



Samuel Neaman Institute
For Advanced Studies In Science And Technology

**Clean Energy Innovation
Policy in Israel:
Identifying Fundamental Principles
through a Case Study of
Smart Grid Policy**



Technion – Israel Institute of Technology

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Clean Energy Innovation Policy in Israel: Identifying Fundamental Principles through a Case Study of Smart Grid Policy

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Executive Summary

This project has been conducted in cooperation between the Samuel Neaman Institute for Advanced Studies in Science and Technology (SNI) and the London School of Economics and Political Science (LSE). The goal of the project has been to analyse policy lessons emerging from Israel's successful efforts to spark, direct, and accelerate the process of technological innovation in the clean energy sector. Specifically, the project examines the case of Israeli smart grid innovation to identify fundamental policy design principles that can be applied across other technology groups and in other countries with different political, economic, and technological contexts.

The background to this study is that Israel is emerging as a key player in clean energy innovation, a trend fuelled by a combination of well-calibrated government policies, effective public-private collaboration, and military and university systems that foster creative RD&D activity and a dynamic innovation ecosystem. Within this highly innovative, R&D centric policy environment, the Israeli smart grid experience provides a particularly interesting and important case study on the governance of technological innovation.

By examining the case of Israeli smart grid innovation and particularly policy instruments being used to advance it, this report describes the building blocks of an innovation-based economy with particular reference to the smart grid. Details are given on key indicators including physical and strategic necessities, the culture of innovation and entrepreneurship, local market and Industry, the role of the Military, Academia and Government, financing and experience gained. This report attempts to answer several key questions: what specific Israeli government policies and institutional structures have encouraged (or retarded) the development of the smart grid sector? How have the public and private sector collaborated to advance the pace of innovation in the sector? Why have successful Israeli smart grid investments worked, and why have unsuccessful ones failed? To what extent have Israel's successes in smart grid innovation resulted from institutional factors, i.e. government policies and structures? To what extent have they resulted from cultural factors, i.e. specific aspects of Israeli society or Israel's much-discussed 'entrepreneurial culture'?

Based on a detailed analysis of these questions, the project formulates a series of more general recommendations of best practices for clean energy innovation policy.

1. Introduction and Background

“If an expert says it can't be done, get another expert”

David Ben Gurion

Israel is a young nation, rich in conflicts and poor in natural resources. Yet over the past fifty years, it has managed to turn its relative disadvantages into driving forces that have transformed it into one of the most innovative and technologically advanced countries in the world [1]. How has Israel risen from a predominantly agrarian economy in the 1950's to a high-tech, entrepreneurial economy today? What factors, including especially public policy factors, have facilitated this rapid and far-reaching technological transformation, and what economic consequences have followed?

The purpose of this study has been to investigate the rise of Israel's innovation-based economy through a case study of the country's emerging 'smart energy' industry. The project has been conducted in cooperation between the Samuel Neaman Institute for Advanced Studies in Science and Technology (SNI) and the London School of Economics and Political Science (LSE). The goal of the project has been to analyse policy lessons emerging from Israel's successful efforts to spark, direct, and accelerate the process of technological innovation in the clean energy sector. Specifically, the project examines the case of Israeli smart grid innovation to identify fundamental policy design principles that can be applied across other technology groups and in other countries with different political, economic, and technological contexts.

The background to this study is that Israel is emerging as a key player in clean energy innovation, a trend fuelled by a combination of well-calibrated government policies, effective public-private collaboration, and military and university systems that foster creative RD&D activity and a dynamic innovation ecosystem. As Senor and Singer document in *'Start-Up Nation: The Story of Israel's Economic Miracle'*, the Israeli government has embraced high-tech innovation as the centrepiece of its economic growth strategy, a move that has had profound impacts on Israel's policy landscape and economic development. At present, Israel spends almost 5% of GDP on R&D, over twice the average within the OECD and more than any other country worldwide.

According to OECD analysis, the Israeli government has played an “instrumental role in financing innovation, especially in SMEs, and in providing well-functioning framework conditions for innovation, including venture capital (VC), incubators, strong science-industry links, and quality university education”. The results of this policy leadership have been major advances in clean tech, ICT, biomedical, and defence technologies, successes which have reaffirmed the government’s commitment to innovation and turned Israel into a critical RD&D centre for technology start-ups and high-tech multinationals alike.

Within this highly innovative, R&D centric policy environment, the Israeli smart grid experience provides a particularly interesting and important case study on the governance of technological innovation. Israel’s climate and geography is highly conducive to a major penetration of low-carbon power, particularly solar, but the country’s isolated, stand-alone grid prevents it from importing or exporting power to balance fluctuating renewable electricity supply. Thus, the development and implementation of a smart grid is one of the most pressing issues in Israel’s energy economy, as it will allow for the balancing of power supply and demand, the integration of more renewables, the implementation of intelligent real-time pricing, and the conversion of consumers into ‘prosumers’ capable of both buying power from the grid and selling excess micro-generated power back to utilities.

Given its strategic importance for Israel’s clean energy future, the smart grid is currently receiving significant government attention and massive public and private investment. Most recently, the MAGNET R&D program, an initiative of the Office of the Chief Scientist of the Ministry for Industry, Trade, and Labor, provided 3-5 years of sustained funding for an Israeli Smart Grid (ISG) Consortium tasked with developing next-generation communication and smart grid management technologies. The public-private consortium consists of seven industrial partners and five leading universities: ECI Telecom, Motorola Solutions Israel Ltd., CEVA, Yitran Communications, PowerCom, RuggedCom, Control Applications, Ben-Gurion University, the Hebrew University in Jerusalem, Ariel University Center of Samaria, Holon Institute of Technology and Tel-Aviv University.

By examining the case of Israeli smart grid innovation and the particular policy instruments being used to advance it, this project attempts to answer the following

questions: what specific Israeli government policies and institutional structures have encouraged (or retarded) the development of the smart grid sector? How have the public and private sector collaborated to advance the pace of innovation in the sector? Why have successful Israeli smart grid investments worked, and why have unsuccessful ones failed? To what extent have Israel's successes in smart grid innovation resulted from institutional factors, i.e. government policies and structures? To what extent have they resulted from cultural factors, i.e. specific aspects of Israeli society or Israel's much-discussed 'entrepreneurial culture'?

Based on a detailed analysis of these questions, the project formulates a series of more general recommendations of best practices for clean energy innovation policy.

2. An Innovation-Based Economy

Innovation is a cornerstone of the Israeli economy and culture. A combination of limited resources, unfamiliar challenges, and a need for national agility have led to a culture that embraces calculated risk taking and new, untested solutions. With this culture as its foundation, Israel succeeded in transforming some of its inherent challenges into opportunities for building an advanced innovation-oriented economy.

The following model provides a brief overview of the main characteristics of the principal dynamics that drive the Israeli innovation-based economy.



Israel's Innovation Model, © 2012 Elad Shaviv

The model presents the dependency between given characteristics of the Israel context, government engagement and policy, and eventually private initiatives.

