The Chief Scientist Office

Research and Development

2012-2014

September 2014
Foreword by the Minister of National Infrastructure, Energy and Water Resources

The Ministry of National Infrastructure, Energy and Water Resources is responsible for the supply and management of energy and the natural resources of the State of Israel. Energy plays a vital role in every part of our modern, productive society and economy. We invest considerable efforts and funds in research and development in this field, to ensure the supply of energy in peaceful times and during emergencies at minimal financial, social and environmental costs.

Within the Ministry, The Chief Scientist Office supports innovative Israeli technologies in several areas:

- Clean renewable energy to increase Israel’s energy security
- Development of fuel alternatives from the newly discovered Natural Gas fields
- Energy Conservation and efficient use of our resources
- Smart electricity grid and a modern electricity market

Promoting knowledge and research in all energy-related fields will strengthen Israel’s energy security, enhance the role of Israel as a center of technological innovation, and leverage Israeli human capital, infrastructure and resources. The Chief Scientist Office supports academic research through grants, and the development of Israeli manpower and expertise through scholarships. The Chief Scientist is also responsible for international collaboration, which is vital in today’s global economy.

These efforts will further strengthen our economy, creating higher living standards at lower costs.

I am proud to present you with a glimpse of the extensive activities at the Chief Scientist Office in this booklet.

Silvan Shalom
Minister of National Infrastructure, Energy and Water Resources
Foreword by the Chief Scientist

The Chief Scientist Office (CSO) provides the Ministry with evidence-based, scientific and technical support for policy making in the areas under the Ministry’s responsibility; i.e.; energy, water and natural resources.

Israel is a geopolitical island, with a high population density. It resides on the verge of aridity with limited natural resources. Therefore, sustainable supply of its needs in terms of energy, water and natural resources is a challenge. A robust, long-term policy must rely on technologies, of which some are not yet readily available. It is the CSO’s role to fill the technological gaps and to prepare qualified personnel to implement such policy in due time. To achieve this, the CSO supports a wide range of R&D activities in academia and industry. Clearly, in today’s global village, international give-and-take is a must. The CSO promotes international networking, technology transfer and collaboration in R&D.

By providing a one-stop-shop to inventors, entrepreneurs and investors in all areas of activity, the CSO is able to accelerate the implementation of innovative ideas. According to criteria, based on international best practices, the CSO’s achievements are impressive.

The Chief Scientist Office is organized in a matrix structure. On one hand, we specialize in several technical fields aiming at achieving excellence. On the other, we set up system-oriented administrations, on specific subjects, defined by our national techno-political objectives. Representatives from all stakeholders take part in the administrations to ensure synchronization on all tasks, resulting in speedy progress of technical and regulatory aspects of the work.

Our success is credited to the excellent, professional and dedicated team we have and the creative minds of the people in Israel’s academia and industry.

This document is intended to showcase our activities. We invite new partners to collaborate with and assist us in accomplishing our national goals. I am certain this will be to the mutual benefit of all partners.

Dr. Shlomo Wald
Chief Scientist
Ministry of National Infrastructure,
Energy and Water Resources
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- Company: Sunboost
- Company: Alfa Sustainable Projects
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- Company: Solaris Synergy

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- Company: EB Clean Energy
- Company: Emefcy

### Some of the Pilot and Demonstration Projects Funded in 2013

**Energy Efficiency**

- Company: HydroSpin Monitoring Solutions
- Company: R-Jet Engineering

**Transportation and Fuel Alternatives**

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**Transport Systems and Fuel Alternatives**

- Company: Redler Computers Ltd.
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- Company: TransBiodiesel
- Company: Engineuity
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**Smart Grid and Energy Efficiency**

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### Contact Information
Introduction

About the Ministry of National Infrastructure, Energy and Water Resources

The Ministry of National Infrastructure, Energy and Water Resources is responsible for the supply and management of energy and the natural resources of the State of Israel: electricity, fuels, natural gas, energy conservation, water, sewage, oil & gas exploration, minerals and ores excavation. The Ministry regulates these fields and acts to ensure an adequate supply during peacetime and in the event of an emergency, under changing energy and infrastructure needs, today and in the future, while balancing between supply and consumption under economic, environmental and social constraints.

In order to meet its objectives and allow the country to realize its goals in the energy and infrastructure fields, the Ministry encourages R&D for the development of renewable energy sources, oil alternatives, smart grids and water treatment, using novel, efficient technologies.

The Chief Scientist

The Chief Scientist Office (CSO), in the Ministry of National Infrastructure, Energy and Water Resources is responsible for providing scientific and technological support to policy makers. The CSO endeavors to collect, investigate and incorporate current technical and economic information pertinent to all ministerial work. It encourages the development of know-how and expertise in relevant fields by promoting R&D activities in Israeli academia and industry and through international cooperation. The CSO promotes local knowledge centers where original technologies are devised and developed to address Israel’s needs today and in years to come. The CSO conducts long-term, system-oriented projects in order to accelerate the implementation of transformative policies and technologies in the Israeli market. The CSO serves as a one-stop-shop for inventors, entrepreneurs, and investors who wish to be involved in the exploitation, production and supply of energy, water and natural resources in Israel and international markets.
Areas of Expertise

The Chief Scientist is a key player in supporting successful development of knowledge and innovation of Israeli researchers and industry. The areas of expertise of CSO-supported projects are illustrated below.

