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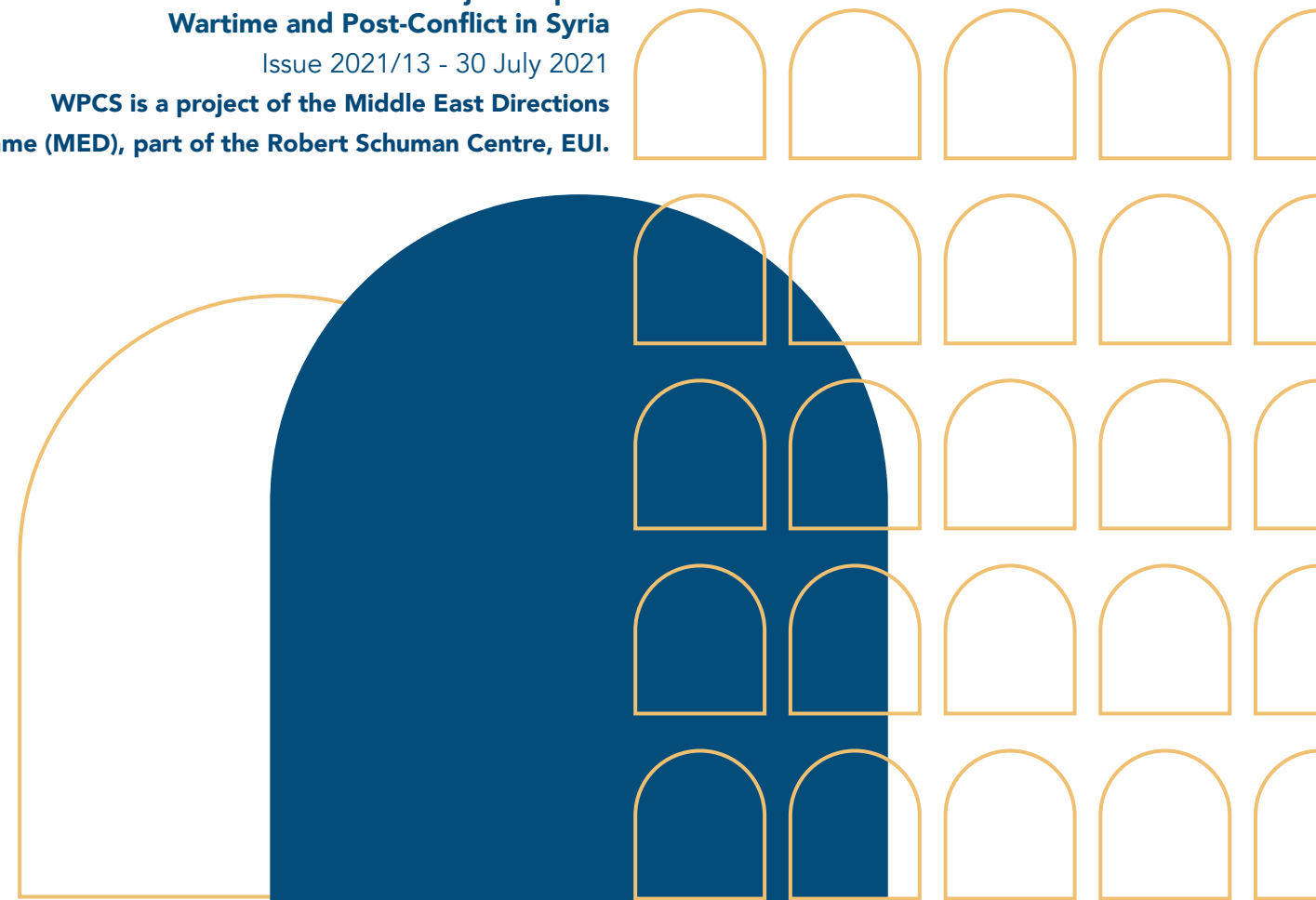
# Syria's Electricity Sector After a Decade of War: A Comprehensive Assessment

**Sinan Hatahet and Karam Shaar**

**Research Project Report**
**Wartime and Post-Conflict in Syria**
Issue 2021/13 - 30 July 2021
**WPCS is a project of the Middle East Directions Programme (MED), part of the Robert Schuman Centre, EUI.**



Published by
European University Institute (EUI)
Via dei Roccettini 9, I-50014
San Domenico di Fiesole (FI)
Italy

Funded by
the European Union

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**Sinan Hatahet* and Karam Shaar****

* Sinan Hatahet is a senior research fellow at the Sharq Forum, Omran for Strategic Studies and a research associate in the Wartime and Post-Conflict in Syria project in the Middle East Directions programme at the Robert Schuman Centre for Advanced Studies (EUI). Hatahet's research interests include the dynamics of Syria's national and local economies; non-state actors; the Kurdish political movement; and the emerging regional order in MENA.

** Karam Shaar is the Research Director of the Operations and Policy Center and a Non-Resident Scholar at the Middle East Institute. His research focuses on Syria's political economy.

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# Executive Summary

Before the 2011 conflict, Syria's electricity infrastructure was barely functional. There were high production and transmission losses with frequent load shedding, especially in the summer. Syria had poor structural and performance indicators: power losses stood at nearly 26% and there were 43 days of power outage per year. Tariffs were low due to heavy government subsidies.

However, ten years of war has worsened matters considerably. *Per capita* consumption of state electricity is 15% of what it was in 2010. For instance, in the first half of 2021, Aleppo had ten-hours of rationing for every hour or half an hour of power; Damascus had, instead, five "dead" hours for one hour of electricity. The damage to the grid and substations can be fixed at reasonable rates with local expertise. This is not the case, though, with power generation plants. The conflict saw four of the 14 plants suffer serious damage, representing nearly 18% of the pre-war installed capacity nationwide. Two other plants near Hama and Damascus have also been damaged but have since been partially repaired.

In 2021, the Ministry of Electricity estimated the sector's production and transmission reconstruction cost at USD 2.4 billion. Though difficult to quantify, indirect losses in lost output in other sectors due to electricity cuts are likely to be orders of magnitude higher. Firms in regime-held areas identify the interruption to essential services as their main obstacle to doing business.

Renewable energy use was falling even before the conflict, from 20% in the early 1990s to 5% as the conflict began. With the continued slowdown in water flow from Turkey and the failure to fix hydroelectric turbines, hydro sources contributed only 2% of public supply in 2020. While the government has made it easier for private investors to participate in the green electricity sector, especially wind and solar energy, their contribution remains negligible.

Despite much talk and numerous memoranda of understanding, very little of the production capacity has been repaired. The country's two principal backers, Russia and Iran, have shown little appetite for following through on agreements due to the government's inability to secure funding. The country's most pressing need is not restoring its production capacity, but, rather, sourcing enough fuels to reach its existing potential and fixing the damaged grid. These electric-related problems are complex and regional politics, sanctions, and technical issues all play their part. But Syria's current electricity crisis is, at base, financial.

## Introduction

Improving electricity generation and distribution were central in the modernisation narrative of the Syrian regime. Since the 1960s, consecutive Baath governments have reinforced state control over the chain of production. This has meant investing in new power plants, transmitters, and expanding the distribution grid into rural areas; all with heavy subsidies.

Up until the outbreak of war in 2011, the country had enough fuel resources to cover most of its oil and gas needs for electricity generation. However, the infrastructure needed to be modernised, with high production and transmission losses. Additionally, demand was outstripping generation capacity. This was due to a lack of investment and resulted in frequent load shedding, especially in the summer.

Neglect, robbery, vandalism, and shelling damaged electricity infrastructure during the conflict. Since 2012, failures in electricity supply have become a chronic problem affecting vital services and, with them, people's livelihoods. The lack of electricity impeded economic activity as the economy continued to contract, especially during the period 2011-2016.[1] According to the 2018 World Bank Enterprise Report, "the intermittent supply of electricity and fuel constitutes the greatest challenges for Syrian firms, with 67.5% of firms citing electricity interruptions as a major or severe problem".[2] Electricity interruptions were, in fact, the most serious reported problem across all categories. In 2021, the situation became still worse, with rationing paralysing most economic activity for hours and hours.

Assessing the needs, resources and obstacles to the rehabilitation of the power infrastructure in Syria is crucial for understanding the challenges and opportunities for economic recovery and stabilisation. In post-conflict countries such as Iraq, Lebanon, Kosovo, and Afghanistan, the electricity sector played a vital role in economic recovery. Numerous studies have investigated the performance of post-war governments in rehabilitating the electricity sector, the potential for adopting renewable energy, and the impact of informal electricity generators and producers.[3] Nevertheless, recent efforts to assess the sector in Syria are incomplete.

UN ESCWA studies published in 2016 and 2020 documented the effect of the conflict on Syria's economy.[4] The report-writers included several guiding principles and a preliminary action plan for post-war scenarios, but they did not provide a detailed analysis of the electricity sector. Similarly, a 2017 World Bank study looked at the overall impact of the conflict, but did not evaluate electricity infrastructure.[5] The Syrian Centre for Policy Research also monitored the impact of the conflict on different economic sectors, with only limited electricity supplies.

