

China-Ghana South-South Cooperation on Renewable Energy Technology Transfer (RETT)

Identification of barriers to renewable energy technology transfer to Ghana

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Identification of barriers to renewable energy technology transfer to Ghana



Outline (Cont.)

Part IV:

- Identification and prioritization of RE technologies in Ghana
- Roadmap for RETT to Ghana



Identification of barriers to renewable energy technology transfer to Ghana



Identification and prioritization of RE technologies in Ghana

- This section seeks to rank and prioritise RE technologies (off-grid) based on their potential for TT and for supporting national developmental goals
- The technologies are first identified and screened to remove those that are unsuitable in the Ghanaian context or have technical barriers that are yet to be overcome at the global level.
- The selected list is then ranked using a multi-criteria decision tool



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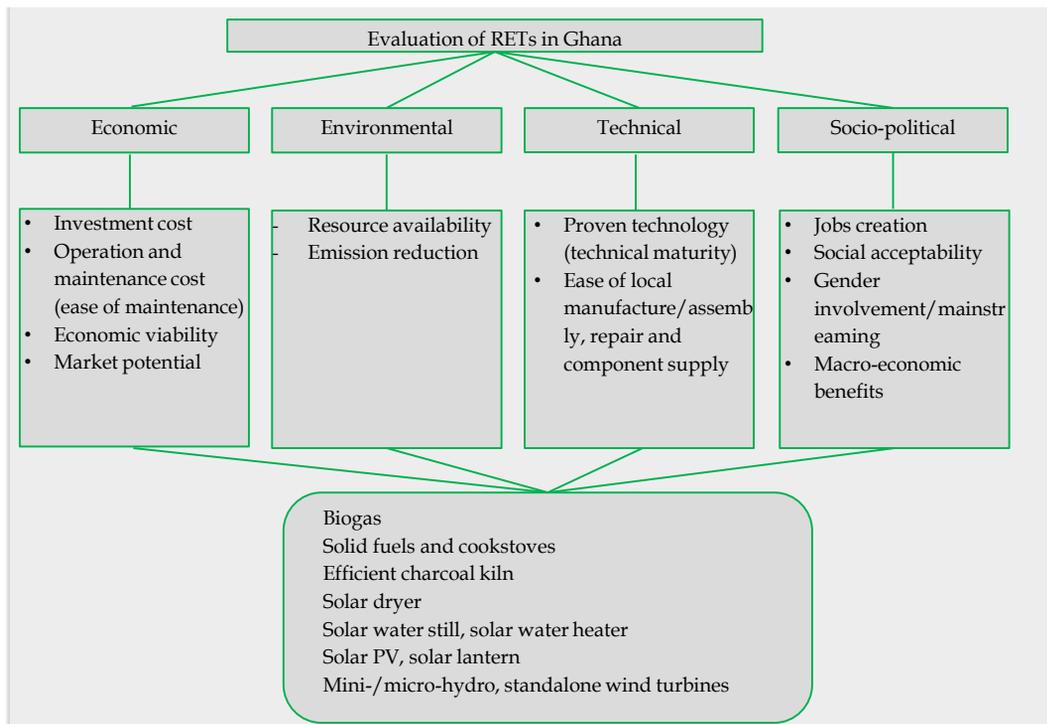
Analytical Hierarchy Process (AHP)

- AHP is a multi-criteria and multi-perspective decision tool
- AHP is a powerful tool and is extensively used in diverse applications and in complex decision problems
- AHP requires the identification of criteria, sub-criteria and alternatives related to a goal

Evaluation of RETs using Analytical Hierarchy Process

- **Step 1:** Definition of main criteria for evaluation of selected RE technologies **with respect to the goal**
- **Step 2:** Breakdown of main criteria into relevant sub-criteria
- **Step 3:** Ranking of main criteria based on pairwise comparison by experts/stakeholders
- **Step 4:** Ranking of sub-criteria based on pairwise comparison by experts/stakeholders
- **Step 5:** Pairwise comparison among RE technologies in relation to all sub-criteria

