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We Need a New Concept for the Security of Electrical Systems in Israel in Emergencies and Routine Times

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The Swords of Iron war has highlighted the urgent need for a new security strategy for Israel's electricity sector, given the military threats that have materialized as well as the emerging climate risks and technological advancements. Israel's unique status as an "electricity island," cut off from neighboring power grids, coupled with its heavy dependence on the natural gas industry, makes it especially vulnerable to threats to its energy infrastructure. All these factors require Israel to formulate a new concept for the security of the electrical system, which will provide emergency response and also improve the system's performance in routine times.

Israel could face prolonged disruption to its supply of electricity due to an accelerated increase in demand or physical damage to natural gas infrastructure, grid infrastructure, or the production system. These numerous challenges emphasize the importance of assessing the preparedness of Israel's electricity sector to handle them. This article presents the main trends in the electricity sector and their significance in the sector's ability to withstand these challenges, including security threats and climate risks to Israel's electrical and energy infrastructure. In addition, recommendations are given for strengthening the sustainability of the electrical system, while taking into account the necessary regulatory changes.

Main Trends in the Electricity Sector—Implications for the Security of the Electricity Supply

The development of economic dependence on the electricity sector: The continuous supply of electricity has always been a crucial component of the functioning of the economy and essential services. Thus, the sustainability of the grid and power stations has enabled trade, industry, the health system, the banking system, and more to continue. In the past decade, dependence on the continuous supply of electricity has expanded to other areas of economic activity, including:

A. The electrification of transportation systems—This includes the rail system, the decision to electrify the urban bus fleet by 2027, and the gradual electrification of private vehicles.

B. The increasing dependence of the water system on electricity—About half of Israel's drinking water is produced at desalination facilities, whose operation requires a continuous supply of electricity.

C. Communication—The increasing dependence of cellular and internet services on the electricity supply.

D. The establishment of data centers—These facilities are characterized by high electricity consumption and are required for the high reliability of the electricity supply. In Israel, the establishment of data centers is expected to grow in the coming years.

Ending the use of coal: Together with a slow transition to renewable energy, ending the use of coal has led to an increased dependence on natural gas. In 2024, natural gas is expected to make up over 75% of Israel's fuel mix. The diversification of natural gas sources has improved due to the commercial operation of three reservoirs and the construction of two connections from the gas reservoirs to the coast. However, Israel does not have facilities for storing natural gas, and damage to one of the reservoirs or pipelines is enough to significantly impair the electricity supply.

Dual-fuel capability: Most of the power plants have been established with dual-fuel capability, which enables them to operate using diesel fuel in case of damage to the gas system. However, in an emergency, it could be difficult to obtain a continuous supply of diesel, as the diesel stocks are limited and depend on imports, and prolonged operation with diesel could damage the availability of the power plants.

Privatization: Following the electricity reform in 2018, the Israel Electric Corporation's share of production is now only around 45%, and it is expected to decrease further due to the privatization of the Eshkol power station and the establishment of additional private power plants. As a result, ensuring the survival of power plants in the face of threats requires that the state provide directives and supervision of private entities, some of which are internationally owned.

Decentralization of renewable energy facilities: Renewable energy now accounts for 12% of electricity generation in Israel. Most renewable energy facilities are decentralized, meaning they are small facilities connected to the

electrical distribution network. The risk of systemic damage to renewable energy facilities is low, as it would require damage to a large number of sites. However, most renewable energy production is concentrated in peripheral areas while the main electrical consumption occurs in the center of the country. Therefore, the supply of renewable energy depends on the transmission network, and the continuity of the supply relies on the grid's survival. A decentralized grid, such as a local solar energy system on the rooftops, offers advantages as it allows for the generation, storage, and use of electricity to occur in the same location. The more decentralized the grid and the closer the proximity between the source of energy production and consumption, the lower the risk of damage to the supply.