1 Rabie Nasser et al., "Justice to Transcend Conflict," Policy Report, *Syrian Centre for Policy Research*, 27 May 2020, https://bit.ly/2UU2Xc7

2 Kinley Salmon, Nabila Assaf and David Francis, "Surviving Firms of the Syrian Arab Republic: A Rapid Assessment," Policy Research Working Paper No. 8397, *World Bank Group*, 2 April 2018, https://bit.ly/3ydX6wH

3 Henrietta Moore and Hannah Collins, "Decentralised Renewable Energy and Prosperity for Lebanon," *Energy Policy* 137, 16 November 2019, https://bit.ly/2V7RnKe; Georges El-Jamal, Hussain Ibrahim and Mazen Ghandour, "Investigation of the Technical-Economic Contribution of Renewable Energy and Energy Efficiency: Lebanese Context," (paper presented at REDEC 2014, 2nd Renewable Energy for Developing Countries, Beirut Lebanon, 26-27 November 2014) https://bit.ly/2VZQBPT; Harry Istepanian, "Iraq's Electricity Crisis," *The Electricity Journal* 27, no. 4, 1 May 2014, https://bit.ly/3rJpog7; Dana Abi Ghanem, "Energy, The City and Everyday Life: Living With Power Outages in Post-War Lebanon," *Energy Research & Social Science* 36, February 2018, 36-43, https://bit.ly/378KKKd; Mohammad Ismail Khan, "Power Sector Strategy for the Afghanistan National Development Strategy," *Islamic Republic of Afghanistan: Ministry of Energy and Water*, 28 May 2007, https://bit.ly/3BeTQ5W; Roland Neifer, "Technical Assistance Consultant's Report: Afghanistan: Addendum to the Afghanistan Power Sector Master Plan," *Think Asia*, 28 November 2014, https://bit.ly/3kxALGe; Nysret Avdiu and Ali Hamiti, "The New Generation Investment and Electricity Market Development in Kosovo," (paper presented at the International Conference on Renewable Energies and Power Quality, Las Palmas de Gran Canaria Spain, 11-13 April 2011), 929–34, https://bit.ly/3rFE5AL

4 Khalid Abu-Ismail et al., "Syria at War: Eight Years On," *ESCWA and University of St. Andrews*, 2020, https://bit.ly/2VWh9RZ; Khalid Abu-Ismail et al., "Syria at War: Five Years On," *ESCWA and University of St. Andrews*, 2016, https://bit.ly/2VWwvpy

5 World Bank, "The Toll of War: The Economic and Social Consequences of the Conflict in Syria," 10 July 2017, https://bit.ly/3zaUeAF

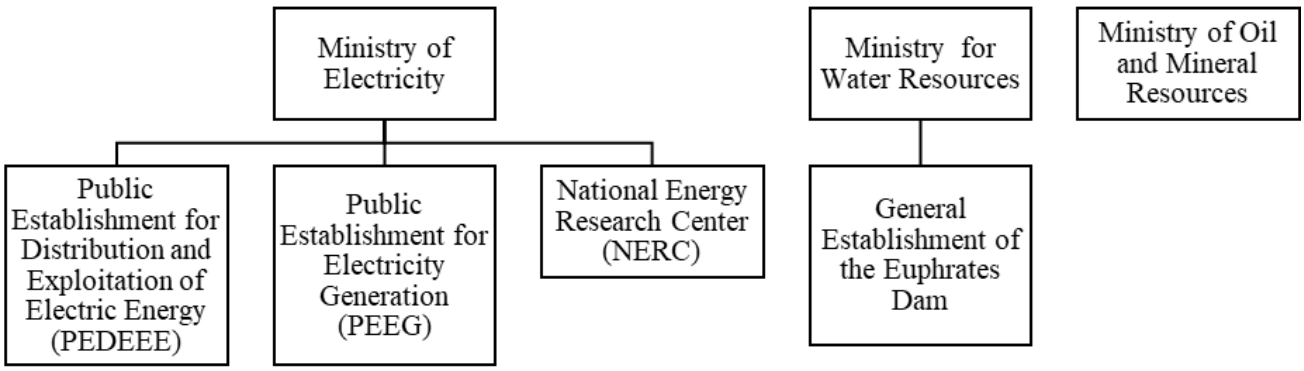
This paper provides the first comprehensive assessment of Syria's electricity sector before and during the conflict and looks at prospects for the sector. The research focuses on regime-held areas because of the centrality of Damascus in managing the electricity sector. The opposition wants autonomy in north-western and north-eastern Syria. But large-scale electricity production is not within the mandate of local authorities, and this is unlikely to change anytime soon. [6] The paper relies on compiling official annual reports published by the Ministry of Electricity, international data, analytical reports, public tenders, and news articles.

6 In opposition-held areas (Idlib and northern Syria) and AANES territory, only early recovery projects in the electricity distribution network have been attempted. In Turkish zones of influence, electricity supply has increased but notably due to service provision from Turkey, as Turkish-Syrian companies have connected the local transmission grid with Hatay and Kilis's. The SRTF - a multi-donor trust fund that serves as a channel for funding from the international community - has also financed and installed a number of small power generators to service hospitals and support some agricultural projects, principally in northern Aleppo and the AANES region. However, no major power generation capacity has been added to any of these regions. Turkey has also provided northern Aleppo and Idlib with electricity, but no major power generation capacity has been added to any of the regions outside of regime control. Sinan Hatahet, "The Recovery of the Local Economy in Northern Aleppo: Reality and Challenges," Research Project Report, (Florence: European University Institute, Middle East Directions, Wartime and Post-Conflict in Syria, 25 March 2021), https://bit.ly/3d3LaW8

# 1. Unmet Needs and Inefficiency in the Pre-War Decade

The Syrian electricity sector was a state-owned monopoly, and the main contributor to the sector was and still is the Ministry of Electricity (Figure 1). In 2010, the government started to encourage private investment in the sector but nothing had come of this by the time war broke out. After years of central control, the regime's decision to allow the private sector in was part of a wider push for liberalisation. However, a surge in private and international investment was always unlikely due to operational hurdles and due also to the lack of genuine competition.

**Figure 1: Public Electricity Sector Management Structure**




Source: Ministry of Electricity – Syria

Syria's electricity infrastructure prior to the war was facing an increasing number of challenges. There were high production and transmission losses with frequent load shedding, especially in the summer. Compared with countries at similar levels of development, Syria trailed behind both in terms of structural and performance indicators: there were almost 26% power losses;[7] and 43 days of power outage per year. Syria had low tariffs though: 4.42 USD cents per kWh.[8] The sector's ability to match growing demand was very uncertain.

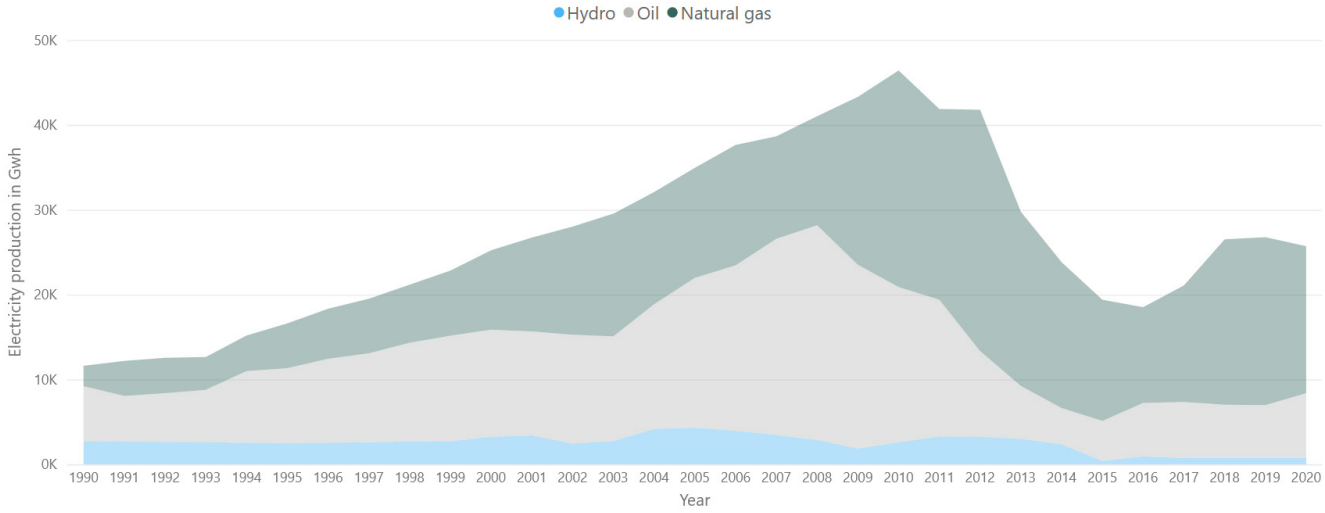
## 1.1. Increasing Dependence on Gas-Fuelled Generation

Before the conflict, there were 14 Syrian power plants, 11 of which operated with fossil fuels and the remaining three of which depended on hydro energy. Overall, as of 2010, combined-cycle turbines produced 48.9% of the total electricity supply, compared with 44.5% from steam turbines and 5.6% from hydro (see Figure 2 and the Annex for further details). Alternatives such as nuclear energy were considered but never materialised due to economic and political difficulties. The oldest plant in operation is Tabqa Dam, which has been online since 1973. The newest is the Jandar plant expansion, which was completed in 2011.

7 Public Establishment of Electricity for Generation and Transmission (PEEGT), "Annual Statistical Report - 2012" (in Arabic), 2012, https://bit.ly/3itm8kL

8 Husam Beides et al., "Syrian Arab Republic Electricity Sector Strategy Note," *Energy Sector Management Assistance Program (ESMAP), World Bank*, 15 August 2009, https://bit.ly/3wOSgo7

## Figure 2: Electricity Production by Energy Source




Source: International Energy Agency (1990-2011) and Public Establishment for Electricity Generation (2012-2020)[9]

In the early 2000s, Syria's reliance on gas for power generation increased considerably for four reasons. First, there was, from the late 1990s, a decline in domestic oil output. Second, combined cycle power plants were increasingly used due to their enhanced efficiency. Third, there was improved access to natural gas both locally and internationally. Fourth, there were logistical reasons. Oil can be easily carried in tankers. But gas requires the construction of pipelines and liquefaction stations prior to transportation. As a result, Syria exported its excess oil supply and consumed all of its locally-produced gas. Although the regime was not motivated by environmental considerations, the reliance on gas had a less negative impact on the environment as emissions produced from gas combustion are much lower than those from oil.

The key turning point in gas reliance came in 2008, as the development of new gas fields was accompanied by a sharp increase in production volume. In 2010, 10,830 million cubic metres were produced, as against 6,240 million in 2008, close to a twofold increase. While all gas production was consumed locally, from 2008, it was possible to import more gas from Egypt through the Arab Gas Pipeline.[10] This increase in access to natural gas accelerated the development of combined cycle plants, and its share of electricity generation jumped 13% from 2008 to 2011. Between 2007 and 2010, 1,050 MW was added by installing new gas-fired turbines and by expanding two existing power plants.[11]

To face its energy and electricity supply shortfall, Syria was encouraged by international development funds to explore the possibility of implementing renewable energy projects. These could have benefited from favourable environmental conditions – Syria has around 300 sunny days a year – and it also has many areas where the average annual wind speed exceeds six m/s.[12] But the Ministry of Electricity never seriously pursued this option as it wanted quicker solutions to close the demand-supply gap.

The only renewable source of energy the Syrian state adopted was hydropower generation. Hydropower generation remained, however, marginal. Poor water availability in the Euphrates (due to climate change)

9 Hydro electricity production is assumed to have not changed in 2019 and 2020 from 2018. The statistics offered by the International Energy Agency (IEA) are at odds with those from the PEEG. For example, in 2018, the former claims Syria produced 18,210 GWh, while the PEEG claims 26,514. Prior to that, the numbers matched rather well.

10 Plans to import from Iran, Iraq and Azerbaijan were also being considered.

11 The al-Nasrieh and Zayzoon power plants converted to a combined cycle in 2007, and so did Tishreen, Baniyas, and Jandar in 2009, 2010, and 2011.

