STUDY

CLIMATE CHANGE, ENERGY AND ENVIRONMENT

A ROADMAP TO PREPARE IRAQS' POWER SECTOR FOR ENERGY TRANSITION

Harry H. Istepanian - Noam Raydan

Reviewed by: Dr Luay Al-Khatteeb

October 2022

→

Iraq federal government's attempts to incorporate renewable energy into the mainstream energy sector, have not been wholly successful due to policy conundrums, ill-designed institutional and governance structures, distorted market mechanisms, and technical challenges, particularly those involving grid connectivity.

→

In this report, the authors present an overview of the status of the electricity sector in federal Iraq with a focus on the key challenges it is facing, before discussing a roadmap towards energy transition, and the major steps that need to be taken for a successful transformation.

→

These will include technical, economic, and legal measures.

مركز البيان للدراسات والتخطيط
Al-Bayan Center for Planning and Studies

FRIEDRICH EBERT STIFTUNG

CLIMATE CHANGE, ENERGY AND ENVIRONMENT

A ROADMAP TO PREPARE IRAQS' POWER SECTOR FOR ENERGY TRANSITION

Harry H. Istepanian - Noam Raydan

Dr Luay Al-Khatteeb

October 2022

https://iraq.fes.de

Table of Contents

Disclaimer

Acknowledgements

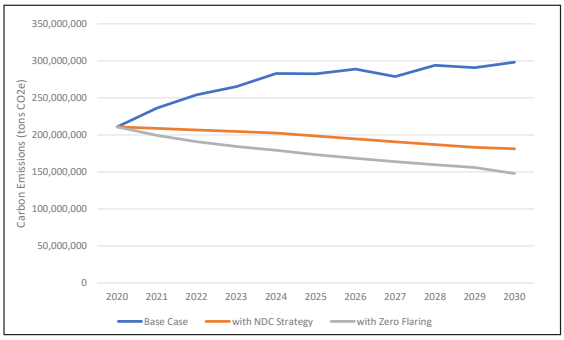
This policy paper was supported by Friedrich-Ebert-Stiftung, Amman. We especially thank Sarah Hepp, the Director of FES Iraq and of the Climate and Energy Project MENA who provided insight and expertise that greatly assisted the research, although Friedrich-Ebert-Stiftung, Amman, may not agree with all of the interpretations/ conclusions of this paper.

Special thanks to Dr. Luay Al-Khatteeb, the distinguished fellow at Columbia University and the former Energy Minister of Iraq for reviewing the work and his valuable comments. Also, we would like to thank Ali Taher, the Director of Al-Bayan Center for Planning and Studies, Baghdad, Iraq for the opportunity to make this work happen.

Excecutive Summary

As Iraq grapples with increasing environmental challenges as a result of climate change, including soaring temperatures, unabating dust storms, and drought, the federal government of Iraq has expressed on various occasions its readiness to transition to clean and sustainable energy. In 2020, the government, and in partnership with the UN Environment Programme (UNEP), launched a process to develop a National Adaptation Plan (NAP) to build the country's resilience to climate change[1]. The plan aims to focus on technology transfer to reduce Greenhouse Gas (GHG) and methane emissions by at least 30 percent from 2020 levels by 2030[2]. The Ministry of Environment, meanwhile, plans to develop a national vision for climate change, including the Nationally Determined Contributions (NDCs)[3] [وثيقة المساهمات الوطنية], and the Framework for their implementation. Being the world's second-worst flaring country after Russia in 2020, Baghdad has also expressed its commitment to utilize associated gas and develop its gas fields for the purpose of reducing its carbon footprint and protecting the environment. Figure 1 shows the variance in carbon emissions under three different scenarios.

Figure 1: Growth of CO2 Emissions of Iraq under Different Scenarios (Authors' analysis)



The various clean energy and environment-focused events which the government has joined so far, may create the illusion that Baghdad is already on a serious path towards energy transition. However, talking about energy transition before preparing the relevant policies and regulatory framework to ensure its success, puts the cart before the horse.

In the power sector, which is the focus of this report, the government's attempts for instance to incorporate solar energy into the mainstream energy sector, have not been wholly successful due to policy conundrums, ill-designed institutional and governance structures, distorted market mechanisms (e.g., poor quality products), and technical challenges, particularly those involving grid connectivity.

In this report, the authors present an overview of the status of the electricity sector in federal Iraq with a focus on the key challenges it is facing, before discussing a roadmap towards energy transition, and the major steps that need to be taken for a successful transformation. These will include the following detailed technical, economic, and legal measures (Figure 2):

1) Increase investment to immediately improve the distribution network, while focusing on increasing generation, including renewable sources, particularly solar energy;

2) Draft and pass the necessary laws that focus on engaging low-carbon investment, and environmental protection;

3) Expand and increase the reliability of electricity supply (e.g., SAIDI, SAIFI, CAIDI)[4];

4) Increase energy efficiency and energy conservation, including the development of energy service companies;

5) Improve electricity sector good governance and performance via a clear separation of duties and functions of enterprises owned by the Ministry of Electricity (MOELC);

6) Establish an independent energy market and transmission system operator, and encourage a gradual move to cost recovery tariffs through full commercialization of the electricity sector; and

7) Develop funding policies and financing schemes that include targeted subsidies and routinely adjusted electricity rates.

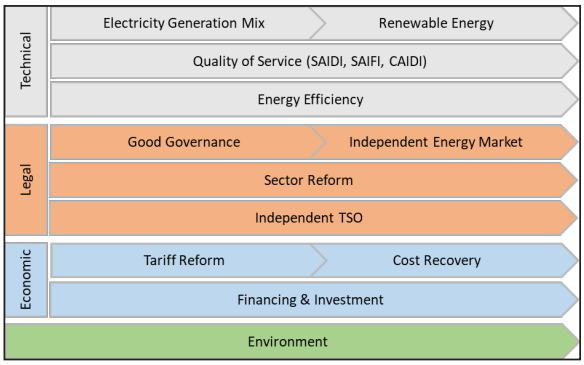
1. UNEP (2020), Iraq launches National Adaptation Plan process for climate change resilience.https://www.unep.org/news-and-stories/press-release/iraq-launches-national-adaptation-plan-process-climate-change

2. The Climate and Clean Air Coalition (2022), Iraq Includes Methane in its Nationally Determined Contributions, Citing Health and Development Benefits. https://tinyurl.com/2nrw7uf8

3. The United Nations defines an NDC as "a climate action plan to cut emissions and adapt to climate impacts. Each Party to the Paris Agreement is required to establish an NDC and update it every five years". https://tinyurl.com/2frxnxrz

4. SAIDI = System Average Interruption Duration Index. It is the minutes of non-momentary electric interruptions, per year, the average customer experienced. SAIFI = System Average Interruption Frequency Index. It is the number of non-momentary electric interruptions, per year, the average customer experienced. CAIDI = Customer Average Interruption Duration Index. It is average number of minutes it takes to restore non-momentary electric interruptions.

Figure 2: Government Key Strategic Areas



To gradually achieve these measures, Iraq will require international technical and financial support, with a major contribution from the private sector and foreign investors. Public investment in Iraq depends directly on public finance, but there is significant scope to reduce overall costs for government by leveraging private finance. This, however, will require an attractive investment environment, which until now remains lacking in federal Iraq.

Acronyms

SAIDI	System Average Interruption Duration Index
AT&C	Aggregated Technical & Commercial
ADB	Asian Development Bank
BTU	British Thermal Unit. There are approximately 3,412BTU in 1kWh of energy
CO2e	Carbon Dioxide Equivalent
CO	Carbon Monoxide
CBI	Central Bank of Iraq
CCGT	Combined-Cycle Gas Turbine
CoR	Council of Representatives
CAIDI	Customer Average Interruption Duration Index
FDI	Foreign Direct Investors
GSA	Gas Supply Agreement
GHG	Green House Gases
GDP	Gross Domestic Product
IPP	Independent Power Producers
IFC	International Finance Corporation
IQD	Iraqi Dinar
INDCs	Intended Nationally Determined Contributions
LCOE	Levelized Cost of Electricity
MW	Mega Watt
MWp	Mega Watt Peak
MWh	Mega Watt-hour
Mt	Metric tons
mmscf	Million Standard Cubic Feet
MOELC	Ministry of Electricity
MoO	Ministry of Oil
NAP	National Adaptation Plan
NDC	Nationally Determined Contributions
NOx	Nitrogen Oxides
R&D	Research and Development
RTPV	Rooftop Photo Voltaic
SOE	State Owned Enterprises
SAIFI	System Average Interruption Frequency Index
TOP	Take-Or-Pay
tscf	Tera Standard Cubic Feet
COP26	The 2021 United Nations Climate Change Conference

IEA	The International Energy Agency
IMF	The International Monetary Fund
IRENA	The International Renewable Energy Agency
UNFCCC	The United Nations Framework Convention on Climate Change
UNEP	UN Environment Programme
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
$US	United States Dollar
EIA	US Energy Information Administration
WBG	World Bank Group

1. Background

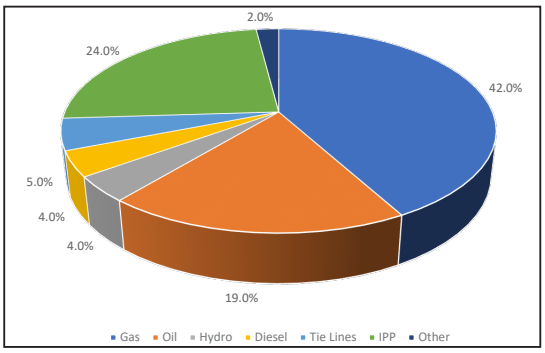
Electricity generation in Iraq is heavily dependent on fossil fuels, with thermal power stations consuming approximately 22 million tons of liquid and gas fuels in 2020 (Table 1).

Table 1: Fuel Consumption for Electricity Generation in 2020 (Source: MOELC, authors' Analysis)

Fuel Type	Quantity (tons)
Natural Gas	12,847,384
Crude Oil	634,866
Fuel Oil	3,050,408
Gas Oil	5,387,059
Total	21,919,717

The contribution of hydroelectricity is quite low, standing at around 4%, despite the presence of the two main rivers of Tigris and Euphrates, while the share of renewable energy, such as biomass, solid waste, solar, and wind energy of total generation remains negligible, notwithstanding the vast potential for renewable resources, particularly solar energy (Figure 3).

