The Least Developed Countries Needs for Changing the Passive Trend of Renewable Energy Exploitation to a Proactive Trend

Mir Sayed Shah Danish1,*, Najib Rahman Sabory1, Ahmad Murtaza Ershad1, Sayed Mir Shah Danish2, Ryoya Ohta3, Masih Sediqi3, Mikael Ahmadi3, Tomonobu Senju3

1Energy Engineering Department. Kabul University, Kabul, Afghanistan
2Electrical Department, Technical Teachers Training Academy (TTTA), Kabul, Afghanistan
3Electrical and Electronics Department, University of the Ryukyus, Okinawa, Japan

Email address: mdanish@ku.edu.af (M. S. S. Danish)
*Corresponding author

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Abstract: The Least Developed Countries adhere to meet the minimum milestone of renewable energy (RE) exploitation for a long-run sustainability. Therefore, RE exploitation as a significant part of this milestone has therefore become a matter of priority. This paper addresses a general framework for RE effective deployment following the actions are considered essential by the help of the lessons-learned and literature finding to deliver an effective guideline. This paper introduces a strategic mechanics, metrics, and milestones for RE development, demonstration and deployment in the context of least developed countries. That draw a systematic procedure to follow to achieve the perspective RE deployment goals through outlining and prioritizing the necessary actions in the short, medium, and long term. This study unlike the literature, designed an appropriate framework that aligning RE technologies deployment with overall business and project management objectives. That ultimately contributes to achieve the goals of strategic mechanics for developing RE deployment in the least developed countries. The purpose of this study is to introduce a roadmap for RE deployment through identification of opportunities, barriers, and solutions; also to incorporate RE policies and programs into implementation plans.

Keywords: Renewable (RE) Deployment, Sustainable Energy, RE Policy, RE Regulation, RE Reform, RE Research, RE Governance

1. Introduction

Access to sustainable energy has become one of the ever-increasing challenges that least developing countries are currently facing. The rapid change in technology and lifestyle, have led to a dramatic increase in electricity demand, which can face planners with the challenge of ensuring the sustainable and clean electricity production. Somehow, the least developed countries are endowed with vast and varied RE resource that have the appropriate wind, solar, geothermal, tidal, and waves. These RE resources require to be utilized in a proper manner considering the multifaceted application, affordability, accessibility, marketability, efficiency, durability, conform, and heath aspects. The transition toward RE is consistent with the various scenarios that require a comprehensive investigation separately in order to be aligned as an optimum solution. In an energy chain, RE plays a significant role in energy supply security, flexibility, accessibility, emergency response and reliability. The greenhouse gases (GHG) emissions issue will challenge the least developed countries more than ever when they go toward industrialization. It is necessary to start from low level of RE and improve it to meet the target to deliver energy for the industrial sector. The analysis indicates [1] that the RE utilization in industry sector has significant upside potential as
well as downside risk of deployment.

2. Paper Structure Graphical Representation

![Diagram of paper structure](image)

3. Challenges

The RE exploitation challenges are mainly associated with economic, environmental, technical, and regulatory constraints in the least developed countries. These constraints include the unstable economic and living most of the citizens under line of poverty, and uncompetitiveness of RE price in energy market, energy production in large scale (TW), and lack of supportive plans of RE and advanced technology in least developed countries; which are allied to lead these nations to rely on primary and fossil fuel resources. Lack of resources (technical and human) in the field of RE technologies in some least developed countries the administrative and employment corruptions are the main obstacles in the way of RE deployment.

4. Focus Area

4.1. Sustainable Energy

The energy sustainability concept intimates that how to use the source in a way that does not compromise the ability of future generations to meet their needs [2, 3]. The sustainability concept for efficient energy supply needs to satisfy these conditions [4]:

- All energy must come from sustainably managed renewable resources.
- Energy must be distributed and used with highest efficiency.

Energy production and utilization have a major impact on environmental pollution and climate changes; as a whole, this has a loin share in greenhouse gases emissions (GHG). The emission of GHG and their mitigation to climate change comes into global focus. According to the reports [5], electricity production and consumption emit at the percentage of approximately 37% of global emissions.

4.2. Energy Accessibility and Affordability

Energy accessibility is a factor of energy sustainability that measures the acceptability and accessibility of energy supply by all in the society. Once of the main concerns of CO\(_2\) in the least developed countries are due to the use of primary energy resources. Usually, the primary resources have a high share in GHG emissions due to lack of access to a clean and secondary form of energy. That it also has been a point of concern for energy economics and statistics due to lack of adequate information on utilizing the energy resources in primary forms.

4.3. Proposed Pathway

According to the [6], for RE policy and strategy better incorporation and implementation four pathways are supposed, to meet the objectives. The assessing of these pathways will ensure a rapid fast RE deployment.