12 Ahmad Al-Jamil and Gennady Ivanovich Sidorenko, "Energy Visions 2035 for Syria," *Journal of Physics: Conference Series* 1614, 2020, https://bit.ly/3BV0ApM

and restricted water flow from Turkey, meant that hydropower generation fell as a share of all electricity production from nearly 23% in the 1990s to only 5.5% in 2010. The later figures are comparable with other countries in the Middle East and North Africa, where renewable energy does not exceed 7% of the generation mix.[13]

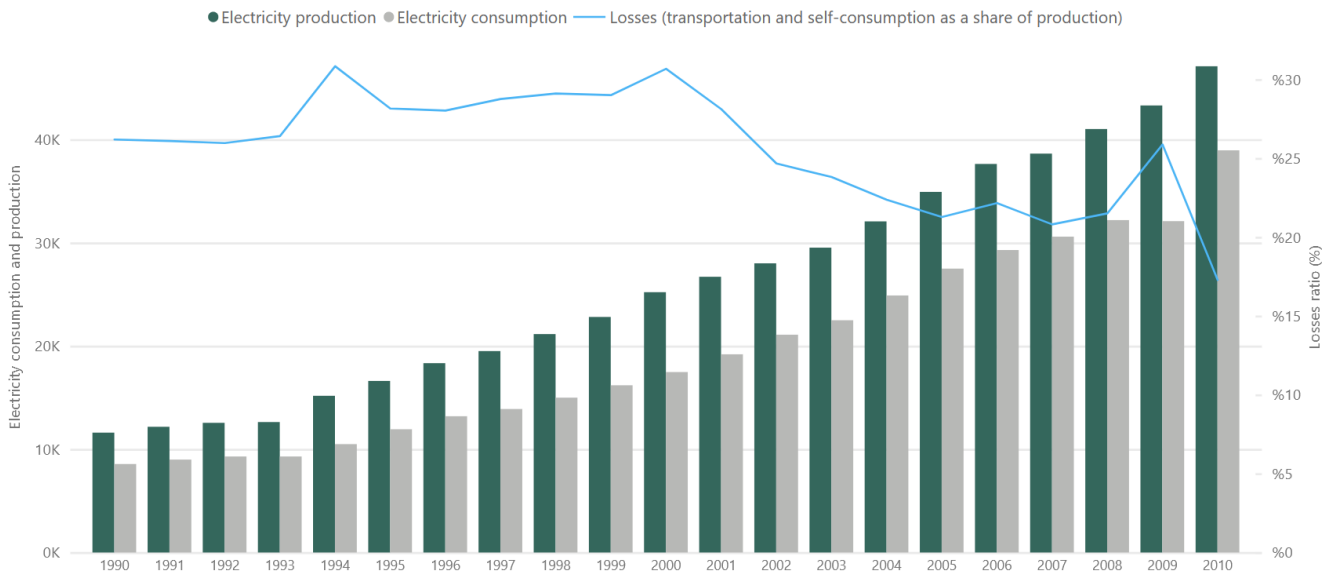
## 1.2. Lost in Transmission

The transmission grid is the second most important component of the power sector as it connects generation plants with electricity consumers. In Syria, the transmission grid mainly consisted of overhead power lines of various capacities which carried the current over long distances. The advantage of overhead cables is their relatively lower installation and maintenance costs. Their biggest disadvantage, however, is the vulnerability of its cables and towers to the weather and other external factors.

In 2010, the primary transmission grid consisted of 5,719 km 230 Kilovolt (kV) lines and 1,594 km of 400 kV high voltage lines.[14] Transmission lines with higher voltages reduce technical losses in distribution and are usually employed to connect regional hubs called “buses”. However, to make high-voltage electricity transport possible, the electricity must first be converted to higher voltages with transformers, introducing an additional infrastructure cost. In Syria, priority was given to expanding the installed generation capacity rather than to optimising electricity distribution and transmission.

While the grid reached 99% of the Syrian population,[15] it was falling behind in terms of maintenance. Over the five years preceding the conflict, total electricity network losses represented, on average, more than 20% of Syria’s total production (Figure 3). Comparable power infrastructure systems internationally tend not to exceed 8% for technical losses and 2% for non-technical losses.[16] Due to deteriorating transmission and distribution grids, technical losses represented nearly two-thirds of total losses, while non-technical losses, including theft and billing and meter reading errors, explained the rest of the deficit.[17]

**Figure 3: Consumption, Production, and Losses from 1990-2010**




Source: International Energy Agency

13 Global News Wire, “Middle East Renewables 2021 - Renewable Energy Policy,” 21 May 2021, https://bit.ly/3BcxBO1

14 Husam Beides et al., “Potential of Energy Integration in Mashreq and Neighboring Countries,” *Energy Sector Management Assistance Program (ESMAP), World Bank*, June 2010, https://bit.ly/3xOkEaZ

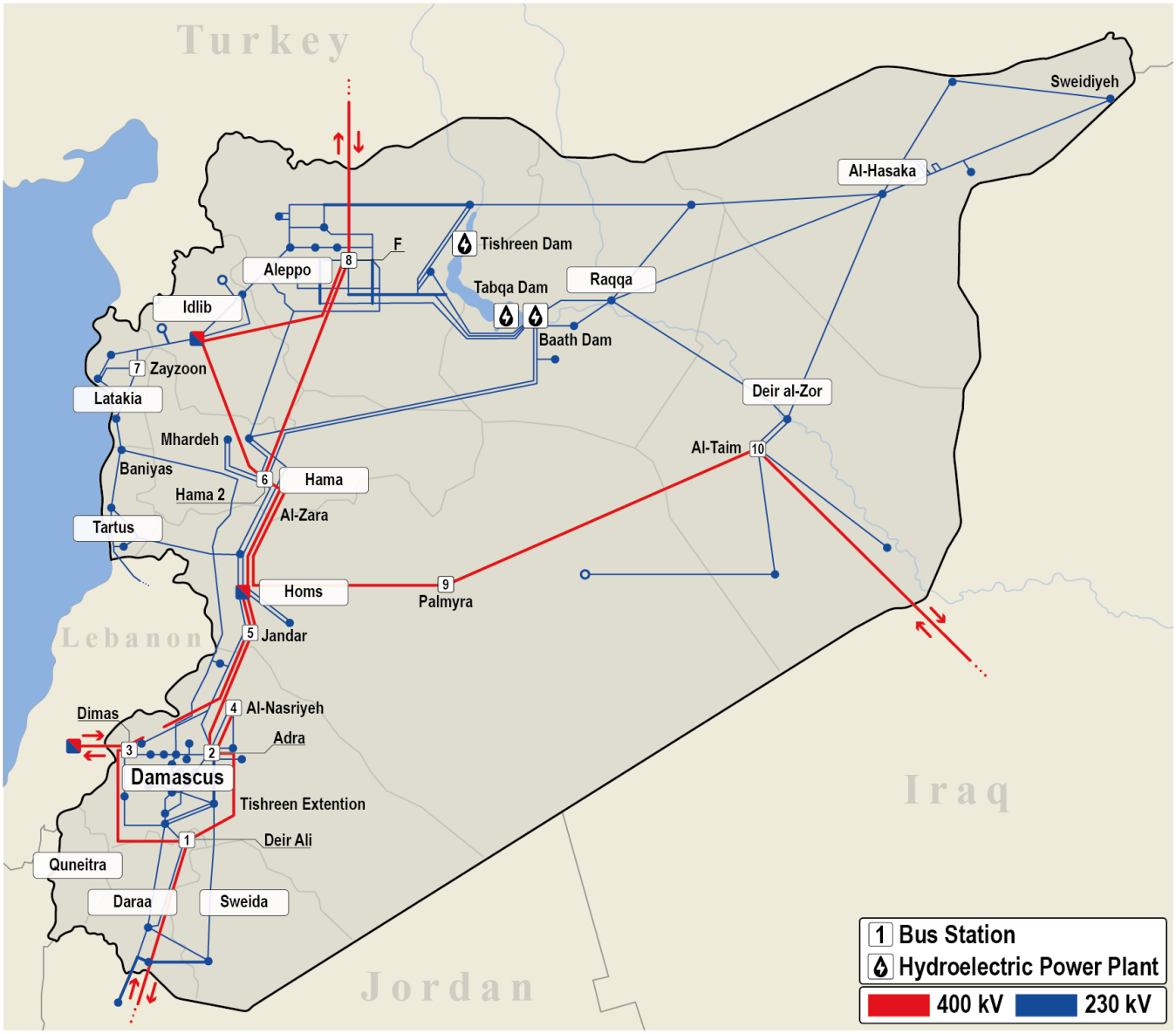
15 Rodayna Amer and Fareed Abou Hamed, “Reality and Prospects of Wind Power in Syria,” *Energy Procedia* 19, 2012, 55–62, https://bit.ly/3f76Pgr

16 Beides et al., “Syrian Arab Republic Electricity Sector Strategy Note.”

17 Ibid.

Nevertheless, 400 kV transmission lines were still used to connect the major consumption hubs to power plants. The 400 kV south-north transmission interface connected major generating plants with the transmission grid and had ten buses, while the lower 230 kV network supplied load centres (Map 1). Despite its limited redundancy in equipment and lines, the reliance on the 230 kV transmission network persisted primarily due to limited transformation capacity in substations that are feeding major load centres. Indeed, the transmission grid consists of 13 high voltage 400/230/66 kV substations, 79 smaller 230/66/20 kV substations, and 365 66/20 kV substations.[18]

### Map 1: Syria's Transmission Grid




Source: The authors based on "Analysis of the Performance of Syrian 400kV Electrical Network."[19]

Around the world, transmission lines are highly interconnected to increase electricity supply reliability. However, in Syria, most of the 400 kV and 230 kV transmission lines were designed as a single circuit. The 400 kV and 230 kV networks were constantly operated in parallel to ensure supply even when the

18 Ibid.

19 Ibrahim Alwazah, Rinat Nasyrov and Raseel Aljendy, "Analysis of the Performance of Syrian 400 kV Electrical Network," (paper presented at UralCon 2020, International Ural Conference on Electrical Power Engineering, Chelyabinsk Russia, 22-24 September 2020), https://bit.ly/3eyAsqN

transmission line was open.[20] In 2011, the transmission capacity of the 400 kV lines was 1,078 MW, a comparatively small value. This created genuine concern about the possible shortage of transmission capacity and required the construction of new transmission lines along multiple routes.

