



רשות החדשנות
Israel Innovation
Authority

Annual Innovation Report State of High-Tech 2022

Opening Remarks

As we do each year, the Israel Innovation Authority is proud to present its annual report outlining the current state of the Israeli innovation industry. This year's situation report differs from previous years due to the structural changes that have occurred in the global economy in general and, specifically in the Israeli economy. These developments stem, among others from an unprecedented flow of capital initiated by governments in most countries worldwide in the wake of the Covid crisis. The end of 2021 was marked by a deceleration in the flow of capital and a parallel bearish trend on global stock markets. Israel too has witnessed a certain deceleration in the rate of capital investment in high-tech companies during the first quarter of 2022 after reaching an impressive peak of 27 billion dollars in 2021. This past year was also a record year in the number of companies growing into complete companies reaching a value of over 1 billion dollars ("unicorns"), their number now standing at more than 40. Another record registered in 2021 was the number of companies initiating IPOs – more than 75 companies. These record achievements led to accelerated growth in the demand for professional high-tech workers, both in R&D and business roles, a demand that led to fierce competition for human resources and a resultant increase in salaries.

Despite all these milestones, there is no guarantee that Israel's high-tech industry will continue to grow and lead the world. Innovative technologies are being developed at an ever-growing rate and their assimilation is accompanied by huge investments that are changing global lifestyles and balances of power. Countries that meet the pace of research, development, and assimilation of innovation for the benefit of their economies, their citizens' welfare, and their national resilience will become influential global forces. Countries that fail to invest, develop, and adopt accelerated innovation will be left behind economically, socially, and military-wise. These developments present Israel with several complex and broad challenges that require a combined government-private sector effort to enable the high-tech industry to continue growing and lead the Israeli economy. The high-tech industry's centrality to the Israeli economy and its role as the State of Israel's primary economic growth engine – demonstrated by this year's high-tech exports exceeding 50% of total Israeli exports for the first time– requires its ongoing rapid development to ensure national resilience.

The challenges to the Israeli innovation hub are manifold and intensifying. The shortage of skilled workers in development roles leads to the transfer of R&D activity to other countries, resulting in new jobs being created there rather than in Israel. While total investment in Israeli R&D, including the private sector, is the highest in the world – more than 5% of GDP (!), the ecosystem focuses on a relatively limited range of software-based technological fields and suffers from low government investment in R&D compared to the rest of the world. This reality also hinders the ecosystem's development in other technological fields. Regulatory and bureaucratic obstacles impair the competitive ability and assimilation of innovation in Israel and prevent the implementation of innovative Israeli technologies in the local economy. These obstacles are also sometimes the reason that Israeli companies transfer activity overseas or even choose to operate there from the outset. These factors may potentially lead to Israel losing its position of global leadership, a trend already expressed today by various global innovation leadership rankings. For example, in the 2021 Global Innovation Index (GII), Israel dropped to being 15th in the overall ranking. As detailed in this report, the Israeli government and the Innovation Authority are therefore acting via different methods to develop new tools aimed at adapting policy and action to contend with the various challenges.

We wish to thank the Economy and Research Division of the Innovation Authority for preparing the report and for raising the issues relevant to the continued prosperity of the Israeli high-tech industry and Israeli economy. We wish to thank all the Innovation Authority employees for their intense and high-quality work throughout the year, the team of professional experts and all members of the research committees, especially the public representatives, for their dedication and professionalism. We also thank the members of the Innovation Authority Board for their important work in delineating its policy and all the Authority's many partners, both within and outside the government, for their endeavor in advancing Israeli innovation.

Dr. Amiram Applebaum

Chief Scientist, Ministry of Economy and Industry
Chairman of the Board, Israel Innovation Authority

Dror Bin

CEO,
Israel Innovation Authority

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Writing and Editing:

Israel Innovation Authority – Economics and Research Division
 Inbal Orpaz – Advisor and Content Editor

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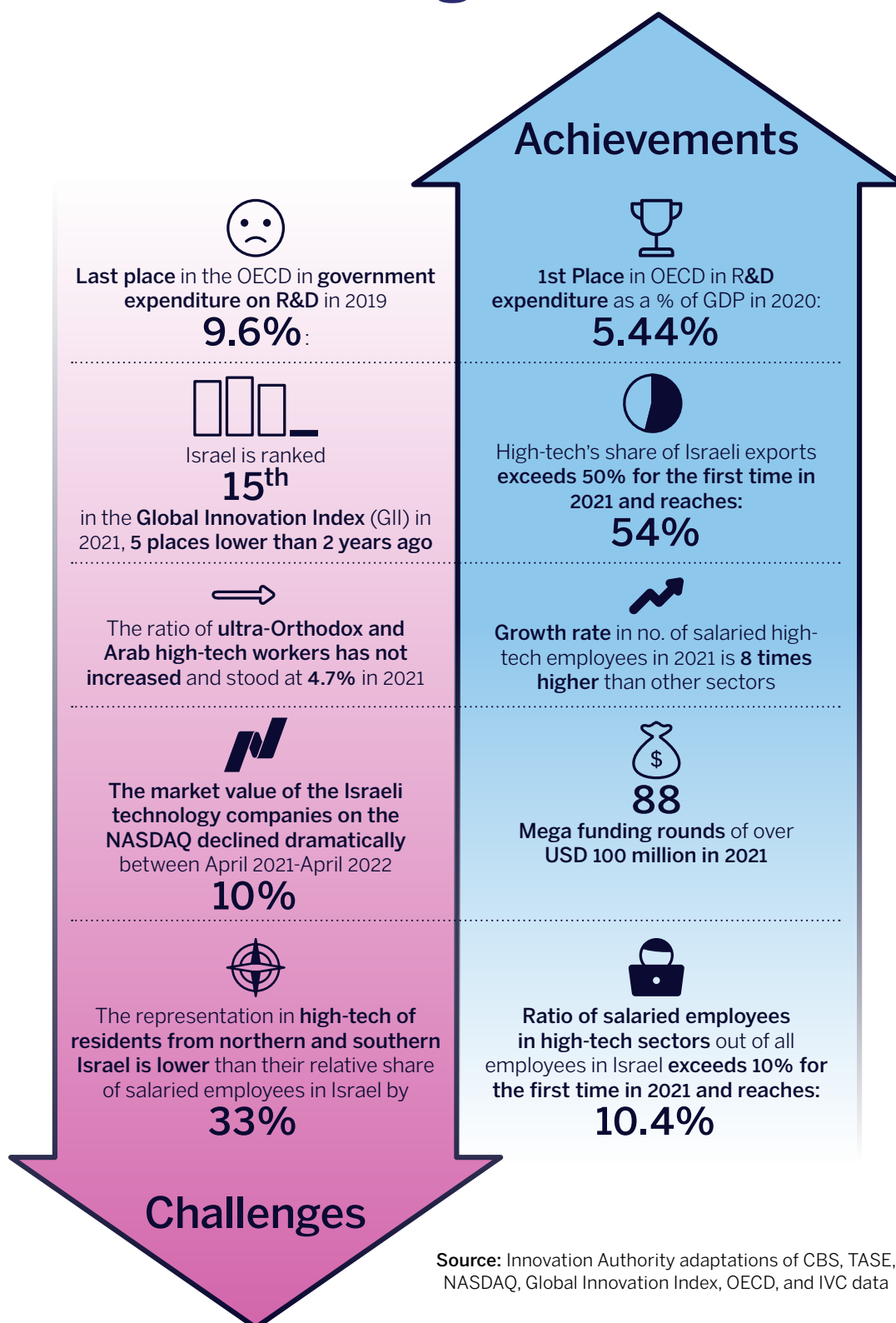
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Introduction: Annual Report The State of High-Tech 2022



Introduction and Main Points: Annual Report - State of High-Tech 2022



Source: Innovation Authority adaptations of CBS, TASE, NASDAQ, Global Innovation Index, OECD, and IVC data

2022 meets high-tech at an interesting intersection: on the one hand, following a decade of record achievements and prosperity, the industry is increasingly strengthening its standing as one of the Israeli economy's central sectors. On the other hand, the capital market is cooling down, a war is raging in Ukraine, and the sanctions imposed on Russia are impacting the global economy and the movement of workers (including in Israel). This comes on the back of the ramifications of the Covid pandemic that broke out more than two years ago. "The High-Tech Situation Report 2022" reflects all the above and presents high-tech's successes and the numbers behind the industry, while shining a spotlight on the challenges that must be contended with in order to continue maintaining Israel's leading position (as local high-tech declines in some global indices).

The first section of the report presents an updated situation report of Israeli high-tech, including the challenges it faces. One prominent figure highlighting this gap is that Israel occupies 1st place among the countries of the OECD in expenditure on R&D as a ratio of GDP. In 2019, Israel exceeded the 5% mark for the first time and in 2020 (the last year for which this figure was published), the figure already stood at 5.4%. In contrast, Israel is ranked last in the OECD in the level of government expenditure on R&D out of total expenditure in this field. In 2019, less than 10% of all expenditure on R&D, equal to 0.5% of GDP, was funded by the state. In comparison, in the US this figure stood at 205 and constituted 0.66% of GDP, while in European countries such as Germany and France it climbed to 30% that were 0.69% and 0.88% of GDP, respectively. These disparities may seem insignificant, but they translate into added annual government investment in R&D of 2.4-5.7 billion shekels. This government investment is directed at groundbreaking high-risk R&D that will ensure continued medium- and long-term growth which the private sector has difficulty funding.

Another prominent contrast is related to workers employed in the high-tech industry – an especially critical issue in a period in which many workers are moving in the high-tech direction and when a national program is being formulated to increase the number of employees in the industry to 15% of all salaried employees. The number of high-tech employees grew by 27,000 during 2021 and the industry now employs 362 thousand workers. High-tech demonstrated especially rapid growth in the number of salaried employees: the growth rate in 2021 stood at 8%, compared to growth of only 1% in the economy's total number of salaried employees during the same period. In other words, workers are joining high-tech at a rate eight times higher than they are joining other sectors of the economy.

At the same time, the unemployment created in the high-tech industry with the outbreak of the Covid pandemic returned to its low pre-Covid level. Those joining the high-tech industry belong primarily to Israel's younger population, as described in detail in the first section of the report. Further evidence of this trend is the fact that computer science was the most popular academic course of study in Israel during the 2019-2020 academic year with more than 20 thousand studying some form of combination of this course – 10.8% of all undergraduate students. Moreover, in all age groups, including those that typically make less career changes, there is an increase in the level of participation in high-tech employment. Nevertheless, high-tech is preserving its standing as an exclusive industry in which growth is primarily that of the (non-Orthodox) Jewish population in central Israel. An examination of the changes in the composition of salaried high-tech employees reveals that only 200 Arabs joined high-tech in 2021 while the number of ultra-Orthodox high-tech employees dropped by 500 (most of this can be attributed to the 1,200 ultra-Orthodox women who left high-tech).

Tel Aviv is the undisputed high-tech capital of Israel as far as the number of workers employed in companies there and the number of companies opening their offices there are concerned. The city is home to over one-third of the high-tech companies operating in Israel and to a quarter of the industry's employees. The figures also reveal that Jerusalem is characterized by mainly small high-tech companies unlike Haifa which has mainly large companies. Beersheba is the fastest growing city as far as the number of new startups is concerned, although these are still small (an increase from 70 startups in 2015 to 100 in 2020).

The industry's centralization was expressed not only in the location of its employers, that is sometimes at a distance from residential areas but also in the places where high-tech employees live. 60.3% of high-tech salaried employees live in cities in central Israel, whereas the general proportion of the employees from all sectors of the economy in these cities is 45.5%. In other words, as CBS data for 2020 reveals, the representation of residents from central Israel in high-tech is 35% larger than their relative share of all Israel's salaried employees.¹ In contrast, the representation of residents from northern and southern Israel in high-tech is 33% lower than their share of all salaried employees. In Jerusalem this figure stands at 50%. Only in the Haifa District does the ratio of salaried high-tech employees match its share of the general population. It should be stressed that these disparities between the periphery and central Israel stem in part from the low high-tech representation of the Arab and ultra-Orthodox sectors of the population which generally live in other areas with a significant concentration of ultra-Orthodox in Jerusalem and of the Arab sector in northern and southern Israel. There are also disparities within the Jewish population between residents of central Israel and the periphery which begin already in the education system. Proportionally more school students from central Israel are eligible for a matriculation certificate, a higher ratio of residents from central Israel with a matriculation certificate are accepted to higher education, and these students demonstrate a greater propensity to turn to studies in high-tech subjects.²

An analysis of the distribution of workers between the different types of Israeli high-tech employers reveals that despite Israel's image as a "startup nation", only 8% of the workers are employed in companies defined as startups, with most being employed in more mature companies. In practice, the greatest concentration of workers is in high-tech industry companies that employ 30% of its workers. This sector primarily includes the defense industries that are among the sector's largest employers.

Additional metrics testifying to the resilience of high-tech and its importance to the Israeli economy achieved significant milestones last year: high-tech exports exceeded 50% of total Israeli exports for the first time and reached 54% in 2021. Furthermore, the ratio of salaried high-tech employees of all salaried employees in Israel passed 10% for the first time this year and stood at 10.4%. At the same time, Israel slid to 15th place in the Global Innovation Index (GII) in 2021, having been ranked 13th in 2020 and 10th in 2019. Israel is ranked first in the Global Innovation Index in several sub-metrics that testify to the breadth and depth of the country's high-tech industry, such as public expenditure on R&D, the scope of venture capital investment rounds, exports of ICT products, and cross-sectoral collaborations in innovation fields. In contrast, Israel is ranked below the global average in other metrics related to infrastructures that are critical for achieving technological progress, such as regulatory climate, participation in public sector digitization processes, the percentage of expenditure on software out of GDP etc.

Another record broken by high-tech companies in 2021 was the total capital raised by startups – approx. 72 billion dollars in a year,³ more than double the previous year. About 56% of the capital was raised by companies that deal in enterprise software, cyber or fintech. Companies in higher-risk fields, with longer development and sales processes that are also generally exposed more to regulatory ramifications, attracted less venture capital investor attention. The large-scale fundraising rounds are becoming more common: 88 of these fundraising rounds in 2021 were defined as mega rounds of at least 100 million dollars. Since 2018, the annual number of mega rounds has increased more than tenfold.

¹ 2020 is the latest year for which this data is available. The communications sector is included in this analysis of the high-tech industry.

² These findings are based on an analysis conducted by the Ministry of Finance and the CBS on people born between 1993-1996 and was presented as part of the work of the High-Tech Human Capital Committee.

³ According to IVC data as of 24.4.2022, and without funding raised via cryptographic IPOs and loans. It should be emphasized that this figure is expected to be updated during the coming months.

In contrast, the recent period has been a more moderate one for the mature technology companies in Israel and dampened the euphoria and excitement that accompanied the wave of IPOs of Israeli companies on Wall Street in 2021. As part of preparing this report, the Innovation Authority examined the data of 125 technology companies with a connection to Israel traded on the NASDAQ and found that their aggregate value declined by 9.4% between April 2021-April 2022, from 252 billion dollars to 228 billion dollars. During the same period, the NASDAQ Index itself rose 9.3%. The value of the Israeli technology companies traded in the TA-35 Index also declined by 9.5%, while the TA-35 Index rose by 22% during the same period. This trend was expressed in the first signs of decreased private market fundraising for startups in Israel and the US during the first quarter of 2022, compared to parallel periods in the previous year. Nevertheless, it is still too early to point to a trend and the fluctuations in startup fundraising should continue to be monitored in the near future.

The second section of the report presents an in-depth discussion of the changing role of the government and the Innovation Authority in the wake of the Israeli high-tech industry's maturation and the evolving competition between innovation centers in many countries, all competing for capital, workers, and entrepreneurs. Among others, Israel's relative share of the global venture capital pie is in decline (despite the increase in the absolute total sum of investments reaching startups). Furthermore, Israel has dropped in rankings related to academia and readiness for future technologies. Action is therefore required to enable the next quantum leap of Israeli high-tech.

During recent decades, government support has focused on laying then infrastructures necessary to establish and strengthen the industry, such as the "Yozma" Program that lay the foundation for the Israeli venture capital industry and the Incubators Program that supported high-risk startups in early stages. The central support tool used was direct support of companies via financial grants. The Innovation Authority's new generation of support and investment tools, that are now being introduced and are detailed in this report, expresses the change in role of the government and Innovation Authority in the innovation ecosystem. This change will encourage the transition of Israeli technologies to the public sector and the lives of Israeli citizens who currently frequently fail to benefit from the fruits of innovation created by Israeli companies. To a large degree, the State of Israel and its citizens are the "barefoot cobbler" with regard to assimilation of the technologies and innovation they enjoy. As part of the Authority's new strategic program, sections of which are presented in this report, it will become a mediating and facilitating factor striving to strengthen the connection between the public sector and the Israeli high-tech industry, in the context of the public services received by Israeli citizens and the public infrastructures for assimilating innovation.

The report details the programs for regulatory sandboxes and opening the public sector as a playing ground for testing new technologies such as autonomous vehicles. Furthermore, collaborations between the public and private sectors are being promoted to develop groundbreaking solutions that will benefit Israeli citizens in fields such as autonomous public transportation or modular construction aimed at increasing the supply of available housing in Israel. The new generation government support tools for innovation will enhance the service provided to the public and daily life and will enable Israel to continue preserving a leading position versus other global innovation hubs.

Israeli technology companies will also be required to adapt themselves to a changing reality and to their new status as mature companies with evolving needs in order to sustain their global growth. To continue being innovative, these companies will need to continue investing in R&D and to diversify the areas of activity and the markets in which they operate. In this context, the report addresses one of the factors that will contribute to the building of complete technology companies in Israel: collaborations between technology companies in Israel and universities and research institutes. Today, most of the collaborations between industry and academia in Israel is undertaken by foreign companies, chiefly Microsoft and IBM which are together responsible for half of the joint research publications conducted in academia and funded by high-tech industry companies. The growing Israeli technology companies generally refrain from utilizing this avenue to support their own continued innovation development despite its availability of high-quality personnel.

In summary, the success stories of Israeli high-tech – including mega funding rounds of growing startups and noteworthy exits – occupy most of the high-tech headlines. However, these stories sometimes hide the challenges latent in the future of high-tech, especially those of young startups in the early stages of operation that are yet to prove themselves. In a broad perspective, the number of new startups in Israel has been declining for several years,⁴ and the number of early funding rounds is growing at a significantly slower rate than that of later rounds. The number of early funding rounds grew by 20% compared to 2019 and stood at nearly 1,000 in 2021, while the number of later rounds doubled itself and reached over 400. As a result of these trends, only 4% of all funding rounds in 2021 (approx. 1.1 billion dollars) were directed to seed stages. Moreover, as mentioned above, more than half of the total capital raised by private technology companies in Israel in 2021 reached just three sectors, all software based. This finding may indicate the development of a diversity and risk distribution problem in the Israeli high-tech industry. The Innovation Authority is constantly monitoring these figures and conducting relevant research.

Another central challenge in which Israeli high-tech must improve is more diverse inclusiveness of different population sectors that, as of 2022, are under-represented, including in terms of its employees' geographical dispersion. Preserving the homogeneity that characterizes high-tech together with its rapid growth and the high demand to work in this field may lead to damage in the Israeli social fabric and increase socio-economic disparities. The rapid transition of high-tech companies to working from home during the Covid crisis and subsequently to a hybrid work model that combines work from home and the office, has opened new employment opportunities. Consequently, companies interested in contending with the chronic shortage of high-tech workers find themselves needing to create attractive opportunities for those living outside central Israel and the country's main centers of high-tech employment. The government must ensure the creation of infrastructures to meet this need, for example, by laying broadband communications infrastructures and creating suitable transportation solutions to reduce commuting times on those days when employees are still required to travel to the office.

In conclusion, Israel must avoid complacency and false expectations that without long-term investments the economy's central export sector will continue leading the global arena. The country's slide down the Global Innovation Index and metrics evaluating the resilience of Israeli academia are evidence of this. Past investments on a national level enabled Israel to occupy leading positions in the field of innovation, and considering the country's significant reliance on this industry, it is vital to safeguard it in today's changing reality.

⁴ See the publication: "A decline in the number of new startups" by the Innovation Authority and Start-up Nation Policy Institute.



Part A:

Israeli High-Tech 2022 Situation Report





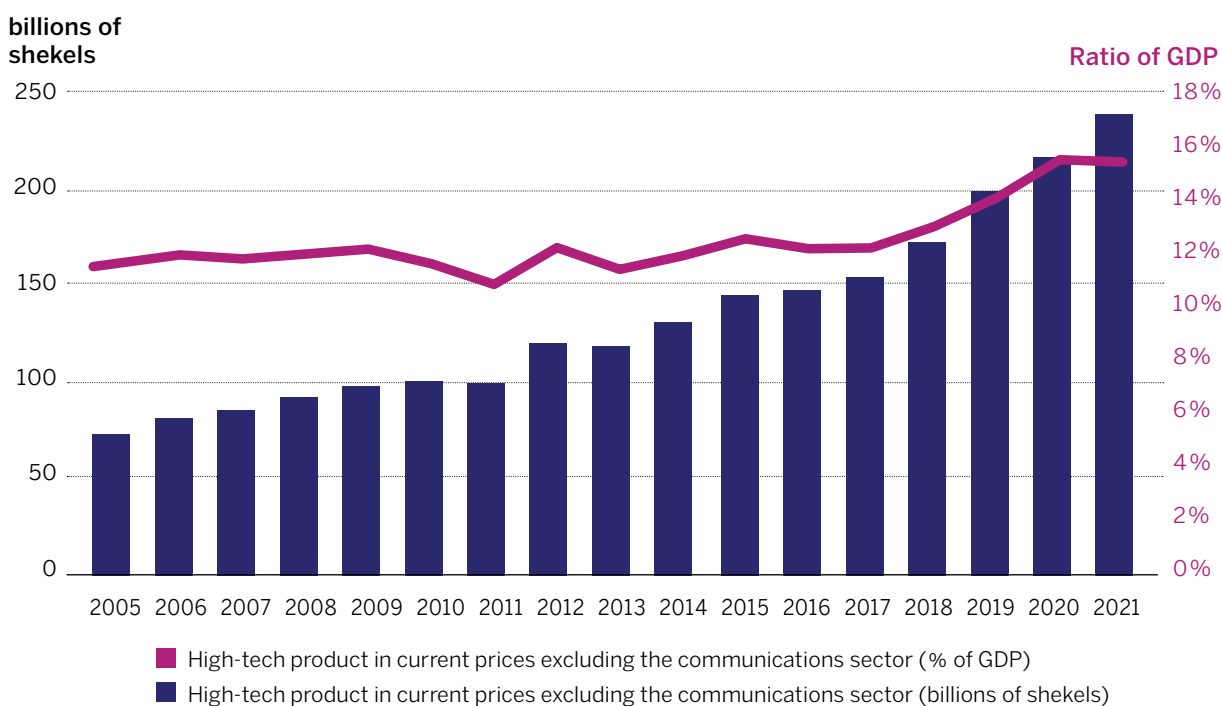
Israeli High-Tech 2022 - Situation Report

High-tech exports exceed half of all Israel's exports for the first time - but the technology companies' value is declining

Israeli high-tech continued to prosper and to constitute the economy's primary growth engine during the past year. The product of the high-tech sectors grew by more than 10% in 2021 and stood at 237 billion shekels, thereby maintaining its relative share of Israel's total GDP – 15.3%. Furthermore, in 2021, high-tech exports exceeded 50% of the State of Israel's exports and stood at 54% (compared to 43% in the previous year), constituting approximately 67 billion dollars.

01 High-Tech Product Grew 10% in 2021 But Maintained Its Relative Share

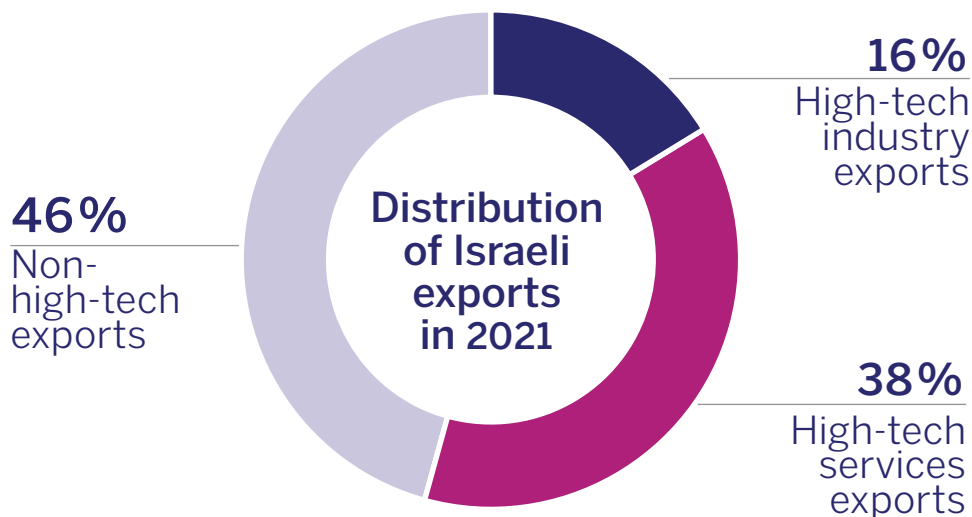
High-tech product in billions of shekels per year, and its ratio of GDP



Source: Innovation Authority adaptation of CBS data

02 High-Tech's Share of Exports Exceeds 50% For the First Time

Distribution of exports from Israel by sector, 2021



Source: Innovation Authority adaptation of CBS data

Nevertheless, 2021 also raised several warning signs for Israeli high-tech that may, in the foreseeable future, impair its ability to maintain a position of global leadership. Among these signs is the decline in the aggregate value of high-tech companies on the various stock exchanges. The Innovation Authority examined the data of 125 technology companies with a connection to Israel,⁵ which are traded on the NASDAQ Stock Exchange and found that their aggregate value declined by 9.4% between April 2021-April 2022, from 252 billion dollars to 228 billion dollars. This, while the NASDAQ 100 Index rose by 9.3% during the same period. The results of the technology companies traded on the Tel Aviv Stock Exchange were even worse – while the TA-35 Index rose by 22% between April 2021-April 2022, the value of the technology companies included in this index dropped by 9.5% during the same period.⁶ In addition, in the first quarter of 2022, the NASDAQ 100 Index declined by nearly 10%. During the coming year, fluctuations on the financial markets, especially those of technology companies, may also impact the Israeli companies in this field.