At the bottommost level are uncontrolled, given characteristics, notably the physical and strategic challenges Israel has faced since its formation. The second level comprises Israel's unique culture as well as its intensive military infrastructure and innovation system. These second-order characteristics emerged almost wholly from the physical and strategic constraints facing Israel. Since its advent, the Israeli government has played a major role in transforming these given and second-order factors into the third level, which comprises local markets and industry, the academy, and government institutions. The government has provided guidance and support to the local industry, which for some time was controlled by the government, and to the academies, which at the early stages were all government-run institutions. This third level, marked by governmental policy support, set the basis for the fourth level of private sector engagement. This fourth level has given rise, ultimately, to new

domains of innovation and a proliferation of advanced innovative technologies and hi-tech companies.

Over time, the Israeli cultures of innovation and risk taking—and the policy configurations that support them—have grown, transformed, and matured. Today, they are considered Israel’s best resource.

According to the World Competitiveness Yearbook [2], Israel is ranked first in the world in the parameter “Entrepreneurship in business” as well as in several other key parameters that enable, and reflect, an innovation- based society and economy. These include:

- Business expenditure on R&D (as % of GDP) – 1st
- Total expenditure on R&D (as % of GDP) – 1st
- Accessibility to capital markets – 1st
- Central bank policy – 1st
- Entrepreneurship in business – 1st

3. Israel – Key Indicators

Israel’s land territory spans over 20,770 sq km. It has a population of nearly 8,000,000 inhabitants as of 2012, a figure which continues to grow at a relatively high rate of over 1.5% a year.

The country's economy is stable, with strong dependency on hi-tech export. The US and Europe are the main target markets for Israeli exporters, though in recent years Asian markets have grown in importance and attention.

Table 1 - Key Economic characteristics [3]

Indicator	Israel
Gross Domestic Product	242,922
GDP Per Capita (U.S.\$)	31,291
Industrial Exports	53,204
of which, hi-tech	21,517
Unemployment Rate (%)	5.6

Data refers to 2011, Figures refer to millions of U.S. \$ unless otherwise stated

4. Physical and Strategic Necessities

Most of Israel's national decision making considerations, and innovative activity, flow from its most dominant physical and strategic needs. These include a strong need for defence, a lack of natural resources, a relatively small population, and geopolitical isolation.

A good example of this is the development of innovative agriculture technologies and smart, efficient water management techniques [4].

Early Israeli leadership in these areas brought Israel into cleantech innovation and development long before the "cleantech" term came into common use.

Shortage of water and the strategic need to be self-sufficient was the basis from which Israel developed knowledge and skills that transformed into commercial solutions. These technologies were first used locally, but over time a growing global appetite for reductions in water pollution and more efficient use of water, particularly for large-scale agriculture, gave rise to an international market for innovative water technologies. This provided new export opportunities and a chance for Israel to leverage its existing technological advantages to gain a global market share.

Ultimately, water technology became a strong export segment, positioning Israel as one of the world's leaders in technologies and methods for irrigation, desalination, and water re-usage.

Similar developments took place in energy technology. With poor local energy resources, yet plenty of sun, it was only a matter of time until scientists and entrepreneurs began focusing their efforts and capital on developing solar technologies.

In recent years, the energy segment has drawn more attention from Israeli entrepreneurs than any other cleantech market sector. A survey conducted for the Ministry of Environmental Protection by Ernst & Young in 2010 found that of the companies registered in Israel as operating in the cleantech area, 47% were active in the energy area, 35% in the water area, and, and 18% in the environment and waste areas [5].

5. Culture

A significant determinant of Israel's success in overcoming its physical and strategic constraints has been a culture of transforming challenges into advantages. Particularly in its early days, Israel's population was characterized by different cultures, different languages, and an overall lack of experience. This combination of factors led to a culture that, instead of relying on existing solutions, often pushed boundaries and used "out of the box" thinking to come up with creative responses to new challenges. Much has been written on Israeli culture and its role in Israel's innovation economy. According to OECD, "the success of the Israeli system is primarily attributable to vibrant business sector innovation and a strong entrepreneurial culture", helped by institutional and governmental arrangements that encourage and foster innovation activity [6].

Some of the cultural characteristics that have been described as most salient to Israel's cultural of innovation include:

Informality: Israel's small size and lack of rigid class distinctions engender a culture of informality and casual behaviour. This is reinforced by mandatory military service requirements, which mix all Israelis together and encourage them to get along with one another and transcend geographic and class backgrounds.

Tolerance for risk: Israel emerged and progressed in the face of adversity and 'newness'. Indeed, the creation of the nation itself was a large-scale experiment in risk-taking. Economically, Israel's early lack of people with "old money" (inherited wealth or established upper-class families) created a relatively level playing field in which most people started from scratch. With little to lose, risk-taking was a low-risk, high reward strategy, and one that became an increasingly predominant feature of Israeli culture.

Multiculturalism: A large influx of immigrants from diverse regions could have been a disadvantage during Israel's formative years. However, it has ultimately served as an advantage because it has fostered a relatively open, flexible culture capable of generating creative, flexible ideas and solutions.

6. The Role of the Military

Since its creation following the Second World War, Israel's geostrategic situation has led its leaders to favour the maintenance of a strong military. Given Israel's small population, it was always clear that maintaining such a force was a major challenge, and that Israel would need to build its military capabilities on the basis of quality rather than quantity.

Acknowledging this challenge, two decisions were taken which later on had a major positive impact on Israel's innovation-based economy:

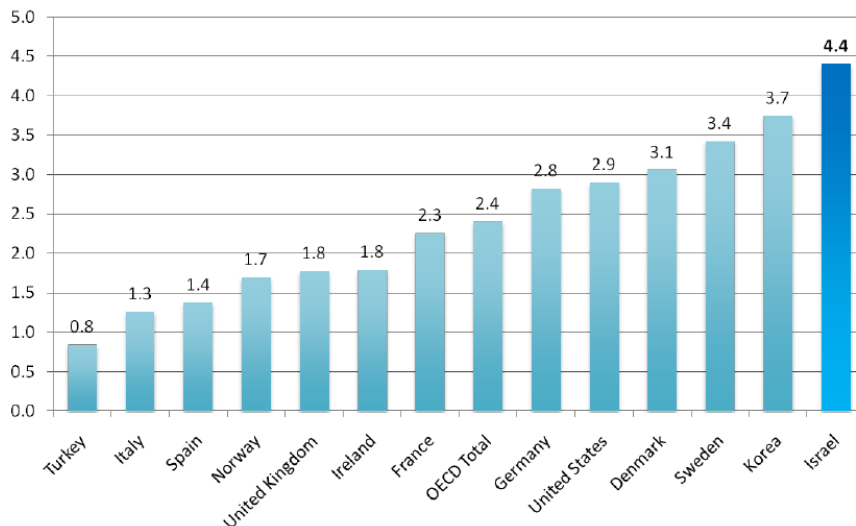
- Compulsory military service for men and women
- Major investment in new technologies for military use

On the cultural side, compulsory service has created strong, lasting social networks that continue far beyond the scope of the military service itself, as well as a strong basis of knowledge in state of the art technologies.

7. Local Market & Industry – Key Players

Israeli industry is heavily committed to innovation, as demonstrated by its high level of investment in R&D. According to OECD analysis, Israel’s expenditure on R&D is among the highest in the world:

R&D Expenditure as a Percentage of GDP 2010



Source: OECD as presented at the “Israel Economy at a Glance 2012” page 21, published by the Israeli Ministry of Industry Trade & Labor (<http://www.moital.gov.il/NR/rdonlyres/631EA402-E7E3-4DF3-BE94-22581CC5AA50/0/IsraelEconomyataGlance2011.pdf>)

Through a heavy and long-standing focus on innovation and R&D, Israel has positioned itself as a pool of knowledge and innovation capabilities. Exporting innovation – either as state of the art products or through foreign acquisitions of companies and their intellectual property – has become standard practice. So too has entrepreneurship and the creation of new enterprises and intellectual property.