## 1.3. Demand Composition and the Supply Gap

Access to electric energy was generally satisfactory as high electrification levels had been achieved, and the bill for electric energy was, on average, a small percentage of household expenditure.[21] In 2010, the PEDEEE registered nearly 5.4 million subscribers: each of them received annual subsidies of USD 320.[22] The residential sector dominated electric consumption with layered tariffs to increase access to electric energy in rural areas and to poor neighbourhoods in cities.

In the decade preceding the conflict, the demand for electricity increased by an average of 7.5% per year. This rapid consumption growth was due, first, to significant growth in the industrial and service sectors; second, a change in household consumption behaviour with the penetration of new energy-hungry house appliances; and third, the lack of efficient energy conservation policies.[23]

Electricity demand was increasing faster than expansion in generation capacity, and this meant outages. Load shedding in 2009 was 671 gigawatt-hours (GWh), compared with 391 GWh in 2008, and was expected to grow in the following years.[24] In 2010, peak demand reached 8,600 MW leading to frequent load shedding that summer. Over the same period, the total installed power generating capacity in Syria was 9,344 Megawatt (nameplate), of which only 7,200 MW was available.[25] The difference was due to technical production losses in older technology turbines and transmission.

A report by the World Bank, in cooperation with the Syrian Ministry of Electricity in 2010, looked to the future. The report-writers estimated that about USD 11 billion of investments in new generating capacity (7,000 megawatts) and an expansion of the transmission and distribution networks would be required through 2020.[26] To meet increasing demand, other suggestions were made. These included an expansion of the generation mix, transmission grid enhancement and an increase in regional connectivity.

## 1.4. Regional Connectivity and Cooperation

In 1988, an agreement to build a regional electricity network was signed by Jordan, Syria, Egypt, Turkey, and Iraq.[27] Each country undertook to upgrade its electricity system to a regional standard, and several interconnections between these countries were established. However, the Gulf War prevented the integration of Iraq, then the largest gas producer of the five. Moreover, the Arab Gas Pipeline was initiated as an international gas infrastructure project from Egypt to Turkey *via* Jordan and Syria.[28]

20 Thus, if the 400 kV transmission line is brought down by a fault, the power flow in the 400 kV line will shift to the 230 kV line, and if the 230 kV line becomes overloaded, this line will be cut off, too. This will cause successive overloading and cut-off in the line, and blackouts may spread over an extensive area. Tokyo Electric Power Services, "Study for Updating Syrian Electricity Sector in Syrian Arab Republic," *Japan International Cooperation Agency*, March 2012, https://bit.ly/377fEme

21 Sami Karaki, et al., "Networking and Outreach Activities in Jordan-Lebanon-Syria for Energy Access II," *The Energy Research Group - American University of Beirut*, 14 February 2005, https://bit.ly/3xcrcz6

22 Rodayna and Abou Hamed, "Reality and Prospects of Wind Power in Syria."

23 Encouraged particularly by the relative low state-subsidised tariffs, the cost of production was estimated at 0.085 USD per kW. Source: Arab Union of Electricity, "Statistical Bulletin 2011 - 20th Edition," 2011, https://bit.ly/3imbXOD

24 Beides et al., "Syrian Arab Republic Electricity Sector Strategy Note."

25 Arab Union of Electricity, "Statistical Bulletin 2011."

26 Beides et al., "Syrian Arab Republic Electricity Sector Strategy Note.".

27 Beides et al., "Potential of Energy Integration in Mashreq and Neighboring Countries."

28 Rafael Leal-Arcas, Nelson Akondo and Juan Alemany Rios, "Energy Trade in the MENA Region: Looking beyond the Pan-Arab Electricity Market," *Journal of World Energy Law and Business* 10, no. 6, January 2017, 520-549, https://bit.ly/3iYLGGv

The sections in Egypt, Jordan, and Syria were implemented in 2008, but the link to Turkey, through Kilis, was never completed.[29]

The Syrian transmission grid was also connected to the Iraqi, Jordanian, Lebanese and Turkish power networks through nine interconnections.[30] Due to its key geographic location, Syria has always been essential in developing regional energy markets. In theory, several projects could have spearheaded Syria's integration with the regional and with the EU internal gas and electricity market. [31] Such projects included constructing a 400 kV link with Iraq and establishing a gas supply from Iraq's Akass field.[32] Benefits to Syria would have included securing necessary gas imports, enhancing bilateral power exchanges with neighbouring countries, and taxing energy exchanges running through its territory.

However, in practice, bilateral exchanges between Syria and its neighbours have been limited to emergency operations. The systematic shortage of electricity in all the region, save for Turkey, has dampened the use of interconnection capacities. According to official data, Syria exported only 902 GWh (mainly from Lebanon and Jordan) and it imported only a little more than 1192 GWh (mainly from Turkey and Egypt) in 2011.[33] Such projects require a high level of coordination between countries and ground to a halt following the outbreak of war in Syria in 2011.

29 Arab Fund for Economic and Social Development, "Arab Gas Pipeline Project – Third Stage (Aleppo – Kalas Section)," 11 February 2009, https://bit.ly/2TB4UJB

30 Beides et al., "Syrian Arab Republic Electricity Sector Strategy Note."

31 Paolo Garonna and Katia Adamo, "Euro-Mediterranean Integration and Cooperation: Prospects and Challenges," *UNECE Economic Essays*, 73-84, 23 November 2017, https://bit.ly/3hLXdJS

32 Beides et al., "Potential of Energy Integration in Mashreq and Neighboring Countries."

33 Arab Union of Electricity, "Statistical Bulletin 2011."

## 2. Impact of the Conflict

The power sector and electricity provision were often used as a tool of collective punishment during the conflict. Either supply was cut to territories under opponents' control or infrastructure was targeted, rendering it useless or at least reducing production and transmission capacity. Electricity infrastructure consequently saw massive damage. This meant substantial costs for repair, or the system was operated at a now reduced capacity. Sanctions have further complicated the export of spare parts and fuel, crucial to the re-establishment of service provisions across the country. This set of challenges not only affected the daily lives of ordinary civilians, commerce, industry, and agriculture. It also shaped the choices made by the Damascus government in responding to the electricity crisis currently unfolding in Syria.

### 2.1. Damage to Generation and Transmission Infrastructure

Power generation and electricity transmission infrastructure were, as noted, damaged during the war. Armed actors – loyalist and opposition – have directly shelled power plants, have destroyed portions of the transmission grid and towers and have targeted gas pipelines feeding electric generators.

During the conflict, three significant plants were destroyed: Aleppo Thermal Station in 2015;[34] Zayzoon in Idlib in 2016;[35] and al-Taim in Deir al-Zor in 2017.[36] Their combined nameplate capacity stood at 1,706 MW before the conflict, or nearly 18.25% of total nationwide capacity.

Eight of the eleven fossil-fuel-run power plants maintained partial or full functionality throughout the fighting.[37] The plants of Mhardeh[38] and al-Zara[39] near Hama, and Tishreen near Damascus,[40] were also attacked, but the damage was less substantial there. The three hydroelectric dams on the Euphrates remained partially operational despite infrequent maintenance and neglect. But they were repeatedly disconnected from the grid.[41]

Transmission lines were also targeted during battles between opposition and regime forces and were subject to looting and theft. In 2019, the PEEG declared that out of its 345 towers, 165 had been destroyed, damaged or stolen during the conflict.[42] In addition, damage inflicted on 400 kV and 230 kV high voltage lines created isolated circuits and disconnected the bigger power plants from the rest of the grid and urban areas from generators in rural areas, which were often under the control of opposition forces.

Gas pipelines and infrastructure were also targeted, causing significant electricity supply disruption. The year 2014 witnessed the peak of opposition attacks on pipelines with the suspension of gas to several power plants across the country. For instance, the Arab Gas Pipeline, supplying gas from Egypt,

34 The plant was subject to regime shelling and bombing when it was under the control of Syrian armed opposition groups and also suffered wide-spread looting after the Islamic State held it for a short while in 2015 and 2016. Ahmad Abdo, "Aleppo Thermal Plant, between ISIS Brutality and the Regime's Madness" (in Arabic), *Ayn al-Madina*, 16 February 2016, https://bit.ly/2Wm9Y5K

35 Reportedly, it was first damaged by regime bombing and it was later looted by the Islamic Turkistani Party. Enab Baladi, "Battles Put the Largest Power Plant Out of Service in the Hama Countryside" (in Arabic), 21 August 2016, https://bit.ly/3xSYCnB

36 The plant was reportedly destroyed by the International Coalition airstrikes on the Islamic State positions in the Deir al-Zor oil facilities. Deir ez-Zor 24, "International Coalition Fighters Target Al-Omar Oil Field" (in Arabic), 6 January 2017, https://bit.ly/2UEGKi5

37 Public Establishment for Electricity Generation, "Annual Statistical Report - 2020" (in Arabic), March 2021, https://bit.ly/3kCg7ol

38 The Syria Report, "New Power Plant Attacked by Armed Groups," 3 June 2016, https://bit.ly/3imZpH1

39 The state's official news agency, SANA, has blamed the al-Nusra Front and Ahrar al-Sham for the attack. Rayyan Muhammad, "The Largest Thermal Power Plant in Syria Is Out of Service" (in Arabic), *Al-Araby al-Jadeed*, 26 June 2016, https://bit.ly/3l9im2U

40 The Syria Report, "Tishreen Plant Attack Raises Power Outages in Damascus," 23 June 2014, https://bit.ly/3z2Q3XA

41 Syria Electricity, "After a Break of Six Years, The Euphrates Dam Is Connected to the Public Network" (in Arabic), 21 May 2019, https://bit.ly/2UTIdRp

42 The Syria Report, "Attacks on Gas Network Continue to Disrupt Power Supplies," 2 June 2014, https://bit.ly/3wND1f8

was targeted in 2014, causing power outages in the Damascus governorate.[43] In the Syrian desert, pipelines were reportedly attacked west of Palmyra, and so was the pipeline connecting al-Shaer field to the Ebla gas processing plant, causing power cuts in Homs and Deir al-Zor.[44] When the Jbeisseh gas plant was targeted, al-Zara and al-Taim power plants went off line as the gas supply was interrupted.[45]

The damage inflicted in the conflict is wide-ranging, then, reducing the production capacity, increasing technical losses in transmission and distribution, and throttling the fuel supply. Any effort to rehabilitate the power sector would not necessarily entail an equal response to all these three crucial components: there are different levels of urgency. The cost of reconstruction remains, though, extremely high.

