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# Modern Strategy with Risk Mitigation of Future Renewable Energy in Iraq

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**Abstract.** Iraq suffers from electricity shortages, through the local market and government institutions, has preliminary and applied information in the field of renewable energies, represented by solar energy, wind energy and bio-energy, at a simple level and small capacities, and in the near future it will rise to the levels of high energy stations. Note that the National Energy Strategy has set the percentage of renewable energy participation from total electric energy to reach 5%, about 2 Gigawatt by the year 2030. The plan includes several interval times, including the introduction of renewable energy in the agricultural sector to withdraw and pump water in drip irrigation systems, and the use of solar water heaters and heating systems and lighting systems operating with photovoltaic solar energy, as well as manufacturing all solar energy supplies and systems such as batteries, inverters, electric charger, solar heaters and solar panels, the effect of education and rationalization of consumption, increasing the efficiency of the use of electric energy, recycling waste to get rid of environmental pollution and producing biogas by Medium and large entrepreneurial systems in Iraqi cities. As well as the introduction of green building techniques in building homes, buildings and residential complexes to reduce electrical energy consumption with the introduction of solar-powered air conditioning systems. Reducing risks in renewable energy projects depends on several factors, including technology risks, monetary currency, natural resources, electrical grid risks, political risks, and the most dangerous are the risks resulting from terrorism and thefts at present in Iraq and requires an advanced and secure security system. Based on public datasets and reasonable assumptions, the provisional results obtained suggest the following; solar PV zones are located in the western region of Al-Anbar along the Jordanian Border. Despite the large capacities of these clusters, they are located at more than 300 km from Baghdad; wind zones are spread across the north-western area of Al-Anbar and south-eastern region, from Baghdad to Al-Basrah governorates.

## 1. Introduction

The simple statistics available to us show that Iraq, through the local market and government institutions, has preliminary and applied information in the field of renewable energies represented by solar energy, wind energy and bio-energy, at a simple level and capacities as shown in the figure 1. Globally, the energy generated from solar energy up to the year 2010 was about 40 Gigawatt, and currently in 2018 it rose to 300 Gigawatt, and expectations for the growth of solar energy production capacity will reach 1,600 Gigawatt in 2030 and will increase to 4,500 Gigawatt in 2050 AD as shown



in the following curve and this shows in the figure 2. The world's interest in the field of solar energy and its future in manufacturing, investment and production.

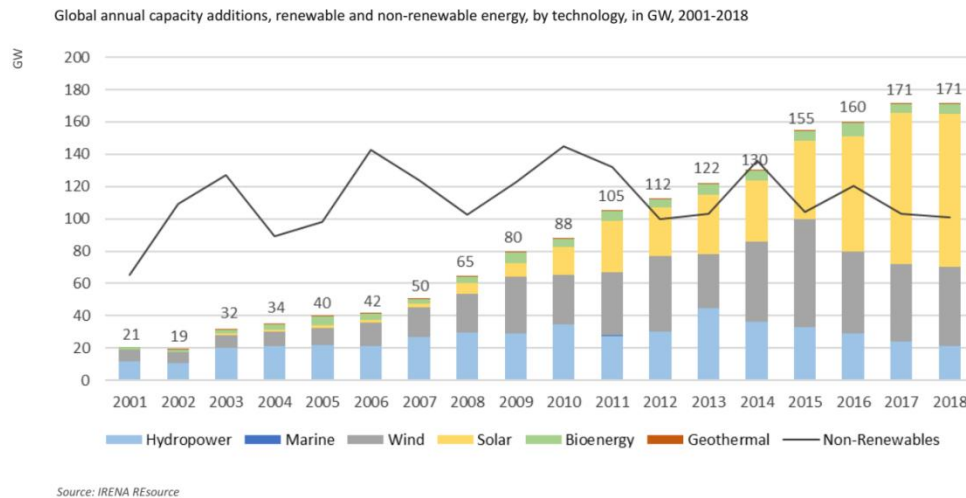


Figure 1. Global annual capacity addition, renewable and non-renewable energy, by technology in GW from 2001 to 2018