Figure 3: Generation Mix (2022) [Date Source: MOELC]



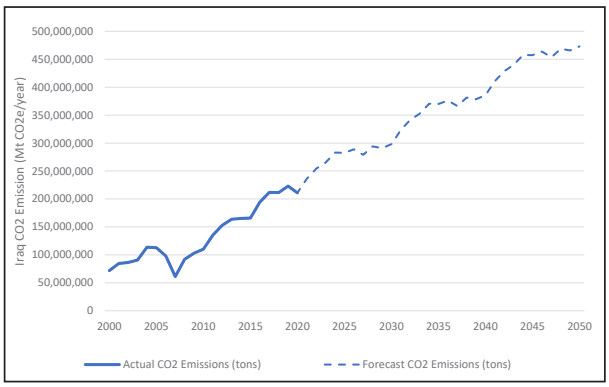
Although Iraq is considered a relatively low emitter of CO2 (with per capita emission of 5.24 metric tons in 2020) compared to some other countries in the region (Table 2)[5], the increase which the country experienced in recent years is alarming. Carbon emissions from Iraq's overall energy sector jumped from 71.7 million Mt CO2e in 2000 to 210.8 million Mt CO2e in 2020, and based on the expected growth in emissions, this amount is likely to increase to 472.9 million Mt CO2e by 2050 (Figure 4).

Table 2: Annual CO2e per Capita

Country	Annual CO2 Emissions [metric tons per capita]
Qatar	37.02
Kuwait	20.83
Bahrain	20.55
Saudi Arabia	17.96
UAE	15.19
Oman	12.17
Iran	8.87
Iraq	5.24

(Data Source: Our World in Data)

Figure 4: Iraq's Actual and Forecast of CO2 Emissions (2000 – 2050)



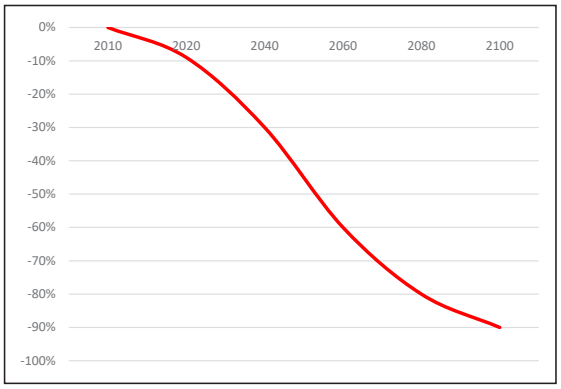
[Source: WBG, Authors' analysis]

Federal Iraq's talk of transitioning to clean energy comes amid an ever-growing consumption of fossil fuels and associated gas flaring which has been contributing to the drastic climate change's effects across the country. Iraq is classified as the fifth most vulnerable country in the world to climate change according to the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA)[6].

Over the past years, the country has suffered from prolonged heat waves, erratic rainfall, desertification, drought, and extreme water shortages[7]. If these changes are not mitigated through sound planning, they will impact the country's GDP in the long term. According to a study published by Stanford University, Iraq's GDP per capita will decline -93% by 2100 due to climate change (Figure 5)[8].

Figure 5: Projected Impacts of Climate Change on Iraq's GDP per capita until 2100

6. UNEP (2019), Global Environment Outlook 6: https://tinyurl.com/2pqf4rrz
7. WBG, Climate Change Knowledge Portal: https://climateknowledgeportal.worldbank.org/country/iraq
8. Stanford University, Economic Impact of Climate Change on Iraq: https://web.stanford.edu/~mburke/climate/map.php



(Source:https://web.stanford.edu/~mburke/climate/map.php)

Additionally, the heavy reliance on fossil fuels, and the ongoing gas flaring, particularly in southern Iraq where key oilfields are located, will impede federal Iraq's climate action plan—through the Nationally Determined Contribution (NDC)— to cut GHG emissions and adapt to climate impacts[9]. The voluntarily commitment of Iraq in 2021 to the Paris Agreement was to cut 1-2% CO2-equivalent emissions from its industry and open a window for US$100 billion investment in green economy, from both the private and public sectors over the next 10 years[10].

Federal Iraq's commitments to green and clean energy sound encouraging. However, in the power sector, which is the subject of this report, they can hardly be realized considering the country's inherited and poor electrical infrastructure. For instance, the national grid in its current condition, cannot withstand additional and substantial supply from any potential clean energy projects, and the transmission and distribution networks must be upgraded to control the heavy technical and non-technical losses. Without these improvements, Iraq won't be able to successfully transition to clean energy in the next decades.

Understanding all these challenges and how they can gradually be resolved is of crucial importance before exploring the landscape of green and clean energy. The following sections will examine the above-mentioned challenges and others in detail before presenting a roadmap for energy transition.

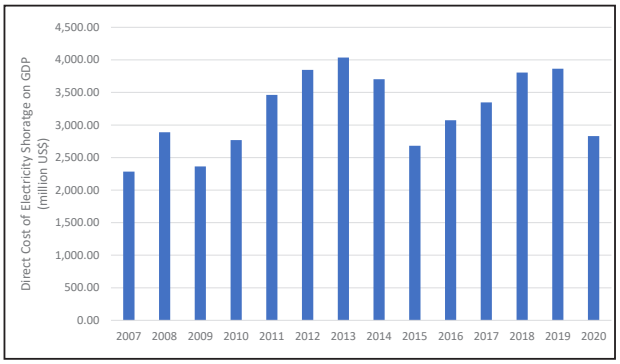
9.UNDP:https://www.undp.org/arab-states/press-releases/iraq-reaffirms-commitment-climate-action-under-paris-agreement-draft-nationally-determined-contributions-document

10. UN-Iraq (2021), As Iraq joins Paris Agreement, UN calls for further support to help the country adapt: https://iraq.un.org/en/161240-iraq-joins-paris-agreement-un-calls-further-support-help-country-adapt

2. Current Status of the Electricity Sector

Power demand in federal Iraq increased significantly after 2003 due to limited but considerable economic development and population growth. Power supply, however, has been insufficient, leading to acute power outages that have affected the lives of millions of citizens, and slowed down economic development (Figure 6). Having to endure prolonged power cuts— that could last for over 12 hours per day— many businesses and industries have been shut down, leading to limited local production, and worsening unemployment, especially among the youth[11].

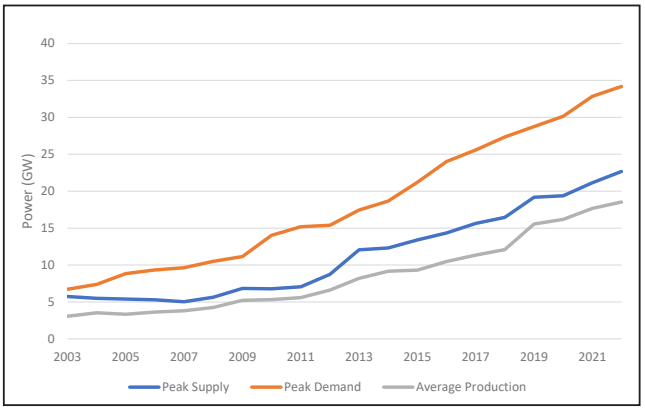
Figure 6: Direct Cost of Electricity Shortage on Iraq's GDP (2007 – 2020) (Authors' analysis)



Electricity services in federal Iraq have remained abyssal despite the increase in power generation over the past years. For instance, although federal Iraq's design capacity is 37,149 Megawatts (MW), the government failed to produce more than 22,250 MW in July 2022, while peak daily electricity demand was at 36,560 MW[12].

In view of the ever-growing supply-demand gap (Figure 7), Iraqi citizens experience daily acute blackouts, particularly during peak summer months when temperatures climb to around 50 degrees Celsius. To make up for these shortages, many consumers have become dependent on pricey power services supplied by polluting and unreliable[13] neighborhood diesel generators—mostly run by groups or individuals connected to political parties.

Figure 7: Iraq Electricity Peak Supply and Demand (2003 – 2021)



[Data Source: MOELC, Author's analysis]

Although generation capacity has improved in the last few years, due to the participation of the private sector[14], this has not been commensurate with improvements to the transmission and distribution networks.

During the period 2013 – 2018, government-owned generation companies produced 510,093,531 MWh, yet distribution companies, which are also owned by the government, managed to sell only 249,713,758 MWh to consumers due to dilapidated transmission and distribution networks. The estimated cost of the Aggregated Technical & Commercial (AT&C) losses exceeded $6.25 billion, leaving the treasury with heavy losses amid a lack of cost-recovery measures in the electricity sector [15].If no immediate action is taken to address this financial waste, the power sector's expenditures are expected to reach US$ 170 billion[16] (base case) by 2050[17]. This is exactly why former Finance Minister Ali Allawi warned in December 2021 that the power sector would have devastating impact on the state's budget in the next few years if the relevant authorities did not carry out urgent reforms[18].

Iraq's capital expenditure in the electricity sector was close to US$ 40 billion during the period 2007 – 2021, amounting to around 50% of the total federal budget

11. According to the World Bank Group, Iraq has the world's youngest population and a youth unemployment rate of 25.2 percent as of 2020: https://trendsresearch.org/insight/covid-19-and-the-youth-unemployment-challenge-for-iraq-and-lebanon/

12. Iraq imports about 1.4 GW from Iran, and natural gas to generate another 5.5 GW, but electricity and gas imports from Iran are often interrupted over payment issues complicated by U.S. sanctions, as well as domestic shortages within Iran.

13. Some owners of generators can suddenly decide to turn off supply due to insufficient fuel for instance, or new fuel prices, forcing many households to wait for the government's power service which usually lasts for a few hours.

14. The independent power producers collectively generate 8,809 MW which accounts 24% of total generation capacity in 2022.

15. The average price of electricity in Iraq is 0.024 US$/kWh for households and 0.041 US$/kWh for businesses (Source: Iraq Energy Institute (2020), Residential Electricity Subsidies in Iraq: Exploring Options for Reform: https://tinyurl.com/2jphs43e

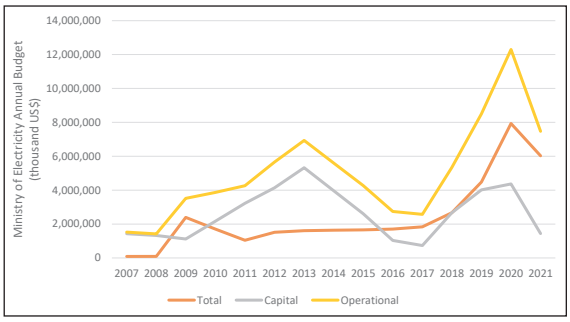
16. At today's US dollar value.

17. The estimate is based on the following assumptions, current and future electricity generation mix (40% gas fired, 19% oil-fired, 4% diesel,33% Solar) to generate 71,048 MW by 2050. The capital cost of different technologies: https://www.e-education.psu.edu/eme801/node/530

18. Ali Allawi's speech in December 2021: https://www.youtube.com/watch?v=zUowbqKPp7w

(Figure 8). During the same period, Baghdad also spent at least US$ 14 billion on imported electricity and costly oil products for power production, including natural gas imported from Iran since 2017. Yet, despite billions of dollars spent on electricity generation, the power sector continues to hamstring economic development.

