

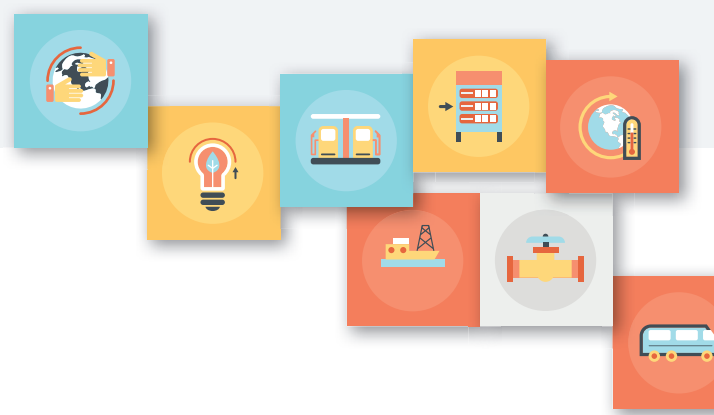


Research and Development 2014-2016

The Chief Scientist Office
Ministry of National Infrastructure,
Energy and Water Resources



January 2017



Foreword by the Minister of National Infrastructure, Energy and Water

The Ministry of National Infrastructure, Energy and Water Resources is responsible for the supply and management of the four basic needs in our lives:

- Electricity
- Gas
- Fuel
- Water

The Ministry is also responsible for the supply and management of Israel's natural resources. Given that energy, water and natural resources play a pivotal role in our social and economic development, we constantly invest in research and development in these fields to ensure a safe, sustainable and environmentally friendly future. This also strengthens Israel's energy security, enhances its role as a technological leader, and establishes Israel as a key player in the global energy technology market.

The Ministry's Chief Scientist Office supports innovative Israeli technologies and new approaches in diverse fields:

- Clean renewable energy to strengthen Israel's energy security
- Alternative fuels from the natural gas fields discovered in the Mediterranean
- Energy conservation and efficient use of our resources
- Water related technologies
- Smart electricity grid and a modern electricity market

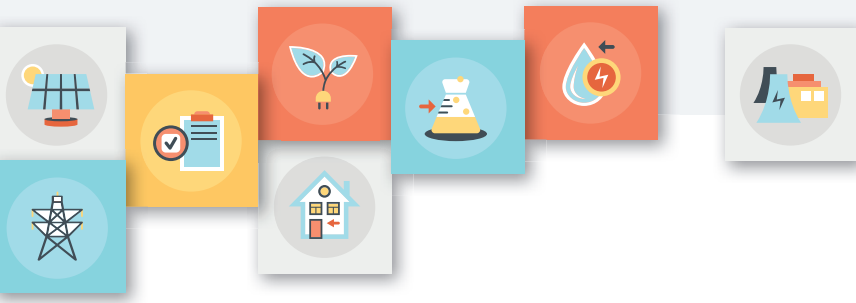
The Ministry's Chief Scientist Office offers targeted support programs to scientists in academia and to startup companies in order to promote and preserve local knowledge and expertise through several types of grants and scholarships. The Chief Scientist is responsible for our international scientific collaboration.

I am proud to present to you a glimpse of the wide-ranging activities at the Chief Scientist Office in this booklet.

A handwritten signature in black ink, appearing to read 'Y. S.'.

Dr. Yuval Steinitz

Ministry of National Infrastructure,
Energy and Water Resources



Foreword by the CEO

National energy resources, infrastructure and water are the main areas our ministry is entrusted with. Within these areas, policy encompasses the production, distribution and use of energy, aiming to reconcile security of supply, competitiveness and ecological sustainability. As energy plays an invaluable role in social and economic development, we strive to constantly be at the frontiers of knowledge and to lead Israel's energy market to be based on cutting edge technologies. This will ensure a safe, sustainable, stable and abundant supply of energy for Israeli citizens.

Within the Ministry, the Chief Scientist Office supports Israeli innovative solutions, connecting academia, industries and technologies in diversified fields:

- Clean renewable energy: solar, wind, biomass and others, as climate friendly resources to increase Israel's energy security.
- Development of clean and efficient fuel and next-generation transport, to reduce Israel's dependence on petroleum.
- Development of methods for energy conservation and efficient use of natural resources. Smart grids technologies for intelligent, flexible and more reliable electricity networks.

Knowledge and research will strengthen Israel's energy security, enhance the role of Israel as a start-up nation, and place Israel as a key player at the global energy market. The Chief Scientist Office supports academia and startup companies, preserving local knowledge and expertise via grants and scholarships as well as establishing international collaboration.

These efforts will allow the ministry to realize its goals in the energy, water and infrastructure fields, to meet the objectives of securing energy supply for modern intensive life, at an optimal economic, social and environmental cost.

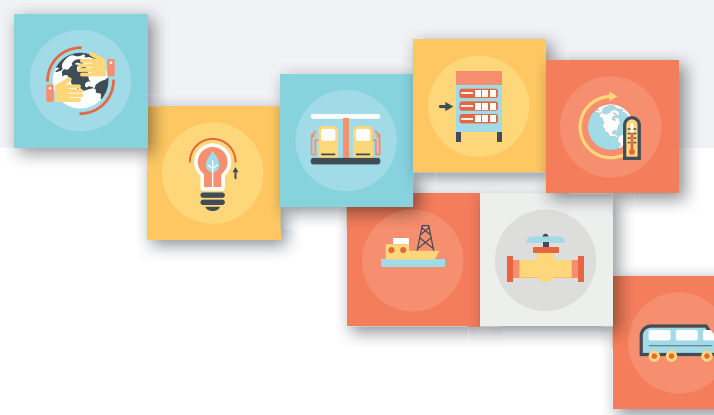
This booklet outlines few of the Chief Scientist Offices' activities we find proud in.

A stylized, handwritten signature in black ink, consisting of a series of loops and a final upward stroke.

Shaul Meridor

Director General

Ministry of National Infrastructure,
Energy and Water Resources



Foreword by the Chief Scientist

I am excited to share with you the highlights of the Chief Scientist Office (CSO) activities at the Ministry of National Infrastructure, Energy and Water Resources. Our goal in producing this booklet is simple: we believe in what we do and we want you to be a part of that.

The Ministry's vision is to lead and carry out policies in the energy and natural resources sectors, to ensure the supply of energy and water needs in routine times and in times of emergency, and the development of natural resources in Israel, in order to improve the public's quality of life and sustainable economic growth.

The CSO plays a central role in fulfilling this vision, primarily by encouraging entrepreneurship and innovation, but also by providing the knowledge required to develop a long term strategy in all areas of our Ministerial responsibilities.

To achieve this, the CSO supports a wide range of R&D activities in academia and industry, and promotes international networking, technology transfer and R&D collaborations. Judging by the criteria of international good practice, the CSO achievements are impressive. Our success can be attributed to the excellent, professional and dedicated team we have and to the creative minds in Israeli academia and industry.

A great deal of time and effort has gone into arranging the information in this booklet in a readily accessible manner, highlighting our activities as well as the innovative ideas and achievements of Israel's talented entrepreneurs at the heart of Israel's growth and its worldwide reputation as the "start-up" nation.

For the complete portfolio of R&D projects we have supported over the years, and for more extensive information about our activities, visit our website at: <http://energy.gov.il>.

We will continue to update this catalogue every 2 years in order to notify you of the latest innovations being pursued. We welcome any comments, questions or suggestions from our readers. Please feel free to contact me any time at: brachah@energy.gov.il.

I hope you find this booklet to be a useful and valuable tool.

Sincerely,

A handwritten signature in black ink, reading "Bracha Halaf".

Dr. Bracha Halaf
Chief Scientist (acting)
Ministry of National Infrastructures,
Energy and Water Resources

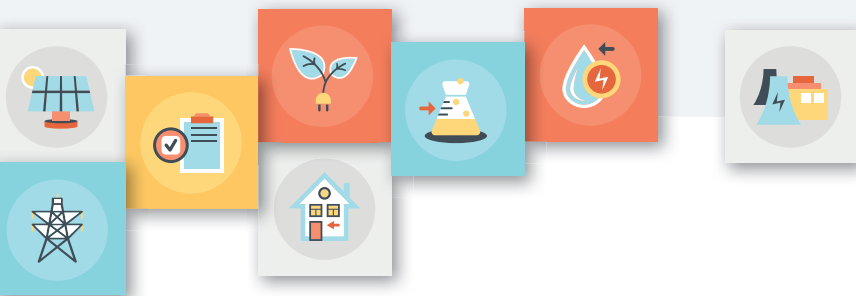
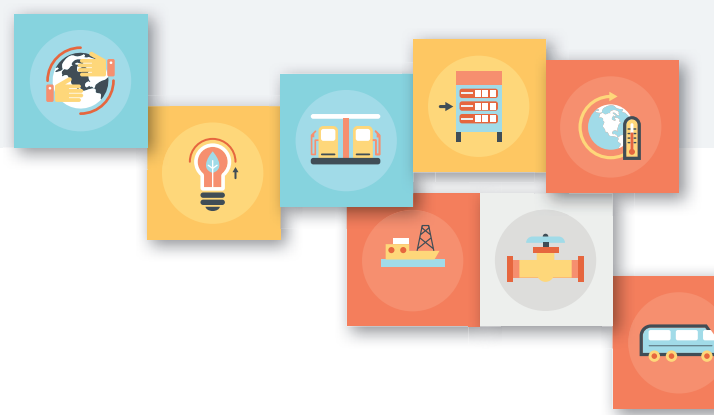
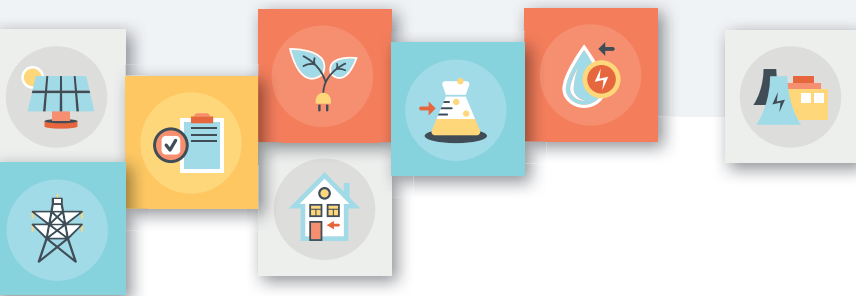


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Introduction

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, sewerage, oil and gas exploration, minerals and ores excavation. The Ministry serves as the regulator and acts to ensure an adequate supply during peacetime and in emergencies, under changing energy and infrastructure needs, today and in the future, while balancing between suppliers and consumers under economic, environmental and social constraints.

In order to meet its objectives and allow the country to realize its energy and infrastructure goals, the Ministry encourages R&D in renewable energy sources, alternative fuels, smart grids and water treatment using innovative and efficient technologies.

Vision

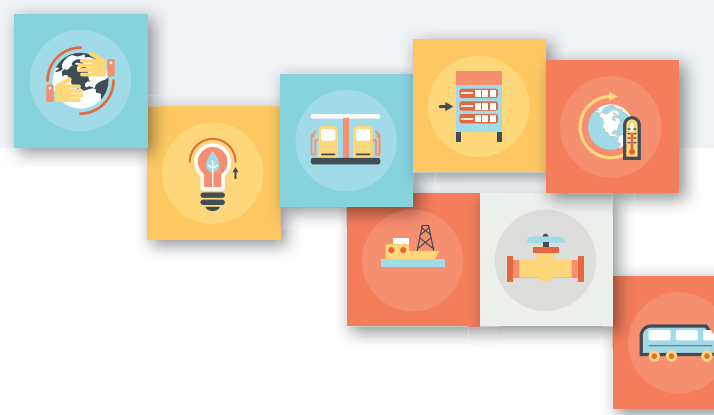
The Chief Scientist Office serves as a knowledge center for the Ministry and the market in the area of energy and natural resources. The Office encourages innovation and entrepreneurship in these areas. We will lead the Government to embrace a broad and long-term vision by developing programs and projects that serve as the basis for an evidence-based policy.

Goals

- To provide a comprehensive knowledge base for the energy and natural resources markets, with emphasis on the long-term vision.
- To encourage innovation and entrepreneurship, and to prepare the market for future challenges.
- To initiate and lead policy.

