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Accelerating Cleantech Commercialization in Israel

Green Innovation as Catalyst for Sustainable Development

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About the Author

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About the program

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Against the backdrop of the Paris Agreement, the program invited policy professionals from Germany and Israel to explore issues relating to the transition to low-carbon economies, with the aim of fostering increased cooperation and exchange of ideas and knowledge between relevant stakeholders from academia, civil society and the governments of both countries. The opinions expressed in this policy brief are solely that of the author and do not necessarily reflect the views of any of the program partners.

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1. Executive Summary

In response to the large societal and economic impacts of the COVID-19 pandemic, some governments have showed interest in harnessing their national recovery programs to boost low-carbon economies at the same time.[1] Leading economists found that a post-crisis green stimulus could help drive economic recovery, whereby investments in clean infrastructure and clean R&D spending are among the key policy items needed.[2] Thus, accelerating the commercialization of clean technology and infrastructure is a promising strategy for Israel's recovery out of the crisis and to rebuild back better for the climate and sustainable development.[3] The recently published plans by the Ministry of Energy to accelerate infrastructure projects in the energy and water economy in order to encourage economic growth are an important first contribution to helping Israel through the crisis,[4] and growing the renewable energy sector must be prioritized over the natural gas industry. With the right policy responses, the COVID-19 pandemic can be a turning point for a more resilient and climate-neutral Israel.

A shift towards decarbonized energy systems, buildings, transportation, industries, land and financial systems requires deep structural changes: innovation in cleantech needs to be developed, proven technologies need to be deployed on a large scale, institutions and markets must be reformed to support the new system, and technological advances must be embedded into the fabric of societies. Addressing the innovation pipeline from R&D through to widespread diffusion could facilitate Israel's transition to carbon-neutrality by providing solutions to pressing sustainability challenges, ranging from clean, shared modes of transportation and climate-smart agriculture, to zero-carbon buildings and renewable energy supply. The potential benefits of green innovations are multifaceted and include new business and employment opportunities, enhanced

societal living conditions, reduced local air pollution, the easing of pressure on climate and local ecosystems, and improved energy, water and food security. Israel has yet to exhaust its potential for the commercialization and scaling up of cleantech to boost national and international actions on climate change and sustainable development.

While many cleantech innovations are already available, they often have a hard time reaching the market. Innovation gaps exist from conceptual ideas to solutions that are ready to be scaled.[5] Proven cleantech solutions that are ready to be brought to commercial scale frequently grapple with an inadequate capital supply and asymmetric information, which can cause market failure.[6] The problem is not the availability of cleantech innovations per se, but rather the narrow and slow diffusion throughout the economy and society that limits their impact in efforts to tackle global sustainability challenges.[7] While numerous technologies are invented in Israel, only few break through. In order to overcome this, more attention must be devoted to policy strategies and instruments leveraging the commercialization and scaling of affordable and reliable zero-emission technologies. This paper considers the Israeli commercialization challenge to deliver empirical insights into a problem that exists around the world: getting cleantech from the lab to the market.

In order to address this problem, 41 Israeli and international experts from start-ups, corporates, investment companies, consulting companies, civil society organizations and governmental bodies have been interviewed, and a workshop with about 50 Israeli stakeholders was held. Building on the findings of these consultations, four key areas for governmental action have been identified which can accelerate the commercialization and scaling of cleantech. The implementation of these policy measures has become even more important in the light of a recovery from the COVID-19 crisis in Israel:

Implement innovation support and regulatory instruments leveraging the transition

The implementation of a mix of innovation support instruments can ease the market introduction of cleantech, while driving investments and limiting the costs. For example, incentives for the adoption of market-ready cleantech can leverage cleantech commercialization and scaling by public and private companies and municipalities. The introduction of regulatory instruments could accelerate the phase-out of technologies and behaviors with negative environmental impacts.

Support the initiation of a cleantech growth fund and strengthen funding support for early stage cleantech

A "Cleantech Growth Fund" could provide funding with the aim of growing start-ups, specifically. It could be initiated by or with support of the government. The introduction of "impact" as a new, additional assessment criterion for governmental funding decisions could support early stage impact funding and, thus, close existing investment gaps. Beyond this, the government can reduce risks associated with pilot and first commercial cleantech projects by enhancing guarantees and serve as a match-making partner; for example, by insuring investments in largely unexploited markets in Africa and Asia through the governmental insurance company ASHRA.

Support strategic cleantech collaboration for market entrance

Expanding governmental support for strategic cleantech collaboration between diverse stakeholders could facilitate the market entrance of start-ups. Actions for collaboration include the promotion of cleantech-focused centers of excellence, cross-ministerial initiatives, public-private partnerships, corporate-start-up collaboration, collaboration between start-ups and medium size companies ('Mittelstand'), and binational cleantech collaborations. The expansion of old and the introduction of new governmental marketing programs could ease start-ups matching with customers.

