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Natural Gas and Israel’s Energy Future
Near-Term Decisions from a Strategic Perspective

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Summary

Introduction

Israel’s electric-power system needs new capacity to meet the demands of its growing economy. Because of long lead times, Israel will need to make expensive, momentous decisions on investing in new base-load generating capacity in the near future. Those charged with planning as well as those who determine and implement policy need to consider likely future levels of demand, the costs and availability of sources of supply, security of supply, reliability, environmental effects, and land use. Decisions have to be made under conditions of deep uncertainty about what the future may have in store.

This study assessed the opportunities and risks the government of Israel faces in shifting to a greater reliance on domestic and imported natural gas. The analysis seeks to help the Israeli government engage in managed change by choosing robust strategies that minimize potential consequences of relying more heavily on natural gas. It does so by applying newly developed methods for strategic planning and decision-making under deep uncertainty to these assessments.

In particular, the study applies an innovative, quantitative robust decisionmaking (RDM) approach to the central question of how large a role natural gas should play in Israel’s energy balance. Rather than relying on the typical planning method of trying to optimize plans around a small number of “most likely” scenarios, RDM helps planners discover strategies that are robust—i.e., strategies that perform well across a large range of plausible futures. Given that we cannot predict
the future, we use RDM to examine the available alternatives and ask which would be best to choose.

We used the RDM methodology to answer the following questions:

- How risky would it be for Israel to greatly increase its use of natural gas to meet future demand for electricity?
- What combination of fuels would be most beneficial for Israel?
- How should Israel’s natural-gas infrastructure be expanded to accommodate necessary increases in electric-power generation?
- What actions can Israel take to guard against future uncertainties?
- How can Israel guard against supply disruptions in natural gas?

Our contribution was to build an analytical framework that planners in Israel may use as a tool to explore these questions in detail. In our study, we perform an analysis designed to demonstrate the use of this tool. Our report on the analysis is divided into two parts. We first consider strategies for natural-gas utilization that would lead to different levels and patterns of demand for the fuel. We did not wish to presuppose any particular volume of natural-gas use and instead sought to derive this level analytically. We then consider strategies for ensuring the supply of the resulting demand for natural gas.

This document is a summary of the more detailed, technical discussion found in Popper et al. (forthcoming).

How Large a Role Should Natural Gas Play in Israel’s Energy Mix?

To evaluate the strategic options for utilization, we set acceptable threshold levels for total system costs out to the year 2030, greenhouse gas (GHG) emission levels in 2030, and the land area required to sustain the electricity generating capacity called for by different strategies. This threshold setting would be set by Israel’s planners and policymakers in their application of this tool.
We judged alternative strategies based on how well they perform in comparison with each other against these criteria across many different plausible futures. We generated 1,400 future states of the world by varying assumptions about future demand, prices, technologies, policies, and external developments. We simulated the results of implementing several strategies in each of these future worlds.

We began with simple strategies, discovered how they failed in certain scenarios, and then modified them to be more robust. We found that making the strategies inherently adaptive—that is, framing them in the form of set rules for observing and then acting on external triggers—led to more successful outcomes across scenarios. This process yielded seven strategies for our final analysis. The first (Baseline) was a typical result of planning that sets an optimal course based on forecasts of future demand and other technical variables. It was not designed for adaptation. To this, we added three forms of rule-based, adaptive strategies. One (Least Cost, or LC) always seeks the least-cost solution for supplying Israel’s energy. Another (Less Natural Gas, or LessNG) seeks a cautious balance between fuel types to minimize the effects of possible natural-gas supply cutoffs. The third (More Natural Gas, or MoreNG) seeks to maximize the use of natural gas. Each of these three exists in two forms—one unmodified and another that allows for the construction of renewable, non–fossil fuel generating capacity and for policies to enhance conservation (Least Cost + Conservation, or LCC; LessNG + Renewables + Conservation, or LessNGRC; and MoreNG + Renewables + Conservation, or MoreNGRC).

We found that plans that are inherently adaptive enhance robustness and, therefore, the chance of meeting Israel’s goals. Another strong finding is that the combination of demand management and utilizing several energy sources, particularly adding non–fossil-fuel alternatives, enhances robustness. When demand is left unchecked and follows the high-growth assumptions, it becomes quite difficult to choose any strategy that will meet each of the cost, emission, and land-use measures. Finally, we found that a strategy that rapidly enhances the use of natural gas in Israel can both be consistent with the interests of Israel’s people and provide security against various risks.
Robust Natural-Gas Supply–Infrastructure Strategies

The principal objection to greater use of natural gas is that its supply could be less reliable than coal or petroleum. What level of natural-gas use may Israel plan without raising exposure to unacceptable risks in the supply of this fuel? For this analysis, we posed several further questions: What infrastructure is needed to meet Israel’s long-term natural-gas demand, and at what cost? How rapidly would different strategies deplete Israel’s newly discovered domestic reserves? How easily can Israel accommodate abrupt reductions in future deliveries of natural gas through foreign import pipelines?

To address these questions, we used a similar RDM analysis to examine the alternatives for additional natural-gas supply through 2030. In particular, we looked at supply from newly discovered domestic deepwater (DDW) reserves and from imports in the form of liquefied natural gas (LNG).

