

POWERING IRAQ: CHALLENGES FACING THE ELECTRICITY SECTOR IN IRAQ

Robin Mills And Maryam Salman

October 2020

→ The unprecedented decline in oil prices since March has left Iraq unable to pay its US\$ 4.2 billion monthly public sector obligations.

→ Iraq's electricity problem is centred around a chronic inability to match supply with demand. In 2019, peak demand was 26 GW, 58% higher than generation capacity.

→ challenge for Iraq, is less in generation capacity, and more in distributing fuel supplies to power plants, and improving the power transmission system.



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1. INTRODUCTION

1. INTRODUCTION

On February 21, 2020, Iraq recorded its first case of the novel coronavirus. Five months later, total recorded cases are 129 000 at the time of writing, and daily reported deaths almost 100. The crisis has battered the country's economic development plans, and put an indefinite question mark over the realisation of a massive US\$ 15 billion electricity infrastructure upgrade roadmap announced by former Prime Minister Adel Abdel Mehdi in April last year. Simultaneously, global energy markets continue to struggle ever since the oil market collapsed between March and April, briefly plunging oil price will drop to low single-digit. Iraq's hydrocarbon revenues have, as a result, fallen to their lowest since the early years after the 2003 US invasion¹.

In May, Abdel Mehdi stepped down to make way for new premier Mustafa Kadhimi, who, within a month of taking office, announced his government would not be moving ahead with a 2020 budget, and would instead focus on formulating a budget for 2021². Partly as a result, pressure has mounted on the country's fragile electricity sector. Lack of funds and proper maintenance has resulted in 12 hour+ blackouts returning to the southern hubs of Iraq's oil sector, prompting protests. On July 26, two protestors were killed by security forces in Najaf³, provoking violence between other demonstrators. Al-Kadhimi's promises of meeting citizens' demands for electricity seem a difficult challenge to meet under the current circumstances, leading him to blame the "corruption and mismanagement" of previous cabinets for chronic power shortages⁴.

The struggles of the electricity sector have a long history. Following damage to the grid and power plants in the first Gulf War (1990-91) and deterioration during the 1990s period of strict international sanctions, infrastructure was further damaged by looting and civil conflict after the 2003 US-led invasion. Corruption and mismanagement led to slow progress in rebuilding the sector and expanding capacity, while demand has continued to grow rapidly because of fast population growth, and the spread of consumer appliances, particularly air-conditioners. Fuel supply to power plants has been a further problem, with continuing high levels of flaring of associated⁵ gas.

In June 2013, Iraq launched an Integrated National Energy Strategy (INES), and was confident that Iraqis would soon enjoy 24-hour power supply, as it unveiled plans to have generation capacity cross 20 GW by 2015⁶ from 10-12 GW. 8 GW of new capacity was to be added to existing capacity, but by 2019, only 4 GW of this was realised, bringing total capacity to 16.5 GW, even though generation managed to reach 19 GW during peak periods. Part of the gap in demand is met by privately-operated generators, but these are expensive, noisy and polluting and generally do not provide enough electricity to run air-conditioning.

Also in 2013, the Basrah Gas Company (BGC), a joint venture between the Iraq South Gas Company (51%), Royal Dutch Shell (44%), and Mitsubishi Corporation (5%) was established to capture associated gas from the Rumaila, Zubair, and West Qurna-1 oilfields for power generation. Since then, capture has risen to 7.2 billion cubic metres (BCM) per year, nearly a

1. MEES, "Iraq's Oil Revenues Collapse", V63 N18 (May 2020)

2. Lawk Ghafuri, "Iraq to dismiss 2020 budget plan, work to secure 2021 budget", Rudaw, June 07 (2020)

3. The National, "Iraq: Mustafa al-Kadhimi orders investigation into deaths of protestors", July 28 (2020)

4. Lawk Ghafuri, "Kadhimi blames electricity shortages on previous cabinets' corruption and mismanagement", Rudaw, July 27 (2020)

5. Associated gas is the natural gas present in a deposit of crude petroleum (in oil fields), either dissolved in the oil, or as a free "gas cap" above the oil in the reservoir

6. Harry Istepanian, "Iraq's Electricity: From Crisis to ISIS," Power Engineering International 22, no. 8 (2014), 32-37

third of associated gas production (~26 BCM). This is a significant success story, but 50% of associated gas is still flared.

In June 2017, Iran began exporting gas to Iraq, via a pipeline through the Diyala province to Baghdad, supplemented by supplies to Basra in 2018. However, this has been opposed by the US, which has encouraged Iraq to find alternative supplies, while giving time-limited waivers to continue the imports.

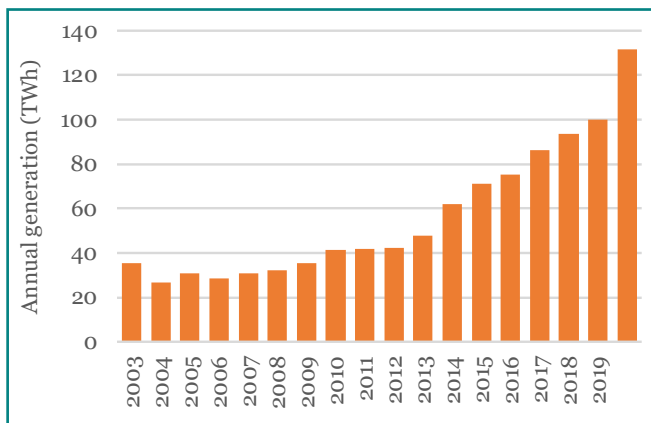


Figure 1 Power generation in Iraq, by year (includes Kurdistan region)⁷

As shown in Figure 1, generation recovered slowly after the invasion and was rather stagnant until a significant improvement in 2014-2018. However, there was a setback during this 2014-18 period due to occupation of large parts of north-western Iraq by the 'Islamic State of Iraq and Al-Sham' (ISIS or Da'esh) group. They caused an estimated US\$ 7 billion of damage to the power sector⁸, and sabotaged or destroyed electricity lines, and the Al Qayara (750 MW)⁹ and Baiji (1600 MW)

power plants¹⁰, which severely interrupted service to the north-western governorates.

There was then a big jump in 2019, following then-Minister of Electricity Luay al-Khatteeb's "fast-track programme" to revive halted power projects, by streamlining contractual requirements and re-shifting the focus of regional companies to summer maintenance schedules¹¹. This resulted in the summer of 2019 witnessing a near 20% jump in generation year-on-year from the same period in 2018, when violent protests broke out in the southern hubs of the country. Also, state grid electricity was delivered to areas liberated from ISIS for the first time after five years of complete shutdown. Nevertheless, this has never been enough to close the gap with demand.

German conglomerate Siemens made headlines in 2018 for vowing to have Iraq's power grid up and running after the defeat of ISIS the year prior. It discussed a slew of "power deals" with the Ministry of Electricity that would boost Iraq's generation capacity by as much as 25 GW if they came to fruition. A US \$15 billion roadmap to this end was unveiled in 2019 by then Prime Minister Abdel Mehdi. 40 gas turbines were to be upgraded with upstream cooling systems, and 13 132/33kV substations would be constructed in Basrah and the central provinces. A new 500 MW gas-fired power plant would be built in Zubaidiya in southern Baghdad, and under a separate US\$ 1.3 billion agreement, the Baiji 1 and 2 power plants, located 250 kilometres north of Baghdad, would be rebuilt, adding 1.6 GW capacity when completed.

