savings are insufficient to cover extra initial investment.
Fuerst and McAllister (2011). Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Values	United States, office market	The author's hypothesis is that green building investors' holding costs should be lower due to attractiveness to occupiers and that this can lead to a rental premium and/or lower vacancy rates. The results from a sample of 197 LEED and 834 ENERGY STAR against 15,000 benchmark buildings confirm these expectations, with certified buildings having an average rental premium of 4–5%. They also cite evidence from other studies showing that present value of reduced operating costs alone cover incremental construction costs to build green.
Eichholtz et al (2009) Doing Well by Doing Good? Green Office Buildings	United States, office market	The study assesses over 1,000 ENERGY STAR certified large office buildings that sold or rented between 2004 and 2007. Certified buildings deliver average rent premiums of 3% per square foot and in effective rents (i.e., rents adjusted for building occupancy levels) even higher—above 7%. Average sales price premiums are 16% (all comparisons are between green and standard buildings located within 0.25 miles). Also revealed is that a 10% decrease in energy consumption leads to an increase in value of about 1%, over and above the rent and value premium for a labelled building. Assessing if premiums are based on energy savings only or whether intangibles also play a role was inconclusive, though the latter appears meaningful.

4.2.3 ASSET QUALITY

Assuming that green properties carry a higher capital cost (even if a small one, circa <5%) – a valid assumption given that the green building market is at early-stage in East Africa – lenders will need to push more capital into the market to reach these borrowers. This is true irrespective of whether debt to equity / debt to income ratios remain constant or are perhaps relaxed due to equity constraints of borrowers. This carries more risk, particularly with the latter (i.e., relaxed ratios), and will require more absolute capital to be kept in reserve.

In theory, extending additional debt is prudent based on the sales premiums, rental premiums, and/or operating cost savings described in the two preceding sections. Moreover there is an additional benefit from green properties meaningful to lenders – the improvement in asset quality. Extending finance to properties that return higher values vis-à-vis comparable properties in the marketplace, and that improves occupant/owner cashflow and satisfaction, should reduce both the likelihood of borrower default and the potential that foreclosed properties will be liquidated at values below their debt liability. This is particularly relevant in the absence of a secondary market where primary lenders remain the long-term holder of the loan and security. **Recent research from both the commercial and residential sector provides evidence that lender risk is lower where capital is extended to green and energy efficient properties**.

A study on mortgage default risk probability from An and Pivo (2018) shows a positive correlation between energy/environmental performance and the likelihood of mortgage default in commercial properties (United States commercial mortgage backed securities data pool). The results show a 34% reduction in default risk for mortgages on LEED/Energy Star office properties in the CMBS market, all else equal. The authors al;so found the impact on default risk comes at least partly from the level of the green achievement, instead of the label alone. In other words, the higher level the level of performance, the greater the risk reduction on mortgage default.

As second earlier study from An and Pivo (2015) also assesses the relationship between building sustainability features and performance of corresponding US commercial mortgages across property types including office, retail, apartment, and industrial[25] . The authors examined 22,813 loans and more than 664,000 quarterly observations of loan performance based on two green parameters: building certification (either LEED or ENERGY STAR), and 'smart growth' locations (i.e. walkable, transit-oriented, near open/green spaces, etc.). Results show that borrowers of ENERGY STAR properties[26] are 20% less likely to default than comparables, based on a default probability model where conventional predictors such as original LTV, contemporaneous LTV and debt service coverage ratio (DSCR), current occupancy rate, refinance incentives, macroeconomic conditions, MSA-fixed effects (metropolitan statistical area), and more, are already included and held constant. The findings, the authors conclude, offer grounds to consider changes to underwriting tools and practices, including offering more attractive borrowing terms to green properties; and that "better models would help lenders better manage risk and better terms on sustainable properties could improve overall market efficiency and environmental outcomes without exposing lenders to greater risk." (22)

A third study (Kaza et al 2014) looks at home mortgage loan performance against sustainability variables, drawing a 71,000 home sample from across the US. About a third of the sample set is homes with an ENERGY STAR label. All homes are on 30-year fixed mortgages. The assessment shows that the odds of a mortgage default on an ENERGY STAR residence, other variables held constant, are one-third less than those on a home in the control group. A mortgage on an ENERGY STAR residence is also 25% less likely to be prepaid. More so, within the ENERGY STAR pool of properties, the level of energy performance matters - more efficient homes exhibit even lower mortgage risks than those on their less efficient but still ENERGY STAR-rated counterparts.

In summary, the authors suggest that lenders and secondary market investors should take into account the energy efficiency of the home used as collateral. For primary lenders, this may result in a higher debt-to-income ratio, lower FICO score[27], or reduction in the interest rate. The result would mean borrowers can qualify for larger loans, a potential benefit for many borrowers in high-cost property markets. They note, however, there are some methodological limitations to the research which limits expressing a strict causal link between the energy efficiency and default. For example, those buying ENERGY STAR homes may be a self-selecting cohort and might simply be more financially able than non-ENERGY STAR owning counterparts.

To further assess the link between green buildings and asset quality, A European banking sector initiative has recently begun. It is a pilot programme to standardise underwriting and preferential pricing of energy efficiency retrofit refinance mortgages and new purchase mortgages for 'near zero energy buildings'. The initiative includes a data capture element on energy savings and loan performance, with the goal to build the evidence base for banks to ultimately lower the capital requirements

25 *All assets have been securitised / issued as commercial mortgage backed securities (CMBS) notes*

26 *The finding holds for both retail and office. There is no multifamily ENERGY STAR thus no such properties in the sample.*

27 *A standard credit rating in the US.*

for those loans on their balance sheet if they use internal models, or receive regulatory assent to apply lower risk-weights for these loans, given the lower probability of default. The concept of lower risk weights has already been agreed to in principal by the EU's banking regulator. The programme intent is also to securitise these assets for a 'green' covered bond. (See European Mortgage Federation Energy Efficiency Re-finance case study in Appendix A for more detail.)

4.3 FINANCE INSTRUMENTS

Based on the benefits discussed in the preceding sections and to help overcome the market barriers to green properties, there are a range of finance instruments that could be considered to increase capital flows to developers and end-buyers of green / energy efficient properties. These are briefly described below, noting that the list is not necessarily exhaustive. The instruments are organised as per Figure 4.1: those targeting a) developers and owners/investors; b) owners/occupiers; and c) lenders and investors.

4.3.1 DEVELOPERS AND OWNERS/INVESTORS

Based on the findings that green buildings offer sales premiums compared to standard buildings, borrowers could take on additional/larger borrowed amounts to cover the added capital costs in development or investor acquisition costs. Higher pre- or resale prices could recover the extra borrowing. This can be accommodated through several means.

- **Higher debt to equity ratio**. For developers who are equity constrained but seeking additional capital to deliver green properties, lenders could allow high debt to equity ratios for qualifying projects. Effectively, borrowers would put up the same equity stake in absolute figures, but this would be lower as a percentage of total project costs due to the higher capex. It is assumed that the end buyers/investors of the properties recognise the value of green buildings and pay higher prices commensurate to the capex premium.

- **Concessional interest rate**. Given the higher capex faced by developers, lenders could offer a lower interest on project financing for qualifying projects. This would effectively lower the cost of development so that it is par with standard development costs. This can maintain affordability and reduce repayment risk where green sales premiums are not yet present in the market. Examples from Mexico and South Africa are described in Appendix A.

- **Performance guarantee**. The use of an energy performance guarantee can be a tool to a) incentivise developers to build green properties for which sales premiums can be applied based on expected energy costs savings, and b) borrowers to gain comfort in taking on additional debt to cover the sales premium. The guarantee would cover the risk of energy under-performance, i.e., expected savings that fall short of additional income needed for debt coverage. This could help narrow any pre-sale/resale differential of green properties as has been observed in Singapore (see discussion on Principal/Agent problem in the Barriers section above).

4.3.2 OWNERS/OCCUPIERS

For owners of properties (occupiers or investors), green and energy efficient buildings offer a level of income generation through one or several factors such as lower running/operating costs (mainly utility bills), rent premiums and reduced vacancies, and on-site energy production. Covering the additional borrowing needed to purchase these higher priced properties could be accommodated through the following instruments which may be used singly or in combination.

- **Higher debt to income ratio**. As most lending models take a limited view of householder or building owner expenditure that misses utility expenditure, borrowers could be approved for larger loans above standard debt to income allowances to factor in lower energy costs. This would capture the higher sales price the buyer is committing to but otherwise not affecting the borrower's ability to repay. Appendix A describes examples from Mexico, Europe, and the United States.

- **Mortgage insurance**. Mortgage insurance is commonly available and required for borrowers taking on high loan to value obligations, e.g. borrowing 90% of the property sale price. Equity constrained borrowers of green properties could take on higher LTV loans provided insurance is available to cover default risk - mainly that the low upfront equity is insufficient to recover outstanding debt in the case of repossession and sale by lender. As with any insurance product, triggering events are expected to be rare if they are properly structured and based on sound risk assumptions. In Canada, high LTV borrowers receive up to a 25% mortgage loan insurance refund/rebate on green properties based on the presumptive value of the energy savings and the borrower's subsequent ability to pay.

- **Mezzanine loan / 'soft' second mortgage**. A mezzanine loan (second lien position) could be applied to the primary loan to cover the added costs between a standard and a green property[28]. This

28 *Note that this type of instrument could suit both project and end-mortgage finance.*

could be concessional to dampen the effect of the extra borrowing, as is used in Germany. Similarly, a soft second mortgage could be used to cover the variance between the standard and green costs and be structured with conditional terms, e.g., deferring upfront borrower obligations for a time period. This assumes that the borrowers' income grows over time which reduces the relative payment risks. The delay on the soft second would allow the borrower's income to grow so as to cover the extra debt due to the green features. Optimally, the mezzanine or second loan would be folded into the primary loan for a single payment/servicing structure.

4.3.3 LENDERS AND INVESTORS

The following can help lenders build loan volume and facilitate increased market liquidity for green properties based on their positive asset quality and income attributes. These instruments are designed to create a more efficient and better functioning market, supported by improved property-level detail on efficient features and the value of green buildings.

- **Lender risk weighting**. Applying variations in the credit risk assessments of individual borrowers and projects based on property attributes could expand a bank's pool of eligible customers. This would use green / energy efficiency measures as a strong potential value driver and predictor of asset value.

- **Capital reserve requirements**. For properties that meet suitable green criteria, lenders could be allowed to maintain lower capital reserve margins based on their lower risk profile. This would free up otherwise dormant capital and help grow market volume. This is the intent of a green finance trial in Europe.

- **Secondary markets and asset-backed securities**. Green labelled properties provide a signifier that could be used by wholesale or investor capital sources to target their resources. For example, a mortgage refinance company such as Tanzania's TMRC that pre- or post-finances mortgage lenders, could designate a capital set-aside for green loans to incentive lenders to address that market. Or institutional investors could target or be attracted to green property ABS's (asset-backed securities) to create liquidity where otherwise there is none. Green ABS's have been issued in the United States and Netherlands.

4.3.4 MAPPING FINANCE INSTRUMENTS TO THE MARKET BARRIERS

The high-level barriers presented in this chapter will need to be overcome through a range of interventions and initiatives. Increasing the availability of finance and having targeted finance instruments to suit the particulars of the market is critical. Figure 21 can serve as a starting point for considering which tools can address certain barriers.

Finance in of itself will be insufficient to substantially move the buildings sector toward achievable carbon emission and resource use reductions presently being under-delivered. Information resources, technical skills, standards and regulations, etc. are all complementary pieces and which are described further in Chapters 7 and 8.

FIGURE 21 **MAPPING FINANCE INSTRUMENTS TO MARKET BARRIERS**

	Higher equipment and material costs	Information asymmetry and transaction costs	Performance data and validation	Principal/agent problem	Local market conditions
Higher debt to equity ratio	✓				✓
Concessional interest rate	✓			✓	✓
Performance guarantee	✓	✓	✓	✓	
Higher debt to income ratio	✓				✓
Mortgage insurance	✓				✓
Mezzanine loan / 'soft' second mortgage	✓		✓	✓	✓
Lender risk weighting		✓			
Capital reserve requirements		✓	✓		
Secondary markets and asset-backed securities		✓			✓

05 LOCALISED ENERGY SYSTEMS AND MICROGRIDS

Technology advances alongside significant cost reductions are creating new possibilities for generating and delivering energy services on a local scale (see Chapter 3.3 for discussion on technology costs). Coupling energy efficient building design with low-carbon energy generation, back-up storage, and advanced local control and distribution can result in low- to even net-zero energy/carbon developments. The result can be enhanced energy security that delivers multiple asset yield benefits to owners and clear advantages for occupiers. While only a limited number of master plan property projects globally have integrated local energy services within their development footprint, the remarkable level of systemic innovation in distributed energy and microgrids – i.e., changes in business models, financing, and system integration - suggests that much wider deployment is possible (IRENA 2016).

Linking property asset and localised energy development[29] is both feasible and imminently practical for East Africa. The high rates of urbanisation; the significant capital inflow to large new property developments; rising retail electricity rates; strong continental experience with urban and rural distributed generation (fossil and renewable); and grid reliability and capacity constraints are compelling drivers for localised energy investment. Fortunately, a paradigm is emerging that can turn what had been a sunk cost for property energy infrastructure and back-up supply into a distinct asset and with multiple value streams. In effect, large property projects can provide a platform for additional, value-added investment in localised renewable energy systems that create both internal and external (wider network) benefits.

The property finance and delivery sectors tend to be risk-averse toward new technologies and changes to tested design, financing, and construction pathways. To help overcome this risk aversion, it is possible for the property and the energy assets to be separated into parallel development tracks tied via power purchase and lease agreements. Localised energy delivery thus gets vested with specialists who bring their own expertise and financing to the project, allowing the lead property developer to focus solely on its core asset. The sections below will explore the rationale for such a co-development approach. **For projects targeting lower-income buyers/residents, it may offer tangible development cost saving and affordability benefits.**

5.1 PROPERTY DEVELOPMENT AND THE LOW-CARBON ENERGY TRANSITION

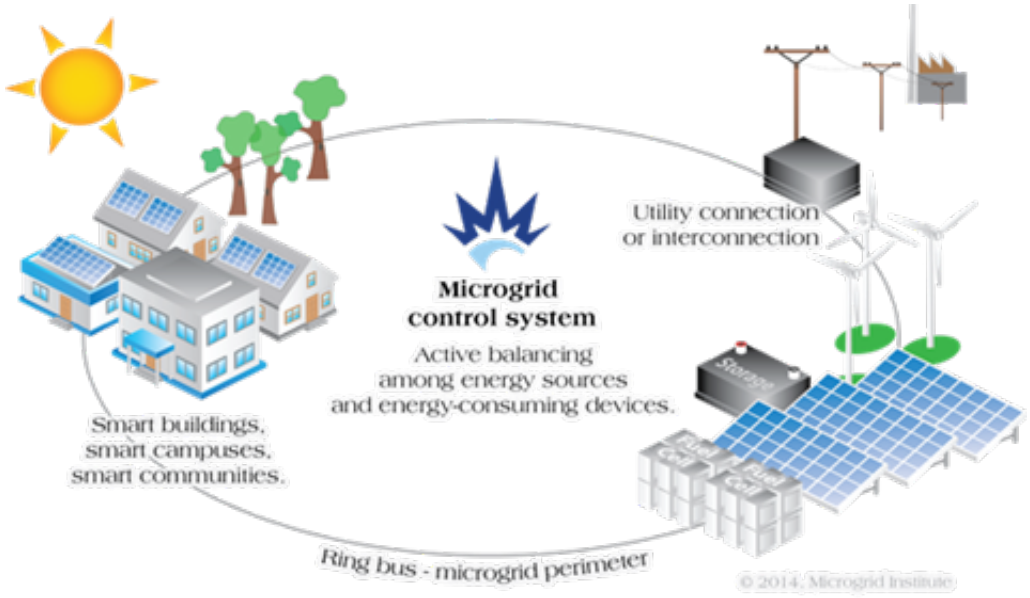
Given the high urbanisation rates and the challenge facing national-level energy supply and distribution systems to keep pace with demand, localised urban energy services can and should play a significant role in ensuring that new developments provide affordable and reliable energy services. The fact that so much new land is being opened for development – much of which is in areas largely free of infrastructure and existing connections – makes the synergy between land/property and energy asset development all the more beneficial. Coupling localised energy investment with capital flows to property can bring economies of scale and shared project development costs between the property and the energy assets. At a large development-level scale, the energy systems' Balance of System costs – the range of soft (design and permitting) and ancillary hard (inverters, racking systems, etc.) elements that are significant factors in total costs and vary greatly by location – can be driven down.

In practical terms, urban distributed energy is already widely is use in the form of diesel back-up. There are over 9 million privately owned diesel generators in Nigeria with a combined capacity four to five times greater than the grid connected capacity - an estimated 14-20GW (Africa-AU RECP 2014). In Kenya, 57% of businesses own generators, and the number is above 40% in Tanzania and Ethiopia (McKinsey 2015). Drawing on the continental experience with rural microgrids, the historical urban reliance on local back-up generation, and generally accommodating regulatory frameworks (World Bank 2017), effective models for urban localised energy/microgrid finance and development can emerge as shown in Figure 22.

For developers and investors of properties, incorporating local energy solutions can bring near-term product differentiation and long-term asset value maintenance; control over energy price variability and peak demand charges for building owners and occupiers; and improved supply security and reliability. Yet for most land developers and their financiers, localised energy is seen as creating

29 *The emphasis here is on entire systems rather than single building-scale photovoltaic installations. A large number of commercial banks in the region already offer loans for rooftop PV to residential and commercial borrowers. This chapter will present a strategy for long-term project finance for systems that serve multiple properties and that may include other utility services such as telecoms, water, and wastewater.*

FIGURE 22 **LOCAL AREA MICROGRID SCHEMATIC**

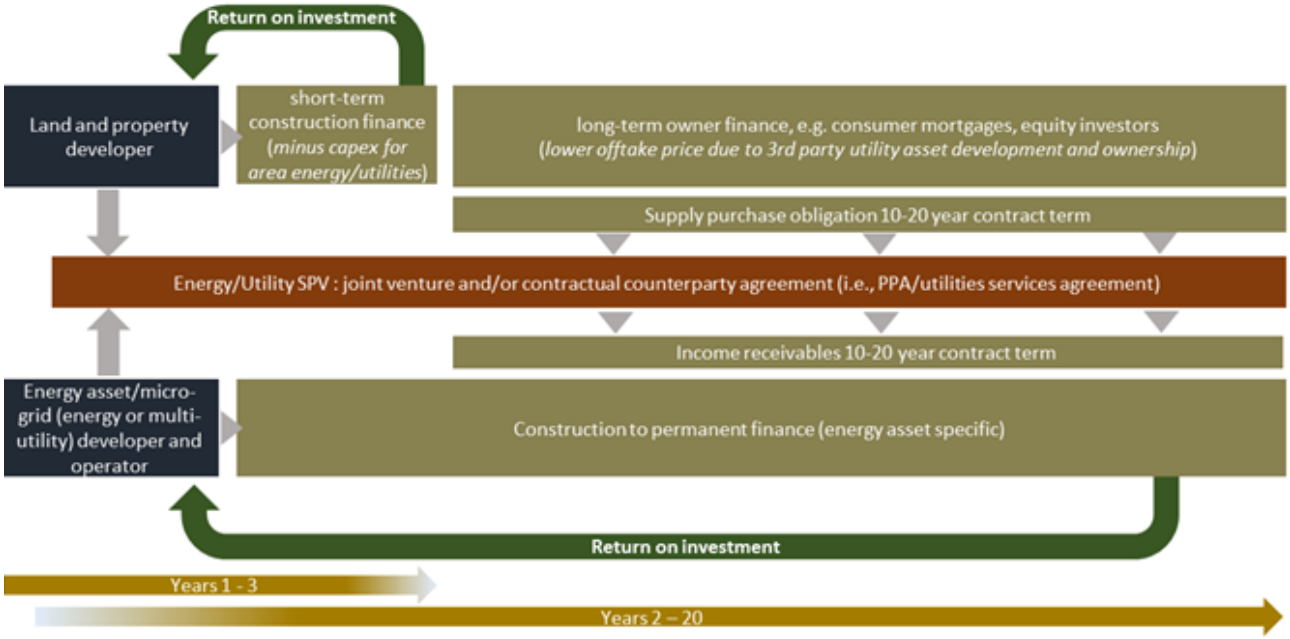


Source: *Microgrid Institute*

greater risk and cost than conventional property design and delivery pathways that simply tie into existing centralised power grids and provide back-up supply via diesel generators. Based on this, an approach that separates the property and the energy assets and attracts a co/secondary developer to execute the design, finance, and delivery of the energy infrastructure could greatly assist. This can help de-risk the technology and execution strategy for the property developer, and even bring capital expenditure relief as the capex for the energy infrastructure is moved to this additional party. For developers struggling to bring low-cost units to market and whose return on capital is based on short-term sales rather than long-term asset appreciation, shifting some of their project capex to an energy developer capitalising its investment on much longer terms can be particularly meaningful.

