Ending Water Scarcity in the Desert: Is it a Mirage?

Examining Desalination Technology As A Solution For Water Scarcity In Israel

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Abstract. This paper examines contemporary efforts to end water scarcity in the Israeli state. Although the supply of water was initially envisioned as a responsibility solely of the state and took on an almost religious importance, developments over the last 15 years have elevated the role of the private sector, through the use of Public-Private Partnerships, in building new desalination plants and other required infrastructure, filling a role formerly held by the state. Although the amount of potable water in Israel has increased, too much focus has been placed on increasing water supply, while initiatives to decrease demand for water have been largely neglected. Negative externalities stemming from the country's embrace of desalination technology, including damage to marine environments, have been largely ignored as well.

Introduction

The headline of a recent *Scientific American* article seemed almost miraculous: "One of the driest countries on Earth now makes more fresh water than it needs" (Jacobsen, 2016: n.p.) Set against a regional context of frequent water shortages and given that the compounding effects of climate change are expected only further to deplete this resource, the author marveled over Israel's newfound ability to create water in the desert. This apparent abundance is a direct result of Israel's decision to rapidly construct mega-scale desalination plants throughout its coastal region from 2005 onwards, leading to the availability of 582 million cubic metres of new water by the end of 2017. Driven mainly by necessity, Israel has become a global first-mover in the construction of mega-scale desalination facilities The implications of this technology are immense, with some observers going as far as suggesting that, "in many places, squeezing fresh water from the ocean might be the only viable way to increase supply" in the coming years (Talbot, 2015: n.p.)

As water scarcity continues to increase around the world, other countries will likely look for new and innovative solutions to counter this challenge. In light of the seemingly unbridled potential of this new technology – and given Israel's apparent success – a proper evaluation and analysis of Israel's apparent success with desalination technology presents a useful case study to determine the extent which large-scale desalination can successfully "solve" water scarcity. As such, this paper sets out to explore the impact and effectiveness of current desalination technology in mitigating Israel's chronic water scarcity. It suggests that while the Israeli case demonstrates that desalination technology is a useful tool to increase overall water supply, it must be used in combination with other supply and demand-side measures to be truly effective in solving water scarcity.

This study proceeds as follows: first, it offers a historical overview of water management within the Israeli state, and then moves on to examine the early implementation of desalination technology in Israel, as well as where the country currently stands. A broader evaluation of the successes and failures of the technology follows sequentially, before briefly concluding with some policy implications both within Israel and, perhaps more importantly, for other states who may be looking to solve their water scarcity challenges. Throughout this process, and in keeping with the theme of this journal, it endeavors to map the political narratives that have shaped the debate and the implementation of desalination policy in Israel.

Historical Overview of Israel's Water Management Regime

At the time of its founding in 1948, Israel inherited the legal doctrine of *Mejelle*, the civil code of the former Ottoman Empire which declared water to be a free good, "jointly owned by the public, like grass and fire" (Laster and Livney, 2009: 122). Management of water resources was thus seen as a responsibility of the state, collectively held on behalf of all of its citizens. In its first decades of existence, the Israeli state aggressively encouraged agriculture-based settlements, which would come to play a "major role in the young economy, providing jobs, food, and foreign currency" (Laster and Livney: 122.) These settlements, crucial for realizing the Zionist vision of "blooming the desert" (Teschner et al., 2013: 95), compelled the state to immediately become involved with the management of water resources in the fledging country, in large part due to the "almost mythic control" agriculture played in the government's economy and ideology (Laster and Livney, 2009: 124).

During these initial years, water scarcity in Israel's arid climate was characterized as a problem of accessibility, not quantity. In effect today, a series of laws passed between 1955 and 1959 were vital in creating a new legal imperative for the state control of water resources. The most important law passed during this time was the eponymous Water Law (1959), which declared domestic water sources as "the property of the people […] managed by the State for the needs of the people and development of the country" (Laster and Livney, 2009: 125). Not only was this law promoted by the Supreme Court to an almost-constitutional level, but it also defined "domestic water sources" so broadly the effect was mainly to position any conceivable source of fresh water – in the present, or occurring in the future - as state-managed (Laster and Livney, 2009: 125). This series of legal developments – coupled with nation-wide construction of a state-owned water conveyance system between 1955-1964 led to the organic development of early Israeli water policy as decidedly socialist in tone.