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Financial Support – *Single point of contact for multiple development stages*

The Chief Scientist supports R&D in several stages of the development process, starting from academic research, through support of pre-seed ideas to pilot and demonstration. Recently, the Ministry has also established a student scholarship program for academic institutions in Israel and abroad, in order to develop the human resource pool in energy professions.

**Support Schemes**

- Scholarships to university students in Israel and abroad
- Academic research projects
- The STARTERGY Fund for early stage start-up companies
- Pilot and Demonstration Projects
- International R&D collaborations, such as Bird Energy, BSF, JRC, FP7 & Horizon 2020
- Classification of Renewable Energy projects as pilot and demonstration for the purpose of obtaining quotas, permits or tax benefits

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Focus Areas

1. Fuel Alternatives

The discovery of large natural gas (NG) reservoirs in Israel offers a unique opportunity for energy independence and economic benefits. The Ministry has established a dedicated administration for promoting the use of natural gas based oil substitutes for transportation purposes. Members of the administration are representatives from government ministries and authorities, as well as representatives from the fuels, petrochemical and fuel additives industries.

Jurisdiction and Objectives

- Establishing a comprehensive “Well to Wheel” policy for incorporating the use of natural gas based petroleum alternatives.
- Consolidating Ministerial priorities toward the optimal use of natural gas within the Israeli economy.
- Collecting relevant professional know-how and conducting comprehensive research in pertinent fields, for the purpose of analyzing and evaluating the various alternatives and the circumstances of their exploitation, taking into consideration their technical and regulatory aspects.
- Establishing a mechanism for promoting and facilitating research and development efforts and their implementation in Israel.
- Consolidating recommendations and facilitating procedures that will assist petroleum alternative companies in acquiring the various permits required for project promotion.

Dr. Bracha Halaf leads the Fuel Alternatives Administration.
2. **Urban Sustainability Administration (“Smart Cities”)**

The focus on sustainable existence in cities has become a priority in light of worldwide urbanization; the urban population is expected to grow from 3.3 billion to 5 billion by 2030. Almost six million people in Israel live in urban areas. The vision of the Administration is to maintain and improve the living standards in cities, by encouraging sustainable existence – often referred to as “Smart Cities”. A smart city strives to make optimal and sustainable use of all its resources, with emphasis on services rendered to the citizen, by maintaining a suitable balance between social, environmental and economic costs.

The Administration is responsible for defining a comprehensive policy to promote sustainability issues, from an integrated perspective of all the resources utilized in this environment. Its activities cover a diverse range of areas: energy, water, sewage, transportation, education, healthcare and leisure, as well as technological and planning issues. The Administration is developing a holistic methodology for urban planning that differs from the methodology in use today.

The Administration includes representatives from government ministries, the Union of Local Authorities, Forum 15 and the Standards Institution of Israel, and will seek assistance from professional committees whose members come from academia, as well as other relevant entities. In addition, the Administration promotes inter-disciplinary dialogue between the various planning entities in the framework of conferences, workshops and pilot projects.

Mr. Edi Bet-Hazavdi and Dr. Shlomo Wald head the **Urban Sustainability Administration**.

3. **Smart Grid**

A smart grid is a modernized electrical grid that uses information and two-way communication technology in an automated fashion to optimize the efficiency, reliability, economics and sustainability of the production and distribution of electricity, when every end point on the grid may be both a producer and a consumer (hence the term “prosumer”).

Operational goals of the smart grid are reliability, survivability, efficiency, security, resilience, optimal asset utilization and operational efficiency. All of these goals are to be achieved under the conditions of ultra-distributed generation from renewable sources, local co-generation (Combined Heat and Power), and conventional large power plants.

The technical challenges are significant, both in the physical management of electricity – such as storage issues and the response to frequent changes in production and demand while keeping the electricity quality high), as well as in
information management—such as how to collect, transmit and analyze production and consumption information, and how to control the various prosumers. Issues of cyber security and privacy are also paramount. However, a few directions have emerged in recent years. Two-way smart metering and demand response, for example, are becoming a reality. Consumption information is collected in real time and the consumer, as well as the system manager, have a way to know and control the consumption in detail. Flexible pricing is also part of the system. However, a system that manages ultra-distributed generation is still lagging behind.

The Chief Scientist aims to assemble a team of experts and stakeholders in order to build the framework for a modern smart grid in Israel.

4. Nuclear Power Plant (NPP)

According to the Ministry’s Energy Master Plan, Israel is expected to face a shortage of about 20% in its electrical production capacity by the year 2050. The Ministry has recognized the environmental and economic benefits of nuclear energy, so in 2013 a Nuclear Power Plant (NPP) Administration was established in order to promote nuclear energy as an additional alternative energy source available from 2030.

The NPP Administration initiated a pre-feasibility study of operating a nuclear power plant in Israel. Its main goal was to determine and analyze the major obstacles to constructing and operating an NPP by 2030.

Main Program Objectives

- Finding and allocating a suitable site for an NPP in Israel, according to the demographical, seismological, geological and geotechnical siting criteria and guidelines of Israel’s IAEC Licensing & Safety Division.
- Defining and resolving special security problems, considering the geopolitical situation of Israel.
- Recruiting a team of experts qualified to establish and operate a Nuclear Power Program.
- Supporting research activity and manpower qualification.
- Initiating several flagship projects, aimed at building the knowledge base and the infrastructure for research facilities, necessary for the implementation of a comprehensive feasibility study (e.g. a thermo-hydraulic NPP laboratory and others).
- Conducting all of the above, as a preliminary step toward developing a full-scale NPP program.
5. National Energy Master Plan

One of the missions of the Ministry is to secure a sustainable supply of energy that meets Israel’s economic needs during times of peace and emergency. The supply must meet a high level of reliability, availability, efficiency and quality standards necessary for a modern and well-developed economy, while maintaining a balance between the economic, social and environmental costs. The energy market requires long-term planning, covering at least 30 to 40 years, with typical infrastructure planning intervals of about 10 years. However, the development of the market depends on many inter-correlated parameters in an environment that involves substantial uncertainties.

