Ministry of Mines and Energy

Revision of National Building Codes to Incorporate Renewable Energy Technologies and Energy Efficiency Principles - Background Review

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Report prepared by:

Authors: Jonathan Curren
Chisakula Kaputu
George Kozonguizi
Howard Harris
Patrick Curran

Contact: Jonathan Curren

E-mail: jonathan.curren@camcocleanenergy.com

Telephone: +27 11 253 3400

Address: Building 18, Ground Floor,
Woodlands Office Park,
Western Service Road,
Johannesburg,
Republic of South Africa
2080

www.camcocleanenergy.com

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Executive Summary

Camco Clean Energy, in conjunction with project partners Saku Energy Enterprise (SEE) and Namibia Housing and Urban Development, were contracted in November 2012 by the Renewable Energy and Energy Efficiency Institute (REEEI) of Namibia to implement the project: "Revision of National Building Codes to Incorporate Renewable Energy Technologies and Energy Efficiency Principles".

The purpose of this project is to review the existing Namibian National Energy Policy, Building Codes and/or National Building Regulations in order to recommend amendments or propose alternatives in order to include energy efficiency (EE) and renewable energy (RE) aspects. In doing so, the areas within the existing Building Codes and Regulations which restrict the implementation of RE & EE technologies and principles within the building sector, will be identified and practical solutions to overcome these will be provided.

Sections 2 and 3 of this report provide a background summary of the situation in Namibia with regard to relevant legislation, policies and programmes related to both energy and buildings. This provides the context of the status quo.

Section 4 provides an overview of relevant international best practice, focusing on Germany, Australia and South Africa, and international codes of practice. The desktop study and review of building codes and regulatory models from the selected countries, alongside International Building Code and Standards, was undertaken order to highlight the broad options in terms of regulatory models in place in other countries.

The study highlights the various levels and integrated nature of standards and control between national federal and state control in Germany. South Africa has adopted and adapted many of the components of the Australian system, as both countries have similar climatic conditions. Various international models and standards are available, which can also be considered and adopted or adapted as required, providing a strong and rigorous foundation.

A key component of any model is the strong legal foundation and the need for mandatory controls. Although voluntary codes provide support and guidance for the building sector, in many instances their level of influence is restricted to the green building sector.

Section 5 provides for a review of the current situation in Namibia in relation to recent activities on the development of building codes, in particular analysing the key studies carried out under NEEP. A key area for further work relates to more detailed analysis and characterisation of the climatic zones to ensure that recommendations around EE and RE for buildings in Namibia are relevant and appropriate to Namibian conditions.

The preceding NEEP baseline study and the REEECAP assessment of options have placed Namibia in a position where the present level of energy efficiency of the building sector is appreciated and have highlighted some interventions which will be appropriate for Namibia.

Based on the above research, three key options are available to Namibia for the successful implementation of Energy Efficiency (EE) and Renewable Energy (RE) in the Building Sector:

- Option 1: International Building Codes and International Standards Organisation standards are used as a basis for development of a Namibian code
- Option 2: South African Regulations and Standards are made available for adoption
- Option 3: A Namibian Standard is developed specifically to implement EE & RE into the existing Namibian building code

Whatever process is followed there are two broad essentials to consider:

- compliance systems, in terms of the possible models for adoption and their routes to compliance within the existing legal and regulatory framework; and
- stringency levels of various interventions to comply with the routes to compliance.

The next phase of this project activity will comprise extensive stakeholder consultation with key public and private sector representatives to ensure that final proposals are appropriate and in line with the Namibian context.

Acronyms and Abbreviations

ABCB	Australian Building Codes Board
BCA	Building Code of Australia
CSIR	Council for Scientific and Industrial Research of South Africa
CDM	Clean Development Mechanism
DIBt	Deutsches Institut für Bautechnik
DIN	Deutsches Institut für Normung
ECB	Electricity Control Board
EE	Energy Efficiency
EN	European Norms
GBCNA	Green Building Council of Namibia
GEF	Global Environment Facility
GHG	Greenhouse Gas
ICC	International Code Council
ISO	International Standards Organisation
MRLGHRD	Ministry of Regional and Local Government, Housing and Rural Development
MME	Ministry of Mines and Energy
NAMREP	Namibian Renewable Energy Programme
NCC	National Construction Code (of Australia)
NDP	National Development Plan
NEEP	National Energy Efficiency Programme
NGO	Non-Governmental Organisation
NSI	Namibian Standards Institute
RA	Regulatory Assessment
RE	Renewable Energy
REEECAP	Renewable Energy and Energy Efficiency Capacity Building Project
REEEI	Renewable Energy and Energy Efficiency Institute
RSA	Republic of South Africa
SABS	South African Bureau of Standards
SADC	Southern African Development Community
UNDP	United Nations Development Programme
VOB	Vergabe- und Vertragsordnung für Bauleistungen
WBSCD	World Business Council for Sustainable Development
WTO/TBT	World Trade Organization/Technical Barriers to Trade

1 Introduction

1.1 Background

The World Business Council for Sustainable Development (WBSCD) (2009) indicates that buildings account for approximately 40 percent of the world's energy usage. The efficient use of energy within buildings is therefore imperative to mitigate rising costs of energy and increasing energy security concerns, and contribute towards reducing global greenhouse gas (GHG) emissions.

Namibia closely mirrors global trends of energy usage in buildings, with estimations of 45% of electricity usage from commercial/industrial consumers and 28% from domestic consumers. The country however faces additional energy challenges due to its reliance on importing the bulk of its electrical energy (over 50%) from the Southern African Power Pool. This brings about increased energy security risks for the country, resulting from the current electrical energy generation constraints in South Africa, coupled with rising electricity prices and infrastructure constraints. This has already been felt with the reduction in supply from Eskom, causing NamPower to run high cost generators to ensure adequate supply of electricity to consumers (ECB 2006). This is coupled with an increasing price of electricity, which is having a negative effect on industrial, commercial and domestic consumers.

In order to overcome these challenges, the Government of Namibia is investigating options to both increase energy security and encourage the efficient use of energy. These options range from increasing the share of renewable energy in the mix of generation, through to developing demand side management and incentives programmes to encourage energy efficiency.

The 2011 Annual Survey on Energy Efficiency in Buildings, by the Namibian Energy Efficiency Programme in Buildings (NEEP), indicated that many stakeholders within Namibia are aware of the need for energy efficiency initiatives, but there is a lack of specific knowledge about how to best implement measures and technologies in their buildings and the economic information needed to analyse the interventions and take a decision on whether to proceed or not.

1.2 Overview of Project

The purpose of this project is to review the existing Namibian National Energy Policy, Building Codes and/or National Building Regulations in order to recommend amendments to the current and any new policy, code or regulation in order to include Energy Efficiency (EE) and Renewable Energy (RE) aspects. In doing so, areas within existing policy and building codes and regulations, which restrict the implementation of RE & EE technologies and principles within the building sector, will be identified and practical solutions to overcome these will be provided.

Hence, the overall outcome of this project will be the provision of comprehensive and practical recommendations on how RE and EE aspects may be established in the building sector in Namibia, through the development of codes, regulations or amendments to the existing building regulations. These recommendations may include:

- the consultation process that needs to be followed in order to overcome the barriers to adoption of the building codes in Namibia,
- outlining the options available, the recommended Regulations and Systems to be established, i.e. the possible "Routes to Compliance",
- realistic and workable implementation paths for professionals, building control officers and other key stakeholders, and

- processes which will be generally applicable to all sectors and integrated with existing law and practice.

1.3 Purpose of the Background Review Report

This background review report is the first phase of this project. It provides stakeholders with the context of this study, key information related to the benefits and the purpose of EE initiatives, barriers to implementation, overview of initiatives to date, current policy and legislative framework governing building codes and international best practice.

The report also highlights the key options available and aims to enable an informed discussion and analysis by key stakeholders.

2 Overview of Namibian Policies and Legislative Framework

This section provides an overview of the institutional and legislative framework upon which new or revised building codes can be implemented or adopted. It establishes the national context and key socio-economic drivers upon which such programmes would be implemented, followed by a brief assessment of the policy frameworks from both an energy and a buildings perspective. It is imperative that such a programme is viewed from both sides due to the separate but mutual drivers and benefits.

2.1 National Context

2.1.1 Namibia Vision 2030

The Namibia Vision 2030 was compiled by the National Planning Commission and launched in 2004. Its purpose was to design a framework and create a vision that sets the direction for how Namibia can develop over the next 30 years. Vision 2030 also serves to guide Namibia's five year National Development Plans (NDPs) and at the same time, provide guidance to national ministries, regional and local governments and other sectors of society.

In order to complement this Vision, the NDP 4 was released to cover the five year period from 2012/13 to 2016/17. This NDP sets out the three priority areas of basic enablers, economic priorities and execution, monitoring and evaluation. The basic enabler priority area identifies both energy infrastructure and housing infrastructure as priority areas to enable the country to meet its developmental goals. In particular is the support of developing adequate baseload power through the construction of energy infrastructure and increased production capacity by 2017. The NDP 4 also describes the aims to develop a robust and effective housing delivery programme, where affordability is the key feature of the programme and that 60% of households will be living in modern dwellings by 2017.

2.2 Energy

2.2.1 White Paper on Energy Policy, 1998

The White Paper on Energy Policy was developed by the Energy Policy Committee of the Ministry of Mines and Energy (MME) and released in May 1998. The Energy Policy sets six specific national goals for the energy sector:

- effective governance,
- security of supply,

- social upliftment,
- investment and growth,
- economic competitiveness and efficiency, and
- sustainability.

The Policy recognises that the Namibian economy is energy intensive due to the significant role of the mining sector, a growing transport sector and the inefficient use of energy by households, industry and in government and commercial buildings. In order to reduce energy intensity and improve economic efficiency, the Ministry of Mines and Energy has the responsibility to:

- ensure that an appropriate level of national resources are invested in demand-side management activities,
- ensure that economically viable energy efficiency technologies and processes are implemented; and
- address barriers or disincentives to energy efficiency and conservation

In order to address these challenges the Policy paper directs the MME to coordinate and where possible, assist in funding studies to determine the nature of energy end-use patterns in all sectors. The issues of information dissemination and education around energy efficiency were also highlighted as a barrier to the adoption of energy efficient technologies and practices and a national awareness campaign was proposed to overcome this. Energy efficiency in buildings and households were also identified as being areas of interest for energy efficiency measures. Accordingly the Policy paper states that: *"Government will promote the use of energy efficient appliances and the construction of thermally efficient buildings in the household sectors"* and "*Government will encourage the application of building technologies and practices enhancing energy efficiency and conservation"*.

In order to meet these outcomes, the Policy paper recommends that the MME takes the lead in developing an energy efficient appliance labelling system and disseminating information to households concerning thermally efficient building practices. The Ministry also commits to encouraging local authorities to set minimum energy efficiency requirements in new building construction and encourage the adoption of measures aimed at saving energy used in water heating, in particular the use of solar water heaters in all buildings. In the industrial and commerce sectors, the MME also committed to taking the lead in conducting show case energy audits in the industrial and mining sector, as well as creating incentives for the acquisition of energy efficient devices and coordinate training to industry on energy efficiency measures.

2.2.2 Strategic Action Plan for the Implementation of Renewable Energy Policies

The Strategic Action Plan for the Implementation of Renewable Energy Policies was conducted in 2006, as part of the United Nations Development Programme (UNDP)/Global Environment Facility (GEF) /Ministry of Mines and Energy (MME) project entitled Barrier Removal to Namibian Renewable Energy Programme (NAMREP). Its goal is to provide organisational support and prioritisation of future renewable energy interventions that are in line with the White Paper on Energy Policy (see section 2.2.1). The Strategic Action Plan listed nine development objectives, which were:

- enhanced capacity of the renewable energy and energy efficiency sector,
- improved renewable energy and energy efficiency knowledge base,
- broadened awareness of renewable energy and energy efficiency,
- equal playing field for renewable energy,
- improved financing mechanisms for renewable energy technologies,

- improved security of energy supply,
- enhanced institutional coordination and integration,
- improved access to energy, and
- sustainable development.

The Strategic Action Plan was also formulated based on the improvements and additions to the existing institutional environment, including the establishment of the Renewable Energy and Energy Efficiency Institute (REEEI). The Strategic Action Plan included 41 policy statements, which ranged from developing and implementing a renewable energy and energy efficiency public awareness strategy, to the establishment of an Electrification Fund and developing renewable energy and energy efficiency guidelines for public institutions.

