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Integrated Framework to Enhance the Deployment of Wind Energy in Libya

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Abstract: ***The recent civil war in Libya has dramatically affected the oil production and led to a severe shortage and instability in electricity supply in Libya. The geographical location of Libya has encouraged the Libyan Government to seek for an alternative source of energy that is sustainable. The preliminary study showed that wind energy is the most appropriate source of energy in Libya. The objective of this paper is to enhance the deployment of wind energy in Libya through developing a framework to help energy policymakers to select the appropriate policy for the wind energy deployment in Libya and provide mechanisms to bridge the gap of the country's excessive dependence on the single source of energy. Data was collected using semi-structured interviews with energy experts in Libya and the questionnaires. The result indicated that there are four main barriers, namely political, economic, technical, and social that inhibit the deployment of wind energy in Libya. The political barrier is the most critical barrier that influences the deployment of wind energy in Libya. Three managerial concepts, force field analysis, value-added engineering and continuous improvement were combined to develop and integrated time-dependent framework to enhance the deployment of wind energy in Libya. The developed integrated time-dependent framework started with ranking the strategic objectives (political, economic, technical and social) according to their importance. In this framework the importance of each objective changes with time (from phase to phase) and each phase focuses mainly on improving one object and at the same time sending feedbacks to the other objectives. The feedback mechanisms are available between the processes to ensure continuous improvement.***

Keywords: Barriers, Deployment, Framework, Integrated, Libya, Wind Energy

1. Introduction

Libya has a high potential of alternative energy sources, the wind energy and solar have real opportunities more than any other sources of alternative energy in Libya based on the currently available information, six million inhabitants distributed over an area of 1,759, 000 km^2. with very long coast nearly 2000 km with 88% of its area desert [4, 5].All these areas have an enormous potential of solar and wind energy and the big percentage of that area is not inhabitant that makes Libya a very good location for renewable power sources.

Alternative energy has been introduced in many applications to fulfil the National Alternative Energy Plan goals in Libya, these technologies are currently impeded by many barriers such as low awareness and lack of experience among the stakeholders in Libya. This is reflected in unclear and unsystematic policy which caused delay in the deployment of wind energy in Libya.

However, more remains to be done to promote the alternative energy deployment in Libya. This is in the context of promoting the use of wind power to reduce reliance on fossil fuel to generate electricity, as well as addressing the problem of lack of energy supply in Libya. The barriers that inhibit the deployment of wind energy in Libya were determined and evaluated through two methods.Firstly, the barrierswere validated using semi-structured interviews with the alternative energy experts in Libya.

Secondly, the barriers were evaluated via questionnaires. The results indicated that fifteen critical barriers prevent the deployment of the wind energy in Libya which werecategorised into four groups according to their importance (Political, Economic, Technical and Social) with the political being the most critical barriers that inhibit the deployment of wind energy in Libya.

In previous studies many rsearches were conducted to determine the barriers that inhibiting the deployment of alternative energy in generalbut very few studies were conductuted cocerning the barriers that inhibit the deployment of wind energy in Libya. This study focused on studying the barriers that inhibiting the deployment of wind energy in Libya. A framework with unique characteristics was developed to overcome these barriers and to bridge the gab in the prvious researches.

2. The Principal Barriers Associated with the Deployment of Wind Energy in Libya

In this study, the energy experts in Libya identified four primary categories associated of barriers that inhibit the deployment of wind energy in Libya. The four groups of barriers are:

1) Political Barriers:

- Monopoly of generation, transmission, and distribution of electricity in Libya by one company (Electrical General Company of Libya, GECOL).
- Strong government subsidies to fossil fuel in Libya.
- Lack of incentives or subsidies from the Libyan government to alternative energy sector.
- There is a gap between the Libyan Government energy policy targets and the current situation of alternative energy projects in Libya.
- Lack of alternative energy experts in the government sector in Libya.
- Lack of Policy, Regulations and Legislations frameworks to manage the investment in alternative energy in Libya.

2) Economic Barriers:

- Lack of funding from Libyan Government Banks for alternative energy projects.
- Lack of capability of the private sector in Libya to finance the alternative energy projects.

3) Technical Barriers:

- Lack of scientific assessment to Alternative Energy Source Capabilities in Libya.
- Lack of technical experience in the field of alternative energy in Libya.
- Lack of availability of Alternative Energy Supporting Technologies in Libya

4) Social Barriers:

- Lack of local initiatives to promote alternative energy deployment in Libya.
- Lack of the training institutions in the field of the alternative energy in Libya.
- Lack of public awareness towards the alternative energy benefits in Libya.
- The negative perception of the public towards importance of alternative energy projects in Libya.

