Original Paper

Identification and Prioritization of Risk and Its Effect of the Renewable Energy Life Cycle Based on Performance and Risk Indicators

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Abstract

Risk management consists of two aspects of risk control and risk assessment in the electricity market. So, risk control should cover the risk and work out of the way of optimal investment portfolios. Thus, the aim of this research is producing solar electricity life cycle profitability. First to identify existing risks in the production of electricity using Delphi technique between 300 experts in 15 Powerhouse. Then, the grey ANP model was the adoption of the New Energy Organization of Iran. The number of risk factors were collected by subject literature in renewable energy in Iran that have analyzed and selected the high-risk factors by ANP GREY method. Finally, to examine the life cycle of solar power, the authors analyzed financial indicators and the life cycle's factors which relates to performance and risk variables, then, the Regression model used in three stages of life cycle. Finally, the result provides incentives for the energy system to support production renewable electricity and aid to increase the profitability of the renewable energy cycle.

Keywords

life cycle, profitability, risk, renewable energy

1. Introduction

Managing risk can be a challenging section in renewable energies due to its compound and dynamic structure (Jaberidoost et al., 2015). Risk is illustrated in terms of uncertain event, which dominates the probability of occurrence of unfavorable outcomes like interruption in power plant production, financial burdens, waste generation and emission of pollutants, etc. (Moktadir et al., 2018). Regarding the crises caused by excessive use of fossil fuels, such as environmental pollution, which has sometimes led to irreparable damage to the ecosystem, as well as approaching the time of completion of fossil fuels, attention to the issue of new energies has become a necessity (Chang, 2011). So, financial engineering is one of the advanced methods in financial affairs, which is effectively based on practical mathematical assumptions or through the application of scientific principles in solving decision-making problems. In fact, financial engineering is defined as any innovation in providing investment and risk management tools for this investment (Assa, 2016).

If in the past new energies were considered as an arbitrary option along with other resources, today this choice has become compulsory, which requires more attention to this case than ever before. Reducing environmental costs, economic savings, creating a suitable environment for energy generation and sustainable development, creating suitable business platforms and investing will be the result of planning and moving towards renewable energies (Chum, 2011). Life Cycle Assessment (LCA) is a structured and comprehensive method for measuring energy flows and energy materials and related publications in the life cycle of products. The ISO 14040 and 14044 standards provide a framework for LCA. However, this framework will provide specialist expertise with a range of options that can influence the credibility of LCA research results and will aid them. IEA (international energy agency) guidelines for coherence, balance, and quality and increasing the credibility of photovoltaic LCAs currently provide guidance (Fthenakis et al., 2011). Actually, renewable resource-based production of sustainable energy is a challenging task to replace fossil fuels, to achieve clean environments, to cut down dependence on other countries, and to challenge the uncertainty about fuel prices. A disturbing statistic is that global oil production is nearing its maximum. The world now consumes four barrels of oil to find a new barrel of it (Singh, 2012). Initially, the analysis and study of the life cycle begin from the extraction of resources; through the production of materials, product parts and the product itself, which is then managed through the subsequent management of "recycling of energy", or discarded through final disposal (Davidsson, Höök, & Wall, 2012).

Today, global organizations are seeking to gain a competitive advantage through the creation of new methods. Some of these organizations gain this advantage by improving environmental performance by complying with the laws and standards and increasing the level of customers' knowledge about environmental laws and standards and reducing the negative environmental effects of products and services. Dimensions such as globalization increased regulation of governmental and non-governmental organizations, and pressure from customers to adhere to environmental issues possess led organizations to develop their environmental and economic performance (Mangla, Kumar,

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& Barua, 2015). In the inevitable nature of the risky investment process, the adoption of informed decisions on the basis of information is of great importance. This will be more crucial when considering the environmental challenges associated with investing (Salm, 2018). All of these serious concerns about the security of the environment are sustainable development that has led to a move towards a renewable, efficient and affordable alternative energy source with the least greenhouse gas emissions. Assessing the life cycle of renewable energy sources is key to observe sustainable development; LCA is renewable energy systems based on the environmental conditions of these resources; therefore, an energy source due to changes in available resources, water, air, environment, economic and social conditions, and policy, etc., cannot be a sustainable development option for all geographical regions (Singh & Olsen, 2012).

In addition, Multiple-Criteria Decision-Making (MCDM) is a computing that features the performance of decision alternatives across multitude, contradicting, qualitative and/or quantitative criteria and results in a compromise dilution (Dadda & Ouhbi, 2014). Applicable methods are significantly applicable, implicitly or explicitly, in many real-life problems and can be foregather in industrial activities where sets of decision alternatives are standardise against conflicting criteria (Triantaphyllou & Mann, 1995). MCDM methods are used in problems within the Renewable Energy (RE) industry. Indicatively, methods employed include the Weighted Sum and Weighted Product Methods (WSM/WPM), the Analytical Hierarchy Process (AHP), the Technique for the Order of Preference by Similarity to the Ideal Solution (TOPSIS), Elimination Et Choix Traduisant La Realité (ELECTRE) and the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE), among others (Kolios, Mytilinou, Lozano-Minguez, & Salonitis, 2016). Therefore, in this paper, we first identify the risks involved in investing 15-megawatt solar power plant. In the second step, using a Delphi technique, a questionnaire will be distributed between managers and experts of the New Energy Organization of Iran, then by pair comparing between existing risks, using the fuzzy Analytic Network Process (ANP). So, we determine the dimension weight and components that alter the solar energy life cycle. Finally, we will analyze the risk and profitability of solar energy by identifying high-risk risks. In general, in this paper, while the authors are explaining the theory of financial engineering, they will examine the role of this method for risk management in the field of renewable energy and accordingly will provide the application of financial engineering in renewable energy.

Actually, the authors have defined environmental management as an attempt to minimize the negative environmental impacts of company products throughout the product lifecycle. This action appears to be imperative due to organizational pressures and increases the efficiency of resources adoption in environmental management. Furthermore, LCA studies are the calculation of the environmental impacts of renewable energy sources and can be related to the same result as sustainable development criteria. Not only is the sun itself the sheer source of energy, but also it is the beginning of life and the source of all other energies. Therefore, presenting this paper is an attempt to highlight the importance of LCA in renewable energies to maximize profitability and cut down risk. The life cycle of solar

energy for generating electricity will take into account all environmental impacts and lifespan resources. As we know, one of the major axes of feasibility studies of the project is its economic appraisal. Any project, regardless of type and size, should be economical. The economics of a project is a guarantee of the investor's usefulness and provides a sustainable and lasting basis for it.

So, investors, managers, planners, and investment managers need to attain acquainted with the processes and methods that are effective on this process and lay hold of them into account in their decisions, in order to arrange informed decisions. In this paper, we will examine financial engineering with the adoption of the solar energy life cycle. Generally, the life cycle profitability model is divided into four stages:

Stage one: Data collection includes inventory life cycle, structural capacity, and resource flow.

Stage two: involves analyzing costs including maintenance costs, operating costs, investments, installation, and other costs.

Stage three: Analyzes future earnings, which calculates the income from assets.

Step four: Analyzes Profitability, which, based on economic ratios, analyzes the profitability index and the expected costs and revenues.

In short, the main aspect of this study is identification and prioritization of risk and it's effect of the Renewable Energy Life Cycle based on performance and risk indicators

2. Theorical

2.1 Life Cycle of Renewable Energy

Consequently, Solar energy is one of the most crucial types of new energy, so this energy, as a renewable energy source, is one of the most crucial alternatives to fossil fuels, are eliminated by human concerns about end-of-life, increasing pollution from its conversion to other energies (Noothout, de Jager, Tesnière, van Rooijen, & Karypidis, 2016). Solar energy sources are more suitable for in remote areas where more sunlight is available.

