GIZ NESP intervention on promoting the use of Solar Water Heaters in Educational Buildings and Hotels

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Development of a SWH promotion mechanism

Action Lines;

1. Baseline Studies (completed and focus of presentation)
2. Technical and Feasibility studies on Pilot implementation of Solar Water Heater System
3. Implementation of SWH system
4. Performance Monitoring of SWH system
5. Development of Standards

1 Objective and agenda of the baseline study

Baseline study

Objectives:

- To develop a baseline that shows the current hot water generation and use profiles in Nigerian schools, hospitals, hotels, and homes.
- Business case development to provide a basis for decision making for NESP intervention programme to promote the use of SWHs.
- Technical and economic market overview of SWH in Nigeria to provide additional information for NESP interventions on SWH promotion
- **Methodology:** Methods include desk research, interviews and visits to buildings, the administration of questionnaires, experiments, and expert's judgements

Contributing experts to the SWH baseline study: Staff of ECN National Centre for Energy Research and Development, University of Nigeria, Nsukka

Content of baseline study SWH in buildings

1 Introduction

2 Overview of domestic hot water preparation in Nigeria

Households — Survey

Educational buildings — Survey

Hospitals — Survey

Hotels — Survey

3 Market overview of solar water heating systems — Survey

Technical and economic overview including market players

4 Potential benefits of SWH use in Nigeria and business case

Business cases for SWH use in buildings

5 Use of SWH in selected building types and market barriers

6 Successful implementation of SWH in buildings: good examples

7 Recommendations for setting up the SWH part of the NESP EE component

2

Findings

Summary of status quo of domestic hot water (DHW) preparation (1)

- Results from surveys in Abeokuta, Minna, and Nsukka: The methods used for water heating are mainly grid electricity, but also kerosene, cooking gas, and in hotels also electricity from generators.
- Electricity tariffs in Nigeria are still low (although rising according to the Multi-Year Tariff Order of the government)
- The associated energy cost savings when using SWHs for domestic application are too low at the moment in comparison with electric heaters (residential buildings, educational institutions and hospitals); therefore full grants for SWH are necessary.
- It is shown that by using SWH the required quantity of hot water can be prepared in all seasons of the year.
- SWH is hardly known; the level of awareness is extremely low.
- The market for SWHs is not yet developed in Nigeria as to lead to gradual fall in the prices.

Summary of status quo of domestic hot water (DHW) preparation (2)

- ECN Centres have developed and installed a few prototype SWH systems waiting for market introduction.
- The custom on imported SWH systems in Nigeria is 0%. Currently, this is the only government incentive on solar water heaters.
- Incentives, grant, and financing models are needed to make SWH attractive for potential users.
- Domestic hot water consumption compared to 5 to 10 years ago shows that consumption is slightly increasing.
- The increase is especially significant in the educational sector due to the advent of private educational institutions who have greater access to hot water preparation devices compared to public schools.
- Suppressed demand for DHW is critical regarding energy consumption and also regarding water consumption. (e.g. no hot water available in public secondary schools)

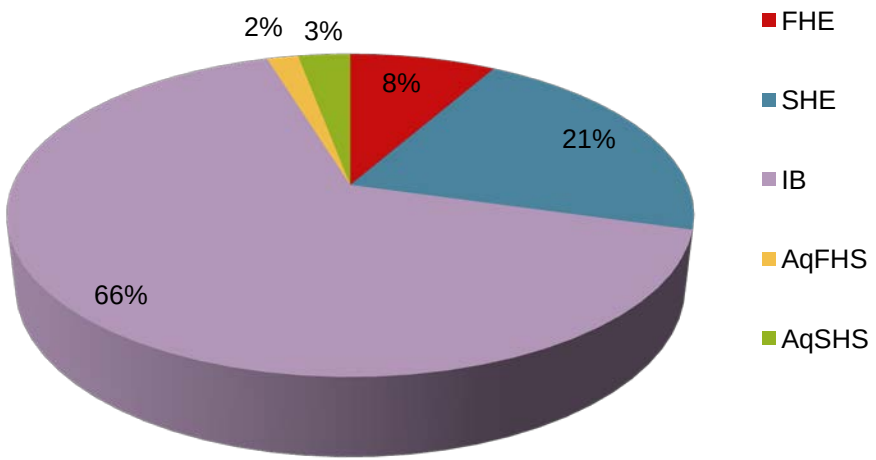
DHW in residential buildings (status quo)

