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POLICY BRIEF

Electricity Cuts and Fuel Switching for Natural Gas Export: Is It Truly Making a Difference?

By: Ali Habib*

1. Introduction

In August 2022, the government announced a new strategy to optimize energy consumption. According to Prime Minister Mostafa Madbouly, the government would use mazut and diesel to produce electricity instead of natural gas, which would be redirected to export. This substitution was anticipated to yield approximately USD450 million monthly or USD4.5 billion annually (El-Din, 2022).

To this end, the government implemented rolling blackouts, initially lasting for one hour a day but extending to several hours over time (Salah, 2022), even during the scorching summer of 2023. When the heat wave broke in November 2022, the government continued the power cuts, which lasted for an average of two hours per day.

This policy brief aims to assess the effectiveness of the government's energy policies, while also presenting alternative policies which promise greater efficacy and mitigate the shortcomings of the existing approach. The period under analysis is fiscal year 2022/23.

2. Background

Egypt is grappling with an economic crisis that has resulted in the devaluation of the Egyptian pound, a shortage of foreign currency, and a rise in inflation (Lewis & Werr, 2023). In February 2022, as a result of the Russian war against Ukraine, several European countries were forced to look for alternative sources of gas. Egypt recognized this as an opportunity to alleviate its economic crisis and earn foreign currency. In just a few short months, by April 2022, Egypt had already brought in an impressive USD3.9 billion in revenue from its gas exports – equivalent to its total earnings in 2021. In 2022, Egypt exported 8.5 million tons of liquified natural gas (LNG), making it the world's 12th-largest natural gas exporter. For the first time, 60% of Egypt's natural gas production was reportedly directed towards Europe (Parker & Mahfouz, 2023).

Unfortunately, this strategy backfired due to the decline in gas production. The Zohr Gas Field experienced ongoing issues with water infiltration, which caused gas production to hit its lowest level by 2023. Egypt's power market relies heavily on natural gas as a fuel, representing roughly 70% of the country's energy mix (BMI, 2023).

In June 2023, heightened pressure on the power grid prompted the government to suspend gas exports temporarily. A severe heatwave struck the nation in July, necessitating energy conservation measures, among them countrywide daily power cuts and increased imports of mazut to fuel power plants. Mazut shipments from Russia to Egypt surged, with a record high of 2.17 million barrels in June 2022, the highest level since April 2015

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(El-Safty, 2022). While officials acknowledged the impact of the gas shortage and heatwave on the summertime power cuts, they minimized the growing production issues at the Zohr field (Parker & Mahfouz, 2023).

This brief will analyze the following policy instruments: the shift from natural gas to mazut, rolling blackouts, and the implementation of energy efficiency programs. These will be assessed according to three criteria: economic efficiency, effectiveness, and equity. The following section will provide a brief explanation of these policies and their impact.

Due to the limited availability of data on electricity production, consumption, and fuel usage,[1] data from the Egyptian Holding Electricity Company's (EEHC) 2021/22 and 2022/23 annual reports will be analyzed by the author to evaluate the aforementioned policies during fiscal year 2022/23. FY2021/22 is the baseline, while FY2022/23 will be used by the author to assess the effect of the policy.

3. Policy Analysis

3.1 Fuel switching policy

Given Egypt's dependence on natural gas for power generation, the first policy solution attempted by the government was to replace it with mazut in some power plants. According to the Egyptian Natural Gas Holding Company's (EGAS) annual report for 2019, 62.3% of natural gas consumption in Egypt went to power generation, followed by industry, which consumed 22.5% (EGAS, 2020). However, according to the Gas Regulatory Authority (GASREG), in 2023, just 31% of gas consumption in winter months and 46% in the summer was used by the government to generate electricity (GASREG, 2024).

According to the 2021/22 EEHC annual report, mazut usage in 2021/22 was 3,401 Ktoe, representing 10% of the total fuel used by the government, while the rest (90%) was natural gas (EEHC, 2023). Mazut usage increased to 4,731 Ktoe in 2022/23, representing 14.1% of the total fuel used that year, while the contribution of natural gas dropped to 85.8% (EEHC, 2024).