But the growth of Israel’s innovation economy has not been without challenges. A focus on building new companies has suppressed the expansion of existing companies, leading to a major debate in Israel on how to establish more “anchor”

companies in addition to growing small companies and intellectual property portfolios that are eventually sold off to global players [7]. Additionally, the small size of the local market makes scaling innovation more difficult, though it is large enough to play an important role in building knowledge and providing a useful test bed, and early adopter of customers.

Though Israel's reputation for innovation rests primarily on its start-ups and entrepreneurial culture, in reality established companies are playing an important role in all new domains of technological activity. In particular, established companies tend to provide both the necessary human capital in the form of skilled engineers and the capital and commitment necessary for diversification into a new area. In the case of energy, several established players remain central to the development of an innovative energy industry and the commercialization of new energy-related products and services.

7.1 The Israel Electric Corporation

Of these established players, the Israeli Electric Corporation (IEC) is perhaps the most important. The only electrical utility in the country, the IEC delivers all generation, transmission and transformation, distribution, supply and sale of electricity across the country. The IEC is operated by the Israeli government, which owns 99.95% of its shares and which creates and enforces the stringent regulations that govern the IEC's operation. The IEC operates a network of power generation with an installed capacity of 12,759 MW, employs some 12,500 people and provides electricity service to 2.52M households [8].

With the electricity market so highly regulated and tightly controlled, it is difficult for young companies to penetrate into the local market. As of 1996, the Israeli Ministry of Energy has enabled independent power providers, (IPPs), to enter the field of electricity generation [9]. Yet by 2011, the installed capacity of IPPs still totalled less than 5% of the total capacity [10] and the IEC remains the only provider in the transmission and distribution areas.

Unlike with the communications and security areas, the local main customer in the electric industry is not yet playing a major role in the encouragement of local knowledge and development. Though Israel recently published a tender for a pilot

smart grid project [11], which the Ministry of Energy and Water has described as one of the key items in the energy sector, on the whole Israel has been slow to establish pilots in this area and encourage the development of innovative local industries.

There are currently discussions between the IEC, the Ministry of Energy, and the Public Utility Authority on how this can be remedied, and, how these critical stakeholders can support plans to encourage the local smart energy industry. One of the early initiatives adopted by the IEC to encourage internal exposure to innovation and get engaged with innovative companies is the establishment of KARAT venture unit.

IEC KARAT (taken from the IEC web site)

<http://www.iec.co.il/EN/Karat/Pages/Background.aspx>

Israel Electric Corporation (IEC) has established an internal venture unit, currently named KARAT (the Hebrew acronym for "Accelerating Technological Ideas") which provides a framework of investment and support services to develop, advance, and commercialize innovative ideas in energy-related fields.

This initiative follows the growing global need for solutions of "green" (clean) electric energy, lower energy costs, and higher system efficiency, with the objective of decreasing global dependency on carbon fuels.

KARAT invites entrepreneurs, "innovators," inventors, and others to submit ideas and proposals in energy-related fields. Selected proposals are nurtured to become early stage business ventures which operate within the KARAT framework. They receive financial support, access to IEC's large pool of experts, access to a live electric network for validation and testing, business development services, access to global strategic partners and other required assistance in order to achieve commercial success.

Vision

- To advance and encourage the development of innovative technological ideas in the fields of renewable energy and the environment
- To promote, assist, and support innovators and entrepreneurs in these areas
- To commercialize ideas, innovations, and inventions
- To help IEC diversify its activities and operations
- To create an Israeli centre and source of expertise in energy related technologies

Mission

KARAT advances innovative ideas related to energy by encouraging and collaborating with entrepreneurs and other innovators to form, support, and finance very early stage business ventures for the commercialization of these ideas.

7.2 Mature Companies

Israel holds the potential to become a world leader in the Smart Energy space, a position that could be achieved most easily by leveraging the innovation capacity, human capital, and market access held by established ICT leaders.

Due to the small size and unique nature of the Israeli electric market, such companies were initially slow to enter the Smart Energy domain, as it was unclear whether the market prospects could justify the needed investments. But we now see leading companies from the following areas taking steps into the smart energy space, in particular in the communications, security, monitoring, data management, and applications areas.

In addition to the ICT industry, some of the largest Defence industry players have recently diversified into the new energy field. Companies such as The Israeli Aviation Industry [12], Rafael and Elbit [13], all provide strong access to foreign governments and key players – in addition to unique technological capacities – that have proven crucial in aiding entry into a highly regulated, tightly controlled infrastructure market.

7.3 The Israeli Smart Energy Association

The development and maturation of the Israeli Smart Energy industry has benefited from the coordinating activities of The Israeli Smart Energy Association (ISEA), which has positioned itself as a national platform to promote and accelerate Smart Energy development and deployments.

The ISEA goal is to position Israel as one of the leading countries in the Smart Energy domain, both in terms of local industry innovation and scale of local adoption of Smart Energy solutions.

Being formed with the blessing of relevant government bodies, the ISEA runs as a private, not-for-profit organization, self-funded by its members. This structure provides the benefits of independence and agility, yet it naturally provides some limitation on organizational scale and impact.

Leveraging the government engagement, the association's global players members, and forming part of the Global Smart Grid Federation, the ISEA facilitates

discussions, builds local knowledge, opens opportunities for industrial cooperation and partnerships, and initiates various initiatives to drive the local industry growth.

The ISEA (www.isea.org.il) initiatives include:

- Knowledge build-up seminars
- Local Conferences
- Facilitating meetings for the local industry with international players
- Webinars and Virtual meetings
- Facilitating meetings between the industry and the local regulators
- Spreading the word in various events and the media
- Engaging its members with international and local working groups
- Promoting the Israeli players at international conferences and events

Taken together, these activities help foster a business environment in which smart energy innovation can thrive and in which innovations, best practices, and skills can be shared and amplified.

7.4 The Smart Grid Consortium

Another interesting industry- driven group that supports the local industry is the Israeli Smart Grid (ISG), a government- supported framework for R&D cooperation, supported by the MAGNET Consortia program in the Office of the Chief Scientist (OCS) of the Ministry of Industry, Trade and Labor. The MAGNET program goal is to encourage industry and academic players to share knowledge and cooperate in order to improve the local competitiveness in the global market place.

MAGNET Consortia are typically initiated by the industry players, focusing on a defined common technology. The ISG, initiated in 2011, was formed to focus on the Smart Grid domain with an emphasis on Communication, Control Systems and Demand Response technologies.

The Consortium may accept new members to join, and is currently comprised of eight industrial companies and five academic institutions: CEVA, Yitran, ECI Telecom, Motorola Solutions, PowerCom, Mobix, Satec and Control Applications. These companies are joined by five academic Institutions including Tel Aviv University,

Ben Gurion University, The Hebrew University, Ariel University Centre and Holon Institute of Technology.

