

Israel's State of Climate Tech 2021

Innovating towards
a better planet



Foreword

Dror Bin, CEO of Israel Innovation Authority & Uriel Klar, Director of PLANETech

Climate change has become a reality much faster than all predicted scenarios and is unequivocally recognized as an all-encompassing threat to the global economy and to humanity. Unprecedented and drastic actions are required to win the race against the impending climate crisis, a major component of which is the implementation of innovative climate technologies. Many of these technologies are still in their early stage of development, far from deployment, or even earlier - at the ideation stage. Business and government leaders who prioritize these actions will be leading the fight against the biggest challenge facing humanity and will, at the same time, gain financial and economic benefits. This report presents the state of Israeli climate tech, revealing a vivid ecosystem - a mix of well-established companies and promising young startups, combined with a growing presence of private investments and significant government support. Israel has the potential to become the leading hub for climate tech innovations. Forming global networks between Israel and the rest of the world is crucial to create opportunities for knowledge sharing, joint R&D, funding opportunities, partnerships and deployment at scale.

A collaborative ecosystem is the key ingredient in the success of Israeli innovation throughout the years. Working together towards a better planet is not a mere cliché but, rather, a key factor of success. This report, the result of collaboration between the Israel Innovation Authority – a deeply rooted government agency – and PLANETech, a non-profit innovation community, demonstrates the power of such an ecosystem.

The climate tech journey gives us an opportunity to tread new paths and create new value. To realize this potential, however, we must all continue to work together. “Israel’s State of Climate Tech 2021” is a powerful source of motivation for doing so.

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The State of Israel views innovation as a valuable resource and vital component in ensuring the continued economic prosperity of the Israeli economy. The Israel Innovation Authority is an independent statutory entity responsible for advancing innovation as leverage towards inclusive and sustainable economic growth in Israel. The Authority's mission is to strengthen Israel's technological leadership and culture of entrepreneurship, and to increase the economic value they generate for the Israeli economy. The Authority regards innovation as the most significant growth engine of the Israeli economy and strives to preserve and enhance Israel's position at the forefront of global innovation.

The Authority formulates policy to implement this mission via a range of financing and assistive tools. In addition, the Authority advises the government and Knesset committees on Israeli innovation policy, monitors and analyzes the changes in technological innovation in Israel and worldwide, and initiates collaborations with other official entities around the world to advance this ecosystem.

PLANETech is a nonprofit innovation community for climate change technologies - a joint venture of the Israel Innovation Institute and Consensus Business Group. PLANETech aims to lead the Israeli and global climate tech ecosystem in tackling climate change via a combination of approaches. This is done by modifying business focus and technologies towards climate change challenges, supporting the deployment and implementation of innovative climate technologies, and by building a global network for climate tech innovators while promoting Israel as a world center for climate change technologies.

The report was written by Dr. Tamar Moise and Uriel Klar of PLANETech and Ari Siegmann of the Israel Innovation Authority.

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Executive Summary

Technological innovations play a crucial role in the global challenge to mitigate and adapt to climate change. Israel is renowned as a global leader of technological innovation and this report sets out to examine, for the first time, Israel's state of climate tech and the potential of its "problem solving" entrepreneurs to provide solutions for the world's greatest challenge

Israeli companies developing technologies that contribute to decarbonization, mitigation, and adaptation were mapped according to the PLANETech Climate Challenge Map. 637 companies were identified as climate tech startup and growth companies, the majority of which are less than 7 years old. Three-quarters of the startups younger than 7 years have less than 10 employees, reflecting the long development period and late onset of growth for climate tech companies, most of which have hardware at the core of their innovation. The number of newly established climate tech related startups surged in 2014 and, since then, their share of all newly-founded Israeli startups has increased each year, reaching 9% in 2020. Challenge areas with the largest number of companies, are Climate Smart Agriculture, Clean Energy Systems, and Sustainable Mobility & Transport, and are comprised of both mature and startup companies. Domains that display the most rapid growth of startups in the last three years are Alternative Proteins and Green Construction while emerging domains showing a significant increase in the number of new startups are Transparent & Agile Supply Chains, Novel Materials, Circularity and Food Loss & Waste.

The climate tech startups have received investments from over 560 investment groups, of which two-thirds are headquartered abroad. Between 2018-2020, total investments in climate tech reached 2.97 billion USD. Less than 1% of investments were from dedicated late-stage funds. Although attracting a significant amount of capital and investment groups, the climate tech ecosystem suffers from lack of the necessary diversity in both type and focus of such investment groups. The Israeli government provides significant complementary support during the various stages of product development. This support totaled 280 million USD between 2018-2020.

Israel's global dominance in specific climate technologies was examined with the SparkBeyond© AI-powered platform. Israel was shown to hold absolute global leadership in the areas of cultivated meat, irrigation systems, and water desalination. When normalizing the results by GDP spending on R&D, Israel also holds a position of global leadership in the entire alternative proteins domain as well as in precision agriculture, sustainable mobility, and solar power.

However, a comparison between the success rate for Israeli Green Deal submissions with that for all Horizon

programs, indicates that Israel is far from realizing its global potential in Europe's largest climate funding program.

Despite demonstrating a growing ecosystem, Israel has yet to exhaust its potential for innovation, commercialization and scaling up of climate tech solutions.

A survey conducted among Israeli climate tech companies revealed that the main challenges to growth are access to capital, regulatory hurdles, and the difficulties of market scale up opportunities. The report concludes with several recommendations for overcoming these challenges and further facilitating the continued growth of climate tech companies in Israel. These include pathways to increase access to private and public capital, increasing commitment of government and regulators, engaging the varied stakeholders in the ecosystem, and showing leadership by adopting an overall vision for a carbon-neutral Israel. A strong governmental mindset and leadership are instrumental in creating strong momentum and transforming Israel into a global leader in climate tech innovation.

ISRAEL CLIMATE TECH ECOSYSTEM AT A GLANCE



600+
Startups &
Growing
Companies



500+
Investment
Groups
(Invested in Israeli
companies)



20+

Academic &
Research
Institutes



\$280M+

Government
R&D Investments
2018-20



01

Introduction

Climate Change – Averting Climate Catastrophe

Climate change represents an urgent and potentially irreversible threat to humanity and to the planet. The Sixth IPCC Report demonstrates the unequivocal role of human influence in the warming of the atmosphere, ocean, and land, leading to changes in the climate system as a whole, as well as frequency and intensity of extreme weather events (Figure 1).

Bold, rapid, and sustained reductions in CO₂, methane, and other greenhouse gases (GHGs) are necessary to limit global warming.¹ The main aim of the 2015 Paris Agreement, ratified by 191 countries,

is to reduce global greenhouse gas emissions such that the rise in mean global temperature will be limited to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels. This entails a reduction of about 50% from the 2019 emission level of 52.4 Gt CO₂e by 2030 and attaining net zero emissions by 2050.

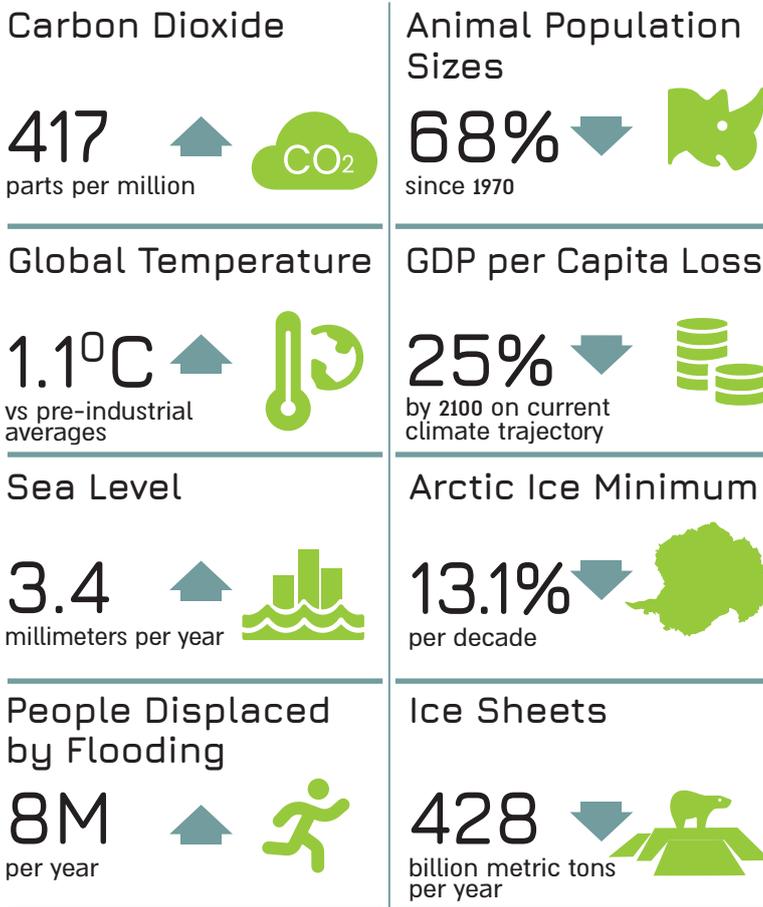
To date, emission trends and pledged national commitments fall well short of the Paris Agreement goals (Figure 3). The emissions gap is large (20-23 Gt CO₂e), and the projected temperature increase in line with current policies is 2.7-3.1°C.

