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Impact of the risks of renewable energy projects on the quality and cost of implementation. Case Study: Renewable Energy Projects in Tartous.

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□ ABSTRACT □

Energy is the most important cause of progress for countries, and investment in its fields is one of the most prominent signs of development, and in light of the current energy struggle the world is witnessing, in addition to the environmental threat with the depletion of some traditional energy sources with time, investment projects in renewable energy sources have become a supportive solution to secure Additional and renewable sources of energy.

In addition, the fact that these investments require capital in addition to precise technologies and qualified personnel, the risk assessment of these projects is of great importance in terms of achieving the required technical goal.

This study presented a list that includes the assessment and classification of risks of renewable energy projects, and by benefiting from the expertise of specialists and viewing a group of implemented and under-implemented projects, a questionnaire was prepared and distributed to a group of specialists, then the data of the results and the degree of severity of risks to the objectives of the project were analyzed, and it was found that about 16% Of the risks, they have a severe impact on the quality of project implementation, and 27% of them have a severe impact on the cost of project implementation.

Keywords: risks, renewable energies, electrical networks, quality of implementation, cost of implementation.

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أثر مخاطر مشاريع الطاقة المتجددة على جودة وتكلفة التنفيذ
دراسة حالة: مشاريع الطاقة المتجددة في طرطوس.

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□ ملخّص□

الطاقة هي أهمّ أسباب تقدّم الدول، والاستثمار في مجالاتها هو من أبرز علامات التنمية في ظلّ الصراع الحالي الذي يشهده العالم على الطاقة، بالإضافة إلى التهديد البيئي مع استنزاف بعض من مصادر الطاقة التقليدية، أصبحت المشاريع الاستثمارية في مصادر الطاقة المتجددة حلاً داعماً لتأمين مصادر إضافية ومتجددة للطاقة.

تتطلّب هذه الاستثمارات رأس مال كبير بالإضافة إلى تقنياتٍ دقيقة وموظفين مؤهلين، وبالتالي فإن تقييم مخاطر هذه المشاريع له أهمية كبيرة من حيث تحقيق الهدف الفني والعائد الاقتصادي المطلوب.

قدمت هذه الدراسة قائمة تتضمن تقييم وتصنيف مخاطر مشاريع الطاقة المتجددة، وبالاستفادة من خبرات المختصين والاطلاع على مجموعة من المشاريع المنفذة وغير المنفذة بعد، تم إعداد استبيان وتوزيعه على مجموعة من المختصين، ومن ثم تم تحليل بيانات النتائج وتحديد درجة خطورة المخاطر على أهداف المشروع، وتبين أن حوالي ١٦% من المخاطر المدروسة لها تأثير شديد على جودة تنفيذ المشروع، و٢٧% منها لها تأثير شديد على تكلفة تنفيذ المشروع.

الكلمات المفتاحية: المخاطر، الطاقات المتجددة، الشبكات الكهربائية، جودة التنفيذ، تكلفة التنفيذ.

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1. Introduction:

The renewable energy sector has witnessed great progress in recent years [1], and since the traditional resources of oil and gas are limited resources, the development of renewable energy systems is very important [2].

As a result, the number of investors in renewable energy projects is increasing dramatically [3], but they always suffer from the possibility of project failure due to the complexity of the investment environment. Therefore, in order to ensure investment returns, the risks to which investments in renewable energy are exposed must identified.

And understanding their types, in addition to knowing the potential outcomes, so as not to lose the opportunity to control and address these risks [4], according to the Global Energy Outlook and with the growth of the world population and the continuous development of emerging economies, the global demand for energy will increase by 30% by 2035 [5].

