REENERGIZING PEACE: THE POTENTIAL OF COOPERATIVE ENERGY TO PRODUCE A SUSTAINABLE AND PEACEFUL MIDDLE EAST

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Synopsis: This article explores potential regional energy cooperation between Israel, Jordan, and Palestine with an eye towards increasing collective sustainability and addressing the present climate crisis. We begin this article by examining the cooperation that was proposed, but never implemented, in the peace treaty between Israel and Jordan, and the Oslo Agreements between Israel and Palestine. We explain how the improved economics of renewable energy generation and desalination provides a unique opportunity to renew the energy-based regional collaboration that was envisioned in these two agreements. We argue that the economic transformation of renewable electricity generation and storage technologies can allow all parties in this region to pursue a more integrated and sustainable regional energy strategy. We then detail specific examples of how the challenges of water and energy scarcity in Israel, Jordan, and Palestine could be addressed more effectively through regional cooperation. We do this by presenting three brief case studies that highlight the potential of regional cooperation in energy production: the Red Sea-Dead Sea project; increased Palestinian autonomy over renewable electricity infrastructure; and the win-win scenario of a proposed plan between Israel, Jordan, and Palestine as they seek to expand desalinated water supply for growing populations while simultaneously reducing greenhouse gas emissions. Mitigating climate change constitutes a global chal-

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lenge which can help expedite long overdue cooperation in improving the energy security and environmental performance of Israel and its neighbors.

"We are working to lay the foundations for the establishment of a new Middle East, a Middle East based on economic cooperation and regional security . . . the World Bank will prepare a list of proposals for regional projects, from the linking of electricity grids of the countries in the region by the way, they calculated that if the electricity grids of Jordan, Egypt and Israel were linked, we could save those countries $6 billion in the planning of the infrastructure of future transportation. The potential is vast; no wonder it is beginning to fire the imaginations of our interlocutors."[1]

- *Shimon Peres, Speech to the Knesset, 1993*

I. INTRODUCTION

Sixteen years after Israeli foreign minister and Nobel Peace Prize laureate Shimon Peres waxed ecstatic about regional cooperation in the field of energy, Israeli solar entrepreneur Yosef Abramowitz traveled to Jordan. His self-appointed mission was to try sell the Hashemite Kingdom a sustainable version of this utopian, energetic vision: Jordan might not be blessed with meaningful fossil fuel reserves, but given Jordanian land resources, it could be the solar equivalent of Saudi Arabia within the Middle East. Jordan's vast areas of empty desert lands were optimal for solar energy generation. Abramowitz's detailed program showed how with international investment, Jordan could not only provide all of its own day-time electricity needs, but also those of Syria, Western Iraq, Egypt, and even Saudi Arabia. In light of political sensitivities, Israel could receive Jordanian-generated electricity via separate transmission infrastructure.

Looking back now somewhat ruefully, he summarizes the bottom line of his many years promoting a regional, renewable energy strategy: "Jordan blew it" –

1. Shimon Peres, Foreign Minister of Israel, Address by Foreign Minister Shimon Peres to the Knesset (May 11, 1993), *in* MINISTRY OF FOREIGN AFFAIRS, 2013.

he explains.[2] "They could have been a solar super power. But instead they can't even provide energy for their own people."[3] This is not embittered rhetoric, but rather an empirical evaluation: sadly, today Jordan continues to import 96% of its energy.[4]

Some twenty-six years have passed since Israel and Jordan signed a peace treaty which ended almost fifty years of enmity.[5] That agreement was intended to go far beyond the cessation of hostilities. It envisioned an entirely new dynamic in the historically-belligerent neighborhood, one in which Israel would cooperate with its neighbors and improve the quality of life for all residents of the region.[6]

The peace treaty also included rhetoric about environmental and joint water management issues, topics that continue to be discussed today.[7] At the time the peace treaty was drafted, however, no area was considered more important than that of "Energy."[8] At the time, neither Jordan nor Israel had any meaningful reserves of fossil fuel—even as many of the countries surrounding them enjoyed a surfeit of oil and petroleum production.[9] While there were—and remain—many asymmetries between the two countries' economies, dependence on energy imports was a problem they shared.[10]

As a result, in Article 19 of the peace treaty, the sides committed to "cooperate in the development of energy resources, including the development of energy-related projects such as the utilization of solar energy."[11] The treaty called for integration of energy infrastructure.[12] For instance, the interconnection of the two nations' electric grids in the Eilat-Aqaba area was supposed to take place upon signing of the treaty.[13] It was considered a symbolic parallel to the interconnection of the two nations and a regional perspective regarding energy. The treaty called for the finalization of the relevant agreements regarding energy within half a year of the treaty's ratification.[14]

There was every expectation that the treaty would herald in a new era of cooperation that would constitute a transformational "win-win" turning point for both countries' unsustainable energy profiles. Unfortunately, in the area of ener-

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2. Interview with Yosef Abramowitz (June 19, 2020).

3. *Id.*

4. TRADING ECON., JORDAN-ENERGY IMPORTS, https://tradingeconomics.com/jordan/energy-imports-net-percent-of-energy-use-wb-data.html (last visited June 22, 2020).

5. Treaty of Peace Between The State Of Israel and the Hashemite Kingdom of Jordan, Isr.-Jordan, Oct. 26, 1994, 2042 U.N.T.S. 393 [hereinafter Treaty of Peace Between Israel and Jordan].

6. Laura Zittrain Eisenberg and Neil Caplan, *The Israel-Jordan Peace Treaty: Patterns of Negotiation, Problems of Implementation*, ISRAEL AFFAIRS 92 (2003).

7. *See* Treaty of Peace Between Israel and Jordan, *supra* note 5, at 396.

8. *See id.* at 401.

9. Nour Mardini, *The Road to Energy Security in Jordan and Israel*, YALE ENV'T REV. (2020), https://environment-review.yale.edu/road-energy-security-jordan-and-israel.

10. *Id.*

11. Treaty of Peace Between Israel and Jordan, *supra* note 5, at 401.

12. *Id.*

13. *Id.*

14. *Id.*

gy, very little, if anything, has come of the heady vision which informed negotiators' expectations and the rhetoric of U.S. President Bill Clinton, Jordan's King Hussein and Israeli Prime Minister Yizhak Rabin when they signed the agreement on the Aqaba/Eilat border on July 25, 1994.[15] Indeed, in his speech, President Clinton, specifically singled out cooperation in electricity as an example of the new harmonization between the former adversaries:

> And as of today, Jordan and Israel have agreed to take the first practical steps to draw their people together and to let the peoples of the world share in the wonders of their lands. They will establish direct telephone links; connect their two nations' electricity grids; open two border crossings between their nations, including one at Aqaba and Eilat, and another in the north; accelerate the negotiations aimed at opening an international air corridor between the two countries; and give free access to third-country tourists travelling between their two nations. These are the building blocks of a modern peace in ancient holy lands.[16]

Even though joint environmental initiatives under the peace agreements have been met with only modest success, there have at least been many repeated attempts to initiate activities that will coordinate environmental policies between Israel and its neighbors. For instance, in the area of water, Israel and Jordan have maintained the water transfers stipulated in Annex II of the agreement.[17] For several years, the countries appeared to be making meaningful progress in establishing a "water swap" based on a new desalination facility in Aqaba.[18] Peace parks were proposed such as the Red Sea Marine Peace Park[19] and the de facto "Naharayim" peace island emerged.[20] Joint initiatives in areas from biological pest control to reintroduction of endangered species served as proof of concept that cooperative environmental projects could indeed be "win-win" ventures.[21]

The lack of progress in the area of Israeli-Jordanian energy was surely a function of the general deficit in mutual trust and the associated loss of momentum in peace-related initiatives. But it was also a function of an unappealing economic calculus.

Similar unsatisfactory results in energy cooperation have emerged from the agreement, "Concerning Israeli-Palestinian Cooperation Programs," a peace trea-

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15. ISRAEL FOREIGN MINISTRY, *Remarks by President Clinton, King Hussein and Prime Minister Rabin at the Signing Ceremony of the Washington Declaration*, 13-14 ISRAEL'S FOREIGN RELATIONS 261 (July 25, 1994).

16. *Id.*

17. *See* Treaty of Peace Between Israel and Jordan, *supra* note 5, at 456-459.

18. AL JAZEERA AMERICA, 'HISTORIC' WATER DEAL SIGNED BY ISRAEL, JORDAN, AND PALESTINIANS (Dec. 9, 2013), http://america.aljazeera.com/articles/2013/12/9/dead-sea-read-seajordanisraelpalestinians.html.

19. Shoshana Gabai, Binational Red Sea Marine Park, *Israel Environment Bulletin* 20(4) (Oct. 1, 1997), https://mfa.gov.il/mfa/pressroom/1997/pages/binational%20red%20sea%20marine%20peace%20park%20-%20oct-97.aspx.

20. Shmuel Avitzur, *The Power Plant on Two Rivers*, ISRAEL MINISTRY OF FOREIGN AFFAIRS, (May 22, 2003), https://mfa.gov.il/MFA/MFA-archive/2003/Pages/The%20Power%20Plant%20on%20Two%20Rivers.aspx.

21. Alexandre Roulin, et al., *'Nature Knows No Boundaries': The Role of Nature Conservation in Peacebuilding*, 32(5) TRENDS IN ECOLOGY & EVOLUTION 305 (Mar. 22, 2017), https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347(17)30057-5?_returnURL=http%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS0169534717300575%3Fshowall%3Dtrue.

ty Israel entered into with Palestine in 1995.[22] Annex VI of that agreement contained specific commitments by the two sides to promote joint work in four areas regarding energy:

> a. develop plans to promote the use of environmentally clean alternative sources of energy such as solar and wind energy;
> b. enhance cooperation in energy conservation;
> c. promote, within the framework of regional cooperation, projects for their mutual benefit in the field of electricity; and
> d. develop options for joint ventures which will include the international business sector in the field of energy production, management and supply.[23]

The agreement envisioned the Palestinians developing independent capacity to generate their own electricity,[24] but progress in this area has been extremely limited. The agreement called for: a Palestinian Energy Authority (PEA) to have the authority to issue licenses and to "set rules, tariffs and regulations in order to develop electricity systems in the West Bank," as well as "construct transmission lines, distribution lines, power stations" and create "an inter-regional electricity connection in the West Bank."[25] Instead, there has been a diplomatic stalemate, intermittent cycles of violence and the ultimate cessation of negotiations on a final status deal between Israeli and the Palestinian leaders.[26] The interim agreement between Israel and the Palestinians in no way purported to comprehensively resolve many critical issues, in particular where the borders would be set, Israel's security expectations, or even important issues involving water and energy.[27] The deadlock has left Palestinians in both Gaza and the West Bank fully dependent on Israeli supplied electricity, which is still almost exclusively generated from fossil fuels.[28]

Indeed, both the Jordanian and the Palestinian agreements with Israel contained an understated hope that any new, shared electricity infrastructure would

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22. The Israeli-Palestinian Interim Agreement On the West Bank and the Gaza Strip, Annex VI, Protocol Concerning Israeli-Palestinian Cooperation Programs (Feb. 10, 1999), https://mfa.gov.il/MFA/ForeignPolicy/Peace/Guide/Pages/THE%20ISRAELI-PALESTINIAN%20INTERIM%20AGREEMENT%20-%20Annex%20VI.aspx.

23. *Id.* at Art. 4 (a)-(d).

24. The Israeli-Palestinian Interim Agreement On the West Bank and the Gaza Strip, Annex III, Protocol Concerning Civil Affairs, Article 10(3) (Sept. 28, 1995), https://mfa.gov.il/MFA/ForeignPolicy/Peace/Guide/Pages/THE%20ISRAELI-PALESTINIAN%20INTERIM%20AGREEMENT%20-%20Annex%20III.aspx. "Pending the establishment of an independent Palestinian electricity supply system or of other supply sources, the Israel Electric Corporation (IEC) shall continue to supply the electricity in order to meet existing and future expected demand in the West Bank. All aspects of supply of electricity to the Palestinian side by IEC shall be dealt with in a commercial agreement, similar to commercial agreements and prices agreed upon for major bulk Israeli consumers."

25. *Id.* at Article 10(2).

26. Israeli-Palestinian Conflict 'Locked in a Dangerous Paralysis', Under-Secretary General Warns Security Council, Urging Political Will, Leadership to Change Course, United Nations Security Council Meetings Coverage (July 23, 2019), https://www.un.org/press/en/2019/sc13895.doc.htm.

27. The Israeli-Palestinian Interim Agreement *supra* note 24, at Annex III, Art. 10 (3).

28. Alon Tal, *Unkept Promises: Israel's Implementation of Its International Climate Change Commitments*, 14(1) ISRAEL J. OF FOREIGN AFFAIRS 21 (Apr. 30, 2020), https://www.tandfonline.com/doi/full/10.1080/23739770.2020.1749965.

include low-carbon and renewable generation.[29] For most of the past twenty-five years, since Israel's peace agreement with Jordan and the Palestinians was signed, the relatively low price of coal and oil undermined the feasibility of any commitments to joint solar and wind projects.[30] Israel's discovery of natural gas created new dynamics and by 2020, Israel was exporting significant quantities of natural gas to Jordan as part of a fifteen-year, $10 billion agreement.[31] But in recent years, the economic calculus surrounding renewables worldwide has begun to change.[32] The steady drop in the price of new wind and solar capacity promises to create significant new opportunities for cooperation—opportunities that were unimaginable in 1994, when the price for residential solar installations was close to $15 per watt (2015 $U.S.).[33] According to data collected by Lawrence Berkeley National Lab, the median price for large non-residential solar installations fell from $9 (2018 $US) per installed watt in 2000 to $2.40 per installed watt by 2018.[34] In 2020, where the price of solar-PV is closing in on $1 per watt, there are more options to meet electric demand economically.[35]

In this article, we explore different ideas for cooperation in the energy field between Israel and its neighbors, with an emphasis on the possibility of such cooperation contributing to a cleaner, more sustainable, renewable electricity infrastructure for all parties. The article opens with a cursory review of the dramatic drop in the price of renewable energy generation and storage technologies. It is argued that this new economic reality bodes well for cooperative ventures that take advantage of different countries' relative advantages. Then, three brief case studies are presented to highlight the potential benefits of cooperation in the energy field:

1) The proposed Red Sea Dead Sea Water Conveyance Project which began as a project to replace water in the shrinking Dead Sea but evolved to contain a significant hydro-electric component;

2) The potential of renewable electricity as the basis for greater Palestinian energy autonomy; and

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29. *See, e.g.*, Oliver Holmes & Quique Kierszenbaum, *Israel moots plan to buy solar power from former enemy Jordan*, THE GUARDIAN (Aug. 23, 2020), https://www.theguardian.com/world/2020/aug/23/israel-moots-plan-to-buy-solar-power-from-former-enemy-jordan.

30. Lion Hirth, *What Caused the Drop in European Electricity Prices? A Factor Decomposition Analysis*, 39 ENERGY J. 1, 143-157; *see also* Roman Mendelevitch, Christian Hauenstein & Franziska Holz, *The death spiral of coal in the U.S.: will changes in U.S. Policy turn the tide?*, 19 CLIMATE POL'Y 10, 1310-1324 (2018).

31. Suleiman Al-Khalidi, *Jordan gets first natural gas supplies from Israel*, REUTERS (Jan. 1, 2020), https://br.reuters.com/article/jordan-israel-gas-idUSL8N2960Q9.

32. Harry Apostoleris, Sgouris Sgouridis, Marco Stefancich & Matteo Chiesa, *Utility solar prices will continue to drop all over the world even without subsidies*, 4 NATURE ENERGY 833–834 (2019), https://doi.org/10.1038/s41560-019-0481-4.

33. David Roberts, *The falling costs of US solar power, in 7 charts*, VOX (Aug. 24, 2016), https://www.vox.com/2016/8/24/12620920/us-solar-power-costs-falling.

34. Galen Barbose et al., *Tracking the Sun, Pricing and Design Trends for Distributed Photovoltaic Systems in the United States*, LAWRENCE BERKELEY NAT'L LAB. (2019), https://emp.lbl.gov/sites/default/files/tracking_the_sun_2019_report.pdf.

35. HOME ADVISOR, AVERAGE PRICE OF SOLAR PANELS, https://www.homeadvisor.com/cost/heating-and-cooling/solar-panel-prices/ (last visited April 21, 2020).

3) A proposed NGO initiative promoting infrastructure that could utilize Israel's relative sophistication and ability to desalinize water and the enormous potential for solar electricity generation in Jordan.

The associated political, regulatory, and economic challenges are considerable and different in each case. But all the examples confirm the original orientation of the incipient peace agreements that envisioned renewable electricity at the heart of a cooperative regional energy strategy. Today renewable generation makes even more sense economically and ecologically.

II. THE NEW ECONOMICS OF RENEWABLE ENERGY AND STORAGE

For many years, there was talk of the potential of desalination to serve as a "game changer" in the "zero sum" dynamics that characterized Middle Eastern water conflict.[36] But the energy demands of the process remained extremely high, making the cost of producing fresh water from the sea prohibitively expensive.[37] Indeed during the second half of the twentieth century the price of desalinating a cubic meter (1000 liters) of water never fell below a dollar.[38] Prior to 1980, desalination remained a marginal contributor to water resources worldwide.[39] It was only technological breakthroughs in the design and efficiency of reverse osmosis membranes[40] that improved desalination economics, and provided countries like Israel, Saudi Arabia, the United Arab Emirates, and Oman with the additional hydrological opportunity to move beyond scarcity.[41] In 1995, cumulative global desalination capacity was about 20 million cubic meters (MCM) per day.[42] By 2019, global desalination had grown to just over 95 MCM per day.[43] Desalinated water has become so cheap that even farmers in the Middle East can begin to use it.[44]

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36. Yuan Zhou & Richard Tol, *Evaluating the costs of desalination and water transport*, 41 WATER RES. RESEARCH 3 (2005), https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2004WR003749.

37. Soteris A.Kalogiro, *Effect of fuel cost on the price of desalination water: a case for renewables*, 138 DESALINATION 137-144 (2001).