03 Israeli Public Technology Companies Are Underperforming

Yields of index and Israeli public technology companies

Yield	Israeli Technology Companies	General Index*
NASDAQ 100	-9.4% ↓	+9.3% ↑
TA-35	-9.5% ↓	+22% ↑

* Index yield (NASDAQ 100 or TA-35) including Israeli technology companies

* The data refers to the period between April 2021 and mid-April 2022

Source: Innovation Authority adaptation of NASDAQ and TASE data

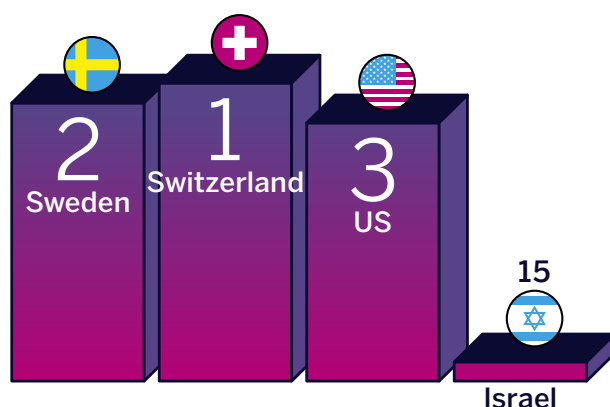
⁵ The locations of company headquarters and offices were examined in this context as well as the identity of the companies' founders and directors.

⁶ Neutralizing the changes in the composition of the indices negates the decline in the aggregate value of high-tech companies included in the index. However, the increase in value of the real-economy and financial companies in the index exceeds 40%.

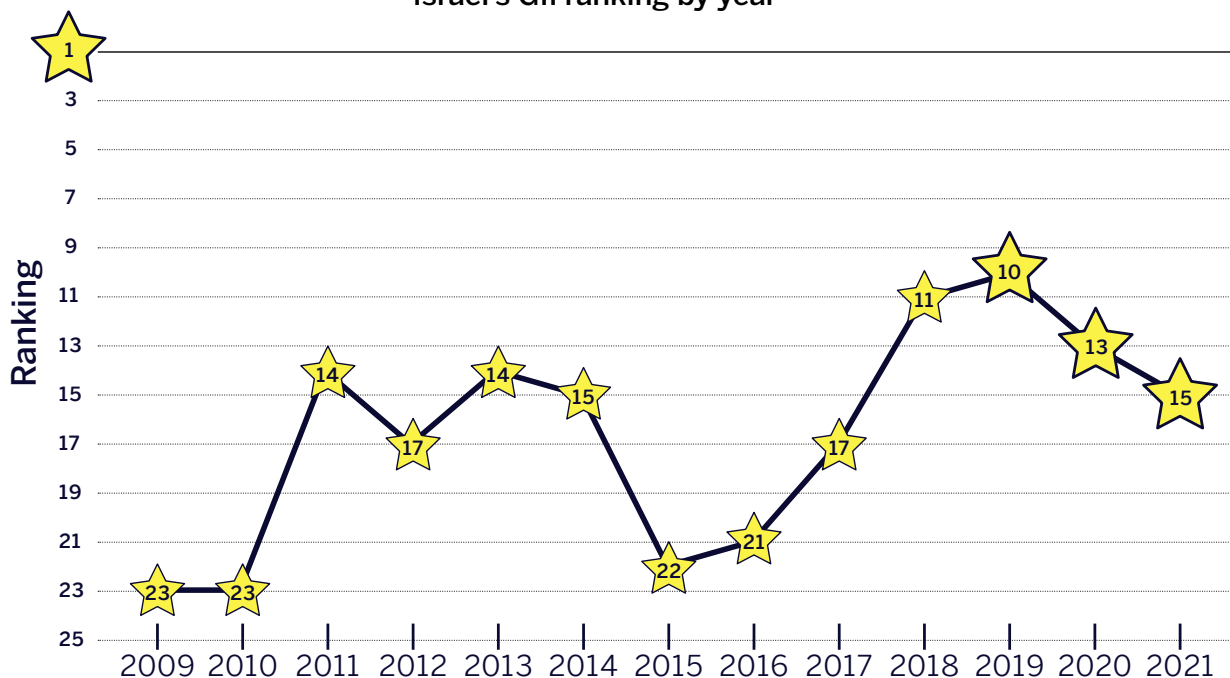
Another warning sign is Israel's decline in the Global Innovation Index (GII) to 21st place in 2021. Israel had previously climbed in the ranking since 2015 and, in 2019, was included in the top 10 countries for the first time since the index was first published more than a decade ago. Since 2019 however, Israel's ranking has dropped.

04 Israel Has Slid Down The Global Innovation Index In The Past 2 Years

Ranking of leading countries in the Global Innovation Index (GII) in 2021



Israel's GII ranking by year

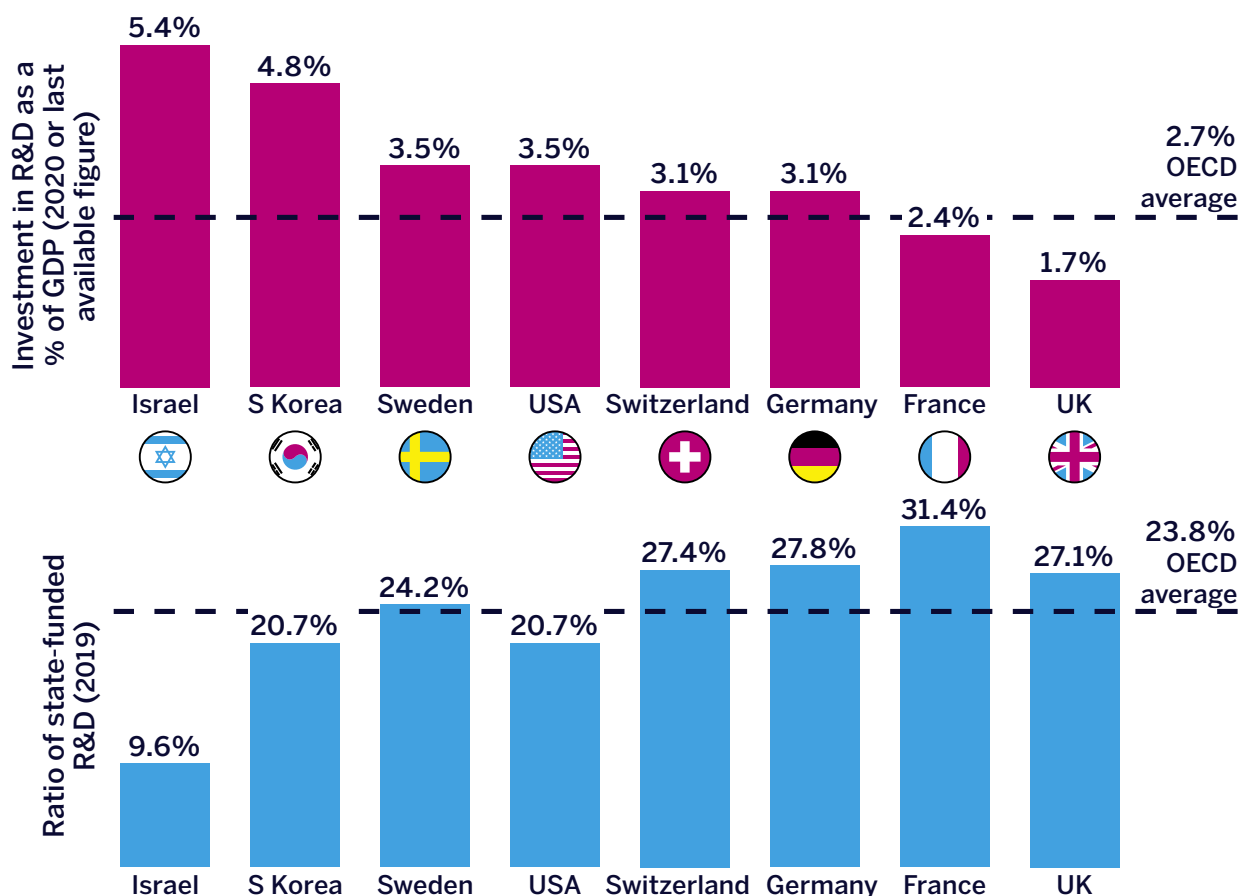


Source: Global Innovation Index

From a positive perspective, Israel continued to lead the list of OECD countries in R&D investments as a ratio of GDP in 2019 (the last year for which such data is available). However, the Israeli government's share of investment in R&D is the lowest of all OECD countries and stood at just 9% in 2019,⁷ after declining significantly in the past decades. In other countries that are considered world leaders in investment in this field, the government share of R&D investment is significantly higher than that in Israel e.g., 20.7% in Korea, 24.2% in Sweden, and 27.8% in Germany. Even in a developed innovation ecosystem such as the US, state investment accounts for 20.7% of the total investment in R&D. This means that R&D funding in Israel relies almost exclusively on the private market compared to other countries, a reality that is indicative of the Israeli high-tech sector's maturity and the high global demand for its products, but which also makes Israeli high-tech particularly sensitive to fluctuations in global capital flows which may be influenced by the war currently raging in Ukraine and by other global trends.

05 Israel Continues To Lead The World In Investment in R&D as a % of GDP And Is The First To Cross the 5% Threshold (2019)

Investment in R&D as a % of GDP and level of state investment in R&D



Source: Innovation Authority adaptation of OECD data

⁷ The last year for which the relevant figure was published in Israel.



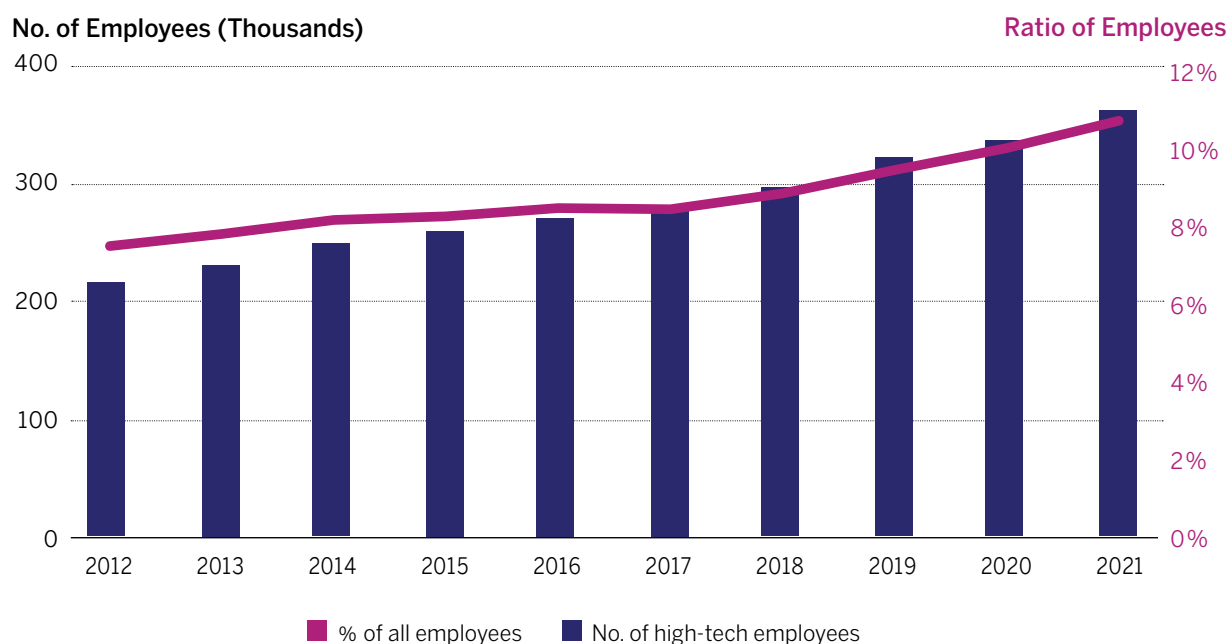
High-tech is growing and has passed 10% employment – but the Arabs and ultra-Orthodox are not joining the party

High-tech is one of the most in-demand sectors of the Israeli economy, attracting workers interested in becoming part of a global and rewarding industry. The number of salaried employees in the Israeli high-tech industry continued to grow and stood at a yearly average of 362 thousand in 2021.⁸ By the end of the year, in December 2021, the number of salaried employees in the high-tech industry had reached nearly 400 thousand. Moreover, the level of available high-tech jobs during the last quarter of 2021 stood at 7.17% compared to 4.61% in the rest of the economy. In other words, the high-tech sector is recovering from the impacts of Covid faster than the rest of the economy, yet another indication of the severe shortage in high-tech workers.⁹ The high-tech industry is characterized by rapid growth: according to CBS data, the number of salaried employees in high-tech grew by 8% compared to the previous year, while the number of salaried employees in the economy at large rose by only 1%.

Israel continues to be a world leader in the ratio of employees in the high-tech industry. This is a further indication of high-tech's centrality in the Israeli economy. For the first time, this ratio exceeded 10% in 2021, reaching 10.4%. The government's goal is to reach a level of 15% by 2026.

06 Ratio Of Salaried High-Tech Employees Crossed 10% For The First Time

No. of salaried high-tech employees (in thousands) and their ratio out of the total no. of salaried employees per year



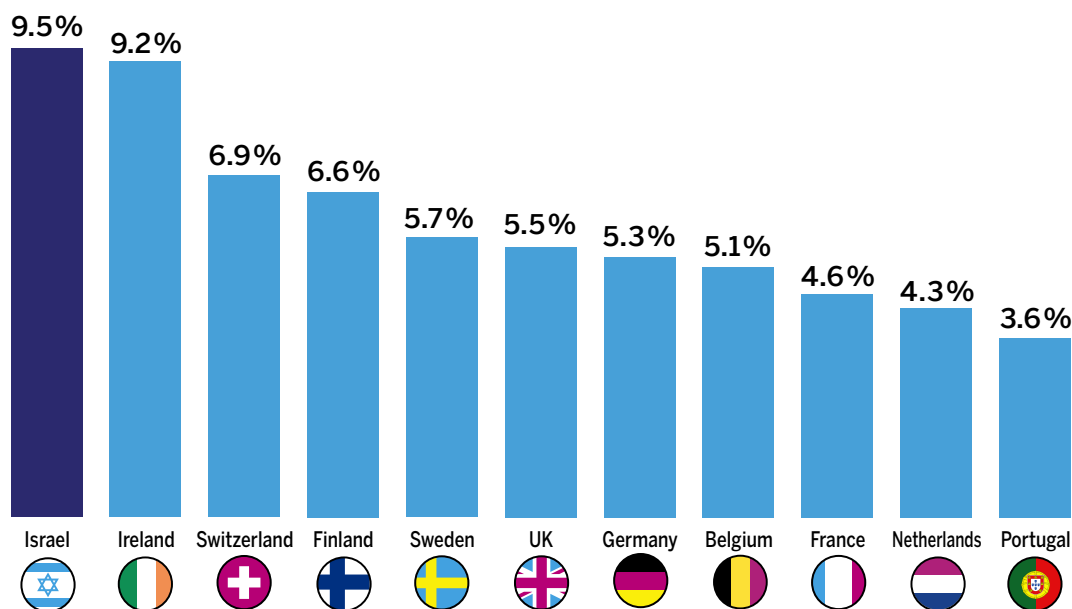
Source: Innovation Authority adaptation of CBS data

⁸ This is the average for 2021. In December 2021, the number of salaried employees in the high-tech industry stood at nearly 400 thousand.

⁹ According to an analysis conducted of high-tech sectors between 2013-2021, based on the Available Jobs Survey.

07 Israel Leads The World In Ratio Of High-Tech Employees

Ratio of high-tech employees as a % of total employees per country (2020)



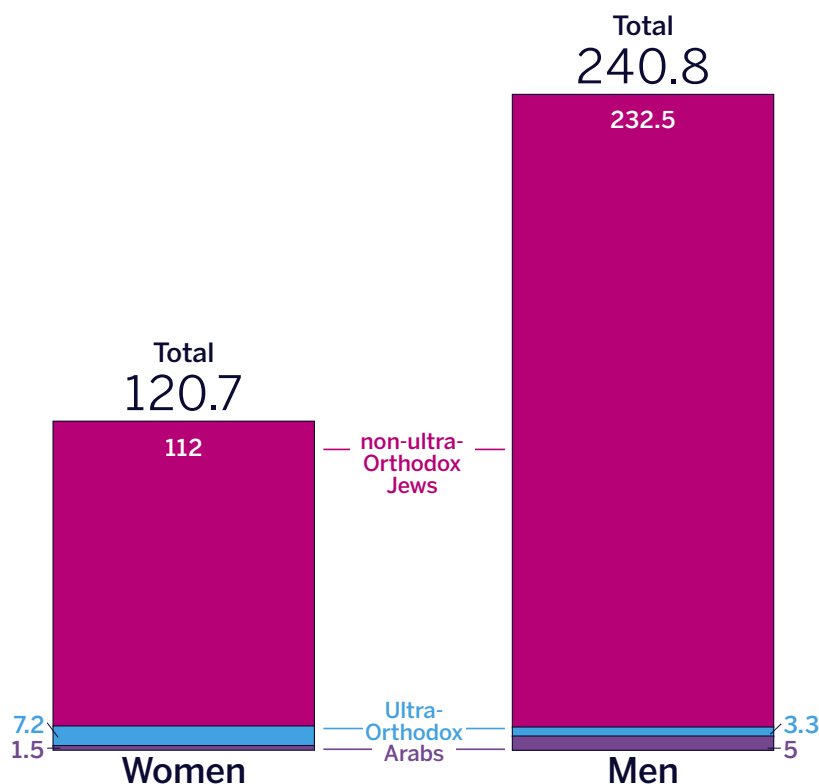
Source: CBS adaptation of Eurostat data

This growth does not however include all sectors of the population. The number of salaried high-tech employees in the Arab sector rose by just 200 in 2021, while the corresponding figure in the ultra-Orthodox sector dropped by 700 employees during the same year, according to CBS data. When searching for the positives in the data for 2021, it is worthy to note the increase of 500 ultra-Orthodox men who joined the high-tech industry in 2021 however this should be considered alongside a decline of 1,200 women employees from the same sector. This figure is an accentuation of the entire high-tech industry where the growth rate of women employees was lower than that of men – 5.9% compared to 9.1% respectively, in 2021. This disparity between men and women can perhaps be attributed to the Covid lockdown periods and restrictions that severely disrupted the education system.

In general, high-tech is preserving its homogeneity as a Jewish industry: less than 20% of its salaried employees are Arabs, most of its employees are non-ultra-Orthodox men, women comprise less than one third of all the industry's salaried employees, and ultra-Orthodox men and women comprise only 3%.

08 An Industry Of Jewish Men: High-Tech Continues To Maintain Its Homogeneity

Distribution of high-tech workers by gender and society (in thousands) in 2021



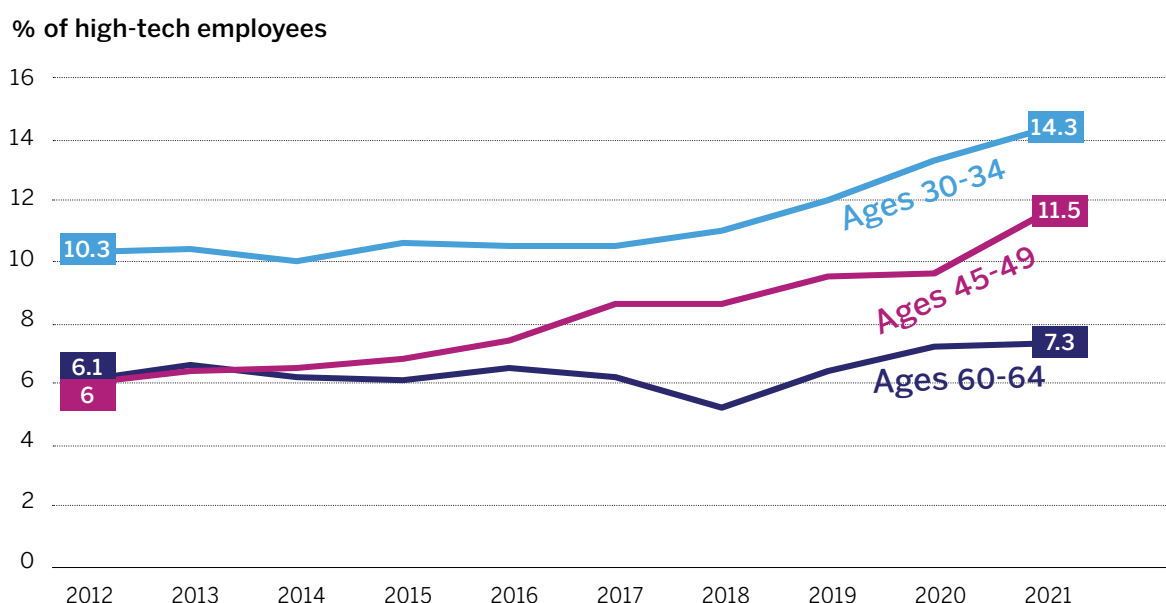
Source: CBS

As can be expected, those choosing to work in the high-tech sector predominantly belong to the younger age groups. Nevertheless, it is interesting to also note a growth in the number of people working in "high-tech" professions in industries outside high-tech. In other words, more people are employed in technology roles that contribute to advancement and digitization in all sectors of the economy at large. A study conducted by the Aaron Institute in conjunction with the Trump Foundation examined the ratio of employees in high-tech and in technology professions in the general economy. The study found that between 2012-2021, the number of those employed in technology professions in Israel rose by more than 160 thousand, with a quarter of these being employed in companies outside the high-tech industry. Furthermore, the ratio of those employed in high-tech and in high-tech roles outside the industry increased, a trend also reflected in older age groups. In other words, technology-oriented professions are not exclusive to the high-tech industry and are becoming increasingly common in all sectors of the economy.

For example, in the 30-34 age group, the ratio of those employed in technology professions in Israel stood at 13% in 2012, a ratio that remained similar until 2017. In recent years however, there has been an increase in the ratio of those integrating into technology jobs, and the figure currently stands at 19% in this age group. An examination of the ratio of employees in companies that belong only to the high-tech sector reveals a growth in this age group from 11% in 2017 to 14% in 2021.

09 High-Tech Mainly Attracts The Young - But Employment Is Increasing In All Age Groups

Ratio of high-tech employees out of all workers, by age group



Source: Aaron Institute and Trump Foundation adaptations of Human Capital Survey

The rate of participation in high-tech also rose in older age groups. For example, according to the study, in the 45-64 age group, the ratio of employees in technology professions rose from 9% in 2017 to 11% in 2021. This reflects significantly slower growth than the younger age groups, but it should be remembered that this is an age group that tends to change their occupation less frequently. The share of employees in high-tech companies in this age group rose from 7% to 9% during the same period.

As a side remark, it should be noted that workers from overseas are another possible source of skilled high-tech workers in the near future. The war currently taking place in Ukraine and its further impact on the Jews in Russian and the region may lead to waves of immigration, among others, of potential high-tech workers.

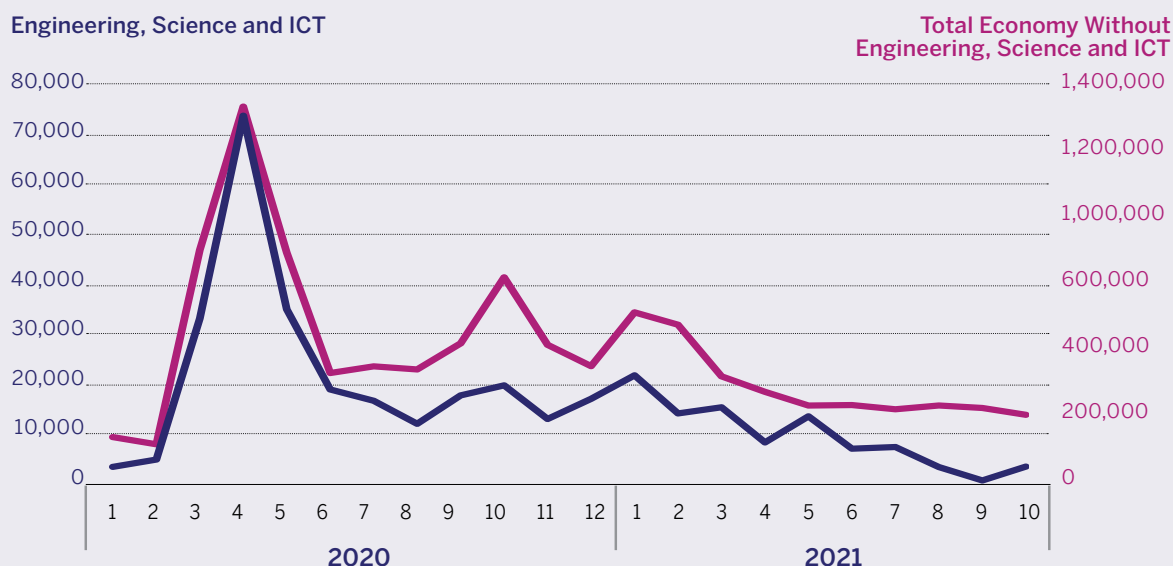
After the pandemic: high-tech unemployment has returned to its low pre-pandemic level

The Covid pandemic naturally had a serious impact on high-tech employees and on the level of employment in the industry. If the first year of Covid (2020) witnessed unemployment in the high-tech industry, that usually suffers from a chronic shortage of employees, the industry resumed "normal business" during 2021, despite new virus strings, among others thanks to the extensive vaccination campaign. Nevertheless, Covid had a fundamental impact on high-tech, namely, a significant increase in the scope of work performed from home during the past two years.