While some of these development objectives have been met, such as the establishment of the REEEI, others are still being implemented or have not been addressed to date.

2.2.3 Development of a Regulatory Framework for Renewable Energy and Energy Efficiency within the Electricity Sector

This project was conducted as part of the NAMREP project funded by UNDP/GEF/MME in 2007. The primary objective was to recommend the essential elements that should make up a regulatory framework to promote renewable energy and energy efficiency in Namibia.

The study identified six general recommendations that require three legal acts and a number of other different regulations, these were:

- Recommendation 1: Establish regulatory framework components that facilitate the development of renewable energy based electricity generation.
- Recommendation 2: Establish regulatory framework components that facilitate the energisation of off-grid, pre-grid and informal settlement households and communities.
- Recommendation 3: Establish regulatory framework components that promote energy efficiency and conservation in order to reduce overall electricity consumption and/or manage peak demand.
- Recommendation 4: Establish regulatory framework components that require government-funded and government subsidised renewable energy/ energy efficiency technologies to meet quality standards.
- Recommendation 5: Establish regulatory framework components that are required for Government to source Clean Development Mechanisms (CDM) funding for renewable energy/ energy efficiency projects and programmes.
- Recommendation 6: Establish regulatory framework components that are required to reduce unnecessary costs that contribute to the high retail costs of renewable energy/energy efficiency technologies.

The policy recommendations ranged from developing national targets for renewable energy to developing feed-in-tariffs and net-metering regulations, through to development of an off-grid master plan and zero VAT on residential solar PV installations. This programme and initiative to develop building codes that promote energy efficiency are supported by recommendation 3.

2.2.4 Electricity Act, 2007 (Act No.4 of 2007)

The Electricity Act (Act No.4 of 2007) established the Electricity Control Board (ECB) of Namibia and granted it powers and functions to set the requirements and conditions for obtaining licences for the provision of electricity. This includes the power and mandate to regulate and set conditions for electricity generators and the trading of electricity. This is particularly relevant for programmes or initiatives that may support net metering. The ECB also has the objective to control consumption of electricity, which could support demand side management and energy efficiency initiatives, including those in buildings.

2.3 Current Building Regulations and Standard

2.3.1 Namibia Building Regulations and Standards

Namibia currently uses the National Building Regulations and Building Standards Act No. 103 of 1977 that was promulgated in South Africa. This Act promotes uniformity relating to the erection of buildings and prescribes building standards. This Act was adopted and has remained in force subsequent to Namibia's independence in 1990. This includes following the South African SANS 0400 supporting codes that define the code of practice for buildings.

Local authorities have also developed their own building regulations and standards, in particular the Municipality of the City of Windhoek. The Municipality of the City of Windhoek is an autonomous entity and has employed building inspectors who receive and assess building plans for compliance with their set standards (see Appendix D). These are done to ensure that buildings are properly designed and positioned for the purposes of ensuring health, safety, welfare and convenience of the end users. Although the building regulations and standards are fairly comprehensive, RE and EE considerations are not a prominent feature or a requirement for compliance.

2.3.2 Standards Act, 2005 (Act no 18 of 2005)

The establishment of the Namibian Standards Institute (NSI) was necessitated by the fact that in October 2006, the South African Bureau of Standards (SABS), which up to that point had been the de-facto technical inspection body in Namibia, notified the government of Namibia that a law was being passed in South Africa taking away regulatory functions from the SABS. The new regulatory body that was established in South Africa was called the National Regulator for Compulsory Specifications (NRCS). The NRCS has no jurisdiction beyond the border of South Africa and thus there would be no standards regulator in Namibia. This prompted the Namibian Cabinet to establish the NSI through the promulgation of the Standards Act, 2005 (Act no 18 of 2005).

In 2005, the Standards Act (no 18 of 2005) was signed, providing for the promotion, regulation and standardisation relating to the quality of commodities. This Act also established the NSI as the regulatory body responsible for the purpose of determining national standards. The Standards Act gives the NSI the function of setting, establishing and issuing standards in Namibia, or to amend or withdraw any standard that has been set. The NSI may also set, or adopt, a standard that has been developed by another body outside of Namibia that has objectives similar to those of the NSI and which the NSI deems appropriate to issue as a standard.

The NSI is the Namibian representative as part of the world standards infrastructure. In terms of an agreement with the World Trade Organization/Technical Barriers to Trade (WTO/TBT), all countries are required to establish clear technical quality infrastructure so that any unnecessary technical barriers to trade could be removed.

As far as the development and adoption of standards is concerned, NSI is mandated to carry out this function in line with the Accreditation Board of Namibia Act No. 8 of 2005, the Standards Act No. 18 of 2005 and the Metrology Amendment Act No. 17 of 2005. In terms of this legislation, NSI carries out the functions of preparing, adopting and publicising standards in compliance with WTO/TBT Agreement. Furthermore, NSI is responsible for the training of stakeholders, especially in the private sector on the understanding of standards, standardisation and quality assurance. In addition, NSI is the national distribution point for selling national, regional and international standards, as required by industry in Namibia. NSI is responsible for coordinating all standardization and quality assurance activities in the country and represents Namibia at regional and international standardization bodies.

In order to issue a Namibian standard, the NSI must publish their intent in the *Government Gazette.* This however does not make the standard compulsory; this can only be achieved when it is declared compulsory by the Minister of Trade and Industry (MTI) through the appropriate regulation. NSI has entered into an agreement with the SABS in South Africa, whereby Namibia is allowed to make use of the South African building standards.

The Ministry of Trade and Industry is responsible for the implementation of the WTO Agreements and has the overall responsibility of ensuring that the obligations under the Agreement are fulfilled, whilst the NSI on the other hand is designated to be the national enquiry and notification for TBT notifications and enquiries – responding to reasonable enquiries from other WTO members regarding Namibian domestic regulations, standards and conformity assessment procedures in draft and in force; and fulfilment of the notification obligations under the TBT Agreement.

In Namibia, the standards are developed in line with international practices and stages (such as the Proposal Stage; Preparatory Stage; Committee Stage; Enquiry Stage; Approval Stage; and Publication Stage). These stages are sponsored and administered by the NSI through the appointment of technical committees and working groups. Standards are developed by organizations known as Standards Development Organizations (SDOs) and National Standards Bodies (NSBs), which operate in a number of areas, notably the NSI; African Regional Organization for Standardization (ARSO); and the International Organization for Standardisation (ISO) or the International Electrotechnical Commission (IEC). These bodies are tasked by governments with the development of appropriate standards under internationally-accepted norms and in accordance with ISO/IEC directives. Furthermore, the norms suggest that the standards shall be developed:

- by properly-constituted and representative Technical Committees (TCs);
- using the principles of "Consensus"; Aligned with the International Standards, wherever possible; and
- to comply with WTO/TBT Annex 3 Code of Good Practice.

2.3.3 MRLGHRD Strategic Plan for the Period 2009 – 2014

The Ministry of Regional and Local Government, Housing and Rural Development (MRLGHRD) Strategic Plan for the Period 2009 – 2014 serves as a management plan for the MRLGHRD to direct and monitor its performance in meeting its contribution to the objectives outlined in the Vision 2030. The MRLGHRD Strategic Plan outlines a number of strategic themes including developing a sustainable habitat for all and identifies lack of awareness, mind set and attitudes, special skills and conventional building codes as a barrier to the under-utilisation of local building materials.

2.3.4 Hierarchy of Control and Responsibility of Building Regulations

The MRLGHRD is the Ministry responsible for overseeing and directing the functions of all local authorities in the country. The local authorities are grouped according to size and are ranked as Part I, II and III municipalities. Not all local authorities have the same status in terms of operations and reporting to the MRLGHRD. In particular, Part I and Part II municipalities are autonomous of the MRLGHRD in the handling of their affairs, while Part III, which basically are villages and settlements report to the MRLGHRD.

All local authorities require their clients to prepare and submit building plans, which are approved in-house by their staff members. The level of approval depends on the complexity of the plan as submitted, whereby the directive of the MRLGHRD may be required.

2.3.5 Local Authorities and Building Regulations

Building planning and construction is carried out within the legal and development policy framework of the country and according to legal procedures as stipulated in various planning and related legislation. These laws and policies regulate and guide building developments, define the scope of work of inter alia architects, quantity surveyors, contractors, building inspectors and so forth and provide the vision and objectives towards town developments. In particular, the main laws related to building regulation are:

- **The National Building Regulations and Standards**, 1977 (Act 103 of 1977), which to date has as yet not been "Namibianized" and in large part still relates to that of the Republic of South Africa. On 24 June 2010, an agreement was reached between the SABS and the NSI, where in terms of paragraph 3.7 of the agreement, scope of activities, the SABS authorises the NSI to adopt South African National Standards (SANS) as Namibian standards. Similarly, paragraph 3.3 of the agreement permits a SANS, or any provision thereof to be referenced in Namibian legislation by referring to the title and the number and the year or edition number. In as far as the enforcement and administrations of these regulations and standards are concerned, the respective municipalities / local authorities are responsible, on behalf of MRLGHRD.

- ***The Local Authority Act of 1992 (Act 23 of 1992 of the National Assembly),*** as amended, which provides for the determination, for purposes of local government, of local authority councils; the establishment of such local authority councils; to define the powers, duties and functions of local authority councils; and to provide for incidental matters. In terms of this piece of legislation, all local authorities in the country are required to be in compliance with its provisions. MRLGHRD is responsible for ensuring that its provisions are adhered to - as such, MRLGHRD is the administrative body.

- ***The Town and Regional Planners Act (Act No. 9 of 1996),*** which provides for the registration of town and regional planners and town and regional planners in training; and to provide for matters connected therewith. The Council for Town and Regional Planners is responsible for overseeing and administering all functions as stipulated in this Act.

- ***Town Planning Ordinance, 1954 (Ordinance 18 of 1954),*** which provides for the preparation and carrying out of town planning schemes and for matters incidental thereto. Municipalities are required to have in place town planning schemes and to sponsor and administer such schemes on behalf of MRLGHRD.

- ***Townships and Division of Land Ordinance, 1963 (Ordinance 11 of 1963)***, which provides to consolidate and amend the laws relating to the establishment of townships and provide for the regulation and control of the development and subdivision of land and for matters incidental thereto. The Namibian Planning and Advisory Board (NAMPAB) and the Townships Board are the principal administrative bodies for this piece of legislation. These bodies are based and form part and parcel of the functions and duties of the MRLGHRD.

City of Windhoek

Unlike other local authorities, the City of Windhoek has its own Building Regulation, which was promulgated by virtue of G/N 57 of 1969 and appeared in the Official Gazette on the 28 April 1969.

The Regulation of the City of Windhoek suggests that every person intending to erect any building within the municipal area shall apply in writing for the approval of the Council on a form prescribed by the town engineer (see Appendix D). This application form has to be accompanied by plans (in duplicate) drawn in accordance with sub-regulation (b) and any further details that the Council may require for the purpose of giving effect to these regulations. In particular, the City of Windhoek has in its employment a Building Control Division of which its core functions are:

- to ensure that the buildings are properly designed and constructed so as to ensure the health ,safety ,welfare and convenience of the clients; and
- to provide a stimulus to greater efficiency and higher standards of services to clients.

The activities of the Division are:

- Approval of building plans to ensure that it complies with building regulations and town planning scheme;
- Conduct inspection on excavation, damp proof, open sewer, close sewer, completions;
- Law enforcement (conduct spot checks to avoid illegal building activities);
- Issuing of completions and compliance certificates;
- Provide copies of existing approved building plans; and
- Advice clients on building procedures and regulations.

Although the City of Windhoek has its own regulations as well as independent expertise, it will be compelled to follow the national codes. The City of Windhoek is currently strict with regard to the adherence of its building regulations and standards; for example the use of building materials, positioning of buildings, glazing and other requirements. The City of Windhoek does not however currently evaluate building plans in relation to EE and RE considerations.

3 Current Situation in Namibia

This section provides a summary of the key recent relevant programmes and studies that have been completed in Namibia relating to energy efficiency and building codes, in addition to highlighting the major barriers to implementation of EE and RE in buildings. To date, a number of comprehensive studies have been carried out, thus providing a strong foundation for the implementation of EE and RE initiatives in buildings in Namibia. This includes initial discussions on the establishment of a local Green Building Council.