Ordinarily, ISO 14040 has defined LCA as "the compilation and assessment of the input of output and the potential environmental impacts of a production system throughout the life cycle" (ISO14040, 2005). Actually, the complete life cycle of renewable energy sources includes every step of the production of raw materials, extraction, processing, transportation, construction (production), storage, distribution, and exploitation. Each of these is in different aspects of the environment, economic and social can have a harmful or beneficial effect. Hence, it is critical to a complete assessment of the fuel chain from a variety of perspectives to achieve sustainable biofuels. Accordingly, Environmental burden covers all types of environmental impacts, including extracting different sources, the release of hazardous materials and use of different types of land (Markevičius, Katinas, Perednis, & Tamašauskienė, 2010). Thus, LCA is a tool that is adapted to assess environmental impacts and resources throughout the product lifecycle, and considers all the features or aspects of the natural environment, human health, and resources; and is defined as a way of analyzing environmental impacts

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of a material, product, throughout the entire cycle (Bartolozzi, Rizzi, & Frey, 2017). Furthermore, LCA environmental analysis adoptions products at all stages of their life cycle from cradle to grave, by the extraction of resources, through the production of materials, product, and product parts, that is reused by subsequent management or by recycling or is discarded by final disposal (Salm, 2018).

The Importance of Assessing the Lifecycle of Renewable Energies

Consequently, the objective of the LCA is to formulate and evaluate various environmental consequences for the realization of a specific factor, and this is a global approach adopted to determine the environmental consequences of a specific product that has entered the cycle more than it has been. Moreover, the LCA method can be useful in obtaining a comprehensive knowledge of the environment and the effects produced by industrial products throughout their entire life cycle. LCA can play a beneficial role in private and public environmental management in relation to products. The LCA method has been chosen for a diverse range of new bio-energy and bio-carbon technologies in recent years (Wang, Huo, & Arora, 2011).

Consequently, LCA's renewable energy production system requires a precise design in terms of purpose and scope of the definition, the selection of the functional unit, the reference system, the system boundaries, and the creation of appropriate inventory and allocation of greenhouse gases in the products and by-products. Generally, LCA is actually developed for the effects of input-output and the extraction of the environment and the entry of greenhouse gases into the environment, both of which can be well linked to an active unit. In an economic or environmental survey, all relationships in the LCA are linear. The focus of the LCA model is on the physical characteristics of industrial activities and other economic processes; LCA does not include market mechanisms or secondary effects on the development of technology. LCA is largely effective in identifying and reducing environmental pressures (Davidsson, Höök, & Wall, 2012).

2.2 Life Cycle Profitability

Initially, Profitability refers to the ability of the organization to generate revenue and profit, investors and creditors are keen on assessing current and future profitability and what factors alter profitability. On the other hand, if the investor wants to grow, develop (one of these sources of financing is past profitability) and has a relative reliance on the future profitability of his investments. So understanding the combined relationship between these two factors (growth and profitability) is so crucial. Sales growth is one of the indicators of activity valuation. Also, the continuous growth of sales and profits results in the market taking less risk to continue its business. Furthermore, the significant increase in the price of petroleum products, after the 1973 oil shock, attracted the attention of energy experts and professionals to one of the most crucial and the widest renewable energy sources. Also, the advent of solar energy research from energy economy perspective, a topic called the solar energy economy was created. So Many factors have led people to the attention and eventually acceptance of the sun as an alternative energy source, yet one of the most attractive features of solar energy from an economic point of view is its capability in reducing overall energy production costs (Chang, 2011).

Well, one of the solar power generation equipment is the photovoltaic system. The importance of using photovoltaic technology is that it directly transforms sunlight into electricity without the use of mechanical and chemical mechanisms. So, some features of photovoltaic systems, which are the main reason for their application, are:

(A) Having a very wide range of production potential that provides generating and using various types of systems from MWh feed source of watches to MW power supplies.

(B) Lack of need to fossil fuels and non-production of any environmental pollutants in the process of energy exchange.

(C) Ease of operation and maintenance of photovoltaic systems without the need for complex equipment, specialist human resource, and additional costs.

(D) High useful life (more than 20 years) (Fthenakis et al., 2011).

Actually, researchers and studies in the field of solar energy are at least divided into four categories, then, economic and financial assessments, marketing, and the assessment of the possible size of the market, the examination of economic parameters (such as employment, environment and energy storage) and the formulation of government policies and programs on energy, (including incentives and fines, rules and regulations, and allocating research credits and research budgets), are the four main axes that are discussed in the solar energy economy, which this paper will deal with an economic and financial assessment of the solar energy life cycle; so that using one of the financial engineering tools, called risk management. First, we will identify and prioritize risks in the life cycle of solar energy, then we will look at the economic analysis of investment in renewable energy.

2.3 Financial Engineering

Actually, Financial affairs are a set of facts, principles, and theories that deal with the collection and equipping of funds and the application and consume of funds by individuals, companies, and governments (Assa, 2016). Also, the financial field in Iran is still considered to be a part of the accounting body, while this area is completely independent and in a different area of science. So, focusing on financial processes and the type of financial decisions that are often related to the future has contrived the risk has an inevitable relationship with financial decision-making. In other words, financial decisions are often related to risk and, consequently, to efficiency. Well, in the definitions of financial engineering, this is also considered as necessary or crucial. In simple terms, financial engineering is a risk management tool (Abdmouleh, Gastli, & Ben-Brahim, 2018).

2.4 Concepts and Definitions of Risk

In 2003, the Committee set up a risk management mission in the electricity market focused on managing congestion and risk management strategies. This workgroup was sent some questionnaires to various companies around the world, which received 37 replies from companies from 18 countries. The framework of working Group examined risk search and risk management methods for market participants (Luthra, Govindan, Kharb, & Mangla, 2016). The committee, whose uncertainties include both market prices and regulatory risks in the short and long term. For these companies, there are

