

Iraq Solar Energy: From Dawn to Dusk

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Harry H. Istepanian

July 2020





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Summary

Iraq is facing multiple challenges for harnessing the indigenous energy resources and devising rational energy policy. The recent dramatic fall of oil prices, Iraq's economic and political shambles, the corona virus (COVID-19) epidemic and the huge expected deficit in the 2020 federal budget are making the task of tackling the electricity shortage more challenging than ever. Unless the government plans to keep the costs down, reform the electricity tariff, and restructure the electricity sector, it is unlikely the power shortage will be solved anytime in the future.

This paper analyses the country's solar energy policy and addresses the barriers for developing the renewable energy system in light of the country's recent turmoil. Green energy, like solar can make a significant contribution to reducing the share of imported energy, buffering oil exports, and reducing the subsidy burden on the government. Although Iraq tends to promote the country's solar energy in two ways: Utility-scale PV units could lead to a reduction in burning of oil and gas, and rooftop solar panels would help individual households reduce their own dependence on "expensive and polluting neighborhood generators". However, there are a lot in between of untapped distributed solutions of small and medium scale solar, which are more than rooftop but less scaled than utility

scale such as distributed generation, which has not been addressed so far in Iraq, and could participate in relieving the overload on the national grid, achieve de-centralization, create jobs, develop SMEs, reduce electricity bills on the long-term.

1. Harvesting sunlight

In July 2019, Iraq's Ministry of Electricity invited independent power producers to participate in developing seven PV solar power sites with a combined capacity of 755 megawatts (MW) in the range between 30 MW to 300 MW. Many local and foreign developers saw the announcement as a move forward in an attempt to diversify the country's energy mix. International organizations, such as the World Bank, IEA¹, IRENA², RCREEE³ and the UNDP⁴, have been providing technical and commercial support to Iraq's efforts in deploying utility-scale and rooftop solar power generation. But it seems now that the anti-government protests that forced Prime Minister Adel Abdul Mahdi and his cabinet to step down in late November 2019, the recent tumble of international oil prices, and the corona virus (COVID-19) pandemic are undermining the government's plan to utilize thousands of hectares in the southern and western deserts for harvesting solar irradiance⁵. Setbacks are not new for Iraq; electricity shortage has emerged as a major constraint to economic growth in Iraq since 2003. The World Bank estimates the annual

1. New IEA report provides practical roadmap to address Iraq's current electricity shortfall and future energy needs <https://www.iea.org/news/new-iea-report-provides-practical-roadmap-to-address-iraqs-current-electricity-shortfall-and-future-energy-needs>

2. IRENA to Integrate Iraq's New Solar Map into Global Atlas <https://www.irena.org/newsroom/articles/2018/Jun/IRENA-to-Integrate-Iraqs-New-Solar-Map-into-Global-Atlas>

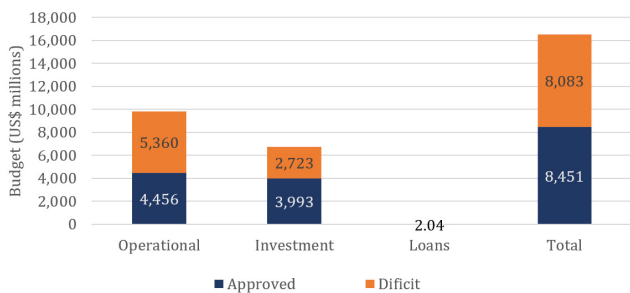
3. Iraq's renewable energy plans had received support from the Regional Centre for Renewable Energy and Energy Efficiency (RCEEE), as well as the United Nations Development Program (UNDP). The two parties signed a new agreement on the implementation of "Catalyzing the use of solar photovoltaic energy in Iraq". The UNDP was helping Iraq's Ministry of Electricity to deploy utility scale solar plants, as well as 5 MW of residential PV.

4. On 04 February 2020, the UNDP signed a letter of agreement with the Governorate of Duhok to establish a pilot solar park that will provide a minimum of two megawatts of electricity within two years. The European Union (EU) provided US\$ 2 million of funding for this project under the UNDP program "Supporting Recovery and Stability in Iraq through Local Development."

5. The western and southern desert covers some 64,900 square miles (16,809,023 hectares), almost two-fifths of the country <https://www.britannica.com/place/Iraq#ref22926> The annual GHI averages between 1899 – 2200 kWh/m² according to Global Solar Map <https://globalsolaratlas.info/map>

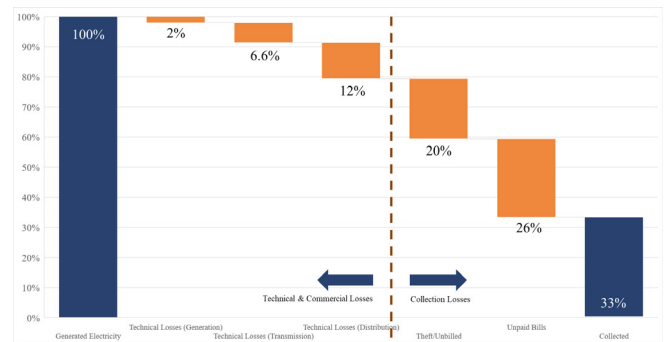
economic cost due to electricity shortage around US \$40 billion (INES, 2013). Inadequate and poor electricity services and infrastructure impedes private sector development and negatively affects economic growth and constrains government attempts to reduce poverty, which were among many other reasons for the continuing anti-government protests nationwide since October 2019⁶.

The simultaneous and compounding challenges of the electricity sector in Iraq are a subsequent result of a failed business model that is unable to generate adequate revenues to sustain itself nor to offer value to its consumers. The financing of the electricity sector is increasingly putting extreme fiscal pressure on Iraq’s federal budget every year⁷ (see below figure).



The Ministry of Electricity Budget (2019) [Source: MoE, Author’s analysis]

Years of internal armed conflicts, underinvestment, mismanagement and corruption have led to a dilapidated infrastructure with low efficiency and high levels of aggregated technical and commercial (AT&C) losses exceeding 50 percent. Over 67 percent of electricity is lost before it is billed (refer to below figure), and the tariff collection is currently covering only about 11 percent of the electricity production and delivery cost. Adding to this burden, a lack of effective metering, and billing system are leaving the actual electricity paid at 33 percent of the total electricity produced.



