The facts?

• Africa has a projected population boom to be about 2.8 billion people by 2060.

• The effect of this growth depends on how each country responds today with policies.

• The NCAHF Agenda is strongly linked to the SDGs

  1. DG 13 Taking urgent action to combat climate change and its impact.
  2. SDG 7 Ensure access to affordable, reliable, sustainable and modern energy for all
  3. SDG 11 Make cities and human settlements, inclusive and sustainable.
Thermal Comfort
Climate Adapted Design
Tables below show the characteristics of an existing vernacular architecture in Hot and Dry climate (Table 1) and Hot and Humid climate (Table 2) of Nigeria.

<table>
<thead>
<tr>
<th>Building form</th>
<th>Volume: compact to minimise heat gains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building envelope</strong></td>
<td></td>
</tr>
<tr>
<td>Openings: narrow and long to minimise solar gains and maximise daylight, small to avoid dust during Harmattan</td>
<td></td>
</tr>
<tr>
<td>High thermal mass: to balance indoor temperatures during day</td>
<td></td>
</tr>
<tr>
<td>Roof: domed roof, with light colours, to control heat gains, shaped to capture and channel rain water</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building form</th>
<th>Volume: expanded to maximise airflow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building envelope</strong></td>
<td></td>
</tr>
<tr>
<td>Openings: wide and shaded to minimise solar gains while maximising ventilation</td>
<td></td>
</tr>
<tr>
<td>Low thermal mass: to avoid heat storage in the envelope</td>
<td></td>
</tr>
<tr>
<td>Roof: pitched roof, covered by palm leaves to allow air infiltration while also able to shed very high intensity rainfall</td>
<td></td>
</tr>
</tbody>
</table>
Envelope Design and Passive Cooling
Climate Adapted Design, Minimizing energy demand.

- Bioclimatic design is based on air control and air quality, heat flows in and out of a building envelope.
- It involves cooling-load-avoiadance measures into buildings, the use building geometries to limit solar gain façades as well as hooded windows to reduce heat gained through openings and hence reduces cooling load.
- Trees, vines, annuals, and green roofs can all help control heat gain and minimize cooling demands on a building.
EE Calculations for a semi-detached bungalow

- Hollow sandcrete wall, $U = 1.5\text{W/m}^2\text{K}$
- Naturally ventilated pitched metal sheeting roof with insulation
- Improved orientation, majority of windows facing N/S
- External shading to windows in the form of 1m horizontal overhang
- 100% efficient fluorescent lighting
EE Calculations for a semi-detached bungalow

Variant 1

- Hollow sandcrete wall, $U = 1.9 \text{W/m}^2\text{K}$
- Pitched metal sheeting roof without insulation
- Single glazing with metal frame, $U = 5.77 \text{W/m}^2\text{K}$
- Badly oriented, majority of windows facing E/W
- No external shading
- 90% of light bulbs incandescent
- Energy inefficient appliances
EE Calculations for a semi-detached bungalow

Variant 2

- Insulated wall, $U = 0.7\, \text{W/m}^2\text{K}$
- Double glazing with metal frame, $U = 3.09\, \text{W/m}^2\text{K}$
- 100% LED lighting
- Energy efficient appliances (TV, refrigerator, microwave)
- 60% of DHW from solar thermal
### Thermal comfort in hot & humid climate

- **BAU**: 57% of hours at or below 28°C
- **VAR1**: 93%
- **VAR2**: 100%

### Thermal comfort in hot & dry climate

- **BAU**: 53% of hours at or below 28°C
- **VAR1**: 79%
- **VAR2**: 99%

### Table of Additional Capital Costs and Energy Savings

<table>
<thead>
<tr>
<th>Bungalow</th>
<th>Additional capital cost for lighting and appliances improvement</th>
<th>Energy savings percentage over BAU</th>
<th>Energy cost savings per year (N/m²)</th>
<th>Annual CO₂ savings per year (kgCO₂/m²)</th>
<th>Thermal comfort improvement: hours/year (H&amp;D/H&amp;H)</th>
<th>Simple payback 15%</th>
<th>Lighting/appliance/PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAR 1</td>
<td>4,028</td>
<td>56%</td>
<td>1,112</td>
<td>27 (52%)</td>
<td>20%/36%</td>
<td>1</td>
<td>Lighting/appliance/PV</td>
</tr>
<tr>
<td>VAR 2</td>
<td>9,028</td>
<td>69%</td>
<td>1,364</td>
<td>33 (64%)</td>
<td>43%/46%</td>
<td>1</td>
<td>Lighting/appliance/PV</td>
</tr>
<tr>
<td>VAR 3</td>
<td>15,600</td>
<td>100%</td>
<td>1,998</td>
<td>49 (100%)</td>
<td>-</td>
<td>15</td>
<td>Lighting/appliance/PV</td>
</tr>
</tbody>
</table>
Additional Costs

• The cost of the BAU was estimated to be ₦25 million. The additional capital need is ₦1.45 million to introduce Variant 1 lighting and appliances efficiency as well as comfort improvement measures

• ₦3.25 more million for Variant 2, which includes wall insulation and improved window glazing.

• The incremental cost of VAR 3 which also includes renewable energy production with PV systems would be ₦5.6 million.

• Annual energy costs drop by 56% and 68% respectively under measures in Variant 1 and Variant 2, in accordance with the electricity savings, which are due to lighting and appliances improvements since no cooling has been assumed for the bungalow.
Project Structure

• Similar to the Mexican NAMA, a proposed donor may give USD100m to AfDB who lends it to several local community banks that offer cheaper mortgages to people who buy certified climate adapted housing (EE units).

• Each, climate adapted housing unit built and financed with low cost mortgage is an ABU (Adaptation Benefit Unit).

• Cost of an ABU may be the cost of the concessional loan or an insurance premium on repayment.
Thank You For Listening!

Adepeju Aderogba
adepejuasake@gmail.com
+44(0)7497790232
+234(0)8020621677