

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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## UNDP Assignment: UNDP/GH/IC/40

### Objectives and scope

- 1. Describe RETT and its components and forms;**
2. Review Ghana's Technology Transfer Regulations, 1992 (LI 1547)
3. Study past and current RETT programmes in Ghana, focusing on those related to China and other developing countries;
4. Study successful case studies of RETT at the global level, analyzing factors that contributed to the success as well as lessons from such programmes
5. Prioritize relevant RETs based on their potential for technology transfer in Ghana, with emphasis on China and other developing countries;
- 6. Examine barriers to RETT, highlighting any Chinese experience whenever possible;**
- 7. Examine and screen all barriers, identify key ones and propose concrete measures to tackle the barriers; and**
- 8. Propose a detailed roadmap for RETT in Ghana.**



## Technology Transfer?



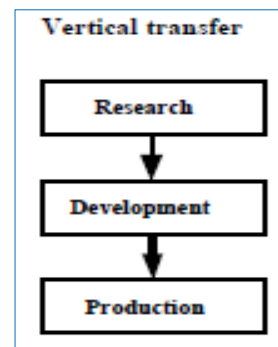
- Generally it is the process of movement of technology from one entity to another
- The technology may include any of the following:
  - Knowledge and skills (non-technical)
  - Goods and services
  - Physical assets (hardware/equipment)
  - Values (organisational and managerial procedures)
- Types of technology transfer – Vertical and horizontal

### Vertical technology transfer

It follows the progressive stages of:

- Invention (basic research)
- Innovation (applied research)
- Development
- Commercialisation

Vertical transfer is usually as a result of Academia-industry relations or research within an organisation



## Horizontal Technology Transfer

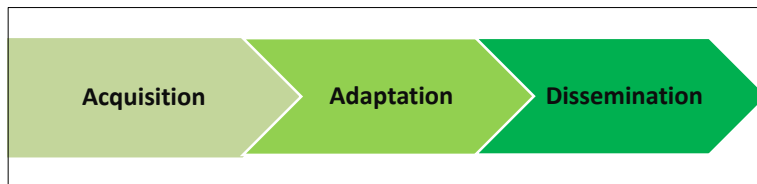
- Horizontal transfer involves a matured technology being moved from one operational environment to another.
- Horizontal transfer is more common when technology is being transferred from industrialised to developing countries.

## Stages of Horizontal Transfer

- Stage 1 involves import of capital goods and equipment
- Stage 2 includes skills and know-how for operating and maintaining equipment.
- Stage 3 encompasses knowledge and expertise for generating and managing technological change.

## Renewable Energy Technology Transfer (RETT)

- RETT refers to the diffusion of mature (advanced and appropriate) renewable energy technologies from one country to another.
- This must enable the receiving country to adapt, deploy and diffuse renewable energy technologies.



## Renewable Energy Technology Transfer (RETT)

- In conclusion, a successful RETT must result in the recipient's ability to;
  - **Use,**
  - **Replicate,**
  - **Improve and,**
  - **Possibly, re-sell the technology**



## IDENTIFICATION OF BARRIERS TO RETT



Barriers to adoption and dissemination of RETs may be grouped into:

- Financial and economic barriers
- Market barriers
- Policy and regulatory barriers
- Information and awareness
- Technical barriers
- Human skills barriers
- Network barriers
- Socio-cultural barriers



## IDENTIFICATION OF BARRIERS TO RETT



### **Financial and Economic Barriers**

- i. High initial cost, interest rate, limited access to capital
- ii. Lack of consumer financing options
- iii. Unstable currency
- iv. Subsidies on conventional systems
- v. High O&M

### **Market Barriers**

- i. Underdeveloped supply chain
- ii. Small market size
- iii. Unstable market situation
- iv. Failed past experience
- v. Lack of successful reference projects



### **Policy and Regulatory Barriers**

- i. Insufficient legal and regulatory framework
- ii. Lack of enforcement of codes and standards
- iii. Unfavourable policies
- iv. Corruption
- v. Segmented Intellectual property protection laws
- vi. Lack of political will
- vii. Inadequate RE codes and standards
- viii. Problems in land acquisition

### **Information and awareness Barriers**

- i. Poor or lack of information about cost and benefits of RETs
- ii. Lack of interest by media in RET promotion



## IDENTIFICATION OF BARRIERS CONT'D

### **Technical Barriers**

- i. Difficulty in getting equipment and spare parts
- ii. Immature technology
- iii. Poor operations and maintenance of facilities
- iv. New technology too complicated
- v. Lack of infrastructure