Technical and commercial losses (2017) [Source: Author’s analysis]

1.1 Gas-to-power or power-from-Sun?

Introducing solar energy in Iraq will undoubtedly harness the country’s energy security. Fuel shortage (mainly natural gas) has blighted Iraq’s power generation for years⁸.

6 Maria Fantappie (2019), Widespread Protests Point to Iraq’s Cycle of Social Crisis, International Crisis Group, <https://www.crisisgroup.org/middle-east-north-africa/gulf-and-arabian-peninsula/iraq/widespread-protests-point-iraqs-cycle-social-crisis>.

7 The budget for the ministry of electricity in 2019 was IQD 10.05 trillion (US\$ 8.4 billion), which represents 7.55 percent of total federal budget (IQD 133.107 trillion).

8 There is less focus on utilizing oil in burning for power generation. The government policy which has been pushed by the World Bank and US DoE is to invest in associated petroleum gas while maximizing the oil production for exporting. However, liquid fuel still contributes a significant percentage of the fuel mix:

Crude oil	345,897,688
HFO	199,477,676
Diesel	14,728,275
Gasoil	12,951,155
Natural Gas	354,642,587

Iraq has pledged to eliminate flaring of natural gas from its southern oil fields by 2022, to put an end for billions of dollars of lost revenue. Iraq’s gas proven reserve is around 130 trillion cubic feet. Iraq’s marketed gas production

Iraq's reliance on Iranian gas imports to satisfy its electricity needs has become part of the political tension between the United States and Iran⁹. The US has been exempting Iraq from adhering to the sanctions by extending temporary waivers to import Iranian gas and electricity. But the United States has requested Iraq to quickly achieve "energy independence" and seek "alternative and diversified" energy sources away from Iran¹⁰. According to the five-year Gas-to-Power Action Plan prepared by Gaffney, Cline & Associates in 2018 for the Government of Iraq (GoI), Iraq needs to invest more than US \$44 billion for five years in gas-to-power value chain¹¹. One of the underpinning features of implementation of the Action Plan is the need for a clear and decisive transition towards the private sector to attract unprecedented levels of capital¹². The demand for electricity is expected to continually rise and will reach 55,000 MW by 2030¹³. Green energy sources including solar, wind and hydropower would be able to contribute 20 - 30 percent of

the electricity mix by 2030 if properly invested¹⁴ and would provide electricity to consumers at the lowest average cost, while freeing up oil and gas for other uses or export equivalent to nine billion cubic meters of gas plus 450,000 barrels of oil per day according to the IEA^{15, 16}.

Iraq's potentials of solar energy are high¹⁷, with an average irradiation of 5.6 kWh per square meter per day over 3,000 hours of bright sunshine per year¹⁸. The country's approach to attract investment in solar energy has not been very successful previously, including the government offer of US¢ 3.5 per kWh feed-in-tariffs (FiT) in 2017¹⁹. Iraq began taking a more decisive move in mid-2019 with the aid of international organizations to formulate a solar policy aiming to deploy several thousand megawatts of utility scale solar plants, as well as 5 MW of residential PV by 2028. While the levelized cost of electricity (LCOE) has dropped dramatically in the last few years²⁰, inducing investment cost at scale in Iraq is still

increases to around 1,765 billion cubic feet over the next decade according to the IEA latest outlook report. This would boost Iraq's gas feedstock to its conventional power plants and reduce the devastating pollution and air quality problems the country faces caused by 570 billion cubic feet of flared gas from the oil fields every year.

9. The annual cost for importing electricity from Iran in 2018 was IQD 516,974 million (US\$ 432.62 million).

10. There is a shortage of fuel gas for power generation in the range 700 – 1000 mmscfd. The Iranian gas is currently supplying gas to Basmaya CCGT, Sadr GTPP, Mansuriya GTPP with total amount 765 mmscfd to generate around 3000 MW.

11. According to the study conducted by the Gaffney, Cline & Associates (2018), the investment in gas-to-power value chain will require \$7 billion for gas fields' upstream, \$17 billion for gathering and processing, \$4 billion for gas transmission and \$15 billion in new CCGTs, conversion of open cycle stations to CCGTs, switching from current oil use back to gas in gas-based power plants. During the Action Plan,

12. <https://rb.gy/emjgkj> – [aljazeera.net](https://www.aljazeera.net) 14/3/2020

13. Harry H. Istepanian and Luay Al-Khatteeb (2015), Turn a Light On: Electricity Sector Reform in Iraq, The Brookings Institution <https://www.brookings.edu/research/turn-a-light-on-electricity-sector-reform-in-iraq/>

14. The plan of MoE is to add 500 – 1,000 MW of renewable energy (mainly solar) to the grid, that compounds to 5 – 10 GW in the next 10 years. In addition, Iraq is currently producing 2,500 MW from the existing hydro power stations on Tigris and Euphrates rivers with plan to build several other new hydro dams in the future.

15. IEA (2019), 'Iraq's Energy Sector: A Roadmap to a Brighter Future', International Energy Agency <https://webstore.iea.org/iraqs-energy-sector>

16. Every 100 square kilometer of solar cells at 24 percent capacity factor has potential to generate about 3.4 billion kWh per year, saving more than 6 million barrels of oil equivalent (BOE).

17. Around 15,000 square kilometers of southern and western regions of Iraq, representing 3.5 percent of its total land area receive sufficient direct solar radiation between 2,800 to 3,000 hours per year.