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Broad deployment of existing technologies as well as scaleup and adoption of early-stage technologies have the potential to reduce global emissions by about two-thirds

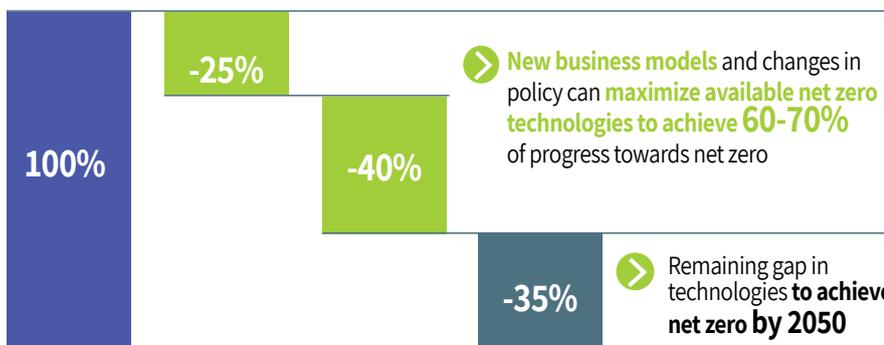
1 IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. Currently in Press.

FIGURE 1 | State of the Planet



Sources: NASA, Carbon Brief, WWF, Royal Society, IPCC; Pew Charitable Trusts

Figure 2 | Technology Gap in Net Zero Emissions



Current CO₂ emissions Mature technologies Technologies in early adoption Remaining net zero gap

Source: Boston Consulting Group²

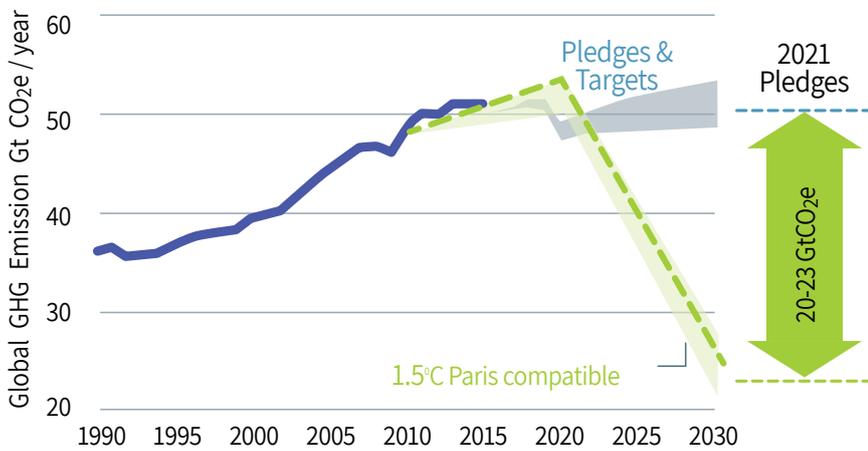
2 <https://media-publications.bcg.com/BCG-Executive-Perspectives-Time-for-Climate-Action.pdf>

Potential of Technologies Towards Climate Mitigation and Adaptation

The development and transfer of technologies has been recognized as an essential core enabling element if we are to meet current pledges, minimize the emission gap, and ensure that the balance of CO₂e added to the atmosphere is net zero. Broad deployment of existing technologies as well as scaleup and adoption of early-stage technologies have the potential to reduce global emissions by about two-thirds (P4 pathway defined by the IPCC, Figure 2). The remaining gap in reducing emissions must be bridged by finding new solutions. Both pathways require measures to address social and institutional barriers to widespread adoption, such as policy changes, new business models, and financial incentives that will enable climate technologies to be implemented feasibly and cost-effectively on a large scale.

Climate technologies address two pathways: (1) Mitigation – reducing the sources of emissions from different sectors such as energy, industry, buildings, transport, food and land-use, alongside enhancing carbon sinks that remove carbon from the atmosphere, and (2) Adaptation - increasing resilience to climate risks and extremes in order to minimize the already apparent adverse impact of climate change that will only be exacerbated in the future.

FIGURE 3 | The Emission Gap Between Pledged and Required GHG Emission Reductions to Reach the 1.5°C Paris Target



Adapted from Climate Action Tracker³

Climate Technology Drivers

The urgency of the climate situation provides lucrative business opportunities for climate technology innovations. Prominent drivers incentivizing climate innovation are:

- The rapid acceleration in net zero commitments from governments, cities, business, and the financial sector.
- Government policy interventions together with the beginnings of legislative measures to mitigate climate change.
- Corporates and investors aligning their business disclosures to requirements of ESG reporting and climate risk disclosures such as TFCD and assessing their transition risk should their long-term strategy and activities not be aligned with climate actions.
- The economic and social costs of climate change impacts alongside the economic opportunities of climate change innovations.

Global Investments in Climate Tech

Investors are increasingly aligning their investment agendas with the mentioned drivers. In the first half of 2021, investments in climate technologies surpassed 14 billion USD (Figure 4).⁴ Annualized, that would easily set a record.

Investments in climate tech increased by 3750% between 2013-2019, and the absolute number and creation rate of climate tech startups as well as the average amount invested per round also increased over the same period.⁵

As capital continues to be raised at an unprecedented pace, many multi-billion dedicated climate funds have been established. **In July 2021 alone, 18.5 billion USD were raised for 4 such funds.**⁶ It is estimated that investments of 3-5 trillion USD a year are needed over the next 30 years (100-150 trillion USD in total) to reach net zero globally.⁷

These larger entities can play an important role in overcoming some of the common barriers to the adoption and diffusion of disruptive climate technologies, such as (a) long-term “patient” investments; (b) the need for large capital investments; and (c) the lack of a supportive value chain and infrastructure.

3 <https://climateactiontracker.org/global/cat-emissions-gaps/>

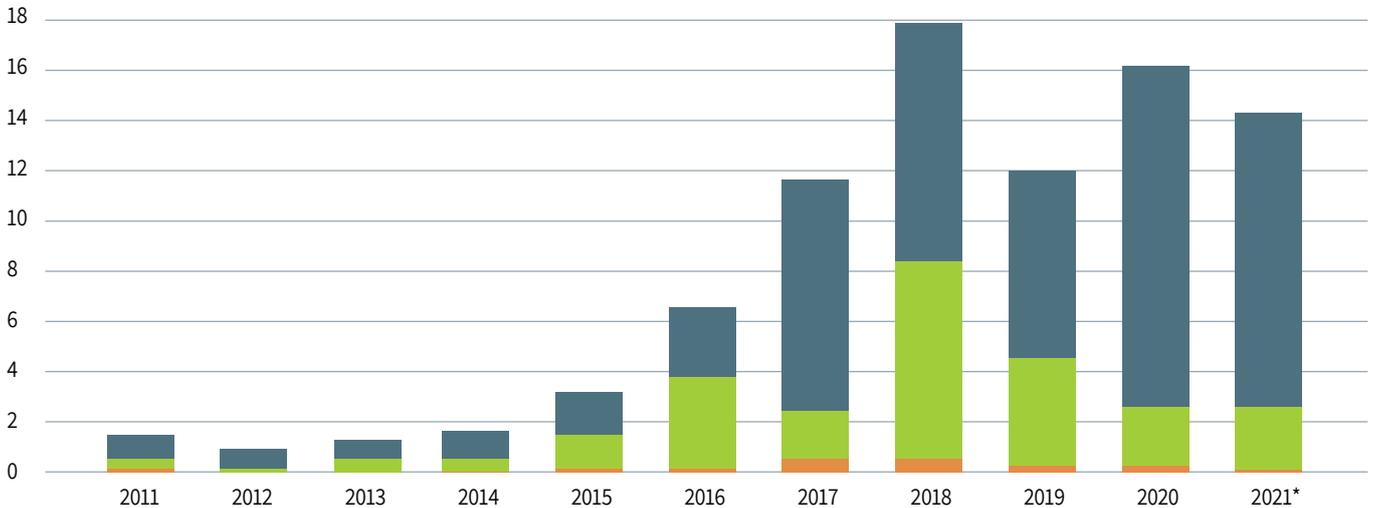
4 <https://pitchbook.com/news/articles/climate-tech-startups-and-investors-fundraising>

5 PwC, 2020, The State of Climate Tech 2020: The next frontier for venture capital, <https://www.pwc.com/gx/en/services/sustainability/publications/state-of-climate-tech-2020.html>

6 General Atlantic, Generate Capital and the asset managers TPG and Brookfield with raised funds of 4 billion, 2 billion, 5.4 billion and 7 billion USD respectively

7 BCG perspectives, The Time for Climate Action is Now, April 2021, <https://media-publications.bcg.com/BCG-Executive-Perspectives-Time-for-Climate-Action.pdf>

FIGURE 4 | Global VC Deals in Climate Tech (USD Billions)



Source: Pitchbook⁸

Angel/Seed

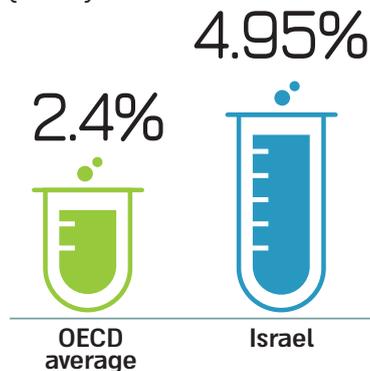
Early VC

Later VC

*As of June 25, 2021

FIGURE 5 | Israel Innovation Rankings

Investment in R&D as a Percentage of GDP Compared to the OECD (2018)



Bloomberg Innovation Index



7th Place

Global Startup Index



6th Place



Israel has long been valued for its thriving innovation ecosystem and highly ranked entrepreneurial capabilities

Source: The Annual Bloomberg Innovation Index, 2020, Startup Genome Report 2020.

Israeli Technology – A Thriving Innovation Ecosystem

Israel has long been valued for its thriving innovation ecosystem and highly ranked entrepreneurial capabilities (Figure 5). Among the factors contributing to Israel's position as a global-tech powerhouse are

the country's success-driven startup and growing companies combined with its groundbreaking academic research, the knowledge and expertise of R&D centers, and the umbrella of a supporting government.

As a result, Israeli technology has historically been a key player in fighting a variety of global challenges. For example,

Israeli cybersecurity companies are at the forefront of companies fighting cyber-terrorism: 41% of global cyber funding is invested in Israeli companies and one of every three cyber unicorns in the world is Israeli.⁹

Could Israeli innovation also be a key player in fighting the global climate crisis?

