INNOVATION 2012

AN ACTIVE INDUSTRIAL POLICY FOR LEVERAGING SCIENCE AND TECHNOLOGY AND ISRAEL'S UNIQUE CULTURE OF INNOVATION

A FOLLOW-UP STUDY TO "ISRAEL 2028 - VISION AND STRATEGY FOR ECONOMY AND SOCIETY IN A GLOBAL WORLD"

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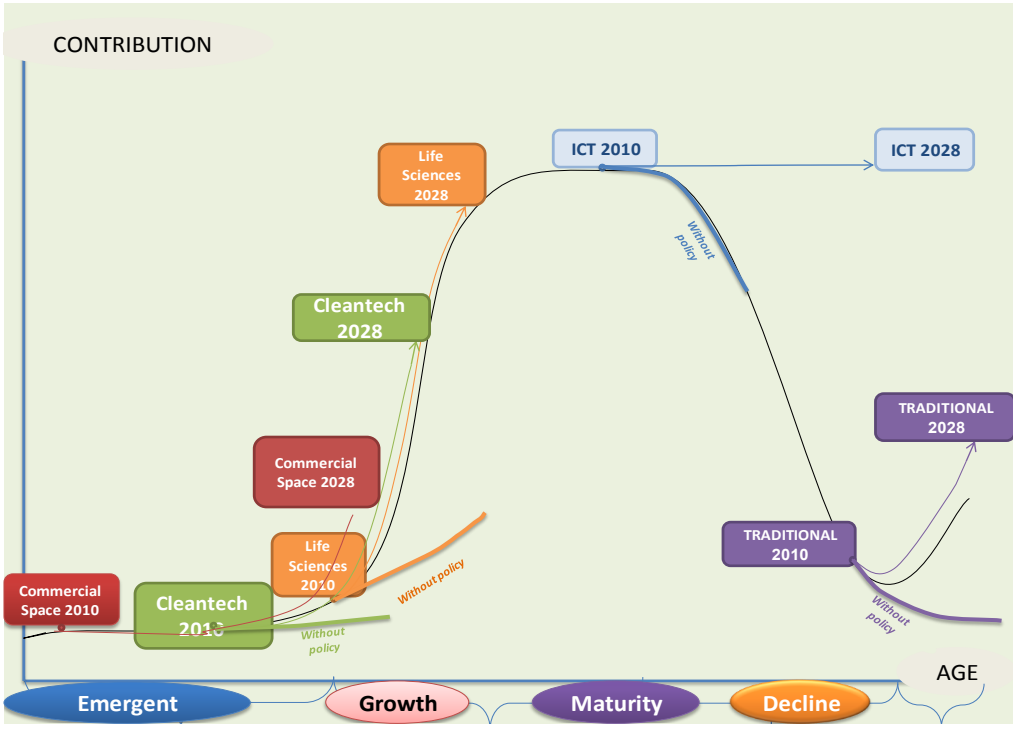
Remark: Appendix teams reports are distributed separately

EXECUTIVE SUMMARY

Innovation 2012 is a strategy to implement the mission outlined in **"Israel 2028 –Vision and Strategy for Economy and Society in a Global World,"** initiated by the U.S.-Israel Science & Technology Foundation and guided by the Government of Israel. This work is a detailed plan of action to implement recommendations made by **Israel 2028** for an industrial innovation policy, specifically related to three out of the ten Israel 2028's key topics: 1) upgrading traditional industries; 2) leveraging existing emerging technology sectors into global knowledge-intensive industries; and 3) sustaining and strengthening the current hi-tech industry in Israel today. The overall goal of the project is to propose a proactive national industrial innovation policy that leverages the advantages of Israel's science and technology alongside Israel's unique culture of innovation and entrepreneurship. The project initiated by the U.S.-Israel Science and Technology Foundation, was prepared for the chief scientist of the Ministry of Economics and was submitted in 2012.

The sectors studied and their objectives are shown in the figure below, which describes schematically the qualitative contribution of the industrial sectors selected for this study on an S curve of industrial life cycle. These specific segments were selected due to their large business potential and Israel's relative advantages in each.

Industry life cycle & contribution to national economy



Project teams analyzed Israel's relative strengths and advantages, identified barriers to industrial growth sector-by-sector and offered pro-active recommendations to achieve industrial success and sustainability. Today, Israel faces a completely new global situation that poses significant challenges to the continued global competitiveness of Israel's knowledge-intensive economy. These challenges cannot be remedied by quick, simple short-term solutions, but rather require the application of wide-ranging, flexible, comprehensive and visionary national industrial policy.

Israel excels in Research and Development (hereinafter: R&D) and has the highest investment in R&D as percentage of GDP in OECD countries. Among other factors, this is the result of very successful, science, technology and R&D policies as discussed recently in a Samuel Neaman Institute report[1] . However, successful R&D alone does not necessarily lead to economic success. Policies and programs must deal with the entire value chain, including encouraging the establishment of local production facilities.

The proximity of R&D to production was vital in the past and seems even more so today as the R&D community must stay up to date about the latest manufacturing technologies. Further it creates employment opportunities to all the workforce segments, not only those directly involved with the R&D aspect of the value chain. Therefore, building industrial success on the basis of R&D in Israel and transferring production outside Israel is not a stable model for long-term success and economic growth based on knowledge-intensive industries. It is this Project Team's opinion that Israel should maintain a balance between basic research, applied research, development and production at both the national policy level and on the level of industrial sectors.

Israel's globalization strategy encourages large international companies to establish R&D centers in Israel. This can be done either by the multi-national setting up local subsidiaries or through sub-contracting to existing Israeli industry. Intel provides an excellent example to follow. Similarly, Israel has invested government funds in supporting private R&D activities in new converging sciences of nanotechnology, and we believe that the challenge of turning this R&D's promising beginnings into manufacturing industries will be part of the next decade's challenge, as described here. The industrial cluster concept, championed by Prof. Michael Porter, [2] according to which universities, incubators and businesses work together in close proximity usually in related sectors, seems crucial for the coming years as well, and should be applied to planning at the national level. A good example is *MATAM* in Haifa with the participation of the Haifa Municipality, the Technion, and scientific incubators, startups and mature knowledge-intensive industries.

When determining how to allocate existing national resources of infrastructures, capital sources and human resources, governments must establish priorities to guide their decisions. However, the meaning of innovation is to refrain from engaging in a zero sum game (where losses balance gains), and instead strive to increase the national pie in the coming years, so that all groups and sectors gain, thus increasing the resources for continued growth. Therefore, we attach great importance to a comprehensive systems' approach to examining national policy,

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1 Zehev Tadmor, "The National Science and Technology and R&D Policy of the State of Israel"*, Samuel Neaman Institute* March 2011.

2 Michael Porter ,*Competitive Advantage of Nations* ,NY, Free press, 1990.

which means linking different sectors, allocating infrastructure resources and generating solutions that create mutual advantages and synergies, alongside coordination between and within government offices.

The common denominator of all the sectors was the search for a long-term national direction enabling accelerated growth to foster an increasing contribution to GDP and employment, and the ability to achieve and sustain competitive advantages in global markets. The project team's selection methodology also included a review of the sectors where Israel has relative advantages and to identify the main barriers to each sector's success. The final step is proposing solutions to the government to help remove barriers and facilitate the growth of an effective industrial leveraging policy.

Common barriers identified across new emerging sectors include: longer time intervals needed between proof of concept and commercialization; importance of academia's contribution to research and the slow adaptation of academia-to-industry knowledge transfer; relative difficulty of establishing strategic relationships and targeting customers in the global market; lack of regulatory procedures to allow rapid buildup of industry and application of innovation and commercialization; access to capital, particularly for the stages between proof of feasibility at the incubator stage and the establishment of a viable local industry ("the valley of death"); lack of cross-fertilization and connections between different sectors to create competitive interdisciplinary leadership advantages; and lack of systematic government directed the policies across different government offices.

The key recommendations for each sector are:

Traditional / classical industry

The team identified small classical companies as the main neglected segment. The major barriers that postpone a breakthrough in small enterprises were identified as:

1. Managers' unwillingness to change long-established patterns of thinking.

2. Lack of systematic support suited to their needs (business, organizational, operational, financial, and technological).

3. Scale and language gaps, which complicate communication between small enterprises and government support mechanisms.

4. Lack of knowledge regarding export potential and lack of courage to dream about export.

It is recommended that the following steps be taken:

1. Designate an official entity to initiate a process of integrating and coordinating all the government programs that are compatible with the characteristics of small enterprises and will effectively guide them.

2. Strengthen and upgrade the activity of *MATI* and the small Industry & Craft Association.

3. Support the concept of "anchor industries" leading to the upgrading, in terms of efficiency and quality, of their subcontractors.

4. Support the establishment of "clusters" on the basis of branch, sector, or geography, leading to economies of scale by leveraging the industrial parks' management teams, *MATI* and the peripheral municipalities' role.

5. Eliminate the term of "low tech" from the professional and public jargon as part of improving the image and setting higher expectations for traditional industries.

6. Strengthen infrastructure weaknesses, including:

    a. Promoting professional and high quality education to enhance manpower skills and readiness to embrace innovation and technology.

    b. Enhancing avenues for management training.

    c. Fostering relations between the industry and academia.

    d. Fostering international industrial collaboration.

    e. Establishing a national program to upgrade quality in traditional industry.

The process of implementing several of these conclusions has already been initiated.

Emerging technology sectors

Israel's economy has been transformed over the last twenty years from an agricultural based economy to one whose continued growth and dynamism is based on science and technology and knowledge-intensive industries. At the same time, the Information Communications Technology (ICT) driven hi-tech expansion of the 1990's has reached a peak and is threatened by global competitive factors and some key impediments to renewed and sustainable growth. As technology development becomes more inter-disciplinary and convergent, newer sectors are emerging that offer the promise of renewed industrial growth to put Israel on course to reach the lofty vision of **Israel 2028**.