Current Interests

- Leveraging the natural gas discoveries to strengthen the Israeli economy, and seizing the opportunity to develop new local knowledge and expertise.
- Leveraging the Paris Agreement to transform the Israeli energy market into a low carbon and energy-efficient economy, and mitigating the impact of energy facilities.
- Promoting renewable energy, and non-fossil energy subject to economic viability constraints (such as the low price of oil and gas) by harnessing technology.
- Smart energy: automated management of energy systems and the electricity grid.



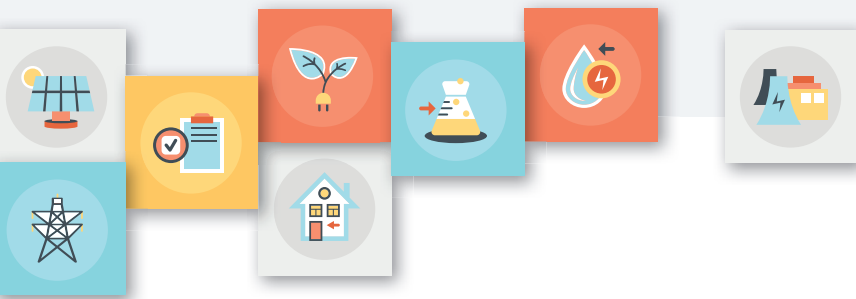
Main Activities

- We give evidence-based scientific and technical support for policy making, with emphasis on a long-term vision.
- We collect, investigate and incorporate current technical and economic information applicable to all Ministerial work.
- We promote development of industrial technology in areas of interest to the Ministry where we foresee a lack or a need.
- We promote international networking, technology transfer and R&D collaborations through direct support and participation in international forums.
- We develop the human and physical resources necessary to implement long term policy:
 - We promote R&D activities in Israeli academia and industry, thus continuously augmenting the human capital available to the State.
 - We support professional and academic training programs directly and through scholarships, in areas needed today and in the future.
 - We promote local knowledge centers, where original technologies are devised and developed, to address Israel's needs today and in the years to come.
 - We organize and participate in conferences, workshops and professional forums.

Operation

We operate on two main levels:

- Financial support for R&D activities.
- Promotion of system-oriented subjects. We seek to collect, compile and assimilate information and regulations, and to provide techno-economic support to policy makers in the following areas:
 - Alternative Fuels
 - Smart Grid
 - Nuclear Power Plant
 - Renewable Energy
 - Continental Shelf Research Program
 - Local Content in the development of the gas discoveries offshore Israel.



Financial Support – *Singlepoint of contact for multiple development stages*

The Chief Scientist supports R&D at the various stages, from academic research to through support of pre-seed ideas, to pilot and demonstration. Recently, the Ministry also established a student scholarship program for academic institutions in Israel and abroad in order to nurture human resources in the energy professions.

- Scholarships for university students in Israel and abroad
- Academic research projects
- The STARTERGY Fund for early stage start-up companies
- Pilot and Demonstration projects funding
- Classification of projects as pilot and demonstration projects in renewable energy in order to obtain quotas, permits or tax benefits
- International R&D collaborations such as Bird Energy, JRC & Horizon 2020 and SOLAR-ERA.NET



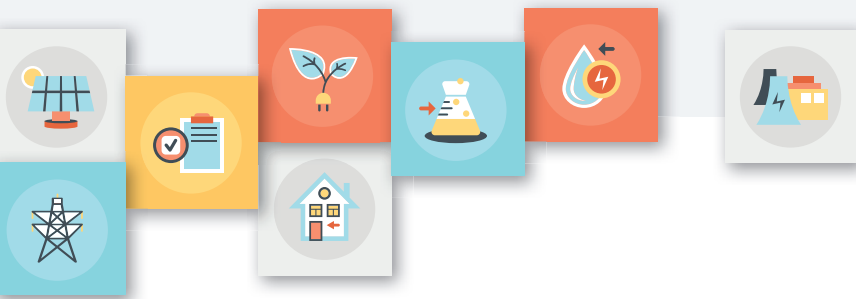
1. Alternative Fuels

The Ministry, through the Chief Scientist Office (CSO) at the Ministry of National Infrastructure, Energy and Water Resources, is a key member of the 'Fuel Choice Initiative' led by the Prime Minister's Office.

The CSO encourages entrepreneurship and innovation in the field of alternative fuels by supporting R&D in the various stages, from academic research to support of pre-seed ideas, to pilot and demonstration projects.

In the years 2012-2015, the CSO granted over NIS 50 million for 55 R&D projects in the following areas:

Area	Budget Sum	Number of projects
Fuels emissions	2,572,312	2
Advanced engines	3,161,468	5
Algae	4,471,053	8
Biochemical conversion	1,915,205	3
Biodiesel	3,000,000	2
Biomass gasification	1,150,000	2
Electric mobility	17,115,545	18
Feedstock production	172,372	1
NG fuels demonstration	8,500,000	6
Technologies: NG/ CO ₂ to fuels	7,920,286	8
Total	49,978,242	55



The CSO also endeavors to collect, investigate and incorporate current scientific, technical and economic information pertinent to alternative fuels. It does so by organizing workshops and conferences, and publishing reviews and techno-economic analyses. Examples of such recent activities include:

- CNG safety workshop: organized with the US Department of Energy, September 2015, Kfar Hamaccabiah.
- Hosting the Executive Committee of the IEA- AMF (Advanced Motor Fuels) Implementing Agreement, October 2015, Jerusalem, Israel
- International Review: Mobile Fueling at CNG ‘Daughter’ Stations: Rules & Regulations on Safety & Distances, December 2015
- International Review: Biomass to Energy - International R&D Challenges, January 2016
- Integration of Natural Gas based Alternative Fuels in Israel Transport sector, Economic Model and Complementary Qualitative Analysis, 2013
- Integration of Waste to Transportation Fuels, Economic Model and Complementary Qualitative Analysis, February 2014
- Electric and Hybrid Vehicles: Techno-Economic Analysis, March 2014.

The CSO, together with the Fuel and Gas Administration, promotes new standards for alternative fuels, such as the Gasoline-Ethanol/Methanol blends and CNG.

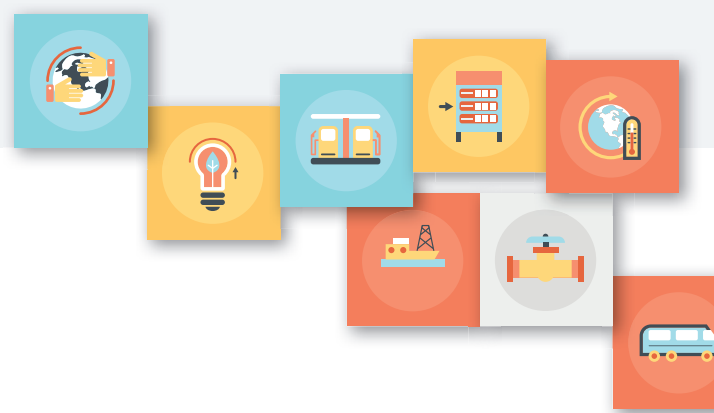
For more information about our activities,
visit our website at: www.energy.gov.il

2. 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, where any end point on the grid can be both a producer and a consumer (hence the term "prosumer").

The operational goals of the smart grid are reliability, survivability, efficiency, security, resilience, improving asset utilization, and operational efficiency.

All this under the conditions of ultra-distributed generation from renewable sources, local co-generation (combined heat and power), electric cars (both battery and hydrogen based) and traditional large power plants.



The technical challenges are substantial, both in the physical world of electricity (such as storage, response to frequent changes in production) and in the information and management world (such as how to transmit, collect and analyse the information, and how to control the various prosumers). However several trends have emerged in recent years. Two-way smart metering and demand response, for example, are becoming a reality. The 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, the part that manages ultra-distributed generation still lags 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, and to help development in this field. A three-year academic research in this area, including consumer behavior, was funded, starting in 2015. In addition, support was provided for a first Microgrid implementation in Israel, and further projects are planned for later in 2016.

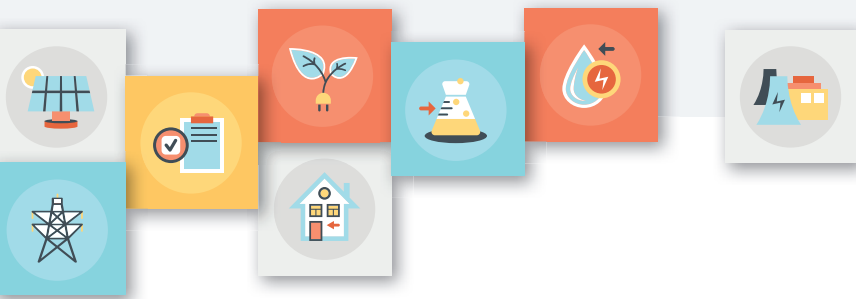
3. Nuclear Power Plant (NPP)

The NPP Administration was established in 2013 within the Ministry's CSO to advance nuclear energy as an alternative energy source. The Administration's primary mission is to advance nuclear power as a resource capable of meeting Israel's energy and environmental needs by addressing and resolving special infrastructure and regulations issues through R&D.

The Administration therefore funds and monitors a whole range of R&D activities, in order to build on the existing knowledge base, and to ensure superior capabilities in the future. These activities focus on a broad spectrum of nuclear fields encompassing advanced reactors, reactor fuel types, advanced materials, waste management and specific safety and security issues. Two flagship projects currently ongoing are:

- A nuclear experimental facility (as part of international collaboration) kicked off in October 2015.
- A thermo-hydraulic laboratory. The preliminary characterization stage would be finalized by the end of 2016.

The Administration actively pursues international cooperation with a view to improving and enhancing our knowledge in the various nuclear disciplines, and with a view to bringing Israeli nuclear criteria and regulations into line with international standards.



- Collaboration with the International Atomic Energy Agency, IAEA: "Writing updated siting criteria and a guideline document for NPPs" (IAEA TC project for 2016-17). An international workshop on NPP Siting Criteria, together with IAEA's experts took place in Tel Aviv in July 2016.

The Administration works closely with experts from universities, industries, national institutes and other Ministries to promote public acceptance of nuclear power as a sustainable energy source, by organizing special workshops. These provide an opportunity for the public and other stakeholders to engage in informal discussions with the Administration and other parties:

- The Second Workshop on "Nuclear-Specific Technical Issues", Ben Gurion University, November 2015.
- The First Workshop on "Energy and Environmental Compliance", Eilat-Eilat Conference, December 2014.

4. Renewable Energy

In September 2015, the Government set a target of 17% of electricity generation from renewable sources by 2030, along with 17% energy efficiency improvements. The Chief Scientist firmly believes that the need to integrate renewable energy (RE) is based on strong rational foundations (in order of importance), as follows:

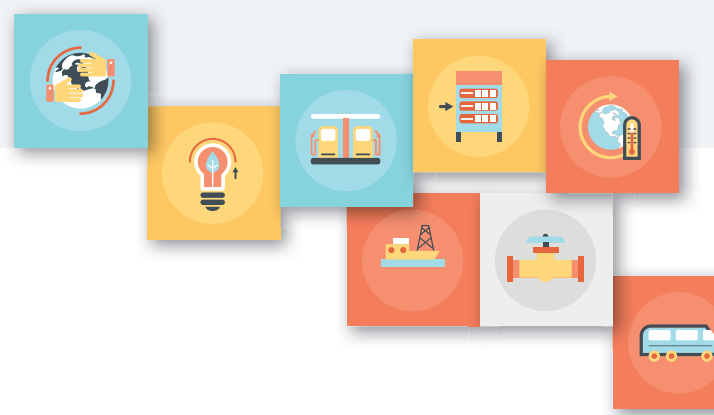
- Increased energy security due to the diversification and decentralization of the sources for generating power
- Reduction in emissions
- Electricity at maintenance costs at the end of the project period (20-25 years)
- Development of the Israeli industry
- Price stability, since the prices are capped at the project set up.

In addition to direct support for companies and research in this field, the Chief Scientist is devoting efforts to rationalize pricing, and to a policy of integrating renewables throughout Government authorities to maximize the contribution of renewable energy to electricity generation. Prioritized research topics in this area include:

- Storage Technologies
- Increased solar conversion efficiency
- Technologies for minimizing harm caused by wind turbines to birds and bats

A close relationship exists between RE and the smart grid, needed to optimize the use of RE.