Storage: The decline in battery prices and the greater integration of renewable energy facilities have led to increased investment in storage, especially in battery technology. It is expected that by the end of the decade, approximately 2.6 gigawatts of storage facilities will be built in Israel. Around a third of these facilities will be connected to the extra-high voltage grid and controlled by the system manager, while the rest will be small, decentralized facilities. Storage facilities could significantly enhance the electricity sector's sustainability in the case of damage. Thus, buildings equipped with solar facilities and storage can ensure the supply of electricity for at least a few hours in the day and evening. In the rest of the sector, storage can provide electricity supply in the evening, even in the event of damage to power plants.

The Security Threats to Israel's Electrical and Natural Gas Infrastructure

The war in the Gaza Strip—unexpectedly forced upon Israel following Hamas's surprise attack on October 7—and subsequent events have further highlighted the growing military threat to Israel by the "resistance front" under Iran's leadership. This front consists of the Shiite axis (Hezbollah in Lebanon, the Assad regime in Syria, the Shiite militias in Iraq and Syria, and the Houthis in Yemen) and the Palestinian resistance organizations (Hamas and the Islamic Jihad). Hezbollah, which spearheads this front, has emerged as Israel's main military threat. Over the past 17 years of relative calm along the Lebanese border since the Second Lebanon War in 2006, it has significantly improved the quality and quantity of its military assets, as evident from its recent deployment of advanced weapons.

The opening of the front on the Lebanese border on October 8 in support of the Palestinians in Gaza has raised the possibility that the ongoing fighting between Hezbollah and Israel, which has escalated for over the past seven months, could deteriorate into a large-scale war. The direct conflict between Israel and Iran, following the unprecedented missile attack on Israel on April 13, has increased

concerns of an all-out multi-front war. Such a war could cause serious harm to the Israeli home front, including damage to electricity and energy infrastructure, encompassing not only land-based electrical facilities but also the gas rigs at sea. This war would differ from previous conflicts in several ways:

The multi-arena dimension: One of the most important lessons from the war in Gaza, which has involved Hezbollah from Lebanon, the Houthis in Yemen, and Shiite militias from Iraq, is that Israel must be prepared to fight on several fronts simultaneously in any future war. Although President Assad of Syria, who is fighting for the survival of his regime, has chosen not to join the current fighting against Israel, there is no guarantee that Syria will not open another front in the future, especially in the event of a war against Hezbollah in Lebanon. The strategy of "convergence of the arenas," formulated by Iran, involves activating its network of proxies against Israel and is part of the regime's national security concept. Consequently, the IDF will need to prioritize between different combat arenas and the distribution of resources for defending the home front in any future war. This suggests that defending civilian electrical infrastructure or repairing damaged parts may not be given priority.

The enemy's military capabilities: Given the accelerated military buildup of Hezbollah in Lebanon and Iran's other proxies, Israel will have to cope with unprecedented amounts of firepower launched at the front lines and toward the home front. These capabilities primarily belong to Hezbollah, which currently possesses about 150,000 missiles and rockets (some claim even more) with ranges that cover the entire Israeli home front. This arsenal includes tens of thousands of missiles with significant destructive capability (anti-tank, cruise, ballistic, coastal, surface-to-air), as well as thousands of improved drones that can fly longer ranges, some of which carry explosives to double the damage, by striking the target and exploding on impact. More concerning is the fact that the organization has recently acquired a large quantity of precision missiles, especially for striking infrastructure. Despite Israel's attempts to prevent this, Nasrallah often boasts that the organization has had precision missiles since 2018.

Increased cyber threats: A new dimension that needs to be systemically addressed is the threat of cyberattacks on military and civilian systems, including energy and electricity infrastructure. These are attractive targets due to their far-reaching consequences for military operations and the home front (functional continuity, daily life, and physical security of the population). Iran is highly active in this area and has developed attack capabilities over the past decade, presumed to be in the hands of its proxies.

Expected damage to the home front: Despite Israel's advanced and effective multi-layered air defense system, it is presumed that in a war against Hezbollah, particularly in a multi-arena war scenario, the Israeli home front would suffer significant damage. Research conducted by the IDF and civilian organizations indicates that Israel would need to deal with approximately 4,000 missile-launches per day, at least in the initial weeks of the conflict, making it impossible to intercept all of them. In this scenario, the air force would achieve air superiority and prioritize defending critical assets, especially military ones such as air force bases and command and control systems. Consequently, damage to some electricity infrastructure would be expected. Additionally, gas rigs might need to cease operation due to the threats they may face, leading to prolonged local and even national power outages. Whether caused by direct damage to infrastructure or intentional disconnection to preserve essential fuel reserves, maintaining essential energy continuity to support the functional continuity of the home front would be difficult.