⁸ <https://pitchbook.com/news/articles/climate-tech-startups-and-investors-fundraising>

⁹ Israel National Cyber Directorate Report 2021



Methodology

This report assesses the current and future potential of Israeli innovation to play a central role in tackling the global climate change challenge.

By undertaking the first mapping of Israeli companies developing technologies aimed at climate change mitigation and adaptation, the report reveals the current strengths of Israeli climate technology innovations.

An AI-driven analysis of global climate innovations identifies Israel's competitive advantage in comparison to other climate innovation ecosystems around the world. The report also evaluates the private capital and government investments in Israeli climate tech companies.

Mapping of Israel's Climate Innovation Arena

Climate tech companies are mapped according to the relevant climate challenges addressed by their innovation. The report begins by describing the PLANETech Climate Challenge Map, the approach employed for compiling the climate companies, and the mapping procedure.



Climate tech companies are mapped according to the relevant climate challenges addressed by their innovation

FIGURE 6 | PLANETech Climate Challenge Map

<p>Built Environment</p> <p>></p> <p>Where we live</p>	 <p>Clean Energy Systems</p> <ul style="list-style-type: none"> • Production • Transmission & Distribution • Storage 	 <p>Sustainable Mobility & Transport</p> <ul style="list-style-type: none"> • Electrification • Alternative Fuels • Fuel Efficiency • Routing & Modality 	 <p>Low Carbon Buildings</p> <ul style="list-style-type: none"> • Operational Emissions • Optimization • Reduced Demand 	 <p>Green Construction</p> <ul style="list-style-type: none"> • Low Carbon Elements • Reduced Material Resources • Infrastructure Resilience 	 <p>Eco-Efficient Water Infrastructure</p> <ul style="list-style-type: none"> • Water Demand • Energy Efficiency • Wastewater Treatment • Resilience
<p>Materials & Manufacturing</p> <p>></p> <p>Things we make</p>	 <p>Novel Materials</p> <ul style="list-style-type: none"> • Biomaterials • Biodegradable Materials • Low Emission & Technology Enablers • Refrigerants 	 <p>Clean Manufacturing</p> <ul style="list-style-type: none"> • Process Innovation • Resource Efficiency • Resource Recovery 	 <p>Circularity</p> <ul style="list-style-type: none"> • Design • Waste • Resource Transparency 	 <p>Transparent & Agile Supply Chains</p> <ul style="list-style-type: none"> • Traceability • Value Chain Optimization • Distribution 	 <p>Carbon Capture & Utilization</p> <ul style="list-style-type: none"> • Capture • Transformation
<p>Land Use</p> <p>></p> <p>How we impact our land</p>	 <p>Climate Smart Agriculture</p> <ul style="list-style-type: none"> • Land Footprint • Reduce Inputs • Resilience • Livestock & Aquaculture 	 <p>Soil Health</p> <ul style="list-style-type: none"> • Erosion • Soil Fertility • Regenerative Practices 	 <p>Alternative Proteins</p> <ul style="list-style-type: none"> • Process • Sensory and Physical Attributes • Nutritional Profile 	 <p>Food Loss & Waste</p> <ul style="list-style-type: none"> • Spoilage • Waste • Value Chain 	 <p>Metal & Mineral Mining</p> <ul style="list-style-type: none"> • Exploration • Extraction • Closure
<p>Nature</p> <p>></p> <p>What we need to revive</p>	 <p>Forests & Land Ecosystems</p> <ul style="list-style-type: none"> • Preservation • Restoration • Sustainable Forestry 	 <p>Oceans & Water Ecosystems</p> <ul style="list-style-type: none"> • Carbon Sequestration • Ocean Conservation • Sustainable Blue Economy 	 <p>Extreme Weather Events</p> <ul style="list-style-type: none"> • Monitoring & Prediction • Disaster Management • Infrastructure & Community Resilience • Wildfires 	 <p>Biodiversity</p> <ul style="list-style-type: none"> • Habitat & Species Monitoring • Habitat & Species Conservation 	 <p>Earth Observations</p> <ul style="list-style-type: none"> • Natural Systems • Wildlife Observations • Carbon & GHG Monitoring

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The PLANETech Climate Challenge Map Presents the main challenges to successful climate change mitigation and adaptation





PLANETech Climate Challenge Map

The PLANETech Climate Challenge Map presents the main challenges to successful climate change mitigation and adaptation, across all activities of our daily life and natural ecosystems. The climate challenges are associated with four main areas: The Built Environment, Materials & Manufacturing, Land Use, and Nature, each of which contain 5 explicit challenges – 20 challenges in total (Fig. 6). This entails a broad and all-encompassing approach rather than focusing on specific economic sectors and services. When focusing on challenges, solutions can be facilitated by innovations from varied technologies that target the areas listed below each challenge. The challenges target the reduction of emission sources, enhancement of carbon sinks, as well as community, nature, and infrastructure resilience.

Climate Tech Companies

A list of Israeli companies identified as active in the climate arena, either having direct climatic impact or developing and implementing technologies that can positively contribute to tackling climate challenges, was compiled from the following databases: CBInsights, HORIZON 2020, Crunchbase, SNC, IVC and the Innovation Authority

database as well as companies listed with the BIRD Foundation, PLANETech, Ecomotion, and the Israeli Smart Energy Association. Details on the founding year of the company and the number of employees were included in the compiled database.

A glossary was compiled, detailing each of the PLANETech Climate Challenges.¹⁰ Each company selected as a climate company was thoroughly examined and classified according to its compatibility to the 20 challenges of the Map. These were designated by relating to the sector attribution of the innovation, the technology it is based on, the innovation's functionality, how and where it is applied, and how (in the case of material products) it is generated. A company's innovation, be it a product, service, or platform, can be associated with multiple challenges. Companies were classified with 1 to 4 climate challenges.

Capital Investments

Capital investments in Israeli climate technology companies were mapped using the Crunchbase and IVC databases. Investor identity and amounts were extracted for each one of the company's completed financing rounds. Investor characteristics, such as headquarters country and investor type (i.e., VC, Angel etc.) were also categorized, and a comprehensive unique investors list was compiled.

¹⁰ <https://www.planetech.org/challenge-areas>



03

Israel's Climate Tech Ecosystem

The mapping procedure, described above, revealed nearly 1,200 Israeli companies that provide solutions to climate challenges. A distinction was made between 637 startup & growth companies and other types of companies. The former category included all the companies founded after the year 2000 and which have raised investments, as well as young companies – founded less than 5 years ago – that are yet to raise funding. We presume that there are many more young startups under the radar which

are not represented in the databases. The discussions below will clearly state whether the analysis relates to all climate companies or to this latter group of startup and growth stage companies (henceforth referred to as “startups”).

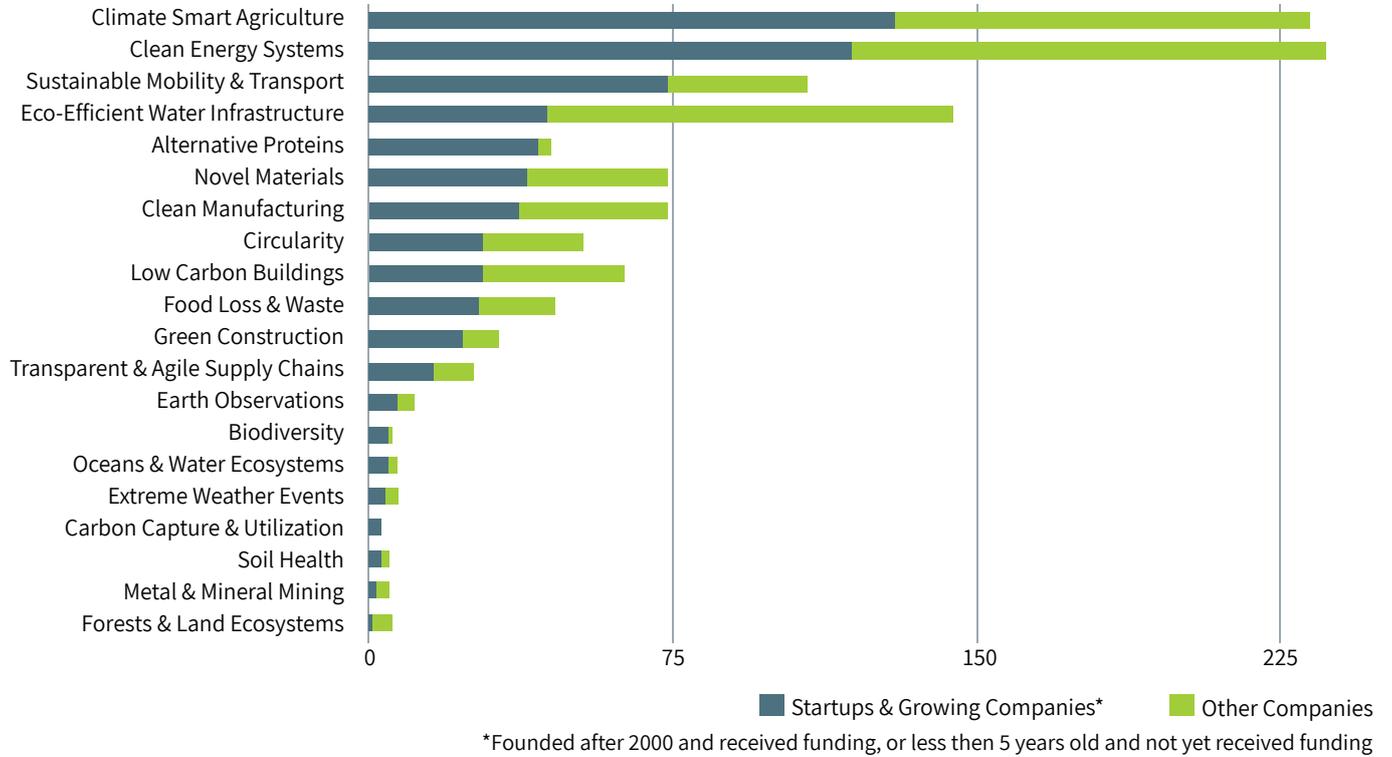
The distribution of the companies between the different climate challenges is depicted in Figure 7, according to a company's **main challenge**. The challenges are presented in descending order, according to

the number of startup that address any given challenge. The three most prolific challenges are Climate Smart Agriculture, Clean Energy Systems, and Sustainable Mobility & Transport, with 130, 119 and 74 startups respectively. The Israeli climate ecosystem is characterized by a mix of veteran, well-established fields with a majority share of mature companies, for example Eco-Efficient Water Infrastructure, and young and growing fields such as Alternative Proteins, which predominantly consist of startups.