A revamping of the pilot and demonstration quotas program is underway to facilitate

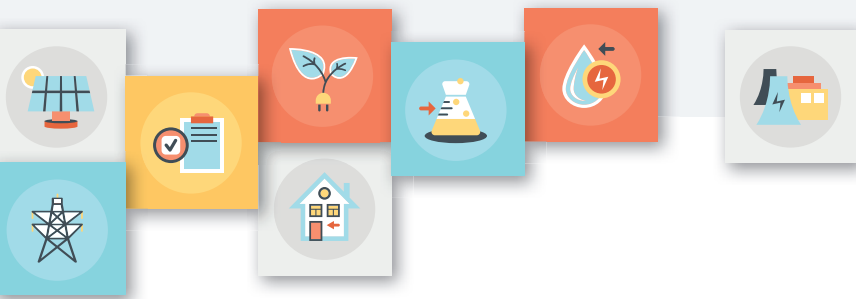


commercialization of innovative Israeli RE technology by integrating it in the grid, which will make it easier to implement a pilot RE project.

5. Continental Shelf Research Program

Given that the availability of land resources for infrastructure on Israel's seashores is decreasing rapidly, the construction of national infrastructures such as desalination plants, onshore facilities connected to the natural gas reservoirs, power plants and ports is becoming ever more difficult. Moreover, public opinion generally opposes ongoing development of the seashore. The Continental Shelf Research Program was initiated in order to study explore the environmental impact of constructing infrastructure on offshore structures, such as artificial islands. With a forward looking agenda, the program set out to explore the environmental and other implications of such construction on marine dynamics. Conducted by the Earth and Marine Sciences Administration, the program was designed to provide decision makers with a practical toolset for evaluating these offshore structures. The research includes the following tasks:

- High resolution mapping of the sub-seafloor (to a depth of 100m), to determine the availability of sediments for the construction of artificial islands
- Characterization of sediment dynamics
- Evaluation of coastal cliff collapse, with emphasis on sea-cliff interaction
- Continuous collection of meteomarine information: operation of two marine observation points: Hadera and Ashkelon
- Construction of oceanography models: modeling of sediment advection-diffusion mass balance model, including environmental parameters such as carbon, nitrogen, phosphorus and oxygen
- Ecological survey of the kurkar ridges (type of sandstone)
- Modeling the impact of tsunami waves on onshore and offshore infrastructure.



6. Local Content in the development of the gas discoveries offshore Israel

The world-class hydrocarbon discoveries offshore Israel and the subsequent massive investments in the development of the discoveries represents an opportunity for the Israeli economy to increase national expertise and employment by creating demand for local goods, services, and manpower (local content). Until now, despite the size and importance of the global exploration and production industry, only a handful of Israeli companies have been significantly involved in the sector. With a view to leveraging the opportunities for the local market, the Ministry has collaborated with the Ministry of Economy and engaged the consulting services of IHS. The following goals have been defined:

- Maximizing the potential overall economic benefits that can be derived from the development of an Israeli-based exploration and production industry supply chain.
- Defining opportunities for Israeli companies to serve the exploration and production sectors, both globally and locally.
- Provide the Ministries with information and recommendations to guide their efforts to maximize the potential development of local industrial capabilities.

The Ministries have appointed a consultation committee including representatives from Governmental offices such as the Ministry of Finance, the Taxes Authority, the Ministry of Environmental Protection, and the Ministry of Justice.



International R&D Collaboration

1. BIRD Foundation



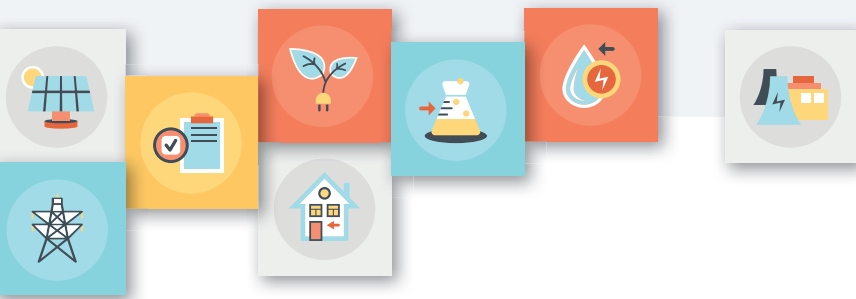
The Israel-U.S. Binational Industrial Research and Development (BIRD) Foundation has supported US-Israel innovation partnerships for almost four decades. Since its establishment in 1977, BIRD has approved more than 900 joint US-Israel projects, leading to major innovations with a considerable impact, and generating revenues of more than \$10B.

In 2009, a new program called BIRD ENERGY was initiated, sponsored and funded by the U.S. Department of Energy/ Office of Renewable Energy and Energy Efficiency (DOE/ EERE) jointly with the Israel Ministry of National Infrastructure, Energy and Water Resources (MIEW). The program has been separately funded annually by each Government to foster cooperation between US and Israeli entities on renewable energy and energy efficiency.

The first round of funding was provided by the two Governments in FY 2009. Since then, 28 collaborative projects have been initiated. Some of the joint projects and innovations funded by BIRD Energy are already realizing their commercial potential.

In December 2014, the US President signed into law the US-Israel Strategic Partnership Act. This act, together with the Israel Government Decision of January 2016, extends the cooperation through BIRD ENERGY to 2024.

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



The following BIRD Energy projects were approved: November 2015

3GSOLAR Photovoltaics Ltd. (Jerusalem, Israel) and Arkema Inc.

(King of Prussia, PA)

Development of thin and flexible printed solar photovoltaics for wireless electronics

Ayyeka Technologies, Ltd. (Jerusalem, Israel) and UIS Holdings, Inc.

(Dexter, MI)

Development of smart grid to distribution enclosures: out-of-the box remote metering, efficiency analytics and performance enhancement

Haogenplast Ltd. (Kibbutz Haogen, Israel) and Global Solar Energy, Inc.

(Tucson, AZ)

Development of solar energy production over water reservoirs

Pentalum Technologies Ltd. (Rehovot, Israel) and Texas Tech University

(Lubbock, TX)

Development of a light detection and ranging (LIDAR) based wind farm controller and optimizer

Solaris-Synergy (Israel) Ltd. (Jerusalem, Israel) and Pristine Sun LLC

(San Francisco, CA)

Development of a utility scale, low-cost floating photovoltaic solar energy system for deployment on water

Yissum - The Hebrew University of Jerusalem (Jerusalem, Israel) and Applied Biomathematics, Inc. (Setauket, NY)

Collaboration on technology to protect birds and bats near wind energy facilities

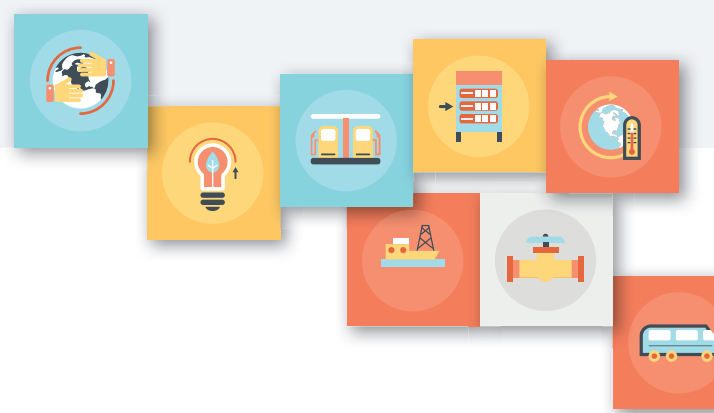
November 2014

Advanced MemTech (Ness Ziona, Israel) and Arkema (King of Prussia, PA)

Development of a carbon nanotube composite membrane that is electrically conductive

Aquanos (Shoshanat HaAmakin, Israel) and Aquagen ISI (South Yarmouth, MA)

Development and commercialization of an algae-activated aerobic wastewater treatment technology



NewCO2Fuels (Rehovot, Israel) and Acumentrics (Westwood, MA)

Development of enhanced performance solid oxide fuel cells for dual application

Silentium (Rehovot, Israel) and GE Energy (Houston, TX)

Development of active noise control for power generation ventilation

TIGI (Petah Tikva, Israel) and Free Hot Water (San Jose, CA)

Development of a Solar Thermal Heating System for US Dairy Farms

Fridenson Logistics (Haifa, Israel) and ChargePoint (Campbell, CA)

Development of a smart grid capable, cloud-connected electric vehicle charging station

2. IEA Implementing Agreements:



PVPS, Solar Paces, HIA, AFC, AMF, and HTS

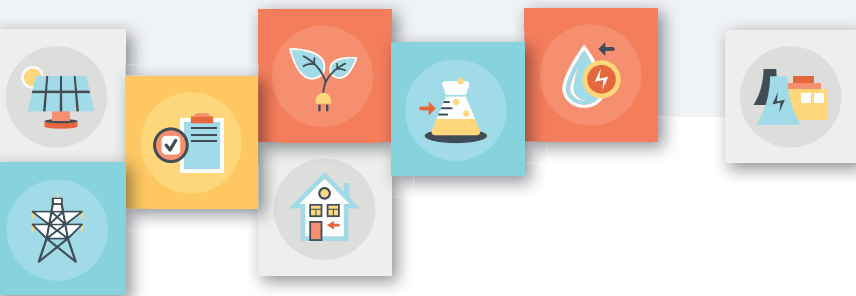
The Chief Scientist Office (CSO) works closely with the International Energy Agency -(IEA), an independent organization within the OECD that has 29 member states. The IEA works to ensure reliable, affordable and clean energy for its member states and beyond. Israel is a member of the OECD and participates in the IEA Technology Collaboration Programs, organized under the auspices of Implementing Agreements.

Israel's participation in such international forums plays an important role in promoting R&D, information sharing and networking with some of the world's leading countries, while:

- Sharing the use of resources.
- Coordinating technical standards.
- Strengthening relationships between researchers from different countries.
- Accelerating the development, application and spread of information.
- Achieving an international consensus on relevant technical issues.
- Identifying industrial markets and increasing export.

IEA Implementing Agreements constitute a platform for developing research cooperation, economic collaboration, and a scientific and technological front in the various energy fields among the participating countries. Implementation of the agreement allows state institutions, including different stakeholders, to participate in international R&D activities targeted by the agreement. The agreements bridge R&D, market needs and existing gaps, and form the basis for growth and development of each of the energy technologies.

Today, there are 40 Implementing Agreements (AI), and new IAs are concluded from time to time. Israel is a member of six Implementing Agreements: PVPS - Photovoltaic Power Systems, Solar Paces - Solar Power and Chemical Energy Systems, HIA - Hydrogen



implementing Agreement, AFC - Advanced Fuel Cells, AMF - Advanced Motor Fuels and HTS - High Temperature Superconductivity.

3. European Union Research Programs

The Ministry of National Infrastructure, Energy and Water Resources believes in the importance of cooperation on R&D programs conducted by the European Union, and seeks to increase the awareness of researchers about the possibility of submitting energy research proposals to the EU's various programs, and to forge partnerships that include Israeli academic institutions and industrial companies.

JPI, ERA-MIN, SOLAR-ERA.NET and Horizon 2020 are examples of R&D programs where Israeli researchers and companies collaborate with European counterparts. The Chief Scientist also encourages collaboration with the **EU Joint Research Centre (JRC)**.

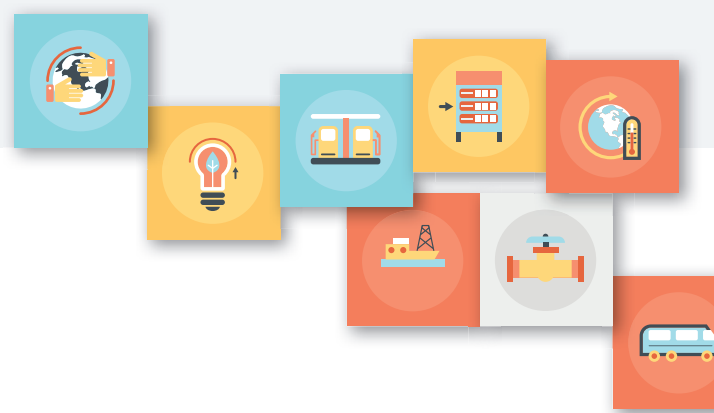
1. Water Joint Programming Initiatives (WATER JPI)

Joint Programming Initiatives are inter-governmental collaborations designed to tackle major social challenges that cannot be addressed by individual countries alone, and that contribute to the development of the European Research Area. Member States and Associated Countries participate voluntarily in joint initiatives to increase the value of relevant national and European R&D funding through joint planning, implementation and evaluation of national research programs. Launched in 2010, the Water Joint Programming Initiative for a changing world, known as the WATER JPI, tackles the ambitious challenge of achieving sustainable water systems for a sustainable economy in Europe and abroad. The WATER JPI includes 20 partner countries: Austria, Cyprus, Denmark, Estonia, Finland, France, Germany, Ireland, Israel, Italy, The Netherlands, Norway, Poland, Portugal, Romania, Spain, Turkey, United Kingdom, Moldavia, Sweden and four observer countries: Belgium, Greece, Hungary, and Latvia.