Figure 8: Iraq Electricity Annual Budget (2007 – 2021)



[Data Source: Iraq Ministry of Finance, Authors' analysis]

In addition to major transmission & distribution losses, the decades-long electricity crisis in Iraq has also been blamed on inadequate fuel supply, lack of sufficient funding, burgeoning subsidies, poor bill collection, low tariffs, and inaccurate forecasting[19]. The root of the problem, however, lies in failed energy policies and poor governance due to vertically integrated monopoly that has led to inefficient operations and financing constraints, hampering any efforts to resolve the chronic power shortages (Appendix A shows the schematic of Iraq's current electricity sector).

The following sections will go over the key existing challenges in the electricity sector, before discussing energy transition and what needs to be done from the part of the government to ensure its success.

2.1. Delays in Developing Gas industry and Reliance on PNG for Power

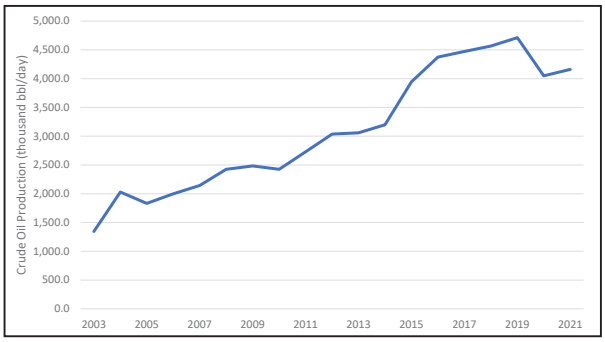
Although Iraq is home to the 12th largest gas reserves in the world, its gas industry has failed to match its production with the rapid growth in demand for electricity (Table 3). Federal Iraq currently produces only 43% of natural gas for domestic use, with the increase in domestic gas production expected to remain between 5 – 7% (compared to 4.6% per year during the last decade), based on the authors' analysis.

Table 3: Natural Gas Consumption in 2020

Source	Volume (mmscf/year)
Domestic Gas	285,408.8
Imported Gas (Central pipe)	226,388.2
Imported Gas (South pipe)	155,335.6
Total	667,132.5

(Source: MOELC, authors' analysis)

The domestic gas supply has failed so far to address the issue of energy security. The development of domestic oil-associated gas and dry gas fields appears to be easy to accept theoretically, but in practice it is complicated due to the Ministry of Oil's concentration on increasing oil production more than capturing associated gas (Figure 9).



[Data Source: BP, MoO, Authors' analysis]

Since 2008, federal Iraq has conducted a series of oil and gas licensing rounds with the government's strategy focused on increasing its oil reserves and raising oil production from 1.34 million barrels per day (bpd) to 4.7 million bpd in 2020. Meanwhile, two of the main Iraqi non-associated gas fields awarded in the 3rd bid round (2010), Akkaz (عكاز) and Mansuriyah, (المنصورية) have yet to be developed partly due to security issues. Table 4 shows the potential gas production which Iraq is planning to add in the next several years.

Table 4: Potential increase in the gas production (2022 onward)

Gas Field	Potential Production (mmscf/day)
Akaz	388.0
Mansuriya	320.0
Fifth Round (Enjana, (Khashim Ahmer	250.0
Artawi	300.0
Basra Gas	400.0
Halfaya	300.0
Nasriya Gas	200.0
TOTAL	2,158.0

[Data Source: MoO]

19. Istepanian, H. (2014), Iraq Electricity Crisis, Electricity Journal, May, Vol. 27, Issue 4, pp. 51 – 69.

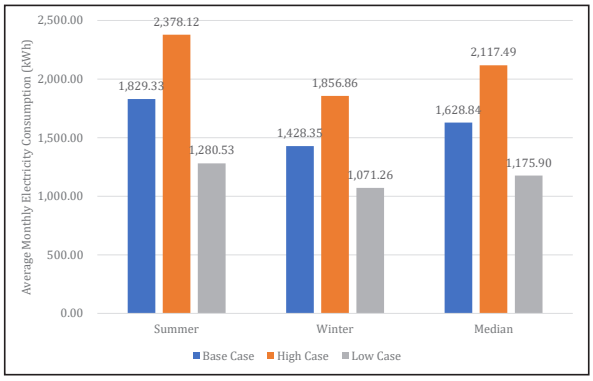
The delay in taking advantage of its own gas resources, has left federal Iraq dependent on Iran for natural gas. Demand for piped natural gas increased from 1,060 mmscf/day in 2017 to 1,940 mmscf/day in 2022[20], with the annual cost expected to exceed US$ 4 billion for an annual import ranging between 6 – 7 billion tons of Iranian gas. These figures show that purchasing gas from Iran for electricity generation is an uneconomical option, yet the federal government continues to rely on it.

2.2. Unreliable Public Supply and Neighborhood Generators

Iraq's economy is considered one of the fastest growing in the Middle East, according to a recent report by the IMF[21], with a GDP of US$ 220 billion in 2021 and an average GDP per capita of about US$ 4,145.9 (2020). The increase in the demand for electricity is expected to reach above 70,000 MW by 2050 due to economic and population growth. Yet, and although more than 95% of Iraqis have access to electricity to a greater or lesser extent, they suffer from frequent and extended power outages. Even when electricity is available, fluctuations in voltage and frequency during peak demand hours have become the norm in most areas in federal Iraq.

The median electricity consumption (base case) for households is 1,628.8 kWh per-month in the main load centers, such as Baghdad and Basra. The median of the low case is 1,162 kWh per month, which is an extremely low level of consumption, even for low-income residential consumers. Figure 10 shows the average monthly electricity consumption for middle-high income households in federal Iraq, knowing that consumption could hit as high as 3,000 – 3,500 kWh/month during peak demand periods.

Figure 10: Average monthly electricity consumption for middle-high income households



(Source: Iraq Energy Institute)

The unfair distribution of electricity supply among high and low-income areas has been widely criticized. There are a total of 4,335,261 (2019) consumers in Iraq, including 3,633,932 households and an additional one million units in slums—which are deprived of basic services, including electricity.

The lack of reliable and consistent electricity from the government has given rise to a vast network of neighborhood generators. Such generators supply households through small diesel-run generators (typically between 100 – 500 kVA) with isolated distribution web of wires (Photo 1) to operate household's essential loads, such as light bulbs, fans, and small appliances[22] when public power supply is unavailable[23].

Although this network of generators constitutes an informal electricity sector, its clout cannot be ignored (see Section 2.7). The annual revenues of neighborhood generators in 2018 reached around $ 4 billion, according to the International Energy Agency (IEA), a sum that was "equal to the amount allocated to electricity sector in the federal budget for capital expenditure in 2019".[24]

20.More than 35% of the consumed fuel were in the form of imported gas from Iran.

21. According to the IMF Report (April 2022), "World Economic Outlook. War Sets Back the Global Recovery", Iraqs economy is forecast to grow by 9.5 percent in 2022, giving it the fastest real GDP growth of all the Middle East and Central Asia countries. The 2023 expectation of 5.7 percent is just one percentage point behind Georgia, the expected leader next year. Meanwhile, consumer prices are expected to rise by 6.9 percent this year and 4.7 percent in 2023. https://www.imf.org/en/Publications/WEO/Issues/2022/04/19/world-economic-outlook-april-2022

22. Operating air-conditioning is tricky when using power supplied by neighborhood generators. Iraqi citizens usually pay around 25,000 Iraqi Dinar per 1 Ampere, and yet a household cannot sometimes operate two ACs at the same time. Additionally, many households that consume 10 Ampere, cannot operate their electric water boilers when using power supply from generators. This usually turns into a major issue during the cold months of winter.

23. Al-Wakeel, Ali. (2021). Local Energy Systems in Iraq: Neighborhood Diesel Generators and Solar Photovoltaic Generation. 10.5772/intechopen.95280.

24. Iraq's Energy Sector: A Roadmap to a Brighter Future, International Energy Agency (IEA), April 2019: https://www.iea.org/reports/iraqs-energy-sector-a-roadmap-to-a-brighter-future

Photo 1: Iraq neighborhood electricity supply wires

2.3. Peak Demand Shortage

Peak demand period is that time of the year (mainly from June – September and November – January) when demand for electricity or consumption of electricity reaches the highest levels. Normally, this coincides with a dry and hot summer, and cold winter.

Given that Iraq's population is growing at a rate of 2.4% annually[25], the peak demand for electricity is bound to increase and expand in duration. Figure 11 shows that the peak demand for electricity during Summer 2022 was over 30,000 MW with technical losses estimated at more than 2,000 MW. Meanwhile, the electricity deficit during peak demand has been a whopping 14,311 MW in 2022, an increase from around 3,661 MW in 2003 (Table 5).

Table 5: Electricity Demand and Production in 2022 according to the Regions

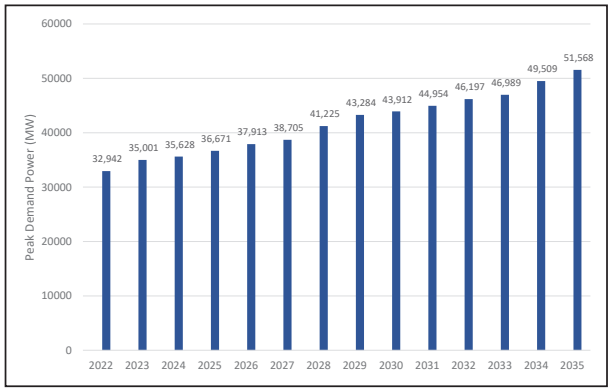
Region	Available Generation (MW)	Load Demand (MW)	Total Generation Demand (MW)	Shortage in Load Demand (MW)	Shortage in Generation Demand (MW)
Northern	2,130	6,150	6,765	4,020	4,635
Middle	9,355	13,713	13,850	4,358	4,495
Middle Euphrates	3,680	6,660	7,360	2,980	3,680
Southern	7,085	10,038	11,041	2,953	3,956
Total	22,250	36,561	39,016	14,311	16,766

(Source: MOELC, Authors' analysis)

25. The World Bank data: https://data.worldbank.org/indicator/SP.POP.GROW?locations=IQ

The growing need for peak power is expected to climb over 51,500 MW by 2035 (Figure 11), and if the government wants to keep pace with this growth, it is required to add 28,500 MW in power generation.

Figure 11: Forecast of Annual Peak Demand for Power (2022 – 2035)



[Authors' analysis]

2.4. High Operating Cost

The bloated operational cost (including fuel cost) is among the several reasons for the high cost of electricity production in Iraq. In 2018, the average cost for fossil fuel power generation in Iraq was 7.40 US¢/kWh (Table 6), which is above the average global operating cost for combined-cycle power plants[26] (3.4 US¢/kWh)[27].

Table 6: Average Costs for Thermal and Gas Turbine Power Station (2018)

Cost Type	Cost (US¢/kWh)
Fuel	2.23
Operation and Maintenance	4.72
Salaries	0.45
Total	**7.40**

[Source: MOELC, Authors' analysis]

As Table 7 below shows, fossil fuel-fired power stations in Iraq tend to have total operational costs that are extremely sensitive to changes in fuel prices which in their turn are heavily subsided.