- Average water consumed per household per day is 101.27 litres.
- The hot water at 100^{o}C (which is then diluted to comfort temperature) consumed per household gave a value of 16.56litres.
- The average cost for heating a litre of water from 25°C to 100°C was also determined.
- The predominant methods used in heating the water are kerosene, cooking gas, and grid electricity.

Year	Cost of heating a litre of water from 25^{o}C to 100^{o}C (₦)				
	Fuelwood	Kerosene	Cooking gas	Charcoal	Grid electricity
Current year	0.78	2.27	2.85	0.72	1.43
2008	0.78	0.97	2.45	0.72	0.82
2003	0.78	0.62	2.10	0.72	0.39

DHW in residential buildings

- The greatest percentage of Nigerians lives in individually built (IB) houses, second is SHE (State Housing Estate).
- 91% of the respondents said they would like SWH to be installed for them.
- Subsidy schemes which can be investment grants or capacity payments, output or production based payments or soft loans are the main drivers of solar energy technology globally. India for instance has popularized SWH by implementing a subsidy scheme that pays up to 90% of the system cost.



Life cycle cost: comparison of water heating systems in residential buildings

Item	Electrical Heater	Kerosene stove	Solar Water Heater
Specification	1.2 kW suitable for 5 persons	5L capacity cooking stove suitable for 5 persons	2.0 m^2 Flat-plate, thermosyphon; suitable for 5 persons
Initial Cost (₦)	20,000.00	10,000.00	300,000.00
Installation Cost (₦)	10% = 2,000.00	None	10% = 30,000.00
Maintenance Cost (₦)	Minimal	Minimal	Minimal
Expected Life Span	8-12 years	5-10 years	15-20 years
Running Cost for (₦)	20 litres/day @ ₦1. 43/litre = 82,368 – 123,552	20 litres/day @ ₦2.27/litre = 81,720 – 163,440	None
Cost from increases in tariff & fuel(5% of running cost) (₦)	4118 – 6178	4086 -8172	None
Life Cycle Cost (₦)	**108,486 – 151,730**	**95,806 – 181,612**	**330,000**

Payback time for SWH purchase and installation is between 18 and 26 years

Profitability of SWH in residential buildings, schools and hospitals

- The payback times for SWH used in place of electric heaters and kerosene stoves vary for the different consumer groups (households, schools, hospitals and hotels) for same energy source.
- The variation is mainly due to the fact that the different consumer groups have widely varying hot water demand, resulting in different SHW system costs and fuel cost savings.
- This explains why in a typical household with very low hot water demand it is still not cost-effective to use SWH.
- The situation is similar in schools and hospitals.

DHW in schools (status quo)

- Grid electricity is a main source of energy for preparing domestic hot water (DHW).
- Per capita daily water consumption: 40-60 litres per day per student, and hot water demand is 20-40 litres.
- Costs for DHW (20 litres) and the amount of energy used: average of N11.47 and 0.773 kWh/student user/day.
- Public secondary schools are generally denied use of water heating appliances in their dormitories due to concerns for fire hazards and electricity bills.
- In private institutions about 37% of those living in dormitories or hostels have greater access to electric DHW preparation devices.
- The demand for hot water for comfort bathing in educational institutions has been there all along, although largely suppressed.