7. Data from Statistical Review of World Energy 2020

8. Wall Street Journal, "Defeat of ISIS in Iraq Caused \$45.7 Billion in Damage to Infrastructure, Study Finds", February 18 (2018), <https://www.wsj.com/articles/defeat-of-isis-in-iraq-caused-45-7-billion-in-damage-to-infrastructure-study-finds-1518389411#:~:text=The%20damage%20to%20the%20housing,age%20is%2020%20years%20old.>

9. GE, "Let There Be Light: How GE Rebuilt An Iraqi Power Plant Destroyed by ISIS", October 22 (2018), <https://www.ge.com/news/reports/let-light-ge-rebuilt-iraqi-power-plant-destroyed-isis>

10. Wall Street Journal, "Siemens: Signs Deal to Rebuild Iraqi Power Plants Damaged by ISIS", September 16 (2019), <https://www.marketscreener.com/SIEMENS-AG-56358595/news/Siemens-Signs-Deal-to-Rebuild-Iraqi-Power-Plants-Damaged-by-ISIS-29209849/>

11. Luay al-Khatteeb, "Fixing Iraq's Power Sector", Iraqi Economists Network, August 22 (2020)

1. INTRODUCTION

Concurrently, US firm General Electric promised 3.3 GW of new generation if 40% of current flared gas were captured¹². It also signed agreements to upgrade, maintain, and rebuild facilities to boost capacity by 5 GW. General Electric's mandate has involved closer cooperation with the Ministry of Oil (MoO) and the Ministry of Electricity (MoE), with US government backing to wean Iraq off Iranian gas supply for electricity generation, while the German focus has mostly been on grid rehabilitation and expansion. General Electric also has a "GE Renewable Energy's Grid Solutions" programme, which might assist in Iraq's plans of developing 635 MW of renewable capacity by September, now likely later, this year, though no discussion to this end has yet taken place. For now, a US \$727 M deal to fortify the country's electricity grid in areas still rebuilding from years of war, has been signed with the MoE. The deal will also link Iraq's grid to Jordan's, reducing overall congestion and ensuring dependable power supply. Another US \$500 M deal was also signed to provide parts and maintenance services to 6 GW of power capacity¹³.

Despite these efforts, Iraq has seen poor progress in serving its people's power needs. Electricity generation per capita, which should be high to meet air conditioning needs, remains one of the lowest in the Middle East. It generates less than Lebanon, even though Lebanon suffers severe power shortages, and only a little more per capita than Egypt and Jordan, despite a significantly higher GDP. Plans for importing 500 MW of electricity from the Gulf Cooperation Council (GCC) countries, first announced in 2019, have also moved slowly, even though Iraq has reportedly built 80% of the connections required on its side. The spread of the coronavirus has stalled Gulf efforts to comply with their end of the deal, which now seems delayed to 2021.

12. S&P Global Platts; shorturl.at/uxGXo

13. GE, "Peak Power: Iraq Taps GE To Bolster Its Electricity Infrastructure", August 24 (2020)

2. RECENT DEVELOPMENTS

2020 has introduced numerous new problems to Iraq's electricity crisis: political instability, the oil price collapse, and the CoVid-19 pandemic.

A senior official from the Ministry of Electricity (MoE) said in July 2020 that electricity supply was down ~1 GW from 2019¹⁴, as technical malfunctions in power plants remained unaddressed due to "foreign maintenance staff" (who are better-trained to handle the unique requirements of local infrastructure) flying home due to the pandemic. This means most Iraqis are now back to having power for 5-8 hours a day. July saw an unusually severe heatwave even by Iraq's standards, with Baghdad reaching almost 52°C, an all-time record, and Basra at 53°C. The high temperatures further reduce output by cutting plant efficiencies. On 4th August 2020, it was reported that generation had improved from 16.25 GW to 18.6 GW as a result of lower temperatures¹⁵ (this compares to demand of about 26 GW).

Electricity shortfalls are compounded by the decline in crucial associated natural gas production from oilfields, as the Ministry of Oil (MoO) curbs output in line with the new OPEC+ agreement to shore up oil prices. Under the agreement, Iraq was to reduce oil production by ~1 million barrels per day (Mb/d) in May and June, from an October 2018 baseline level, but failed to comply fully, ushering in Saudi intervention, and the promise of a US\$ 500 million "financial sweetener" to abide by cuts.

The Saudi loan is a fraction of what Iraq loses monthly due to the longstanding gap between demand and supply of electricity, estimated by generation planning studies at US \$3.3 billion¹⁶. It also does little to align the Ministry of Electricity and Ministry of Oil, between whom cooperation has historically

been patchy. A recent rally in oil prices will remain insufficient to meet Iraq's US \$50 billion annual public sector expenses. Moreover, federal crude exports have already been cut by a record 715 kb/d in July on October 2018's baseline levels, which means roughly a billion dollars of lost revenue at current Brent prices. The Saudi loan shall, therefore, go into paying civil servant wages and other government liabilities unmet by hydrocarbon revenues. OPEC cuts are being phased down from August 2020 onwards, with a further reduction from January 2021 to April 2022 and an end to cuts thereafter¹⁷. This is, of course, dependent on global oil market developments. But Iraq is under additional diplomatic pressure to cut below its August-December 2020 quota to make up for insufficient compliance in May-July. This could involve further Saudi financial aid in return for compliance.

Domestic needs have also been challenged, even though refinery runs have continued at 70-80%¹⁸ to provide fuel for the domestic market. For instance, OPEC pressure has already resulted in gas shortages for power generation. On July 01, two units of the Amara-gas fired power plant (Units 1 and 3) were shut down due to low gas supplies from the 370 000 barrels per day (b/d) PetroChina-operated Halfaya oilfield, which the MoO had ordered to reduce production from by 100 kb/d. The reduction implies ~0.54 BCM/y of gas output being cut, or 67% of what Amara consumes to run at capacity.

Pressure on new Prime Minister Mustafa al-Kadhimi to deliver solutions to the country's electricity problem has seen him direct oil companies to transfer power generated at their fields to the national grid, as output drops under the OPEC+ pact. Eni-operated Zubair will send power generated to support oil operations to the local grid, while the

14. The National, "Iraq: Mustafa al-Kadhimi orders investigation into deaths of protestors", July 28 (2020)

15. Harry Istepanian, <https://twitter.com/HarryIstepanian/status/1290544043852587010>

16. Parsons Brinckerhoff, "Iraq Electricity Masterplan: 2010 to 2030", Final Report (December 2010), 3-9

17. Fitch Ratings, "OPEC+ Cuts Tapering Reflects Recovering Oil Demand", July 16 (2020)

18. Qamar Energy Research

2. RECENT DEVELOPMENTS

Basrah Oil Company (BOC) will supply 150 MW from its Petrochemicals Company. Rumaila will send an additional 30 MW from its generation facility. Additionally, the MoO will supply free diesel feedstock to generator owners¹⁹. But these moves will only have a limited impact on improving electricity provision, while free diesel is expensive for the government and entrenches the rent-seeking behaviour of the “generator mafia”.