## 2.2. Daunting Costs and Slow Reconstruction

The cost of fixing generating turbines varies significantly but often requires foreign expertise. The reconstruction of the power grid, on the other hand, involves restoring transmission lines and installing new substations. This can mostly be done with local expertise. As for transmission grid restoration costs, in 2016, Imad Khamis, the then Minister of Electricity, noted the urgent need to repair or replace five large 400/230/66 kV substations (USD 24 million per unit), thirty smaller 230/66/20 kV substations (USD 18 million per unit), and at least thirty-five 66/20 substations (USD 3.5 million per unit).[46] Additionally, the cost of building high voltage transmission lines is estimated to be about USD 120,000 per km for the 400 kV lines and USD 70,000 for 230 kV lines.

In spring 2021, the Ministry of Electricity estimated losses to the electricity sector since the beginning of the Syrian conflict at USD 2.4 billion in terms of production capacity and transmission reconstruction costs.[47] However, overall losses to the sector should also count revenue losses, including unpayable and uncollectable bills and the depreciation in unused nameplate capacity due to fuel shortages and transmission suspensions. Generally speaking, economists do not agree on a single measure for indirect losses, making such estimates extremely difficult.

Moreover, the effects of these indirect losses are compounded and imply a significant dropping off in industrial and agriculture productive capacity from forgone output. In fact, according to the 2018 Enterprise Survey, firms identified the interruption to services (electricity, water) as the main obstacles to doing business in regime-controlled areas.[48] There is little data available on the actual economic losses caused by power outages. In 2012, outages were estimated to account for USD 400 million and USD 2.29 billion just a year later.[49] The head of the Electricity Ministry's planning unit estimated indirect losses from lack of electricity to various sectors, residential zones, and institutions at nearly USD 60 billion from 2012 to 2017.[50] The vast discrepancies between 2012 and 2017 could be explained by the increasing intensity of fighting between regime and opposition forces. But they also cast doubts on the accuracy of government statements.

43 The Syria Report, "Suspension of Supplies from Pipeline Lead to Renewed Power Outages," 26 May 2014, https://bit.ly/3ewzk6W

44 Zaman al-Wasl, "Explosion Targets the AGP in Qalamon" (in Arabic), 30 September 2014, https://bit.ly/3wUGVmw

45 Although the Jbeisseh plant had a nominal capacity of 2.9 million cubic meters a day (cbm/day), it produced an average of only 800,000 cbm/day in early 2014. The Syria Report, "Attack Suspends Production at Power Plant," 3 February 2014, https://bit.ly/3iqcb7s

46 B2B-SY, "The Damages to the Electricity Sector in Syria Are Recorded at More than 1,500 Billion Syrian Pounds, According to Prevailing Prices" (in Arabic), 1 March 2016, https://bit.ly/2UTMlkn

47 Enab Baladi, "The Regime Government Issues a Report on the Extent of Damage to the Electricity Sector in Syria" (in Arabic), 12 April 2021, https://bit.ly/3ktC1dl

48 Salmon, Assaf and Francis, "Surviving Firms of the Syrian Arab Republic: A Rapid Assessment."

49 The Syria Report, "Power Outages Cost the Economy SYP 23 Billion," 22 January 2012, https://bit.ly/3ilRPq8; The Syria Report, "Economic Impact of Power Outages Estimated at SYP 218 Billion," 18 February 2013, https://bit.ly/2TtpsUk.

50 Reuters, "Syria Producing More Energy After Army Recaptures Gas Fields," 26 September 2017, https://reut.rs/3BgklrD; 24 Media, "2.2 Billion Dollars in Losses for Syria Due to Electricity" (in Arabic), 12 February 2013, https://bit.ly/3e8y2Px

Throughout the conflict, the Ministry of Electricity has had little success in restoring or improving production capacity. For instance: 30 MW were restored at the cost of USD 30 million in al-Zara; USD 35 million were spent to maintain production in Mhardeh; USD 18 million to increase capacity in Tishreen; and USD 8 million to repair a station at al-Taim.[51] Between 2016 and 2020, the Ministry also declared that SYP 100 billion was spent on restoring the transmission grid and rehabilitating damaged power towers.[52] For more significant repairs, the Ministry has opted for external expertise and has accordingly multiplied the number of tenders it issued to repair the most damaged plants. It has had, though, little or no success. Syria would need capital inflows and it would need technology that the Ministry previously preferred to purchase from western companies. Neither of these conditions are likely in the current economic and political climate. Overall, electricity production capacity fell from nearly 9,344 MW in 2010 to 5,150 in 2021.[53]

The de-escalation of the conflict, which started in late 2017, has allowed the regime and the opposition to conclude some local deals to reconnect and repair parts of the transmission grid. For instance, in 2018, the Ministry of Electricity and opposition groups north of Homs reached a deal whereby electric supplies to the opposition were restored in return for repairing the 400 kV transmission line linking the Jandar power plant with the city of Hama.[54] In 2019, a similar deal was reached to repair the 230 kV high voltage line linking the Tabqa hydroelectric power plant (under Syrian Democratic Forces control) to the Hama-2 transmission bus station (under regime control).[55]

## 2.3. Changes in Production and the Promise of Green Alternatives

As set out in Figure 2, in 2012, total production stood at 41,772 GWh, then fell to 29,763 in 2013, 23,819 in 2014, 19,396 in 2015, and 8,529 GWh in 2016. After this monotonic decline in electricity output, a slight recovery occurred in 2017, with the recapture of large swathes of territory from Islamic State and other opposition factions. The recovery continued until 2019, with limited repairs and a general improvement in economic activity in regime-held areas. In 2019, electricity production stood at 26,755 GWh, nearly three times more than the lowest point in 2016. Nevertheless, production output fell again in 2020 due to challenges in procuring oil and gas.[56] Partial data for 2021 suggest that total electricity output dropped to 24,959 GWh, which is 45% less than in 2011. *Per capita* consumption of state electricity stands at nearly 15% of what it was in 2010.[57]

In 2020, nearly 70% of Syria's power supply was generated by gas-run power plants, with the remainder operating primarily on oil derivates.[58] Half of the required gas and oil are procured locally, while the regime relies on its allies to secure the rest.[59] Thus far, the Iranian credit line has arguably financed most of Syria's foreign oil procurement. But there have been irregular flows due to sanctions on both countries and due to logistic difficulties, including Israel's targeting of oil convoys.[60] Moreover, other

51 The Syria Report, "Power Sector Losses Estimated at USD 2.4 Billion," 21 April 2021, https://bit.ly/3iiHYY0

52 The equivalent of 100 billion SYP in USD is meaningless due to exchange rate fluctuations.

53 Hanaa Ghanem, "A Decrease in the *per Capita* Share of Electricity between 2011 and 2020 from 2,378 to 1,190 Kilowatt-Hours" (in Arabic), *al-Watan*, 5 July 2021, https://bit.ly/3rh3C2S

54 Enab Baladi, "After the Agreement, Maintenance of the Homs Countryside Tension Line Will Begin" (in Arabic), 27 January 2018, https://bit.ly/3xKD0K2

55 Syria Electricity, "After a Break of Six Years, the Euphrates Dam Is Connected to the Public Network."

56 Ghanem, "A Decrease in the *per Capita* Share of Electricity."

57 Ibid.

58 Public Establishment for Electricity Generation,"Annual Statistical Report - 2020."

59 The Syria Report, "Government Puts Wartime Oil Sector Losses at USD 91.5 Billion, Admits Gas Oil Shortages," 10 February 2021, https://bit.ly/36L8mUY

60 Gordon Lubold, Benoit Faucon and Felicia Schwartz, "Israeli Strikes Target Iranian Oil Bound for Syria," *Wall Street Journal*, 11 March 2021, https://on.wsj.com/3z9TonJ

sectors such as manufacturing and oil production also require gas and have recently started to increase their share of gas consumption. The Russian-run fertiliser plant at Homs, for instance, consumes 1.2 million cubic metres a day, and the Ministries of Oil and Industry an additional 1.5 million.[61]

Given the state's failure to satisfy electricity needs, local communities have sought alternatives. As early as 2013, black markets for fuel and electricity-generating supplies were flourishing. In many conflict-affected cities, commercial and private generators and batteries serve as the primary source of electricity for local inhabitants. Many households converted small electrical appliances so that they worked with twelve-volt batteries. To obtain electricity, people pay a subscription directly to generator owners. The subscription fee depends on the consumption of amperes. An "ampere" is sold for USD two on average, but it is subject to increases based on the market price for fuels. A family requires at least three to four amperes to cover their basic electricity needs, which amounted to nearly 10% of an average middle-class household income in 2018.[62] However, recent hikes in the price of oil derivatives are likely to have made electricity far less affordable.[63]

The decline in overall electricity supplies has caused substantial disruptions in production cycles; most cities receive only a few hours of electricity a day. The Ministry has applied a "rationing" policy *via* load shedding through the country. In April 2021, Ghassan al-Zamil, the Minister of Electricity, announced the unification of the electricity rationing program in the various governorates, so that power would be delivered for an hour for every 4.5 "dead" hours.[64] "Electricity rationing" is a term the Ministry has employed since the 1980s to describe the frequent load shedding caused by its inability to match power demand. Despite al-Zamil's commitment to fair distribution, electricity availability varies considerably among neighbourhoods within a single city, and between urban and rural areas. Schedules are changed, in an unpredictable fashion, with little warning, depending on fuel availability. For instance, in 2021, Aleppo witnessed a ten-hour rationing period for an hour or half an hour of power,[65] while Damascus received one hour of power for five "dead" hours.[66]

Unable to significantly increase current production levels, the NERC has increased its efforts to accelerate the adoption of renewable energy. This process had already begun before the conflict but failed to pick up because of a lack of funds and expertise. The Damascus government had put forth several incentives to encourage private funds to invest in renewable energy.

In 2016, President Assad issued the Private Public Partnership Law and set rules and regulations for investment in the electricity sector. The Prime Minister also issued executive order #1763 to set prices for buying electricity from privately-owned generators.[67] In 2019, the Ministry of Electricity published a ten-year strategy to increase renewable energy output to 5% of total electricity production.[68] Its strategy relies principally on: encouraging turnkey projects; granting tax reductions and offering incentives to manufacturers of relevant equipment; reducing tariffs on the import of related technology; and buying electricity produced by the private sector. To provide some form of stability to the contractors, the Ministry of Electricity set the buying prices in Euros and provided preferential rates for renewable energy from landfill gas, biomass, wind, and solar power.