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uncertainties in the electricity market such as market prices, demand, density, fuel costs, investment, clean production permits, regulatory risk and the cost of pollution. Each of these uncertainties can lead to various market risks (Zhang, Qiu, & Zhang, 2017). It should be kept in mind that each of these risks can have a different impact on any type of company (production, transmission, distribution, wholesale and retail), therefore, to manage each of these risks, all its angles must be first, and each of them has a different risk management strategy for each one (Dinarvand, 2015). So, they are elaborated in the following in Figures 1 and 2.
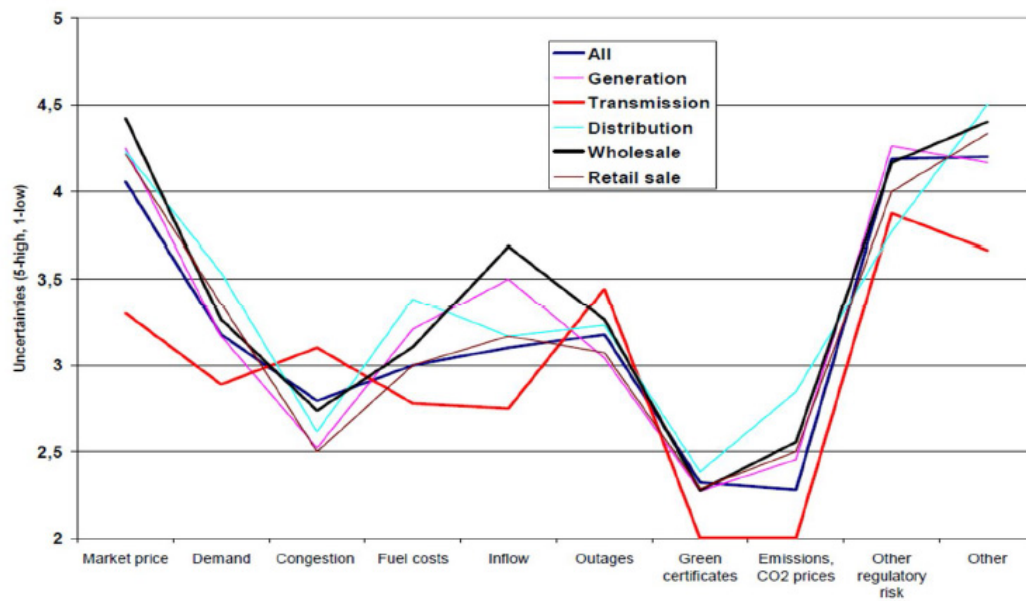
Figure1. Uncertainties in the Short Term (Less than 2 Years)
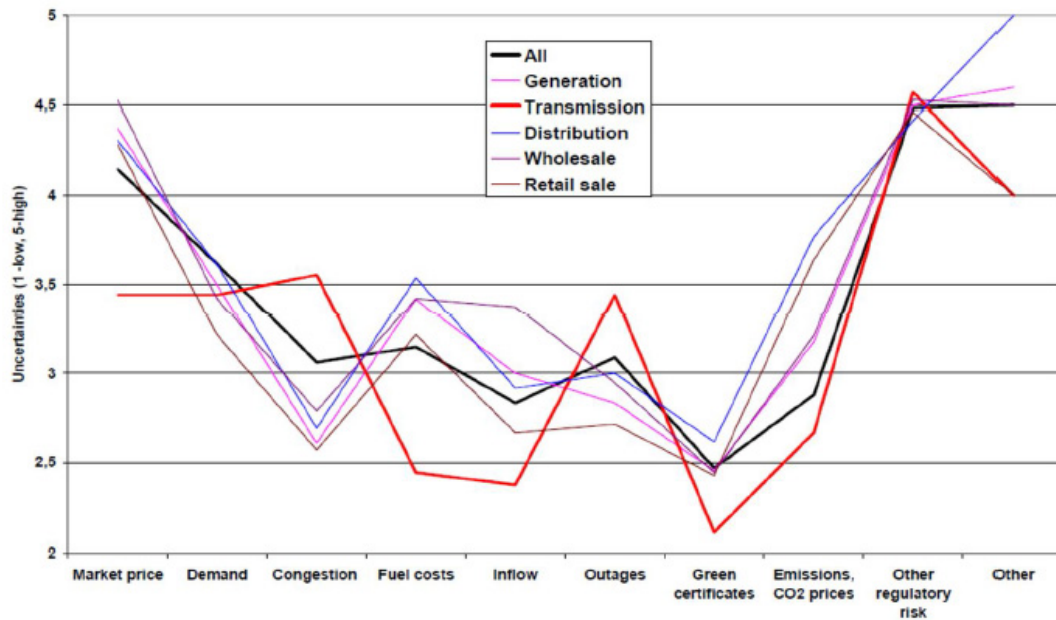
Source: www.ises.org.

Figure 2. Uncertainties in the Long Term (Less than 2 Years)

Source: www.ises.org.

According to Figure 3, it can be seen that each of the risks of the type of ownership (private or public) can have vary degrees of importance (Number 5 for the highest degree of importance and number 1 for the least degree of importance) for the risk manager of that set (Mangla, Kumar, & Barua, 2016).
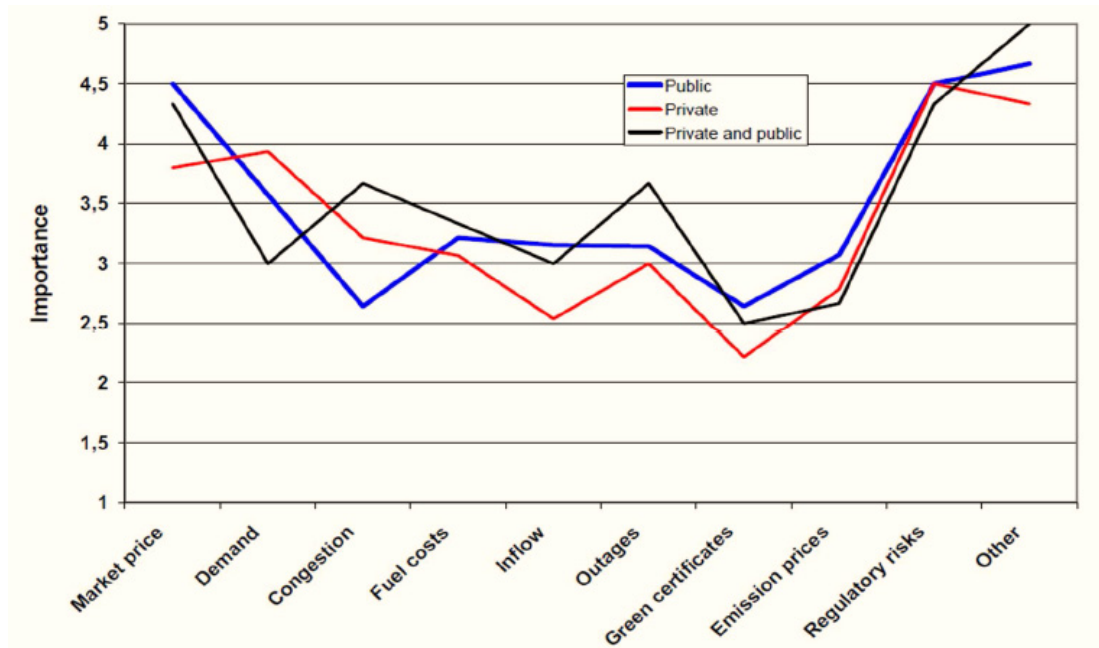
Figure 3. Importance of Long-Term Uncertainties Regarding Ownership (Less than 2 Years)

Source: www.ises.org.

Renewable energy development in Iran has progressed data rapid pace especially from 2010, while continued strong growth over the next decades desired, there is as significant need to identify and analyze enablers that allow for the design of numerous policy initiatives. Consequently, several definitions of risk can be found in various scientific sources, each of which, depending on the dimension or angle of view, has provided a different definition for risk, which elaboradted in the following (Salm, 2018):

¬ The risk is anything that threatens the present or future of the asset or the ability of the solar power station, institution or organization for earning money.

¬ The risk of an asset is the probable change in the future return from that asset.

¬ The term "risk" refers to the possible loss, the degree of probable loss, and the probability of loss. In this regard, risk involves both the probability of profit and the probability of loss.

¬ The risk is the likelihood of a change in the advantages and benefits foreseen for a decision, an event, or a future state.

¬ The probability is that there is no assurance to change. Ordinarily, if there was sufficient assurance of change, the assured changes would be secured within the framework of the foreseen advantages and benefits.

Research Goals and Questions

The objectives to be discussed in this article will be defined as follows:

1) Identification of risks in the solar energy life cycle.

2) Risk ranking for the solar energy life cycle.

3) Investigating the effect of financial indicators on increasing the profitability of solar energy lifecycle based on performance and risk indicators.

Theoretical Background

Actually, the study of the literature and history of the subject illustrates that research has not been done with the present study. So the innovation had confirmed by the author. It provides in Table1:

Table 1. Historical Research

Result	Target	writers	Title of research
The result provides that policy risk was the main factor affecting the investment in the early development stage, and policy risk and technology risk downturn gradually, market risk has gradually	the topic of renewable energy investment risk is studied in this paper using the system dynamics method	(Liu & Zeng, 2018)	Renewable energy investment risk evaluation model based on a dynamic system

become the main uncertainty affecting the investment in the mature evolution stage.			
The result showed, combing unsuccessful coal with renewable energy. Then their analysis shows that there exists an optimal combination of gas and renewable energy in electricity production which does not compromise the financial system.	This study illustrates a unique and novel perspective on the contact between renewable energy investments and financial stability.	(Safarzyńsk, Jeroen, & den Bergh, 2018)	Financial stability at risk due to investing rapidly in renewable energy
The results of the study presented that supply related risks such as fluctuation in imports arrival, lack of information sharing, key supplier failure and non-availability of materials should be prioritised over operational, financial and demand have great effect on risks.	Aims at identifying and analyzing the risks occurring in the supply chains of the pharmaceutical industry and proposing a decision model, based on the Analytical Hierarchy Process (AHP) method, for evaluating risks in pharmaceutical supply chains.	(Moktadir, et al., 2018)	Decision modeling for evaluating risks in pharmaceutical supply chains
The results of this study indicate that a central heating network with RES can be used as a potential trial to improve the performance of energy supply sources.	Use of a life-cycle to evaluate potential and environmental impacts.	(Bartolozzi, Rizzi, & Frey, 2017)	Are central heating systems and renewable energy sources always an environmental win-win solution? Case Study of Life Cycle in Tuscany, Italy