In order to promote emerging technology sector's development and growth an in-depth understanding of the sector is required. Three sectors in different stages of growth were selected for study to develop new policies and programs, namely: Biotechnology and Life Sciences; Cleantech; and Commercial/Civilian Space.

Biotechnology and life sciences

Israel is recognized globally as a source of knowledge and innovation in research and technology in the area of life sciences. In spite of intensified attention to the life science industry in all its aspects, including Office of the Chief Scientist (OCS) preferential treatment, the industry has yet to mature and realize its enormous potential.

While long-range planning for the life sciences industry needs to be continued in 2011, following are the Biotechnology/Life Sciences team's key interim additional recommendations:

1. Continue the preferential support of OCS support for the sector.

2. Set a road map to incorporate the long range strategic policy planning for the LS sectors along with criteria for measuring success as detailed in the team report.

3. Encourage the consolidation and integration of the small companies operating in complementary areas into larger, more globally competitive entities. This will enable the creation of a critical mass and synergy. This can be achieved by granting OCS support preferences and/or incentives for such consolidations.

4. Promote business development studies for scientists and managers in the fields of biopharmaceuticals and Medical Devices. This should include exchange programs for scientists and engineers, already working in the industry, to gain managerial and global business development experience. A model program can be initiated in the US lead by the OCS and USISTF.

5. Increase the government incentives to attract more large global companies to invest in Israel in both R&D and production.

6. Establish an Israeli Food and Drug Administration (FDA) equivalent. Details need to be discussed in the road map that was recommended.

7. Finalize the laws for clinical trials. Companies would greatly benefit from the ability to perform early human studies (Pilot and Phase I) in Israel because of both geographical proximity and financial considerations. Furthermore, there are still an insufficient number of professionals dealing with clinical trial management and execution.

8. In the pre-clinical stages, Israel is lacking in Good Laboratory Practices grade animal facilities, forcing most companies to conduct their pre-clinical animal testing abroad at higher costs in terms of both time and money. The establishment of such infrastructure should be supported by the government and ILSI, the Israel Life Sciences industry organization.

9. Motivation for the establishment of Contract Research organizations (CRO).

10. Motivation for the establishment of Contract Manufacturing organizations (CMO).

11. Develop a Private Equity-like fund dedicated for mature companies that can serve as an "Exit" option to Venture Capital funds. This Fund would be in addition and complement to the recently initiated emerging companies Bio Funds.

12. Hospital research centers innovation should be encouraged by aligning IP ownership treatment for researchers with that of other research scientists (under process).

Cleantech

The State of Israel, like most developed countries, allocates significant budgets to solve strategic objectives related to reducing the emission of greenhouse gases, creating alternative sources of energy, improving the water balance, and treating the growing and worsening problem of waste. Without special attention to developing a strong local industry, monies will be spent on imported solutions and the opportunity to develop a new knowledge-intensive export industry will be missed.

The goals of the Cleantech team's recommendations are:

1. To develop clear and integrated policies to promote the development of a local and export-oriented Cleantech industry.

2. To encourage innovation and the entry of mature and traditional industries into this arena.

3. To create available infrastructures for pilot projects (beta-sites).

4. To create conditions to enable adequate availability of financing.

It is recommended that unique tools be provided to develop the area on four major planes:

1. Institutionalization and significant strengthening of Newtech in the Ministry of Industry, Trade and Labor.

2. Adopt and upgrade Chief Scientist's various programs and support tools so they are suitable for Cleantech sectors that are infrastructure intensive.

3. Leverage government tools to motivate private capital to support the Cleantech industry.

4. Encouragement of the local market to deploy innovative Israeli Cleantech solutions.

The total government investment required, US$ 250 M, spread over 5 years constitutes a minimal part of the revenue that will be created by this industry.

Commercial / civilian space industry

In spite of the very early stage of the commercial/civilian space industry in Israel, a few key factors led to its inclusion in the Innovation 2011 project: unique military space capabilities, a strong research community, a recent national commitment to the sector's development, and the opportunities for fruitful collaboration with the United States.

The team's recommendations relate primarily to leveraging the NASA-ISA relationship for the purpose of developing a robust commercial/civilian space industry in Israel that will become a genuine strategic partner for American space industries. It is essential that the NASA-ISA relationship be upgraded to creating collaboration, particularly with respect to NASA's Science Mission Directorate.

The main recommendations as further detailed in the industry section are:

1. Making Israel Aware of NASA’s needs and how it operates.

2. Making NASA aware of Israeli capabilities.

3. Mission-Oriented cooperation.

4. NASA SBIR opportunities.

5. G2G- Signed agreement.

6. Technology incubators and Magnet programs.

7. Academic and scientific outreach through the channel of NASA.

8. Develop relationships with more NASA Research Centers in addition to NASA Ames, namely Goddard Space Flight Center, NASA Headquarters, Kennedy Space Center and the Jet Propulsion Laboratory.

9. Export Institute support to arrange trade missions to the NASA research.

The first five recommendations could be implemented by the development of an Israeli NASA Space Science Business Plan, which would require only modest amount of funding support from the new Israeli civil space budget in 2011. We believe that this is the highest priority task for ISA in 2011.

Current ICT-based hi-tech industry

While rapid changes in global markets may endanger current Israeli hi-tech strategies and competitive advantages, these five Israel core drivers of innovation were identified as permanent:

Resilience, stubborn persistence, role models, desire to change the world, lack of fear of risk

The team identified several key impediments to renewed sustainable growth and leadership for hi-tech industries. The most prominent impediments are a shortage of engineers, decreasing access to capital and tendency to seek early exits and sale of promising technology companies abroad.

To remove the impediments the team recommends the following:

1. Provide funding for 1500 engineering students each year for at least the next five years. Approximate cost $45M.

2. Increase the budget of the OCS by at least 15% annually for each of the next five years.

3. Offer tax credits and other incentives for mergers and acquisitions by and between Israeli companies to encourage economies of scale and development of global Israeli companies.

Adopting and implementing Innovation 2011

The industrial innovation policy recommendations and perspectives address issues at the foundation of Israel's ability to foster and sustain economic growth based on knowledge-intensive industrial activity. The OCS should lead the implementation of the proposed recommendations in coordination with the National Council on R&D, the Ministry of Finance and the National Council on the Economy in the Prime Minister's Office. A consistent, integrated effort will yield ongoing, sustainable growth enabling the realization of the vision and goals of **Israel 2028.**

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INTRODUCTION

Innovation 2011 is a continuation project in the program **"Israel 2028: Vision and Strategy for Economy and Society in a Global World"** (henceforth: "Israel 2028"), which was initiated by the U.S.–Israel Science and Technology Foundation. **Israel 2028** is an extensive, integrated strategic plan for realizing national objectives. It is aimed at elevating Israel to the top 15 nations in terms of economic achievement and quality of life, raising GDP per capita to more than $50,000 (in 2006 terms) at the same time increasing social solidarity and narrowing social gaps.

Israel 2028 analyzed Israel's current economic and social situation, examined dilemmas facing policy-makers and articulated high-level national policy goals and recommendations in addition to identifying key impediments to their implementation.

Continuous, dedicated, detailed long-term planning in the spirit of **Israel 2028** was left for individual government ministries which would also lead sector-based implementation. The Ministry of Industry, Trade and Labor and the Office of the Chief Scientist expressed their willingness to guide a follow-up program in three particular inter-related subjects outlined in **Israel 2028**:

1. Israel and the Global Challenge.

2. Leveraging Scientific/Technological R&D.

3. Upgrading and assimilation of innovation in traditional industries.

Common to these subjects is the major role that the manufacturing industry plays as an engine of national economic growth. Traditional industry is the largest industrial sector; however, its contribution to the economy (in terms of GDP/capita) is much smaller than that of knowledge-intensive industries [3] which serve as the anchor of Israel's innovation culture. Ensuring the continued viability of traditional industries requires a significant upgrading of its competitive capacity and productivity.

Traditional industry employs more than half of the industry of labor market, [4] although its productivity and pay are the lowest in the Israeli economy, in contrast to knowledge-intensive industry. Upgrading traditional industry will tend to reduce salary and social gaps which characterize the "dual economy" identified in **Israel 2028**. Productivity per employee is presented in the following figure:[5]

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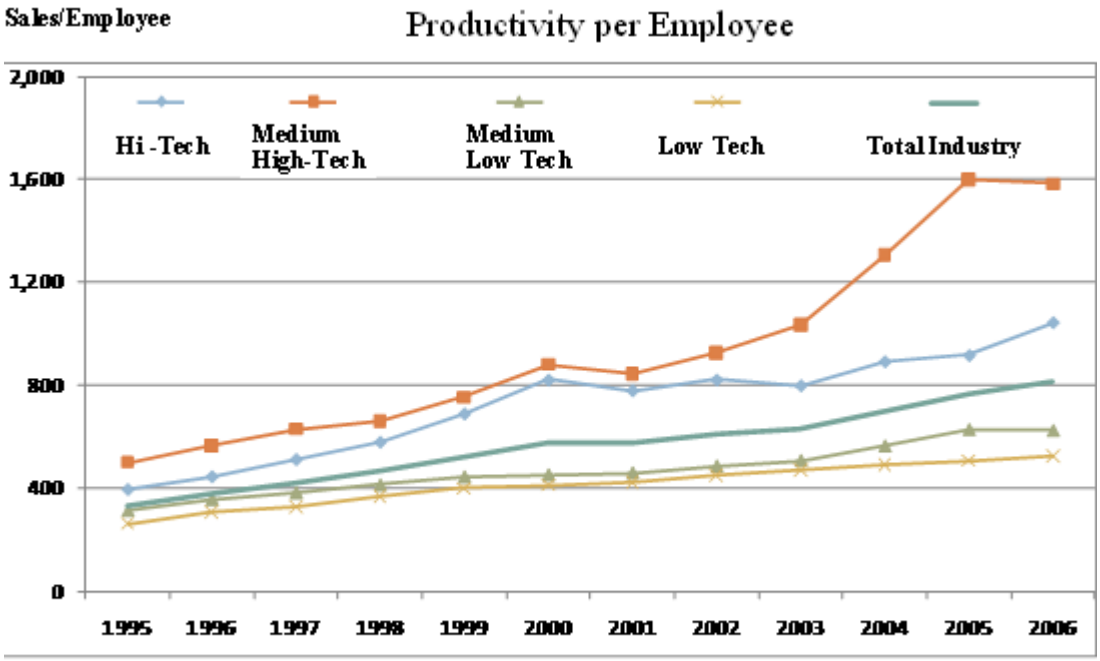
[3] "Committee's report on Measures to Empowering the Periphery and Traditional Industries (*The Makov Report*)", *State of Israel, Ministry of Industry, Trade & Employment* October 2007 (Hebrew, P.7).