The implementation of these policy measures has become even more important in the light of a recovery from the COVID-19 crisis in Israel.

Show global climate leadership and accelerate the problem-driven development and deployment of cleantech solutions

As Israel responds to the COVID-19 crisis, it needs to show strong climate leadership and work together with other governments toward a Global Green Deal. The relevance of cleantech innovation could be increased by embedding it within a broad vision for a climate-neutral Israel by around mid-century. An ambitious, holistic and integrated climate action plan would outline not only concrete emission pathways but also technological pathways requiring the problem-driven development of policy options, strategies and solutions. In this context, the government will need to consciously choose to invest in cleantech and abandon support for old polluting technologies. Strong governmental will and leadership could create strong momentum – the 'campfire' experts have been calling for – and make Israel a global front runner in cleantech innovations.

2. The Role of Green Innovation in Climate Action and Sustainable Development

This policy brief is being published at a time when the world is still suffering from the COVID-19 pandemic. In response to the huge societal and economic impacts of the pandemic, some governments want to harness their recovery programs to get out of the crisis and boost low-carbon economies at the same time.[9] Leading economists surveyed 231 finance ministry officials, central bank officials, and other economists, representing 53 countries including all G20 nations, and found that a post-crisis green stimulus can help drive an even better economic recovery.[10] Among the key policy items needed are investments in clean technologies and infrastructure, and clean R&D spending.[11] Thus, accelerating clean technology and infrastructure has become even more important in the light of the current COVID-19 pandemic.

The recently published plan by the Ministry of Energy to accelerate infrastructure projects in the energy and water economy in order to encourage economic growth is an important contribution to helping Israel through the crisis.[12] The energy and water sectors will play a central role in setting Israel on a pathway towards net-zero emissions: renewable energy will provide a climate-neutral energy supply and power energy-intensive desalinization plants. The renewable energy economy must therefore be prioritized and remaining barriers to renewables removed in order to avoid a lock-in to a fossil system. The short-term solutions adopted now must be in line with medium- and long-term climate and SDG objectives. According to recent research, three different policy horizons are important for navigating transitions towards carbon-neutrality in the crisis: (1) providing financial relief to the cleantech economy

most affected by the crisis in the short term (months); (2) stimulating a green economic recovery in the medium term (years); (3) and building resilient and sustainable energy and water systems (among others) in the long term (decades).[13]

With the right policy responses, **the COVID-19 pandemic could be a turning point on the way to carbon-neutrality**, and can speed up transformation processes toward more resilient systems.[14] The carbon emission reductions we have witnessed under the COVID-19 pandemic are what is needed each year over the next 20 to 30 years in order to achieve global net-zero emissions. This will require deep structural changes to our energy systems,[15] buildings, transportation, industries, land and financial systems. The window of feasibility is still open, but we must act now for a sustainable, zero-carbon future.

Technological and social innovations have been recognized as a major accelerator for efforts to deliver on climate and sustainable development goals.[16] The 2030 Agenda[17] for Sustainable Development and the Paris Climate Agreement[18] call for sustainable infrastructures and technologies as well as "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development".[19] Israel is committed to achieving the aims of both international agreements. In 2019, Israel published its first national review on the implementation of the SDGs;[20] Israeli SDG ambitions aim to "[harness] innovation to leave no one behind". Achieving this will require appropriate policy strategies and instruments to leverage innovations for climate action and sustainable development,[21] and to deliver Israel's Nationally Determined Contributions under the UNFCCC.[22]

Cleantech covers diverse technological innovation across sectors. Clean technologies – or 'cleantech' – are defined here as technologies

that eliminate greenhouse gas (GHG) emissions and environmental pollutants, improve environmental and social conditions, and facilitate the transition to a circular economy and energy systems, based on renewables. Examples of cleantech include solar and wind energy technologies, electric and shared vehicles, energy efficiency technologies, efficient water use technologies, circular and climate-neutral materials, and waste management solutions.