3.1 Green Building Council of Namibia

In order to amplify its mandate over the greening concept of buildings, the Namibia Energy Efficiency Programme (NEEP) in the first quarter of 2012 set into motion efforts to establish the Green Building Council of Namibia (GBCNA) as a step towards promoting and facilitating green building practices in the country. This initiative is a GEF funded project to promote energy efficiency in buildings in Namibia.

The development of the GBCNA has taken place under NEEP in order to increase institutional capacity and awareness of green buildings and the requirements to which buildings need to comply in order to be rated as a green building. The main task of the GBCNA is to develop and operate the Green Building Rating System and to promote and facilitate green building practices, technologies and operations in the construction and build environment.

Accordingly the GBCNA would aim to:

- Be an affiliated member of the World Green Building Council
- Be a non-profit organisation
- Have membership drawn from all sectors of the Namibian buildings related industry

In order to establish the GBCNA the following activities have been initiated:

- Guidance has been received from the World Green Building Council on the formation of GBCNA,
- Support has been obtained from Green Building South African (GBCSA) for documents and guidance in establishing the GBCNA,
- The Associated Working Group was formed in February 2012 to develop a business plan, secure funding, identify and invite members and register the GBCNA with the Namibian authorities and the World GBC,
- Support has been garnered from many organisations, institutions and government agencies such as the MME; MRLGHD; UNDP; Arandis Town Council; EMCON Consulting Group; Nina Maritz Architects; Nedbank Namibia and independent consultants. These organisations have formed the Associated Working Group (AWG) that are working towards the formation of GBCNA,
- Development of the business plan and registration of a trust for the GBCNA by PricewaterhouseCoopers (PwC) Namibia. The members of the AWG have become the trustees of GBCNA,
- Pledges by NEEP and Nedbank Namibia of US$11,000.00 and N$20,000.00 respectively for the establishment of GBCNA
- Compilation of a database of potential members.

Namibia has been granted “Prospective” status by the World Green Building Council which gives GBCNA 12-24 months to prepare for the “Emerging GBC” status. At this stage of membership, the Prospective Green Building Council is required to expand its core founding group, develop a constitution and by-laws, compile a comprehensive business plan, demonstrate the staffing needs moving forward, develop a logo and registered trademark, register legally as a non-profit organization, open a bank account and secure seed funding. This group is expected to meet these requirements as per the World GBC expression of intent.

As of this date, efforts are underway to secure a United Nations (UN) Volunteer/Technical Expert through UNDP to assist GBCNA. The AWG will soon recruit the Board of Directors and invite members to join GBCNA as soon as the business plan is finalised. Following this, the interim Trustees will hand over GBCNA to the Board of Directors as soon as it is constituted.

The GBCNA intends to attain the “Emerging GBC” status with World GBC before the end of 2013.

3.2 Namibia Energy Efficiency Programme in Buildings (NEEP)

The Namibia Energy Efficiency Programme in Buildings (NEEP) is the major programme in the country that aims to promote the use of energy efficient technologies and practices in Namibia’s commercial and residential building sector. NEEP is co-funded by the GEF and UNDP under the Framework for Promoting Low Greenhouse Gas Buildings. This is a three year programme and is being implemented by the MME and REEEI at the Polytechnic of Namibia.

The NEEP project’s objective is geared towards the reduction of Namibia’s energy-related GHG emissions through the nationwide adoption of energy-efficient technologies and practices in the commercial and residential building sector, with a focus on government buildings, hospitals, hotels, schools and possibly a sample of residential buildings. In particular, the activities of NEEP include the following:

- Development of improved regulations (standards and labelling of building appliances) and adoption of building codes for energy savings,

- Provision of auditing and energy marketing services to stimulate the demand and supply of EE services and technology, particularly through the introduction of mandatory audits in public and commercial buildings,
- Strengthening of institutional capacity and awareness on EE in building that would further contribute to the adoption of EE technologies and best practices.

This study aims to contribute towards meeting the outcomes of NEEP, in particular investigating the development of improved building regulations and suggestions for the adoption of building codes that will enable EE and RE in Namibia's building sector.

3.3 NEEP Baseline Study

The NEEP baseline study aimed to establish building energy benchmarks in Namibia and identify and review the current energy efficiency standards with a view to making recommendations on energy efficiency approaches that are appropriate for Namibia.

The study included 52 commercial buildings from four localities (Windhoek, Keetmanshoop, Oshkati/Ongwediva, Walvis Bay/Swakopmund). The buildings selected were based on the building occupancy for large shops, office and hotels as defined under SANS 10400. In order to develop energy benchmarks, a wide variety of data was collected including electricity usage records, floor area, occupancy and other data including other energy sources where applicable. Energy benchmarks measured comprise of the total annual energy consumption divided by the net square metre area of a building (unit $kWh/m^2/annum$), as defined by SANS 204 (the South African National Standard governing EE in buildings).

Of the limited sample of building types surveyed in the NEEP Baseline Study (retail, office and hotels) it was found that supermarkets were the most energy intensive, and that office buildings were the least. A significant discrepancy between the SANS 204 values for annual energy usage and demand for large shops and hotels and the actual energy usage and demand values obtained in the NEEP Baseline study is noted. The comparison of average annual energy consumption of all buildings surveyed against energy benchmarks and SANS 204-1 showed a poor correlation. The same benchmarking for offices only indicate a better correlation.

The observations should however have been made with adjustment for an exclusion of the operational energy uses of these buildings. Operational energy is not [fully] accounted for in the SANS 204 Performance Requirements, against which the Namibian buildings were compared. Operational energy is most significant in the Retail occupancy categories such as supermarkets where commonly some 60% to 70% of energy usage is as result of refrigeration equipment for display cabinets and cold rooms, the heating by bakeries and warm oven displays and other operational energies. These energy usages are considered to be Occupant or Tenant initiated loads and do not form part of the energy usage attributable to the building itself and the Performance Requirements of Table 2 & 3 of SANS 204.

The NEEP baseline study analysis of energy usage and demand fails to take cognisance of the methodology used for the construction of the Table 2 & 3 data in SANS 204, which is to assume levels of occupancy and times of occupancy as per stipulation, which will not often be experienced in reality, e.g. Hotels operating at 100% occupancy day and night. Similarly, Office buildings are stipulated to be modelled as occupied on a 12/5 basis (twelve hour day and five day week) at an occupant density of 1 person per $15m^2$. Hence the analysis should have included a normalisation of the actual data to the same stipulations, as would be envisaged in an approach to follow the principles of ISO/SANS 50010; Measurement & Verification of Energy Savings methodology.

The NEEP baseline study highlights the comparison of similar buildings with a wide range of high and low actual energy usages values about the benchmarks, indicating that there is substantial scope for energy efficiency improvements in less efficient buildings. As part of the present project a review of the reported energy usage and demand data, including a normalisation of this data for more accurate comparison against SANS 204 can be conducted.

3.4 Annual National Survey on Energy Efficiency

The purpose of the Annual National Survey on Energy Efficiency in Buildings is to measure and evaluate the effectiveness of initiatives that have focussed on changing energy consumption practices in Namibia. The Annual National Survey on Energy Efficiency in Buildings is commissioned by REEEI, in collaboration with the MME, GEF and UNDP and falls under NEEP.

The first Annual National Survey was conducted in 2011. The results indicated that there exists an awareness of renewable energy and energy efficiency issues amongst the general populace, but that knowledge regarding the implementation and evaluation of appropriate measures was lacking. The study also recommended a number of targeted groups for knowledge dissemination as well as areas of knowledge and capacity to be developed.

The Annual National Survey on Energy Efficiency in Buildings for 2012 is being conducted to further understand the level of penetration of EE technologies and practices in the building sector and the developments around EE in buildings.

3.5 Renewable Energy and Energy Efficiency Capacity Building Project (REEECAP)

This study, conducted under the REEECAP programme, was entitled *Revision of Namibian Building Codes to incorporate Renewable Energy and Energy Efficiency*. The aim of this study was to assess and recommend which RE and EE intervention could potentially be included in the development of Namibian building codes. The interventions were assessed for a low-income, medium-income, high-income household and an office block and evaluated under the varying climatic conditions found in Namibia.

The REEECAP study makes use of the Builders Toolkit, which is based on NewQuick software, which takes a single hot day and single cold day analysis and extends this by way of an algorithm to estimate an annual energy usage. Comparative results are given, which indicate relative energy usage and demand, percentage persons comfortable and temperature graphs.

The caveat of the inaccuracy of NewQuick and its successors is explicitly stated in the REEECAP report. The report recommends that this analysis needs further in-field testing to corroborate the results and that the energy usage figures are not to be regarded as absolute. An approach which has been used in other International regimes is to select a software programme which is ASHRAE 140 or ISO13790; Energy Performance of buildings – Calculation of energy usage for space heating and cooling compliant or have been proven to give reasonable accuracy via the BESTEST check. These models will have all appropriate building physics parameters incorporated and are 8760 hour per annum models which feed sequentially into one another. Such software (and weather files) have been scrutinised by the Agrément Board of South Africa and accredited for use in achieving compliance with SANS10400XA; Energy Usage in Buildings, in Rational Designs. See Appendix B for an example of outputs from VisualDOE, a software which is ASHRAE 140 compliant and more comprehensive than NewQuick.

A concern with the modelling technique used is that interventions appear to have been applied in a sequence which causes the first intervention to ‘steal’ from subsequent interventions. The correct approach being to model all proposed interventions in a combined case and then ‘unpack’ each intervention of the model, such that each impact is viewed in isolation of others.

The relative energy savings and merit of each intervention is therefore not accurately reflected in the REEECAP report and will be prejudicial to some of the interventions assessed.

The financial viability of a basic level of EE intervention for roof insulation, cavity masonry walls and solar water heating is indicated in the REEECAP study. In combination with work done in other regimes this may be adequate to support a proposal for such items in a mandatory Building Code for Energy Efficiency.

The report argued that there is a strong case for the integration of passive solar intervention, including building orientation, ceilings, insulation, natural ventilation and two skin brick walls with air gaps to be included; the report also argued for the inclusion of solar water heaters and solar lights. Awareness around RE and EE measures was however highlighted as a concern. The report provided a voluntary checklist of minimum requirements for RE and EE measures for low-income, medium-income and high-income households, that was intended to be held by the Institute of Architects. The report also aimed to serve as a temporary addendum to the National Building Standards SABS 0400; this however has not been achieved to date.

4 International Best Practice

4.1 Introduction

A desktop study and review of building codes from selected countries and international organisations was undertaken in order to highlight the broad options available and present current best practice in terms of regulatory models and building codes or standards frameworks.

This section reviews the building code systems in place for Germany (with emphasis on the regulatory framework), Australia (with emphasis on the code development and operation process), South Africa (with emphasis on the detailed interventions to be considered), and the International Building Codes and Standards that are potentially available to support the Namibian building codes and standards development process. Specific reference is made to how these various building codes have incorporated RE and EE considerations.

The Regulatory Framework and Building Codes themselves in place in the Federal Republic of Germany, the Commonwealth of Australia and the Republic of South Africa all have to a greater and lesser degree a commonality in that the principles of the so-called Nordic structure are employed in all (see section 4.4). It has to be noted that the framework selected for the development of building codes is not dependent on the climate of a specific country. While considering the climatic conditions is essential for ensuring that guidelines contained within the selected building codes framework contribute to sustainability (see section 5), they do not dictate the framework that can be chosen. The framework chosen for the development of building codes, or components of building codes, should be selected to ensure congruence with prevailing policy direction, acceptance from stakeholders and ease of implementation and enforcement.

4.2 Germany

4.2.1 Legal Framework for Building Codes

The Federal Republic of Germany has a complex regulatory framework for administering and prescribing regulations for building developments. The complexity arises, as legislative power regarding building regulation is held at the local or state level, thus each of the sixteen states of Germany has their own building regulations that are tailored to their unique situations[1].

States are required to develop their building codes based on a model building code which is developed at the federal level. The federal ordinances generally set a minimum level of regulation with the states being allowed to set increasing levels of regulation[1]. Laws and regulations that are developed at the federal level, such as the Energy Saving Ordinance, also have to be implemented and translated to function at the state level.

Municipalities have limited regulation development and setting powers, and take their guidance from the state and federal level. They are however empowered to regulate certain technical issues, for example determining the use of energy supplies in the municipality.