In 2014, the WATER JPI launched the Water Works 2014 ERA-NET Cofund, partially funded by the EC under Horizon 2020. In this framework, 17 funding organizations from 15 countries jointly published a call for research proposals on the following topics:

- Water Treatment, Reuse, Recycling and Desalination.
- Water Resources Management.
- Mitigating the Impacts of Extreme Events (Floods and Droughts) on a Catchment Scale.

Over 200 collaborative transnational research proposals were submitted. Each involved a consortium of a minimum of three partners from three participating countries. About 40 proposals were approved for the full proposal stage and 16 research studies funded. The Ministry funded the following research programs, where Israeli partners are part of a consortium:



- WE-NEED- WatEr NEEDs, availability, quality and sustainability (Italy, Portugal, Spain and Israel): in collaboration with Prof. Brian Berkowitz and Dr. Yishai Dror of the Weizmann Institute of Science.
- PROGNOS: Predicting in-lake responses to change using near real time models (Sweden, Ireland, Denmark, Norway and Israel), in collaboration with Dr. Gideon Gal of Israel Oceanographic and Limnological Research.

2. ERA-MIN

ERA-MIN is an ERA-NET program focused on the Industrial Handling of Raw Materials for European industries and is supported by the European Commission's 7th Framework Program. Seeking to establish networks and mechanisms to foster research in the field of industrial production and supply of raw materials in line with the "EU Raw Materials Initiative", ERA-MIN has gathered a consortium of 19 partners from 15 states (Finland, France, Germany, Hungary, Ireland, Italy, The Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Turkey and United Kingdom). Israel recently joined ERA-MIN and intends to participate in the next joint call, under the name ERA-MIN2.

3. SOLAR ERANET

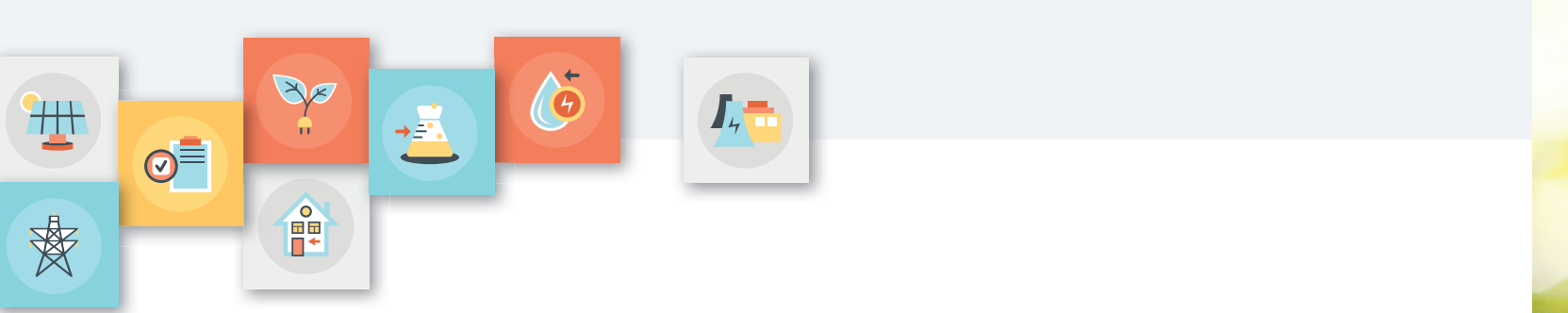
SOLAR-ERA.NET is a network bringing together more than 20 countries and innovation programs in the field of solar electricity technologies. The network of national funding has been established in order to increase transnational cooperation and to contribute to achievement of the objectives through dedicated joint calls. Israel has participated since 2014 and several Israeli projects are currently active.

4. JRC

The Joint Research Centre (JRC) is the European Commission's science and knowledge service, which employs scientists to carry out research in order to provide independent scientific advice and support to EU policy.

In 2012, an MOU was signed between the Joint Research Centre (JRC) and the Israel Ministry of National Infrastructures, Energy and Water Resources to deepen cooperation and promote projects of mutual interest to Europe, Israel and the international community, via the CSO, primarily in the fields of energy and transportation.

The projects are selected annually by means of a peer review process within the "Call for Tenders – Academia" framework, with a bi-national team making the final selection. Semiannual meetings, alternating between Israel and Europe, are held to review ongoing projects and to select new ones.



The ongoing projects are listed hereunder:

Project Title	Starting Year	Budget (NIS)
Electrifying public transport in complex urban systems: the case for city buses and taxis	2014	876,274
Exhaust emissions of FF vehicles fueled with M70	2014	1,572,862
ART: Autonomous Road Transportation	2015	592,572
Total		3,041,708



Facts & Figures

1. Academia

The Ministry of National Infrastructure, Energy and Water Resources strives 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 is working to develop the human resources alongside the scientific capabilities and know-how.

• Scholarships

The Ministry has initiated a scholarship program to foster national expertise and promote employment in the development of hydrocarbon discoveries offshore Israel. The main aim is to encourage students to acquire the knowledge and capabilities to enable them to integrate into an evolving industry and regulation of the ecosystem. The Ministry offers two scholarship programs:

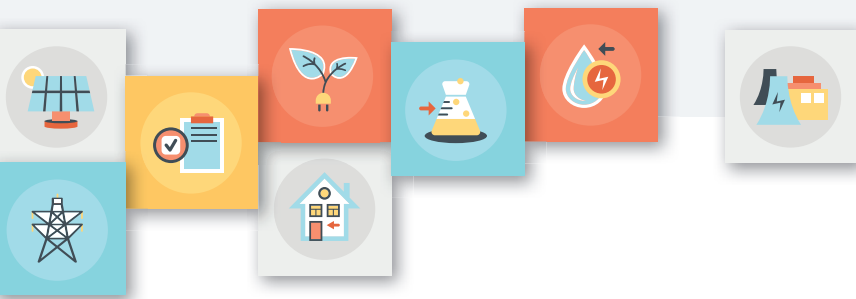
Scholarships in Israeli academic institutions: the program is open to Israeli citizens only, for M.Sc. and Ph.D. studies.

Scholarships in leading research and academic institutions abroad: the program is open to Israeli citizens only, for postdoctoral fellowships, and in some years for Ph.D. studies as well.

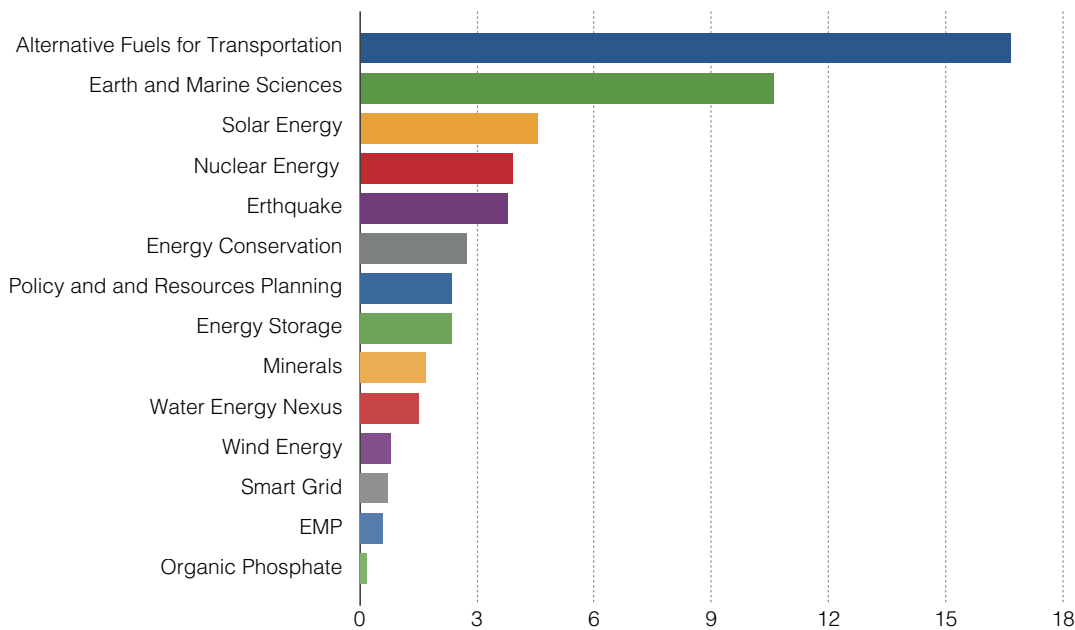
The program commenced in 2011, and granted 57 academic scholarships from 2014 to 2015 totaling NIS 4,750,000, and another 5 postdoctoral scholarships totaling NIS 1,440,000.

• Academic Research

In this program, the Ministry funds applied research in the energy, earth and marine sciences.



Academic Research

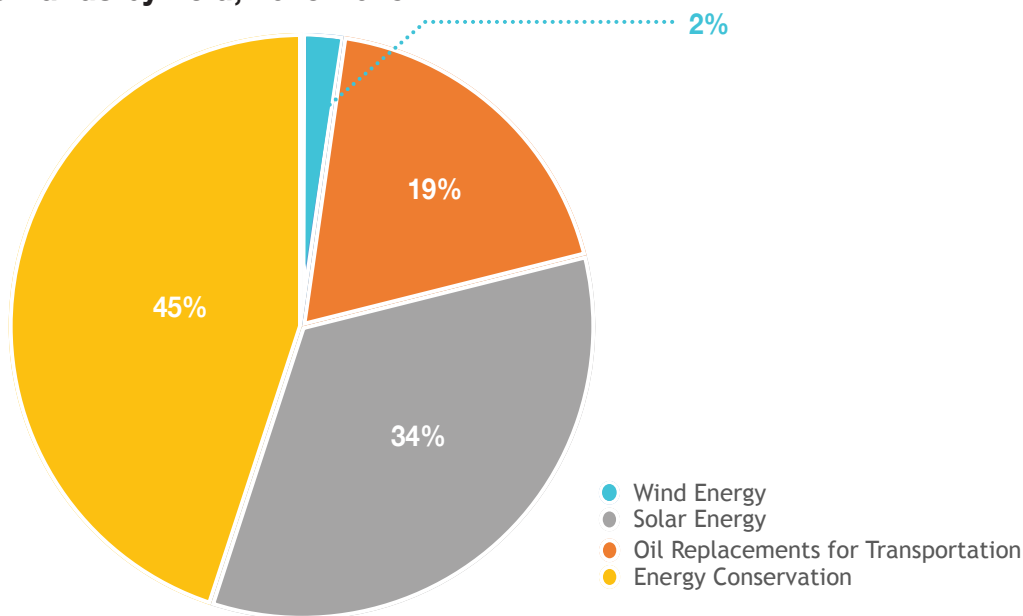


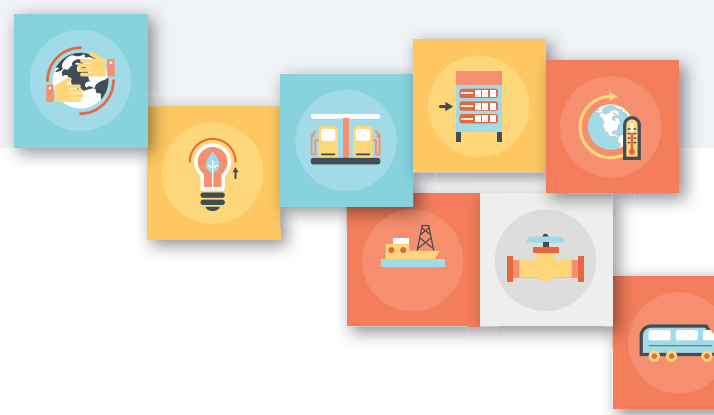
2. The STARTERGY Fund

The Ministry set up a start-up fund (STARTERGY), to encourage entrepreneurs and help startup companies reach the proof of concept/ prototype stage, from where they can proceed to raise private funds. The fund grants up to NIS 750,000 or 62.5% of the project budget.