The results of this paper are used to suggest perfect practice. This paper also highlights where further research is unique to afford reliable design-stage assessments in the future.	This paper provides the incorporation of renewables in building life cycle assessments.	(Galpina & Moncaster, 2017)	Renewable energy inputs in the life cycle assessment
The research illustrates that the product recovery risks and process risks criteria possess highest priority and need considerable managerial responsiveness for reducing the green supply chain susceptibility and hence performance improvement.	This study proposes an integrated methodology of fault-tree analysis (FTA) and the fuzzy analytical hierarchy process (AHP) approach, for analysing green supply chain risks under the fuzzy surroundings.	(Mangla, Kumar, & Barua, 2016)	An integrated methodology of FTA and fuzzy AHP for risk assessment in green supply chain
A new energy storage system is proposed, which is proposed as a technology suitable for small-scale energy storage. An authorized power plant (photovoltaic power plant) is used to satisfy the energy demand of a radio base station for cellular telecommunication communications.	The purpose of this paper is to help develop a comprehensive, yet practical and reliable, tool for assessing systematic sustainability, based on Renewable energy life cycle assessment.	(Petrillo, De Felice, Jannelli, & Autorino, 2016)	Life Cycle Assessment (LCA) and Analysis Model (LCC) for an Independent Combined Renewable Energy System
The presented decision framework may offer some valuable guidelines for policy makers to develop their plan of action in terms	this paper aims to identify and prioritize the indicators to develop a decision-support framework for the	(Luthra, S.; Mangla, S.K.; Kharb, R.K., 2015)	Sustainable assessment in energy planning and management in Indian perspective

of design of both short term and longterm flexible decision strategies,to assess the sustainability inenergysystems.	sustainability assessment in energy planning and management in Indian context.	
This is due to the fact that the market and investment incentives are influencing factors Installing solar power generators in Taiwan.	The solar energy potential in-home use for the country Taiwan has been evaluated.	(Chang, 2011)	Analysis of renewable energy policies for the Taiwanese island administrative district
They concluded that these systems had economic and environmental implications for the provision of Electricity is a good home-use for villages.	Evaluation and evaluation of photovoltaic (PV) systems for supply Electricity in rural India.	(Chandrasekar, Tara, & Kandpal, 2010)	Risk Assessment Based on the Development of Renewable Technologies in India
Three regulatory, political and force majeure risks are considered risky. And they have the most impact on investing in renewable energy in African countries.	Identifying and introducing risks that prevent investing in renewable energies.	(Komendantova, Patt, Barras, & Battaglini, 2009)	Understanding the Risks in Renewable Energy Projects: Central Asian Solar Energy

3. Method

Since the main goal of this research is to identify and assess some risks inherent in the renewable energy life cycle in a 15 MW solar power plant, it can be said that the present research is applied research for an objective. This research is descriptive-non-experimental in data collection method and is a case study among the various descriptive research methods. In this article, due to the research approach adopted in the operation, the survey community is composed of managers, experts and senior experts of new energy organizations in Iran. Riza and Vazilis (2015), given that the number of experts as interviewees should not be high, will suggest a total of 5 to 15 people. The experts have a minimum undergraduate degree, a minimum of 5 years' job experience, and experience of energy-related risks. In this study, 20 questionnaires were distributed and 20 questionnaires were finally collected from 15 solar power stations of Iran, that we collected 300 questionnaires.

Therefore, it is important to use decision making approach or model that make possible to revalue the success contingent probability (Yang & Hsieh, 2009). There is a reason that why these methods like Analytic Hierarchy Process (AHP (Note 1)), Analytic Network Process (ANP (Note 2)), Goal Programming, Delphi, Decision Making Trial and Evaluation Laboratory (DEMATEL) and Fuzzy Logic have been used for this kinds of intention (Satty, 2004). One of the drawback of AHP is that it does not allow to evaluating interrelations and influences between the factors that compose the decision making process. Hence, Saaty expanded a general structure called Analytic Network Process (ANP) (Wang & Xing, 2008). This method is a induction of AHP and is used in decision making processes in which it is identified that decision factors and criteria may have so strong interrelations and effects generating a high impact on the decision (Raisinghani, Meade, & Schkade, 2007). So, in this paper, one of the MCDM (Note 3) approach is used to select the best risk out of 10 alternatives. Then, the grey ANP technique was proposed by Laarhoven and Pedrych (1983). In the first stage, ANP is used to rank the risk of life-cycle of renewable energy according to the criteria. So, ANP is an important method for analysing and solving multi-criteria decision-making problems. It uses all the factors and criteria for making the best decision, as well as inner and outer dependencies. As in ANP is quite successful in decision-making problems that have uncertainty and interaction between decision criteria.

Firstly, reviewing the literature of studies and the opinions of the experts of the New Energy Organization in Iran, identifying risks and using the Delphi technique, the final risks were screened and selected. Then the grey ANP model is adopted for the relative importance of the risks.

It should be noted that regard to the selection of economic risk, the risk, and performance index was collected from the research literature was selected based on the studies of (Davidsson, Höök, & Wall, 2012), (Cucchiella, D'Adamo, & Gastaldi, 2014) and (Xu, 2007), after ranking the identified risks, taking into account the dangerous risks in the solar energy life cycle, and taking into account the indicators collected from the background of the issue, the impact of each indicator on the profitability of the life cycle of 15 megawatts solar energy will be dealing with using the Regression model, and we will select the indicators that alter the profitability. Finally, we look at the role of financial engineering in boosting profits, as well as reducing the life cycle risk of solar energy. The power of the test of the life cycle effect can depend on the ability to appropriately classify firms-years into life cycle stages. The life cycle classification variables include dividend, sales growth, capital expenditure as a percentage of the total value of the firm and firm size for both risk and performance measures. Also, based on equation (1), I incorporate performance measures and risk measures, examined by prior studies under the topic, and specify the following empirical model:

$$PRO = \alpha_0 + \alpha_1 \, LEV_{it} + \alpha_2 \, SIZE_{it} + \alpha_3 \, CE_{it} + \alpha_4 \, ROS_{it} + \varepsilon_{it} \qquad (1)$$

Natural log of beginning market value of equity for firm j; LEV, firm j; SIZE are selected for risk measures. And the natural log of change in percentage sales growth for firm j; CE, natural log of differenced cash flows from operation divided by the prior-year market value for firm j; ROSj, are selected for performance measures, also Profitability Index as a dependent variable. In addition, this

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relationship is modeled through an interruption term or error variable εit an unobserved random variable that adds "noise" to the linear relationship between the dependent variable and regressors. This hypothesis has analyzed for each stage of growth, maturity and decline and stagnant life-cycle groups. In addition, all financial information in this research has been collected from the Power Research Institute in Iran. Therefore, all relevant financial information has been approved by the researchers and the relevant organization.

4. Result

First of all, the intended risks were collected by studying the theoretical foundations and opinions of the experts of the Renewable Energy Organization. The first step was to find out the content validity of the opinions of the experts. Then all questionnaires were distributed among managers and experts of the intended organization. After reviewing and selecting crucial indicators from their point of view, the questionnaires were distributed for the second time. Finally, the analysis was conducted after reaching the ideal answer. Reliability of the tool was calculated using incompatibility rate, which all of them are less than 0.1, indicating the reliability of the tool. Since the reliability of the results of the questionnaire "Determining the weights and importance of criteria and sub-criteria of life cycle risk using the network analysis process" is closely related to the compatibility of the respondents' judgment. Therefore, calculating the incompatibility rate of decision matrices from the judgment of each respondent ensured the reliability of the results of the questionnaire. In the case of an inconsistency rate of less than or equal to 0.1, there is compatibility in the paired comparison, and it can be continued. Otherwise, the decision maker should review the paired comparison (Vivas, De Las Heras, Segura, & Andújar, 2018). In this study, all rates are less than 0.1, which is confirmed. Table 2 summarizes the risks collected from the research literature.