61 Al-Iqtisadi, "A New Gas Well Supports Electricity with 150,000 Cubic Metres per Day" (in Arabic), 23 May 2020, https://bit.ly/36OIfg1

62 Youssef Diab and Abboud Hajjar, "Electricity in War-Torn Aleppo: A New Form of Urban Management," *Metropolitics*, 23 November 2018, https://bit.ly/3x7oCug

63 RT Arabic, "Syria, a New Rise in the Prices of 'Unsubsidised' Gasoline" (in Arabic), 6 July 2021, https://bit.ly/3ez6seu

64 Syria TV, "The Assad Regime Announces the Unification of the Hours of Electricity Rationing in Its Areas of Control" (in Arabic), 15 April 2021, https://bit.ly/3hq2NBo

65 Enab Baladi, "Consolidation of Rationing and Promises to Improve Electric Power in Syria" (in Arabic), 15 April 2021, https://bit.ly/3ezhRLh

66 Skype interview with a Damascus businessman, 18 May 2021.

67 Syrian Arab Republic Presidency of the Council of Ministers, "Resolution No. 1763" (in Arabic), 31 May 2016, https://bit.ly/3B3oeAi

68 Syrian Arab Republic Presidency of the Council of Ministers, "The Ministry of Electricity's Strategy for Renewable Energies until 2030" (in Arabic), 28 October 2019, https://bit.ly/3k7PTKd

Since January 2019, 73 renewable energy projects under the Private Public Partnership Law have been approved. Sanctioned projects mainly consist in photovoltaic stations, with a production capacity ranging from 1 to 5 MW, located in Rural Damascus, Homs, Hama, Tartus and Sweida governorates. Otherwise, only two wind turbines have been approved at Sheer in Hama governorate. The value of the declared assets of all these renewable energy projects amounts to a little over USD 170 million, but their actual value could be considerably higher.[69]

Several companies are involved in the sector. We might mention a sample here: Blue Planet Alternative Energy, the Lebanese TFS Sal, Solarec (a joint venture between PEEG and Syronics), Al-Mashreq for Green Energy, Adel & Adam Trading LLC, the Syrian European Group for Heavy Industries (partner of the German company Harting GmbH), Nafori, Tamim Taleb Ali Establishment for Trading and Industry and Alma LLC. The owners of the companies are primarily Syrian nationals, and some are expats with experience in the field from Saudi Arabia, the EU and Ukraine. None, note, are from the Syrian business community which emerged in the years leading up to the war or thereafter. The lack of interest from regime businessmen points perhaps to low returns in this sector. Their engagement in the electricity sector continues to focus on oil procurement from north-eastern Syria and abroad and on the protection of oil and electricity production facilities.[70]

Electricity from green sources does not, at present, exceed 1.5% of all generated power. Investors and contractors remain reluctant to engage further due to the political and economic instability and due, too, to the fear of Western sanctions.[71] Regime-controlled media tends to exaggerate green energy successes, as part of a broader narrative that promotes the return of normalcy to Syria. Looking past the hype, Aleppo, Deir al-Zor, Daraa and Raqqa, where the electricity infrastructure suffered particularly badly, have not been affected by the current initiatives.

69 The declared capital of projects in Syria, in general, tends to be lower than the reality because of tax evasion.

70 Georges Haswani, Ayman al-Jaber and Hussam Qaterji are known for working in these areas.

71 Attaqa, “Syria Is Counting on Renewable Energy to Solve the Electricity Crisis” (in Arabic), 2 June 2021, https://bit.ly/3f1SPol

## 3. Foreign Assistance and Investments: Disillusion and Reality

In a press conference held on 27 January 2021, the Minister of Electricity, Ghassan al-Zamil, launched a new campaign under the title "Imagine Your Life Without Electricity."[72] The conference's objective was to prepare the Syrian people for decreased electricity production and for further distribution difficulties. But it also served as an occasion for the Minister to announce new contracts to repair power plants in Aleppo and Deir al-Zor.

The rehabilitation of the Syrian electricity sector requires foreign engagement. This is true for the procurement of turbines to increase production capacity, for the spare parts necessary for replacing damaged transformers, and for the repair of failing plants. International sanctions are slowing down this process. Moreover, while the Syrian government has the expertise to fix the creaking and half-destroyed transmission grid, it lacks the funds to do so. The government also lacks both the funds and the expertise for fixing or installing new production capacity. As an alternative, they have asked their foreign allies to implement and finance these ventures.

Before the conflict, the only investors in the Syrian electricity sector were the PEEG and the PEDEEE. However, the state had often relied on foreign funds to obtain low-interest loans for the longer repayment period provided by developed countries and Arab Gulf States. Moreover, the Ministry of Electricity regularly brought in external expertise and know-how to import new technologies, turbines, and spare parts. As a result, foreign participation in Syria's electricity sector was highly diversified,[73] and contractors were encouraged to finance their awarded deals with international funds and loans. Sanctions and political and economic instability have considerably changed the profile of the companies involved and the government's *modus operandi*.

### 3.1. Sanctions and the Loss of Potential Support

The impact of sanctions on the reconstruction of the power sector is multi-layered. Firstly, they impede the capacity of non-Syrian companies to engage with the regime. Secondly, they restrict Damascus' ability to fund these projects as financial transactions through the international banking system are barred. Third, they thwart Syria's access to energy markets both for fuel procurement and transportation.

While the US had virtually no involvement in Syria's electricity sector, Europe used to have a considerable influence. European companies bought crude oil, sold refined products, technology, spare parts, and built new power plants. European financial institutions, such as the European Investment Bank, also financed the expansion of the Syrian electricity grid in the early 2000s.[74] Similarly, regional organisations financed studies and projects to help renew Syria's creaking electricity sector. They even invested and issued concessionary loans to finance new power plants. For instance, the Arab Fund for Economic and Social Development,[75] the Islamic Development Bank,[76] and the Saudi Fund for Development backed various projects in the power sector in the pre-war decade.[77]

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72 Al-Sharq al-Awsat, "'Imagine Life without Electricity' Is the Slogan of the Syrian Government for Citizens" (in Arabic), 29 January 2021, https://bit.ly/3i3lFVU

73 With companies from Europe, Japan, China, South Korea, and to a lesser degree Russia, India, and Iran taking an active role.

74 In 2000 and 2001, the bank financed the electricity transmission and distribution network with USD 214 million. In 2004 it issued a loan of USD 240 million to finance the expansion of Deir Ali power plant, and USD 280 million for the construction of new power plant in Deir al-Zor.

75 KUNA, "Fund for Economic and Social Development Lends Syria 30 Million Kuwaiti Dinar" (in Arabic), 8 February 2005, https://bit.ly/2USOM6z

76 Al-Jazeera, "The Islamic Bank Finances Two Power Plants in Syria" (in Arabic), 24 May 2006, https://bit.ly/3e8QRC4

77 Al-Jazeera, "Saudi Arabia Finances a Power Station in Syria" (in Arabic), 6 April 2011, https://bit.ly/3huMCD4

US sanctions on Syria in August 2011 contributed to the fuel procurement crisis the electricity sector has experienced. Obama's Executive Order 13582 designated several entities in the Syrian energy sector and prohibited all transactions with them, including transfers of funds, goods, and services.[78] The Trump administration extended sanctions to Syrian individuals involved in financing the regime. Additionally, in June 2020, the US Congress signed the "Caesar Act" into law, authorising the US government to sanction foreign entities and individuals conducting business with the Syrian government and its military and intelligence agencies. The secondary objective of sanctions is to discourage foreign investments in Syria, including investments in the electricity sector.

The initial US sanctions in August 2011 were matched by the Arab states and Turkey in November of the same year, on respectively 27 and 30 of that month. The regional response came through the Arab League which prohibited dealings with Syria's central bank and all trade exchanges except for strategic and vital food crops.[79] Regional participation in this sanction regime was important for the success of US policy, as Arab financial institutions had previously awarded low-interest loans to Syria to expand its generation capacity. Turkey, meanwhile, had exported small amounts of electricity to Syria. Sanctions effectively ended these minor interventions.

The EU waited until 19 January 2012 to ban companies in its member states from investing in the electricity sector. However, the European decision was the most important in terms of impact and in terms of technical details. EU Council Regulation, no 36 in that year, created two restrictions on the electricity sector. Firstly, there was a ban on providing financial loans and equity investment to Syrian entities engaged in constructing new power plants for electricity production. Secondly, there was a ban on the sale, supply, transfer, and export of equipment and technology for constructing new power plants. The regulation only allowed limited exemptions for the performance of obligations in contracts concluded before 19 January 2012. In 2013, EU member states were allowed to deliver some power generation capacity to opposition-held areas (if supported by the Syrian National Coalition), for which they needed a specific license.

As for oil procurement, the effect of sanctions is real but secondary, though it theoretically prevents the regime from oil procurement on international markets. Despite sanctions, the regime's primary cause for fuel shortages is a lack of funds as two of the world's largest energy suppliers, Iran and Russia, take no notice of sanctions, while Egypt remains happy to continue its supply of natural gas. In that sense, the Lebanese banking sector's collapse has damaged Syria's capacity to finance and pay for purchased oil and gas much more than EU or US sanctions. Regime businessmen had used their offshore bank accounts in Lebanon to circumvent sanctions on Syria.

In theory, these unilateral sanctions do not prevent the Ministry of Electricity from seeking expertise from other technology exporters. However, Syria is not able to access international funds for developing countries' power sector such as the Union for the Mediterranean, or the Clean Technology Fund. Sanctions also mean that Syria cannot benefit from technical support in maintaining power plants built by sanction-bound companies: for instance, Deir Ali, Jandar or al-Zara. A lack of funds and sanctions has obliged the Ministry to opt for less prestigious technology exporters and contractors such as those based in Iran and Russia.

While European companies are bound by EU sanctions, a few have explored the potential of investing in the Syrian power sector. Before the Syrian conflict, Siemens was particularly active, building a combined cycle extension to the Deir Ali power plant,[80] and signing a contract in November 2011 to extend the

78 US Government Publishing Office, "Executive Order 13582 of August 17, 2011. Blocking Property of the Government of Syria and Prohibiting Certain Transactions with Respect to Syria," 1 January 2012, https://bit.ly/2V38D3q

79 The League decision was binding but allies kept trading and exchanging regardless. However, Saudi Arabia, Qatar and Kuwait, the larger donors in the region, were the driving force behind the decision and their commitment to the ban was self-motivated.

80 A.S.T.E, "Deir Ali", *2016–2017 Al Shatta for Technical Engineering*, https://bit.ly/3BgpxMf

al-Nasriyeh plant. In October 2010, a Greek-Italian consortium was awarded a contract to build a power plant in Deir al-Zor,[81] and even though a sanction exception exists for projects signed before January 2012, the project was never fully executed. Indeed, the political and economic climate halted all these projects, and only some expressions of interest have since been made. For instance, in April 2015, a relatively small German company called Power International signed an MoU in Damascus for delivering a 360 MW gas-powered plant.[82] The MoU was never made concrete and was most probably a media stunt. Also, in August 2015, the Norwegian Jacobsen Elektro and the Austrian Harris Group Engineering companies reportedly met with the Ministry of Electricity in Damascus.[83] No contract nor MoUs were signed, but the regime exploited the visit to promote its political narrative of economic recovery.