Researchers have conducted a lot of research that focused on studying and evaluating the risks affecting renewable energy investment projects [6] [7]. Research has indicated multiple types of risks, including political risks, technological risks, economic risks, security risks and other classifications [8]. Among the risks of developing renewable energy projects, in order to identify the risks of investment in the fields of renewable energy, given the current energy crisis and the conditions in Syria, we need to search for ways to provide energy at a cheap cost and renewable and fast solutions [9], and Syria faces challenges in how to meet demand The increasing demand for electricity, due to the lack of fossil fuel resources, lack of production, and sabotage in the electricity network, Syria is located in the solar radiation zone and has about 300 sunny days with high solar radiation throughout the year, and there are many areas where the average speed exceeds The annual wind is 6 m / s [10], therefore, investment in renewable energy projects is a necessary option in order to provide electric energy, and to achieve the technical purpose of these projects, a study must be made Evaluating the risks of renewable energy investment projects for each project.

The classification of these challenges and risks differs from one country to another, according to the conditions prevailing in it, as well as depending on the mechanisms and methods of development and support for this technology. The risks of renewable energy projects have been studied and evaluated in many countries, including, for example: Azerbaijan, where risks have been classified and 31 sub-risks evaluated. By the study sample, which consisted of 12 experts in the fields of economics, business administration, and energy systems. According to the experts' opinion, the most influential risk factors are those related to energy policy and the mechanisms of connection to the electric grid, in addition to financial risks [11].

An assessment of the risks of renewable energy projects was also conducted in Russia, and the study focused on the risks related to the methods of government support for these projects, as the analysis of data showed the ineffectiveness of government incentives for the renewable energy sector terms providing soft loans, such projects initially have a minimum level of risk. In addition, as the project progresses, the level of risk increases [12].

In China, the risks of renewable energies classified and the impact of sub-risks and the interaction between them studied. The results showed that the risks of subsidy policies are the main risk for renewable energy investments in the initial stage of the project, and with continuous technological progress and improvement of support policies, marketing risks become the main risk for investment in renewable energy. In addition, technological advances have reduced technical risks [8].

2. The aim of the research:

Evaluating the risks of renewable energies projects, developing a list that includes risk classifications and evaluating the degree of risk and its impact on the project objectives represented by (the quality of project implementation, and the cost of project implementation).

3. Research materials and methods:

List of 29 risks that renewable energy projects could face was proposed, classified into 8 categories. In order to revise these risks and classify them in a manner consistent with the nature of the targeted projects, they were presented to a group of engineers concerned with preparing studies and supervising the implementation and investment of renewable energy projects, and these risks were classified and sub-risks identified within these categories as shown in Table.

Table١ Project Risk Rating

Risks	Classification	Sequencing
1.Develop the necessary plans. 2.Choose a project site. 3.The experience of the executing technical staff. 4.The technical condition of the equipment. 5.The readiness of the industrial sector to secure the necessary materials.	Technical reasons	١
6.The presence of economists specialized in developing renewable energy projects. 7.Flexibility of banking systems. 8.High investment costs. 9.High operating costs 10. High maintenance costs. 11. Poor funding. 12. Price changes. 13. Determine the appropriate tariff.	Economic reasons	٢

14. The changing nature of renewable energy resources. 15. Climate changes in location. 16. Environmental harm to the system.	environmental reasons	٣
17. Community acceptance of the systems. 18. Lack of knowledge about the advantages of using renewable energy. 19. Community stability.	Societal reasons	٤
20. Clarity of regulations. 21. Delay in obtaining the necessary approvals. 22. Experience of administrative staff.	Administrative reasons	٥
23. Existence of legal controls for connection to the electrical network. 24. Technical infrastructure of the electrical network. 25. The expertise of the technical staff to implement the linkage project.	Reasons related to the electrical network	٦
26. Flexibility of regulations and laws. 27. Changing the techniques and methods of government support.	organizational reasons	٧
28. The shortage in the number of producers. 29. Consumers are not aware of the importance of using renewable energies.	Commercial and marketing reasons.	8

Then, we developed a questionnaire for distribution to technicians (engineers and technical observers) who are directly related to the implementation phase of renewable energies projects and connection to the electrical grid. Their point of view, so that the answers are distributed among 5 possibilities (extremely dangerous, dangerous, moderately dangerous, not dangerous, does not pose any danger), and they were also asked to determine the possibility of each risk occurring within 5 possibilities as well, which are (always, often, sometimes, slightly, rarely). the study sample included engineers and technical observers working for the General Electricity Company of Tartous, and they are directly concerned with preparing studies and supervising the implementation of projects, with a group of investors in renewable energy projects in the city.

