

# The Critical Success Factors for Renewable Energy Projects Implementation

K. V. Mokan, T. C. Lee, R. Ramlan

**ABSTRACT**---Securing energy sources is an essential part of life for all human beings in the world. There are many natural energy sources worldwide, some are non-renewable energy and some are renewable energy. Renewable energy sources are clean energy derived from natural resources that are constantly renewed and will never run out. The problems that encouraged the conducting of this study were the energy-related environmental issues as well as the lack of awareness among the public and lack of publication of critical success factors (CSFs) of renewable energy projects. In order to address these issues, this study conducted a systematic literature review to identify the CSFs for renewable energy project's implementation. There are several types of renewable energy sources such as solar energy, wind energy, biomass energy and tidal power. Renewable energy is the most outstanding source of energy and the most viable solution to the global increase of renewable energy demand for electricity, heating and cooling and transportation. This paper discusses a review about different CSFs for renewable energy project implementation by referring to the previous studies on related topics. Based on these sources of literature, it was found that social, technology, government, economic, organization and management and the environment were the CSFs that ensured the success of renewable energy projects. This review acted as a guideline for the renewable energy industry to manage its projects. This research also contributed to building knowledge by facilitating more research on CSF in implementing renewable energy projects in the future. The CSFs are not only useful for future research but also useful to improve government policy on the renewable energy sector.

**Index Terms:** Renewable energy, Natural resources, Environmental issue, Critical Success Factors (CSFs).

## I. INTRODUCTION

In this modern age, energy is an essential resource in daily life and people are getting more concerned in choosing the energy sources which are eco-friendly. Renewable energy demand globally increased proportional to population growth, industrial development, rural area development and fast depletion of limited conventional energy [1]. Renewable energy is also known as alternative energy sources and contributes to a sustainable electricity generation system. Renewable energies are not "run out" resources and can be quickly replenished time after time by natural processes which do not involve the consumption of resources like fossil fuels. The application of renewable energy is based on the resources available in the location

which follows the geographical conditions of certain places [2].

## II. RENEWABLE ENERGY

There are several types of renewable energy sources such as solar energy, wind energy, biomass energy and tidal power. Solar power is the amount of energy which the sun radiates every day. Solar energy has the highest probability to provide clean, safe and reliable power. Wind energy is the movement of air in the atmosphere that is collected to become usable energy. Wind energy is a commercially accessible sustainable energy source, with advanced wind power plants producing electrical power [3].

Biomass consists of all types of organic matter from fuel wood to marine vegetables which can be converted into useful forms of energy [4]. Tidal power is the energy produced from sea tidal currents. According to Stritih et al., [5] tidal power was developed to improve the energy efficiency of tidal streams which are currents in the sea water that are made as the water of the sea rises and drops with the movement of the tides.

In addition to that, renewable energy also has many benefits and importance especially with regard to the environment. Renewable energy technologies are clean sources of energy which have less impact on the environment compared to conventional energy technologies [3]. Renewable energy would not cause any environmental pollution problems and among its main advantages is that by a one-time investment, a sustainable energy source can be obtained for a long time without affecting the environment.

Can Şener et al., [6] also mentioned multiple benefits of renewable energy sources such as increase in energy security, provide sustainable economic growth and pollution reduction, reduce water usage footprint, lower wastewater pollution and lower solid waste pollution. In support of that, Paravantis et al., (2018) [7] stated that the creation of new employment opportunities, improvement to environmental and quality of life as well as independence from solid fuels are also renewable energy benefits that must be taken into account.

## III. CRITICAL SUCCESS FACTORS

Critical Success Factors (CSFs) method has been implemented in various fields of study to identify the most critical factors that affect industries successes. The concept of critical success factors was proposed by Rockart (1979)

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**K. V. Mokan**, Department of Production and Operation Management, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja 86400, Batu Pahat, Johor, Malaysia.

**T. C. Lee**, Department of Production and Operation Management, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja 86400, Batu Pahat, Johor, Malaysia.

**R. Ramlan**, Department of Production and Operation Management, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja 86400, Batu Pahat, Johor, Malaysia.

[8] to ensure the organizations meet their success by control over its CSFs. Soheili Rad (2015) [9] stated that CSFs are formed by an organization to reach their goals and the top management plays an important role in an organization to inspect their surroundings to implement the CSFs technique. CSFs is very important in any organization to achieve their goals, missions and strategies as well as improve the status of their organization. Based on available literature, it was found that social, technology, government, economic, organization and management and environment are the CSFs that ensure the success of renewable energy projects.