SWH in hospitals (status quo)

- Most of the hospitals however utilize grid electricity for water heating.
- The quantity of hot water used in hospitals depends on the number of in- and out-patients the hospital can attend to.
- The exact quantity of hot water need of the hospitals could not be deduced from this work as most of the hospitals did not keep these records.
- The respondents indicated that each in-patient in the hospital requires 15 litres/day of warm water (100 ^{o}C) for bathing and 2 litres/day (100 ^{o}C) for making hot beverages.
- In terms of kilo-watt hours, this amounts to 1.313 kWh.

SWH in hotels

- The use of SWH could be profitable in hotels.
- Results show that between 3 and 10 years, the cost of deploying SWHs in hotels will be paid for from the savings to be made if used instead of grid electricity and electricity from diesel generators respectively.
- However, most hotels have decentralized systems of water heating for hot water prepared for bathing and laundry. Thus, the installation of SWH in existing buildings is hardly possible.

Comparison between Life-Cycle Costs of SWH and other heating methods for providing hot water in a hotel with 100 guest rooms

Item	Electrical Heater	Diesel Generator	Solar Water Heater
Specification	1.2 kW installed in each room	20 KVA Cummins generator	34 units of 2.0 m^2 Flat-plate, thermosyphon
Initial Cost (₦)	2, 000,000.00 @ 20,000/unit	1,950,000.00	10,200,000 @30,000.00/unit
Installation Cost (₦)	10% = 200,000.00	10% = 195,000	10% = 1,020,000
Maintenance Cost (₦)	Minimal	20% = 390,000	Minimal
Expected Life Span	8-12 years	10-15 years	15-20 years
Running Cost for (₦)	N5128 /100 room/day = 14,768,640 – 22,152,960	N11,902/100 room/day = 42,847,200 – 64,270,800	None
Life Cycle Cost (₦)	16,967,640 – 24, 351,960	45,382,200 – 66,805,800	11,220,000
Cost savings from replacing with SWH (₦)	13,131,960	55,585,800	-
Payback time (years)	**10.25**	**3**	

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3 NESP SWH promotion approach

NESP SWH Strategies (1)

It is the objective of the SWH part of the NESP energy efficiency component to contribute to SWH market development in Nigeria. Because a SWH market hardly exists, activities must comprise all policy measures in order to boost the use of SWH in the country:

Regulations and supportive actions

- Integration of SWH as a requirement into the energy building code and GBCN
- Development of SWH design guideline (as part of the EEB design guideline)

priority activity 2014

Qualification

- Trainings for technicians on solar water installation and maintenance
- Trainings for architects, engineers, builders, and the real estate sector

Promotion and awareness

- Awareness campaign addressing key stakeholders

SWH Strategies (2)

Support to pilot/demonstration project

priority activity 2014

- Technical, economic feasibility and design studies
- Financial support (partially) to pilot project implementation
- Monitoring, evaluation and dissemination of results

Financing mechanisms and business models

- Adapted ESCO model
- Joint-stake partnership
- Third-party financing

Development and implementation of standards for SWH

- Possible cooperation with SON under the lead of ECN to develop a SWH standard based on the relevant ISO standard

4 Ongoing activities

Institutions to demonstrate SWH pilot projects

- Educational institutions: A secondary school would be used to demonstrate the SWH technology(Full grant)
- Hotels: Most existing buildings use decentralised hot water supply. Therefore the activity might mainly address new buildings with a central hot water supply or selected parts of existing buildings (e.g. laundry). This is a very demanding task and will be carried out later when more technical expertise is available.

SWH pilot projects

- Identification of site for pilot implementation
  - Feasibility study funded by NESP
  - Joint or full funding of SWH in case of implementation
- Implementation phase of pilot project
  - Technical assistance and accompanying control of the SWH acquisition and installation
  - Hand over protocol and monitoring during operation
  - Evaluation and lessons for future projects (preparation of roll-out)

Input for standard development (SWH standards)

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Many thanks for your attention!

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