To overcome this, the Ministry assembled a multidisciplinary team to develop practical planning tools that will assist the decision makers in quantitative assessment of long-term policies and their impact.

These planning tools include an integrated set of models for each sub-market such as electricity, natural gas and fuels, and a methodology for policy assessment. We are looking for robust solutions that are stable over a wide range of possible scenarios.

The system was developed with the aid of TAHAL Limited as the main contractor.

It was tested for soundness, based on consumption projections, as well as infrastructure development plans already approved by Government. The outcome of this test confirmed the validity of the key guidelines of the Master Plan, including recommendations for management, development, operation, regulation and related R&D for the energy market. The Administration will continuously improve and review the models and the methodology, while examining new scenarios for the Energy Master Plan.

6. Renewable Energy

On February 2010, the Ministry published its policy and plan for the integration of renewable energy sources into Israel’s electricity generation system. Subsequently, the government decided to set a target of 10% renewable electricity generation by the year 2020. The Chief Scientist strongly believes that the need to integrate renewable energy rests on strong rational foundations (in order of importance):

- Increased energy security due to the diversification and decentralization of Israel’s power sources
- Emissions reduction
- Long-term price stability: Providing consumers with electricity at fixed prices until the end of the project period (20-25 years), then reduced to maintenance costs only
- Development of renewable energy industries in Israel
In addition to providing direct support to companies and research in this field, the Chief Scientist is devoting efforts to rationalize pricing, based on broad advantages of renewable energy, as well as the integration of policies that encourage their use by government authorities, in an effort to maximize the contribution of renewable energy as part of Israel’s energy production capability.

7. Continental Shelf Research Program

The availability of land resources for development of national infrastructure on the coastline of Israel is decreasing rapidly. Therefore, the construction of new installations, such as desalination plants, onshore facilities connected to the natural gas reservoirs, power plants and ports is becoming difficult. Moreover, public opinion is, in most cases, against continued development of the coastline.

The Continental Shelf Research program was initiated in order to explore the environmental impact of constructing infrastructure on offshore structures, such as artificial islands. The study, conducted by the Earth and Marine Sciences Administration, was designed to explore the long-term implications of such construction on marine dynamics and to provide decision makers with a practical set of tools for evaluating these offshore structures. The research included the following:

1. High-resolution mapping of the sub-seafloor (to a depth of 100m), with the aim of determining the availability of sediments for the construction of artificial islands.
2. Characterization of sediment dynamics.
3. Evaluation of the coastal cliff collapse with emphasis on sea-cliff interaction.
5. Construction of oceanography models: modeling of sediment advection and diffusion mass balance model, including environmental parameters such as carbon, nitrogen, phosphorus and oxygen.
6. Ecological survey of the kurkar ridges.
7. Modeling the impact of tsunami waves on onshore and offshore infrastructure.
1. BSF and BSF Energy

The United States-Israel Binational Science Foundation (BSF) coordinates a joint program by the United States Department of Energy (DOE) and Israel’s Ministry of National Infrastructure Energy and Water Resources, known as BSF Energy, in which U.S. $1.2 million a year is invested in academic energy projects. The BSF promotes scientific cooperation between the two nations, by way of supporting joint research projects in various fields of basic and applied science. The BSF has supported thousands of leading Israeli and U.S. scientists, including 36 Nobel laureates.

For more information, visit the website: www.bsf.org.il

Examples of funded projects are:

- Northwestern University and Tel Aviv University: Relaxation, Polarization, Energetics, Design and Efficiency in Ordered Organic Photovoltaic Systems.
- University of California, Irvine and Tel Aviv University: Modular Topologies of Photovoltaic Systems.
- University of Illinois, Urbana-Champaign, Stanford University and Technion - Israel Institute of Technology: Stability by Design for Distributed Power Markets: Leveraging Control and Game Theory to Create Better Power Grids with Improved Performance, Better Stability and Efficiency.
2. BIRD Foundation

The U.S. Department of Energy (DOE), the Israel Ministry of National Infrastructure, Energy and Water Resources and the BIRD Foundation have established “BIRD Energy”: a program for United States - Israel joint renewable energy development, in which $3.4 million a year is invested in energy projects. This partnership between Israel and the United States began as a result of the U.S.-Israel Cooperation in Energy Independence and Security Act of 2007 and the Israeli Government approval of the program in 2008.

The BIRD Foundation’s mission is to stimulate, promote and support industrial R&D for the mutual benefit of the United States and Israel.

BIRD’s activities include matchmaking services between Israeli and American companies. It supports approximately 20 projects annually. The cumulative sales of products developed through BIRD projects have exceeded U.S. $8 billion.