Very little changed for several decades. The 1959 Water Law also called for the creation of a national water company, Mekorot, which was entrusted with the operation of the national water system. The system was, and still is, immense – it lifts water from 213 metres below sea level to 151 metres above sea level – and consumed initially nearly 25 percent of the state's entire electricity generation. Today, it is still the leading user of energy in Israel, although its share has dropped to only six percent of total energy consumption (Teschner et al., 2011: 264). Importantly, the conveyance system has effectively "turned the country into one basin" (Reznik et al., 2017: 223). In contrast to other countries, where periods of water scarcity and drought may be limited to specific regions, Israel's conveyance system supplies water to the entire country. This distinction is important for policymakers and those overseeing the management of water resources since the consumption of a water unit at a particular location within the state must, therefore, be weighed against the need for a unit of water at all other locations in the country.

Israel's profound "hydro-ideological support of agriculture production" eventually led to trouble, however, as the already-scarce water sources had by the end of the 1970s been used "to a degree of environmental compromise" (Teschner et al., 2013: 96). The depletion of Israel's only lake, the Sea of Galilee, to within a few inches of a "black line" at which salt infiltration would flood the lake and ruin it forever proved to be a catalyst for change (Teschner et al., 2013: 96). The state began to examine new supply-side measures to increase the total amount of water, establishing 178 reservoirs across the country's rain gradient in the early 1990s. These reservoirs allowed the collection of 125 million cubic metres (MCM) per year of fresh water (Tal, 2006: 1082). Demand-side responses to conserve water resources were also embraced. Domestically, the upgrading of inefficient plumbing, along with car washing and toilet regulations, along with seasonal usage restrictions, helped to keep water consumption steady throughout the late 1980s and 1990s (Tal, 2006: 1082).

Decision-makers within the state water management apparatus generally ignored wide-scale desalination as a viable solution for water scarcity during this period due to its extremely high cost of nearly $2.50 a cubic metres in 1970.[1] [2] An unprecedented series of droughts in the late 1990s once again lead to significant public pressure on policymakers and elected officials to solve Israel's water crisis. This overt pressure, coupled with a decrease in the cost of desalination technology persuaded the administration to conduct a series of studies into the main issues related to creating "a new national water source" based on the construction of several large-scale desalination plants, and to create, "on the basis of these studies' findings, an optimal long-range desalination master plan" (Dreizin et al., 2008: 148). The Israeli Minister of Finance initially blocked the plan, as he believed that desalination would still prove too expensive in the long run and that seawater desalination should be a last resort only after the development and utilization of all other water sources and a water pricing reform (Dreizin et al., 2008: 148). Ultimately, the timely release of a report forecasting a thirty percent reduction in rainfall due to climate change during another series of droughts caused the minister to cave to what had become an intolerable environmental problem (Becker and Wart, 2015: 541). The desalination studies were subsequently rushed through on a fast track basis (Dreizin et al., 2008: 148).

The culmination of these studies led the Israeli Water Commission to propose a "Desalination Master Plan" in 1997 to develop large-scale desalination plants along Israel's Mediterranean Coast to increase the country's water supply (Feitleson and Rosenthal, 2012: 275). The plan was deemed to be feasible for several reasons. The first, and most important, was that technical advances in desalination technology had decreased the price of desalinated water drastically, from $2.50 per cubic metres to just 58 cents (Talbot, 2015: n.p.) This rapid development of the technology led to the perception that it was "an economically, politically and strategically superior alternative" to other options on the table (Teschner et al., 2013: 92). Moreover, the potential supply of desalinated water was perceived to be endless, given Israel's proximity to the Mediterranean Ocean, and the plants would also require highly-skilled employees to fill a variety of jobs, employing hundreds of Israelis in meaningful and high-paying work (Semiat, 2000: 194). Thus, the perceived political advantages of successfully carrying out the master plan were significant. Not only would politicians be able to claim that they had solved Israel's historical water scarcity, but they would create jobs and improve the lives of their citizens in doing so.