The consortium current focus is on the following research topics:

- *Developing distributed architectures and topologies to allow scalability, survivability and resiliency of utilities' communications networks*
- *Forecasting models for consumption and Demand Response control mechanisms*
- *Developing technologies and protocols for real time prediction, monitoring and control of potential failures, automatic isolation and self-healing of communication and electricity networks*
- *Advanced monitoring of electricity quality for grid stability and methods for local and decentralized network management*
- *Optimizing Power Line Communication (PLC) effectiveness and capacity*
- *Adaptation and optimization of advanced wireless communication technologies to future Smart Grid infrastructure*

Source: ISG web site <http://www.isg.org.il/>

The formation of the ISG, and the dynamics created by industry and academic players engaging in the Smart Grid space, drives additional players to consider getting involved in the domain. In particular, The ISG members attract knowledge and interest, and the funding support provided by the OCS provides an attractive opportunity for investment in the field.

8. Academic Institutions Engagement

Since its formation, Israel has placed a significant focus on creating strong educational opportunities for its population. This focus stemmed from an acknowledgement that there are few natural resources in Israel, and that Israel's economy would therefore have to be knowledge-based; from a long-standing Jewish tradition of deep study of sacred texts; and from historical employment and ownership restrictions which have led Jewish people to focus on academic-based professions.

The consequences of this continuous focus on education can be seen at the high marks that Israel receives in global education comparisons. According to OECD's 2012 Education at a Glance statistics on tertiary education achievement, Israel ranks 3rd out of 41 in percentage of 25-64 year olds who have attained tertiary education, and 1st out of 37 in percentage of 55-64 year olds who have attained tertiary education. Moreover, Israel ranks 6th out of 37 on total public and private expenditure on education as a percentage of GDP, at 7.2% and 6.2% respectively.

Importantly, academic research—though always important in the evolution of new innovative domains within Israeli industry—was rarely the primary basis for the proliferation of any domain. Rather, the academy played a more fundamental, underlying role by providing basic knowledge to young graduates, deep professional knowledge in the form of academic staff engagement with industry, and a pool of young and talented entrepreneurs.

In the case of the creation of the domestic clean technology industry, The Israeli academy has played a major role. However, in the specific area of smart energy technology, the academic sector appears to have had less influence than in other areas of clean technology. It seems that the great success of the Israeli ICT industry drew much attention and talent to the study of electronics, to the detriment of research into medium and high voltage technologies. However, this is beginning to be corrected by Israeli academic institutions, who are taking a newfound interest in these topics.

Most current engagement by Israeli academic institutions takes the form of applied studies. For example, the Technion- Israel Institute of Technology, is developing plans to use the campus itself as a test bed and trial site for new Smart Grid technologies.

Tel Aviv University established a renewable energy focus combining some 55 research groups across seven TAU faculties. Together, they are investigating dozens of projects in solar energy, biomass and biofuels, wind energy, energy policy, energy economics and security, and mechanisms for converting, storing and managing energy once generated.

The Holon Institute of Technology (HIT), another technical institute, has taken Smart Grid research as one of its highlights and unique differentiators. HIT, which prides

itself on its innovation and entrepreneurial focus, invited several Smart Grid industry companies to join forces and collaborate with its renewable energy, power systems, quality control, energy reduction, and Smart Grid research.

Some of the subjects being researched under this program include [14]:

- *Fault detection and analysis for enhancing Smart Grids capabilities*
- *Self-healing and load management in smart grid- the ability to control vast amount of consumers in order to heal a power system in the case of instability.*
- *Non-intrusive algorithms for managing electric vehicles charging schemes.*
- *Optimization of power systems with high insertion of renewable sources.*
- *Energy reduction projects.*

9. Government Support for Smart Energy Innovation

The Ministry of Industry, Trade and Labor (MoITAL) focuses on the promotion of economic growth in Israel. This includes encouraging and supporting international commerce in order to assist Israeli businesses in enhancing export activity and entering new markets abroad.

Traditionally, MoITAL has been the most influential ministry driving the development of Israeli industries. In the case of Smart Energy, two main units at the Ministry of Industry Trade and Labor are deeply engaged in developing this emerging sector: The Office of the Chief Scientist (OCS), which operates programs that support any kind of R&D activity in Israel, and NewTech, a unique office tasked with promoting the Israeli Cleantech industry.

In addition to MoITAL, the Ministry of Energy and Water Resources (MoEWR) has also taken steps to play a significant role in supporting and encouraging new ventures

in smart energy. These ministries collaborate on encouraging new emerging Smart Energy ventures, both through informal support and formal programs.

9.1 The Ministry of Energy & Water Resources

The Ministry of Energy and Water Resources is responsible for the national infrastructures, and within those - Energy is one of its main focus areas. The ministry holds the responsibility for the overall Energy market structure and with the Israeli Electric Corporation being a state- owned corporation – the ministry plays a key role in defining the directions, evolvement and deployment of Smart Energy in Israel.

The Office of the Chief Scientist within the Ministry of Energy and Water Resources traditionally acts as the scientific and technological advisory and guiding body to the ministry. Acknowledging the interdependency between local industry and local infrastructure, and with the major changes the energy sector it is currently undergoing, the office is taking a proactive role in driving and encouraging the local new energy ventures.

Smart Grid and Energy efficiency are one of the office's focus areas (aside from areas such as oil alternatives, fourth-generation nuclear power plants, and others). To support new development and new ventures in those fields, the office has allocated support and funding programs and initiatives.

The main program the office operates to support new ventures is called Hezkek, (which is the Hebrew word for "Start-Up) [15]:

"In 2007 the Ministry of Energy and Water Resources announced the establishment of the Hezkek Foundation. This organisation is designed to facilitate research, development and new initiatives in the fields of renewable energy and energy efficiency, and to place Israel in the center of global research and development in this field.

Through this foundation, the Ministry of Energy and Water Resources encourages technological enterprises which promote feasibility studies within the energy domain, in areas including energy efficiency, smart networks, oil alternatives for transportation and industrial purposes, biomass energy generation from various types

of refuse, hydrogen technologies, more efficient utilization of fossil fuels, and conventional renewable energies such as wind, solar energy and fuel cells.

In particular, the Foundation assists fledgling energy and energy efficiency projects by financing up to 62.5% of a program's approved budget, up to a total of 625,000 Israeli Shekels."

9.2 The Ministry of Industry, Trade and Labor

The Ministry of Industry, Trade, and Labor (MoITAL) is the main ministry responsible for the continuation and the growth of Israel's innovation and export-based economy.

The ministry operates various departments and tools to support and encourage applicative academic research, formation of new ventures, local and global cooperation, export and expansion into new geographic territories.

There are three entities which operate under the ministry with significant focus and impact on supporting the local smart energy industry: The Office of the Chief Scientist, Israel's Investment Promotion Center and NewTech, and the Israeli Export Institute.

Each of those three drives various initiatives and allocates resources to help the formation of this industry.

9.3 MoITAL - The Office of the Chief Scientist (OCS)

The Office of the Chief Scientist (OCS) of the Ministry of Industry, Trade, and Labor (MoITAL) operates programs and initiatives to support and accelerate R&D activity, commercialization of academic research, and R&D cooperation among local and international players.

The Office's supporting budget, allocated to the various programs and initiatives that it supports, is defined on a yearly basis, and varies according to government constraints. Typically it is around USD400M – USD500M per annum.

Though the MoITAL OCS does not operate a program dedicated to Cleantech or Smart Energy, the allocation of resources and focus to these areas is growing steadily.