### **Human Skills Barriers**

- i. Lack of skilled personnel for manufacturing and installation
- ii. Lack of personnel for preparing project
- iii. Lack of service and maintenance specialists
- iv. Inadequate training facilities



### **Network Barriers**

- i. Weak connections between stakeholders promoting the new technology
- ii. Strong network of conventional technologies favoured by legislation
- iii. Difficult access to external manufacturers/institutions
- iv. Lack of involvement of stakeholders in decision making
- v. Weak network between foreign institutions and local ones

### **Socio-cultural Barriers**

- i. Lack of interest in shifting from conventional energy to RE
- ii. Consumer preference and social biases
- iii. Lack of confidence in new Technology
- iv. Dispersed/widely distributed settlement
- v. Lack of understanding o local needs
- vi. Fear of failure



## **METHODOLOGY FOR RANKING**



- The desk study identified about 70 stakeholders, categorized into 5 groups:
  - Academia and research institutions
  - Manufacturers/producers and service providers
  - International NGOs and Developmental partners
  - Policy and regulatory bodies
  - Financial institutions
- Structured questionnaires were developed and used to elicit views from the identified stakeholders

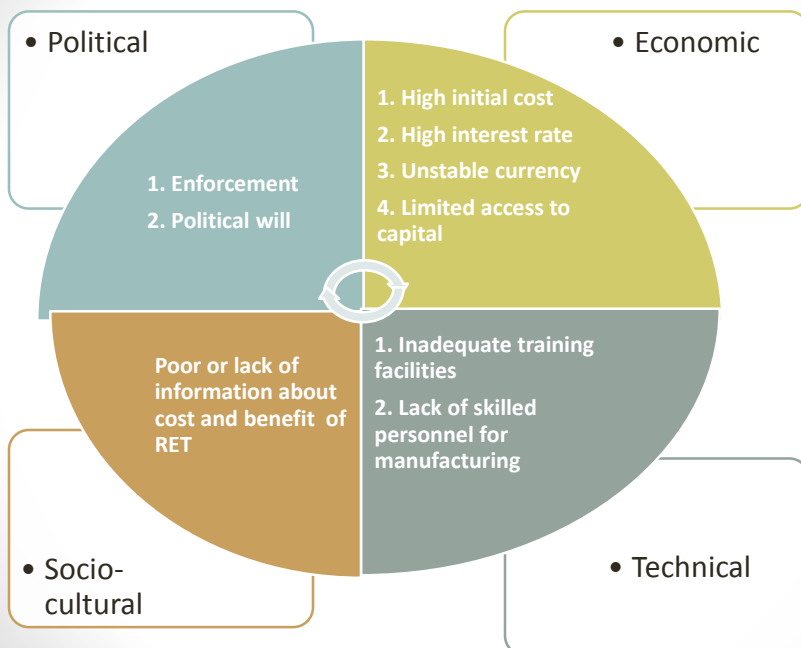


## METHODOLOGY CONTINUED



- 51 stakeholders were asked to rank the barriers using an ordinal scale
- Initial ranking of all the barriers was based on the least total score to identify the important barriers
- Final screening was based on more than 50% of the respondents considering such barriers as very important in each of the main categories

### RESULTS OF FINAL SCREENING USING PESTEL ANALYSIS







## PROPOSED MITIGATION ACTIONS



## MITIGATION ACTIONS: **POLITICAL BARRIERS**



### **PREVIOUS AND EXISTING INTERVENTIONS**

#### **Laws**

- Renewable Energy Law

#### **Policies**

- National Energy Policy
- Bioenergy policy (draft)
- National Environment Policy

#### **Plans**

- Strategic National Energy Plan (SNEP)
- National Renewable Energy Strategy
- Energy for Poverty Reduction Action Plan (EPRAP)

## LACK OF POLITICAL WILL

Mitigation actions	Specific steps	Responsible bodies
Expedite development of RE master plan	<ol style="list-style-type: none"> <li>1. Secure funding for RE masterplan</li> <li>2. Engage consultants to develop RE masterplan</li> <li>3. Engage stakeholders</li> <li>4. Align and integrate masterplan into GSGDA</li> </ol>	MOP NDPC EC
Operationalize RE fund under RE law	<ol style="list-style-type: none"> <li>1. Develop guidelines for utilisation of RE fund</li> <li>2. Government should dedicate seed money to the RE fund</li> <li>3. Engage with bilateral and multilateral donor agencies for additional funding</li> <li>4. Identify alternative funding mechanisms</li> </ol>	MOP NDPC EC MOFEP
Develop national programmes on prioritised RETs	<ol style="list-style-type: none"> <li>1. Engage consultants to develop national programmes on prioritised RETs</li> <li>2. Engage stakeholders</li> <li>3. Dedicate financial resources under RE fund for prioritised RETs</li> <li>4. Set up coordination offices to coordinate programmes</li> </ol>	MOP EC