In sum, large, master planned property projects (initiated by the private or public sector) offer scale that can be attractive for specialist distributed energy developers and financiers. What has historically been a sunk infrastructure cost – energy and other utility pipes and wires – can be turned into its own investable asset with distinct value and returns. Engaging with an energy/microgrid delivery partner will vest this process with agents who are more conversant with the technologies and the available financing resources. Figure 23 summarises how this co-development of property and energy assets within a single development scheme might be structured.

FIGURE 23 **LOCALISED ENERGY DEVELOPMENT WITHIN LARGE PROPERTY PROJECTS**



5.2 LOCAL RELEVANCE AND EXAMPLES

Property projects best suited to attracting an energy co-developer will be of a scale where power generation potential is in the 1-10 MW range. Mixed-use developments that include many different building types and uses can create energy balance benefits for maximising on-site electric and thermal energy supply and storage options, though single-use developments can be accommodated. Single long-term owners/equity investors or estate management entities are optimal so as to minimise the number of counterparties to any energy asset leasing and off-take agreements.

For typology, low- to mid-rise buildings offer a roof area to floor space ratio so that PV generation creates a reasonable supply vis-à-vis overall demand. Other technologies, such as micro or central combined heat and power units and ground-source heat pumps, can be used in combination to increase supply for higher density developments. It is imperative that energy efficiency features of the building stock are designed-in to maximise the value of the energy output. The proximity between generation and consumption is inherently efficient and has been shown to propel energy efficiency awareness amongst consumers. Projects with land areas unsuited to building but which could host photovoltaics can further maximise the local energy yield, e.g., car parking/car shading structures. Integrating energy storage and energy management systems across the site (i.e., a local-area microgrid) is increasingly cost effective and can lead to complete energy self-sufficiency in certain circumstances. At a minimum, it provides 'islanding' capability to maintain baseload power during times of grid disruption.

A handful of new development projects in the region offer examples of integrated energy and property development. In Nairobi, Garden City, a mixed-use residential and retail complex[30] is an example of a third-party energy asset developer collaborating with the property leader for localised energy. (See Appendix A for more information.) Other retails malls and commercial office estates in Kenya (in construction) and South Africa (fully or partially completed) are integrating photovoltaics during development and/or have added PV systems post-development. This includes Menlyn Maine, Mall of Africa at Waterfall Estate, and Black River Park in South Africa; and Two Rivers Mall in Kenya[31]. And there are many international examples from which property developers and financiers can learn from in other parts of the world[32].

30 *Phase 1 of the project contains 330,000m2 of retail space plus 76 apartment and townhouse units.*

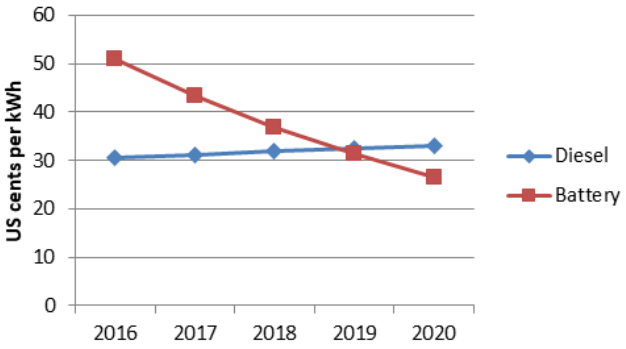
31 *Two Rivers will be a diesel/PV hybrid similar to Garden City. Installed capacity is to be two megawatts of solar energy and 10MW of diesel power.*

32 *Examples include: Schlierberg Solar Settlement, Germany (59 residential units); One Brighton, England (172 apartments with community-owned district energy heating system); Higashimatsushima City, Japan (neighbourhood microgrid with PV (470 kW total), biodiesel generator (500 kW) and energy storage (500 kWh), and capable of grid independence for 3 days); Kings Cross Central, London (see Appendix A for more details); and SOMO Village, California (3.1 megawatts of solar energy, enough power to supply 50 percent of the development's energy use).*

5.3 REDUCING FINANCE AND DEPLOYMENT BARRIERS

Local renewable generation decisions will ultimately be made on cost, and current figures are compelling. The World Bank notes that solar PV can already deliver power at less than 15US¢/kWh with long-term price certainty in Africa – figures that compare favourably to retail electricity prices in the EEBEA countries. Moreover, diesel generator power is on average two to four times the price of grid power. Both are subject to global price volatility and electricity tariffs are generally rising. Meanwhile battery storage in Africa presently delivers power at around US¢48-55/kWh and is sharply trending downwards. Once batteries hit levels comparable to distributed diesel generation (circa US¢35-40/kWh), scarcely any justification will remain for diesel back-up (Figure 24). Using present battery costs and projecting a conservative 15% price drop per annum, the time in which the cost curves will cross one to two years. For any large-scale property project entering into feasibility assessment and planning, this is effectively the timeframe in which newly constructed units will be occupied. **To not include localised renewable supply and storage in project design and planning is to subject future occupants to higher than necessary energy costs**.

FIGURE 24 **BACK-UP ENERGY COSTS – BATTERY VERSUS DIESEL**



Localised energy costs are highly contingent on the availability and cost of capital. According to the International Energy Agency (IEA), the average cost of solar power in Africa would be cut in half if the continent could obtain the same cost of capital as in Germany. Figure 25 is just one example of the impact of interest rates, showing a range of projected production costs in Uganda for systems between 1-100MW[33] at different weighted average cost of capital rates.

33 *Systems of this size tend to be utility scale installations, through what is termed the Commercial and Industrial market (C&I) are installations ranging from 1-10 MW installed at industrial parks, campus, and commercial building rooftops. The figures in the graphic, then, are on the very low end of what is feasible for distributed energy within property master plans.*

Market advances in the US and Europe show how localised energy assets can be matched to innovative financial products and investment schemes[34] that result in lower capital rates and longer tenors – a critical need given the high upfront capital but very low ongoing marginal production costs. The innovation comes from securitising the income stream from an aggregation of multiple renewable energy assets – many at the small/distributed scale – to return capital to project investors. In these markets, coupon rates below 3% have been achieved, which becomes a proxy for low-end cost of capital. Importantly, aggregation and securitisation can suit long/multi-stage property projects, as multiple smaller (modular) assets can be brought together from many different property schemes as they reach production.

Long-tenor project finance for localised energy assets is likely to come from specialist equity-heavy funds rather than commercial bank project finance. However, commercial banks will be important for the relationships they hold with the property sector and the role they play in credit decisions to developments that integrate these additional, secondary assets[35]. And there are potential commercial bank finance roles to be played on the energy side as well. Options include, for example, vendor finance to distributed energy companies; early-stage debt to bring projects forward to the point where longer-term 'green' debt and equity sources can step in; and 'warehousing' facilities that compile small assets for greater scale in advance of securitisation.

To activate the market, commercial banks and property developers will also need improved technical knowledge, and assurances that complementary public-sector strategic and regulatory frameworks are in place. Knowledge of that supply chain maturity ranging across technology vendors to O&M providers is also important. Banks who hold first lien positions on properties with distributed energy assets financed separately will also need to be versed in contractual arrangements between the parties (energy asset owners and hosts, and energy end-users) lest they are perceived as creating property debt repayment risks.

34 *e.g., YieldCos, Solar REITS, and 'green' bonds*

35 *Property developers that secure large project debt and equity packages suggest that they will be bankable counterparties to a localised energy/multi-utility microgrid purchase agreement. The fact that the energy/utility asset has a built-in off-taker will assist in bringing affordable finance to that side of the project.*

FIGURE 25 **LEVELISED COST OF ELECTRICITY FROM SOLAR PV IN UGANDA AGAINST THE WEIGHTED AVERAGE COST OF CAPITAL**

Source: *Fraunhofer ISE (2015): Current and Future Cost of Photovoltaics. Long-term Scenarios for Market Development, System Prices and LCOE of Utility-Scale PV Systems. Study on behalf of Agora Energiewende*

BLACK RIVER PARK SOLAR PLANT FEEDS POWER TO CAPE TOWN

Source: *http://www.greenbusinessguide.co.za/black-river-park-solar-plant-feeds-power-cape-town/*

GRID TIED SOLAR PV SYSTES AT THE TWO RIVERS MALL IN NAIROBI

Source:*https://www.powerpoint.co.ke/index.php/gallery/two-rivers-mall-grid-tie-installation?page=4*

06 GREEN PROPERTY FINANCE MODELS

This chapter presents three high-level models to demonstrate how the principles behind the finance instruments and the localised energy systems strategy described in Chapters 4 and 5, respectively, can be applied. The models are based on indicative projects only with many assumptions made on cost, revenue, and finance details. They offer a reference point for the ways to finance and generate financial benefits from green properties and larger scale master planned projects. **The modelling highlights some of the challenges to financing improved energy and resource efficiency and distributed energy given the interest rate, production cost, and market liquidity features of the four countries. These do not create insurmountable obstacles, but rather show how local context needs to be factored in to new product development.**

6.1 SHORT-TERM CONSTRUCTION/ PROJECT FINANCE

The model is based on **concessional-rate** project finance to offset the higher capital costs associated with green buildings. As it is unlikely that that market will positively price green property features, developers will be dis-incentivised from bring green projects to the market if sales and/or rental prices remain in-line with similar standard properties. The need to keep unit prices equal would result in lower developer margins on sold units – assuming that development finance for the extra costs could even be arranged. Cheaper finance, however, could levelise the standard and green production costs and remove this dis-incentive.

The model is for the delivery of middle-income units such as small detached or semi-detached maisonettes, or basic apartment block structures. The development costs of the model are based on a handful of data points drawn from publicly available sources (see Appendix C for details). From these and other background information on regional market conditions, the model uses the data points shown in Table 8 for a 100-unit, middle-income housing development, middle income housing development.

The model is used to determine the interest rate concession required to deliver the completed green units at a sales price on par with standard construction costs, assuming a green cost premium of 5% and 8% (but no sales uplift) and maintaining an 80/20 debt to equity ratio. The results are as provided in Table 9.

TABLE 8 **CONCESSIONAL INTEREST MODEL VARIABLES**

DESCRIPTION	VARIABLE
Per unit floor area, square metre	80
Total development floor area, square metre	8,000
Construction costs, US$/m^2 (hard costs only)	600
Development costs, US$/m^2 (services, fees, contingency included*)	720
Developer's profit margin	20%
Mortgage term	3 years
Interest rate	18%
Payment schedule, principal and interest	quarterly
Debt to equity ratio	80/20

**Land value assumed as additional 10% of development costs and credited as an equity contribution*

TABLE 9 **CONCESSIONAL INTEREST MODEL RESULTS (20% EQUITY CONTRIBUTION)**

KEY FINANCIAL INDICATORS	STANDARD (US$)	5% PREMIUM (US$)	8% PREMIUM (US$)
Development cost per m^2	720	756	778
Total development cost	5,760,000	6,048,000	6,220,800
Equity contribution	152,000	1,209,600	1,244,160
Balance to be financed (loan principal)	4,608,000	4,838,400	4,976,640
Total payment (principal and interest), 3 years	6,064,102	6,008,361	5,977,202
Total investment (equity plus debt payments)	7,216,102	7,217,961	7,221,362
Break even cost on total investment, per unit	72,161	72,180	72,214
Unit price with developer profit (20%)	86,593	86,616	86,656
Interest rate	**18.00%**	**14.00%**	**11.75%**

TABLE 10 **CONCESSIONAL INTEREST MODEL RESULTS (<20% EQUITY CONTRIBUTION)**

KEY FINANCIAL INDICATORS	STANDARD (US$)	5% PREMIUM (US$)	8% PREMIUM (US$)
Development cost per m^2	720	756	778
Total development cost	5,760,000	6,048,000	6,220,800
Equity contribution	152,000	1,149,120	1,150,848
Debt to equity ratio	80/20	81/19	81.5/18.5
Balance to be financed (loan principal)	4,608,000	4,898,880	5,069,952
Total payment (principal and interest), 3 years	6,064,102	6,083,465	6,066,538
Total investment (equity plus debt payments)	7,216,102	7,232,585	7,217,386
Break even cost on total investment, per unit	72,161	72,326	72,174
Unit price with developer profit (20%)	86,593	86,791	86,609
Interest rate	**18.00%**	**14.00%**	**11.50%**

As the tables shows, **an interest rate concession of 400 basis points or 625 basis points would be needed to equalise the end cost to the buyer for a 5% and 8% green premium, respectively**. In this scenario, the developer would provide additional equity in absolute figures in order to maintain the 80/20 ratio based on the higher construction cost. These additional equity contributions amount to $57,600 (5% premium) or $92,160 (8% premium). Based on the borrower's ability to maintain the 20% equity, the lender's risk is reduced provided the concessional capital can be sourced.

For reference, the same model was run but with the equity ratio softened (Table 10). This would be the case for an equity-constrained developer who has limits on the absolute capital it can contribute to the project.

The goal is again to test the concessional interest rate required to keep the green end-unit sales price on par with standard units.

It is only in the 8% green premium scenario that the concessional interest rate changes from the above findings, and in fact the change is marginal (25 basis points).

6.2 GREEN HOMEBUYER MORTGAGE

The model looks at the changes that lenders could make to debt to income ratio when assessing borrower credit worthiness, based on whether the mortgage is for a standard or green property. It assumes that borrower repayment capacity is improved for the green property due to the utility costs savings, and therefore the borrower can handle more debt other factors remaining equal.

The model was run for two scenarios. One is the lowest cost formal production house as reported by CAHF for Uganda as of mid-2016 (refer to Chapter 2, Graphic 2.1); the second is the indicative cost of a middle-income unit, nominally in Kenya, as modelled in the preceding section. Green premiums are added to both units (5% for the low-cost and 8% for the medium-cost, respectively). While there are variations between the low- and medium-cost unit as to the tenor, interest rate, and borrower down-payment, these variables remain constant when the green premium is applied to the unit (Table 11). All prices are in $USD.

TABLE 11 **DEBT TO INCOME VARIATION, STANDARD VERSUS GREEN MORTGAGE**

KEY FINANCIAL INDICATORS	LOW COST	5% GREEN PREMIUM	MEDIUM COST	8% GREEN PREMIUM
Location	Uganda		Kenya	
Mortgage term	15 years		20 years	
Mortgage rate	18%		16%	
Unit price	US$ 30,000	US$31,500	US$ 86,600	US$93,528
Down-payment	20%		10%	
Equity contribution	US$ 6,000	US$ 6,300	US$ 8,660	US$ 9,353
Balance to be financed / debt obligation	US$ 24,000	US$ 25,200	US$77,940	US$ 84,175
Annual payments	US$4,638	US$4,870	US$13,012	US$14,053
Annual mortgage cost differential		US$232		US$1,041
Debt to income ratio*	30.0%	31.5%	30.0%	32.4%
Annual income	US$15,460	US$15,460	US$43,373	US$43,373
Average annual urban household income	US$ 3,502		US$ 5,007	

**mortgage debt only; excludes taxes and insurance*

A conservative 30% debt to income ratio was used as the starting point, recognising that the actual ratio would be higher if all additional factors typically underwritten (e.g., property insurance, any applicable mortgage insurance, and taxes) were included. The model shows that the ratios would only need to be increased modestly (by 1.5% and 2.4%) to allow the borrower to secure a green mortgage. The model also assumes that the borrower is able to maintain the same equity ratio, providing either a 20% or 10% down-payment which is higher in absolute figures for the green properties. Note that the last row of the table shows the average annual urban household income from Chapter 2, Figure 14. This is simply to highlight the affordability challenges facing the East African market generally.

In order to relax their debt to income requirements, lenders would need some indication that the borrower's capacity to repay has indeed improved – effectively, that the energy savings exceed the added debt burden. To test this, energy/utility costs were assessed for Uganda and Kenya alongside presumptive household consumption figures representative of prospective buyers for the units. The data pool on household energy usage and costs is shallow; the model should be taken as a indicative reading of the savings/income value.

For the low cost housing model, individual studies assessing household energy consumption from Uganda, Tanzania, and Rwanda were reviewed. These figures were then referenced against figures from the EEBEA energy audit report which includes data for residences in Kenya, Tanzania, and Uganda. Note that these figures are electricity only, though household energy consumption will involve other fuels that can be affected by green design. Therefore an escalation factor was added to capture expenditure on all fuels. the resulting monthly expenditure range for a low-income household is 10 - 31 USD (using individual country exchange rates).

The energy estimates for middle-income/medium-cost housing are based on studies and data points from Kenya and South Africa, and cross-checked by findings from the aforementioned EEBEA energy audit report and informal research on cost of living data for the four EAC countries. Based on these sources, monthly middle-income utility costs range from US$40 – 124. See Appendix C for more information on the data sources and assumptions used to derive the low and middle income figures.

Table 12 summarises the net value of the green investment, based on anticipated utility costs and savings vis-à-vis a standard property, incorporating the additional equity contribution and mortgage principal and interest.

The results show that the energy cost savings alone are insufficient to generate a positive return. This is due to the combination of the high mortgage rate and low utility expenditure. In this scenario, the green premium would need to be capitalised in the property resale value – an unlikely enticement for potential mortgagees given present market conditions. Therefore, Table 13 summarises how a lower interest rate for the green property, in addition to the relaxed debt to income ratio, could generate a positive net value. The mortgage interest is reduced by 75 basis points to 17.25% on the low-cost property, and 100 basis points to 15% on the mid-cost property. (Figures changed from Table 12 are in italics.)

TABLE 12 **GREEN MORTGAGE NET VALUE**

KEY FINANCIAL INDICATORS	5% GREEN PREMIUM Low-cost	8% GREEN PREMIUM Medium-cost
Location	Uganda	Kenya
Mortgage term	15 years	20 years
Mortgage rate	18%	16%
Annual utility costs (Yr 1)*	US$ 300	US$ 1,020
Predicted energy reduction **	20%	30%
Predicted Yr. 1 utility cost savings	US$ 60	US$ 306
Annual additional green mortgage costs	US$ 232	US$ 1,041
Additional equity contribution	US$ 300	US$ 693
First year net cost	(US$ 472)	(US$ 1,428)
Cumulative net cost +	(US$ 2,383)	(US$ 10,526)

** Utility costs are based on US$25 and US$85 monthly expenditures. Future utility costs escalate at a steady rate of 6% per annum.*

*** 20% was selected as the baseline energy savings consistent with the IFC's EDGE green assessment tool (see Chapter 8 for more details). The 30% reduction is in-line with the additional green premium.*

+ Cumulative cost is over the full mortgage term and incorporates the above energy cost inflation.

TABLE 13 **GREEN MORTGAGE NET VALUE (INTEREST RATE ADJUSTED)**

KEY FINANCIAL INDICATORS	5% GREEN PREMIUM Low-cost	8% GREEN PREMIUM Medium-cost
Location	Uganda	Kenya
Mortgage term	15 years	20 years
Mortgage rate	17.25%	15%
Annual utility costs (Yr 1)	US$ 300	US$ 1,020
Predicted energy reduction	20%	30%
Predicted Yr. 1 utility cost savings	US$ 60	US$ 306
Annual additional green mortgage costs	*US$ 69*	*US$ 289*
Additional equity contribution	US$ 300	US$ 693
First year net cost	*(US$ 309)*	*(US$ 676)*
Cumulative net benefit	*US$ 62*	*US$ 4,784*

For the lender, the interest rate reduction to make the investment net positive is modest, and in fact makes for a smaller change in the borrower's debt to income ratio. At these lower borrowing costs, the ratios move from 30% (standard property) to 30.4% (low-cost) and 30.7% (medium-cost) for the green properties, respectively. From the lender's risk perspective, it is worth noting that the energy savings become cash-positive (that is, savings exceed the additional mortgage payment) in year 2 for the medium-cost property and in year 4 for the low-cost property.

The model reveals that the net value of energy savings against added debt is minimal. This is a challenge for the market given the cost of debt and utility expenditure figures. Interest rate reductions greater than those modelled (75-100 basis points) are likely necessary to create an attractive return for the borrower.

6.3 LOCALISED ENERGY AND PROPERTY DEVELOPMENT

A net present value model for a localised energy system has been developed to show the financial benefit from distributed energy. The model is from the property developer's perspective, that is, the accumulated value from distributed energy from a range of sources such as reduction in purchased energy, property value uplift, reduced need for future energy efficiency retrofitting, and so forth. A positive NPV makes the possibility of attracting a development partner for the energy assets highly likely. In such a scenario, a portion of the property developer's capex may be moved from its budget to the energy developer's budget, lowering the borrowed amount and principal and interest repayments on that debt.