The total number of respondents in the questionnaire was 60 subjects with varying years of experience, as shown in Table ٢ and 45 responses approved out of the total responses.

Table٢ The number of years of experience for the targeted elements in the questionnaire

The number of target items	Years of Experience
١٣	Less than 5 years
٢٢	5 to 10 years
٢٥	10 to 20 years old

Thus, 78% of the sample have more than 10 years of experience in the fields of renewable energy.

3.1. Data analysis:

The responses designed according to a five-point Likert scale, which weighted as shown in Table ٣ for the degree of risk:

Table ٣ the scores for the answers are distributed to the degree of danger

Grading (a)	Hazard Degree	Sequencing
٥	very dangerous	١
٤	Dangerous	٢
٣	Medium risk	٣
٢	Not dangerous	٤
١	does not pose any danger	٥

In Table٤ , the response scores given for the likelihood of the risk occurring:

Table٤ The scores of the answers are distributed for the probability of recurrence of the risk

Grades (a)	Probability of Hazard Occurrence	Sequence
٥	always	١
٤	often	٢
٣	Sometimes	٣
٢	slightly	٤
١	rarely	٥

Then the data was unpacked using statistical tests for frequencies and arithmetic averages, and the importance index (IMPI) factor adopted. We will need to specify two factors. The first is the frequency index ($F.I$), and the severity index ($S.I$), where the frequency index defined by the equation (1), and risk index defined by the equation (2).

$$F.I\% = \frac{\sum a * n}{5 * n} * 100 \qquad (1)$$

$$S.I\% = \frac{\sum a * n}{5 * n} * 100 \qquad (2)$$

The values for factor a are taken in equation (1) from Table٤ , and in equation (2) from Table ٣, n is the number of approved responses from the questionnaire.

Then the significance factor for each risk calculated from equation (3) [13]:

$$IMPI\% = \frac{F.I * S.I}{100} \qquad (3)$$

4. Discussion:

In this research, we classified the risks of renewable energy projects and assessed the sub-risks based on the analysis of expert opinion data, taking into account the limited experience at the level of the Syrian Arab country in developing renewable energy sources, as well as the lack of statistical data.

Figure 1 shows the percentage of the importance factor calculated on the basis of expert opinion in the study sample for each risk factor. We found that the most influential risk factors are those related to the legal controls of the connection mechanism with the electrical grid, the risks related to high operating costs, as well as the risks related to consumers' awareness of the importance of using energies renewable.