3.1.1 Economic efficiency

As a result of this policy, replacing natural gas with mazut in 2022/23 saved approximately 52,737,970 MMBTU[2] (1.47 billion m3).

Liquified Natural Gas[3] prices at the Title Transfer Facility (TTF) hub[4] reached a record high of over USD90/MMBTU in August 2022 before dropping again in December to around USD20/MMBTU. The Egyptian government was thus keen on exporting as much as possible to secure windfall profits. By June 2023, natural gas prices had dropped to approximately USD10/MMBTU (Trading Economics, 2024). Because the quantity and timing of LNG exports are unknown, this paper uses USD30/MMBTU as the average price, based on several officials' announcements that target USD30/MMBTU as the export price (CNN, 2022).

According to the author's calculations, this should have resulted in revenues from natural gas exports of USD1.5 billion annually or USD132 million monthly in 2022/23[5]. This figure aligns with the announcement from officials that the use of mazut had earned revenue of USD100–150 million monthly (Salah, 2022).

1 EgyptERA stopped publishing the monthly reports on their website in May 2023.

2 Million British Thermal Unit, 1 MMBTU equals 293.07 KWh.

3 To export natural gas, it has to be liquefied.

4 TTF is a virtual trading point for natural gas in the Netherlands and Europe's most significant gas benchmark.

5 By multiplying the saved natural gas quantity (52,737,970 MMBTU) by 30 USD/MMBTU.

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However, two additional aspects should be considered in order to fully assess this policy's economic efficiency: the price of mazut purchased and the impact of its use. Starting with the former, the estimated price of mazut is USD14/MMBTU (CNN, 2022), or the equivalent of approximately USD530/ton. This will make the total cost of purchasing the mazut that replaced natural gas approximately USD738.3 million. Thus, the net revenue from the fuel switching policy is USD843.8 million for 2022/23.

Mazut is a viscous, dark, and heavy fuel oil used for several purposes, such as generating power, producing diesel, and heating houses. It is known for its economical price, wide availability, and the relative ease of its refinement process. Nevertheless, the utilization of mazut in power plants has several drawbacks, including heightened levels of harmful emissions (EEHC, 2015). In Egypt, the emission factor reached 376.7 tonCO2e/GWh in 2022/23 and 381.8 tonCO2e/GWh in 2021/22, increasing from 367.58 tonCO2e/GWh in 2020/21 when natural gas represented 98.2% of total fuel consumption. The reduction in emissions in the later years was because EEHC implemented a more efficient operation strategy. Overall, the policy resulted in approximately two million tons of CO2e that could be associated with the use of mazut.

The use of mazut not only increases harmful emissions, but also damages the equipment of power plants, which entails higher maintenance costs (for spare parts and labor), the accelerated depreciation of the equipment, and lower efficiency of the power generation unit (EEHC, 2015). These additional expenses resulting from mazut usage are difficult to quantify, but they nevertheless diminish the overall benefits of the fuel-switching policy and its economic efficiency. Additionally, this strategy may necessitate a heightened reliance on foreign currency to procure spare parts for power plants.

3.1.2 Effectiveness

As presented in the analysis above, switching from natural gas to mazut saved only 4% of the natural gas used compared to the previous year (2021/22). Further, this policy is ineffective as it cannot be applied to all power plants. It could only be applied to steam power plants, representing 30% of the total installed capacity and contributing just 22% of the total generated power (EEHC, 2024). Moreover, the use of mazut does not allow for the full utilization of the generating unit's capacity (EEHC, 2015).

3.1.3 Equity

Lower-income groups and marginalized communities—particularly those living in densely populated areas—often face exacerbated effects of climate change, including the deterioration of air quality. Air pollution is made worse by the use of mazut, which has a direct negative impact on the overall health of the population. Younes (2022) reveals that Egyptian households spend around 10% of their income on health-related expenses. Compounded with the inaccessibility of adequate healthcare and means of transportation for lower-income patients and their companions, the fuel substation policy thus widens the gap of inequity in the Egyptian context (Younes, 2022).

3.2 Reducing electricity supply to residential consumers

The second policy instituted by the government was to reduce the electricity supply to residential consumers in order to curtail natural gas consumption in power plants. Rolling blackouts were introduced for a period of one hour a day, subsequently extended to two hours, but with the decline in domestic gas production, blackouts became a tool to deal with higher demand for electricity in the summer, not as a saving measure.