The model is based on a conceptual master plan for a proposed 26 hectare mixed-use development in Accra, Ghana[36], and is similar to middle- to higher-income planned developments being constructed in the EAC. The level of detail available makes it an effective reference model. The master plan calls for 280,000m^2 of floor space across residential (36%), office (48%), retail (4%), hotel (6%), and hospital (7%) land uses. This will be built out in two phases.

The typology is low- to mid-rise with building heights ranging from 1-10 storeys. A parking structure is also planned (Figure 26 to 28).

The model presents cost and benefit ranges. There are a number of assumptions in the model such as: 50-75% of the total building roof area can accommodate PV; a 3% electricity rate escalation off of present averages for Accra [37] substituting battery for diesel back-up during periods of grid outages; indicative capex/cost of capital ranges for property construction (including a green premium and small interest rate concession) and distributed energy consistent with values in East Africa; and assumed energy use reduction compared to standard practice. This is a simplified treatment but aims to show the potential income streams and value capture of hedging energy expenditure from a combination of efficient design and stable, lower-cost renewable energy generation and back-up; and potential sales/rental uplift and lower cost of capital for the property due to the project's green features. Figure 29 and 30 show the itemised potential benefits, and net value.

The model shows a small potential negative to a much larger potential positive value. Note that it does not include other possible income and value sources that localised energy networks can likely provide in the near future such as peak demand management (payments for load-shedding) or electrical vehicle charging. The cost of capital assumptions in the model are also conservative and will move lower as the market matures. The model also reveals that self-generation of roughly 25-35% of demand is possible based on the master plan's land-use and typologies.

To test the value of shifting a portion of the capex for site infrastructure to a dedicated energy asset developer, the model was adjusted so that the project finance amount to the lead property developer was reduced by 3% and 5%, respectively, for the lower and upper costs and benefits ranges. This is a representative percentage for energy/utility related site works that could shift to the distributed energy finance and delivery package. **The accrued benefits to the property developer (lower capex and reduced interest payments) over the term of the construction loan amounts to between US$ 10.6 and 32.2 million, or 2.6 – 6% of the total construction finance principal and interest based on a three to five year tenor**.

36 *The conceptual master plan was prepared by dhk Architects (South Africa). The master plan and original NPV model was presented at PowerGen Africa (2015) and Africities 7 (2015), based on the PowerGen conference paper: Ulterino, M (2015). Embedding distributed energy in new property development: strategies for a localised, low-carbon energy transition. PowerGen Africa, Cape Town, July 2015.*

37 *A blended residential and commercial retail rate was used. Converted to US$, it is 0.20 – 0.24 kWh.*

FIGURE 26 **CONCEPT PLAN: ACCRA NORTH MIXED-USE DEVELOPMENT - LANDUSE PLAN (SOURCE: DHK ARCHITECTS)**

FIGURE 27 **INDICATIVE BUILDING DESIGN: OFFICE PRECINT (SOURCE: DHK ARCHITECTS)**

FIGURE 28 **INDICATIVE BUILDING DESIGN: RETAIL SPACE (SOURCE: DHK ARCHITECTS)**

FIGURE 29 **LOCALISED ENERGY BENEFITS (000,000 US$)**

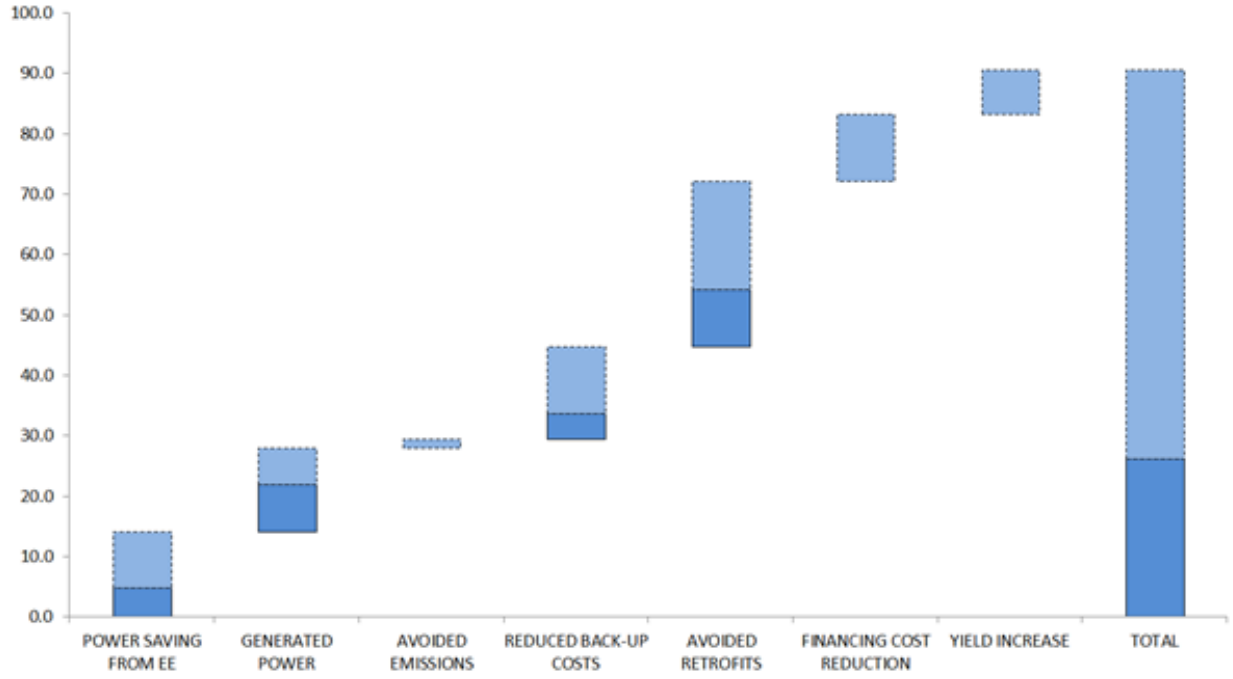
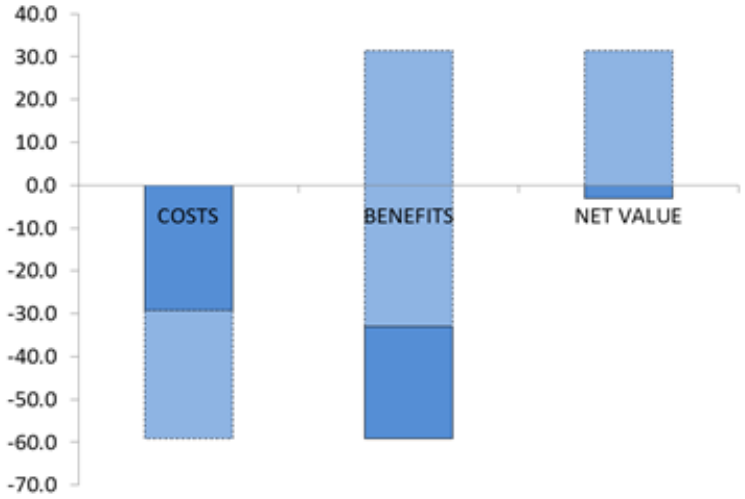


FIGURE 30 **LOCALISED ENERGY NET VALUE (000,000 US$)**



07 GREEN MORTGAGE UNDERWRITING

The level of green/efficient property design and development is very low in the region at present. The barriers described in Chapter 4 largely account for this. As with any paradigm shift, the effort to change standard practices and refocus supply and finance chains to accommodate the new opportunity takes time and is invariably supported by a combination of regulatory push and market pull. Fortunately, **the fundamental approaches to how loans are underwritten do not require change. What will be needed, however, is a step-change in knowledge of how data and performance measurements, valuation practices, and lender risk and prudential standards can help address the supply of and demand for green financial products**. Similar to the evidence base for the value and benefits of green buildings, there is substantial experience and resources from outside the region which can inform how green finance practices are developed in East Africa.

7.1 ROLE OF GREEN BUILDING STANDARDS AND DATA MONITORING

There are a wide range of tools available to design and development teams to improve energy and environmental performance of buildings. Generally these are design-based tools. They set principles and guide decisions from preliminary design through to construction and handover. While they are predictive of enhanced building performance, they do not measure nor guarantee in-use performance. As a basis for lending decisions, however, they do provide value through the process controls they create (e.g., staged checks, prescribed information collection and management, etc.); and guidance on best practices related to elemental design and material selection, applicable 3rd party standards, and modelling protocols for energy use and water consumption.

TABLE 14 **SAMPLE OF GREEN BUILDING MEASUREMENT AND CERTIFICATION SCHEMES (DESIGN AND CONSTRUCTION))**

RATING TOOL	DESCRIPTION
LEED (US): http://www.usgbc.org/leed BREEAM (UK): http://www.breeam.com/ Green Star (Australia): http://new.gbca.org.au /green-star/ GreenMark (Singapore): https://www.bca.gov.sg/ GreenMark/green_mark_buildings.html	These are multi-criteria green certification rating tools applicable to multi-family residential, commercial, retail, hotel, and institutional buildings. Developed initially for home markets (country of origin listed in parenthesis), they are widely utilised internationally. This is particularly the case on large projects involving international institutional or corporate investors or occupiers. These tools have developed in-use assessment modules so that operational performance can be compared against the design rating, but the proportion of projects that provide both design and in-use ratings is low.
Green Star – South Africa: https://www.gbcsa.org.za /green-star-sa-rating-system/ Green Star SA – Kenya http://kenyagreenbuildingsociety.co.ke/	The Green Building Council of South Africa has adapted the Australian Green Star framework, but with changes to suit local conditions. (For residential buildings, GBCSA has adopted EDGE – see below.) In Kenya, Green Star SA has also been adopted, with provisions that individual credits be adjusted for differing contextual conditions. The Kenyan and South African versions suit a range of building types, applied from the design phase of a project and up to two years from practical completion.

RATING TOOL	DESCRIPTION
EDGE (World Bank/IFC): https://www.edgebuildings.com/	EDGE was created to support IFC investments in the property sector as a means to engage developers on green design and measure costs and benefits. It is also used as part of wholesale finance agreements between the IFC and commercial banks to promote green building practices. EDGE targets environmental benefits in a narrower range of impact areas than tools listed above. Its focus is energy/carbon, water, and materials. A minimum 20% improvement in each category is required. It was designed specifically to suit construction practices and market factors in middle- and lower-income countries. While certification fees apply, they are low in comparison to other tools used internationally, and the assessment tool is freely available on-line. (See the case study in Appendix A for more information.)
EnEff:ResBuild India: http://www.ittoolkitindia.com/index.php	This software programme was developed by the German and Indian research institutions the Fraunhofer Institute and TERI. It is part of a finance initiative of the German development bank KfW with the National Housing Bank (NHB) of India to launch a funding scheme for energy efficient residential buildings. The software is used to measure efficiency improvements and verify the finance arrangement. It calculates the projected energy demand and identifies energy saving potential in comparison to a reference building. (See the case study in Appendix A for more information.)
ENERGY STAR (US): https://www.energystar.gov/ Energy Performance Certificates / EPC (EU): https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings/certificates-and-inspections NABERS (Australia): https://nabers.gov.au/	These are energy-only assessments that are most relevant for existing buildings (as a measure of in-use energy consumption) but that have been adapted for new builds. The results are banded (i.e., 1-100; A-G rating; 0-6 stars); and are relative, that is, comparing one building against collected data for other properties. (EPCs are an exception to this – ratings are indicative from building design and systems features). The data pools against which predicted and actual performance of single buildings is very deep which lends credibility to the rating. The rating bands can be adjusted over time to reflect improvements in the overall building stock, i.e., a 3 star-rated NABERS building will need to be more energy efficient than, say, buildings assessed 10 years prior.)

Most, if not all, dedicated financial products for green property will rely on an externally branded or internally developed standard/assessment and certification resource[38]. For the East African market, examples that could be applied or that offer useful context are summarised in Table 14. Information on other assessment methods/certification schemes for low- to moderate-income housing in Brazil and the US are also described in Appendix A. Such objective design and in-use assessment and performance data can support investment and lending decisions in green buildings.

As described in Chapter 4, green ratings can act as a proxy for ability to repay additional 'green premium' borrowing from realised energy savings, or as a factor in sale or rental price uplift. Creating a better understanding within the finance and investment sector of data sources or performance indicators of better energy performance for incorporation into lending decisions thus requires attention. In fact, it can be argued that because efficiency and energy use are treated indifferently (that is, assumed to be of equal relevance in all properties), present practices not only fail to justify green premiums but potentially miss 'brown' discounts that should be applied to properties unlikely to hold value over time based on changing market conditions, energy prices, and regulatory changes[39].

Progress has been made in mature markets for having energy factors considered in underwriting, but even there it is fairly early stage. There are guidelines from secondary markets and regulators for primary lenders underwriting energy efficiency mortgages, but these are largely discretionary (and niche) practices within commercial banks. In the United States, national legislation has been proposed[40] that will require expected energy costs be included in the principal, interest, taxes, and insurance figures now entered into the equation when qualifying a borrower for a mortgage or a home improvement loan. Other actions that mature market property and finance sectors have initiated or are considering which could be considered in East Africa include:

38 *Externally branded tools may require project sponsors to pay registration and certification fees to the industry association or NGO that manages the standard.*

39 *For example in the UK, starting April 2018 there will be a requirement for any properties rented out in the private rented sector to have a minimum EPC energy performance rating of E. Properties of poor energy quality will face retrofit costs that other more efficient properties can avoid. This is a potential risk for lenders if their portfolio includes many inefficient properties with high/long remaining balances.*

40 *The Sensible Accounting to Value Energy (SAVE) Act.*

- lenders obtaining permission from borrowers to collect energy data as part of the credit agreement;

- instituting ***Process Performance*** steps and checks between lenders and developers to ensure that the process for delivering green buildings (which varies from standard buildings) is systematic and verifiable, e.g. following integrated design principles, using energy modelling and forecasting, detailed commissioning plans, post-occupancy measurement and verification plans, green design handover for occupant and staff training, etc.; and

- standardising how green/efficiency features are communicated in marketing materials and agent listings.

Other practices and proposals involve more rigorous data capture and validation for individual buildings over time. These would improve lender's risk assessments by building a deeper data pool, and owners/investors ability to capture the income generating and asset appreciating benefits of green properties - though with a process cost. For example:

- In Australia, ***Commitment Agreements*** are formal contracts between the state-level NABERS (National Australian Built Environment Rating System) administrator and a commercial office property developer. The developer commits to achieving a specific post-construction in-use energy rating; in return, the developer may advertise the rating in advance of its measurement, with contractual levers to ensure rectification of the in-use performance lags. The use of Commitment Agreements has been proposed by a consortium of property sector stakeholders in the UK who have noted that significant performance gap in newly constructed buildings between anticipated and actual energy use, and the present lack of standard data gathering and measurement in the industry (Bordass et al 2016).

- Based on trials in a handful of European countries, pan-European industry associations have lobbied for the use of ***Building Energy Passports***. The passport would be assigned to the building (not the owner). It would be issued at new construction or re-sale with an Energy Performance Certificate, and add data over time based on energy audits to find improvement options, measured energy data, etc. It would systematically track energy data post-retrofit and plan for staged retrofits over many years (EMF-ECBC 2016).

- '***Green tagging***' properties is an idea where banks and other lenders/investors are advised or compelled to match environmental standards or certifications to loans originated and/or held in portfolio, and make the results available. In practice, this might be buildings which have been assessed though one of the several voluntary or mandatory energy or environmental performance rating tools. Green tagging, proponents suggest, would create better market transparency on the flows of finance to energy efficient assets and products; provide valuable information on the portfolios of energy efficient loans that could be packaged as asset-backed securities into green bonds; and provide the basis for evaluating the financial performance of energy efficient loans relative to their inefficient alternatives (Robins and Sweatman 2016).

These three ideas listed above are realistically medium- and long-term market structuring initiatives for the EEBEA countries to consider. Meanwhile, **the availability of green assessment tools that have been successfully applied in emerging markets offers a solid platform from which lending practices can evolve**. It must be remembered, however, that rating tools measure environmental outcomes, not financial outcomes, and thus should not necessarily be the sole basis for underwriting decisions (Muldavin 2010). Valuation practices can be a bridge between the environmental insights generated by rating tools and the financial evidence base.

7.2 VALUATION PRACTICES

Lenders' investment decisions weave facts about the borrower's ability to pay with the value of the property that secures the loan. For the latter, independent, 3rd-party valuation reports provide the evidence for the appraised value that sets the loan limit. Securing credit for properties with higher capex costs and/or price premiums vis-à-vis comparable properties will be difficult unless the market appraisal assures the bank the additional borrowing is justified. As the underwriter makes its risk assessment, it needs to be educated on the benefits of energy efficiency and ability to effectively review the valuer's findings (Doyle and Bharhava 2012).

Valuation practices often use one of the following methods (Table 15). Any have the potential to incorporate energy efficiency and green design features, but are challenged in doing so due principally to lack of data. The first two are more common in residential markets (single-family homes) and the latter two for commercial properties.

The latter two methods perhaps offer the greatest scope to deliver near-term appraisal differentiation for green properties given the shallow market data on costs and sales. Properties with distributed energy assets are particularly well suited to these methods as the energy generation income is predictable based on data from comparable national and international locations.

TABLE 15 **SUMMARY OF VALUATION PRACTICES**

METHOD	GREEN PROPERTY ASSESSMENT BARRIERS
Cost approach – determines the cost to replicate the house in its current location	Lack of data on the green premium capex (if any), or knowledge about which features of the property are green and their cost basis, can create inaccuracies. There may also be uncertainties at the economic life of green technologies and how these are depreciated.
Sales comparison analysis - compares the asking price against similar local properties	In a market with very few green properties, identifying and citing comparables is challenging.
Income or income capitalisation method – rental values that the property could generate, and the implied risk to the income stream	In areas with few rental properties, or where the green rental premium (if any, and how generated[41]) is not accurately assessed, value can be misquoted. Capitalisation rates can also be subject to valuer judgements.
Discounted cash flow analysis (DCF) – an analysis of future expected cash flows (e.g., rental income) discounted back to present value based on the investment inputs	Financial modelling requires a range of data points (including qualitative factors such as occupant satisfaction) that may be hard to generate, and also subject to valuer judgements, e.g., discerning residual value or exit yield at the end of the cash generating period.

Experience internationally again shows where appraisal methods are evolving. In the UK, the RICS (Royal Institute of Chartered Surveyors) has since 2014 listed sustainability as a factor that valuers need to take into account when performing valuations and risks assessments for their clients. It requires valuers to collect sustainability related information which could potentially impact on value, regardless whether there is direct market evidence. This change in standards is linked to an agreed industry process for improving data collection, from which market values can be more accurately discerned over time. Valuers are also required to flag up the absence of information, or the failure to provide this information, as a potential risk factor to lenders[42].

RICS provides valuers with a standardised sustainability checklist for gathering data and modelling. Similarly, the Appraisal Institute (US) has, since 2011, offered a Sustainability Addendum for use with the Uniform Residential Appraisal Report (Figure 31). The three-page form provides appraisers an opportunity to formally recognize energy efficiency improvements as a part of a home valuation assessment. The addendum addresses not only energy efficiency, but sustainability factors such as water conservation measures and public transportation as well. A commercial version is also available.

Other initiatives in the EU supported by European Commission grant funding are addressing the skills gap in the valuation industry. Renovalue[43] has created and trialled a training toolkit for property valuation professionals, with particular attention to factoring energy efficiency and renewable energy into valuation practices. ReValue[44] is developing standards so that the value of energy efficiency value in residential real estate (private and social) is fully captured.

7.3 LENDER RISK AND PRUDENTIAL STANDARDS

Banking regulators in each of the four EEBEA countries have either firm standards or practice guidelines on borrower and credit terms such as income to debt and loan to value ratios. While green mortgages may move toward the edges of these standards and practices, e.g., higher debt levels relative to income, or smaller downpayments relative to the size of the loan, stakeholder consultations suggested that banks have sufficient headroom within their regulatory confines to relax these values. Other features of green mortgages, such as lower interest rates or longer tenors, are market-based decisions made by individual banks[45]. The high wholesale cost of capital and difficulty in securing long-term wholesale debt make significant rate or tenor concessions unlikely on a pure commercial basis, though regulations would not necessarily prevent it.