#### A. Economic

Economic is an important aspect in the development of any country. Energy usage especially increase in renewable resources usage is one of the essential features that contribute to the economic growth of a nation. An economic factor is strongly related to money, national income, values and import export balances. The increase in price of non-renewable energy sources had impacted global economies in a negative way and renewable energy sources are an alternative for future economic development [6]. Examples of economic factors which affect the success of renewable energy projects are investment costs, production costs and operational and maintenance costs. Solar energy gains more attention than other renewable energies for economic development because of increases in the prices of fossil fuels and reduction of fossil fuel sources [10]. This coincides with Pandey et al., [11] that stated that the implementation of current systems using solar energy is more economical than using fossil-fuel.

According to Büyüközkan&Güteryüz, [1] economic feasibility and financial viability should be considered before implementing a power generation project. It was mentioned that economic factors include investment costs, operation and maintenance costs, R&D costs, production costs and return on investment, which contributed in the selection of renewable energy sources in Turkey. Luthra et al., [12] specified that the Green Supply Chain Management (GSCM) practices provide economic benefits such as competitive advantages and implementation of GSCM can also reduce the high costs of hazardous materials disposal.

Abdmouleh et al., and Ali et al., [13,14] stated that effective financial support is essential for the success of renewable energy integration. The public and private sectors provide the requisite funds through grants and loans toward the operational costs. Overall. The related financing is very complex and changes from time to time [15]. Kumar et al., [16] stated that any economic investment includes financial perspective, development of productive users and competitive factors are all considerable challenges in renewable energy projects. Economic considerations include competences, target and structure; all are important criteria in developing a company's profitability [17]. Shen et al., [18] stated that investors' financial capacity in the project's development and purchasing power of green buildings improved together with economic growth.

#### B. Environment

Environment means all the surrounding with living and non-living things. The production of conventional energies

causenegative impacts to the environment affecting human health and other living things such as plants and animals [19]. Examples of environmental factors which affect the success of renewable energy projects are carbon dioxide emission, air pollution, land use requirement and impact on the ecosystem. In Turkey, renewable energy resources (RER) are considered as alternative to fossil fuel sources because RER not only helps to reduce negative environmental effects but also produces clean energy in the ecosystem [1]. Likewise, Zhao & Chen [20] also mentioned that China faced environmental pollution due to the consumption of fossil fuel sources and found an alternative in solving the issue by adopting renewable energies.

Moreover, environment factors that include carbon dioxide emissions, air pollution, environment impacts and land requirements are the main reasons for choosing alternative energy [6,12,21]. Renewable energy acts as an alternative to prevent or reduce dependency on the diminishing sources of fossil fuels and reduce the negative effects on the environment [22]. George & Ouseph Babu [22] declared that solar energy is a suitable source to generate electricity compared to other sources. This is because a solar cell produces clean energy that has a low environmental risk than other types of electricity sources.

Furthermore, solar energy also provides positive environmental effects such as reduction of carbon dioxide emissions, reduce waste gases, reduce solid wastes, recovery of degraded lands, reduce waste water and do not emit greenhouse gases [1,6,20-22]. It's also supported by Büyüközkan&Güteryüz [1] that mentioned that greenhouse gas emissions such as carbon dioxide and nitrate oxide which cause global warming, air pollution and acid rain will decrease. Xu et al [15] also stated that priority is given to environment protection in building energy efficiency retrofit (BEER) projects by reducing carbon dioxide emissions and performing energy efficiency initiatives in developing green buildings.

#### C. Social

Social factors can change over time and they include public confidences, attitudes, opinions and interests on renewable technologies [6]. Public interest, social acceptability, job creation, community support, public confidence and private sector involvement are the social factors that contribute to the success of renewable energy projects. Social factors were identified as a strong factor that contribute to changes in the energy development industry. The changes occur because customers are willing to pay more for electricity that is produced from renewable energy sources and it automatically encourages the renewable energy industries to increase their development of renewable energy technologies (RET) [17]. Solangi et al., [10] conducted a research on the social acceptance of solar energy in Malaysia and the results showed that the majority of Malaysians highly supported the installation of solar energy.