38. Mohammed Dore, *Forecasting the economic costs of desalination technology*, 172 DESALINATION 207-214 (2004).

39. Alon Tal, *The Desalination Debate – Lessons Learned Thus Far***,** 53 ENV'T 2011 5, 35-49 (2011); *see also* Uri Yermiyahu, Alon Tal, Alon Ben-Gal, Asher Bar-Tal, Jorge Tarchisky, & Ori Lahav, *Rethinking Desalinated Water Quality and Agriculture*, 318 SCIENCE 920-921 (2007).

40. SETH M. SIEGEL, LET THERE BE WATER: ISRAEL'S SOLUTION FOR A WATER-STARVED WORLD (2015).

41. Ian James, *In the Middle East, countries spend heavily to transform seawater into drinking water*, AZ CENTRAL (Nov. 29, 2019), https://www.azcentral.com/story/news/local/arizona-environment/2019/11/29/middle-east-oman-water-desalination-reliance-costs/2123698001/.

42. WORLD BANK, THE ROLE OF DESALINATION IN AN INCREASINGLY WATER-SCARCE WORLD 29, https://openknowledge.worldbank.org/handle/10986/31416 (2019).

43. Ivan Sola, *Survey to Study the Limiting Factors of Desalination Development in Different Countries*, IDA GLOBAL CONNECTIONS 29 (2020), https://issuu.com/idadesal/docs/aaff_ida_global_connections_summer20_dv.

44. Yermiyahu, *supra* note 39, at 920-21.

One can argue that a comparable new era of plentiful low-carbon energy should be in the making for the sun-rich Middle East. Ironically, it is not the ubiquitous oil—whose market price recently dropped to new lows[45] that might be the catalyst for regional cooperation. Rather, renewables have the potential to play such a role. This is possible because the cost of solar energy and storage has plummeted so dramatically.

In 2012, an article in the magazine, *The Economist*, contained an empirical observation predicting a continuous lowering in the price of photovoltaic solar power.[46] The prediction was attributed to Richard Swanson, the founder of *Sun Power Corporation,* and was referred to as "Swanson's Law."[47] Swanson's Law was likened to Moore's Law, named after Gordon Moore, a co-founder of Intel.[48] In 1965, Moore anticipated that about every two years the number of transistors that could fit into a fixed space would double.[49] This progress would manifest in a steady drop in the cost of computing power.[50] In the solar field, Swanson's Law predicts that the price of photovoltaic cells used to produce electricity from solar panels will drop 20% each time global manufacturing and cumulative shipped capacity doubles.[51]

It seems that for now, Swanson's estimate enjoys considerable validation. At the time the *Economist* article was published, the pre-installation cost of a watt of solar-PV capacity was just under a dollar—already a far cry from the $77 price tag for a solar-watt in 1977.[52] But today, eight years later, manufacturing a solar-watt of capacity, by some recent estimates, only costs 32 cents.[53] This constitutes a 6,000 percent total drop in price in forty-three years.[54] Recently, two solar manufacturers based in China (*Risen Energy* and *Trina Solar*) began offering 500-watt, 50-cell photovoltaic modules that could continue the trend of decreasing solar-PV prices.[55]

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45. Lizzy Gurdus, *Crude prices plunge to lowest level in history — what Cramer and others are watching,* CNBC (Apr. 20, 2020), https://www.cnbc.com/2020/04/20/crude-prices-plunge-to-record-lows-cramer-others-on-whats-next.html.

46. Geoffrey Carr, *Sunny Uplands*, THE ECONOMIST (Nov. 21, 2012), https://www.economist.com/news/2012/11/21/sunny-uplands.

47. *Id.*

48. *Id.*

49. Carla Tardi, *Moore's Law,* INVESTOPEDIA (Aug. 27, 2020), https://www.investopedia.com/terms/m/mooreslaw.asp.

50. *Id.*

51. Richard M. Swanson, *A Vision for Crystalline Silicon Photovoltaics,* PROGRESS IN PHOTOVOLTAICS: RESEARCH AND APPLICATIONS, DOI: 10.1002/pip.709 (Feb. 1, 2006). *See also* Tam Hunt, *Swanson's Law and Making US Solar Scale Like Germany,* GREENTECH MEDIA, https://www.greentechmedia.com/articles/read/is-there-really-a-swansons-law.

52. Carr, *supra* note 46.

53. John Weaver, *MIT and NREL See Solar Modules Reaching Well Below 20¢ Per Watt*, PV MAGAZINE (Jan. 29, 2020), https://pv-magazine-usa.com/2020/01/29/mit-and-nrel-see-solar-modules-well-under-15%C2%A2-per-watt/. *See also* Zhe Liu, *Revisiting Thin Silicon for Photovoltaics: A Technoeconomic Perspective,* ENERGY AND ENVTL. SCI. (Oct. 25, 2019), https://pubs.rsc.org/en/content/articlehtml/2019/ee/c9ee02452b.

54. Liu, *supra* note 53.

55. Tim Sylvia, *How the New Generation of 500 W Panels Will Shape the Solar Industry*, PV MAGAZINE (Mar. 6, 2020), https://www.pv-magazine.com/2020/03/06/how-the-new-generation-of-500-watt-panels-will-shape-the-solar-industry/.

A. Israel

The new economics of renewable energy are increasingly manifesting in Israel's electricity market. A new tender for solar-powered electricity generation in Israel was recently conducted by Israel's Electricity Authority.[56] The terms of references not only included electricity generation, but also a minimum capacity of four hours of daily electricity storage.[57] Of the forty-five proposals that were submitted, eleven were accepted, for a price of 5.8 cents a kilowatt hour[58] – less than half of the average retail residential electricity price in the United States and about one-third of Israeli residential electric prices.[59] Indeed, government projections suggest that the country's electricity consumers could save one billion dollars if renewable electricity generation increased to 30% of total generation by 2030.[60]

Given the country's limited dimensions, Israeli environmentalists are unhappy about the prospect of giving up vast swaths of land to solar fields.[61] But there are clear limits on how much electricity solar panels on the country's roofs can provide. Indeed, the cost per MW of installed capacity for small, residential pV systems is higher than that of utility scale solar systems.[62] While Israel's Green Energy Association has always held the view that rooftops could provide no more than 5-7% of the country's electricity, given improvements in technology, it hopes that this might reach 10%.[63] But the reality is that if Israel is to attain the Ministry of Energy's new 2030, 30% renewable electric generation goal and eventually a decarbonized electric system by 2050, the lion's share of renewable energy will likely come from large solar facilities.

B. Jordan

Jordan's electricity system has suffered instability and chronic shortages due to its dependence on non-domestic fuel imports.[64] The country's population

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56. *See* Emiliano Bellini, *Israel's Solar-Plus-Storage Tender Concludes With Final Price of $0.0578/kWh,* PV MAGAZINE (July 2020), https://www.pv-magazine.com/2020/07/15/israels-solarstorage-tender-concludes-with-final-price-of-0-0578-kwh/.

57. *Id.*

58. ISRAEL ELEC. AUTH., THE FIRST TENDER FOR ESTABLISHING PV FACILITIES WITH STORAGE CAPACITY ENDS IN TREMENDOUS SUCCESS (July 14, 2020), https://www.gov.il/he/departments/news/pv_agira.

59. ELECTRIC CHOICE, ELECTRICITY RATES BY STATE, https://www.electricchoice.com/electricity-prices-by-state/ (last updated Apr. 2020). *See also* GLOBAL PETROL PRICES, ISRAEL ELECTRICITY Prices (Mar. 2020), https://www.globalpetrolprices.com/Israel/electricity_prices/#:~:text=Israel%2C%20December%202019%3A%20The%20price,of%20power%2C%20distribution%20and%20taxes.

60. ISRAEL ELEC. AUTH., CESSATION OF COAL USE IN ISRAEL'S ELECTRIC SYSTEM (Nov. 2019), https://www.gov.il/BlobFolder/policy/mediniyuthivatzahut/he/Files_mediniyut_pecham_hafhata_11_2019.pdf.

61. *See generally* SOC'Y FOR THE PROT. OF NATURE IN ISRAEL, PROMOTING SUSTAINABLE PLANNING, https://natureisrael.org/EPD/Open-Spaces (last visited Oct. 8, 2020).

62. Donald Chung, et al., *U.S. Photovoltaic Prices and Cost Breakdowns: Q1 2015 Benchmarks for Residential, Commercial, and Utility-Scale Systems*, NAT'L RENEWABLE ENERGY LAB. (Sept. 01, 2015), https://www.osti.gov/servlets/purl/1225303.

63. Interview with Eitan Parnass, Director of the Green Energy Association of Israel (Aug. 12, 2020).

64. Nour Mardini, *The Road to Energy Security in Jordan*, YALE ENV'T REVIEW (Jan. 7, 2020), https://environment-review.yale.edu/road-energy-security-jordan-and-israel.

continues to grow and with it, the demand for electricity.[65] Beginning in 2003, the Hashemite Kingdom began to import natural gas from Egypt to replace the oil which had traditionally fueled its electric generation.[66] But poor reliability in natural gas supply from Egypt forced Jordan to purchase large quantities of fuel-oil.[67] Today, some 10% of the country's GNP goes to pay for import of fuels which in 2018 amounted to 8,922 kilotons of oil equivalent.[68] Jordan has sought to increase its energy independence: on the one hand moving to exploit the highly polluting, but locally available shale oil, with a 570-megawatt power plant, which could provide about 15% of the country's electricity.[69] At the same time, Jordan set a goal of 10% renewable electricity generation by the end of 2020.[47]

To increase renewable electric generation, the Jordanian government has offered a suite of financial incentives including tax breaks, customs exemptions, and support from foreign and international aid agencies.[70] Today, some 7% of electricity generated in Jordan comes from low-carbon sources.[71] The government is actively trying to expand the renewable sector, seeking investors to provide the 20 billion dollars in investment capital that in order to build an additional 2,000 MW of renewable electricity generation capacity.[72]

C. Palestine

Palestine is divided into two separate geographical regions: the West Bank and Gaza, each with its own unique energy systems and challenges. The energy infrastructure in the West Bank and Gaza reflect a pathology of neglect and underdevelopment. A recent study concluded that "the total electricity consumption per habitant in Palestine is the lowest in the region (0.79 MWh per capita) and costs more than in any other Middle Eastern country."[73] The 2.7 million Palestinians in the West Bank consume some 4.9 TWh of electricity annually, over 90% of which is generated in Israel and sold to them by the Israel Electric Corporation.[74] Even though Palestinian per capita electricity consumption is modest (only a quarter of Israel's consumption levels, and somewhat lower than

65. Ghaida Abu-Rumman, et al., *Current Status and Future Investment Potential in Renewable Energy in Jordan*, SCI. DIRECT 1 (Feb. 2020), https://sciencedirect.com/science/article/pii/S2405844020301912.

66. Simon Henderson, *Jordan's Energy Supply Options: The Prospect of Gas Imports from Israel*, THE GERMAN MARSHALL FUND OF THE UNITED STATES 5, 6 (2005), https://www.gmfus.org/publications/jordans-energy-supply-options-prospect-gas-imports-israel.

67. *Id.*

68. Ghaida Abu-Rumman, et al., *supra* note 65, at 2.

69. THE HASHEMITE KINGDOM OF JORDAN NAT'L ELEC. POWER CO., ANNUAL REPORT 2018 13 (2018), https://www.nepco.com.jo/en/annual_report_en.aspx.

70. Ghaida Abu-Rumman et al., *supra* note 65, at 1-2.

71. *Id.* at 2-3.

72. *Id*. at 1.

73. Abel Juadi, et al., *Overview of Renewable Energy Potential* in Palestine, 65 Renewable and Sustainable E. Rev. 943 (2016).

74. WORLD BANK GRP., WEST BANK AND GAZA ENERGY EFFICIENCY PLAN 2020-2030 21 (June 2016), http://documents1.worldbank.org/curated/en/851371475046203328/pdf/ACS19044-REPLACEMENT-PUBLIC-FINAL-REPORT-P147961-WBGaza-Energy-Efficiency-Action-Plan.pdf.

Jordan's)[75] the infrastructure in the West Bank is often inadequate to provide electricity, especially when demand reaches its highest levels during July and August.[76] Nonetheless, essentially all Palestinian homes in the West Bank have electricity.[77] As many Palestinians, especially those living in refugee camps, do not pay for their electricity, a significant debt to the Israel Electric Corporation has accrued, which has stymied the operation and expansion of the electricity delivery system.[78]

Gaza's energy circumstances are worse than those in the West Bank. 1.9 million residents of this tiny enclave have intermittent electricity supply from a power plant in Nuseirat, along with imports from Israel and Egypt.[79] In practice, more than 60% of Gazan electricity is imported from Israel.[80] Egyptian power supply frequently malfunctioned and repairing of feeder lines has not always been effective.[81] The sole power plant located inside of Gaza runs on highly-polluting diesel, and due to intermittent fuel supply, it has a low capacity factor.[82] As a result of Israeli and Egyptian restrictions on fuel imports, Gaza's sole power plant for many years partially relied on fuel smuggled in by tunnel under the Egyptian borders.[83] In 2017, Gaza's only power plant stopped producing electricity altogether, reducing power to four hours per day for Gazan residents.[84]

The Gaza Distribution Company, officially authorized to oversee energy supply, reports that chronic power shortages undermine health, water, and sanitation, as well as the local manufacturing and agricultural sectors.[85] A World Bank Report from 2018 reports that, "Gaza is already experiencing severe shortage with electricity supply of less than 6 hours per day, affecting homes, hospitals, schools, and businesses."[86] The report estimates that electricity demand will continue to annually grow by 3.5% for the foreseeable future, which will require

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75. *See* WORLD BANK GRP., WORLD DEVELOPMENT INDICATORS, http://datatopics.worldbank.org/world-development-indicators/ (referencing Per capita electricity consumption levels based on 2014 data).

76. Abel Juadi, et al., *supra* note 73, at 953-955; *See Peace to Prosperity: The Economic Plan: A New Vision for the Palestinian People*, The White House 13, https://www.whitehouse.gov/peacetoprosperity/.

77. Abel Juadi, et al., *supra* note 73, at 953-955.

78. N. Gal E, Sandler T. Abu Hamed S, Halasah, *Renewable Energy Cooperation in the Lower Jordan Basin: Turning the Energy Trilemma into a Positive Sum Game*, INSS Special volume on Climate Change and National Security (forthcoming in 2020).

79. WORLD BANK GRP., SECURING ENERGY FOR DEVELOPMENT IN THE WEST BANK AND GAZA 5, 166 (2017), http://documents1.worldbank.org/curated/en/351061505722970487/pdf/Replacement-MNA-Securing EnergyWestBankGaza-web.pdf.

80. *Id.* at 5.

81. *Id.* at 8.

82. *Id.* at 5.

83. UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, IMPROVEMENTS TO GAZA ELECTRICITY SUPPLY at n.1 (July 2019), https://www.ochaopt.org/content/improvements-gaza-electricity-supply.

84. Oren Lieberman*, Gaza Crippled by Electricity Crisis as Power Plant Runs out of Fuel*, CNN, (Apr. 17, 2017), https://edition.cnn.com/2017/04/17/middleeast/palestinians-gaza-power-plant-crisis/index.html.

85. UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, GAZA STRIP ELECTRICITY SUPPLY (2018), https://www.ochaopt.org/page/gaza-strip-electricity-supply.

86. WORLD BANK GRP., WEST BANK AND GAZA: SECURITY ENERGY FOR GROWTH AND DEVELOPMENT, (Apr. 27, 2018), https://www.worldbank.org/en/about/partners/brief/west-bank-and-gaza-securing-energy-for-growth-and-development.

a three to four billion-dollar investment to meet local energy security objectives.[87] At present, there are modest rooftop solar facilities installed in Gaza, installed to increase the reliability of electric supply to hospitals and other essential services.[88]

Given these circumstances, solar electricity generation offers Palestinian power-systems managers in both the West Bank and Gaza many advantages, both logistical and political. And there is no reason why the Palestinian Authority, Jordan, and Israel should not be part of the great transition to renewable energy taking place worldwide. Based on the consensus views of sixty-five market and technology specialists, Bloomberg's 2019 *New Energy Outlook* Review projects that while two-thirds of the world's energy came from fossil fuels in 2018, by 2050, at least two-thirds of the world's energy could be low-carbon.[89] The United States Energy Information Administration (EIA) projects a 50% increase in world energy use by 2050.[90] The EIA also projects that solar, wind, and hydroelectric will be the largest source of global primary energy, surpassing nuclear, petroleum, natural gas, and coal by 2050.[91]

Solar energy's intermittency has always posed a major constraint to scaling up beyond 30% of annual electricity generation.[92] In order to supply the consistent power needed to meet continuous and fluctuating demand, power systems that rely on high levels of solar generation require significant backup generation for times when the sun is not shining.[93] Even countries like Jordan, where there is an average of 310 sunny days a year,[94] will need to ensure that backup generation capacity or storage exists for their electric system on cloudy days and, of course, during the evening and night hours if large amounts of solar capacity are integrated into their power system.

Here again, technological progress is posed to break traditional assumptions and limitations. In recent years, there has been massive investment in energy storage technology development, perhaps as a result of precipitous drops in the price of lithium-ion based battery technology. For instance, during the first half of 2019 alone, venture capital firms invested $1.4 billion in corporations working in the field of battery storage technology.[95] The results have been remarkable.

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87. *Id.*

88. UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, IMPROVEMENTS TO GAZA ELECTRICITY SUPPLY (July 2019), https://www.ochaopt.org/content/improvements-gaza-electricity-supply.

89. BLOOMBERG, NEW ENERGY OUTLOOK (2019), https://bnef.turtl.co/story/neo2019/page/2/1.

90. U.S. ENERGY INFO. ASS'N. EIA PROJECTS NEARLY 50% INCREASE IN WORLD ENERGY USAGE BY 2050, LED BY GROWTH IN ASIA (Sept. 24, 2019), https://www.eia.gov/todayinenergy/detail.php?id=41433.