[4] Prime Minister Office, Socio-Economic Agenda, Israel 2008-2010**,** http://www.pmo.gov.il/PMOEng/PM+Office/Departments/eco20082010.htm **.**

[5] "Science, Technology and Innovation Indicators in Israel: An International Comparison (Third edition)", *Samuel Neaman Institute*, 2010, P. 112; "Business R&D", *Israel Bureau of Statistics*, 2006.

Figure I: Productivity per Employee



Israel's apparent satisfaction with the achievements of knowledge-intensive industries masks accumulating difficulties facing these industries' path to sustainability and self-renewal. Increasing global competition for technology-intensive products and services; competition for R&D services, for direct foreign investment and for venture capital; and the tendency of companies to prefer early exits rather than pursue long-term growth and development strategies mandate careful, continuous and comprehensive strategic planning and implementation.

PROJECT GOAL

The goal of **Innovation 2012** is to propose alternative pro-active national, industrial policies and programs. This will enable Israel to leverage advantages in science and technology along with its culture of innovation and entrepreneurship to achieve national growth targets and reduce social gaps.

Israeli success in leveraging scientific and technological R&D into economic growth is the result of special circumstances and the massive public investments in research and higher education in decades past. Given the changes taking place in the international arena and the long-term constants required to develop and sustain the infrastructures of scientific-technological human capital, the need for a long-term comprehensive national policy for industrial innovation has never been so critical.

INDUSTRIAL SECTORS SELECTED AND METHODOLOGY

Traditional / classical industries

Traditional industries make the largest contribution to the economy in terms of product and employment; therefore no long-term industrial strategy can succeed unless its capability to contribute to national economic growth is significantly augmented. **Innovation 2011's** goal is to develop a proactive, directed policy for classical industries that will open up opportunities for upgrading its capabilities and significantly expanding its exports. The proposed policies will facilitate a transformation from a local market focus to a global one, thereby stimulating further increases in productivity. In place of the various separate and un-coordinated national programs, even within the Ministry of Industry, Trade and Labor, we propose integration and coordinated policies and programs to more effectively and efficiently serve the needs of veteran classical industry allowing its dedication to the national imperative of growth.

Guided by the conclusions of **Israel 2028**, the classical industry team pursued an analysis of existing programs and a set of pragmatic recommendations for short and long-term actions:

1. An experienced senior industry manager was recruited to head the team.

2. Experts were recruited nationally and integrated into the project team. Other experts were consulted, field visits to plants and in-depth interviews with classical industry managers were conducted and success stories were studied.

3. The team met monthly for a year, with the presence of the project's management team.

4. Strategic and operative recommendations were developed by small groups.

Integration of all finding and recommendations for comprehensive industrial policy was done by the project leader.

The team used existing literature, auxiliary materials (such as the Makov Committee Report)[6] industry site visits and interviews. The team focused primarily on the actual processes of implementing programs and tools that had already been identified in the past as being suitable, and looking for ways to expand and deepen them in order to turn existing beginnings into a real revolution. The contribution of the Office of the Chief Scientist in recent years, by offering preference for R&D in traditional industry, which is already showing signs of improvements in several businesses that were able to take advantage of this assistance, should be especially noted.

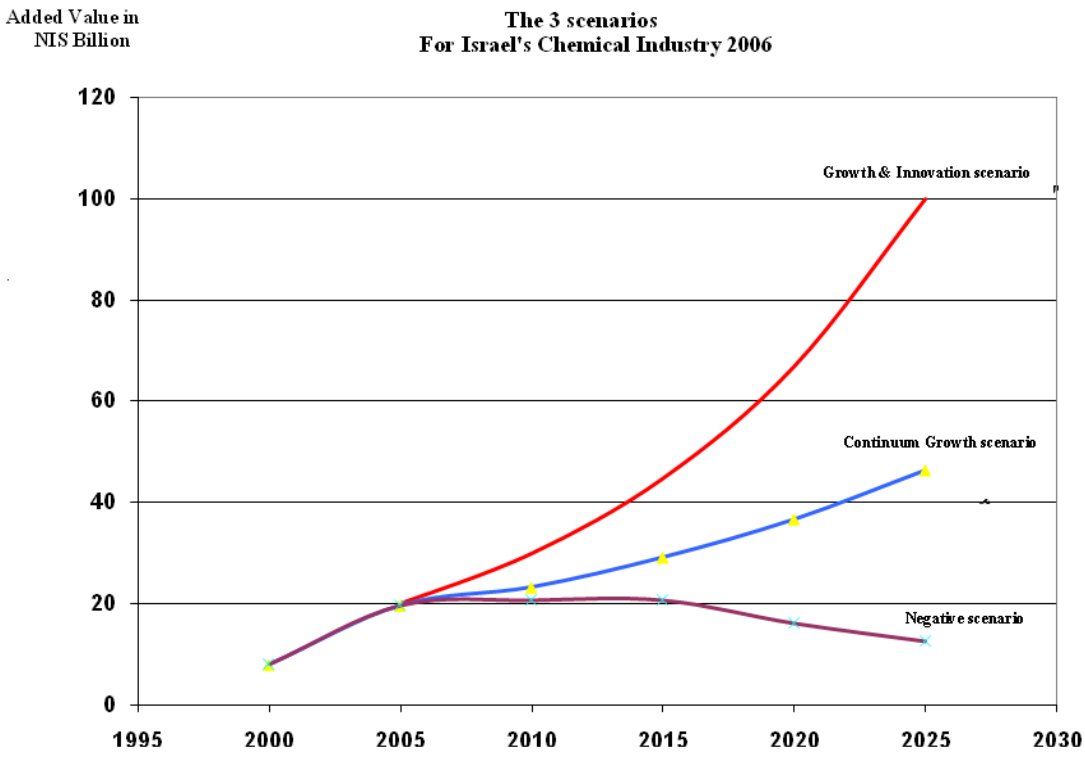
[6] *The Makov Report*, *Ibid.*

Leveraging scientific / technological achievements for thriving and sustainable knowledge-intensive industries (emerging technologies)

We faced an initial dilemma about how to apply **Israel 2028** efficiently and saw two essential ways to perform the project. First, we considered whether to perform an analysis of policies to encourage innovation and globalization of industry without referencing or differentiating between various specific industries. Alternatively, an industry-specific focus could be pursued. Choosing the second path meant selecting emerging knowledge-intensive sectors in various stages of maturity characterized by promising growth opportunities alongside relative advantages for success. **Israel 2028** had already pointed to a number of industrial sectors possessing high potential for providing the greatest contribution to employment, GDP, and the development of a balanced and healthy economy.

Selection of the industry-specific focus was also motivated by the success of a previous SNI project for the chemical industry conducted over the years 2004 – 2007. That project's recommendations were embraced by government and the chemical industry alike resulting in adoption of innovation in meeting new environmental regulations on the one hand and increasing productivity on the other. The project envisioned three possible development scenarios: arrested growth, continued growth, and the growth with assimilation of innovative technologies, as shown in the following figure:

Figure II: The 3 scenarios



The scenario of growth and innovation was realized beyond all expectations, encouraged by government action according to a proactive and deliberate national policy. Together with a clear commitment to invest in the environmental protection and promote new directions by the industry, this allowed the attainment of all the necessary conditions required for accelerated growth.

Three new emerging technology industries, in different stages of maturity and each possessing special characteristics were chosen as the focus for the three teams:

1. **Life sciences / biotechnology**

2. **Commercial / civilian space industry**

3. **Cleantech industry**

These segments were selected due to their large business potential and in order to create an orderly system for analysis as the basis for forging a comprehensive, continuous and updated industrial national policy. In addition, specific reasons vis-à-vis each sector strengthened our determination. For instance, the long-standing OCS preferences for life science projects and the impending launch of new dedicated government backed Biotechnology venture funds made analysis of the sector timely. Both in commercial space and Cleantech, new government attention in the form of a recent report of the Israel Space Agency to the President calling for massive investment over the next five years and policies related to water technology and oil substitutes for transportation increased the government's receptivity to new policy directions.

Guided by the conclusions of **Israel 2028**, we made a determination to deal not only with resolution of short-term problems, but to recommend ways to institutionalize long-term infrastructures and policy, as detailed in the following series of actions:

1. Three teams were established, one per selected sector each with the potential for development of new knowledge-intensive industries based on present global forecasts and Israel's relative advantages.

2. Experts were recruited nationally and integrated into the project teams. Other experts were consulted, and measurements or comparisons were conducted according to pre-defined international criteria (benchmarking).