For more Info, visit the website: www.birdf.com

Examples of funded projects are:

- GenCell (Petach Tikva, Israel) and Innovative Machine Corp. (Birmingham, AL): Development and Industrialization of a New Cathode for a Next Generation Electrochemical Fuel Cell Generator.
- Winflex (Kibbutz Moran, Israel) and GE (Niskayuna, NY): Development of a Wind Turbine Generator with an Inflatable Rotor.
- Bromine Compounds Ltd., a company within Israel Chemicals Group and part of ICL Industries Products (BeerSheva, Israel) and Sustainable Innovations, LLC, (East Hartford, CT): Hydrogen Bromine Regenerative Fuel Cells for Smart Grid Energy Storage and Renewables
- Pythagoras Solar Ltd. (Petach Tikva, Israel) and BISEM Inc., (Sacramento, CA): Unitized UL Certified BIPV Glazing System

3. IEA Implementation Agreements (IAS)

The Chief Scientist Office works closely with the International Energy Agency - IEA, an independent organization within the OECD, which includes 29 countries. The IEA works to ensure reliable, affordable and clean energy for its member countries and beyond.

This collaboration is realized by several Implementing Agreements (IAs), specifying the obligations and rights of all participating parties, intellectual property
rights, etc. As of today, there are 40 IAs, and new IAs are being formulated from time to time. Israel is a member in six Implementing Agreements: PVPS, Solar Paces, HIA, AFC, AMF and HTS, and is in the process of joining Wind and EBC.¹

4. IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organization that supports countries in their transition to sustainable energy. It serves as the principal platform for international cooperation, as well as a repository for policies, technologies, resources and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including biomass, geothermal, hydropower, ocean, solar and wind energy in the pursuit of development, energy access, energy security and low-carbon economic growth and prosperity.

The Chief Scientist is Israel’s representative in IRENA and promotes ongoing cooperation with this organization.

5. European Union Research Programs

The Ministry of National Infrastructure, Energy and Water Resources sees great importance in cooperating on R&D programs carried out by the European Union. The Ministry encourages Israeli researchers to submit research proposals in the energy field to the various programs implemented by the Union, as well as fosters partnerships that will include Israeli academic institutes and industrial companies.

Solar ERA.NET, JPI and Horizon 2020 for example are R&D programs, in which Israeli researchers and companies collaborate with their European counterparts. In addition, the Chief Scientist encourages collaboration with the EU Joint Research Centre (JRC).

6. Bi-National Cooperation

- The Chief Scientist promotes bi-national cooperation with numerous countries such as France, Germany, Italy, Canada and others. By signing bilateral agreements (MOUs) between governments, the Ministry encourages formation of joint R&D projects, exchange of knowledge and know-how related to policy and regulation. This encourages trade and business development.

- The Chief Scientist hosts delegations coming to Israel to explore and be introduced to local companies and academic institutes.

1. Academia
The Ministry of National Infrastructure, Energy and Water Resources has set a goal to make Israel an international center of excellence in the fields of renewable energy, alternative fuels and energy efficiency. To achieve this goal, the CSO supports endeavors contributing to the development of human resources with scientific capabilities, know-how and expertise.

- **Scholarships**
The program started in 2011, and so far has granted 77 scholarships totalling 7.2 million Israeli Shekels (ILS).

- **Academic Research**

  Distribution of Funds by Subject 2008-2013

  - Fuel Alternatives and Transportation Systems; 33%
  - Energy Efficiency and Conservation; 19%
  - Renewable Energy; 19%
  - Energy Storage; 16%
  - Energy General; 12%
2. The STARTERGY Fund

The Ministry set up a start-up fund (STARTERGY), to encourage entrepreneurs. The aim of the fund is to assist them in reaching the proof of concept/prototype stage, so they can raise private funding. The fund grants up to 625,000 ILS (about US $180,000), or 62.5% of a project budget.

- Between the years 2007 and 2013 the STARTERGY fund invested 29 million ILS in more than 60 projects.
- 60% of companies supported by the CSO attracted additional investments from Israel and abroad totaling 83 million ILS (about US $24 million) – more four times the Government’s investment of 18.5 million ILS (about US $5.3 million).
- 60% of the companies hold patents on their product or idea.

**Distribution of Funds by Subject 2008-2013**

- Renewable Energy: 31%
- Energy Storage: 40%
- Fuel Alternatives and Transportation Systems: 29%
3. Pilot and Demonstration Fund

The aim of this fund is to assist companies in scaling their innovative products to full production deployment. There is special emphasis on selecting projects focusing on renewable energy and oil substitute technologies in transportation. The fund grants up to 1.5 million ILS (about US $430,000), or 50% of the project budget.

- Since initiated in 2011, the Pilot and Demonstration Fund has invested 29.5 million ILS (about US $7.8 million) in 30 projects.
- 20 out of 24 projects have been completed or are in advanced stages of completion of declared project goals.
- 55% of companies supported by the CSO attracted additional investments from Israel and abroad in a total amount of 50 million ILS (about US $14.3 million).
- 50% of the companies hold patents on their product or idea.

Distribution of Funds by Subject 2008-2013
Some of the Projects Funded by STARTERGY in 2012

Solar Energy

**Company: P.V. NanoCell**

**Project: Nano copper ink, for inkjet printing of conducting lines on Photovoltaic wafers**

PV NanoCell Ltd. (PVN), is a privately-held startup company located at the south industrial zone of Migdal Haemek. Dr. Fernando De La Vega, who has more than 20 years of experience and 11 patents in the field, established it in 2009. PVN is focused on the development and manufacture of materials and technologies that will enable substantial cost reduction in the manufacturing processes of solar cells. The main concept of PVN is to develop a unique nano-ink, based on nanometric materials, for printing the conductive grid on PV wafers using Inkjet technology.