According to the Office's public statements, support for Smart Grid R&D projects counts for some 15% of the Office's total budget [16]. The various programs come to address the different needs in term of sizes and stages of the companies and the technologies.

Some of the more relevant programs to Smart Energy include:

- The R&D Fund is the main program through which the OCS financially supports R&D for new products
- Technological Incubators – are heavily sponsored by the OCS to encourage private investors to engage in these high risk ventures.
- The MAGNET program under which industry and academic institutes can form consortia to share information for the development of new products, co-sponsored by the OCS.
- An important organization under the OCS is MATIMOP which promotes international R&D cooperation with global companies and organizations.

More information on the various programs can be found at the OCS web site <http://www.moit.gov.il/NR/exeres/3C96E1CF-EDFA-4F16-BACE-216773805124.htm> and formal publications.

9.4 MoITAL - NewTech

Israel NewTech is a unique program that runs under the “Israel's Investment Promotion Center” with the task of accelerating and supporting the Israeli Cleantech industry.

The program was initiated through the Israel strategic needs for water related technologies and the belief in a strong global need for such technologies, and later expanded to support also energy- related industries. The program is unique, both by being a cross-ministerial program, and by being focused on a specific industry.

NewTech operates mainly as a facilitator and governing entity and runs its initiatives through other governmental entities such as the Office of the Chief Scientist or the Israeli Export Institute to which it also allocates its funds. Through the allocation of those targeted funds, NewTech is able to ensure that those entities allocate sufficient resources and focus on the cleantech industry.

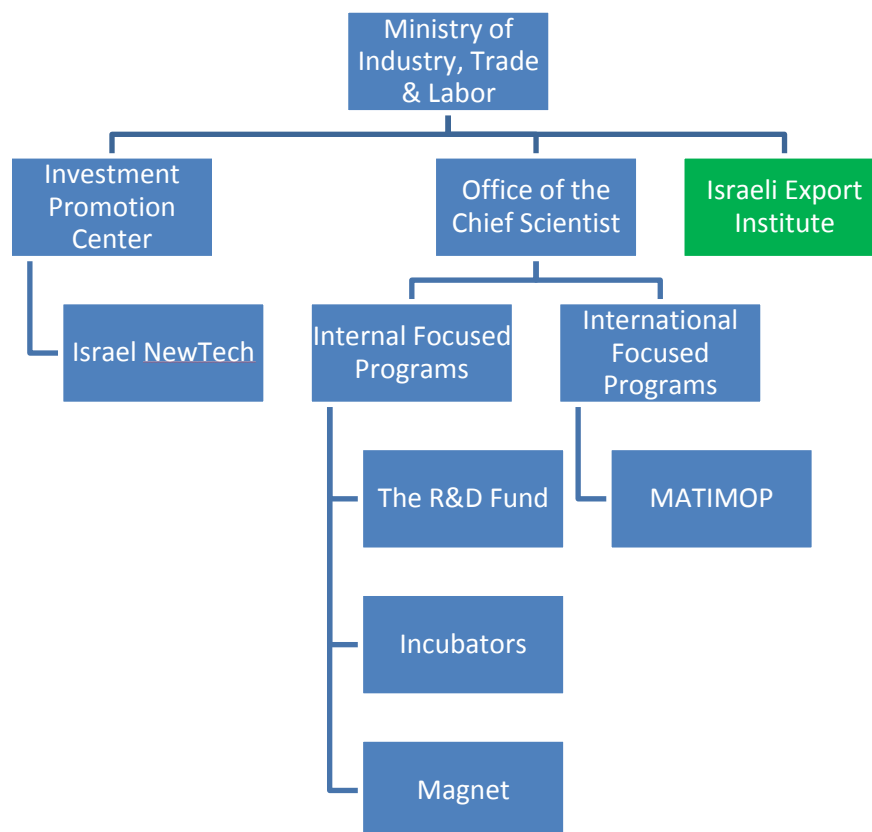
9.5 MoITAL - The Israeli Export Institute

The Israeli Export Institute (IEI) operates as a not-for-profit organization under the Ministry of Industry, Trade and Labor.

IEI provides support to the local industry, with exposure to international customers and partners, providing information on the various geographies needs and business structure, and assisting with relationship build-ups for the relevant companies.

The organization operates closely through Israeli commercial and economic attachés, and its initiatives are organized by industries with Smart and Renewable Energies, now one of the focus areas for the IEICI.

The above-mentioned entities and programs of MoITAL can be seen in the following chart:



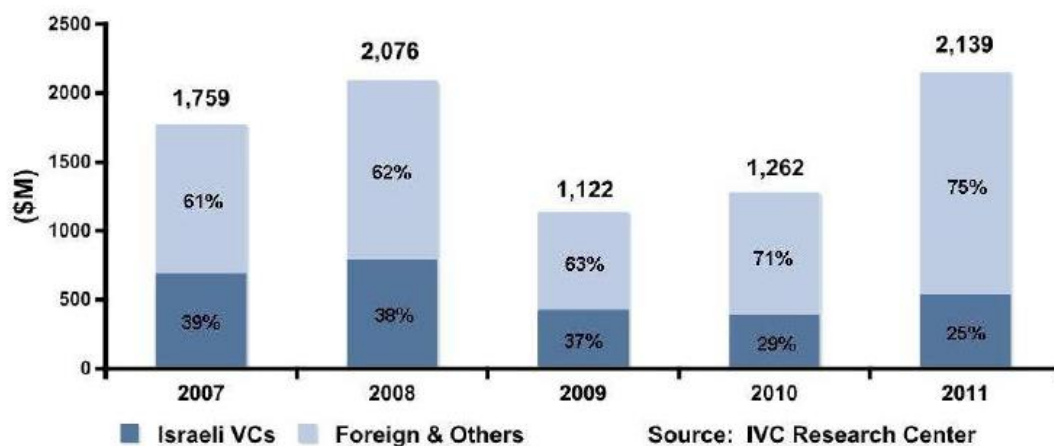
10. Financing

The major challenge for entrepreneurs in the Smart Energy domain is lack of funding resources available for new ventures in this domain. There is a tremendous un-served need for VC funding for innovative Smart Energy start-ups.

The Israeli Venture Capital market, which grew strongly over the last two decades, has still not recovered from the 2008 economic downturn, and is going through a process of maturity and focus.

Even with a governmental effort to encourage the local institutional investors to increase their allocations for investments in VCs, efforts which were accompanied by several incentive plans, still the Israeli venture capital funds are heavily dependent on foreign investors, with an estimated 75% of their funds coming from overseas investors.