4.2.2 Rules and Standards Comprising the Building Code

The structure of building regulations and control in Germany is determined by the federal system and the reliance on the approval process for eligible products[1]. The Building Codes of the States are issued by the federal government and comprise a list of acknowledged technical rules. These technical rules have been approved or developed by the German Institute for Standardisation (DIN) and provide guidance on what needs to be considered in the planning, design and construction of buildings[1].

A further list of technical rules is compiled by the German Institute for Civil Engineering (DIBt), which is an agency of the federal government. The list is compiled from the acknowledged technical rules developed by the DIN. Thus the acknowledged technical rules developed by the DIN are given official status. The DIBt publishes the list of technical rules on their website to allow for easy access by all stakeholders[2].

The buildings regulations are generally formulated as guidance and functional statements and in many instances do not provide explicit requirements in the areas of planning, design or construction of a building. In some cases however operative requirements are mandated. To overcome any confusion, federal and state level authorities' issue executive decrees for operative requirements; these however are not mandatory. A designer or builder has to prove that their intended construction methods are equal or greater than that which has been decreed.

4.2.3 Generally Accepted Practices

A number of generally accepted rules and practices have also been developed in Germany. Generally accepted rules and practices are those that are recognised to be theoretically correct and have thus become common practice[1]. These technical norms and standards have then been compiled into a list of generally accepted technical rules (known as aaRdT). The aaRdT allows consumers to know what they can expect from a builder, in particular around issues such as safety, health and environmental protection. The aaRdT has become recognised as unofficial building regulations, as many state level building regulations refer directly to the aaRdT, or these norms are included in standardised building contracts[1].

The aaRdT is however not fixed and is continuously being updated by builders, authorities or courts. If a particular building standard or norm is not applied building contractors and designers

[1] PRC, 2011. Screening National Building Regulations, Germany - Case Study (Online). Available: http://ec.europa.eu/enterprise/sectors/construction/files/compet/national-building-regulations/prc-de_en.pdf
[2] Deutsches Institut für Bautechnik, 2012. About DIBt (Online) Available: http://www.dibt.de/index_eng.html

are at risk of being held liable. New norms are constantly being developed and arise from discussion between a wide variety of stakeholders including the private sector, industry associations and government institutions. A norm or standard can also be developed by a technical body or association and included into the aaRdT, if considered current best practice.

4.2.4 Standards for Construction Products

The state building codes require that construction products are useable, i.e. to enable the works, if built according to the relevant building regulations, to function during normal maintenance period and for an adequate length of time. In order to ensure this, the DIBt issues a list of approved construction products.

Products that have been approved, tested and certified to existing standards by the DIBtb are automatically eligible and appear on the list of approved construction products and require no further inspection. If a product wishes to attain certification then it has to be approved by the DIBt, this is done through approval from a special advisory committee[1].

4.2.5 RE and EE Considerations

Germany has a history of promoting the inclusion of EE and RE requirements into building design and construction[3]. The current building regulations actively incorporate the policies and decision outlined in the Energy Saving Regulation (EnEV 2007/2009). The EnEV sets requirements for the overall energy performance of new buildings and major renovations to existing buildings which include space and water heating, ventilation, cooling, lighting and other areas[4]. Overall energy policies in Germany also set targets for buildings these include:

- All new homes must meet a minimum of 14% of total energy consumption for heating and domestic hot water with renewable power. Mandatory from 1 January 2009
- Older buildings must have 10% of heating needs met by renewable energy by 2010, and 14% of heating needs by 2020.
- Development of Energy Performance Certification that assesses and rates the EE performance for all new and renovated buildings.

Since 2009 and the introduction of the building codes, policies and standards, a million homes have been refurbished to comply with the EE and RE requirements, providing an energy saving of 50%[5].

[3] *Galvin, R. 2010. Thermal upgrades of existing homes in Germany: The building code, subsidies and economic efficiency. Energy and Buildings: Volume 42, Issue 8, June 2010*

[4] *Pfliegner, K., Schuberth, J. and Gumb,G. 2012. Mechanisms to Encourage Private Sector Investment/Participation in Low-Carbon Development - The Case of Germany (Online). Available: http://www.oecd.org/env/climatechange/Case%20study%20Germany.pdf.*

[5] *Schlomann,B., Muach,M. and Eichhammer,W. 2009. Energy Efficiency Policies and Measures in Germany. Karlsruhe: Fraunhofer Institute for Systems and Innovation Research.*

4.3 Australia

4.3.1 Development of the Building Codes of Australia (BCA)

The Building Codes of Australia (BCA) is a performance based building standard and thus it prescribes desired performance results of a building, rather than the method and practises that need to be undertaken to construct the building. The BCA was developed based on the best practices from a number of overseas models, including New Zealand, UK, Swedish and Dutch and is housed under the Australian Building Codes Board (ABCB)[6].

In July 2004, the ABCB announced that the BCA would prioritise specific sustainability issues, including energy, water, material and indoor environment quality.[7] To support technical aspects of the building codes, the BCA makes use of standards that are usually developed by Standards Australia; the national standards institute[7].

4.3.2 Regulatory Framework for the BCA

The BCA is produced and maintained by the ABCB on behalf of the Australian Government and State and Territory Governments. The BCA is designed to offer a nationally consistent, minimum standard for building safety, health, amenity and sustainability[6]. The BCA contains technical provisions for the design and construction of buildings and other structures, covering such matters as structure, fire resistance, access and egress, services and equipment, and energy efficiency.

Building control is the responsibility of each State and Territory, but as the ABCB is an institution of the Council of Australian Governments (COAG) the BCA has been given the status of building regulations by all Australian states and territories[8]. This allows for the consistent application of building codes throughout Australia.

The BCA applies to all new buildings, renovations or additions to existing buildings and when building classifications are changed[8]. Building legislation is not retrospective and thus the regulation does not apply to the refurbishment of an existing building[8].

4.3.3 Performance Based Requirements

As mentioned earlier, the BCA is a performance based building code and consists of a hierarchy of objectives, functional statements and performance requirements. The objective and functional statements serve to act as guidance and describe what is expected from the building and how the building is to fulfil that expectation[8]. The performance requirements set the minimum acceptable performance that must be achieved to meet the objective, including describing level of performance which must be met by building materials, components, design methods and construction methods. Performance requirements are however often qualitative [8.] An example of a performance based requirement hierarchy can be seen in Figure 4-1 (section 4.4.1 as part of the South African case study).

4.3.4 Energy Efficiency Provisions

The BCA has included mandatory energy efficiency performance requirements, verification methods and deemed-to-satisfy provisions for buildings since 2003. They have taken a phased approach to inclusion, starting with EE measures for residential (class 1) and non-habitable (class 10) buildings. This was further expanded to include the rest of the building classes in 2005 and 2006, which included commercial and industrial buildings.

[6] *Australian Building Control Board (ABCB). 2012. About the National Construction Code (Online). Available: http://www.abcb.gov.au/about-the-national-construction-code/the-building-code-of-australia*
[7] *Beauchamp, B. 2007. Sustainability and the Building Code of Australia.*
[8] *ABCB, 2010. Energy Efficiency Provision for BCA Volume One.*

The deemed-to-satisfy provision outlined in the *Energy Efficiency Provision for BCA 2010 Volume One*[8] set requirements for:

- insulation to the building fabric (roof, walls and floor);
- measures to control unwanted heat gain or loss through glazing and roof lights;
- measures to reduce air leakage through the building envelope and the building fabric (i.e. chimneys, flues and gaps between lining and claddings;
- measures to facilitate air movement for cooling;
- minimum efficiency levels and energy sources for lighting or heating, ventilation and air conditioning equipment.
- measure to reduce supply from water heaters, insulation to hot water supply pipework and ducts, pipes and plant of central heating and cooling systems; and
- measures affecting heating, pumping and covers for swimming pools.

4.3.5 Example of Performance Requirements for EE

The objective of the EE provisions in the BCA is to reduce GHG emissions[8], and as such increasing the EE of buildings plays a crucial role in this regard. In order to meet this objective there are two functional statements contained in the BCA, these are:

Box 1. Functional Statements

a. A building, including its services, is to be capable to efficiently use energy; and
b. A building services for heating are to obtain their energy from-
    i. A source that has a low GHG intensity; or
    ii. A source that is renewable on-site; or
    iii. Another processes as reclaimed energy

Therefore based on the objective and the functional statement, a performance requirement as specified in the BCA[8], include for example around heating:

Box 2. Performance Requirements

Heating such as for a conditioned space must, to the degree necessary, obtain energy from-

a. A source that has a GHG intensity that does not exceed 100g CO_2e/MJ of the thermal energy load; or
b. A source that is renewable on-site such as solar, geothermal or wind, or
c. Another process as reclaimed energy

However, when undertaking the construction of new building work that is associated with an existing building, there are factors that might affect compliance with the building regulations, in particular location of the building, internal configuration and other factors.[8] The performance requirements thus provide flexibility in determining compliance and if it can be demonstrated that the activities meet the 'degree of compliance' necessary. If it is demonstrated so, the relevant building council may accept the alternative solution. The acceptance of this alternative solution does however have to be based on an objective test and the provision of proof is on the onus of the designer or developer [8]

4.3.6 Demonstrating Compliance of Buildings

The BCA outlines two methods for demonstrating compliance with the performance requirements, namely:

- Deemed-To-Satisfy provisions (DTS), or
- Verification Method to assess an alternative solution.

The DTS demonstrates that a building meets the minimum criteria for EE in the applicable climate zone. This includes using materials, components, design factors and construction methods designated by the ABCB or requirements set by Standards Australia. If these guidelines are followed then the building automatically results in compliance[6].

A verification method is another way of demonstrating compliance with the performance requirement outlined in the code. The intent of a verification method is to prove that an alternative solution meets the performance requirements. This is a key provision of a performance based building codes as there is no obligation to adopt any set requirements. Thus if it is proved that the method meets the performance requirements it can be accepted as being in compliance with the relevant building codes or regulations.

4.4 South Africa

4.4.1 South African Regulatory Framework

The South Africa National Building Regulations are characterised by their so called ‘Nordic structure’, a performance based solution, with environmental protection objectives established in the Constitution of the Republic, and the legal authority for Regulations of the Building Industry being established in a long standing piece of legislation; Act 103 of 1977; The National Building Regulations and Standards Act.

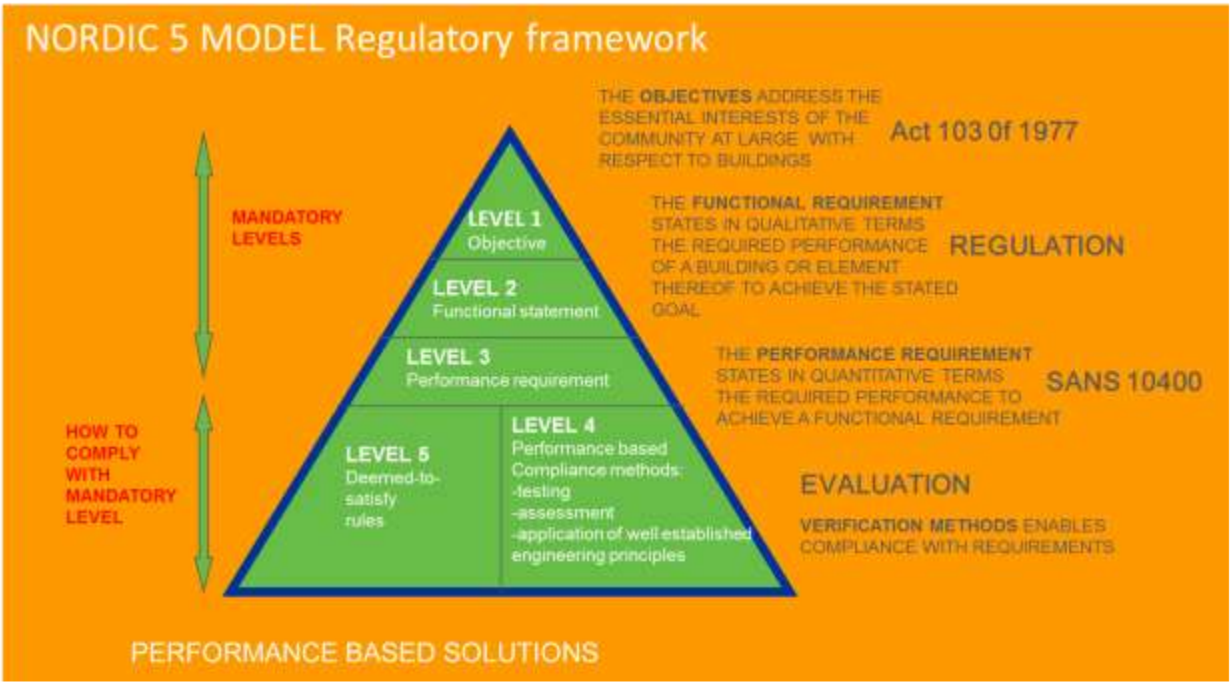

Figure 4-1: Nordic Model Regulatory Framework[9]

[9] *National Regulator for Compulsory Specifications, 2012. Energy Efficiency Building Regulations (Online). Available: http://www.cityenergy.org.za/files/resources/generation_workshop/National%20Energy%20Efficiency%20Building%20Regulations%20(NCRS).pdf*

The National Building Regulations were Gazetted and thereafter for many years were published along with the SANS 0400 series of Standards as the so-called' Blue sections'. It was the' Blue sections' which were actually the law as the National Standard and were in general the Prescriptive Requirements, often referred to as the "deemed-to-satisfy" portion of the building code.