AHP model



Initial screening of RE technologies

Selected technologies for ranking

Area	Initial list of RETs
Biomass and bioenergy	Biogas
	Solid fuels and cookstoves
	Clean charcoal kiln
Solar thermal	Solar water still
	Solar water heater
	Solar dryer
Solar photovoltaic	Solar PV
Hydropower	Mini- and micro-hydro
Wind energy	Standalone wind turbine

RE technologies screened out and not included in ranking

Area	RETs screened out	Reason for screening out technology
Biomass and bioenergy	Landfill gas	Process of harnessing landfill gas complicated; lack of well-engineered landfill sites; economics unfavorable.
	Biodiesel	Lack of successful projects; economics of biodiesel from Jatropha unfavorable; lack of infrastructure for biodiesel dispensing stations; use of edible oils unsustainable.
	Ethanol (1st gen)	Use of food materials; expensive when used as cooking fuel; lack of infrastructure when used as fuel in engines
	Ethanol (2nd gen)	Complex technology for small scale applications; technologies still at research/pilot stages
	Bio-oil, syn-gas, etc.	Complex technology for small scale applications

RE technologies screened out and not included in ranking

Area	RETs screened out	Reason for screening out technology
Solar thermal	Solar ovens/cookers	Not too successful in Ghana; too dependent on radiation; appear not to fit into traditional cooking
	Concentrated solar power/heating	Low direct normal radiation (DNI) for Ghana.
	Solar fuel	Technology under development

AHP Model: Economic Criteria

Sub-Criteria	Description	Key Point
Investment (upfront cost)	Total upfront cost of having a RET for a household or institution	The lower the relative cost the more favourable the RET
Operation and maintenance cost (ease of maintenance)	The cost of operating or maintaining RET by a user (household/institution). Will include cost of spare parts, cost of paying experts to do maintenance, and frequency of maintenance.	The lower the relative cost the better
Economic viability	Economic/financial benefits derived by users for paying for the RET. May include income savings from reduce expenses as a result of the RET.	The higher the financial (economic) benefits, the better.
Market potential (scalability and replicability)	Possibility of building business on RET at existing economic conditions.	The higher the market potential of the RET, the better.

AHP Model: Environmental Criteria

Sub-Criteria	Description	Key Point
Resource availability	Availability of renewable resource for which the RET is obtained/produced from. E.g. solar irradiation, wind speed, biomass, hydro-sources, etc.	The higher the resource availability for the RET, the better.
Emission reduction	Potential to contribute to greenhouse gas emissions reduction based on the conventional fuel displaced or improvement in fuel/energy efficiency as a result of the RETT.	The higher the emissions reduction potential, the more favourable the RET

AHP Model: Technical Criteria

Sub-Criteria	Description	Key Point
Technology maturity (proven technology)	How well is the technology developed and successfully disseminated in Ghana and other developing countries	RET with a higher maturity is more favourable
Ease of local manufacture/ assembly, repair and component supply	The potential to set-up local manufacture/assembly plants of the RET. Potential for higher local content in manufacturing, fabrication, installation and repair.	RET with a higher possibility of local content in fabrication, installation and supply is considered better.

AHP Model: Socio-political Criteria



Sub-Criteria	Description	Key Point
Jobs creation	Employment opportunities from design, development, fabrication/manufacture, supply of components, distribution, installation and repair.	Higher job creation potential is preferable.
Social acceptability	The adaptability of RET to local use. Acceptable of technology by households and institutions. Positivity of public opinion.	Higher social acceptability is better.
Gender involvement/ mainstreaming	Possibility of women involvement in all aspects of the RET	Higher women involvement is better.
Macro-economic benefits	Contribution to national energy security; contribution to attainment of national developmental goals such as GSGDA.	RET with more macro-economic benefits is better

AHP Analysis: Outputs



- Construction of a matrix, expressing the relative values of the set of attributes – criteria, sub-criteria and RETs

	Economic	Environmental	Technical	Social and political
Economic				
Environmental				
Technical				
Social and political				



AHP Analysis: Outputs

- Relative weights (ranking) will be determined via the determination of eigen vectors.
- Consistency ratio will be determined to measure the consistency of individual judgements
- Matrix calculations will be used to obtain an overall vector