From 2013 to 2015, the STARTERGY fund invested NIS 13 million in over 21 projects.

Distribution of funds by field, 2013-2015



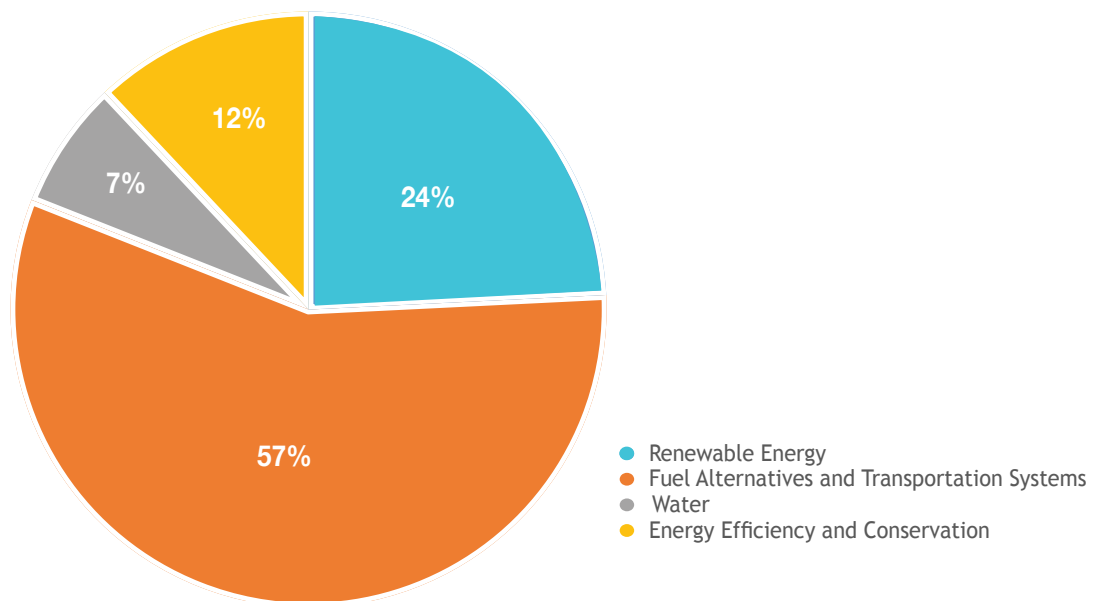


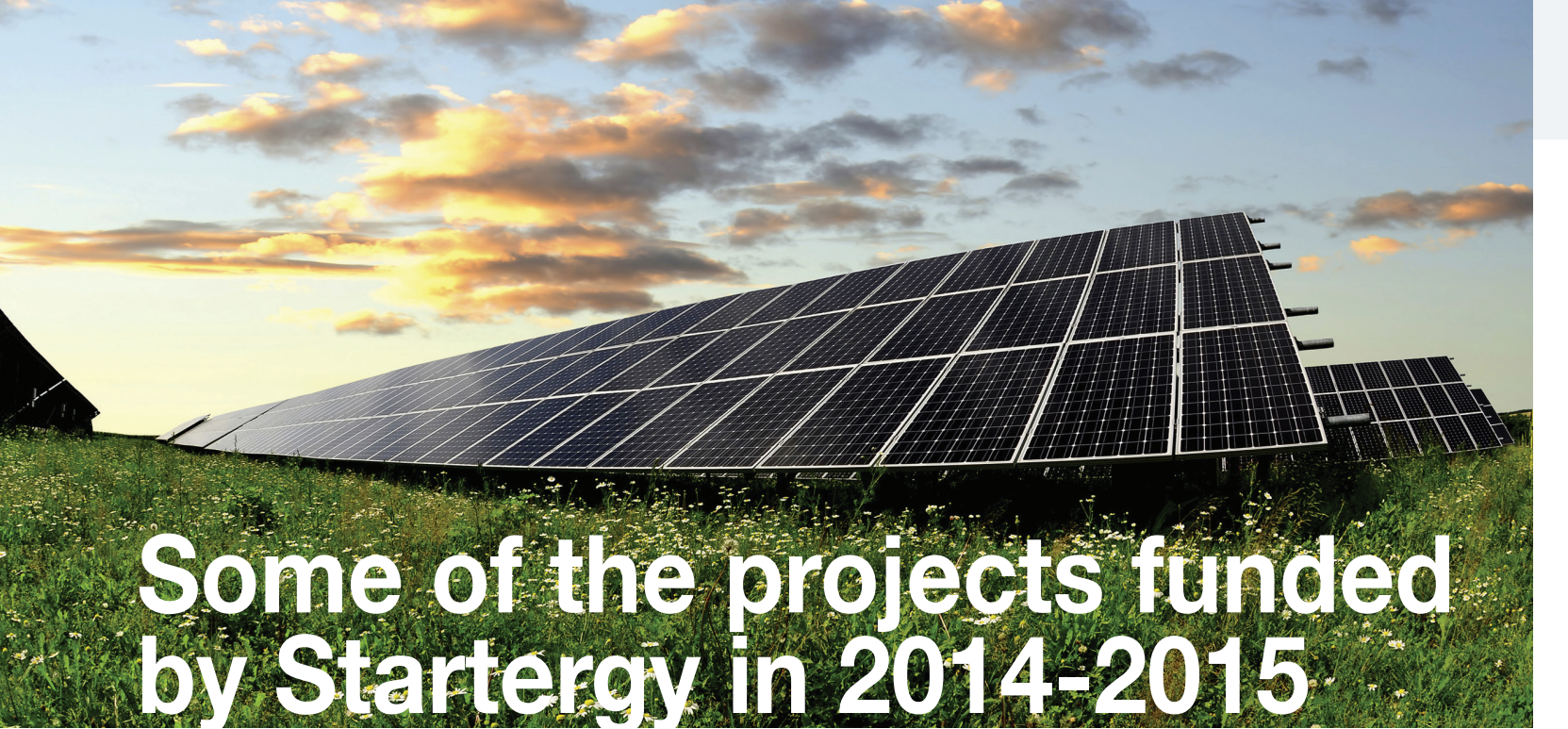
3. Pilot and Demonstration Fund

The purpose of this fund is to assist companies scale their innovative products to full production. Priority is given to renewable energy and alternative fuel technologies in transportation. The fund grants up to NIS 1,500,000 or 50% of the project budget. As of 2016, the grant was increased to NIS 3,000,000 for alternative fuel projects.

- Initiated in 2012, the Ministry has invested over NIS 43 million in 37 projects.
- Twelve of the 37 projects have been completed since the beginning of the program in 2012. Others are at the advanced stages of completion.

Distribution of funds by field, 2013-2015





Some of the projects funded by Startergy in 2014-2015

Company: Green 3C Biotech

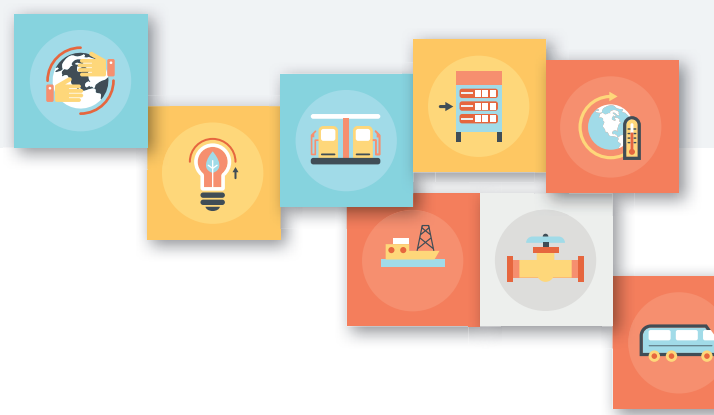
Project: Producing New, Non-GMO, highly advanced fungal enzymes, for converting agricultural waste into cost effective biofuels

3C Biotech is a private bio-innovation company, basing its unique technological platform on natural non-GMO, multi-enzymatic blends of oxidative, ligninolytic, cellulolytic and proteolytic enzymes.

- The company's products are designed to:
- Transform plant waste into biofuels and bio-based chemicals.
- Demolish the toughest industrial and environmental pollutants.
- Improve industrial food and beverage production.
- Increase the nutritious quality of animal feed.
- Enhance agricultural productivity, and complement or replace chemical pesticides and fertilizers.

The company exceeded its technological goals and achieved important milestones that are attracting European biotechnological and biobased material companies.

3C Biotech, as well as its partners, share the common goals of advancing biotechnological solutions in response to global environmental and sustainability challenges. Together, they offer new potential for meeting the world's demand for improved biofuels and bio-based chemicals, and for cleaner water and food.



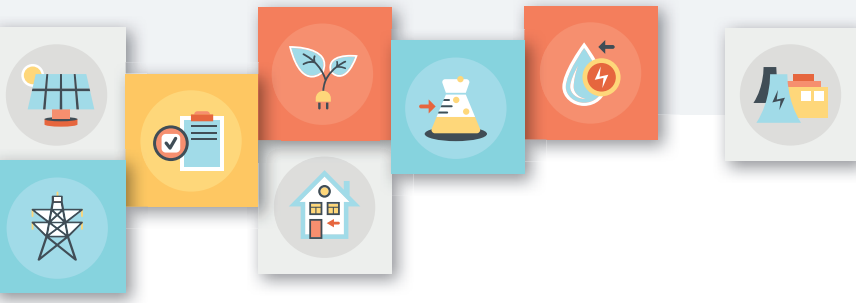
Company: Nayam Wings

Project: wind propulsion systems for maritime vessels



Nayam Wings, a green energy venture, develops wind propulsion systems for maritime vessels, which will cut fuel consumption by 20-100%.

Nayam Wings is developing a large vertical wing installed on the sea vessel deck. The company's groundbreaking idea is the use of a vertical wing connected dynamically to the ship's deck with automated control. This dynamic connecting mechanism enables the wing to be constructed of an asymmetrical multielement airfoil, which provides the highest possible lift coefficient (4+). It can also be positioned at the ideal 3-D angle at any moment, providing the highest effective lift power possible along the course of the sailing. As a result, our product develops 50% to 300% higher thrust than any competitor.

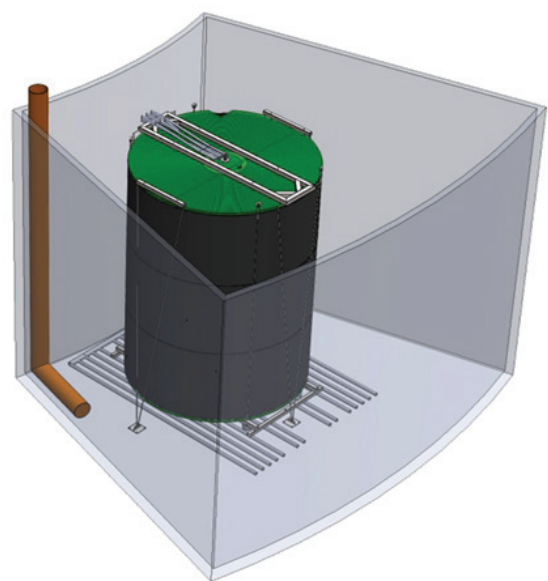
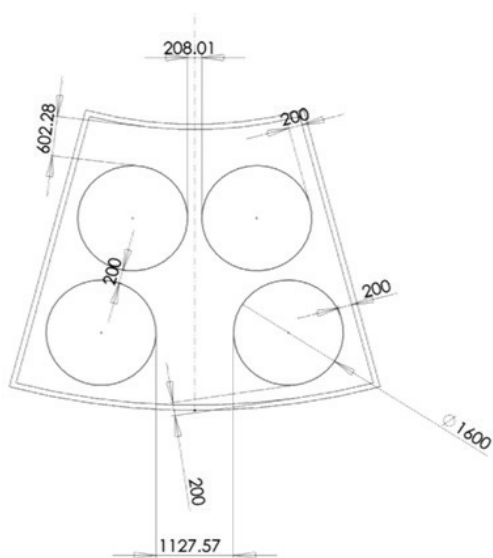


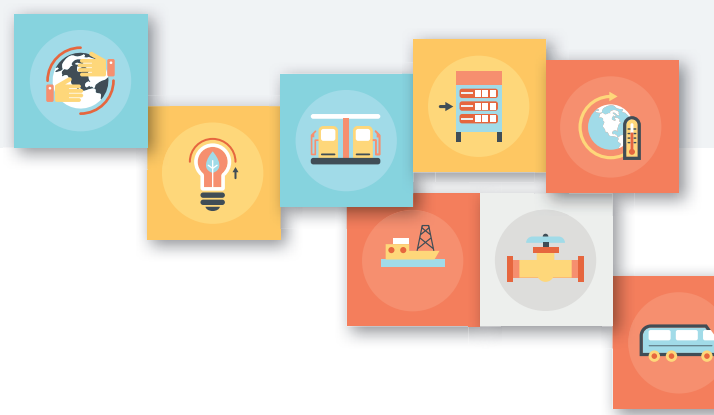
Company: Emefcy

Project: self-respiring membranes for energy efficiency in wastewater treatment

Emefcy was founded in 2008 as a startup company dedicated to developing, manufacturing and marketing novel energy efficient wastewater treatment processes. The company is currently traded on the ASX (under EMC), and is already marketing its first developed MABR (Membrane Aerated biofilm Reactors) product in selected markets around the world, offering small wastewater treatment plants many benefits, including: lower purchase cost, lower operating cost and superior treatment quality.