The three most prolific challenges are Climate Smart Agriculture, Clean Energy Systems, and Sustainable Mobility & Transport

FIGURE 7 | Israeli Climate Companies

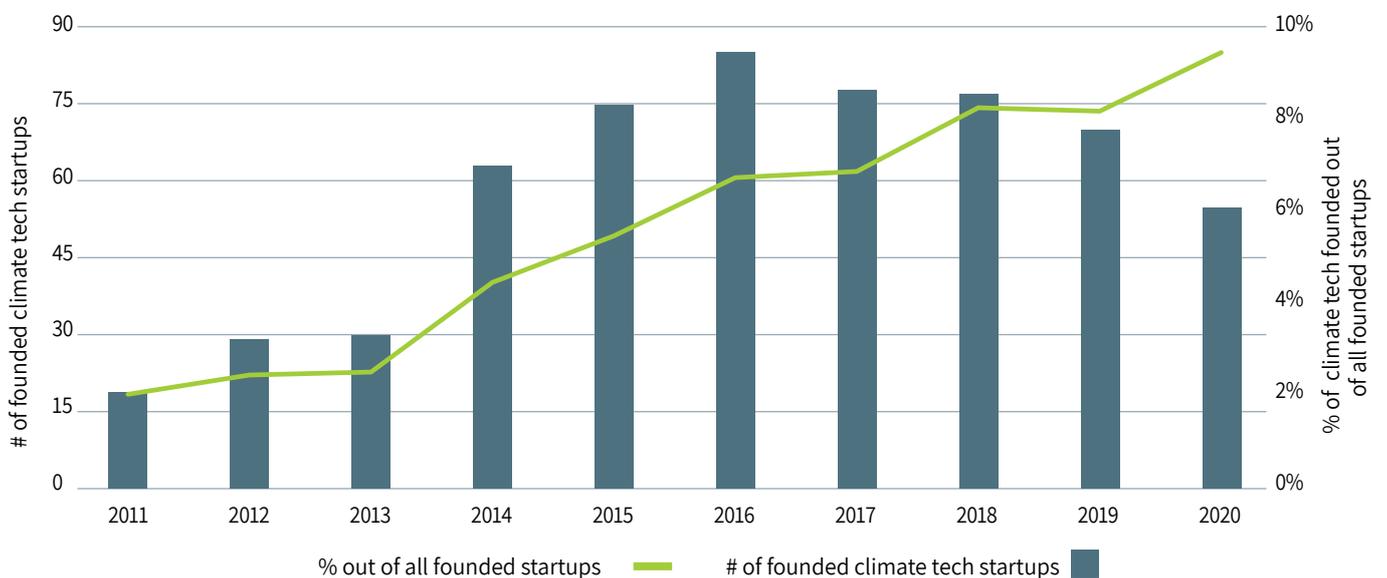


The local ecosystem witnessed a surge of newly established climate tech companies back in 2014, and since then, a relatively constant number of startups have been established each

year. **Climate tech startups occupy a growing proportion of all newly founded Israeli startups across all sectors each year** (Figure 8). This trend is striking considering the general

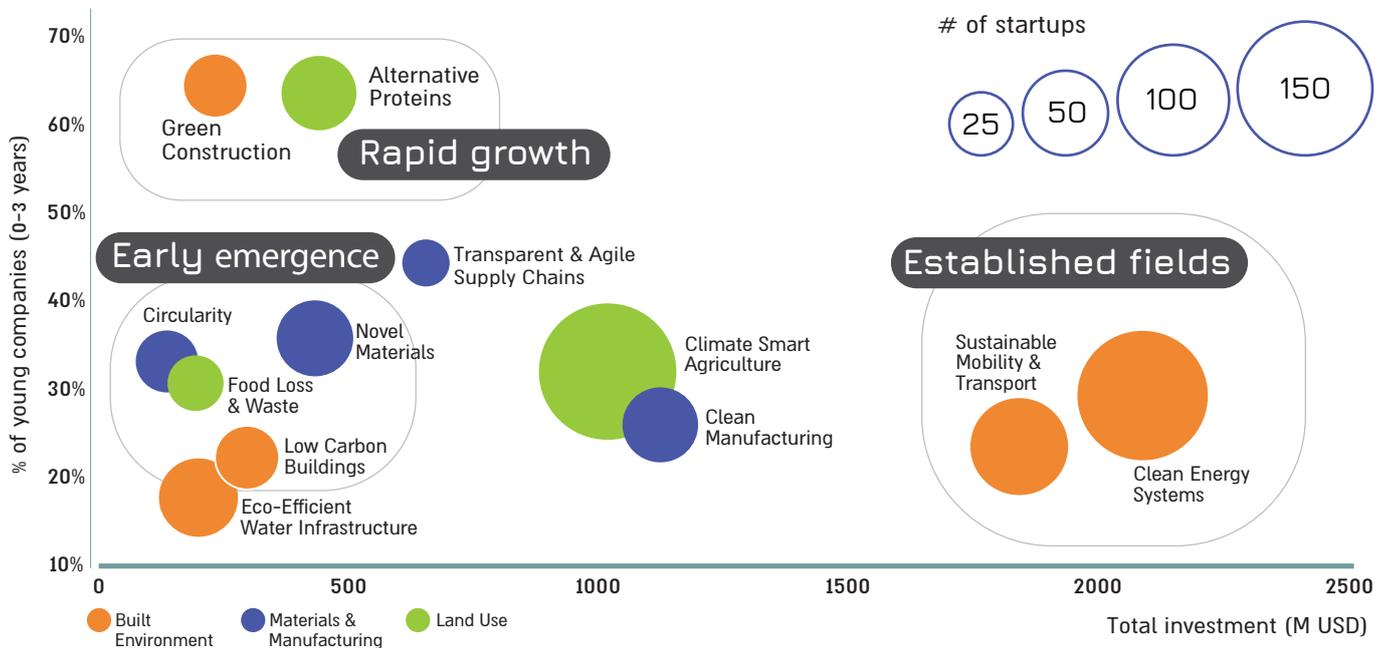
decrease of newly established startups in the Israeli ecosystem, especially during the COVID-19 crisis.

FIGURE 8 | Climate Tech Startups Founded by Year



Israel's Climate Tech Ecosystem

FIGURE 9 | Growth Map of Climate Tech Domains



Israel is renowned as a leader in Alternative Proteins, and the emergence of startup in Green Construction, where materials choices and site management can reduce resources use and waste, has high potential for meaningful decarbonization

An analysis of the growth rate of startup companies for any given challenge is shown in Figure 9. The graph depicts the percentage increase in the number of startup companies over the last 3 years (2018-2020), and the total number of startups and total known investments¹¹ per challenge area.

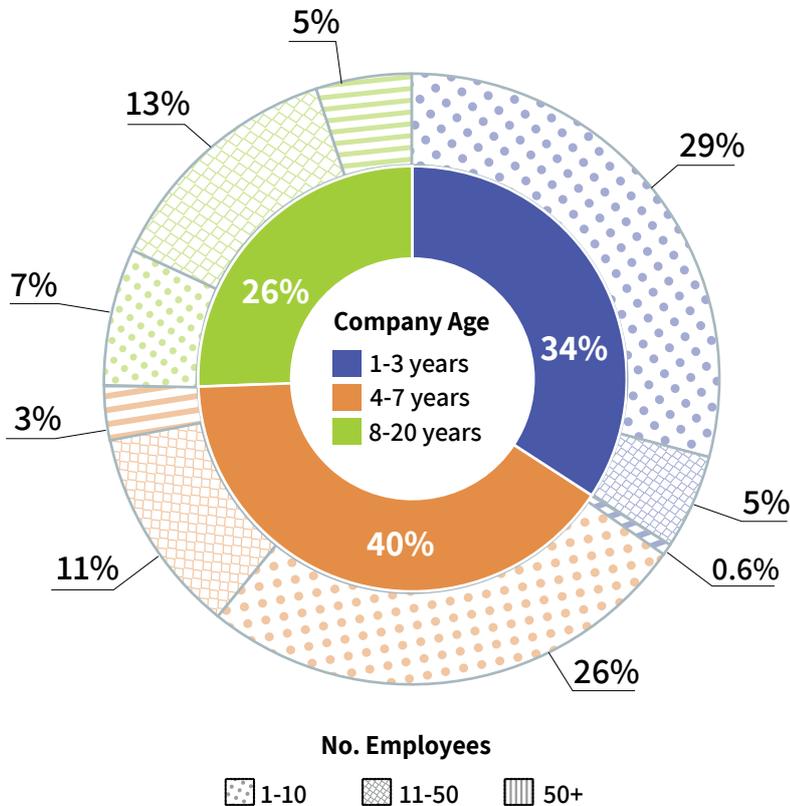
The challenges are grouped into a number of clusters with similar characteristics. Cluster 1 consists of the **established fields** of Sustainable Mobility & Transport and Clean Energy Systems that have received the largest total funding sums over time. The relative growth of startups over the last 3 years in this cluster is moderate (between 20-30%) and is based on well-established and mature companies in these domains (see Figure 7). Cluster 2 – **rapid**

growth – includes challenges that have grown in terms of the number of companies, and that are expected to raise increased capital in the coming years. Israel is renowned as a leader in Alternative Proteins (as described later in the report), and the emergence of startups in Green Construction, where material choices and site management can reduce resource use and waste, has high potential for meaningful decarbonization. Cluster 3 – **early emergence** – includes a group of challenges, each with 30-40 startups and a growth of 30%-40%. These challenges are highly interrelated i.e., novel materials can support circularity, and circularity and consumption patterns can support

reduction in food loss and waste. These are domains with emerging innovations, and reflect the increased global interest in and commitments to advancing decarbonization via innovations in these areas. Outside these clusters, Climate Smart Agriculture (CSA) comprises a large number of companies, and a consistent and high creation rate of new startups. Clean Manufacturing plots in proximity to CSA, and encompasses an array of platforms, both software and hardware, for improvements and optimization of industrial production processes that minimize energy and resource use and reduce waste. The relatively high investments in this challenge domain result from large