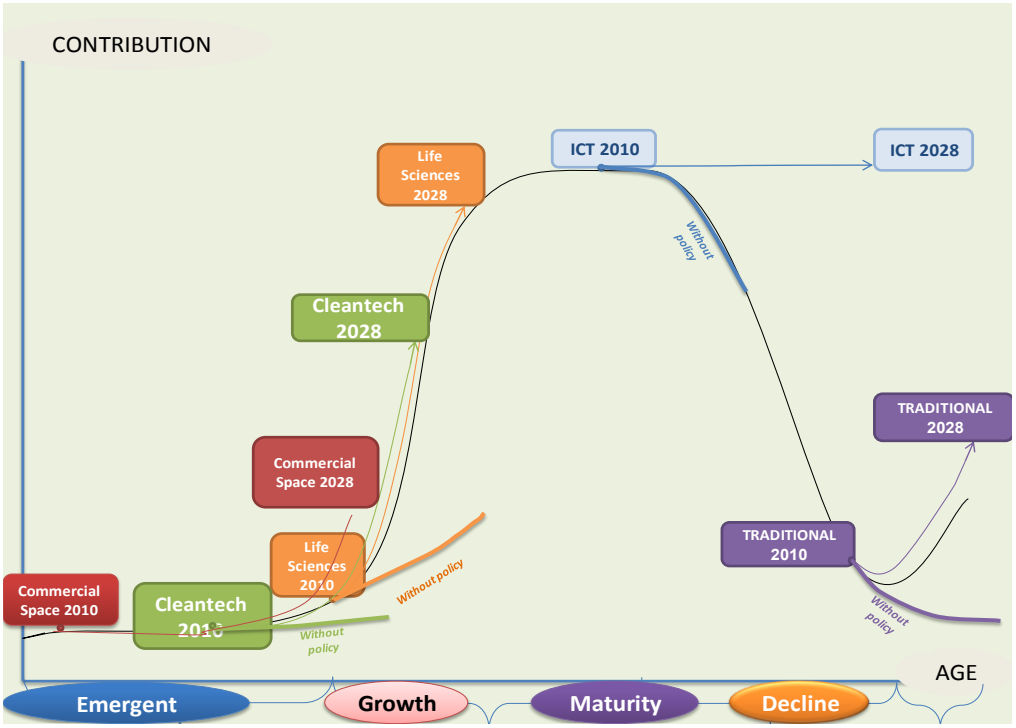
3. Each team operated independently, with the presence of the project's management team.

4. Strategic and operative recommendations were developed by each team.

5. Integration of all team reports and recommendations for comprehensive industrial policy was done by the project leaders.

The figure below presents the qualitative contribution of the selected sectors, as well as hi-tech/ ICT and classical industry in terms of GPD per capita vis-à-vis the sector's "life cycle"**.**

Figure III: Industry life cycle & contribution to national economy



There is a distinct life cycle to virtually all industries, characterized by a so-called S-curve: initial slow rate of growth, accelerating rate of growth, then declining rate of growth, reaching a peak of saturated demand and then later a decline. Life sciences, commercial/civilian space and Cleantech, though differing in age, are all in process of growth with significant potential for national economic and employment contribution.

This project assumed a different character in each area according to its particular character; in some the priority was to identify and recommend that barriers be removed; in others it was necessary to identify opportunities and focus on them; in others a policy that supports capital, etc.

The hi-tech team focused on examining the ecosystem; the life sciences team focused on drawing lessons from the preferential policies prevailing for the last decade; while the Cleantech team concentrated on identifying the opportunities and advantages of Israeli industry, on identifying impediments and suggesting remedies; and the space team dealt mainly with ways of achieving leveraging international cooperation, with a focus on the United States.

Primary findings

The common denominator of all the teams and the sectors chosen was the search for long-term national directions enabling accelerated growth of these industries to foster an increasing contribution to GDP and employment, and the ability to achieve and sustain competitive advantages in global markets. Eventually, the method included:

1. A review of the branch, from a global point of view.

2. Identifying the advantages and niches in which Israel has a relative advantage, emphasizing knowledge and the capacity for innovation.

3. Identifying the main barriers to the sector's success.

4. Presenting solutions to the government to help remove the barriers and allow effective industrial leveraging.

The common solutions to the barriers identified throughout the work are:

1. A longer time interval is necessary between proof of concept and the attainment of a business startup in all the sectors examined than in ICT.

2. Improving the relations between academia and industry in transferring knowledge to industry in Israel.

3. Deepening the support for establishing relations and partnerships and target customers in the global arena.

4. Completing regulatory processes that will allow rapid buildup of industry in Israel and motivate the application of new innovations.

5. Assistance with raising funds for the stages between proof of feasibility at the incubator stage and the establishment of a local industry.

6. Promoting connections between different sectors to create competitive interdisciplinary leadership advantages.

7. Systematic integrated government policy that directs the policies across different government offices.

SUMMARY REPORTS OF SPECIFIC SECTORS

Classical industry team summary

Whether Israeli classical manufacturing industry can succeed in an environment where emerging countries, such as China and India, dictate the rules of the game, was answered positively by success stories from kibbutz industries. Kibbutz industries comprise about 300 plants, most of which are classical industries, with about 33 thousand employees, strong presence in the periphery and sales of about 40 billion NIS, [7] more than half of it as export. Its success is based on a combination of excellent manpower, a strong drive to learn, an emphasis on development and creativity, the support of the entire kibbutz during the difficult startup

[7]Michal Palgi, "Organization in Kibbutz Industry", in Leviatan, U., Oliver, H. and J. Quarter eds; *Crisis in the Israeli Kibbutz: Meeting the Challenge of Changing Times* (1998), Praeger Publishers, P.1-20; see also: *Kibbutz Industry Association*, http://www.kia.co.il/eng/.

period, and the readiness to change direction, e.g., from pure agriculture to a combination of industry and agriculture.

The success formula of the kibbutz industry, along with the success of few role model classical industries, such as Strauss and Iscar, is the result of leadership, vision, perseverance, organization, and strategy, along with a drive to create a global position. Such success can be duplicated at the national level, through promoting a management that models values of craftsmanship, diligence, entrepreneurship, vision, courage, accountability and professional pride. These characteristics were found in the field everywhere: in the Jewish sector, in the Arab sector, in the center of Israel and in the periphery.

The team decided to focus in particular on a segment of small classical manufacturing, those industries with less than fifty (50) employees, because these make up approximately 90% of the total number of companies in the entire classical industry sector.[8] Despite the existence of industrial leadership potential, alongside government awareness of the issues faced by these industries, there is little evidence of any forward movement - an apt metaphor is of a car with an engine, but no gear box.

To enable classical industry to contribute its share to the **Israel 2028** objectives the team examined the first "wave of revolution" in classical industries utilization of innovation and R&D led by the Office of the Chief Scientist, that provides preferential grants and mentors from hi-tech. Ensuring the continuity and success of the OCS programs will provide the basis for a second "wave of revolution" focusing on plants employing fewer than 50 workers, which constitute the majority of the classical industry manufacturing factories, but are detached, for a variety of reasons from the existing government support systems. These smaller enterprises are the main engines for employment and job creation.

The major barriers that postpone a breakthrough in small enterprises were identified as:

1. Manager's unwillingness to change long-established patterns of thinking.

2. Lack of systematic support suited to their needs (business, organizational, operational, financial, and technological).

3. Scale and language gaps, which complicate communications between small enterprises and government support mechanisms.

4. Lack of knowledge regarding export potential and lack of courage to dream about export.

It is recommended that the following steps be taken:

1. Designate an official entity to initiate a process of integrating and coordinating all the government programs that are compatible with the characteristics of small enterprises and will effectively guide them in receiving necessary assistance from the existing support mechanisms.

[8] "Unified Categorization of Industry*", Central bureau of Statistics*, February 2011, P. 1-312.(Hebrew).

2. Strengthen and upgrade the activity of *Mati* and the Industry and Craft Association that function as reliable bridges with small enterprises.

3. Support the concept of "anchor industries" leading to the upgrading, in terms of efficiency and quality, of their subcontractors.

4. Support the establishment of "clusters" on the basis of branch, sector, or geography, leading to economies of scale by planning and motivating by support preferences.

5. Eliminate the term of "low tech" from the professional and public jargon as part of improving the image and setting higher expectations for classical industries.

6. Promote infrastructure issues, including:

    a. Promoting professional and high quality education to enhance manpower skills and readiness to embrace innovation and technology.

    b. Enhance avenues for management training.

    c. Fostering relations between the industry and academia.

    d. Fostering international industrial collaboration.

    e. Establish a national program to upgrade quality in classical industry.

In some of the above areas, the process of implementing the conclusions has already been started by integrating classic industry team members and other organizations that were willing to commit themselves to this mission. In addition, some of the relevant government offices have already started to act in the spirit of these recommendations. The following actions that are already being executed by some team members since the beginning of 2011 are noteworthy:

1. Model/anchor industries that maintain long term cooperation in guiding small businesses have been selected and recruited to the challenge.

2. A training course for traditional industries modeled on TIM (Technion Institute of Management) in combination with the mentoring by senior team members. The first course commenced in February 2011.

3. Organizing regional clusters via industrial parks. Start-up meetings were met with much enthusiasm from the scientific and large companies' leaders.

4. Academia-industry cooperation by expanding the programs of the Knowledge Center for Innovation at the Technion vis-à-vis classical industry. Seminars delivered in 2010 made use of the information collected by the project, including success stories.

5. Enhancing the Agency for Small Businesses. The small industries need upgrading in many aspects in addition to the R&D and innovation. They are not used to approach the government for support and therefore need to be motivated. The Agency for Small

Businesses should widen its programs of enhancing quality and excellence and would initiate programs for innovation as a follow on. Once the small companies are motivated and equipped with the minimum needed know-how, they could use the existing Chief Scientist's budgets and programs.