We examined four basic strategies. In one, Israel draws all additional future supply from DDW reserves. In another, Israel first relies on this resource and then adds LNG later when needed. In two others, Israel builds out both fuel paths at the same time. In one, it relies primarily on DDW reserves as the main supply, with LNG as a supplement. The other does the reverse to prevent too-early depletion of the domestic supply. We crafted a number of different strategies around each of these four basic forms, varying amounts and types of storage of natural gas and backup fuels, levels of storage, amount of supply taken from the existing foreign supply pipeline, and level of “insurance” Israel seeks in the form of infrastructure designed to make up for possible supply disruptions.

As before, we chose criteria for assessment. In this case, we set acceptable thresholds for supply-system costs, depletion of domestic reserves, and potential unmet demand. Again, it will be necessary for Israel’s planners and leaders to set the appropriate thresholds to move

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1 The depletion of any new natural-gas deposits under Israel’s control will most likely not occur by 2030, the end date of this study. However, the strategies that will shape the period beyond 2030 will be chosen and put in place well before that year.
beyond the proof-of-principle analysis in this monograph. When looking solely at the question of adequacy of supply, we found the following:

- The DDW Only strategy is insufficient unless long-term demand remains low and deliveries from now-existing foreign pipeline sources exceed 3.5 billion cubic meters (BCM) per year.
- For higher levels of demand, a second source of supply, such as an LNG terminal, is needed in addition to domestically produced natural gas.
- If Israel can rely on foreign supply of an annual 7 BCM of natural gas through foreign pipeline imports, the DDW Then LNG approach can meet demand and postpone the high capital costs associated with building an LNG terminal.

Israel’s policymakers must determine what are acceptable costs or rates of depletion and whether one is more important than the other. RDM is a means to make the trade-offs between strategies explicit and to determine which factors should govern the choice among them. To illustrate this capability, we asked how different strategies would compare in the face of an abrupt disruption in supply. We simulated a one-year shutoff of all supplies through foreign pipeline sources in 2025. We found no change in the rank order of preferred strategies when we varied assumptions about the probability of a supply cutoff. But, when we looked at our assumptions about the ratio between costs uniquely associated with the LNG supply chain and those for DDW-derived natural gas, we found that this ratio played an important role in identifying the most-robust strategies.

A finding like this provides decisionmakers with a concrete description of what the trade-offs are and what drives the differences between strategies. The analysis also suggests that Israel would be doing well to develop its newly found domestic resources as a principal means for meeting future natural-gas demand. Given the lead times for construction of both this and a potential LNG fuel stream, the final decision on the latter might be left until the full costs and potential benefits of the former are better known. An LNG infrastructure is insurance for Israel, but building it too early may impose unnecessary costs on the
country. It is also clear from the full analysis (reported in Popper et al., forthcoming) that, as natural-gas dependence grows, the requirement for storage of standby switch fuels, principally diesel, both on site and in central repositories, will become more crucial to ensuring that large portions of electricity generation capability are not placed at risk by unforeseen discontinuities of supply.

**Implications of Analyses**

This study carefully laid out the competing objectives and constraints facing Israeli policymakers while directly confronting the problem of deep uncertainty. Our goal was to demonstrate the value of an adaptive approach to energy-infrastructure planning as well as to identify those elements of adaptive plans for natural gas that enhance the ability to achieve successful outcomes under many different sets of future conditions.

In doing so, we arrived at several implications. They should be viewed as indicative but not necessarily conclusive. In particular, while we had no means to assign priorities among the various goals we consider in this study (supply security, costs, emissions, land use, depletion of domestic reserves), the government of Israel would need to do so in applying our analytical framework. This would most likely alter several of the implications derived from our analysis. Since completing this proof-of-principle analysis, a possibility has arisen for technology transfer and collaboration with planners in Israel that would allow more authoritative inquiries into government choices. Therefore, we now discuss only those findings that appeared most strongly from the initial effort. Their value lies in pointing to the most-fruitful avenues for Israel’s planners to investigate in greater detail using the tools we have created for this project. We will present a fuller set of findings, including those more dependent on policy priorities, in a supplemental report when that work is complete.
• Curbing growth in demand for electricity is Israel’s first line of defense for energy security. No factor had as much influence on scenario outcomes as slower growth in electricity demand.

• Israel should adopt a two-stage planning process for decisions on expanding generating capacity. The first stage should use current planning techniques to make decisions on capacity additions through 2015. However, for capacity additions beyond 2015, a more adaptive approach should be initiated that separates the planning process from the construction decision.

• Israel may primarily invest in natural-gas combined-cycle (NGCC) power plants, provided that sufficient supply may be ensured to fuel these plants.

• Israel should take delivery of contracted volumes from its current foreign supply source and consider new contracts up to the physical maximum available through the existing pipeline, if competitively priced.

• Because of cost and vulnerability concerns, Israel should prepare for, but not yet invest in, an LNG terminal.

• Israel needs to maintain a diversified mix of fuels for generating electric power to reduce risks to the supply and cost of fuel. Despite higher costs, Israel should invest in some solar-thermal electric-power plants or use solar thermal to preheat steam for fossil fuel–fired power plants.

• The Israeli government should regulate the wholesale and retail prices of domestically produced natural gas based on the cost of imported gas.

• Because the costs of the available options for storing natural gas are so high, Israel should guard against disruptions in natural-gas supplies by storing sufficient quantities of diesel—not natural gas—to smooth future supply disruptions.

• Israel should continue with plans to build an inland high-pressure natural-gas distribution pipeline to parallel the existing offshore pipeline.