91. *Id.*

92. VARUN SIVARAM, TAMING THE SUN, INNOVATIONS TO HARNESS SOLAR ENERGY AND POWER THE PLANET, (2018)

93. *Id.*

94. Saad S. Alrwashdeh, *Comparison Among Solar Panel Arrays Production with A Different Operating Temperatures In Amman-Jordan*, 9(6) INT'L J. OF MECH. ENG'G AND TECH. 420–429.

95. Jeff McMahon, *Huge Battery Investments Drop Energy-Storage Costs Faster Than Expected, Threatening Natural Gas,* FORBES, (Oct. 29, 2020), https://www.forbes.com/sites/jeffmcmahon/2019/10/29/huge-battery-investments-drop-energy-storage-costs-threaten-natural-gas-industry/#8953a547c3b1.

The economics of lithium-ion batteries has improved dramatically and their price has plummeted by almost 90% since 2010.[96] The cost of one kilowatt hour (kWh) of lithium-ion storage was $1,183 in 2010. Nine years later, the price was only $156 per kWh of lithium-ion storage.[97] In the automotive context, these lithium-ion battery prices suggest that the cost of a thirty kWh lithium-ion electric car battery dropped from $35,000 in 2010 to $5,000 today.[98] All told, by 2019 storage prices have fallen 76% since 2012.[99] The price of lithium-ion batteries is expected to drop further during the coming years, perhaps to $60 per kWh by 2030.[100] While this price drop in lithium-ion battery storage is certainly good news, the decrease alone may not be enough to incentivize a large shift towards the storage of low-carbon electricity for night-time power supply over the coming decade.

Israel's electric demand in 2019 ranged from an hourly minimum of roughly five GW, to an hourly peak of just over thirteen GW.[101] Israel's grid operator, the Israel Electric Corporation, has the responsibility of ensuring sufficient generation to meet peak-demand with a healthy reserve margin.[102] This means that during hot summer days, almost all of Israel's power plants will be running at full capacity. In the middle of the night during periods of low-demand, however, many of Israel's power plants will not be generating electricity. Meeting any new growth in additional nighttime peak demand can be met with power plants that are already built and paid for, at the marginal cost of generating electricity (mostly fuel costs for natural gas plants). In order to meet evening demand with low-carbon generation instead of natural gas generated electricity, Israel must build both the generation capacity itself and the accompanying storage capacity. From a fiscal perspective, for the immediate future, the option of simply ramping up existing capacity may be preferable to building new generation and storage.

96. Kip Kleen, *As battery costs plummet, lithium-ion innovation hits limits, experts say*, S&P GLOB. (Mar. 13, 2020), https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/as-battery-costs-plummet-lithium-ion-innovation-hits-limits-experts-say-58613238.

97. Veronika Henze, *Battery pack prices fall as market ramps up with market average at $156 per kWh in 2010,* BLOOMBERG NEF (Dec. 3, 2019), https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019.

98. Paul Caine, *Falling Battery Price Transforms Economics of Green Energy*, WWTW SCI. AND NATURE (Jan. 2, 2020), https://news.wttw.com/2020/01/02/falling-battery-price-transforms-economics-green-energy.

99. *Id.*

100. Henze, *supra* note 97.

101. Israel 2019 State of the Economy Report (July 23, 2020), https://www.gov.il/BlobFolder/generalpage/dochmeshek/he/Files_doch_meshek_hashmal_doch_mashek_2019.xlsx; (In the near term, Israel will likely continue to supply the majority of Palestine electricity.).

102. *Id.*

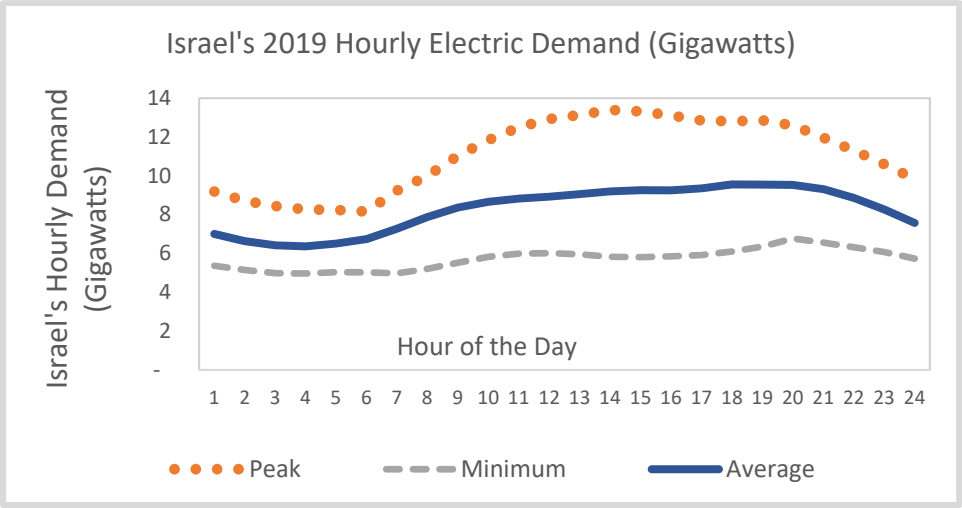

Figure 1: Israel's 2019 hourly minimum, average, and peak power demand in GW.

At a utility scale, the economics of storage and solar PV generation are a bit different than at the residential scale. The Middle East does not yet have sufficient installed storage capacity and cost data to reference, yet American data is illustrative. With 536 MW of installed lithium ion battery capacity in 2017, the United States had deployed more utility-scale lithium-ion storage than any other country.[103] Indeed, during the previous decade, roughly 40% of cumulative global lithium-ion capacity growth took place in America.[104] Of the U.S. lithium-ion storage capacity through 2017, approximately 495 MW (92% of the capacity) was deployed in the utility-scale sector (systems that are larger than 1,000 kW), 8% was deployed in the commercial sector (systems of 10–1,000 kW), with the residential sector capacity (systems smaller than 10 kW) only trivial, at less than 1%.[105]

Meeting Israel's evening electric demand requirements via lithium-ion storage would be an enormous undertaking that would require the support of the public, policy makers, the Israel Electric Corporation (which serves as Israel's grid operator), various government ministries, and likely large private invest-

103. Ran Fu, Timothy Remo, & Robert Margolis, *2018 U.S. utility-scale photovoltaics-plus-energy storage system costs benchmark,* NAT'L RENEWABLE ENERGY LAB. TECHNICAL REP., (Nov. 2018) (According to the U.S. National Renewable Energy Lab (NREL), the cost of a 60 MW standalone utility scale storage facility varies from $380 per kWh (4-hour / 240 MWh discharge capacity) to $895 per kWh (0.5 hour / 30 MWh discharge capability), assuming a $209 per kWh cost for the lithium-ion battery. This translates to a $91 million cost for the 4-hour battery system.).

104. *Id.*

105. *Id.*; In a separate study, NREL projects that the capital cost for a 4-hour lithium ion battery system could fall to between $124 to $338 per kWh by 2030. *See* Wesley Cole and A. Will Frazier, *Cost Projections for Utility-Scale Battery Storage,* NAT'L RENEWABLE ENERGY LAB. (June 2019).

ment. As mentioned, over a twenty-four hour time period, Israel's peak electric demand fluctuates dramatically: the highest daily peak typically occurs in the summer at around three p.m. and falls during the evening hours.[106]

Even providing a relatively small portion of Israel's nighttime electric demand via battery systems would be extremely expensive. 10% of Israel's peak nighttime hourly demand was just over 800 MW in 2019.[107] To supply 800 MW of power for four hours would require just over thirteen 60-MW battery systems. Providing 800 MW for eight hours would require almost twenty-seven 60-MW battery systems, or 1,600 MW of installed battery power capacity and 6,400 MWh of electric energy storage capacity. To put this in perspective, as of 2018, the United States had a total installed lithium-ion battery power capacity of 869 MW, with 1,236 MWh of electric storage capacity.[108] Using NREL's current lithium-ion storage cost estimates, supplying 10% of Israel's evening peak electric demand for eight hours could require an investment of roughly $2.4 billion for the battery systems alone. If battery systems continue to fall in price to $124 per kWh in 2030, the capital cost would fall to $800 million.

Herein lies the reason that Israel has yet to build a meaningful amount of utility scale storage. In the evening, Israel has a large number of natural gas power plants that are not being used. To provide electricity in the evening, Israel can tap existing natural gas power plants, and only incur the marginal cost of electric generation. In order to provide even 10% low-carbon electricity during the evening, Israel would have to shoulder the prodigious costs of building a multi-billion dollar battery storage system, as well as the low-carbon solar PV generation to charge it. If battery prices continue to drop, then the prevalence of storage for residential and utility-scaled uses could increase. If Israel's vehicle fleet steadily becomes electric, it is possible that electric vehicle batteries could be utilized to meet some of the country's storage requirements.[109] Nonetheless, the enormity of the shift required for the country's present electric grid to integrate solar-PV and utility-scale lithium-ion storage systems should not be underestimated.

Given these dynamics, how might regional cooperation be harnessed to move electricity systems throughout the region from the present reliance on fossil fuels to a new sustainable age of renewable energy? International expectations for reduced greenhouse gas emissions, along with the new renewable economic calculus create opportunities. The following summaries of proposed regional projects do not constitute an exhaustive list of cooperative ventures in the energy field. All, however, emerged in a general context, where low-cost, renewable electricity infrastructure projects could provide an opportunity for in-

106. Israel 2019 State of the Economy Report, *supra* note 101.

107. *Id.*

108. U.S. ENERGY INFO. ADMIN., BATTERY STORAGE IN THE UNITED STATES: AN UPDATE ON MARKET TRENDS 5 (July 2020), https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf

109. Idan Liebes, Ora Ayalon, Roland Steinmetz, Roos van der Ploeg and Peter Hogeveen, *Electric Vehicles Charging Infrastructure in Israel Implementation Policy and Technical Guidelines*, SAMUEL NEAMAN INST. FOR NAT'L POLICY RESEARCH (May 2018), https://www.neaman.org.il/en/Files/Electric%20Vehicles%20Charging%20Infrastructure%20in%20Israel%20SNI.pdf.

creased cooperation and development while potentially reducing costs and adverse environmental effects in Israel, Jordan, and Palestine.

III. ISRAEL-JORDAN-PALESTINE ENERGY-WATER NEXUS

The water-energy nexus is commonly used to convey the interdependence of water and energy supply systems. It takes substantial amounts of energy to extract, treat, and transport water from its source to its point of end-use. This is especially true when drinking water is derived from desalination whose energy demands are typically far greater than tapping water from conventional sources.[110] Additionally, many thermoelectric power plants are located near large water sources because they utilize water to produce steam for electric generation as well as for cooling purposes.[111] The term "water-energy nexus" is general, and can be further defined depending on the specific system(s), regions, and political entities under enquiry.[112] In the case of Israel and Jordan, cooperation on energy and water production has been raised as a strategy to address prevailing water scarcity, rising population levels, and increased water use by different sectors, as well as the energy and environmental implications of the anticipated expansion in water production.[113] In the present context, proposals have been made to consider the potential of binational cooperation and how increasing coordination might enable a pareto improvement over the current status quo for water and energy in both countries.[114]

Without a large and reliable supply of electricity, which is required for large desalination facilities, pumping, treatment, and extraction, Israel and Jordan would not be able to provide water for their growing populations. Thus, providing an increasing water supply in the future will require an increase in electric generation. Israel and Jordan are both signatories to the Paris Agreement and have committed to reducing CO_2 emissions in the future.[115] Israel and Jordan's electric sectors are both almost completely reliant on carbon-intensive fossil fuels for generation.[116]

Over the last three decades, Israel and Jordan's electric generation has changed remarkably. Since 1990, Israel's electric generation has more than tri-

110. *Id.*

111. *Id.* at 11.

112. *Id.* at viii.

113. *See* ECOPEACE MIDDLE EAST, WATER & ENERGY NEXUS, https://ecopeaceme.org/projects/water-energy/ (last visited Oct. 12, 2020).

114. *See, e.g.*, ECOPEACE MIDDLE EAST, WATER-ENERGY NEXUS PRE-FEASIBILITY STUDY, https://ecopeaceme.org/wp-content/uploads/2017/12/Water-Energy-Nexus_November-2017.pdf
(last visited, July 20, 2020) (presenting an excellent summary of such a program).

115. ECOPEACE MIDDLE EAST, CLIMATE CHANGE, WATER SECURITY, AND NATIONAL SECURITY FOR JORDAN, PALESTINE, AND ISRAEL (Jan. 2019), https://ecopeaceme.org/wp-content/uploads/2019/01/climate-change-web.pdf.

116. Nour Mardini, *The Road to Energy Security in Jordan and Israel*, YALE ENV'T REVIEW (Jan. 7, 2020), https://environment-review.yale.edu/road-energy-security-jordan-and-israel.

pled from 20.9 TWh to 69 TWh in 2018.[117] But Jordan's electric generation has increased almost six-fold, from 3.6 TWh in 1990 to 20.3 TWh in 2017.[118] In 1990, Israel relied on 52% coal and 48% oil for electric generation.[119] Since 1990, the fuels used to generate both Israel and Jordan's electricity have changed dramatically.

In 2000, Israel began to phase out fuel-oil electricity generation and in 2003 began to phase in natural gas generation.[120] In Figure 2, we show that a decade later in 2010, 60% of Israel's electricity generation was still coal-based.[121] With the discovery and development of major natural gas reserves off of Israel's Mediterranean coast, in 2012, new policies at the Ministry of Energy began to expedite a rapid transition to natural gas electric generation.[122] By 2014, less than half of Israel's electricity relied on the burning of coal.[123] Only four years later, in 2018, Israel generated approximately two-thirds of its electricity from natural gas, one-third from coal, and the rest from solar, wind, and fuel-oil.[124] Present plans call for the total phase out of coal by 2025.[125] The switch from oil and coal based electric generation to an electricity supply predominantly fueled by natural gas significantly reduced the emissions of $PM_{2.5}$, SO_2, and NO_x.[126] If system-wide methane leakage rates can be controlled, natural gas electric generation is about half as carbon-intensive as coal generation.[127] Recent studies, however, suggest that the life-cycle greenhouse gas emissions from natural gas generation could be comparable to those from coal-fired generation, if system-wide methane leakage rates are high.[128]

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117. INT'L ENERGY AGENCY, ISRAEL COUNTRY PROFILE, https://www.iea.org/data-and-statistics?country=ISRAEL&fuel=Energy%20supply&indicator=Electricity%20generation%20by%20source (last visited July 23, 2020).

118. INT'L ENERGY AGENCY, JORDAN COUNTRY PROFILE, https://www.iea.org/data-and-statistics?country=JORDAN&fuel=Energy%20supply&indicator=Electricity%20generation%20by%20source (last visited July 23, 2020).

119. IEA, *supra* note 117.

120. *Id.*

121. INT'L ENERGY AGENCY, ELECTRICITY INFORMATION 2020, DATA & STATISTICS: ELECTRICITY GENERATION BY SOURCE, ISRAEL 1990-2019 (Oct. 9, 2020), https://www.iea.org/data-and-statistics?country=ISRAEL&fuel=Energy supply&indicator=ElecGenByFuel [hereinafter Elec. Info. 2020 Isr.].

122. Alon Tal, *Will We Always Have Paris? Israel's Tepid Climate Change Strategy*, 10(3) ISR. J. OF FOREIGN AFFAIRS 405, 413, 416 (2017).

123. Elec. Info. 2020 Isr., *supra* note 121.

124. ORG. FOR ECON. COOP. & DEV., FOSSIL FUEL SUPPORT: COUNTRY NOTE, ISRAEL (June 2020), www.oecd.org/fossil-fuels/; Adi Wolfson, Ophira Ayalon, Alon Tal, *A Strategic Analysis of Electricity Generation Alternatives: A Perspective from the Future*, 4(3) J. OF ENVTL. SCI. & PUB. HEALTH 282, 290-91 (2020).

125. *Fossil Fuel Support*, *supra* note 124, at 1; Air Quality & Climate Change Unit, *Policy Papers: Israel 2050*, ISR. MINISTRY OF ENVTL. PROT. (Aug. 13, 2019), https://www.gov.il/en/departments/policies/israel_2050; Xinhua, *Israel to End Coal Era by 2025: Energy Minister*, XINHUA NET 1 (Nov. 13, 2019), www.xinhuanet.com/english/2019-11/13/c_138552538.htm.

126. Wolfson, *supra* note 124, at 286, 288.

127. *Id.* at 9.

128. Christine Shearer, et al., *The Effect of Natural Gas Supply on US Renewable Energy and Emissions*, ENVTL. RESEARCH LETTERS 1, 6 (2014); *see also* Christina Nunez, *Switch to Natural Gas Won't Reduce Carbon Emissions Much, Study Finds*, NAT'L GEOGRAPHIC 2 (Sept. 25, 2014), https://www.nationalgeographic.com/news/energy/2014/09/140924-natural-gas-impact-on-emissions/.

Historically, from 1971 until 1988, 100% of Jordan's electricity was generated by combusting oil.[129] Starting in 1989, Jordan began to rely on natural gas for generation, peaking at 90% of generation in 2009, but falling back to 7% in 2014 and 48% in 2015 due to interruptions in supply from Egypt (see Figure 3).[130] As a result of the gas supply interruptions from Egypt, Jordan's National Electric Power Company (NEPCO) had to purchase costlier fuel-oil for electric generation.[131] NEPCO almost went bankrupt and accumulated debts of close to $8 billion USD.[132] As of 2015, Jordan's non-hydroelectric renewable generation was less than 1% of total generation,[133] an energy transition was in the air. By mid-2018, NEPCO announced that 93% of electricity was generated from natural gas and the remaining 7% was from renewables.[134] Recently, proponents of electricity strategies based on renewables and even the idea of 100% renewable systems have gained traction in both local academic and commercial circles.[135] Given that both Israel and Jordan will require additional electric generation to meet future demand from growing populations, as well as growing desalination electric demand for water production, decarbonization of the electric sector would require a monumental transformation.[136]

129. Zaid Salem H. Abu-Hamattech & Ali F. Al-Shawabkeh, *An Overview of the Jordian Oil Shale: Its Chemical and Geological Characteristics, Exploration, Reserves and Feasibility for Oil and Cement Production*, 51(4) CENT. EUROPEAN GEOLOGY 379, 386 (2008), https://core.ac.uk/download/pdf/194781161.pdf; *see also* E.S. Hrayshat, *Analysis of Renewable Energy Situation in Jordan*, 3(1) ENERGY SOURCES, PART B: ECON., PLANNING, & POLICY 89 (Dec. 2007).