18. Istepanian, H. (2018), 'Solar Energy in Iraq: From Outset to Offset', Iraq Energy Institute, UK <https://iraqenergy.org/product/solar-energy-in-iraq-from-outset-to-offset-report/>

19. The FiT program was scrapped and replaced by round 1 which was announced in mid-2019.

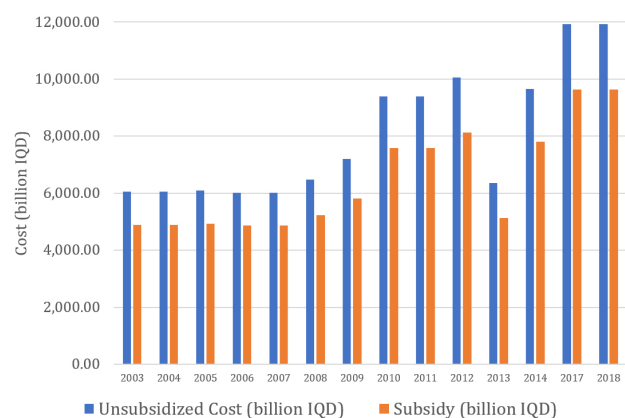
20. The latest study published by IRENA in November 2019 states the average solar LCOE of US\$0.085/kWh produced by projects commissioned in 2018 is set to fall to US\$0.048 in 2020, and \$0.02 by 2030. https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Nov/IRENA_Future_of_Solar_PV_2019.pdf A comparative analysis of the LCOE of an open-cycle gas turbine ranges between US\$ 0.04- 0.06/kWh, while higher efficient CCGT show a LCOE

5 – 7 higher than other Middle East and GCC countries, which have seen faster growth in investment and expected to reach US \$1,000 billion by 2030²¹.

1.2 Current status of solar energy in Iraq

During Iraq Energy Forum 2019 last September, many Gulf Independent Power Producers (IPPs), including the Saudi Arabian energy conglomerate ACWA Power, expressed readiness to sign a long-term power purchase agreement (PPA) with the GoI to finance, build, and operate large-scale PV power plants in the southern part of Iraq near the Saudi border. However, the investors' enthusiasm is marred now by the public protests and uncertainty of the current government, causing a major shake-up in foreign investors' confidence in Iraq's already-weak economy. With the ongoing unrest and almost daily protest, the future of the first round of solar investment remains unclear²². The fragile security situation is not only to be blamed for Iraq's plan to attract foreign investments, but also lies partly on poor regulations and mismanagement of renewable energy portfolio by the successive governments since 2005. The country's outdated laws and regulations, unwieldy bureaucracy and deep-rooted corruption do not keep pace with the international fast-changing market of renewable energy. Many investors in the past have expressed their concern that economic, political, transparency and security uncertainties were tending to inhibit their interest to mitigate the risks of entering the Iraqi market unless the government is willing to pay above-market prices²³. This is expected to

add up to the cost of the first round despite the continuing drop in the prices of the PV panels. The government mandate to provide cheap electricity to its people is putting the Ministry of Electricity (MoE) in a difficult spot when it comes to developing a sustainable business model as the general public's perception is that publicly owned utilities are providers of social services and the government is expected to make losses for the sake of public interest. The end-user average tariff has been frozen to US \$1.5 per kWh for most consumers. With its inability to raise revenue constrained, the Ministry must keep bulk generation cost down in order to remain solvent²⁴. The volume of subsidies has exceeded the notional amount of US \$32 billion since 2008 (see below figure) and has begun to erode MoE's capital base.



Electricity Subsidies (2008 – 2018) [Source: MoE data, IEI]

Our estimate of financial subsidies for 2018 is exceeding IQD 5,650 billion (US \$4.73 billion) with the subsidized fuel or IQD 10,464 billion (US \$8.76 billion) without subsidized fuel (see

range between US\$ 0.07 – 0.11/kWh. Both the fossil fuel and PV solar energy are substantially less expensive than the neighborhood private generators, whose LCOE range is US\$ 0.64 -1.3/kWh (Source: IEA).

21. MESIA, Solar Outlook Report 2020, <http://enterprise.press/wp-content/uploads/2020/01/MESIA-Annual-Solar-Outlook-Report-2020.pdf>.

22. In May 2019, the Ministry of Electricity has launched a first round of tender for a 755 MW of on-grid solar PV. The Ministry invited international and local companies to participate in the projects located across five provinces including Babel, Wasit, Karbala, Al-Muthanna and Diwaniyah. The main purpose of the round is to develop the economic and technical understanding of country's future solar technology developments. The projects are expected to complete in 12 months period from the point of signing the PPA with the investors under BOO model.

23. Author's private communication.

24. Istepanian, H. (2020), Residential Electricity Subsidies in Iraq: Exploring Options for Reform, Iraq Energy Institute, UK, March <https://iraqenergy.org/2020/03/19/residential-electricity-subsidies-in-iraq-exploring-options-for-reform/>.

below table)²⁵.

	With Subsidized Fuel	Without Subsidized Fuel
Total Actual Production without commercial losses ((million MWh	102.53	
Total cost of electricity production (billion IQD) [billion \$US	[6.04] 7,218	12,032 [10.07]
(%) Losses	61.0	
Electricity received after commercial losses (million MWh	39.95	
Collected revenue (billion IQD) [billion \$US	[1.31] 1,568	
Subsidies (billion \$IQD) [billion US	[4.73] 5,650	10,464 [8.76]
Percentage of financial subsidies (%)	78.3%	87.0%

Subsidies amount with and without fuel subsidies (2018) [Source: MoE]

With access to heavily subsidized fuel and no political appetite for passing the high initial costs of renewable technologies onto the consumers, the most likely scenario will be the government's continuation to delve into fossil fuel generation. Even when the government is willing to develop large scale solar parks, the RFI put forward for developing the first round has failed to attract global players and financiers in renewable energy despite more than 40 local and foreign companies were shortlisted as qualified bidders²⁶. Nonetheless, the GoI should expect the power purchase price will be materially higher by several fold

than elsewhere in the region, mainly because Iraq has neither created a track record in implementing utility scale solar power projects in the past nor are there any precedents for the long-term project finance necessary to reduce the cost of capital on infrastructure projects. Iraq does not have access to the low cost, long term limited-recourse project debt widely available for GCC and other MENA countries (those with proven IPP track records) as most global financiers and lenders are unfamiliar with Iraq and its infrastructure investment environment. Furthermore, Iraq's credit rating stands at Caa1 (Moody's), one notch above 'default', compared to the investment grade of the GCC states. In addition to these financial considerations, the country's solar irradiation is 10 -15 percent less than nearby comparable countries such as Egypt, Jordan, Saudi Arabia and UAE.