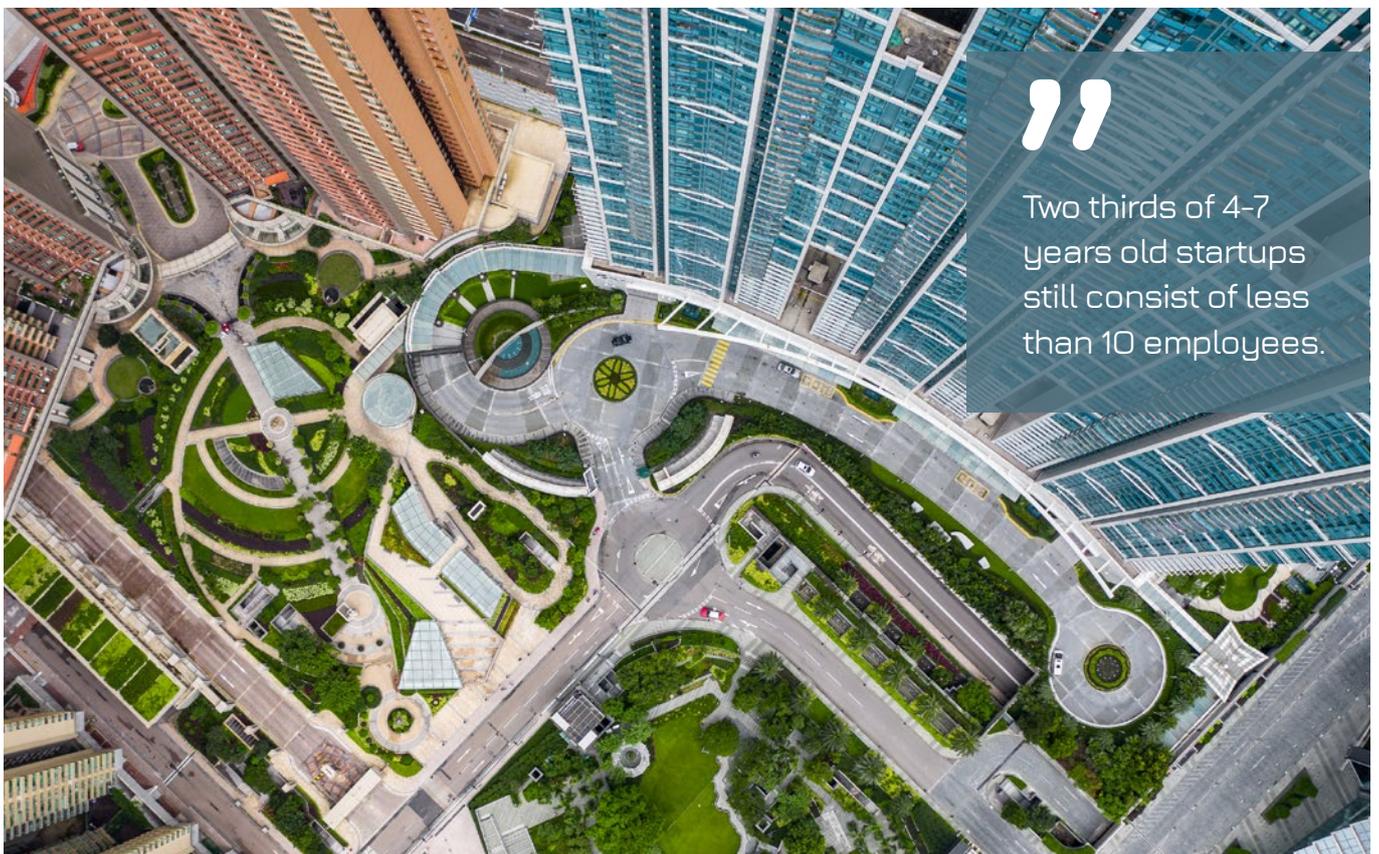
¹¹ See the “Capital Investments” section for information on limitations of investment data.

FIGURE 10 | Climate Tech Startups by Age and Size



investments in a few companies. Startups addressing the supply chain showed a marked growth of 44%. Supply chain traceability is a crucial component of decarbonization and enables energy efficiency, waste minimization, and visibility with regard to emissions and climate risk along the value chain and is another domain worthy of attention.

While the Israeli climate tech domains are at different stages of growth, the majority of the startups (74%) are **less than 7 years old** and are evenly distributed between subgroups of 1-3 years and 4-7 years old (Figure 10). As most companies (62%) are small in size, having less than 10 employees, it is interesting to note that two-thirds of 4-7 years old startups still consist of less than 10 employees. This emphasizes the uniqueness of the ecosystem and, perhaps, its main challenges – a long development period, high risk, and late onset of growth.





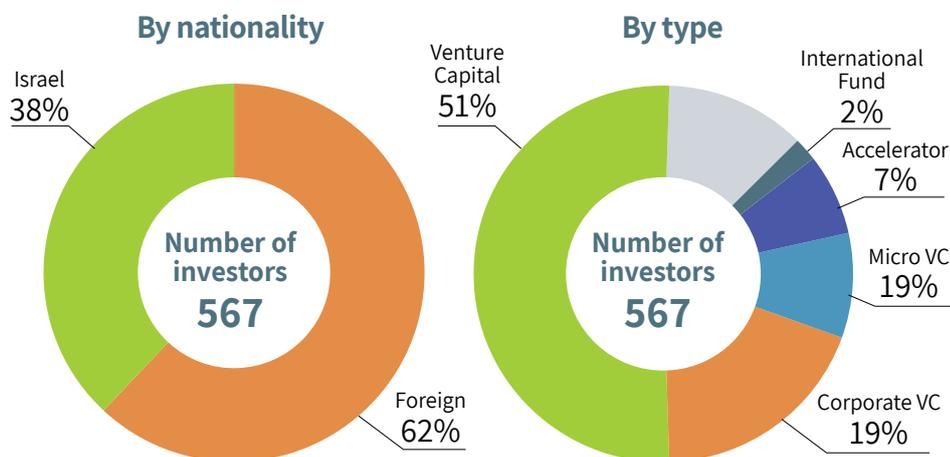
Capital Investments

As described above, the climate tech domain encompasses a broad variety of solutions which directly or indirectly address global climate challenges, that are based on varied technological platforms, and which are associated with many industry sectors. The resultant added complexity in attributing capital investments to climate tech from available data sources enables only partial retrieval of information. As such, private capital data provided in this section is preliminary and should be taken with caution.

Climate Tech Investments

- Investments in climate ventures **totaled 2.97 billion USD** during 2018-2020, demonstrating a compound annual growth of 14%. Initial data suggests that the total capital invested in climate tech startups during the first half of 2021 was nearly 40% more than the total amount invested during the previous 3 years.

FIGURE 11 | Climate Tech Investors



Source: Data retrieved from Climate DB, IVC and Crunchbase
Analysis based on 307 companies with investment data and excludes private investors

- The two climate challenges which attracted the most funding over these years were **Clean Energy Systems and Sustainable Mobility & Transport**. Alternative Proteins displayed promising growth in raising capital.
- 2020 saw a surge in Initial Public Offerings (IPOs) conducted by climate tech startups on the Tel Aviv Stock Exchange. Five startups, primarily from the **energy sector**, conducted a public offering (25% of total IPOs in 2020), while 11 have already filed IPOs during the first 3 quarters of 2021.

FIGURE 12 | Government Support for Climate Tech Industry in 2018-20

Climate Tech Investors

- Israeli climate tech attracted almost 570 investment groups and a significant number of additional private investors (not included in the following analysis).
- Of the 20 investment groups that have invested the highest total amounts in Israeli climate tech startups – none are dedicated climate funds. Moreover, in Israel, to date, there is no dedicated climate tech investment group.
- Of the 10 most active investment groups in Israeli climate tech, 4 are operating a government-supported incubator, thereby highlighting the importance of such government support in the climate domain.
- Four of the most active investors in the global climate tech space (both in the number of deals and the amounts invested),¹² have invested in Israeli climate ventures (SOSV, Sequoia, Khosla Ventures, and Techstars).
- Less than 20% of the 570 investor groups are attributed to corporate venture capitals (CVCs). Late-stage dedicated funds conducted less than 1% of the active investments, thus demonstrating the low level of capital diversity available for climate ventures.

Government Support

- The Israeli government invested more than 280 million USD during 2018-20 in promoting R&D in climate tech startups (all the data below pertains to this timeframe) (Figure 12).