The opportunities of green innovations are multifaceted: Green innovations could create new business and employment opportunities, enhance societal living conditions, reduce local air pollution, relieve pressure on climate and local ecosystems, and improve energy, water and food security. In addition, innovation can provide co-benefits, including reducing water stress and heatwave impacts, and healthier air quality. Recent research suggests that clean energy yields an economic return three to eight times higher than the initial investment,[23] and bold action to foster low-carbon growth could deliver $26 trillion USD in economic benefits by 2030.[24] The economic benefits would come with strong co-benefits in terms of prosperity, health, security and the economy. [25]

Two thirds of cleantech and green innovationsremain in a niche market and do not achieve widespread diffusion.[26] Innovation gaps exist from conceptual ideas to ready to be scaled solutions:[27] Carbon neutral steel and cement and applications for climate-smart agriculture are environmental innovations currently in the niche phase, while renewable energy technologies, electric cars and zero-energy buildings remain in the diffusion phase.[28] The Exponential Roadmap report by scientific institutions, civil society organizations and the private sector, for example, highlighted 36 demonstrated, high impact solutions that are available to be scaled, and which could half global emissions by 2030.[29]

3. Objective and Contribution of this Policy Brief

This policy brief outlines concrete actions for policy to accelerate the commercialization of cleantech in Israel. Recognizing the recent efforts made by the Israeli Ministry of Environmental Protection and the Israel Innovation Authority to establish environmental technologies programs, including The Beta Sites project, further measures seem necessary in order to create a flourishing cleantech market. This policy brief is based on empirical research conducted with the aim of better understanding what is holding back cleantech commercialization, and what policy strategies and instruments could support diverse actors in the Israeli cleantech ecosystem in their efforts to diffuse and deploy cleantech innovations.

The policy recommendations outlined in this paper are based on a scientific literature review, 41 expert interviews with start-ups, corporates, investment companies, consulting companies, civil society organizations and governmental bodies in Israel, Germany and the US as well as further conversations and input from meetings, conferences and workshops. Key research findings were discussed at the workshop "Accelerating Cleantech Commercialization – Key Action for Impact" on 31 October 2019, which was led by Diana Süsser and organized by the Heinrich Böll Foundation Israel (HBS), the Israel Public Policy Institute (IPPI) and the Israel Innovation Authority (IIA). The workshop brought about 50 stakeholders from start-ups, corporates, investment firms, civil society organizations and the government together to discuss key challenges and solutions to accelerate the Israeli cleantech ecosystem. Given the context of the fellowship program, comparisons have been drawn between Germany and Israel and references to best-cases were made.

4. The Status Quo of the Israeli Ecosystem and Challenges for Cleantech Commercialization

4.1 The Israeli Innovation & Cleantech Ecosystem

Over the past three decades, Israel has emerged as an important global center of innovation.[30] It has often been claimed that Israel's entrepreneurial spirit is rooted in a history of overcoming obstacles and developing solutions to create a country.[31] Coming up with innovative ideas seems to lie in the Israeli mindset: Innovations grow fast in Israel and technologies are delivered and executed fast. Today, the country is home to myriad pioneering start-ups, and is the second largest innovation hub after Silicon Valley.

The Israeli innovation ecosystem ranks high on several indexes: Israel entered the top 10 of the Global Innovation Index for the first time,[32] and ranks number six in the 2017 Global CleanTech Innovation Index[33] (compare Table 1). Israel ranks highest in terms of gross domestic spending on R&D globally (4.5% of GDP),[34] large patent activity, high tech density, researchers concentration density, highly educated workforce, and capacity to produce and exploit innovative ideas,[35] cultural and social norms, and physical infrastructure.[36] Israel ranks low, however, in terms of governmental policies, cleantech commercialization, manufacturing value added, and tertiary education efficiency.[37] The start-up ecosystem is characterized by a large openness for new ideas, on the one hand, and a high acceptance of entrepreneurial failure, on the other. Table 1 summarizes some key characteristics of the Israeli innovation ecosystem in comparison to Germany – a country known for its cleantech commercialization strength.

The strategic integration of Israel's cleantech start-ups could contribute to the decarbonization of the economy. Israel has about 650 cleantech companies (authors' calculations based on Startup Nation Central data base) among the 6,500 start-ups listed under the Start-up Nation Central data base.[38] The largest number of Israeli cleantech companies fall under the categories Energy & Power and Environment & Resources, which also covers water technologies. Israel's efforts to overcome water challenges are viewed as a great example from which learning could be derived for other sectors. Israel's cleantech interest has shifted towards clean mobility, agriculture and food and circular materials in recent years, a development that is in line with a broad trend in global cleantech investments - moving away from the energy and power sectors to the aforementioned segments.[39] The decarbonization of entire economies will require that consideration be given to interactions between different sectors: climate-smart agriculture needs new water irrigation technologies; climate-neutral electric mobility needs renewable electricity; and climate-neutral buildings need circular materials and renewable energy.