130. IEA Statistics, *Electricity Production from Natural Gas Sources (% of Total) – Jordan*, THE WORLD BANK (Oct. 9, 2020), https://data.worldbank.org/indicator/EG.ELC.NGAS.ZS?locations=JO; Electricity Information 2020, *Data & Statistics: Electricity Generation by Source, Jordan 1990-2018*, INT'L ENERGY AGENCY (Oct. 9, 2020), https://www.iea.org/data-and-statistics?country=JORDAN&fuel=Energy supply&indicator=ElecGenByFuel [hereinafter Elec. Info. 2020 Jordan]; Renewables Information 2020, *Data & Statistics: Renewable Electricity Generation by Source (Non-Combustible), Jordan 1990-2018*, INT'L ENERGY AGENCY (Oct. 9, 2020), https://www.iea.org/data-and-statistics?country=JORDAN&fuel=Energy supply&indicator=RenewGenBySource [hereinafter Renewables Info. 2020 Jordan]; *see also* The Associated Press, *Jordan Seeks to Reopen Natural Gas Supply from Egypt*, THE TIMES OF ISRAEL (Nov. 7, 2012) at 1.

131. The Associated Press, *supra* note 130, at 2.

132. *Id.;* ROYA NEWS, NEPCO: ELECTRICITY COMPANY SCORED JD5.5 BILLION IN LOSSES, NOBLE WAS 'LAST OPTION' (Jan. 1, 2020), https://en.royanews.tv/news/19635/NEPCO--Electricity-company-scored-JD5-5-billion-in-losses--Noble-was--last-option.

133. IEA Statistics, *Electricity Production from Renewable Sources, Excluding Hydroelectric (% of Total) – Jordan*, THE WORLD BANK (Oct. 9, 2020), https://data.worldbank.org/indicator/EG.ELC.RNWX.ZS?locations=JO; Renewables Info. 2020 Jordan, *supra* note 130, at 1.

134. J.T., *93 Per Cent of Jordan's Electricity Generated by Natural Gas*, THE JORDAN TIMES (May 5, 2018), https://www.jordantimes.com/news/local/93-cent-jordan's-electricity-generated-natural-gas.

135. Suhil Kiwan, Elyasa Al-Gharibeh, *Jordan Toward a 100% Renewable Electricity System*, 147 (pt. *1)* RENEWABLE ENERGY: AN INT'L J. 423, 425-26 (Mar. 2020).

136. Alon Tal, *Addressing Desalination's Carbon Footprint: The Israeli Experience*, WATER: MDPI 197, 198, 202-03, 211 (Feb. 2018).

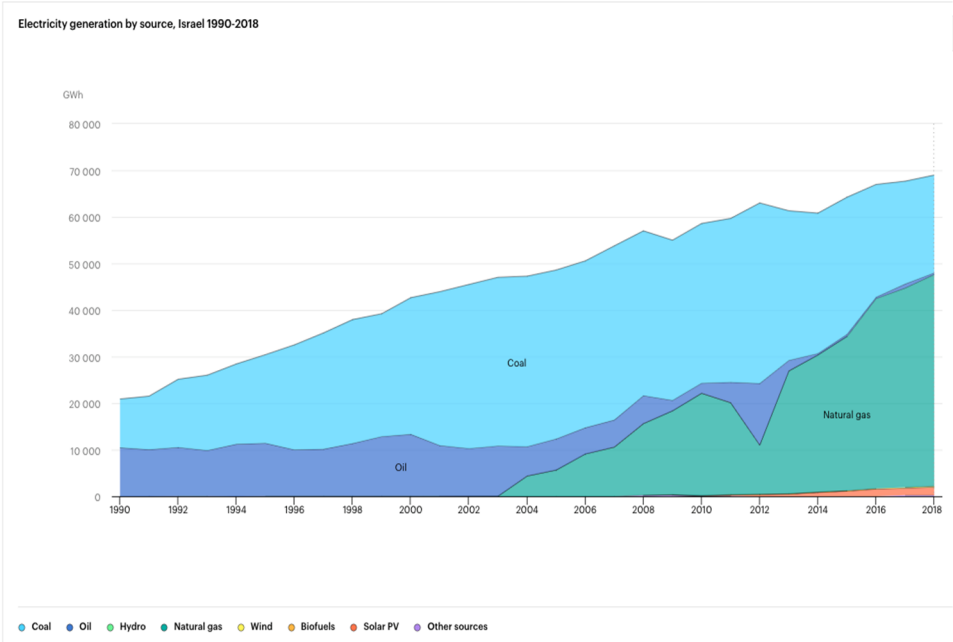

Figure 2: Electric generation by source in Israel from 1990-2018 in GWh (International Energy Agency).

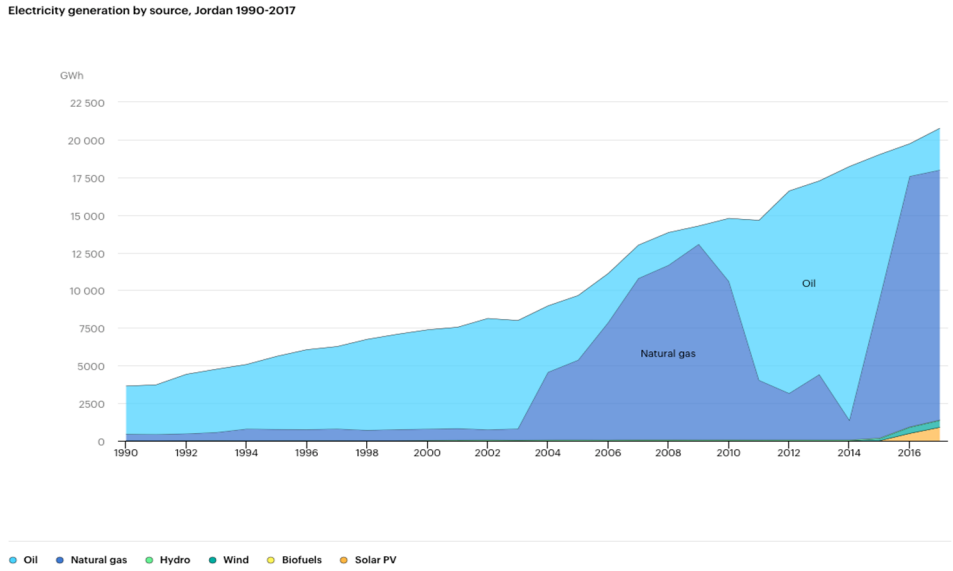

Figure 3: Electric generation by source in Jordan from 1990-2017 in GWh (International Energy Agency).[137]

137. Electricity Information 2020, *Data & Statistics: Electricity Generation by Source (Area Chart), Jordan 1990-2018*, INT'L ENERGY AGENCY (Oct. 9, 2020), https://www.iea.org/data-and-statistics?country=JORDAN&fuel=Energy%20supply&indicator=ElecGenByFuel.

Both Jordan and Israel rank among the five most water-stressed countries in the world.[138] Despite similar rankings, the water reality for an average citizen in Israel and Jordan is drastically different. While Israelis have reliable access to water in their homes 100% of the time, the situation in Jordan is quite different. Despite increasing recognition of the severity of present scarcity, most Jordanians, with the exception of those in Aqaba, only have access to water roughly once a week.[139] Due to the intermittency of water supply, many Jordanians fill large rooftop storage tanks with water when they have access, and must purchase water via truck delivery if they run out.[140] Additionally, many Jordanians do not feel that it is safe to drink the tap water, and purchase expensive bottled drinking water.[141]

In Israel, the demand for water is far greater than the 1,800 MCM/year annual sustainable yield available from renewable surface and groundwater sources such as lakes, rivers, and aquifers.[142] The uncertainty and variability inherent in natural water sources led Israel to pursue new strategies to increase water supply and reduce variability.[143] Israel began to treat domestic wastewater (500 MCM/year) as an additional resource, and by 2016, 87%, or just over 400 MCM, was treated and used predominantly for irrigation in agriculture. An additional breakthrough for Israel's water security has come from desalination.

In response to a severe water crisis in 1999, the Israeli government decided to pursue large scale reverse-osmosis, seawater desalination.[144] In 2005, the first of Israel's new generation of desalination plants became operational, and by 2015, Israel was producing 600 MCM of water via desalination from five different facilities, providing 80% of the country's drinking water.[145] The amount of desalination is expected to increase dramatically over the coming decade in re-

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138. WORLD RESOURCES INST., BETA AQUEDUCT COUNTRY RANKING, BASELINE WATER RISK COUNTRY RANKINGS (Oct. 9, 2020), https://www.wri.org/applications/aqueduct/country-rankings/.

139. Elizabeth Whitman, *A Land Without Water: The Scramble to Stop Jordan from Running Dry*, 573 NATURE 20, 21 (Sept. 2019), https://media.nature.com/original/magazine-assets/d41586-019-02600-w/d41586-019-02600-w.pdf; *see also* Elaine Denny, et al., *Sustainable Water Strategies for Jordan,* UNIV. OF MICH. INT'L ECON. DEV. PROGRAM 1,3,10-11 (Apr. 2008), http://www.umich.edu/~ipolicy/Policy%20Papers/water.pdf; *and* Hana Namrouqa, *Water Resources Operating at Highest Capacity as Demand Surges by 40 percent*, THE JORDAN TIMES (Mar. 23, 2020), https://www.jordantimes.com/news/local/water-resources-operating-highest-capacity-demand-surges-40-cent.

140. Denny, *supra* note 139.

141. JORDAN NAT'L. AGRIC. INFO. SYS., AMMAN RESIDENTS REMAIN DISTRUSTFUL OF TAP WATER–STUDY (May 23, 2012) (citing The Jordan Times), http://nais-jordan.gov.jo/Pages/NewsDetails.aspx?lang=EN&Cat=0&I=3001&DId=0&CId=0&CMSId=397&id=2390842.

142. ISRAEL MINISTRY OF FOREIGN AFFAIRS, ISRAEL'S CHRONIC WATER PROBLEM (2013), https://mfa.gov.il/MFA/IsraelExperience/AboutIsrael/Spotlight/Pages/Israel-s%20Chronic%20Water%20Problem.aspx.

143. *Id.*

144. Abraham Tenne, *Sea Water Desalination in Israel: Planning, coping with difficulties, and economic aspects of long-term risks*, STATE OF ISRAEL WATER AUTH. (Oct. 2010), http://www.water.gov.il/Hebrew/ProfessionalInfoAndData/2012/12-Desalination-in-Israel.pdf.

145. STATE OF ISRAEL MINISTRY OF FOREIGN AFFAIRS, ISRAEL: A GLOBAL LEADER IN WATER MANAGEMENT AND TECHNOLOGY (last visited June 18, 2020), https://mfa.gov.il/MFA/AboutIsrael/Documents/water.pdf.

sponse to growing water demand,[146] along with a commensurate rise in Israel's carbon footprint.[147]

In contrast, despite similar levels of water scarcity, Jordan has struggled to supply its citizens with consistent access to water for domestic use.[148] The Jordanian Ministry of Water and Irrigation (JMWI) estimated that its annual water demand from all sectors in 2015 was approximately 1,400 MCM, and that renewable water resources total 780 MCM per year.[149] In other words, groundwater resources in Jordan are being used at twice their natural recharge rates.[150]

Jordan's groundwater sources are categorized according to twelve different groundwater basins.[151] The safe yield of these groundwater sources totals about 420 MCM annually, while 2017 abstraction totaled 642 MCM, creating a deficit of 223 MCM.[152] The largest source of groundwater withdrawals, around 140 MCM annually, is from the Disi fossil aquifer in southern Jordan, which is shared with Saudi Arabia.[153] The Disi aquifer is steadily being extracted with no replacement in sight. The remaining portion of Jordan's water supply comes from a combination of surface water from the Jordan River basin (290 MCM/year) and waste-water reuse.[154]

Even though its population is slightly smaller, Israel uses roughly double the amount of water that Jordan does.[155] Nonetheless, the two countries allocate water in similar proportions across sectors. The majority of both Israeli and Jordanian water is consumed by their agriculture sectors.[156] In 2015, the JMWI estimated that 51% of total water resources in Jordan were allocated for agriculture, 42% went to domestic consumption, and 4% was used by industry.[157]

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146. *Id.*

147. Alon Tal, *Unkept Promises: Israel's Implementation of Its International Climate Change Commitments*, ISRAEL J. OF FOREIGN AFFAIRS (Apr. 30, 2020).

148. USAID, USAID WATER AND DEVELOPMENT COUNTRY PLAN FOR JORDAN, https://files.globalwaters.org/water-links-files/Jordan%20Country%20Plan%20final.pdf.

149. *Id.*

150. USAID, WATER RESOURCES & ENVIRONMENT (last updated Oct. 1, 2020), https://www.usaid.gov/jordan/water-and-wastewater-infrastructure [hereinafter WATER RESOURCES & ENVIRONMENT].

151. Francois Molle, et al., *Groundwater Governance in Jordan: The case of Azraq Basin*, USAID POLICY WHITE PAPER (April 2017).

152. *Id.*

153. Alsharifa Hind Jasem, et al., *The Fate of Disi Aquifer as Strategic Groundwater Reserve for Shared Countries* (Jordan and Saudi Arabia), J. OF WATER RES. AND PROT. (Sept. 26, 2011).

154. UNITED NATIONS ECON. AND SOC. COMM'N, INVENTORY OF SHARED WATER RES. IN WESTERN ASIA (accessed July 23, 2020), https://waterinventory.org/surface_water/jordan-river-basin.

155. ISRAEL WATER SECTOR, WATER CONSUMPTION, http://www.water.gov.il/Children/Water/Pages/Water-Consumption.aspx.

156. *Compare* WATER RESOURCES & ENVIRONMENT, *supra* note 150 (noting that Jordan's agriculture sector consumption accounts for 50% of the country's water supply) *with Water Sector in Israel IWRM Model*, ISRAEL WATER AUTHORITY (2015), http://www.water.gov.il/Hebrew/ProfessionalInfoAndData/2012/02-Israel%20Water%20Sector%20-%20IWRM%20Model.pdf (finding that the agriculture sector makes up 58% of Israel's water consumption).

157. *Id.*

While agriculture comprises more than half of Israel and Jordan's water consumption, it accounts for only 2.4% and 4.5% of GDP, respectively.[158]

Because water is scarce and agriculture makes up a small portion of Israeli and Jordanian GDP, one could argue that to address future water demands, both countries could simply reduce the amount of water allocated to farmers, and import a greater portion of crops and food in the future. In both countries however, there are strong agrarian traditions, as well as food security concerns.[159] A recent analysis, for instance suggests that Israel actually imports some 80% of the calories consumed by its residents.[160] These concerns only increased during the Covid-19 crisis when some grain exporting countries decided to suspend exports in order to reassess their food reserves.[161] In Jordan, the destabilizing effect of potential increased unemployment justifies the strategic importance of agricultural water consumption, and maintaining the current level of agriculture water allocations from an employment perspective.

In Israel, annual agricultural water use has remained largely unchanged from 1970-2018, while consumption in the domestic sector has almost tripled during the same time period.[162] In Jordan, from 2000-2013, there was annual variation in consumption in each sector.[163] Nonetheless, overall, industrial and agriculture remained roughly steady over time, while there was a consistent annual increase in domestic consumption. The increase in domestic water use in Israel and Jordan is in a large part due to the relentless rise in population.[164]

In 1960, Israel's population was 2.1 million people and increased to 9.1 million people by 2019.[165] Since 2002, Israel's population growth rate has been steady at approximately 2%.[166] Jordan's demographic expansion has been even more phenomenal:[167] In 1960, Jordan's population stood at 933,000 people and

158. U.S. CENT. INTELLIGENCE AGENCY, THE WORLD FACTBOOK – MIDDLE EAST ISRAEL (last accessed July 23, 2020), https://www.cia.gov/library/publications/resources/the-world-factbook/geos/is.html.

159. Hadas, E., & Gal, Y., *Barriers Preventing Food Security in Israel, 2050*, 12 MANAGING GLOBAL TRANSITIONS: INT'L RESEARCH J. 1, 3, 12 (2014).

160. Fridman, D., & Kissinger, M., *A Multi-Scale Analysis of Interregional Sustainability Applied* to *Israel's Food Supply*, 676 SCI. OF THE TOTAL ENV'T 524-534 (2019).

161. Robyn Dixon, David L. Stern & Almaz Kumenov, *As Borders Harden During Pandemic, Some Countries Look to Hold on to Their Own Food,* WASH. POST (Apr. 8, 2020), https://www.washingtonpost.com/world/as-borders-harden-during-pandemic-some-countries-look-to-hold-onto-their-own-food/2020/04/08/385600e4-7459-11ea-ad9b-254ec99993bc_story.html.

162. ISRAEL CENT. BUREAU OF STATISTICS, WATER PRODUCTION AND CONSUMPTION, https://www.cbs.gov.il/he/publications/doclib/2019/23.shnatonwaterandsewage/st23_06.pdf.

163. H.E. Dr. Hazim El-Naser, *Jordan Water Sector Facts and Figures 2013*, JORDAN VALLEY AUTH. 12 (2013), http://www.jva.gov.jo/sites/en-us/SiteCollectionDocuments/W.%20in%20Fig.E%20FINAL%20E.pdf.

164. Alon Tal, *Will Demography Defeat River Restoration? The Case of the Jordan River*, 111 J. OF WATER RESEARCH 404 (2017).

165. ISRAEL CENT. BUREAU OF STATISTICS, ISRAEL'S POPULATION ON THE EVE OF 2020 - 9.1 MILLION PEOPLE, https://www.cbs.gov.il/he/mediarelease/DocLib/2019/413/11_19_413e.pdf.