Table 2. Risks Identified from the Research Literature

Delphi expert opinions	Background and theoretical foundations	Identified risks
×	(Yousefi & Izadpanah, 2015) (Komendantova, Patt, Barras, & Battaglini, 2009) (Noothout, de Jager, Tesnière, van Rooijen, & Karypidis, 2016) (Jouzi, Jafarzade, & Afzali Behbahani, 2015) (Moktadir et al., 2018) (Mangla, Kumar, & Barua, 2016) (Luthra, S.; Mangla, S.K.; Kharb, R.K., 2015)	**Operational risk**
×	(Yousefi & Izadpanah, 2015)	**Delivery risk**

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	(Chandrasekar, Tara, & Kandpal, 2010)	
×	(Liu & Zeng, 2017) (Komendantova, Patt, Barras, & Battaglini, 2009) (Noothout, de Jager, Tesnière, van Rooijen, & Karypidis, 2016) (Mangla, Kumar, & Barua, 2016) (Luthra, S.; Mangla, S.K.; Kharb, R.K., 2015)	**Environmental risk**
×	(Liu & Zeng, 2017) (Komendantova, Patt, Barras, & Battaglini, 2009) (Jouzi, Jafarzade, & Afzali Behbahani, 2015) (Moktadir et al., 2018)	**Capital risk**
	(Komendantova, Patt, Barras, & Battaglini, 2009) (Jouzi, Jafarzade, & Afzali Behbahani, 2015)	**Structural risk**
×	(Liu & Zeng, 2017) (Komendantova, Patt, Barras, & Battaglini, 2009) (Chandrasekar, Tara, & Kandpal, 2010) (Jouzi, Jafarzade, & Afzali Behbahani, 2015) (Moktadir et al., 2018) (Luthra, S.; Mangla, S.K.; Kharb, R.K., 2015)	**Technical Risk**
×	(Liu & Zeng, 2017) (Noothout, de Jager, Tesnière, van Rooijen, & Karypidis, 2016) (Jouzi, Jafarzade, & Afzali Behbahani, 2015) (Komendantova, Patt, Barras, & Battaglini, 2009)	**Political risk**
×	(Komendantova, Patt, Barras, & Battaglini, 2009) (Jouzi, Jafarzade, & Afzali Behbahani, 2015) (Liu & Zeng, 2017) (Moktadir et al., 2018) (Mangla, Kumar, & Barua, 2016) (Luthra, S.; Mangla, S.K.; Kharb, R.K., 2015)	**Economic risk**
×	(Yousefi & Izadpanah, 2015) (Komendantova, Patt, Barras, & Battaglini, 2009) (Noothout, de Jager, Tesnière, van Rooijen, & Karypidis, 2016)	**Regulatory risk**
×	(Komendantova, Patt, Barras, & Battaglini, 2009) (Yousefi & Izadpanah, 2015)	**Social risk**

(Noothout, de Jager, Tesnière, van Rooijen, &

Karypidis, 2016)

(Mangla, Kumar, & Barua, 2016)

(Luthra, S.; Mangla, S.K.; Kharb, R.K., 2015)

Initially, Delphi questionnaires were carried out during four stages which are elaborated in the following:

Stage 1: 10 criteria which were selected from the literature of this research took place at the discretion of the assembly and it was asked to rank from 1 to 10. Some of the experts, no comment about some of the criteria and those criteria omitted from the list of factors. Finally, 8 factors were selected for the rest of the research.

Stage 2: The authors designed the second questionnaire for the remaining 8 main criteria and some sub-criteria.

Stage 3: After the second questionnaire analysis, the authors calculated the rate of pay conflicts, following that, the third questionnaire was designed by the authors. In this stage, we analyzed 8 main criteria. Finally, four of them were selected by those experts.

Stage 4: In the last stage we examined all sub-criteria which belongs to those four main criteria which were selected.

So, the background of those expertise people who were participating in this research are elaborated in the following in Table 3:

Table 3. Descriptive Statistics

Background		Frequency	Percent
SEX	Men	300	100
	Woman	-	-
TOTAL	300		100
AGE	26_35	-	-
	36_45	185	0.61
	46_55	90	0.30
	More than 56	25	0.09
TOTAL	300		100
Education	Master	88	0.30
	PhD	212	0.70
	Others	-	-
TOTAL	300		100
Job Background	6_10 years	76	0.25

	11_15 years	106	0.35
	16_20 years	-	-
	More than 21 years	118	0.40
	Others	-	-
TOTAL	300		100
	Finance and risk Affairs	83	0.28
	Power and Energy Affairs	95	0.31
Job position	Economic and Planning Affairs	58	0.20
	Environmental Affairs	64	0.21
TOTAL	300		100

4.1 Grey Model (ANP) Based on Results from Delphi Model Questionnaire

So, the steps of the grey ANP method in this study have computed into six steps, which we will discuss each one I the following.

Step One: This step is to identify the criterias and sub-criterias to be used in the model.

Step Two: Then structure the ANP model hierarchically (goal, criterias and sub-criterias).

Ordinarily, in the previous section, the factors and life cycle risks extracted from the relevant literature and related theoretical literature were examined and refined by the questionnaire "Identifying the most crucial risks altering the life cycle of solar power", and the series of the criteria was determined on the basis of their correspondence with the opinions of the experts. Actually, for the application of ANP, it is first necessary to draw up the structure of this problem that has shown in Figure 4.

```
                          Risk selection

   investment risk    Political risk    Regulatory risk    Economic risk

        I1                 P1                R1                E1

        I2                 P2                R2                E2

                           P3                                 E3

                           P4                                 E4

                                                              E5

                                                              E6
```
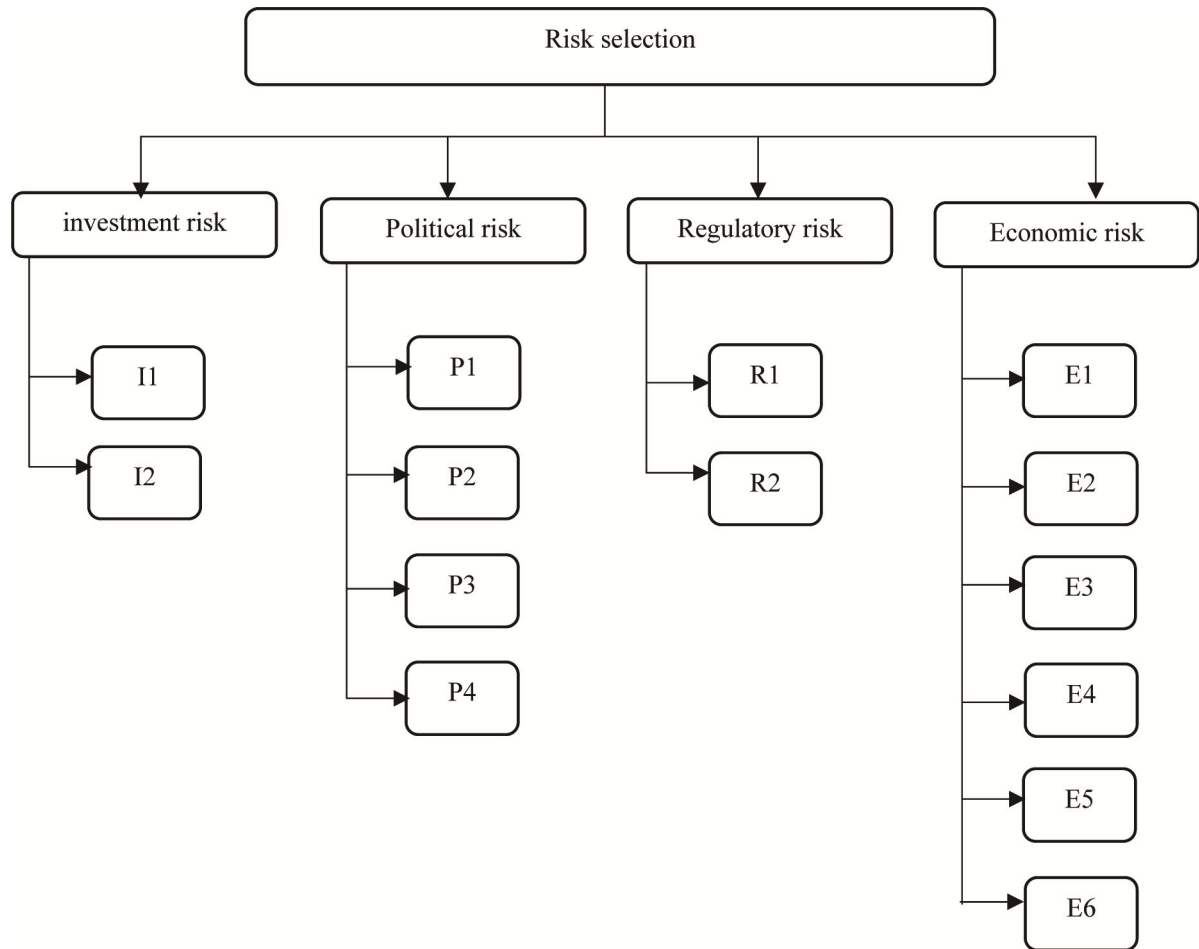
Figure 4. Hierarchical Structure