One of the signs of the high-tech industry's recovery in 2021 is an increase in the number of its new employees. If in 2020 the number of workers in the high-tech industry rose by only 14,000, in 2021 this increase nearly doubled, standing at 27,000 new employees. Furthermore, the diagram below shows that the level of unemployment among workers with technology-related vocations that typify high-tech returned to the pre-Covid level. This occurred in contrast to the total economy's general unemployment rate that remained slightly higher than the months preceding Covid.

10 No. Of Unemployed in Technology Professions Has Returned To Pre-Covid Levels

No. of workers unemployed and on unpaid leave by profession



Professions in fields of science, engineering and ICT include sectors 21, 25, 31 and 35 with and without an academic degree

Source: Adaptation of Innovation Authority and Chief Economist's Division in Ministry of Finance to CBS data



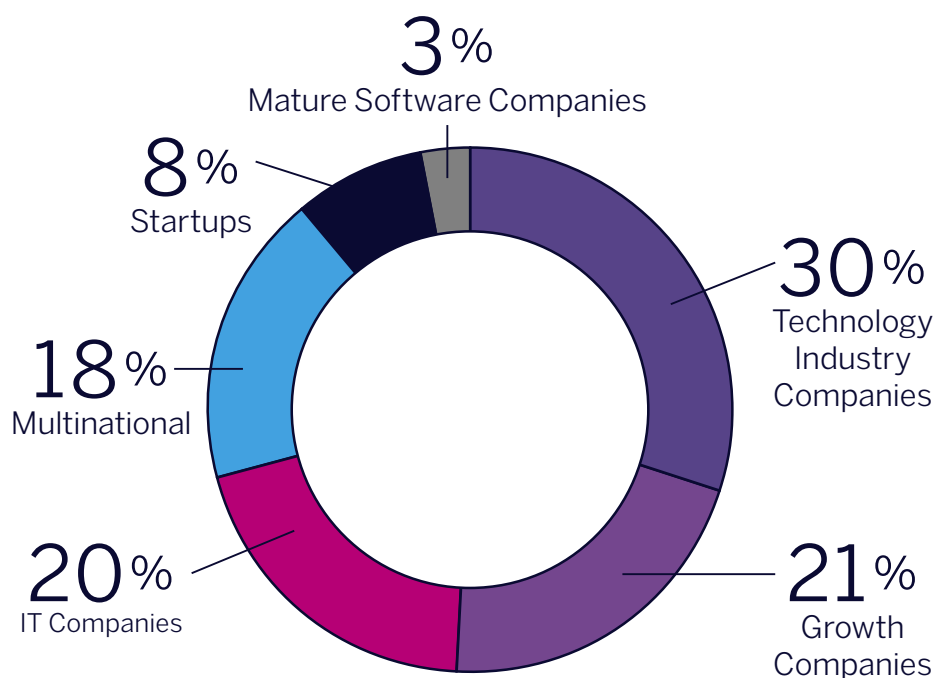
Tel Aviv is the undisputed high-tech capital of Israel and most high-tech workers are not employed in startups

As part of the preparation for compiling this report, the Innovation Authority conducted a comprehensive analysis, being published here for the first time, of the characteristics of Israeli high-tech employers and employees. Its goal was to arrive at an accurate and updated map of the distribution of high-tech workers between the different types of companies, while relating to the companies' geographical dispersion, thereby obtaining an updated picture of the industry's demographic characteristics.

The distribution of high-tech employees between the different company types reveals that despite Israel's image as the "startup nation", only 8% of the industry's employees work at companies defined as startups (i.e. young startup companies). In practice, most of them (30%) are employed at high-tech industry companies that primarily include the defense industry which is the largest high-tech employer. The next largest employers are growth companies (21%), IT companies (20%) and multinational corporations (18%).

11 Technology Industry Companies and Growth Companies Employ Over Half Of All Israeli High-Tech Workers

Distribution of high-tech workers by type of employer (2021 data or last updated figure)



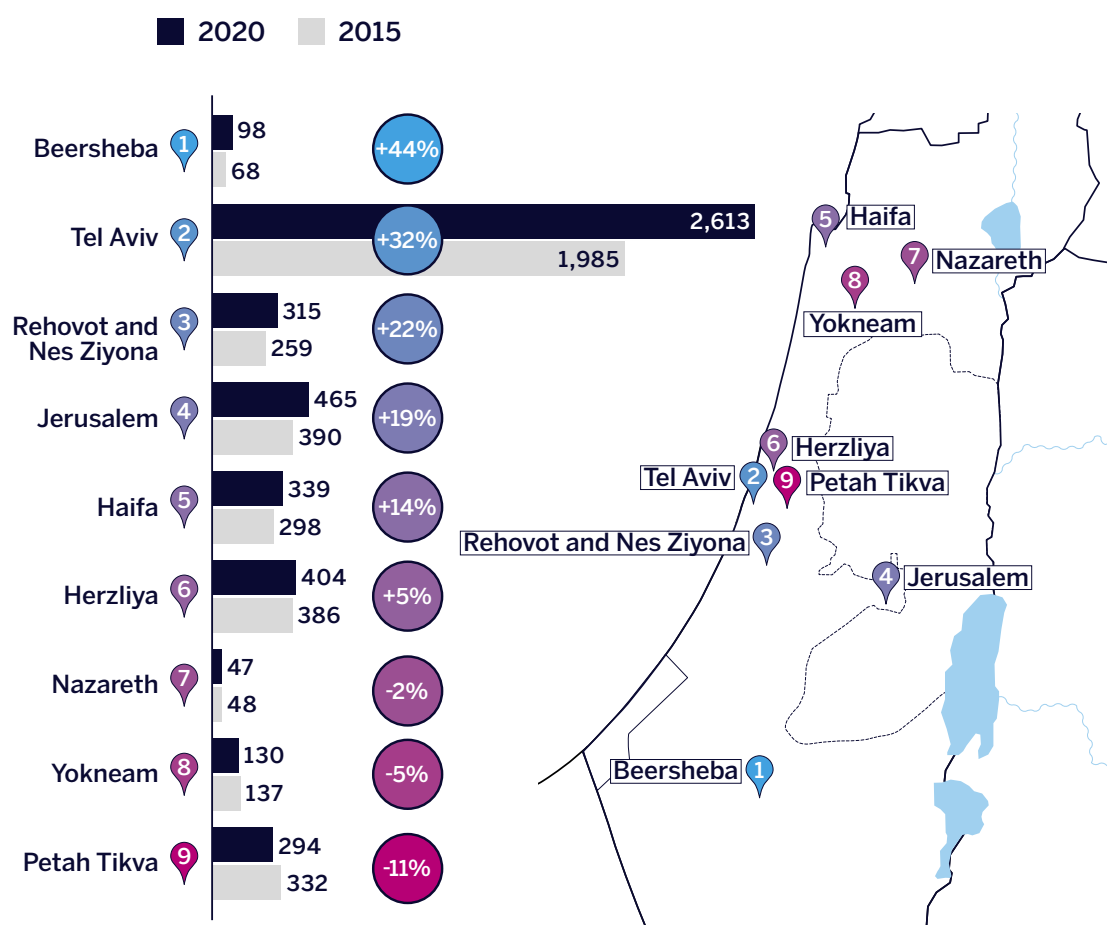
Source: Innovation Authority adaptation of CBS, STKI IT Market Study, IVC, and TASE data

Analysis of the high-tech companies' geographical dispersion reveals that Tel Aviv is home to more than one third of the companies operating in Israel and to one quarter of high-tech employees. The next cities in the ranking for number of high-tech employees are Haifa and Herzliya with 13.6% and 7.7% respectively. The neighboring cities Rehovot and Nes Ziyona collectively host 6.6% of the country's high-tech employees.

An examination of changes over time reveals that Tel Aviv is also the city in which the most technology companies were opened between 2015-2020, both in terms of the number of companies and the growth rate.¹⁰ It should be noted that although Jerusalem is home to 6.8% of Israel's high-tech companies, these employ only 4.2% of the workers. In other words, Jerusalem is characterized by an abundance of small startups and not of large companies that employ significant numbers of workers. This contrasts to Ra'anana – a city with a similar share of the country's high-tech employees (4.6%) but with less than half the number of companies (3.2% of all the companies) i.e., a city typified by a concentration of large companies rather than startups.

12 Tel Aviv Has The Fastest Growing No. Of High-Tech Companies, Petach Tikva Has Lost The Most

The no. of companies operating in each city per year, and the growth rate 2015-2020

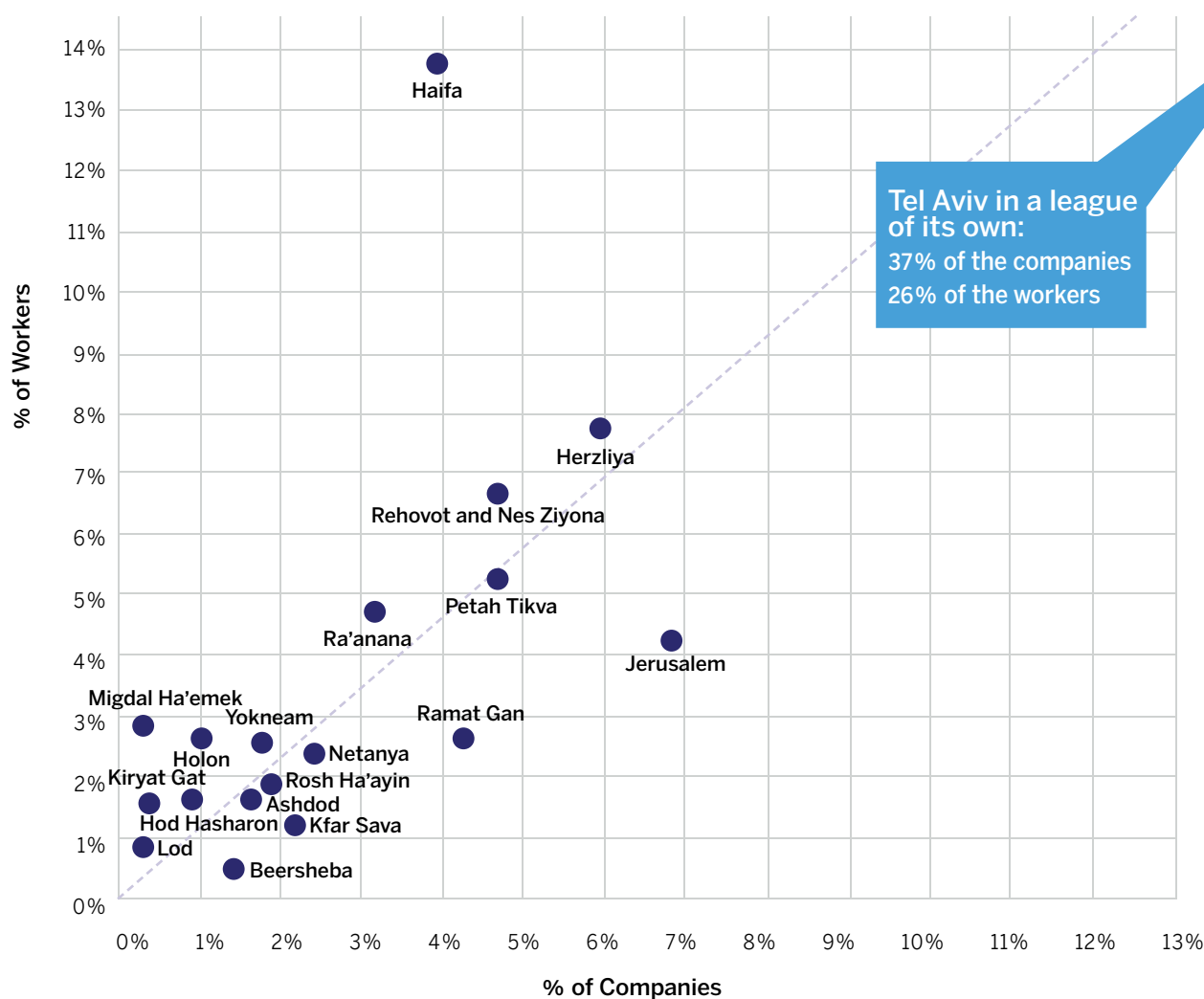


Source: Innovation Authority adaptation of IVC data

¹⁰ After neutralizing the cities with less than 100 companies in 2020.

13 Startups In Jerusalem and Mature Companies In Haifa: Distribution Of High Tech Companies And Employees

Ratio of high-tech companies operating in a city out of all high-tech companies in Israel and the % of their employees of all high-tech employees



Source: Innovation Authority adaptation of IVC data



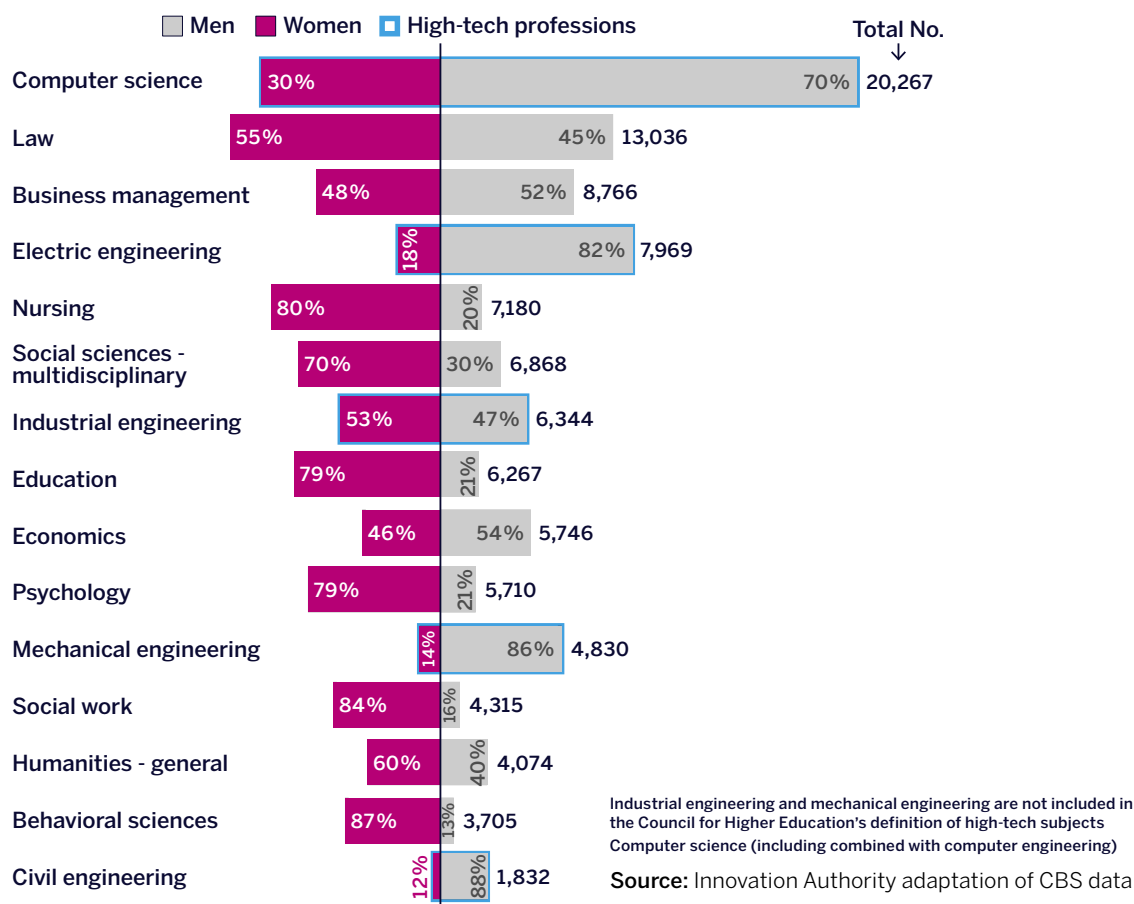
Most popular course of study in Israel: Computer Science

Young Israelis identify the opportunities waiting for them in the high-tech industry and acquire an education that will enable them to join its ranks. Evidence of this can be seen in the fact that high-tech subjects star in undergraduate students' study preferences at universities and academic colleges. Female students are however a distinct minority in these departments and only few graduate students choose to further their professionalization via more advanced degrees.

In the 2019-2020 academic year, computer science was the most popular course of study among academic undergraduate students in Israel.¹¹ The number of students in courses that included some combination of this subject stood at 20 thousand – 10.8% of all undergraduate students.

14 40% of Undergraduate Male Students and 13% Of the Female Students Study For A High-Tech Degree

Distribution of undergraduate students at universities and academic colleges, by study course and gender (2019-2020)



¹¹ Academic colleges and universities, excluding colleges of education.

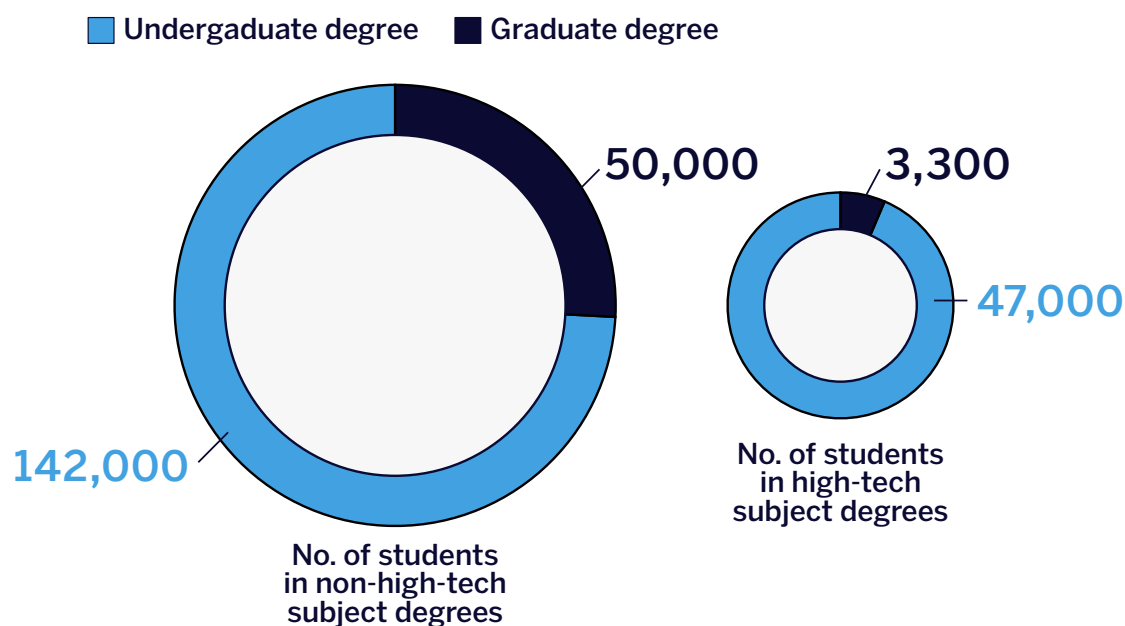
At the same time, the popularity of the different high-tech subjects is not the same among men and women. While computer science is popular to a similar degree among men and women (1st and 2nd places, respectively), electrical engineering is ranked second among male students but only 20th among female students (6,545 male students compared to 1,424 female students). Less distinctly high-tech subjects such as mechanical engineering and industrial engineering also rank higher among men (5th and 7th, respectively) than among women (33rd and 9th, respectively) who prefer to study law, education, and nursing. The ratio of female students in industrial engineering (3,394) is however higher than that of male students (2,950 in number).

Considering these gender differences in preferences it is unsurprising to find that while nearly 40% of the male students turn to high-tech subjects in academia, only slightly more than 13% of the women choose these subjects. This is a significant disparity that subsequently influences the ratio of women employed in high-tech.

Despite the large number of students choosing to study high-tech subjects, only a small proportion of them continue to more advanced degrees in this field. An examination of the number of graduate students reveals that there were only 3,000 high-tech graduate degree students in Israel in the 2019-2020 academic year, comprising 7% of those who studied for an undergraduate degree. This figure is five times higher in the other academic fields i.e., a ratio of 35% of undergraduate students who continue to graduate degrees.

15 High-Tech Graduates Do Not Progress To Advanced Degrees In This Field

No. of undergraduate and graduate degree students, by subject and gender (2019-2020)



Source: Innovation Authority adaptation of CBS data

These figures were among the considerations that led to Government Resolution No. 455 in October 2020 aimed primarily at increasing the number of research graduate students in high-tech subjects by 60%, and at doubling the number of doctoral students in these subjects compared to 2019. These goals were to be achieved by the 2024-2025 academic year.¹² One of the explanations for the choice of undergraduate high-tech students not to continue to more advanced degrees would seem to be the high salaries waiting for them when they enter the job market after their studies. The attractive conditions offered to university graduates fail to incentivize them from investing further time and resources in advanced academic degrees.

¹² See: [Government Resolution 455](#)

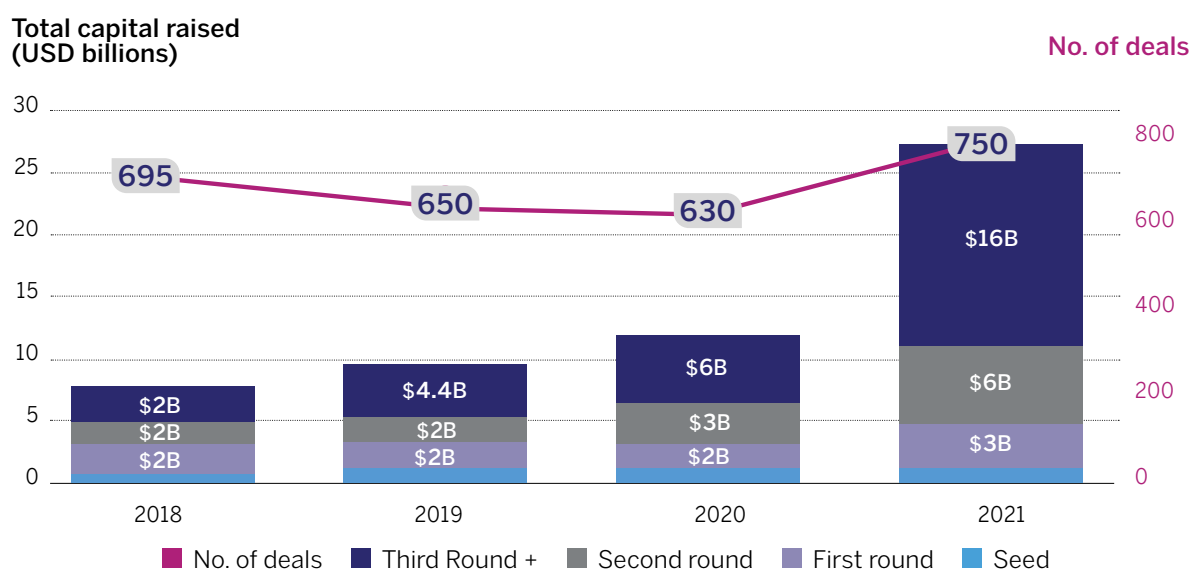


Israeli startups raised over 25 billion dollars in a year – 56% of the investments were in enterprise software, cyber, and fintech

Israeli startups continue to break fundraising records. According to the latest IVC data, 800 startups raised 27 billion dollars in 2021. The amount of capital flowing to Israeli high-tech in 2021 was more than double that of 2020.

16 Most Investments In Startups Are At Advanced Stages

Total investments in private Israeli high-tech companies per year, by funding round (USD billions)



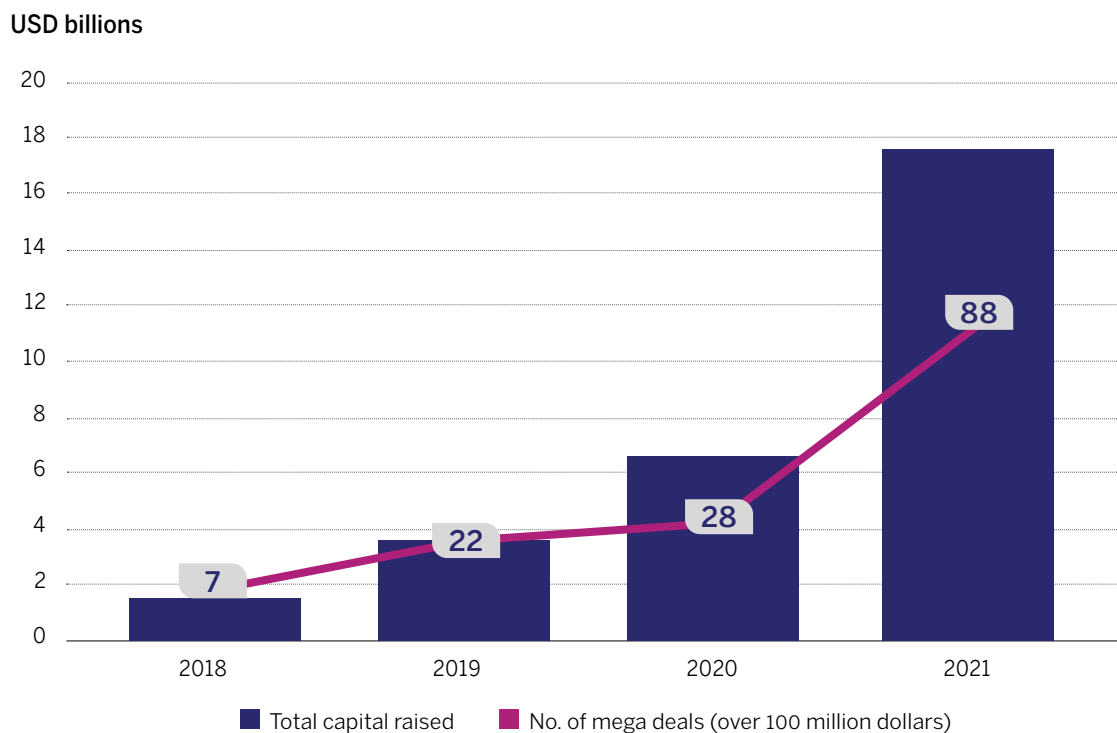
*As of April 2022, excluding loans and crypto currency IPOs.