3. Framework Development

The proposed theoretical framework started with the strategic objectives that are to be achieved to accomplish a certain vision. These strategic objectives are to be achieved via some initiatives. The vision to be achieved using the proposed framework is to help the Libyan government to achieve energy security through the deployment of wind energy. Operationally the proposed framework had three components. These three components are based on previous theories and concepts. The components are value added, importance and time. The proposed framework integrated these concepts to balance between the four strategic objectives (political, economic, technical and social) as shown in figure 1. The proposed integrated framework will change the way decision makers in the energy sector think in Libya.

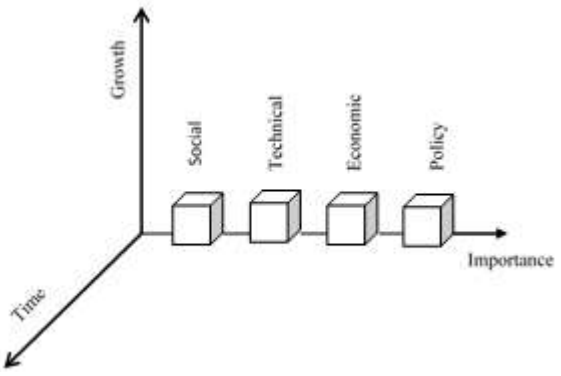

Figure 1: Three components of the theoretical Framework

4. Integrated Framework Objectives

The framework was developed based on the outcome of the analysis from the questionnaire and the semi-structured interviews. Three managerial tools which are force field analysis (FFA), value added engineering (VAE) and continuous improvement (Kaizen) were used to develop the framework. The theoretical framework provided the basis for a long-term process of deployment of wind energy in Libya and created a list of measures to be considered to enhance the deployment of wind energy in Libya. The measures are: developing the regulatory framework and energy policies, providing source of funding for wind energy projects, exploiting the offshore for wind energy projects, increase public awareness, change public attitude toward sustainable energy and simplify the Libyan government policy to deploy the wind energy in Libya in the future.

The developed framework has a new concept which is the dynamic nature (continuous improvement) with feedbacks to all processes, in this study as earlier the political barriers are the most important barriers that inhibiting the deployment of wind energy in Libya. To reduce the impact of these barriers, Libyan government should do some changes (improvements) for the existing energy policies in Libya, for example, develop new regulations and legislations that enhance the investments in the alternative energy projects. These changes (improvements) are not final and further changes (improvements) will be imposed on the policies, as a result of the feedbacks from the other processes (economic, technical and social initiatives) while improving the other processes. While developing the initiatives to solve the economic barriers, some investors may not agree on the financing policy developed earlier, so a feedback to improve the policy is essential and so forth. That means Libyan government should take step back and modify the policy that been developed earlier.

To develop the framework, the four groups of barriers that prevent the deployment of wind energy in Libya were replaced by strategic objectives. The framework addressed many of the initiatives to achieve the strategic objectives and ultimately overcome the barriers contributed to delay of the deployment of wind energy in Libya. These initiatives are derived from the outcomes of the results analysis as shown in figure2.

5. Two Dimensional Framework

The outcomes of the interviews and questionnaires indicated that the four groups of barriers that inhibit the deployment of wind energy in Libya (political, economic, technical and social) are all very significant, however, according to the feedback from the questionnaires respondents and interviewees, the political barriers are the most important among the groups followed by the economic barriers, technical barriers and finally the social barriers. Figure 3 shows the ranking of the barriers that prevent the deployment of wind energy in Libya. Developing the adequate energy policies and regulations has the top priority and then developing the roadmaps that will eliminate the other barriers. Hence, the proposed framework uses the value-added concept and start with improving the energy policy. The Libyan Government will improve energy policies and regulations using the initiatives proposed earlier.