- **Israel Innovation Authority (IIA)** supported 290 ventures with a total budget of 250 million USD during 2018-20 (16% of its annual budget). The average approval rate of climate-related applications was higher than the IIA's general approval rate, indicating the high quality of projects applying for support.
- The IIA supported ideation and early-stage ventures via 7 incubators and innovation labs and promoted generic research via 4 "MAGNET" consortia.¹³
- Pilot program – The IIA invested 60 million USD together with 7 government ministries and entities to climate tech startups for support ventures in their later-phase R&D pilot testing and implementation.
- The IIA has also provided support to climate companies for implementation of their R&D project within commercial manufacturing facilities.

Additional Support from Government Ministries

- In addition to collaborating with the IIA in the Pilot Program, the **Ministry of Environmental Protection** has collaborated with the IIA and the **Ministry of Economy and Industry** in supporting early-stage ventures in joint public-private innovation labs.
- The **Ministry of Economy and Industry** is focusing efforts on circularity domains via the "Industrial Symbiosis" Program and the Israel Resource Efficiency Center.
- The **Ministry of Energy**, in addition to collaborating in the IIA Pilot Program, is also promoting climate innovation in dedicated support programs across the innovation value chain from academic research to pilot projects (total of 30 million USD).
- Other government ministries operate climate support projects via their Chief Scientist departments.



Of the 20 investment groups that have invested the highest total amounts in Israeli climate tech startups – none are dedicated climate funds. Moreover, in Israel, to date, there is no dedicated climate tech investment group

¹² PwC, The State of Climate Tech 2020: The next frontier for venture capital

¹³ MAGNET – An IIA incentive program that provides grants for R&D collaboration between industrial companies and research institutions developing technologies together.



05

Israel as a Global Climate Tech Player

Several indices were examined to evaluate Israel's role as a global climate tech player.

A recent global climate tech investment report identified and ranked the top 10 global climate tech hubs according to geographics and the total fundings obtained by the companies headquartered there.¹⁴ Silicon Valley, Boston, and Berlin led the rankings, while Israel did not feature. A different index, the Global Cleantech Innovation Index, draws upon 15 indicators to explore where entrepreneurial clean technology companies are most likely to emerge. The latest version, dated

2017, **ranked Israel 6th** among the 40 countries indexed.¹⁵

Another global presence indicator is the participation level in the European Horizon Green Deal Program. Data compiled from 20 calls for proposals as part of the Horizon 2020 Green Deal indicates that Israel is below average both in the level of overall participation as well as in success rates. **A comparison between the success rate for Israeli Green Deal submissions with that for all Horizon programs, indicates that Israel is far from realizing its potential in Europe's largest**

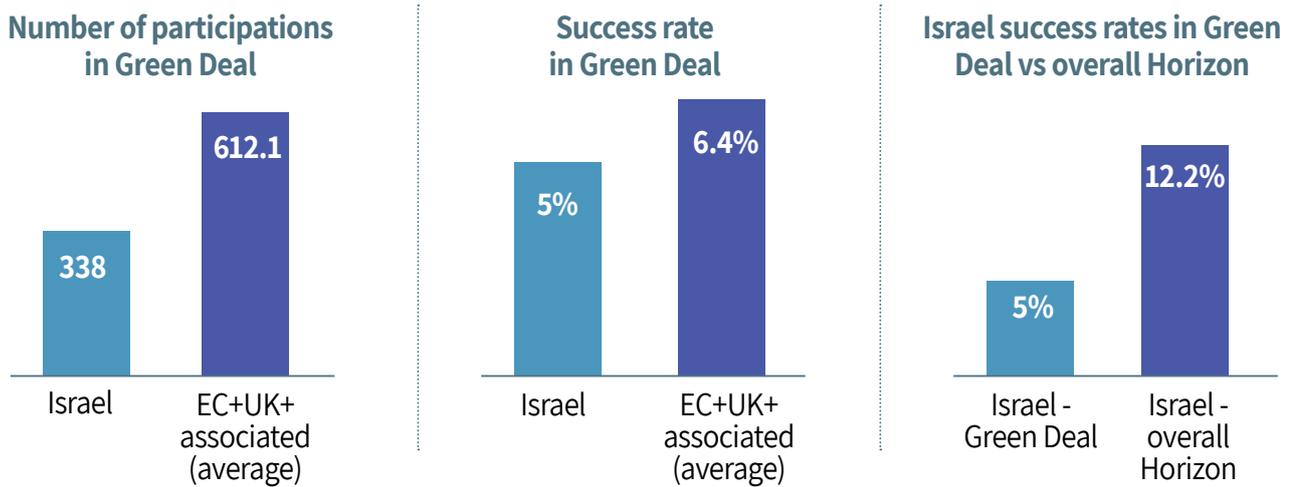
climate funding program (Figure 13). Further analysis is still necessary to assess industry vs academia participation and levels of success.

To evaluate Israel's global dominance in specific climate challenges and in the absence of any such published analysis, we made use of Artificial Intelligence. We collaborated with SparkBeyond®, an Israeli startup which developed an AI-powered problem-solving platform, to assess Israel's global dominance in various climate tech domains. Technological dominance was determined by measuring scientific knowledge (the

14 PwC, 2020, The State of Climate Tech 2020: The Next Frontier for Venture Capital

15 Global Climate Innovation index 2017 at: https://i3connect.com/gcii/country_rank

FIGURE 13 | Israel in Green Deal & Horizon EU Programs



number of scientific publications) and the industrial implementation of such knowledge (the amount of relevant news on business, funding, R&D milestones etc.) emerging from each country. After selecting the technologies to be assessed, an AI analysis was conducted of more than 50,000 data sources and a comparison was made between Israel and the G20 countries.

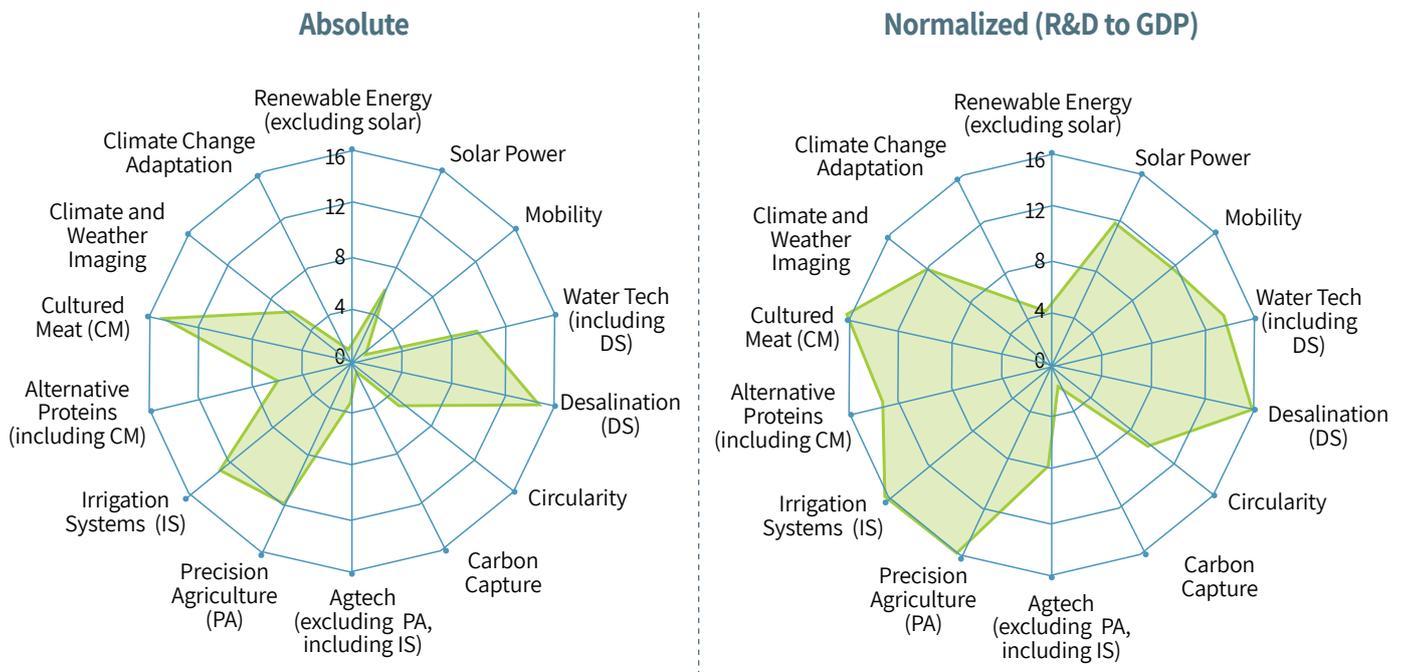
The sum of the outputs for each assessed technology, for any given country, was defined as “raw” results and indicated each country’s level of leadership in a specific technology. Each country was ranked on a scale between 16 (best leading country) and 1 (doing most poorly). These raw results provide an “absolute ranking” that take into account each country’s successes while disregarding the country’s size or level of investment in

R&D. It is hardly surprising therefore that large, prosperous countries like the US and China feature at the top of the list for most technologies. To account for this, we normalized the raw results by factoring in the national GDP spending on R&D. These results provide a “normalized ranking”.

The analysis was conducted both for specific technologies and for groups of technologies clustered into broader categories.

” Among the 58 technologies assessed, in absolute terms, Israel ranked 4 times in the top 5 (Cultured Meat, Water Desalination, Irrigation Systems, Soil Amendments)

FIGURE 14 | Israeli Climate Tech Relative to the World



- **R&D Spending** - Normalizing by 'GDP spending on R&D' results in the relative increase in Israel's ranking with respect to the other nations analyzed. This may point to the beneficial results of Israel's high level of investment in R&D for its climate-tech industry.
- Among the **11** technology areas assessed in absolute terms, Israel ranked **1** time in the top 5, and in normalized terms, ranked **6** times in the top 5 (Solar Power cluster, Alternative Proteins, Mobility cluster, Climate & Weather Imaging cluster, Water Tech cluster, Precision Agriculture cluster) (Figure 14).
- Among the **58** technologies assessed, in absolute terms, Israel ranked 4 times in the top 5 (**Cultured Meat, Water Desalination, Irrigation Systems,**

Soil Amendments), and in normalized terms, ranked 20 times in the top 5.