Climate Risks to the Electrical System

The electrical system in Israel, like many electrical systems around the world, is coping with a wide variety of environmental risks that could significantly affect the reliability of the electricity supply, the cost of electricity generation, public health, and the environment. However, due to its geographical location and being a climate change hotspot, warming and drying up at twice the average pace, Israel is even more exposed to climate change.

The main climate trends resulting from climate change, according to a report published by the Israel Meteorological Service in 2023, indicate that the weather in the region has become hotter, drier, and more severe. Consequently, we can expect extreme weather phenomena, including prolonged heat waves, heavy precipitation, floods, and fires, as well as natural disasters such as earthquakes and tsunamis. Although the report mainly addresses adaptation—preparedness for climate change and extreme weather events—it does not discuss mitigation, such as activities and plans to reduce greenhouse gases. Changes being made in the field of mitigation, such as the electrification of the transportation sector and transition to renewable energy, will be a challenge that the system will need to address.

In accordance with the first report of Israel's Climate Change Adaptation Administration, the main risks to Israel's electrical system as a result of climate change are as follows:

Increased consumption of electricity: Extreme weather events such as prolonged heatwaves and cold fronts will lead to a significant increase in energy consumption. According to the latest forecast published by Noga Ltd. in August 2022, the demand for electricity is expected to grow by 3.1% by 2030, and then by 3.7% between 2030 and 2040. This increase is the result of fast population growth combined with an improved standard of living, partial electrification of transportation, industry, and the household sector as well as increased economic activity. These changes will affect both electricity demand and the entire electricity sector.

Malfunctions and power outages: Increased use of air conditioning due to prolonged extreme heat or cold can overload the electricity system and lead to frequent malfunctions, as it is not able to adapt to such conditions. In addition, hot weather can cause massive fires that could damage the electricity transmission grid, especially in forested areas. Transmission infrastructure could also be damaged during extreme storms, floods, or hail. A strong storm in the Mediterranean Sea could also pose a threat to the natural gas rigs and ports.

Reduced transmission capability: The distance between energy production sources and consumers in Israel ranges from 100 to 700 km. The transmission of electricity from the periphery to the central regions of the country requires the development of a transmission and transformer system, which is not required when the production is local. More than 70% of Israel's electricity is currently produced in southern Israel, while 70% of the demand and the main consumption centers are concentrated in the central region. In addition, hot weather conditions prevalent in Israel limit the extent of electricity transmission on long-range transmission lines during the hot afternoon hours in the summer.

Deteriorating water quality: The rising sea level along with decreased precipitation contributes to increased groundwater salinity, while population growth leads to higher water consumption and greater need for desalination as a primary source of drinking water. The establishment of additional water desalination facilities will further increase the demand for electricity.

The Challenge of Developing the Grid

Increasing the share of renewable energy in the fuel mix makes it possible to reduce the exposure of the electricity sector to damage in the natural gas supply and power plants. In recent years, there has been a focus on establishing renewable energy facilities in areas of high consumption. However, fully realizing the potential for such facilities also requires the development of renewable energy

facilities at remote locations and the development of the grid to transmit electricity to the areas of consumption.

The minister of energy recently approved a plan to develop the transmission network, and another plan to develop the distribution network is currently being prepared. However, implementing the plans is expected to be a lengthy process, as a large number of projects have not yet received statutory approval. The approval processes are also expected to take a long time. The construction timelines are also expected to be longer than planned given the numerous projects outlined in the plan.

One possible solution to address the delay in developing the grid is to maximize the use of the existing grid. This includes incorporating storage facilities in substations, implementing measures to monitor the grid load, and utilizing dynamic load management techniques.

