Promoting Energy Efficiency in Buildings

ECREEE Workshop 10th June 2014, Praia, Cape Verde

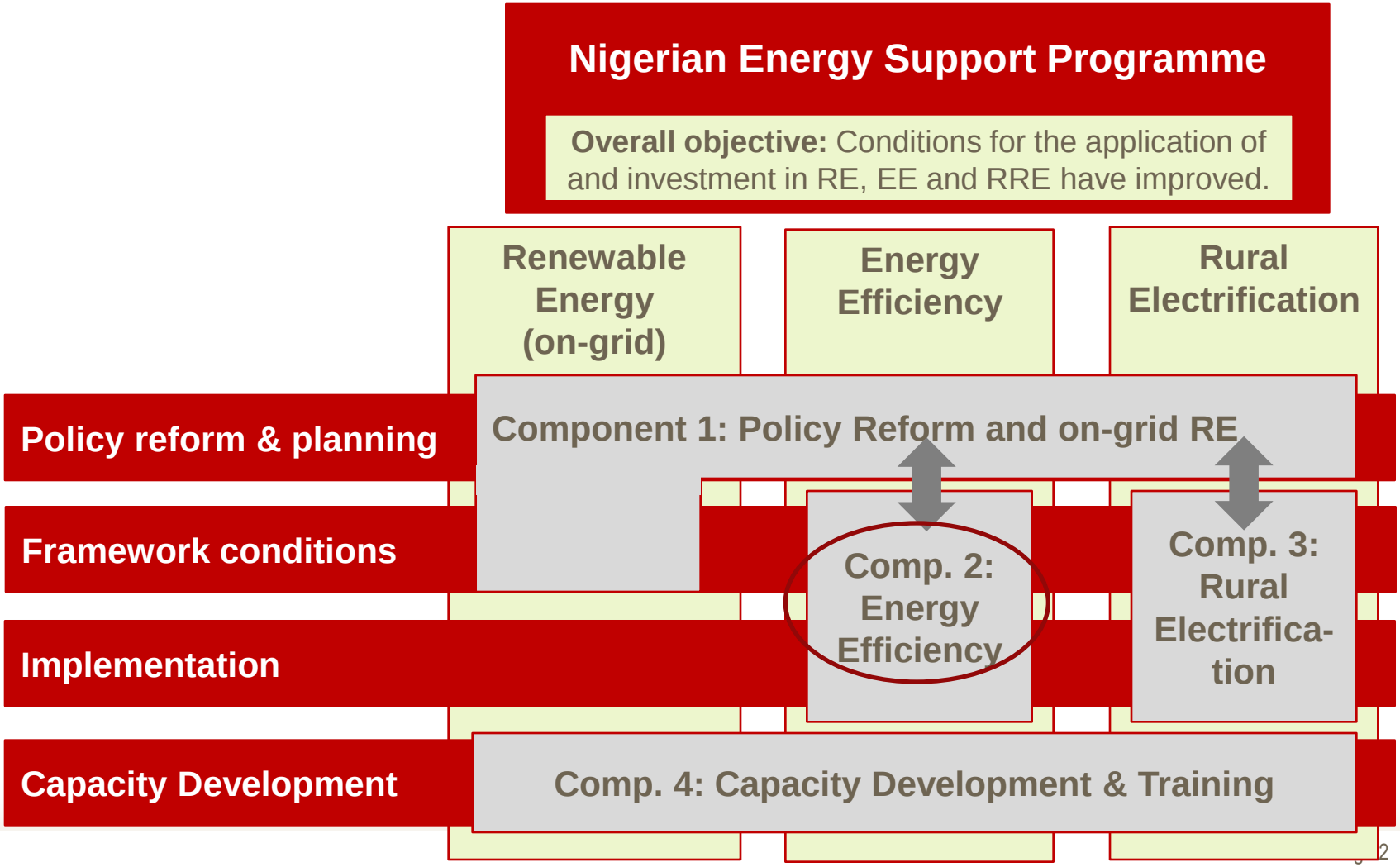
Presentation by:

Ene Macharm, EE Adviser NESP

Daniel Werner, Programme Director NESP

The Nigerian Energy Support Programme (NESP/GIZ) in Collaboration with the Federal Ministry of Power (FMP)

The Nigerian Energy Support Programme (NESP)
Intervention Levels



GIZ NESP Energy Efficiency Intervention

Overall Objective:

- Framework conditions for energy efficiency (EE) are improved and concrete measures generate energy savings

Specific Objectives:

- The policy framework for EE at Federal Level is reviewed, updated and improved
- EE standards and further support mechanisms are defined and implemented by relevant institutions
- Promotion measures for energy efficiency solutions are under implementation (awareness programmes and pilot implementation)

Concrete Outputs of GIZ NESP

- Supporting the development of a Building Energy Efficiency Code (BEEC) with technical documents
- Supporting the development of a Building Energy Efficiency Guideline (BEEG) as a working document to support the implementation of the BEEC.
- Supporting the development of EE standards in appliances (SWH, and Refrigerators or AC's)
- Supporting the implementation of Pilot Projects via technical and financial contribution (SWH and EE buildings)
- Supporting the development of further EE support mechanisms (e.g. financial mechanisms)

Stakeholders

Key stakeholders:

- Public sector: FMLHUD, FMP, SON, Fed. Mortgage Bank
- Private sector: Association of Construction Professionals in Nigeria, e.g. Architects Registration Council of Nigeria (ARCHON), Green Building Council of Nigeria (GBCN)
- International organisations: UNDP, UN Habitat, ECREEE

Baseline study (completed): energy efficiency in buildings (EEB)

Objectives: To have an overview of EE in buildings as a basis to clearly define interventions to promote EE in buildings

Methodology: The method used for this study was desk research, selected expert interviews, administration of questionnaires to conduct surveys, building inspections, and energy consumption calculations.

Contributing experts to the EEB baseline study were:

- Staff of National Centre for Energy Efficiency and Conservation, ECN
- University Lecturers
- Private Sector

Motivation for energy efficiency in buildings

Urgent need for energy efficiency in buildings due to:

- the rapid population growth and continuing rural-urban migration, and the **pressing need for decent housing**; **Nigeria's 17 million housing deficit would require N59.5 trillion**;
- the growing number of sector reforms in Nigeria (agriculture, telecommunication, energy) is leading to a **greater demand for offices** as international investors are on the increase;
- the **suppressed demand for energy services**, meaning that energy consumption will skyrocket as soon as affordable energy supply is constantly provided, also due to **very cheap and and very wasteful electric appliances imported from China**;
- the trend towards constructing according to **international style of architecture**, leading to an enormous amount of cooling energy consumption;
- the lack of constant electricity supply.

Energy generation and demand as at 14th Oct 2013

GENERATION REPORT | FACT SHEET

as of **October 14, 2013**

Peak Generation 3,636.10 MEGAWATTS (MW)	**Peak Demand Forecast** 12,800.00 MEGAWATTS (MW)
Energy Generation 3,395.42 MEGAWATTS HOUR/HOUR (MWH/H)	**Energy Sent Out** 3,314.77 MEGAWATTS HOUR/HOUR (MWH/H)
Highest Peak Generated 4,517.6 MW on December 23, 2012	

Source: Presidential Task Force on Power (Website, http://www.nigeriapowerreform.org/)

Content of the baseline study energy efficiency in buildings

1 Introduction
2 Energy efficiency in buildings: the challenge in a nutshell
3 Climate zones and related measures of bioclimatic architecture
4 Policy elements to promote energy efficiency in buildings
5 Important actors of the Nigerian building sector
6 Legal framework conditions of the building sector
7 Financing of buildings — Survey
8 Building related energy aspects — Survey
9 Households: assessment of potential EE business cases — Survey
10 Public admin offices: assessment of EE business cases — Survey
11 Energy efficiency in buildings and market barriers
12 Successful implementation of EEB: good examples
13 Activities of other donors
14 Recommendations for setting up the EEB component of NESP

Bioclimatic architecture considers climate data and site specific information

Based on the major 3 climatic zones of Nigeria;

- The Tropical Rainforest Climate or the Equatorial
- The Tropical Savannah Climate or Tropical Wet and Dry Climate
- The Sahel Climate or Tropical Dry Climate

The climate responsive building design concept in the tropical rainforest climatic zone and that of the tropical savannah climatic zone are very similar. Due to the frequent rainfalls in these climate zones, the building design concepts adopted are high pitched roofs for effective water drainage to avoid roof leakages, high DPC levels to avoid damp and moist attack on the walls.