[1] All financial figure presented are in USD.
[2] A cubic metre of water, or 1000 litres, is what the average Israeli uses per week at the time of writing.

Desalination: A Brave New World

Despite its apparent promise to solve Israel's chronic water scarcity, the implementation of the master plan was initially delayed for several years due to three factors. Above-average winter rains in 2002 and 2003 appeared to reduce the impact of the droughts on Israel's water reserves, lessening the intense political pressure to find an immediate and viable solution. Finding suitable land for the construction of the desalination plants, which are quite large and must also be immediately next to the ocean, on the overcrowded coastal strip of Israeli territory also proved to be challenging (Tescner et al., 2013: 97). Additionally, and most importantly, the construction of the new desalination plants – in part to appease the Minister of Finance, who was still concerned about cost overruns – were to be built by Public-Private Partnerships (PPP), a shift from the historic state monopoly on water management. The state would still be responsible for pricing and distributing water, but the construction and operation of the new plants were put to tender, with the successful company allowed to build the plant and then sell desalinated water in perpetuity to the state at the regulated prices. As a result of this shift in policy, time was needed to create new oversight bodies, such as the Water Desalination Authority, as well as to evaluate the bids put in by private companies (Tescner et al., 2013: 97). By 2004, a national physical master plan had been approved with four major plants to be built, and the first, in Ashkelon, came on-line just a year later in 2005.

Israel's water conveyance system continued to be state-owned under Mekerot even with the shift to public-private partnerships in the construction and operation of the new desalination plants. In effect, this meant that it was neither efficient nor desirable to build smaller, regionalized desalination plants, as a small number of large plants connected to the conveyance system were perceived to be able to supply the entire country with fresh water (Meindertsma et al., 2010: 452). After the initial success in Ashkelon in 2005, four more plants were constructed, the last set to come on-line just a few weeks after the time of writing. The five plants will be able to produce 582 MCM of water annually, meeting about two-thirds of Israel's projected domestic needs. These will not be the last plants; the Israel Water Authority has already approved zoning for another four large plants to be built by 2025, although their capacity remains undetermined (Rinat, 2017, n.p.) By 2020, somewhat amazingly, it has been claimed that 1 billion cubic metres of desalinated water will be introduced into the water supply system per year, meaning it should be possible to start replenishing the overdrawn natural water reservoirs, raising their levels to stop further deterioration of their quality and even to reverse the degradation processes and rehabilitate the natural water reservoirs" (Tenne et al., 2011: 16). Questions remain, however, about how much water the conveyance system will be able to handle each year. Conceivably, there is a point at which increasing the production of desalinated water would provide diminishing returns because it would exceed the total capacity of the pipes that make up the conveyance system and upgrading the system throughout the nation would likely prove costly. Extensive consultation of both academic literature and government documents has frustratingly left this question unanswered.

Although different methods of desalination exist, the design used by the five plants currently in operation is known as reverse-osmosis, which draws in seawater and then uses significant amounts of energy to force the saltwater through semi-permeable membranes. This process allows the fresh water through the membrane into a collection container where it is then piped into the national conveyance system while holding salt ions and other particles back and discharging them into the ocean (Talbot, 2015, n.p). This method of desalination, while more efficient at a large scale than other technologies, is energy intensive. On average, it takes 3.85-kilowatt-hours to produce a cubic metre of water, meaning that close to four kilowatts of energy are needed for an entire hour to desalinate enough water to meet the needs of one Israeli for a week (Tal, 2006: 1083). On a macro level, between 30-50 percent of the total cost of the desalination process is associated with energy consumption, which, in Israel, has historically been produced through imported fossil fuels, and more recently offshore national gas deposits (Meindertsma et al., 2010: 450). Plants must also operate continuously, meaning that any switch to sources of alternative energy must not only be able to generate huge amounts of power, but they must also be able to supply the plant 365 days of the year (Becker et al., 2010: 1047).