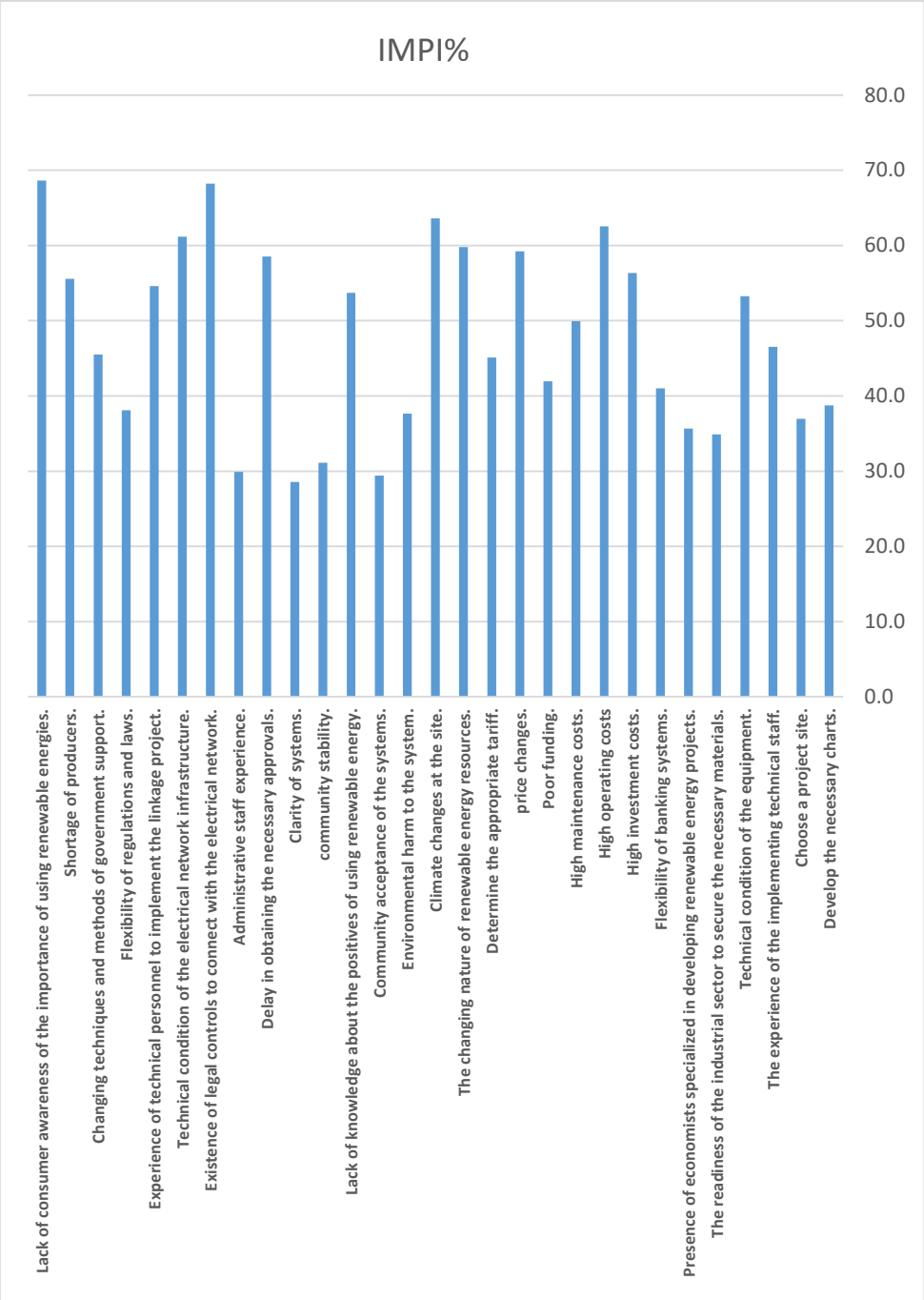

Fig 1 Significance factor IMPI%

Then we graded the severity based on the resulting values as shown in Table ٥.

Table ٥ Severity score

domain	Hazard Degree	
(75 to 100)%	very dangerous	١
(50 to 75)%	Dangerous	٢
(25 to 50)%	Medium risk	٣
(10 to 25)%	Not dangerous	٤

(0 to 10)%	does not pose any danger	٥

For ease of reading the data, the risk score converted into a heat map showing the impact of each risk on the project objectives (implementation quality, project implementation cost) as shown in Fig 2 , where the dark color indicates a low risk score and the lowest score in the color gradient represents a severe risk score.