In the Sahel climatic zone, the climate responsive building design concepts consist of courtyard designs, buffer zone control spaces line, double walls with air space in-between, provision of sun shades and wind breakers, low pitched roof and parapet walls.

Nigerian building stock – architecture and materials

Architecture – building designs:

- Characterised by the post-modern buildings of the 1990's
- The concept of energy efficient bioclimatic architecture as used in traditional architecture seems to have lost its usage.
- Major determining factors: copying international designs, finance, cost of materials, workmanship.

Construction methods and materials:

- Materials available in the various zones and methods of construction of buildings are basically the same.
- Local materials like mud for bricks and thatches for roof are hardly used in the urban areas as the foreign designs do not suite their use.
- Little or no patronage of these building materials by government, corporate bodies and individuals for use in building their houses.

Nigerian building stock – energy consumption

- Grid electricity is still cheap but is being reviewed (Multi Year Tariff Order).
- Generation capacity is seriously hampered by poor generation capacity, poor gas supplies, poor grid infrastructure, lack of EE.
- Metering and billing:
  - **Analogue metering:** The analogue meter had been the major type of billing system used for metering the energy consumed by electricity consumers over the years in Nigeria. The meter measures the energy consumed monthly.
  - **Estimation:** Estimated billing is computed based on the general assumption of the energy an average household would consume in a month.
  - In some cases the meters are never read in six months and in other cases the estimates are arbitrary.
  - **Prepaid metering:** Consumers pay their bills upfront but meters are grossly inadequate.

Energy efficiency in buildings business cases

- A key problem is the lack of data.
- Thus, assessment of business cases was based on surveys and case study analyses in Minna in Niger state (chosen to represent the Northern climatic zone) and Abeokuta in Ogun state (chosen to represent the Southern climatic zone).
- Business cases were calculated for households and public administration offices.
- Calculations resulted in substantial energy and cost savings based on the life-cycle costing approach.
- In practice, there are 3 major challenges:
  - Challenge 1: Initial investment costs pose a challenge regarding finance
  - Challenge 2: Realistic profitability calculation based on real savings
  - Challenge 3: Annual budgeting which is the usual method of financing of public administration office buildings through government budget does not consider energy efficiency.

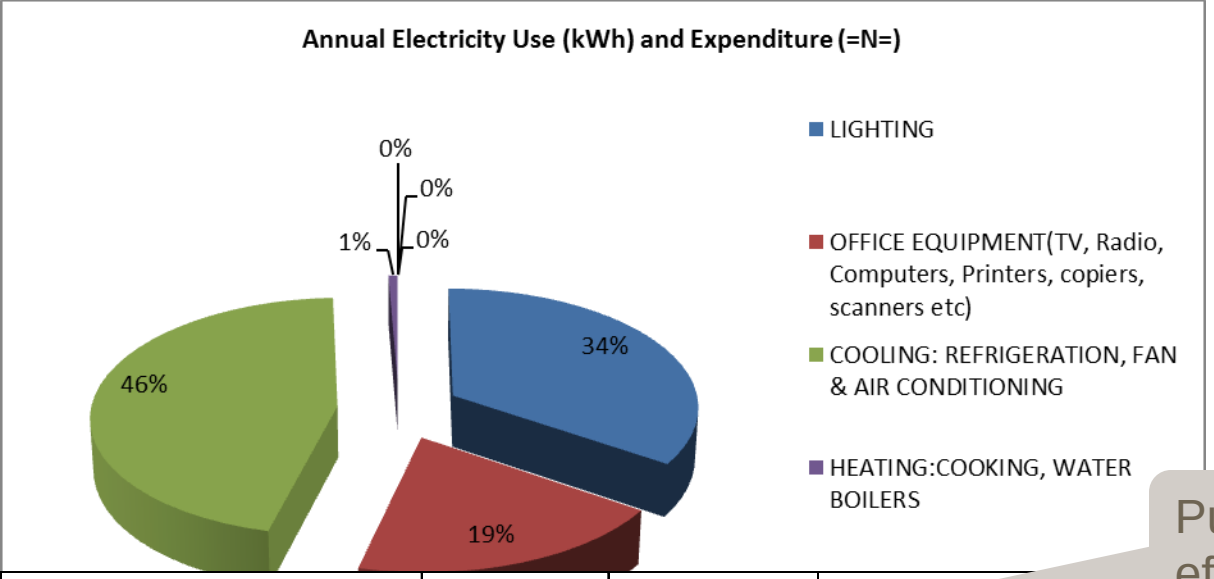
Energy consumption in the selected public administration office buildings