Table 7: Fuel Costs

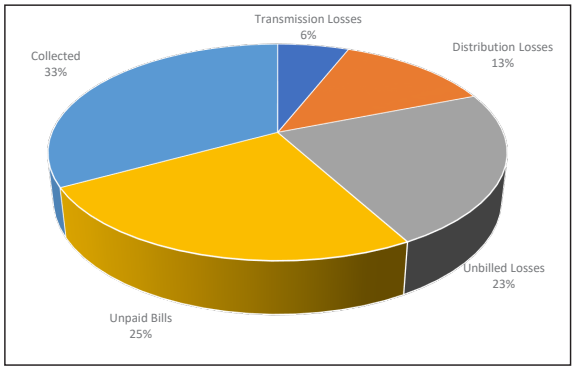
Fuel Type	Unit	Ministry of Oil Price (US$/ Unit)	US Price (US$/ Unit)
Natural Gas	M3	0.041	0.128
Gas Oil	M3	0.357	0.5
Fuel Oil	Liter	0.083	0.1
Crude Oil	Barrel	0.92	70.89[28]

(Source: MOELC)

2.5. High Aggregated Technical and Commercial losses

The Aggregated Technical and Commercial (AT&C) losses represent the percentage of power produced by the MOELC-owned distribution companies for which the ministry does not receive payment. The electricity network in Iraq suffers from astronomical AT&C losses, which amount to around 58 - 62%. While some proportion of this loss is inevitable due to physical factors (use of poor-quality equipment and aging distribution networks), the commercial losses are mainly caused by theft, lack of metering, and poor electricity bill collections (Figure 12).

Figure 12: Transmission and Distribution AT&C



(Source: MOELC, authors' analysis)

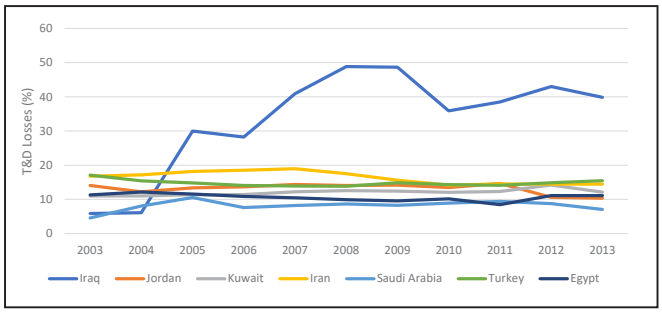
On the issue of collecting electricity bills, and despite the government's efforts to increase the collected revenues from consumers over the past years—by hiring private companies— the reduction in AT&C losses has remained slower in Iraq than in neighboring countries, where the AT&C losses on an average are about 10-15% (Figure 13).

26. A combined-cycle power plant uses both a gas and a steam turbine to produce up to 50% more electricity from the same fuel than a traditional simple-cycle plant : https://www.ge.com/gas-power/resources/education/combined-cycle-power-plants

27. IRENA (2020), Renewable Power Generation Costs in 2021: https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021

28. Average Brent Oil price in 2021.

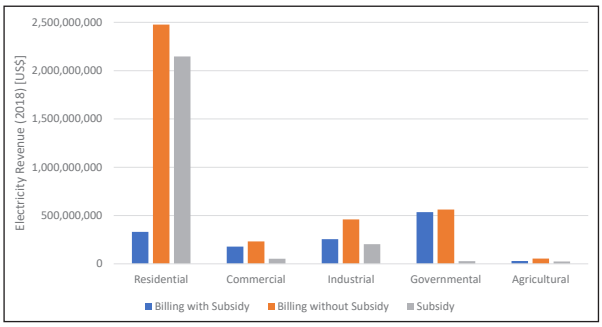
Figure 13: Iraq T&D Losses Compared to neighboring countries (2003 – 2014)



[Source: WBG, Authors' analysis]

The MOELC's collected revenues from selling electricity to consumers[29] was US$ 1,329.2 million in 2018, while government subsidies exceeded US$ 2,456 million (65%) for 39,153,4 MWh sold[30]. The aggregated book losses (on accrual basis) of the MOELC exceeded 7,498.5 million in 2018 alone, a loss which is generally absorbed by the treasury. This financial waste[31] turns the MOELC-owned enterprises into a heavy burden that relies on state subsidies, and on the ministry of finance for funds while lacking effective cost-recovery methods.

Figure 14: MOELC Electricity Revenue in 2018

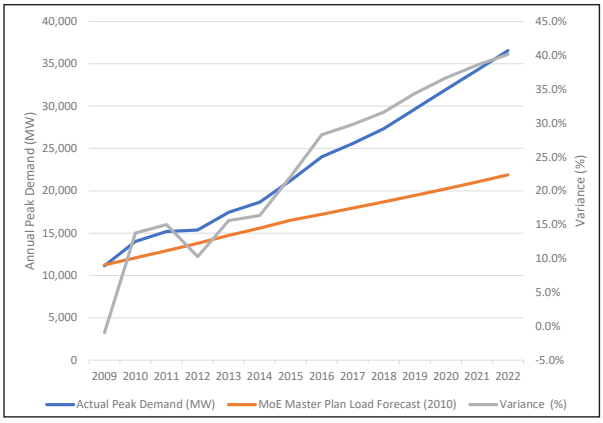


Curbing losses and improving collection rates will have a dramatic impact on the MOELC's revenues, and will reduce government subsidies (Figure 14). Considering the current losses in the electricity sector, and to fully recover costs, the tariff, which has not been revised for decades to reflect the periodic increase in cost of living, or the hike in fuel prices, would need to be set at around US¢22.5/kWh of units sold. However, if AT&C were reduced to 10%, and bill collections increased to 95%, the cost recovery tariff would fall to about US¢9.2/kWh, a rate that is close to the current average tariff. If the high system losses are not curbed, the power sector is expected to require an operating subsidy of about US$9.0 billion per annum (ECA, June 2017).

2.6. Lack of Accurate Demand Forecast

There has been a major flaw in forecasting electricity demand since the MOELC's 2010 Master Plan was released in 2010. The variance between the actual and forecasted demand reached more than 40% in 2020. Improving forecasting methods to determine future demand would help the MOELC devise plans for power production and distribution in such a way that power outages would be minimized. The peak demand as forecasted in the MOELC Master Plan (2010) versus the actual for the period 2009 – 2022 is shown in Figure 15.

Figure 15: Actual and Forecast Peak Demand (2009 – 2022)



[Source: MOELC, Authors' analysis]

Long-term planning for power production and distribution must factor-in the demand-side variations, and alternative energy sources to meet or adjust the supply side factors affecting the power sector.

2.7. Corruption in the Electricity Sector

Corruption is pervasive in Iraq's electricity sector, affecting services to citizens, projects to develop the electrical infrastructure, and efforts to reform this vital sector.

The interference of political parties is one of many forms of corruption, which has transformed the ministry of electricity from an institution that's supposed to provide reliable services to society and contribute to economic development, into a source of revenues for influential factions. Unfortunately, this is generally known even among electricity sector employees themselves. Therefore, and in such an environment rife with corruption, successful

29. The only group that is amenable to payment is the governmental and commercial sector which represents 14% of total consumers.

30. The federal budget for the Ministry of Electricity in 2018 was US$ 8,827.5 million excluding the foreign loans, fuel subsidy by the Ministry of Oil and cost of electricity and fuel imports from Iran.

31. Iraq produced 5,100,935,311,000 kWh during the period 2003 – 2018. Taking an average electricity tariff for all categories at 2.74 US¢/kWh, the government should have been able to collect a total revenue of more than US$ 13.9 billion from selling electricity.

projects that can positively contribute to the economy and the country in general, can hardly be realized.

The disruptive and destructive role some political parties play for instance was evident when they opposed government plans to hire private companies to collect bills in return for consistent electricity supply[32]. Political parties perceived such schemes as an attempt to cut consumers' reliance on a network of private generators in which they have vested interests. Political parties also control how some electricity projects are awarded, a process which involves cash payments that constitute bribes.

All the above-mentioned challenges have been stalling the development of Iraq's electricity sector which can hardly take the path towards energy transition before undergoing the required reforms. For that reason, the next chapters examine federal Iraq's announced commitments so far towards energy transition, and the necessary conditions for achieving this.

32. Mawlawi, Ali. (2020). Public Sector Reform in Iraq, Catham House: https://www.chathamhouse.org/2020/06/public-sector-reform-iraq-0/about-author

3. Energy Transition: Current Challenges

In October 2021, the federal government announced its plan to reach 33% of clean energy production by 2030, with more than 6,000 MW coming from solar sources[33]. The country's current solar generation capacity does not exceed 300 MW.

The UAE's renewable energy developer Masdar reached an agreement with Baghdad to build four solar projects in Iraq with a total capacity of 1,000 MW. The projects are divided between 450 MW in the DhiQar governorate, 100 MW and 250 MW in Ramadi, 100 MW in Amara, and 100 MW in Mosul. The Ministry of Electricity also announced that it had reached an agreement with the Saudi Company ACWA Power to build 1,000 MW solar power project in the Najaf governorate[34]. Although these deals would contribute to Iraq's efforts to start shifting its energy sector to clean energy, it is worth noting that they were motivated by regional politics, and it is unclear if such agreements will be implemented.

Iraq has also concluded several other deals with companies outside the Gulf region for solar projects, notably with France's TotalEnergies and PowerChina (See Table 8).

However, the list of government plans for solar projects will unlikely come to fruition before at least 2025. Although the government does appear to be more serious this time around about solar power, the current political paralysis gripping the country has put all such plans on hold, and it remains to be seen how any future government will proceed with the projects.

Table 8: Planned Solar Projects (2021)

Project	Capacity (MWp)
Power China Solar PV Park[35]	2,000
Chinese Firms, Muthana (130 (MW, 500 MW	630
TotalEnergies, Artawi Solar Park, Basra	1,000
Masdar (450 MW Dhi Qar, 350 MW Ramadi, 100 MW Amara, (100 MW Mosul	1,000
ACWA Power	1,000
MOELC (7 locations including (Contract with Scatec	755
(UNDP (residential PV	5
Total	6,390

[Source: News agencies]

Moreover, if the federal government wants to successfully achieve such a transition, it will have to focus on addressing several technical, legal, and financial issues to curb the challenges that will most likely interfere with its attempts to transform Iraq's fossil fuel-based power sector to renewables. The sections below look into how the federal government has been approaching the issue of energy transition, and how some issues will affect its plans for clean energy if left unresolved.

3.1. Outdated Grid Infrastructure and T&D Losses

Most of the talk about renewable energy in Iraq, namely solar energy, misses the most important question: how will the national grid, in its current poor condition, absorb additional volumes of power?

The national grid has not been revamped technologically where it can absorb thousands of megawatts of solar energy due to its variability and intermittency. For this reason, the national grid cannot evacuate large volumes of non-dispatchable power without energy storage facilities.

Scaling up variable generation would require grid expansion and upgrades so that power systems can access high-quality solar resources. Technically, there is a limit on how much variability the existing power system can handle in terms of voltage and frequency variability.