If these recommendations are followed, the classical industries team estimates a minimum growth potential in the first few years to be a doubling of productivity and output, half of which will be exported. This means an increase of approximately 20 billion NIS in sales and an increase of 10 billion NIS in export. There is reason to believe in far greater potential that can be realized through further waves of innovation and an effective integration of classical industry in increasing production capacity to serve new emerging markets for the Cleantech, life sciences and space sectors.

Cleantech policy team summary

The State of Israel, like most developed countries, allocates significant budgets to solve strategic objectives related to reducing the emission of greenhouse gases, creating alternative sources of energy, improving the water balance, and treating the growing and worsening problem of waste.

These huge budgets have created a new global industry, the Cleantech industry, which focuses on manufacturing a variety of products and providing services that lead to the improvement of operational performance while reducing the negative impact on the environment (pollution, energy consumption, waste).

The increasing global need for alternative energy sources, the shortage of fresh water, climate change, and global urbanization processes continue to grow and to involve extensive investments. New and exciting areas, which were unknown until recently, emerge and have the potential to reshape industries and economies. Examples are smart transportation, smart-water, smart-grid, energy efficiency, and green construction.

There is no doubt today that the various Cleantech areas, which are intertwined with each other and a variety of industries, will lead to blossoming in comprehensive fields of knowledge, to the creation of a widespread global industry and to renewed growth of mature and traditional industries in need of new markets. The global process has already begun, and the window of opportunity to turn Israel into a significant player is now.

Without a strong local Cleantech industry, government budgets will be directed mostly to purchasing foreign solutions, increasing import, and increasing Israel's dependence on foreign industries. Conversely, accelerating the promotion of a local Cleantech industry will lead to the establishment of a thriving export branch while returning a considerable part of the large budgets back to the state treasury, budgets that will be directed to creating jobs, through profits from knowledge-intensive and export-oriented industry.

Israel has many advantages that position local industry at a good starting point on the way to institutionalizing long-term leadership for innovative and profitable industries in several Cleantech branches. Nonetheless, in light of the business promise offered by this area, other countries compete in promoting Cleantech industry of their own and even attract foreign

companies and knowledge. The development rate of this industry is accelerating and we therefore must adjust our support infrastructure to this situation.

The goal of the Cleantech team was to promote a general strategy and to focus on removing a limited number of major barriers, which hold local industry back from taking a leap forward to its proper place of leadership globally. The analysis and evaluation were developed later as an expansion of previous government decisions that were made and proven to be efficient in terms of creating a forward momentum for the Israeli Cleantech industry, while setting an objective for the industry's growth pace so that within a decade it will reach annual export of 20 billion dollars while creating 400,000 jobs.

In light of the points just mentioned, the potential, the economic and strategic importance for Israel, the increasing competition and the promising beginnings of the local Cleantech industry, the focus was on characterizing the barriers in the path of rapid growth. Several major barriers were characterized, each constituting a substantial obstacle on the way to industrial acceleration. The most substantial barriers include:

1. Decentralized support between many government offices.

2. The shortage of funding for development and establishment of companies.

3. The difficulty in obtaining beta sites, and funding for the first commercial projects.

4. The need to penetrate emerging markets (especially India and China).

The first question that arose for examination in the process of analyzing the possibilities for removing the barriers was the need for governmental involvement versus the expectation that private market forces could be harnessed. An examination of this issue raised two main points, as follows:

1. Subsidies and support given to the establishment of local Cleantech industries by governments in most developed countries place the private market in Israel in a distinct disadvantage.[9]

2. Due to the early stage of development, there is a learning curve that the entrepreneurs, investors and even local customers still need to pass through. The private market finds it difficult to finance this learning curve and we believe that it is government's role to assist in accelerating the learning process along with building adequate infrastructure suited to accommodate rapid growth.

These two basic facts led us to the conclusion that the government should lead the early moves and, without this primary leadership, the rate of private involvement cannot withstand the increasing competition in international markets.

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[9] See two interviews with Itay Zetelni, Cleantech leader, Ernst & Young Israel, (Hebrew) 7/3/2011: 18/11/2009
http://www.tashtiot.co.il/2011/03/07/
http://www.tashtiot.co.il/2009/11/18

The second substantive question examined was whether to treat the Cleantech area as single whole, or to focus on one or more of its sub-sectors. It is our recommendation that during the strategic planning stage and while establishing the supporting tools, the Cleantech industry should be treated as a whole. In later stages, it may be possible to prefer one or more sub-sector over others while using the tools applied to the entire branch. The main reasons for this recommendation are:

1. Despite the differences between the sub-sectors in the branch, they are not completely independent. Vice versa, there is a strong affinity between most of the sub-sectors. For example, solid waste treatment is related to sewage treatment or to wastewater recycling; energy efficiency is related to green buildings; water production (e.g., desalination) is related to energy production and demand and so on.

2. In most cases, both the main barriers and the main players, namely, the markets, customers and investors, are common to all the Cleantech branches.

Nonetheless, one cannot ignore the fact that the government has already decided on at least two directions that will be given national preference: the first, water is where there is a growing global need on the one hand and in which Israel has already a clear relative advantage on the other. The other area is that of alternative fuels for transportation, where it is crucial for Israel that the world finds a solution that will break the present dependence on fossil fuel sources. Integration of the recently discovered natural gas resources may enhance our ability to realize this decision effectively.

In consideration of government constraints in targeting allocation of resources, the recommendations we make allow for considerable leveraging of the private market and its integration into the effort to promote Cleantech industry development. The goals of the recommendations are:

1. To lead to clear and integrated policies to promote the Cleantech industry.

2. To encourage innovation and the entry of mature and traditional industries into this arena.

3. To create practical and available infrastructures for pilot projects (beta-sites).

4. To create conditions to enable adequate availability of financing.

For this purpose, it is recommended that unique tools be provided to develop the area on four major planes:

1. Institutionalization and significant strengthening of Newtech in the Ministry of Industry, Trade and Labor.

2. Adopt Chief Scientist's various programs and support tools so they are suitable for Cleantech sectors that are infrastructure intensive.

3. Leverage government tools to motivate private capital to support the Cleantech industry.

4. Tools to encourage the local market to deploy innovative Israeli Cleantech solutions.

Development of the Cleantech sector, now in its early stages, will grant Israel another opportunity to position itself at the forefront of global technology development. The total government investment required, US$ 250 M, spread over 5 years (about 50 million dollars a year for 5 years), constitutes a minimal part of the revenue that will be created by this industry.

Summary of life sciences team

Israel is recognized globally as a source of knowledge and innovation in research and technology in the area of life sciences. It is fast in the development and assimilation of innovative medical technologies and faster still in the development of medical equipment and innovative medicines. It is the leader in the number of medical device patents per capita and second in the number of Biopharma patents per capita.[10]

Israeli physicians and scientists are at the cutting edge of global leadership as innovators and early adaptors of technology in cardiology, neurology, orthopedics, oncology, metabolic disorders and immunology, infectious diseases, patient monitoring, emergency medicine, surgery, and other fields. Six leading drugs on the global market today are based on Israeli technology and in 2009, these blockbusters, which include the two major therapies for multiple sclerosis, earned more than $9 billion in revenues.

The life sciences team looked at the life sciences sector as a whole, including biotechnology, biopharmaceuticals, medical devices and diagnostics. Led by the OCS's chief advisor on life sciences and the chair of ILSI (the Israel Life Science Industry association), the team set as its primary goal in this aspect of the **Innovation 2011** project as articulating a vision and a strategy for the Israeli Life Sciences industry for the next two decades. Its intention in recommending creation and implementation of policies and programs to support the required science, technology and innovation capabilities is to enable the emergence of sustainable global market leadership in the life sciences industry.

The team sought to address the discrepancy between academic and technological achievement and the continuing inability to build a thriving industrial sector. Despite the emphasis placed on biotechnology by the OCS since the year 2000, and today's dedication of almost 30% its budget to life sciences' technology development and nurturing company development, the industry remains fragmented: 80% of companies have less than 25 employees and most of them apply early exit, rather than long-term growth business strategies. Moreover, only two of six leading drugs on the global market, Teva Pharmaceutical's Copaxone and Azilect, are actually produced by an Israeli company. In the other cases, the inventors were not able to find local partners, prompting overseas companies to carry the brunt of the commercialization.

The life sciences team study covers three main subjects:

[10] United States Patent & Trademark Office (USPTO) 2009, analyzed by Israel Life Science Industry (ILSI).

1. Definition of long range objectives, methodology, and a presentation of the many current government support tools already in place.

2. Presentation of the Israeli life sciences industries, the result of a decade of government support and significant growth.

3. Analysis of the gaps and the barriers on the path to achieving a growing and sustainable industry.

Current OCS programs have been developed over time, and when taken together form an ad hoc strategy. However, the policy behind the programs needs updated systematic analysis and planning.

One of the key dilemmas facing the OCS in increasing the share of support dedicated to life science projects has been that between preferences and neutrality, both in general vis a vis other industry sectors, and in particular among the sub-sectors of the local industry, i.e., Biopharma, devices, health IT, etc. On one hand, the devices industry started in Israel decades ago and it has been successful in achieving global sales. On the other hand the biotechnology and biopharmaceuticals sectors have a huge global potential for growth that has largely been untapped. In addition, Israel's life science and pharmaceutical industries are well positioned to gain significant global market share both in the development and production phases. We believe that leading multi-national companies may be attracted to open or expand local sourcing of R&D for their new drug pipelines in a similar way that the ICT multi-nationals R&D centers provided a boost to that industry. Therefore, we recommend continuing with the preferences given to the sector, whereas at this stage we recommend that a holistic approach be pursued, whereby all sectors supported without specific priorities. As part of the need to continuously analyze and update policy, the balance between preference and neutrality should be discussed again within the next three years or earlier, based on the actual results.