Ecosystem	Israel	Germany
Population (official governmental data)	9.2 million	83.2 million
GDP growth (2017, annual % change) and per capita (2017; PPP, international $)[32/2]	3.3% | 36.4 thousand	2.5% | 50.8 thousand
R&D intensity* (OECD data)[34] (*R&D intensity is defined as R&D expenditures divided by GDP)	highest R&D intensity at 4.5%	3% yearly on R&D; accounts for 30% of all R&D expenditure in the European Union
2017 Global CleanTech Innovation Index: Ranking[33] Top countries (#1-#5 in order): Denmark, Finland, Sweden, Canada, USA	Rank #6	Rank #8
2017 Global CleanTech Innovation Index: Archetype[33]	Archetype 2: 'Cleantech start-up generator'	Archetype 3: 'Cleantech Commercialiser'
2017 Global CleanTech Innovation Index: Commercialised Cleantech Innovation[33] Top 3 Cleantech Commercialiser: Denmark, Singapore, Sweden	Rank #17	Rank #4
Bloomberg Innovation Index 2020: Ranking[35/1]	Rank #6	Rank #1
Bloomberg Innovation Index 2020: top three scoring categories[35/1]	R&D intensity; researcher concentration; high-tech density	high-tech density; patent activity; manufacturing-value added
2019 Global Innovation Index Ranking[32] Top 8: Switzerland, Sweden, USA, Netherlands, Great Britain, Finland, Denmark, Singapore	Rank #10 Israel enters the top 10 for the first time in 2019.	Rank #9
2018 Global Competitiveness Index 2018: Ranking[35/3]	Rank #20; best performer in Middle East	Rank #3
Global Competitiveness Report 2018[35/3] ranking of innovation ecosystem; global lead in business dynamism: USA; global lead in innovation capacity: Germany	Business dynamism: #5 Innovation capacity: #16	Business dynamism: #2 Innovation capacity: #1

Table 1. Comparison of the Israeli and German Innovation Ecosystems. Source: Own table based on data sources referenced.

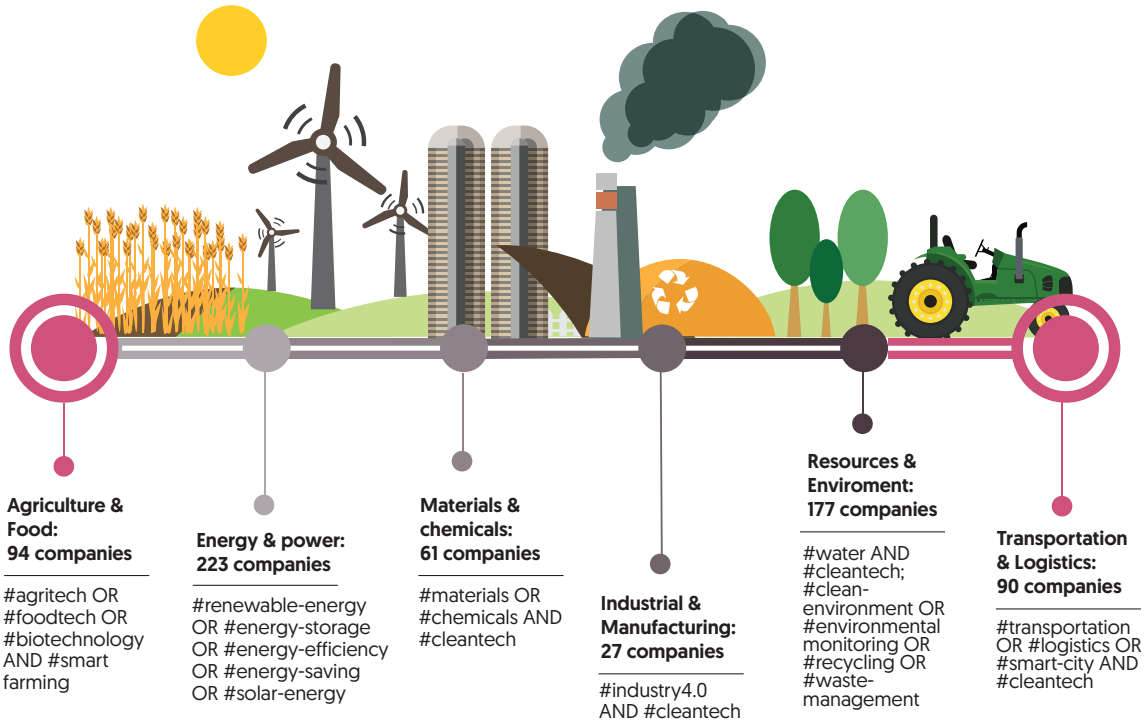

Figure 1: The Israeli Cleantech Ecosystem. Source: own figures and calculations based on keywords. Data base: calculations based on keywords search of the Start-Up Nation Central, October, 2019. Cleantech themes based on CleanTech Group.