PVN is in an advanced R&D phase of developing a nano-silver ink. It has received commercial approval from several players in the industry for a first-generation, nano-silver product and is expecting to receive an approval for the second generation.

Implementation of Inkjet technology, in combination with the use of the nano-copper ink developed by PVN, will lead to a 25% price reduction for solar electricity because of manufacturing cost reduction of PV cells and increased efficiency.
**Company: SolarBead Ltd.**  
*Project: InverBead*

SolarBead Ltd. develops innovative solutions to improve performance of PV Solar Systems. More power can be generated from each module and from the whole system regardless of environmental conditions. The InverBead is the solution for new installations and DCBead is designed to serve as an upgrade solution. Both are based on a smart micro-inverter concept with SolarBead’s unique algorithm and features. The InverBead provides AC from each module directly to the grid while the DCBead provides high voltage DC directly to the system’s string inverter.

**Company: Tigi**  
*Project: Storage collector based on transparent insulation technology*

The purpose of the venture is the development of a solar water heating collector, having integral storage capability. Success of the program will enable launching of an innovative product having key advantages:

- Aesthetic and compact design. The water heating system will not require an external tank, as is common today
- Significantly higher efficiency, even in weather conditions that prevent economic use of existing technologies
- Competitive pricing

This novel solution is made possible by Transparent Insulation Honeycomb technology, which significantly increases the efficiency of the collector over other state-of-the-art technologies.

**Company: Burning Solar**  
*Project: Multi Junction Carbon Solar Cell*

Burning Solar is developing an innovative solar cell technology based on Carbon that will achieve record high energy conversion efficiency at very low cost. The company began operation in March 2010 and is funded by the Israel Electric Company (IEC) under its “KaRaT Innovation Center” program.

Burning Solar is developing a single unique Carbon-based structure, which enables building a wide-spectrum multi-junction with very high conversion efficiency (goal is to reach >25%). The raw material is inexpensive, abundant, and environmentally friendly (non-toxic). The process is based on the principles of nanotechnology and a variable carbon element structure.
Smart Grid and Energy Efficiency

Company: Greenlet Technologies
Project: Multi-phase controller for load management in smart grids

The project’s goal is to develop a multi-phase power controller and meter, for power savings and demand-side management. The controller supports multi-phase power systems, particularly 3-phase power for the Israeli market and two-phase system for the U.S. market, per NEMA-10-30 and NEMA-14-30 U.S. standards. The unit is a controller and a meter, which is remotely controlled from the system operator’s control center. The controller is plug-and-play, i.e. it is easily installed by non-professional customers (quick self-deployment).
Some of the Projects Funded by STARTERGY in 2013

Smart Grid and Energy Efficiency

**Company: M. G. Lightning**  
**Project: Photovoltaic production and prediction system**

The Company develops a prediction and optimization system that maximizes electricity production of PV installations. The system suggests design changes to a specific PV system and enables building a prediction model for each photo-voltaic system based on weather prediction, actual weather data and historical results of production. The system enables prediction of production 24 hours ahead of time with no requirement for expensive hardware or satellite photographs, thereby enabling optimization and smart grid interactivity to small PV system owners.

**Company: Power Sense Wireless**  
**Project: SmartEnergy sensors for enterprise**

SmartEnergy sensors enable the automatic shutdown of electrically-powered devices when people are not present, for the purpose of energy savings. Using SmartEnergy is transparent to the users.

The technology can also be used to automatically turn on electrically powered devices, when people are within proximity, and thereby improving user experience and satisfaction.

The solution is aimed to be installed in industrial structures and businesses, but it can also be used in private homes with some modifications.
Company: Vectored Photonix  
Project: A “SMART” high-efficiency lighting fixture

Twenty percent of global electricity generation is used for lighting. Being the single largest consumer, and a wasteful one at that, lighting presents the ideal industry to benefit from increased energy efficiency. Successful development of the “SMART” Digital Lighting Fixture (DLF), promises to increase luminaire efficiency many times over, leading to a significant reduction in carbon emissions, while at the same time providing superior quality of lighting. The “SMART” digital illumination technology is based on solid-state LED light sources, microprocessor control and computer imaging. Due to the DLFs high photometric efficiency, coupled with controllability of where and when light is delivered, it offers higher quality illumination at lower overall cost of ownership. Based on U.S. patent 8,100,552 from January 2012, Digital Illumination’s platform technology can be used for lighting homes, offices and streets, as well as for automotive headlights. The lighting market is estimated at $75 billion per year globally, with the $8 billion U.S. market targeted as the niche with the greatest potential benefit from smart technology. Penetration is conservatively estimated to reach $20 million in sales after 5 years.
Some of the Projects Funded by STARTERGY in 2014

Smart Grid and Energy Efficiency

**Company: EnVerid Systems**
**Project: Development of innovative materials for reduction of energy consumption in AC systems**

EnVerid Systems (EVS) has developed a revolutionary, patented approach to indoor air treatment, allowing a reduction of 80% -90% of the volume of outside air needed for replacement. Conditioning outside air requires energy, to bring it to the desirable temperature and humidity for indoor use. Therefore, EnVerid's approach of treating and reusing indoor air instead of conditioning outside air, reduces the energy consumption of HVAC systems. At peak cooling loads the savings have been shown to be as high as 50%.
Transport Systems and Fuel Alternatives

Company: Designer Energy

Project: Developing an enzymatic complex preparation for producing second-generation biofuels from paper waste

The global dependence on fossil fuels together with adverse effects of local and global air pollution have increased the demand for alternative and sustainable liquid transportation fuels. Producing first generation bioethanol is not practical in Israel, as water and land are limited. However, there is an increasing need for production of second-generation green fuels from municipal, industrial and agricultural solid wastes.