Evaluation of Israel's Desalination Paradigm

Although the sheer amount of water produced by the desalination plants – a projected one billion cubic metres per year by 2020 – sounds impressive, it is contended that the ability of the current desalination technology to solve Israel's long-standing water scarcity has been vastly overstated. Thus, the evaluation of Israel's new desalination paradigm is divided into three sections: environmental impacts, the internal political economy of the decision-making process, and the psychology of water supply and demand in Israel. Furthermore, throughout these sections, the argument is put forth that the main actors who have benefited from desalination technology are the companies who produce the technology and who have won the tenders to build the plants, as well as politicians and decision-makers at the policy level from a short-term perspective. In contrast, citizens living near the plants appear to be the most negatively impacted in the short term. Although, when taking a long-term view, it is suggested that Israel's marine environment and broader Israeli society could both potentially suffer serious negative consequences.

Environmental Concerns

A major, but underpublicized environmental problem associated with Israel's desalination plants is the discharge of huge amounts of highly concentrated salt water. There is no scientific agreement on the long-term effects of brine and salt discharges from desalination plants into the marine environment, but several studies have found that the discharge contains dangerous cleaning chemicals from the plants (Meidnertsma et al., 2010: 454), and has led to increased metal concentrations on nearby shores and a substantial increase in salinity to the surrounding waters. Several scientists studying desalination efforts worldwide have concluded that the significant uncertainty surrounding the environmental impacts of desalination means it should be avoided when at all possible (Becker et al., 2010: 1046). Environmental groups have pointed to recent "red blooms" of phytoplankton next to the discharge pipes from several desalination plants as evidence that the plants are hurting Israel's marine environment, although no studies have been conducted on how the effects of desalination may harm the fishing and aquaculture sectors of Israel's economy (Teschner et al., 2013: 98).

Another major environmental problem associated with desalination plants is the emission ofair pollutants due to the energy requirements of the plants. Israel's energy needs are mostly met through imported fossil fuels and some natural gas, leading to the perception that the Israeli government "regards the emission of greenhouse gases and climate change as an irrelevance" via their unequivocal endorsement of the desalination plants (Meindertsma et al., 2010: 455). Jerusalem, Tel-Aviv, and Gaza City are all currently exposed to air pollution levels detrimental to public health according to international standards. Although data is limited, the emissions produced by the plants have been correlated with further air pollution increases in these cities (Meindertsma et al., 2010). Paradoxically, although Israeli companies have developed some of the world's most advanced solar energy equipment and the state enjoys a nearly endless supply of sunshine, the country generates a meager 2.5 percent of its electricity from solar. These solar companies have become "frustrated by government bureaucracy" and have mostly taken their experience abroad (Associated Press, 2017: n.p.) This portrayal of government bureaucracy is worrisome and highlights how the desalination plants have benefitted a select few Israeli corporations. Under Israel's new PPP process, the bids to construct desalination plants must also include the cost of building and operating an adjacent power plant to meet the plant's energy needs.

Taken on its own, this is not especially problematic. Trouble emerges, however, because the desalination companies who have won four out of the five bids are owned by corporations that also have a quasi-monopoly on the energy sector, meaning they can submit a lower bid based on savings from power generation. The dominance by the same few corporations of Israel's water and electricity sector has already been tagged as "the new monopoly, a private one cross-cutting water, and energy sectors" (Teschner et al., 2011: 464). Between 2006 and 2012, when the first wave of desalination plants was being built and coming on-line, the stock price of the Israeli multinational Israel Chemicals Limited, which directly or indirectly owns three of the five plants, tripled from three dollars to twelve dollars – during the global financial recession, no less. Corporations controlling the desalination plants also have a vested interest not to invest in or encourage the expansion of renewable energy, since its advancement runs directly counter to their economic interests and ability to bid on future desalination projects competitively. Thus, as Israel increasingly finds itself locked-in to these PPPs, it is also locking itself into a future of high carbon dioxide emissions and increasingly poor air quality with little room to renegotiate later on.