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3.2.1 Economic efficiency

To evaluate the economic efficiency of this policy, it is imperative for us to first assess the revenue accrued from the controlled blackouts. Owing to the current limitations in data availability, an analysis of the average electricity consumption per subscriber for 2021/22 and 2022/23 was used by the author to project the electricity savings. Given that the electricity reduction pertains to buildings, these were further delineated by the author according to three distinct categories: residential, commercial, and government and public utilities. The table below shows the pertinent calculations and resulting outcomes.

	Residential	Commercial	Government and public utilities
No. of subscribers 2022/23 (1000)	34,968	4,481	193
No. of subscribers 2021/22 (1000)	33,623	4,210	191
Energy sold (GWh) 2022/23	63,415	8,919	17,283
Energy sold (GWh) 2022/23	62,912	8,646.7	15,460
Energy sold per subscriber (2022/23) (kWh)	1,813.52	1,990.40	89,549
Energy sold per subscriber (2021/22) (kWh)	1,871.10	2,053.85	80,942
Energy savings per subscriber (kWh)	57.58	63.45	-8,606.81
Total savings (GWh)	2,013.63	284.3	-1,661.12

Note: A negative sign means an increase in electricity consumption.
Data source: (EEHC, 2023), (EEHC, 2024). Results calculated by author.

The above calculations indicate that approximately 2,000 gigawatt-hours (GWh) of energy were saved by the government in residential areas as well as 284.3 GWh in commercial establishments as a result of this policy. These savings represent about 1% of the total electricity production sector. However, 72% of these energy savings were negated by increased consumption in governmental buildings and public utilities.

Assuming that the average efficiency of power plants is 45%[6] and that the natural gas saved from conservation measures is exported at a price of USD30/MMBTU, the estimated revenue comes to approximately USD145 million.

Disrupting the electricity supply to commercial establishments entails financial costs. Furthermore,

6 The average efficiency of thermal power plants reached 49.77% in 22/23 (EEHC, 2024), and 5% losses are estimated in the transmission and distribution lines.

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residential structures accommodate various economic entities such as companies, retail outlets, healthcare facilities, and other enterprises (United Nations Human Settlements Program, 2016), all of which experience downtime during power disruptions. These repercussions subsequently manifest as diminished GDP and reduced government revenue.

It is a formidable challenge to quantify the financial repercussions of decreased productivity resulting from disruptions in electricity. Nevertheless, a tentative approximation can be offered by the author. At an energy intensity of 1.78 kWh per USD1 of GDP in Egypt (Habib et al., 2023), the author calculates that the losses incurred solely by commercial entities reach an estimated USD160 million.[7] This figure surpasses the total savings accruing from this policy without factoring in the losses sustained by diminished economic activities within the residential sector.

3.2.2 Effectiveness

The policy is ineffective for several reasons. Firstly, any electricity saved by interrupting supply to the residential and commercial sectors is offset by increased consumption in other sectors. Public buildings have the potential to decrease energy consumption by up to 50%, according to a World Bank study (2017). However, as indicated by the table above, in the period examined here, government buildings witnessed elevated electricity usage, which cannot be offset since they are not revenue generating and contribute minimally to economic activity. Although existing government directives provide for the rationalization of electricity consumption in these settings, implementation on the ground and oversight to ensure compliance face significant challenges. For example, it is very difficult to control the lighting and air conditioning systems in every office in old government buildings, which do not have central cooling systems.

It is challenging to ascertain the precise impact of the interrupted electricity supply, whether intended or otherwise, on various facets of economic activity in Egypt without resorting to quantitative models based on accurate data. That said, it is highly probable that the direct and indirect costs, such as the risk of societal disruptions in reaction to the government's conduct, significantly surpass the monetary savings.

3.2.3 Equity

The policy necessitates an unequal distribution of the controlled power cuts, as evidenced by the following factors:

1. Certain critical facilities, such as hospitals, have been exempted from the blackouts (Sharkawy, 2023).

2. At the end of 2023, the Ministry of Electricity's debt to the Ministry of Petroleum amounted to EGP168 billion. Egypt continues to subsidize electricity for those with the lowest electricity consumption by increasing the cost for the biggest consumers. However, several reports indicated that some areas were experiencing longer periods of electricity outage than other areas (Attaqa, 2022). The geographical distribution of the affected areas suggests that they were precisely where subsidy expenditures were higher.