4.2 Gaps and Challenges of Cleantech Commercialization and Scaling

One of the main challenges for Israeli start-ups lies in commercialization. This is not unique to Israel: There are many cleantech innovations out there around the globe, but they have a hard time reaching the market. Two thirds of cleantech and environmental innovations remain in a niche market and do not achieve widespread diffusion.[40] In particular, cleantech solutions that have been researched and proven and are ready to be brought to commercial scale often face an inadequate capital supply and asymmetric information, which can result in market failure.[41] But the successful commercialization of solutions is essential if we are to exploit cleantech's potential in tackling global sustainability challenges.

The specific challenge of cleantech commercialization might be grounded in cleantech characteristics. Cleantech differs in its nature from other technologies in terms of its protracted development, greater technological uncertainty, higher policy risks, lower return and/or longer return rates, higher investment volumes, context-specific implementation of global market potential, and so forth.[42] This seems to hold true specifically for so-called 'hardware'-focused cleantech companies, while software-focused cleantech enjoys the advantages of shorter development times and lower capital requirements common to software-focused companies in general.

Successful commercialization of solutions is essential if we are to exploit cleantech's potential in tackling global sustainability challenges.

Although cleantech commercialization is a global challenge, Israel might be falling behind other countries. According to the 2017 Cleantech Innovation Index, Israel ranks number 6 in the overall Index, but only places 17th in terms of cleantech commercialization. R&D alone does not lead to technological diffusion. The leading cleantech commercializers are Denmark, Singapore and Sweden. A strong commercialization is expressed by the countries' own implementation of cleantech, strong cleantech exports, the large number of public cleantech companies and the large number of renewable energy jobs. For example, Singapore efficiently supports the scaling up of cleantech innovation in its own country, despite its small market size.[43] Despite the fact that Israel recently expanded its support of pilot cleantech, it still focuses on exporting technological innovations to foreign markets, while falling behind in operationalizing technologies in Israel.

"Taking it to the market is always the real challenge", said the CEO of a water technology start-up. Based on the expert interviewees and recent research,[44] specific barriers and challenges for the development and commercialization of Israeli cleantech could

be identified (Figure 2). The barriers and challenges have been grouped into four categories: technology, market, finance and policy:

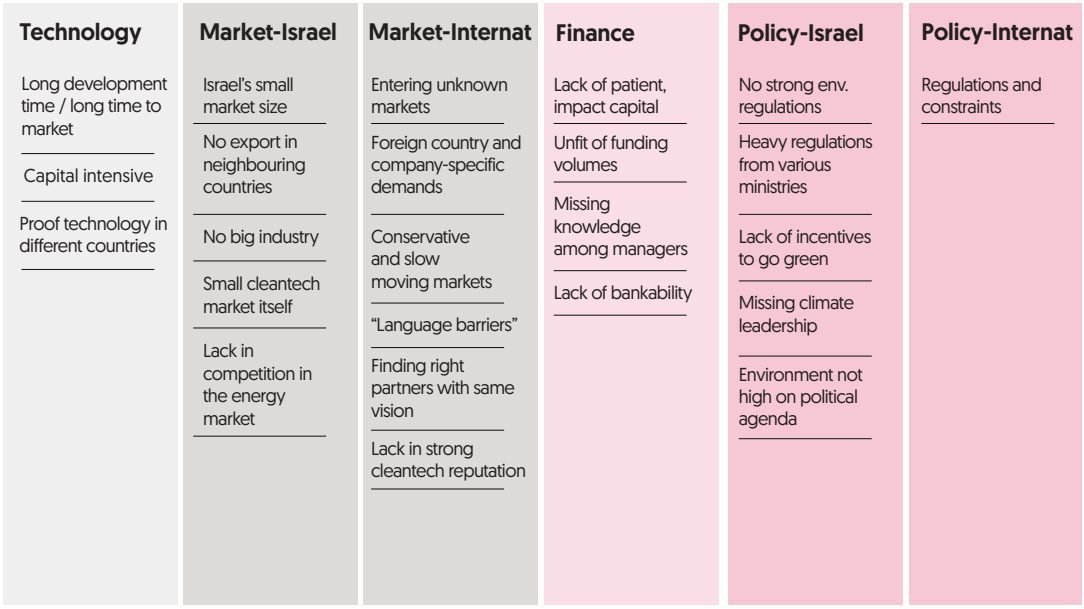

Figure 2: Challenges of Israeli cleantech commercialization. Source: Own figures based on empirical research.