2. Iraq's solar energy policy

No doubt the outbreak of the Corona virus (COVID-19), low oil prices and the expected huge deficit in 2020 federal budget will distract the government away from its renewable energy plans at least on the short-medium term. Tough economic measures are expected and massive budget cuts are envisaged during 2020 - 2021. However, the situation will be an opportunity for the government to disengage the electricity sector from any economic crisis that might roam in the future. The sharp decline in the oil market will bolster the transition to diversify the energy mix and improve the energy efficiency using renewable energy, which will create jobs, reduce energy bills and improve the environment.

Iraq still does not have a clear policy plan for renewable energy that should be continuously reviewed and updated according to the

25. The Ministry of Oil has supplied the Ministry of Electricity equivalent to IQD 4,814 million (US\$ 4.02 billion) of subsidized fuel in 2018. It is important to recognize that the accounting approach to measuring subsidies ignores the fact that the economic cost of electricity provision may be significantly higher than the accounting cost (Source: IEI (2020), <https://iraqenergy.org/2020/03/19/residential-electricity-subsidies-in-iraq-exploring-options-for-reform/>)

26. <https://www.pv-magazine.com/2019/11/27/iraq-plans-second-750-mw-solar-tender/>, PV Magazine (27/11/2019)

government's integrated energy policy²⁷. In January 2019, the UNDP has issued a tender to seek solar consultants to help the MoE in catalyzing the solar photovoltaic energy policy, which still needs to be materialized²⁸. However, there is a general impression that most recommendations on the energy policy as stated in the Integrated National Energy Strategy (INES) in the past were either ignored or partially implemented even if they appeared to be successful due to weak institutionalization of government enterprises. The rooftop solar energy development (which engages both the consumer and government) has been discounted by the government for many years due to poor distribution infrastructure and retailing business. Changing renewable energy policy is not sufficient unless the entire electricity sector is reframed and 're-cultured' in order to make the rooftop solar program successful and sustainable.

2.1 Off-grid or on-grid?

The government has initiated a pilot program in 2018 for four years to install 8,000 kilowatts (kW) rooftop solar panels for houses and the government owned buildings including schools and hospitals in Baghdad and other provinces²⁹. The concept has been advocated by many international donors like the World Bank in post-conflict countries³⁰. Such initiatives will enable Iraq to stimulate the development of rooftop solar energy market by creating legal and fiscal instruments such as direct funding or subsidies to encourage partnerships between local industry and solar energy companies³¹. Rooftop solar PV systems also offer potential for consumers to reduce their electricity bills, and be part of the broader basket of solutions for the electricity shortage.

Could the flat rooftops of Iraqi houses be a sustainable source of free power for the households? The current high electricity subsidies (see figure below), which are among the highest in the region in absolute terms (equivalent to 7.86 percent of total federal budget), dismiss any incentive for consumers to take energy saving measures or invest in

27. The Integrated National Energy Strategy 2013-2030 (INES) report by Booz&Co is outdated and needs comprehensive reviewing. However, INES defines briefly a vision for Iraq's solar energy future, assesses the solar energy resources available to Iraq, and considers renewable generation to be used in the short term to supply remote off-grid demand locations, while large-scale solar power plants can be connected to the grid in the medium-to long-term. INES report forecasted that renewable capacity will exceed 2 GW, approximately 4-5 percent of total system capacity by 2030. Iraq is unable to achieve such target especially with current economic and political turmoil.

28. The \$35.1 million project intended to support the development of a regulatory framework, technical guidelines, capacity building and institutional arrangements for the development of public and private independent power producer solar projects. The policy document was not made available to the public.

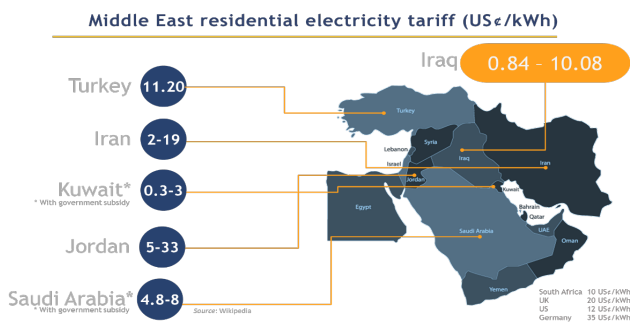
<https://www.pv-magazine.com/2019/01/08/iraq-takes-first-concrete-steps-into-solar> , PV Magazine (8/12/2019).

29. The MoE has announced in March 2020, a tender document to supply and install 130 rooftop PV panels for houses in six provinces (Ninawah, Kirkuk, Diyala, Kerbala, Maysan, and Dhi'Qar) on an estimated total cost of IQD 1.17 billion (US\$ 980,000) for each province on an average of US\$ 7,500 per solar unit.

30. In 2018, the World Bank initiated a US\$ 50 million grant to finance off-grid solar systems in Yemen to power vital basic services and improve access to electricity for vulnerable Yemenis in rural and outlying urban areas. The program relied on the commercial solar market, which has grown despite the conflict, providing further support to the local economy and creating jobs. The program is implemented in partnership with the United Nations Office for Project Services (UNOPS) and in collaboration with the local private sector, including micro finance institutions, solar equipment suppliers, and technicians.

31. Public and private banks besides micro financiers can fund the initiative either in kind or in cash with the help of international institutions such as the case in Jordan, West Bank and Yemen.

alternative energy³². High upfront cost and limited or no access to debt finance is making the consumers often reluctant – or do not have the means – to invest the high upfront amount required to install rooftop solar systems³³.



Middle East residential electricity tariff (US¢/kWh)
 [Source: Wikipedia, MoE]

While most of the world countries are embracing on-grid rooftop PV solar energy, current Iraqi legislations do not allow for net metering scheme³⁴, public utilities are not forthcoming for implementation as these imply negative cash flows. Where solar is reimbursed through FiTs³⁵ or other long-term power purchasing agreements (PPAs), contract enforceability is also a concern due to the MoE’s weak balance sheet and/or poor quality of service.