The interruption of electricity supply leads to distributional effects as individuals seek to mitigate its impact by acquiring generators, batteries, and battery-operated fans (Abdelhamid, 2024). This has a disproportionate impact on lower-income groups, reducing their net income and imposing additional financial burdens. Moreover, the lack of electricity during hot summer days presents significant health and safety concerns (Katzan & Owsianowski, 2017).

7 By dividing the energy saved from the commercial sector (284.3 GWh) over the energy intensity (1.78 kWh/USD).

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4. Policy Option

4.1 Energy efficiency program

An alternative policy option to the above is an energy efficiency program to be implemented across all sectors. Egypt has considerable potential to reduce its energy consumption by following best practices in energy consumption, given its already higher energy intensity usage.[8] For example, the energy intensity by GDP for Egypt is 1.78 kWh/USD, compared to 1.73 kWh/USD for Morocco, 1.42 kWh/USD for Qatar, and 1.67 kWh/USD for UAE (Habib et al., 2023).

4.1.1 Economic efficiency

Numerous studies conducted by domestic and international organizations have shown the substantial potential for more efficient energy usage in Egypt. Below are selected findings from these studies, demonstrating the areas where energy efficiency measures could be implemented and the anticipated cost savings.

In 2017, the World Bank conducted a study to assess the feasibility of implementing energy efficiency measures in residential, commercial, and public buildings, specifically in Cairo and Alexandria. The investigation found that public buildings could achieve energy savings of 30–50%, estimated at 1,753 GWh with a payback period of less than two years, accounting for approximately 60% of the savings generated from electricity cuts in the residential sector. Moreover, the study indicated that commercial buildings could potentially achieve savings of 40–60%, with estimated savings of 1,205 GWh and a payback period of less than one year. However, the study did not provide explicit figures for residential buildings due to the complicated nature of implementing energy efficiency measures in this sector (World Bank, 2017).

One notable example pertains to the industrial sector, where three main electric motor-driven systems constitute 45% of electricity consumption in industrial motor systems (UNIDO, 2023). A survey conducted by UNIDO revealed that more than 60% of the installed motors fell below standard efficiency, while over 56.3% were over a decade old. The survey concluded that implementing motor system optimization measures, inclusive of low and no-cost strategies, in conjunction with motor replacement, has the potential to yield over 40% of the total technical electricity savings. This suggests a potential saving of approximately 5 GWh, surpassing savings achieved through other policy alternatives. It should be noted that Egypt has implemented Ministerial Decree 463/2020, which restricts the introduction of new motors with low energy efficiency classes into the Egyptian market (UNIDO, 2023). Despite this regulation, a majority of motors in use exhibit low efficiency and are often refurbished rather than replaced, as found by the survey.

Another opportunity for economic efficiency can be found in the residential sector through the use of more energy-efficient air-conditioning units. Air conditioners constitute up to 40% of the total electricity consumption in one apartment (Eltawil, 2023). Replacing the non-inverter air conditioner with an inverter air conditioner could lead to significant savings. Compared to non-inverter ACs, inverter ACs could save up to 62% of energy during cooling operation and 76% during the heating operation (Eltawil, 2023).

The implementation of this policy necessitates minimal to no capital investment by the government. The cost of maintaining 1 kWh is generally lower than the cost of generating it, with a range between 1:7 and 1:14, based on 2017 generation and saving costs (Ministry of Electricity and Renewable Energy, 2017).

Within the industrial sphere, this policy mandates

8 Energy efficiency programs use structural improvements and best practice strategies such as more efficient appliances, equipment, and improved controls to help reduce energy use.

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the enforcement of existing regulations accompanied by consistent monitoring and oversight after implementation.