## DEVELOPMENT AND ENFORCEMENT OF STANDARDS AND CODES



Mitigation actions	Specific steps	Responsible bodies
Develop/adopt standards, codes and labels for biogas plants, SWH, solar dryers, wind mills and other RETs.	<ol style="list-style-type: none"> <li>1. Build capacity of staff and equip the Ghana Standards Authority (GSA)</li> <li>2. Engage with organisations with experience in other countries</li> <li>3. Obtain funding from RE fund and from donor agencies</li> <li>4. Develop and pass LI on standards, codes and labels for RETs</li> <li>5. Build capacity of staff and equip the EC for effective monitoring and enforcement</li> </ol>	GSA EC Parliament



## ECONOMIC BARRIERS



### PREVIOUS AND EXISTING INTERVENTIONS

- Consumer financing schemes (eg. GEDAP)
- Import duty exemptions on solar systems and wind mills
- Refrigerator rebate scheme
- E&CO and Acumen Funds supporting RE projects



## HIGH INITIAL COST



Mitigation actions	Specific steps	Responsible bodies
Develop and implement tax incentives on prioritised RETS	<ol style="list-style-type: none"> <li>1. Implement import tax incentives for raw materials and intermediate products for local fabrication of prioritised RETs</li> <li>2. Initiate tax holidays and incentives for investment on prioritised RET</li> </ol>	MOF EC MOFEP GRA GIPC
Provide financial support for RET investment in prioritised sectors	<ol style="list-style-type: none"> <li>1. Provide soft loans supporting RET investment</li> <li>2. Provide direct financing to RET entrepreneurs</li> <li>3. Seek grants from bilateral and multilateral donors to set up incentives and soft loan schemes</li> <li>4. Use part of the RE fund to support consumer financing and RET investment</li> </ol>	MOF EC MOFEP GRA



## HIGH INTEREST RATE



Mitigation actions	Specific steps	Responsible bodies
Provide financial support for RET investment in prioritised sectors	<ol style="list-style-type: none"> <li>1. Provide soft loans supporting RET investment</li> <li>2. Provide direct financing to RET entrepreneurs</li> <li>3. Seek grants from bilateral and multilateral donors to set up incentives and soft loan schemes</li> <li>4. Use part of the RE fund to support consumer financing and RET investment</li> </ol>	EC MOFEP



## TECHNICAL BARRIER



### PREVIOUS AND EXISTING MEASURES

#### Training facilities

- UENR, TEC-KNUST, GTUC
- CREK-K'POLY, Energy System Dept. – Koforidua Polytechnic,
- DENG

#### RETs production facilities

- Solar PV module assembly plants
- Pellets manufacturing plant
- Cookstoves manufacturers
- Biogas service companies

## INADEQUATE TRAINING FACILITIES

Mitigation actions	Specific steps	Responsible bodies
Strengthen existing training facilities	<ol style="list-style-type: none"> <li>1. Support existing institutions to expand programmes to cover priority RETs</li> <li>2. Harmonize and standardize training materials</li> <li>3. Build capacity of key RE research/training institutions in prioritised RETs</li> <li>4. Enhance and encourage coordination between institutions</li> <li>5. Allocation portion of RE Fund to expand training and research facilities</li> <li>6. Set-up dedicated funds for RETs deployment and demonstration</li> </ol>	MoP EC MoE COTVET
Build capacity of researchers and trainers in RETs	Promote networking with external centres of excellence Dedicate part of RE fund for capacity development	MoP EC MoE
Set-up dedicated centres of excellence in the prioritised areas	Develop modalities for established centres in existing institutions; Allocate funds for the establishment of the centres	MoP EC MoE COTVET