Better data on building performance, and locally relevant investigations on the cost and value of green properties, would significantly improve banks' understanding of risk and appropriate product pricing for green property mortgages. This data set will build over time as will understanding of the 'bankability' of the green performance factors. For example, there will be degrees of lender appetite to value all or a portion of the energy and cost savings. In a study of multifamily housing in New

41 *For example, income generators may be the result of incentives, the timing of which is ideally known and fixed but may in reality be uncertain. Changes to feed-in-tariffs for renewable energy in several European countries (UK, Spain) and US states (Hawaii, Arizona) are cases in point.*

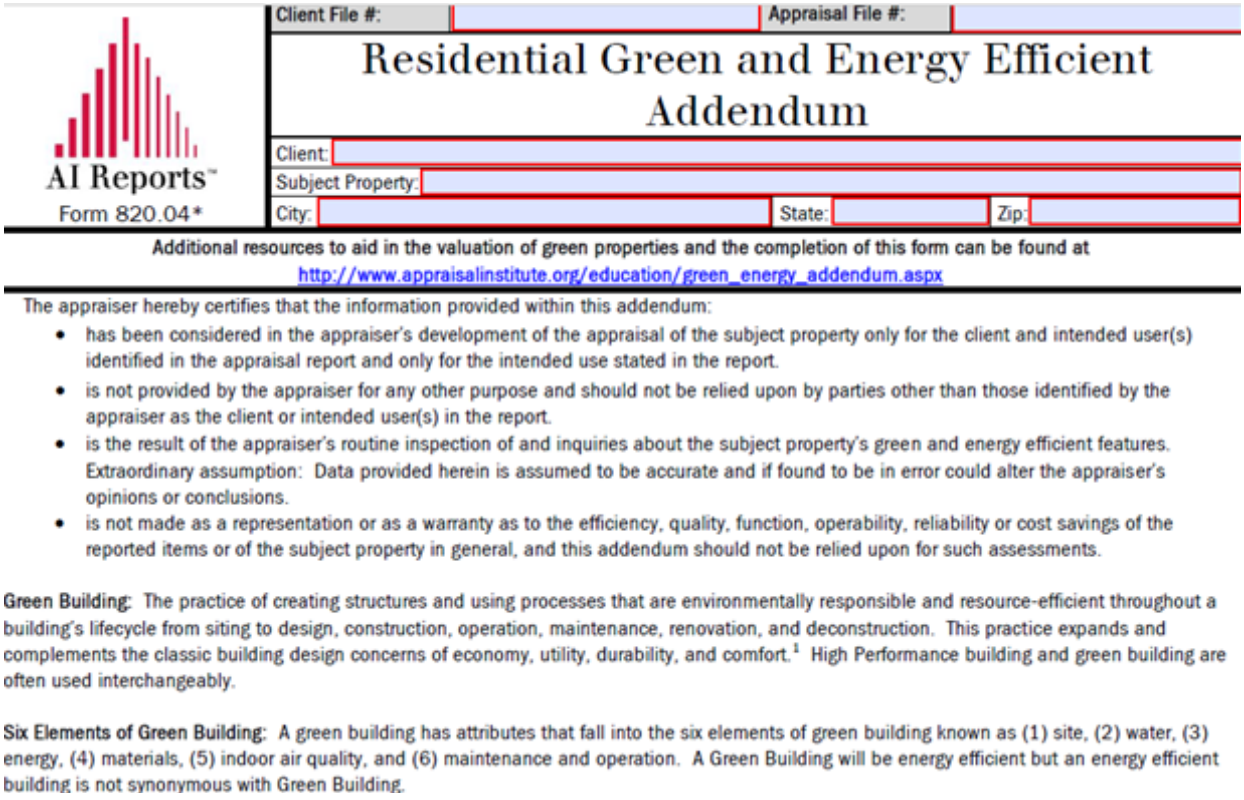
42 *Conversely, there are instances of valuers receiving instructions by lenders to ignore green property features due to the uncertainty in areas such as costs and prices. However, following this instruction would result in a misleading appraisal report that does not reflect the true physical and economic characteristics of the property (Adomatis 2015).*

43 *http://renovalue.eu/*

44 *http://revalue-project.eu/*

45 *Save Kenya, where interest rates (in terms of upper limits) are uniform across the sector.*

FIGURE 31 **APPRAISAL INSTITUTE RESIDENTIAL SUSTAINABILITY ADDENDUM (EXCERPT)**



AI Reports™
Form 820.04*

Client File #: | Appraisal File #:

Residential Green and Energy Efficient Addendum

Client:
Subject Property:
City: | State: | Zip:

Additional resources to aid in the valuation of green properties and the completion of this form can be found at
http://www.appraisalinstitute.org/education/green_energy_addendum.aspx

The appraiser hereby certifies that the information provided within this addendum:

- has been considered in the appraiser's development of the appraisal of the subject property only for the client and intended user(s) identified in the appraisal report and only for the intended use stated in the report.
- is not provided by the appraiser for any other purpose and should not be relied upon by parties other than those identified by the appraiser as the client or intended user(s) in the report.
- is the result of the appraiser's routine inspection of and inquiries about the subject property's green and energy efficient features. Extraordinary assumption: Data provided herein is assumed to be accurate and if found to be in error could alter the appraiser's opinions or conclusions.
- is not made as a representation or as a warranty as to the efficiency, quality, function, operability, reliability or cost savings of the reported items or of the subject property in general, and this addendum should not be relied upon for such assessments.

Green Building: The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's lifecycle from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classic building design concerns of economy, utility, durability, and comfort.[1] High Performance building and green building are often used interchangeably.

Six Elements of Green Building: A green building has attributes that fall into the six elements of green building known as (1) site, (2) water, (3) energy, (4) materials, (5) indoor air quality, and (6) maintenance and operation. A Green Building will be energy efficient but an energy efficient building is not synonymous with Green Building.

Source: *Appraisal Institute*

York City that were subject to energy efficiency retrofits, a retrospective review of the universe of properties found that while fuel savings projections ranged from 25% to 50% across about two-thirds of the buildings, most projects actually saved 10% to 40% from their previous baseline consumption (Deutsche Bank 2012). The report lists a number of potential factors for the mismatch: how much of the associated scope of work was implemented, equipment specifications, the quality of construction and ongoing facility management, and the quality of the energy audit. The conclusion for lenders is to establish a "cap" on the energy savings against which the loan is written. How this cap is derived will vary, but individual lenders should use both modelled and empirical evidence to support theirs.

The above example is based on energy retrofits, whereas EEBEA's focus is on new construction. New building energy savings are harder to predict due to the lack of a directly applicable 'before' baseline. Fortunately, the significant additions to the building stock in EAC countries – at rates much greater than found in mature economies – at least gives pool of similar vintage and occupier profile properties against which in-use performance differences could potentially be tracked and assessed.

It is likely that lenders will require independent opinions on energy performance in support of finance it offers. This is not uncommon in energy efficient finance programmes globally and is likely to be part of any new initiative in the EAC target countries. This needs to be integrated to the underwriting process in a manner analogous to appraisals. Stakeholder discussions revealed that valuations cost somewhere between 0.3% and 3% of the value of the loan. Providing additional energy assessments/green design assessments to support lending decisions is likely to add an additional similar amount to the loan (passed to the borrower directly or indirectly). Over time, this feature may fade as the valuation sector becomes more effective at providing information on green property features and performance.

Note that it is possible that an individual's energy consumption will rise as buyer/occupants move from substandard to better quality housing. This may be particularly so for low-income groups. In this case, the value of the green property to the owner/occupier may still be higher but quantified in different ways, e.g., occupant health, satisfaction, and comfort. How lenders should assess these circumstances and assess value is an area that requires deeper investigation. It may be that the aggregate social benefits are sufficient to warrant public resources to secure the outcome, for example, interest rate subsidies or downpayment assistance. However, even where borrowers are spending more on energy in new premises compared to old, asset value should still improve over time vis-à-vis other new properties lacking green design features.

Lenders will also need to weigh considerations on general market conditions, e.g., will vendors for green materials or renewable energy systems be viable entities over the course of warranty periods. Additionally with on-site energy, lenders will need to consider the different ownership structures (particularly 3rd-party owned) and counterparty arrangements and the effect on credit risk and valuations.

08 DEVELOPING GREEN PROPERTY FINANCE PRODUCTS

As presented in Chapter 4, there is sound evidence of the financial value generated by green properties. Capturing this value should be the goal of new finance products. Chapter 5 describes a finance and delivery approach for distributed energy networks tied to large-scale master planned developments. Green property finance models developed for this guide highlight the opportunities and challenges for green lending within the regional market conditions. Further Information on the role of green building assessments and data monitoring, changes in valuation practices, and successfully applied green finance products internationally give firm evidence that commercial returns can be generated alongside resource and environmental benefits. Collectively, **this information provides a foundation for commercial banks and developers/investors to pursue green property development and finance in a manner that effectively manages risk and creates financial gain**.

The target market recommendations that follow are suggested starting points for the finance and development sectors to increase capital flows to green, efficient, and low-carbon buildings. These will help position East African finance sector alongside broader international trends for green capital deployment. Other actors in the property and distributed energy value chain will need to be engaged and part of a market development process so that supportive efforts in information and capacity, standards and best practice initiatives, and regulations are aligned.

8.1 RECOMMENDED TARGET MARKETS

8.1.1 CONCESSIONAL CONSTRUCTION FINANCE

To address the gap in green/energy efficiency mortgage finance, targeting development rather than end-mortgage finance is recommended. There are several reasons for this recommendation to address the 'supply-side' for green buildings.

1. There are inherent programme development and management efficiencies in influencing a small number of developers that are creating a large volume of housing and commercial units, as opposed to engaging with individual buyers who require one-by-one targeting on the value of green property.

2. This approach can learn from experience/initiatives in low- and middle-income countries from institutions such as SHF Ecocasa in Mexico (involving Inter-American Development Bank and KfW), investments and resources from IFC / World Bank in several countries, and National Housing Bank (NHB) of India.

3. Experience in the United States suggests that the take-up for green finance products has been stronger in project rather than retail finance (see the Community Preservation Corporation and Fannie Mae case studies in Appendix A for more information). Green retail mortgage take-up in the US has in fact been particularly low, in spite of having been available nationwide since the 1990s. Two of the main green mortgage products available to consumers – one which is backed by a government mortgage insurance guarantee provided to primary lenders (FHA), and the other sponsored by one of the main secondary market buyers of loans originated by primary lenders (Fannie Mae) – closed only 4,781 loans in total between 2010 and 2013, and 183 loans between 2006 and 2008, respectively. (Kolstad 2014). Transactional complexity and lack of information/poor information exchange between the homebuyer and the underwriter are cited as key factors in the lack of scale (Kaza et al 2014).

4. Experience in the United States (HomeStyle Energy Mortgage and PACE financing) and Europe (EU-wide pilot and existing programme in Germany) with green retail mortgages has further shown that there is stronger interest in mortgage re-finance to incorporate efficiency features in existing buildings, rather than in loans for newly built homes. However, the re-finance market in East Africa is very small, and the EEBEA programme focus is principally the new-build market.

The construction debt should be provided at concessional interest rates so that the resulting green property price borne by the end-buyer is equal or very close to the cost of competing non-green properties in the market. (See Chapter 6 for modelled results on such a loan structure.) No dedicated green end-mortgage finance would be required so long as the concessional construction finance creates this cost parity.

The construction finance would be targeted to projects that meet a prescribed energy efficiency or green design standard, or utilise an approved list of technologies. For the former, this may be one or more of the rating/assessment schemes outlined in Chapter 7, the most likely of which are EDGE, Green Star, and/or GreenMark; or potentially a specifically designed resource for the market, e.g, Brazil's Selo Casa Azul or the EnEff:ResBuild in India. A technology list approach has been utilised for green mortgages in Mexico (i.e, Infonavit Hipoteca Verde[46], as described Appendix A).

Using finance to build the supply of green housing/property rather than retail demand has the advantages of

- targeting a relatively small number of very large government or parastatal developers, and known cohort of private developers with large development footprints – the former of whom can be agents in carrying out public policy goals such as low-carbon growth and housing affordability;
- fewer engagement and decision-points; and
- the potential to streamline green design and material selection processes to suit volume developers.

An initiative should be structured to capture data on cost variances, post-occupancy energy consumption, occupant satisfaction measures, and information on any pre-sale or resale premiums. This will build evidence for developers, lenders and consumers that green properties can be delivered within reasonable cost tolerances, and that energy and resource efficiency features perform and create savings and value as expected. This will enable the eventual introduction of green end-mortgages to compensate for an expected loss of concessional construction finance following a period of early stage market growth.

There is a challenge in ensuring that bank engagement with property developers on green design is well-informed and at an early enough stage so that green features can be cost-effectively incorporated. The concessional product will also need to be sufficiently improved over 'business as usual' to overcome inertia to new development processes and generally low-risk attitudes within the industry. Green building generally suffers from "ambiguity aversion", i.e., the uncertainty over the distribution of project returns leads to avoidance even if modelling and research suggests positive financial gains. This means a borrowing rate lower that the projected project IRR - perhaps by several points - may be needed (Bardhan et al 2014). Managing equity constraints of developers, as noted in Chapter 2, also requires consideration and potential application of targeted financial instruments (e.g., debt to equity ratio changes, performance guarantees).

8.1.2 LOCALISED ENERGY ASSET DEVELOPMENT AND FINANCE

The pace of development activity and number of large-scale projects in EAC's urban areas suggests that separating the energy assets from the property assets, and vesting the energy asset delivery within a separate finance and delivery package, should be actively explored. Such an approach can help apportion risk and improve affordability. Several parastatal developers engaged during the consultation process expressed general support for this concept.

The property sector will need to initiate the first steps toward this. At a project level, actions needed includes financial modelling and provisional market-testing to discern costs, benefits, and potential partnership arrangements; and design and process management to integrate local generation and distribution system in project concept master plans. Following stages would move into more detailed development of financial and financing strategies; direct engagement with potential energy/local utility asset development and delivery partners; and engineering assessments and integration of detailed engineering concepts.

Financing for the energy asset will be based on income receivables of a long-term power purchase agreement (PPA) to serve the newly constructed buildings. This steady cash flow and the near-zero marginal operating costs makes the long-term financing economic. For the property developer, there is an advantage if a portion of the capital budget for site energy distribution (presently delivered though short-term finance) can be shifted to the separated energy asset budget. This could bring a property capex reduction of few percentage points which no longer needs to be recaptured at the point of sale (see modelling from Chapter 6). Housing affordability should thus improve through the combination of the capex reassignment and energy cost security from the localised energy network.

One or several pilot projects with individual parastatal or private developers (including property development teams within commercial or national development banks) could help assess and define:

46 *While Infonavit Hipoteca Verde is a consumer mortgage product, the approved technology approach has created a level of standardisation in terms of green housing production which the East African market can learn from.*

- an appropriate asset ownership and delivery structure;
- energy contracting and counter-party details, including long-term energy (and potentially additional locally networked utilities), and operation and maintenance arrangements;
- market readiness, i.e., the depth of the partnership pool and sources of dedicated energy finance; and
- lead property developer and end-user financial benefits.

Large estate and precinct development projects can be levers to accelerate low-carbon energy deployment. Beyond the anticipated benefits to property owners and occupiers, these additional capital stock investments can also provide wider utility network/system benefits such as easing grid constraints and lowering peak demand (the most costly power to deliver). As such, engagement with energy/utility regulators and providers is important[47]. Linking property with energy asset development also creates additional project finance opportunities for the banking sector.

Present experience in Sub-Saharan Africa with rural microgrids and with urban energy installations (rooftop solar electric and thermal systems), and international exemplars of localised energy networks tied to property development, can provide meaningful guidance on these new applications. **Replicability can be anticipated as initial projects offer proof of concept, and contract and finance terms that can become part of standardised packages**. Structured engagement activities to bring together disparate market actors (specialist energy finance, local energy network developers and operators, property developers and financiers, etc.) should be considered.

8.2 POTENTIAL CAPITAL AND PROJECT FINANCE RESOURCES MARKETS

Potential sources of wholesale/investment capital and support instruments, and finance resources to facilitate trials and accelerate deal flow, should be targeted for early stage market development. Many of these will be international sources, though the share of indigenous finance sources should increase over time.

8.2.1 INTERNATIONAL FINANCIAL INSTITUTIONS (IFIS) AND DONOR FUNDS

Instruments from IFIs and donors can be a much needed source of lower cost capital and technical support for new finance market/product development initiatives. Channelling lower cost wholesale capital from these sources for green construction finance can be structured through:

- credit lines extended to individual large developers (including governmental/parastatal organisations);
- credit lines extended to individual financial institutions who on-lend to development projects; or
- a credit facility held by an individual lending institution such as a national or regional development bank or development agency to provide senior or subordinated debt to construction projects.

IFI and donor finance is particularly meaningful in early-stage markets where commercial finance lacks the capacity and track-record for successful project identification, credit underwriting, and appropriate risk-pricing. Optimally, the credit is combined with project preparation technical support to help build capacity and make the market for future non-concessional commercial finance. Examples of credit on-lending facilities structured in this way include:

- SUNREF, an initiative of Agence Francaise Developpement (AFD), has 70 partner banks in 30 countries (including Kenya and Uganda) who have received lines of credit for on-lending for energy efficiency and renewable energy projects. Project identification and technical due diligence support is also provided[48].
- The European Bank for Reconstruction and Development (EBRD), which is capitalised through partner national governments, similarly provides wholesale capital and technical support through its numerous national and regional Sustainable Energy Finance Facilities[49]. Energy efficiency investment now accounts for over 25% of the EBRD's annual lending (Bhattacharya et al., 2015).

Donor or IFI money could also be blended with national commercial sources and structured as:

- a single senior project loan at a below market rate,
- a subordinated concessional loan to cover the

47 *While the local and regional experience with self-generation indicates that regulatory frameworks are not overtly problematic, clarity will be required on the specific allowances and variances for individual microgrids and energy systems.*

48 *See https://www.sunref.org/en/ for more information.*

49 *See http://seff.ebrd.com/index.html for more information. In Africa, EBRD programmes are restricted to North African countries.*

capex differential between standard and green construction, or

- a project guarantee to cover equity contribution shortfalls (in case of default); project under-performance (e.g., efficiency savings below modelled ranges[50]); or potentially currency hedges if seeking to attract investment from international commercial debt and equity sources.

World Bank/IFC is an obvious target for collaboration in green property initiatives based on their experience in the region and internationally lending to banks and developers for green construction finance (See Appendix A for more details). For localised energy asset finance, it is often the case that capital from specialist equity players and IFI debt funders exceeds the availability of bankable projects, though admittedly these funders seek medium- to larger-scale generation projects for wholesale energy supply, or rural distributed energy[51]. Urban distributed energy system/microgrid finance is something of a gap at present. There is a 'chicken and egg' problem in needing to build project pipelines so as to shift capital sources to this sub-market. Thus rather than focusing on the gap in debt and specialist equity sources, the primary need is preparation support so that projects and finance can find a match. For that, initiatives such as the Sustainable Energy Fund for Africa (AfDB), Renewable Energy Performance Platform (REPP) (multi-donor), and Green Mini Grid Facility Kenya (UK Aid) may be potential contributors. Finding innovative ways to bring commercial project energy finance alongside commercial bank property debt and equity could help lower the cost of capital.

8.2.2 GREEN BONDS

Green bonds are an emerging subset of the national, subnational, and institutional/corporate bond market. Put simply, these are bonds issued with parameters or strict conditions on how the proceeds will be invested. As with standard bonds, issuances can be tied to general revenue or specific income or asset backed revenues. They appeal to investors seeking both economic and environmental returns and can apply to a range of investments/finance needs such as property, energy efficiency upgrades, mass transit, renewable energy, and water supply and wastewater management systems. At present, the market is favourable for issuers. The investor appetite is great enough that coupon rates are at or below benchmarks for the location and asset class.

The overall corporate bond market in East Africa is small, thus the immediate opportunity to raise and utilise private bond proceeds for green property and local energy finance is modest. However, experience elsewhere demonstrates the general viability. Several commercial property developers in mature markets[52] have successfully issued green bonds, the proceeds of which are being used for buying green properties or efficiency retrofits of existing buildings. In China, the developer Modern Land issued a US$350 million bond in 2016 for green property development and redevelopment (i.e., properties with green building certification, or additional energy saving of 15%/30% for new construction/renovations). This is a 3-year note with a 6.875% coupon. There are also examples of primary and secondary mortgage lenders that have issued green mortgage backed securities (See Appendix A for information on two of these, Rabobank Green Bond (Netherlands) and Fannie Mae (US). Similarly, in 2015, YES Bank of India raised in excess of US$150 million (5-year maturity, 8.85% coupon) for renewable energy project finance.