4.1.2 Effectiveness

This policy is more effective than the two other policies discussed here because it can be universally applied across all sectors and in diverse circumstances, and it has no adverse implications. Furthermore, it stands to yield numerous favorable outcomes, including increased profitability and lower carbon emissions due to lower overall energy consumption. It also allows better access to markets which mandate a low carbon footprint on their imported goods, such as the European market. An increased demand for these products and services also boosts the energy efficiency sector and associated products.

The UNIDO Industrial Decarbonization Accelerator website offers real case studies from the Egyptian industrial sector.[9] These case studies have shown energy savings ranging from 3% up to 94% in some industries such as denim manufacturing, leather tanning and cement production , with a payback period of less than two years. Additionally, the annual carbon savings from these initiatives could reach 180 tons (UNIDO, 2023).

In accordance with the second National Energy Efficiency Action Plan (NEEAP II), a total of 22 pilot projects were carried out to enhance lighting system efficiency during the period 2015–2017. This was achieved by replacing traditional lighting systems with energy-saving ones and incorporating LED technology in various types of buildings, including government facilities, hotels, banks, shopping malls, and residential complexes. The estimated energy savings from these initiatives amount to around 9.5 million kWh, equivalent to EGP5.6 million (Ministry of Electricity and Renewable Energy, 2017).

4.1.3 Equity

It is essential to recognize that energy efficiency can reduce energy expenditures, foster employment, and advance the welfare and security of individuals. However, efficiency policies and initiatives that overlook disadvantaged households may exacerbate inequities. Utility authorities, regulatory entities, and governmental bodies bear a responsibility to alleviate energy inequalities for low-income, renting, and marginalized households by implementing meticulously structured energy efficiency measures and regulations.

There have been no studies that assess the impact of implementing energy efficiency and equity in Egypt, but research conducted in other regions provides valuable insights. For instance, a study in China aimed to quantify the effects of energy efficiency on energy poverty and income inequality. Its primary conclusion was that improving energy efficiency not only alleviates energy poverty but can also reduce income inequality due to the positive correlation between energy efficiency and social productivity. However, the impact of energy efficiency is heterogeneous and asymmetric. In essence, the specific impact of energy efficiency hinges on the prevailing levels of energy poverty and income inequality. Policymakers should accordingly tailor their approaches to local conditions when formulating policies (Dong et al., 2022).

This is reiterated in another study conducted in seven developing Asian countries between 1990 and 2022. The researchers analyzed multiple factors influencing income inequality, including energy efficiency. Their research revealed a negative correlation between energy efficiency and income disparity, suggesting that improving energy efficiency could potentially alleviate the income gap between the rich and the poor (Wei et al., 2024).

9 Egypt. (n.d.). Industrial Decarbonization Accelerator. https://www.industrialenergyaccelerator.org/category/egypt/?area-of-work=energy-efficiency.

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Fair and impartial energy efficiency policies and programs should not exacerbate societal, environmental, or economic disparities, but rather should strive to diminish them. Well-structured energy efficiency initiatives with proficient financial mechanisms have the potential to mitigate energy imbalances.

The implementation of energy efficiency projects across industrial, commercial, and residential sectors promises substantial energy savings. However, effective execution necessitates regulatory oversight from the pertinent ministries. Specifically, the Ministry of Industry could promulgate sector-specific guidelines for optimal energy-efficient practices.

5. Discussion and Conclusion

The prolonged foreign currency deficit experienced by Egypt since 2022 has put significant strains on the country's economy, which undermines its efforts to achieve sustained economic growth. In response, Egypt has curtailed its domestic natural gas consumption and is exploring avenues for gas export in order to generate short-term hard currency income and alleviate the foreign exchange shortage.

However, the measures taken to free up the country's natural gas resources for export, including rolling blackouts and the substitution of certain power plant fuels with more environmentally damaging alternatives, have yielded suboptimal outcomes. As evidenced by the analysis in this brief, the shift to alternative fuels has marginal benefits, while the losses incurred due to electricity cuts outweigh the benefits. Moreover, electricity consumption in certain sectors has increased, further underscoring the inefficacy of these measures.

It is crucial to emphasize that the current extended electricity outages result from a natural gas shortage and are not part of the fiscal analysis for the period 2021/22–2022/23. Nonetheless, the proposed alternative policy has greater potential to alleviate the existing natural gas shortage and the economic burden on the fiscal budget.

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