¹⁹. Iraq Oil Report, “Iraq draws electricity from oil projects to help failing power grid”, July 17, 2020

3. BUDGETARY CHALLENGES & FISCAL PRESSURES

The unprecedented decline in oil prices since March has left Iraq unable to pay its US\$ 4.2 billion monthly public sector obligations, including spending on salaries, pensions, and the running of government offices. A mild gain in prices in May saw revenues recovering slightly, but at US \$2.1 billion, were only 50% of Iraq’s commitments, excluding energy investment spending. The decline in revenues has already caused visible financial strains, forcing Mustafa al-Kadhimi’s new government to tap into its foreign reserves, estimated at about US \$66.7 billion²⁰, in order to meet salary obligations of its civil servants for May.

high ask, unless prices rise sharply. There is some speculation that Iraq’s government account has dwindled to just US \$300 million at the end of May²², which puts immediate pressure on al-Kadhimi to put together solutions to tackle Iraq’s economic crisis.

To this end, he has assembled a high-level “economic crisis committee”, that will examine the country’s options to increase revenues and reduce expenditures without cutting back on essential supplies to Iraqis. Discussions have focussed on reducing state employees’ benefits, but such moves might imperil the legitimacy of his newly-formed government. Worse, it could add fuel to the ongoing protests, ushering in mass unemployment in a country that has an official unemployment rate higher than 12.8%²³. Overcoming the several irregularities and setbacks in electricity reconstruction efforts of former administrations are costly and complex, and even if reducing state employee benefits might have the quickest result in saving government finances, such efforts won’t be sufficient to execute meaningful reform. Moreover a reduction in salaries and other benefits will impact consumer purchasing power, depressing the gross domestic product (GDP), which is set to contract by -4.7% in 2020 (Figure 4). Continuing political opposition and a stalemate that has blocked the release of the budget has also slowed, if not entirely halted, progress on the smart grid distribution model decided with Siemens. The deals with GE to rehabilitate existing power plants and reinforce transmission networks in provinces liberated from ISIS might also be delayed.

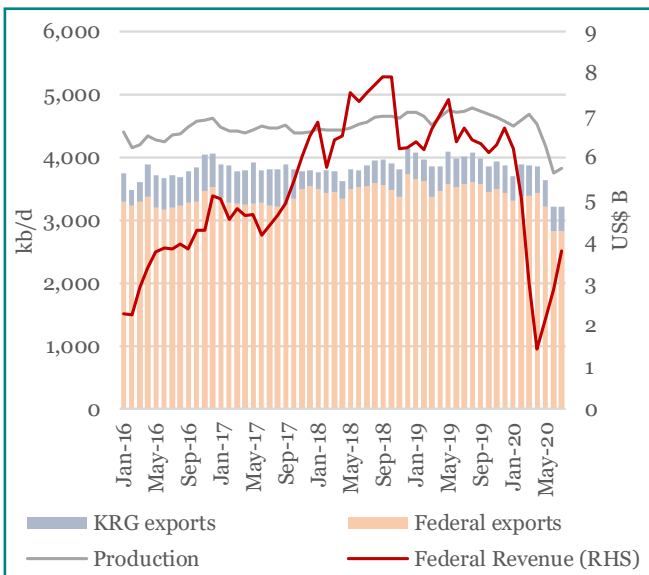


Figure 2 Iraq’s monthly oil revenues²¹

The country last drew from its forex reserves in 2014 after Haider al-Abadi was elected Prime Minister, but would prefer to spend as little of its (limited) reserves as possible. Now that the federal government has announced that it won’t be moving ahead with a 2020 budget, hope of an increase, or even resumption, in investment spending in the near-term seems a

20. Fitch Ratings, April 2020

21. Qamar Energy Research; Iraq Oil Report; Media sources

22. Ahmed Mehdi, “Compounding Crises: Iraq’s oil and energy economy”, The Oxford Institute for Energy Studies, July (2020)

23. World Bank, 2019

4. NATURAL GAS DEVELOPMENT REMAINS SLOW

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Most of Iraq's current power generation comes from natural gas, supply of which has risen substantially since 2009. This is due to an increase in associated gas output (the by-product of oil production) and efforts to capture flared gas, and in large part due to imports of Iranian gas since 2017. Increased supplies of natural gas have helped cut crude oil burn for generation and also free up fuel oil for exports, but shortages remain.

There are only two producing non-associated²⁴ gas fields in the country currently. These are the 4.1 BCM/yr Khor Mor gas field in the Kurdistan region, and the 0.5 BCM/yr Siba gas field near Basrah. Two other major non-associated fields, Akkas near the Syrian border in the Anbar province, and Mansuriyah in Diyala, remain undeveloped, with past contracts with international firms having run into commercial and security problems. There are also large undeveloped non-associated fields in the Kurdistan region, including Chemchemal (operated by the Pearl Petroleum consortium along with Khor Mor), Miran and Bina Bawi (both operated by Genel Energy) and others. These fields have been intended since 2013 to feed exports to Turkey, but this project has not proceeded.

Current associated gas production is ~19 BCM/yr on an annualised basis, 7 BCM lower than 2019's level of 26 BCM due to oil output constraints under the OPEC+ agreement. Captured gas volumes have also suffered, even though flaring has seen a noticeable reduction; from 13 BCM flared in 2019, only 7.3 BCM was flared in June 2020, as oil output inched closer to the 3.6 Mb/d target set by OPEC and the MoO. Capture has been affected due to reduced associated gas producing as oil production is curtailed. This has translated

into temporary shortages of crucial feedstock for power plants in high-demand areas. However, capture volumes from international oil companies'-operated fields should not be as impacted, if carefully managed to ensure dry gas processing and extraction operations remain uninterrupted.

Major reasons for the long-running shortages are a lack of adequate facilities to process the captured gas, and limited pipeline capacity to power plants. National nameplate carrying capacity (excluding the two Iranian pipeline connections to the national gas and strategic pipelines) is ~11 BCM, though available capacity is lower. The pipeline network is about 1775 kilometres long, extending from Basrah to Mosul, but years of unrest, war, sanctions, terrorist attacks and deterioration has meant that a large part is non-operational or operates well below nameplate capacity. Carrying capacity from Iran to Baghdad and Basrah could be as high as 16 BCM, but, here too, logistical constraints and bottlenecks at receiving facilities in both cities means pipeline connectivity cannot be extended to high demand areas without further investment. Moreover, several state-run oilfields still lack gas pipelines connecting them to processing units, even though these fields may produce significant associated gas²⁵.

24. Non-associated gas is gas that comes from pure gas reservoirs that are not connected with petroleum in liquid form, unlike associated gas, which refers to the natural gas found in solution in oil within an oil reservoir (see footnote 5).