At the national and sub-national level, bond issuances which can channel project development finance to the property and localised energy sectors are a possibility. The Kenya Green Bond Program was formally launched by the national government and other key stakeholders in Kenya in March, 2017. Details on the prospective issuance are still to be determined, but may be targeted to refinancing existing debt rather than finance for new projects. In Johannesburg, the city government successfully issued a government green bond (the first in sub-Saharan Africa), part of which will be used for renewable energy (photovoltaics and solar hot water).

8.2.3 GREEN REITS

REITs (Real Estate Investment Trusts) draw in equity from a wide range of retail or institutional investors and offer improved liquidity in property investment. REIT enabling legislation and capital markets regulation in each of the EEBEA countries is either fully approved or in progress. The market is very small at present.

Most REITs in mature markets focus on existing assets, rather than new property development, due to the need to disburse regular dividends to investors. Having a sufficiently deep pool of income-generating property assets that REITs can manage and/or acquire is a short-term barrier to market growth in the region. Specialised development REITs such as Watsumishi in Tanzania – a closed-end rather than publicly listed REIT with public/institutional investors - may be more likely in the near-term.

As with Green Bonds, investors seeking economic and financial returns can target Green REITs. These are green

50 *Brazil's Energy Efficiency Guarantee Mechanism (EEGM) supports investment into commercial building energy efficiency via a fund issued by the Inter-American Development Bank and the Global Environment Facility. The guarantee covers up to 80% of the value of the energy efficiency investment against the risk that the project underperforms either financially or technically against the expected performance.*

51 *For example: Africa Renewable Energy Fund; Lekela Power; Green Africa Power; Climate Investor One; and ElectriFI.*

52 *For example: Digital Realty Trust, Regency, Unibail-Rodamco, and Vornado Realty Trust*

property finance platform that use high-performance real estate as a market differentiator to attract investors. As was described in Chapter 4, the evidence base that green properties generate better income and yields applies to REITs as well. Research into a commercial property REIT in North America shows that that when the share of environmentally certified buildings increases by one percent, there is a corresponding 17 basis point decline in corporate bond spreads (Eichholtz et al. 2015). Another study comparing 18 green REITs to 49 non-green REITs, also in North America, offers evidence that performance (efficiency) gains leading to improved operating performance is a significant contributor to green REITs generating a higher return on assets, leading to superior stock performance (Sah et al 2013).

8.3 UNDERWRITING AND VALUATION PRACTICES

Experience in mature and emerging economies shows that capacity building/training to underwriters to write green loans is critically important. Where project finance initiatives have proven more successful, significant engagement between programme sponsors (internally within finance institutions or externally from wholesale capital sources) and underwriters has featured. By extension, capacity development needs to be targeted at borrowers, too (i.e., developers) - both to build demand for green finance products and also to ensure that underwriters and borrowers are vested in the process and can manage additional or differentiating process features compared to conventional projects. This will be the case for localised energy finance as well.

Addressing the skills and capacity gap could be taken up by bankers or developers associations, banking regulators, housing and construction agencies, and civil society organisations. Indigenous resources that can provide specialist technical, design, and finance advice related to green property project specifically and industry-wide capacity building generally – national green building chapters and universities, for example – could be part of any skills and knowledge initiatives. IFI or donor support may be needed given some of the resource limitations of the above institutions, but ultimately this needs to be driven by industry participants. Typical relationships at large commercial banks active both in project (construction) finance and in retail (end-mortgage) finance - and that use the former to build pipelines for the latter – can also help create an intra-institutional flow for learning and skills transfer between green construction and green end-mortgage finance.

There is mixed opinion on the capacity of the property valuation sector to effectively assess green design and energy efficiency to meaningfully support lending decisions, but the majority view is that the profession is not adequately skilled or trained in this area. As described in Chapter 7, this is common across countries regardless of income level where green building is still a niche within the overall market and the evidence base for quantifiable value improvements is still modest. It should be expected that resources such as guidance notes and standards, and green valuation training, will be needed for the EAC region. These may be modelled from examples in Europe and North America.

8.4 BUILDING AND BANKING REGULATIONS AND VOLUNTARY PRACTICES

The sections below provide information on two initiatives in the region – one regulatory, one voluntary – that can create an overall increase in the knowledge of environmental impacts of buildings and property and help fill the information gap that is present in the industry. As regulatory controls improve, standard practices will evolve so that basic environmental benefits are delivered through the land and property development activities as a matter of course. The commercial finance sector will evolve concurrently, as this becomes the baseline from which the industry operates. But there will still be need for specialist green finance for projects exceeding code requirements. Voluntary initiatives of the finance and property sector can become focal points for capacity and new product development activities.

8.4.1 RWANDA GREEN BUILDING REQUIREMENTS

Improving building codes in each of the EEBEA countries to address energy use, water consumption, material selection, and other environmental factors is one of the core activities of the EEBEA initiative. To date, this has progressed furthest in Rwanda though changes in the 2015 National Housing Policy.

The Government of Rwanda, through the Rwanda Housing Authority (RHA), is in the process of setting design principles and basic standards that will apply to all new construction. A Green Building Council has been established, housed within the RHA, that will have an independent role in setting standards and establishing green review and approval processes for regulatory building controls. The green design standards will cover how buildings address:

- impact on climate change;
- energy demand for a) construction and b) building operation;
- land consumption (building location, but also the

impact of material production on the hinterland's carrying capacity);

- impact on water resources;
- impact on other resources;
- respect to green planning principles; and
- use of green technologies.

The Singaporean GreenMark environmental rating tool will be adapted to local conditions and used to establish and certify designs against the baseline regulatory standards. This will include a building materials calculator to measure impact. A companion version of GreenMark for more advanced (voluntary) levels of environmental achievement will also be established. Incentives may be introduced in the future for buildings that exceed the basic green standards and achieve higher levels of certification.

8.4.2 KENYA SUSTAINABLE FINANCE INITIATIVE

In Kenya, the Sustainable Finance Initiative (SFI) is an industry-led effort to shift banking practices to align the economic, environmental, and social impacts of lending. In September 2013, the CEO Roundtable of the Kenya Bankers Association (KBA) committed to establishing a sustainable finance working group. 12 commercial banks joined the working group, which received external support for capacity building from the Dutch and German development banks, FMO and KfW. In addition to capacity building on credit risk management that captures environmental and social responsibilities, the working group prepared research on drivers of the green economy, and established the KBA's Sustainable Finance Principles.

The KBA's 2015 working paper "Sustainability in the Financial Sector in Kenya" found that 'sustainable banking' is a novel idea in the Kenyan market. Most banks do not have policies on sustainability and very few banks were generating sustainability reports. The report recommended a hybrid approach to implementing sustainable banking in Kenya, that is, a set of codes generated by industry alongside a compliance mechanism governed by the national banking regulator. The resulting Sustainable Finance Initiative (SFI) Guiding Principles are structured around five core elements: 1) Financial Returns and Economic Viability; 2) Growth through Inclusivity and Innovation; 3) Managing and Mitigating Environmental and Social Risks; 4) Integrating Resource Scarcity and Choice; and 5) Responsible Business Ethics and Valuing Long-term Returns.

The SFI Principles were officially launched on 1st December 2015. The Principles draw from and harmonise several global best practice standards, including the Equator Principles, IFC Performance Standards, Nigerian Sustainable Banking Principles, African Development Bank (AfDB) Green Growth Policy, Global Reporting Initiative (GRI) Reporting Guidelines, UNEP Finance Initiative (UNEP-FI) Guidelines, UN Global Compact Principles, ISO 26000:2010, and Kenya's National Climate Change Policy (draft). Capacity building at Kenyan Banks on implementing the sustainability principles in credit risk, new product development, governance and internal management, and reporting is ongoing. To ensure that the activities remain public, KBA committed to providing progress reports from its sustainable finance working group. A yearly Catalyst Awards to recognise individual bank progress is also part of the initiative, and was held for the first time in October, 2016.

8.5 A FRAMEWORK FOR CAPACITY AND MARKET DEVELOPMENT

Developing commercially sound finance products to deliver the critically needed resource and efficiency gains in the land and building development sector will require new skills and knowledge within lending/investment and development organisations. These sectors – collectively through industry bodies, or within individual institutions – will need to be lead stakeholders for this. Many actors from across government and utilities, design and engineering professionals, and NGOs and research institutions, will need to be actively engaged as well.

The framework diagrams below, while simplified, show that there are several connected areas which are part of a holistic product development and market building exercise. **Focused effort is needed in creating locally relevant data sets, and costs/benefits and value capture models. While the international evidence base on green value premiums and the role of finance mechanisms in unlocking this value is instructive, assumptions and models need to be carefully calibrated to the East African market conditions.**

8.5.1 CONCESSIONAL CONSTRUCTION FINANCE

Figure 32 outlines a process for bringing a green construction finance product to market, as described in Section 8.1.1 above. The intent of this project finance is to equalise the cost of construction between green and standard properties and thus end-price to buyers/occupiers. This will start to build the supply of green properties; create producer and consumer understanding and demand for green properties; and build the evidence base on green building benefits.

Though not a comprehensive list, Table 16 provides best practice and knowledge resources may be drawn upon to deliver this finance mechanism.

8.5.2 LOCALISED ENERGY ASSET DEVELOPMENT AND FINANCE

Figure 33 outlines a process to assess the commercial viability for localised energy systems (potentially bundled with other local utility services, e.g. water, wastewater, and data) within large-scale development plans. The emphasis is on networks rather than individual elements, i.e., rooftop solar panels on individual buildings. If only the latter is pursued, this could fit within a concessional construction loan as described above, with the property developer taking on delivery risk and recapturing the investment at the point of sale. Alternatively, the systems approach is premised on creating a separate local energy/utility asset that can be financed and delivered by a dedicated delivery partner. Doing so could create affordability gains, value uplift, resource and carbon savings, and wider network benefits greater than could be achieved on an individual elements basis.

In sum, the availability of finance resources, the economic return to the lead property developer, and the availability of delivery and operations partners for splitting the energy and property assets should be assessed. The exercise needs to justify to property developers/investors that localised energy asset finance and delivery is market-ready, the financial benefits for lead developers can be realised, and that delivery and operations risks can be managed as highlighted in Figure 33.

Some best practice and knowledge resources which may be drawn upon to deliver this finance mechanism are provided in Table 17.

FIGURE 32 **GREEN CONSTRUCTION FINANCE: PRODUCT AND MARKET DEVELOPMENT ACTIVITIES**

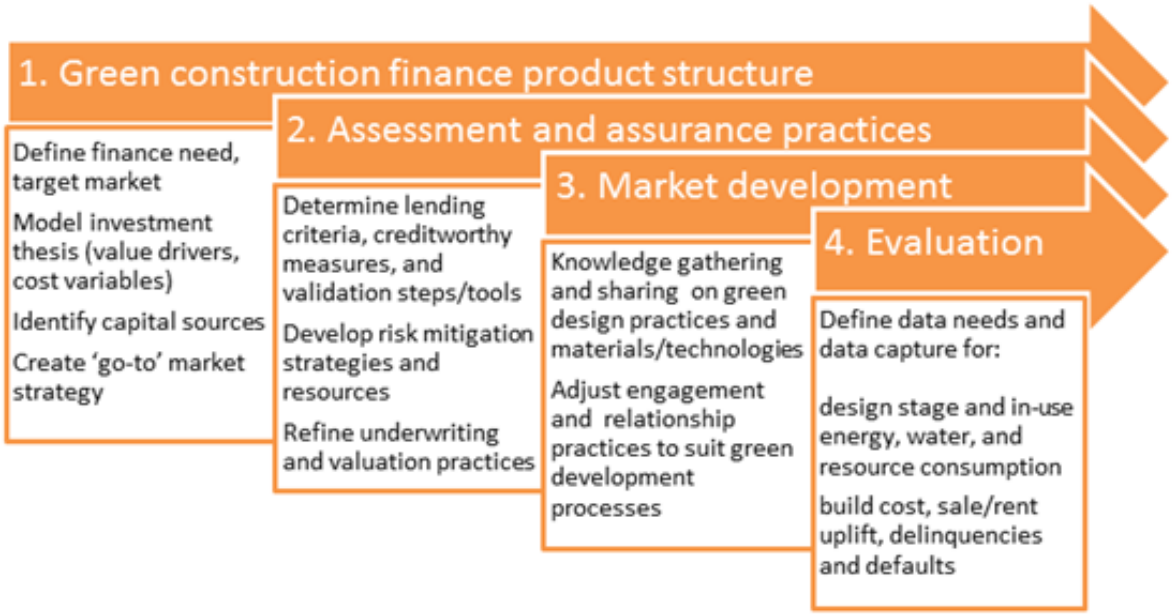


TABLE 16 **SUMMARY OF VALUATION PRACTICES**

PRODUCT & MARKET DEVELOPMENT ACTIVITIES	RESOURCES
1. Green construction finance product structure	• International green mortgage products (e.g., Mexico, South Africa, India, United States, etc.) • IFIs and national institutional investors • Green bond market.
2. Assessment and assurance practices	• Green building tools (e.g., EDGE) • Performance guarantees and mortgage insurance (e.g., Brazil, Canada) • RICS (UK), Appraisal Institute (US) and RenoValue, ReValue (EU) green valuation checklists and knowledge tools
3. Market development	• EEBEA technical guidance documents and knowledge resources • National green building councils
4. Evaluation	• International energy and water audit protocols and post-occupancy evaluation methods • Loan and property performance tracking (e.g., Community Preservation Corporation, Enterprise – US, EU Energy Efficiency Re-finance pilot).

FIGURE 33 **LOCALISED ENERGY FINANCE: PRODUCT AND MARKET DEVELOPMENT ACTIVITIES**

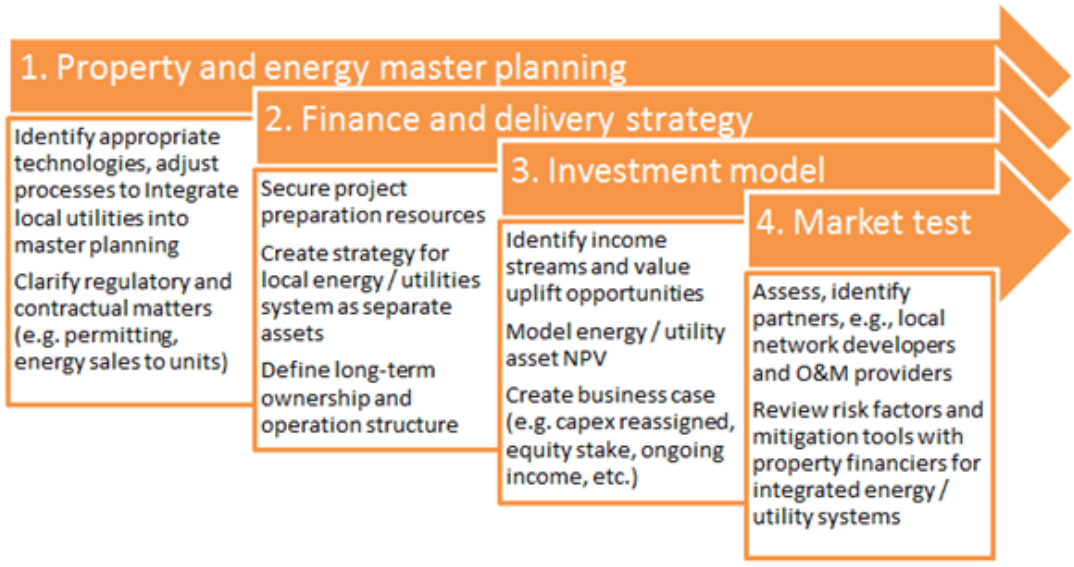


TABLE 17 **BEST PRACTICE AND KNOWLEDGE RESOURCES WHICH MAY BE DRAWN UPON TO DELIVER THIS FINANCE MECHANISMS**

PRODUCT & MARKET DEVELOPMENT ACTIVITIES	RESOURCES
1. Property and energy master planning	• Technology and regulatory framework reviews (e.g., IRENA, REN 21, World Bank RISE 2016) • EEBEA technical guidance documents and knowledge resources • International case studies (Europe, US, Japan)
2. Finance and delivery strategy	• Project preparation grants from IFIs or donors (e.g., Sustainable Energy for Africa, Renewable Energy Performance Platform/REPP, Green MiniGrid Facility)
3. Investment model	• National or regional examples of rural or industrial/large commercial energy generation systems and microgrids
4. Market test	• National or regional renewable energy councils or industry associations • Specialist equity funds • Risk mitigation instruments (e.g., currency hedge, performance guarantees)

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A BEST PRACTICE CASE STUDIES

A1: GREEN MORTGAGES IN MEXICO

There are several activities within the Mexican housing development and finance sector with impact on green building practices, particularly in the middle- and lower-income market segments. The Green Mortgage program of Infonavit is the most well-known of these. Other initiatives by SHF, CONAVI, and individual commercial banks have also added to the results achieved.

Infonavit – also known as the National Workers' Housing Fund (Instituto del Fondo Nacional de la Vivienda para los Trabajadores) was established in 1972. It is a private-sector worker's pension fund. Employers are obligated to make it available to all workers, who make 5% payroll contributions to the Fund. Thus capitalised, it originates mortgage loans directly to contributors without intermediation of banks, financing companies or brokers. It originates approximately 70% of all Mexican mortgages.

CONAVI - National Housing Commission (Comisión Nacional de Vivienda). The housing regulator in Mexico, and source of home buying and mortgage subsidies for low-income Mexicans.

SHF - Sociedad Hipotecaria Federal. A National Credit Corporation which operates as a second tier (wholesale) bank with the mandate to develop the primary and secondary markets for mortgage financing consistent with societal needs (i.e. affordability, security of tenure, etc.). Amongst other functions, it provides project finance to developers and retail credit solutions to potential buyers unaffiliated with Infonavit.

INFONAVIT HIPOTECA VERDE (GREEN MORTGAGE)

Infonavit began a green mortgage pilot project in 2007 to help its borrowers incorporate cost-effective energy efficiency features into their homes. At the end of the pilot in 2011, over 630,000 green mortgage loans had been approved, yielding energy reductions of 30 – 50% compared to homes taking standard Infonavit mortgages. The programme has since become permanent and available nationally to all Infonavit borrowers. Over 1.5 million green mortgages have now been originated.

Hipoteca Verde is structured as generally prescriptive, that is, based on technology and building element options chosen by customers, rather than green building rating or certification based. Homebuyers are granted additional borrowing capacity beyond the standard income and equity ratios to add a 'green mortgage' to finance a range of pre-approved energy, water, and carbon saving features and technologies that can be added to the newly constructed home they intend to purchase[53]. The amount of extra borrowing relates to the borrower's income which is predictive of energy expenditure. A formula is used to scale the amount of the credit they are eligible for to ensure that the borrower's extra repayment does not exceed the energy savings achieved. As lower-income buyers use less energy, they will have less 'income' from energy savings to repay the green mortgage. Thus the amount they are eligible to borrow is smaller compared to a higher-income borrower. The graphic shows this scale, with the third column (Green Mortgage Amount) being the amount of the extra borrowing that is added to the home purchase price/borrowed amount.