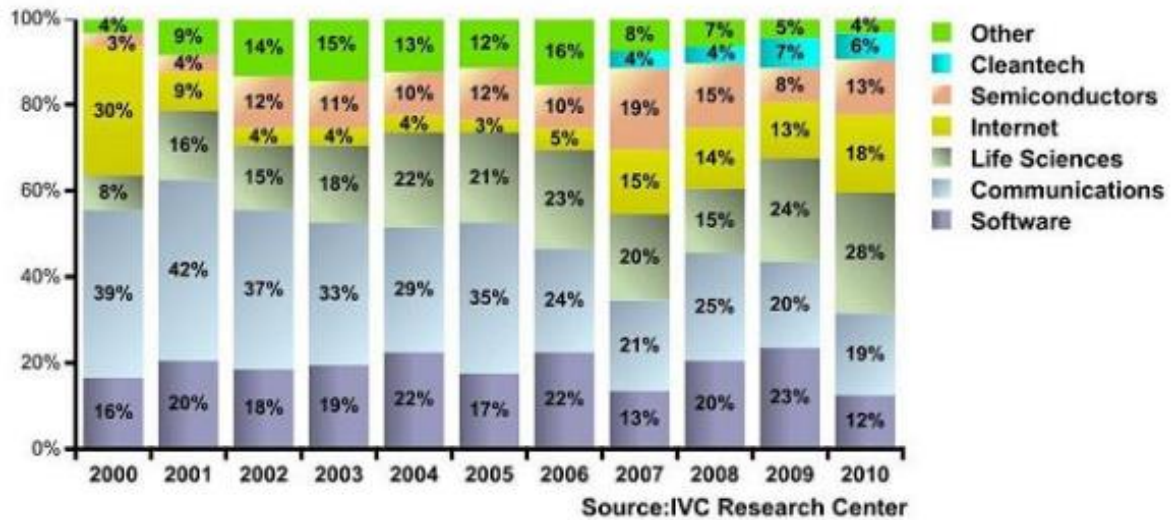
As can be seen in the chart below, the local High-Tech companies managed to overcome the current reduced level of available financing, by addressing foreign investors directly. Yet, with such a high dependency on foreign investors (around 90% in 2011), the local companies are under enormous stress to present higher-than-average returns compared to their overseas competitors having home-based investments.



Capital Raised by Israeli High-Tech Companies by Year (2007-2011 \$M)

Source: Summary of Israeli High-Tech Company Capital Raising 2011, IVC and KPMG Report

The demand for relatively high ratio of success to risk, by both the Israeli VCs and the Israeli companies, is making fund raising for Cleantech related ventures a real challenge. As can be seen from the chart below, overall VC investments in Cleantech ventures, accounts for well below 10% of overall VC investments.



Capital Raised by Israeli High-Tech Companies by Sectors by Year (%)

Source: Summary of Israeli High-Tech Company Capital Raising – 2010, IVC and KPMG Report, IVC Research Center, 2010

Smart Energy, which falls between High-Tech and Cleantech, is a new and less familiar domain, certainly compared to the Internet /Cellular /Communications spaces, but also compared to Water or Solar. As of today there are very few investment managers in Israel that are familiar with the smart energy space and can evaluate relevant investments in the field.

On the positive side, the local investors are commonly familiar with the Smart Energy related technologies, even if not with the markets, and understand the potential in this space. In addition, International investors are showing growing interest in the potential Israeli innovation in the space. The result is a fairly long list of local and global investors, with one or two investments in the field which enable the more experienced entrepreneurs to raise initial funds, either locally or from foreign investors. The challenge, however, remains for young entrepreneurs looking to enter the field.

Some of the current local and global investors with investments in the field in Israel:

Venture Capital Funds

Local focus relates to Venture Capital firms that are either fully dedicated or mainly focused on investments in the Israeli market.

Venture Capital	Local focus	Main Tech
Capital Nature	Y	Energy
Gemini VC	Y	ICT
Genesis Partners	Y	ICT
Good Energies	N	Energy
GreyLock Partners	N	ICT
Israel Cleantech Ventures	Y	Cleantech
Israel G-Tek	Y	Cleantech
Norwest Venture Partners	N	ICT & Med
Plenus	Y	Broad
Tamir Fishman	Y	ICT
Terra Ventures	Y	Cleantech
Vertex VC	Y	ICT
Virgin GreenFund	N	Cleantech
Walden International	Y	ICT

Corporate assisted funds

Corporate	HQ
Alstom	France
GE	US
Israel Electric Company	Israel
Qualcomm Ventures	US
RAD Group	Israel
Rafael	Israel
Schneider	France

Currently, incubators and angel investors have become a more feasible option for start-ups in the smart energy space, with some discussions to set-up dedicated Smart Energy incubators.

11. Experience

Endless stories, studies, and books have been written on the success of the Israeli Hi-Tech sector. Much of it can now be leveraged to grow innovative companies in new domains. Both in terms of technology, but even more from a business perspective, Smart Energy companies are leveraging the established success of the Hi-Tech industry.

In terms of technologies:

The vast knowledge gained in the fields of: Communication, network management, operations optimization, knowledge management and analysis, security, core applications, end-user applications, and mobile applications – all are relevant to developing solutions in the Smart Energy Space.

From a business perspective:

Even if it seems different at first look, the utility and municipality markets are fairly similar to how the Telecommunications market was 20 years back. Many of the industry veterans and Israeli Hi-Tech leaders are familiar with, and have gone through the changes in regulations and opening-up of the Telecommunications market, and understand the challenges and ways to address it.

Workforce:

Hi-Tech entrepreneurs, looking for new and exciting fields, are showing growing interest in the Smart Energy field. Beyond the technical knowledge, they bring valuable entrepreneurial knowledge in establishing resource-constrained operations, learning the market needs, recruiting VC funding, and developing international operations.

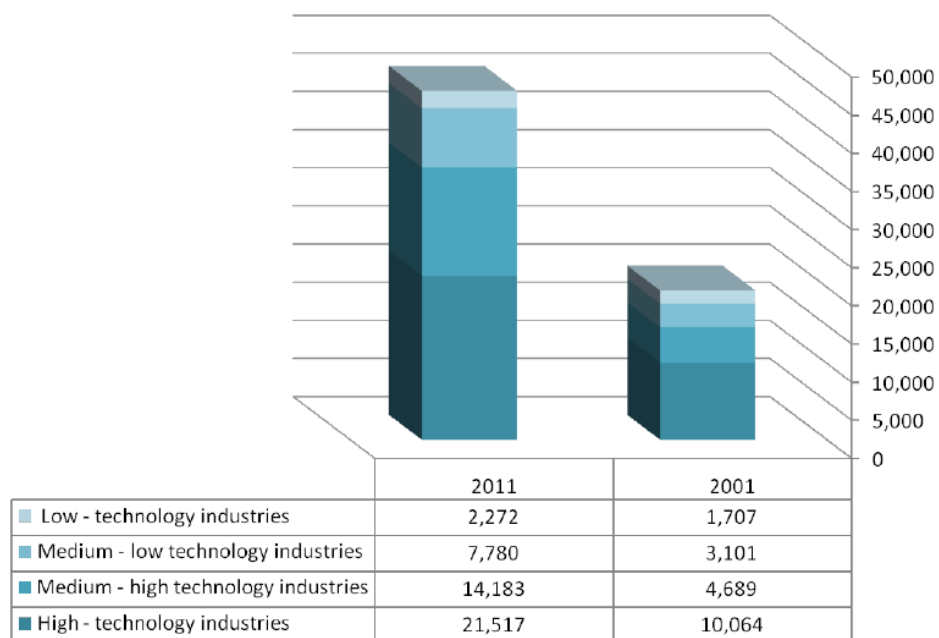
The nation can enjoy today the fruits of its innovation culture, its previous investment in building up entrepreneurial know-how and business practices.

Indeed, many of the entrepreneurs in the Smart Energy space come from the Hi-Tech sector, "pulling" their previous teams, friends, and sometimes even their investors.