Additionally, investments in the T&D (transmission and distribution) sector are highly overshadowed by investments in the power generation. Any serious transformation to clean energy, however, will require developing the T&D networks in faster paces to meet additional generation capacities from renewable sources.

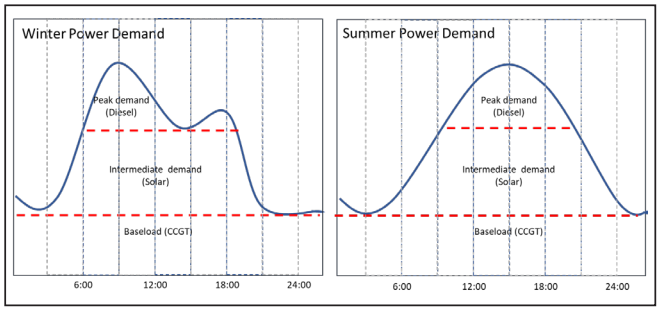
3.2. Solar Power and Baseload Demand

Traditionally, the baseload of Iraq's power system has been covered by oil and gas-fired power plants. These plants are characterized by high capital and fuel costs (and they are the main source of carbon emissions). Iraq will still need to have fossil fuel-fired power stations, mainly combined-cycle gas turbines, to provide the baseload generation, while peaking power plants from the solar PV power stations will meet the demand for electricity

33. Iraq in negotiations with foreign companies to produce 12,000 MW of clean energy: https://tinyurl.com/2zsak48m
34. Gulf solar projects, including those led by ACWA and Masdar, have achieved world-record low-priced power purchase agreements; around 1 cent to 1.5 cents per kilowatt hour. The bid price for the bigger Scatec plant was about 3.6 cents per kWh, which reflects the higher risk in these projects than in the Gulf. These higher risks relate to the better-established track record of GCC countries in power purchase agreements as well as their stronger credit ratings and lower security risks compared to Iraq.
35. Iraq News (2022), China to construct two solar power projects in southern Iraq: https://www.iraqinews.com/iraq/china-to-construct-two-solar-power-projects-in-southern-iraq/

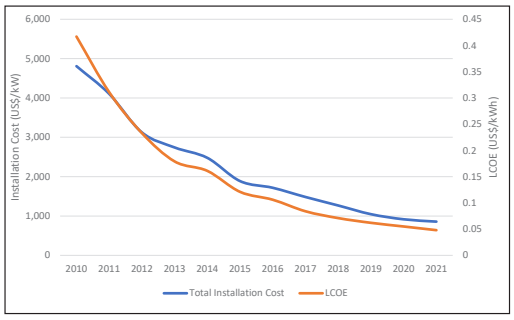
throughout the day (Figure 16)[36].

Figure 16: Typical daily variation in power demand in Iraq during winter and summer months



It is difficult for the Iraqi power system to rely only on low-capacity factor solar PV to meet constant electricity needs without an effective energy storage system in place[37]. It is also unfeasible now to rely only on renewables to meet constant electricity needs, especially for power systems with a large deficit like Iraq. Thus, the economics for the baseload in Iraq's case suggests that the natural gas should be available continuously, which appears to be the most viable option (Figure 17).

Figure 17: Global Weighted Average Installation Costs and LCOE for PV, 2010-2021



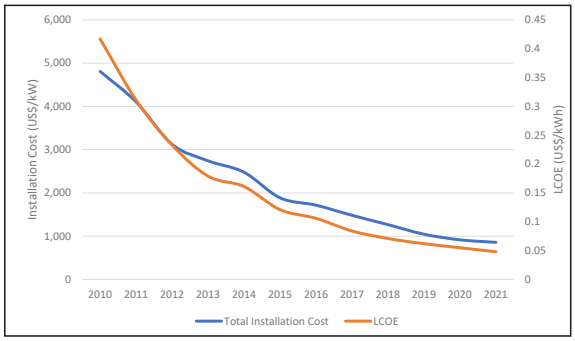
(Data Source: IRENA)

3.3. Cost of Generation

Although the cost of renewables decreased remarkably in the past decade (Figure 18)[38], Iraq's energy sector is driven in a way that costs are always rising due to the high risks of investment in the country. Geopolitical risks, political instability, and the volatile security climate are always adding to the costs of supply chains, logistics, and other related issues. These are among the reasons why some regional investors requested over the past few years a tariff that is five-folds higher than the tariff of the world's largest solar power project, the 2GW Al Dhafra Solar PV project (USD 1.35 cents/kWh) in Abu Dhabi, UAE[39].

For instance, in 2018, the Saudi Arabian energy conglomerate, ACWA Power, proposed to build two solar power stations, 1,000 MW each, in Saudi Arabia and Iraq. The Levelized Cost of Energy (LCOE) for the Iraq-based project was US¢ 6,5 per kWh compared to US¢ 1.65 per kWh for the Saudi-based one.

Figure 18: Global Weighted Average Installation Costs and LCOE for PV, 2010-2021



(Data Source: IRENA)

3.4. High Costs for Replacing Oil-Fired Plants

Most of the large oil-fired power plants in federal Iraq were built more than thirty years ago (except Wasit thermal power station)[40], with an estimated efficiency of a mere 30%, which is way below the average level of other types of electricity generation. The cost of subsidized fuel for oil-fired plants in Iraq is within a range of 0.64 – 2.43 US¢/kWh (lowest is Wasit and highest is Baghdad South

36. Solar energy has low-capacity factor (15-19%), which makes the grid more susceptible to potential interruptions or drops in performance. Solar technologies are notoriously weather-dependent, and they have the lowest capacity factor compared to nuclear power (90.3%) and gas turbine (42.5%) systems—which are most advantageous when operated continuously and at full load: https://www.e-education.psu.edu/eme807/node/667

37. The capacity factor for Solar PV is 16% compared to other renewables and fossil-fuel power generation [Source: IRENA (2021), Renewable Power Generation 2020, p.11: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Jun/IRENA_Power_Generation_Costs_2020.pdf

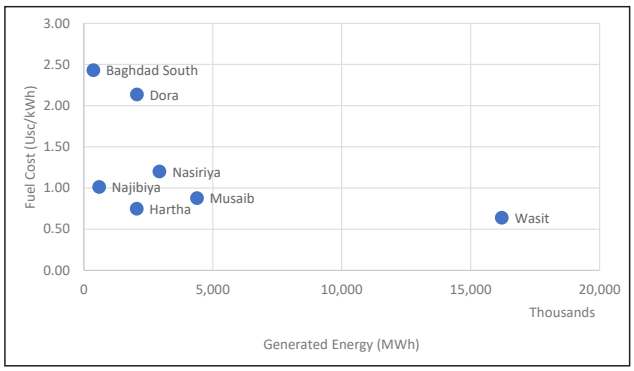
38. The global weighted average levelized cost of electricity (LCOE) of new utility-scale PV sunk to US$ 0.048 per kWh, a declined by 88% between 2010 and 2021: https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021

39. Noam Raydan and Harry Istepanian. Despite scorching heat, solar power remains mirage in Iraq, Amwaj.media, 2021: https://amwaj.media/article/iq-iraqi-oil-ministry-s-latest-solar-power-annoucement-a-new-spin-on-old

40. The total operating capacity of the thermal power stations is 4,678 MW (2019).

power plant) as shown in Figure 19.

Figure 19: Generated Energy versus Fuel Costs for Thermal Power Stations (2019)



The old thermal power stations which are forecasted to sequester 125 million MtCO2e emissions over the next 10 years should be decommissioned or rehabilitated to reduce harmful emissions such as nitrogen oxides (NOx), sulfur oxides (SOx), as well as carbon emissions. The estimated program cost of replacing the existing 7,200 MW thermal power stations is around $5 - 7 billion.

According to the latest capacity expansion plan by the MOELC, maintaining the current percentage of liquid fuel (crude oil, gas oil, HFO and diesel) at 24% goal, implies adding around 12,000 MW of oil-fired power generation to the energy mix by 2050. Although this will raise generation capacity for the country, it will also significantly increase carbon emissions by 66.5 million MtCO2e annually. This goes against federal Iraq's proclamations about the urgency to mitigate GHG emissions that contribute to climate change which is having a heavy toll on the country and its people.

3.5. Emissions Laws and Regulations

The federal government's talk about transforming the energy sector to clean and green energy, and its National Adaptation Plan (NAP) to build the country's resilience to climate change, appear to conflict with its plans to increase generation capacity using fossil fuels.

Federal Iraq officially ratified the Paris Agreement— that aims to limit global warming— in 2021[41] to reduce 15% of GHG emissions by 2035[42]. Under the National Determined Contribution (NDC), Iraq "will voluntarily cut 1-2% CO2-equivalent emissions from industry and open a window for US$100 billion investment in green economy, from both the private and public sectors over the next 10 years."[43]

To meet its NDCs, and move towards a green economy, Iraq will have to issue new laws and regulations to limit GHG emissions by large power stations which burn carbon-based fuels, as early as possible. This will include 23% of Iraq's total generation which is produced using liquid fuel, such as crude oil and heavy fuel oil.

Photo 2: Power Station in Baghdad

41. As part of the international climate policy regime, Baghdad submitted in 2015 its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC), highlighting its contributions to the global climate change mitigation effort: https://unfccc.int/news/iraq-submits-its-climate-action-plan-ahead-of-2015-paris-agreement

42. President of Iraq, Barham Salih, approved Iraqs accession to the Paris Agreement on climate change on January 13th, 2021:https://presidency.iq/EN/Details.aspx?id=2169
Under the Paris Agreement, Iraq must determine, plan, and regularly report on the contributions it undertakes to mitigate global warming, and is required to communicate contributions as NDCs.

43. As Iraq joins Paris Agreement, UN calls for further support to help the country adapt, December 1, 2021, United Nations: https://iraq.un.org/en/161240-iraq-joins-paris-agreement-un-calls-further-support-help-country-adapt

3.6. Limited Awareness Campaigns and Lack of Financing

Limited awareness campaigns have been launched so far to educate the Iraqi society about the benefits of using renewable technologies. For instance, the poor information available to consumers about the benefits of Rooftop Photovoltaic (RTPV) is a major challenge for the uptake of PV projects, especially in the residential segment. Low awareness has been found to be a major hurdle for the uptake of RTPV.

This lack of information is further compounded by the absence of both skilled workforce and technical training facilities to take charge of the installation, commissioning, and proper maintenance of renewable projects. Technology transfer mechanisms/policies are not nationally supported, and academic/R&D institutes are not technically equipped with testing and certification labs[44].

Moreover, the lack of necessary financing for renewables does not help. Most financial institutions do not have lending mechanisms for RTPV projects, and they are also reluctant to fund them. It is reported that banks traditionally charge developers high interest rates depending on the associated risks, nature of the project, and the credit rating of the borrower.

Understanding all the above-mentioned challenges is necessary before devising a plan for energy transition, and which we discuss in the next chapter. The federal government is unlikely to succeed in laying down the foundation for energy transition if it did not embrace serious steps towards resolving these decades-long problems in its power sector.