166. WORLDOMETER, ISRAEL POPULATION (2020), https://www.worldometers.info/world-population/israel-population/.

167. *Id.* A closer look at these data show that Jordan's annual population growth rate has ranged from a low of 1.8% to a high of 8.8% from 1960-2018. By 2002, Jordan's annual population growth rate was at 1.9%, however, from 2007-2014 it was over 4% annually, due in part to the influx of Syrian refugees.

by 2020 reached 10.8 million people.[168] The recent influx of refugees has accelerated this phenomenon dramatically.[169] By 2018, Jordan's population growth rate was back to 1.8%.[170] In Gaza and the West Bank, total population has also increased, from 2 million Palestinians in 1990 to 4.6 million in 2018.[171] The Palestinian population growth rate has receded over time from 4.6% in 1990 to 2.6% in 2018, but fertility levels are still far above replacement levels.[172] In short, if Israeli, Jordanian, and Palestinian populations continue to grow at 2% per year, then their collective population could expand from 24 million in 2020 to almost 47 million people by 2055.

In order to meet increasing future domestic demand for water, Israel plans to build another desalination plant at Sorek (200 additional MCM per year), and expects to increase total desalination capacity to 1,100 MCM by 2030.[173] Since Israel has access to the Mediterranean Sea along its coast, desalination can be carried out in close proximity to population centers, reducing the amount of energy needed for pumping water to consumers. This in turn reduces the overall costs and carbon footprint of desalination.[174] Jordan, on the other hand, only has access to the Red Sea, which is located over 325 km from Amman, at an altitude roughly 1,000 meters lower.[175]

Desalinating water from the Red Sea to increase water supply to Jordan's population, therefore, is costly due to both the distance and elevation increase from the Red Sea to Jordan's population centers, which are mostly in the center and north of the country.[176] Currently, Jordan has one desalination plant in Aqaba that produces five MCM per year.[177] But government officials recently announced plans for the Aqaba-Amman Water Desalination and Conveyance Na-

168. U.S. CENT. INTELLIGENCE AGENCY, *supra* note 158.

169. UNHCR, UNHCR CONTINUES TO SUPPORT REFUGEES IN JORDAN THROUGHOUT 2019 (Dec. 31, 2019), https://www.unhcr.org/jo/12449-unhcr-continues-to-support-refugees-in-jordan-throughout-2019.html. By the end of 2019, the number of total refugees registered through the United Nations in Jordan stood at 744,795 and the Jordanian government estimates that there are 1.3 million Syrians currently in Jordan. Hashemite Kingdom of Jordan Ministry of Planning and International Cooperation, *The Jordan Response Plan for the Syria Crisis 2017-2019,* Jordan Response Platform (Sept. 20, 2016) https://reliefweb.int/sites/reliefweb.int/files/resources/JRP%2B2017-2019%2B-%2BFull%2B-%2B%28June%2B30%29.pdf.

170. UNHCR, *supra* note 169.

171. THE WORLD BANK, POPULATION TOTAL – WEST BANK AND GAZA 1990-2019*,* https://data.worldbank.org/indicator/SP.POP.TOTL?locations=PS.

172. WORLDOMETER, STATE OF PALESTINE POPULATION (2020), https://www.worldometers.info/world-population/state-of-palestine-population/.

173. MINISTRY OF FINANCE, *Seawater Desalination in Israel* (2018), https://mof.gov.il/en/InternationalAffairs/InfrastructuresAndProjects/Projects/Pages/Background_DesalinationInIsrael.aspx

174. *Id.*

175. HASHEMITE KINGDOM OF JORDAN MINISTRY OF WATER & IRRIGATION, ENVIRONMENTAL AND SOCIAL ASSESSMENT DISI-MUDAWARRA TO AMMAN WATER CONVEYANCE SYSTEM (June 2004), https://www.eib.org/attachments/pipeline/20080462_esia_en.pdf.

176. ECOPEACE MIDDLE EAST & KONRAD-ADENAUER-STIFTUNG, WATER ENERGY NEXUS: A PREFEASIBILITY STUDY FOR MID-EAST WATER-RENEWABLE ENERGY EXCHANGES 18, 58 (David Katz & Arkadiy Shafran eds., 2017).

177. Ryuichi Fukuhara & Masahiro Murakami, et al., *The Advantages of SeaWater Desalination for Regional Cooperation in Water Resources Management*, UNIV. OF JORDAN 8-9 (2001).

tional Project, which at first would produce 130 MCM per year, with the potential to reach 350 MCM annually.[178]

Extracting, filtering, pumping, desalinating, treating wastewater, and transporting potable water from sources to users requires large quantities of energy, mostly in the form of electricity. The vast majority of electricity in Israel and Jordan is generated from fossil fuels.[179] In 2015, the water sector consumed 1,745 GWh, or approximately 15% of Jordan's annual electricity demand.[180] Similarly, the water supply is responsible for approximately 10% of Israel's national electric demand.[181] In 2018, Israel's total electric consumption was 60.5 TWh and Jordan's was 18.5 TWh.[182]

In Israel, desalinating water requires roughly 3.5 kWh per m^3 (3.5 GWh per MCM).[183] Desalinating the 1,500 MCM of additional water that Israel and Jordan requires for future domestic use necessitates an addition of just over 5 TWh of additional electric generation annually. This does not include the electricity required for pumping water from desalination plants to domestic end users. To put this in perspective, the generation of 5 TWh of electricity would require the equivalent of one additional dedicated 800-MW natural gas combined cycle power plant operating with a 70% capacity factor.

In short, both Israel and Jordan need to dramatically expand the amounts of water delivered to their growing populations over the coming decades. Since naturally occurring water sources are already over-utilized, additional water supply above current levels must come from desalination. Planning and building the necessary water and energy infrastructure will be challenging, especially given both countries' commitment to decarbonization as signatories to the Paris Climate Agreement.[184] At the same time, all climate change models envision significant reductions in the amount of naturally occurring water over time.[185] While Israel has a national water carrier that could be utilized for future desalinated water transport, Jordan currently lacks the substantial infrastructure required to transport water from a desalination plant near the Red Sea to population centers in the north.

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178. THE JORDAN TIMES, JORDAN'S FIRST WATER DESALINATION PLANT OPENS IN AQABA, PROJECT TO MEET AWABA'S WATER NEEDS UNTIL 2035 (Mar. 18, 2017), https://www.jordantimes.com/news/local/jordan's-first-water-desalination-plant-opens-aqaba; Hana Namrouqa, *Water Ministry Launches First Phase of Aqaba-Amman Water Conveyance National Project*, THE JORDAN TIMES, (Feb. 27, 2020), http://jordantimes.com/news/local/water-ministry-launches-first-phase-aqaba-amman-water-conveyance-national-project.

179. *See* INT'L ENERGY AGENCY, ISRAEL, https://www.iea.org/countries/Israel (last visited Oct. 8, 2020); *see also* INT'L ENERGY AGENCY, JORDAN, https://www.iea.org/countries/Jordan (last visited Oct. 8, 2020).

180. Tal, *supra* note 136, at 8.

181. *Id.* at 2.

182. *See* ISRAEL, *supra* note 179; *see also* JORDAN, *supra* note 179.

183. Tal, *supra* note 136, at 7.

184. Alon Tal, *Unkept Promises: Israel's Implementation of Its International Climate Change Commitments*, 14 ISRAEL JOURNAL OF FOREIGN AFFAIRS 21 (2020).

185. Jonathan Woetzel et al., *A Mediterranean Basin without a Mediterranean Climate?*, MCKINSEY GLOB. INST. (May 28, 2020), https://www.mckinsey.com/business-functions/sustainability/our-insights/a-mediterranean-basin-without-a-mediterranean-climate; *see also* Amit Givati & Adi Tal, *The Hydrological Situation in the Kinneret Basin, Observed and Projected Trends on the Basis of Hydro-Climatic Models* (in Hebrew), 8(4) ECOLOGY AND ENVIRONMENT 12-19 (2017).

These circumstances are highly favorable for cooperation around future water and energy infrastructure between Israel and Jordan. The integration of the two neighbors' water and energy systems could be mutually beneficial from a financial, energy, and environmental standpoint. A recent initiative for cooperation has been developed by a regional environmental NGO, EcoPeace Middle East.[186]

The EcoPeace 2017 pre-feasibility study outlines scenarios in which Jordan could supply Israel (or Palestine) with low carbon electricity, and Israel could provide desalinated drinking water to Jordan.[187] While Israel and Gaza have access to the Mediterranean Sea for desalinated water, they have limited space for the development of solar and wind installations that could be used to decarbonize the electric sector.[188] Jordan, on the other hand, only has access to the Red Sea, but has large amounts of open space for the potential development of solar and wind power installations.[189]

The premise of the EcoPeace initiative is that Israel could desalinate water in its north at a plant in Hadera and pump it up to the Atar Eshkol reservoir.[190] From the Eshkol reservoir, water could flow by gravity to population centers such as Amman. If this project were to come to fruition, presumably Jordan could avoid building infrastructure to desalinate and pump water from the Red Sea, potentially increasing economic and energy efficiency of supplying water to its population, while reducing the energy and carbon footprint of local water supply. Implementation of the EcoPeace vision has the potential for economic savings and could also produce significant, albeit less quantifiable geo-political gains involving healthy interdependencies within the region.

IV. HYDRO-ELECTRICITY AS PART OF RED SEA-DEAD SEA WATER CONVEYANCE PROJECT

The Red Sea Dead Sea Water Conveyance Project is an idea that was first publicly "launched" at the 2002 Johannesburg World Summit on Sustainable Development.[191] But it is premised on a surprisingly old idea of taking advantage of the height differential between the Mediterranean (or the Red Sea) and the low-lying Dead Sea for hydro-electric power.[192] In his 1902 novel, *Altneuland*, (The Old New Land), Theodore Herzl, the founder of the modern Zionist movement, called for a canal system that would deliver water from the Mediterranean to the Dead Sea in order to produce electricity.[193] The 21st century

186. ECOPEACE MIDDLE EAST & KONRAD-ADENAUER-STIFTUNG, *supra* note 176, at 6.

187. *Id*.

188. *Id*. at 63.

189. *Id*. at 8, 13, 63.

190. *Id*. at 6, 16.

191. Press Release, World Leaders Stress Importance of Regional Cooperation as High-Level Segment of World Summit Continues, UN Press Release Env/Dev/700 (Sept. 4, 2002), https://www.un.org/press/en/2002/envdev700.doc.htm.

192. TINA NIEMI ET AL., THE DEAD SEA: THE LAKE AND ITS SETTING (1997); *see generally* Uri ten Brink, *The Dead Sea, The Lake, and Its Setting,* EOS: SCI. NEWS 239 (May 1998).

193. Alon Tal, POLLUTION IN A PROMISED LAND – AN ENVIRONMENTAL HISTORY OF ISRAEL 208 (2002); *see generally* THEODOR HERZL, ALTNEULAND (The Old New Land) (2011). Herzl was not the first

proposal enjoys the benefit of decades of feasibility studies that showed the higher cost-effectiveness of delivering Red Sea water in such a system.[194] Rather than an energy project, initially the "Red-Dead" Canal was envisioned as an engineering solution to address the steady drop in water supply to the Dead Sea and the steady contraction of an iconic natural, cultural, and tourist resource.[195]

The Dead Sea is located along the Syro-African Rift. The sea has long held the distinction of being the "lowest place on earth," with water levels historically recorded at 395 meters below sea level.[196] Filling an original area of over 800 km^2, it is also the world's deepest hyper-saline lake.[197] With 33.7% salt content (ten-times that of most oceans) the Dead Sea is thought to be the world's most saline water body, making the marine environment uninhabitable for aquatic organisms, with the exception of some particularly steadfast microbial fungi and bacteria.[198] For many people though, the Dead Sea is quite salubrious: the combination of high concentrations of minerals along with low altitude and scorching sun provides a proven treatment for skin ailments such as psoriasis and atopic dermatitis.[199]

As a terminal lake, the Dead Sea receives almost all of its water from the Lower Jordan River.[200] In its original state, the river was fed by two main sources: the annual overflow from Lake Kinneret, the region's only freshwater lake; and the natural flow from Syria – and then Jordan – of the Yarmouk River.[201] Yet, as population size and agricultural activity in the region grew, so did water diversions to irrigate lands in Israel, Syria and Jordan. Demand from municipal water users in riparian countries also rapidly expanded.[202] Currently, very little water is left in the River Jordan.[203] Indeed, for decades, only a tiny trickle reaches the Dead Sea—by some estimates a mere 2% of the historic

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person to note the hydro-electric potential of the altitude differential. William Allen, a British naval officer was the first to publish the idea in 1855 following his visit to Ottoman Palestine. *See also* J. Vardi, *Mediterranean–Dead Sea* Project, HISTORICAL REVIEW 31-50 (1990).

194. NAT'L ACAD. OF SCI., WATER FOR THE FUTURE: THE WEST BANK AND GAZA STRIP, ISRAEL, AND JORDAN (1999).

195. D.E. Rosenberg, RAISING THE DEAD WITHOUT A RED SEA-DEAD SEA PROJECT? HYDRO-ECONOMICS AND GOVERNANCE, HYDROLOGY AND EARTH SYSTEM SERVICES (2011).

196. ISRAEL MINISTRY OF FOREIGN AFFAIRS, ISRAEL AND JORDAN LAUNCH GLOBAL CAMPAIGN TO SAVE THE DEAD SEA (Aug. 10, 2002), https://mfa.gov.il/MFA/MFA-Archive/2002/Pages/Israel%20and%20Jordan%20Launch%20Global%20Campaign%20to%20Save%20t.aspx.

197. Ilana Steinhorn & Joel R. Gat, *The Dead Sea,* 249 SCI. AM. 3 (Oct.1983), https://www.jstor.org/stable/10.2307/24969012; I. German & A. Hecht, *The Dead Sea Hydrography from 1992 to 2000,* 35 J. OF MARINE SYS. 169-181 (2002), https://www.sciencedirect.com/science/article/pii/S0924796302000799.

198. *Id*.

199. ALON TAL, THE LAND IS FULL: ADDRESSING OVERPOPULATION IN ISRAEL 23-24 (2016).

200. Michael Beyth, *The Red Sea and the Mediterranean–Dead Sea canal project*, 213 DESALINATION 24 (2007).

201. *See generally* AARON WOLFE, HYDROPOLITICS ALONG THE JORDAN RIVER: SCARCE WATER AND ITS IMPACT ON THE ARAB-ISRAELI CONFLICT (1995).

202. Alon Tal, *Will Demography Defeat River Restoration? The Case of the Jordan River*, 111 J. of WATER RESEARCH 404-419 (2017).

203. Assaf Chen, et al., *A Tale of Two Rivers: Pathways for Improving Water Management in the Jordan and Colorado River Basins*, 112 J. OF ARID ENVIRONMENTS, 109-123 (2015).

flow.[204] The proximate result is a 1.2 meter average annual drop in the shoreline of the Dead Sea and a dramatic constriction in the size of the waterbody.[205] Other impacts include the opening of enormous sinkholes, which pose a scar on the landscape, an impediment to local agricultural activity, and an acute safety hazard for local residents and visitors.[206]

Seeking to avoid the kind of natural resource catastrophe seen in places like the Aral Sea[207] and Lake Chad[208] (where ill-advised diversions and mismanagement led to the dramatic shrinking and decimation of the water bodies[209]), Israel and Jordan began to consider possible strategies to restore the disappearing Dead Sea. Not surprisingly, neither Israel nor Jordan volunteered to reduce their water consumption upstream.[210] And so it was that bringing water from the Red Sea or even the Mediterranean in a canal (and then in subsequent plans, a closed pipe) became the only meaningful solution on the table.[211] Neither of the countries, however, was willing to pay the prodigious anticipated expenses associated with an infrastructure initiative of this magnitude.[212] Eventually, highlighting the peace dividends, the World Bank was drafted to assess the feasibility of the initiative and, perhaps, help with its funding.[213]

The Palestinian National Authority was initially left out of the project. Following criticism for the exclusion of Palestinian interests in the Dead Sea,[214] in 2005, the Palestinian Authority was included as part of a plan for integrated development. The new plan submitted to the World Bank now went beyond simply increasing water supply, but contained a significant energy component.[215] Accordingly, the three primary objectives of the plan were presented as:

1. to save the Dead Sea from environmental degradation;

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204. Sarig Gafny et al., *Towards a Living Jordan River: an Environmental Flows Report on the Rehabilitation of the Lower Jordan River*, ECOPEACE/FRIENDS OF THE EARTH MIDDLE EAST (May 2010).

205. *Id.*

206. Joseph Marks, *Israel's Dead Sea Sinkholes Swallow the Unwary--and Tourism*, THE SEATTLE TIMES (June 24, 2009), https://www.seattletimes.com/life/travel/israels-dead-sea-sinkholes-swallow-the-unwary-8212-and-tourism/.

207. *See generally* William Wheeler, *Mitigating Disaster: The Aral Sea and (Post-)Soviet Property*, 11 GLOB. ENV'T (2018).

208. Ben Taub, *Lake Chad: the World's Most Complex Humanitarian Disaster*, THE NEW YORKER (Dec. 4, 2017), https://www.newyorker.com/magazine/2017/12/04.

209. For a description of the pathology of these and other depleted water bodies: *see* Andrey Kostianoy, Peter Zavialov & Sergey Lebedev, *What do we know about dead, dying and endangered lakes and seas?*, *in* DYING AND DEAD SEAS CLIMATIC VERSUS ANTHROPIC CAUSES 1 (J.C.J. Nihoul et al. eds., 2004).

210. Karin Aggestam & Anna Sundell, *Depoliticizing water conflict: functional peacebuilding in the Red Sea–Dead Sea Water Conveyance project*, 61:7 HYDROLOGICAL SCI. J., 1302-1312 (2016).

211. *Id.*

212. COYNE-ET BELLIER, RED SEA--DEAD SEA WATER CONVEYANCE STUDY PROGRAM, Draft Final Feasibility Study Report No. 12-147-RP-04 (July 2012).