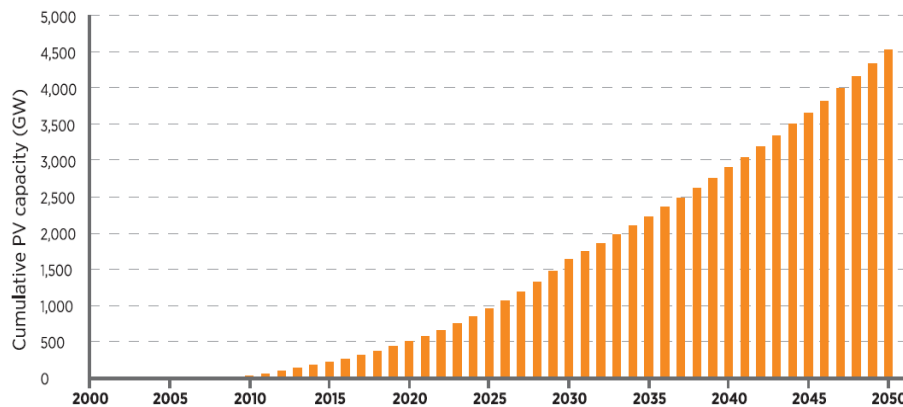


Figure 2. Cumulative PV capacity Gigawatt with time in the world

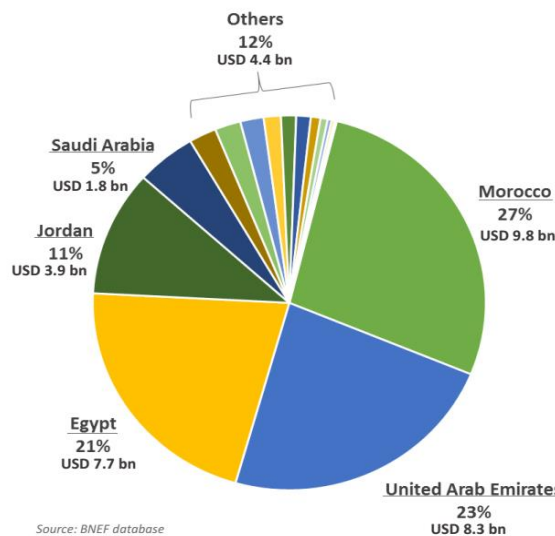
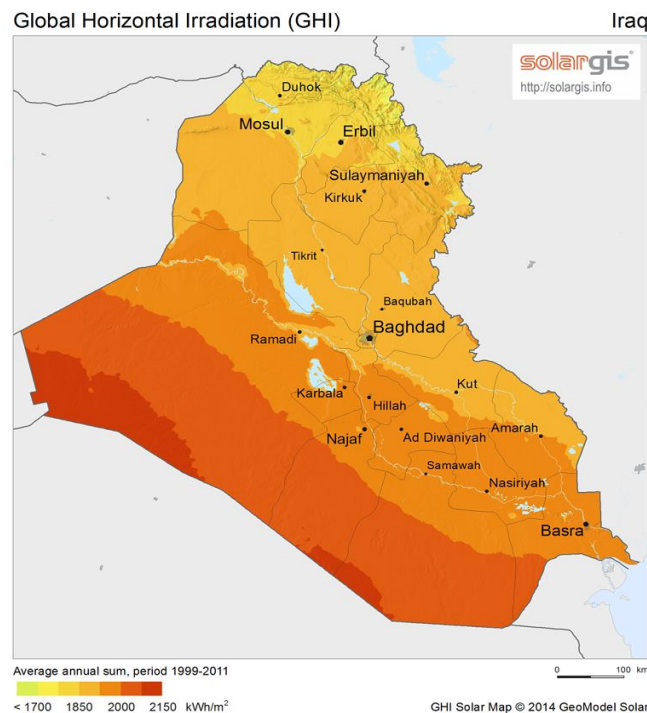


Figure 3. Cumulative investment in renewable energy, Arab League countries, 2004 – 2019



**Figure 4.** Global Horizontal irradiation in Iraq

The Cumulative investment in renewable energy, Arab League countries, by country, 2004 – 2019 as shown in the figure 3. We see from this summary that Iraq has no long-term plans in the field of renewable energies, especially the production of electrical energy from solar energy with high solar radiation in Iraq, which is estimated at about 2000 kilowatts per year per square meter. As in the following attached figures and some important information about solar energy in Iraq as shown in the figure 4. [1-14].

## 2. The Future vision of employing renewable energies in Iraq:

Renewable energies are one of the new sources of environmentally friendly energy that most countries of the world have introduced in many applications to reduce dependence on fossil fuels (oil, gas and coal), which is the source of environmental pollution. In all countries of the world, there is a plan and a future vision to introduce increasing percentages of renewable energies in the production of electric energy and other uses.