25. Harvard University's Belfer Center and Rice University's Baker Institute Center for Energy Studies, "The Geopolitics of Natural Gas: Natural Gas in the Republic of Iraq", November 2013

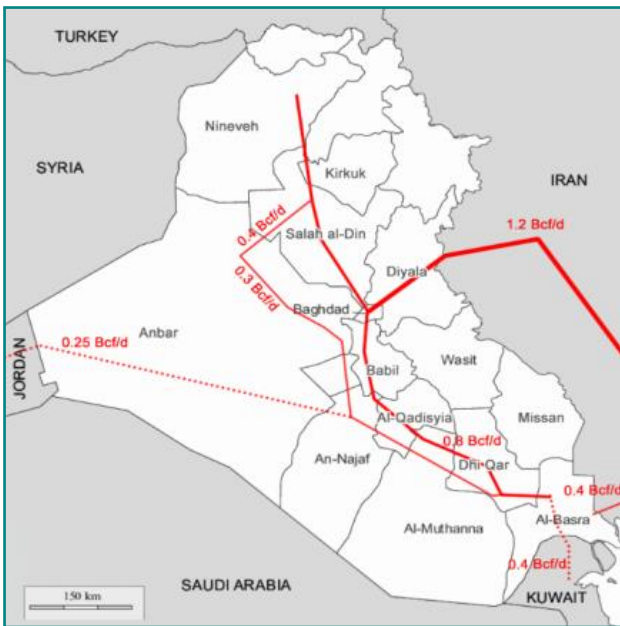


Figure 3 Federal Iraq gas pipelines network²⁶

In 2018, the MoO signed a partnership agreement with drilling services firm Baker Hughes to capture up to 2 BCM of natural gas from the Nassiriya and Gharraf oilfields, and a 1 BCM capture deal with Orion Gas for the Nahr bin Omar oilfield, in April 2018. Baker Hughes’ natural gas capture project was to be a two-phase programme, and the first of its kind based on the MoO’s EPCF (Engineering, Procurement, Construction and Finance) contract.

Under Phase-1, the project was to support the development of an integrated natural gas complex in Nassiriya, followed by an expansion of the complex into a complete facility that would refine dry gas, liquefied petroleum gas and condensate under Phase-2. All captured and processed dry gas would power Iraqi power plants in the south to reduce expensive imports from Iran. The project with Orion Gas was to be developed on the same terms, in line with Iraq’s commitment to eliminate routine flaring by 2030 under the United Nations and World Bank ‘Zero Routine Flaring’ initiative, but both projects had an extensively long negotiation period, with final decision still not taken by

December 2018.

The Basrah Gas Company (BGC) has plans to increase capture to 16.5 BCM by 2023, while a joint venture agreement with American firms Honeywell and Bechtel for a new flared gas capture facility, the Ratawi Gas Hub, was signed in July last year, to capture 3.1 BCM of associated gas from Lukoil-operated West Qurna-2, and state-run fields Ratawi, Majnoon, Luhais, Tuba, and Subba between the Basrah and Dhi Qar provinces. Disagreements over the leadership of the joint-venture agreement led Bechtel to quit the project, and other competitors, including a consortium of General Electric, Iraq-owned engineering firm Uruk, Acwa Power, and possibly Saudi Aramco, have expressed interest in reviving negotiations for the gas hub. But even with a rapid agreement, delivery of significant additional processed gas will take several years.

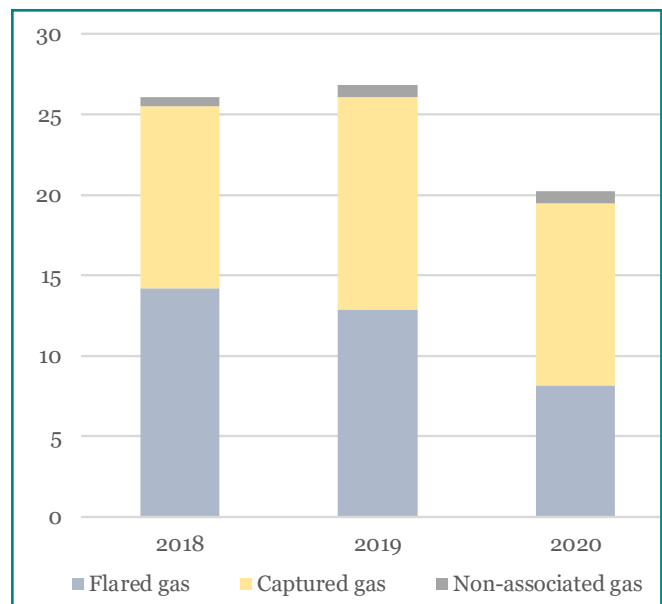


Figure 4 Flared gas production in Iraq (excluding Kurdistan region), BCM²⁷

Concerted efforts to develop gas resources could result in narrowing the gap between electricity demand and supply by 2025. To this end, six oil and gas field development

26. Qamar Energy Research

27. Qamar Energy Research

4. NATURAL GAS DEVELOPMENT REMAINS SLOW

contracts from Bid Round-5, held in April 2018, were signed in January 2020 under former Prime Minister Abdel Mehdi's tenure. These could add 7.6 BCM/yr of new gas from the bid's gas plays, which include two blocks in the Diyala province, Gilabat-Qamar and Khashm al-Ahmar-Injana, and the Khider al-Mai block on the Kuwaiti border²⁸. The shallow depth of reservoirs at Khashm al Ahmar-Injana could encourage quick development, as well as its being located in proximity to the Khor Mor gas field in the autonomous Kurdistan region and its surrounding infrastructure.

The current period of low oil prices, under US\$ 45 per barrel, however, will blunt investments in the sector. A rise in security incidents by Islamic State (IS) militia in and around Diyala could undercut start-up of operations. Sharjah-based oil and gas company, Crescent Petroleum, who holds the rights to both fields as well as Khor Mor and the nearby undeveloped Chemchemical field, has indicated it could develop its Bid Round-5 wins by 2023. Given lengthy delays in other Iraqi field developments and the impact of low oil prices and the pandemic, this appears exaggerated. Nearby Mansuriyah can offer 3.3 BCM/yr for surrounding power plants if fully developed, supplying gas-short Baghdad and the northern provinces. Under domestic efforts, it could reach first output of 1 BCM by 2025, but remains undeveloped, even though a Ministry-established "Energy Council" has been put together "to secure financing" in an attempt to bring in international companies. Finally, there have been discussions with the government of the autonomous Kurdistan region to "import" gas, probably from Khor Mor and/or Chemchemical, estimated to take 6-12 months from agreement to build the required pipeline. Another recent agreement has been for 450

MW of electricity supply directly to Federal Iraq from the Bazian power station between Chemchemical and Sulaymaniyah, likely via an existing 400 kV, single circuit transmission line to Baghdad. However, this is subject to fuel provisions for the plant (if surrounding fields are developed in a timely manner), which currently has a nameplate 500 MW capacity and supplies the surrounding region. The agreement might progress once Bazian increases capacity to 750 MW, allowing it to meet demand as planned 200 MW imports from Turkey commence²⁹.