These energy saving calculations are validated through modelling and empirical evidence, which is undertaken every 6 months by external experts. The pre-approved technologies include items such as solar hot water systems, LED lighting, roof and wall thermal insulation, double-glazed windows, water saving taps, flow-control valves, and more. Most families realise savings between US$ 15-

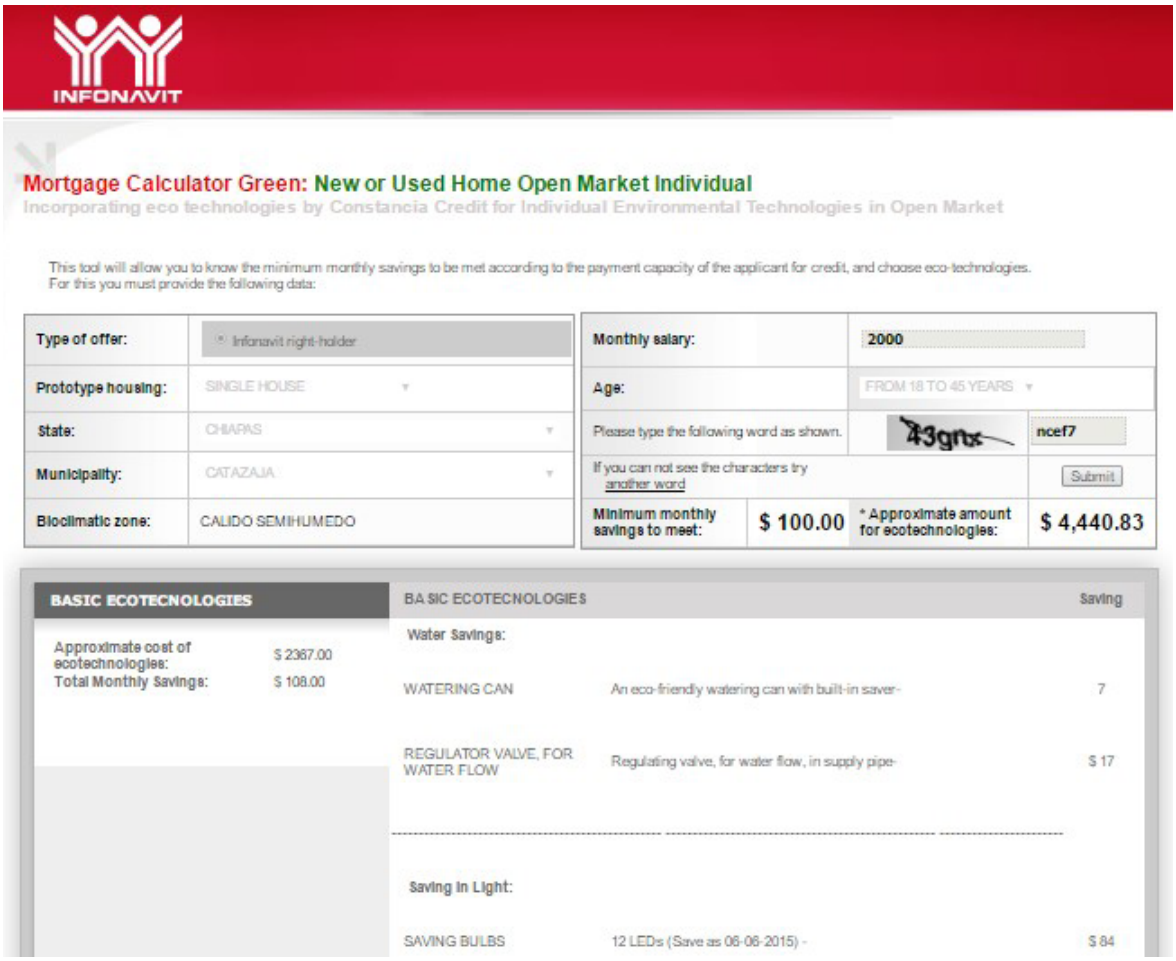
53 *To clarify, it is a single loan taking out by the customer, not two separate loans (i.e., a 'base' mortgage and additional 'green' mortgage).*

FIGURE A1 **MINIMUM SAVINGS AMOUNTS REQUIRED FOR A GREEN MORTGAGE**

Income: Times Minimum Wage (TMW)	Minimum monthly savings amount required	Green Mortgage Amount in TMW	
1.00 - 1.59	US$ 7.4	Up to 2	US$ 302.5
1.60 - 3.99	US$ 15.9	Up to 10	US$ 1,512.3
4.99 - 6.99	US$ 18.5	Up to 10	US$ 1,512.3
7.00 - 11.00	US$ 21.4	Up to 15	US$ 2,268.5
From 11.00	US$ 29.6	Up to 20	US$ 3,024.6

Source: *BSHF Building & Social Housing Foundation (2015)*

FIGURE A2 **SCREENSHOT, GREEN MORTGAGE CALCULATOR**



30 per month, which is the net gain over the additional mortgage payment.

Management and evaluation tools have been developed to support the programme as it has grown. An evaluation system (SISEViVe-Ecocasa is its acronym in Spanish) is used to model and measure the energy performance and environmental impact of green-mortgaged dwellings. It uses co-variates such as location and bio-climatic factors, building type, and usage for measuring energy demand, and water and energy consumption. The approved technology list thus accounts for climate variables so that only technologies appropriate to the location (e.g. need for mechanical heating or cooling) are approved. Infonavit

have also created an on-line green mortgage calculator (refer to Figure A2) so that individual buyers can see the amount of the green mortgage they qualify for and select the applicable technologies based on their location and borrowing capacity.

Infonavit is also responsible for administering subsidies such as downpayment grants that are made available from CONAVI (National Housing Commission) through the National Housing Fund. Interest rates are also below market. Since 2009, all housing receiving CONAVI subsidies must incorporate eco-technologies via Infonavit's green mortgage. Rates start at 4% for CONAVI beneficiaries[54] .

The reach of Infonavit has been a significant factor in the programme's success. With nearly three-quarters of the origination market, it has the leverage to push technology suppliers and developers to lower prices and provide the types of products and technologies it deems needed to meet the green mortgage objectives. At the outset, Infonavit and its industry partners struggled with the lack of standards to regulate the quality and efficiency of the new green products. In response, it worked in partnership with regulatory bodies on appropriate quality standards and auditing protocols, and with the construction sector for training on the correct installation. Awareness-raising initiatives targeting consumers have also featured. This has both built demand for the products and technologies; and also generated better understanding of environmental and financial benefits from green buildings, and post-installation use and maintenance for the efficiency gains to continue.

In creating the programme, Infonavit benefited from donor/IFI support for various project development and management elements such as product and technology assessment, the SISEViVe evaluation system, and sector/supply chain capacity building.

SHF ECOCASA

Ecocasa grew out of a NAMA[55] project to measure the potential of energy efficient/low-carbon housing to cost-effectively meet Mexico's carbon emission reduction targets. The NAMA project designed, built, and assessed three housing prototypes in various Mexico climatic zones: Ecocasa I, Ecocasa II and PassivHaus Level - the latter being the most demanding, based on the German Passivhaus design standard. The Ecocasa Program takes its name from this initial activity

Whereas Infonavit's Hipoteca Verde is based on technology lists, the NAMA concept and subsequent Ecocasa programme is based on whole-house design and performance. This leaves the designer or developer with more flexibility to mix passive approaches and active technologies to meet pre-determined environmental performance metrics – in this case, a minimum 20% GHG reduction from a standard social/low-cost home. Experience internationally shows performance-based systems are more cost-effective than prescriptive/technology-based approaches. Ecocasa will test this for Mexico. It is supported by grants and loans from KfW (German Development Bank) and the Inter-American Development Bank.

Amongst other functions, SHF provides short-term construction finance for Ecocasa projects. Thus the supply of energy-efficient housing is targeted through a 2% interest rate concession to developers[56]. It contracted with five construction companies selected via a tendering process to deliver nearly 28,000 homes in its first phase (end of 2016). The programme includes extensive monitoring during the design, construction, and post-construction stages. Findings from the evaluations show energy bill savings of up to 28%, and an improvement in occupier quality of life and in the thermal comfort to the interior of the homes.

The experience with the programme thus far suggests that most large developers have access to reasonably low-cost credit so the concession is not that meaningful to those companies. Mid-sized developers, however, are more attracted to the concession and the programme has made a point of working with companies of that size. The opportunity to use a green brand/label on marketing the homes has been equally as meaningful to the participants as the concessional loan.

IFI DIRECT INVESTMENT IN LENDERS AND BUILDERS

There are several examples in Mexico where IFI credit has been extended to commercial banks and developers for green property project finance. Examples include:

- An IFC term loan (US$ 22.5 million) to VINTE, a private developer of low- and middle-income housing that builds homes targeting the Infonavit green mortgage market. This focus on green design has resulted in faster sales for VINTE of their units.

- IFC provided the mortgage lender Vertice with a revolving loan equivalent to US$ 25 million. The loan supports mortgage origination activities to people buying homes that incorporate energy efficiency and other green features.

54 *Lower-income borrowers who do not qualify for the CONAVI subsidy may also pay below market interest rates on Infonavit loans. With Infonavit's access to low-cost capital via worker contributions, and through fees and repayment income, high-income borrowers cross-subsidise mortgage rates for lower-income borrower. Rate ranges are from 4-10%.*

55 *Nationally Appropriate Mitigation Actions for greenhouse gas emission reductions, as per the Kyoto Protocol.*

56 *SHF is also arranging end-mortgages for the Ecocasa homebuyers.*

- For the nationwide homebuilder Urbi Desarrollos Urbanos, IFC and the Canadian Government provided low-cost financing of up to US$105 million to build energy efficient homes for low-income people. The goal is for Urbi Desarrollos Urbanos to construct nearly 36,000 affordable green units annually by 2017.

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UNEP (2014). State of Play of Sustainable Building in Latin America. United Nations Environment Programme, Sustainable Buildings and Climate Initiative.

A2: IFC / WORLD BANK: EDGE AND GREEN HOUSING FINANCE TOOLKIT

International Finance Corporation, the private sector lending arm of the World Bank, provides credit for housing production through finance to developers and commercial banks worldwide. To help reduce environmental impact and carbon emissions in its property related activities, IFC have developed its own green building assessment and certification tool called EDGE - Excellence in Design for Greater Efficiencies.

EDGE was launched in 2014. While there are many green building assessment and rating tools in use globally, EDGE offers three significant points of difference from those most commonly used:

1. it has a narrower focus for environmental measurement, with certification based on performance in just three key areas: energy, water, and materials;

2. it was designed specifically for middle-income and emerging market countries; and

3. certification costs and processes are minimised to ensure compatibility with a wide range of market segments, including affordable housing.

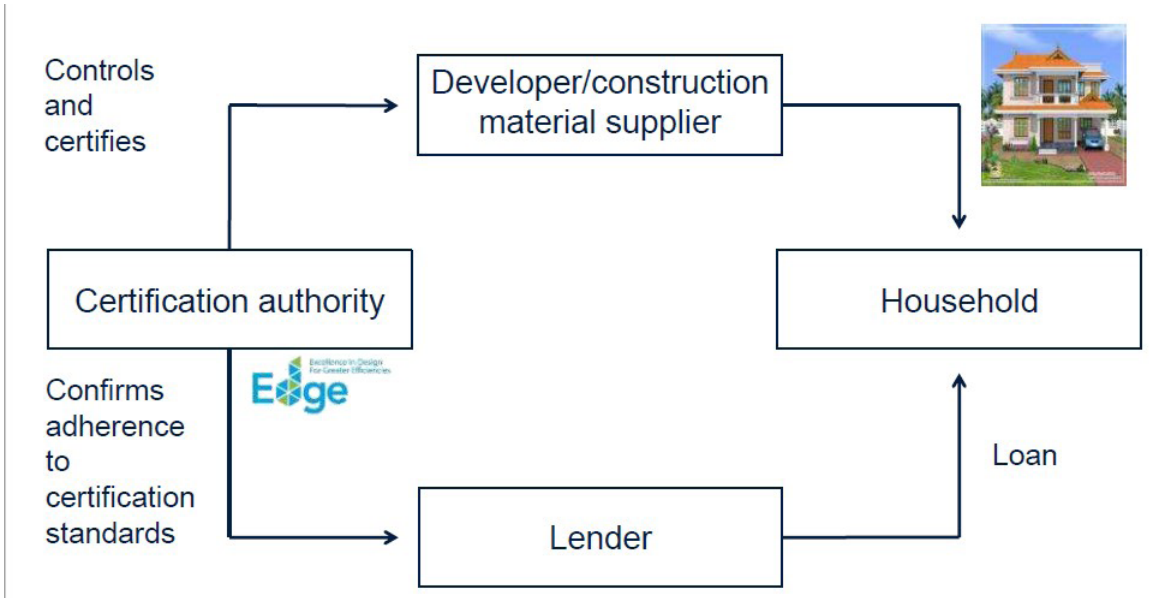
EDGE is a web-based software tool accessible from https://app.edgebuildings.com/#/. The assessment methodology uses the projects' climate conditions, building type, orientation and design, and product and technical specifications to calculate environmental impact. EDGE certification is available to buildings which achieve a 20% improvement over a 'standard' greenfield property in the same location in the three impact categories (energy, water, materials). The tool guides decision-making during the design and construction process and quantifies performance on the basis of lower energy and water consumption, and reduced embodied carbon of materials. It also creates a fast reporting mechanism for primary lenders or developers accessing IFC funds as per conditions of the IFC agreement, as well as for other external purposes, e.g., product marketing and corporate sustainability reporting. Note that certification at the design stage is provisional; a post-construction audit is required to ensure the end result matches the design.

Tying the use of EDGE to loan agreements with individual developers, IFC have the means to push borrowers toward better practices that are cost-effective within the terms of the finance agreement. At a country level, IFC and the EDGE team have developed information sharing and capacity building relationships with institutions that can influence the property design, development, and finance sectors. It has initially focused on a handful of target countries (e.g., Mexico, Viet Nam, Philippines, South Africa, Peru, Colombia, and more), but the tool is available for project-level use anywhere[57] . Formal certification can be secured at a very low cost compared to other green ratings tools (circa US$25 per unit/building), with certification bodies influencing both the finance and production side of the green building process.

For its engagement tool with individual finance institutions, IFC have created a '**Green Housing Finance Toolkit**' which provides a structured approach for developing green mortgage programmes within primary lender organisations. The toolkit combines market assessment for green buildings (supply and demand); product development and marketing support (for

57 *Summary information on individual EDGE projects can be seen at their website: https://www.edgebuildings.com/projects/*

FIGURE A3 **EDGE CERTIFICATION PROCESS**



construction finance or retail mortgages); and interaction and alignment between material and technology suppliers, developers, and lenders. It helps to orient commercial bank processes for more effective risk pricing of loans for green development/green buildings, including through the use of EDGE and development of other materials and manuals for internal training and operations.

SOUTH AFRICA

The **Green Building Council of South Africa (GBCSA),** in collaboration with IFC, has designated EDGE as the standard assessment tool for the South African residential market. GBCSA set a seven-year target to certify 20% of the homes brought to market with EDGE by 2022. EDGE certification has also been linked to programmes for lower cost construction finance. Examples include:

- In late 2015, the commercial bank **Nedbank** and the **Development Bank of Southern Africa (DBSA)** created a concessional rate construction finance fund for development of 400 EDGE certified affordable housing units. It is estimated that occupiers of these units could save R350-450 per month (US$26-33) compared to utility costs in non-certified units. This effectively adds approximately 2-3% to a family's gross monthly income. Nedbank is also providing lower-cost finance to **Valumax Asset Management**, an affordable housing developer with a five-year plan to build 6,000 EDGE compliant rental units in the Johannesburg area.

- **International Housing Solutions (IHS)**, a South African private equity firm that partners with financial institutions, real estate developers, private capital groups, and local government authorities to provide equity finance for affordable housing projects, is presently raising a nearly US$200 million fund (IHS II). A portion of this will be dedicated to green development, supported by low-cost capital from institutions such as KfW and International Finance Corporation (IFC). IHS is presently applying EDGE to the Ravenswood development, consisting of 188 2br units with expected utility savings of R3,200 per unit (US$ 235) annually.

INDIA

Value and Budget Housing Corporation (VHBC) is an Indian property developer established in 2008, with a focus on the affordable and entry level housing market. In 2012, IFC took an US$11 million equity stake in VHBC for a new development in Bangalore, providing long term equity capital which is not readily available for the affordable housing segment. The subsequent development achieved EDGE certification in 2014, and was awarded the "Best Green Building Project" prize at India's 12th National Convention and Real Estate Awards. The project produced savings of 33% (energy), 39% (water), and 23% (material efficiency) as compared to baseline practices for the locality. Key energy savings features included reduced window to wall ratio; reflective paint for external walls; external shading devices; energy-efficient ceiling fans; energy-saving light bulbs in internal spaces, commons areas, and external spaces; and solar hot water collectors. The project also featured use of insulated form construction technology to shorten delivery times as well as improve material efficiency.

PNB Housing Finance Ltd, a division of Punjab National Bank, received a US$75 million investment in 2015 from IFC via a secured fixed/floating rate 5-year corporate bond. The proceeds from the issuance are being used to finance construction of EDGE-certified residential apartments/ buildings. PNB Housing Finance on-lends to housing finance companies who develop the residences.

FIGURE A4 **VAIBHAVA BANGALORE, DEVELOPED BY VHBC.**

Source: *IFC EDGE project database: https://www.edgebuildings.com/projects/vbhc/*

FIGURE A5 **THE TIARRA HOUSES AN AFFORDABLE HOUSING COMMUNITY IN BATAGAS, SOUTH OF METRO MANILA**

Source: *World Bank - Philippines: Shattering the Myths: It's Not Tough to Build Green. 1/29/2015*

PHILIPPINES: IMPERIAL HOMES

Imperial Homes Corporation, a developer of low- and middle-income housing, is presently building the Philippines' first affordable homes fitted with solar panels. The developments of Tierra Premiere and Delsey Homes collectively include 1,000 attached two-story homes with a total floor area of 36 square meters each. Design-stage measurements suggests these homes will reduce consumption of energy by 32%, water by 28%, and embodied energy in materials by 38%. Some units may be net energy exporters on an annual basis.

VIET NAM: NATIONAL HOUSING ORGANISATION

The National Housing Organisation has undertaken EDGE certification of 238 residential units from a 17 story complex near Ho Chi Minh City. The apartment building will not be air conditioned, but rather use improved insulation and high performance glazing to minimise heat gain. The Bank for Investment and Development of Vietnam and the Vietnam International Bank are providing reduced interest rate mortgages with finance up to 85% of the unit price to homebuyers.

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A3: SELO CASA AZUL CAIXA (BRAZIL)

Caixa Econômica Federal (CEF, or CAIXA) is a finance institution of the Brazilian government that provides basic banking services and implements government initiatives in housing finance, urban development, commercial lending, investment fund management, and the handling of social programs and income transfers. In the housing sector, it provides direct finance to property developers and well as mortgages to end-purchasers. It is also an administrator of the Government's Minha Casa Minha Vida (MCMV, or "My House My Life"), a housing development subsidy program for low-income housing production and purchase. For MCMV, CAIXA establishes the design and construction requirements for developers; manages finance subsidies; and in a special programme element, incentivises water solar heater installation by subsidising the cost of the heater.

In 2010, CAIXA created its own voluntary 'green label' assessment and certification scheme for projects it finances called Selo Casa Azul. It is a multi-category rating system for capturing social and environmental attributes of residential developments. While other international green rating systems are used in Brazil, Selo Casa Azul was the first to be designed specifically for that country. It was developed by a multidisciplinary team led by three universities with the goals of reducing natural resource consumption in housing, reducing the cost operating and maintaining the building, and to raise awareness about the benefits of sustainable buildings.

Projects can be scored as Bronze, Silver, or Gold depending on the number of measures taken. There are a possible 53 points available across six categories:

1. Urban quality
2. Thermal comfort
3. Energy efficiency
4. Materials and resources
5. Water efficiency
6. Social practices.

CAIXA does not offer special financing terms or incentives for achieving a Selo Casa Azul rating, though individual concessions from CAIXA to developers may be granted based on intent to secure a green rating, amongst other relationship factors. Developers are however able to promote the projects' sustainability attributes and utilise a public branding scheme for certified projects in order to attract purchasers. There is a small certification and assessment fee associated with the scheme. Certification is channelled through CAIXA's existing network of engineers

FIGURE A6 **SELO CASA AZUL SEALS**

Source: *Shoji, Pereira and Printes (2013)*

who make field visits during construction to check on the status of works. The guidelines state that CAIXA can impose a penalty of 10% of the development value on projects that achieve a provisional (design) certification but that fail to achieve their originally proposed measures.

Take up of the rating has been reasonably low. The CAIXA website lists 10 projects[58] that have received certification, totalling more than 5,000 units. By comparison, Brazil is one of the world leaders in terms of projects certified under LEED (Leadership in Energy and Environmental Design, the tool of the US Green Building Council[59]). There is a difference though in target markets: CAIXA's tool targets lower income housing where developer margins are quite thin, whereas most LEED projects are in the commercial sector and/or designed for the higher end of the property market. It has been suggested that a limitation of the Selo Casa Azul is that too many of the indicators rely on qualitative rather than quantitative measurements. For developers with limited understanding of green building, discerning approaches and providing certification evidence to meet the qualitative measures can be more time-consuming than strictly quantitative measures. The programme has however been credited with raising awareness of green design within the sector generally and placing more emphasis on social considerations in low-income housing production.

Note that another government financial institution - BNDES (Brazilian Development Bank) - provides a low-cost finance line for the construction and renovation of buildings that make use of the Programa Brasileiro de Etiquetagem (Brazilian energy efficiency labelling program, PBE Edifica) as a prerequisite. In order to obtain the funding, new buildings must achieve level A (based on an A-E scale), and renovations level A or B. Reaching the energy efficiency level can be measured/assessed either through specification of prescriptive products and elements, or energy use simulations.

58 *http://www.caixa.gov.br/sustentabilidade/produtos-servicos/selo-casa-azul/Paginas/default.aspx (in Portugese)*

59 *Figures from 2013 cite 680 LEED projects under registration (intent to be formally certified), and 88 certifications in place in Brazil.*

FIGURE A7 **PARAISÓPOLIS, SAO PAOLO**

These 171 low income housing units were the first in Sao Paolo to obtain the Selo Casa Azul seal, achieving Gold certification. Delivering the Gold project required only a 1% increase in construction costs.