44. In 2008, the University of Baghdad renamed the Department of Nuclear Engineering to the Department of Energy Engineering to include renewable energies in the department's curriculums.

4. A Road Map Towards Energy Transition Strategy

Iraq will require financing, technology transfer, and capacity building to jump-start the clean energy transition[45]. Reducing future GHG emissions from the electricity sector and curbing AT&C losses cannot be realized without the following measures which in their turn will hinge on the availability of international financial and technical resources (Figure 20):

1) Introduce a new law for renewable energy and energy efficiency by 2025;

2) Rehabilitate and modernize the distribution network for main load centers, including Baghdad, Basrah and Mosul;

3) Have optimal generation mix with most of the new capacity being Combined Cycle Gas Turbines (CCGT's), which are the most fuel efficient with strict monitoring of GHG including NOx and CO;

4) Improve the fiscal performance of the power sector and developing efficient and effective sector management;

5) Promote private sector investments in renewable energy through incentives, as well as attract Foreign Direct Investment (FDI)

6) Develop mechanisms and regulations to mobilize financing by local banks and financial institutions,

7) Increase the total production capacity from renewable energy sources, besides solar, at least 33% by 2040—such as wind, biomass, and hydrogen technology, in addition to increasing the share of hydro power in the power generation mix so that it reaches 5% by 2045, so that Iraq would be able to generate around 50% of its total energy from renewables by 2050.

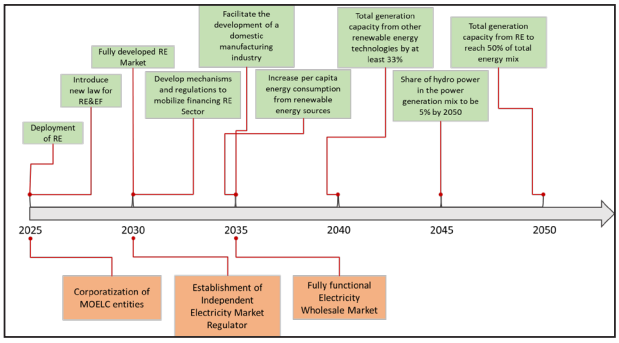
8) Lower the average price basket of tariff by allowing a competitive bidding for new projects whereas all taxes and duties are waived for the import of machinery required for renewable energy projects;

9) Facilitate the development of a domestic manufacturing industry for solar panels and associated equipment by 2035 (thereby lowering costs, improving service, generating employment, and improving local technical skills)[46];

10) Increase per capita energy consumption from renewable energy sources to improve social welfare especially in low-income governorates; and

11) Revise the national energy policy so that the aim would be to bring an optimal development of electricity generation, transmission, and distribution while bringing an end to the use of liquid fuels.

Figure 20: Renewable Energy Development Strategy Timeline (2025 - 2050)



These measures are part of a long strategic plan to achieve renewable energy development by 2050. It would be unreasonable to expect the federal government to embark on all of them immediately, but there are certainly some policies and reforms that need to be adopted in the next few years, and which we highlight below.

4.1. Quality of Service and Commercial Performance

The power sector's substandard operational efficiency has led to poor financial performance and severely affected the ability to invest in better quality and quantity of electricity services. High technical losses, and a poor bill collection system for instance have removed all incentives for energy conservation and energy efficiency.

With respect to the high technical losses, these could be addressed by undertaking necessary investments to strengthen the network infrastructure based on in-depth power system planning and modeling studies. Improvements in power supply availability and reliability through enhanced generation of electricity would then need to be complemented by stronger revenue management systems.

45. For the implementation of the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement (Paragraph 5 of Article 4) states that "support shall be provided to developing country Parties for the implementation of this Article, in accordance with Articles 9, 10 and 11, recognizing that enhanced support for developing country Parties will allow for higher ambition in their actions".

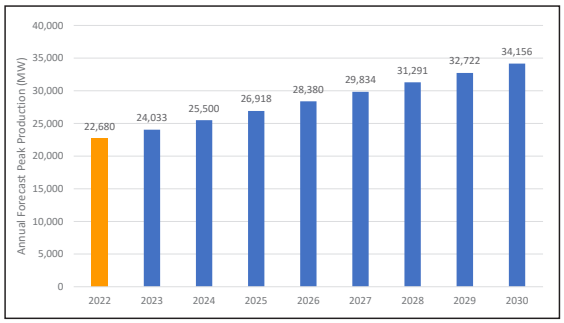
46. In May 2022, The General Company for Electrical and Electronic Industries planned to construct a plant to manufacture solar energy-powered pumps with electrical transformers to cater for the rising domestic demand for these products and reduce the dependency on imports : https://solarquarter.com/2022/05/09/iraq-is-planning-to-construct-a-plant-to-manufacture-solar-energy-powered-pumps/

Once a publicly acceptable level of supply reliability is established, electricity tariff should be reviewed toward a gradual alignment of price with cost estimated at about US¢10/kWh. As tariffs begin to reflect the economics of power production, demand-side management measures could be introduced as customers are then likely to respond.

4.2. Engaging the Private Sector

Energy transition would require funding beyond available public resources. Unlike the fossil fuel sector, renewable energy can be largely driven by the private sector to meet the target of producing 33% of total generation by 2030, as set by the government. Federal Iraq will require an estimated investment of US$ 15 – 20 billion in power generation alone, which is expected to reach approximately 33,000 – 35,000 MW by 2030 (Figure 21).

Figure 21: Forecast of Annual Peak Production 2022 - 2030 (Base Case)



It is estimated that with a weighted average capital cost for solar energy at US$ 980 per kWp, a target of 11,000 MW by 2030 will require an approximate investment of US$ 10.78 billion[47]. However, given the persistent fiscal constraints of the government's treasury, the private sector should be incentivized as a key player to drive the renewable energy sector in Iraq.

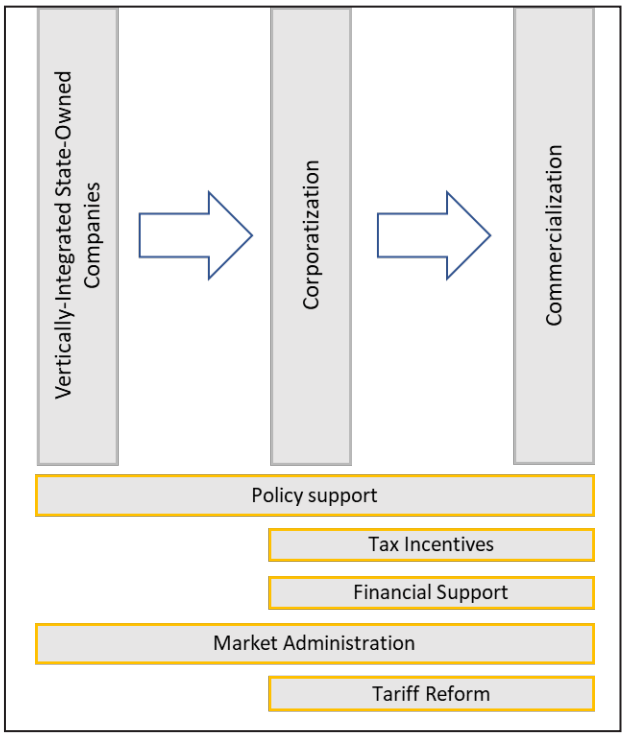
Given the size of the investment required to stir the development of renewable energy, it is crucial to design and promote innovative business models supported by well-designed fiscal and financial incentive structures. These business models, for instance, should be designed to mitigate the existing roadblocks for the larger uptake of developing utility-scale solar PV and RTPV systems, and their diversity is in line with models to promote solar energy deployment in various other countries. Models such as rent-a-roof/lease, community based, and plug-in RTPV have been deployed to varying degrees globally.

4.3. Restructure Electricity and Legal Entities

After the new Electricity Law was passed in 2017, the generation, transmission, and distribution entities which belong to the MOELC were supposed to be corporatized, but this has yet to happen[48].

Restructuring the electricity sector and making it efficient and competitive, should be considered an integral part of the energy transition map (Figure 22). Operations are currently vertically integrated within an MOELC-owned monopoly and with very little room for competition and the entry of Independent Power Producers into the power market. Therefore, the federal government needs to commence the corporatization of the state companies, transforming the generation, transmission, and distribution entities into a separate legal body— in other words, separate from the ministry/government, with their own associated rights and obligations, including governance structures, managing budgets, borrowing, procurement, labor employment, payment of taxes and dividends.

Figure 22: The Reform Continuum



Moreover, it is necessary for the government to shift

47. According to IRENA, the global weighted-average total installed cost of Utility-scale solar PV›s projects commissioned in 2019 fell below the US$ 1,000/kW mark for the first time, to just US$ 995/kW [Source: IRENA (2022), Renewable Power Generation Costs in 202: https://www.irena.org/publications/2022/Jul/Renewable-Power-Generation-Costs-in-2021

48. Harry Istepanian (2020), Iraq's economic White Paper misses a key issue for the energy sector, The Atlantic Council: https://www.atlanticcouncil.org/blogs/menasource/iraqs-economic-white-paper-misses-a-key-issue-for-the-energy-sector/

from a "single-buyer" electricity market to a "multi-buyer" model49. A "multi-buyer" model will assist the government to transition towards a competitive market for increasing operation efficiency, improving the service quality to consumers, as it will also create a competitive market that will reduce the electricity bills paid by consumers to neighborhood generators. Through such an electricity market, buyers and sellers will treat electricity as a commodity (Appendix B).

Furthermore, Iraq lacks the necessary regulatory framework for renewable energy investment, as clear and strong regulations and mechanisms are absent. Even the Electricity law No. 53 (2017) does not carry any vision for renewable energy in the country. Given that the current government has been expressing its readiness to transform the energy sector, it cannot embark on such a mission without passing new legislations. The key legislations that are currently missing include the renewable energy and energy conservation law (قانون الطاقة المتجددة وترشيد الطاقة), private generators regulatory law (قانون تنظيم عمل المولدات الأهلية), and the energy regulatory commission law (قانون هيئة تنظيم قطاع الطاقة).

4.4. Ensuring a Just Energy Transition

The three major components which Iraqi consumers would like to see during an energy shift are sustainability, affordability, and reliability of the electricity supply. Additionally, the potential pathway towards green energy would require a just transformation that contributes to job creation, social justice, and a fair transition of government employees from a fossil fuels-based energy sector to a green economy. A just transition needs to minimize the negative impacts of the shift to a green economy and maximize social and economic opportunities for both women and men.

Moreover, energy services at affordable prices are considered inevitable for long-run economic growth, productivity, and welfare. The availability of efficient electricity supply at affordable prices is also important to reduce energy poverty especially for households that are deprived of reliable energy and cannot afford costly supplies from private generators. For this reason, the current share of energy expenditure in their total income ('the energy burden'), which is disproportionately high, should be considered in any energy transition plan.