Source: Innovation Authority adaptation of IVC data

The central contributing factor to the rise in fundraising is the increasing frequency of funding rounds, each of which raising over 100 million dollars. About two thirds of the capital raised in 2021 was in funding rounds of this size. The number of "mega" rounds increased more than tenfold within 3 years – to 88 in 2021. At the same time, the number of funding rounds grew in each stage. The rate of growth in the sum raised in seed, A, B, and later funding stages during 2021 was 60%, 80%, 110%, and 160%, respectively.

17 The No. Of Mega Fundraising Deals Rose Tenfold In 3 Years

No. of mega deals (over 100 million dollars) of private high-tech companies per year



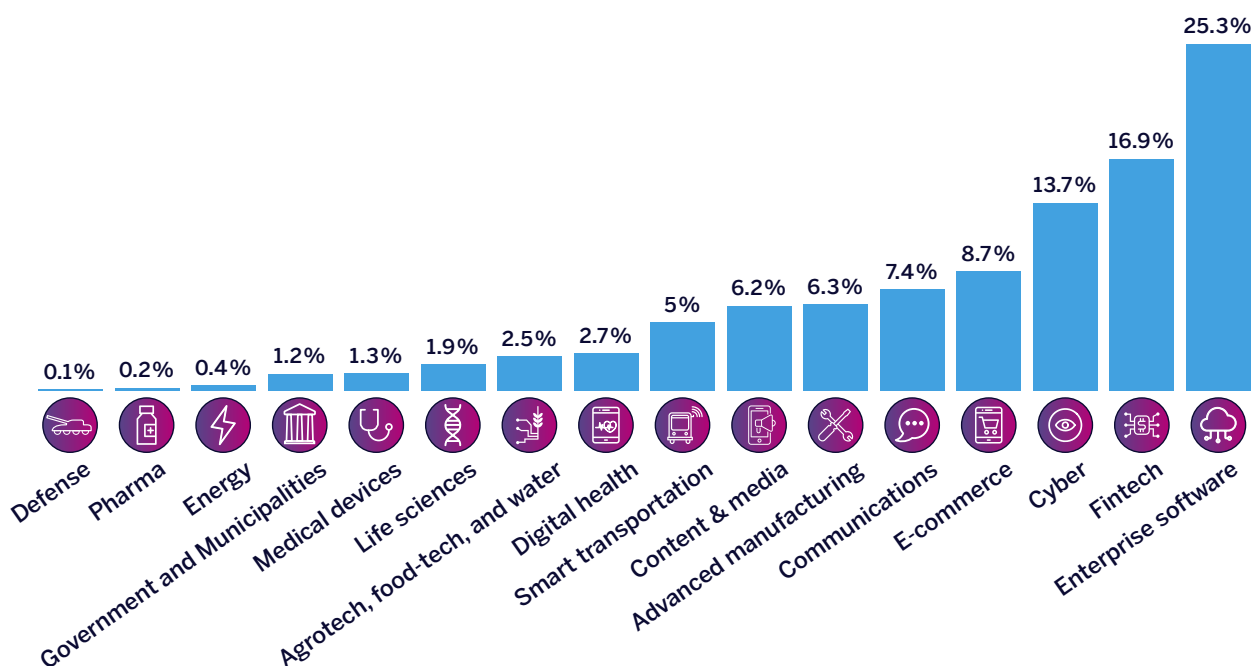
Source: Innovation Authority adaptation of IVC data

Regarding the areas of activity of the companies that raised capital during 2021, the leading field was enterprise software that attracted 27% of the capital raised. Two other fields that continued to concentrate investors' attention were fintech and cyber that together constitute 38% of the capital raised by startups in Israel. In other words, over half the total capital attracted by Israeli high-tech in 2021 reached only three fields. This figure indicates a high concentration of investor interest. Fields that attracted less attention from investors were agriculture, energy, and life sciences that together attracted only 10% of the capital raised.

In recent years, private market investments in Israeli startups, primarily via venture capital funds, were focused mainly in software companies, and in companies from the high-tech services sector in general. The private market follows global trends in and demands for technologies in this field. The fact that most of the investments are concentrated in a limited number of fields that benefit from especially large funding rounds is also reflected in the current composition of the more mature companies that have grown in Israel. Moreover, these investments are expected to determine the composition of the large mature companies in Israel in the coming years.

18 Enterprise Software, Fintech, and Cyber Startups Attract Most Of The Investors

Distribution of investments in private high-tech companies by area of activity (2021)



The mirror image of the giant investments in software fields is the startups and companies in the fields of hardware and high-risk areas that are characterized by longer development processes and that enjoy almost none of the prosperity in the high-tech industry. In other words, the existing situation will affect the technological and industrial diversity in Israel in the years to come. There is therefore scope for reconsidering government investment in R&D, including increasing its ratio vis-à-vis GDP, in a way that also contributes to the diversity of high-tech in areas characterized by higher risk. Increasing government investment will contribute to the reduction of Israel's high dependence on foreign capital in favor of investments in R&D and to the ramifications of the expected macro-economic changes as the result of global transition from the low interest rate environment.



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Israel Innovation
Authority



Part B:

What Will Enable the Next Quantum Leap of Israeli High-Tech?





The Next Quantum Leap of Israeli High-Tech:

It seems as if Israeli high-tech has existed forever, but it is actually one of the younger sectors of the local economy. In a relatively brief period over the past few decades, Israeli high-tech has established itself as a significant factor in the local economy, not only contributing to employment, exports, and other important macro-economic indices. The Israeli economy has become largely dependent on the high-tech sector. Israeli high-tech has enjoyed accelerated growth in recent years, a phenomenon that is expressed by the emergence of Israeli technology companies that are not seeking a quick "exit" sale to multinational giants, that raise unprecedented sums of funding, and which go public and are traded on the stock exchange. Furthermore, these companies also employ large numbers of employees in Israel and overseas and enjoy large-scale sales revenues.

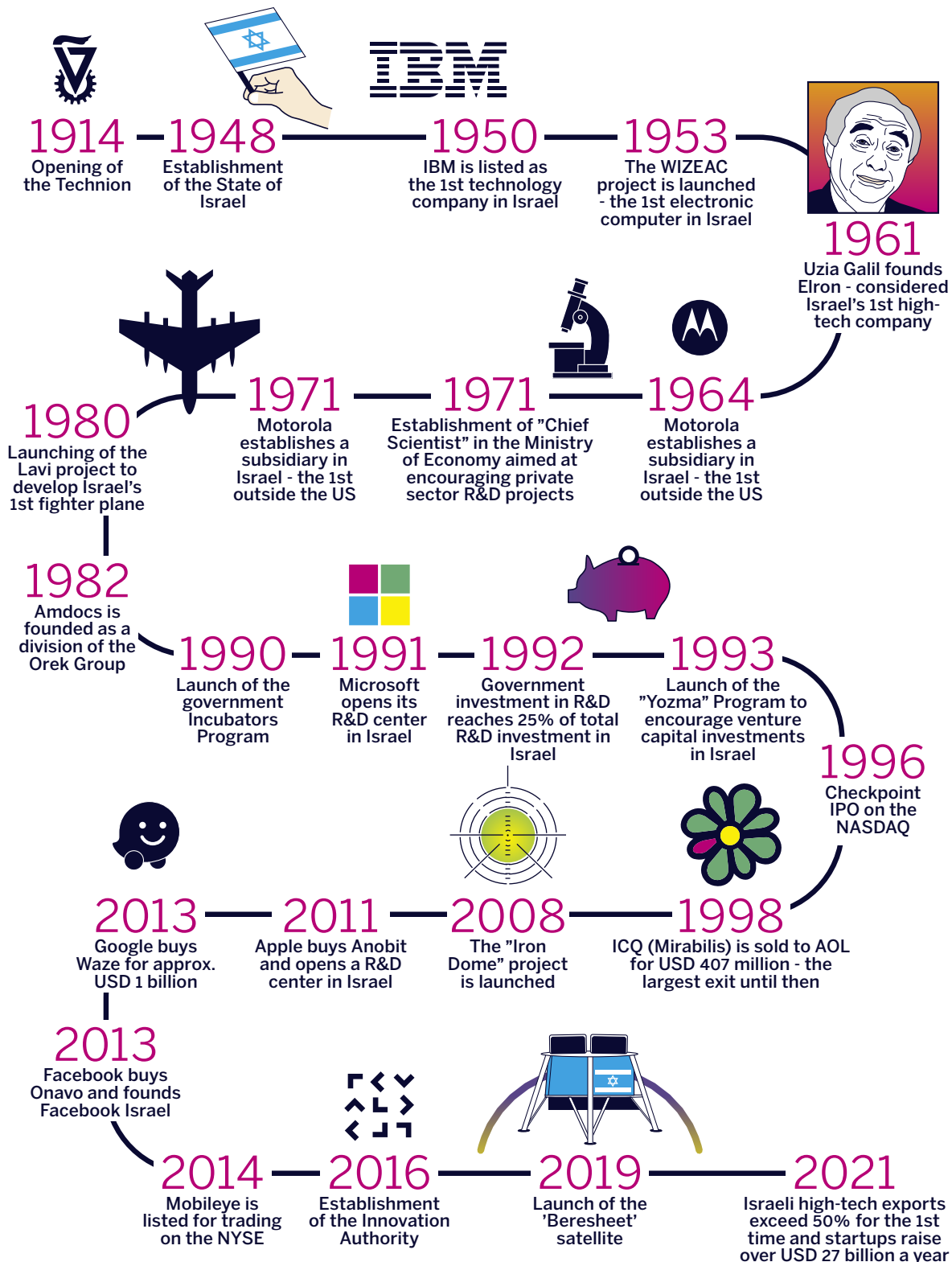
Israeli high-tech relies, among others, on excellent human capital, world-leading academic institutions, and venture capital investors that facilitate the development of local startups. Israeli high-tech also includes companies from the defense industry that are at the forefront of technological development and multinational corporations which develop innovative solutions in Israel while also serving as investors, buyers, and partners of local startups throughout the different stages of their existence.

The past two years signify a turning point for the Israeli high-tech industry that has now reached a more mature stage of its development. Among the current period's characteristics are the large number of Israeli startups that have become public companies, and the Covid pandemic's impact on the labor market. As a result, the challenges confronting the Israeli high-tech industry and the relevant solutions are also changing.

Since the inception of Israeli high-tech, the state has played an important role in removing obstacles and laying infrastructures to advance Israeli innovation. For example, in its very early stages, Israeli high-tech contended with serious funding challenges. In response, during the 1990s, the government laid infrastructures critical for the growth of the Israeli venture capital sector via the "Yozma" program and strove to solve funding problems of R&D-oriented startups via programs that provide them with direct financial support. At the current point in time, Israel is home to an extensive and strong high-tech industry and funding difficulties have abated. These difficulties exist today primarily in the companies' early life stages and in especially high-risk areas that are generally characterized by deep technologies, long "time to market" (TTM), or regulatory obstacles. This trend has been manifested in recent decades by a decline in the level of government expenditure out of total investments in Israeli high-tech from 25% at the beginning of the 1990s to less than 2% today. In other words, the private market has almost totally assumed the role filled previously by the state at the industry's outset and has now become the primary funder of high-risk innovation in Israel.

Today, alongside the change in the Israeli innovation arena, the government's role within the industry must also be revised in order to meet existing needs and to enable Israel's next quantum leap. The goal is to enable Israel to preserve its position as a global technology leader while facilitating an improvement in the level of technological innovation available to Israeli citizens.

19 Significant Milestones In The Development Of Israeli High-Tech



What are the Revised Needs of Israeli Innovation in the Current Era?

The Israeli innovation hub competes with other global hubs of innovation, that include cities or small countries such as Paris, Toronto, Sweden, Singapore, Switzerland, Boston, Berlin, Chicago, Seattle, and Ireland. Israel leads the group of hubs in metrics such as the number of young seed-stage startups, ranks second in the absolute number of high-tech employees, and fifth in the number of high-tech employees per capita. In contrast however, Israel's ranking in other metrics has deteriorated e.g., the level of venture capital investments it attracts. According to 'CrunchBase' data, while the relative share of investments in hubs such as those in Berlin and Paris has grown in the past two decades, the share of venture capital investments flowing to Israel declined during the same period from 18% of total investments in the hub groups examined to 11%.

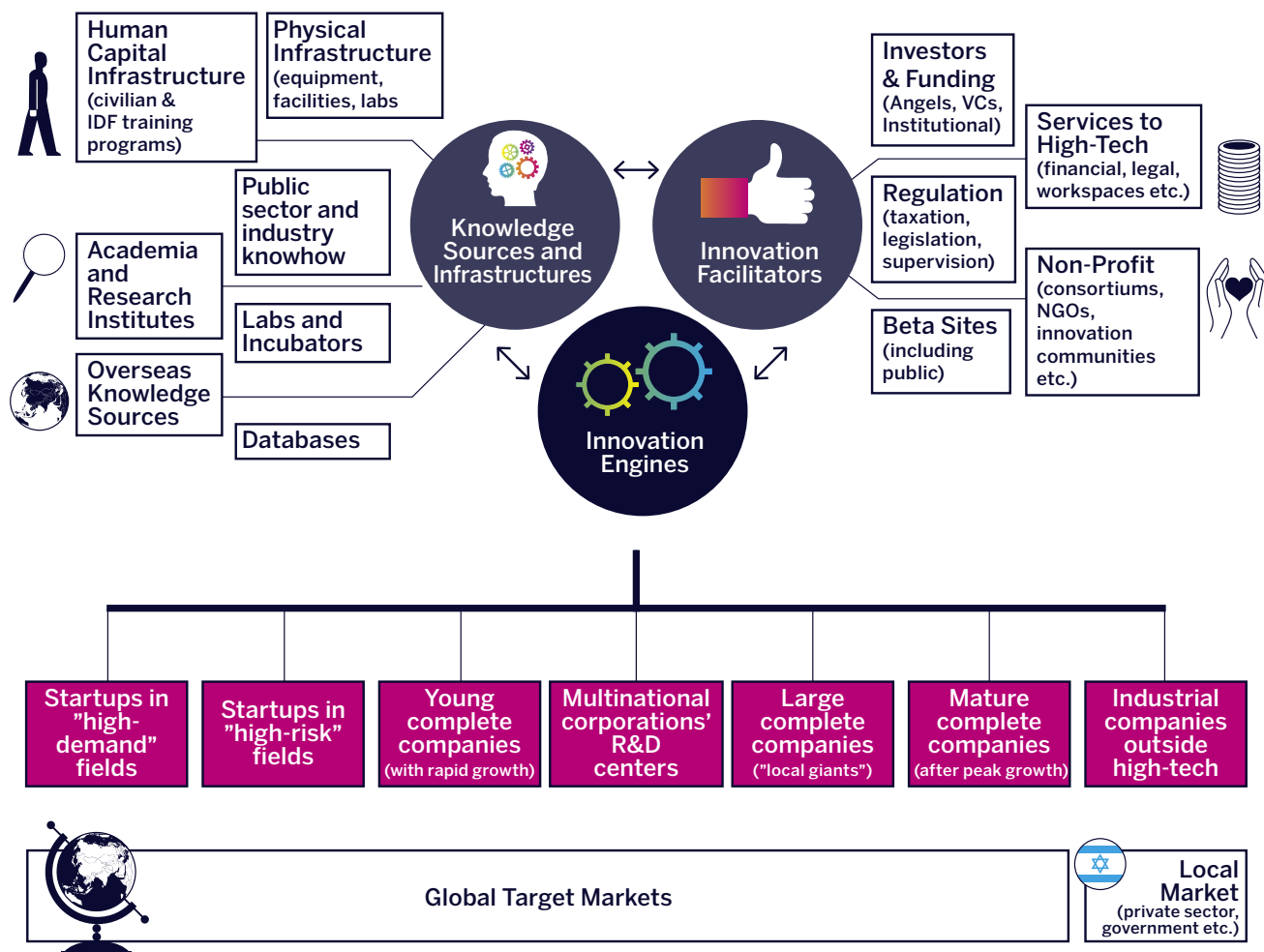
To ensure that Israel maintains its leading position vis-à-vis other global innovation hubs, solutions must be found for the challenges facing Israeli innovation. These challenges can be divided into two central groups: the first includes the current commercial needs of the Israeli high-tech industry and of the companies themselves. The industry consists of a diverse range of organizations including startups in "high-demand" and/or high-risk fields, growth companies, local giant companies, and multinational corporations' R&D centers. The challenges relevant to the Israeli high-tech industry include, among others, a severe shortage of technology workers, guaranteeing readiness for future technology trends, reinforcement of the growing and whole companies in Israel, and exposing the companies to overseas markets.

The second group of challenges is related to connecting Israeli innovation to the local private and public sectors. A disparity exists today between the groundbreaking innovation developed by Israeli high-tech employees in Israeli and global companies, and the level of digital and innovative services available to the Israeli public. In other words, "the shoemaker's son always goes barefoot". In this sense, the Israeli public does not benefit from Israeli innovation in the course of its daily life. The challenges related to this issue include removing obstacles to enable the experimentation and assimilation of pioneering technologies in Israel, funding R&D and innovative infrastructures in companies that are not part of the high-tech industry and in the public and private sectors, encouraging innovation-based management in non-technology companies, assimilation of advanced technology in the economy, and training workers in the skills needed for engaging in innovation.

The solutions that will meet the updated needs of the industry involve players from all parts of the Israeli innovation ecosystem, including the "innovation engines" themselves i.e., the entities that engage in developing technologies (including startups, growth companies, R&D centers etc.). In addition, apart from the innovation engines, it is worthwhile to note the "innovation facilitators" – the institutions responsible for the infrastructures and services (including venture capital and other investors, different regulators, training entities etc.), and the sources of knowledge – organizations that create scientific, technological, or other unique knowledge that can be transformed into innovation. For example, academic institutions and research institutes or the end clients themselves who possess knowledge about their innovation needs. Connecting the entities that belong to these three groups generates innovation that is subsequently used by end clients in diverse Israeli and global target markets.

The Innovation Authority, as an advisory entity to the Israeli government in the fields of innovation, is also currently required to adapt itself to the new reality. As part of the new role the Authority is assuming, it is also updating its existing solutions' offering, which until now, focused primarily on direct financial support for companies. The Innovation Authority's role makes it a mediating entity that enables the achievement of the next quantum leap of Israeli innovation, for example, by addressing the economy's significant challenges in the fields of housing and transportation. Later in this section of the report, we will present a detailed examination of two central challenges facing Israeli innovation: connecting Israeli technology companies to academia in order to ensure continued innovative R&D that enables their continued growth; and connecting Israeli innovation to the public and private sectors in Israel with the aim of enabling them to provide the Israeli public with advanced services. We will thereby gain an in-depth understanding of the problems and their significance, and present alternative solutions based on the Innovation Authority's new strategy.

20 Map Of Israeli Innovation Hub





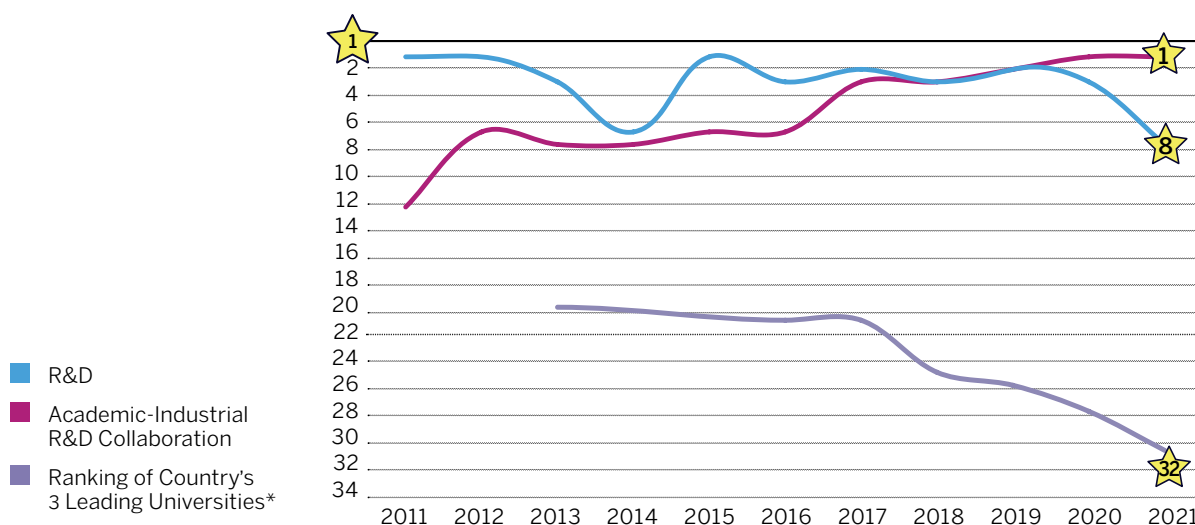
The Unrealized Potential of Israeli Technology Companies: Collaborations Between Industry and Academia

A significant proportion of the historical breakthroughs in the world of technology are based on research that originates in academia. In the research laboratories, scientists and researchers uncover new discoveries, the commercial application of which creates a new world of developments and progress. The prominent examples in Israel over recent decades are the Copaxone medicine developed by Prof. Ruth Arnon from the Weizmann Institute in conjunction with TEVA, and the computerized vision system for motor vehicles developed by Prof. Amnon Shashua from Hebrew University that led to the foundation of the Mobileye corporation.

Overseas, the largest technology companies, recognizing the importance of collaborations with academia for their continued growth, strive to establish such collaborations, with some even maintaining their own labs in academic institutions. A look at Israel reveals a slightly complex picture. On the one hand, Israel is ranked first in the world in the field of collaborations between academia and industry according to the Global Innovation Index (GII). Nevertheless, an in-depth examination reveals that this flattering fact stems primarily from the activity of the foreign companies that operate development centers in Israel. IBM and Microsoft alone are responsible for half of the research collaborations. In total, 85 percent of the collaborations between industry and academia are undertaken by multinational companies.