Political Economy of the Decision-Making Process

Another criticism of Israel's embracement of desalination technology is that it has allowed politicians and policymakers to displace concerns and conflicts about Israel's water security rather than addressing the problems head-on, sacrificing long-term planning and management for short-term political gain. Indeed, Teschner et al. suggest that the adoption of the technology means decision-makers "no longer face the uncertainty of rains, nitrate and pollutant concentrations in aquifers and declining water level in the Sea of Galilee… instead, there are new technical questions, such as who will win the tenders to operate the plants, what would be sufficient depth for the brine discharge pipes from the plants, and stable sources of natural gas required to power the desalination plants" (2013: 98). The type of decisions falling in the second category are fundamentally less explosive, and therefore, less threatening to politicians concerned with re-election than those in the first category. In this sense, Israeli politicians have benefited, at least in the short term, from the implementation of desalination technology.

Nevertheless, the government's decision to rapidly implement and expand desalination capacity led to a series of problems that could have been avoided – or at least, been accounted for – before the plants were fully operational. Although desalination plants are able to produce high-quality fresh water for public consumption, the water from the plants is devoid of some key minerals which cannot be easily added by authorities, such as magnesium. Although desalinated water is typically combined with other "natural" sources of fresh water before being distributed for domestic consumption, nearly half of Israel's population consumes below the recommended amount of magnesium (Rosen et al., 2017: 88). Deficiencies in magnesium have been positively linked to substantially increased risks of heart disease, and the study's authors concluded that Israel's reliance on desalinated water could be harmful to consumer health in the medium to long term (Rosen et al., 2017: 95).

The immense scale and centralization of the desalination plants pose additional problems. The coastal regions, where the five existing plants are located, have extremely high population densities. In these already-crowded areas, the construction of desalination plants results in the loss of significant coastal open spaces, which in some cases were previously marine parks or reserved for public enjoyment (Tal, 2006: 1083). Citizens have raised objections to the plants based on the amount of noise and visual pollution they generate. Residents adjacent to the new construction sites are also concerned that the construction of the plants will allow for further industrialization of the area, thereby contributing to more pollution and decreasing the quality of life (Rinat, 2017: n.p.). Finally, the centralized nature of the desalination plants means that they are susceptible to emergencies in the vicinity, both in water and on land. The membrane technology currently used in the plants is extremely delicate. If unexpected pollutants in the marine environment – from an oil spill, for instance – appear, the plants would be severely damaged (Zinat, 2017: n.p). This risk could have been mitigated if Israel had chosen either a more regionalized desalination strategy or a strategy the involved other sources of water besides desalinated seawater, but the preference for centralization means that the state cannot afford to have even one plant go off-line for any length of time if it wants to meet the increasing water needs of the country.

Finally, the rush for politicians to "solve" Israel's water crisis has led the state to mainly ignoring more cost-effective strategies. Under the 1997 Water Master Plan, desalination plants were chosen in large part because of their perceived cost-efficiency relative to alternative solutions. The actual economic cost of desalination has since been questioned widely. Becker et al. offer perhaps the most comprehensive refutation of the economic arguments undergirding desalination. In sum, the authors suggest that factoring in environmental externalities, the real cost of desalination is anywhere from 6.5 to 20 cents higher than the cost in real terms (2010: 1049). Using this actual cost of desalination as a baseline, Becker et al. conclude that Israel could save over 700 MCM at a cost less than that of desalination, through a combination of demand and supply-side solutions, including reducing evaporation from reservoirs and marginally increasing prices for water used by the agriculture sector (2010: 1053). Although the full list of recommendations is too much to evaluate, given the scope of this paper, Becker et al.'s suggestions are attached for further consultation.