4.5. International Support For Energy Transition

As part of the international climate policy regime, Iraq submitted in 2014 its Intended Nationally Determined Contributions (INDCs) to the United Nations Framework Convention (UNFCCC),[50] highlighting its contributions to global efforts to mitigate climate change. Iraq's climate target under the NDC is to reduce 20% from its projected emissions by 2030 (review Figure 1).

Iraq seeks to achieve the following objectives as part of its climate goal:

1) Improve NDC planning, policy, strategy, and legislation,

2) Strengthen an enabling environment for NDC implementation,

3) Accelerate the policy coherence and integration to achieve the United Nations' Sustainable Development Goals (SDGs) in the light of its Sustainable Development Report 2020 (SDR2020); and

4) Enhance NDC measurement, reporting and verification, and transparency of climate action.

Baghdad stated that the implementation of the NDCs, and the voluntarily reduction of GHGs in the energy sector, will rely on the developed countries' fulfillment of their obligations in financing, and transferring environmentally friendly technology to vulnerable developing countries[51].

To implement the NDC, however, and receive international financial support, the federal government should undergo several reforms in the power sector, and hasten the adoption of the necessary legislative policies to address energy transition and climate change. New policies and initiatives should include the national renewable energy and energy efficiency policy which will outline Iraq's plan to increase the use of renewable energy sources[52]. In addition, Iraq requires a renewable energy master plan to outline the framework and mechanisms for increasing the levels of renewables-based electricity

49. Currently, the Ministry of Electricity is the purchaser of all energy produced by the IPPs. Although this might protect the IPPs from commercial risks, it comes at a cost for electricity budget and the government's huge subsidies.

50. The UNFCCC aims to stabilize greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate system, and within a time frame that allows ecosystems to adapt naturally and enables sustainable development:
https://unfccc.int/about-us/about-the-secretariat

51. Ibid.

52. Istepanian, H. (2020), Towards Sustainable Energy Efficiency in Iraq, Friedrich Ebert Stiftung and Al-Bayan Center for Planning and Studies :
https://library.fes.de/pdf-files/bueros/amman/16449.pdf

generation to 33% in 2030[53]. This would be a major first step towards closing Iraq's energy deficit by 2030.

Once such measures have been taken, or once Iraq has at least prepared the power sector to transition to renewable energy, it will be in a position to attract international climate finance.

Climate finance refers to "local, national or transnational financing—drawn from public, private and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change."[54] The UN Convention, as well as the Kyoto Protocol and the Paris Agreement, call for financial assistance to be provided by country Parties that can assist vulnerable developing countries for the purpose of achieving the objectives of the UNFCCC[55]. For this reason, the Convention established a financial mechanism to provide financial resources to developing country Parties. Among the entrusted operating international entities of the financial mechanism are the Global Environment Facility (GEF) and the Green Climate Fund (GCF), in addition to two special funds, the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF), which are both managed by the GEF, and the Adaptation Fund (AF)[56].

Among the countries that have received financial support via these international operating entities are Egypt and Kazakhstan.

In Egypt, the Green Climate Fund's (GCF) investment with the European Bank for Reconstruction and Development (EBRD) has financed a group of solar power projects in the Benban solar park. The GCF's contribution to this Egyptian project was reportedly USD 154.7 million "in order to unlock private investment by renewable energy providers." [57] Meanwhile, in Kazakhstan— where more than 70 percent of electricity is generated using coal[58] -- the GCF in 2018 completed what it called "its largest disbursement to date [that year] of USD 86.7 million." This was part of a project[59], in partnership with EBRD, to assist Kazakhstan in moving away from old coal plants[60].

Iraq too will require international technical and financial support for its energy transition, with a major contribution from the private sector and foreign investors. But this cannot happen without first reforming Iraq's electricity sector.

53. https://renewablesnow.com/news/iraq-targets-33-clean-energy-by-2030-759029/
54. Introduction to Climate Finance, UNFCCC: https://unfccc.int/topics/introduction-to-climate-finance
55. Ibid.
56. Ibid.
57. Energy transition accelerates with GCF support : https://www.greenclimate.fund/news/energy-transition-accelerates-with-gcf-support
58. Kazakhstan has set out ambitious and welcome clean energy transition plans but must overcome historical reliance on fossil fuels, IEA review says : https://www.iea.org/news/kazakhstan-has-set-out-ambitious-and-welcome-clean-energy-transition-plans-but-must-overcome-historical-reliance-on-fossil-fuels-iea-review-says
59. More details about the project can be found here: https://www.greenclimate.fund/project/fp047
60. Ibid.

5. Conclusions

The electricity sector in Iraq lacks five basic structural reform packages that need to be embraced for a successful energy transition at a later stage:

1. New electricity-related legislations;
2. Independent regulatory entity and energy market;
3. Full corporatization, and full vertical and horizontal unbundling of the MOELC-owned companies;
4. Private sector participation (particularly in generation and retail market); and
5. Commercialization through creating a competitive wholesale power market

These need to be incorporated into an energy transition strategy, and for this reason the federal government is required to update its Integrated National Energy Strategy[61] (2013-2030) that would take both immediate and long-term policy measures to manage the transformation of the energy sector.

With respect to the immediate policy measures, the government should take steps to operationalize the new electricity law (2017), so that the process of restructuring the MOELC, as we detailed in the report, becomes possible. Furthermore, energy transition in Iraq cannot succeed if the power sector remains unprofitable and completely dependent on the state's treasury. The federal government needs to start thinking how to make the electricity sector profitable through embracing cost-recovery measures, which will depend on the long-awaited improvements in the metering and bill collection systems. And all this cannot be achieved without hammering out a legal framework to allow private/ foreign participation / ownership in the power sector. Preparing and implementing the necessary regulatory framework is an integral step to attract renewable energy investment.

Finally, once the federal government is ready to transform the power sector, it needs to ensure that it is a just transition that prioritizes fair social and economic opportunities for all Iraqis. All these fundamental steps will depend on the political and security conditions in the country— which have been volatile since last year, affecting the government's work and future projects. In the power sector, the delays on the part of the Council of Representatives (CoR) to approve the federal budget for 2022, has stalled the implementation of a plan[62] to develop comprehensive solutions for electricity shortages under the supervision of a joint committee comprised of the electricity, oil, and finance ministries. If such delays persist in the future, federal Iraq will fail to turn its talk on energy transition into effective actions.

61. The Integrated National Energy Strategy 2013–2030 (INES), funded by the World Bank, was launched by the federal government in June 2013. The background work was carried out by Consultants Booz & Co. The draft final was issued in April 2012, but only the executive summary of INES was made public:
https://documents.worldbank.org/en/publication/documents-reports/documentdetail/406941467995791680/integrated-national-energy-strategy-ines-final-report

62. جريدة المدى لجنة مشتركة لتنفيذ خطة تضع حلولًا شاملة لأزمة الكهرباء (2022/07/27).

6. Bibliography

Alasady, A. M. (2011). Solar energy the suitable energy alternative for Iraq beyond oil. International Conference on Petroleum and Sustainable Development. 26, pp. 11-15. Singapore : IACSIT Press.

Al-Douri, Y., & Abed, F. M. (2016). Solar energy status in Iraq: Abundant or not—Steps forward. Journal of Renewable and Sustainable Energy, 8(2), 025905. https://doi.org/10.1063/1.4947076

Al-Kayiem, H. H., & Mohammad, S. T. (2019). Potential of renewable energy resources with an emphasis on solar power in Iraq: An outlook. Resources, 8(1), 42. https://doi.org/10.3390/resources8010042

Al-Khafaji, H. (2018). Electricity generation in Iraq: Problems and solutions. Al-Bayan Center for Planning and Studies.

Al-Khatteeb, L., & Istepanian, H. (2015). Turn A Light On: Electricity Sector Reform in Iraq. Washington, DC: The Brookings Institution.

al-Khatteeb, L., Alwash, A., & Istepanian, H. (2018). The Need for Middle East Economic Confederal Union. London: Iraq Energy Institute.

Al-Maleki, Y. A.M. (2020, February 20). Overview of Iraq's renewable energy progress in 2019. Iraq Energy Institute. https://iraqenergy.org/2020/02/20/overview-of-iraqs-renewable-energy-progress-in-2019/

Booz and Co. (2012). Iraq Integrated National Energy Strategy.

IEA – International Energy Agency. (2014). Integrated national energy strategy of Iraq – Policies. https://www.iea.org/policies/5632-integratednational-energy-strategy-of-iraq

IEA – International Energy Agency. (2016). Iraq renewable energy auction – Policies. https://www.iea.org/policies/6119-iraq-renewableenergy-auction

IEA – International Energy Agency. (2017). World energy outlook 2017. https://www.iea.org/reports/world-energy-outlook-2017

IEA – International Energy Agency. (2019). Iraq's energy sector: A roadmap to a brighter future. https://www.iea.org/reports/iraqs-energysector-a-roadmap-to-a-brighter-future

IEA – International Energy Agency. (2020a). Data and statistics. https://www.iea.org/countries

IEA. (2019). Iraq Energy Outlook. Paris: International Energy Agency. Retrieved October 5, 2022, from https://www.iea.org/reports/iraqs-energy-sector-a-roadmap-to-a-brighter-future

Iraqi Economists. (2020, December 28). Iraq's economic White Paper misses a key issue for the energy sector, by Harry Istepanian. http://iraqieconomists.net/en/2020/12/28/iraqs-economic-white-paper-misses-akey-issue-for-the-energy-sector-by-harry-istepanian/

Istepanian, H. (2018). Solar energy in Iraq: From outset to offset (Publication No. IEI181018). Iraq Energy Institute. https://iraqenergy.org/product/solar-energy-in-iraq-from-outset-to-offset-report/

Istepanian, H. (2020). Iraq solar energy: from dawn to dusk. FriedrichEbert-Stiftung. http://library.fes.de/pdf-files/bueros/amman/16324–20200722.pdf

Istepanian, H. (2020). Residential electricity subsidies in Iraq: Exploring options for reform. (Report No. IEI90320). Iraq Energy Institute. https://doi.org/10.13140/RG.2.2.11398.32324

Istepanian, H. (2020c). Towards sustainable energy efficiency in Iraq. Friedrich-Ebert-Stiftung. http://library.fes.de/pdf-files/bueros/amman/16449.pdf

Kazem, H. A., & Chaichan, M. T. (2012). Status and future prospects of renewable energy in Iraq. Renewable and Sustainable Energy Reviews, 16(8), 6007–6012. https://doi.org/10.1016/j.rser.2012.03.058

Latif, H. (2018). Developing Iraq's infrastructure through a sovereign wealth fund. (Publication No. IEI190318). Iraq Energy Institute. https://iraqenergy.org/product/developing-iraqs-infrastructure-through-a-sovereign-wealth-report/

Ministry of Electricity. (2010). Iraq electricity masterplan (S. 63). http://www.iraq-jccme.jp/pdf/archives/electricity-master-plan.pdf