Over the past year a number of new OCS programs, along with industry-wide Government support tools have been approved for operation in 2011:

1. New dedicated government-leveraged Biotechnology Venture Funds with an emphasis on investment in bio–pharmaceuticals. The government will be one of the limited partners and will commit and aggregate the amount of USD 80 million in the new funds. This program is intended to address the unique issue of longer funding cycles for biotechnology companies and to assist them in passing through the so called "valley of death".

2. National Forum of R&D (Telem) decided to provide support for creation and expansion of centers of infrastructure equipment that service the life sciences R&D community in Israel. This is intended to address a fundamental problem that has often forced companies to outsource performance of certain development steps abroad.

3. A new program, *Kamin*, is being launched in early 2011 aimed at encouraging technology transfer from the academia to industry. This program offers up to 90% in government grant support for large development projects.

4. The government is providing incentives to encourage institutional funds' to make investments in knowledge-intensive companies. The program's total budget is NIS 200 million and must ensure a minimum return on investment. Though applied to all knowledge-intensive industries, a significant part of these newly available funds will be used to enhance the life sciences industries, as well as other emerging technology industries.

5. An "Angel Investor" tax credit for knowledge-intensive industries is now in place to encourage early-stage investment. This credit is due to be applied also to R&D companies.

While long-range strategic policy planning for the life sciences needs to be continued and strengthened in 2011, we offer the following interim recommendations:

1. Continue the preferential support of OCS for the sector.

2. Set a road map to incorporate the long range strategic policy planning for the LS sectors along with criteria for measuring success. We should keep in mind that Biotechnology/Life Sciences at large is still an emerging sector. Therefore, identifying and analyzing the needs, and suggesting appropriate policies, will be an interactive long term process.

3. Encourage the industry to organize in clusters and the consolidation and integration of the small companies operating in complementary areas into larger, more globally competitive entities. This will enable the creation of a critical mass and synergy. This can be achieved by granting OCS support preferences and/or incentives for such consolidations. Thereby, larger local companies will be in a position to purchase more early-stage innovations.

4. Promote business development studies for scientists and managers in the fields of biopharmaceuticals and Medical Devices. This should include exchange programs for scientists and engineers already working in the industry, to gain managerial and global business development experience. A model program can be initiated in the US lead by OCS and USISTF.

5. Increase the government incentives to attract more large global companies to invest in Israel in both R&D and production.

6. Establish an Israeli Food and Drug Administration (FDA) equivalent. Details need to be discussed in the road map that was recommended.

7. Finalize the laws for clinical trials. Unfortunately, Israel still does not have a law dealing with the conduct of human clinical studies, but efforts are underway to facilitate this much needed legislation. In addition, the Ministry of Health is understaffed and review cycles are therefore extremely long. In the clinical stages, companies find it very difficult to receive approvals from the Ministry of Health to conduct human trials using experimental devices and new compounds. Companies would greatly benefit from the ability to perform early human studies (Pilot and Phase I) in Israel because of both geographical proximity

and financial considerations. Furthermore, there are still an insufficient number of professionals dealing with clinical trial management and execution.

8. In the pre-clinical stages, Israel is lacking in Good Laboratory Practices (GLP)-grade animal facilities, forcing most companies to conduct their pre-clinical animal testing abroad at higher costs in terms of both time and money. The establishment of such infrastructure should be supported by the government and the ILSI.

9. Motivation for the establishment of Contract Research companies,

10. Motivation for the establishment of Contract Manufacturing companies.

11. Private Equity like fund dedicated for mature companies that can serve as an "Exit" option to VC funds. This Fund will be in addition to that of the government supported emerging companies Biotechnology Venture Funds.

12. Hospital research centers innovation should be encouraged by aligning IP ownership treatment for researchers with that of other research scientists (under process).

Commercial / civilian space industry team

In spite of the very early stage of the commercial/civilian space industry in Israel, a few key factors led to its inclusion in the Innovation 2011 project: unique military space capabilities, a strong research community, a recent national commitment to the sector's development, and the opportunities for fruitful collaboration with the United States.

The goal of the commercial/civilian space team was to examine ways and means for leveraging cooperation between the civilian space agencies of Israel (ISA) and the United States (NASA) to boost the development of the industry in Israel. Based on the mapping and analysis of the present situation, and their respective future agency plans, the project intended to identify a variety of fields with the potential for future cooperation.

The team, coordinated by the Yuval Ne'eman Space Workshop at Tel Aviv University, brought together experts from ISA and all the major aerospace industries in Israel. It analyzed the present situation in both Israel and America; and then held a series of expert round-table discussions for the purpose of initial brainstorming, consultation, setting of priorities, formulating operational frameworks, drawing conclusions and making recommendations.

Overcoming unique obstacles – developing unique capabilities

Necessity has been the greatest driver for innovation of Israel's unique capabilities in space. Due to the geo-political location of Israel, which is bordered to the east by hostile Arab countries, it is the only country in the world which launches its satellites to the west. By launching to the west, Israel was forced to find solutions for its limited payload capacity, forcing it to develop smaller and lighter-weight satellites.

Contrary to popular belief, a significant number of Israel’s space assets are either commercial

or civilian. Additionally, 2 of the 4 satellites which Israel is now developing for launch in the near future are for civil applications. Needless to say, the national security satellites with reconnaissance capabilities have enhanced Israeli expertise in the field of Earth Observation. As of today, Israel has developed the lightest synthetic aperture radar, and is considered a leader in this field. Its LEO High-Resolution Imaging satellites are among the best in the world, and Israeli leadership in the field of miniaturization and micro-technologies make its satellites much lighter and cheaper to produce and launch.

It's important to note that although NASA and ISA have had cooperative space efforts underway since 1985, thus far it has not resulted in the development of any significant space hardware by Israeli space industries for NASA missions. So one of the main purposes of this report is to help Israel chart a course by which Israeli space industries and university researchers can design, develop and operate space hardware that will be used in cooperative space missions with NASA. Most recently, in August 2010 NASA and ISA signed a joint statement of intent to expand the agencies' cooperation in civil space activities.

NASA's portfolio consists of three major program elements: Human space flight, science and aeronautics research. NASA's second largest investment is in science, where NASA plans to invest more than $5 billion each year on scientific research missions. The team believes that **scientific projects have the most potential for Israeli participation and cooperation**.

A task-force, appointed by the President and the Prime Minister of Israel, has recently recommended a framework for a new national commercial space program. The task-force submitted its report and recommendations in June 2010

The report outlines Israel's strengths, weaknesses, opportunities and challenges for achieving its goals in space. The task-force recommends that the government invest NIS 300 million a year for five years in space research and activity, aside from defense–related investments in space activity. The funding that is expected to be provided for Israel's new space plan would represent a significant increase for Israel's non-military space program, however, **for Israel to be successful with NASA, it needs to view it as a customer with whom it seeks to do business with by selling its capabilities.** A change on this order presents a challenging change in approach. Alongside this are other significant challenges:

1. Lack of knowledge within Israeli Government, space industry and research institutions of NASA needs, work procedures and whom to approach to effectively discuss collaborations.

2. Lack of knowledge within the US (NASA, industry and academia) of Israel's space capabilities.

3. International Traffic in Arms Regulations (ITAR) stands as an obstacle to joint projects. However, advanced planning and the use of dual-citizens can help to solve ITAR-related problems.

Recommendations

The team's recommendations relate primarily to leveraging the NASA-ISA relationship for the purpose of developing a robust commercial/civilian space industry in Israel that will become a genuine strategic partner for American space industries. It is essential that the NASA-ISA relationship be upgraded to creating collaboration, particularly with respect to NASA's Science Mission Directorate.

1. Making Israel Aware of NASA's Needs and How it Operates

A detailed market assessment of NASA's science program should be performed to gain an understanding of the needs of NASA's science program in time-phased, priority order, along with understanding how NASA, its contractors and academic research institutions all interact and make teaming decisions.

2. Making NASA Aware of Israeli Capabilities

Based on NASA's priority science needs, the OCS should lead a comprehensive compilation of scientific, academic, and industrial capabilities that Israel has and how they relate to NASA's needs. It should also procure NASA's "wish list" of technologies based on mission priorities and make them readily available to Israeli industry

3. Mission-Oriented Cooperation

Seek out specific science projects and needs of NASA and look for ways to utilize Israel's specific relative advantages and capabilities to participate in those missions.

4. NASA SBIR Opportunities

Assess the opportunities for utilizing NASA-SBIR program to develop collaborations between US and Israeli small and medium high technology companies.

5. G2G- Signed Agreement

Israel should pursue a formal broad-based cooperation agreement to be signed between the governments of the United States and Israel regarding space.

6. Technology Incubators and Magnet Programs

Utilize the programs of the OCS, in particular the MAGNET and Scientific Incubators as platforms for cooperation between NASA and Israel. The Israeli government is willing and able to put up front money to support the development of new technologies with industrial and commercial applications.

7. Academic and Scientific Outreach

As mentioned above, we recommend for Israeli industry and academia wishing to cooperate with NASA to seriously consider working their way through the channel of NASA"s space science route. In this respect we also recommend to explore the channel of education and academic collaboration, in order to benefit from the experience of NASA in educating youth.

8. NASA Research Centers

Develop relationships with NASA Research Centers, similar to the one existing with Ames, to include Goddard Space Flight Center, NASA Headquarters, Kennedy Space Center and the Jet Propulsion Laboratory.

9. Trade Missions

In cooperation with the Export Institute, trade missions should be organized to visit NASA research centers and the surrounding industrial companies.

The first five recommendations could be implemented by the development of an Israeli NASA Space Science Business Plan, which would require only modest amount of funding support from the new Israeli civil space budget in 2011. We feel that this is the highest priority task for ISA in 2011.