21 Israel Has Become A World Leader In Collaborations Between Academia And Industry, But The Level Of Research And Its Academia Is Declining

Israel's ranking over time in selected GII metrics



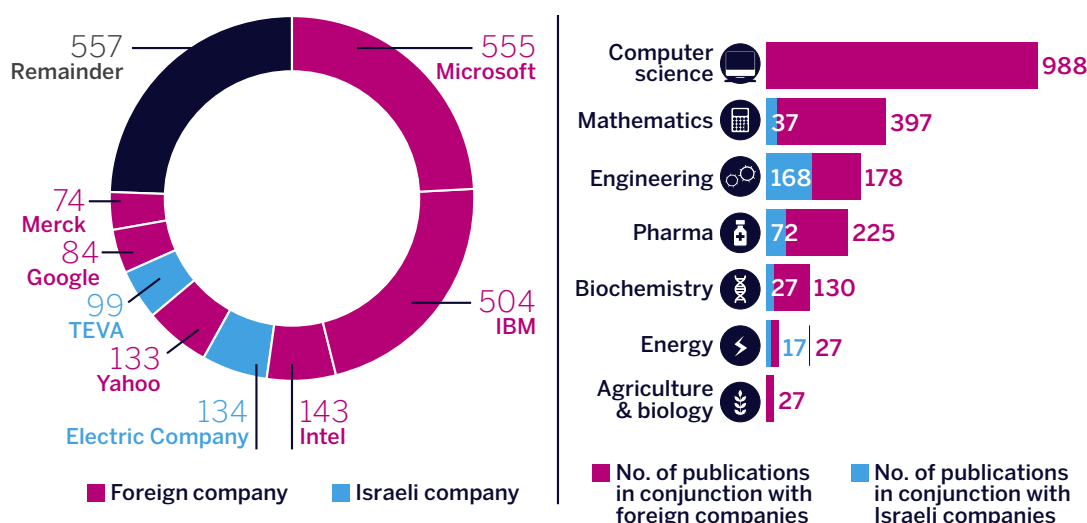
Source: Global Innovation Index data

*Based on the British Quacquarelli Symonds (QS) Index surveying over 1,000 global academic institutions

In contrast, the local technology companies make almost no use of this avenue and focus instead mainly on internal organizational R&D that relies on the expertise and human capital at their disposal. The exceptions to this rule in Israel are the Israel Electric Company, TEVA, and the defense industry companies Rafael, Israel Aerospace Industries, and Elbit. One surprising finding is the small number of collaborations between Israeli companies and academia in the fields of computer science, the fields with most collaborations, comprising over 20 percent of academic research output in Israel.¹³

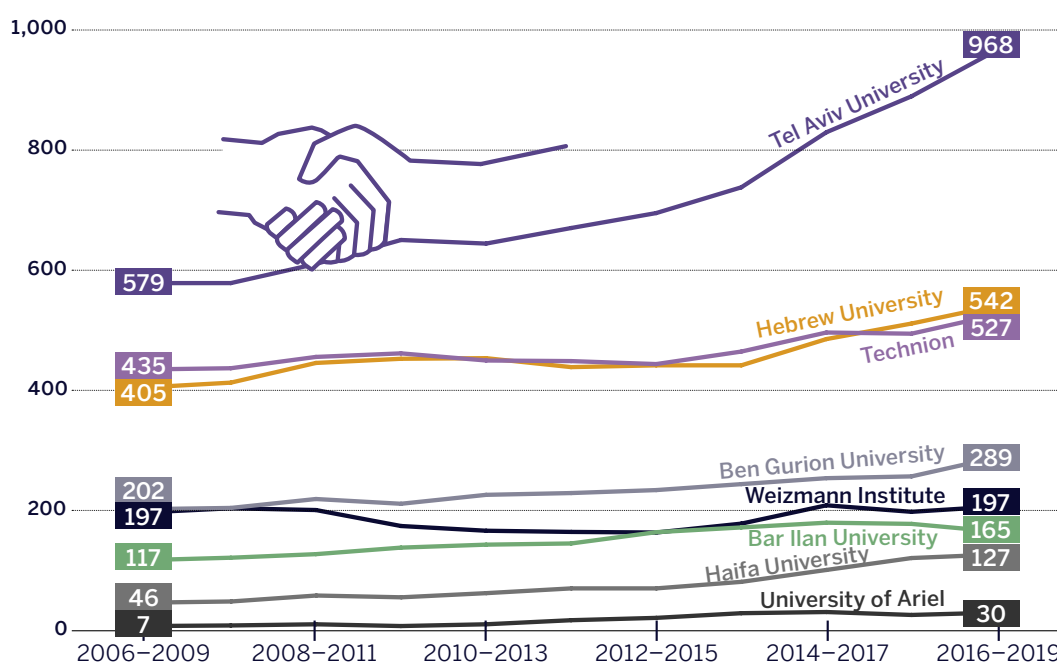
22 Most Of The Value From Collaboration With Academia Reaches Foreign Companies

Business partners in funded academic research 2012-2016, by company and field



Source: Neaman Institute, R&D output in Israel, Scientific Publications, 2018 (2012-2016 data)

No. of publications in conjunction with at least 1 industry entity



Source: Innovation Authority adaptation of CWTS Leiden Ranking data for 2021

¹³ See [the report published by the Samuel Neaman Institute on the outputs of R&D in Israel: Scientific Publications](#) – An International Comparison, 2021 (Heb).

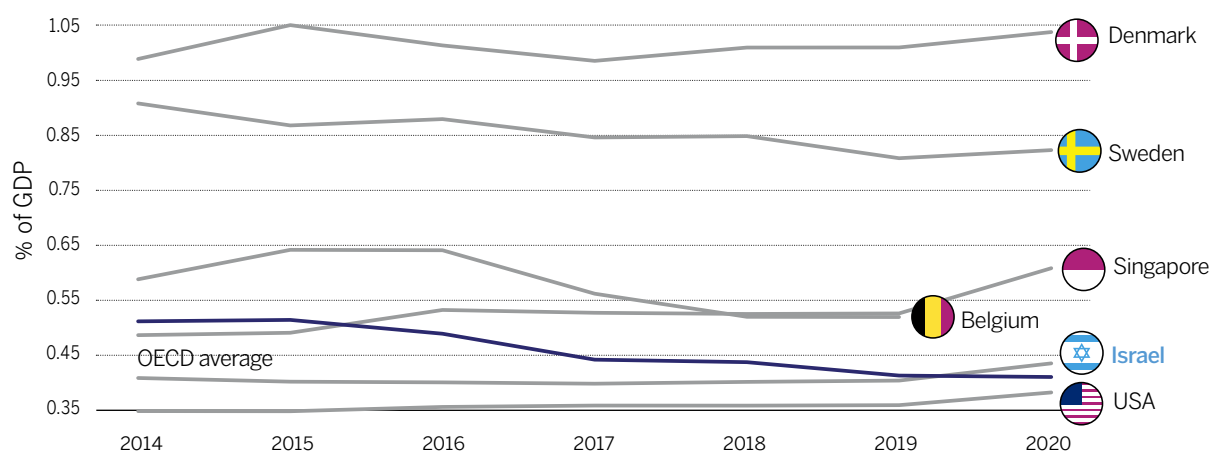
Israel ranks high (and is still improving) in the international index of per capita investment in R&D however, an opposite trend can be detected in Israel's ranking in per capita academic investment in R&D (from 3rd in the OECD in 2006 to 26th in 2018)

This is a long-term trend that indicates a significant erosion in the level of competitiveness of Israeli academia and may, in the decades to come, influence future developments on which Israeli high-tech will rely.

23 Ongoing Erosion Of Israel's Ranking In Academic Investment In R&D And Academic Output

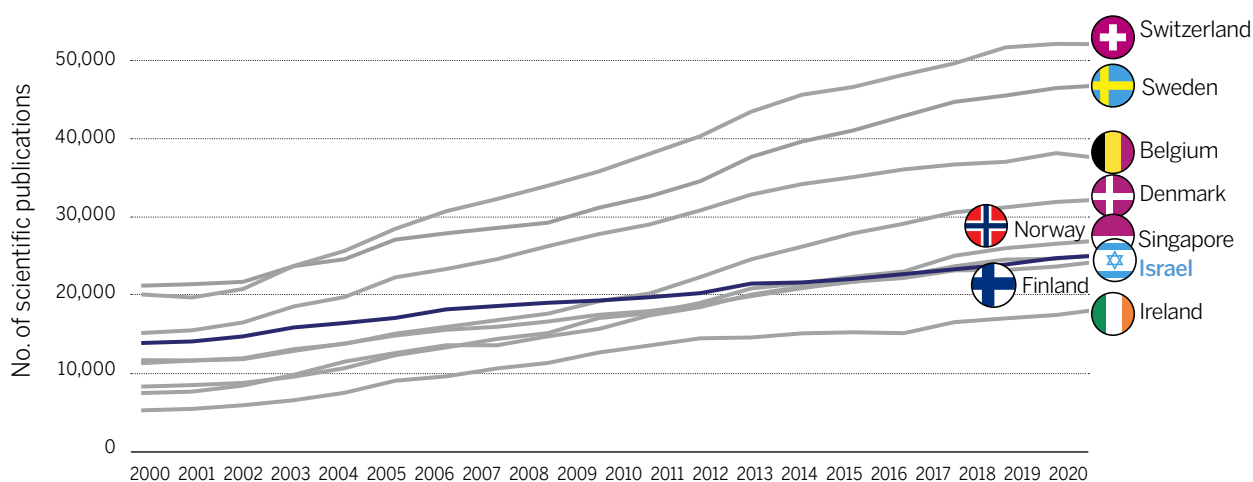
Academic investment in R&D as a % of GDP, the change in the no. of scientific publications and the no. of most highly cited articles – Israel and benchmark countries

➤ Academic investment in R&D as a % of GDP



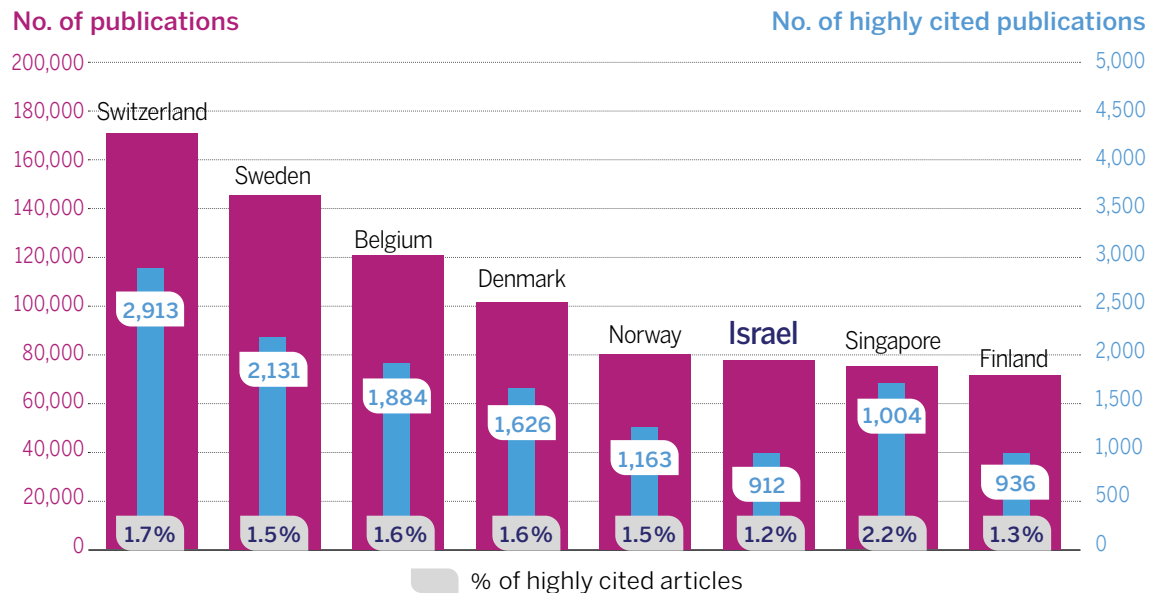
Source: Innovation Authority adaptation of OECD data

➤ Change in no. of scientific publications - Israel and benchmark countries 2000-2020



Source: Samuel Neaman Institute adaptation of bibliometric database figures

➤ No. of most highly cited articles in the field - Israel compared to selected countries 2018-2020



Source: Samuel Neaman Institute adaptation of bibliometric database figures

Strengthening the collaboration between academia and Israeli industry may prove to be a win-win factor benefitting both parties. On the one hand, Israeli companies may find academia to be a source of high-quality research human capital that can meet the needs of the industry which suffers from a chronic shortage of workers. On the other hand, this human capital from academia will expose Israeli companies to advanced knowledge and will enable them to make the next quantum leap and further extend their ability to continue being innovative and competitive on the global market.

As far as Israeli academia is concerned, it may find Israeli industrial companies, that have in recent years benefitted from the injection of significant capital, to be a source of innovative research questions with high commercialization potential. These collaborations can lead to a growth both in the number of high-quality articles emanating from Israel (that is relatively low in relation to the benchmark countries),¹⁴ and in the income of the knowledge commercialization companies in academia. These incomes have suffered an ongoing and significant decline from approx. NIS 1.9 billion in 2012 to just NIS 500 million in 2019. Furthermore, this collaboration may also increase the number of startups that are based on academic knowledge which, although increasing somewhat in recent years, still stands at only several dozen each year.

24 Academia's Income From Knowledge Commercialization Is Declining

Income of commercialization companies in millions of shekels from sale of intellectual property

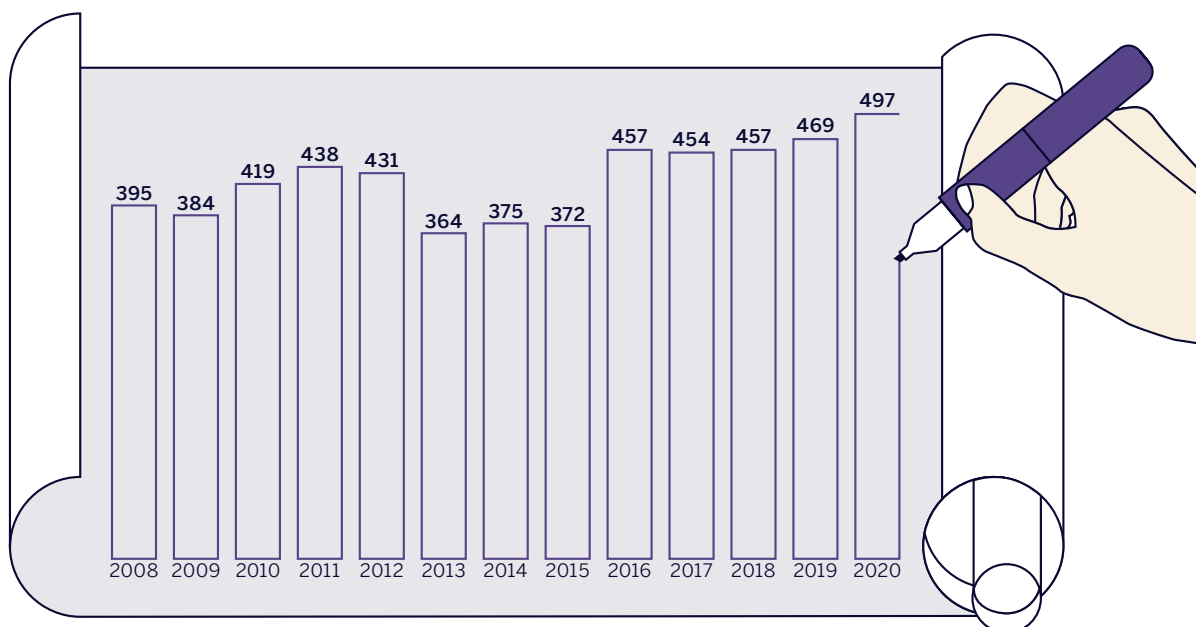


Source: Innovation Authority adaptation of CBS data

¹⁴ See the report published by the Samuel Neaman Institute on R&D outputs in Israel: Scientific Publications – An International Comparison, 2021 (Heb). The benchmark countries are small developed economies – Belgium, Denmark, Norway, Singapore, Finland, Sweden, and Switzerland.

25 Patent Requests - No Significant Change Over Past Decade

No. of commercialization companies' patent requests



Source: Innovation Authority and Shaldor adaptation of CBS data

The importance of collaboration with academia is further reinforced by the fact that it enables brainstorming that ultimately generates the development of novel ideas. A study conducted in 2021 by the Samuel Neaman Institute on the Innovation Authority's Consortiums Program examined the benefits for each of the parties involved in the joint research. The Consortiums Program creates collaborations between companies from Israeli industry, including startups, and academic research groups for self-development of groundbreaking pre-product technology. The Samuel Neaman Institute study, that was based on questionnaires answered by 250 researchers in academia and industry, revealed that this joint brainstorming is one of the main reasons for entering joint projects.

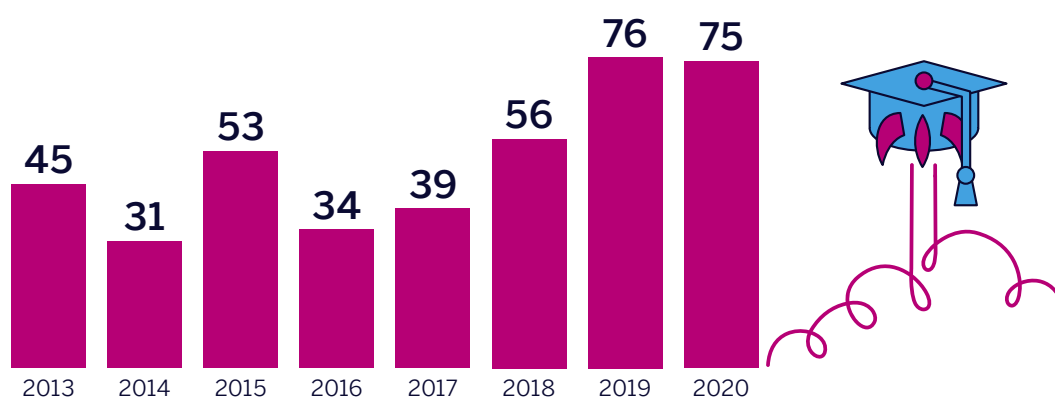
The study also found that the creation of trust and commitment between the two partners is the prime motivation for collaboration, for both academia and industry equally.¹⁵ According to this study, the main outputs of the consortiums' collaborations are academic articles and patents, indices that have both suffered from stagnation in Israeli academia in recent years. One should note the activity of Tel Aviv University that has shown significant growth via several collaborations with industry. This may stem from the concentration of Israeli high-tech activity in the city.

¹⁵ Leck, Eran. Gilad, Vered. Getz, Daphne and Tziporfal, Sima (2022). Evaluation of R&D Instruments for Fostering Academia-Industry Collaboration: The Case of the Magnet Consortia. The Samuel Neaman Institute for National Policy Studies (Forthcoming).

Another significant warning sign for the quality of the research at the foundation of Israeli high-tech comes from the maturation of the industry expressed in the significant wave of IPOs of Israeli technology companies during the last two years. Studies show that the level of innovation in a company declines by 40 percent following an IPO,¹⁶ a decline that does not stem from a drop in the scope of R&D activity, which is unchanged, but rather, results from a change in focus of the company's R&D activity that becomes more conservative and less original, becoming directed towards profit margins. This change in the company's R&D strategy is primarily expressed in the departure of leading inventors and the decline in productivity of those who remain. In other words, the level of innovation in the wave of current Israeli unicorn companies, and in those that recently conducted an IPO, may be adversely affected, and decline in coming years. To compensate for this, and to maintain the Israeli ecosystem's growth and level of competitiveness, Israeli technology companies must diversify the sources of their R&D, among others by creating collaborations with Israeli academia. At the same time, effort must be made to ensure that Israeli academia has access to the means necessary to conduct international standard studies.

26 After Years of Stagnation, The No. Of Academic Startups Is Showing Signs Of Growth

No. of academic startups



Source: Innovation Authority and Shaldor adaptation of CBS data

¹⁶ It should be noted that the companies strive to compensate themselves by recruiting new employees, opening startup subsidiaries and, mainly, via mergers and acquisitions.
See Bernstein, Shai. "Does going public affect innovation?", The Journal of Finance 70.4 (2015), 1365-1403.

Strengthening Collaboration Between the Industry and Academia for a Better High-Tech Future

Several insights arise from the picture presented above: first, collaborations between industry and academia are based primarily on large and stable companies with a significant cashflow that can afford long periods of development. In Israel, we see that although there is a fair number of Israeli technology companies with significant cashflow,¹⁷ these collaborations are overwhelmingly based on large international companies. Second, in recent years, Israeli academia has generated world-class research, also attracting the interest of companies with global deployment, although this situation may change due to the relative decline in research investment in Israeli academia compared to the rest of the world. Third, the current wave of prosperity experienced by the Israeli high-tech sector, that is expressed in the creation of whole public technology companies alongside the opening of fewer new startups, may actually lead to a decline in the quality of R&D conducted in Israel.¹⁸

Therefore, action should be taken to bolster the research activity in Israeli academia in general and, specifically, the research collaboration between Israeli academia and Israeli technology companies. The Innovation Authority operates several programs aimed at creating collaboration between academia and industry, primarily the Consortiums Program described above. As part of this program, 38 consortiums were opened between 2010-2021 with the participation of hundreds of large companies, small and medium-sized companies such as Evogene, Senseera, AccuBeat, and Polygon, as well as dozens of academic institutions including all the Israeli universities.

Furthermore, because there is generally a significant culture gap between industry and academia, manifested for example in the different pace of work, objectives, and goals, the Authority operates two programs aimed at creating collaborations between an individual researcher or small group of researchers and a single supporting company that identifies commercial potential in the research and is maybe even interested in adapting it for its own needs. The first of these programs is the Applied Research in Academia Program that aims to bridge the gap between knowledge created in academia and the needs of the industry, and to create technological proof of concept (POC) for the preliminary research achievements. The second program is the Knowledge Commercialization Program that aims to validate the knowledge, adapt it to the company's needs, and train the company's employees, in order to reduce the existing obstacles in commercializing knowledge from academia.¹⁹

A good example of the value that a small company can derive from the Authority's programs supporting academia and from the collaborations with industry is the Senseera corporation that began operating with an applied academic project supported by the Authority. As part of the project, an innovative method was developed in the lab of Prof. Nir Friedman from the Institute of Life Science and the School of Computer Science and Engineering at the Hebrew University to diagnose a wide range of diseases via a simple blood test. Using a unique and sensitive technique, the development helps identify dying cells in different body tissues, thereby enabling to identify a range of different disease situations with a single blood sample, including various forms of cancer, and heart and liver diseases. Based on this knowledge and with the support of external investors, the company was established while commercializing the academic knowledge and has since become a world leader in its field. Today, the company is leading the establishment of a medical fluid diagnosis consortium consisting of more than 20 different entities: academia, hospitals, biological banks, and other companies from the fields of sensors and deep genome analysis. The consortium's goal is to develop the next generation of disease diagnosis based on a wide range of biological signals, using Artificial Intelligence.

¹⁷ 25 technology companies traded overseas (90% of them on the NASDAQ) and with a connection to Israel reported a net profit of over USD 10 million in 2020. More than half of them reported profits of over NIS 100 million.

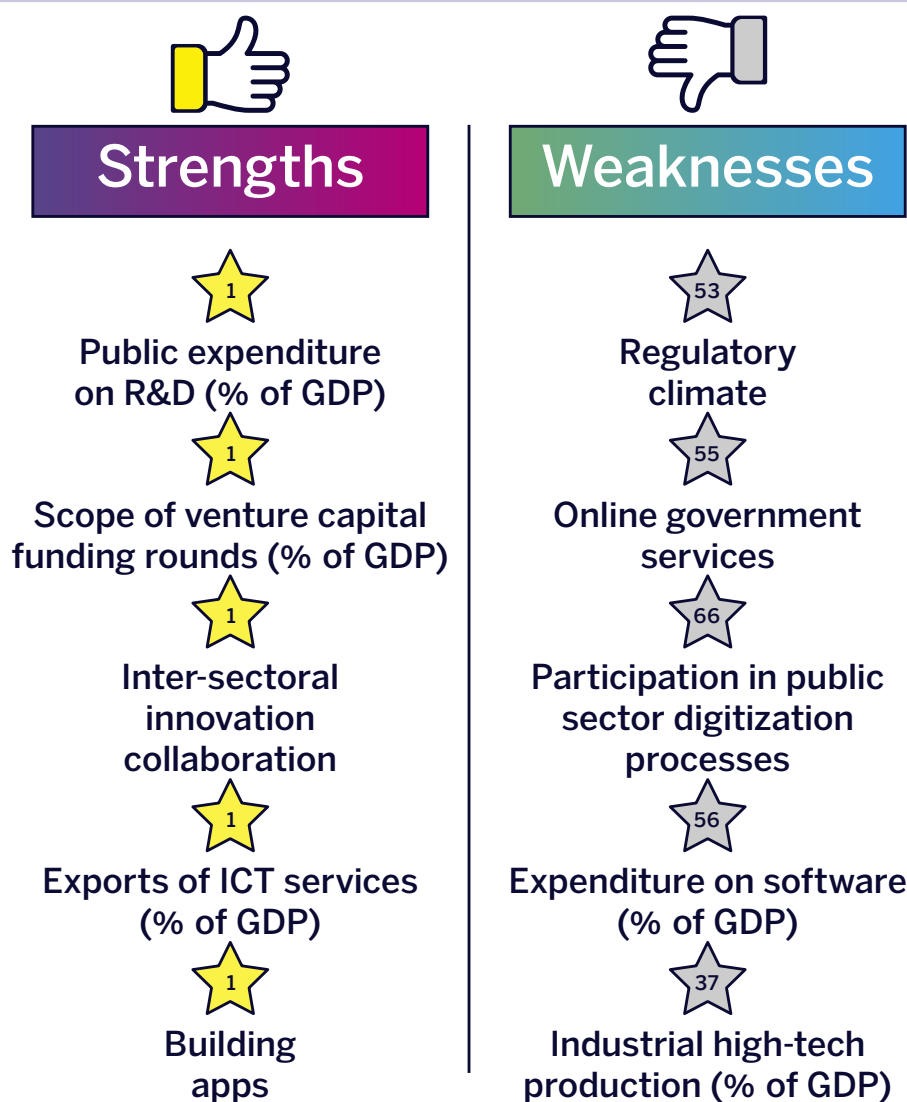
¹⁸ The quality of R&D is generally measured according to publication of academic articles and on patents.

¹⁹ For more details on these programs, see [Appendix](#).



Connecting Israeli Innovation to the Public and Private Sectors

27 Israel Leads In Innovation But Lags In Assimilating It In The Local Economy
Israel's global ranking in selected metrics from the Global Innovation Index 2021



Source: Global Innovation Index 2021

While Israeli technology companies are at the forefront of global innovation, their developments are frequently exported elsewhere and fail to benefit the Israeli economy or its citizens. Furthermore, a disparity exists between Israeli innovation developed in local high-tech companies and multinational development centers, and the level of digitization and technological infrastructures available to these companies. Evidence of this disparity can be seen in Israel's ranking in various parameters of the Global Innovation Index (GII) for 2021. On the one hand, Israel leads the rankings in different metrics, indicating the breadth and depth of the Israeli high-tech sector, such as public expenditure on R&D, the scope of venture capital funding rounds, export of ICT products, and inter-sectorial collaborations in areas of innovation. In contrast, Israel ranks below average in other metrics related to infrastructures critical for attaining technology advancement, such as a regulatory climate, participation in digitization processes of the public sector, the ratio of expenditure on software out of GDP, and others.²⁰

The pace at which advanced communications infrastructures are deployed in Israel – via optic fibers – was accelerated recently and reached 50% of the country's homes by the end of 2021. This was achieved following a massive investment aimed at closing the existing gap.²¹ Nevertheless, the available 'bit rate' in Israel is still behind that of the world's leading countries: Israel is ranked 32nd in the world as of February 2022 with a median broadband bit rate of 90.42 MB per second, according to Ookla.²²

It is unsurprising therefore that the business and public sectors in Israel lag behind the relevant benchmark countries to which Israel compares itself with regard to digitization and technological innovation. OECD data also reveals that the Israeli business sector is below the OECD average in application and use of various technologies such as use of social media networks, cloud computerization, CRM technologies, and big data and Artificial Intelligence technologies. In all these metrics, the Israeli business sector ranks below the average use of the OECD countries. The public sector in Israel also suffers from a similar disparity: according to UN data, Israel is ranked 66th in participation of the public sector in digitization processes.²³ One of the significant challenges to digitization of the Israeli public sector is a lack of natural language processing tools. In this context, there are two primary obstacles: a lack of economic incentive for the private sector because of the small size of the Israeli market, alongside a lack of databases necessary to train models of natural language processing. The State of Israel is therefore investing 180 million shekels via the National Artificial Intelligence Program to develop natural language processing tools for semitic languages (Hebrew and Arabic).