Currently Emefcy continues to innovate and develop new and improved products. Specifically, the company is developing a different configuration of its MABR to address existing large wastewater treatment plants. The initial stage of this new development includes a preliminary study, detailed design, procurement and installation of a full-scale hydraulic model, most of which has already been completed.





Company: Florafotonica

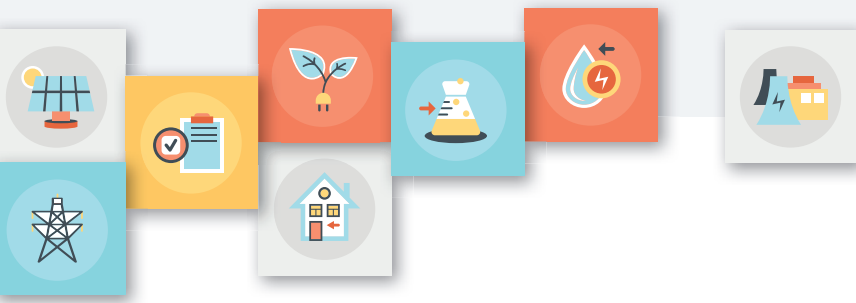
Project: Power saving light system for agriculture

Florafotonica is an Israeli startup company that has developed a groundbreaking technology for photoperiod and photosynthesis in 21st century agriculture called 'Adaptive Dynamic Frequency Grow-light'. The technology utilizes multispectral wavelength LED in a unique operation mode to enable the grower to implement specific light prescriptions and protocols to enhance crop biomass and quality while reducing energy consumption.

Photoperiod lighting in the flower industry is used to grow the plants outside of their natural season by extending daylight time. Florafotonica's LED based light system for photoperiod has demonstrated outstanding results by reducing farmer's electricity consumption by 93% and improving crop quality at the same time. The technology was tested over a two-year period on several varieties of flowers in different locations with consistent results.

Florafotonica continues to develop its unique multispectral LED based Grow-light system for photosynthesis in indoor farming. The system was tested as a supplementary light source for tomatoes and as the sole light source for several crops such as lettuce, mint and parsley. So far, the results have been very promising and have demonstrated a reduction in electricity consumption of up to 50%, while improving crop quality. Although still under research, the technology can also influence the composition of the active molecules in some plants, thus contributing substantially to indoor farming productivity, quality and efficiency.





Company: Linum Systems

Project: Solar, hybrid air-conditioning system based on turbomachinery

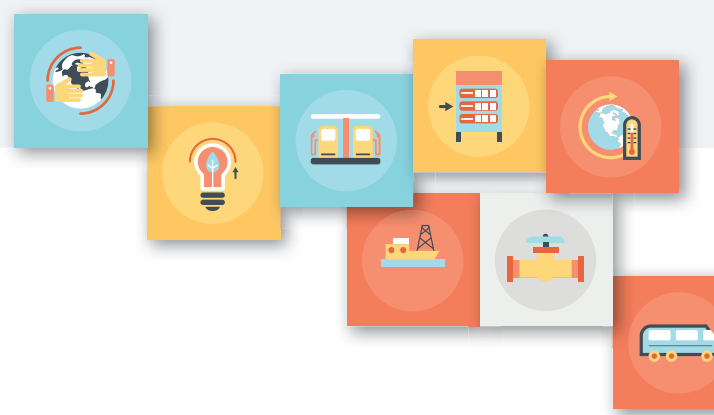
Linum Systems SP3 is a solar hybrid air-conditioner, driven by heat from solar energy or any other waste heat, electric energy or both, and providing cooling, heating and water heating.

The A/C runs on heat for as long as heat is available, adding electricity as required. At night, the A/C runs on electricity. The SP3 can save 40% of the A/C electricity bill to the customer without compromising comfort.

The Linum SP3 A/C has the same look and feel as today's A/C and is operated and maintained in a similar manner. It can easily be installed by regular installers without any need for special personnel or training.

The system is based on a patented turbine driven cycle converting heat to mechanical power in a combined power and cooling cycle.

Linum optimized and tested the system turbine compressor unit (TCU) and ran cooling and heating tests of the A/C unit. The project improved the efficiency and performance of the system, bringing it The SP3 System during tests closer to commercialization.



Company: N.A.M. Technology

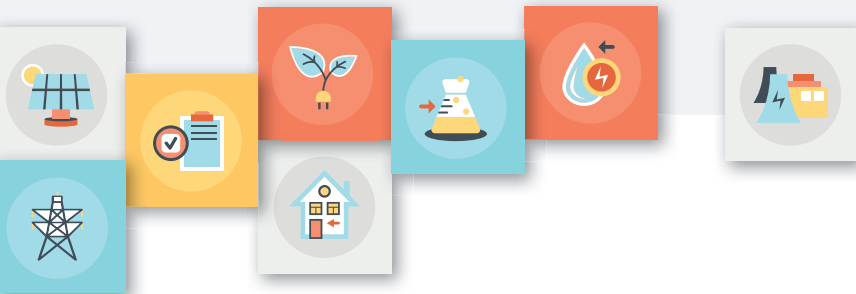
Project: the adsorption cooling system for refrigeration vehicles

N.A.M. Technology Ltd. began development of a cascade chiller with low energy consumption in January 2015. The chiller aims to replace existing low temperature chillers (in the -40°C to 45°C range, which use ammonia and pose threat to environment and to human health due to frequent technological accidents, often in proximity to residential areas, and even in city centers.

The first prototype chiller was assembled in the summer of 2015, and testing began in September of that year. The machine's parameters exceeded expectations, demonstrating stable operation at temperatures of as low as -50°C .

The prototype is approaching the market- introduction stage.



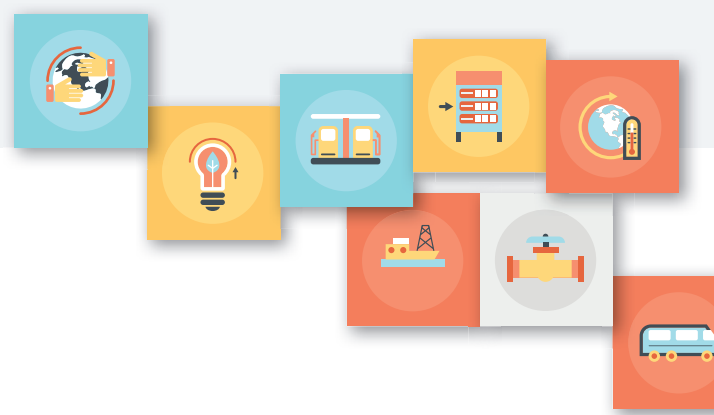


Company: M.G. Lightning

Project: Early fault detection in PV systems

M.G. Lightning develops photovoltaic performance, fault and yield prediction tools based on machine learning algorithms. It has successfully developed algorithms for predicting next day's hourly production of even small residential systems, using only data from the inverter and from basic local weather prediction servers. The company now applies these algorithms to yesterday's historical weather data to ascertain whether the system performed as expected in the weather conditions that prevailed over the system yesterday, thereby improving availability of small residential systems. The company is now working on predicting PV system faults before they occur by developing a new set of machine learning algorithms that work on inverter data from sites in Israel and around the world, in collaboration with IEA-PVPS Task 13.





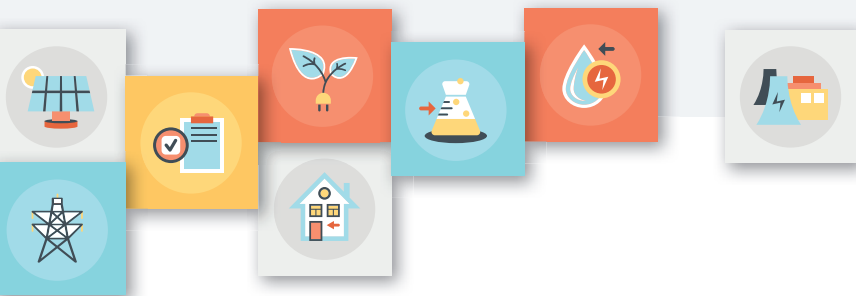
Company: SolarPaint

Project: Solar paint

SolarPaint develops a paint formulation and an electrode netting, which, upon simple installation and application, is transformed into an economical, aesthetic and efficient solar harvesting system. The first product being developed is a light and flexible 1m x 1.6m electrode netting trimmable by simply using a scissors to cut it to the desired shape to cover the exteriors of walls and roofs.

The netting will be sold painted with the solar paint being developed by the company, coated with a colorful protective topcoat and complete with standard electrical connectors, ready for simple installation. The paint developed contains a combination of an active material and other materials acting as stabilizers, binders and fillers in the finished solar cell. The cell itself is built such that the electrons in the active material undergo excitation in reaction to solar radiation. The electronic properties of the active material and the electrode netting facilitate charge separation and efficient conduction of charges to produce an electric current. The chemical processes used in their synthesis are simple and enable attractive pricing and widespread use.





Some of the pilot and demonstration projects funded in 2014-2015

Company: New CO2 Fuels

Project: Developing simultaneous dissociation of H₂O and CO₂ into Oxygen and Syngas for a synthetic fuel production system

New CO₂ Fuels Ltd. (NCF) is an Israeli start-up company that is developing a product for dissociating CO₂ and H₂O to produce synthetic fuels.

The NCF product, which was developed based on the technology researched by Prof. Karni at the Weizmann Institute of Science, is very efficient due to the high operating temperature of about 900°C.

Over a year ago, NCF has successfully completed a set of tests with its proof of concept units: one operated by thermo-solar power, and the other simulating the utilization of industrial excess heat.

The results of the tests proved the viability of the unique NCF product and technology.

At this time, NCF is defining a commercial-size system, and is in the process of designing the commercial Reaction unit (RU), targeted to dissociate CO₂ at a rate of 100 T/yr. This RU will be the building block for NCF full-scale industrial installations.

NCF plans are to install and operate the first commercial-size pilot unit at an industrial setup in the course of 2017.

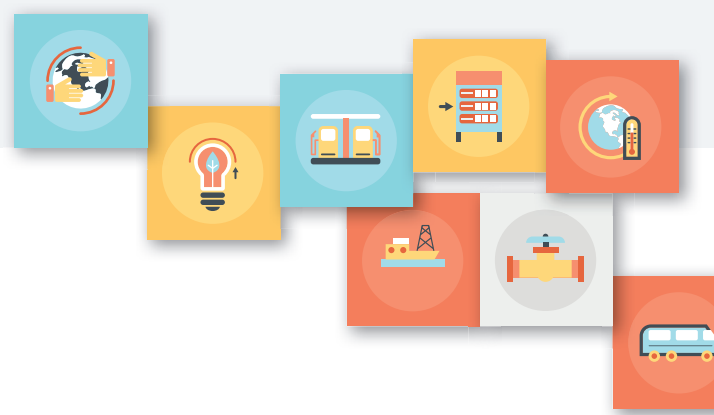
The major milestones in the NCF work plan are: design and implementation of several unique internal components in the product; design, fabrication and testing of the solar driven prototype (see picture below); and design of the test station for the commercial-size reaction unit.