## 3.2. Assistance from Assad's Allies

Since 2012, dozens of licenses, contracts, and MoUs have been awarded to contractors to build power plants of varying sizes and technologies across the country. The Ministry of Electricity is still issuing tenders and trying to attract foreign funds for its projects. However, the choice of contractor is influenced by political considerations, and only a few projects have seen the light of day. Iran, Russia, and other BRICS countries are better placed to invest in the sector, thanks to their close relations with the regime.

### 3.2.1. Iran

During an official visit to Tehran on 12 September 2017, the then Minister of Electricity, Zuhair Kharboutli, signed two contracts and an MoU to deliver Iranian equipment, technology, and know-how for the electricity sector.[84] The agreement involved an extensive list of projects, including: the construction of a 540 MW combined cycle power plant in Latakia; the supply of five power generators in Baniyas with a total capacity of 125 MW; the rehabilitation of two turbines in the Aleppo Thermal Plant with a combined capacity of 400 MW; the rehabilitation of al-Taim power to produce 90 MW; and the maintenance of the Jandar plant.[85] In total, these substantial agreements would have represented 12.4% of Syria's pre-war production capacity.

On 2 October 2018, the PEEG awarded the Latakia Power Plant project to Mapna and the Aleppo Thermal Plant to the Iran Powerplant Repair Company (IPRC).[86] Mapna is an Iranian conglomerate, established in 1993, specialising in power, oil and gas, railroad projects, and the production of gas and steam turbines; IRPC, on the other hand, is affiliated with the Iranian Ministry of Energy and was established in 1981 as Fundamental Management of Tavanir Repairs. The Latakia deal is valued at USD 472 million and stipulates the delivery of a first turbine within 18 months, a second six months later, and a third within 34 months, along with a 70km pipeline linking the plant with the gas distribution network.[87] The Aleppo project was awarded a contract worth USD 147 million to deliver turbines number 1 and 5 on-site.[88]

81 METKA, "Combined Cycle Power Plant of 724 MW, Deir Azzour, Syria," accessed 12 July 2021, https://bit.ly/3ez0H0t

82 Bachir El Khoury, "Electricity: A German Company Signed a Contract with Bashar Al-Assad's Syria" (in French), *Slate*, 6 May 2015, https://bit.ly/3ktbXza

83 Hazem al-Sabbagh, "Electricity Minister: We Will Support Foreign Investors in Power Sector," *Syrian Arab News Agency (blog)*, 18 August 2015, https://bit.ly/36HGzVF

84 Reuters, "Iran Signs Agreements with Syria to Repair and Restore the Electricity Grid" (in Arabic), 9 December 2017, https://reut.rs/3kCEceZ

85 Al-Jazeera, "Iran Signs a Contract to Supply Electricity to Aleppo" (in Arabic), 12 September 2017, https://bit.ly/3AUKJHm

86 Syrian Arab News Agency, "Syrian-Iranian Talks to Enhance Strategic Cooperation in the Electrical Sector" (in Arabic), 29 September 2018, https://bit.ly/2UoVVvx; Iran Press, "Tehran and Damascus to Boost Cooperation in Electricity Generation," 2 October 2018, https://bit.ly/3hM47Pi

87 Sputnik News, "At a Cost of EUR 400 Million ... a Syrian-Iranian Agreement to Establish an Electric Power Plant in Latakia" (in Arabic), 2 October 2018, https://bit.ly/3xMl1mk

88 Business 2 Business Syria, "Minister of Electricity: A Contract Worth EUR 124 Million with Iran... and This Is What It Includes?" (in Arabic), 14 April 2021, https://bit.ly/3Bj3696

While the Syrian government does not have the financial resources to fund these projects, it can rely on credit from Iran to cover some of the costs. Even in cases where the Iranian credit line does not suffice, Tehran has often found additional resources to pay for its ventures in Syria. Iran has consistently sought concessions from the regime in exchange for its support in areas such as phosphates and oil. According to the Secretary for Syrian Affairs of the Arab and African Office of the Iran Trade Promotion Organization (TPO), Soheila Rasoulinejad, Iran's exports of non-oil products to Syria between March and May 2021 increased by 73% over the same period last year. The hike was largely due to the shipment of components and parts of steam turbines worth USD 30 million.[89] The turbines are likely to have ended up in the projects in Latakia and Aleppo.

Nevertheless, it is worth noting that Iran's margin of manoeuvre has, in financial terms, shrunk since the Trump administration reimposed and tightened sanctions on the country in late 2018. So, despite their best intentions, Syria's Ministry of Electricity and Iranian companies struggle to honour their commitments. For instance, in January 2020, the Ministry cancelled the IRPC contract citing difficulties in procuring the necessary spare parts and insufficient funds for the repair of the Aleppo plant. The PEEG eventually awarded the same contract with the same conditions to Mapna, nearly a year later. It is unclear how the project will be funded.

### 3.2.2. Russia

During an official visit to Moscow on 31 January 2018, the then Syrian Minister of Electricity, Zuheir Kharboutli, signed a "roadmap agreement" with Russia to build new power plants with a total capacity of 2,650 MW (28.3% of Syria's production capacity before the conflict) and to repair three turbines in the Aleppo Thermal Plant.[90] This agreement was initially agreed upon a few months earlier in Sochi on 9 October 2017,[91] and it included other projects in the energy and reconstruction sectors.[92]

The electricity part of the agreement stipulated the addition of two steam turbines with a combined capacity of 600 MW in Mhardeh, and two other turbines with the same capacity at Tishreen; the construction of a new 500 MW combined-cycle plant in Deir al-Zor, and a 350 MW steam turbine in Aleppo. It included, too, the repair of three turbines with a total capacity of 600 MW each at the Aleppo Thermal Plant.[93]

The main contractor chosen by Russia to execute these projects is Technopromexport. In a step toward fulfilling the contract, the Rostec subsidiary signed an MoU with the Syrian Ministry of Electricity to carry out four power generation projects with similar specifics on 2 February 2018.[94] The company had had experience operating in Syria: the first time between 1968 and 1973 with the construction of the Tabqa Dam;[95] and the second time in 2006 when it brought in two 200-MW turbines to the Tishreen power plant.

However, there were no details in the roadmap on the financing terms. The value of these projects is estimated at more than USD 2.3 billion, and it was not clear whether the Ministry of Electricity was expected to fund them or whether Russia would do so through a loan or another credit facility.[96]

89 Tehran Times, "Exports to Syria Jumps 73% in 2 Months on Year," 21 June 2021, https://bit.ly/36P0Po0

90 Jalal Bakkour, "Russia Tightens Its Grip on the Syrian Energy Sector" (in Arabic), *Al-Araby al-Jadeed*, 2 February 2018, https://bit.ly/3k9fYII

91 Enab Baladi, "A Russian-Syrian 'Roadmap' in the Field of Oil, Gas and Electricity," 10 October 2018, https://bit.ly/3ezknBd

92 Sputnik News, "A Roadmap for Russian-Syrian Cooperation in the Field of Energy, Oil and Gas" (in Arabic), 9 October 2018, https://bit.ly/3AS7onN

93 The Syria Report, "Syria Awards Power Plant Contracts to Russia but Has No Money to Pay for Them," 6 February 2018, https://bit.ly/3kxJGrm

94 Reuters, "Russia's Technopromexport May Rebuild Four Syrian Power Plants," 2 February 2018, https://tmsnrt.rs/3ewSNEV

95 World Bank Group, "Syria - Second Damascus Water Supply Project," 31 March 1976, https://bit.ly/3xO7ieU

96 The Syria Report, "Syria Awards Power Plant Contracts to Russia."

Unsurprisingly, the roadmap – lacking financial backing – was never implemented. A year later, to overcome the Ministry of Electricity's financial difficulties, Technopromexport suggested funding the projects itself in exchange for receiving exploitation rights over the plant. However, it is not clear whether the Ministry has granted their request or not.[97]

In November 2020, Stroyexpert Middle East was awarded a license to build two solar power stations, one in Homs with a capacity of 1 MW and another one in the Damascus suburbs with a 2 MW capacity.[98] There are no public records that show the level of advancement on these two projects.

### 3.2.3. Companies from other countries

India and China also have good relations with the regime and enjoy a considerable advantage in investing in the Syrian electricity sector. However, as public records show, their engagement has been limited and has primarily involved exporting equipment and spare parts to Syria. Except for official visits and meetings with Syrian officials, their approach to engagement in the sector has been prudent and exploratory. Fear of secondary sanctions and security and economic risks might explain their lack of interest. But the lack of funds to finance reconstruction projects in Syria has also considerably hampered their willingness to increase their market involvement.

For instance, Bharat Heavy Electricals Limited (BHEL), a state-owned Indian company, was awarded a USD 485 million contract for adding 400 MW to the existing Tishreen Power Plant near Damascus in 2008.[99] The project was partially funded by the Export-Import Bank of India, which extended a concessionary loan of USD 240 million and released the first instalment of USD 100 million in 2010.[100] The remaining USD 245 million was expected to be funded by Syria or by an international financial institution. Despite receiving equipment worth USD 75 million, BHEL suspended its work on the plant at the end of 2011 for security reasons.[101] During an official Syrian visit to India in January 2016, the resumption of work on the Tishreen plant was announced.[102] Three years later, the company's return was once again proclaimed during an official Indian visit to Damascus,[103] but there is still no indication of activity on the site.

Accustomed to investing in high-risk environments, China has shown restraint in Syria. This was also true before 2011, showing China's deeper concerns over the feasibility and rentability of long-term investments there. Instead, Chinese companies conducted short transactional deals focused on trade and the export of equipment. For instance, in 2018, they supplied 800 small electric generators and 60 kilometres of cables as part of a Chinese grant of USD 12 million.[104] In 2016, Xian Electric Engineering and Ri Liu Power International built a substation in Latakia governorate for a USD 15 million contract.[105] As the sector needs billions of dollars to be brought back to its pre-war state, China's interventions are so small in magnitude that they have had no discernible impact on overall electricity supplies.