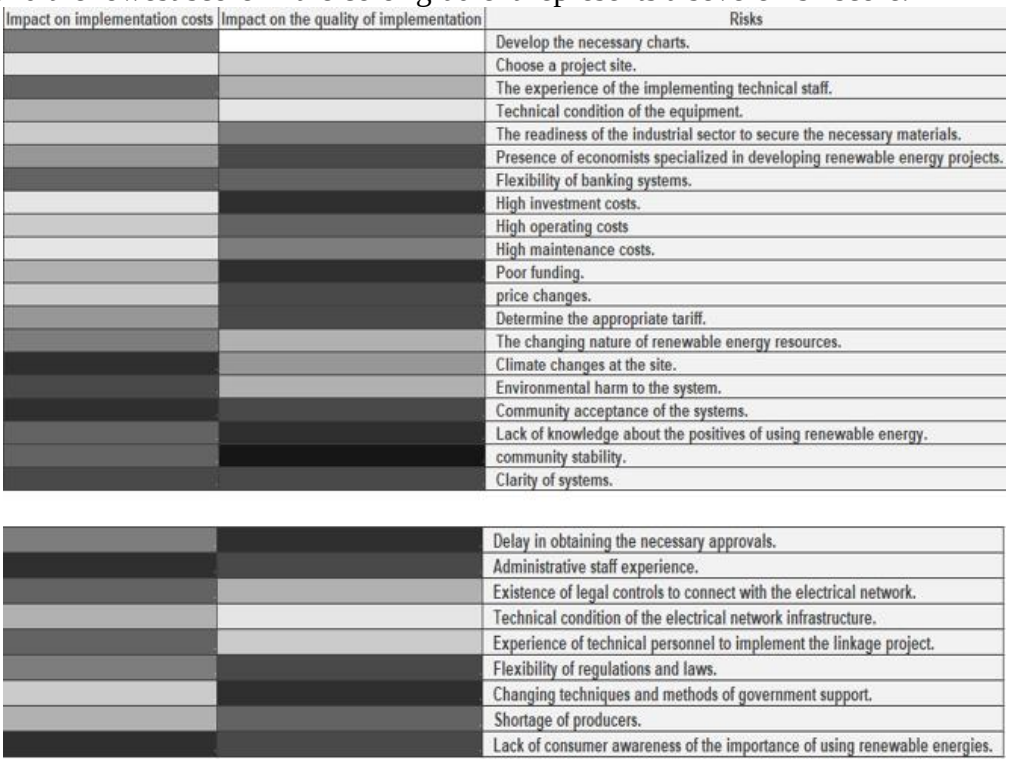

Fig 2 The degree of risk to the project objectives

We found that 16% of the risks had a severe impact on the quality of the implementation of the project, and the most severe types of risks affecting the quality of implementation were the reasons related to the technical condition of the existing electrical network, the development of the necessary plans for the project, and the experience of the technical personnel involved in the interconnection project, and 27% of them were severe The impact on the cost of the project, the most influential of which are the reasons related to choosing the appropriate site for the project, and the reasons classified as economic.

5. Results comparison:

We compared our findings in this research with a number of research studies that studied risk assessment in renewable energy projects, and this shown in Table 6:

Table 6 Comparison of results

search	year	Study case	risk assessment
[8]	2017	China	In the advanced stages, political risks considered the most influential, while with technological progress; marketing risks become the most influential. In return, technological progress reduced technical risks.

[11]	2019	Azerbaijan	The most influential are the financial risks and the risks of interconnection with the electrical network.
[12]	2020	Russia	The most influential are the risks of government support, especially in the pre-implementation phase.
submitted research	2023	Tartous/Syria	The risks that severely affect the quality of implementation are the risks related to the technical condition of the existing electrical network, drawing up the necessary plans for the project, and the expertise of the technical staff involved in the interconnection project. The risks that greatly affect the cost of the project are the risks related to choosing the appropriate location for the project, and the risks classified as economic.

6. Conclusions:

This study dealt with the impact of risks on the main objectives of the project represented in the cost of implementation, and its quality, during the implementation of renewable energy network projects. .

Show results:

1. Failure to assess risks when implementing renewable energy projects and connecting them to the electrical grid, so that they avoided and the technical and economic effects that result from them.
2. The most influencing risk factors are those related to legal controls for the connection mechanism with the electrical grid, risks related to high operating costs, as well as risks related to consumers' awareness of the importance of using renewable energies.
3. 16% of the studied sub-risks have a significant impact on the quality of project implementation.
4. 27% of the studied sub-risks have a significant impact on the cost of project implementation.

7. Recommendations:

In view of the special nature of renewable energy projects, and in order to achieve the required technical goal, and the economic goal required by investors, we recommend studying and evaluating the risks in these projects to achieve the required goals. In addition, ensuring that the implementation carried out with high quality and within the necessary technical specifications, as well as that graphic and statistical study developed for the studied and implemented projects and the percentage of their vulnerability or exceeding the risks of implementation and investment of renewable energy projects.

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