12. Export

The Israeli industry, and in particular the Israeli High-Tech industry is heavily export-driven. With a small local market, and limited national resources, export is critical to the economic stability of Israel, and as can be seen in the following cart, is on a constant growth.

TOTAL INDUSTRIAL EXPORTS (EXCLUDING DIAMONDS):



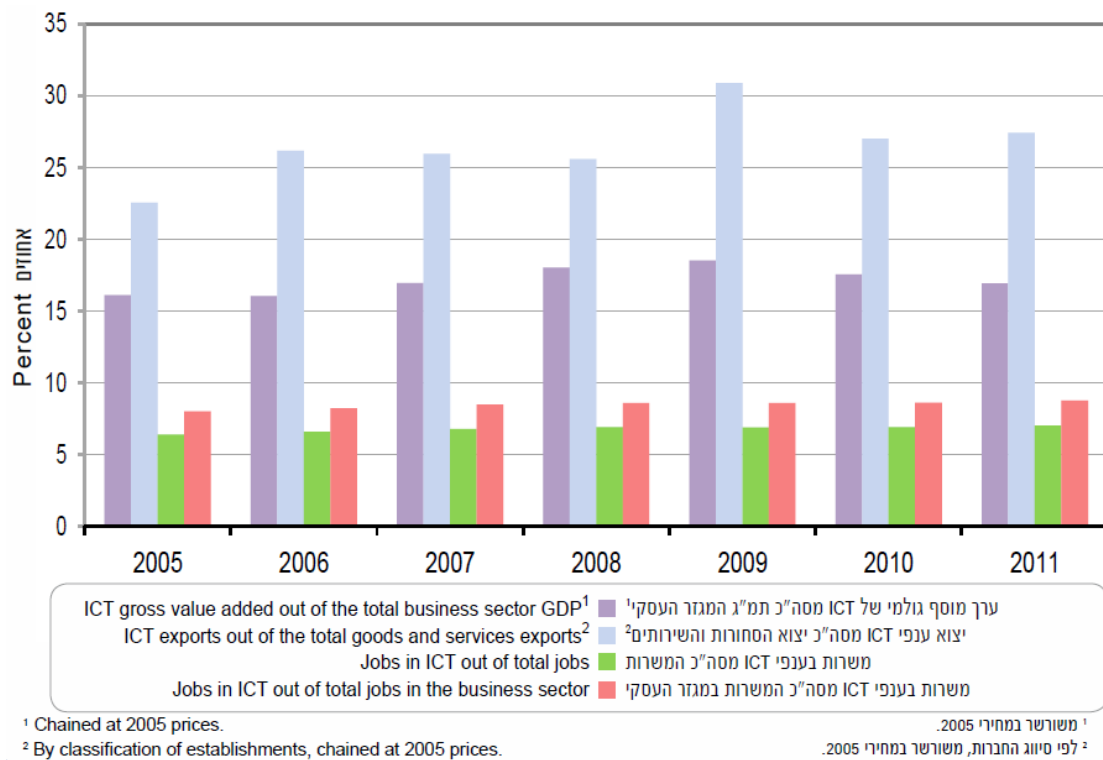
Israel's export of goods, (MILLIONS OF U.S. \$)

Source: Central Bureau of Statistics as presented at the "Israel Economy at a Glance 2012" page 7, published by the Israeli Ministry of Industry Trade & Labor (<http://www.moital.gov.il/NR/rdonlyres/631EA402-E7E3-4DF3-BE94-22581CC5AA50/0/IsraelEconomyataGlance2011.pdf>)

The High-Technology sector is taking the lead in this export-driven economy, with most High-Tech companies having become practically independent of the local market.

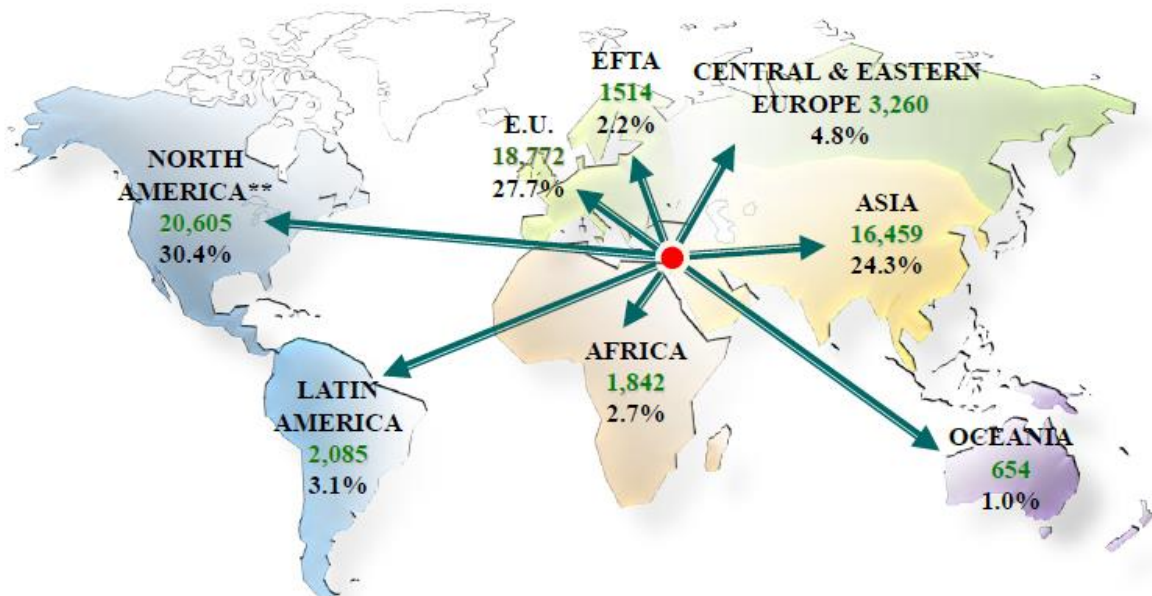
Unlike traditional business growth, which calls for international expansion only after a company has stabilized some local business, it is very common for local new ventures, sometimes with only 2-3 people, to immediately approach international markets as their first target market.

The following chart describes the ICT Sector's Share of the Total Gross Domestic Product, Exports and Jobs, 2005-2011



Source: <http://www.tradingeconomics.com/israel/ict-service-exports-percent-of-service-exports-bop-wb-data.html>

With very limited ability to trade with neighbouring countries, Israel's main markets are North America, Western Europe, and APAC. With a heavy focus still on the US and Western Europe, APAC is capturing growing importance with the Israeli



government investing significantly to increase the trade and export, especially to India and China.

Israel's Export of Goods 2011 (US\$M)

Source: Central Bureau of Statistics as presented at the "Israel Economy at a Glance 2012" page 3, published by the Israeli Ministry of Industry Trade & Labor (<http://www.moital.gov.il/NR/rdonlyres/631EA402-E7E3-4DF3-BE94-22581CC5AA50/0/IsraelEconomyataGlance2011.pdf>)

The international business culture plays an important, if not crucial, role in driving the Israeli Smart Energy industry forward. With a small, monopolized, and highly regulated, local electricity market – new ventures will stand very low chances to succeed.

The experience gained over years by the ICT sector, enables the current Smart Energy entrepreneurs to start their ventures and grow without the limitations of the local market.