2.2 What about distributed generation?

Distributed generation (DG) such as community solar and microgrid are yet not exploited but can play a vital role in the

32. The number of subsidized customers has increased by 30 percent since 2010. Efforts to reduce subsidies to offset the burden of the increasing number of customers suffered a setback when further subsidized tariffs were introduced in 2018 (see below table for details). All residential customers, regardless of their total consumption are subsidized at the same rate for the same level of consumption. The bulk of the subsidies (approximately 48 percent of the paying consumers) are supporting the non-poor with consumption exceeding 1,500 kWh per month (Source: Istepanian, H. (2020), Residential Electricity Subsidies in Iraq: Exploring Options for Reform, Iraq Energy Institute, UK, March).

Category	Monthly Consumption range in kilowatt-hour (kWh)	Tariff (IQD per-kWh)
Residential	1 - 1,500	10
	1,501 - 3,000	35
	3,001 - 4,000	80
	4,001+	120
Commercial	1 - 1,000	60
	1,001 - 2,000	80
	2,001+	120
Industrial	All	60
Governmental	All	120
Agricultural	All	60

33. The MoE states on its website that it is currently working with several local banks to facilitate easy loans for households to install rooftop solar panels <https://rb.gy/jjgysn>.

34. Net metering is an electricity policy which allows utility customers to offset some or all of their electricity use with self-produced electricity renewable energy source. Net metering works by utilizing a meter that is able to spin and record energy flow in both directions. The meter spins forward when a customer is drawing power from the utility grid (i.e., using more energy than they are producing) and spins backward when energy is being sent back to the grid (i.e., using less energy than they are producing).

35. A feed in tariff (FiT) scheme provides a guaranteed premium price to the renewable electricity producer and put an obligation on the grid operators to purchase the generated electricity output. The price is typically guaranteed for a long period in order to encourage investment in new renewable energy sources for power generation plants.

integration of renewable energy resources in Iraq. DG can offer many economical and technical benefits associated with increased demand for electricity. The key driving factors and benefits that would accelerate the deployment of DG in Iraq at the national level (if proper incentive policies are set), includes cost savings for infrastructure due to aging and overloading of transmission line³⁶. However, DG needs to be designed in a proper way so that the overall efficiency of the power system is increased with less total capital cost, higher installed generation, higher capacity factor on all assets, and higher reliability of the system³⁷. The MoE is able to promote renewable energy through DG so that the customer's dependency on power from national grid can be reduced. Nonetheless, development of DG on consumer side needs extensive regulatory and supportive administrative policies, along with awareness of its benefits to the prosumers. Currently, there is no technical or legal definition of DG by the MoE. The recognition of microgrid as a platform for integration of renewable energy resources to get clean and green energy is inevitable once a framework and policy for implementation is put in place with firm steps to get more benefits from distributed generation.

2.3 Solar Energy Regulatory framework

The INES traverses economic and social terrain of Iraq's energy sector and recognizes the unstable equilibrium among social justice, equity and economic efficiency. The regulatory framework for the renewable energy is briefly stated in Article 2 (5) of the Electricity Law No. 53 (2017),

"Supporting and encouraging the use of renewable energies in various fields and the settlement of their industries."

The MoE has not been able to achieve its

objectives set by the Law and unable to draw fixed legal and administrative policies for the renewable energy in accordance with the INES. The lack of cooperation with the private sector and citizens to promote alternative energy sources, the absence of regulations that allows the private sector and citizens to install on-grid renewable energy sources and sell excess energy to the public utility are among many reasons for such failure to achieve a coherent market for renewable energy. Besides, there hasn't been any major investment in this area for the past period due to the following:

- The incompatibility of the provisions of the investment law in respect of the objectives of the MoE and the investors' needs has resulted in significant obstacles during the process of developing and/or applying investment responsibilities and investment returns while applying FiT.
- The lack of sufficient protection such as government sovereign guarantee has disrupted investors' appetite to develop projects and reduced investment levels.
- Strict laws have not been enacted for the purpose of identifying the importance of renewable energy to avoiding the above-mentioned obstacles.

Nevertheless, a draft law for Renewable Energy was submitted to the Ministerial Energy Council for reviewing since early 2019. The law aims among many objectives to encourage the public and private sector to participate in developing the renewable energy. But it is highly unlikely now the draft will be introduced to the parliament for debate until after the new elections in late 2020 or early 2021. Foreign and local investors were hoping that the new law once approved, will facilitate with clear mandate to finance, build

36. Iraq has spent approximately IQD 400 billion (US\$ 335 million) of the federal budget on rehabilitation and new transmission projects in 2019.

37. A. Hirsch, Y. Parag, and J. Guerrero (2018), "Microgrids: A review of technologies, key drivers, and outstanding issues", *Renewable and Sustainable Energy Reviews*, vol. 90, pp. 402–411.

and operate renewable energy projects. Many developers have raised concern in the past of slow and bureaucratic processes in obtaining land permission, financing, and access to transmission infrastructure. Currently, Iraq does not have a law that allows the private sector to export and sell electricity generated from renewable sources or any other means to the national grid. The new law will hopefully enable the consumers to become prosumers in utilizing their houses rooftop to install solar PV panels for their own usage and sell the excess energy to the utility companies. Such scheme is far from implementation any soon due to lack the required infrastructure including net metering.