Source: *Shoji, Pereira and Printes (2013); UNEP (2014)*

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Bezerra and Oliveira (2014). An Overview of Energy Efficiency and Sustainable Construction Certifications and Labels in Brazil and Rio de Janeiro. 14ª Conferência Internacional da LARES Edifício Manchete, Rio de Janeiro - Brasil 18, 19 e 20 de Setembro de 2014.

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A4: NATIONAL HOUSING BANK (NHB) OF INDIA - ENEFF: RESBUILD

NHB, a wholly owned subsidiary of the Reserve Bank of India, is a dedicated finance institution established for increasing credit to the Indian housing sector. Amongst other functions, it provides wholesale finance to retail lenders, has created a secondary market for mortgage backed securities, channels finance from special government initiatives, and acts as a sector regulator.

The German development bank KfW signed a collaborative agreement with NHB in 2010 for finance and capacity development for green middle-class housing in India. A credit line of 50 EUR million was extended to NHB (blended from concessional and standard credit KfW windows) for re-financing energy efficient housing loans; along with a 1.5 EUR million grant to provide technical assistance for energy efficiency certification and labelling, and for marketing and training of key actors such as housing developers, energy auditors, and housing finance institutions. Capacity support is provided through the German Fraunhofer Institute and Indian The Energy and Research Institute (TERI).

For labelling and certification, an existing tool of the Fraunhofer Institute that provides energy simulation and calculates savings from baseline conditions was adapted for the local context (building typologies and design elements, climatic conditions, etc.). The tool, EnEff ResBuild India, calculates prospective energy consumption based on

- Building architecture (orientation and shading)
- Thermo-physical properties of building materials (heat ingress or retention of conditioned air)
- Lighting load (energy consumed from lamps and fixtures; daylighting features)
- HVAC system efficiency (energy consumed for space cooling)
- Hot water system (heating efficiency and energy saved from solar hot water systems)

Savings are calculated against a reference case building. The KfW finance agreement requires that buildings achieve a 30% energy reduction. The programme is structured so that interested developers receive technical advice on proposed designs and assistance with meeting the energy reduction target. Once projects are completed and assessment against the design parameters is confirmed, a certificate is issued to the developer. Buyers of individual units can then access the lower-cost finance via the KfW/NHB credit facility (on-lent to the mortgage originator). Over 20,000 units have been certified.

SOURCES:

Fraunhofer IBP Press Release 5.10.2012: Fraunhofer IBP Energy Performance Software Encourages Construction of Energy Efficient Buildings in India. Retrieved 05 August 2016 from https://www.ibp.fraunhofer.de/en/Press/Press_releases/pm-05-10--energy-efficient-buildings-india.html

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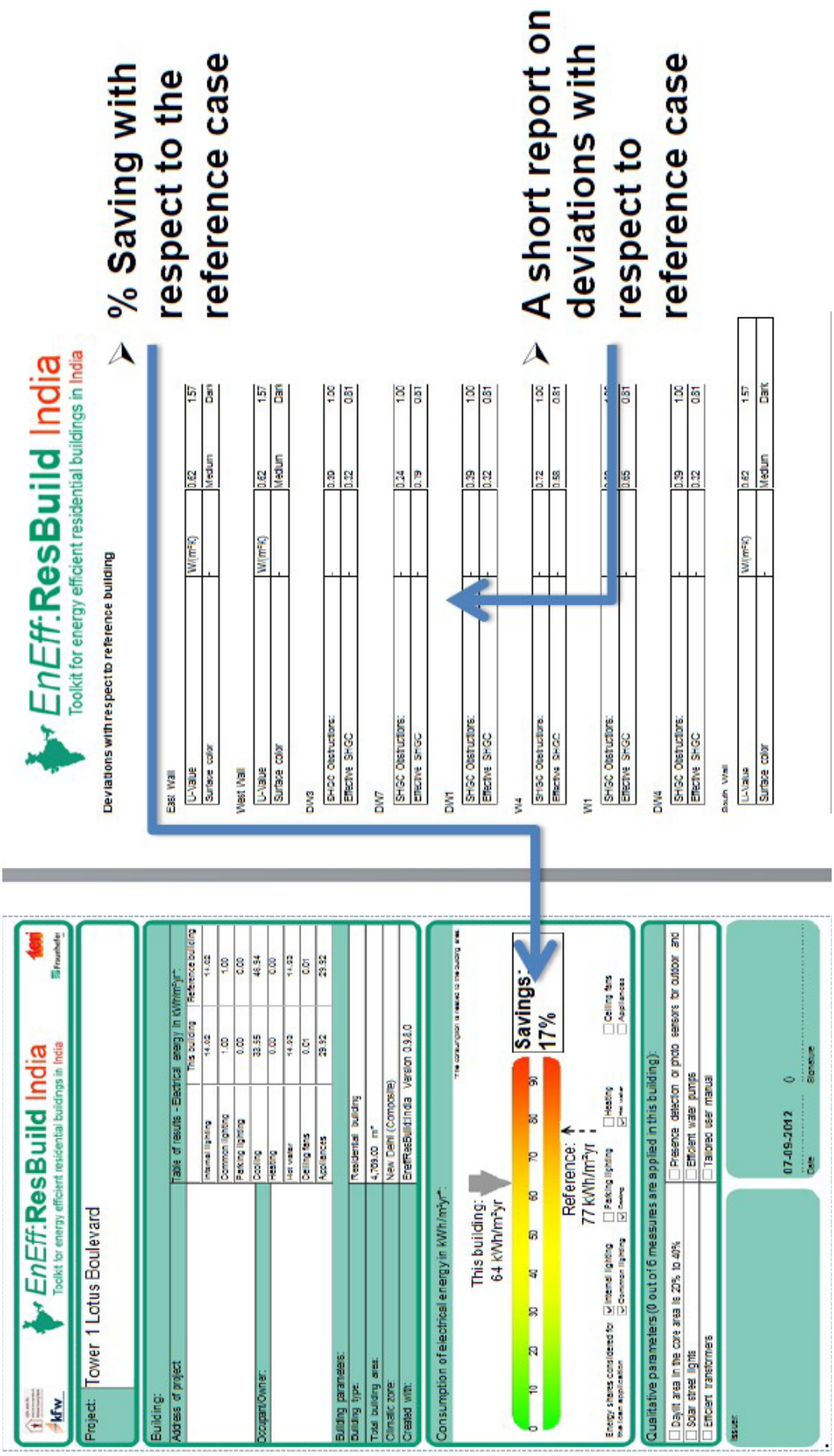
The Energy & Resources Institute (TERI).Report on Validation of Assessment tool: "IT Toolkit EnEff ResBuild India" 2012. Retrieved 14 February 2017 from http://www.ittoolkitindia.com/index.php/downloads

Workshop Summary Report Preview of Residential Energy Efficiency Assessment Tool KfW-NHB, Promotional Programme of Energy Efficiency in New Housing in India Workshop event 15th March, 2011. Retrieved 14 February 2017 from http://www.ittoolkitindia.com/index.php/downloads

FIGURE A8 **EnEff:ResBuild simulation report**



Source: *IT Toolkit EnEff ResBuild India, Fraunhofer IBP (http://www.ittoolkitindia.com)*

A5: EUROPEAN MORTGAGE FEDERATION ENERGY EFFICIENCY RE-FINANCE

A finance sector initiative for developing standardised energy efficient mortgage products across Europe was launched in late 2016. It is being led by the trade body European Mortgage Federation and involves 13 participating banks. Additional partners involved in project development and marketing, and in energy and loan performance data capture and assessment during the two-year pilot, are the Ca'Foscari University of Venice, RICS (Royal Institute of Chartered Surveyors), European Regional Network of Green Building Councils, E.ON (energy utility) and SAFE Goethe University Frankfurt. The pilot is providing preferential interest rates to borrowers purchasing very energy efficient new homes, or undertaking energy efficiency renovations of existing homes at the time of purchase. For retrofits, banks will offer homeowners additional funds on top of the purchase price for efficiency improvements (bundled to a single loan). Once the renovations are complete in line with an initial efficiency audit, the lower interest rate will be applied to the loan.

The mortgage concession is geared to standardised home energy ratings in the European Union, with labelling bands from A – H. The interest rate discount will be determined on a progressive scale, aiming to incentivise more significant improvements in properties from the D to A rating bands. The consumer would receive a larger percentage discount (Energy Rating A = 100% of potential discount) the further they move their property up in terms of energy rating.

A further intent of the pilot is to determine tangible differences in asset quality between higher and lower energy rated properties. Research in Europe and North America suggests that green properties create a value premium to owners and that default rates are lower for mortgagees of green properties. The pilot will test if energy efficiency mortgages reduce the risk of holding assets with banks' portfolios. A positive correlation will result in lower capital charges against these assets, freeing up capital for other investments.

SOURCES:

Bloomberg: Cheaper European Mortgages on Tap to Energy-Efficient Homes, September 20, 2016. Retrieved 22 September 2016 from: https://www.bloomberg.com/news/articles/2016-09-20/cheaper-european-mortgages-on-tap-to-energy-efficient-homeowners

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- EMF-ECBC Energy Efficient Mortgages Initiative: http://ecbc.hypo.org/Content/Default.asp?PageID=613
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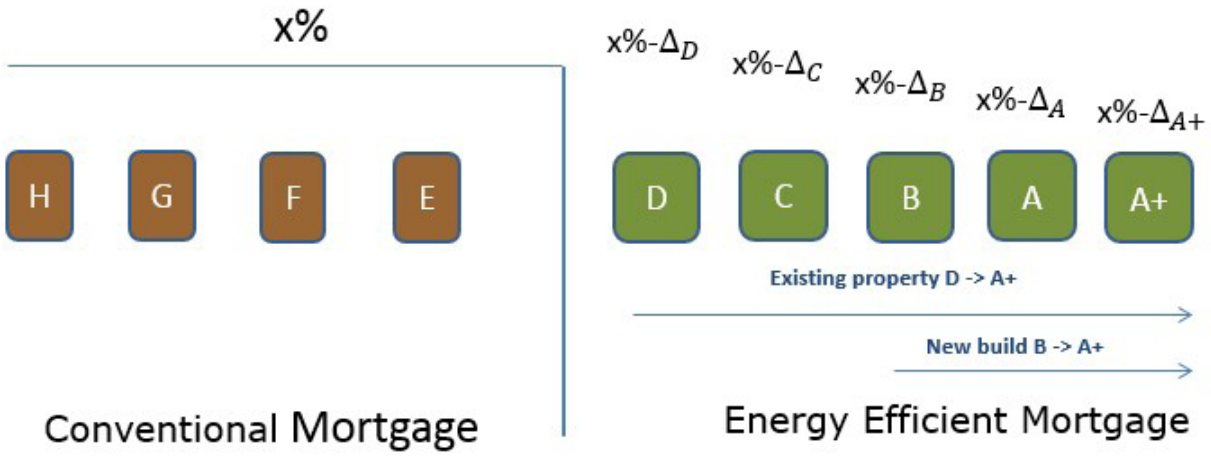
FIGURE A9 **RELATIONSHIP BETWEEN THE HOME ENERGY RATING AND PREFERENTIAL INTEREST RATE**



Source: *European Mortgage Federation (2016)*

A6: KFW ENERGY EFFICIENCY MORTGAGE (GERMANY)

KfW is the development bank of Germany. Parts of its national mandate include providing housing finance, and credit for projects and initiatives that reduce carbon emissions. To promote energy efficient housing that exceeds German building code requirements, KfW lends a portion of the total mortgage amount at a preferential rate for purchase of new build or existing housing. Exceeding the already stringent standard codes typically requires the use of renewable energy and additional insulation. It is this added cost compared to a code-compliant house that the interest rate subsidy targets. Loans of 100,000 EUR per housing unit are available at lower than commercial interest rates. The concession can be scaled so that the better the energy standard, the more favourable the terms.

The loan is organised through the primary lender so that the borrower is taking a single loan for the property. The borrower sees a single blended rate that combines the lower interest KfW portion with the larger commercial bank portion. Loan servicing rests with the primary lender. Loan underwriting utilises an energy performance assessment tool developed by KfW[60].

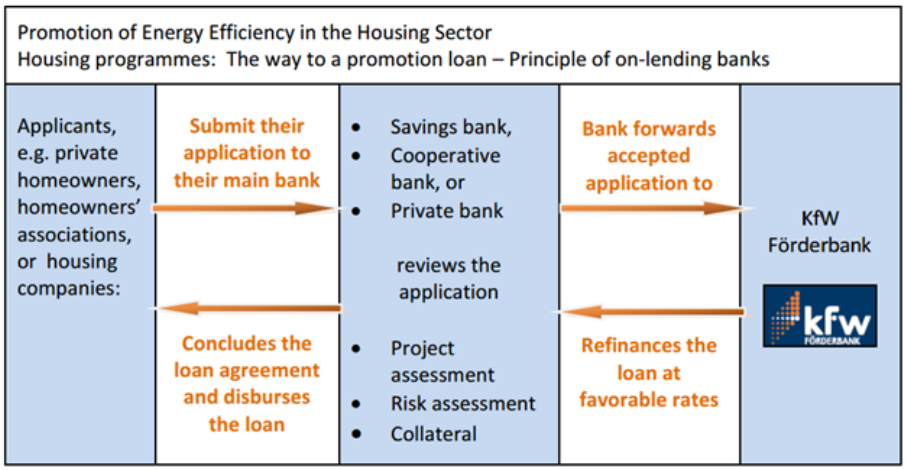
SOURCES:

Hermes, S (2011). Promoting Energy Efficiency in Residential Buildings. Presentation from the Preview-Workshop on Residential Energy Efficiency Evaluation Tool Developed by Fraunhofer IBP and TERI, New Delhi, Mar 15, 2011
KfW: Energy-efficient Construction and Home Ownership - https://www.kfw.de/inlandsfoerderung/Privatpersonen/Neubau/index-2.html

Schröder, M, Ekins, P, Power, A, Zulauf, M, Lowe, R (2011). The KfW Experience in the Reduction of Energy Use in and CO2 Emissions from Buildings: Operation, Impacts and Lessons for the UK. UCL Energy Institute and LSE Housing and Communities.

60 *This same tool was adapted for use in India. See the NHB case study above.*

FIGURE A10 **KFW ENERGY EFFICIENCY LOAN STRUCTURE**



A7: FANNIE MAE – GREEN SECONDARY MORTGAGE MARKET (US)

The Federal National Mortgage Association (known as Fannie Mae), is a listed company with US Government guarantee. Its purpose is to expand the secondary mortgage market by securitising mortgages via mortgage-backed securities (MBS). The securitisation proceeds are returned to primary lenders who can then reinvest in new mortgage origination. Fannie Mae (along with a handful of additional secondary market participants also backed by government guarantee) effectively create standard underwriting practices, as loans compliant with secondary market guidelines create liquidity for primary lenders. Fannie Mae is the most active secondary company in green finance, principally for multifamily properties.

MULTIFAMILY GREEN MORTGAGE

Fannie Mae is the largest secondary buyer of multifamily residential mortgages in the US. The typical loan it purchases are long tenor permanent finance such as a 10/9.5 mortgage loan (i.e., loans with a 10 year loan term and a 9.5 year prepayment premium term). Over the past five years, Fannie Mae have developed a number of specific green finance and refinance products to incentivise developers to produce and owners to retrofit green residential rental units. The primary incentive is access to a lower interest rate – up to 39 basis points - for buildings with a recognised green building certification. For retrofit/ refinance properties, Fannie Mae will cover the cost of an energy and water audit to determine savings potential and investment need. Extra finance can then be extended to cover the retrofit costs, provided the savings exceed the investment on a life cycle basis[61] . (See summary sheet overleaf for individual products.) Loans from these green multifamily programmes are purchased and securitised as Green MBSs, the first of which was issued in 2012. Cumulative issuances are in the tens of billions of dollars.

Lessons learned from the Fannie Mae's experience are that market uptake requires capacity building with primary lenders so that the underwriting process is well understood and that the value of the product can be clearly explained to potential borrowers. This effort needs to be sustained over years. In Fannie Mae's case, this sustained capacity effort has led to green loans becoming approximately 5-7% of its total multifamily book.

HOMESTYLE ENERGY MORTGAGE

In the single-family market, Fannie Mae targets both cash-out refinancing and the purchase of existing homes. For existing owners, Fannie Mae has found that energy efficiency improvements are unlikely to be made unless the owner is considering an equity release for other purposes. There are circumstances however where the owner has already financed an efficiency improvement but at a higher cost – for example, emergency repairs paid for with unsecured personal finance products that require little or no underwriting lead time. Thus its HomeStyle product was designed for either:

- paying off higher-interest energy improvement debt, including PACE (Property Assessed Clean Energy) loans (see later case study appendix for information on PACE);
- financing up to 15% of the as-completed appraised property value of a home, based on corresponding energy audit and assessment report; or
- financing up to US$3,500 in simple weatherisation (e.g., draught-proofing) or water-efficient improvements with no energy report.

HomeStyle was not designed to stretch borrower's debt to income ratios based on the derived income gain (energy and utility savings) nor address asset value readjusted for a property's green features. Rather, it is mean to ensure that there are no overt credit constraints such as high-cost borrowing or lack of mainstream products to owners seeking to integrate efficiency improvements to their mortgage. For borrowers, HomeStyle's primary advantage is the 15% cash-out provision (standard Fannie Mae refinance products allow for a 10% cash-out only), and the ease of the no-audit weatherisation finance for smaller investments. For primary lenders, Fannie Mae has reduced the fees it charges to mortgage originators for loans on-sold to Fannie Mae as an incentive to promote the green finance.

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61 *As per Fannie Mae guidelines, 50% of the projected savings as determined through the efficiency audit can be applied to the capital finance.*

FIGURE A11 **SUMMARY OF FANNIE MAE MULTIFAMILY GREEN FINANCE PRODUCTS**

Fannie Mae Multifamily Green Financing Products

	Green Rewards	Green Building Certification Pricing Break	Green Preservation Plus
Ideal fit	Existing properties ready to make energy- and water-saving improvements	New construction or existing properties awarded a green building certification	Existing properties ready to make energy- and water-saving improvements
Loan type	Refinance, acquisition, supplemental, and 2nd supplemental	Refinance, acquisition, and supplemental	Refinance and acquisition, Multifamily Affordable Housing only
Interest Rate and Rate Lock	Fixed-rate with Streamlined or Early Rate Lock option, or variable-rate	Fixed-rate with Streamlined or Early Rate Lock option, or variable-rate	Fixed-rate only
Energy and water audit report cost	100% paid by Fannie Mae	N/A	100% paid by Fannie Mae
Pricing incentive	Lower interest rate	Lower interest rate	Lower interest rate
Additional loan proceeds	Up to 5% more than standard DUS Loan; underwrite 75% of owner and 25% of tenant projected cost savings	Standard DUS	Up to 5% more than standard DUS Loan
Minimum projected consumption reduction	20% energy or 20% water consumption	None	None
Minimum green improvement budget	None	None	At least 5% of loan proceeds
Maximum LTV	Standard DUS	Standard DUS	Up to 85%
DSCR	Standard DUS	Standard DUS	1.15x
Documentation requirements	Energy and water audit report	Current, Fannie Mae-recognized green building certification	Energy and water audit report; Pest Management Report

Source: *https://www.fanniemae.com/content/fact_sheet/competitive-advantage-green-financing.pdf*

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A8: GREEN MULTIFAMILY AFFORDABLE HOUSING (US)

ENTERPRISE GREEN COMMUNITIES

Enterprise is a not-for-profit lender/investor, developer, advisory, and policy advocacy organisation for the production and maintenance of affordable housing in the United States. The Enterprise Green Communities initiative was launched in 2004 as a means to coordinate technical advice, access to government grants, and investment for green and efficient affordable housing. Enterprise subsequently developed its own green assessment and certification scheme – Enterprise Green Communities. It is a voluntary initiative; Enterprise provides technical support as well as equity investments in projects that meet the criteria.

The Green Communities framework is suitable for new construction, and substantial to moderate rehabilitation (renovation) in both multifamily and single-family projects. It is a multi-criteria tool, based on achievements in the following eight categories:

1. Integrative Design
2. Location + Neighborhood Fabric
3. Site Improvements
4. Water Conservation
5. Energy Efficiency
6. Materials
7. Healthy Living Environment
8. Operations, Maintenance, and Resident Engagement

More than just environmental performance of buildings, the criteria create a significant emphasis on location and amenity considerations to ensure that properties have access to transit and/or are in walkable areas, provide supportive services to residents, and add to community stability and social wellbeing.