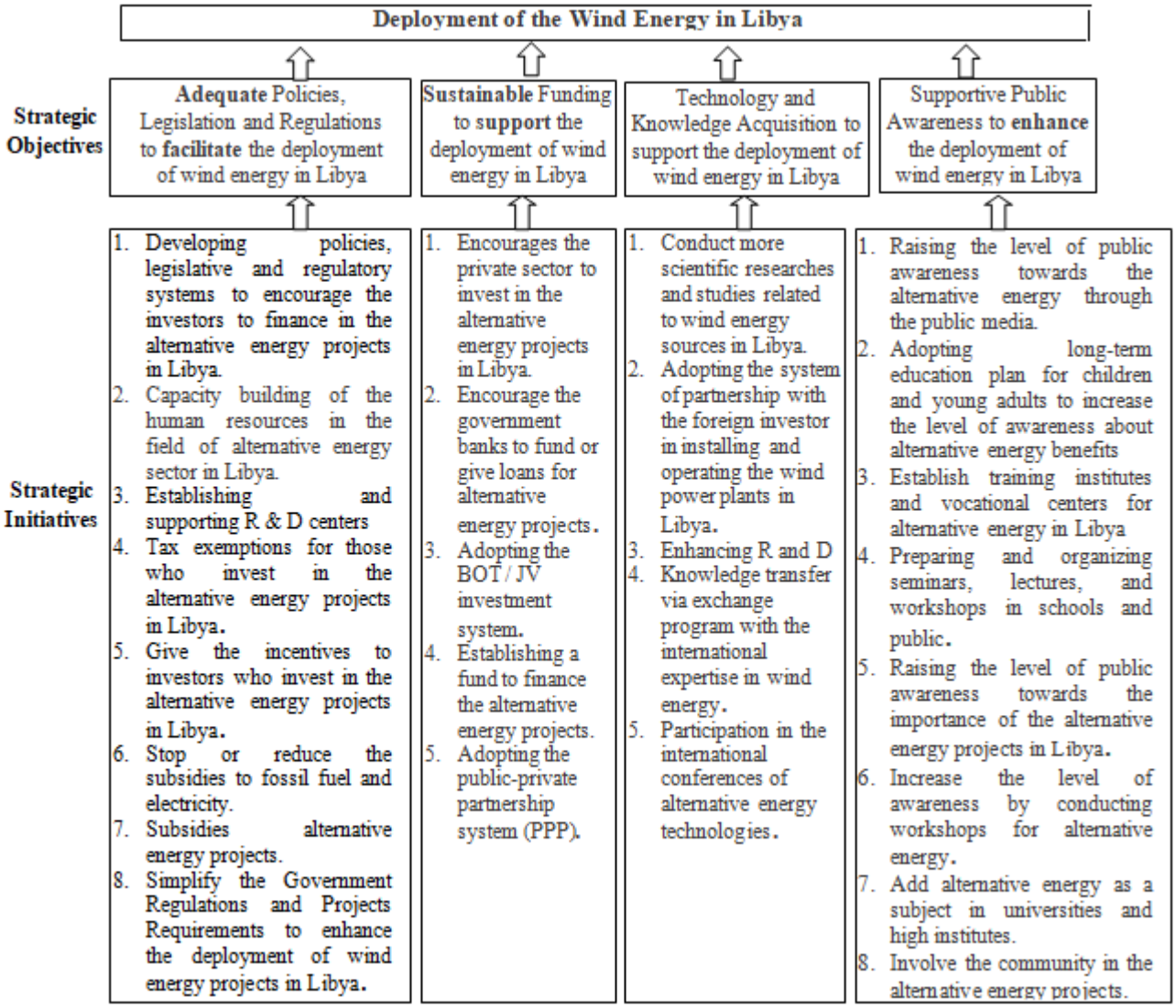

Figure 2: framework for enhancing the deployment of wind energy in Libya

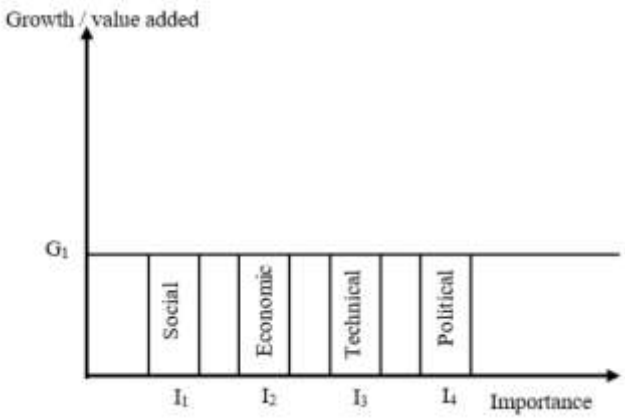

Figure 3: Ranking of barriers that inhibit the deployment of wind energy in Libya

6. Integrated Framework

The author proposed an innovative approach that combines three managerial tools or concepts which are Force Field Analysis (FFA), Value Added Engineering (VAE) and Continuous Improvement (Kaizen) in one framework. Previous researchers conducted many studies to determine the barriers that inhibiting the deployment of alternative energy and very few proposed solutions to eliminate these barriers. Moreover, these researchers did not include in their proposed studies how to implement these solutions. In this study, an integrated framework with unique characteristics was developed to bridge the gap in the previous researches. The integrated framework started with ranking the four groups of processes that achieve the strategic objectives (political, economic, technical and social) according to their importance. The importance of each objective changes with time (from phase to phase). Each phase focuses mainly on

improving one objective and at the same time sending feedbacks to the other objectives. The feedback mechanisms are available between the processes to ensure continuous improvement. The four phases are combined in one integrated time-dependent framework. A flowchart of the integrated time-dependent framework is shown in figure 4. The integrated time-dependent framework will assist in:

- Developing efficient and lean policy that enhance the deployment of wind energy in Libya
- Better decisions making using data received via continuous feedback.
- Measuring the outcomes of the processes to identify the weak points and develop proper plans to improve them.
- Continuously reviewing the effectiveness of the policies.