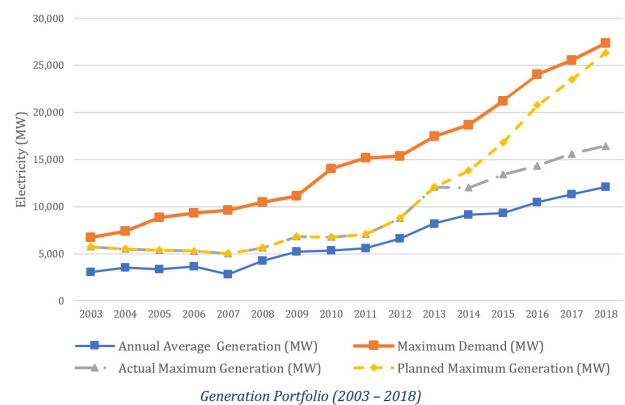
There are two strategic objectives that underlie the INES recommendations related to renewable energy regulatory framework and that should be at the heart of Iraq's long-term energy policy and vision for sustainable energy development:

- To support environmentally sustainable technologies;
- To attain greater energy security through a steady increase of electricity production in Iraq using renewable energy sources that are available in Iraq (e.g. solar, hydro, and wind)
- The issues that are critical to the successful realization of the renewable energy regulatory framework are: 1) government's vision for utilization of the renewable energy in Iraq must be clearly defined and economically justified; and 2) the framework that takes into account of Iraq's unique socio-economic, infrastructural and environmental features.

The enhancement of the regulatory framework for renewable energy in Iraq, through the regulatory framework that regulates plans, policies and funding schemes, promotes the development of the role of renewable energies in achieving the trends of energy security. Moreover, Iraq has to adopt a financial scheme for the development of the renewable energy, through the establishment of the renewable pertaining to promoting renewable energies under sustainable development.

2.4 Solar energy and International Oil Companies

Iraq electricity consumption according to the IEA is projected to double to 150 terawatt-hours (TWh) in 2030 from 75 TWh in 2018³⁸. If the current supply for new generation continues, Iraq will be able to add 8,000 - 10,000 MW of power generation to the grid in the next five years to reach 28,000 - 30,000 MW by 2025 including on average 1,000 - 1,500 MW of renewable energy (mainly utility-scale solar PV)³⁹.



Generation Portfolio (2003 - 2018)

However, many are skeptical that Iraq will be able to meet future demand for electricity unless the Ministry of Oil is able to capture most

38. IEA (2019), 'Iraq's Energy Sector: A Roadmap to a Brighter Future', International Energy Agency <https://webstore.iea.org/iraqs-energy-sector>.

39. In November 2019, the energy advisor to the prime minister has announced during a conference held in Berlin, Iraq's government plan for second 750 MW solar tender with no details for the tender was given (Source: PV Magazine, <https://www.pv-magazine.com/2019/11/27/iraq-plans-second-750-mw-solar-tender/>).

of associated gas from the oil fields⁴⁰. Besides, the national grid infrastructure needs a major transformation to fulfill the ever-increasing electricity demand and ability to integrate non-dispatchable renewable energy sources. To achieve the high amount of renewable energy generation, the current grid system should be converted to a smart autonomic system while attempting to reduce the high aggregated technical and commercial losses percent by 5 – 10 percent per annum.

The international oil companies (IOCs) can play an important role in promoting renewable energy in Iraq through an offset program that enables IOCs to invest in development of renewable energy projects to assist Iraq to meet the high demand for electricity and commitment for the reduction of greenhouse gasses from oil & gas extraction operation. The offset program should aim to offset an amount representing a proportion of the main oil or gas energy produced towards a secondary objective to generate electricity from renewable energy sources. The IOCs might become a major player in delivering sustainable solutions for the electricity shortage⁴¹.

2.5 Lessons from MENA region

Iraq is currently trailing behind other countries in the MENA region including Jordan, GCC states, Morocco, and Egypt when it comes to developing PV solar energy. However, in 2018 only 0.3 percent of energy came by renewables in the MENA region compared with 40.2 percent in the Asia-Pacific region, 30.7 percent in Europe and 21.2 percent in North America⁴².

Solar energy has been gaining maximum traction in the UAE. The energy strategy for 2050 targets is an energy mix combining renewable, clean energy sources and nuclear power to meet the Emirates' economic requirements and environmental goals of 44 percent clean energy, 38 percent natural gas, 12 percent coal and 6 percent nuclear. The UAE expects to save \$192 billion by 2050 in the energy sector if the renewable energy development goes as planned⁴³. In May 2019, Dubai began the second phase of what will be the world's largest solar park. Worth some \$14 billion, the park will eventually produce 5,000 MW of energy, enough power for about 800,000 households. By 2050, the UAE will have invested approximately \$150 billion in renewable energy. This is expected to save the country \$192 billion through reducing dependence on gas subsidies⁴⁴.

The Moroccan government sets clear policies to direct their energy industry through the National Plan of Priority Actions (PNAP) and the National Energy Strategy (NES). The NES major objective is to ensure that 20 percent of the country's energy needs are met through renewable energies. Similarly, another related goal is to ensure that the country attains an energy efficiency of 20 percent by 2020 and a further 15 percent by 2030. The PNAP has set to diversify the fuel mix including promoting renewable energy as major objective aims with plans to integrate energy markets in the Euro-Mediterranean region.

Egypt has committed to the widespread deployment of renewable energy technologies, mainly PV. To date, the country's total installed

40. The World Bank estimates Iraq will need to invest \$28 billion of capital across the gas-to-power value chain in the next five years. Iraq is flaring around 1,552 mmscd from the south oil fields and 280 mmscd from the north oil fields (excluding KRG).

41. Istepanian, H. (2018), 'Solar Energy in Iraq: From Outset to Offset', Iraq Energy Institute, UK <https://iraqenergy.org/product/solar-energy-in-iraq-from-outset-to-offset-report/> .

42. BP (2019), BP Statistical Review of World Energy 2019, 68th edition, p.51 <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf> .

43. Bloomberg, C:\Users\histe\Documents\Renewable Energy Bayan\UAE Sees \$192 Billion Savings in Switch to Green Power From Gas (27/03/2017)

44. The Arab Weekly, <https://thearabweekly.com/uae-becoming-leader-renewable-energy> (17/03/2019)

capacity of renewables amounts to 3.7 GW, including 900 MW of solar and wind power. The Egyptian government has set renewable energy targets of 20 percent of the electricity mix by 2022 and 42 percent by 2035.