Producing biofuels from biomass involves 3 main processes: Chemical or physicochemical pretreatment, hydrolysis of the biomass into fermentable sugars by cellulolytic enzymes or bacteria and fermenting the sugars into ethanol. Production of the enzymatic complex in the lab enables biomass hydrolysis using the non-viable bacteria cell as a microcarrier. This new method has three main advantages: 1) Preserves the enzymatic activity for longer periods, 2) Enables hydrolysis at high biomass loadings 3) Recycles the enzymatic complex efficiently. In addition to the production of the major enzymatic complex, the addition of exogenous enzymes is being tested. These enzymes will be produced using efficient expression setups like HCDC (High Cell Density Cultivation). The fermentable sugars produced from the depolymerization of the biomass will be used for producing ethanol.

Prior to its current project, the company developed a pilot plant of second-generation biofuel production from municipal waste using Accelerated Bacterial Hydrolysis (ABH) technology, funded by the Pilot and Demonstration Fund in 2012.
Company: F-Sys Research & Development
Project: Spin-stroke engine

F-Sys Research & Development is developing a mechanical demonstrator for the SpinStroke engine. Based on a combination of technological principles derived from both piston and Wankel rotary engines, the innovative SpinStroke engine has several key features:

1. **High efficiency** - improvement of up to 25% versus existing engines.
2. **Multi-fuel (“flex”) engine** - designed to burn multiple types of fuels in its operation, without the need for special adjustments (LPG, ethanol - E85, bio-diesel).
3. **Structural simplicity** - the engine structure is expected to reduce up to 50% of the internal parts (compared to classic piston engines).
4. **Low Weight** - expected improvement of 40% in engine weight. This element will improve vehicle energy efficiency (in addition to improving engine efficiency).
5. **Small physical dimensions** - the physical dimensions of the engine will be smaller by up to 50% of equivalent combustion engines. This element will allow further reduction in vehicle weight and additional improvement in energy efficiency.

These features will allow the SpinStroke engine to fit into existing vehicles without the need for carrying out structural changes in the vehicle. In the long term the SpinStroke engine could be integrated into electric vehicles as a range extender.
**Company: Tour Engine**

**Project:** An ultra-efficient split-cycled engine fueled by natural gas and diesel

Natural Gas (NG) engines are not only less polluting, they are also a step toward becoming oil independent for countries with large reservoirs of NG (such as the United States and Canada). Israel has clearly similar interests due to its recently-found NG reserves. Development of an ultra-efficient internal combustion engine will assist in paving the way to increase the use of natural gas as an alternative to fossil fuels.

The TourEngine™ Split-Cycle Solution is a patented opposed-cylinder, split-cycle combustion engine with the potential for substantial efficiency gain as a result of its superior thermal management. In the TourEngine™ design, the two cold strokes, Intake and Compression, occur in one cylinder that remains relatively cold. The hot strokes, Combustion and Exhaust, on the other hand, occur in a separate, adjacent cylinder that is both higher in temperature on a continuous basis, and larger in volume.
Some of the Pilot and Demonstration Projects Funded in 2012

Transport Systems and Fuel Alternatives

Company: Phinergy
Project: Aluminum-air energy system for electric vehicles

Phinergy is a leading developer of CO$_2$-free, ultra-capacity, metal-air batteries. Its core activity focuses on the development of aluminum-air and zinc-air energy systems and their critical components. The company provides a very efficient solution to the Electric Vehicle’s (EV) critical issue of autonomy. Thanks to its breakthrough technology, the company has developed a range-extender allowing the common driver to drive an EV in the same driving profile as a traditional gasoline-fueled vehicle without emitting CO$_2$.

Phinergy’s aluminum-air energy system has significant advantages over state-of-the-art batteries, such as superior specific energy (the amount of energy stored per unit weight), short refueling time, long life with no significant degradation in performance, reduced cost and fully recyclable materials.
Wind Energy

Company: Winflex
Project: Development and testing of flexible rotor wind turbines

Winflex flexible-rotor light-weight wind turbine technology allows use of wind energy as a viable, cost-effective alternative to fossil fuel energy sources for a wide range of power needs. Winflex more than doubles the system’s cost effectiveness and brings safety to a level not yet achieved by existing wind turbine technologies. The company successfully built and tested a 132 kW pilot unit.

Solar Energy

Company: Sunboost
Project: Pilot plant for the demonstration of optical boosters in front of PV modules

The Sunboost installation comprises optical boosting using proprietary static, glass or plastic add-on panels that are set in the gaps between rows at opposite tilt to the PV panel row to redirect the light insulating the gaps onto the adjacent PV modules. These boosters provide balanced boosting at angles higher than 120 degrees between booster and module, thereby mitigating non-uniform boosting issues, compared to specular or diffusive reflectors that were considered in the past.

The system can be incorporated in new installations or retrofitted in existing installations, such as commercial flat rooftop installations. It may also be used to compensate for systems aging in older power plants.
Company: Alfa Sustainable Projects  
Project: Solar Decathlon China 2013 - Team Israel

Solar Decathlon is an international competition of leading academic institutions and industry to design, build and operate a Net Zero Energy Building. The Israeli Team is a joint venture of Shenkar College of Engineering and Design, College of Management Academic Studies (COMAS), Tel Aviv University, and Neri Bloomfield School of Design, reinforced by some of the leading manufacturing and consulting firms in Israel. This joint effort is Israel’s most advanced attempt to implement such a concept. The team has developed a prototype of an 80 sq.m. residential home, which integrates some innovative Israeli Cleantech products to achieve a super energy efficient building, which will produce more energy that it consumes.