There are other routes to compliance which are also 'deemed-to-satisfy' the Regulations, and these are in general Rational Design options, and alternative building systems which have been found to be acceptable and of equal performance to the Prescriptive Requirements by the Agrément Board of South Africa. Rational Designs are performed or developed by 'Competent persons' who are suitably qualified and Professionally Registered Architects, Engineers or Natural Scientists. These persons are required to have Professional Indemnity insurance and can be sued in their personal capacity should building designs not conform to the Regulations.

Amendments to the National Regulations of South Africa have in recent years established the authority of a National Standard which is by Regulation 'deemed-to-satisfy the Regulations and hence the Act. The principle standard is SANS10400XA; Energy Usage in Building. This standard invokes other standards such as SANS 204 Energy Efficiency in Buildings and numerous other standards governing the methods of calculating thermal resistance, hot water usage and the performance of Solar Hot Water heaters etc.

4.4.2 Regulation XA and Supporting Standards

Energy Usage in Building was effectively made mandatory by amendment to the National Building Regulations. The Regulations XA1, XA2 and XA3 were gazetted in September 2011.

- Regulation XA1 is a Functional Regulation which requires that energy is used efficiently in building;
- XA2 establishes a hot water requirement which requires a portion of hot water heating to be by way of an energy efficient or renewable technology; and
- XA3 establishes SANS 10400XA as being deemed-to-satisfy the Regulations. This section contains the three routes to compliance in satisfaction of the Nordic principles of Figure 4.1

As SANS 10400XA is deemed-to-satisfy the Regulations the standard presents to building owners as a very convenient route to establish compliance with Regulation XA1.

SANS 204 is a voluntary standard. The principle adopted by the Technical Committee 59G, which has developed the SANS 204 version as published in 2008, is that the standard is a "Rational Best Practice" standard [Chairman. L. van Wyk]. This is to imply that the standard will be updated periodically in order to continually reflect what is affordable in terms of yielding a non-parochial rate of return, and will cover any building elements and technologies which can be directed to this purpose.

This has provided a convenient bench-mark for the South African Green Buildings Council to apply to the four star or lowest of the Green Star assessed ratings.

The SANS 204 standard provides for three routes to compliance:

i. A Prescriptive route of standard performance based solutions for major aspects such as the Thermal Resistance of the shell and tables for the efficiency of appliances such as lighting and air-conditioning. This corresponds to the Method 5 as set out in figure 4.1.

ii. A Performance Assessment route which requires an energy modelling by a Competent Person on a 'Whole Building" method and finally:

iii. A Reference Building method which is essentially a Rational Design which need to be performed by a so called ‘Competent Person’.

Alternative routes to compliance as are envisaged for the Method 4 or lower level of the triangle of hierarchical routes to compliance are supplied in addition to the Prescriptive route. These routes are set out diagrammatically in figure 4.2 below.

4.4.3 Compliance with National Building Regulations

The system of compliance can be described by the diagram in Figure 4.2 below:[10]

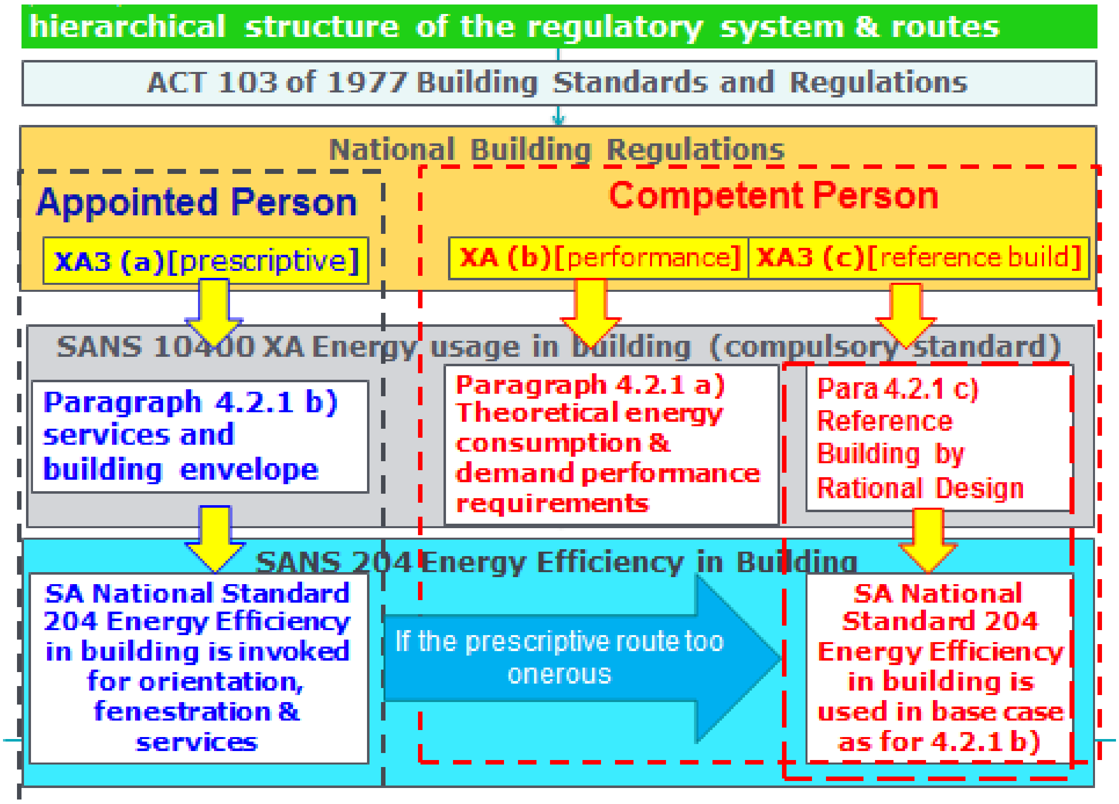

Figure 4-2: Hierarchical structure of SA regulatory system and routes[9]

4.4.4 Administrative Aspects

The National Building Regulations (NBR) are administered by the National Regulator for Compulsory Specifications [NRCS, ‘The Regulator’], which is a Directorate of the Department of Trade & Industry. A review system is managed by the Regulator, and the nominee of the Regulator has established the Amendments to the NBR and the South African National Standard 10400XA, in conjunction with the SABS. A standard template for the Applications for Building Planning has also been implemented for use by all Local Authorities.

The South Africa National Building Regulations place the Building Professional in an onerous position and reliance is placed on these individuals and firms to correctly understand the Regulations and Standards. It is their responsibility to ensure that plans drawn and submitted to the Local Authority, and in the eventual delivery to clients, are in terms of the contractual obligations and furthermore in compliance with the law.

The Local Authorities have a duty to apply the Regulations and other Planning Regulations and to implement the law [Regulations]. Municipal management structures are required to provide plan evaluation and building inspections by officials and staff.

[10] *Handbook for the application of the Amendments to the National Building Regulations for Energy Usage, Harris,H.C.,2012.*

Significant training efforts have been organised by the Regulator, in terms of approved training material, courses and trainers as well as a systematic training programme for Building Control Officers around the country.

4.4.5 Standards Development

The process of standards development in South Africa is achieved by a committee of experts drawn from all interest groups and Stakeholders, and the standard document is the outcome of a consensus process. The experts are generally volunteers who are often representing sector interests, with some contribution from Professional Engineers and Architects. The resultant Draft South African Standards are subject to Public Review over a 60 day process of participation and criticism. If all queries and criticism can be satisfactorily dealt with, the standards may be published and adopted for use by affected parties.

SANS 10400XA went through all of the processes required of a South African National Standard (SANS). The involvement of the Regulator and experts from the NRCS was pivotal in the development of this document, as the nature of SANS10400XA is that the standard is essentially a compulsory standard. SANS10400XA was developed out of a voluntary standard SANS 204; Energy Efficiency in Buildings, but it incorporates only the aspects of Energy Efficiency which were politically possible. It builds in most of the important energy conservation aspects, but leaves others for a further stage. These are detailed in paragraph 4.4.7 below.

The SANS 204 standard had been born out of three state funded research projects which included an Impact Assessment, which was carried out by the precursor of the NRCS office. Key to the structuring of the SANS 10400XA document was a review of the implications of the SANS 204 standard for the South African Government Low Cost Housing programme. The SANS 204 standard is a voluntary standard in South Africa and has been adopted by government as the minimum standard for new office complex buildings. The Green Buildings Council makes use of SANS204 as the base case Four Star level for energy efficiency.

4.4.6 The Role of the South African Bureau of Standards (SABS)

The SABS is a Standards, Quality Assurance, Accreditation and Metrology (SQAM) institute within the South African Department of Trade and Industry and administers and leads all standards development processes. The SABS role is to promote the development of standards and provision of information and conformity assessment services. SABS has participated in the development of international standards, and continues to play a key role in the development of SQAM infrastructure amongst members of the South African Development Community (SADC). This included signing agreements for use of SABS developed standards in other SADC member states.

SABS, through its specialised Regulatory Division, the National Regulator for Compulsory Specifications (NRCS) has the unique role of developing and promulgating the National Building Codes and Standards. It takes the leading role in the Standards development process and remains the sole custodian of these developed National Codes and Standards.

4.4.7 Lessons Learnt in Establishing the Regulations XA and Supporting Standards

The current SANS204 (voluntary) proposals were developed from the Australian standards (The Building Code of Australia i.e. BCA). The similarity between Australian building codes and Southern African circumstances is a compelling reason for adopting this point of departure. This is motivated by the fact that both Namibia and Western Australia occupy the west coast of their respective continents from latitudes 17°S to 27°S, thus the climates are similar, Further similarities exist in that distances between centres are great and energy costs are at a similar level.

The present South African Climate Zones (see Appendix C) are approximate in terms of their boundaries, as in the current map they are hand drawn. The climatic data for the major population centres has been roughly aligned to these zones, not in terms of any strict climatic criteria. The climatic data for each major centre is taken as representing the balance of the geographic region, and hence the climate zones cover a range of temperature, humidity and radiation, with micro-climates not being differentiated. An electronic map is planned in the next update of the standard and this will improve the accuracy of site climate zone labelling.

The Prescriptive measures included in SANS 204 are generally conservative (i.e. imposing a high and somewhat expensive level of stringency) and are accepted as not being precise but are designed to be adequate to prevent an excessive use of energy in under-performing buildings. In deciding the stringency levels of each of the interventions, many compromises are made in the interests of simplicity.