Saudi Arabia's Vision 2030 development blueprint recognized that "the kingdom's impressive natural potential for solar and wind power generation remains largely untapped" and pledged to generate 9.5 GW of renewable energy by 2030. In 2018, Saudi Arabia generated 0.2 TWh of power from solar – a small fraction of the 383 TWh consumed by the Kingdom but it is about to change as the Kingdom is targeting to generate 27.3 GW of renewable energy capacity by 2024 and 58.7 GW by 2030 through 30 solar-energy parks and five more wind farms across the country.



GCC States IPP Renewable Energy Plans

(Source: IRENA)

The ambitious targets set by MENA countries is expected to translate into a combined 80 GW⁴⁵ of renewable capacity by 2030 based on national plans to fulfill the countries' ambitions, the establishment of policy, regulatory, technical and economic frameworks enabling

the scaled-up deployment of renewables to be indispensable towards advancing the creation of an integrated power market across the region, which Iraq needs to play a major part of it.

3. Time to remove barriers

The failure of the solar energy policy in Iraq during the last decade is widely blamed due to lack of a clear strategy and effective legislation that would have allowed private investments to infiltrate the market to utilize this technology efficiently and effectively as in other countries of the region. Lack of a conducive institutional structure and business environment for decades has severely inhibited Iraq's ability to deliver financially sustainable foreign direct investment (FDI) into the electricity sector in general and renewable energy in particular⁴⁶. The MoE directorates are lacking adequate commercial performance abilities with limited financial capacity to run a successful business model and adapt with the fast-changing energy market in the region⁴⁷. The pro-FDI Investment Law 13 of 2006, which opened the state-led economy for the first time to all foreign investors, was a big step to move forward, but the overall investment climate in Iraq remains predominantly weak in generating revenues and employing people⁴⁸.

As the country is facing several challenges, the most alarming being security, poverty and the struggle to rebuild its war-torn regions. These severe handicaps make it even more necessary to build a solid regulatory framework for the renewable energy development which enshrines strong investment rights and protection against political parties' interference

45. IRENA, Middle East & North Africa, <https://www.irena.org/mena>

46. Lack of security increases and political instability are major factors impacting economic development in Iraq including FDI inflows and should be understood more in the concept of levels of severity rather than in absolute detrimental terms (Source: Hanna. G. et al (2014), 'Foreign Direct Investment in Post-Conflict Countries: The Case of Iraq's Oil and Electricity Sectors', International Journal of Energy Economics and Policy Vol. 4, No. 2, pp. 137-148.

47. The role of the MoE is dominantly operational of the generation, transmission, and distribution entities rather than policymaking and market regulation.

48. Hanna. G. et al (2014), 'Foreign Direct Investment in Post-Conflict Countries: The Case of Iraq's Oil and Electricity Sectors', International Journal of Energy Economics and Policy Vol. 4, No. 2, pp. 137-148.

and influence⁴⁹, to some extent, offsets the huge corruption risks that prevail in much of the MoE. There is also a need for a smooth transition of the electricity sector from a public-sector dominance into a more diversified sector where private investment brings its contribution to meet the future growth, creation of jobs and access to global value chains⁵⁰.

The fact remains that the current initiatives by the government are not sufficient to stimulate significant growth of using solar energy in Iraq for several barriers, some which have been acknowledged by the government and others not⁵¹:

3.1 Financial barriers

The website of the Ministry of Electricity provides the needed technical and financial regulations for citizens to finance and install roof-top solar units⁵². However, affordability and lack of adequate financing channels remain the main challenge. The government needs to take the initiative to make investments in the solar energy sector more appealing through funds, tax incentives and customs exemptions to eliminate the financial barriers. Tax incentives, similar to ones in Jordan, should include 100 percent tax exemption for ten years when investing in renewable energy construction in certain areas where socio-economic developments are needed.

3.2 The electricity grid

Another key factor hindering the development of solar energy is lack of supporting infrastructure. The unstable nature of the electricity grid in Iraq will present a major challenge to the operator during power

off-take from solar energy as the power system is preliminary designed to support the needs of centralized systems with marginal or no spinning reserve. Since 1990s, the grid has been facing several concurrent challenges besides the high AT&C losses. The development in the grid has not kept pace with the electricity demand and the addition of new generation⁵³. As a result, a sizable share of power transformers, feeders, and distribution transformers are overloaded or operating under capacity. Overloading has been increasing the likelihood of technical faults and network failures, causing outcries among the public especially during summer time⁵⁴. It is unexpected the transmission and distribution sector will attract private investment and the government has been ambivalent about whether or not it will proceed with the corporatization of distribution directorates as a result of restructuring of the electricity sector.

3.3 Public-private competition

The double-dipped subsidies of the oil and gas fuels supplied to the power stations and extremely low electricity tariff to the consumers are inhibiting the drive for businesses and households to seek alternative sources for electricity in one hand, while the high upfront capital cost of the PV panels is making consumers reluctant to switch from the neighborhood generator monthly payment on the other. Besides, solar energy has been further marginalized as the negative externalities such as the health and environmental impacts associated with air pollution through fossil fuel power plants have never factored into the electricity prices in Iraq while at the same time, positive externalities such as the social and environmental benefits

49. TV interview with Minister of Electricity Luay AlKhatteeb, 20/2/2019 (in Arabic), <https://ahlalrafidain.online/ar/index.php/2019-02-19-20-31-36/item/324-2019-02-20-12-57-37>.

50. Istepanian, H (2014), "Iraq's Electricity Crisis", *The Electricity Journal*, May, Vol. 27, Issue 4, pp. 51 – 69.

51. Harry H. Istepanian and Luay Al-Khatteeb (2015), *Turn a Light On: Electricity Sector Reform in Iraq*, The Brookings Institution <https://www.brookings.edu/research/turn-a-light-on-electricity-sector-reform-in-iraq/>.

52. The Ministry of Finance has finalized an easy loan scheme through which the public and private banks are able to finance the capital investment and installation costs for households with roof-top solar units from accredited manufacturers and suppliers https://www.moelc.gov.iq/uploads/attachments/info_1.pdf.

53. Iraq achieved for the first time a peak generation exceeding 20 gigawatts (GW) in summer 2019.

54. AlJazeera.com, <https://www.aljazeera.com/news/2018/07/electricity-cuts-iraq-life-unbearable-summer-heat-18073111220743.html>, (31/7/2018)

of clean energy have been completely ignored. As a result, neighborhood generators and low electricity tariff will remain dominant while the penetration of rooftop solar energy will remain marginal.