Buildings	Energy (kWh)	Energy (kWh)	Area (m^2)	Annual Energy Use Intensity (kWh/m^2)		% EUI Reduction
	Typical	Improved		Typical	Improved	
Building 1	114,744.73	99,716.64	1650	69.54	60.43	13.53
Building 2	403,643.66	244,928.88	10000	40.36	24.49	39.25
Building 3	635,840.86	522,922.18	4165	152.66	125.55	17.76
Building 4	1,253,168.28	1,046,261.66	5775	217	181.17	16.51
Building 5	43,778.45	34,265.45	1456	30.07	23.53	21.75
Building 6	599,581.58	450,222.70	4785	125.30	94.09	24.91
Building 7	1,212,605.10	989,517.06	5775	209.97	171.34	18.40

Examples:
Building 1 and 2: correct orientation and window to wall ratio is 40%
Building 3 and 7: wrong orientation and window to wall ratio is 60-70%

"Energy" contains consumption for lighting, office equipment, cooling (refrigeration, fan, air conditioning), heating (cooking, water boilers)
"Improved" is improved regarding office equipment: Calculations show that government can save a significant amount of energy and money throughout the life when energy efficient appliances are utilized in buildings.

Energy consumption data for building no 2 (Block C, New State Secretariat Complex, Governor's Office, Oke Mosan, Abeokuta)



Purchase and installation energy efficient lighting: 2,4 Mio Naira

	Electricity Unit Cost	Annual kWh	Annual Cost	Annual kWh	Annual Cost	Annual kWh	Annual Savings Naira
APPLIACNCE/EQUIPMENT	N/kWh	Present (Typical) Status		Proposed (Improved) Status		Savings	
LIGHTING	22.84	139,181.76	3,178,911.40	25,062.91	572,436.91	114,118.85	2,606,474.49
OFFICE EQUIPMENT(TV, Radio, Computers, Printers, copiers, scanners etc)	22.84	77,944.36	1,780,249.09	33,348.42	761,677.91	44,595.94	1,018,571.18
COOLING: REFRIGERATION, FAN & AIR CONDITIONING	22.84	183,846.35	4,199.050.59	183,846.35	4,199,050.59	-	4,337,175.76
HEATING: COOKING, WATER BOILERS	22.84	2,671.20	61,010.21	2,671.20	61,010.21	-	62,947.04
CLEANING EQUIPMENT	22.84	-	-	-	-	-	-
ELECTRIC MOTORS (e.g. LIFTS)	22.84	-	-	-	-	-	-
OTHERS	22.84	-	-	-	-	-	-
TOTAL		403,643.66	9,219,221.29	244,928.88	5,594,175.62	158,714.78	3,625,045.67

Example for overheating caused by building orientation

Ministry of Education, Ministry of Justice and Deputy Governor's office Complex, Governor's Office, Oke Mosan, Abeokuta