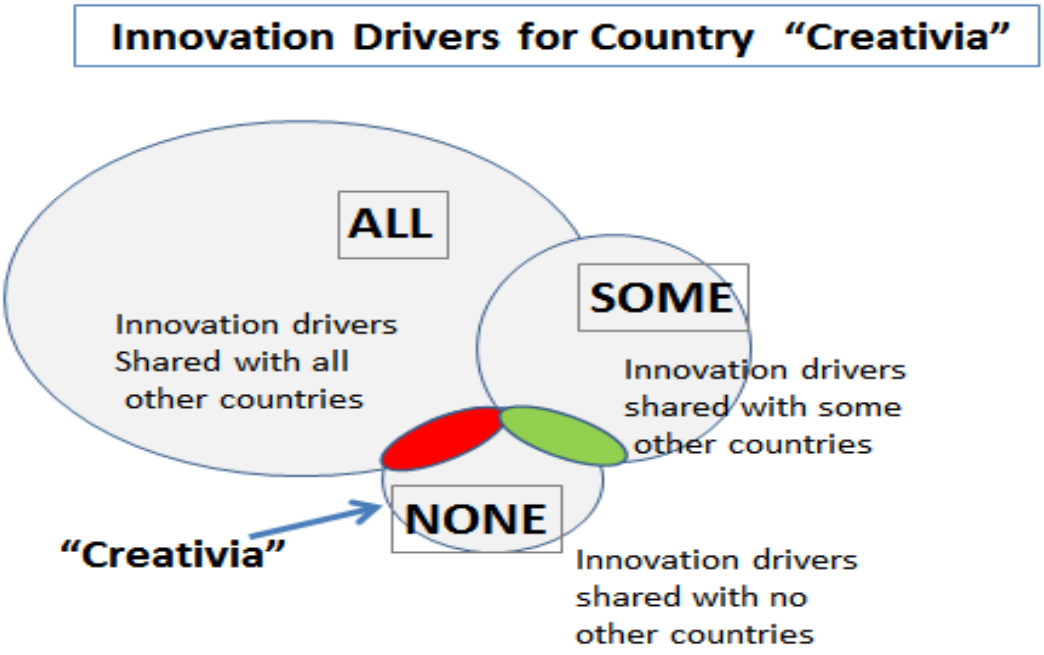
ICT veteran hi-tech team

Over the past twenty years, the Israeli hi-tech industry has been the main growth engine of the Israeli economy, transforming the entire economy along with its own global success. Based on electronics, computers and communications, known as ICT (Information and Communications Technology), it is represented by a number of large companies, such as Check Point, Amdocs, ECI, and more, alongside numerous medium-sized, early-stage and startups. In addition, a number of large global companies, such as Intel and HP, which purchased Israeli technology, established R&D centers in Israel.

In spite of hi-tech's great achievements there are increasingly worrisome trends that threaten this crown of Israeli industry. Over the last 15 years, no new companies have become truly global, that is, with export sales in excess of US$ 100 M. Moreover, many companies with such potential have preferred to sell out to large international companies (exit) rather than to continue with development towards becoming large Israeli global companies. These factors, together

with the decrease in the scope of available venture capital do not encourage the establishment and growth of new hi-tech industries as in the past, and even maintaining the present conditions is more difficult than ever before.

Therefore the hi-tech team engaged in a required process of renewed creative thinking to formulate a policy that addresses these issues and fosters long-term viability for hi-tech industries in general. To initiate such thinking, we decided to start by learning the characteristics of the Israeli hi-tech ecosystem and from there to continue to propose appropriate policy measures. In this, we were aided by a new technology, developed concurrently by SNI for the European Union, for shaping innovation policy aligned with (and consistent with) national culture and institutions. The principle of this system is based on the notion that every country has a given number of innovation 'drivers' – processes and capabilities that underlie its innovation success. Some of these drivers are unique to a particular country, and are shared with no other country. Some of them are shared with *some* other countries. And some are common to *all* countries engaged in innovation.



Reinventing Israel's hi-tech industry: An innovation ecosystem analysis

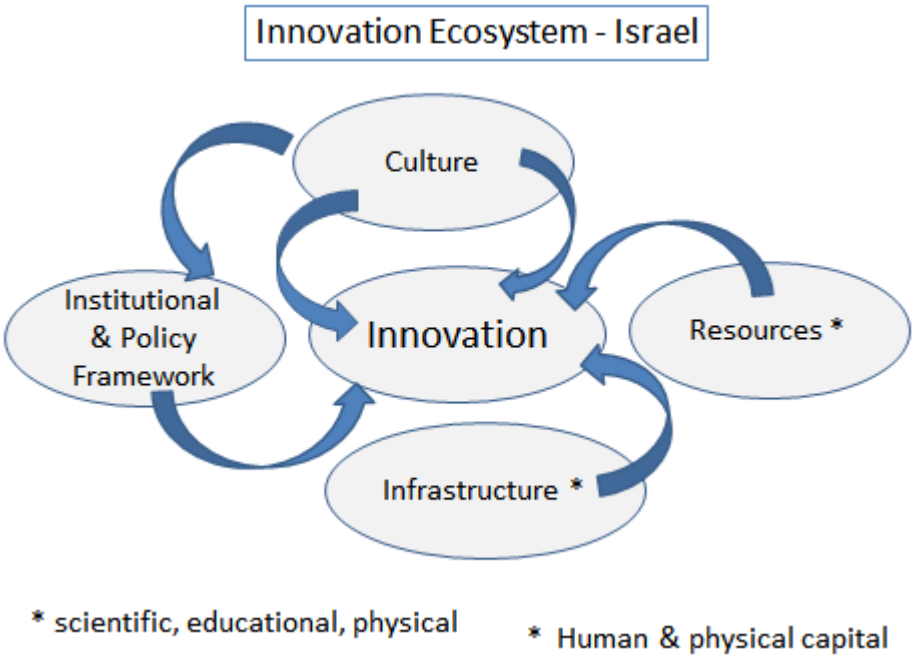
The innovative methodology is to create "visual innovation ecosystem maps", applicable to any country, then to facilitate cross-country comparisons**.** Several interesting conclusions emerge from the pilot project in which a small group of experts 'brainstormed' mapping Israel's hi-tech ecosystem and its future directions.

First, though the great majority of the participants have an engineering, scientific or technical background, it was striking how strong an emphasis was placed on 'soft' or cultural factors, such as 'resilience'. This confirms that innovation, creativity and entrepreneurship emerge from the cultural foundation of our nation which in turn is the fount of all innovation performance and policies. Failure to align innovation policies with a country's culture will lead to the abject failure of such policies.

Second, of the existing processes that foster innovation, many are specific and unique to Israel. For instance, uniquely Israeli institutions - military support of R&D, including military intelligence and its investment in high technology, Office of the Chief Scientist, Law for Encouragement of R&D and Investment, etc., are keys to Israel's innovation ecosystem, and must be constantly re-evaluated, as they are vital policy levers.

Third, among the processes for strengthening the innovation system are those that relate to creating a strong free democratic and egalitarian society, beginning with the foundation of primary and secondary education. This reflects the paradox that while startups are created by a tiny elite of creative entrepreneurial individuals, members of this elite are not specifically those who excel in traditional educational frameworks, measured by grades, for instance. If innovation is in part 'breaking the rules', some outstanding entrepreneurs will be those who are in part rejected by the formal traditional educational system. Only a society and economy that offers opportunities to innovators outside the conventional system will fully exploit its creative potential.

A simple initial version of the ecosystem is shown below. This 'map' will be greatly extended and shown in sharper detail after a factor analysis is completed of the second-stage analysis, in which participants show the links between their 'anchors' and 'processes'.



The four key factors driving innovation are a) culture, b) institutions, including policy, c) infrastructure (scientific, educational and physical) and d) resources, including both human and physical capital. A full evaluation of how well the innovation ecosystem works requires careful examination of all these aspects.

The team and the project management believe that a key direction for Israel's hi-tech industry is to transform it from a dangerously thin sliver of Israel's economy, employing at most one worker in every 10, a "thin red line", to a thick backbone of the economy, by expanding traditional or 'classic' industries to embrace many of the management practices that characterize high

technology – strategic planning, global marketing, innovation, investment in research and development, etc. It is our hope that hi-tech companies can be enlisted in this effort, for their own benefit, finding traditional products for which a technology-intensive component can create competitive advantage. We have already found that nations like Norway have at least in part succeeded in implementing such a policy; Israel can learn much from them. [See Espen Dietrichs, "Adopting a 'Hi-tech' Policy in a 'Low-Tech' Industry, the Case of Aquaculture in Norway" 1995].

We close on a note of optimism. A study done among 50 highly-innovative Israelis (engineers engaged in semiconductor design) reveals that the wellsprings of Israeli innovation lie deep in the history and culture of the nation, and reflect a foundation that does not become obsolete. The top innovation 'drivers', according to this sample, are as follows: [11]

1	Resilience	13.75
2	Stubborn Persistence	10.75
3	Role models	9.93
4	Desire to change the world	9.25
5	Lack of fear of risk	8.59

While rapid changes in global markets may endanger current Israeli hi-tech strategies and competitive advantages, these core drivers of innovation are permanent and underpins the future of hi-tech companies. It is these qualities that will drive any reinvention of Israel hi-tech industry.

The team identified several key impediments to renewed sustainable growth and leadership for hi-tech industries. The most prominent are a shortage of engineers, decreasing access to capital and tendency to early exits and sale of promising technology companies abroad.

To remove the impediments the team recommends the following:

1. Provide funding for 1500 engineering students each year for at least the next five years. (Approximate cost per student is US$ 30,000/yr. – total US$ 45 M.

2. Increase the budget of the OCS by at least 15% annually for each of the next five years. Preferably, the budget should be increased annually by US$ 250 M which in turn would cover the costs of funding engineering students – assuming a multiplier of 4 to one (Dr. Y. Sheinin).