Step Three: Pairwise comparison and local weights estimation

In this step, on the basis of the inner and the outer dependencies, criterias of each cluster and clusters themselves are compared pairwise. As Saaty's scale examined, it allows the decision maker to give out relative ratings, by expressing his preference between each pair of criterias verbally as equally important, moderately more important, strongly more important, very strongly more important, and extremely more important. These descriptive disposition would then be translated into numerical values 1, 3, 5, 7, 9, respectively with 2, 4, 6, and 8 as intervening values for comparisons between two successive judgments. After reviewing each of the pair comparison tables, we will compare the calculation and control of their compatibility which is shown in Table 3. So, the purpose of each of the following steps is to obtain special vectors (W21, W22, W32, and W33) to complete the primary super-matrix (imbalanced). It is shown that the most substantial risk factor is Economic Risk which has toched the highest weight in comparision other risks, about 0.298 also the next important risk is Investment Risk in the Renewable Energy Life Cycle, see Table 4, for more information.

Table 4. Invertible Matrix of Numerical Comparisons. Comparison of Primary Criteria with Purpose

Metrics		investment risk	Political risk	Economic risk	Regulatory risk	EigenvectorW$_{21}$
		C_1	C_2	C_3	C_4	
investment risk	C_1	0/195	0/244	0/171	0/200	**0/218**
Political risk	C_2	0/081	0/098	0/133	0/120	**0/091**
Economic risk	C_3	0/391	0/244	0/320	0/240	**0/298**
Regulatory risk	C_4	0/081	0/073	0/110	0/080	**0/097**

Step Four: Supermatrix formation and analysis

As summarised above, a local weights vector acquired from the paired comparisons represents the impact of a given set of criterias in a component on another criteria in the system (Saaty, 2004). In this section, the local weights vectors are each entered as a part of some column of a matrix, known as a supermatrix, as presented in Table 5 of the Weights Matrix. This matrix illiustrates the influence of a criteria on the left of the matrix on an element at the top of the matrix (Promentilla, Furuichi, Ishii, & Tanikawa, 2007). Clearly, the highest weight is the most important sub-criterion in the Renewable Energy Life Cycle.

Table 5. Weights Matrix Derived from Pairwise Comparisons of Subclasses

Weight Matrix W₃₃		Any problem with financial resources	The inability of the	Failure to supply	The role of	Change in government	Stop in government	Change in rules	Delay in granting the necessary permissions	Stop business because	Supplier resources	Energy recovery systems	Government inability to pay bills	Rising Inflation	Increase exchange rate
		C_{11}	C_{12}	C_{21}	C_{22}	C_{23}	C_{24}	C_{31}	C_{32}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{46}
Any problem with financial resources	C_{11}								0/224				0/118		
The inability of the investor to fulfill financial obligations	C_{12}	0/328		0/175					0/274		0/295	0/156	0/136		
Failure to supply equipment from abroad	C_{21}	0/260							0/244	0/178	0/257		0/144		
The role of governments in investing in the power grid	C_{22}					0/660		0/515							
Change in government support priorities	C_{23}				0/167										
Stop in government supportive policies	C_{24}	0/412	0/290						0/124				0/095		
Change in rules	C_{31}												0/075	0/301	
Delay in	C_{32}			0/224			0/660			0/258		0/312	0/195	0/161	

granting the necessary permissions															
Stop business because of the risk of damage	C_{41}		0/224										0/170		
Supplier resources	C_{42}		0/224			0/340				0/279	0/256			0/337	**0/277**
Energy recovery systems	C_{43}	0/710	0/153							0/170				0/201	**0/246**
Government inability to pay bills	C_{44}								0/134	0/115	0/147				
Rising Inflation	C_{45}						0/280						0/067		**0/152**
Increase exchange rate	C_{46}				0/340						0/142	0/148			
Total weights		1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00

Step Five: Calculate the global weight of Super Matrix

To concede the cumulative influence of each criteria on every other criteria with which it interacts, the supermatrix is elevate to limiting powers (Saaty & Vargas, 1998). So before taking the limit, it must first be declined to a column stochastic matrix. Then Via normalization, the normalized weight arrays can be found in the appropriate rows of the normalized limit supermatrix. They are the global weights for all the criterias. In this way, each element of the imbalanced super-matrix column cluster is multiplied by the relative importance vector of that cluster (from the cluster matrix) which is presented in Table 6.

Table 6. Imbalanced Super Matrix

	Goal	C1	C2	C3	C4	C11	C12	C21	C22	C23	C24	C31	C32	C41	C42	C43	C44	C45	6
Goal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_1	0/218	0	0/213	0/214	0/245	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_2	0/097	0/145	0	0/144	0/135	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_3	0/298	0/266	0/261	0	0/263	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_4	0/091	0/168	0/130	0/144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C_{11}	0	0/276	0	0	0	0	0	0	0	0	0	0	0/224	0	0	0	0/118	0	0
C_{12}	0	0/469	0	0	0	0/328	0	0/175	0	0	0	0	0/274	0	0/295	0/156	0/136	0	0
C_{21}	0	0/254	0	0	0	0/260	0	0	0	0	0	0	0/244	0/178	0/257	0	0/144	0	0
C_{22}	0	0	0/272	0	0	0	0	0	0	0/660	0	0/515	0	0	0	0	0	0	0
C_{23}	0	0	0/134	0	0	0	0	0	0/167	0	0	0	0	0	0	0	0	0	0
C_{24}	0	0	0/320	0	0	0/412	0/290	0	0	0	0	0	0/124	0	0	0	0/095	0	0
C_{31}	0	0	0/274	0	0	0	0	0	0	0	0	0	0	0	0	0	0/075	0/301	0
C_{32}	0	0	0	0/279	0	0	0	0/224	0	0	0/660	0	0	0/258	0	0/312	0/195	0/161	0
C_{41}	0	0	0	0/266	0	0	0	0/224	0	0	0	0	0	0	0	0	0/170	0	0
C_{42}	0	0	0	0/320	0	0	0	0/224	0	0	0/340	0	0	0/279	0	0/256	0	0/337	0/277
C_{43}	0	0	0/2	0/135	0	0	0/710	0/153	0	0	0	0	0	0/170	0	0	0	0/201	0/246
C_{44}	0	0	0	0	0/339	0	0	0	0	0	0	0	0/134	0/115	0/147	0	0	0	0
C_{45}	0	0	0	0	0/351	0	0	0	0	0	0	0/280	0	0	0	0	0/067	0	0/152
C_{46}	0	0	0	0	0/310	0	0	0	0	0/340	0	0	0	0	0/142	0/148	0	0	0
Σ	1/00	2/00	2/00	2/00	2/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00	1/00

Step Six: Calculation of the Limit Super-Matrix

Accordingly, the results from determining the weights of criteria and sub-criteria have shown in Table 6 and the final weight of the criteria is an economic risk (0.393), investment risk (0.238), regulatory risk

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(0.164), political risk (0.127), respectively, were the highest importance among the main criteria. The limit matrix in Table 8 shows the final weights.