Company: Matalon  
Project: Photo-voltaic facility with tracking and concentrated sunlight.

Matalon’s project combines two systems designed to improve PhotoVoltaic power plant efficiency. The first system concentrates sunlight onto photovoltaic cells arranged in a panel, in a simple, yet effective way that does not require cooling the cells, and uses moderate concentration.

The second system is a tracker, based on solar cells, that requires no use of battery or micro-processor, but generates its power. These combined methods of tracker and moderate CPV panel can generate higher energy output at lower costs.

Company: Solaris Synergy  
Project: 50 kWp demonstration plant for solar electricity generation, based on a novel floating CPV technology

Solaris Synergy has developed a new solar energy technology, using a low-cost concentrating photovoltaic (CPV) concept designed to float on water surfaces, utilizing inexpensive, easy-to-manufacture platforms, based on a unique, patent-pending cooling technology. This technology has two key advantages:
• Significant reduction of the installed cost of the system compared to existing systems;
• Secondary use of “industrial” water surfaces, freeing up valuable land resources, while simultaneously preserving water quantity and quality by reducing evaporation and inhibiting algae growth.

Waste to Energy

**Company: EB Clean Energy**

**Project: Demonstration of production of biocoal from municipal solid waste, as a replacement of coal, for generation of green electricity in coal-fired power stations**

E.B. Clean Energy (EBC) has developed a novel technology for the conversion of any biomass into biocoal. Biocoal has a number of advantages over biomass: logistics, operation, safety and cost-effectiveness. EBC’s pilot plant currently produces biocoal at a rate of one ton per hour. EBC has shown that it can produce biocoal from municipal solid waste (MSW) by torrefaction, and that this biocoal is also suitable for co-firing in coal-fired boilers.

**Company: Emefcy**

**Project: Virtually zero energy consumption treating wastewater with SABRE (spiral aerobic bio-reactor) technology**

Wastewater treatment is an energy intensive process, consuming 2% of global energy production. Emefcy has developed a technology to reduce the power consumption of biological wastewater treatment by more than 95%, or in other words – by a factor of more than 20. A product based on this technology has been labeled SABRE – Spiral Aerobic Bio-Reactor and has reached the pilot stage. Emefcy is gradually scaling up the piloting and demonstration activity in order to validate the technology for itself and for the market. In addition, Emefcy’s team has developed production capabilities for full scale products that it needs to test and optimize.
Company: HydroSpin Monitoring Solutions  
Project: Smart water network self-powered monitoring and energy saving solution

Over 13% of the electricity produced in the United States is used to operate water networks. Researchers show that these costs can be reduced significantly when online data is used to indicate pressure and flow across the water network, including at distant locations where it is currently not feasible to deploy sensors. HydroSpin has developed an in-pipe micro-energy generation system that can generate power for sensors and transmission systems that are located near the water network and can supply energy for online measurement and transmission.

Company: R-Jet Engineering  
Project: Build demo plant for clean energy 40 kw CHP (combined heat and power) turbo-generator for the distributed generation (DG) market

R-Jet is in the process of developing a combined heat and power (CHP) turbo-generator (TG) to provide power and heat for the distributed generation market.  

The advantages of the project are compelling:

- Delivers 36 kW of electricity at 35% electric efficiency and 59 kW of heat (hot water or steam) resulting in a total efficiency of 90%.
- Produces energy with low pollution levels. Projected emissions: NOX < 10 ppmv (at 15% O₂); CO < 40 ppmv (at 15% O₂).
- Includes development of a gas turbine which works with various fuels and is easily adaptable to work with solar energy, including hybrid capabilities.
- Includes development of a core engine which will be the base for larger engines (up to 175 HP).

**Transportation and Fuel Alternatives**

**Company: Delek Energy**
**Project: Compressed natural gas vehicle fueling station**

The Project’s scope includes the construction and operation of a public Compressed Natural Gas (CNG) fueling station. Supporting private vehicles, light commercial cars and light trucks, this new fueling option will encourage the use of bi-fuel natural gas (NG) vehicles and may encourage customers to convert their cars to CNG.

**Company: NewCO₂Fuels**
**Project: Heat exchanger for Stirling engine**

NewCO₂Fuels was founded in 2011 in order to develop solar systems for CO₂ dissociation into CO and O₂. The project is based on technology developed at the Weizmann Institute from 2005-2011.

The company provides a solution for high CO₂ emitting facilities, such as power plants and cement factories. The process converts CO₂ to a fuel such as CO and O₂ or liquid fuels such as methanol, using heat and electricity. The solution uses solar energy to raise the gas temperature to about 1000°C for performing the chemical processes in a highly efficient and economically applicable way. The remaining energy needed for the gas dissociation will be provided by electricity generated from a Stirling engine driven by solar energy. In order to provide the heat required for the operation of the Stirling engine, the system will use the residual heat of the gases (CO and O₂) exiting the dissociation cells. The heat transfer process to the Stirling engine requires a unique heat exchanger development with very high temperature durability.

The main challenges in developing the heat exchanger lie in the need to deal with two different heat sources (two gases with different flow rates) at high temperatures, and a need for high temperature oxidation endurance.