There are some challenges and obstacles to using renewable energies effectively and stably in Iraq, namely:

1. Scientific and technological challenges in some applications that require technology transfer to Iraq.
2. The lack of a clear long-term policy and strategy at the national level.
3. The absence of legislations that support the renewable energy sector.
4. Lack of solid financial and economic support for building solar, wind, and biofuel plants, or hydrogen, or waste recycling plants, and obtaining electrical energy from them or others.
5. Lack of foreign investment opportunities and failure to support the national or foreign Investor in Iraq due to the current circumstances.

Lack of cultural awareness among the citizen, the leader, and the Iraqi political question of the importance of renewable energies and their benefits, despite the acute shortage of electric power and in the long run in Iraq.

## 2.1. Importance of renewable energies in Iraq:

There are many importance parameters of renewable energies existing in Iraq as following:

1. Iraq is one of the countries rich in renewable energies, especially solar energy, which requires attention and investment in a way that serves Iraq now and in the future.
2. The demand for energy in general is increasing at the global level despite the progress made in the use of renewable energy globally, as it has now reached a production of 222 GW. The demand for oil is also increasing and is expected to increase in the future due to the depletion of global oil reserves.
3. The renewable energy investment in Iraq will provide a part of oil production for domestic consumption, which can be exported and provide additional revenues.
4. It contributes to preserving the environment, reduces pollution and has a positive impact on public health.
5. Providing many new job opportunities for the unemployed and recent graduates, as the technologies of renewable energies are simple, not complicated, and easy to learn.
6. Most of OPEC oil-exporting countries have turned to renewable energies, as they are a source of energy that is not depleted and strengthens their national economy.

## 2.2. The future vision to employ renewable energy activities in Iraq:

Through the experience of the Ministry of Science and Technology and the rest of the scientific and research centre in other ministries in the field of renewable energies, focus on the most important axes necessary from the outcome of efforts, studies and basic and applied research and building some pioneering systems in many areas of renewable energies applications requires concentration and drawing the future vision in Transferring renewable energy technology and settling it in Iraq according to an axis [15].

## 3. Renewable energies strategy until 2030 (short and medium term plan):

Some points for short and medium term plan as following:

1. One of the most important axes is the necessity of planning the introduction of renewable energy technology to reduce the load on the national electrical grid by investing in the fields of solar energy, wind and others. Note that the National Energy Strategy has set the percentage of renewable energy participation from the total electric energy to reach 5%, about 2 Gigawatt by 2030, from an average of 40 Gigawatt, but so far there are no real initiatives to support this strategy.
2. The necessity to put forward a plan to produce a solar energy plant with a capacity of one megawatt, both of which are separate and connected to the network, in order to achieve very important goals because it is the first station that fits with the Iraqi environment, its evaluation and knowledge of all technical and technological matters for it from implementation, operation and maintenance in coordination with international companies to introduce high capacity stations in Iraq distance.
3. Urging and encouraging the Ministry of Electricity to introduce electric power production stations to the areas close to the grid and remote areas that operate with solar and wind energy, as the Ministry of Electricity took the initiative to allocate funds in 2011, to establish of solar and wind power stations of about 400 megawatts, which will expire until 2015, but failed for many reasons.
4. Establishing small systems of solar energy up to (1-20) kilowatts or more to generate electrical energy at the domestic, commercial and industrial levels and can be linked to the national network by using special energy meters for measurement and benefiting from the experiences of other countries such as Jordan and Germany in this field with the preparation of an integrated program for this purpose.

5. Introducing renewable energy into the agricultural sector to withdraw water and pump it into drip irrigation systems, according to the area, type of crops and the required quantities of water.
6. Make a plan for the use of solar water heaters, heating systems and lighting systems operating with photovoltaic solar energy.
7. The axis of the Ministry of Industry must take advantage of the capabilities available to them to manufacture all supplies and systems of solar energy, including batteries, inverters, electric charger, solar heaters, solar panels and others.
8. The axis of education and rationalization of consumption and increasing the efficiency of the use of electric energy optimally, for example the use of modern lighting lamps.
9. The environment axis, which is the interest in recycling waste to get rid of environmental pollution and biogas production, through medium and large pilot systems in Iraqi cities. As well as the introduction of green building techniques in building homes, buildings and residential complexes to reduce electrical energy consumption with the introduction of solar-powered air-conditioning systems.
10. Focusing education in the field of renewable energy and working on issuing the solar atlas and winds and updating the data annually for the purpose of adopting them in the designs of Entrepreneurial systems and issuing their documents and the necessity to include renewable energy topics within the curriculum for (middle) secondary school and college students and postgraduate students.