Enterprise offers early stage design support to ensure that no- and low-cost interventions are integrated into site planning and building design. Certification requires that project proponents submit both pre- and post-construction assessment information. Enterprise reports that since 2004, 38,000 housing units have been delivered against the Green Communities criteria at an investment value in excess of US$2 billion.

Enterprise has over several years provided cost and specification guidance to developers to facilitate the application of Green Communities. Most recently in 2015, Enterprise published an incremental cost guide for the Green Communities framework. While not providing a costs and benefits assessment, it does offer guidance on cost differences, if any, to move from code compliant design to meeting the Green Communities criteria. This is presented under the scoring criteria in each of the eight improvement categories.

COMMUNITY PRESERVATION CORPORATION GREEN FINANCE INITIATIVE

Community Preservation Corporation (CPC) is a not-for-profit lender to developers of affordable housing projects. It pools capital from multiple commercial bank and institutional investment sources for both construction and permanent finance. In 2009, it launched its Green Finance Initiative, designed to extend additional funds to borrowers to address energy and efficiency in their buildings. The initiative has been backed by several investors.

A typical CPC Green Finance project is either for a substantial renovation or new construction. Many projects involve government subsidies (such as tax abatements for the preservation or new provision of affordable units) and are required to integrate resource efficiency measures as a policy condition. Others are compelled by CPC to consider and implement green features. There is no preferential lending involved at present, though CPC does provide advice and support to borrowers that help in keeping soft costs equal between green and non-green projects. CPC estimates that about 20% of its portfolio is tied to green finance properties.

To access the additional financing for the efficiency upgrades, energy modelling is done for new construction and energy audits for refurbishments. The additional borrowing is bundled within the underlying mortgage and based on the cost-effective energy and water efficiency measures, that is, net value of savings over added repayment. CPC typically factors that 50% of the predicted energy savings from its audits and modelling will be realised and can be used in finance decisions.

The Green Finance Initiative includes an additional energy audit one year after the retrofits are completed, and long-term monitoring of heating fuel, electrical, and water usage. Monitoring post-retrofit energy usage and pooling this data has in fact lagged since the initiative was introduced. Improving this monitoring has been recently prioritised. It is hoped that as data quality and management improves, it will offer a more accurate evidence base for predictive savings.

SOURCES:

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Enterprise

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http://sustainablecommunitiesleadershipacademy.org/resource_files/documents/new-york-green-finance-case-study.pdf

A9: LOCAL ENERGY SUPPLY: GARDEN CITY, NAIROBI

Garden City is a mixed-use residential and retail complex in Nairobi. The first phase of the master plan is complete with full build-out construction underway. Totals for the master plan are 400 residences, a shopping mall, 600,000 square feet of office space, business hotel, medical centre, and three acre central park on 32 acres of total land. Development value is expected to exceed US$500 million.

Garden City is an example of collaboration between a third-party energy asset developer and property developer for localised energy. In such a model, the property owner creates space for the energy assets and purchases the energy generated, with the energy system developed and owned by a third-party entity. The power purchase agreement (PPA) between the parties enables the energy developer to secure the project finance.

The project developer and owner, Actis, was seeking to improve the security of the energy supply, achieve a LEED[62] Gold or Silver rating for the project, and to shade the carpark area. This combination of needs led to the delivery of an 850 kW solar electric array mounted on a car shading structure. The owners of Garden City entered into a PPA at a commercially attractive rate with the energy developer NVI Energy. The power generated is sold to retail tenants as part of their service charge within the lease. There is a 12 year build/maintain agreement between Garden City and NVI Energy, and after 10 years energy system ownership transfers to the property. The installation is a PV-diesel hybrid system, designed so that the PV supply is drawn first as the cheapest electricity source, followed by grid electricity, and then back-up diesel as needed during times of grid interruption.

62 *LEED (Leadership in Energy and Environmental Design) the green building rating system of the US Green Building Council and used globally.*

The Garden City property developer (a private equity fund) is also the long-term owner of the property. This was a factor in securing finance against the PPA agreement. Given the long-term alignment between the parties starting at the design stage meant that the risk of non-payment was considered low. The energy finance is also private equity financed from sources targeting renewable energy investments. There are limited finance options for distributed energy systems in this market, thus the cost of capital is high by international standards. Even so, the economics line up given the high retail electricity rates, good solar insolation, and predictable power output.

SOURCES:

Actis: interview with Mike Kingshott, May 2015

Africa Property News: Garden City Mall to provide solar panel covered car park canopy, 2014-07-28. Retrieved 17 February 2017 from: http://www.africapropertynews.com/east-africa/3038-garden-city-mall-to-provide-solar-panel-covered-car-park-canopy.html

NVI Energy: interview with James Irons, May 2015

SolarCentury: Garden City – Africa's largest solar car port system. Retrieved 16 February 2017 from: http://www.solarcentury.com/ke/case-studies/garden-city-africas-largest-solar-car-port-system/

FIGURE A12 **GARDEN CITY MALL AND SOLAR CARPORT**

Source: *Garden City (http://gardencity-nairobi.com/mall/) and Solar Century https://www.solarcentury.com/garden-city-solar-carport-launch/*

A10: KINGS CROSS DISTRICT ENERGY SYSTEM AND LOCAL AREA UTILITY (UK)

King's Cross is being built on a 67-acre (27 hectare) piece of inner-city land in central London, behind the Kings Cross and St Pancras train stations. In 2008, a property developer – Argent - and the two major landowners formed a joint partnership called the Kings Cross Central Limited Partnership (KCCLP). The partnership is now the single land owner at King's Cross. The development, which is intended for completion in 2020, has been funded through a combination of equity, senior debt, and recycled development receipts. The build-out plan for Kings Cross includes:

- 50 new buildings with 4 million square feet of retail and office space, and 2,000 homes
- 20 new streets
- 10 new public squares
- 26 acres of landscaping and open space (1/3 of the total site area)
- Total anticipated development cost of £3 billion

As part of the Partnership's focus on energy efficiency, a local area utility was created for power supply, water supply, and telecommunications. The core of the system is a central combined heat and power (CHP) plant that generates electricity for the area's common uses and heat to provide thermal and water heating across 99% of the development. Each building's connection to the CHP dispenses with the need for boilers in the buildings themselves and results in an energy bill reduction of circa 5%. The central plant will eventually be sized/powered by three gas-powered engines. In total the CHP will offset about 80% of the scheme's power demand. Solar panels, ground-source heat pumps, and solar thermal systems are also being used to meet a 50% reduction in carbon emissions, relative to the average levels in the surrounding area.

The KCCLP, in partnership with an engineering services company called Metropolitan, created an ESCO (energy services company) to operate the network, provide thermal energy to tenants and electricity for the development area management (excess electricity is sold to the grid), organise and manage billing, etc. This entity is known as Metropolitan Kings Cross (MKC). While the property developers have a significant equity stake in the ESCO, they cede operations and management functions to it. The structure of the partnership and operations is shown in the Figure A14 below.

The Energy Centre which houses the system's boilers and thermal stores is co-located in a structure with housing, retail, and car parking. From the developer's perspective, the energy installation had a minimal impact on land-take and could be integrated easily with other more productive land uses.

According to members of the KCCLP management team, developing an ESCO and providing utility services was not part of the initial master plan. This approach was added in the course of securing planning approvals. This integrated energy and property approach was a departure for the principals and required effort to implement beyond what is typical for land and property projects of

FIGURE A13 **KINGS CROSS DEVELOPMENT AREA, CENTRAL LONDON**

Source: *Argent*

this size. Managing the legal structure and regulatory considerations as an energy and utility supplier; phasing the local energy system delivery within the property build-out; and ensuring supply security to occupants are some of the new challenges they faced. But there have been several benefits, including a positive return on equity invested, accelerated planning approval for the overall master plan, and marketing advantages. In terms of ongoing operations, the local energy/utility system creates better control over the delivery of services and is a means to stay engaged with tenants. With an ability to capture information on energy usage and other utility consumption, the ESCO can also offer additional services to customers such as carbon reporting or advice on minimising consumption.

SOURCES:

Argent (2015) Sustainability: Strategies for Public realm & Energy. Study tour presentation, September 2015

Urban Land Institute: ULI Case Studies – Kings Cross. Retrieved 15 February 2017 from: http://casestudies.uli.org/kings-cross/

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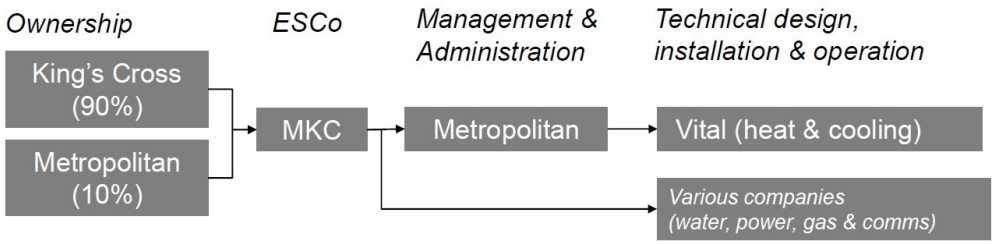
FIGURE A14 **KINGS CROSS LOCAL UTILITY NETWORK STRUCTURE**



Source: *Argent*

Key: Metropolitan – a provider of district heating systems and equity partner; Vital – engineering and construction contractor

A11: RABOBANK GROEP OBVION NV GREEN BOND (NETHERLANDS)

Green bonds are a new class of investment instruments and sit within the existing national, subnational, and institutional/corporate bond market. Capital raised from green bonds is designated for investments in sustainable projects or assets. As with standard bonds, issuances can be tied to general revenue, or specific income or asset backed revenues.

Rabobank Groep Obvion is a Dutch mortgage lender. It has a solid history of issuing mortgage-backed notes to investors, typically with five year maturities. The green bond will be a subset of its current STORM bond programme, with properties segregated based on the home energy rating. It was floated in middle 2016 and raised EUR 500 million. The bond was more than 2x oversubscribed, demonstrating the market demand for green securities. It was the world's first green residential mortgage backed issuance.

The proceeds were used to refinance 2,500 existing mortgage loans originated and serviced by Groep Obvion. The portfolio of securitised assets is comprised of 39 month loans for properties in the top 15% of the Dutch residential mortgage market in terms of energy efficiency, or those that have shown at least a 30% improvement in energy efficiency from time of initial purchase. The portfolio has a weighted average (WA) original loan to market value (OLTMV) of 90.3% and a WA debt to income ratio of 27.9%.

As the Green Bond market is still in its early stages, there is a lack of standardisation or globally agreed definition of what makes a bond green and rules that should apply to its issuance. There are, however, several voluntary standards and guidelines from various national bank, capital market regulators, and NGOs which is leading toward a set of commonly agreed principles. For this transaction, the bond was certified under one of these - the Climate Bond Standard from a leading NGO in this market space, the Climate Bonds Initiative (CBI). Obvion also engaged a services consultancy to provide a third-party assurance to review the sustainability criteria and provide investors fuller information on the green label.

SOURCES:

AEGON: 50 Shades of green: Investments the market is hungry for, 01/08/2016. Retrieved 01 August 2016 from: https://www.aegon.com/en/Home/Investors/News-releases/2016/50-Shades-of-green-Investments/

Bloomberg: Rabobank's Obvion Plans First Green Home Mortgage Backed Bonds, May 23 2016. Retrieved 02 August 2016 from: https://www.bloomberg.com/news/articles/2016-05-23/rabobank-s-obvion-plans-first-green-home-mortgage-backed-bonds

Fitchs Ratings: Fitch Assigns GREEN STORM 2016 B.V.'s Notes Final Ratings, 30 JUN 2016. Retrieved 01 August 2016 from: https://www.fitchratings.com/site/pr/1008248

Obvion: Obvion N.V. Issues EUR 500m Green STORM 2016 RMBS to finance energy efficient housing, 10 June 2016. Retrieved 01 August from: https://www.kfw.de/nachhaltigkeit/PDF/Nachhaltiges-Investment/Press-Release-Green-Storm.pdf

Sustainalytics (2016). Green Storm 2016 – Obvion: Framework Overview and Second-Party Review by Sustainalytics. May 2016.

A12: PACE ENERGY EFFICIENCY FINANCING (US)

Property Assessed Clean Energy financing (PACE), developed in the US, is a mechanism where a loan for energy efficiency upgrades is tied to the property rather than the borrower. It was designed to address one of the key barriers to motivating property owners to invest in energy efficiency: the probability of remaining at the premises for a time longer than the payback period. In PACE transactions, 100% financing is made available, and the value of the energy efficiency loan is shifted to a tax lien on the property. The repayment, captured through a tax assessment, is then spread over a long time frame (circa 10 – 20 years). If the property owner sells the property while the assessment is still being repaid, the lien remains with the property and is transferred to the new owner. For lenders, the assessment of whether to finance a project is thus more closely tied to the improved value of the property rather than just the credit worthiness of the initial borrower. PACE is suited to both residential and commercial properties.

PACE is structured to take advantage of several market characteristics.

1. Property tax regimes in the US are well established and repayments via tax obligations are considered very low risk. Wholesale capital costs to fund loan programmes are low as a result.

2. Because PACE liens are tax-based, they take a senior position to underlying mortgage loans which further reduce the repayment risk and keep capital costs low. (All PACE programmes require state or local enabling legislation for tax liens of this nature.)

3. PACE programmes can draw from multiple public and private capital sources. Because property taxes are assessed and retained locally in the US, some PACE programmes are capitalised through municipal bond issuances. Others rely on finance pools from utility programmes or private investors wholly.

4. Because of the long tenor of the lien/repayment obligation, PACE is suited to a range of cost-effective but longer payback efficiency measures such as thermal fabric improvements and on-site renewable energy generation.

While PACE has increased finance flows to energy efficiency improvements, it has not been free of obstacles. The fact that the tax lien takes first position ahead of the mortgage loan has been flagged by the secondary residential mortgage agencies in the US. There is concern that loans previously sold to the secondary market that take on PACE financing will affect the borrowers repayment ability and put the underlying mortgage at risk. Secondary buyers have barred purchase of primary home loans for properties with a PACE tax lien unless the senior status of the mortgage loan is maintained. To address this, secondary lenders have developed refinance products for mortgagees to retire the PACE debt and fold the cost of the energy efficiency improvements into the refinanced primary mortgage (refer to the above summary of the Fannie Mae HomeStyle Energy Mortgage). Some homeowners have additionally found that selling a home with a PACE lien limits the pool of potential buyers and increases transaction time.

The long-term and predictable nature of the tax lien repayment makes PACE loans attractive for securitisation. Cumulative securitisation value of residential PACE loans exceeds US$1.5 billion. Total loan value of commercial and residential PACE loans issued since 2009 is nearly US$3 billion.

SOURCES:

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B CONSULTEES

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Prashant Kapoor	Principal Industry Specialist, Climate Change Department	IFC / International Finance Corporation
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Luca Bertolot	Secretary General	EMF-ECBC (European Mortgage Federation / European Covered Bond Council)

C FINANCE MODELS DATA POINTS

MODEL: SHORT-TERM CONSTRUCTION/ PROJECT FINANCE (CHAPTER 6.1)

The model requires input data on project development costs and unit sale prices. The model is based on several data points drawn from publicly available sources:

- July, 2016 Average multi-unit high-rise construction costs (US$ / m2, excludes land, site works, and professional fees) in Nairobi (US$660), Kigali (US$1,037), Dar es Salaam (US$716), and Kampala (US$739) (AECOM 2016).
- Figures for Kenya residential building costs per square meter in 2016 are US$490, US$510, and US$670 for Individual detached or terrace style house, townhouses, and apartments low-rise (all medium standard), respectively. Figures are hard construction costs only (Turner & Townsend 2016).
- 2015 property conference presentation in Nairobi, hosted by McKinsey, stating costs of US$700-800 per m^2 to build moderate cost housing in sub-Saharan Africa (Realopedia 2015).
- Kenya (unweighted) average constructions costs ranging from US$347 – 523 per m^2 for low-cost to high-cost low- and high-rise housing. These are 2011 figures and exclude site works (AfDB 2013).
- Cost of construction in Kenya are 15,000-33,000 KSh/ sq.m. (circa US$200-400 per m^2 – 2012 prices). Costs are for building only including basic finishes, but excluding site-wide works and infrastructure. (The source notes that figures are anecdotal based on stakeholder discussions). (Kalra and Bonner 2012).
- Costs for medium to high-specification/material units targeting low and middle income occupants in Kigali range from US$210-620 per m^2 (assumed at 2011 prices but present exchange rate) (EuropeAid 2012).
- The construction cost for Kigali homes built of formal materials per the building code ranges between US$450-US$600/m^2. Developer profit margins range between less than 10 to 30% (World Bank 2012).
- Estimated ratio of cost of building construction to cost of on-site infrastructure and land to profit margins is in the region of 2.5:1:1 for a typical 50 m2 dwelling costing 3.5 - 4.5 million KSh (US$44,000 – 56,000, 2011 prices) (ibid)
- Formal housing development cost structure: 60% materials; 10% each for land, infrastructure, and professional fees; 5% each for contingencies and finance costs (AfDB 2013).
- The average asking price of all mid to upper class properties offered for sale in Kenya, based on 1-3 bedroom units as of 3Q 2016 (8,000,000 – 9,000,000 KES / US$77,000 – 86,000) (Hass Consult 2016)
- 2013 off-plan 1 and 2 bedroom sales prices of 90,000 and 108,000, respectively, for a Nairobi 48 unit development (AfDB 2013, based on Shelter Afrique data and interviews).

MODEL: GREEN HOMEBUYER MORTGAGE (CHAPTER 6.2)

The model requires input data on household energy consumption, translated to annual energy expenditure for all sources.

For the low-cost housing model, individual studies assessing household energy consumption from Uganda, Tanzania, and Rwanda were reviewed. These were cross-referenced against figures from the EEBEA energy audit report for housing in Kenya, Tanzania, and Uganda.

- Data in Uganda was drawn from 79 household energy assessments. It shows monthly electric consumption ranging from 7 kWh to 472 kWh, with 78 kWh as the median figure (Drazu et al. 2015). Based on a data distribution of consumption by property size, a monthly electric consumption figure of 52 kWh is assumed to match an indicatively sized low-cost unit.
- Other research suggests that electric consumption in grid-connected low-income urban households can

be quite small. Data points for Tanzania (Maliti and Menenwa 2011) and Rwanda (Netherland Foreign Ministry 2014[63]; Republic of Rwanda 2014[64]) show very low figures, circa 6-50 kWh per month for households. It is not clear how much of the data range sits within formal production housing, but it can be assumed a portion will be.

These figures are electricity only. Household energy consumption will involve other fuels that can be affected by green design. The Uganda study finds that all energy use (converted to kWh) is seven times the average monthly household rate for electricity only. Thus to compensate, a cost escalation factor of five was utilised to determine total household energy costs[65]. Using the consumption figures, retail electric costs, and other energy escalation factor, the resulting monthly expenditure range for a low-income household is **US$10 - 31** (using individual country exchange rates).

The data points for middle-income/medium-cost housing are based on data from Kenya and South Africa, and cross-checked by findings from the aforementioned EEBEA energy audit report and informal research on cost of living data for the four EAC countries. Figures are electricity plus additional utilities. The data references are:

- In Kenya, middle-income household expenditure of 5,500 - 6,000 KES for utilities monthly (2011 figures) (Kalra and Bonner 2012)

- For a typical South African 2-bed affordable home occupied by a family of four, estimated electricity usage of 600kWh at an average cost of R1,50/kWh, plus R100 for water (R1 = .074 US$) (Veldsman 2016)

- Spot-check comparisons to average monthly utilities figures (electricity, heating, water, and garbage) based on cost of living figures for a 915 square foot apartment Local currency figures are rationalised with current US$ exchange rates.

Based on the above, monthly middle-income utility costs range from **US$40 – 124**. Data points from the EEBEA energy audits in Kenya are similar, mostly toward the low and middle part of this scale.

63 *Grid-connected households in Rwanda consume on average 11 kWh per month. An average household in the Netherlands consumes 280 kWh/month.*

64 *Currently around half of Rwandan electricity consumers are using less than 20kWh per*

65 *While retail electricity costs are known, the proportional use of other fuels and their costs is difficult to calculate but assumed to be lower on a per kWh basis). Retail electricity data sources are:*

- *Uganda:http://www.dignited.com/13575/these-are-the-current-umeme-power-tariffs-rates/*
- *Tanzania: Maliti and Menenwa 2011*
- *Kenya: Kenya Power Electricity Cost Tariffs & Schedule of Tariffs 2013. http://kplc.co.ke/img/full/zcaJOzy5QmNN_Schedule%20of%20Tariffs%202013.pdf*
- *Various rates across East Africa, based on UN Economic Commission for Africa research, reported in The East African (2015).*

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