In 2013, Iraq signed a deal with Iran to import 50 million cubic metres of gas per day (Mcm/d), divided equally between Baghdad and Basrah. Imports were held up by insecurity in Diyala and attacks on crews constructing the pipeline to Baghdad, but began in earnest in June 2017, and have since averaged between 4-5 BCM, even though the deal allows for imports of up to 18 BCM to meet peak demand. A major reason for this is the high price of the Iranian natural gas, which is oil-linked, and at current Brent crude prices is around US\$ 5.1 per million British thermal units (MMBtu), plus domestic tariffs. For comparison, current spot LNG prices for delivery in October 2020 were about US\$ 4/MMBtu, while contractual prices paid for dry (processed) gas from BGC are around US\$1.7/MMBtu at current Brent crude levels³⁰. Nevertheless, the price paid to Iran is still far cheaper than the alternatives of fuel oil and diesel, which Iraq still relies on for much of its power generation.

Iran was able to negotiate these relatively high prices since Iraq does not have LNG import facilities (and LNG prices have historically been higher than current levels), and there have been no other ready suppliers of pipeline gas in Iraq's

28. Middle East Economic Survey

29. Harry Istepanian, <https://twitter.com/HarryIstepanian/status/1288398525080825857>

30. Spot prices are market-based prices and more volatile than oil-linked gas prices, and more accurately reflect the seasonality of demand and occasional supply disruptions. Oil-linked prices face a delayed impact of market disruptions, because they incorporate (typically) a 3-month backdated average of the Brent or Japan import crude price. For deliveries to Asia, oil-linked pricing is delayed twice, also because crude cargoes can take up to 4 weeks to arrive, and pricing for them is determined based on the loading dates.

neighbourhood. Delays in payments have also resulted in gas supplies being shut-off by Iran in the past, even though under current circumstances, the Islamic Republic will be relieved to continue sending its gas to Iraq in order to earn some much-needed export revenues.

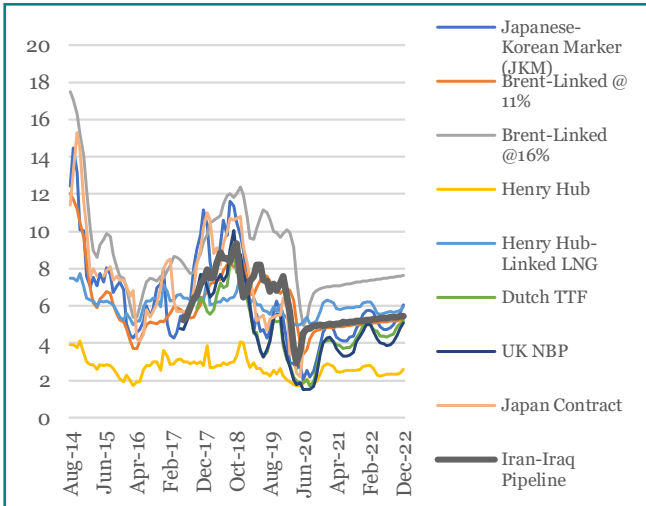


Figure 5 Iran-Iraq pipeline gas price versus global LNG, US\$/MMBtu³¹

Pressure from the US to diversify its gas supply saw Iraq receive only a 30-day waiver in March to continue importing Iranian gas, even though this was extended into a 120-day waiver in May, due to Washington’s wish to support the new Al Kadhimi government and the double whammy of high coronavirus cases and lack of funds for developing natural gas resources. Even before the re-imposition of US sanctions against Iran, Iraq had been facing diplomatic pressure from American channels to undertake concerted development of its natural gas assets, both associated and non-associated, in partnership with US companies.

31. Qamar Energy Research

5. THE CHALLENGED POWER-GAS NEXUS

5. THE CHALLENGED POWER-GAS NEXUS

The electricity system in Iraq is effectively split in two, with the semi-autonomous Kurdistan region operating its own sector. Both Federal Iraq and KRI have a state-owned sector run by their respective Ministries of Electricity with a monopoly over transmission and distribution.

However, generation in Kurdistan is mainly via independent power producers (IPPs) contracted to the Ministry there, whereas the federal MoE operates most of its own generation, with a limited use of IPPs, which started to generate in 2017. In contrast to Federal Iraq, Kurdistan has managed to establish a reasonably reliable electricity service, powered by gas and some diesel, even though the fiscal burden has been heavy. For instance, diesel for the Dohuk power plant is estimated to cost US\$ 100 million per month more than gas would³². However, electricity provision is ~15 hours daily, compared to the southern parts of Federal Iraq, where power supply is only 5-8 hours daily currently. In July 2020, the 300 MW fuel oil-powered Khabat plant near Erbil began operations, which should somewhat improve availability in the Kurdistan region³³.

Iraq's electricity problem is centred around a chronic inability to match supply with demand. In 2019, peak demand was 26 GW, 58% higher than generation capacity. Shifting demographics, as the population grows and people migrate from villages to larger cities and major metropolises, expanding use of air-conditioning, rising summer temperatures due to climate change, and catching up to suppressed demand, could result in peak demand crossing 37 GW in the next 5 years³⁴, even though GDP shall face a sharp contraction in 2020 (-4.7% according to the World Bank). Other studies

suggest that the rise of population could have peak demand reach 50 GW by 2030³⁵.

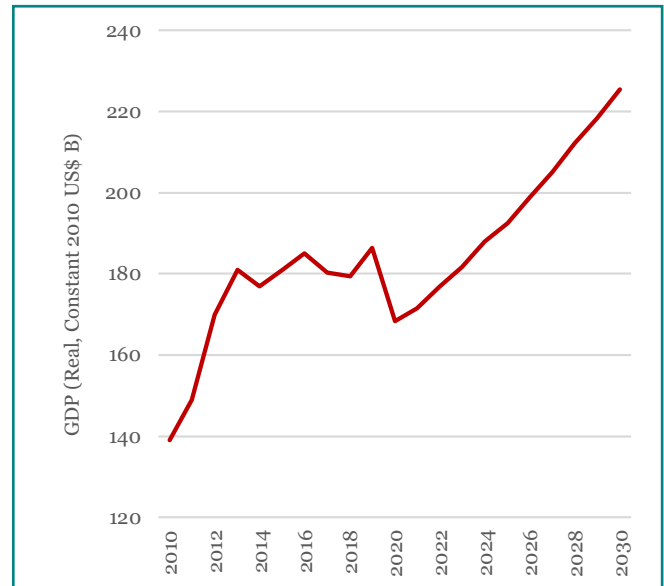


Figure 6 Iraq's GDP forecast to 2030, US\$ B³⁶

Almost all marketed gas in Iraq is used for power. Most of current installed capacity is gas turbines (which can run on gas or diesel) and steam turbines (which can run on gas, diesel, fuel oil or crude oil). These are inefficient. The country has fewer than 10 more efficient combined-cycle gas turbines (CCGTs) currently, most running below capacity due to transmission constraints, breakdowns, and lack of fuel. Most of the new capacity being installed is higher-efficiency CCGTs (including conversions of existing plants). Also, over 40% of the current CCGTs are located in the central provinces, the centre for transmission losses and technical faults, or further up north, around Mosul and Kirkuk, which have limited connectivity to the grid because of sabotage and lack of maintenance.