3. Offer tax credits and other incentives for mergers and acquisitions by and between Israeli companies to encourage economies of scale and development of global Israeli companies.

Summary of findings and recommendations to achieve objectives

[11] Respondents were 'given' NIS 100, and asked to allocate them among 10 possible innovation drivers according to the importance of each.

The main message of this report is that Israel needs *to plan strategically and persistently direct a long-term strategic policy* for the continued development of the industry in Israel. Crucial elements in this policy relate to industries with high growth potential, such as Cleantech, biotechnology/life sciences and civilian space industries, together with clear policies to upgrade the traditional industries. It is vital to integrate all of them into one coordinated and comprehensive set of policies.

As we have read in an article published recently by Prof. Tadmor, *Israel's National Policy on Science and Technology*, Israel has adopted a decentralized science, technology and R&D policy, which developed over the years, leading Israel to the forefront of scientific and technological knowledge in the world.[12] This achievement is the result of an excellent combination of higher education infrastructures, basic research, applied research and building an advanced productive industry. Within this delicate web, the enterprises that combined R&D with production and did not limit themselves exclusively to either one of these activities gained outstanding achievements, while the enterprises where R&D and production were separated, stood out for their failure. For example, independent state research institutions (such as the fiber, plastics, rubber and ceramic institutions) did not survive so well and only those who joined manufacturing industries, such as TAMI, succeeded.

The closeness of R&D to production was vital in the past and seems even more so today as it keeps the R&D community updated with manufacturing technologies and creates employment opportunities to all the workforce segments. Hence, it could be argued that building industrial success on the basis of R&D in Israel only and removing production from Israel will not constitute a recipe for sustainable success over the years. The point is that Israel has to maintain a balance between basic research, applied research and production, both at the national level and at the particular level of industrial sectors. Part of the current globalization strategy is to encourage establishment of R&D centers by large international companies in Israel, a direction that we warmly support. However, from a national point of view it is important to encourage the implementation of some of the fruits of R&D in Israel, and direct policies to encourage it. This could happen in plants owned by a global company or through sub-contracting some of the manufacturing to other local Israeli industry. A good example is global Intel, which has manufacturing plants in Israel and also sub-contracts a lot of work to classic and hi-tech industries in Israel. Israel has invested in an R&D in the new sciences of nanotechnologies, and we believe that the challenge of turning it into manufacturing industries is part of the next decade challenge, as described here.

In our view, Porter's cluster idea,[13] according to which universities, incubators and businesses work together on specific disciplines or sectors in close vicinities seems vital for the coming years as well, and it should be incorporated in planning at the national level. Good examples are *MATAM* in Haifa, *Atidim* in Tel Aviv, and *Ramat Hovav* in Be'er Sheba.

[12] Tadmor, *The National Science and Technology*, ibid.
[13] Porter, *Competitive Advantage*, ibid.

Innovation 2011 recommends specific mechanisms to achieve the following objectives:

1. Effective upgrading of the classic, traditional industrial sector, which is entrepreneurial in its character but has been left behind and has difficulty competing in the new global alignment.

2. Strengthen existing ICT-based knowledge-intensive plants and creating motivation and support for their growth, rather than selling knowledge to global companies that transfer production out of Israel.

3. Support establishing necessary infrastructures to enable universities and industry to direct their efforts towards business directions with growing markets.

4. To provide the national tools to achieve access to existing and emerging global markets.

Seemingly, we are dealing with allocating national resources for infrastructures, sources of capital and human resources; however, the meaning of innovation is to refrain from zero-sum games (where losses balance gains), and instead comprehensively enlarge the national pie in the coming years, so that all groups and sectors gain, thus increasing the sources for continued growth. Therefore, we attach great importance to an overall system analysis approach towards examining and formulating national policy, which means linking different sectors, allocating infrastructure resources and generating solutions that create mutual advantages and synergies, and coordinating between and within government offices.

Unification under the umbrella of national policy – Israel excels in innovation in its work culture and Israeli's are always looking for ways to innovate and renew. This advantage was already expressed in the **Israel 2028** and was noted as a driver that has propelled Israeli competitiveness over the years. Innovation is a common factor found throughout industry, but in practice we found that classical traditional industry has not yet fully embraced this culture for its own benefit. In contrast, stands a robust knowledge-intensive industry with strength in ICT, academia with strength in science, and the beginnings of new knowledge-intensive industries in the life sciences, environmental sciences (Cleantech), and the space industry.

The first conclusion drawn throughout the course of our work is the need to integrate the various industrial branches under a single national policy. The concept is for knowledge-intensive, progressive and high-quality industry to act as a leader and customer for products and services from traditional industry and, in addition, use its acquired experience in the globalization process to guide the extensive veteran industry with the government's support of this process.

Developing effective mechanisms – Israel's scientific capabilities may serve to leverage knowledge-intensive industries in the above-mentioned areas at a much quicker pace than prevailing today. Also, cooperation between the academia and industry may be effectively, despite the existence of successful programs that are directed toward this goal, such as MAGNET and MAGNETON. To create long term and sustainable industries on the basis of the scientific-technological advantages coupled with innovative capabilities in industry, mechanisms of greater openness and motivation should be developed for effective transfer technologies to

industry and initiate more cooperation with the academia. For example, as part of this project we recruited the Center for the Advancement of Innovation at the Technion to develop programs of instruction and mentoring for traditional industrial leaders, with an emphasis on enhancing innovation processes as the key upgrading factor.

Below, we summarize the recommendations that are common to all sectors, as well as the specific and unique recommendations for each sector according to time scales: immediate-short, intermediate, and long.

SUMMARY OF MAIN RECOMMENDATIONS

Time Scale	Biotechnology/ Life Sciences 	Civilian Space Industry 	Traditional Industries 
Immediate	Establishing a global Innovation Center for Life Sciences Realizing the new Bio funds. Support of the bio-medical centers for innovation and IP partial ownership for staff. Holistic approach toward life sciences (as opposed to the preference for Biopharma). Continue support for the sector	Execution of the government's budget for the next 5 years. Detailing the industrial program. Support collaborative policy with NASA also with the Israeli funding. Mission oriented cooperation Trade mission to NASA NASA SBIR opportunity exploration	Integration at the MOITAL or government level. Dedicated program for small companies Improving the industry's image through incentives for innovation and R&D Instruction of the industry, based on the TIM model. Industrial Parks- based clusters
Intermediate	Expanding infrastructures for clinical research, tissue bank, etc., Academic BD in biopharmaceuticals science Complete regulatory reform. Improve options for Multi-nationals to invest in Israel. Priority to integration manufacturing + R&D public Funds for long range infrastructure	Continue international collaboration projects such as with Italy and expand them with government funding. Continued development of miniature satellites, support of centralized budgeting. G2G agreement with NASA	Model Excellent industries forum for support & instruction. Structured government support of Quality Improvement Programs. Innovation and export in traditional industries. Leveraging directed cooperation to enhance the traditional industries.
Long	OCS motivation for consolidation and \integration of small companies Motivate and support clusters by disciplines Israeli FDA equivalent Law for clinical trials Motivate establishment of CRO and CMO	National preference for industry that leverage space industry.	Encouraging clusters, consolidation and conglomeration. Professional and technical education and establishing regional schools. Integration of hi-tech to support affirmative action for the traditional industry.

Time scale	Recommendations common to all branches	Hi-Tech ICT	Cleantech 
Immediate	Combined funding public-private capital; see biotechnology fund. Urgency of treatment Integration of national industrial policy in the government	Government funds to sustitute for reduced venture capital by leveraging government funds Complete a comprehensive, large-scale Ecosystem analysis and drawing operative conclusions.	Government funding to leverage private funding that includes local companies. Strengthening Newtech to integrate and provide centralized promotion of Cleantech. Strengthen infrastructures and operating beta sites (pilot facilities). OCS tools for Cleantech including approval of 50M$ *5 for 5 years plan
Intermediate	Apply nanotechnologies across the sections Motivate clusters structure in each emerging sectors by disciplines	Analyzing China and India and combining funds and collaboration at international level. Ballanced support tools for Attracting international companies versus increasing the local industry - integrate manufacturing in Israel	Preferential regulations to promote the industry. Regulatory preferences for local innovation trials. International Connections with national support – information, promoting relations and agreements, funds such as BIRD for Cleantech. Integration with traditional industries as affirmative action.
Long	Motivate integration of ICT as an advantage for all sectors	Preferential policy for Israeli companies with over $100 million in sales	Long term funds. Mechanisms for local technology validation

APPENDIX

LIST OF ACRONYMS

BD	Business Development
CMO	Contract Manufacturing Companies
CRO	Contract Research Companies
FDA	US Food and Drug Administration
G2G	Government to Government
GDP	Gross Domestic Product
GLP	Good Laboratory Practices
ICT	Information and Communication Technologies
ILSI	Israel Life Science Industry
IP	Intellectual Property
ISA	Civilian Space Agencies of Israel
ITAR	International Traffic in Arms Regulations
LEO	Low Earth Orbit
MAGNET	The MAGNET Program, in the Office of the Chief Scientist of the Ministry of Industry, Trade & Labor, sponsors innovative generic industry-oriented technologies to strengthen the country's technological expertise and enhance competitiveness.
MAGNETON	Program for Technology Transfer from Academy to Industry, supports cooperative research projects, held by an industrial company and an academic researcher, encouraging technology transfer from the academy to the industry.
MATAM	Scientific Industries Center (Hebrew Acronym)
MATI	Business Development Centers (Hebrew Acronym)
NASA	US National Aeronautics and Space Administration
OECD	Organization for Economic Co-operation and Development
OCS	Office of Chief Scientist
R&D	Research and Development
SBIR	Small Business Innovation Research
SNI	Samuel Neaman Institute for National Policy Research
TIM	Technion Institute of Management
US	United States of America
USISTF	US Israel Science and Technology Foundation