²⁰ Global Innovation Index, 2021.

²¹ Ministry of Communications data.

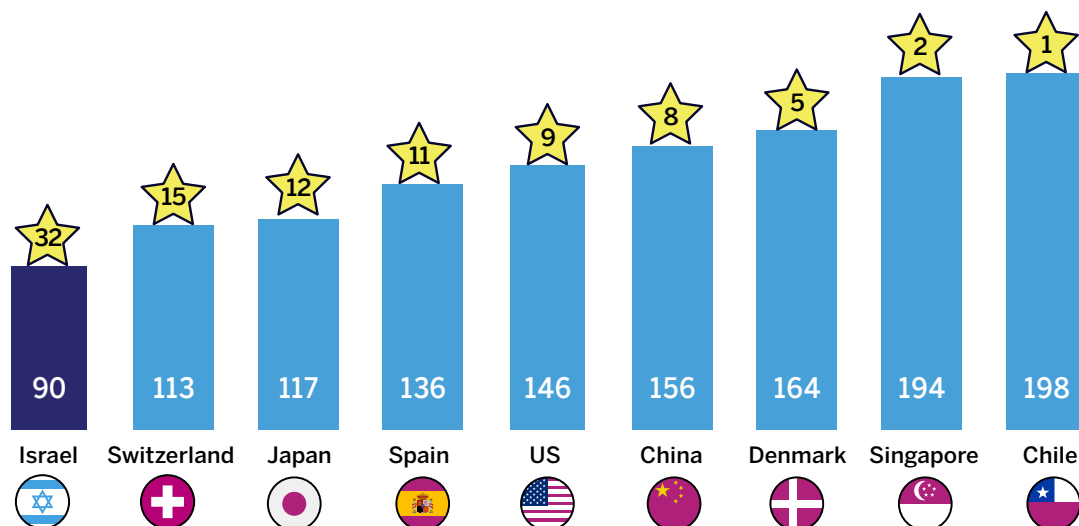
²² [Ookla speed test](#)

²³ [Public sector digitization processes - UN ranking](#)

28 State Of Technological & Digital Infrastructures In Israel

Ranking of selected countries according to bit rate and ratio of households connected to optic fibers in Israel

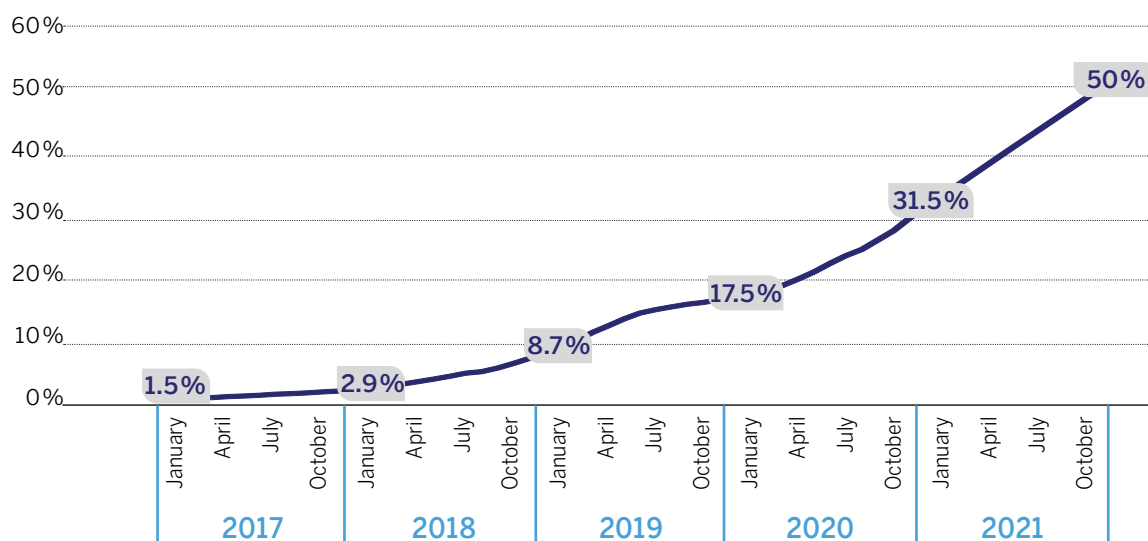
> **Chile, Singapore and Denmark lead - Israel is 32nd in the world in bit rate**
Median broadband bit rate and global ranking by bit rate (megabytes per second)



Source: Innovation Authority adaptation of Ookla data

> **Accelerating the connection: about half the Israeli households are connected to fiber optics infrastructures**

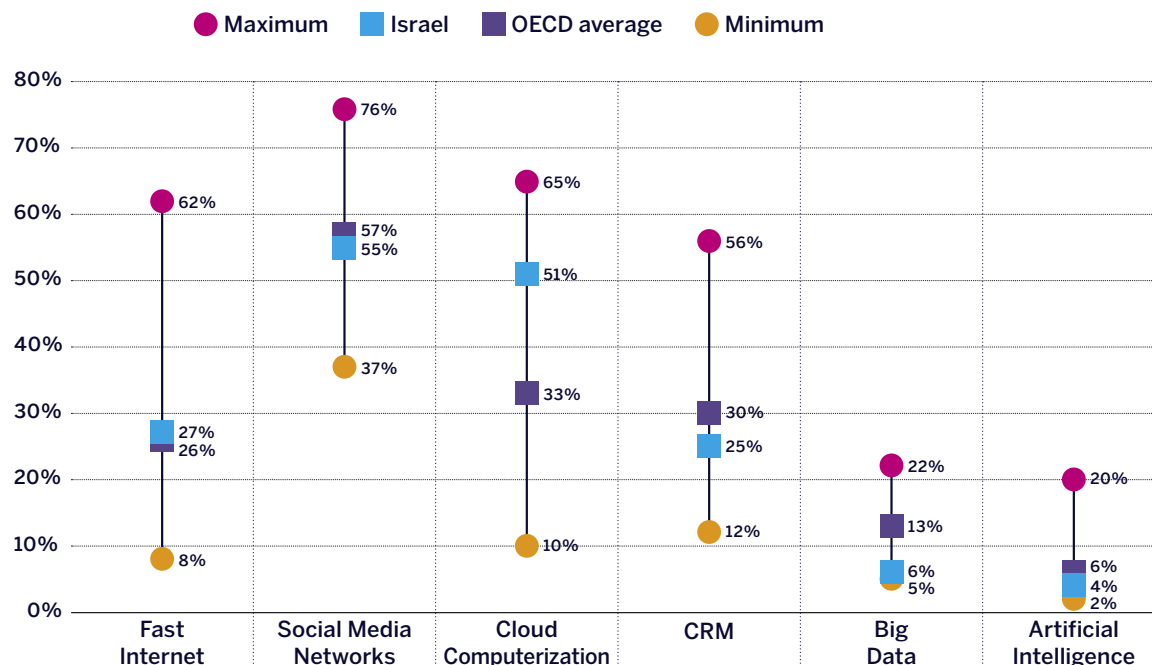
Ratio of households connected to fiber optics infrastructures in Israel, by month



Source: Ministry of Communications data

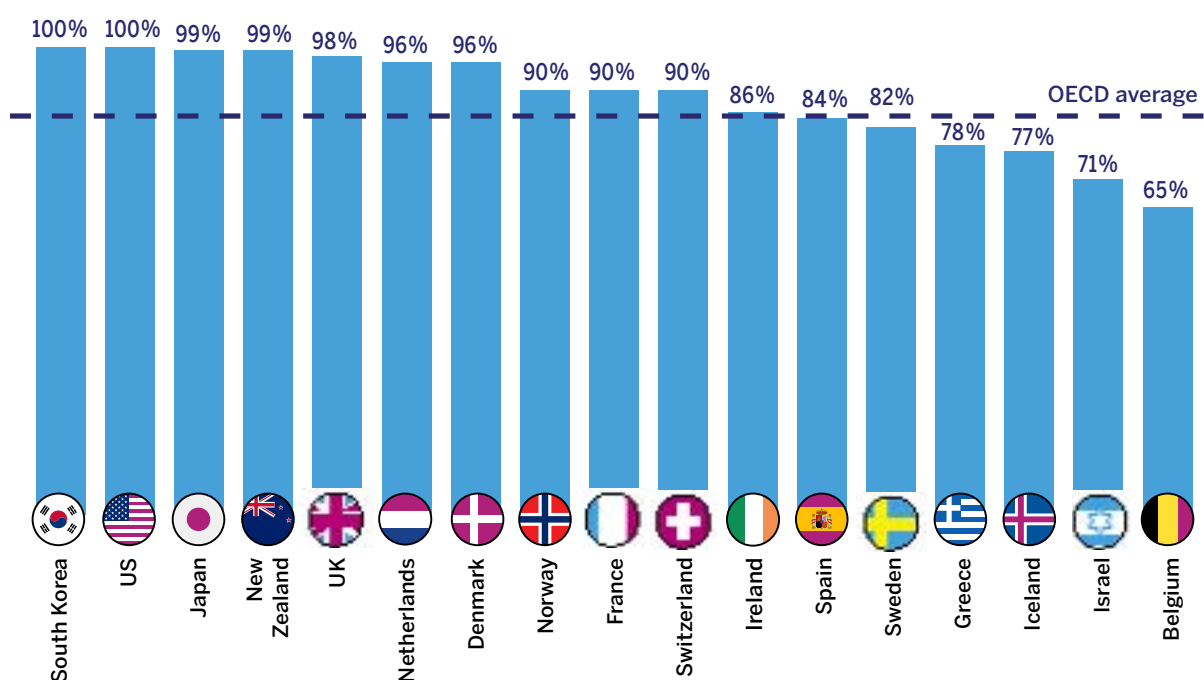
29 The Israeli Private Sector Lags Behind The OECD Countries In Adoption Of AI & Big Data

Adoption rate of selected technologies in Israel and the OECD countries (% of all companies, 2020)



Source: Be'eri and Esperanza (2021), Strategy and Policy Planning Division in the Ministry of Economy and Industry; Adaptations of Israeli ICT survey by the CBS and data from the paper: OECD - Diffusion of selected ICT tools and activities in enterprises, 2019 (Last updated: Nov. 2020)

30 Israel Ranked 66th of OECD Countries In Digital Participation In Public Sector Index



Source: Innovation Authority adaptation of Global Innovation Index 2021 and UN E-Government Knowledgebase 2020 data

These disparities have several negative ramifications for Israel:

1. The citizens of the State of Israel do not fully benefit from the fruits of Israeli innovation

Israeli citizens have only limited access to Israeli-made technological innovation which instead benefits the citizens of other countries. For example, the insurance company Lemonade that offers low-cost insurance policies that are priced using AI technologies, does not offer its services in Israel because, the company claims that the database required for the company's pricing model is not digitally accessible in Israel.²⁴ In other words, in this example, the gap in digitization of government services hinders the assimilation of Israeli innovation and contributes to the high cost of living in places where technology can lower costs. Moreover, companies in the fintech and insurance sectors are subject to regulation, and Israeli startups frequently prefer to adapt their solutions to American or other regulation, rather than to Israeli regulation.

2. Israeli technology companies may transfer activity overseas

Israeli technology companies frequently need an operational environment in which they can conduct initial applications and demonstrations of their technologies during the different development stages. This is especially true for rigorously regulated areas or complex products and services that require infrastructures such as autonomous vehicles, food-tech, and digital health. If Israeli companies do not derive benefit from the pilots and preliminary application in Israel or if the regulatory environment does not enable them to do so, they can be expected to seek these opportunities elsewhere as part of their accelerated growth process. This may weaken the Israeli innovation hub in the medium- and long-terms. In contrast, attractive opportunities for conducting preliminary pilots and applications in Israel can attract important business activity of startups, multinational companies, and pilot beta sites in a diverse range of economic sectors. One example illustrating the potential for the Israeli economy is the National Drone Initiative that was established to advance the use of drones for public benefit. The drones can help reduce congestion on the roads by establishing a national network of aerial routes that can be used, among others, for transporting medicines and medical equipment, or for deliveries in the retail market.

The initiative provided all stakeholders – from the operating companies, service providers, technology companies, potential users, and regulators – an opportunity to visualize the future operational environment. The initiative attracted both Israeli and international companies that sought to participate in it despite not having been awarded an Innovation Authority grant, because of the pilot's unique nature and its contribution to their development. Furthermore, many commercial companies (selling ice-cream, soap, sushi etc.) joined the initiative to test the economic model most appropriate for using drones to deliver their products to the end client.

3. Non-high-tech economic sectors miss out on economic benefit inherent in technological innovation

To take the next step and adapt themselves to the 21st century, all sectors of the economy, including the public sector – from health organizations and ports, via commercial companies, to food companies – must apply innovative technologies. Furthermore, collaboration with Israeli startups via "Open Innovation" processes will expose Israeli companies in all sectors to innovation and, via technology, assist them to establish and reinforce a competitive advantage in the global arena.

²⁴ [These cutting-edge Israeli inventions are unavailable in Israel - Business - Haaretz.com](https://www.haaretz.com/business/article.aspx?id=385444)

To Facilitate, Pilot and Implement: How Government Policy Can Promote Innovation

A collaboration between the public and private sector forces alongside a formulation of government innovation-supportive policy are required to create synergy between Israeli innovation and the daily lives of Israeli citizens, Israeli companies, and the public sector. Such policy will enable the strengthening of the local innovation hub, will ensure its continued global leadership, and will aid expansion of technological innovation's benefit to further economic sectors.

Thus far, the Authority's involvement focused primarily on direct financial support to fund high-risk R&D in startups and technology companies. In light of the changes in the required policy and the industry's maturation, the Innovation Authority's role has also expanded, and it will serve as a mediator and facilitator in implementing the new policy. The Authority will strive to reinforce the connection between the public sector and the Israeli high-tech industry – both with regard to the public services that Israeli citizens receive, and the public infrastructures used for assimilating innovation (i.e., regulation, physical infrastructures, access to data, and others).

The new generation of solutions that will be implemented by the Innovation Authority and other public sector entities, includes a variety of tools that will transform the government into one that initiates innovation via various projects, into a government that adopts technological innovation as a pilot site and target market, and into a government that facilitates innovation via advanced and flexible regulation. We will now detail how the various new tools are beginning to be executed in projects at different stages of planning and implementation.

The new supportive tools for advancing innovation in Israel:

1. Government Initiating Innovation: Advancing Public and Private Sector Collaborations to Develop Groundbreaking Solutions

Current Situation:

During its initial years of operation, the Innovation Authority (and previously, the Office of the Chief Scientist) espoused the use of supportive tools in R&D without government direction or focus i.e., without indicating specific technological fields or investing in their development and advancement. Underlying this view was the 'bottom-up' approach, dependence on the private market (entrepreneurs and investors) to identify and choose technological-business opportunities, and government stimulus in those fields in which a level of innovation can be found at the global forefront.

Required Change:

Today, given that Israeli technology companies raise huge sums from the private sector and grow their global activity without any government support, the Innovation Authority focuses on the creation of new supportive tools in places with distinct market failures which, without government support, will prevent Israeli high-tech from continuing to be a world leader. One of the new supportive tools facilitating this is "reality-changing innovative initiatives" – collaborations between the public and private sectors aimed at generating a significant change in a specific and defined area such as public transport or residential construction. These changes will impact the lives of Israeli citizens via assimilation of technology. Innovation initiatives involve government entities, technology companies, regulators, pilot sites for testing technologies, and implementational entities. The inter-sectorial collaborations within the framework of the innovation initiatives will provide unique pilot opportunities while also creating a supportive regulatory and operational framework that will enable the technology companies participating in the initiative to penetrate the market after a successful pilot phase. Furthermore, this support will also allow government and regulators to design future regulatory solutions and to become world leaders in their respective fields. The innovation initiatives will run for 2-4 years and will include identifying a need, gathering knowledge from Israel and overseas, recruiting government and private partners, funding a pilot, and monitoring the results.

The innovation initiatives will focus on areas in which there is a need or a public challenge alongside a technological-commercial advantage for Israel, and in cases where there is a need for regulation or a coordinated government effort to realize the potential. The first innovation initiatives in the fields of smart public transportation and modular construction have already been launched as will be detailed below. During the coming year, the Authority will examine, together with leading government partners, further opportunities to jump-start reality-changing innovation initiatives in fields with an intersection between technological-commercial potential, and Israeli leadership to help in resolving a public challenge.

31 Central Components Of Innovation Initiatives



Source: Innovation Authority

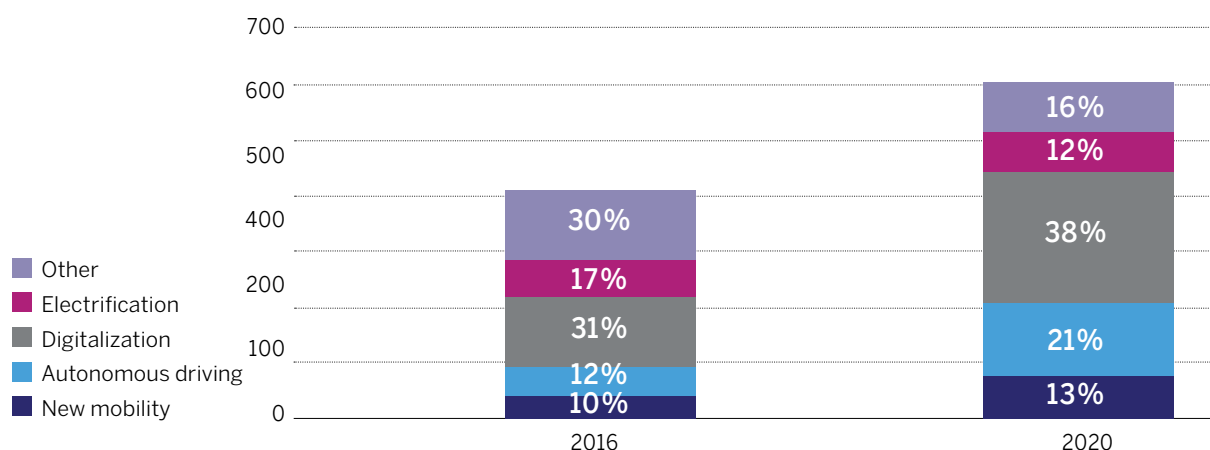
The First Innovation Initiatives:

A Joint Initiative to Promote Autonomous Public Transportation in Israel

Although historically Israel has not been a dominant player in the automotive industry, in an era when motor vehicles are becoming smart and driving themselves, Israel has in recent years acquired a leading position in this field. The number of Israeli startups in the field of smart transportation rose from 400 in 2016 to over 600 in 2020. The most significant growth was in the number of startups established in the field of autonomous vehicles with an annual average growth of 26% during this period. Furthermore, since 2008, more than 20 of the world's largest car manufacturers and their suppliers have opened development centers in Israel, including GM, Honda, Volkswagen, Ford, and others. This field also generates significant business activity with companies raising 1 billion dollars in 2021. Furthermore, one of the largest success stories to come out of Israel in the last decade is the Jerusalem company, Mobileye. The company was established by Prof. Amnon Shashua and Ziv Aviram and developed a technology for advanced driver assistance systems (ADAS), that is also used to develop technologies for autonomous (driverless) vehicles. Mobileye's IPO in 2014 set the company's value at more than 5 billion dollars – at the time, the largest IPO by an Israeli company. In 2017, the company was bought by Intel for more than 15 billion dollars in the largest acquisition deal for an Israeli company.

32 Travelling To The Future: With A 50% Increase In The No. Of Startups In The Field, Israel Is Becoming A Smart Transportation Superpower

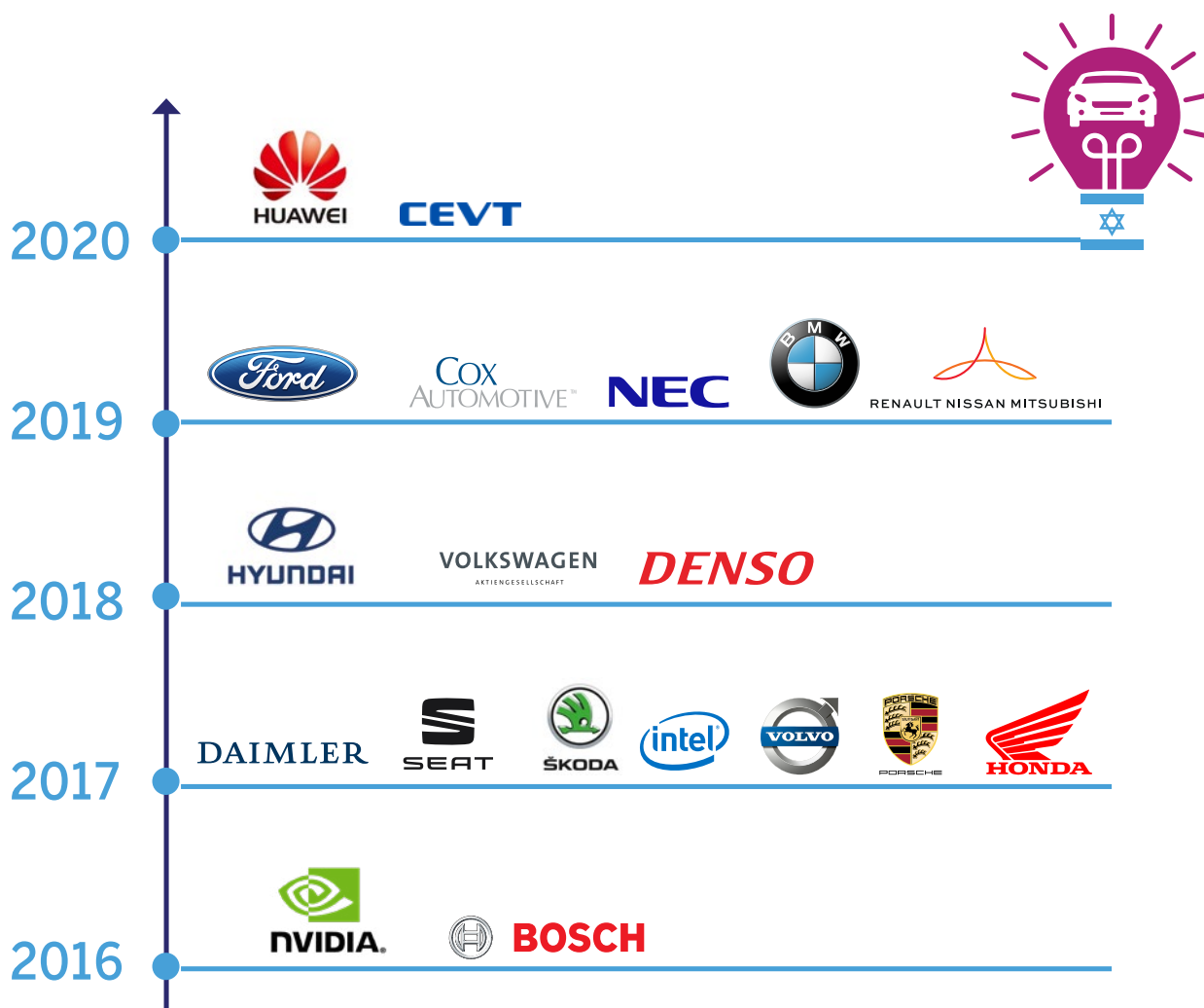
No. of startups active in Israel per year in the field of smart transportation, by category



Source: Israel's Automotive and Smart Mobility Industry, Ecomotion and Roland Berger, 2021

33 Auto Manufacturers Are Opening Development Centers In Israel

Companies that opened smart transportation R&D centers in Israel, by year



In other words, there is a significant knowledge base for technologies in the auto and transportation field in Israel. At the same time, the startups in this field are contending with challenges that hinder their global growth. According to an EcoMotion survey conducted in 2021, approximately 40% of the startups in this field report that one of their most significant challenges is a lack of access to piloting sites.²⁵

To assist the companies and to transform Israel into a leading global beta site for innovative technologies in the field of autonomous vehicles and to take advantage of the unique knowledgebase created in Israel, an amendment to the Road Transport Order was approved in March 2022. This amendment will enable to conduct more advanced pilots than those permitted today (e.g., operating a driverless autonomous vehicle). Specifically, Israel is especially interested in integrating the market's existing technologies into the Israeli public transportation system.²⁶

With the laying of an advanced regulatory infrastructure, the autonomous vehicle can now be harnessed to improving Israel's public transportation system and to transform Israel into a leading beta site in the field of autonomous public transportation pilots. To this end, a "reality-changing innovation" initiative has been launched to advance autonomous public transportation in Israel. The initiative is being promoted by the Ministry of Transport's Public Transport Authority, the Innovation Authority, and Ayalon Highways. The expected benefits from the initiative are aimed at one of the largest challenges facing the State of Israel – traffic congestion – by streamlining the public transportation system, improving service and passenger experience, and enhancing safety. Furthermore, the initiative is expected to assist the country and the transportation sector to contend with the problem of manpower and the severe shortage of drivers, via transition to fleets of autonomous buses within the next few years.