213. *Id.*

214. Eric Abitbol, *Developing Water and Marginalizing Israel/Palestinian Peace: A Critical Examination of the Red Sea-Dead Sea Canal Feasibility Study Process*, 5(1) J. OF PEACEBUILDING & DEV. 35-49 (2009).

215. WORLD BANK GRP., RED SEA – DEAD SEA WATER CONVEYANCE CONCEPT FEASIBILITY STUDY AND ENVIRONMENTAL AND SOCIAL ASSESSMENT: INFORMATION NOTE – JULY 2007, 1 (Oct. 27, 2013), http://site-sources.worldbank.org/MENAEXT/Resources/RDS_Background_Note_V050707.pdf?resourceurlname=RDS_Background_Note_V050707.pdf.

2. to generate hydroelectricity and desalinated water at affordable prices to the citizens of Jordan, Israel and the Palestinian Authority; and
3. to build a symbol of peace and cooperation in the Middle East.[216]

When distilled to its essence, the details of the plan involved the laying of a massive intake pipe to be located in Jordanian territorial waters in the Gulf of Aqaba. Some two billion cubic meters would be pumped each year out of the Red Sea and conveyed up the Jordanian side of the Arava Valley for 180 km until reaching the banks of the Dead Sea.[217] Initially, the plan envisioned sea water being pumped through a pipeline until reaching its highest point, and then flowing gravitationally down to the low-lying Dead Sea.[218] Along the way, some of the water would pass through a desalination plant, which over-time would come to produce a prodigious quantity (850 MCM) of water per year.[219] The proposed system includes pipelines to deliver the potable water to Amman, the West Bank, and Israel.[220] At the same time, some 55% of the water pumped up the Arava valley would be released as brine into the Dead Sea.[221] Following full implementation of the proposed project, over a number of years, the Dead Sea shoreline levels would return to roughly 410 meters below sea level (where they stood in 2002) up from present ~430 meter levels.[222]

As time went on, however, the project became much more than simply a water conduit. Taking advantage of the 423-meter elevation difference between the Gulf of Aqaba and the sub-sea-levels at the Dead Sea, it was suggested that a hydroelectric plant be established adjacent to the Jordanian village of Fifa on the southern tip of the Dead Sea, three km east of the border.[223] Fifa is seen as an ideal site, located at the lowest possible point along the route, to maximize height differential and expand the Red-Dead project from merely a water supply initiative to a renewable energy generation system.[224]

The World Bank commissioned a feasibility study that considered six different configurations for the project, based on different conveyance alternatives and two alternate levels of *high* or *low* desalination production.[225] Assuming a pipeline conveyance and maximum desalination output, rather than relying on a single facility, the highest electricity generation would be achieved by using two separate plants: one immediately upstream from the desalination pretreatment plant and the second one at a lower location.[226] The water driving the turbines

216. *Id*. at 2-3.

217. *Id*. at 3.

218. *Id.* at 3.

219. COYNE-ET BELLIER, *supra* note 212, at 19.

220. *Id.* at 2.

221. Doron Markel et al., *The Red Sea–Dead Sea Conveyance Feasibility Study, 2008–2012*, *in* WATER POLICY IN ISRAEL: CONTEXT, ISSUES AND OPTIONS, 181, 183-184 (N. Becker, ed., 2013).

222. JOHN ANTHONY ALLAN ET AL., RED SEA—DEAD SEA WATER CONVEYANCE STUDY PROGRAM, STUDY OF ALTERNATIVES, PRELIMINARY DRAFT REPORT, EXECUTIVE SUMMARY AND MAIN REPORT, 2, 12 (2012).

223. COYNE-ET BELLIER, *supra* note 212, at 38.

224. *Id.* at 30, 38.

225. *Id*. at 39.

226. *Id*.

would not include any desalinated water, but only untreated Red Sea water along with "reject brine" from the desalination process.[227] Thus, as the desalination infrastructure expands to meet growing water demand, the amount of net-electricity produced would drop accordingly.

The World Bank analysis looked at two different types of turbines for the hydroelectric facility: *Francis* and *Pelton*, preferring the latter on the basis of economic, hydraulic, and maintenance criteria.[228] The study expressed concern about the selection of materials to be utilized in the facility, as there is only one other example worldwide of hydroelectric power being generated by flowing salt water.[229] Presumably, the long-term integrity of turbines and other equipment remains uncertain given concerns about accelerated corrosion from the highly concentrated saline water.[230] Based on the different possible engineering options, the range of installed generation capacity anticipated from the hydroelectric facilities spanned between 150 MW and 250 MW.[231]

As mentioned, a feasibility study funded by donations from the United States, France, and Sweden was conducted by the World Bank, and dragged on for the better part of a decade.[232] The results came as a surprise: when the project was first announced in 1992, the original estimates for implementation were only $800 million.[233] After the World Bank fully evaluated a far more ambitious proposal, the anticipated costs initially swelled to some $5 billion (U.S.) – a sum that later reached $7.5 billion[234] —and ultimately reached the astronomical total of $10–$11 billion (U.S.).[235] These World Bank cost estimates did not include additional operation and maintenance costs of approximately $400 million per year.[236] These large capital and recurring operation and maintenance costs presumably are difficult to justify given the current national budgets of both Jordan and Israel. [237]

In order to make the project more consistent with the actual economic capabilities of the local partners and the likely support that might be received from

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227. *Id*. at 40.

228. COYNE-ET BELLIER, *supra* note 212, at 42.

229. *Id*. at 42.

230. *Id.*

231. *Id*. at 44.

232. Imad El-Anis & Roy Smith, *Freshwater Security, Conflict, and Cooperation: The Case of the Red Sea–Dead Sea Conduit Project*, 129 J. DEVELOPING SOC'YS 12-13 (2013); BANK INFO. CTR., WHERE IS THE RED SEA-DEAD SEA WATER CONVEYANCE PROGRAM GOING?, https://journals.sagepub.com/doi/abs/10.1177/0169796X12470552.

233. Ministry of Reg'l Coop., *Israel and Jordan Launch Global Campaign to Save the Dead Sea***,** ISRAEL MINISTRY OF FOREIGN AFFAIRS (Aug. 10, 2002), https://mfa.gov.il/MFA/MFA-Archive/2002/Pages/Israel%20and%20Jordan%20Launch%20Global%20Campaign%20to%20Save%20t.aspx.

234. *Red Sea-Dead Sea Water Conduit Project*, BANK INFO. CTR., https://bankinformationcenter.org/en-us/project/red-sea--dead-sea-water-conduit-project/.

235. Markel et al., *supra* note 221, at 188.

236. *Id.*

237. For a thorough and concise presentation of different alternatives for saving the Dead Sea, *see Comments of EcoPeace/Friends of the Earth Middle East to World Bank Public Hearings concerning Red Dead Conduit Project*, Amman, Jerusalem and Ramallah (February 13, 2013), https://ecopeaceme.org/uploads/13606843611~%5E$%5E~FoEME_Position_Paper_on_WB_RDC_Public_Hearing_2013_English.pdf.

donor nations, a smaller version of the project eventually was approved by all three parties.[238] In 2013, representatives of the Israeli, Jordanian, and Palestinian governments signed an initial agreement at the World Bank in Washington to connect the Red Sea and the Dead Sea with a pipeline.[239] The scope of the project was far more modest in scale than the original plan.[240] The agreement involved a "water swap" where Israel agreed to utilize roughly half of the 80 MCM of water produced in a new Aqaba desalination plant for use in the south, while in exchange, transferring the same amount to Jordan's capital Amman in the north.[241] Energy, however, was conspicuously absent from the new proposal. Even this downsized project (and the bombastic rhetoric of its proponents) was not without its critics.[242]

In the "water swap agreement," the amount of water carried north was 5% of the original proposed quantities, as the pilot pipeline would only deliver 100 MCM of brine annually.[243] The project could be implemented through a buy, operate, and transfer (BOT) model at a total price of $300 to $400 million.[244] For some time, the project remained "in play" – primarily due to its potential for solving Jordan's pervasive and worsening water scarcity crisis, rather than its energy contribution.[245] Indeed, no mention is made in the Water Swap agreement about the hydroelectric facilities that were to be located near the Dead Sea shore. And as Israeli/Jordanian relations grew increasingly troubled and tense, even the project's most keen advocates began to give up hope.[246] The vision of exploiting the idiosyncratic topographic conditions and prodigious drop to the Dead Sea to produce clean energy has survived for some 120 years. It would seem that any eulogies for this engineering challenge are premature.

As a case study, there are two lessons which emerge from *Red Sea-Dead Sea Water Conveyance Project* that are relevant to the general theme of this article: (1) Unilateral actions to take advantage of the unique topography for hydroelectric power generation are simply not feasible and require cooperation; and (2)

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238. Imad El-Anis & Roy Smith, *Freshwater Security, Conflict, and Cooperation: The Case of the Red Sea–Dead Sea Conduit Project*, 129 J. DEVELOPING SOC'YS 1, at 12 (2013).

239. Sharon Udasin, *Israel, Jordan, PA sign trilateral agreements to 'swap' and share water*, JERUSALEM POST (Dec. 10, 2013), https://www.jpost.com/Enviro-Tech/Exclusive-Israel-Jordan-PA-to-sign-trilateral-water-swap-sales-agreements-334505.

240. THE WORLD BANK, SENIOR ISRAELI, JORDANIAN AND PALESTINIAN REPRESENTATIVES SIGN MILESTONE WATER SHARING AGREEMENT (Dec. 9, 2013), https://www.worldbank.org/en/news/press-release/2013/12/09/senior-israel-jordanian-palestinian-representatives-water-sharing-agreement.

241. Udasin, *supra* note 239.

242. Alon Tal, *New Israeli-Jordanian-Palestinian Water Agreement Will Not Prevent Shortages*, HUFFINGTON POST (Dec. 15, 2013), https://www.huffpost.com/entry/middle-east-water-agreementb4450304.

243. Udasin, *supra* note 239.

244. Amiram Barkat, *World Bank to finance Red Sea-Dead Sea conduit*, GLOBES (Dec. 9, 2013), https://en.globes.co.il/en/article-1000900407.

245. THE GUARDIAN, JORDAN HOPES CONTROVERSIAL RED SEA DEAD SEA PROJECT WILL STEM WATER CRISIS (Mar. 20, 2014), https://www.theguardian.com/global-development/2014/mar/20/jordan-water-red-sea-dead-sea-project.

246. Sue Surkes, *Sinking Israel-Jordan relations leave Dead Sea, a natural wonder, low and dry*, TIMES OF ISRAEL (Nov. 7, 2019), https://www.timesofisrael.com/sinking-israel-jordan-relations-leave-dead-sea-a-natural-wonder-low-and-dry/.

the international community has been less forthcoming with funding for joint projects than was hoped for by the local parties. If regional energy projects are going to move from theory to practice, it will take political will and financial resources (either public or private) from the governments of Jordan and Israel. While the international community is encouraging and will provide a platform to facilitate discussions, for the foreseeable future, it is unlikely to write the check.

V. THE PATHOLOGY OF PALESTINE'S MISSING ELECTRICITY

Electricity supply for Palestinians in the West Bank versus Gaza is an entirely different story. According to a 2013 report by the Palestine Economic Policy Research Institute-MAS, while 99.8% of households in the West Bank have 24-hour access to electricity, "the daily power service for 97.2 percent of Gaza's households is barely 16 hours."[247] Electricity in Gaza comes from one centralized 140-MW capacity diesel-fueled power plant, up to 120-MW from the Israel Electric Corporation, and up to 30 MW from Egypt.[248]

Given the shortage of electricity supplied to Gaza, it is challenging to estimate what the peak and baseload demand might be if electricity was available continuously. Although Gaza's sole power plant is rated at 140-MW, it currently generates between 40-60 MW of electricity because it is running on diesel fuel instead of natural gas.[249] Current electric supply in Gaza comprises but a third of the estimated electric demand, leaving residents with access to electricity on average for only four hours a day.[250] Electricity scarcity and unreliability pose major economic challenges to Gazans. The shortage of electricity hinders refrigeration of food, adversely impacts the operation of hospitals, and decreases the productivity of businesses.[251] Such scarcity serves to highlight the potential for regional cooperation to enable the transmission of additional electricity to Gaza. And indeed, there are modest "glimmers" of what could – and should be a far more significant regional electricity network. Gaza imports small amounts electricity from Egypt (up to 30 MW) and the Jericho region imports modest quantities of electricity from Jordan (up to 25 MW—with plans to increase to 80 MW).[252] But this does not tell the real story on the ground. The problem is that

247. PALESTINE ECON. POLICY RESEARCH INST., BACKGROUND PAPER ROUNDTABLE (4): THE ELECTRICITY SECTOR: CURRENT STATUS AND THE NEED FOR REFORM 1, 3 (May 31, 2014), http://www.mas.ps/files/server/20141911184358-1.pdf.

248. Hedy Cohen, *Israel, Turkey eager to rebuild Gaza*, GLOBES (June 30, 2016), https://en.globes.co.il/en/article-israel-turkey-eager-to-rebuild-gaza-1001136597.

249. INT'L TRADE ADMIN. AND THE U.S. DEP'T OF COMMERCE, WEST BANK AND GAZA – COMMERCIAL GUIDE (Oct. 13, 2019), https://www.trade.gov/knowledge-product/west-bank-market-overview?section-nav=2000.

250. Ali Sawafta and Nigdal al-Mughrabi, *Palestinians turn to the sun to reduce their power shortfall,* REUTERS (Aug. 9, 2018), https://www.reuters.com/article/us-israel-palestinians-solar-energy/palestinians-turn-to-the-sun-to-reduce-their-power-shortfall-idUSKBN1KU164.

251. *Report on UNCTAD assistance to the Palestinian people: Developments in the economy of the Occupied Palestinian Territory*, UNITED NATIONS CONFERENCE ON TRADE AND DEV. 9 (July 22, 2019), https://unctad.org/meetings/en/SessionalDocuments/tdbex68d4_en.pdf?user=46.

252. Mohammad Tayseer, *Jordan Plans to Boost Power Supply to Palestinian Areas*, BLOOMBERG, (July 7, 2019) https://www.bloomberg.com/news/articles/2019-07-07/jordan-plans-to-boost-power-supply-to-palestinian-areas.

the Palestinian and the Israeli electric systems are already fully integrated—arguably too integrated—which makes the challenge for regional coordination almost paradoxical. To have meaningful and authentic cooperation, Israel must begin to "pull back" and reduce its historic level of control over the Palestinian electric system.

Since Israel conquered the West Bank and Gaza in 1967, electricity generation and delivery infrastructure for Israelis and Palestinians in the area has been largely indivisible. This phenomenon reflects the dramatic upgrade in Palestinian accessibility to electricity which accompanied the Israeli occupation.[253] For example, when Israel conquered Gaza from the Egyptian army in 1967, only 18% of the households there had access to electricity.[254] Within fourteen years the percentage had risen to 89%.[255] But as the years went by, this intensive intervention has come to mean that the single most dominant characteristic of the Palestinian electrical system is that Israel controls it. Given the assumption that cooperation in transboundary energy initiatives involves volition on the part of all parties and "win-win" dynamics that are embraced by all sides, cooperative dynamics in energy policies should begin by ensuring Palestinian energy independence as part of a coordinated regional network.

Subsequent to Israel's occupation, there was a single distribution company providing Palestinians electricity in the West Bank. The Jerusalem District Electric Company (JDECO) was actually founded during the British Mandate, but assumed its present legal structure in 1956 when the West Bank was under Jordanian control.[256] Since then, additional electricity distribution companies have been established in under the Palestinian Authority: Southern, Northern Tubas and JDECO.[257] But JDECO continues to be the dominant provider, providing electricity directly to Palestinians in East Jerusalem, Bethlehem, Ramallah and Jericho—all told about 30% of Palestinian households and businesses.[258] The new Palestinian electricity suppliers share the same fundamental attribute as the veteran JDECO: they also purchase their electricity almost entirely from the Israel Electric Corporation.[259] Indeed, less than 10% of the West Bank's electrici-

253. Reuters Staff, *Israel to shift West Bank power supply to Palestinian Authority in $775 million deal*, REUTERS (May 1, 2018), https://www.reuters.com/article/us-israeli-palestinians-electricity/israel-to-shift-west-bank-power-supply-to-palestinian-authority-in-775-million-deal-idUSKBN1I23QP.

254. *See e.g.*, Dan Perry, *6-day war begets 50 years of strife for Israel*, AP NEWS (May 29, 2017), https://apnews.com/article/8dfd6ed105a14c6ab82d78ad5aae2a10.

255. DANIEL GORDIS, ISRAEL, A CONCISE HISTORY OF A NATION REBORN, 352-53 (2016).

256. *See* STATE OF ISRAEL PUB. UTIL. AUTH. ELEC., JERUSALEM DISTRICT ELECTRICITY CO. LTD ("JDECO") – DESCRIPTION OF CORPORATE BUSINESS, https://pua.gov.il/English/Documents/Appendix%20B%20-Jerusalem%20District%20Electricity.pdf

257. Sara Badiei, Vivien Foster and Roger Coma-Cunill, *Securing Energy for Development in the West Bank and Gaza*, WORLD BANK GRP. 34 (Mar. 31, 2016), http://documents1.worldbank.org/curated/en/351061505722970487/pdf/Replacement-MNA-SecuringEnergyWestBankGaza-web.pdf.

258. Itai Trilnick, *Israel Renews Palestinian Power Supplier's License, Despite Debt*, HAARETZ, (July 1, 2013), https://www.haaretz.com/israel-news/business/.premium-w-bank-power-co-gets-debt-reprieve-1.5289628.