The following interventions are the main Prescriptive measures in the South African National Building Regulations:

- Orientation: Guidance is given that buildings in colder climates should have their dominant window areas facing the direction of predominant warming radiation (i.e. north), however this is not a compulsory aspect. Experience has shown this to be the correct approach as clients must be able to face views and away from unsightly neighbouring constructions etc.
- Shading: A minimum level of window shading was intended to be mandatory in SANS10400XA, however the intention did not carry through as a result of the lay-out of the document and the wording, and the provisions of paragraph 4.4.1.2 are by-passed. This oversight could be among the changes or amendments to SANS10400XA at the first review.
- Roofs: This is the major area of design change and area of cost impact of the Prescriptive Measures to be applied in SANS10400XA (and SANS 204).
- Roofs incur the highest levels of solar radiation of building surfaces and are often the dominating surface in terms of area from which heating losses occur. The roof and ceiling assembly therefore has a high thermal resistance (R-value) specified in both the mandatory SANS10400XA and the voluntary SANS204. The Life Cycle Cost (LCC) analysis showed a marginal increase in LCC for multi-storey buildings with concrete roofs, and for day-time occupied buildings such as offices and retail malls. Thus an improvement in the simplistic one R-value for all buildings would be to introduce two levels of stringency; one for those with a 24 hour/day occupancy, another for those which can be assured of being used only during business hours, and perhaps also to allow trade-off of roof insulation R-value for R-value in other surfaces such as the walls.
- Walls: The SANS10400XA prescriptive requirements for walls envisage that walls are either low mass walls or masonry walls:
- If walls are of low mass such as a timber frame or light steel frame construction, the walls are required to have a minimum thermal resistance or R-value of either 1.9 or 2.2 m^2K/W depending on the climatic zone/severity.
- If walls are comprised of a 140mm hollow concrete block and single layer of plaster or are constructed of two leaves of brick they are deemed-to-satisfy the requirements. The acceptance of the poor (low R-value of <0.3) thermal resistance of these masonry walling solutions is a political compromise intended to allow for their continued usage in Government buildings, and particularly the 140mm hollow concrete block for low cost housing. If the necessary increase in budget from the Namibian Treasury is not

secured for improving the walling of low cost housing, a similar approach might be adopted by Namibia.

- Windows: If the area of fenestration is not restricted to a level which is less than approximately 20% of Net Floor Area and if glazed elements are un-shaded, then the solar gain and conduction gains and losses can give rise to an energy usage premium and a major long run expense for a structure.
- In SANS 10400XA a rule is in place which requires that, if fenestration areas divided by Net Floor Area is greater than 15%, a set of calculations need to be performed, which will invoke either shading of glazed areas or performance glazing which will reduce the heat losses and gains. This rule acts as a check on the energy efficiency of the fenestration design and it will compensate for sub-optimal orientation, over large windows, or inadequate fenestration specifications.
- There are two sets of calculations; one for naturally ventilated structures and another for air-conditioned buildings. Only the first of these has been normalised for South African conditions and the Australian Air-conditioning Energy Constants are therefore in place. These constants develop the budgets of heat energy gain or loss allowed for each floor and each elevation. They are possibly giving rise to unnecessary expense or they are not providing as a check/break on energy usage for maintaining the set temperatures for the buildings. It is hoped that a review of this aspect of SANS10400XA will be undertaken by the SABS Technical Committee TC60X and 59G in the near future.
- In addition to the window and translucent door requirements there is a system for selecting the performance of roof-lights and glazed areas of the roof.
- Floors: There are no requirements for under-floor insulation, except if there is in-slab heating to be specified.
- Lighting: SANS204 levels of Lighting Power Density are invoked in Table 12 of the document and these levels are not at all stringent. SANS204 will however be upgraded to reflect a South African Best Practice code in the near future.
- Heating, ventilation and air conditioning (HVAC); SANS204 is again invoked for the energy efficiency of HVAC aspects (Table 14; Co-efficient of performance or CoP) which are not at all onerous and require to be updated to reflect South African best practice..
- Building sealing: All window areas of all buildings are required to limit air infiltration or exfiltration to a minimum tested level. Building sealing is not about insulation, rather ensuring that the performance of window and door seals and other gaskets used in the construction are regulated. This provision is ruling out the usage of timber and steel windows and may be unnecessary for residential buildings in Namibia.
- Hot water: The provision of domestic hot water is governed by Regulation (XA2) which states that all installations should have not more than 50% of their hot water energy inputs by electrical resistance heating. Thus either a heat pump or solar-water heating system is required to satisfy the regulations. This measure is calculated to ensure that new buildings reduce their demand on the national electricity grid, and that renewable energy solutions and options have an opportunity to replace in part the carbon (coal) based electrical generation.

4.4.8 Namibian and South African Regulatory Framework Congruence

Namibia and South Africa make use of the same legislation, i.e. Act 103 of 1977; the National Building Regulations and Standards Act, the National Building Regulations (NBR) developed to serve this Legislation and up to 2008 the 'SABS 0400-1987; Code of Practice for the implementation of the National Building Regulations', to effect the building code. The SABS, which was responsible for producing the SABS 0400, falls under the Department of Trade and Industry and acts as the technical advisor to the Minister.

Building failures (structural) and market failure (energy) in South Africa have encouraged the government to tighten up on numerous practices. It has therefore made use of the National Building Regulations and Compulsory Standards to ensure that sub-standard building design practices, under specification materials, poor electrical equipment quality, and uncontrolled site practices do not take hold as norms. Some (few) amendments to the Regulations have been enacted since 1990 and the new series of SANS 10400; The application of the South African National Building Regulations Parts A to XA, have been developed to replace the SABS 0400 series.

The Namibian National Building Regulations and SABS0400 are part of a Regulatory System which is in place and has been operative for many years. The fundamental objective is to ensure safety in building.

There is an opportunity for decision makers to progressively introduce Sustainable Building practices to Namibia via the adoption of suitable standards either in-full or in part. SANS 204; Energy Efficiency in building is available to Namibia for adoption as a Namibian National Standard, and as a resource for voluntary adoption by building owners and developers, who seek to apply best practices.

If adopted SANS204 can then be referenced by a compulsory standard such as SANS 10400XA; Energy Usage in building, or a new similar Namibian standard to be developed specifically for the purpose of mandating energy efficiency.

It would be convenient having these systems developed at no cost to Namibia by a regime with similar climatic conditions and legal system to South Africa, with the opportunity to correct and adjust the documents for local application.

4.5 International Codes and Standards

4.5.1 International Building Code (IBC)

Other model building codes have been developed at an international level that can be adopted or adapted by countries or other levels of local government. In particular is the International Building Code (IBC), which has been developed by the International Code Council (ICC). The IBC explicitly includes sections on EE and as such provides minimum design requirements. The requirements are directed towards the design of building envelopes with adequate thermal resistance, low air leakage, and toward the design and selection of mechanical, water heating, electrical and illumination systems that promote efficient resource utilisation[11].

4.5.2 International Standards Organisation

In terms of standard development, the International Standards Organisation (ISO) based in Geneva Switzerland has commenced a programme to develop a comprehensive set of standards which are designed to support the development of building codes around the world.

[11] *ICCSafe, 2012. About ICC (Online). Available: http://www.iccsafe.org*

This programme is currently underway and the main framework standard ISO 23045 is being used as a guideline[12].

Any member country of the ISO or the country representative body (such as the NSI) can make use of the current or future system of ISO standards. These can be used to structure a system to support the development of country, or regional, specific building standards[11]. For example the current standards could be used to guide the development of buildings in Namibia:

- ISO8301; Standard test method for steady state heat flux measurement and thermal transmission properties by means of the guarded hot-plate method. (i.e. Thermal Conductivity determination)
- ISO6946; Building Components and building elements - Thermal resistance and thermal transmittance – calculation method
- ISO 23045; Building Environmental design – Guidelines to assess the energy efficiency of new buildings
- ISO 16818: Building environment design - Energy efficiency – Terminology

4.6 Conclusion

As has been seen from the case studies in this section, the process of developing, legislating and enforcing building codes varies between countries. There are however two predominating types of building codes frameworks that are in use, the model building code (as seen in Germany and the IBC) and standard building code (as seen in Australia and South Africa)

The inherent difference between the two approaches is where jurisdiction lies for enforcement of building regulations. Model building codes are preferred where jurisdiction is held by regional or local authorities, thus they serve as guidance but can be tailored to specific local conditions. Standard building codes are generally applied uniformly across a country or region and thus are preferred where building regulation jurisdiction generally applies at a higher level of government, or there is active buy-in from regions.

These frameworks of building codes can however include either of the processes for determining the requirements that needs to be met for buildings, that is through either setting performance requirements or mandatory processes, products and methods. The setting of performance requirements have generally been preferred internationally as they allow for flexibility with regard to building construction, while ensuring that minimum limits have to be met around energy usage, sources, health and safety. It places the onus on the designer or developer to ensure and prove that the building meets regulations. This does however increase the administrative burden for regulating bodies as they need to analyse and approve all applications. Setting mandatory minimum standards do allow for these to be overcome, but they also do not allow for flexibility and thus may discourage the construction of some buildings.

The varying building code systems are however increasingly beginning to implement components to ensure that EE and RE consideration are taken into account in buildings, whether new construction or major renovations. The consistency is that these building codes set or promote aspects of equipment, components, design process and monitoring to ensure that EE and RE consideration are adequately implemented and achieve their goals. EE and RE requirements of building codes, whether mandatory set or performance driven are being tailored to the country or region specific climatic conditions to ensure optimal performance of the building structure and safety, health and comfort of building occupants.

[12] *ISO. 2012. Standards (Online). Available: www.iso.org*

Building codes are implemented and respected when the correct enabling environment and legislative framework is in place and are able to be administered. The framework for implementation, either mandatory or performance driven, has to be tailored to the specific countries capacity, legislative framework, while the detailed minimum requirements of the regulation or codes need to be aligned with a country's unique political, economic, and social situation and climatic conditions.

5 Sustainability in the Building Sector in Namibia

5.1 Sustainability in Buildings

Sustainability in buildings is a multi-faceted concept and incorporates issues such as reducing GHG emissions, disaster resistance, energy efficiency, costs reduction, ensuring health and safety and promoting environmental considerations. In particular, sustainability in buildings encourages the efficient use of resources, in particular energy and water, while maintaining the quality of habitation for building occupants and users. This can also have effects on economic development through providing long term benefits to households through reducing costs and improving living conditions.

Introducing sustainability concepts into the building sector, in particular around EE and RE, for Namibia has the potential to assist in meeting the targets outlined in Vision 2030, NDP 4, The White Paper on Energy Policy and the MRLGHRD Strategic Plan 2009 – 2014.

5.2 The Role of Building Energy Efficiency Standards

International experience shows that market forces are inadequate to effect the required energy efficiency changes quickly. In most countries, a legislative and regulatory intervention has been required to ensure compliance and the desired EE outcomes in new and renovated buildings.

It was recommended in the NEEP baseline study that a well-designed and consistently implemented national energy efficiency programme, based on a progression of measures rolled out as part of an overall, on-going, long-term programme to introduce energy efficiency in the country's building stock is likely to yield the best long-term results. Such measures include:

- Setting national energy and energy efficiency targets,
- Development of EE standards for buildings,
- Appliance labelling or equipment and appliance energy efficiency standards
- Taxation of in-efficient products e.g. incandescent lamps and subsidies for more expensive energy efficient products
- Voluntary (and in time compulsory) reporting of energy and CO2 intensity of commercial and industrial operations, possibly as part of a carbon disclosure project,
- Increased information dissemination around EE and RE, and
- Building Energy Audits and Assessments, for existing buildings, possibly with some direct support for these audits, and Energy Performance Certificates for buildings

The Public sector was identified in the NEEP study as the logical starting point for the implementation of building standards in Namibia. These would act as demonstration buildings and provide national and market leadership. This however would also have additional benefits, as the introduction of energy efficiency standards could yield substantial long-term cost reductions for the running of government facilities.

Architects and designers are the influencers in the decision making process of prospective building developers. If energy-related operating costs are brought to the attention of owners and tenants then the correct decisions can be taken to ensure an energy efficient design. The introduction and application of energy efficiency measures in new buildings has been successfully driven by building professionals in many other countries.

5.3 Barriers to EE and RE in buildings in Namibia

There are currently a number of barriers to the adoption of building sustainability concepts in Namibia, in particular around the introduction of EE and RE considerations. The baseline scenario in the Namibian building sector, outlined in the Annual National Survey on Energy Efficiency conducted in 2011, identified barriers such as:

- Current national building codes do not incorporate standards and recommendations on EE and RE for various aspects including the building envelope, lighting, water heating and indoor air quality,
- There is no EE standards and labelling system in Namibia,
- Building owners do not have access to dedicated financial instruments to introduce EE technologies into their buildings,
- Building owners have limited access to technical resources to conduct energy audits and there is a limited availability of qualified energy auditors,
- Lack of awareness around investment required and the financial feasibility of investing in EE technologies,
- Limited promotion of EE activities and awareness raising programmes from all stakeholders, and
- There are no significant programmes or legislation that offers incentives promoting the uptake of EE technologies

These barriers to the uptake of EE and RE technologies are consistent with those faced in other countries throughout the world. In order to overcome these barriers a wide variety of measures need to be implemented, starting with information dissemination and awareness raising, as well as the development of regulation or incentives to encourage the transition and incorporation of RE and EE technologies and building methods.