Furthermore, the social acceptances of Renewable Energy Power Generation (REPG) project in China also have links with parties which are policy makers, financing institutions, insurances companies, developers and the public where all the parties were responsible for the success of REPG projects. According to Alam et al., [23] private sector participation and user's awareness are important in the development of renewable energy projects. Private sector investor can also develop marketing programs to create awareness among the community members and encourage them to use renewable energy sources and this was also supported by [24] study. Private sector involvement towards sustainable products also contributes to the success of the energy industry.

Moreover, Darmani et al. [17], mentioned that a societal network means the relationship between parties such as public and private partnership, suppliers' partnership and others all contribute to the development of renewable energy projects. Social acceptance of renewable energy among its communities can only be achieved when they are aware of environmental issues. Streeter & Jongh [25] said that community participation is important and without community buy-in and trust, energy projects would not achieve success. Energy projects also create job opportunities for the unemployed in the community and they are often hired to help improve their skill sets.

#### D. Technology

According to Xu et al., [15] technology refer to a new material of energy sources that improve measures. Technology introduction is essential in an energy industry which could change the progress of the industry's development [17]. Examples of technology factors that affect the success of renewable energy are R&D development, technical, innovative technology, advanced technology, new technology and information technology. The renewable energy process focuses on the implementation of new technologies when they become mature as well as enhancing existing technologies by improving their practices [13]. Luthra et al., [12] achieved GSCM goals through technology transfers to its retailer and utilized information technology systems to improve the communication and cooperation among its supply chain activities.

Furthermore, technology factors also represent technical and operational methods which includes operating experiences and R&D expenditures on how renewables are used, as reported by [6]. Maqbool et al., [26] mentioned that technological factors are important principles in renewable energy projects as well as technical factors which are cost and time that will increase customer satisfaction and loyalty in the future. Power generation techniques plays a crucial role to develop advanced technology for the renewable energy industry. R&D development, learning new technology and market access condition for renewable materials all contribute to power generation techniques [20]. It shows that implementation of a project with proper techniques of technology could ensure the success of the project.

In addition to that, Maqbool et al., [26] mentioned that technological factors are important principles in renewable energy projects as well as technical factors which are cost and time that will increase customer satisfaction and loyalty in future. Consequently, Luthra et al., [12] also stated that technology advancement helps in reducing environmental issues as well as aid in developing the world economy. Solar power was determined as the cleanest technology to produce electrical energy, especially solar PV technology [21]. Solar technology also provides low cost adoption of renewable energy in houses of the community [27]. PV technology is proven as a safe technology to be used and carries lower environmental risks compared to other types of energy technology [19].

#### E. Government

Government support is very important in attaining the success of renewable energy projected and it also plays the biggest role in developing renewable energy sources projects especially during the earlier stages of technology development [13]. Government policies, politics, financial support and Feed-in-Tariff (FiT) programme are government factors that affect the success of the implementation of renewable energy projects. In many countries, new governmental policies were introduced to make changes in their current energy systems to achieve highly sustainable energy systems [16]. Abdmouleh et al., [13] also mentioned that adopting adequate appliances and strategic planning by the government are important aspects in developing sustainable energy sources.

Furthermore, the government used Feed-in-Tariffs (FiT) and tendering arrangement as the main mechanisms to support renewable energy sources development [13]. The Malaysia Government introduced the FiT programme in the Tenth Malaysia Plan to increase usage of renewable energy as well as to address concerns with regard to policy issues [23]. In Malaysia, the FiT programme was valued by the tax charged on electricity production that affects the economy. The government also supported the implementation of new solar energy policies in Malaysia as well as boosting solar energy usage through certain subsidies and increased the taxes for the fossil fuel industry.

Renewable energy projects are able to be successful, if the government provides supportive research grants for the projects and implements the right energy policies [17]. Monetary loans is another way of support by the government by motivating the bankers to provide more loan financing for renewable energy project [13]. Based on Can Şener et al., [6] political and regulatory factors are also included under governmental policy. Political factors consist of democracy and the green party while regulatory factors consist of subsidies and the Kyoto status. According to Abdmouleh et al., [13] political factors include national energy policies, socio-economic benefits and political attitudes that also contribute to renewable energy development.