5. Policy Actions to Drive Cleantech Commercialization

5.1 Incentives and Regulatory Instruments

The Israeli government should implement a mix of policy instruments to support the market introduction of cleantech. Environmental policies, such as market-based instruments and economic/fiscal incentives, regulatory measures and long-term strategic planning are highly relevant to efforts to drive innovation and improve the risk and return structure of cleantech projects.[45] The choice of instruments must be made with consideration of Israel's geographical and political contexts and existing narratives to support cleantech across sectors.

Incentives could increase the "appetite for innovations" and adoption of market-ready cleantech by public and private companies and municipalities.

The following concrete points of action have been identified:

- **Incentives could increase the "appetite for innovations" and adoption of market-ready cleantech by public and private companies and municipalities**: Experts consulted for this paper suggested that tax reductions could be provided to private companies that invest a specific percentage of their revenue in sustainable innovations or bonus/cash grants could be offered for innovation investments. For public companies, the government could define a specific percentage of a company's revenue that must flow into the adoption of pilot and first commercial projects. Previous programs with Israeli water utilities have been identified as positive examples and it has been suggested that these be re-established. Furthermore, incentives should be also applied to individual investors (business angels and family offices). One expert stated the need to expand the Angel Law, which provides individual investors with tax benefits for investments in R&D-intensive deep tech companies.

- **A price on carbon could make cleantech more competitive:** Currently, political debates around the world are heating up about pricing models for fossil-fuels such as certificates, charges and taxes. The Israeli government should discuss the potential and interactions of a carbon price with other innovation support market instruments. Lessons could be derived from countries which have implemented a carbon tax, such as Sweden, Switzerland, Denmark and the UK.

- **Environmental regulations could promote the phase-out of environmentally harmful technologies and behaviors and ease the market-entrance of cleantech:** Israel could orient its regulations on the EU, such as the Ecodesign Directive, which sets mandatory ecological requirements for energy-using and energy-related products. Environmental regulations could encourage companies to set emission reduction targets and implement cleantech, which could be done in the framework of initiatives such as Science-based Targets or RE100.

- **The adoption of public procurement criteria can boost the adoption of latest best-practice Israeli cleantech for new development plans**, e.g. in public buildings and spaces. Thus, the government, municipalities and the military could become the leaders and role models in adopting (Israeli) cleantech. In the view of the experts, available best-practice standards are not up to date and not site-specific enough to be applied.

- **Military entrepreneurship could be activated for R&D in cleantech:** With the support of appropriate

environmental regulations and incentives, Israeli military organizations could wield their extensive R&D capacities and lead the commercialization of cleantech.

5.2 Financial Support for Early Stage Companies

The Israeli government should expand its strategic funding and support of investments in innovations that are "consistent with a pathway towards low greenhouse gas emissions and climate-resilient development".[46] To leverage such investments, "risk, return and impact must go hand in hand" as one interviewed expert stated. The government should work together with other stakeholders of the innovation ecosystem towards a holistic and systemic investment approach, offering funding opportunities for cleantech from R&D to market diffusion. Consideration should also be given to the idea of funding entire technology value chains as a means of accelerating sectoral transformation.[47] The involvement of different actors is compatible with the greater diversity and resilience in the financial market and perhaps even instrumental to engineering the transition to zero-carbon economy.[48] The following points of actions have been identified:

- **The funding focus should shift towards growth funding:** Money seems to be especially missing for pilot projects and first full-scale sites. The governmental Beta Sites program has been assessed as a good measure, however, it lacks sufficient financial resources. For the later stage, Israel has no active investment bank or foundations to fund growing start-ups, unlike Germany for example. The governmnet could therefore play a major role in filling this gap and move spending from R&D to growth funding in order to accelerate commercialization and scaling up. In doing so,

Israel would follow the example of other countries like Sweden and Germany, which have expanded late-stage investments.

- **Israel should establish a 'Cleantech Growth Fund'**: A multi-investor growth fund could specifically support cleantech and/or SDG start-ups in the growth phase. The Israeli government could act as an initiator and funder, and provide the 'umbrella' for private sector investors (e.g. business angels, family offices, corporates and banks). Germany, for example, has started the initiative Tech Growth Fund to promote the expansion of financing. An important module of the initiative is the Venture Tech Growth Financing program by the SDG-committed KfW support bank, which provides venture-debt funding as a solution between venture capital and classical capital market. Moreover, experts in Germany also see a demand for an enhanced growth funding and the establishment of a targeted "Sustainability Growth Fund", which could provide the middle market (German term: Mittelstand) access to innovative technologies.