## LACK OF SKILLED PERSONNEL FOR MANUFACTURING

Mitigation actions	Specific steps	Responsible bodies
Conduct capacity building programmes for entrepreneurs and local enterprises	<ol style="list-style-type: none"> <li>1. Undertake capacity needs assessment of local enterprises</li> <li>2. Develop training skills oriented programmes/manuals in prioritised RETs</li> <li>3. Conduct regular technical training for local enterprises in prioritised RETs</li> <li>4. Build collaborative linkages between local enterprises and their counterparts in China or other developing countries advanced in RETs</li> </ol>	MoP MESTI EC NGOs, CSOs and Women Groups
Arrange networks and partnerships for local enterprises with counterparts in other countries	<ol style="list-style-type: none"> <li>1. Explore possibilities for networking</li> <li>2. Link local enterprises to counterparts in China and other developing countries</li> <li>3. Fund trips and visits of local firms to foreign exhibitions and trade shows on prioritised RETs</li> <li>4. Identify and fund training programmes in Ghana with experts from China and other developing countries</li> </ol>	EC



# SWOT ANALYSIS OF MITIGATION MEASURES



## EXPEDITE DEVELOPMENT OF RE MASTER PLAN



<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>I. Commitment of Ministry of Power, Energy Commission and other local stakeholders</li> <li>II. Support of developmental partners notably UNDP, GIZ, DANIDA, World Bank, etc.</li> <li>III. Availability of RE law</li> <li>IV. Availability of national policy documents – National Energy Policy, SNEP, Bioenergy Policy (draft), etc.</li> <li>V. Availability of FITs for RE sector</li> <li>VI. Availability of local capacity</li> </ul>	<ul style="list-style-type: none"> <li>I. RE Authority not established</li> <li>II. Draft Bioenergy Policy not yet approved</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>I. High potential of RE resources in Ghana</li> <li>II. RE resources well-known and well-mapped</li> </ul>	<ul style="list-style-type: none"> <li>I. Lack of funds for development and implementation</li> <li>II. Delays in review and approval of masterplan</li> </ul>



## OPERATIONALISE RE FUND UNDER RE LAW



Strengths	Weaknesses
I. RE fund regularised under RE law II. RE fund account established	I. Absence of clear-cut institutional framework for operationalising the fund II. Inability of government to commit funds
Opportunities	Threats
I. Efforts to achieving national RE targets II. Support from bilateral and multilateral donor agencies (Chinese Government, World Bank, DANIDA, GIZ, JICA, DGIS, European Commission,, GEF, etc.)	I. Government commitment to allocate funds for RE Fund II. Lack of dedicated funds III. Inadequate support of external donors



## DEVELOP NATIONAL PROGRAMMES ON PRIORITISED RETS



Strengths	Weaknesses
I. RE Law supports funding of RETs II. Availability of local expertise III. Experience in previous national programmes such as GEDAP, SHEP, etc. IV. Strong institutional framework and networking V. Availability of national policy documents – National Energy Policy, SNEP, Bioenergy Policy (draft), etc.	I. RE Authority not yet established II. RE Fund not yet operationalised III. Poor record in pursuing RE targets
Opportunities	Threats
I. Support from bilateral and multilateral donor agencies (World Bank, DANIDA, GIZ, JICA, DGIS, European Commission, Chinese Government, GEF, etc.) II. Experience and lessons from other countries in the South on similar programmes	I. Government commitment to develop specific programmes on prioritised RETs II. Government commitment to allocate funds for prioritised programmes III. Possibility of not receiving external support



## DEVELOP AND IMPLEMENT TAX INCENTIVES ON PRIORITIZED RETS



Strengths	Weaknesses
<ul style="list-style-type: none"> <li>I. RE Law supports funding of RETs</li> <li>II. Availability of local expertise</li> <li>III. Experience in previous national programmes such as GEDAP, SHEP, etc.</li> <li>IV. Strong institutional framework and networking</li> <li>V. Availability of national policy documents – National Energy Policy, SNEP, Bioenergy Policy (draft), etc.</li> </ul>	<ul style="list-style-type: none"> <li>I. RE Authority not yet established</li> <li>II. RE Fund not yet operationalised</li> <li>III. Poor record in pursuing RE targets</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>I. Support from bilateral and multilateral donor agencies (World Bank, DANIDA, GIZ, JICA, DGIS, European Commission, Chinese Government, GEF, etc.)</li> <li>II. Experience and lessons from other countries in the South on similar programmes</li> </ul>	<ul style="list-style-type: none"> <li>I. Government commitment to develop specific programmes on prioritised RETs</li> <li>II. Government commitment to allocate funds for prioritised programmes</li> <li>III. Possibility of not receiving external support</li> </ul>