A. Baseline emissions projection pathway: This pathway mainly forces the energy production sectors that are directly involved in GHG emissions (for large scale energy generation) to rely on alternative zero-emission (RE) technologies.

![Proposed Pathways](image)
B. Control strategy projection pathway: This pathway deals with control change and regular update of policies and strategies and shall be quantifiable, surplus, enforceable and permanent.

C. Emerging/voluntary measures pathway: This pathway concentrates on the available options and their emerging adoption and/or RE voluntary measures. A voluntary program is not enforceable against an individual source or implementing party.

D. Weight of evidence (WOE) determination pathway: This pathway is a supplemental analysis to an attainment demonstration when there is no predefined measure for air pollution and climate changes.

5. Strategic Mechanism of RE Deployment Development

The objectives set out in a RE deployment strategy will not be achievable, if it is not comprising these factors: enable optimum exploit of RE local resources, establish a close integration and contribution to national energy need, spurring economic development, contribute GHG emissions reduction, reducing safety risks from conventional energy source, balancing the use of RE and non-RE resources, and can be utilized for multi-purposes. Implementation of such strategy will intend to tackle the barriers in the way of RE deployment in the lease developed countries. Adequate setting RE goals are more challenging to be achieved in action, as noted in [7] “The interaction between RE goal setting and studies of operation feasibility can give policymakers a basis for assessing potential challenges, solutions, and economic impacts of increasing the level of variable RE on the grid”.

Table 1. Journey Map for Strategic Mechanism of RE Deployment Development.

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Preparing / Initiation</th>
<th>Develop</th>
<th>Implement</th>
<th>Monitor / Evaluate</th>
<th>Deliver / Optimize</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Define scope boundaries</td>
<td>Coordinate and finalize the deliverables within stakeholders’ responsibility</td>
<td>Put forward with action items</td>
<td>Measure progress against the predefined baseline</td>
<td>Confirm deliverable/phase competes within the predefined objective</td>
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<tr>
<td></td>
<td>Identify stakeholders</td>
<td>Draw a feasible roadmap for achieving the setting goals</td>
<td>Define sub-scope of action item</td>
<td>Evaluate the factors that influence the performances and cause changes</td>
<td>Update stockholders with information (deliverable/phase description, planning/design data, internal and external factors, policies and strategies influences, financial data, change control and audit information, etc.)</td>
</tr>
<tr>
<td></td>
<td>Establish steering committee</td>
<td>Categorize near, medium and long term goals</td>
<td>Request scope change if finds against the goal and milestone</td>
<td>Develop timely change request through integrated change control</td>
<td>Gain formal acceptance of the deliverable/phase</td>
</tr>
<tr>
<td></td>
<td>Engage Experts and Scholars</td>
<td>Conduct expert workshop to consensus on barriers and priorities</td>
<td>Follow work-flow and authorization system</td>
<td>Inform stakeholders of any approved changes</td>
<td>Register, index, and archive the deliverables</td>
</tr>
<tr>
<td></td>
<td>Set milestones and design the SM</td>
<td>Determine detailed requirements (resources; human, timeline, budget, technology, permissions, etc.)</td>
<td>Establish team acquiring, forming, norming and rewarding mechanism</td>
<td>Report of progress</td>
<td>Update stockholders with lessons learned knowledge base</td>
</tr>
<tr>
<td></td>
<td>Uncover initial requirements, assumptions, risks, constrains, and opportunities</td>
<td>Develop SM purpose and scope statement (include requirements into scope)</td>
<td>Perform regular quality assurance and audit</td>
<td>Forecast near behavior of the performance and reserves</td>
<td>Call for expert workshop and hand off the deliverable/phase</td>
</tr>
</tbody>
</table>
Here, some useful related information about the above table is directly quoted from [8] as following:

(1) At this phase needs to answer several questions:
- What are the boundaries of the roadmapping effort?
- Which technology areas or classes will the roadmap consider? Which energy sources or end-use sectors will be considered?
- What is the time frame for the roadmapping effort?
- Is the roadmap a 5-year plan, a 20-year plan or a 50-year plan?
- What is the current state of the technology under consideration (current installed base, potential energy savings, cost, efficiency, etc.)?
- How will the organization conducting the roadmapping effort implement and use the resulting roadmap?
- Will the roadmap be used primarily to guide national government decision making?
- Will the roadmap need to engage the private sector to achieve the stated goals?
- What existing tools or analysis, such as other roadmaps, can be used to influence scoping decisions?

(2) Monitoring and tracking:
- Who will be responsible for tracking progress towards roadmap goals and milestones?
- What data and analysis tools will be needed to create and track roadmap metrics?
- What new information will be required to adjust technology scenarios as time advances?
- Who should be involved in re-evaluating technology pathways at regular intervals?
- How will national policies be adjusted if roadmap targets are not being met?