NewCO₂Fuels previously received support from the STARTERGY fund and is now in its Pilot and Demonstration stage.
Some of the Pilot and Demonstration Projects Funded in 2014

Transport Systems and Fuel Alternatives

Company: Redler Computers Ltd.
Project: Advanced EV power-train controller

Redler Computers Ltd. has been developing embedded systems based on Digital Signal Processor (DSP) and Field-Programmable Gate Array (FPGA) for many years.

During recent years, the company has developed a unique technology for military use, called Multi-Axis Motor Controller (MAMC), which enables small rockets and smart munitions to operate using Lithium batteries. By using a proper Pulse-Width Modulation (PWM) synchronization, the battery may supply DC current to the motors.

Since the power-train systems of cars produce a large amount of ripple current, the company is developing a demonstrator to prove how PWM technology can be used to reduce this ripple current to a minimum and improve the efficiency of the electric motor.
**Company: Dor Chemicals**  
*Project: Motor vehicle field trial run using a mixture containing 85% gasoline and 15% methanol - M15*

Dor Chemicals has been working with methanol over the past forty years, and intends to outline a practical way to use methanol gasoline fuel blends in Spark Ignition Engines. The use of methanol is consistent with the government’s policy to find alternative transportation fuels in order to reduce Israel’s dependence on imported oil products.

Under the supervision of a governmental steering committee, a pilot is being carried out by Dor Chemicals in order to fully characterize the effect of using M15, required for use and standardization in Israel as a motor fuel. The pilot includes 10 vehicles operating on M15 and 3 control vehicles running on standard 95 octane gasoline, each accumulating 100,000 km. The trial examines the vehicles’ mechanical systems, as well as the fueling infrastructure (fuel tankers, underground fuel-tanks, the piping and the fuel dispensers). Laboratory tests of the fuel stability, engine performance on test-bench, road tests, vehicle performance and vehicle-generated emissions were also conducted.

**Company: TransBiodiesel**  
*Project: Enzymatic conversion of recycled oil and fat trap to biodiesel for transportation using a new enzymatic process*

TransBiodiesel has developed and patented an economically-viable and environmentally-friendly biocatalyst for the mass production of biodiesel from multiple feedstocks. The company has also developed its standard continuous enzymatic biodiesel production process to meet high production rates, cost-effectiveness and international specs for biodiesel. TransBiodiesel is the first company to provide a solution that meets the requirements of government mandates, opens up production to new sources of second-generation feedstocks, and significantly lowers the cost of production. The company is making its technology available worldwide. The largest commercial plant produces 32,000 tons of EN-spec biodiesel per year using low-quality waste feedstocks (FFAs > 50%). Furthermore, TransBiodiesel has developed engineering concepts for industrially viable mobile units that can produce biodiesel in remote areas.
**Company: Engineuity**  
*Project: Production of diesel (Syngas) from natural gas ($\text{CH}_4$) and $\text{CO}_2$*

Engineuity is developing an innovative process to produce standard diesel fuel from natural gas and carbon dioxide. This is a considerably less expensive alternative to production of diesel fuel from crude oil. The program objectives are to demonstrate a novel process to produce a synthetic diesel fuel with less than 15 ppm of sulfur, by operating an innovative prototype reactor producing 100 kg/h of syngas. The process is more modular, more efficient and less expensive than existing methods.

![Syngas reactor scheme](image)

**Company: Elbit Energy**  
*Project: Super capacitor production line*

Elbit Energy developed a state-of-the-art, high power, aqueous supercapacitor, based on a flexible, modular approach with customizable characteristics and dimensions, tailor-made to meet the specific requirements of high-voltage, high-power applications. It is a cost-effective, “green” technology with a unique electrode preparation process and an advanced ruggedized mechanical structure, resulting in highly-effective capacity, extended lifecycle, rapid response time, reliable performance unaffected by temperature extremes, and unique environmental capabilities.
Company: Battery Switchy  
Project: Charging and vending systems for electric scooter batteries

The vision of this project is the creation of a network of compact, automated vending machines that can easily be installed in urban locations, without any special infrastructure, serving as switching stations for electric scooter users to easily exchange an empty battery for a full one.

Solar Energy  
Company: Heliofocus  
Project: Connecting solar steam to Ramat Hovav turbine 1MW

The project is to connect solar steam to Ramat Hovav turbine in an amount that will generate 1MW of electricity. The technology is called HelioBooster™. It provides high-temperature steam (for maximal efficiency) to boost existing power plant production. This unique technology injects steam directly into the turbine of the high-temperature power plant, thereby allowing compensation for the common decrease in efficiency during peak hours (which are also the hottest hours), or alternatively, raising the production capacity of the station.

This project’s scope of 1MW of electricity, when connected to the station, is designed to increase the capacity of the station at peak hours when there is a decrease in turbine efficiency.
Smart Grid and Energy Efficiency

**Company: Green Power Management**

**Project: Smart grid server**

This project aims at developing a technology and a series of products that will allow the power company to automatically and remotely manage customers’ electricity usage, instead of having to send specific requests to them. Tariff for time of use is not common among domestic consumers, although they consume a third of the nation’s electrical energy. There is a lack of simple tools available to command and control the domestic load. Industrial and commercial consumers, however, usually have control systems (SCADA), through which they monitor electrical systems such as air conditioning. These control systems are costly, require installation and maintenance, and therefore are not suitable for the domestic consumer.

Green Power Management previously received support from the STARTERGY Fund and is now in the Pilot and Demonstration stage. Green Power Management is a subsidiary of Loginet Systems.
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