Comparative analysis of water-shortage mitigation alternatives.

	Desalination	Increased Wastewater Treatment	Reduced Evaporation from Reservoirs	Installation of Water Savers	Higher Prices for Water in Agriculture	Changes in Park & Garden Plants & Irrigation	Advanced Grey Water Systems
Direct costs (US$/CM)	0.52	0.45	0.01	0.45	0.20	0.61	~2.00
External costs (US$/CM)	0.065		?		0.03		
Total costs (US$/CM)	0.585	0.45	?	0.45	0.23	0.61	~2.00
Total project costs (million US$)	187	52	0.5	85	71	43	Not calculated
Amount of water saved or added (MCM/year)	320	116	37	190	320	70	0

Table 1- Comparative analysis of water-shortage mitigation alternatives (Source: Becker et al., 2010: 1053.).

Psychology of Water Supply and Demand

Despite the environmental risks and economic inefficiencies with desalination, the single biggest issue associated with desalination technology – and specifically, the way it has been politically positioned - is its encouragement of water consumption in Israel that is unsustainable in the long term. The country has traditionally fostered a mentality of hyper-conservation of water resources; water was previously treated as an ideological good above and beyond a regular consumable commodity. Even as recently as 2009, the state launched a nation-wide, multimedia awareness campaign imploring citizens to conserve water as a result of significantly depleted freshwater resources. The campaign used the extremely low level of the Sea of Galilee as a prominent symbol of the crisis. Throughout 2009 and part of 2010, awareness was raised across radio, television, and the internet; newspapers even featured a "Sea of Galilee tracker" depicting the water level of the lake (Rejwan, 2011: 29). As opposed to the construction of desalination plants, which aimed to address the shortage by increasing supply, the campaign aimed to address the shortage from the other side of the equation: by lowering demand for water. It was incredibly successful. Over its duration, a 10 percent reduction in domestic consumption of water was observed. Even more importantly, months after the campaign's end domestic per capita consumption rates remained at the lowered level, suggesting that the attitude of conservation was more entrenched in Israeli society and not just a temporary response to the perceived crisis. The entire campaign cost $7.5 million to run; translated into the amount of water saved, the Israeli government had paid just over ten cents per cubic metre of water saved, a price less than one-fifth the cost of desalinated water today (Rejwan, 2011: 29).

As another demand-side measure, the IWA also announced in 2009 that it would significantly raise the tariff on marginal consumption of water, effectively leaving rates unchanged except for the top tier of consumers. These changes also led to a lowering of consumption patterns – between an eighteen to twenty percent year-over-year reduction – but political pressures lead to the cancellation of these price adjustments just one year later (Becker et al., 2010). Regrettably, these political pressures on decision-makers were created by other government officials and water officials who, proud of their achievements in rapidly increasing the supply of fresh water due to the construction of desalination plants, came out with statements in 2010 and 2011 “to the effect that Israel was no longer suffering from a water shortage” (Katz, 2016: 7). These statements were patently untrue and remain so today. Even with Israel’s current desalination capacity – which is 70 percent more than in 2011 –the country is still solidly in the category of countries suffering from chronic water scarcity (Katz, 2016: 8). Israel still has huge historical groundwater deficits from years of overdrawing its natural resources – about three to four times its total current desalination capacity – and a “legacy of depleted aquifers and desiccated streams” (Katz, 2016: 8). However, for the first time in the state’s 60-year history, policymakers and officials were telling the population that their supply-side management was a permanent solution to this historically omnipresent challenge.