- **Impact should be introduced as additional assessment criterion for governmental R&D funding**: A strong mechanism for supporting cleantech could be the introduction of 'impact' as an assessment criterion for future governmental funding decisions. This mechanism would enhance R&D and later-stage funding of impact-driven solutions. The application process should provide start-ups the opportunity to express their potential impact through the lenses of the SDGs by stating contributions to goals and targets, and ways to measure their impact. This would allow for the specific

consideration of impact-driven start-ups. In doing so, the Israeli government would follow the example of the European Investment Bank, which recently launched an ambitious new climate strategy and energy lending policy. In addition, the government should support the development of guidelines for sustainability and impact assessment and the monitoring of start-ups to measure the impact of current and future innovations. Introducing this criterion would require a common understanding of how impact should be measured. As a co-benefit, the process of dialogue and development could help to close knowledge gaps in the investment management community with respect to sustainability and impact identified in this research. Germany for example, is working on the development of an impact assessment framework in collaboration with the Institute for Standardization.

- **Enhanced blended funding and governmental guarantees can reduce risks for investors**: A risk reduction program that includes match-making funding and guarantees should be considered. The suggestion has been made that the governmental risk insurance company ASHRA could insure innovation projects in less-stable developing countries as a means to support the market entrance of start-ups in unexplored markets in Africa and Asia.

- **A broad debate on sustainable finance should be initiated in Israel in order to increase awareness among investors and mobilize investment flows into sustainable technologies**: Israeli banks, insurance companies and pension funds should be encouraged to take a much

more active role in financing Israeli cleantech, driving the transition to a zero-carbon economy. Thus, the Israeli government should actively initiate a discussion about the need and importance of sustainable finance with the aim of building a sustainable finance strategy. The European Action Plan for Financing Sustainable Growth and the work of the European Commission's High-Level Expert Group (HLEG) on Sustainable Finance could serve as important points of reference.

5.3 Foster Collaborations for Market Entrance

Global challenges can only be solved if diverse stakeholders collaborate and build new partnerships. Israel has existing collaboration programs in the cleantech field. However, according to Israeli experts, "little cleantech makes [currently] its way from research to industry". The strengthening of existing and the establishment of new cleantech collaborations between academia, start-ups, industry and/or governmental bodies could support and enhance R&D and commercialization of cleantech. Marketing programs, such as roadshows and site visits organized by the Expert Institute, have been assessed as highly beneficial for strengthening marketing and international collaboration. These should accordingly be strengthened further and expanded in the context of the following different forms of collaboration:

The strengthening of existing and the establishment of new cleantech collaborations between academia, start-ups, industry and/or governmental bodies could support and enhance R&D and commercialization of cleantech.

- **The Israeli government should support the redesign of existing and the establishment of new, independent centers of excellence in order to deepen cleantech collaboration between academia and industry:** Recent research by the Milken Innovation Centre[49] identified a lack of demand for environmental technologies in the market

and a lack of cleantech-dedicated investment funds which both result in a prioritization of other technological fields in the technology-transfer offices. The Centre has called for existing programs to be adjusted and new supporting programs established in order to improve the technology transfer process for the environmental technologies[50]. Centers of excellence could improve the process from the laboratory to the industry and encourage open innovation and demand-driven collaboration to commercialize cleantech.[51] Especially the Scandinavian countries are leading in terms of cleantech clusters and could serve as role models.

- **Government ministries should cooperate to create joint cleantech initiatives:** Global challenges and their solutions extend beyond tech fields and ministries. As with the Fuel Choices and Smart Mobility Initiative, government ministries should join forces to create a competitive market for other cleantech fields and remove any hurdles presented to them by Israeli bureaucracy and policy. Doing so could help to simplify or reduce sectoral regulations applied by various ministries. In light of Israel's substantial renewable energy potential, a coupling of renewable energy generation and digital technology offers a promising field for joint ministerial efforts.

- **Public-private partnerships can connect start-ups and municipalities, and bring municipalities to the forefront of piloting and commercializing new innovations:** Israel views innovation largely in terms of the economic opportunity to export technologies. However, municipalities should be taking a lead role in the adoption of Israeli innovations, and bureaucratic barriers that hinder uptake should be lowered.

- **Specific programs could enhance the multi-directional benefits of corporate-startup and SME-startup partnerships:** Corporates can lend credibility to a company and its products before the market and investors. Their support can help start-ups along the pathway to commercialization by providing financial assistance and institutional knowledge, and can open doors to new customer, distribution, and geographic channels.[52] However, these potentials are often not exhausted and, thus, partnerships have less value for start-up development than would be expected.[53] The government could support strategic cooperation between corporates and start-ups, through programs such as the recently established governmental program The Environmental Innovation Lab project. These projects could also benefit collaborations between start-ups and medium-sized companies. In the view of the experts, there is a large potential in linking Israeli innovations with medium-sized companies in Germany, for example.