How will it work?

During the first stage of the initiative, the companies selected will conduct pilots operating autonomous buses in designated pilots and beta sites, with the goal of achieving technological and regulatory feasibility. In the second stage of the initiative, the companies will operate an autonomous public transportation line on public roads that will steadily increase in scope during the two years of the pilot. The initiative is expected to connect public transportation operators and innovative Israeli and global technology companies that are developing autonomous driving systems, and to increase public exposure to autonomous vehicles and their characteristics – namely, safety, travel experience, and environmental advantages. The initiative will also include an examination of operating models and of their economic efficacy.

Promoting Modular Construction to Increase the Housing Supply in Israel

While Israel has a technological advantage in the field of smart transportation that led to the creation of a joint initiative, the need behind an initiative in another area stems primarily from the demand on the ground – Israel's housing challenge. The construction industry in Israel creates 55 thousand housing units a year using existing technologies.²⁷ This while the future housing demand forecasted for 2040 stands at 70 thousand units a year,²⁸ reflecting a need to increase the annual supply of housing units by 30% in less than two decades. One of the ways to contend with the gap in the supply of housing is by extensive assimilation and adoption of advanced technologies to industrialize construction, specifically technology for modular construction.

Volumetric modular construction is an innovative construction method in which most of the process is transferred to the factory where complete 3D modules are produced in an "assembly line" method. The modules include the components of the building's external frame, thermal and acoustic insulation, and even pipeline system, electric devices, bathroom fixtures, flooring, windows, doors, and more. The modules are transported to the construction site where they are assembled into the final building (generally including a reinforced concrete core and base floors). This construction method is expected to shorten the duration of construction by 20%-50% and to increase the industry's productivity, alongside further advantages of construction quality, site safety, and the environmental impacts of the construction process.²⁹

²⁵ Israel's automotive and smart mobility industry, EcoMotion and Roland Berger, 2021

²⁶ Israel's automotive and smart mobility industry, EcoMotion and Roland Berger, 2021

²⁷ Beginning and completion of construction October 2020-September 2021, CBS.

²⁸ The Strategic Housing Program for 2017-2040, National Economic Council, May 2017.

²⁹ McKinsey & Company, Modular Construction: From projects to products, 2019.

The Ministry of Construction and Housing, together with the Innovation Authority and the National Building Research Institute (NBRI) at the Technion have recently published a call to receive information on constructing buildings using the modular construction method and on establishing factories to manufacture modular units. The goal of this call was to receive information from local and global industry players about the feasibility of widespread adoption of this technology in Israel including the need for supportive regulatory infrastructure and promoting the local manufacturing industry. An NBRI survey conducted among professional entities in the construction industry revealed significant obstacles in the assimilation of the modular construction method in Israel. Among the prominent obstacles found were the high level of coordination required between the various planning and implementation entities during construction, a lack of supportive regulation and standardization, and the need to educate both buyers and renters.³⁰

According to the information gathered in the survey, consideration will be given to the possibility of a joint initiative – together with the Ministry of Construction and Housing – to construct residential buildings using modular construction. As part of this initiative, all stakeholders – entrepreneurs, contractors, local manufacturers, and various regulators – will be able to acquire local knowledge of and experience in this method, including practical experience in managing and executing projects of this kind. Furthermore, a coordinated project can help create a unique list of requirements for modular construction in the Building Systems Unit at the Technion that is responsible for approving innovative construction methods. The initiative will provide a tailored regulatory solution and will pave the way to more widespread adoption of this method in Israel. Finally, the project will also help future homebuyers to understand the benefit inherent in the quality of building and living aspects of modular construction.

2. Government Adopting Technological Innovation: The Public Sector as a Playing Field for Piloting Technologies

Current Situation:

As part of the Innovation Authority's collaborations with a diverse range of public entities, including governmental entities, administrative authorities, government corporations, and local authorities, numerous challenges have been found that influence their ability, especially those of governmental entities, to manage joint work processes with the high-tech industry. Among others, difficulties arise in conducting pilots and acquisition processes with public entities and in assimilating innovative technologies. One of the challenges is the difficulty to characterize the technological solutions required by governmental entities, partly because of limited exposure to market innovations and insufficient familiarity with the existing technologies available in the industry. Even in those cases in which the public sector is partner to characterization and pilot processes of innovative technologies, the acquisition process fails to reach completion and ultimately the technology is not assimilated due to the structure of the public procurement processes that are sometimes cumbersome and overly bureaucratic. Another challenge stems from the fact that in many cases, the high-tech industry fails to approach governmental entities or to adapt its solutions to them. This difficulty is the result of the slow-paced decision-making regarding acquisition and assimilation of technology, and privacy restrictions that prevent governmental entities from sharing the data necessary to adapt the technology to their needs.

Required Change:

To improve the level of cooperation and coordination between the private and public sectors, there is a need to characterize, build, and implement joint work processes between public entities and the high-tech industry. This will enable the parties to familiarize themselves with each other, to reach a common understanding on the challenges, and to complete the acquisition processes on the way to rapid and extensive assimilation of technological innovations. Some of the next generation of Innovation Authority solutions therefore transforms it into an entity that assists and promotes consultation processes with public entities in fields related to technological innovation. The Authority provides support by offering expert technological reviews that help the government entities' early-stage decision-making process. The Authority also participates, alongside the relevant governmental entity, in funding the adaptation of the technological product to the government needs and its subsequent implementation.

³⁰ See: [Industrialization of Residential Construction Report Via Architectural, Engineering, and Implementational, 3D Modular Units Aspects, 2019](#)

At the same time, the Authority surveys best practices for innovative technology procurement in Israel and overseas, and assists various public partners in accessing and designing similar models. Based on these models, principles can be proposed for synchronizing public and private sector work processes: from the stage of design partnership, via the pilot partnership stage,³¹ to implementation of technology procurement and the assimilation of technology for an ongoing use. These principles are based, among others, on similar processes implemented in the Israeli defense establishment and on the innovation partnership procedure in the EU and UK. This unique procedure enables suppliers to develop technologically innovative products or services while receiving monetary payment throughout the development, and subsequently continuing directly to the stage of acquisition and assimilation without the need for a further tender procedure. These procedures offer a sequential process from the characterization stage, via the pilot stage, through to procurement, with the aim of allowing government entities and technology companies to progress without administrative delays.

2. Government Facilitating Innovation

Regulatory Sandboxes: Adapting Regulation to Test Innovative Technologies

Current Situation:

Regulation plays a key role in promoting or hindering the assimilation of innovation. In many cases where no appropriate regulation exists, a situation may arise whereby no early-stage demonstration of a product or service is conducted in Israel, their production is not conducted in Israel, and they will not be offered for use on the local market. All this while countries worldwide have in recent years developed mechanisms to assist their local companies contend with global competition via technological innovation alongside adaptation of a regulation sandbox for innovative products, services, and business models. As a result, Israel – as an innovation facilitating country – faces increased competition.

Required Change:

One of the prominent regulatory tools employed in recent years by countries leading the way in assimilation of technological innovation is the "regulatory sandbox". This method is based on the underlying understanding that innovative technologies develop at a rapid pace which, in general, is faster than the pace at which regulation is created and updated, and that the regulator lacks the necessary technological knowledge to comprehensively regulate the industry. As part of the regulatory sandboxes, governments enable companies and organizations to test innovative products, services, and business models without complying with all the existing regulatory rules and while significantly reducing the regulatory uncertainty. This way, companies can test products and services in a facilitating and safe environment without violating existing regulatory constraints. Regulatory sandboxes also include additional tools such as regulatory signposting and non-enforcement letters in which the regulator expresses his intent to forego enforcement of certain regulatory clauses in order to facilitate the activity of a company offering innovative products or services.

Regulatory sandboxes also have significant advantages for the regulators themselves, enabling them to learn and become familiar with the industry and its needs by establishing an independent connection with the industry. In this way, they encourage regulators to collaborate with the industry by creating defense mechanisms for consumers when adopting innovative products. Furthermore, these regulatory sandboxes help regulators to identify a need for regulatory reforms and for the creation of information-based regulation.

One of the prominent fields in which countries operate regulatory sandboxes today is fintech.³² In 2020, there were approximately 70 regulatory sandboxes operating worldwide. This approach has also gained momentum in recent years in additional fields such as transportation, health, and climate. For example, in 2018, Japan announced a general regulatory sandbox, not limited to a specific pilot, that covers the fields of financial services, health, and transportation.³³

Regulatory sandboxes are expected to constitute a critical layer of an innovative regulatory environment that will support the financial and taxation tools and will encourage the penetration of innovative products and services into the Israeli market in a way that aids market acceleration and its increased growth. An advanced and innovative regulatory environment in which it is possible to experiment in research, development, assimilation, and marketing of innovative technologies constitutes a significant magnet for Israeli and foreign high-tech companies.

³¹ See: [Innovation partnership procedure](#)

³² See: [The Map of Regulatory Sandboxes](#)

³³ For information on the regulatory sandbox program in Japan, see

An Example of a Regulatory Sandbox: Testing Autonomous Vehicles








The introduction of autonomous vehicles into the public domain significantly increases the potential to change the future of Israeli transportation and accelerates the development of local industry, economic growth, and the efficiency of the transportation sector. Furthermore, it can increase the safety of passengers and pedestrians and reduce traffic accidents. At the same time, the development processes of autonomous vehicles pose complex technological and regulatory challenges. The State of Israel, at the forefront of development in the field of advanced technological systems for autonomous vehicles, is therefore striving to remove the various obstacles in order to advance this trend.

Tests in driving autonomous vehicles have been conducted throughout Israel since 2018, including the independent driving system driving the vehicle, but these include a backup driver responsible for taking control of the vehicle in case of emergency. Furthermore, there are no passengers in the vehicle during the tests and it is not used for commercial purposes. These tests are conducted according to a specific permit provided by the National Traffic Supervisor who is qualified to exempt those conducting test on a vehicle from the obligations of drivers in regular vehicles, such as the driver's obligation to hold the steering wheel.³⁴

A precedential law, composed by the Ministry of Transport and Road Safety together with the Ministry of Justice and with the professional support of the Innovation Authority, came into effect in March of this year. This law was the result of a 2017 government resolution about the creation of a national smart transportation program. The legislation will transform Israel into an autonomous vehicles' beta site at the highest levels of autonomous driving so that, for example, the pilots can evaluate car safety without the presence of a driver. Among the leading countries alongside Israel in this field are California and Arizona in the US and other countries in Europe – Germany and France – and in East Asia – Japan and Singapore. Israel enables to check passenger and commercial service solutions with autonomous vehicles, a reality that is expected to transform Israel into an attractive global focal point of piloting and assimilating this technology. The uniqueness of Israel's sandbox is the possibility of commercial operation of a driverless autonomous vehicle anywhere and without restrictive constraints. This possibility is also recognized as Level 5 Autonomy although Level 5 autonomous vehicles have not yet been fully developed. In practice therefore, the State of Israel has prepared a regulatory infrastructure for a future technology and will be able to progress to pilots of fully autonomous vehicles when this technology becomes available.

34 Israel Leads The World In Regulation And Facilitates Pilots Of Autonomous Vehicles

Comparison of autonomous vehicle regulation in different countries

Countries	Pilots with driver in restricted surroundings	Driver-less pilots in restricted surroundings	Pilots in unrestricted surroundings
 Singapore	✓	✓	✗
 Germany	✓	✓	✗
 France	✓	✓	✗
 יפן	✓	✓	✗
 US (California & Arizona)	✓	✓	✓
 UK	✓	✗	✗
 Israel	✓	✓	✓

Source: regulation survey conducted by Innovation Authority

³⁴ According to Regulation 16a of the Road Transport Order.



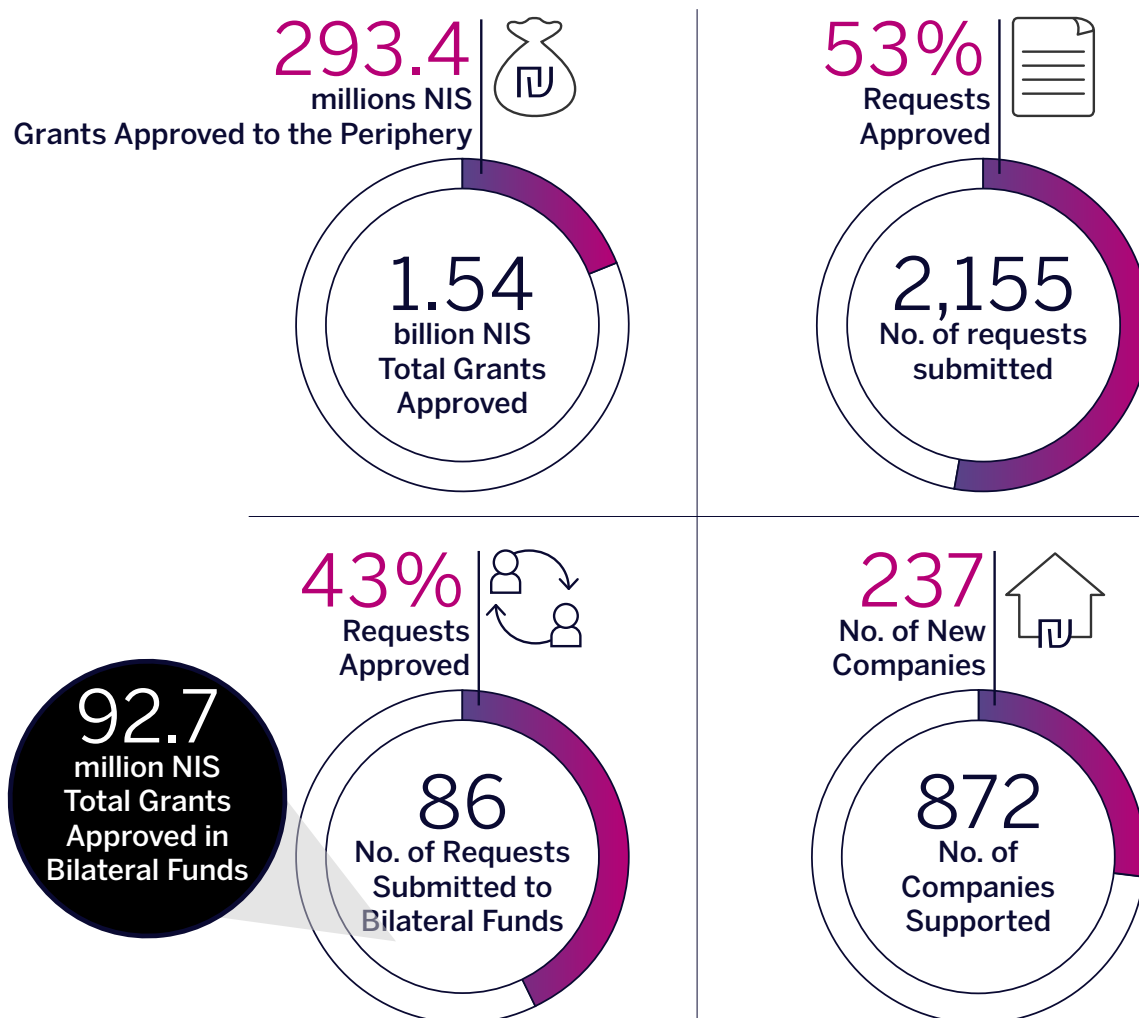
Appendix: Activity of the Israel Innovation Authority's Divisions





In 2021, the Innovation Authority's divisions implemented a wide range of measures aimed at advancing the growth of the Israeli innovation ecosystem. This chapter presents the main activity of the various divisions during 2021 and the way in which they translated the Authority's policy into action and specific policy tools.

35 Summary of Innovation Authority Divisions' Activity





The Startup and Business Development Division supports early-stage entrepreneurs and startups in the ideation stage, and corporations interested in exposure to open innovation via partnership in technology incubators and innovation labs. The Division assists the ideation process – from development of an initial technology idea to a complete product – and in advancing the initiative with the aim of reaching advanced stages of capital raising and sales. Furthermore, the Division operates various support programs designed to encourage the market to join forces and advance the area of human capital by developing innovative programs and initiatives. To this end, the Division constitutes a source of government and public knowledge in the spheres of high-tech human capital.

The Division's Incentive Programs:

Startup Programs

Ideation (Tnufa) Program: The Ideation (Tnufa) program is intended for fledgling entrepreneurs who are interested in formulating and advancing an innovative technological concept to the initial R&D stage, in preparation for Proof of Concept (POC) and/or construction of an initial prototype. The program's goal is to assist in the project's technological POC and commercial applicability, thereby enabling it to raise private funding and/or recruit a business partner for further development. The program provides a maximum grant of up to 85% of the approved budget, with a maximum grant of NIS 100,000 for the initial 12 months period and a further NIS 100,000 for a second period (or up to double for innovative solutions in the field of Bio-Convergence).

Seed Program: The program is intended for startups in the seed stage that are developing technologies in fields with complex regulation and an extended timeframe until implementation, or technologies that are part of an evolving market. The support will be awarded to companies that have not raised more than NIS 5 million (before making their submission to the program) and that have already signed a memorandum of understanding with a venture capital investor experienced in high-risk investments who is interested in making an initial seed investment in the company. Find more details below.

Technological Incubators Programs: The program aims to support investment in technology companies in their early stages by creating a support system that will expedite their development of innovative technology ideas in their initial stages into advanced startup companies that are suitable for continued investment. The program also aims to encourage technology entrepreneurship and commercialization of groundbreaking technologies from research institutions to industry in complex and high-risk fields and to strengthen Israel's technology innovation environment in the field of seed investment. The program is also intended to assist high-tech companies in unique and complex technological fields to formulate and test products, with technological POC, conducting pilot tests etc. The technological incubators, that provide support and assistance to early-stage initiatives, are located in and operated by local and international commercial companies and by venture capital investors with the ability to provide quality added value and support startups and fledgling entrepreneurs. The comprehensive support offered by the incubator includes technological and business guidance, connections to strategic partners, additional investors, and potential clients, a physical site and infrastructures, administrative services, legal advice, and financial services. No financial investment is required by the entrepreneur as part of the program – 85% of the budget is funded by the Authority (up to a maximum sum of NIS 3.5 million for up to two years, according to the type of project and geographical location of the incubator) and 15% is funded by the incubator operators.

Entrepreneurial Incubators in the Periphery Program: This program is aimed at promoting the development and strengthening of innovation systems, technological entrepreneurship, and employment in Israel's geographical periphery via collaboration between specially designated incubators and higher education institutions, students, entrepreneurs, and startup companies. This collaboration is achieved via research activity, development, and commercialization of incubator companies that are based on local initiatives. As part of the program, a local project operating within the incubator will be entitled to a grant of 85% of the approved budget from the Innovation Authority, up to a maximum budget of NIS 1 million, and a grant of 60% from the Innovation Authority, up to a maximum budget of NIS 1 million for a second year of activity. No financial investment is required by the entrepreneur as part of the program – supplementary funding is provided by the incubator that can also assist with follow-on funding. The comprehensive support offered by the incubator includes technological and business guidance, connections to strategic partners, additional investors, and potential clients, a physical site and infrastructures, administrative services, legal advice, and financial services.

Technological Innovation Labs: This program is intended for entrepreneurs in the preliminary stages of a project, who need unique infrastructures and expertise to prove the feasibility of a technological idea. The program is also intended for corporations interested in collaborating with Israeli startups. The assistance to entrepreneurs is provided through innovation labs operated by the industry's leading corporations via an open innovation model. The program enables startups to access unique technological infrastructures, market insights, and unique channels of marketing and expertise to which they currently lack access, with the aim of proving feasibility on the way to transforming a technological idea into a commercial product. The program provides a grant of up to 85% of the approved budget, up to a maximum grant of NIS 1 million for up to a year (and up to NIS 3 million for a period of up to two years in the Digital Health Sub-Program). A grant of up to 50% of the approved budget, up to a maximum sum of NIS 1 million will be awarded for a further period of 1 year (up to NIS 3 million for a period of up to two years in the Digital Health Sub-Program).

Advancing Technology Entrepreneurship in Haifa: This program is aimed at reinforcing and strengthening the city of Haifa's status as a high-tech industry hub in the Israeli ecosystem and to advance technological innovation in the city. The program's goal is to increase the number of startup companies and technological initiatives in Haifa, with emphasis on its Lower City neighborhood. The program encourages synergy and collaboration between principal city focal points such as City Hall, academia, industry, the business sector, and the non-profit sector, with the aim of bolstering urban infrastructures and the use of the city's strategic assets, encouraging independence of entrepreneurial parties, and strengthening the Haifa entrepreneurial community while integrating populations such as ethnic minorities, Ultra-Orthodox, women and Israelis of Ethiopian descent.

Young Entrepreneurship Program: The Authority is working in conjunction with the Ministry of Education to promote an entrepreneurship incentive program that will constitute an efficient tool for encouraging and educating young people in business, scientific, and technological entrepreneurship. The participants in the program will gain practical experience in developing knowledge and products while utilizing Ministry of Education scientific and technological infrastructures such as 'Eshkol' (Cluster) and 'Tapuah' (Apple) science centers and science museums as part of their initiative to transform a technology idea into a product of economic value.

Human Capital Programs

Coding Bootcamps Program (34): In response to the shortage of skilled high-tech personnel, the Authority has been operating a program since 2018 that supports extra-academic courses (coding bootcamps) aimed at increasing the supply of programmers and data science graduates in Israel. These intensive and practical programs locate candidates with significant potential, provide them with the necessary theoretical and practical knowledge, and train them, in a relatively short period of time, for work in the high-tech industry as programmers and data scientists. The graduates can therefore make a real and immediate contribution to the company. The program's goal is to increase the number of graduates acquiring relevant practical training who are placed in high-tech development jobs at salaries of over NIS 14,000 (within 15 months of completing the course). The bootcamps were chosen in a competitive procedure for a period of three years.

The Advanced Technology Studies Workshop (HaSadna) Program: The huge demand for experts in advanced technology professions requires innovative models for training experts in this field and for upgrading skilled professionals already employed in the high-tech industry. The Workshop Program focuses on support of a joint advanced training framework for engineers in high-tech companies, led by the industry, in advanced development professions. Proficiency in algorithmics in the field of Artificial Intelligence (AI) has become vital and relevant in almost every field of technology. The Innovation Authority's initiative to assist high-tech companies in training their employees stems from the need for high-quality expert personnel and is aimed at enhancing the important activity taking place in academic institutions and providing training in further AI areas that are required by the industry.

High-Tech Specialization Program (42): In response to the challenge of recruiting inexperienced workers in the high-tech industry, this program offers grants to high-tech companies that create employee specialization programs. As part of these programs, new graduates with a university degree or a degree in practical engineering in technology professions ("juniors") will be accepted and trained for entry-level development roles. The company will receive a grant of NIS 50,000 for every candidate they hire for a minimum of six months with a monthly salary of at least NIS 15,000 and who receives on-the-job training. The juniors' training model will be adapted to each company's specific needs and may be based on the company's internal resources and/or external organizations and trainers.

Human Capital for High-Tech Fund (44): The Human Capital Fund is a unique program aimed at encouraging the creation of innovative solutions coming from the market, to expand entry routes to high-tech employment and to upgrade or improve the existing high-tech human capital in R&D and growth positions (sales, marketing, finances, legal etc.) in the high-tech field.

The fund offers grants for budget requests according to the following rungs:

- For budget requests of up to NIS 1 million – 50%, 60%, or 70% of the approved budget.
- For budget requests of NIS 1 million -15 million – 30%, 40, or 50% of the approved budget, according to the committee's decision.

Industry Training and Placement Program (45): As a response to the high-tech employment crisis that developed as the result of the Covid pandemic, the Innovation Authority, in conjunction with the Ministry of Finance, and the Ministry of Economy and Industry, launched an emergency program to finance the immediate large-scale training and placement of workers in a variety of high-tech professions. The program offers grants to training entities and companies implementing a process that combines training for and placement in in-demand technology and business jobs. Preference will be given to requests that emphasize high-percentage placement, employers' involvement in defining the training program, and the provision of practical specialization.

New Projects:

Programs to Promote Entrepreneurship and Seed-Stage Startups: These programs are intended to establish a supportive network for the creation and mentoring of new initiatives and entrepreneurs from the ideation stage, to create an innovation ecosystem that supports entrepreneurship, and to increase the number of investors at the pre-seed and seed stages. The programs also encourage entrepreneurship and increased numbers of initiatives and new companies from the seed stage via three sub-programs:

- a. A program to establish angels' clubs
- b. A program to establish technology innovation centers and the possibility to include activity aimed at advancing high-tech employment
- c. A program to establish technology accelerators

As part of the programs, grants will be given for up to NIS 900,000 per year, for the three years franchise of the angels' club; NIS 2 million each year, for the five years franchise of establishing a technology innovation center; and a further NIS 1 million for each operational year, if the proposal includes activity aimed at advancing high-tech employment, and NIS 1 million per year for 2-4 years for the franchise of establishing a technology accelerator.