NCF Solar powered unit – in operation



NCF Reactors test unit - (system model)



Company: Advanced MemTech

Project: The water-energy nexus: Energy savings in wastewater treatment via membrane bioreactor (MBR)

MemTech is an Israeli-based company that develops game-changing, ultra-high flux membranes for wastewater treatment, which dramatically reduce both CapEx and OpEx in water and wastewater treatment.

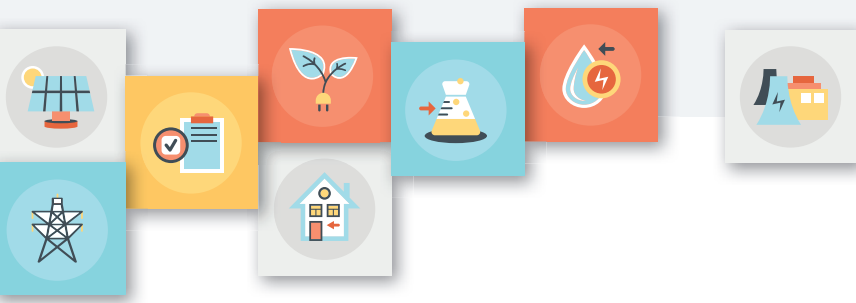
The company is supported by tier 1 strategic partners: the Technion Israel Institute of Technology; Mekorot, Israel National Water Company; Arkema, the polymers multinational, and the SEB Alliance.

The Company's polymer enables high flux through its membranes at low pressure, offering a clear competitive advantage:

- Lower CapEx and lower OpEx
- Less membrane area – smaller footprint
- Less fouling- reduced energy usage

The ultrafiltration membrane is 10 times more hydrophilic, has radically lower fouling and much better rejection. These features benefit the user by providing a high flux MBR membrane with a small footprint, higher quality effluents for unrestricted wastewater recycling, lower fouling and thus reduction of the energy cost, and a highly customized product tailored to the client's needs.

MemTech is conducting a pilot to demonstrate the unique capabilities of its membrane system for wastewater treatment, and continues to make advances in the product's development, enhancing market acceptance.



Company: Electroad

Project: Wireless energy system for electric transportation

Electroad is developing a unique technology that charges an electric vehicle wirelessly with minimal infrastructure under an asphalt road in an automobile's driving lane.

The company focuses on public transportation within cities and will be offering the following benefits:

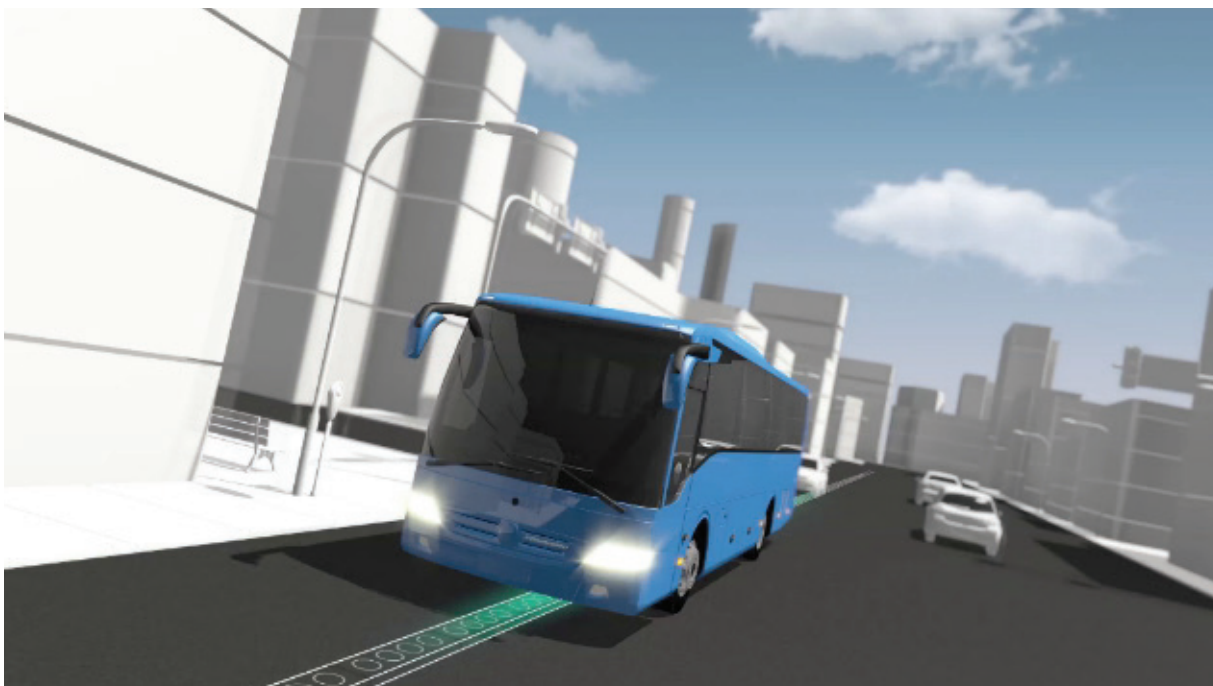
Public transportation with zero emissions, minimal noise, no need for a battery, without a charging burden or range anxiety, and with cost savings for everyone including public transportation operators, government, municipalities and passengers.

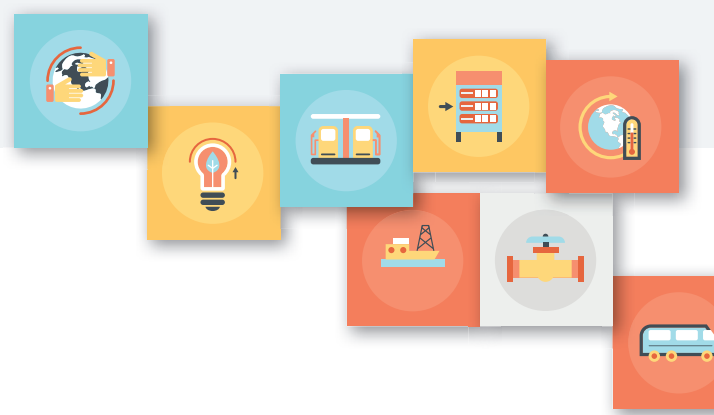
To reach our goal, we faced several challenges, both technological and operational. Within 18 months almost all the technological issues and risks were resolved, as follows:

Technology: ElectRoad developed the first prototype, demonstrating a workable system.

Radiation: The Company developed a unique, patent pending solution to reduce radiation.

Regulations: ElectRoad joined the SAE J2954, IEC 619180 "Wireless Power Transfer" committees, and developed the system under these international standards.





Company: AseptoRay (MGT Industries)

Project: Pasteurization technology for the beverage industry

Pasteurization is the most common process in the beverage industry. Based on the discovery 250 years ago that heating liquids to a certain temperature kills harmful bacteria, it is also highly energy consuming. Thermal pasteurization, requiring both steam generation and electrical cooling, is used in the production of more than seven billion liters of beverages a year worldwide.

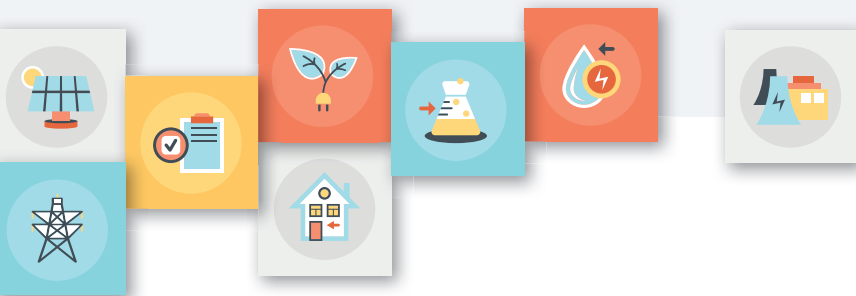
AseptoRay™ was founded to meet the need of the food and beverage industry for non-thermal effective pasteurization that can target all unwanted bacteria regardless of the liquid's turbidity. Unique in the market, AseptoRay's proprietary solution is based on ultraviolet (UV) technology that is capable of treating low UVT (UV Transmittance) liquids and totally opaque products. AseptoRay's solution dramatically reduces energy consumption, increases food safety and quality, and offers an environmentally friendly and sustainable pasteurization process.

The company has succeeded in scaling up the technology developed for small capacity and underutilized production lines to larger operations. Furthermore, it conducted a pilot at a leading international beverage manufacturer. Based on a nonthermal pasteurization method, AseptoRay's systems cut energy costs by 70% and 85% and greatly reduce carbon emissions in the beverage processing industry.

AseptoRay won the international CleanTech Open Global Ideas competition in San Francisco last year.

AseptoRay is a business unit of MGT Industries Ltd., a privately owned company established in 1969. MGT specializes in the design and manufacture of custom stainless steel tanks, mixing systems, road tankers, and process solutions. Providing superior tailored and turnkey solutions, the company has established itself as a leader in the worldwide process industry.





Company: Brenmiller Energy

Project: Demonstration of the Energy Center in a 1.5 MW Prototype Plant

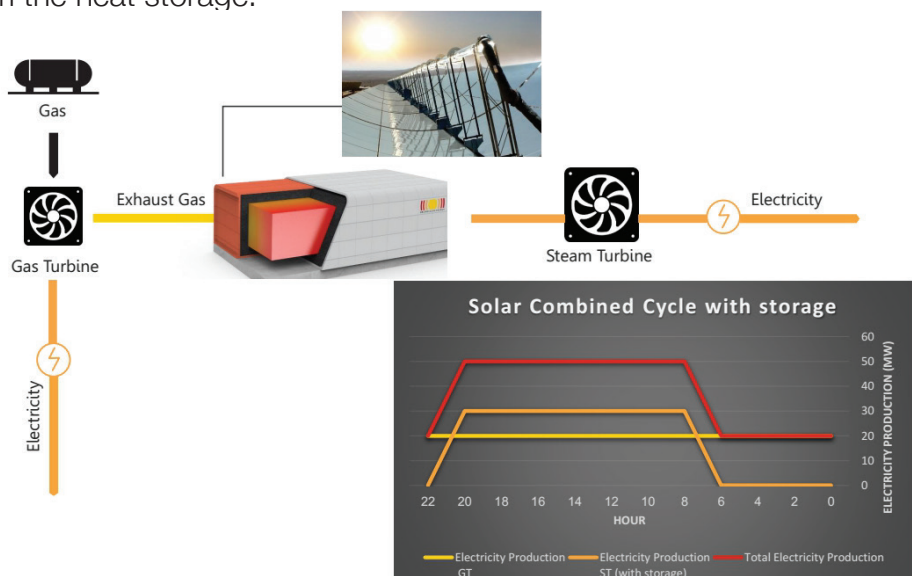
Brenmiller Energy has many years of experience in designing, building and operating solar and hybrid power plants. The global trend for deployment of distributed generation systems has increased the demand for thermal energy storage (TES) technologies, and the company has developed a unique storage solution for this market.

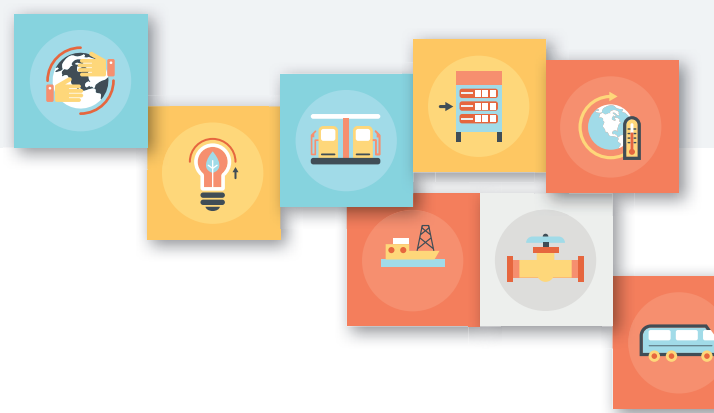
The ENERGY STORAGE CENTER from Brenmiller Energy accepts multiple heat sources, renewable or other, and delivers a single, stable energy output, enabling complete resource optimization in distributed hybrid stations. Its advantages include use of green and clean storage media, high cost-effectiveness, and modular adaptation to different system sizes, low-cost O&M and the company's full IP coverage of this key element. The unit inherently integrates the steam generation for the stored heat.