(3) Stakeholder participation:
- Who will set roadmap goals and milestones?
- Who will be responsible for ensuring that goals are met?
- What human resources are available to accomplish roadmapping activities and priorities?
- Who will be responsible for carrying out activities?
- Which stakeholders will be critical in ensuring roadmap success?

(4) Data and analysis activities:
- Roadmaps based on strong analysis will obtain consensus more easily.
- Government-sponsored analysis requires fewer resources and can be developed more quickly but may ignore critical technology or market issues.
- Conducting analysis in partnership with stakeholders maximizes support from business, government and community leaders but takes more time.
- The data, models, and analytical skills available may not be sufficient.

(5) The expert workshop is also often needed to make choices among possible scenarios or options revealed by data and analysis activities.
- Build consensus on goals and targets.
- Evaluate and verify assumptions (such as technology costs or performance metrics).
- Identify key technical and institutional barriers.
• Define alternative technology pathways to overcome the obstacles.
• Develop implementation strategies with priorities for action.
• Diverse technical expertise ensures fewer potential gaps.
• The critical market, policy, social and institutional factors should be considered.
• Broad consensus facilitates roadmap implementation.
• The roadmap should not rely solely on existing data and analysis.
• Greater stakeholder involvement increases roadmap development time and requires more resources.
• Longer, more detailed stakeholder processes may make it harder to achieve consensus.

Technology situation analysis:
• Which technologies will be addressed?
• In which market sectors or segments will the technologies be applied?
• What public policies can help or hinder application of the technologies in the relevant market sectors or segments?
• Consider point to point:
  • Development status
  • Technology performance (e.g. conversion efficiency)
  • Technology costs
  • Environmental impacts (air, water, and land impacts)
  • Technology potential (saturation levels/other limitations)
  • Links to other technology areas

Critical input:
• What data are needed to establish baseline conditions, set goals and targets, and prepare forecasts?
• Are essential analytic capabilities and tools available to evaluate alternative scenarios?
• What technical expertise is needed to evaluate technology performance and limitations?
• Which regulators and policy leaders can provide insight on factors affecting technology adoption?
• Which private entities will be critical to technology success?

Purpose, process and participants:
• Why is the roadmap being developed?
• Scope and objectives: what is the roadmap expected to do?
• How will the roadmap be developed and implemented?
• Who will be involved?
• Resources constrains:
  • What skills and tools will be needed to prepare the roadmap?
  • What funds are available to develop the roadmap?
  • Is there enough time for broad stakeholder engagement?
  • Are sufficient personnel available to manage and implement the roadmap development process?
  • Are appropriate data and analytic tools available to support analysis?

Market feasibility situation analysis:
• Suppliers
• Distributors
• Customers (including outlook for demand by end-use sector)
• Financing aspects
• Market penetration
• Existing studies/forecasts for the market/energy sector
• Policy feasibility situation analysis:
  • Current status and requirements
  • Existing laws and regulations

Point to point consideration:
• Will goals and milestones include date-based, quantitative targets?
• What information must be included in the roadmap?
• What level of detail is needed for effective implementation and action?
• What supporting information and data are needed?
• Will activities be assigned to organizations for action?
Throughout the SM process, the interaction of code of ethics and professional conducts are expected that can be broken as social and professional responsibility down into these categories [9]:
• Responsibility
• Respect
• Fairness
• Honesty

6. Recommendation and/or Solution

The principle of an integrated solution for RE exploitation is correlative to multi-dimensional measures that can be considered from policy, revolution, reform, governance, researches and development perspectives.

6.1. RE Policy and Regulation

Desirable socio-economic improvement needs for an emerging economic and technical policies at an accelerating rate of ensuring RE exploitation and non-RE resources harvesting. That can be achieved through integrated strategic energy planning.

1) Formulate and implement clean low-carbon energy revolution strategy and action plan, which prioritize renewable energy [10].
2) Improve the green tax system and carbon trading market system to create a fair playing field for renewables.
3) Identifying the critical enablers that impact on RE exploitation.
4) Draw a sustainable energy system in compliance of present socio-economic criterial in order to be competitive and secure.
5) Formulate energy revolution strategy and action plan for the near, medium and long term.
6) Design an efficient energy procedure that overcomes the inter-stakeholders’ complexity, and balance among energy producers, distributors, operators, regulators and consumers interacts.
7) Develop a transparent governance and employment frameworks to meet the proposed RE goals.
8) Ensure short and long term energy supply security in view of flexibility and affordability criteria [11].
opportunities are important that pointed out as following:

For an efficient RE reform and governance, understanding the uncertainties, investment initiative, and integrated solution is known exigent for energy sector reform and governance.