5.3.1 Potential Energy Efficiency Improvements in Namibia

It was noted in the NEEP Baseline study that urban areas comprise mainly of residential land, and that domestic electricity consumption is of the order of 40% of total urban consumption. The benchmarking of domestic energy consumption for Namibia is proposed in the NEEP as necessary and that the sector is expected to yield considerable savings potentials if energy efficiency measures are introduced.

Without a survey of actual household energy usage and appliances in use, but based on the studies of average electrical usage and demand, as well as anecdotal evidence of the offerings in the market place by way of appliance advertising and in-store displays, this would indicate that the residential sector can contribute to the improvement of energy efficiency in buildings. Hence the Building Codes should include measures which ensure that future Namibian home-owners are not burdened by an ever increasing stock of energy inefficient buildings.

It is suggested in the REEECAP report that it might be easier to achieve efficiency savings in commercial buildings than it would be with domestic energy efficiency, due to the easier availability of capital in this sector, but this should not deter efforts to make progress in the residential sector.

Key results from the life cycle cost analysis, from the REEECAP report, of middle to upper income (150m^2) residential buildings are reproduced below:

- North orientation is financially advantageous for a project in Windhoek
- Thermal Insulation is financially feasible by way of a combination of fibre on ceiling with aluminium foil tile under-lay, and will reduce energy usage by 57%
- Using roof tiles over corrugated iron sheeting is beneficial from a government project perspective, but not for a private project
- Creating an air-gap in double skin walls is beneficial from a government project perspective
- Double glazing is not financially viable and is only beneficial in the short winter months
- Clay houses are as energy efficient as double skin brick houses and are cheaper to build, making them extremely viable propositions where feasible
- An increase in window size (from 22.5m2 to 35m2) results in a small efficiency reduction, but has the advantage of additional natural light in the building.
- Changing wall colour is not a financially viable energy efficiency intervention for mid to high income households

Notes to the modelling results:

1. Shading is modelled on the south side window of the low-income home and this is shown to be very beneficial, but is intuitively unlikely and requires re-evaluation.
2. Reduced window size from 36m^2 to 22.5m^2 has given rise to only 45kWh per annum of savings, but this is modelled in comparison with a base case which is already insulated and therefore the insulation is eroding the energy saving potential of the window.
3. The advisory regarding steel roof versus clay tile is questionable as the thermal resistance contribution of both materials are very low, and without a tile under-lay both roofing systems are not used to the thermal optimum.
4. The double brick cavity wall options need to be re-evaluated for the same reason as 2 above.

5.3.2 Non-building Codes Issues

The NEEP baseline study reports a demand for information regarding appliance efficiency. Many respondents indicate that they are eager to make more informed choices but lack access to clear information. The view is expressed that the research of and dissemination of such information is best done centrally, by some branch of Government and the recommendation in this report may be to adopt one or another standard of appliance labelling.

The Regional Electricity Distributers are expected to have little direct interest in energy efficiency, except when the bulk supplies are to be purchased or generated at high cost, such as for peak hours when it may need to be generated from the burning of expensive fossil fuels. This provides opportunity for the Electricity Control Board to empower generators to give financial support to a Demand Side Management programme which will subsidise interventions that can serve to move electrical energy use to off-peak hours and reduce overall electrical energy usage.

The Ministry of Mines and Energy is the custodian of Namibia's energy-related policies, however the roll-out and application of energy efficiency standards in buildings may be better suited to another agency or government department. The responsibility for policy development, legal and regulatory frame-work, human resources, technical and financial preparations will need to be assumed by this body.

5.4 Climate Characterisation

Crucial to ensuring sustainability in buildings is aligning recommendations to the prevailing climatic conditions. This ensures that adequate technologies are recommended that can take advantage of the climatic conditions (e.g. solar resources), but also ensure that buildings are constructed in a manner that ensure the health, safety and comfort of occupants. Thus gaining an understanding of the climate characteristics prevalent in Namibia is essential to the development of effective building codes.

5.4.1 Preceding Climatic Classifications for Namibia

The CSIR was responsible for a significant amount of research undertaken in the 1960's and 1970's, with a particular focus on the relation between climate classification and zoning. In the early 1980's the relationship between climate, building materials and building performance was conducted. During this process climatic data for Namibia was collected and published in Report 300 of 1981 by Van Deventer.

The CSIR research work formed the basis for the development of a climatic map of Southern Africa. These climate maps and findings served to guide the development of National Building Regulations and Building Standards Act No. 103 of 1977 of South Africa, which is the current act in use in Namibia (see section 2.3.1). These climatic maps still form part of the new development of South African building codes and can be seen in SANS 10400 Part XA; Energy Usage in Buildings as a hand drawn map based on the original map (Appendix C, Figure 2).

5.4.2 Current Computer Climate Files for Namibia

It will be possible for professionals and energy modelling experts to compile computer based climate files for Namibia based on the climate data available and thus to develop Rational Designs utilising this data.

Climate files for; Windhoek, Alexander Bay and Keetmanshoop are available on Bsimac software. Design Builder files are in the process of being created for many locations by the software vendors.

5.4.3 Influence of Climate on EE and RE Specifications

The variations of climatic zone result in a range of energy usage of 7.5% for a standard unimproved office building between Windhoek and Keetsmanshoop, as per a modelling of using Bsimac (an Agrément SA accredited energy modelling software package).

The energy usage effect of climate in comparison with Alexander Bay and Runtu is within the range between Windhoek and Keetmanshoop. It is imperative that any future RE & EE intervention specifications and stringency levels are subjected to an analysis of efficacy and affordability in the context of the various climate zones in Namibia. This will be conducted in following stage of this assignment, once clearer direction is obtained around the approach to be taken to incorporate EE and RE in Namibia's building codes.

6 Options Analysis

6.1 Provisional Recommendations with Respect to a Building Code

The preceding NEEP baseline study and the REEECAP assessment of options have placed Namibia in a position where the present level of energy efficiency of the building sector is understand and a number of interventions have been highlighted as being potentially appropriate for the country.

The review of international practices provides guidance as to what systems have been put in place in other countries and which could be implemented in Namibia. These International systems have common essentials and are drawn from the options of: mandatory codes or prescriptive codes, setting performance requirements and rational designs, and mixtures thereof to assess compliance and to achieve flexibility between options. The mixtures of these tools are driven by directive, legislation or regulation, depending on the preferred country legal framework (see section 4).

Subsidiary to the chosen compliance system is the individual intervention areas to be selected such as roof insulation, lighting etc. The process of selection of interventions, the selection of the levels of intervention, or the stringency thereof are generally the same for all countries. The results will vary for the assumptions made with regard to interest rates, inflation, the cost of energy, the likely rate of escalation of power costs, the cost of implementing various interventions, as well as the expected life of the buildings or the interventions themselves.

Based on an analysis of the studies previously conducted in Namibia and international best practice (identified in section 4) a number of provisional recommendations have been developed for consideration. These predominantly revolve around creating an enabling environment for the adoption of EE and RE consideration in building process and standards development. The provisional recommendations are grouped according to the following categories:

a. ***Regulatory measures*** which would include a mandatory standard with energy usage performance requirements for the various classes of commercial, industrial and residential buildings. These would be climatically differentiated, and also prescriptive alternatives, to be consistently applied by all Local Authorities for all buildings.

b. ***Enforcement, Information dissemination and awareness*** creation for architects, designers and engineers, for a voluntary adoption of best practice EE standards and for green building performance criteria in Namibia. Training programmes for architects, designers and engineers, suppliers, contractors and workmen to deliver the required solutions. Omitted but extremely important is the training of building professionals in EE and the implementation of any mandatory standards, and the up-skilling of Building Control Officers or Building Inspectors to be able to enforce new building plans and sites for compliance.

c. ***Financial incentives*** are recommended where there is market failure and the costs of applying renewable energy technologies are presently yielding marginal returns.

d. ***Public buildings leadership***, where The Department of Works (DOW), as developer of all public buildings in Namibia, supports the adoption of Energy Efficiency in a National Building Code and undertakes to apply this code in all projects.

6.2 Options Available

Based on the above research, there are three options available to Namibia for the direction and implementation of RE and EE considerations in the building sector. These include:

- **Option 1**: Application of International Building Codes and International Standards Organisation standards as a basis for development of the requirements for EE and RE in the Namibian building sector,
- **Option 2**: The adoption of selected South African Regulations and Standards, as consistent with the current legislative framework regarding building codes in Namibia, or
- **Option 3**: Develop a Namibian specific standard to implement EE & RE and that can be adopted into the Namibian building code. This can be modelled on international standards such as South Africa, Australia, ISO or the International Building Codes

Whatever standard development process is followed there are two broad essential elements to put in place:

- The compliance systems, whether mandatory or performance based in terms of the possible models for adoption and their routes to compliance, within the existing legal and regulatory framework
- Stringency levels of various interventions to comply with the routes to compliance

6.2.1 Option 1: Adopt International Building Code and International Standards Organisations documents

The International Best Practice review of Section 4 above shows that the International Building Code (IBC) is available for use by Namibia; however the details of this option have not been fully investigated. It is likely that these standards incorporate a level of stringency which would be at a similar level as a Green Building in the USA.

The IBC can, in conjunction with ISO and European Norms (EN) standards, form a comprehensive system of documents assembled to create a National Building Code. These documents would need to be referenced in a new Namibian national building regulation. It may be that the level of stringency can be modified or reduced to levels considered desirable and affordable to the Namibian market.

The nature of the EN and ISO systems is that they are generalised and offer broad alternatives and need to be supplemented with local standards to get to the parochial country requirements. The body of EN/ISO Standards does not provide any legal framework.

The international review shows that the EN and ISO standards present a model which is available to Namibia to use as support for a suite of local standards, but will require some considerable tailoring to meet Namibian needs at present.

6.2.2 Option 2: Selected Adoption of South African Regulations or Standards

The Namibian Building Code is based on the same legislation as South Africa, the same Regulations and similar Standards (SABS 0400). Furthermore the Administrative system overseeing the implementation of the code in Namibia is very similar to that in place in South Africa.

Since 1990 there has been only one major overhaul of the South Africa National Building Regulations (2008) and a new series of Standards the SANS10400 series has been developed. These are available for adoption in total or in part.

Namibia is perhaps in a fortunate position to be able to survey the success or otherwise of South African efforts to update their building code and can choose to adopt that which is considered appropriate. Many of the proposals made above are presented as result of the record of these South African measures.

This approach would be simple in the sense that the formal adoption of Regulations XA, SANS 204 and SANS10400XA and will give effect to the decision.

6.2.3 Option 3: Develop Namibian Standard for Energy Usage and Energy Efficiency in building

A Namibian Standard can be developed specifically to implement EE & RE into the current Namibian building code. The potential exists to model or adapt components of other standards so they are applicable in a Namibian context. This could include the adaptation of South African and/or ISO standards.

The essentials of the Nordic structure can be followed in Namibia if the South African or Australian type documentation route is followed. This would entail establishing Functional Objectives in Regulations and Prescriptive and Performance Requirements in a Namibian Standard, similar in purpose to the SANS 10400XA document in South Africa. This could also entail referencing to existing standards either developed by the NSI or partners, such as SABS, e.g. the SANS 204 document could also be adopted as a voluntary standard and this could be referenced where this is desirable.

ISO standards or ASHRAE standards can also fulfil this role and be structured such that all the fundamentals are in place with foundation level standards, and layers of higher/superior standards are built up on these standards, and finally with amendments to align with the present SABS 0400 Code of Practice and the empowering regulation.

EE and RE objectives have been placed in Namibian state policy and planning documentation[13] (see section 2.2.1), which has been developed out of legislative authority. This can be followed with an amendment to the existing Namibian National Building Regulations. This could affect energy issues in isolation, or could be part of comprehensive overhaul of the regulations.

6.3 Summary of Options

Table 6-1 below provides a summary of the options provided in section 6.2. In particular it outlines the proposed responsibility for implementation, including an outline of the process of implementation and development, ease of implementation, barriers to implementation, benefits, and risks involved.