#### F. Organization and Management

Organization plays an important role in the success of a project by possessing best practices towards the

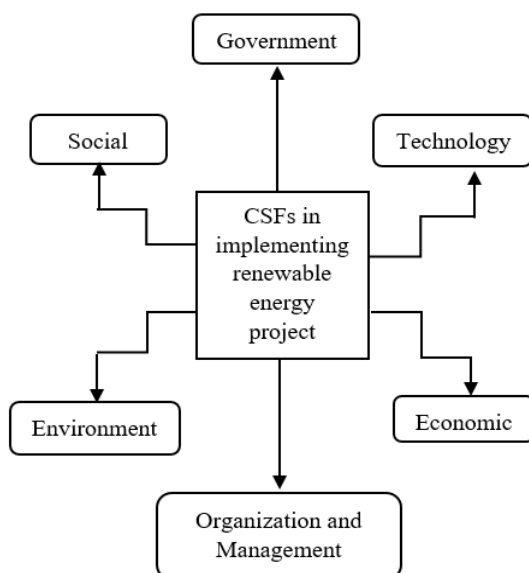
**Fig1: Conceptual Framework of CSFs in implementing a successful renewable energy project**

organization's goals [26]. Management also has a strong relationship with organizational structure. Examples of organizational and management factors that affect the success of renewable energy are leadership, teamwork, top management support, risk management and stakeholder participations. The working organization's support to top management, especially the project manager, will ensure the project's success because the project manager is the person in-charge to supervise the project [28]. According to Forrest & Wiek[29], the organisation and the management are the recognised entities, management committee and responsible workgroup which are flexible to find roles that fit their capacities.

Furthermore, Kumar et al., [16] stated that renewable energy development depends on organizational management which consists of capacity strengthening, client relations and stakeholder participation. A strong leadership is also essential in managing a renewable energy project [15,24,25]. The duty of a team leader is to resolve any problems related to the renewable energy project with the senior management's support and employing the problem solving method known as risk management. Maqbool&Sudong[28] mentioned that a project team can solve a project's problems by referring to previous project team's reports. It is not only helpful to solve problems but also helps to identify client's needs from the project.

In addition, Saleh et al., [24] conducted a research on the implementation of energy management towards sustainability in Malaysian universities. Top management's support, availability of a comprehensive facility energy management team and stakeholders' involvement are the factors related to organization and management. Top management's support includes the creation of clear guidelines and policies, the creation of incentives such as awards, certification and financial rewards, allocation of sufficient resources and provision of training to improve the behaviour of managers and employees.

Fig 1 below shows six CSFs for successful renewable energy project implementation.



#### IV. CONCLUSION

Renewable energy has high potential to be implemented in many countries. This research was chosen because the energy demand is increasing globally every year and this research is anticipated to be of significance for certain parties which include renewable energy companies' developer, end users and the government.

This review should act as a guideline for the renewable energy industry to manage their projects. The CSFs identified in this study should help the developers to recognize the CSFs that need to be considered in order to make a renewable energy project successful. In short, it can be said that this research helps developers to understand better about CSFs in implementing renewable energy projects.

This review should also contribute towards building knowledge because publication regarding renewable energy issues is still poor. The research advanced in recent days is anticipated to facilitate more research on CSF in implementing renewable energy projects in the future. Then, users of renewable energy will also increase when the benefits of renewable energy implementation are identified. The CSFs are not only useful for future research but also useful to improve the government's policy in the renewable energy sector.

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## AUTHORS PROFILE



She is a Master student in Master of Science in Technology Management at the Faculty of Technology Management and Business, UTHM. She pursued bachelor degree in Technology Management (production and Operation) with Honours in UTHM in 2018 and she done A-level in science stream at Penang Matriculation College. Kogila vani currently doing her master research in identifying and evaluating critical success factors (CSFs) in implementing solar energy project in Malaysia by using Analytic Hierarchy Process (AHP) approach



He is a head of department in Department of Student Talent Empowerment at Student Development Center and lecturer in Production and Operation Management at the Faculty of Technology Management and Business, UTHM. He pursued Mechanical Engineering studies at Phd level in UTHM in 2016. His bachelor degree and diploma also in Mechanical Engineering in UTHM. Dr. Lee TeChuan has multidisciplinary research interest includes Surface Modification of Titanium for Biomedical Application, Photocatalytic Film, Extraction of Hydroxyapatite from Natural Resources, Biocomposites, Biomaterials, Industry 4.0, 3D Printing Technology, Renewable Energy and Waste Water Treatment (Heavy Metal Removal).



She is a senior lecturer in Operation and Management at the Faculty of Technology Management and Business, UTHM. She pursued Manufacturing Information technology studies at Masters level in UTM in 2005. Her bachelor degree is in Computer Science BSc. (Hons.) in UTM. Rohaizan has multidisciplinary research interests that encompass production and operation management and decision making.