With the advantages, lie also some challenges in building a new venture which immediately starts its operations overseas. The local experience in working internationally has equipped the entrepreneurs with good tools to address issues such as the distance, related expenses, market knowledge, culture, and language. Entering the Smart Energy space presents an additional challenge - utilities and regulators in the energy space are still very cautious and conservative, and often expect to see some deployment operating in a vendors' home country – a requirement which proves as a major obstacle and holds back many Israeli innovative ventures in the space.

Another challenge facing Israeli Smart Energy entrepreneurs when addressing international markets is the need to establish a business eco-system with customers, system integrators, and other key players. The government and the Israeli Smart Energy Association are playing a key role in helping the young industry in starting to develop this important network of business and cooperation.

Those current challenges, as tough as they may be for the current entrepreneurs, are expected to be solved as the industry grows and builds local leaders who are well familiar with key players in the target foreign markets.

13. Smart Energy – The New Domain

It is where some critical mass is reached that all the pieces start to really play together: with the government creating dedicated supporting programs which make funds and activities more viable; the academy allocating more resources and programs, which provides more skills and knowledge; and the local industry getting more involved, providing local opportunities and drive. These trends drive the investors and entrepreneurs to take more risk and attract more global attention to make the new export- driven industry flourish and establish a new successful, innovative domain.

In building the new Smart Energy domain, the local entrepreneurs are able to gain from the foundations already in place for both the ICT and the renewable energy

domains. Technologies and business experience can now provide a leap frog to quickly form a leading edge in this new and fast growing space.

Israel seems to be right at the edge of getting all the pieces together, with growing interest now coming from the government, the academy, and the local industry, to significantly step in as a one of the world leaders in the Smart Energy innovation centres. Both established companies in related industries (mainly ICT) as well as individual entrepreneurs are intensively looking for the right opportunities to enter the space, and new ventures are being frequently formed.

14. Sample list of Israeli Companies in the Smart Energy Domain

Company	Web Site	Field	Size	Stage
Alvarion	www.alvarion.com	Wireless broadband solutions	over 500	Sales
BeemTech	www.beemtech.com	EE applications	10 to 50	Sales
Better Place	www.betterplace.com	Electric Vehicles	over 500	Sales
BrightSource	www.brightsourceenergy.co	Solar Energy	over 500	Sales
Computerized Electricity Systems (CES)	www.c-e-systems.com	SG network management&monitoring	10 to 50	Sales
cVidya Networks	www.cvidya.com	SE data analysis&management	100-500	Sales
ECI Telecom	www.ecitele.com	SG communications	over 500	Sales
EnVerid Systems	www.enverid.com	Energy Efficiency Applications	up to 10	Sales
ETV Energy	www.etvenergy.com	Batteries & Energy Storage	up to 10	R&D
Gnrgy	www.gnrgy.com	Energy Management	up to 10	Sales
G-Patrol Ltd	www.g-patrol.com	EE applications	up to 10	Sales
GreenLet Technologies	www.greenlet.net	Smart Grid Network Management and Monitoring	up to 10	Sales
GridOn	www.gridon.com	Energy Management	up to 10	Sales
Israwind	www.israwind.co.il	Wind Energy	up to 10	Exploring
Leviathan Energy	www.leviathanenergy.com	Wind Energy	up to 10	Sales
Linum	www.linumsystems.com	EE applications	up to 10	R&D
LNCON	www.lncon.com	HVAC EE applications	up to 10	Pilot
Metrolight Ltd.	www.metrolight.com	EE applications	10 to 50	Sales
Metrycom Communications	www.metrycom.com	Powerline maintenance	up to 10	Pilot
Mobix	www.mobix.com	SG communications	10 to 50	Sales
MTR Wireless Communications	www.mtrcom.com	SG communications	up to 10	Pilot
Nation E	www.nation-e.com	Energy Storage	10 to 50	Sales
Nortex Technologies	www.nortex-tech.com	SG network management&monitoring	up to 10	Exploring
Powercom	www.powercom.co.il	SE data analysis&management	10 to 50	Sales
RADiflow	www.radiflow.com	SG security	10 to 50	Sales
SolarEdge Technologies	www.solaredge.com	SG network management&monitoring	100-500	R&D
TrDiNetworks	www.tridinetworks.com	EE applications	up to 10	Sales
unique technology	www.collectric.net	Smart Metering	10 to 50	Sales

Acknowledgement

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References

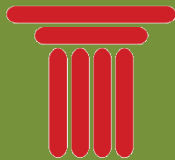
1. The Global Innovation Index, 2012
2. IMD World Competitiveness Yearbook, 2011 (as presented at the “Israel Economy at a Glance 2012”, page 28, published by the Israeli Ministry of Industry Trade & Labor (<http://www.moital.gov.il/NR/ronlyres/631EA402-E7E3-4DF3-BE94-22581CC5AA50/0/IsraelEconomyataGlance2011.pdf>))
3. Central Bureau of Statistics as presented at the “Israel Economy at a Glance 2012” page 2, published by the Israeli Ministry of Industry Trade & Labor (<http://www.moital.gov.il/NR/ronlyres/631EA402-E7E3-4DF3-BE94-22581CC5AA50/0/IsraelEconomyataGlance2011.pdf>)
4. Boch, Alex, 2007: Ministry of Industry Trade & Labor, Water Technologies in Israel.
5. Ministry of Environmental Protection, by Ernst & Young, Promoting the Cleantech industry in Israel, 2010, page 9.
6. OECD Science, Technology And Industry Outlook 2008 – ISBN 978-92-64-04991-8, page 170)
7. TheMarker news, Interview with the Israeli PM, 2009, <http://tbk.mako.co.il/article/421692>.
8. Israel Electric Corporation Ltd. Information flyer, 2012.
9. Electricity Sector Law, 5756-1996
10. Israel Electric Corporation Ltd. Web site on Independent power producers <http://www.iec.co.il/EN/IR/Pages/IPPs.aspx>
11. (Israeli Electric Corporation Tender No.: 2000600527, Smart Grid Project)
12. <http://www.globes.co.il/serveen/globes/docview.asp?did=1000654179&fid=1725>
13. <http://capitalnature.com/partners/>
14. Vered Holzmann, Dean Academic Entrepreneurship: Quality and Excellence. Holon Institute of Technology publication, 2011.
15. Ministry of Energy and Water Resources web site: <http://energy.gov.il/English/Subjects/RAndDChiefScientist/Pages/GxmsMniResearchAndDevelopmentProjects.aspx>

16. Globes magazine published round table with Gil Shaki from the MoiTAL OCS, 27/12/2012.

<http://www.globes.co.il/news/article.aspx?did=1000809560>

Further reading

- DEVELOPMENTS AND TRENDS IN ISRAELI EXPORTS, the Economic Department, The Israel Export and International Cooperation Institute, May 2012
- Soumitra Dutta, Augusto Lopez-Claros, Irene Mia: INSEAD and The World Economic Forum, Israel Factors in the Emergence of an ICT Powerhouse.
- Israel's R&D INCENTIVE PROGRAMS, www.moital.gov.il/madan.htm
- The Israeli Economy, Israeli Ministry of Finance, Summer 2011, written by Assaf Luxembourg, supervised by Mr. Roni Hershkovitz
- COMING CLEAN: The Global Cleantech Innovation Index 2012, The Cleantech Group, lead authors: Vince Knowles
- The Israeli NewTech program web site: <http://israelnewtech.gov.il/English/AboutUs/Pages/default.aspx>



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