- **Precision Agriculture** - Israel ranked 5th in absolute terms and 1st when normalized, due to its relative strengths in soil mapping, irrigation systems, and satellites for precision agriculture and satellites technologies.
- Israel ranked 4th in **Climate & Weather Imaging** in normalized terms due to its relative strength in aerial drones and satellite technologies. This technological knowledge and expertise which originates both from the civilian and defense industries can be further exploited for climate solutions.
- Israel has been a global trailblazer in **Water-Tech** for decades, its

strength largely resulting from the contribution of desalination technology (ranked 2nd in absolute and 1st when normalized). Desalination is an excellent example of potential synergies and trade-offs between mitigation and adaptation technologies. Desalination increases the supply of fresh water in a world affected by global warming and water scarcity. Conversely – it is an energy intensive process and creates concentrated brines. Continued innovation, based on the vast knowledge and experience of the sector, in materials, processes, energy sources and mineral recovery, can further the transition of desalination to a globally accessible eco-efficient water supply and transform Israel from a cleantech leader in this field to a climate leader in this field.



Opportunities & Barriers to Climate Tech in Israel

In this section we reflect on the existing and potential strengths of the Israeli climate ecosystem and the global impact of the various climate tech domains. We highlight a number of technologies that provide solutions to global climate challenges and in which Israel is well positioned. This list is by no means exhaustive, and there are certainly additional technologies that could, and should, be promoted. For example, **green hydrogen** – its availability, storage, distribution, and implementation – is a crucial component of current and envisioned transformations in the energy and transportation sector, as it enables high temperature processes, long duration energy storage, and long-haul heavy-duty transportation for which electrification is not a solution. **Israel has a prolific academic community with research focused on electrolyzers and fuel**

cells from which a number of startups have emerged. Joint R&D and collaborations with international players (from academia and industry) could further promote this field. **Carbon capture, storage, and utilization (CCUS)** is another field considered a global imperative for reaching net zero emissions, mitigating temperature increases caused by carbon pumped into the atmosphere in the past, and for achieving deep decarbonization in the industrial sector as it transitions to lower emission processes. CCUS requires both capture from point sources as well as direct air capture (to date, there are only 15 direct air capture plants in the world),¹⁶ and innovations that can progress to cost effective scale ups are essential. **Israel's point of departure is similar to most other countries, and success would have an immense global impact.**

”

This unique expertise can act as a platform to accelerate climate tech startups and provides opportunities for AI companies to pivot towards advancing solutions to fight climate change

¹⁶ <https://www.iea.org/reports/direct-air-capture>, retrieved September 2021.



Artificial Intelligence as a Technology Driver

Artificial Intelligence (AI) contributes to the fight against climate change across a wide variety of sectors including electricity, transportation, industry, buildings, forestry, land use, and many others. By supporting distributed energy grids, precision agriculture, sustainable supply chains, environmental monitoring, energy-efficient buildings, and enhanced weather and disaster prediction, AI-based innovations reduce greenhouse gas emissions and resource consumption, and aid in climate adaptation. By accelerating scientific discovery and improving computational simulations, AI acts as a primary technology driver in many additional cross-cutting domains from which climate innovations evolve.

Israel has proven capabilities in AI, is home to successful AI startups in a variety of fields and is ranked 6th in the 2020 The Global AI Index.¹⁷ This unique expertise can act as a platform to accelerate climate tech startups and provides opportunities for AI companies to pivot towards advancing solutions to fight climate change.

¹⁷ <https://www.tortoisemedia.com/intelligence/global-ai/>

Challenge: Alternative Proteins

Numbers: **45** companies of which **42** are startups (**6%** of all startups).
These startups have raised a total of **364 million USD**.



Technology Showcase:

5 startups in cultivated meat/dairy, 10 in fermentation, 21 in plant-based proteins. The number of startups is growing rapidly each year and investments increased 11-fold (1140%) between 2018 and 2021. Of the 42 startups, 34 were established from 2016 onwards, and 15 of these were established in 2019 and 2020.

Four alternative protein companies are publicly traded on the Tel Aviv Stock Exchange (2 cultivated meat, 1 plant based protein and 1 fermentation company) which serves as a means to raise the capital needed to support the long path to market, even prior to commercialization.

Why Cultivated Meat?

The traditional meat industry is responsible for high levels of greenhouse gas emissions (directly from livestock and indirectly through growth of livestock feed) in addition to its disproportionate use of resources

such as land and water. As global demand for meat is not expected to decline, cultivated meat can provide a source of complete protein, valuable minerals, and vitamins while drastically decreasing emissions, water use and land use.

One of the primary challenges for cultivated meat is to reduce the costs, such that it will be cost-competitive after scale-up.

Why Israel?

Cultivated meat companies were established in Israel as early as 2015, and have raised 185 million USD, 51% of the total funding for Alternative Protein startups. Israel ranks second in the world (after the United States) in the total number of fermentation and cultivated meat companies.¹⁸

¹⁸ <https://gfi.org/blog/israel-innovation-report/>.

Barriers to Climate Tech in Israel

The challenge of decarbonization encompasses all areas of the economy and requires both technological advances and ways to contend with scaling complexity of the technologies. Climate tech entrepreneurs must navigate an intricate web of regulators and incumbent corporations, as well as existing infrastructure, manufacturing processes, and supply chains. They need to develop a product that meets and exceeds the specifications, standards, cost-effectiveness, and requirements of an existing integrated system and, in many cases, be ready for a changing industry landscape and new value chain. Success requires the collaboration of a wide set of partners and investors. A survey conducted among nearly 200 Israeli climate tech companies revealed the main challenges that companies

face during their development and growth stages (Figure 15). The three dominant self-reported challenges are:

Access to Capital

Climate tech startups face difficulties in obtaining venture capital investments. **Although attracting a significant amount of capital and investment groups, the climate tech ecosystem still suffers from lack of diversity in type and focus of such investment groups.** 85% of the survey respondents have hardware at the heart of their innovations. Capital requirements for hardware are higher than those for software at all developmental stages (i.e., product, proof of concept and pilot projects), and product development and physical system transformations simply take much longer and are more complex than software deployment. Large investments may be required before products are proven, and

companies must often survive longer, while sustaining losses, before achieving scale or profitability. Because investors need to consider returns on a time vertical of decades rather than years, and the path to an exit is not always clear, a generalist VC partner finds it difficult to sign a term sheet.

Regulatory Hurdles

Regulation can be overly complex and can inhibit innovation. Utilities and public infrastructure are prominent clients for climate tech sectors such as energy and water and are tightly regulated markets, making it difficult for startups to navigate their way through the list of requirements. In Israel for example, more than 10 different regulatory approvals are necessary for an energy startup to deploy its solution. In addition, regulatory markets are fragmented and differ geographically making rapid expansion difficult.

Challenge: Clean Energy Systems

Numbers: 235 companies of which 119 are startups (18.6% of all startups). These startups have raised a total of 2 billion USD.



Technology Showcase:

Of the 119 startups, 23 (20%) are solar energy companies, 34 (29%) are energy storage companies, and an additional 30 (25%) provide 'software only' solutions for energy management.

Why Energy Storage?

Energy storage enables mass implementation of intermittent renewable energy such as solar, wind and waves. Storage makes it possible to better balance electricity supply with demand, enhances flexibility, reliability, and resilience of centralized and micro-grids, and can be deployed to avoid costly new transmission infrastructure and peaker plants.

Electrification, widespread use of renewables, and behind-the-meter solutions have led many nations to increase the availability of financial incentives for storage investment.¹⁹ Li-ion batteries are the dominant and most cost-effective form of storage for mobile applications such as EVs but have limited performance and limited (and not always

sustainable) raw material sources. Innovative solutions are required to increase capacity, improve performance, enhance durability (especially for grid-scale storage) and develop effective long duration energy storage, from 10 hours to several days, at scale. Storage innovations (based on technologies such as electrochemical, mechanical, thermal, chemical carriers, or any combination of these) will typically have multiple revenue streams, through deployment in an array of stationary and mobile systems.

Why Israel?

Israel has a growing population of startups with impressive traction of private capital with nearly 30% of all Clean Energy Systems startups focusing on Energy Storage solutions. Of these 34 startups, 22 (65%) were established from 2016 onwards, and 12 (35%) of these were established in 2019 and 2020. Collectively, they have raised \$265 million USD with 5 startups raising 85% of this sum.

¹⁹ Deloitte Center for Energy Solutions, 2018, Supercharged: Challenges and Opportunities in Global Battery Storage Markets.



Challenge: Climate Smart Agriculture

Numbers: **212** companies of which **130** are startups (**20%** of all startups).
These startups have raised a total of **950 million USD**.



Technology Showcase:

Of the 130 startups, 69 (53%) are precision agriculture companies.

Why Precision Agriculture?

Precision agriculture increases agricultural productivity while optimizing farm management and more efficient use of water, pesticides, nutrients, and other inputs. This reduces emissions, increases soil health, and decreases expansion of agricultural areas and changes in land use.

A major challenge for precision agriculture is developing implementations that are suitable and accessible to farmers, especially in developing countries. These are mostly small farm holders with low financial capabilities to implement new technologies.

Why Israel?

The historical innovation of Israeli water-tech has facilitated the development of Israel's strength in precision agriculture. Israel's preexisting strength in ICT, data mining and software, together with expertise in the fields of drones and satellites, enable the adaptation of existing technologies into innovative agricultural solutions such as soil mapping, smart irrigation and fertigation systems, and satellites for precision agriculture.