#### **4. Renewable energies strategy until 2050 (long-term plan):**

Some points for short and medium term plan as following:

1. Establishing factories and laboratories of raw materials and other requirements involved in the manufacture and assembly of renewable energy systems, similar to the Ministry of Renewable Energy in India and others.
2. Establishing private colleges or institutes in the field of renewable energy technology.
3. Establishing high-capacity plants in the field of solar energy, wind and biomass.
4. Allocating a sum of money to renewable energies in the long run.

#### **5. Investing in solar energy:**

There are main reasons that drive the capitals to invest in solar energy with high confidence, namely:

1. The sun is a permanent radiant source of solar energy for a lifetime. The estimated lifespan of the sun is about 5 billion years.
2. Solar energy is a technically proven energy and technology, and the implementation of the project is easy and simple, most of the parts are fixed and do not require maintenance or complex techniques.
3. Solar panels have a long life of more than 30 years with product protection, reliability and successful investment experiments.
4. Investing in solar energy is tested and tangible in terms of profits, and no company has invested solar energy so far, and it is not a share of profit or loss, as profit in it is one of its important advantages.
5. Investing in solar energy is a sure profit, but the most important thing is government support for it in terms of tax exemption and giving legal and legislative facilities to obtain benefits for both parties.

### 5.1. The most important current investment projects:

The most required important current investment projects at the present time and for the future to employ them in the service of the Iraqi citizen and the impact of the economic return on both the Iraqi state and society, which are as follows:

1. Photovoltaic power stations (PV stations) for the production of electrical energy from solar energy and large capacities, ranging from one megawatt to one hundred megawatts, the type of connection to on-grid and independent off-grid national grid, which is one of the Ministry of Electricity's priorities at present.
2. Photovoltaic power stations (PV stations) for the production of electrical energy from solar energy and small capacities such as (5, 10, 15 and 20) kilowatts installed in homes, homes and private and government buildings at an attractive price and under the condition of selling in instalments to state employees, for example, an advance that does not exceed 20% of the cost of the system is paid, and the rest are refundable installments examples are shown in the attached table.
3. Engaging strongly in the field of transportation with electric energy, such as electric bicycle, scooters, transport vehicles, with solar energy, or supplied with electricity from a ground station at home from solar energy, and there are examples in the attached pictures. All of these projects have a positive impact in reducing fuel consumption, environmental pollution and rationalizing electrical energy consumption from the national grid, as well as the Iraqi street culture by entering solar energy into daily life.

### 5.2 The obstacles facing renewable energy investment projects in Iraq:

Through practical experience in concluding contracts that have been concluded or will be concluded in Iraq. There are now six types of obstacles facing investment projects in the renewable energy sector, which prevent the sober investing parties from participating in submitting their offers to implement these projects.

1. Legislative obstacles resulting from investment laws and regulations.
2. Implementation obstacles related to the relationship with the tax institutions, customs, and entry visas for foreign workers.
3. Social and security obstacles in project sites due to the date there are stable and unstable areas (security unrest from ISIS and others) in Iraq.
4. Financial and banking obstacles.
5. Supervisory obstacles resulting from the multiplicity of regulatory agencies.
6. The deadly red tape in the delay of official approvals in Iraq (wasting time).

### 6. Risks and mitigation facing investment projects for renewable energies in Iraq:

There are many types of risks that impede the tasks of renewable energy projects and their progress during implementation in Iraq, and these risks include: technology risks, currency risks, liquidity risks, human resources risks, regulatory risks, electrical network risks, and political risks, the risks of the other party in dealing and finally the risks of refinancing risks. All types of risks are studied before the start of the project, with the development of appropriate and alternative solutions in the event that any type of risk occur as shown in table 1.