97 The Syria Report, "Russian Company Offers to Build Power Plant on IPP Terms," 18 June 2019, https://bit.ly/3hOtKz3

98 Stroyexpert is a Russian limited liability firm that has set up several local companies in Syria in land reclamation and that trades in industrial, automotive, dams, irrigation, and other types of equipment. The Syria Report, "Russian Firm Enters Syria's Renewable Energy Sector," 16 December 2020, https://bit.ly/3es24hp

99 Reuters, "India's BHEL Gets $485 Mln Contract for Syria Plant," 30 June 2008, https://reut.rs/3zgzpnv

100 Embassy of India in Damascus Syria, "BHEL, India and PEEGT of Syria Sign Contract for Tishreen Thermal Power Plant Expansion," 8 May 2014, https://bit.ly/36Lfdha

101 Utpal Bhaskar, "Strife in Syria Halts Bhel's `2,000 Crore Project," *Livemint*, 15 April 2013, https://bit.ly/3rjEatE

102 Business Standard, "India to Complete Stalled Projects in Syria | Business Standard News," 13 January 2016, https://bit.ly/3BkX3Rl

103 Elizabeth Roche, "New Delhi Steps Up Bid to Help War-Torn Syria Rebuild Its Infra," *Livemint*, 5 June 2019, https://bit.ly/2Tj7gN8

104 Enab Baladi, "A Grant from China.. 800 Power Transformers Arrive in Syria" (in Arabic), 10 October 2018, https://bit.ly/2UZLA9u

105 The Syria Report, "Chinese Companies Earn New Contracts in Electricity Sector," 13 September 2016, https://bit.ly/3rh4Vic

In fact, China has never built a fully-fledged power plant in Syria.[106] PowerChina and SinoHydro, two state-owned engineering companies, have shown some interest in increasing the Chinese footprint in the sector, but no concrete agreements have emerged to date. For instance, the deputy head of PowerChina visited Latakia to discuss the construction of a 600MW power plant, but the deal was finally awarded to the less prestigious Mapna Iranian company. Chinese companies also considered participating in the reconstruction of Aleppo's Thermal Plant, but Iranian and Russian companies ended up, as noted above, landing the contract. Similarly, officials from the Tebian Electric Apparatus company discussed the possibility of supplying 120MW mobile gas turbines,[107] but talks never resulted in a contract.

Iran's and Russia's political and military engagement *vis-à-vis* the regime justifies their contribution to its economic survival. But other energy technology exporters face considerable financial and legal challenges before entering the Syrian market. Hence, it is unlikely that we will witness increased investments from other countries in the Syrian power sector in the foreseeable future.

106 China National Electric Equipment Corporation (CNEEC) has been selected to build an extension to the al-Zara Power Plant in 2009, but the project was not carried out.

107 Business 2 Business Syria, "The Ministry of Electricity Is Considering Importing Portable Gas Sets to Generate Electricity," 27 September 2016, https://bit.ly/3evRmGF

## Conclusion: Bottlenecks and Future Prospects

Before the 2011 conflict, Syria's electricity sector was trailing other developing countries both in terms of structural and performance indicators, enduring nearly 26% of power losses and 43 days of power outage per year. However, ten years of war has made the situation immeasurably worse, with the *per capita* consumption of state electricity not even 15% of what it was in 2010.

There are no accurate or official statistics that detail the number of beneficiaries from the electricity produced by the PEEG today. Most recent official data suggest that the number of residential subscribers fell from 4.5 million in 2011 to 4.2 million in 2018 (a 6.7% decline).[108] However, such figures do not take into account the former subscribers who are no longer serviced by PEEG in areas where the regime is no longer in control. Therefore, such data cannot be relied upon to estimate the change in the aggregate level of demand for electricity. However, it is safe to assume that the current number of beneficiaries from the electricity provided by the Ministry of Electricity cannot exceed 12 million, including the small areas in northeast Syria's urban centres that remain under regime control.[109] On the other hand, as stated earlier, electricity production capacity fell from nearly 9,344 MW in 2010 to 5,150 in 2021.[110] In percentage terms, while the number of beneficiaries fell 43.7%, production capacity fell by a similar rate, 44.8%. In fact, it is also safe to argue that electricity demand *per capita* has also fallen due to significant economic contraction, which means that the existing production capacity might be enough for the needs of the population.

With the current population size and the likely level of consumption, the problem with lack of access to electricity does not lie, in the first instance, with electricity production capacity. Instead, it depends on two other factors. First, there is the incomplete recovery of the transmission network in war-torn areas. Second, there is the lack of fuels to power the electricity plants. Throughout the conflict, while damage to infrastructure determined the upper bound of possible electricity supply, energy was often the key variable in determining output. After all, the PEEG has struggled and continues to struggle to obtain enough energy to operate the plants at maximum available capacity. For example, in 2021, to operate the total available capacity for gas-powered turbines responsible for 70% of the supply, the PEEG requires 18 million cubic metres of gas daily, of which it was able to obtain only 8.2 million (46%).[111]

The difficulty in accessing energy sources to power the plants is partly down to decreasing oil production from regime areas and the control of the Autonomous Administration of North-East Syria over the majority of production facilities. Iran and Russia are expected to close the gap in fuel demand by exporting oil and gas to Syria, but there are considerable financial and logistical challenges for procurement.

Syria's electricity production capacity might be enough for the current number of beneficiaries residing in regime-held areas and for their low level of economic activity. However, a political settlement that would pull the country back together, spur economic growth and increase the number of beneficiaries would mean that the electricity sector would struggle in terms of output: the areas outside regime control do not have electricity production on an industrial scale. In such a scenario Syria might, with a functioning government, be able to convince donors and international electricity companies to invest or re-engage in the sector. But supply will likely take a few years to catch up with a reconstruction-led rise in demand. Sectors that are more reliant on electricity, such as industry, will struggle more than others.

108 Arab Union of Electricity, "Statistical Bulletin 2011 - 20th Edition," 2018, https://bit.ly/37dWniQ

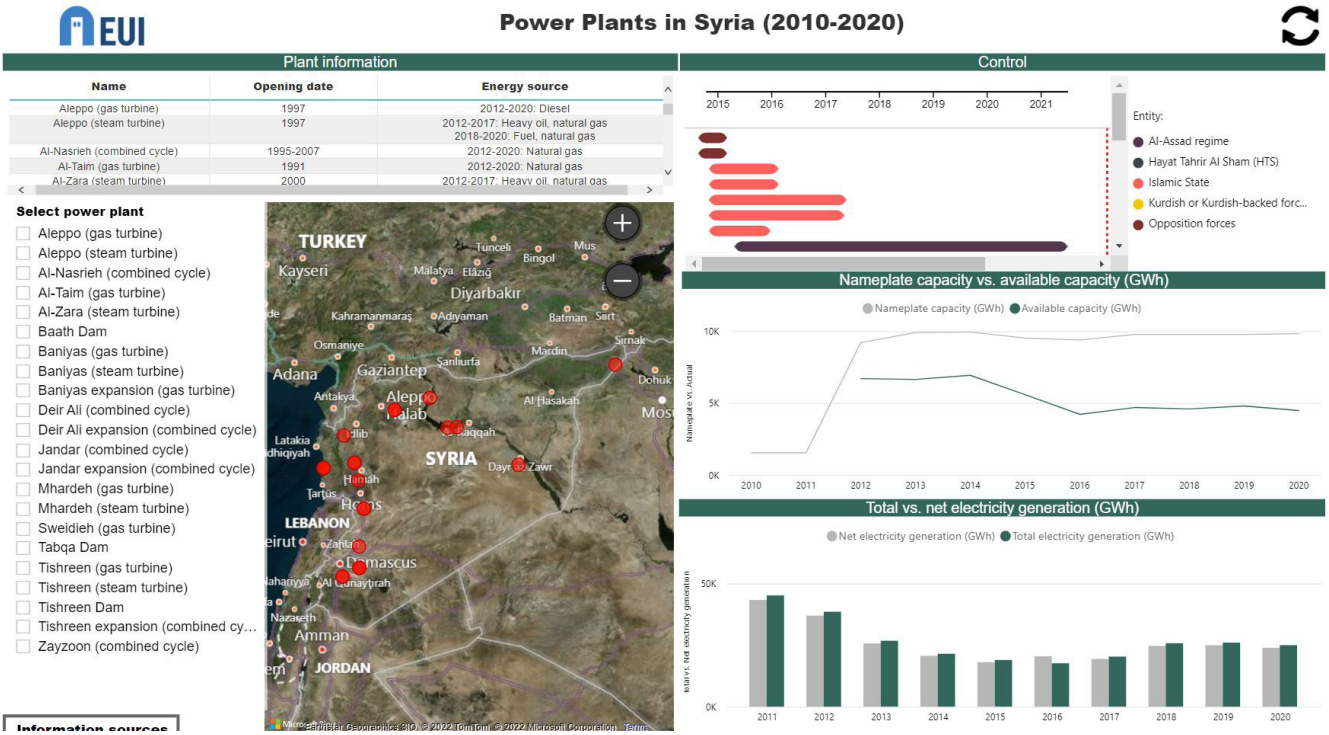
109 William Christou and Karam Shaar, "2021 Budget Reveals the Depth of Syria's Economic Woes," *Atlantic Council*, 1 December 2020, https://bit.ly/3xY9Qr4; The authors argue that the population of regime-held areas is now 11.7 million. In addition, 300,000 people in Northeast Syria benefit from Damascus supply of electricity but do not fall under direct regime control.

110 Pre-war available capacity is outlined in the Annex: "Interactive Dashboard for the Electricity Generation Plants," Middle East Directions, Wartime and Post-Conflict in Syria, 30 July 2021, https://bit.ly/3xV8kGb; Ghanem, "A Decrease in the *per Capita* Share of Electricity between 2011 and 2020."

111 Ibid.

In the foreseeable future, regime areas will continue to muddle through. They will struggle to source enough fuels to power plants, while tinkering with the electricity grid as government backers refuse to invest heavily in supporting it. Until then, expect more dysfunctional supply and the use of small generators, much as in neighbouring Iraq and Lebanon, squeezing what remains of economic activity in Syria. Regulating small private providers and improving coordination between them will prove a problem for the whole country for a long time to come. With no improvement in the finances of the Syrian government on the horizon, citizens will continue to suffer from a lack of electricity. Damascus's inability to address the crisis will worsen the already deplorable humanitarian situation and add to the waves of migration.

# Annex: Interactive Dashboard for the Electricity Generation Plants




Designed by the authors, July 2021

This interactive dashboard contains information on the establishment year, production, energy source, military control, efficiency, and satellite imagery for all power generating plants in Syria throughout the conflict. Select an individual plant from the left of the dashboard to see the information relating to it. For example, in the photo below, you see the information relating to Zayzoon plant. This dashboard is best viewed on a pc, rather than on a mobile device: https://bit.ly/3xV8kGb

**Research Project Report**
Issue 2021/13
30 July 2021

doi:10.2870/939516
ISBN:978-92-9466-084-8
QM-02-21-984-EN-N

Publications Office
of the European Union