Of the 69 startups in precision agriculture, 42 (60%) were established from 2016 onwards, and 7 (10%) of these were established in 2019 and 2020. Collectively, they have raised 489 million USD, 51% of the total funding for Climate Smart Agriculture startups.

FIGURE 15 | Industry Main Challenges

Scaling up

The main barrier to deploying and scaling up a climate solution is the need for a mature value chain. A startup needs to consider many different players and stakeholders to successfully launch a product. Furthermore, scaling up climate tech often requires enormously large capital. This is often facilitated by financing mechanisms structured as project- or asset-based investments provided by debt or infrastructure investors or via dedicated large scale climate tech financiers. The barriers to companies' scale up can exist even after a successful pilot, when technical risks have been overcome and unit economics are promising.

Main Challenges:



72%

Stated **access to capital** as their main challenge



30%

Highlighted **regulation** as a main barrier



28%

Mentioned difficulty to **scale-up** their product

Additional Challenges:



30%

of green construction companies highlighted the need for **professional guidance**



37%

of energy companies cannot find a **suitable beta site** for their product



33%

of companies can model their climate impact

Challenge: Sustainable Mobility & Transport

Numbers: **137** companies of which **75** are startups (**12 %** of all startups).

These startups have raised a total of **1.8 billion USD**.



Technology Insights:

Of the 75 startups, 25 (33%) are in New Mobility - technologies and infrastructure that facilitate shifts to low carbon transportation modes (notably in the area of shared mobility, micro-mobility and high-capacity public transport services), influence individual travel behavior, and provide alternatives to traditional vehicle ownership.

Why New Mobility?

Integration and increased capacity of new mobility services such as shared, public, and low-carbon private transportation (e.g., bicycles, e-bikes, electric mopeds), have the potential to replace travel by personal single-passenger cars. Digital connectivity can improve operations and enhance capacity, and, together with electrification, contribute to the reduction of energy use and emissions from urban transportation.

A challenge facing new mobility is ensuring that full life cycle analysis confirms lower emissions for any new

mobility mode in a particular setting, e.g., the impact of "deadheading" - the empty vehicle travel distance - in ride-sourcing schemes needs to be assessed. Emissions can depend also on capacity, occupancy, infrastructure, and maintenance, and all these need to be assessed alongside the user convenience of more multimodal travel.

Why Israel?

As new mobility is predominantly software-based, the field can nurture itself from the proliferating Israeli ICT ecosystem and rely upon the well-established and experienced Israeli automotive innovation sector. Of the 25 startups in new mobility, 13 (50%) were established between 2016, and 6 (20%) of these were established in 2019 and 2020. Collectively, they have raised 1.19 billion USD.



Looking Ahead

Israel has the capability to contribute substantially to global emission reductions. Locally developed and adopted technologies are already responsible for emission reductions around the world that may be greater than the emissions the country itself generates. Increased adoption on a nationwide scale and increased global deployment would further increase Israel's internal and global contribution to emission reduction commitments.

However, Israel has yet to exhaust its potential for innovation, commercialization and scaling up of climate tech solutions.

Fully realizing the potential of the Israeli climate technologies will both diversify the Israeli high-tech industry and create a global climate tech hub (with all its economic benefits), while a sustainable climate tech industry will promote global efforts for treating unmet climate needs, drive Israel towards meeting its national climate goals, boost employment and the economy, enhance local living conditions, reduce air pollution, and improve energy, water, and food security.



However, Israel has yet to exhaust its potential for innovation, commercialization and scaling up of climate tech solutions.

Climate tech deployment, especially with regards to infrastructure, is highly dependent on the government, both as a regulator and as a dominant customer. For its part, the government has a clear incentive to enable the development of local technological solutions and assist the country in achieving its national climate targets and must therefore take a significant and active role in driving the climate ecosystem forward.

This can primarily be achieved by:

Unlocking the Pool of Private and Public Capital

Create a local sandbox – Turn national infrastructure into a

technological beta site which, together with regulatory waivers, will enable startups to learn, consult, test, and showcase a successful first implemented product in Israel and increase their chances for gaining private investment or a market for their product.

Make international partners and funding programs accessible -

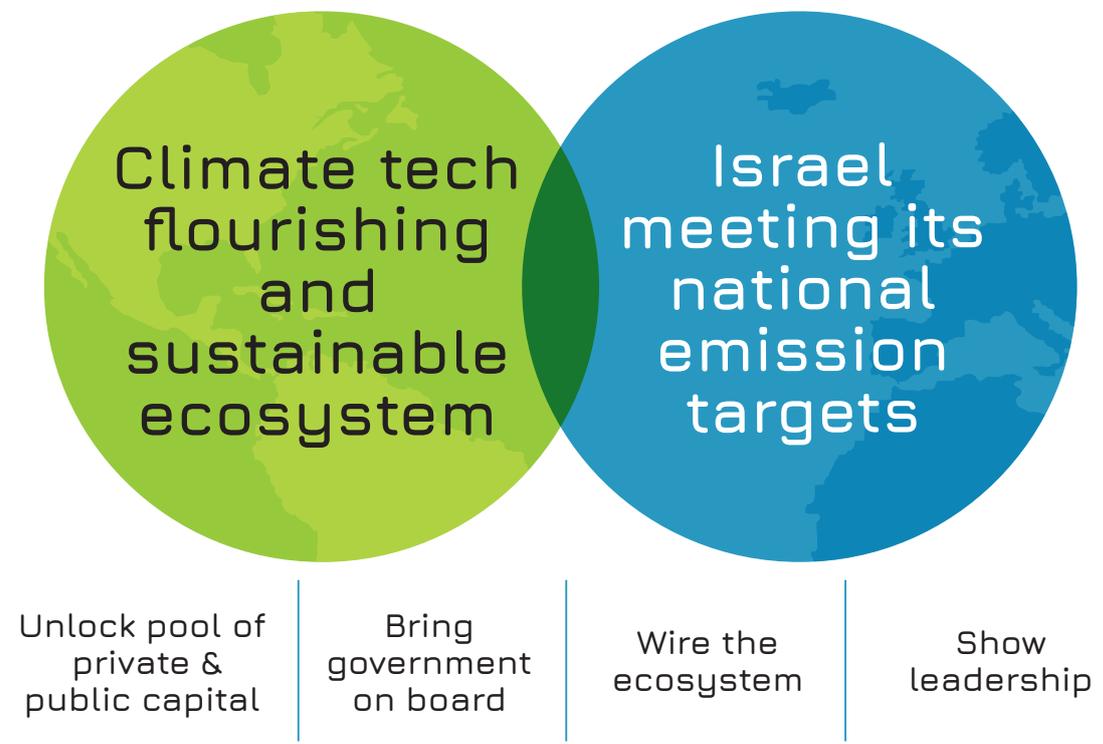
Expose Israeli technologies and startups to the large-scale international funding programs such as the EU Green Deal, and provide the support necessary to increase their chances of receiving a grant. In addition, leverage Israel's international agreements (such as with the US federal government) to connect local entrepreneurs with large

corporations' knowledge, expertise, and calls for open innovation which will assist in scaling up their business.

Align government funding criteria with those of the private funds -

Implement environmental, social and governance (ESG) criteria and assess the potential climate impact of technologies via the Israel Innovation Authority's evaluation process. Government grants usually serve as a startup's first investment and assist in aligning their investor pitch with global standards, thus increasing their chances to gain private capital traction, including climate dedicated, global VCs.

FIGURE 17 | Global Technological Leadership Combined with National Green Economy



Bringing Government on Board

Apply regulations that facilitate the entrance of climate tech companies to the market - Israel should orient its regulations towards global benchmarks such as EU climate change mitigation instruments. Such new regulations could encourage companies to set short-term and long-term emission reduction targets and apply climate tech technologies.

Government ministries' collaboration to create joint climate tech initiatives to incentivize ideation of novel solutions - All government ministries need to assess how their missions affect climate and vice versa, identify the most significant challenges, and call on the ecosystem to provide climate change-related solutions that align with and advance their objectives. Financial incentives for deployment and scale up can be offered.

The Israeli innovation ecosystem responds tremendously well to government calls to assist in times of crisis. The early stage of the COVID-19 crisis is a great example of this. Government ministries should join forces, define national climate-related challenges, and call on the ecosystem to respond and offer solutions.

Wiring the Ecosystem

Enhance the “ecosystem effect” by creating a viable stream of knowledge, data and innovation between critical parts of the ecosystem - Connect the unmet need of local industry and government entities, together with novel solutions proposed by academia and entrepreneurs' capabilities to develop these into a viable product.

Engage world-leading Israeli high-tech companies in the climate crisis and national mitigation effort - Expose high-tech companies and entrepreneurs to unmet climate needs, provide the necessary training and knowledge to pivot existing technologies towards climate challenges, while creating new business models and opportunities.

Enhance the multifaceted benefits of partnerships between large corporations or SMEs and startups - Successful corporate implementation of technologies can give a startup more credibility in the eyes of customers and investors. Such partnerships can help startups progress towards commercialization by providing financial assistance and institutional knowledge, and can open doors to new customers, distribution channels, and geographic locations.

Showing Leadership

Create an overall vision for a carbon-neutral Israel as part of an ambitious, holistic, and integrated climate action plan - The growth potential of climate tech innovation could be fulfilled by embedding it within a broad vision for a carbon-neutral Israel within a designated timeframe. Such a national plan would go beyond the recently revised and improved NDC²⁰ and outline not only concrete emission pathways but also development of policy options, strategies, financial incentives and solutions. A growing number of countries have adopted legislation specifying a target of net zero emissions by 2050 or earlier. Doing the same would allow Israel to fulfil and go beyond the committed national contributions under the Paris Agreement.



A strong governmental mindset and leadership would be instrumental in creating strong momentum and transforming Israel into a global leader in climate tech innovation

20 Nationally Determined Contribution submitted to the UN Framework Convention on Climate Change, August 2021