Table. 1. Derisking Renewable Energy Investment Public instrument table for renewable energy

No	Risk Category	Barriers Description	Policy Derisking Instruments Activities
1	Power Market Risk	Risk arising from limitations and uncertainties in the energy market.	Establish transparent, long-term national renewable energy strategy and price and market access risk for RE projects



2	Permits Risk	Risk arising from the public sector's inability to efficiently and energy-related licensing and permits	Establish a one-stop-shop for renewable energy permits; processes for permits Contract enforcement and resource mechanisms
3	Social Acceptance Risk	Risk arising from lack of awareness and resistance to renewable energy in communities and end-users	Awareness-raising campaigns targeting communities and end-users Pilot models for community involvement at project sites
4	Resource & Technology Risk	Risk arising from use of the renewable energy resource and technology	Project development facility, feasibility studies; networking; training and qualifications Research and development; technology standards; exchange of market information
5	Grid/Transmission Risk	from limitations in grid management and transmission infrastructure in the country	Strengthen transmission company's operational performance, grid management and formulation of grid code
6	Counterparty Risk	Risk arising from utility's poor credit quality and an IPP's reliance on payments	Strengthen utility/distribution company's performance
7	Financial Sector Risk	Risk arising from general scarcity of investor and investor's lack of information and track record on renewable energy	Financial sector policy reforms Strengthen investors' (debt and equity) familiarity with and capacity regarding renewable energy projects.
8	Political Risk	Risks arising from country-specific governance and legal characteristics	
9	Currency/Macroeconomic Risk	Risks arising from the broader macro-economic environment and market dynamics	

## 7. Results and discussion

There are many important points to be reached in the results data from Data setting. These relate to renewable resources, infrastructure, land and terrain features, equipment costs, and operation and maintenance costs in addition to infrastructure and socio-environmental datasets – on transmission lines, topography, protected areas, land use and population growth – which help in determining the technical potential; and both technical and financial factors – such as equipment specifications, discount rates, installation costs, operation and maintenance costs, and load profiles – which help in estimating the economic potential.

The suitability assessment is a GIS-based multi-criteria decision analysis that establishes the suitability of an area to host utility-scale renewable energy projects. These areas are assessed by combining renewable resource (solar or wind) data with technical (electrical grid network, slope), and socio-environmental. A clustering technique has been used to create defined zones around the country to host utility-scale projects. The output of this clustering is a zones map showing prospective areas of sizes varying from 16 km<sup>2</sup> to 25 km<sup>2</sup> for solar and 6 km<sup>2</sup> to 251 km<sup>2</sup> for wind (Figure 5 and 6).

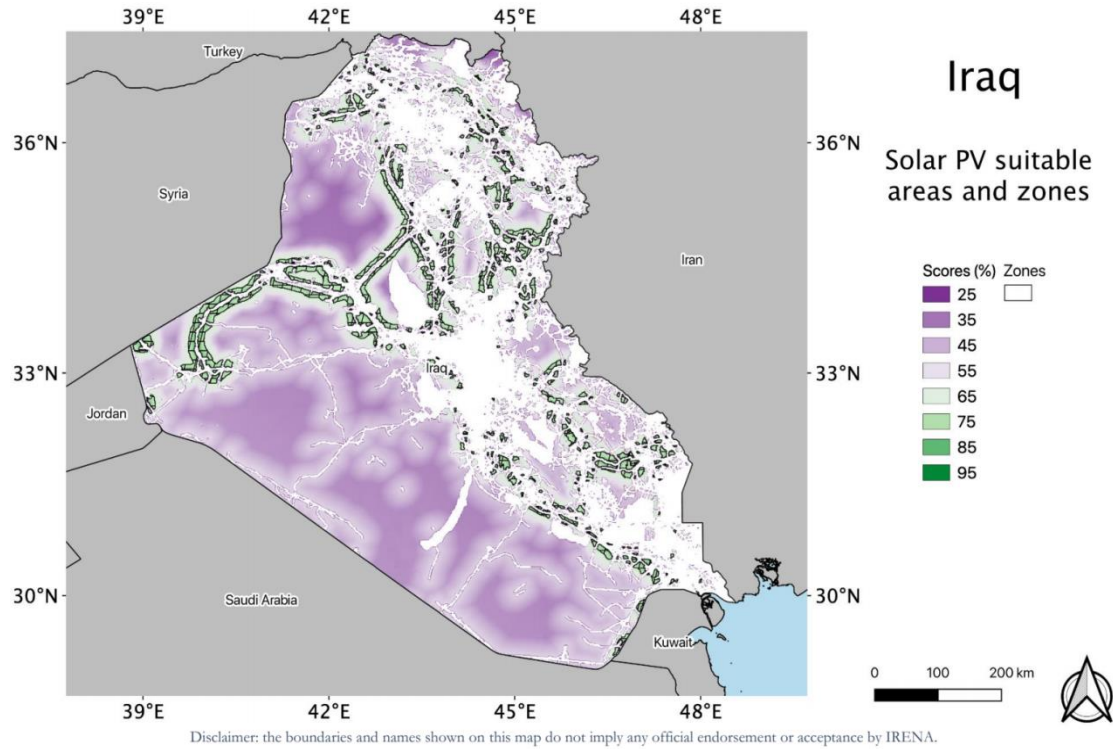
The attributes of each defined zone are calculated using the hourly renewable resource, load profiles and assumptions related to the equipment and economic values. An analysis of the results will be carried out using other datasets, including the renewable generators, renewable energy targets, and generator and grid levelised costs of electricity (LCOE).