## DEVELOP AND IMPLEMENT TAX INCENTIVES ON PRIORITIZED RETS



Strengths	Weaknesses
<ul style="list-style-type: none"> <li>I. Import duty waiver on solar and wind power systems already exist</li> <li>II. GIPC Act</li> <li>III. Local experience in developing tax incentive schemes</li> </ul>	<ul style="list-style-type: none"> <li>I. Ambiguous tax incentives subject to the interpretation of the tax officer</li> <li>II. Weak institutional network</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>I. National targets on RE</li> <li>II. Experience and lessons from other countries in the South on similar programmes</li> <li>III. Support from bilateral and multilateral donor agencies (World Bank, DANIDA, GIZ, JICA, DGIS, European Commission, Chinese Government, GEF, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>I. Loss of government revenue</li> <li>II. Abuse of the incentive schemes</li> </ul>





## PROVIDE FINANCIAL SUPPORT FOR RET INVESTMENT IN PRIORITISED SECTORS



Strengths	Weaknesses
<ul style="list-style-type: none"> <li>I. Ghana Infrastructure Fund</li> <li>II. Local experience in setting-up similar funds (e.g. GEDAP)</li> </ul>	<ul style="list-style-type: none"> <li>I. RE Fund not yet operationalized</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>I. Support from bilateral and multilateral donor agencies (World Bank, DANIDA, GIZ, JICA, DGIS, European Commission, Chinese Government, GEF, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>I. Ability to pay back loan</li> <li>II. Misapplication of fund</li> </ul>



## SET-UP DEDICATED CENTRE OF EXCELLENCE IN THE PRIORITIZED RETS



Strengths	Weaknesses
<ul style="list-style-type: none"> <li>I. Climate Innovation Centre established by World Bank</li> <li>II. Centre for RE and EE established at Kumasi Polytechnic</li> <li>III. Established technology transfer centres by MESTI (e.g. CRTDI of Kumasi Polytechnic)</li> <li>IV. Availability of local expertise</li> </ul>	<ul style="list-style-type: none"> <li>I. High cost of certain equipment</li> <li>II. Existing training facilities spread across the southern parts of the country</li> <li>III. Poor maintenance culture</li> <li>IV. Weak collaboration among existing training centres</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>I. Universities/polytechnics/research institutions spread across country and could serve as starting point</li> <li>II. Support from external training and technology centres</li> </ul>	<ul style="list-style-type: none"> <li>I. Lack of funds accessibility</li> <li>II. Misuse of facilities</li> <li>III. Budget cuts may peg this lower on government's developmental agenda</li> </ul>



## ROADMAP FOR RETT



- Roadmap has been developed in the form of a proposed policy timeline from 2016 to 2025
- Involvement of stakeholders
- Targets for prioritised RETs
- Stages of technology transfer for prioritised RETs are considered



## PRIORITIZATION OF RETS



RET	Relative weight	Rank
Solar lantern	0.0862	1
Solar dryer	0.0822	2
Solar PV	0.0821	3
Solar water heater	0.0818	4
Solid fuels	0.0805	5
Biogas	0.0792	6
Solar water still	0.0788	7
Efficient charcoal kilns	0.0765	8
Standalone wind turbine	0.0731	9
Mini- and micro-hydro	0.0719	10
Ethanol	0.0707	11
Biodiesel	0.0695	12
Bio-oil and synthetic-gas	0.0674	13



## TARGETS FOR PRIORITISED RETS



Technology	Stage		
	1	2	3
Solar lantern	✓	✓	
Solar dryers	✓	✓	✓
Solar PV	✓	✓	
Solar water heaters	✓	✓	
Solid fuels and cookstoves	✓	✓	✓
Biogas	✓	✓	✓
Efficient charcoal kilns	✓	✓	✓
Standalone wind turbines	✓	✓	
Mini- and micro-hydro (using general experience in hydro)	✓	✓	

### Why focus on China?

- China is a destination for R&D related investments by foreign companies and countries
- This has brought a lot of highly sophisticated technology to China, making it one of the largest economies in the world today, and a technology powerhouse
- China has moved from importing technology, to locally manufacturing and exporting similar technology

## Why focus on China?

- China has also achieved a lot in renewable energy
- China made the highest investment or net capacity addition into hydropower, solar PV, wind power and solar water heating in 2013
- In 2013, China invested more in RE than did all of Europe combined, and it invested more in renewable power capacity than in fossil fuels
- The fact that China is itself on the ascendancy due to the benefits it has derived from technology transfer, rightly positions them be able to assist Ghana and other countries and lead them towards achieving similar feat.

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