Table 7. Supper Matrix

	Goal	C1	C2	C3	C4	C_{11}	C_{12}	C_{21}	C_{22}	C_{23}	C_{24}	C_{31}	C_{32}	C_{41}	C_{42}	C_{43}	C_{44}	C_{45}	C_{46}
Goal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C_1	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000
C_2	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000
C_3	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000
C_4	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000	0/000
C_{11}	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042	0/042
C_{12}	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134	0/134
C_{21}	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004	0/004
C_{22}	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094	0/094
C_{23}	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001	0/001
C_{24}	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080	0/080
C_{31}	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006	0/006
C_{32}	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158	0/158
C_{41}	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060	0/060
C_{42}	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106	0/106
C_{43}	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136	0/136
C_{44}	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044	0/044
C_{45}	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010	0/010
C_{46}	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037	0/037

Table 8. The Final Weight of the Criteria and the Sub-Criteria of Failure

ranking	Relative priority in network	Relative Cluster Priority	under the criteria	Code	Metrics	Row
2	0/094	0.228	Any problem with financial resources	C_{11}	investment risk	1
	0/134		The inability of the investor to fulfill financial obligations	C_{12}		2
4	0/042	0.127	Failure to supply equipment from abroad	C_{13}	Political risk	3
	0/004		The role of governments in investing in the power grid	C_{21}		4
	0/001		Change in government support priorities	C_{22}		5
	0/080		Stop in government supportive policies	C_{23}		6
3	0/006	0.164	Change in rules	C_{24}	Regulatory risk	7
	0/158		Delay in granting the necessary permissions	C_{31}		8
1	0/060	0.393	Stop business because of the risk of damage	C_{32}	Economic risk	9
	0/106		Supplier resources	C_{33}		10
	0/136		Energy recovery systems	C_{34}		11
	0/044		Government inability to pay bills	C_{41}		12
	0/010		Rising Inflation	C_{42}		13
	0/037		Increase exchange rate	C_{43}		14

4.2 Solar Power Life Cycle Model

Accordingly, Anthony and Ramesh (1992) adopted four variables to divide firms into life cycle stages: sales growth, capital expenditures, divided profits ratio, and solar power station's age. So, in this research, determining the power generation position in the life cycle curve, regardless of the stage of introduction, is considered only in the stages of growth, maturity, and decline, which using these four variables and according to Chen and Park (2006) methodology, it is elaborated in the following:

• First, the amount of each of the variables of sales growth, capital expenditures, dividend profits ratio, and a solar power station's age for each year is calculated individually for each solar power station.

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• Years of companies are divided into nine classes based on each of the four variables and using statistical classes in each industry, as it is categorized in the intended class, according to Table 9, its score is between 1 to 9.

• Then, in each solar power station, a combined grade is obtained for each year that is classified to the following conditions in one of the stages of growth, maturity, and decline:

A. If the total score is between 16 and 20, it is in the growth stage.

B. If the total score is between 9 and 15, it is in the maturity stage.

C. If the total score is between 4 and 8, it is in a phase of decline (Chen & Park, 2006).

Table 9. The Status of the Life Cycle of Electricity Generation in the Last 9 Years

Dividend	Expenditure and capital expenditures	Sales growth	Age	floors	Total	Life cycle status
9	4	9	9	First floor 2016	31	**Growth**
8	3	8	8	Second floor 2015	27	**Growth**
7	2	7	7	Third floor 2014	23	**Growth**
6	9	6	6	Fourth floor 2013	27	**Growth**
5	8	5	5	Fifth floor 2012	23	**Growth**
3	1	4	4	Sixth Floor 2011	12	**maturity**
2	7	3	3	Seventh floor 2010	15	**maturity**
4	6	2	2	Eighth Floor 2009	14	**maturity**
1	5	1	1	Ninth floor 2008	8	**Decline**

Furthermore, the results illustrate that the curve of the life cycle of electricity generation in 2008. In addition, the result given that the establishment of solar power has started since 2008. In this year, the life cycle of electricity was in decline stage. It was at maturity stage from 2009 to 2011. Finally, it was at the growth stage between 2012 and 2016. Well, electricity production is still in the growth stage. Therefore, the results show that to increase the product life cycle, it is necessary to interpret the

variables, and their impact at each level of the life cycle and comparing them with the actual values of the selected indicators. Finally, the result provides the actual values of each index and descriptive statistics of the variables in the years under study.

4.3 Descriptive Statistics

Table 10 represents descriptive statistics of explanatory variables, as well as variables according to the solar power station's stages to the life cycle of electricity generation, to distinguish the stages of growth, maturity, and decline. As you can see, the deviation is wide among the descriptive statistics of these variables during the stages of the life cycle are observed. Actually, sales growth and capital expenditure growth have dramatically declined. The solar power stations in the growth stage have the highest sales growth and the most expensive capital. The solar power stations in the decline stage, have the least growth Sales and lowest capital expenditures. Also, the solar power station's largest size belongs to the smallest, and smallest companies owned by the decline stage of the solar power stations.

Table 10. Descriptive Statistics of Variables

	LEV	SIZE	CE	ROS	PRO
Mean	7.8288	55.756	8.5936	.6968	19.631
Std. Deviation	2.5748	31.314	.18856	.4475	14.574
Growth Stage					
	lev	size	ce	ros	pro
Mean	4.6504	26.640	3.4718	.8360	30.014
Std. Deviation	4.9756	40.011	3.8178	.4464	47.024
Maturity Stage					
	lev	size	ce	ros	pro
Mean	3.2988	20.945	3.301	.9160	39.644
Std. Deviation	3.9124	30.152	3. 800	.3171	45.177
Decline Stage					
	lev	size	ce	ros	pro
Mean	3.5299	14.810	2.292	.780	15.872
Std. Deviation	3.1859	11.375	2.904	.260	18.287

4.4 Regression Results

The results of fitting the regression model for the total statistical sample as well as statistical samples of each the stages of growth, Maturity, and decline are shown in Table 11. It is indicating the overall significance of the model. According to the result, lack of multicollinearity between independent variables, the remaining independence and the adequacy of the models also are confirmed. As you can

see in Table 11, all coefficients of estimation of risk criteria and their significance are supported except ROS, but these coefficients are significantly different in terms of growth, maturity and decline stage. For instance, LEV significant in growth, maturity, and decline stages are respectively, 0.009, 0.000 and 0.000. while, SIZE significant in growth, maturity, and decline stages are containing, 0.451, 0.000 and 0.000. Also ROS is respectively, 0.690, 0.000 and 0.000. In general, the results of Table 11 illustrate that the relevance of risk and performance criteria in growth stages, Maturity and decline have a significant difference with each other.