Regional Cooperation to Ensure the Continuity of Supply

The Israeli electricity sector is an "electricity island" as it does not connect to neighboring countries. This means that in the event of damage to gas reservoirs or power plants, it is not possible to meet demand through redundancy from neighboring electricity sectors. Regional cooperation could also enhance Israel's energy security by diversifying production sources and stabilizing relations in the region. Cooperation with Egypt in the field of natural gas and between Israel, Jordan, and the United Arab Emirates, together with the United States, within the framework of the Abraham Accords—in which Jordan would export 600 megawatts of green energy to Israel, while Israel would double its export of desalinated water to Jordan, reaching up to 200 million cubic meters per year—illustrate the potential for regional cooperation but also the difficulties of implementing it.

In recent years, several avenues for cooperation have been discussed, and it is worth assessing their progress as part of a comprehensive response to ensure the industry's sustainability:

A. The discovery of natural gas reservoirs has facilitated regional cooperation, including bilateral cooperation whereby Israel supplies gas to Jordan and Egypt, as well as collaboration in the East Mediterranean Gas Forum (EMGF) regional framework, which was established in 2018 and comprises 8 countries—Egypt, Jordan, Greece, Cyprus, Italy, France, the Palestinian Authority, and Israel.

B. In the Israel–Cyprus–Greece triangle, two ambitious projects are on the agenda: the first is the relatively more advanced plan to connect Israel's power grid with Cyprus and Greece, known as the EuroAsia Interconnector; and the second is the EastMed Pipeline, which aims to establish a natural gas pipeline from the eastern Mediterranean to Europe; however, the prospects of advancing this project appear less certain at present.

C. While there are evidently challenges in advancing cooperation with additional Arab countries, the possibility of normalization with Saudi Arabia in the future could facilitate the import of hydrogen and/or renewable energy.

D. Other possibilities for cooperation, albeit in the longer term and less likely, are on the issue of natural gas, if natural gas is found in Lebanon and/or within the Palestinian Authority, there is potential for cooperation in the future. As part of the vision for the day after the war, the rehabilitation of the Gaza Strip could also include developing the gas field off the coast of Gaza.

Conclusion and Recommendations

The main measures that should be advanced are as follows:

A. The production system:

   1) Promoting the installation of renewable energy systems, with storage and management technologies, to mitigate the risks to Israel's electricity and energy industry.

   2) Encouraging the development of decentralized production facilities, particularly behind-the-meter systems.

   3) Advancing a plan for agrivoltaic systems to increase the renewable energy production.

B. The grid system:

   1) Implementing a national emergency plan for accelerating the development of the power grid, including milestones for implementation, control mechanisms, backup capabilities, and quick grid repair during emergencies.

2) Developing smart management capabilities for the distribution network to effectively manage decentralized production and storage as well as local management of demand.

3) Establishing independent operational capabilities for decentralized distribution networks (microgrids) to ensure uninterrupted power to local consumers in the event of grid malfunction or damage.

C. The natural gas industry:

1) Advancing regional natural gas cooperation to increase redundancy and reduce the threat to the system

2) Expanding gas storage capabilities

3) Maintaining liquid gas connection capability for emergency purposes.

D. Demand

1) Implementing arrangements to manage demand and integrate household consumers into these arrangements.

2) Formulating emergency regulations for the electricity sector to prioritize the allocation of electricity during supply shortage as a result of damage to power plants or the grid.

In conclusion, the significance of the electricity sector to the Israeli economy has increased in recent years, along with threats posed by climate change and terrorism. Renewable energy is a central component in the response to these threats, as it does not depend on the supply of fuels from external sources, and it is naturally decentralized, making it less vulnerable to attacks. Accelerating the growth of renewable energy production would help mitigate some of the risks the industry expects to face in the future.

Therefore, it is necessary to develop a new concept for Israel's electrical systems that would not only address peak hours, which will become more extreme due to climate change, but also potential security emergencies. Many countries around the world are adopting a security-oriented approach to advancing their green energy agenda. This is a lesson to be learned from countries like Europe, which has responded to the energy crisis caused by the Russia–Ukraine war, and California, which is preparing for extreme weather. This concept should prioritize renewable energy, storage, grid development, demand management, and regional cooperation.