Energy consumption of households

VARIANTS OF HOUSEHOLD BUILDINGS	SCENARIO Low/medium/ high income	LOCATION	
		ABEOKUTA	MINNA
Number of occupants	Low	1-4	1-4
	Medium	2-6	2-10
	High	2-10	2-18
Construction cost	Low	8.4m^2 - 72m^2 floor area - About ₦1,919,720.25	
	Medium	112m^2-162m^2 floor area - About ₦3,626,659.05	
	High	112m^2 to 225m^2 floor area - About ₦6,797,999.25	
Type and amount of energy consumption	Low	Total energy consumption 6kWh/day to 14kWh/day N10,000-N35,000 spent annually on electricity N15,000 – N25,000 spent annually to fuel generators **Fans are used for cooling/ventilation**	
		Electric hot plates and kerosene stoves; N15,000 –N40,000 is spent annually on kerosene/gas	About N18,000 is spent on charcoal/firewood
	Medium	Total energy consumption is 15kWh/day - 30kWh/day N10,000-N60,000 spent on electricity bills N20,000 – N80,000 spent annually to fuel generators N30,000 –N60,000 is spent annually on cooking Most households use more than one energy supply for cooking **Majorly, fans are used for cooling. Few have air-conditioners**	
	High	Total energy consumption is 40kWh/day - 80kWh/day Annual expenses on electricity bills is N25,000-N110,000 N60,000 – N450,000 is spent annually on petrol/diesel for generators N25,000 – N200,000 is spent on cooking annually **Air conditioners and fans are used for cooling**	

General aspects – policy development and implementation

- In national energy efficiency policy there is a symptomatic unbalance between efforts for preparing polices, and preparations for policy implementation.
- The vast majority of policy makers are focused on incorporating requirements of international policies and requirements into national strategic and legislative frameworks, without thorough consideration of national circumstances, i.e. without taking into account the level of energy efficiency market maturity in Nigeria.
- Moreover, there is a general lack of focus on policy implementation.
- Currently a national energy efficiency policy in Nigeria exist only in draft form.

Recommendations to stakeholders for successful business models

- Sector-specific financing and business models are needed to boost energy efficiency in buildings.
- Co-operation with energy companies is urgently needed regarding metering and billing.
- A “contingency fund” (or another method) will be needed as part of the business model to attract investors in energy efficiency, in order to balance the risk due to possible fraud (metering and billing).
- Data must be collected to build the basis for decision making:
  - Co-operation with NERC: The Government requires that NERC develops and maintains a dedicated industry-wide data centre which will help promote sound policy making, efficient markets, and the public understanding of the health of the industry (Presidential Task Force on Power).

Concrete EEB activities

- Voluntary and mandatory energy building codes:
  - Supporting energy building code development: Contribution by commenting on drafts and providing technical expertise.
  - Support the development of a design guideline as a working document to aid energy building code implementation.
- EEB support mechanisms: priority activity 2014
  - Financial: Developing financing schemes and business models.
  - Capacity building: Trainings for staff in charge of building permits and commissioning, trainings for architects, engineers, etc.
- Promotion and awareness measures for EEB: Workshops and awareness campaign
- Support to pilot projects priority activity 2014
  - Housing: designing and constructing an energy efficient and affordable building

Concrete EEB activities

Design guideline for affordable energy efficient buildings:

- The designs of buildings need to be revised to comply with climatic requirements and to tap the energy efficiency potential.
- The guideline will refer to building orientation, architectural design, building materials, renewable energy supply systems on site (solar water heating and PV generator hybrid systems).
- The guideline will:
  - be internet-based for wide distribution;
  - showcase exemplary building designs and thus help with the development of energy minimum requirements in the building code;
  - help architects and builders to explain energy efficient buildings to their clients;
  - serve as training material for the building sector.

Recommended approach to ensure synergy with ECREEE and avoid duplication of efforts

GIZ/NESP will recommend the following approach to strengthen synergy with ECREEE

- NESP will finalise on planned activities on Energy Building Code development and standards development on appliances (e.g. Refrigerators and in future SWH (after the completion of a pilot project).
- Feed results of their initiatives to ECREEE to support their activities in other ECOWAS Countries.
- Meetings would be arranged to discuss challenges faced and success achieved with the aim of strengthening Cooperation.

Many thanks for your attention!

Ene Macharm, NESP Energy Efficiency Unit, GIZ
Tel. 07052183838
E-mail: ene.macharm@giz.de
Internet: www.giz.de