[13] *The Energy White paper of 1998*

Table 6-1: Summary of Options

	Option 1: Adopt International Building Code and Standards	Option 2: Adopt South African Regulations or Standards	Option 3: Develop Namibian Standard for RE and EE in Buildings
Code Development Process	Engagement is initiated with the IBC and ISO to determine if they are suitable for adoption in Namibia. If deemed suitable then these would have to be tailored to Namibia's situation.	Undertake an analysis of current South African regulations and standards to see if they are suitable for adoption in Namibia	A process would have to be initiated to develop RE and EE regulations and standards that are specific to Namibia for adoption by appropriate bodies.
Code Adoption Process	New legislation and regulation required to supersede current Namibian regulations	Existing law in Namibia would need to be superseded by the latest South African regulations and standards	Existing law is utilised and updated to include an EE and RE standard
Lead Agency in Development	NSI	NSI	NSI, MME, MRLGHRD and MTI
Code/Standard Custodian	NSI	NSI and SABS	NSI
Benefits of Adoption	Alignment with international best practice	Existing and established regulation, Aligns with existing Namibian legislation, Parts of South Africa have similar climatic conditions to Namibia, Existing partnership between NSI & SABS.	Solution tailored to Namibia's context, Aligns with tested and practical international best practice.
Barriers to Adoption	Time to evaluate the applicability of the regulations and standards, Generic standards that are not aligned with the specific requirements of Namibia, Potentially high costs associated with necessary consultation requirements , legal fees and time to implementation	South African standards and regulation may be considered inappropriate	The complexity associated with development of new standard, Potentially high costs associated with necessary research, consultation requirements, legal fees and training.

	Option 1: Adopt International Building Code and Standards	Option 2: Adopt South African Regulations or Standards	Option 3: Develop Namibian Standard for RE and EE in Buildings
Risks to Adoption	Delay in development and adoption of standards, Requirements not accepted by stakeholders. Political will for adoption of international standards	Not accepted at local level, Requirements seen as too stringent, costly or inappropriate for Namibia, Political considerations about adopting standards developed in another country	Potentially complex development process, Lack of technical capacity to institute recommendations, Limited awareness around the development of building codes and their application

6.4 Way Forward

This report provides an overview on the background of the present situation in Namibia alongside current international best practice for the development of a regulatory frameworks and adoption of RE and EE measures. No explicit identification of the required minimum levels, measures or processes that should be implemented to ensure EE and RE have been made in this report as this can only be done once the direction of development in terms of regulatory framework has been agreed with all stakeholders.

The three options provide potential directions to be debated by key stakeholders and a preferred appropriate route selected. Once clear direction is received then a plan of implementation can be developed and adopted and the specific EE and RE components can be evaluated, presented and refined and presented back to stakeholders for further consultation and approval.

As per the Energy White Paper, the proposal (the selected route to the development of the Namibian Building Code adopted) should be subjected to a Regulatory Assessment (RA); comprising an Environmental, Economic and Social Impact Assessment.

It may be required that the RA should precede the publishing of Energy Regulations and the adoption of suitable Energy Usage and Efficiency Standards.

In terms of the objective, the barriers to successful implementation will need to be identified by stakeholders, with ideas for the mitigation thereof canvassed, and presented as an integral part of the plan of implementation of the RE and EE measures.

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Appendix B: Example of Notional Building Modelling

VisualDOE is a research software programme developed by the United States Department of Energy, and it has been used in many such Building code evaluations.

The specification is detailed and a VisualDOE model is developed to assess the energy usage and demand performance of the home without improvement and then with all interventions included (Improved to DTS). Each of the possible interventions is then unloaded from the model.

Electrical Use Summary

Alternative	Lights	Equipment	Heating	Cooling	Fans	Hot Water	Ext. Lights	Total
Electrical End-use Totals (kWh)								
Base-case	4 900	2 450	8 426	3 188	3 587	13 929	394	36 874
Rational Design	3 408	2 450	1 799	1 905	2 522	0	394	12 478
Improved to DTS	3 408	2 450	1 107	3 081	3 832	10 510	394	24 782
DTS without roof insulation	3 408	2 450	2 464	3 609	3 646	10 510	394	26 481
DTS without wall insulation	3 408	2 450	3 747	1 859	2 891	10 510	394	25 259
DTS without floor insulation	3 408	2 450	2 249	2 305	3 307	10 510	394	24 623
DTS without building sealing	3 408	2 450	3 246	3 049	3 832	10 510	394	26 889
DTS wall insulation & thickened north	3 408	2 450	1 269	3 141	3 781	10 510	394	24 953

Energy Cost Summary (N$/y)

Alternative	Total Electric	Total Utility	Incremental First Cost	PV Life Cycle Cost*
Total Energy Cost (N$/y)				
Base-case	N$16 014	N$16 014	N$0	N$295 581
Rational Design	N$5 419	N$5 419	N$33 978	N$117 611
Improved to DTS	N$10 762	N$10 762	N$10 930	N$177 024
DTS without roof insulation	N$11 500	N$11 500	N$6 290	N$183 773
DTS without wall insulation	N$10 970	N$10 970	N$7 518	N$176 822
DTS without floor insulation	N$10 694	N$10 694	N$9 552	N$174 596
DTS without building sealing	N$11 678	N$11 678	N$9 430	N$189 661
DTS wall insulation & thickened north	N$10 837	N$10 837	N$10 930	N$178 181
DTS wall insulation & thickened north	N$841	N$841	N$-1 500	N$11 479

* 30 year life cycle w/ 7% discount rate.

Monthly Electrical Usage (kWh)

Alternative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Base-case	2 751	2 373	2 568	2 543	3 399	4 423	4 513	3 593	2 782	2 658	2 587	2 683
Rational Design	1 157	983	1 003	797	958	1 362	1 380	998	858	925	965	1 092
Improved to DTS	2 241	1 980	2 155	1 899	1 988	2 141	2 211	2 013	1 940	2 033	2 008	2 172
DTS without roof insulation	2 345	2 049	2 197	1 907	2 158	2 556	2 623	2 210	1 998	2 087	2 086	2 264
DTS without wall insulation	2 088	1 818	1 926	1 718	2 146	2 872	2 913	2 230	1 812	1 861	1 866	2 008
DTS without floor insulation	2 133	1 876	2 031	1 794	2 036	2 437	2 485	2 079	1 865	1 930	1 905	2 052
DTS without building sealing	2 290	2 009	2 169	1 907	2 243	2 803	2 849	2 318	2 005	2 057	2 038	2 201
DTS wall insulation & thickened	2 262	1 994	2 162	1 890	1 991	2 185	2 259	2 022	1 941	2 039	2 019	2 187

Monthly Electrical Power Demand (kW)

Alternative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Base-case	7	6	6	8	12	15	15	13	10	7	7	6
Rational Design	4	3	3	3	4	5	6	5	3	3	3	3
Improved to DTS	5	5	5	4	5	6	7	6	4	4	5	5
DTS without roof insulation	5	5	5	5	7	9	9	8	5	5	5	5
DTS without wall insulation	5	5	5	4	7	8	9	8	6	4	5	5
DTS without floor insulation	5	5	5	4	6	8	9	7	5	4	4	4
DTS without building sealing	5	5	5	5	8	10	10	9	6	5	5	5
DTS wall insulation & thickened	5	5	5	4	5	7	8	7	5	5	5	5

Appendix C: Climate Zones of Namibia

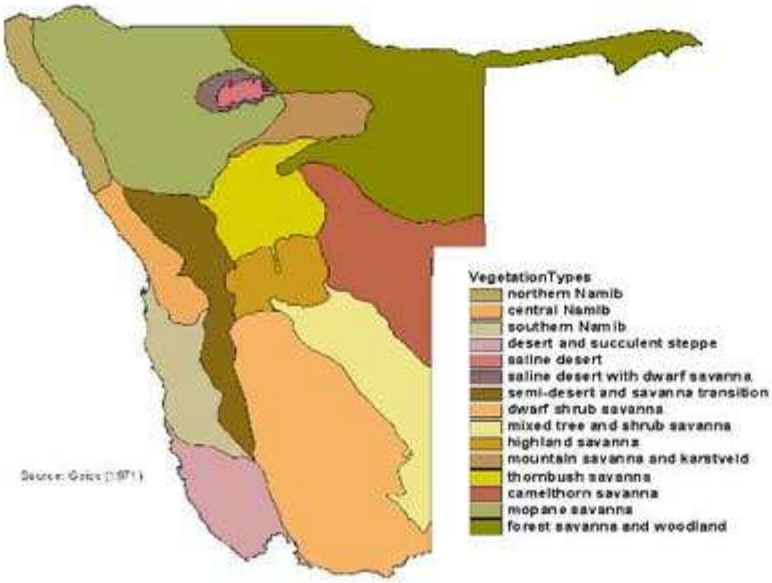

Figure 1; Vegetation types of Namibia from Sweet, J. and Burke,A.

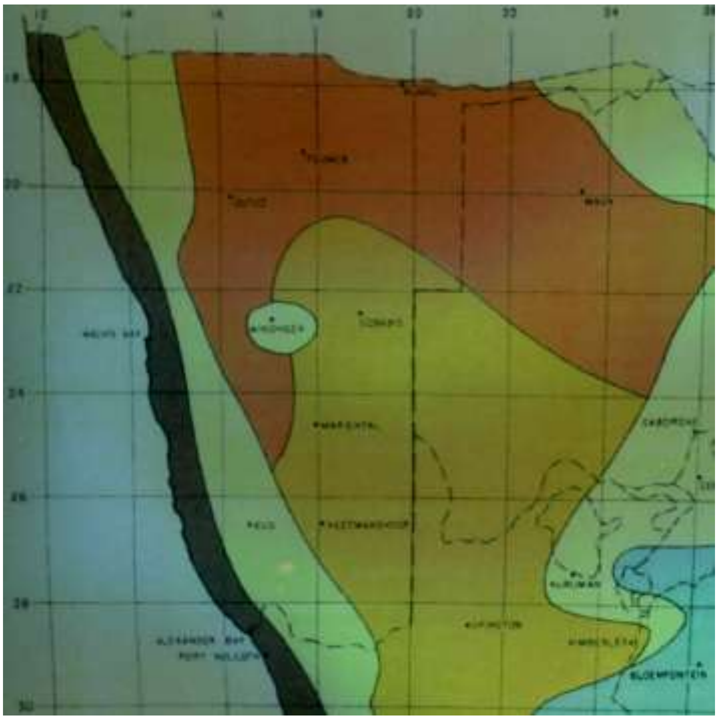

Figure 2: CSIR Climate Zone map of Southern Africa (cropped)

The above maps show a degree of congruence, and may be corrected and adopted for Namibian Climate Zone purposes.

Appendix D: City of Windhoek Building Plan Inspection Form

City of Windhoek *City of many faces* Department of Urban Planning & Property Management Building Division	Erf No.:
	Township:
	Addition to Sectional Titles (Yes / No)

Submission of Building Plans

WINDHOEK MUNICIPALITY: BUILDING REGULATIONS

GOVERNMENT NOTICE NO 57 OF 28 APRIL 1969

Building plans will only be accepted for approval, if this form us filled in completely and if the applicable fees have been paid. Building plans must be signed by the owner and his/her name and address must be shown on the plan. In case of a registered architect, land surveyor or professional engineer, his profession and registration number (if any) must also be shown.

TO STRATEGIC EXECUTIVE

URBAN PLANNINGPROPERTY MANAGEMENT

I, the undersigned hereby make an application to carry out certain works set forth in the plans sent herewith and the following schedule, and I undertake to execute the same in strict accordance with the municipal building regulations as amended and promulgated in accordance with the local authorities act 1992 (23 of 1992).

Schedule relative to building regulations		FOR OFFICIAL USE ONLY
Description of Work	Dwelling / Additions / Boundary Walls / Pool	**Building Plan No.:**
Street From Which Entrance is Obtained		
Materials: Foundation	Concrete	
Materials: Walls	Cement Bricks / Concrete / Other (*specify*)	
Materials: Damp Course	Brickgrip 250 micron / Other (*Specify*)	
Materials: Roof Cover	Specify (*SIBR., etc.*)	
% Ventilation - Window Space of Each Room		
Volume of Swimming Pool (cub. meter)		
Value of Buildings	N$	

Total Built-up Area: (m2) (According to outside measurements)		
Dwelling/s:	1) m^2	2) m^2
Outbuildings:	m^2	Garage, carport, servant's room, etc.
Total new additional area:	m^2	

Must be completed in block letters

Owner's details		Designer / Architect / Draughtsperson	
Name		**Name**	
Postal Address		**Postal Address**	
Tel. / Cell.:		**Tel. / Cell.:**	
E-mail Address		**E-mail Address**	
Signature	**Date:** / /	**Signature**	**Date:** / /