- **Israel should expand bilateral cleantech collaborations,** involving engineering and utility companies, certification bodies, research institutions, and ministries to enable R&D collaboration and accelerate the commercialization of new technologies. Bi-national programs should be expanded with an exclusive focus on specific cleantech, such as solar and water technologies, and with a strong focus on cleantech commercialization, including in largely untouched markets in Africa and Asia. The interviewed experts referred to BIRD, the Binational Industrial Research and Development Foundation, for energy and water technologies between Israel and the USA as a potential role model for collaboration with other countries.

5.4 Show Global Climate Leadership

Israel needs to respond to the COVID-19 crisis with strong climate leadership to deliver on climate targets and the sustainable development goals, and work together with other governments toward a Global Green Deal. Interviewed experts stated that they "[...] would love to see a government that is bold on its Paris/COP goals" and asked "where [is] the government that stops investing in fossil fuels?" These statements are a call for the government to choose to actively support and invest in cleantech and abandon support for old polluting technologies. The experts called for a 'campfire' similar to the Yosma program in order to bring attention to Israel's outstanding cleantech innovations. This 'campfire' could be created by using Israel's geographical and political context and narratives as a backdrop to define problems and address demands for solutions. Two key points of action have been identified:

- **The relevance of cleantech innovation could be increased by embedding it into an overall vision for a climate-neutral Israel:** An ambitious, holistic and integrated climate action plan would outline not only concrete emission pathways but also technological pathways demanding the problem-driven development of policy options, strategies and solutions. More than 20 countries are discussing or have agreed on a net zero 2050 target,[54] and a growing number of countries, such as the UK and France, have implemented climate laws to reach net zero by 2050 or earlier. Doing the same would allow Israel to fulfil and go beyond the committed National Contributions under the Paris Agreement.[55]

Israel needs to respond to the COVID-19 crisis with strong climate leadership to deliver on climate targets and the sustainable development goals, and work together with other governments toward a Global Green Deal.

- **Strong governmental leadership should be coupled with enhanced environmental education:** In comparison to other OECD countries, the Israeli population does not have a high awareness of environmental issues: In Israel, environmental quality ranks ninth among eleven key concerns.[56] Bolstering public understanding of the need to combat climate change, and the relevance and opportunities of cleantech could increase interest among inventors and investors alike. Many of the experts interviewed highlighted the importance of adopting a more problem-driven approach to the development of new innovations. Integrating environmental education and entrepreneurial thinking in the curricula of schools and universities could foster a new generation of climate and SDG innovators with the ability to contribute to a climate resilient Israel and a sustainable future.

6. Conclusion

This policy brief outlines concrete recommendations for political action to accelerate cleantech commercialization in Israel. The empirical findings of the expert consultation reveal the potential of different measures to overcome the identified cleantech challenges and drive commercialization. What is needed for cleantech innovations to unfold their potential is a holistic view of innovation, which encompasses the entire process from R&D through to widespread diffusion.

The Israeli government can help innovators to overcome the cleantech commercialization challenge through:

1. A Mix of Incentives and Regulation

A mix of innovation incentives and environmental regulatory policies (e.g. investment-driven tax reductions or cash grants) could accelerate market demand for cleantech even in more conservative industries and support national commercialization successes.

2. Expansion of Funding Opportunities

Expansion of impact and growth funding (e.g. by introducing a cleantech growth fund) can provide the capital needed along the innovation cycle and help start-ups to overcome the financial 'valley of death'. Moreover, associated technological and financial risks can be minimized via risk sharing measures, such as governmental guarantees.

3. Strategic Public-Private Partnerships

Public-private partnerships as well as business-to-business cleantech collaborations, along with good marketing, can ease the market entrance of start-ups and support customer acquisition. Strategic collaborations across ministries, in addition, can reduce the regulatory burden of ministries and increase the relevance for cleantech innovations.

With strong climate leadership, Israel can set course towards climate neutrality around mid-century, and create more buzz for the Israeli cleantech, which is needed to achieve this ambitious goal. An ambitious climate action plan, for example, could increase demand for the development and deployment of cleantech solutions.

The implementation of these political action fields is even more important in the light of the current COVID-19 pandemic. It is vital that the short-term solutions adopted now are in line with medium- and long-term climate and SDG objectives. Accelerating the commercialization of clean technology and infrastructure is a promising strategy for Israel's recovery from the COVID-19 crisis. Israel needs a green and just recovery package that triggers investments in clean infrastructure projects and clean R&D spending, among others. Israel's cleantech ecosystem can help to create new green jobs, reboot the economy, and support efforts to overcome the country's sustainability challenges. If Israel's government takes the required action, Israel could become a global R&D leader and trading hub for cleantech and other technologies, while benefiting from the opportunities of cleantech in terms of prosperity, health, security and the economy.

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