The Program to Advance Technological Innovation in Beersheba: This program is intended to create a high-tech hub in the Negev by advancing technology entrepreneurship and increasing the number of startup companies in Beersheba. Special emphasis will be given to the fields of activity with existing industrial mainstays that can serve as a focal point to attract companies: ICT (cyber, G5 communications, Artificial Intelligence, organizational software), industry and sustainability, and health. The program encourages the creation of synergy and collaboration between principal city focal points (City Hall, academia, industry, and the business sector), the bolstering of urban infrastructures with an emphasis on R&D infrastructures, the creation of large companies' R&D and innovation centers, the strengthening of the Beersheba entrepreneurial community while integrating populations such as ethnic minorities, Ultra-Orthodox, women and Israelis of Ethiopian descent – including branding and marketing the city as a Negev high-tech hub and as a center of entrepreneurship and innovation. As part of this program, the Innovation Authority will award a grant of NIS 25 million for a period of 4 years.

The Technological Innovation Labs Program: A new technological innovation lab in the field of digital health began operation as part of the general technological innovation labs program. As part of this sub-program, the lab's companies will receive a grant of up to 85% of the approved budget, up to a maximum grant of NIS 3 million for a period of up to two years, and a grant of up to 50% of the approved budget, up to a maximum sum of NIS 3 million for a further period of up to two years.

Human Capital Fund: 49 different programs were chosen as part of the first and second calls for proposals in the Human Capital for High-Tech Fund Program (44). Most of the programs focus on advancing sectors of the population currently under-represented in the industry – women, the Arab sector, the ultra-Orthodox sector, and residents of the periphery, as well as advanced technology training courses such as VLSI and sustainability.

The programs received total grants of NIS 54.2 million (state funds) and NIS 63.3 million (private funding) and will train 13,600 participants during the next two years. Furthermore, 5 operating entities were chosen to integrate new immigrants and returning Israeli citizens with R&D experience. Over the next two years, these entities will run programs to locate and sort relevant participants, provide them technology training and soft skills workshops, and place them in local high-tech companies.

Below is a summary of the programs selected in the second call for proposals:

Type of Program	No. of Programs Approved	Total No. of Trained Participants (in 2 years)
Juniors and extra-academic training	16	6,615
Training for under-represented populations	19	3,200
Bringing human capital from overseas	5	1,016
Training in advanced tech professions	8	790
Training platforms	1	2,000
TOTAL	49	13,621

The Division's Performance in Numbers:

- > 99 requests were submitted to the various incubator programs during the year, of which 85 were approved for total grants of NIS 150 million.
- > 325 requests were submitted to the Tnufa (Ideation) Program of which 108 were approved for total grants of NIS 12 million.
- > 28 requests were submitted to the Innovation Labs programs of which 22 were approved for total grants of NIS 14 million.
- > 1 request was submitted to the Advancing Technology Entrepreneurship in Haifa program and a grant of NIS 7,500,000 was approved.
- > As part of the Young Entrepreneurship Incentive Program, the 'Unistream' NGO, via a dedicated joint NIS 1.25 million budget from the Innovation Authority and the Ministry of Education, also operates technological entrepreneurship training programs for youths aged 14-18 in schools and designated centers around Israel, with an emphasis on the geographical and social periphery.
- > One group consisting of the market's leading companies operates as part of the Workshop (HaSadna) Program and trains the employees of the participating companies in Artificial Intelligence-related professions. The lecturers leading the programs are senior industry figures from the companies that are members in the operating group of companies alongside professional instructors, with the proposed syllabuses being submitted and approved by the Innovation Authority. 600 employees will be trained over a 3-year period that will receive investment of NIS 6 million representing a 66% funding ratio.
- > Over 6,300 allocations were approved as part of the Emergency Training and Placement Program (45). These were divided between development roles and technology and business roles that support development. The subsidized training programs will also be held in periphery areas and will be tailored to under-represented populations, with an emphasis on the ultra-Orthodox and Arab sectors, at a total budget of NIS 16 million. The training courses will be run by 29 training entities and 18 employers who will conduct the training and placement of the graduates. In addition, as part of this program, 5,600 workers were trained in the high-tech industry during 2021, with a third of these being in core roles and the remainder in supporting core roles- and business positions.



The Growth Division

The Growth Division supports startups and companies in growth stages, mature companies, and R&D centers operating throughout Israel. The division helps to advance companies' competition and technological leadership with the aim of increasing the pace of their growth and their potential.

The Division's Programs:

R&D Fund: This program supports commercial companies currently developing new products or upgrading an existing technology. The program offers the largest financial incentive awarded by the State of Israel for Israeli corporations' R&D activity and is offered to all sectors with the aim of strengthening and advancing the Israeli economy. The fund's activity also includes designated programs to support startup companies owned by members of Israel's minority populations and/or ultra-Orthodox and/or women and another designated program supporting breakthrough generic research and development in R&D-oriented companies.

Joint Government Support for High-Tech Technological Innovation (Pilots): This program allows technology companies to conduct R&D, including programs for operating pilot sites in a variety of innovation systems, including those with rigorous regulation and with governmental influence, while enhancing the perception of the economic value created in Israel. Collaborating with government entities via the incentive program increases their ability to strengthen innovation systems in fields under their responsibility, provides better access to regulation, state assets, and public infrastructures, and that ultimately improves the level of knowledge and professionalism of both the Innovation Authority and government in advancing these innovation systems for the benefit of the general public. This incentive program is intended to support research or development and to provide a response to market failures that exist in new and growing innovation systems, including those resulting from regulation and government impact. These market failures are characterized by high levels of technological risk, complex implementation, limited access to pilot testing sites, or difficulty in receiving regulatory approval. This program includes sub-programs specifically designated for various sectors such as health, transportation, environmental protection, the Government Companies Authority, agriculture, cyber, energy, internal affairs, teleprocessing, finance and securities, tourism, communications, internal security, space, etc.

Assistive Tech ("Ezer-Tech"): This program has been operating since 2011 and is the result of collaboration between the Innovation Authority and the National Insurance Institute funds. The program's goal is to encourage R&D of industrial products that provide technological solutions for the disabled and thereby enabling them to integrate into society and the labor market. Assistive technologies possess the potential to generate dramatic change in the lives of people with disabilities and to enable them to conduct healthy, independent, and respectable lives enabling them to contribute in all spheres of life: employment, education, leisure etc.

New Projects:

Last year, the Innovation Authority expanded the scope of tailored initiatives focusing on fields with defined market failures and that without government support will endanger the continued leading position of Israeli high-tech. These projects are a concentrated and coordinated public-private effort that includes a critical mass of multi-sector pilot activity which includes, as needed, government entities, technology companies, regulators, testing sites, and implementation bodies, led by the Innovation Authority, that are aimed at generating a reality-changing development in a specific technology field in Israel. This is, in effect, a further facet of the Innovation Authority's policy measures, the goal of which is to maximize an organization's existing knowledge and tools and enable the Authority's support to have the maximum possible influence in advancing Israeli technological innovation.

The Division's Performance in Numbers:

- 95 requests were submitted to the Institutional Investment Programs,³⁵ of which 93 were approved for secured investments totaling NIS 848.8 million.³⁶
- 639 requests were submitted to the R&D Fund Program of which 274 were approved for grants totaling NIS 533 million.
- 157 requests were submitted to the Pilots Program of which 67 were approved for grants totaling NIS 69 million.
- 3 requests were submitted to Sub-Program (35) – Biotechnology and Medical R&D Centers. All 3 requests were approved for grants totaling NIS 26 million.
- 49 requests were submitted to the "Assistive-Tech" Program of which 14 were approved for grants totaling NIS 9 million.

³⁵ Requests submitted to and discussed by the Research Committee

³⁶ To complete the picture, it should be noted that in December 2020, one request was submitted and a further 6 were submitted in January 2022, all of which were approved. The scope of security for these requests stood at NIS 6.68 million and NIS 103.96, respectively.



International Collaboration Division

The International Collaboration Division helps create a competitive advantage for Israeli companies via international collaborations in fields of research and innovation. The Division strives to facilitate access to knowledge, partnership in global research and innovation and market pilots, as well as collaboration with multinational corporations, public entities, and leading research institutions worldwide. The Division is responsible for the Innovation Authority's global connections that advance research and innovation collaborations on strategic issues. Operating under the auspices of the Division is the ISERD (Israel-Europe Research & Innovation) Directorate responsible for Israel's interface with the European R&D framework program.

The Division's Programs:

R&D With International Partners Incentive Program: This program provides support to Israeli companies working with foreign partners on commercialization-directed R&D projects to develop new technological products or to significantly upgrade an existing technology. The program also provides Israeli companies with an opportunity to work with foreign partners via a financial incentive that enables to share the risk in funding the project and helps with finding foreign technology partners.

Pilots with International Partners Program: This program supports Israeli companies' technology pilot programs in different fields that will be conducted at overseas companies or that will be based on their capabilities, data, or information. The program grants Israeli companies an opportunity to test their technologies in real conditions via a financial incentive that enables to share the existing risk in funding the project and assistance with finding international sites for the pilots. Products submitted as part of this incentive program must be ready for testing (after proof of feasibility and development of most of the product) and without additional significant R&D content.

Bi-National Funds Incentive Program: This program provides support for Israeli companies collaborating with foreign companies in the US, India, Singapore, and Korea on R&D projects of new technology products or the significant upgrade of an existing technology. The program's financial incentive, financed by the bi-national funds, enables to share the risk of funding the project and offers support in the search for foreign technology partners.

There are currently four bi-national funds:

- > I4F – Israel-India
- > BIRD – Israel-United States
- > SIIRD – Israel-Singapore
- > KORIL – Israel-Korea

The ISERD Directorate - European Program for Research and Innovation – Horizon Europe:

The European Framework Program for Research and Innovation is the world's largest platform for collaborations in this field, with a total budget of EUR 95.5 billion over 7 years. Israel is an associate member of the program and Israeli entities are entitled to submit requests for grants. ISERD – the Israel-Europe Research & Innovation Directorate – is responsible for advancing Israeli activity in the European research arena and aims to provide Israeli entities with access to the European Framework Program. The program provides direct funding for a vast range of sectors and entities according to calls for proposals, both via individual grants to outstanding researchers and to outstanding companies, and via grants to consortiums in fields of European preference. The program is intended for any organization or legal entity that would benefit from cooperation in international research, development, and innovation processes: companies, startups, corporations, research and academic institutions, government agencies, hospitals, municipalities, non-profit organizations, and others. The Horizon Europe program will implement the "Green Deal" policy that constitutes the European Commission's roadmap for advancing UN goals of achieving climate sustainability by 2050. To this end, specific challenges are identified relating to climate change and damage to the environment. The strategy formulated in the Green Deal initiative outlines a program of significant economic and social changes in Europe that advance efficient utilization of resources and a transition to a circular and clean economy, conservation of biological diversity, reduction of environmental pollution, and use of research and innovation to adopt a sustainable, equitable, inclusive social change. As part of the program, 30 percent of the grants will be allocated to the Green Deal policy.

The central sub-programs intended for companies are:

Accelerator EIC: for small- and medium-sized groundbreaking companies. This program offers grants and equity investment proposals.

Consortiums Program: offers a grant for projects that answer calls for proposals in different fields. Consortiums will consist of at least three partners from three different countries, one of which must be a member country. The consortiums enable companies to collaborate with researchers.

Missions: the program defines five major missions in the fields of cancer, smart cities that are climate balanced, adaptation to climate change including social transformation, healthy oceans, seas and lakes, and healthy earth and food. The projects chosen will be ambitious and multi-disciplinary and will meet the criteria determined as part of that mission.

The program runs several sub-programs in fields of preference in which the Authority participates:

- > The CHIPS Micro-Electronics Program
- > The M-ERA.NET Program in materials science
- > The MANUNET Program in advanced manufacturing
- > The PRIMA Program for Mediterranean cooperation in fields of food and energy
- > The QuantERA Program for research in the field of Quantum Technologies
- > The Graphene Flagship for graphene and brain research
- > The ICT AGRO Program for research in the field of precision agriculture
- > The CHIST-ERA Program for collaborative research in ICT fields

The Division's Performance in Numbers:

- 99 requests were submitted to the R&D and Pilots with International Partners Incentive Programs of which 48 were approved for a total of NIS 60 million.
 - 114 requests were submitted to the first stage of a pilot program with 4 leading global health centers, 20 of which advanced to the second stage. Of these, 14 projects were approved for total support of NIS 8.6 million. The approved projects include innovative technologies for remote monitoring and control of patients, use of AI systems for issuing recommendations and supporting medical decisions, and software tools for streamlining cancer treatment.
- 51 requests were submitted to the Bi-National Funds Program of which 22 were approved for a total of NIS 47.3 million.
- 13,000 Israeli requests were submitted to the European R&D Horizon 2020 Program between 2014-2020. Of these, 1,666 grants totaling EUR 1.27 billion were approved (preliminary figures).³⁷ Furthermore, 5 Israeli requests were approved as part of the ECSEL Program in the field of micro-electronics for total grants of NIS 20 million.
 - 209 Israeli companies submitted requests in 2021 to the EIC Accelerator Program for outstanding companies of which 16 Israeli companies were approved grants totaling EUR 37 million and equity proposals worth EUR 101.6 million.

³⁷ Final figures are expected only after the finalization of the winning companies' funding agreements. Likewise, 2021 data has yet to be received.



The Technological Infrastructure Division is responsible for advancing the development of groundbreaking generic and pre-product technology, commercialization and transfer of knowledge from academia to industry, the establishment of R&D infrastructures, and for supporting the development of dual civilian-defense technologies. The Division's programs are open to entrepreneurs, companies, and research institutions for individual or collaborative research.

The Division's Programs:

MAGNET Consortiums Program: Consortiums of Israeli industrial companies and academic research groups working together to realize a common vision of groundbreaking pre-product technology research. The technology focuses on fields of importance on the global market in which Israeli industry has or may have a competitive advantage. The program enables the distribution of knowledge and cooperation between the consortium partners, which may be otherwise difficult to achieve. The program enables the formation of different consortiums for a period of 3 years, via broad-based partnership of industry entities, that are focused on a limited number of companies or those aiming to build an infrastructure of knowledge via research institutions that are directed by the industry.

Academic Knowledge Transfer Program: This program incentivizes biennial applied research with innovative technological feasibility originating in academia and its advancement to the stage at which an Israeli industrial company will adopt it to develop as a commercial product. The program's goal is to bridge the knowledge gap between academia and the industry's needs, with the option of leading a project to a stage where it attracts the interest of business entities and, ultimately, achieves a commercialization agreement with the research institution. The program allows the project research to be accompanied by a corporation that envisions its subsequent commercial potential. Adding a corporation to the consortium will therefore be allowed at all stages of the project, to increase its chances for commercialization in Israeli industry. This program includes 3 sub-programs: Knowledge Transfer with an Accompanying Corporation, Knowledge Transfer without a Corporation, and Preferred Pharma Research that allows for triennial activity. In addition, a technology-business expert will be allocated to approved projects via the Authority's expert subject matter sub-contractors, in order to assist researchers in honing their scientific and business activity and to adapt it to market requirements. This benefit will be given to institutions that choose to add this expert (whether from the Authority's list of experts or one proposed by the institution itself).

Projects approved as part of this program that met the technology criteria and those stipulated by the committee, will be given the option of requesting further support for an "inclusive feasibility lab". This activity will enable funding of an external service laboratory, will demonstrate compiling of technological development, and will yield value for the industry which will ultimately allow the project's commercialization and transfer of knowledge to the industry.

Knowledge Commercialization Program: A program promoting cooperation between academic research groups and an Israeli industrial company, with the goal of proving technological feasibility of the preliminary academic research's achievements. The program is intended to enable a company to absorb the knowledge developed by the academic institution and to adapt it to its needs for developing groundbreaking products. The program includes repetition of the research results, their validation, adaptations to industrial conditions, and industrial application. The program includes three biennial sub-programs – MAGNETON, Knowledge Import, and Continued MAGNET:

- > **MAGNETON and Knowledge Import** – the R&D program will include the transfer of knowledge from one or more research institutes (Israeli or foreign respectively) to an Israeli industrial corporation, primarily via repetition of the research results, their validation, adaptations to industrial conditions, and industrial application.
- > **Continued MAGNET** – continued joint R&D activity of an industrial corporation member in the consortium and a research institution on a selected project conducted in the consortium.

MEIMAD – Dual Military, Defense, and Commercial R&D Program: This incentive program is a joint venture of the Innovation Authority, Ministry of Finance, and the Defense Ministry's Administration for the Development of Weapons and Technological Infrastructure. The program supports the development of creative pre-product solutions for military needs and commercial markets. The program's goal is to promote military and commercial R&D of dual use technologies, which on the one hand contribute to national security, and on the other hand possess commercial potential. This program includes three sub-programs: MEIMAD Academia (see Academic Knowledge Transfer above), MEIMAD Industry (see Knowledge Commercialization above), and MEIMAD Pre-Product – groundbreaking pre-product technology developments with dual-use potential (the project is for up to 2.5 years).

R&D Infrastructure and Equipment Program: This program enables the establishment of R&D infrastructures needed by the industry for innovative and groundbreaking R&D. Government support for the establishment of infrastructures is required when a significant industry need arises for such infrastructure and when, for the following reasons, there is no economic justification for its establishment without government support:

- a. There is no such infrastructure in Israel and the need exists for significant knowledge and funding that would be uneconomic for a specific Israeli company.
- b. Accessibility to the exiting infrastructure overseas incurs high costs or does not conform to the needs of industrial users in Israel.
- c. The infrastructure and facilitating its accessibility will create fertile ground for building an ecosystem in this field in Israel.

Establishing the infrastructure can be undertaken by a group of users, or by an industrial corporation, by buying infrastructure equipment to provide R&D services for industrial corporations to advance Israeli industry.

Applied Research in Industry Program: This program supports companies that invest large-scale budgets in research / preliminary development processes of groundbreaking technology. Among the emphases of the program:

- > **Innovative high-risk R&D** - Engaging in high-risk research and the development of innovative technologies grants a company a significant advantage and allows it to penetrate new markets and to influence the growth of the Israeli economy.
- > **Attractive funding model** - The program offers participation in risks inherent in the development process of a new technology, regardless of future profits or successes. The grant will be 55% of the program's total budget approved by the research committee.
- > **Quality-Standard support** - The support of the Innovation Authority, given only after a project undergoes comprehensive professional examination and evaluation, constitutes a quality standard for companies in the industry. This quality standard helps in recruiting investors at various stages of a company's activity.

New Projects:

IGBT (Israel Biochip Technology Consortium): is a consortium of leading companies and researchers from the field of electronic chips and biochips. The consortium's goal is to develop generic technological bricks aimed at creating an Israeli competitive technological advantage in the field of continuous medical monitoring of the human body, based on data measured by multiple sensors. The consortium integrates well with the Innovation Authority's efforts to advance the field of bio-convergence as a significant growth engine of the Israeli economy.

Applied Research in the Industry: NOVA is a 28-year-old company with revenues of over USD 400 million and with more than 800 employees, of whom 400 are in Israel. The company submitted a request for support in developing a new metrology technology that will enable the early electrical characterization of the components built in the semiconductor industry's assembly line. The product, that will be constructed using the technology will be innovative and will allow to conduct an electrical test at a significantly earlier stage than that possible today. No such product currently exists in the growing metrology market.

Knowledge Commercialization: CEVA is a company that develops advanced sound solutions to improve human-machine and interpersonal communication. The company submitted a request to the Knowledge Commercialization Program at Bar-Ilan University for a field that focuses on algorithms for Machine Learning and Deep Learning. The project pertains to the integration of new mechanisms in products' software and hardware components (the bx- processor, ClearVox sound filter) to reduce noise and improve sound quality. The future products, in which the technology developed in this program will be incorporated, include communications and multimedia devices and others.

Applied Research in Academia: A study conducted by Prof. Malachi Noked from Bar-Ilan University on surface modifications aimed at creating innovative protection levels to improve the operation of rechargeable lithium batteries. The funded study will assist in the development of an innovative nanometric coating on the silicon anode of a next-generation lithium-ion battery and help enhance its performance by approximately 30%. This technology has commercialization potential with different companies in Israeli industry that have large needs on the local and global markets and can contribute significantly from a sustainability perspective.

MEIMAD Applied Research in Industry: Lurya Defense and Aerospace submitted a request to develop a ballistic helmet and a helmet for civilian purposes. The helmet combines soft and hard protection, connected via a spring switch, and has improved performance in protection from amor-piercing bullets and trauma wounds. This idea represents high-level functional and technological innovation on a global level. The company is also interested in developing a process for the 3D printing of boron carbide. (Boron carbide).

The Division's Performance in Numbers:

- Work plans of 11 consortiums were approved during 2021 as part of the Consortiums Program, for grants totaling NIS 175 million (NIS 47 for new consortiums and NIS 128 million for follow-up programs). Furthermore, 5 projects were submitted to establish new consortiums during 2021 and received preliminary approval. The final decisions on these requests will be made during 2022.
- 21 new and follow-up requests were submitted to the MEIMAD Program of which 17 were approved for grants totaling NIS 12.5 million.
- In the R&D Infrastructures Program, a follow-up period was approved for the NLP Consortium and for the Smart Transportation Consortium totaling NIS 8.5 million. In addition, approval was given for the establishment of an R&D infrastructure in synthetic biology for grants totaling NIS 9.7 million for the first year of activity.
- The Authority's Research Committee in the Applied Research in Industry Program discussed 22 requests for a total budget of NIS 82 million. Six new requests were approved for total grants of NIS 15.4 million and a further NIS 26.7 million was awarded to follow-up requests.
- 85 requests were submitted to the Knowledge Commercialization Program of which 58 were approved for total grants of NIS 48 million.
- 388 files were submitted to the Applied Research in Academia Program, with or without an accompanying corporation, including MEIMAD Academia, (205 new files of which 132 were approved) for total grants of NIS 107 million.



The Advanced Manufacturing Division assists companies from the manufacturing sector and factories interested in developing products and implementing innovative technologies. The Division strives to strengthen the manufacturing industry and enhance its competitiveness by applying R&D processes and innovation.

The Division's Programs:

R&D Preparatory Program: The program aims to create an innovation-oriented change in companies from the manufacturing industry sectors, with the goal of enhancing the competitiveness of the participating companies. The program is operated as a complementary tool for the manufacturing industry and is intended to assist companies with the initial stages of R&D. The program offers companies without prior experience in R&D and in leading innovation processes, or companies that require focus and guidance with their R&D activities, the assistance of technology experts to bolster their R&D programs. The program provides various supportive tools including mapping and examination of possible R&D directions, testing of technological feasibility, resolution of engineering faults, improvements in the manufacturing process, and pre-manufacturing preparations for early-stage companies.

MOFET (R&D in the Manufacturing Industry): The MOFET Program leads technological R&D programs that have the potential to improve productivity of a company or factory, while at the same time creating technological differentiation that will achieve competitive advantages in the local and global markets. The MOFET Program is intended for industrial factories interested in implementing technological innovation processes by developing innovative products, improving and developing existing products, or developing and enhancing production processes. The program is for manufacture-oriented companies or companies preparing for manufacturing, and that meet the program criteria. As part of this program, a company may submit focused R&D programs including development of a new product, use of advanced materials, and development of an innovative production process.

Transition from Development to Production Program: This program aims to assist companies to successfully navigate the transition from development to production, with the aim of establishing production lines and factories in Israel using advanced technologies. The program constitutes a quantum leap for companies in developing a production process for advanced products, offers financial support, guidance, and assistance in removing obstacles during an early-stage company's transition from product development to that of mass production.

The program accepts requests in which two thirds of the budget is allocated to the development of production processes. The program is intended for companies and factories producing or preparing to produce in Israel and that are interested in developing innovative production processes or production processes for globally innovative products.

New Projects:

Breaking the Paradigm and Introducing R&D into the Manufacturing Industry: The manufacturing industry is entering the world of R&D, as can be seen by the 30% annual growth in the number of R&D submissions and approved grants. About 50% of the submissions in 2021 were from industry that had not previously engaged in R&D (plastics, metals, food, etc.). Over 50% of the companies are located in Development-A Zones. 180 companies submitted a first-time request for support in the MOFET and R&D Preparatory Programs.

Establishing Factories in Israel with Advanced Technology: Two new calls for proposals were issued in 2021 in the Transition from Development to Production Program, that enables companies to develop production processes while setting up the factory and to strengthen its production activity in Israel. This program provides ongoing support for companies that have completed the product development stage and are developing the production processes, in fields such as medical devices, pharmaceuticals, energy, alternative proteins, and others. To date, 70 companies have submitted requests as part of this program, 50 of which were approved for total grants of NIS 85 million. Of these, approximately 70% of the submissions were in the fields of medical devices, pharma, and energy. About 85% of the companies are early-stage companies (sales of up to US 10 million) with significant growth potential in Israel.

Collaboration with Government and Innovation-Promoting Entities: For the first time, the Advanced Manufacturing Division initiated collaboration during 2021 with the Defense Ministry's Administration for the Development of Weapons and Technological Infrastructure in order to advance dual R&D programs in the manufacturing industry. 22 requests were submitted as part of this program to develop new products and production processes for advanced technological products that represent innovation in both the civilian and military markets, and which enable Israeli manufacturing companies to compete globally. In addition, collaborations were formulated and extended with the Ministry of Economy and Industry, the Ministry of Construction and Housing, the Ministry of Agriculture, the Ministry of Energy, and the Ministry of Health to advance R&D programs in manufacturing companies in various sectors.

The Division's Performance in Numbers:

- 213 requests were submitted to the MOFET Program of which 145 were approved for grants totaling NIS 108 million.
- 90 requests were submitted to and approved by the R&D Preparatory Program for grants totaling NIS 6 million.
- 42 requests were submitted to the Transition from Development to Production Program of which 33 were approved for grants totaling NIS 57.5 million.



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