259. WORLD BANK, WEST BANK AND GAZA ASSESSMENT AND ACTION PLAN TO IMPROVE PAYMENT FOR ELECTRICITY SERVICES IN THE PALESTINIAN TERRITORIES STUDY ON ELECTRICITY SECTOR CONTRIBUTION TO NET LENDING (Nov. 25, 2014), https://www.un.org/unispal/document/auto-insert-200068/.

ty is produced locally within the Palestinian Authority by Palestinian generators.[260] The Israeli Electricity Corporation provides 88% of total Palestinian electricity consumption, at a total cost of close $800 million per year.[261]

The scarce amount of locally generated electricity in the West Bank is surely not due to a dearth of Palestinian legislation and institutions.[262] The Palestinian Authority has enacted several electricity related regulations, starting with the 2009, "Electricity Decree Law,"[263] which seeks to decentralize the key functions associated with electricity (Generation, Transmission, and Distribution). In order to ensure the institutional platform for the policy, a Palestinian national transmission company, the Palestine Electricity Transmission Company (PETL), was established by a decision of the Palestinian Cabinet on October 1, 2013.[264] Amongst the company's objectives are upgrading the level of electricity services by implementing a single buyer model and "diversifying electricity supply through power purchase agreements with local generation sources and interconnections with neighboring countries."[265] In practice, this means that PETL handles negotiations with Israel related to electricity. PETL is also responsible for signing power purchase agreements with independent power producers.[266] Yet, given economic constraints and the geographical fragmentation of the areas of the West Bank controlled by Palestinians, many municipalities choose not to rely on the official Palestinian supplier and simply signed separate contracts with the Israel Electric Corporation.[267]

Indeed, the PETL is surely not the sole player in electricity supply: some 100 Palestinian municipalities already purchase electricity from Israel (which they then regulate).[268] Municipal governments sell the electricity directly to local residents and businesses.[269] As city tax collection is extremely limited in many Palestinian towns, the ability to turn a profit on electricity sales constitutes

260. Randa Hilal and Tawfiq Nassar, *Private Sector Engagement Analysis in Electricity/Solar Energy, and Youth Job Opportunities Study*, DCA/NCA PALESTINE JOINT COUNTRY PROGRAM 13 (Nov. 26, 2018), https://www.kirkensnodhjelp.no/contentassets/babdd17d712344e4a417e6dde3100ce2/the-solar-energy-study-palestine-2018.pdf.

261. Ora Koren, *The Israel Electric Corporation Will Supply the Palestinians with 2.8 billion shekels of electricity a year*, THE MARKER (May 15, 2018), https://www.themarker.com/dynamo/1.6049356.

262. Ibrahim Marei, *Developments in law and policy: the promotion of green energy in the electricity sector of Palestine*, 35(1) J. OF ENERGY & NAT. RES. L. 47-67 (2017).

263. Palestinian Energy Authority's Constituting Law N12 for 1995 (Palestine) 7 Palestine Gazette 10; also: 39 Electricity Decree Law N13 for 2009 (Palestine) 81 Palestine Gazette 13.

264. Mediterranean Transmission Sys. Operators, *Representatives of Palestine Elec. Transmission Co. and of Palestinian Energy & Natural Res. Auth. met the Sec'y Gen. of Med-TSO in Ramallah* (May 17, 2019), https://www.med-tso.com/notizia.aspx?Id=123&t=1&f=.

265. P.E.T.L.P.S, (2020) *The Palestinian Electricity Transmission Company Ltd.* "*About Us,"* https://www.linkedin.com/company/petl-ps.

266. Officer of the Quartet, *A Palestinian-Israeli Power Purchase Agreement Signed for Energizing Al-Jalama Substation* (July 2017), http://www.quartetoffice.org/page.php?id=5e7b59y6191961Y5e7b59.

267. Marei, *supra* note 262, at 49.

268. Energy Global Practice, *Implemen. Completion and Res. Report on Trust Fund Grants in the Amount of U.S. $ 14.5 Million to the West Bank and Gaza for an Elec. Util. Mgmt Project* (March 24, 2017).

269. Nidal Rashid Sabri, Rania Jaber, Deema Hanya, *PPPs in Palestinian Municipal Activities as Perceived by Stakeholders*, *in* PROBLEMS AND PERSPECTIVES IN MGMT. 4, 5 (2010).

one of the few sources of revenue for local authorities to cover the costs of providing education, health, and basic municipal services.[270]

The existing arrangement leaves the Israel Electric Corporation essentially in control of electric infrastructure in the West Bank. It also serves to stymy the ability of Palestinian electricity companies to expand and reach economies of scale. Ironically, however, Israeli involvement in Palestinian electricity supply may empower local governments more than a centralized Palestinian electricity system would, as the Israeli supplier is happy, or at least indifferent, to selling the municipalities electricity and surely does not begrudge any profits that they take.

Given the consistent access to copious quantities of sunlight in both the West Bank and Gaza (320 days a year)[271] — with 3,000 hours of sunshine and an average solar radiation of 5.4 kWh/m[272] — and given the dramatic reduction in the price of photovoltaic electricity systems, it might be assumed that Palestinian energy strategies should be anchored in renewable generation. Unfortunately, electricity produced via natural gas has been prioritized by Palestinian policy makers as the preferred pathway forward towards increased energy independence.

In fact, for some time, Palestinian entrepreneurs, coordinated by the Massader investment group, have been planning to establish a 450 MW natural gas-powered plant in Jenin.[273] If implemented, the proposed Jenin facility would be the largest Palestinian power plant.[274] The natural gas for the plant, presumably, would be delivered to the West Bank from the considerable (but as of yet undeveloped) gas fields located twenty-two kilometers off of the Gaza shoreline.[275] The field is quite shallow, lying at a depth of a mere 2,000 feet, and some estimates suggest that it could be developed for as little as $300 million dollars.[276]

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270. WORLD BANK, *supra* note 259.

271. U.N. DEV. PROGRAM, RENEWABLE ENERGY GENERATION THROUGH SOLAR PANELS FOR PUBLIC EDUCATION HEALTH AND WATER FACILITIES IN THE GAZA STRIP, https://www.ps.undp.org/content/papp/en/home/operations/projects/environment_and_energy/renewable-energy-generation-through-solar-panels---gaza.html#:~:text=The%20Gaza%20Strip%20has%20an,renewable%20energy%20an%20ideal%20option.

272. Mohammed Ziad Yamin, *Renewable Energy in Palestine*, ECOMENA (Feb. 23, 2020), https://www.ecomena.org/renewables-palestine/.

273. MASSADER, JENIN POWER PLANT (2017), http://www.massader.ps/en/project/1518343235.

274. GAS TO POWER J., PALESTINE ADVANCES 450 M.W. GAS POWER PROJECT (Sept. 13, 2019), https://gastopowerjournal.com/projectsafinance/item/10067-palestine-advances-450-mw-gas-power-project.

275. Rights to develop the field were originally sold to British Gas in 1999. But after the second intifada brought tensions between the Palestinians and the Israelis to new heights, the Israeli Electric Company pulled its support of any cooperative venture due to fear that any profits would be used by the Hamas government to purchase weapons and military capacity that would be used against Israel. Realized that their concession was embroiled in a political quagmire, British Gas sold its rights to develop the field, making any pathway forward extremely unclear, especially give the surfeit of gas already produced in Israeli fields and the slump in natural gas prices in international markets. *See* Al Jazeera, *The Gaza Gas Deal* (June 5, 2019), https://www.aljazeera.com/programmes/aljazeeraworld/2019/06/gaza-gas-deal-190603142512559.html.

276. Tim Boersma, Natan Sachs, *Gaza Marine: Natural Gas Extraction in Tumultuous Times?*, RESEARCHGATE (Feb. 2015), https://www.researchgate.net/publication/272494277_Gaza_Marine_Natural_Gas_Extraction_in_Tumultuous_Times.

Yet, it is worth remembering that even if the gas field off of Gaza's coast is developed, the gas would likely have to flow via the Israeli gas network to the Jenin facility. Indeed, the Israeli infrastructure developed to export gas pumped at the Leviathan field off the Israeli coast to Jordan is actually located near Jenin. In other words, Palestinians will continue to depend on cooperation with Israel for their energy. It makes little economic sense to create a parallel network rather than use the existing infrastructure established for utilization of the gas extracted from Israel's Leviathan or Tamar fields.[277]

The possibility of Israel supplying the gas from its newly operational "Leviathan" field on the Carmel coastline to Palestinian consumers has been on the table as an alternative for some time.[278] Long before the fields became operational, the Palestinian Electric Company signed a $1.2 billion twenty-year deal with the Noble-Energy/Delek group to purchase gas from the site.[279] The deal, however, was later nixed for a variety of economic and political reasons.[280]

This type of agreement might make sense geographically and economically, but surely would do little to move the Palestinian electricity system towards energy independence. The cost of building the Jenin gas-fired electricity generation station was originally estimated at $620 million and its proponents promised that it would become operational within two years.[281] But like many Palestinian infrastructure ventures, it hardly seems to have moved forward in recent years. And Palestinian infrastructure projects often end up costing more than optimistic planners predict.[282] The Massader website, quite naturally, is still keen about the venture. The company claims that when completed, the gas-fired plant will supply "approximately 50% of Palestine's current total electricity consumption," which it will deliver to the Palestine Electricity Transmission Company for distribution.[283] But many loose ends remain. Chief among these, the Gaza gas field itself remains undeveloped and is still a disputed topic of negotiation between Israeli and Palestinian leadership.[284] Like innumerable other important Palestinian infrastructure proposals, progress is ultimately dependent on the state of the

277. Personal Communication with Nurit Gal (July 4, 2020); *see also* Ahmad Melham, *Will Israel Go Through with Plan to Develop Gaza Gas Field?,* AL-MONITOR (Jan. 30, 2020), https://www.al-monitor.com /pulse/originals/2020/01/ palestinian-authority-israel-import-gas-gaza-field-power.html.

278. Eran Azran*, Palestinians Become First Customer of Israel's Leviathan Gas Field,* HAARETZ (last updated Apr. 10, 2018), https://www.haaretz.com/israel-news/business/palestinians-to-buy-israeli-gas-1.5308230.

279. TOI Staff, *Palestinians to be First Buyers of Israeli Natural Gas,* TIMES OF ISRAEL (Jan. 6, 2014), https://www.timesofisrael.com/palestinians-to-be-first-buyers-of-israeli-natural-gas/.

280. Sharon Udasin, *Woodside Terminates Leviathan Deal*, THE JERUSALEM POST (May 21, 2014), https://www.jpost.com/business/business-news/woodside-terminates-leviathan-deal-352893.

281. David Israel, *PA Reveals Construction of Largest Power Plant Coming "Soon"*, THE JEWISH PRESS (Sept. 8, 2019), https://www.jewishpress.com/news/eye-on-palestine/palestinian-authority/pa-reveals-construction-of-largest-power-plant-coming-soon/2019/09/08/.

282. *See, e.g.*, Ibrahim Mahamid & Amund Bruland, *Cost Deviation in Road Construction Projects: The Case of Palestine*, AUSTL. J. OF CONSTR. ECON. & BLDG. 58, 66 (Feb. 2012), https://www.researchgate .net/publication/278008111_Cost_deviation_in_road_construction_projects_The_case_of_Palestine

283. MASSADER*, supra* note 273.

284. Melham, *supra* note 277.

tenuous and turbulent relations between Israel and the Hamas-led Gaza government.[285]

With regard to supplying Gaza with electricity, Israel generally prioritizes humanitarian considerations over security concerns and therefore has ensured that electricity was supplied to Gaza over the past thirteen years, notwithstanding the openly hostile position and intermittent violent actions of the Hamas-led government there.[286] This is not just for tactical reasons. Legally, the government was required to do so. In 2007, Israel's Supreme Court intervened when electricity was being cut to Gaza on the grounds that the resulting damage to the civilian population was in violation of international law.[287] The Israeli military had argued in the case that the imported electricity was being used to support terrorist activities against Israel.[288] Supreme Court Chief Justice, Dorit Beinish, accepted the government's position, holding that having withdrawn from the Gaza Strip, Israel indeed had no formal obligation to supply electricity and other products to Gaza.[289] Nonetheless, Beinish ruled that international law required that in times of conflict Israel still needed to provide essential humanitarian needs.[290] There have been instances in which Israel has temporarily halted fuel supplies to Gaza, for example, in response to attacks on Israel originating in the strip.[291] But, almost without exception, the Supreme Court decision has been implemented.

To some extent, this issue has been finessed by transforming the controversy into a largely commercial matter. In practice, payment for electricity imported into Gaza is made by the Palestinian Authority government in the West Bank to the Israel Electric Corporation.[292] Over the years, the Fatah-led administration has intermittently suspended these payments for Gaza when it finds itself in conflict with the rival Hamas regime there.[293] This constitutes a meaningful tool for pressuring the Hamas leadership, as it quickly leads to reduced power supply by the IEC and an immediate worsening in quality of life in the Strip. Presumably, by letting the Palestinian government in Ramallah have a say in when power is,

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285. *Id*.

286. Dov Liber, *After Months of Cuts, Israel to Increase Electricity to Gaza at PA's Request*, TIMES OF ISRAEL (Jan. 7, 2018), https://www.timesofisrael.com/after-months-of-cuts-israel-to-increase-electricity-to-gaza-at-pas-request/.

287. HCJ 9132/07 Ahmed v. The Prime Minister (Jan. 30, 2008), State of Israel Judicial Authority Database P. 11, 20-22 (translated in English) (Isr.). *See also* Donald MacIntyre, *Court Halts Gaza Electricity Cuts but Fuel Reductions Stay*, THE INDEPENDENT (Dec. 1, 2007), https://www.independent.co.uk/news/world/middle-east/court-halts-gaza-electricity-cuts-but-fuel-reductions-stay-761712.html.

288. HCJ 9132/07 Ahmed v. The Prime Minister (Jan. 30, 2008), State of Israel Judicial Authority Database, at P 2, 11 (translated in English) (Isr.).

289. *Id.* at P 11-12.

290. *Id.* at P 11, 15, 22.

291. Times of Israel Staff, *Israel shut off fuel supplies to Gaza after spate of arson attacks*, TIMES OF ISRAEL (June 25, 2019), https://www.timesofisrael.com/israel-shuts-off-gas-supplies-to-gaza-after-spate-of-arson-attacks/#gs.f7a47z.

292. Reuters Staff, *Israieli electric company ends power cuts to West Bank after Palestinians pay debt,* REUTERS (Jan. 22, 2020), https://www.reuters.com/article/us-israel-palestinians-power/israeli-electric-company-ends-power-cuts-to-west-bank-after-palestinians-pay-debt-idUSKBN1ZL0W9.

293. *Id*.

and when it is not, provided to Gaza, Israel is empowering the official PA Fatah government and bolstering its status among the Palestinian public. Ostensibly, during recent years, during those times when power to Gaza is restricted by Israel, it involves "business considerations" by the Israel Electric Corporation, who treats Gazans like any other customer who is not paying electricity bills.[294] Indeed, little distinction is made by the company in its collection policy for electricity supplied in the Gaza versus the West Bank, notwithstanding the latter's friendlier, *Fatah* administration.[295]

Currently, Palestinian electricity in the West Bank is supplied by Israel via 161-kilovolt (kV) high-voltage transmission lines.[296] Israeli supplied electricity is transformed from 161-kV to flow on 33-kV or 22-kV transmission lines towards Areas A, B, and C in the West Bank.[297] In the middle of these 33-kV or 22-kV lines are Israeli-controlled coupling points.[298] After crossing one of 200 coupling points across the West Bank, electricity flows into Areas A, B, and C.[299] After these coupling points, Palestinian Distribution Companies distribute the electricity and either send it to municipalities or to other consumers.[300] In practice, this means that if a Jenin gas-powered plant becomes operational, ironically, it may need to connect to Israeli transmission infrastructure.[301] Presumably, Israel could purchase the electricity from a power plant in Jenin, redistribute, and then re-sell it back to Palestinian customers.

This turns out not to be a trivial matter and the terms of such a trade and even a strictly commercial agreement are as of yet unresolved. What is clear is that for the foreseeable future, even if the Palestinians dramatically expand their electricity production, Israeli involvement in their energy system will not simply disappear. There is, however, some hope for Israeli-Palestinian cooperation in the future that could enable increased Palestinian autonomy over their electricity management.

In 2017, high-ranking Israeli and Palestinian officials celebrated the completion of an electric substation in Jenin, which is the first Palestinian-owned electric infrastructure in the West Bank.[302] Ownership of this substation and the construction of subsequent substations in the West Bank, would enable Palestinians increased autonomy over their power distribution. The construction of this sub-station was a collaborative effort between IEC, the Palestinian Electric Au-

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294. *Id*.

295. Barak Ravid, *Israeli Government Says Not Behind Electric Corp. Decision to Cut West Bank Power*, HAARETZ (Feb. 23, 2015), https://www.haaretz.com/.premium-israeli-gov-t-not-behind-west-bank-power-cuts-1.5310995.

296. Personal Communication with Dr. Tareq Abu Hamed, (July 24, 2020).

297. *Id*.

298. *Id*.

299. *Id*.

300. *Id*.

301. Personal Communication with Dr. Tareq Abu Hamed, *supra* note 296.

302. Dov Liebner, *In deal with Israel, PA Takes 'historic' step toward energy independence,* TIMES OF ISRAEL (July 10, 2017), https://www.timesofisrael.com/in-deal-with-israel-pa-takes-historic-step-toward-energy-independence/.

thority, and the PA.[303] There are additional substations planned in the Hebron area in the south, near Ramallah in the center, and near Nablus in the northern West Bank.[304] When these sub-stations are completed, Palestinians will be able to control the electricity distribution throughout much of the area controlled by the Palestinian Authority.[305]

Given the schism between the Gaza Hamas-led government and the Palestinian Authority in the West Bank, and the Hamas government's unwillingness to tolerate any Israeli presence in the region, it is not clear why Palestinian energy policy continues to place such emphasis on natural gas supplied via Gaza. It would make more sense for Palestinians to rely on solar generation and utilize Israeli generation to balance electric grid supply and demand rather than pursue a power system based on natural gas from the Mediterranean. One could argue that the Palestinian policy makers should shift their focus to a more "renewable centric" one.