Table 11. Regression Model Estimation in Three Stages of Life Cycle Assessment

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
Total Case	(Constant)	-19557872210	2602409560.000		-7.515	.002		
	lev	1742826464	273841021.600	3.484	6.364	.003	.549	1.074
	size	-1.659	.226	-3.565	-7.355	.002	.511	2.857
	ce	636781197	73349291.720	.824	8.681	.001	.497	3.367
	ros	13454571	31397432.740	.041	.429	.690	.488	3.476
Growth Stage	(Constant)	119958406	77025242.980		1.557	.013		
	lev	36653149	10296515.790	.803	3.560	.009	1.000	1.000
	size	.174	.218	.289	.799	.451	1.000	1.000
	ce	36762917	9503939.899	.825	3.868	.006	1.000	1.000
	ros	-99365246	160371200.700	-.228	-.620	.555	1.000	1.000
Maturity Stage	(Constant)	-25334321.030	34.311		-738378.200	.000		
	lev	10568296.700	3.359	.933	3145889.563	.000	.001	834.598
	size	.017	.000	.148	677462.056	.000	.002	450.413
	ros	14766025.320	31.915	.081	462661.414	.000	.003	289.376
	ce	12142550.610	51355.367	1.000	236.442	.000	1.000	1.000
Decline Stage	(Constant)	-25445046.250	1383545.794		-18.391	.000		
	lev	10721965.050	116840.806	.949	91.766	.000	.001	687.493
	size	.015	.001	.132	21.045	.000	.004	252.895
	ros	14723084.620	1287596.229	.081	11.435	.000	.003	322.965
	ce	12111226.670	56090.007	1.000	215.925	.000	1.000	1.000

5. Discussion

Actually, renewable energy arranges these technologies more affordable by playing a vital role in providing global energy demand. For this reason, conducting such research seems to be necessary. In this study, the risk of the investment was ranked after identifying the risks of the solar energy life cycle. Also, the basic barriers to the market, as well as the perception of the high risk of investment in this sector, have contrived it possible to limit the development and financing of renewable energy projects, in particular, solar power. Although, reducing solar energy technology costs have significantly decreased their initial investment costs, renewable energy projects continue to face a lot of hardships in many parts of the world, which has led to an increase in the initial investment costs, market risks, and barriers. Actually, another crucial point to be noted is the regulatory risk that ranked third. This risk includes the delay or non-provision of the essential permission to carry out the project, terminate the project contract and change the tax laws. This is one of the things that will alter investment risks and increase production costs. In prioritizing life cycle risks, the political risk was ranked fourth, with the following risks: confiscation, expropriation, nationalization; the risk of foreign exchange; war; political stability; sanctions and other political violence; termination of the contract; Legal and bureaucratic risks. It can be said that if the organization funds and government institutions at the beginning of investing in renewable energy, and especially in developing countries, would aid private sector investors to finance their projects, it would significantly decrease the risk of investment in this field and the trust of the non-governmental sector will be increased to finance these types of projects and in the future it will be fully developed by the private sector. As a result, the results of this study are consistent with studies including Moktadir et al. (2018), Jouzi, Jafarzade, and Afzali Behbahani (2015) and Moktadir et al. (2018) identified Investment risk in supply chains and renewable energies. Liu and Zeng (2017), Noothout, de Jager, Tesnière, van Rooijen, and Karypidis (2016), Jouzi, Jafarzade, and Afzali Behbahani (2015) and Komendantova, Patt, Barras, and Battaglini (2009) identified Political risk in renewable energies. Komendantova, Patt, Barras, and Battaglini (2009), Jouzi, Jafarzade, and Afzali Behbahani (2015), Liu and Zeng (2017), Moktadir et al. (2018), Mangla, Kumar, and Barua (2016) and Luthra, S.; Mangla, S. K.; Kharb, R. K. (2015) identified Economic risk in supply chains and renewable energies. And, Yousefi and Izadpanah (2015), Komendantova et al. (2009) and Noothout et al. (2016) identified Regulatory risk in supply chains and renewable energies.

6. Conclusion and Recommendations

The results contribute to the importance in three stages of the life cycle (growth, maturity, decline) on the relevance of risk and performance criteria, as well as explanatory power, increase the risk criteria. So, the risk factors in the growth stage have the highest, and the stage of puberty illustrates the lowest level. Initially, it should be noted that government agencies that initially funded projects will need simple methods such as reducing transaction costs, utilizing domestic incentive prices and, most crucially having long-term goals, to cut down risk. To increase the amount of investment in the

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renewable energy sector, projects related to this sector should provide greater and easier access to large and substantial investors. So, the proper structure of finance can lead to an increase in the volume of investment and will be accompanied by a reduction in the cost of the life cycle of electricity generation. Also, the focus on high-efficiency projects, such as combined cycle power plants, somewhat cut downs the risk of the private sector. Therefore, the results of this study are consistent with the results from studies by Comandtova et al. (2009) that identifies the risks of renewable energies and with the study by Petrilo et al. (2016), which evaluates the life cycle and economic impacts of it.

Consequently, the total cost of solar power is lower than other sources of energy for electricity generation. Thus, governments can invest more in solar power plants, in addition to aid with the socio-economic development, they can reach to major goals such as sustainable development, reduction of environmental pollution, preservation of part of fossil fuels for future generations, saving in the long run and utilization of free solar energy.

According to the analysis and the results of this study, solar energy development requires incentives to change the energy system. At least 95 countries adoption different incentives to support renewable energy production. Given the fact that Iran has just entered the field of renewable energy, it is essential that these incentives are also taken into consideration in Iran. One of the incentives in this study is to encourage tax credit for investment. According to this incentive, it is allowed to provide a tax credit to private investors in the renewable resource sector to compensate for their tax by investing in their activities. Initially, another incentive is the increase in the profitability of renewable energy. Plus, Renewable energy, encouraging financing facilities and equity bonds, which includes financing facilities such as low interest loans, interest-free loans, loan guarantees and equity bonds, which the financial projects and alter the financial indicators of the projects through changes in the composition of financing sources. In fact, this variable can be profit-driven through input into the variables of the financing of the project and has no effect on the costs and revenues of the project. It does not arrange a significant change in financial indicators, and the facilities in the financial resources' sector have replaced the shareholders and cut down it.

In the incentive for producer tax credits, as suggested in this research, the mechanism is that if a person is subject to the tax credit, the amount of his tax decreases and his power production becomes justifiable. This exemption does not relate to the taxable income of a person but depends on the amount of its production. Incentive tax deductions will alter exploitation phase costs of income tax. The tax deduction incentive is applied in two situations: First: Definition of the revenue bracket; second: As a result of a 50 percent reduction in the tax rate; these incentives have a positive effect and, of course, a low impact on all.

Finally, it is recommended that all solar power plant managers, decision makers, financial analysts, potential investors and investors in the Solar power plants should be made aware of the need for financial analysis. So, analysis of investment projects in financial assets and securities to assess the level of risk, timing and a net present value of future cash flows and the capital liabilities, due to

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different levels and heterogeneous degree of risk perception to the critical life cycle company is attentive and important. Also, optimal placement results are at minimal risk and maximum returns, so making the environment more transparent and making the results even more effective.

7. Limitations

Firstly, the results of this research can be extensible for other organizations and industries. Certainly, those companies which are managed by private organizations are not extensible. Because risk factors are different in each industry.

Next, one of the most important factors and basic research projects of the existence of adequate information resources are timely and accessible in most countries. But in developing countries, such as Iran, lack comprehensive and complete information centers on the one hand and the confidentiality of the information, on the other hand, an obstacle to the flow of information from the falling information resources to the research centers and researchers.

Also in this study, a fuzzy ANP based structural model has presented with four critical risks in order to assesss ustainability in energy planning and risk management. Other indicators have not been documented and classified and the findings are based on expert's opinion, thus, the evaluation procedure need to be carried out carefully.

In addition, lack a comprehensive database is the most important issues and problems of this industry which is examined. Therefore, the establishment of the advanced systems software and hardware to ensure the correct and transparent flow of information is very important.

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Notes

Note 1. Analytical Hierarchy process

Note 2. Atrial natriuretic peptide

Note 3. Multiple-criteria decision-making