An independent power producer (IPP) programme, al-Samawa, aimed to jump-start

32. World Bank, 2015

33. Kurdistan Regional Government, 14 July (2020), <https://gov.krd/english/government/the-prime-minister/activities/posts/2020/july/prime-minister-masrour-barzani-opens-300mw-steam-power-station-in-khabat/>

34. Qamar Energy Research; author's calculations

35. Parsons Brinckerhoff

36. World Bank; Qamar Energy Research

the market was first launched in 2010, with the 750 MW al-Samawa CCGT power plant to be the first to be established under the scheme. A decade later, and the plant is yet to achieve completion, with industry onlookers expecting commission only in 2025. However, IPPs have gone into operation at Rumaila near Basra, under Shamara Holding (1500 MW, and targeting 3000 MW eventual capacity); and Besmaya at Baghdad (Mass Global and GE, with Phase 3 to take capacity to 4500 MW).

The Ministry also planned a large programme of solar power, Iraq's first significant renewable generation other than hydropower. An initial tender in July 2019 was for 755 MW of solar capacity across seven sites. An earlier (and too low) feed-in tariff of 3.5 USD/kWh was scrapped, with the country moving to the auction-based model successfully deployed elsewhere in the region. However, these have not progressed further following the change of government, and with investor concerns over financial guarantees.

In September 2019, the government signed an agreement with the Gulf Cooperation Council Interconnection Authority for 500 MW of supply, to be connected via Kuwait³⁷. There are also plans for a 300 MW connection with Jordan. In July 2020, the electricity ministry announced plans to buy 450 MW from Kurdish firm KAR Group and 200 MW from Turkey (see 4), and said that 80% of the link to Kuwait was complete³⁸.

³⁷. Kate Dourian, "Iraq's Electricity Challenges Mount as Oil Revenue Slows to a Trickle", Arab Gulf States Institute in Washington, May 15 (2020), <https://agsiw.org/iraqs-electricity-challenges-mount-as-oil-revenue-slows-to-a-trickle/>

³⁸. Dania Saadi, "Iraq to import power from Turkey, Kurdish company to address severe shortages", SP Global Platts, July 28 (2020), <https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/072820-iraq-to-import-power-from-turkey-kurdish-company-to-address-severe-shortages>

6. SOLUTIONS LACK FOCUS ON GRID REINFORCEMENT

Failures of the Iraqi power sector policy can be broadly grouped into four categories. These include, first, a fixation on increasing generation capacity to meet demand to the neglect of fuel, maintenance and grid improvement; second, poor or non-existent demand side management (DSM) measures; three, a failed tariff collection system; and lastly, lack of interest in utilising alternative and/or renewable energy sources.

The most immediate challenge for non-Kurdistan Iraq, though, is less in generation capacity, and more in distributing fuel supplies to power plants, and improving the power transmission system. Nameplate capacity in 2018 was about 30.3 GW³⁹, more than enough to meet demand, but much of this was unusable because of war damage, lack of maintenance and fuel shortages. Peak generation was about 19 GW in summer 2019, plus 1.4 GW of electricity imports from Iran, compared to estimated peak demand of ~26 GW. The difference is met by power cuts and the use of distributed neighbourhood diesel generators, which receive fuel at subsidised prices. Funding of the electricity sector has lacked coherent strategy since 2003, and efforts have been directed more to developing new generating capacity, rather than upgrading and expanding the country's dilapidated transmission and distribution (T&D) network.

The main outline of Iraq's transmission grid is shown in Figure 7. It has about 5200 km of 400 kV grid and 12500 km of 132 kV grid. This links to the distribution grid at 33 and 11 kV via 132/33/11 kV substations⁴⁰. Challenges associated with the transmission grid are mostly technical in nature. These include, majorly:

1. Long single-phase lines: Transmission line protection for long single phase lines is a complex challenge, particularly in Iraq,

due to various technical difficulties. These include low short-circuit current level and high line loading operating conditions, need for single-pole recloses and neutral reactors, and poorly developed communications schemes. Limited capabilities of the MoE and lack of locally trained experts further compound the problem.

2. Unbalanced loading: High-demand centres like Baghdad and most of southern Iraq, as well as the industrial sector, have a higher number of unbalanced loads, which consume large amounts of reactive power. This results in a degradation of power transfer capability of the transmission lines, simultaneously causing under-voltage problems. Typically current is increased to maintain power supplied to the load, which results in entire transmission lines going off.
3. Poor standard of equipment: Transmission equipment in Iraq is decades old, which increases the stress on the grid and the risk of widespread blackouts. Also, local capabilities in developing transmission equipment (such as transformers, switchgear, and high voltage technology) are extremely limited, with the power sector relying almost entirely on foreign firms.
4. Improper earthing: Electricity supply systems in Iraq are improperly earthed, affecting not only the magnitude and distribution of short circuit currents through the system, but also human safety. Improper earthing, alongside faulty electrical wiring, has resulted in scores of transmission-related fires, in some cases also causing human fatalities.
5. Limited connectivity: Even though Iraq's grid stretches from Mosul down to Basrah, over 1/5th of the network is unusable due to years of conflict and lack of maintenance. Major congestion is apparent in central

39. Iraq's Power Conundrum: How to Secure Reliable Electricity While Achieving Energy Independence, <https://blogs.lse.ac.uk/mec/2020/03/24/iraqs-power-conundrum-how-to-secure-reliable-electricity-while-achieving-energy-independence/>

40. <https://wbgeconsult2.worldbank.org/wbgeect/download?uuid=c2fa7598-bbod-49d7-90df-8b2669aca7e8>

Iraq, in and around Baghdad, where other non-technical losses of electricity take place, such as rampant theft and “hooking”. Most of western and northern Iraq has poor connectivity, and needs significant expansion to accommodate power imports, as well as technical expertise on design details, line length, and operating conditions. Typical line losses of electricity, currently, are in the range of 4-8%⁴¹.