While the physical infrastructure lags, the legislative support for increased renewable generation in the West Bank is already in place. In 2015, the Renewable Energy and Natural Resources Law was enacted by the Palestinian parliament in Ramallah to incentivize development of renewables and increase their percentage amongst the total energy mix.[306] In theory, Palestinian energy policy is designed to establish significant renewable energy capacity through a decentralized network of small generators.[307]

In order to encourage entrepreneurial efforts and more Palestinian autonomy over electric system management in the West Bank, the Palestinian Investment Fund developed a range of incentives for investors.[308] Independent power producers are given priority if their prices can fall 10% below those charged by the Israel Electric Corporation.[309] Palestinian banks also offer "solar incentive loans" at reasonable terms.[310] If a resident of the West Bank wants to put solar panels on a rooftop (commercial or residential), financial incentives are available.[311] The World Bank is also working with the PA to streamline and standardize power purchase agreements in order to facilitate the development of more renewable generation by the private sector.[312] The French government created the

303. *Id*.

304. *Id*.

305. *Id*.

306. PALESTINIAN INV. PROMOTION AGENCY, RENEWABLE ENERGY (last visited June 22, 2020), http://www.pipa.ps/page.php?id=272e14y2567700Y272e14.

307. Imad H. Ibrik, *An overview of electrification rural areas in Palestine by using micro-grid solar energy*, *in* 6 Cogent Engineering (2019).

308. Marei, *supra* note 262; *see also* Abu Amer, Ahjmad, *How this solar energy project will meet Palestinians' electricity needs*, AL-MONITOR (Nov. 10, 2019), https://www.al-monitor.com/pulse/originals/2019/11/palestine-solar-energy-power-stations-israel-economic-ties.html#ixzz6Q6bRRQH0.

309. *Peace to Prosperity: A Vision to Improve the Lives of the Palestinian and Israeli People*, (Jan. 2020), https://www.whitehouse.gov/wp-content/uploads/2020/01/Peace-to-Prosperity-0120.pdf

310. *Id*.

311. *Id*.

312. WORLD BANK, WORLD BANK GROUP (WBG) ASSISTANCE STRATEGY FOR THE WEST BANK AND GAZA DURING FY18-21, http://documents1.worldbank.org/curated/en/339871512568083583/pdf/AS-1113-West-Bank-Gaza-Final-to-SECPO-11142017.pdf

"SunRef" initiative, providing 35 million euros for solar projects in Palestine, inter alia providing debt finance at reasonable terms.[313] If projects are successfully completed, part of the loan turns into a grant.[314]

The adoption of solar-PV systems in the West Bank in Gaza, perhaps due in part to financial incentives, is also starting to gain traction. Historically, some 60% of Palestinian homes have utilized passive solar systems for heating their water at a cost ranging between $250 and $350.[315] The number of solar PV panels on the roofs of Palestinian homes, hospitals, schools, banks, and even mosques appears to be growing at a rate of almost 100% a year across the West Bank and Gaza.[316] Municipal Palestinian governments are now considering shared ventures with solar entrepreneurs to build small and medium solar PV installations.[317] And yet, when compared with the solar electric generation levels achieved in many Mediterranean countries (including Greece[318]) aggregate Palestinian renewable production is extremely modest. As of 2012, total renewable energy in Palestine was a mere 1.4% of the energy mix and no data suggest that this percentage has increased dramatically.[319] To what can the disappointing Palestinian solar performance be attributed?

Two fundamental obstacles are responsible for the low level of renewable electricity generation and the lack of meaningful progress in Palestinian efforts to attain energy independence and produce low-carbon electricity:

(1) *Land shortages:* Under the Israeli-Palestinian interim peace accord,[320] most of the open spaces in the West Bank are located in Area C, which is under full Israeli control (military and civil administrations).[321] Solar entrepreneurs complain that requests to Israeli authorities for permission to establish solar generation facilities in Area C—even on lands that are environmentally damaged or

313. Agence Francaise de Developpement, SUNREF PALESTINE : DEVELOPING A MARKET FOR GREEN INVESTMENTS (last visited Sept. 8, 2020), https://www.afd.fr/en/carte-des-projets/sunref-palestine-developing-market-green-investments

314. *Id*.

315. PALESTINIAN CENT. BUREAU OF STATISTICS, HOUSEHOLD ENERGY SURVEY, Ramallah (Jan. 2015), http://www.pcbs.gov.ps/post.aspx?lang=en&ItemID=1439.

316. Ali Sawafta, Nigdal al-Mughrabi, *Palestinians turn to the sun to reduce their power shortfall*, REUTERS (Aug. 9, 2018), https://www.reuters.com/article/us-israel-palestinians-solar-energy/palestinians-turn-to-the-sun-to-reduce-their-power-shortfall-idUSKBN1KU164.

317. INT'L RENEWABLE ENERGY AGENCY, FUTURE OF SOLAR PHOTOVOLTAIC: DEPLOYMENT, INVESTMENT, TECHNOLOGY, GRID INTEGRATION AND SOCIO-ECONOMIC ASPECTS (Nov. 2019), https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Nov/IRENA_Future_of_Solar_PV_2019.pdf.

318. Helen Skopis, *Greece Produces More than 20 Percent of Power from Renewables*, GREEK REPORTER (June 19, 2019), https://greece.greekreporter.com/2019/06/19/greece-produces-more-than-20-percent-of-power-from-renewables/#:~:text=Greece%20is%20one%20of%20nine,from%20solar%20and%20wind%20power.

319. Yamin, *supra*, note 272.

320. UNITED NATIONS, ISRAELI-PALESTINIAN INTERIM AGREEMENT ON THE WEST BANK AND THE GAZA STRIP (Sept. 28, 1995), https://peacemaker.un.org/sites/peacemaker.un.org/files/IL%20PS_950928_InterimAgreementWestBankGazaStrip%28OsloII%29.pdf.

321. *Id*.

arid and incompatible with farming, are consistently rejected.[322] Sometimes objective reasons for Israeli recalcitrance exist. For example, there are three West Bank locations under Palestinian Authority jurisdiction where significant potential for wind turbine installation exists.[323] But in each case, the Israeli air force vetoed requests by developers due to air traffic constraints.[324] In other cases, however, the rejections appear more arbitrary. As a result of the unfavorable attitude of the Israeli civil and military authorities, most Palestinian solar projects end up being limited to Palestinian controlled Areas "A" and "B," which are characterized by either urban or suburban land use.[325] This means that the opportunity costs of solar projects, in terms of foregone real estate or other development, can be prohibitively high.

(2) *Inadequacy of the electricity grid:* Existing Palestinian transmission and distribution infrastructure is often at maximum capacity, with power outages becoming increasingly common.[326] This is not surprising: the West Bank population has been steadily growing for the past fifty years and the electricity infrastructure has not kept pace. The limited transmission and distribution capacity is exacerbated by Palestinian refusal, on principal, to share electricity infrastructure installed for the benefit of Jewish West Bank settlements, which they perceive as illegitimate and illegal. And when the Palestinian Authority falls behind on its electricity bill payments, the blackouts are even more frequent.[327] The paradoxical result is that in areas like Jericho, where the potential for solar-powered generation is enormous, there is not currently transmission that would enable new electricity generation to be sent to population centers like Ramallah, which is only twenty kilometers away.[328]

There are several solutions to the present general stagnation in the Palestinian renewable sector. Some potential solutions involve institutional collaboration. Theoretically, it is possible that the Palestinian Authority and Israel could agree to deliver electricity via a wheeling arrangement where electricity would be transferred from one electricity system to one outside the boundaries of the grid, perhaps in Jordan. As the countries sought to reduce fossil-generated electricity, Palestinian renewables could contribute to total reduction in the collective carbon footprint. But none of the major transmission agencies are inclined to facilitate such arrangements and so constrained distribution and transmission ca-

322. Gershon Baskin, *Encountering Peace: Taking over the land*, JERUSALEM POST (Dec. 11, 2019), https://www.jpost.com/opinion/encountering-peace-taking-over-the-land-610654.

323. Hilmi S. Salem, *The Potential of Wind Energy in Palestine with Healthcare and Residential Examples in the West Bank and the Gaza Strip*, 13 J. OF NATURE SCI. AND SUSTAINABLE TECH. 73, 86 (2019).

324. Zafrir Rinat, *Golan wind turbine project may be shelved over objections of Israel Air Force*, HAARETZ (Jan. 14, 2018), https://www.haaretz.com/israel-news/.premium-golan-wind-turbine-project-may-be-shelved-over-air-force-objections-1.5730482.

325. Adel Juaidi et al., *An overview of renewable energy potential in Palestine*, 65 RENEWABLE AND SUSTAINABLE ENERGY REVIEWS 943, 944 (2016).

326. Nir Hasson, *Daily Power Outages Hit East Jerusalem Amid Increased Demand*, HAARETZ (Jan. 29, 2020), https://www.haaretz.com/middle-east-news/palestinians/.premium-daily-power-outages-hit-east-jerusalem-amid-increased-demand-1.8466766.

327. Miriam Deprez, *Planned blackouts hit the West Bank in response to rising debt*, MONDOWEISS (Dec. 2, 2019), https://mondoweiss.net/2019/12/planned-blackouts-hit-the-west-bank-in-response-to-rising-debt/.

328. Adel Juaidi et al., *supra* note 325, at 956.

pacity continues to impose limits on new renewable production.[329] Occasionally, there are exceptions to the rule. For example, with funding from the Arab Bank, the Palestinian Authority built a 7 MW solar installation near Jericho and pressured JDECO to accept a wheeling arrangement.[330] Beyond rooftop installations, however, there is little progress with significant solar capacity additions in the West Bank, with few major projects in the pipeline.

Other solutions might involve technological fixes, such as increased utilization of electricity storage technologies for "prosumers" and other "off-grid" producers. As described, energy storage prices are dropping precipitously.[331] There is a sense that it will not be long before it makes more economic sense to generate electricity with renewable sources and storage than to pay the ongoing economic and environment price of fossil fuel-powered electricity.[332] In the interim, however, the inclusion of lithium-ion electricity storage would substantially increase the price of a new Palestinian solar generation facility.

It would seem, therefore, that the simplest way for regional cooperation to expand renewable electricity production (and Palestinian energy autonomy) would be for Israel to adopt a more supportive policy for establishing renewable energy facilities in Area C, where it retains full control of development.[333] Palestinians surely possess the engineering capacity, capital, and requisite motivation.[334] Indeed, most Palestinian solar projects are projected as generating a handsome 10% annual return on investment.[335] There appears to be a willingness among several international AID agencies as well as the World Bank to provide the guarantees (such as a sovereign wealth fund or direct collateral to investors). These serve to mitigate concerns about investing in an inherently unstable environment.[336] But no renewable breakthrough can be expected without greater access to land.

VI. CONCLUSION

At first glance, Israeli, Jordanian and Palestinian energy dynamics have little in common. Israel's economy and electricity infrastructure are comparable to those of Europe, while Jordanian and Palestinian levels of electricity consump-

329. WORLD BANK, ECONOMIC MONITORING REPORT TO THE AD HOC LIAISON COMMITTEE (May 4, 2017), https://www.un.org/unispal/wp-content/uploads/2017/10/EMR_AHLC270417.pdf.

330. Palestine Inv. Fund, *The Palestine Investment Fund (PIF) and Arab Bank sign $20 million solar power financing agreement*, PV MAGAZINE (Apr. 9, 2018), https://www.pv-magazine.com/press-releases/the-palestine-investment-fund-pif-and-arab-bank-sign-20-million-solar-power-financing-agreement/.

331. Energy Storage Europe, *Energy Storage Europe: New storage technologies and multiple-use applications on the rise*, PV MAGAZINE (Jan. 21, 2020), https://www.pv-magazine.com/press-releases/energy-storage-europe-new-storage-technologies-and-multiple-use-applications-on-the-rise/.

332. Micah Ziegler et al., *Storage Requirements and Costs of Shaping Renewable Energy Toward Grid Decarbonization*, 3 JOULE 2134-53 (2019).

333. INT'L LABOR ORG., THE OCCUPIED PALESTINIAN TERRITORY, AN EMPLOYMENT DIAGNOSTIC STUDY (2019), https://www.un.org/unispal/wp-content/uploads/2018/04/ILOSTUDY_040418.pdf.

334. *Id*.

335. Dr. Ayman Rabi & Dr. Isam Ghanem, *Pre Master Plan Solar Energy Production in Palestine* 45 (2016).

336. Personal Interview with Gershon Baskin, *supra* note 114.

tion more closely resemble those in developing countries.[337] But they share the characteristics of being energy "islands" that remain largely dependent on fossil fuels which are not only more polluting, but today can be more expensive than renewable electricity.[338] A transition towards renewables could provide greater autonomy and security for all parties. Given the need to provide storage and backup, the most economically efficient and environmentally beneficial policies involve expanded cooperation. Coordinated energy infrastructures and policies are likely to produce meaningful geo-political gains and healthy interdependencies within the region.

Israel would surely benefit from increased Palestinian solar generation. At present, there is growing opposition across Israel to a new generation of privately-owned, natural gas-powered plants that the government has proposed.[339] Opponents to the new natural gas power plants cite their high carbon footprint relative to solar generation, potentially high methane leakage rates, and a range of adverse environmental impacts on local communities.[340] Increasing Palestinian electricity generation would enable Israel to reduce its electricity supply to the Palestinian Authority, possibly obviating the need for several new massive, fossil-fuel driven plants. Changing Israel's status from that of an "energy island" to a catalyzer of regional cooperation holds the potential to build political bridges and transmission capacity throughout the region.

On April 22, 2020, the Director General's Office in Israel's Ministry of Energy released a position paper entitled: "Accelerating Infrastructure Projects for the Energy and Water Systems to Encourage Economic Growth".[341] The five-page document suggests a 25 billion shekel influx (approximately $7 billion U.S.) of government investment.[342] The context for the proposal is set forth in the opening section:

> The day that we manage to meaningfully contain the [COVID-19] epidemic, is also the day we will need to respond quickly and sharply in treating the economic crisis taking place at present . . . with the end of the health crisis, like the rest of the countries in the world, we will need to act even more in initiating many, sizable projects, to the extent possible to resuscitate the economy . . . . The means for investing in energy related projects are diverse. We believe that this characteristic makes Energy Projects attractive for implementation at this time, by moving the wheels of the economy forward.[343]

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337. *Id*.

338. *Id*.

339. Sue Surkes, *112 top scientists call on government to abort plan for gas-fired power stations*, TIMES OF ISRAEL (Nov. 19, 2019), https://www.timesofisrael.com/leading-scientists-call-on-government-to-abort-plan-for-gas-fired-power-stations/.

340. Alon Tal, *Natural Gas is No Longer Green Enough*, TIMES OF ISRAEL (Sept. 13, 2019), https://blogs.timesofisrael.com/natural-gas-is-no-longer-green-enough/.

341. Director General, Israel Ministry of Energy, *Accelerating Infrastructure Projects in the Energy and Water Sector to Encourage Economic Growth* (May 3, 2020), https://www.gov.il/BlobFolder/news/economic_growth_news/he/economic_growth.pdf.

342. *Id*.

343. *Id*.; *See also* Lior Gutman, *The Ministry of Energy Formulate a Program to Accelerate the Economy at an Investment of 25 billion shekels*, KALKALIST, (Apr. 26, 2020), https://www.calcalist.co.il/local/articles/0,7340,L-3811050,00.html?ref=facebook.

The memo continues to list several categories of projects—from creating a natural gas pipeline to Eilat, to electric vehicle and compressed natural gas infrastructure for cleaner transportation, to smart city upgrades, and to increasing the capacity and the efficiency of the country's electricity grid.[344] But by far the single most significant proposed outlays involve direct investment in solar energy and wind energy projects, as well as a 3.5 billion shekel fund for interest-free loans to incentivize the development of renewable energy projects.[345] While the policy paper does not employ the exact language of "Green New Deal" rhetoric used in Europe[346] or by American Democratic Party leaders,[347] the fundamental orientation is indistinguishable.

It would seem that what is conspicuously lacking in the new energy strategy, however, is a regional dimension. In a country which ecologically is no larger than a postage stamp, Israel needs to broaden its vision. Creating regional initiatives not only allows for greater economies and expands the potential pool of investors dramatically, but reduces tensions across the region, which increases the benefit–cost ratio of any project. This is true even if it is impossible to precisely characterize the benefits of a given regional initiative.

With the recent, Corona-driven global economic decline affecting income and development around the world, economic pragmatism alone should drive decision makers to seek cooperative energy ventures that allow each player in the region to utilize their comparative advantage. Moreover, the international community expects to see significant reduction in the carbon footprint of all countries in the region. Unfortunately, until now, trends have run in the opposite direction. Although all of the region's countries signed the UN Framework Convention on Climate Change thirty years ago, none has made a serious effort to decarbonize their electricity generation. Since 1990, Israel's reported greenhouse gas emissions have risen by 78%; Jordan's greenhouse gas emissions have increased by 154%; and the Palestinian Authority by 515%.[348] As water resource production will continue to require expanded, energy-intensive desalination, these trends will grow worse unless there is a fundamental shift towards low-carbon sources of electricity.

One common denominator found in the three cases described above is that they all reflect the low priority afforded in all three countries to both regional cooperative projects and to a transition towards a low-carbon energy system. The climate crisis is a sufficiently acute emergency for humanity to push leaders in the region to begin working together to create energy systems that do not rely on fossil fuels and their resulting greenhouse gas emissions. As they reap meaning-

344. *Id*.

345. *Id*.

346. David Maya-Drysdale, Louise K. Jenson, Brian V. Mathiesen, *Energy Vision Strategies for the EU Green New Deal: A Case Study of European Cities*, 13 ENERGIES 2194 (2020).

347. Raj Patel & Jim Goodman, THE LONG NEW DEAL, 47:3 J. OF PEASANT STUDIES 431-463 (2020).

348. Greenhouse gas increase estimates averaged from a range of sources including the websites of the CIA World Factbook, https://www.cia.gov/library/publications/the-world-factbook/; World Bank (Eurostat) https://www.worldbank.org/en/programs/icp/brief/eurostat-oecd-ppp-program; United Nations Framework Convention for Climate Change, https://unfccc.int/; and Israel Central Bureau of Statistics, https://www.cbs.gov.il/.

ful economic and environmental benefits, the associated peace dividends would be incidental.