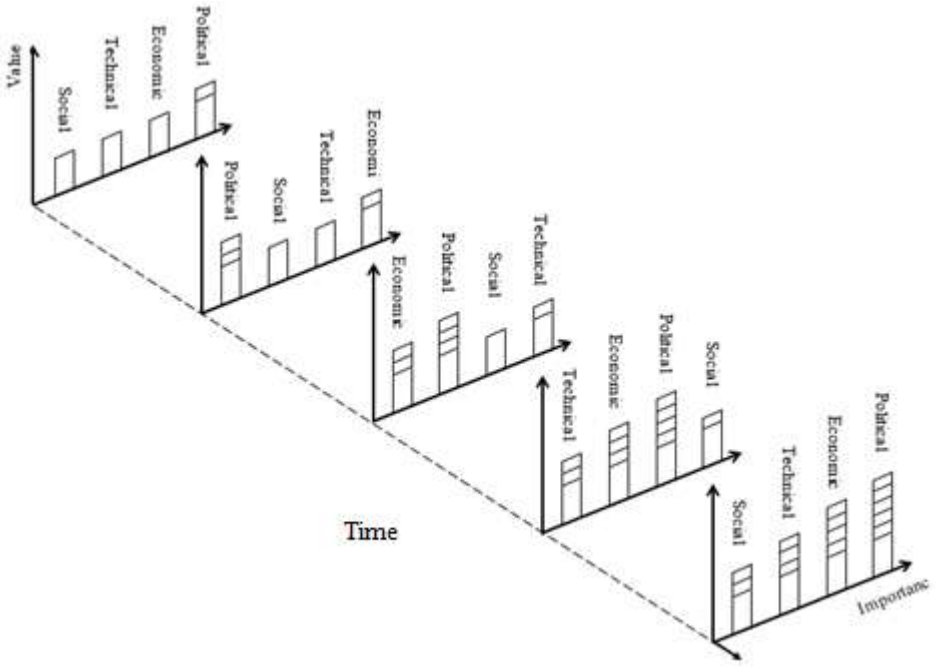

Figure 4: Integrated time-dependent Framework

Characteristics of the Developed Integrated Framework

1) The integrated framework started with ranking the four groups of processes that achieve the strategic objectives (political, economic, technical and social) according to their importance.
2) The importance of each objective changes with time from phase to phase.
3) Each phase focuses mainly on improving one strategic objective and at the same time sending feedbacks to the other strategic objectives.
4) The feedback mechanisms are available between the processes to ensure continuous improvement shown in figure 5.
5) The phases are combined in one integrated time-dependent framework.

Framework Validation

The method used to validate the framework in this study is via Subject Matter Experts (SME). Alternative energy experts were selected and were asked to comment on the developed framework. The proposed framework was sent to five alternative energy experts. The feedback from the subject matter experts agreed on the proposed framework and their comments are quite positive and used to refine the framework.

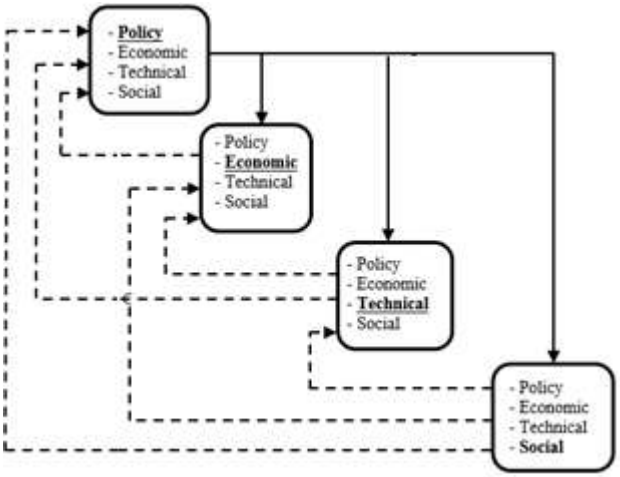

Figure 5: The feedback and continuous improvement process

7. Conclusion

There are four groups of barriers that inhibit the deployment of wind energy in Libya. The first fifteen barriers were selected as input to develop an integrated time-dependent framework that enhances the deployment of wind energy in Libya. The integrated time-dependent framework comprises four phases (strategic objectives) ranked according to their importance. The unique characteristic of this integrated time-dependent framework is that the importance of the ranking of the strategic objectives changes with time and there are continuous feedbacks across the processes to

ensure effective streamline of information and hence better communication and improvement.

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