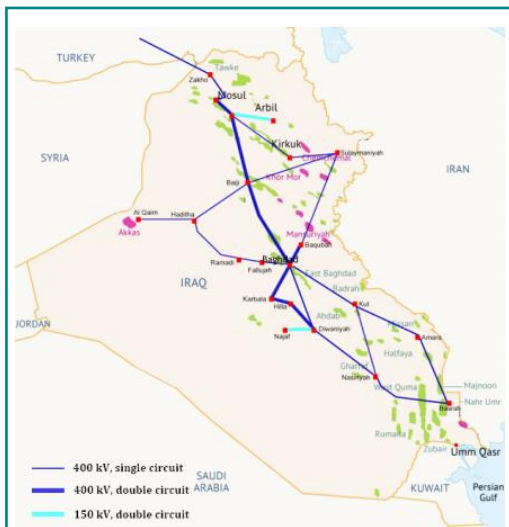


Figure 7 Iraq's electricity transmission network⁴²

These challenges have increased since 2003, but have historically received little focus from previous cabinets. Under the largely technocratic Abdel Mehdi government (October 2018-May 2020), minister Luay al-Khatteeb oversaw significant improvement in both generation and T&D (as visible in Figure 1), but was not in position long enough to make longer-term gains. New electricity minister, Majid Mahdi Hantoush, also a technocrat, recently hailed the “importance of electricity imports” from neighbouring Iran, and renewed the power import contract from the Islamic Republic for another two years, stating that Iraq would draw on Iran's expertise to fix its old and dilapidated power grid⁴³. However, this seems more a sop to a vague memorandum of understanding (MoU) signed between both countries in December 2018 for “cooperation”

in the energy sector, rather than an actual commitment to receiving support from Iran. The recent US\$ 1.2 B deal signed with GE for reinforcing the country's grid and rehabilitating power plants in and around areas discussed under the Iranian meetings (such as Karbala and Najaf), speaks to this fact.

In 2019, the Ministry unveiled plans to finance a US\$ 3 billion upgrade of the T&D network (US\$ 2 billion for transmission and US\$ 1 billion for distribution) to make the grid capable of delivering at least 20 hours of electricity across the country. The plan failed to receive approval from the Council of Representatives following then-Prime Minister Abdel Mehdi's exit from his post. Lack of central government funds means the MoE cannot finance this upgrade, as current electricity tariffs cover almost nothing of costs. Moreover, the MoE has complained about the absence of a supportive regulatory, institutional framework necessary for reform, which, alongside general corruption and political lobbying, reflects on the poor performance and management of the sector.

Developing new interconnections and upgrading the grid network into a modern power system (PS) capable of supplying near-24 hour power is a complex process. The existing grid is continuously subject to sudden changes in load demand, short circuit faults, equipment outages and generator failures, as well as weather damage and sabotage⁴⁴, and regional subdivisions of the MoE (Table 1) are ill-equipped to successfully manage contingencies. Yet billions of dollars have been injected into expanding existing capacity as a stopgap solution to Iraq's chronic demand problem. The country has planned 14 new combined cycle power plants (or CCGTs) by 2025, with a total design capacity of ~13 GW, but has not considered grid stability and design to support these. These new plants will require an additional ~18 BCM of gas, on top of current sales gas volumes of 14 BCM, to be

41. Qamar Energy Research

42. Qamar Energy Research

43. Financial Tribune, “Iran, Iraq Power Export Contract Renewed for Two Years”, June 05 (2020)

44. Khalid al-Taie, “Iraq repairs power lines blown up by ISIS”, Diyaruna, May 06 (2020)

6. SOLUTIONS LACK FOCUS ON GRID REINFORCEMENT

able to fire at capacity. The main associated gas projects would add 12.1 BCM, and Mansuriyah plus the 5th-round fields another 10.9 BCM. In theory, this could be sufficient, but it demands much more rapid progress than has been made historically, at a time when the Iraqi government has virtually no investment funds.

Table 1: Ministry of Electricity’s Regional Subdivisions⁴⁵

	Supply	Transmission	Distribution
North	General Company of Electricity Production, North Region	General Company of Electricity Transmission, North Region	General Company of Electricity Distribution for the North
Central	General Company of Electricity Production, Middle Region	General Company of Electricity Transmission, Middle Region	General Company of Middle Electricity Distribution
Euphrates	General Company of Electricity Production, Al Furat Region	General Company of Electricity Transmission, Upper & Middle Euphrates Region	General Company of Baghdad Electricity Distribution
South	General Company of Electricity Production, South Region	General Directorate of Electricity Transmission, South Region	General Company of South Electricity Distribution

Achieving satisfactory performance from the electricity grid, could, according to current estimates, take anywhere from 10-12 years⁴⁶ (Figure 8), a lengthy timeline. The MoE, in 2010, put together a short-term plan for developing 400 kV systems that could carry 400 MW on a single line, or 800 MW on double lines. This is yet to be realised, with current efforts, under Siemens, concentrated on reconfiguring existing 132 kV systems around Baghdad to overcome high fault problems. Most of north and north-west Iraq remains omitted from efforts to rehabilitate infrastructure after

suffering severe damage under the occupation of ISIS.

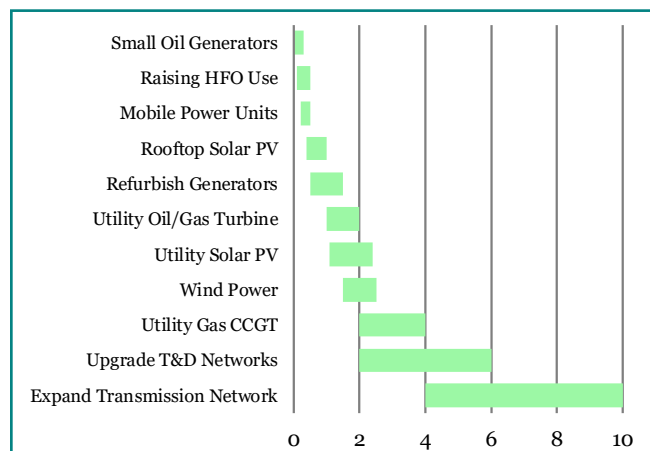


Figure 8 Best Technology for Improved Electricity Supply by Years to Complete⁴⁷

T&D losses are between 40-50%, with up to 90% of these attributed to distribution losses, including technical losses, and non-technical ones like theft, non-billing, faulty energy meters and tampering, and hooking/tapping on transmission lines. Lack of maintenance and spares, and unplanned capacity growth add to technical losses. For comparison, T&D losses in Iran are about 12.6%, and the world average is ~8%⁴⁸.

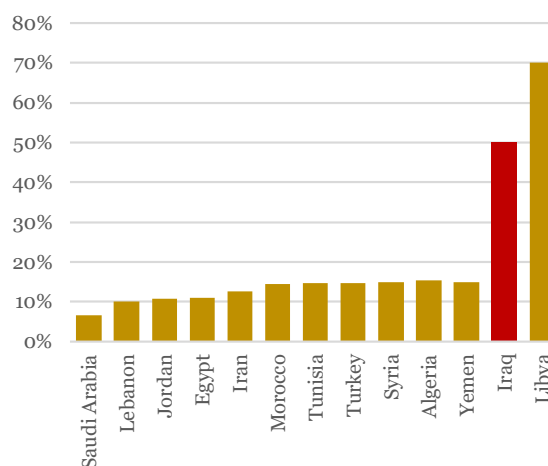


Figure 9 T&D losses in the region⁴⁹

45. Ministry of Electricity, Iraq

46. Iraq Energy Institute

47. Yesar Maliki, Iraq Energy Institute

48. Poudineh, Sen, & Fattouh, “Advancing Renewable Energy in Resource-Rich Economies of the MENA”, 2016

49. P. K. Mallick, “Iraq’s Electricity Sector is Caught in the US-Iran Power Struggle”, 14 December (2018),

Including losses and non-payment, about two-thirds of generated power is not paid for. About 23% of generated electricity is lost to illegal connections. Meters are often outdated or malfunctioning; about 80% of meters are more than 30 years old and some have never been recalibrated. Even customers who pay their bills are only covering about 10% of the real cost of electricity provision, making it impossible for the MoE to stand on a commercial basis⁵⁰. This requires continuing large budget transfers, with electricity subsidies costing about US\$ 12 billion annually⁵¹. Inefficient management and operation of the distribution sector is a key contributor to the issue, and a lackadaisical attitude towards subsidy reform, net metering, and privatisation compounds the issue. End-user metering is very poor, made up of outdated and malfunctioning meters and widespread theft or unmetered connections. According to the Ministry of Electricity, there were over 160 000 unmetered customers in 2015⁵², likely an underreported figure, and much higher in 2020.