The results of this bragging have not been positive. Demand management measures were quickly phased out by officials, leading many Israelis to conclude that water in Israel was no longer scarce. Between 2013-2016, real prices for domestic water consumption dropped by 20 percent, even though water expenditures represent only one percent of annual household *disposable* income, and as of 2013 average water rates were lower in Israel than the average for OECD countries, many of whom do not have water scarcity (Katz, 2016: 8). Per capita and absolute water, consumption has increased in Israel every year since 2011; a nation-wide survey in 2016 found that nearly 50 percent of respondents agreed with the false statement that “Israel did face water scarcity in the past, but no longer does” (Katz, 2016: 8). In this sense, an increase in water supply from desalination technology has been offset by rising consumption, resulting in a net-zero gain. The most problematic aspect of this development is not that consumption rates have been increasing, but that policymakers and politicians have lost their legitimacy to promote demand-side initiatives given their repeated self-aggrandizement for having “solved” the issue. This handwringing would be irrelevant if desalination had made sure that the supply of domestic water was able to outpace the demand, but this is not the case. Indeed, Katz goes as far as suggesting that the introduction of desalination technology was only ever going to be able to “obviate the need for further overdrafts” given Israel’s continued economic and population growth, as well as Israelis’ desires for an increasing quality of life, which will likely necessitate further water consumption increases (2016: 9).

The success of desalination technology in increasing water supply has been portrayed as the ultimate solution to Israel’s water scarcity, with damning consequences. At the time of writing, despite the extra water provided by the desalination plants, Israel is undergoing another severe drought. The previous four years are reported to have “overtaxed Israel’s unmatched array of desalination plants, choking its more fertile regions and catching the government off-guard” (Rabinovtich, 2017: n.p.) The Sea of Galilee is forecast to hit its lowest level ever – never mind in the last ten or twenty years – this winter. Proposed cuts to water consumption have drawn vehement opposition from a public who was told only four years earlier by the minister responsible for the water authority that “today, it can it can be claimed with confidence that the water crisis is behind us” (Katz, 2016: 7). Desalination technology may have been able to provide Israel with 582 new cubic million litres of water, but the country seems to have returned to the exact situation that prompted the construction of the plants in the first place.

Policy Implications and Conclusion

In this section, several policy implications arising out of Israel's new desalination paradigm are highlighted before offering some concluding thoughts about the potential of desalination technology writ large. Firstly, the Israeli government must immediately focus on prioritizing demand-side measures, especially given the future limited potential of desalination technology. The government would be well-advised to leverage the current water crisis in trying to restore an ethos of water conservation among citizens and work to continue that mentality even as the drought eventually subsides. Although politically unpopular, the government should also raise the water tariffs that it has cut over the past few years, especially on the top tier of consumers, at least to where the tariffs stood before. Tariffs in Israel remain below the OECD average; however, at the risk of losing political capital and given Israel's unique geographic circumstances, these rates should ultimately be set higher than the OECD average. Thirdly, any freshwater from additional desalination plants should be immediately directed into restoring natural groundwater supplies, which have been neglected for at least the last 30 years and serve as a critical backup for water planners in the case of future droughts. Fourthly, the state should alter its tender process for the building of future plants to ensure it is both more competitive and should promote the construction of plants that are not reliant on fossil fuels, or at least partly dependent upon alternative energy. Fifth, and finally, the government must look at alternative supply and demand-side measures, outlined in the previous section, that would be both less environmentally damaging and more cost-effective than desalination.

What can be learned from Israel's experience with desalination technology? On the whole, the potential of the technology to solve Israel's – and indeed, global – water scarcity has been significantly exaggerated. It is not a question of if the technology works or not – it does, at least to a certain extent. Some may even suggest that, for all its problems, the technology is justified given its ability to create drinkable water in otherwise parched areas. In some instances, it is acceptable. The bigger problem lies in the fact that desalination technology, as it stands today, is unable to provide a limitless source of consumable water, as has been implicitly and explicitly suggested by politicians looking to offer a "permanent" solution to water scarcity within their borders. Without responsible planning, this expectation-reality gap can subsequently lead citizens in water-scarce nations to consume water resources well above their means, leaving the state's water resources in a worse position than before the implementation of desalination technology in the first place. Current desalination technology represents a useful way for water planners and state bureaucrats to increase overall water supply, but the technology should, and must be seen as a tool to be used in conjunction with multiple other demands and supply-side measures, instead of a singular solution.

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