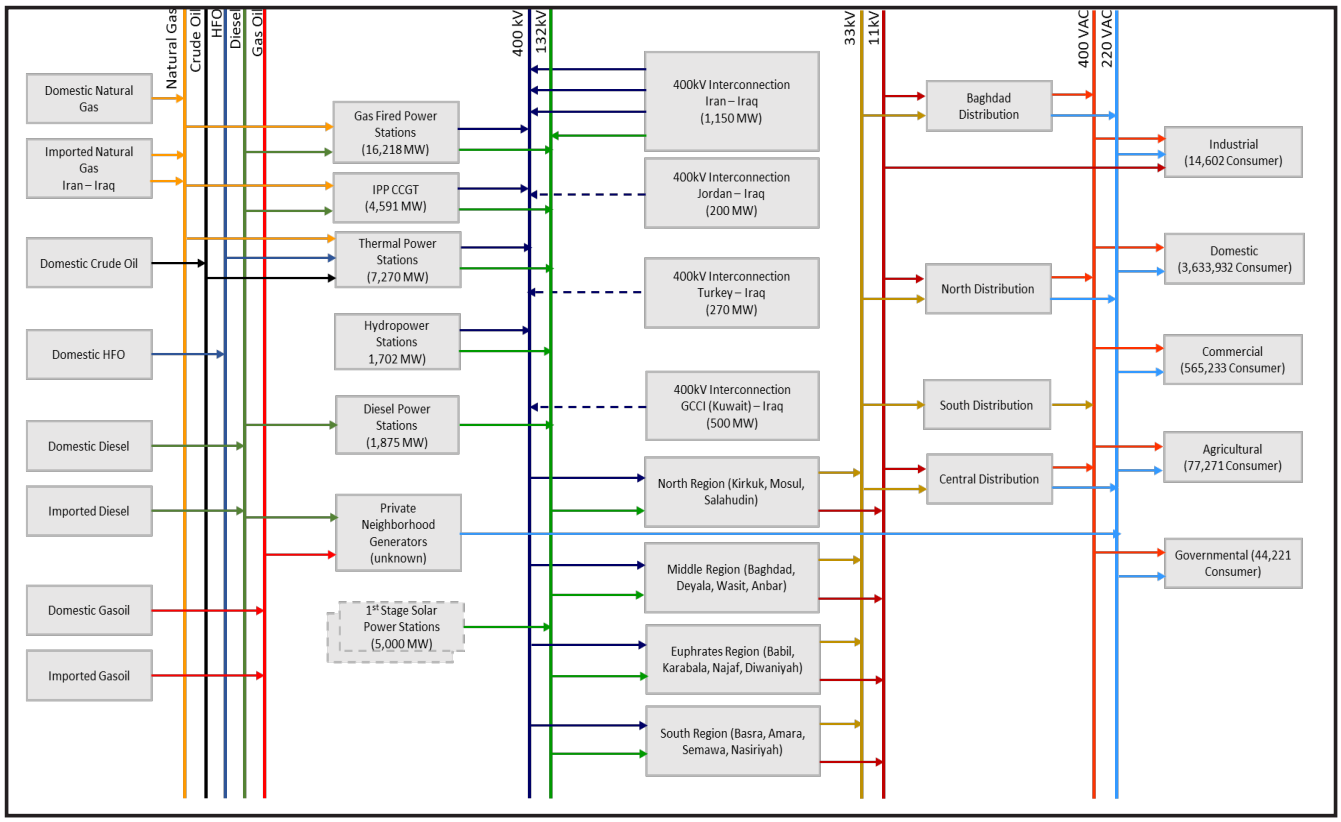
Ministry of Planning. (2018). National development plan 2018–2022. http://www.iraq-jccme.jp/pdf/archives/nationaldevelopmentplan2018_2022.pdf

Ministry of Planning. (2019). »The future we want« - Iraq vision for sustainable development 2030. https://mop.gov.iq/en/min_publications/view/list?id=18&lastcontent=474

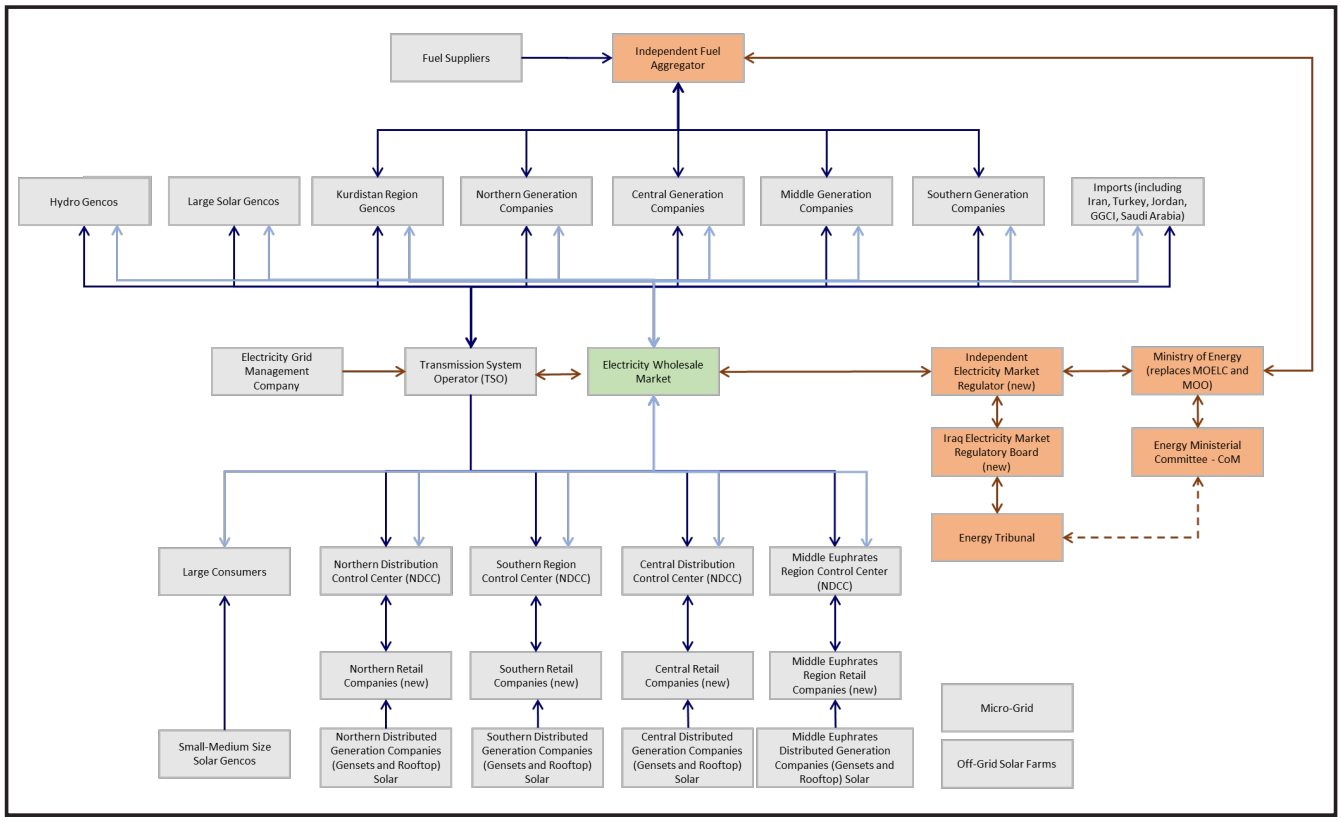
Qamar Energy. (2018). Iraq: Renewable power potential. Iraq Energy Institute. https://iraqenergy.org/product/iraq-renewable-power-potential-by-qamar-energy/

RCREEE – Regional Center for Renewable Energy and Energy Efficiency. (2020, December 14). Iraq. https://www.rcreee.org/member-states/iraq/4021

Appendix A -Iraq Electricity Energy Schematic



Appendix B - Iraq Energy Market Multi-Buyer Conceptual Design



About the Authors:

Harry Istepanian

Harry Istepanian is an independent consultant based in Washington DC. He has more than 35 years of experience in the energy and water sector, including technical and economics of energy and water projects in the Middle East and South East Asia. He is, amongst others, a Chartered Engineer in the United Kingdom, a Member of the Institution of Professional Engineers New Zealand, and a certified Project Management Professional (PMP).

Istepanian holds a Bachelor of Science in Electrical Engineering and a Master's Degree in Engineering Management from the University of Auckland in New Zealand.

His work has been published in various media outlets, as well as international journals, such as the Power Engineering International, and the Electricity Journal of Energy Economics and Policy, in addition to think-tanks that include the Brookings Institution and the Atlantic Council, amongst others.

He's currently a Senior Fellow at the Iraq Energy Institute.

Noam Raydan

Noam Raydan is an independent energy researcher and consultant living and working in Baghdad since 2019. Her work has been published by various media outlets, including Forbes.com and Energy Fuse. In 2021, she took charge of preparing an investigative report and a documentary on Lebanon's energy imports sector, including the country's efforts to import oil products from Iraq. Her latest investigative work and research can be found on her newly launched publication THE CHOKEPOINT.

Prior to that, she was a geopolitical analyst at ClipperData (now Kpler), a New York-based energy market research firm, covering the MENA region. She assessed how political and macroeconomic developments affect energy markets.

She also has extensive experience covering political and security developments in Syria, Lebanon, and Iraq for media outlets like the Wall Street Journal and the Financial Times.

IMPRINT

Friedrich-Ebert-Stiftung | Amman Office

P.O. Box 941876 | Amman 11194 | Jordan

https://amman.fes.de

To order publications:

amman@fes.de

The various clean energy and environment-focused events which the federal government has joined so far, may create the illusion that Baghdad is already on a serious path towards energy transition. However, talking about energy transition before preparing the relevant policies and regulatory framework to ensure its success, puts the cart before the horse. The electricity sector in Iraq lacks five basic structural reform packages that need to be embraced for a successful energy transition: new electricity-related legislations, independent regulatory entity and energy market, full corporatization and full vertical and horizontal unbundling of the MOELC-owned companies, private sector participation (particularly in generation and retail market), and commercialization through creating a competitive wholesale power market.

As part of immediate policy measures, the government should take steps to operationalize the new electricity law (2017), so that the process of restructuring the MOELC becomes possible. Furthermore, energy transition in Iraq cannot succeed if the power sector remains unprofitable and completely dependent on the state's treasury. The federal government needs to start thinking how to make the electricity sector profitable through embracing cost-recovery measures, which will depend on the long-awaited improvements in the metering and bill collection systems. And all this cannot be achieved without hammering out a legal framework to allow private/ foreign participation / ownership in the power sector.

These fundamental steps will depend on the political and security conditions in the country— which have been volatile since last year, disrupting the government›s work and future projects. If such obstacles persist in the future, federal Iraq will fail to turn its talk on energy transition into effective action.

مركز البيان للدراسات والتخطيط
Al-Bayan Center for Planning and Studies

FRIEDRICH EBERT STIFTUNG