6.2. RE Reform and Governance

Adequate estimation of the energy demand as the foundation for understanding useful share of RE exploitation is known exigent for energy sector reform and governance. For an efficient RE reform and governance, understanding the uncertainties, investment initiative, and integrated solution opportunities are important that pointed out as following:

1. Defining a feasible benchmark for effective factors on RE deployment (reduction of GHG emissions, tackling action to keep global temperature change at a predefined level (global warming).
2. Develop a framework for decarbonization of the energy systems, which still in the least developed countries mainly rely on fossil fuels and primary energy resources.
3. Ensure security of energy supply and prevent from energy dependency on a single source, as key policy objectives (For instance; Afghanistan imports about 80% of electricity from its neighboring countries).
4. Deploy decentralized energy system and reconfigure the energy production and accessibility topology.
5. Assess the energy systems enhancement opportunities; for example, improving efficiency and reduce energy demand across the energy system by applying different sustainable measures all together [12].
6. Underline energy losses reduction opportunities from energy production to end-user.
7. Examine the impact and consequence of the integrated plan for RE exploitation and advancement of primary energy resources to ensure the transition toward a sustainable energy system.
8. Put forward an achievable RE deployment milestones in line with the existing energy policies and with coordination of involved organizations.
9. Ensure well-functioning of RE plan with cautiously considering the economic, technical, social, environmental and political aspects of a least developed country (which are almost in transition).
10. Promote sustained large-scale development of renewable power generation [10].
11. Explore the ample supplies capacity of affordable local RE resources in form of alternative for traditional energy supply disruptions.
12. Enable effective combinations of various types of RE technologies in different types of application (centralized and decentralized for multi-purposed (combined heat and power).
13. Engagement of public through a better understanding of RE technologies, advantages, opportunities, promotional subsides, and the importance of transformation from traditional energy resources.
14. Align the RE policy with involved organization for achieving a massive RE targets (energy efficient building, geocluster energy efficiency, green and smart city).
15. Establish a sound body of certification and training accreditation scheme for human resources empowerment.
16. Promote innovation and deployment of new technologies in public and industry sectors with negligible cost to the economy, and accepting the climate change challenge an opportunity in these areas, rather than a barrier [13].
17. Deploy cost-effective emerging technologies for increasing the efficiency of energy supply and consumption.
18. Transit from traditional to an advanced industrial research and demonstration program in the least developed countries for optimum RE deployment.
19. Identify and prioritize the long term RE resources potential and their deployment cost effectiveness to deliver the RE milestone.
20. Energy related policy, and regulations optimization and uptake of innovative energy strategy for long-run sustainability.
21. Modernization of the energy systems chains through integration of RE for synergies between the various energy resources.

6.3. RE Investment

1. Sum up on RE technologies quality and quantity production inside the country by attracting national and international investment.
3. Establish energy market mechanism in adaptable with RE development strategy.

6.4. RE Research

According to the [14], close coordination with researches partners will create new opportunities and pave the way for a smooth RE deployment. To initiate an RE research activity, at the first these steps are to be pursuit:
• Identification of energy sector stakeholders.
• Define the stakeholders’ authority and responsibility against RE exploitation and climate changes transition.
• Establish an associated executive energy platform of representations of different stakeholders such as research communities and academic affairs (universities), industrial (technology), and investors.

That follows through main item actions of conducting an RE research:
• Basic RE Status Observed
• RE deployment perspective (milestone)
• Feasibility of RE deployment milestones
• Definition of adequate scope
• Formulation of an action plan for medium and long term
• Design theoretical concepts and models of RE exploitation behavior that comprise the analysis and assessment of policies and strategies applications to address the predefined scope.

6.5. Along with Time

This strategic mechanism of RE deployment development aims to cover RE related aspects that provide the framework to develop and action plan establishing close coordination between RE stakeholders for policy, regulatory update to adjust them in to a possible framework for medium and long term RE exploitation.

As a fact, over the medium to long term the RE energy exploitation and deployment behavior, cost, support, and technologies are in variation. Of course, technology costs, innovation breakthroughs and barriers to deployment will change over time [1]. So, close monitoring and update of RE policies and deployment are key to meet the goal. The expert committees are exigent to established with consisting of various RE stakeholders to update the RE roadmap on an annual basis.

7. Conclusion

This study manifest that is taking appropriate actions based on the adequate strategy will not only drive RE deployment in the least developed countries; but will also improve the socio-economic through creating jobs and increase energy accessibility. The proposed strategic mechanism of RE deployment development can be counted an ample guideline for putting RE deployment in action. Also, this study can be counted an opener for further researches for those interested in this theme.

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