Based on public datasets and reasonable assumptions, the provisional results obtained suggest the following:

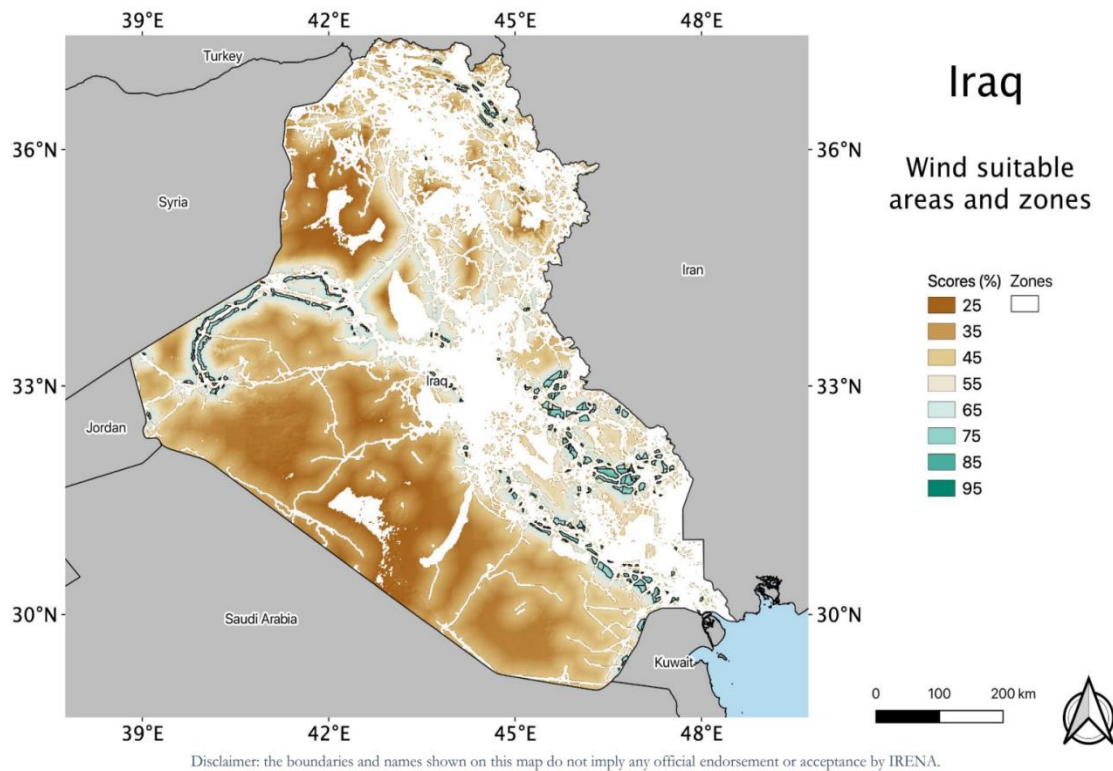
- solar PV zones are located in the western region of Al-Anbar along the Jordanian Border. Despite the large capacities of these clusters, they are located at more than 300 km from Baghdad;



- wind zones are spread across the north-western area of Al-Anbar and south-eastern region, from Baghdad to Al-Basrah governorates.



**Figure 5.** Zoning assessment for solar PV in Iraq



**Figure 6.** Zoning assessment for onshore wind in Iraq

The results presented in this study remain provisional, as complete calculations have not been undertaken at this stage. In this respect, the locations of prospective zones are designated without considering their final generation profile or economic features.

### Conclusion:

Many importance parameters of renewable energies existing in Iraq that Iraq is one of the countries rich in renewable energies, especially solar energy, which requires attention and investment in a way that serves Iraq now and in the future. Reducing risks in renewable energy projects depends on several factors, including technology risks, monetary currency, natural resources, electrical grid risks, political risks, and the most dangerous are the risks resulting from terrorism and thefts at present in Iraq and requires an advanced and secure security system.

### Acknowledgments

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