3.4 Information & technology access

Limited information on solar energy related information and technology is also prohibitive to project development in Iraq. In June 2018, IRENA developed in coordination with the UNDP and RCREEE integrated a new solar resource of Iraq into IRENA's Global Atlas. The solar map will help to identify Iraq's best solar resources, informing and facilitating renewable energy planning across the country. The map has been very important for showcasing Iraq's potential solar resources, key information about land availability, populated areas and grid access.

The availability of solar data is vital for supporting investor interest and project development. Technical knowledge regarding the potential of mature technologies is also largely unavailable as a result of deficient resource assessment databanks and a lack of understanding about relevant technical and cost considerations. A lack of information regarding energy supply and demand at the dispersed level was hindering commercialization of solar energy affected by a lack of information on durability, reliability and performance of PV panels.

3.5 Capacity building and training

The government hired more than 500,000 new employees since November 2019 in an attempt to appease months of anti-government rallies. Several thousands of the unskilled workers who have joined the Ministry of Electricity should be admitted to apprenticeship programs to become the future workforce for the solar program. At present, there is a lack of both trained personnel and training facilities for the installation, operation, and maintenance of solar energy. Skilled individuals from a wide range of technical

disciplines are required to develop sound and commercially viable industry. Without an adequate indigenous skilled and semi-skilled workforce, a sustainable renewable energy industry in Iraq will be difficult to achieve.

3.6 Social awareness and acceptance

There is a considerable lack of awareness regarding renewable energy technologies and the benefits they can provide to communities. This is largely due to inadequate awareness programs aimed at educating the general public on the advantages of installing rooftop PV panels compared to monthly payment to the neighborhood generators. Practical information regarding the financing from local banks and financial institutions is also limited thereby preventing communities from exploring the option.

4. A Path forward

Iraq's solar energy strategy should be based on attracting foreign direct investments with strong commitment to diversifying its energy mix and to become energy independent bolstered by its willingness to collaborate with international array of local and foreign partners. Iraq's path forward is not, however, free of potential pitfalls. In order to ensure financial support for its solar energy infrastructure, the country should demonstrate both political and economic stability. Doing this effectively will not be easy. Iraq, like other resource-rich frontier markets, will almost certainly attract enormous foreign investments as the battle against bureaucracy, corruption, sectarianism and nepotism continues. If the country proves judicious and capable of channeling investment into key infrastructures, the benefits to the economy will grow exponentially. It is a bold but necessary step for the government to consider transferring subsidies from fossil fuels to renewable energy in order to bridge the competitive gap between them. It is also important to note that the cost burdens and gains of transferring subsidies are shared by both consumers and producers. Another

approach to bridge the competitive gap between renewable energy and fossil fuels is to account for the negative and positive externalities through offsetting some of the revenue from oil and gas toward a renewable energy program. The negative externalities associated with fossil fuel combustion include health and environmental costs and the positive externalities associated with solar energy include reduced air pollution caused by oil fields⁵⁵.

Financing the solar energy will remain the bottleneck for stimulating and encouraging project development in Iraq. Financing arrangements to support investment in solar energy must be developed at the local, national, and international level in order to encourage technology adoption. Aside from government subsidies, innovative funding programs should be developed, particularly for small solar project investors along with entering negotiations with investment banks and international financing institutions for IPP projects.

Iraq's energy policy makers should disengage from political impasses and focus on the future of the energy sector itself and its role in the national economy. Energy security should be emphasized in the first place. In the Iraqi case that is very convincing – for both the government and people. Current investment legislation and energy laws in their current forms are not helping to foster energy security unless several amendments are introduced to correct its many flaws and contradictions. More importantly, it cannot exist on its own without a fresh policy amid the low oil prices that defines the framework under which it should function post oil-based economy. The notion of solar energy in Iraq is more of a want than a need should be reviewed. The country is currently not as motivated to develop alternate energy sources as are other countries in the region, where development of renewable energy development has made substantial

progress towards energy diversification that is likely to pay dividends in the long term.

The answer to strengthening the presence of solar energy in Iraq does not lie in any one solution to these challenges; rather, a holistic approach must be employed. The GoI must take bold steps towards restructuring energy policy in order to increase energy security and move towards a sustainable electricity supply in the future. Primarily, policies should focus on bridging the competitive gap between solar energy and fossil fuels through measures such as subsidy transfers and accounting for negative and positive externalities. Increasing the competitiveness of solar energy alone is not sufficient; issues such as poor transmission and distribution infrastructure, financing and bankability must also be addressed.

The path towards a sustainable energy future in Iraq is by no means simple, but a solution certainly exists. Although a number of approaches have been presented to encourage the growth of renewable energy in Iraq, all of these solutions will undoubtedly require significant effort and dedication on behalf of the government. Iraq must consider the long-term social, economic and environmental benefits of solar energy power generation for its people. Investing in sustainable energy technologies today will pave the road towards a secure energy future for tomorrow.

55. Istepanian, H. (2018), 'Solar Energy in Iraq from Outset to Offset', Iraq Energy Institute, UK, October <https://iraqenergy.org/2018/10/18/solar-energy-in-iraq-from-outset-to-offset/> .

This paper analyses the country's solar energy policy and addresses the barriers for developing the renewable energy system in light of the country's recent turmoil. Green energy, like solar can make a significant contribution to reducing the share of imported energy, buffering oil exports, and reducing the subsidy burden on the government. Although Iraq tends to promote the country's solar energy in two ways: Utility-scale PV units could lead to a reduction in burning of oil and gas, and rooftop solar panels would help individual households reduce their own dependence on "expensive and polluting neighborhood generators". However, there are a lot in between of untapped distributed solutions of small and medium scale solar, which are more than rooftop but less scaled than utility scale such as distributed generation, which has not been addressed so far in Iraq, and could participate in relieving the overload on the national grid, achieve de-centralization, create jobs, develop SMEs, reduce electricity bills on the long-term.