Because current tariffs for electricity (Table 2) are near-zero for regular consumers, demand is essentially infinite⁵³. The ongoing demand on power generation cannot be tamed through DSM measures without immediate restructuring of tariffs (see Section 8).

Table 2 MoE Current Tariff Scheme⁵⁴

Tariff US\$ Cent per kWh	Range of consumption level
Domestic	
0.8	1-1500 kWh
2.9	1501-3000
6.7	3001-4000
10	4001 and more
Commercial	
5	1-1000
6.7	1001-2000
10	2001 and more
Industrial	
5	Flat rate
Agriculture	
5	Flat rate

Privatisation of distribution has regularly been cited as the first step of a potential reform policy. However, caution precedes privatisation reforms. According to former Minister of Electricity, Luay al-Khatteeb, the government believes privatising the sector is akin to a “radical” reform, which might cause widespread opposition from political hardliners, or put thousands of civil servant employees out of employment⁵⁵ in a country where unemployment levels have soared in recent weeks due to coronavirus-led lockdowns.

referenced Stratfor (2018), World Bank, World Development Indicators; Harry Istepanian, “Iraq’s Electricity Tariff Reform”, Iraq Energy Forum, September (2019), referenced World Bank Group data (2014)

50. Al-Khateeb, 2020

51. Mehdi and Al-Saffar, “Compounding crises: Iraq’s oil and energy economy”, Oxford Institute for Energy Studies, July 2020

52. World Bank

53. Luay al-Khatteeb, “Fixing Iraq’s Power Sector”, Iraqi Economists Network, August 22 (2020)

54. Barik Schuber, “Main Policy Failures and the necessity of effective reforms of the Iraqi Power Sector”, Iraqi Economists Network, August 23 (2020)

55. Luay al-Khatteeb, Harry Istepanian, “Turn a Light On: Electricity Sector Reform in Iraq”, Brookings Doha Center (March 2015), 4-5

7. RENEWABLE ENERGY IS STILL A PIPE DREAM

As can be seen in Figure 8, an obvious part of the solution to Iraq's electricity crisis is renewable energy. The country has a good variety of renewable resources, including exploitable hydropower, abundant sunshine on unused land, and good wind speeds in certain areas. Given chronic power shortages and difficulties with natural gas development, distributed renewables could become an economic and practical part of the generation mix. However, integrating renewable energy with the existing national grid shall pose a significant challenge, even if significant power capacity is developed. Remote areas such as Anbar, good sites for solar photovoltaic plants, will either require extended connections to the grid, or battery storage.

A small amount (36.5 MW) of solar PV was installed during 2013-14, and parts of Baghdad feature solar street-lighting. There are also some rare cases of solar cells being used in residential units. The INES foresaw 2 GW of renewables by 2030, including new hydropower. However, it rejected large-scale solar on the grounds that it was (then) too expensive compared to natural gas resources, even though the MoE subsequently planned 50 MW solar/wind hybrid plants in remote locations, where they would be competitive with diesel generators. Following the defeat of ISIS, the Iraqi government issued a long list of projects for international investment and reconstruction, including 410 MW of solar power, as well as a solar research and manufacturing centre. The MoE's own projections showed 2.7 GW of solar PV being installed between 2017-20 (excluding KRI, and northern provinces). Projects were awarded to some regional companies: 465 MW in five locations to Sama Baghdad, and 230 MW in four locations to Kuwait-based al-Dana International. However, in the absence of a

clear plan, priorities and an investment model, these did not go ahead.

Currently, Electricity Law (53) of 2017 regulates the adoption of renewable energy, its activities and "nationalisation" under the MoE. A subsequent draft Renewable Energy Law was passed through the MoE to the Iraqi Ministerial Energy Council, the highest executive energy body in the country. The Law was prepared with the help of the UNDP Regional Renewable Energy Centre, but is yet to be finalised, leaving the MoE as the executive authority controlling the development and financing of renewable energy projects in the country. Under the Law, institutions and individuals can generate renewable power for their own use, with access to the national T&D grid or to sell to the MoE under a PPA. This led to numerous companies approaching the MoE with offers for solar projects, and a feed-in tariff was established at \$ 3.5/kWh, inspired by the low prices achieved in some neighbouring countries. Low-interest loans were also offered for rooftop solar installations⁵⁶.

However in May 2019, the feed-in tariff was abandoned after criticism for being "repressive", and instead the MoE launched a competitive tender for 755 MW of solar PV across several sites (two solar parks of 300 MW and 225 MW capacities, and 5 smaller projects, ranging in size from 30-50 MW), pre-qualifying 45 bidders, including companies like Total, Siemens, and Acwa Power. Bids were received for this on 1st September, but it is unclear whether an award will be made before the scheduled elections in June 2021. Later in the year a Ministry advisor revealed plans for another 750 MW to be launched in the first quarter of 2020⁵⁷, in line with plans for renewables to account for 20% of the generation mix by 2030. Encouraged by their home governments, Saudi Arabia's Acwa Power and the UAE's Amea Power proposed renewable energy projects in Iraq as part of

56. Yesar al-Maliki, 2020

57. Emiliano Bellini, "Iraq plans second 750 MW solar tender", PV Magazine, November 27 (2019)

supporting the government and offsetting Iranian influence. Acwa Power proposed two 1 GW solar projects; one would be based in Saudi Arabia and export to Iraq at a tariff of USD 1.65/kWh, while the other would be in Iraq with a tariff of USD 6.5/kWh, reflecting the difference in business risk between both countries.

Since then, Iraq has faced major turmoil, with several candidate prime ministers abandoning their posts after Abdel Mehdi resigned. Progress on renewable technologies has therefore been slow, with most projects still a pipe dream at this stage. Distributed solar power would seem to be an ideal initiative for Iraq, but opposition from the “generator mafia”, politicians with stakes in local diesel generators, and poor progress on electricity tariff reform, will keep this from transpiring anytime soon. Financial and economic constraints are often cited by political hardliners opposed to uptake of renewable projects, while structural constraints, such as a lack of legislative, executive, and relevant authorities, apart from the MoE, to encourage the production and use of renewable advanced technologies for energy production, will continue to contribute to the poor attractiveness of the sector. Technical challenges, such as grid extension and reinforcement, and limited local capabilities in unique renewable energy markets, such as firming, frequency regulation, and peak shaving, shall add to limited uptake.