For the final approval and bankability of the product, the company is assembling the first product unit at the 1.5MW pilot plant in the south of Israel, near the city of Dimona.

Full commissioning and running of the 1.5MW pilot plants, and subsequently of 10MW plants, incorporated in the ENERGY STORAGE CENTER, will ensure a mature market launch and upgrade to the larger size plants as required for the distributed market on the global sun-belt.

A combined cycle gas turbine charges the heat storage with its exhaust heat. The solar field also charges the heat storage. Electricity can be generated on demand by the steam turbine from the heat storage.





Company: Dor Chemicals

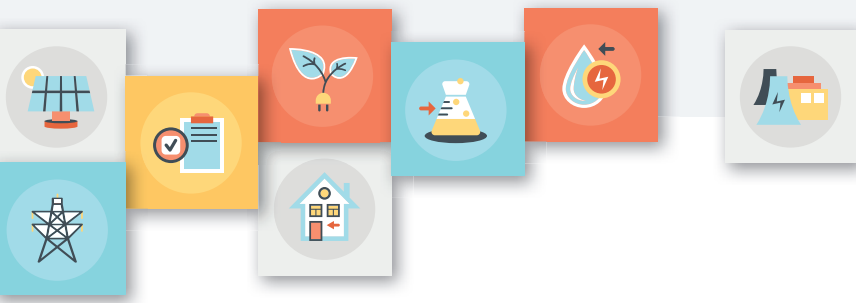
Project: Motor vehicle field trial run using a mixture of 85% gasoline and 15% methanol (M15)

Dor Chemicals has been working with methanol for the past 40 years, and intends to outline a practical way of using 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 fuel products. Under the supervision of a Government steering committee, a pilot was conducted by Dor Chemicals in order to fully characterize the effect of employing M15, required for use and standardization in Israel as a motor fuel.

The pilot included 10 vehicles running on M15 and 3 control vehicles running on standard 95octane gasoline, each accumulating 100,000 km. The trial examined 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. Following the success of the experiment, Fiat Chrysler entered into robust collaboration with Dor Chemicals. In addition, the Israeli Standardization Committee approved a new Israeli standard for M15. This is a unique and unprecedented step; since until now, Israel has adopted European fuel standards only.



Company: R-Jet

Project: Build Demo Plant to demonstrate use of Fossil Fuel substitutes with TG40 KW CHP (Combined Heat and Power) Turbo-Generator

The company is developing a unit capable of charging the batteries of electric hybrid vehicles.

Until this market is penetrated, the unit is also being developed as a CHP (combined Heat and Power) unit for the immediate distributed generation market.

For this application, the TG-40 commercial gas turbine will generate 36kW of electric power and 57kW of heat energy.

By the end of 2014, a TG-40 prototype was designed and manufactured.

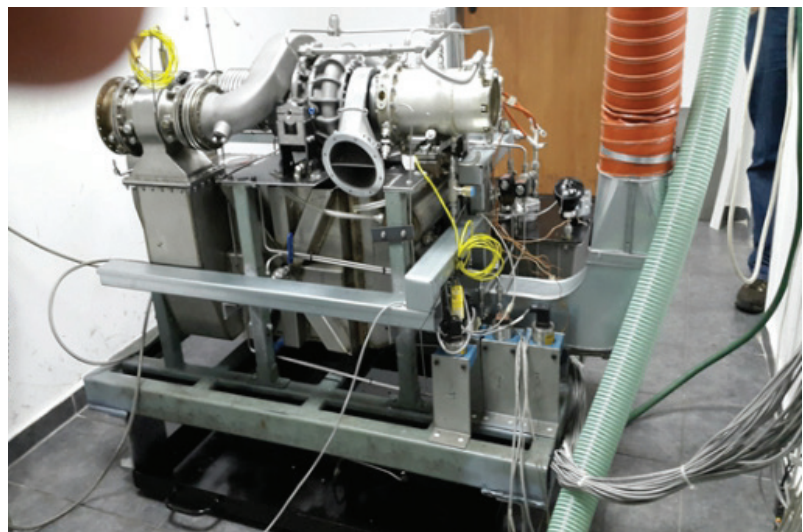
A test bench was designed and set up, capable of carrying full engine power by providing electric energy to special resistors simulating electric load to the grid.

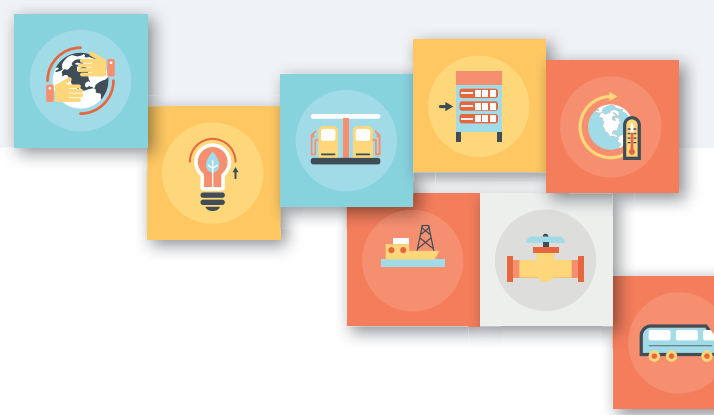
The TG-40 is designed for a multiple fuel capability.

For the electric vehicle application, the company uses the same gas turbine but with a new power electronic unit that delivers 500 V DC to lithium batteries instead of the resistors.

In 2015 a new control system and power electronic system was designed.

Major problems addressed and resolved in the past 18 months included the dynamic behavior of the gas turbine, such as critical speeds, avoidance, and redesign of rotor and stator support.

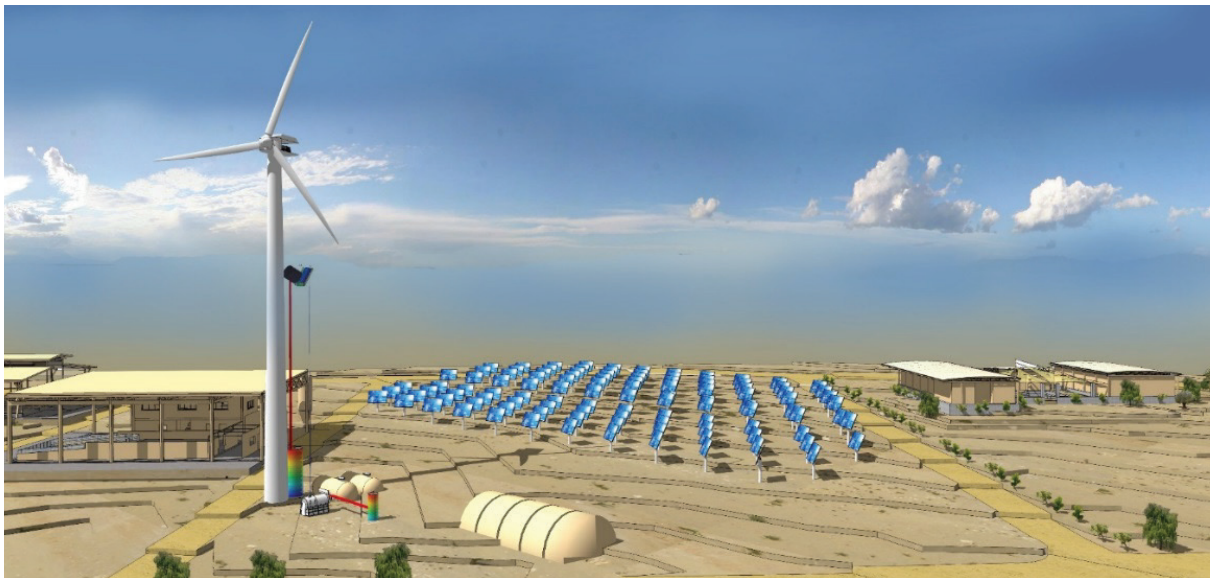


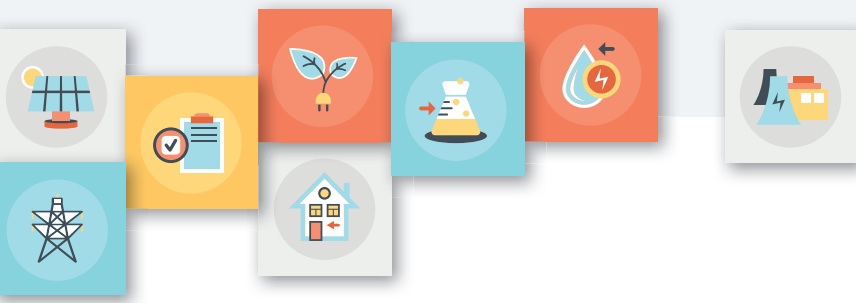


Company: Wadi Attir

Project: Project Wadi Attir – an integrated system for dispatchable energy generation, utilizing wind-solar sources.

Wadi Attir is building a world-class 100KW storage in a rural ecological village in Hura (in southern Israel). The system will provide for the entire energy needs (hot water and electricity) of the village on its own, without grid backup. This project will also demonstrate an innovative underground compressed air storage technology on a full commercial scale.





Company: Solatics

Project: Solar PV systems on water reservoir cap

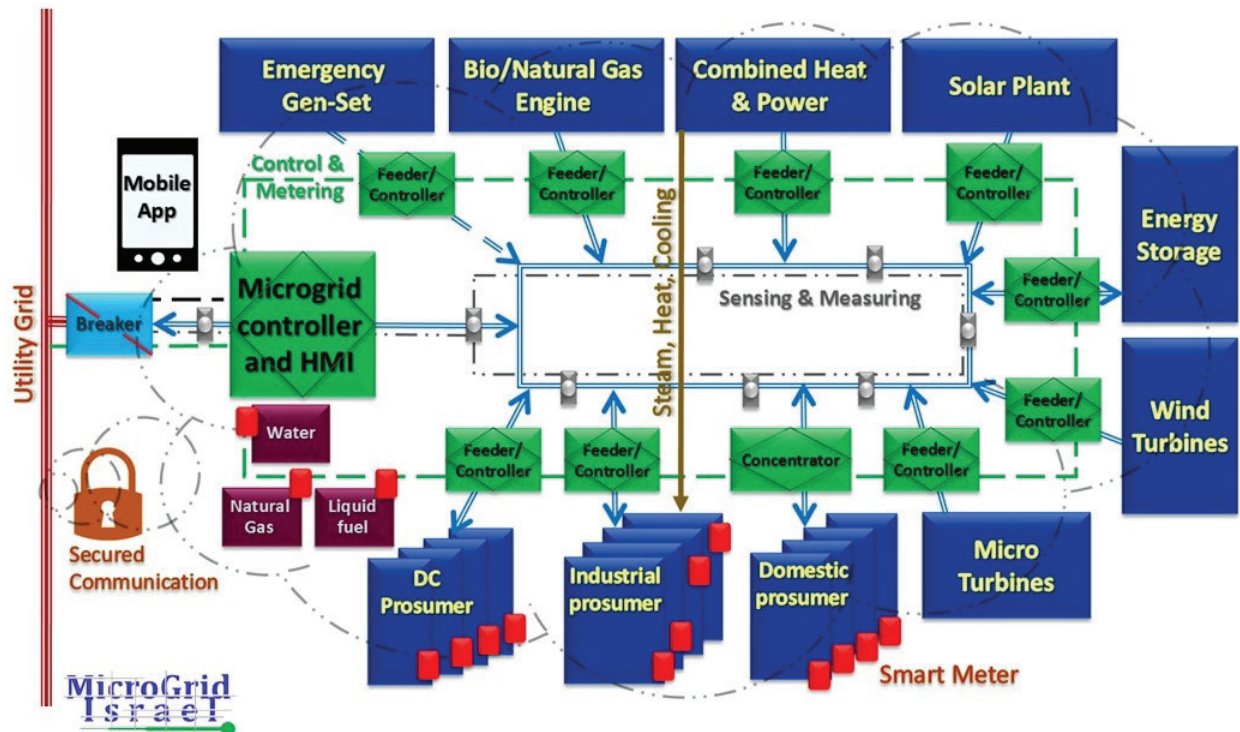
Solatics develops PV Integrated Membrane (PVIM) technology, which lowers the cost of solar PV installation on water reservoirs, landfills, brownfield sites and even on flat-roof applications where standard solar PV systems cannot be installed.

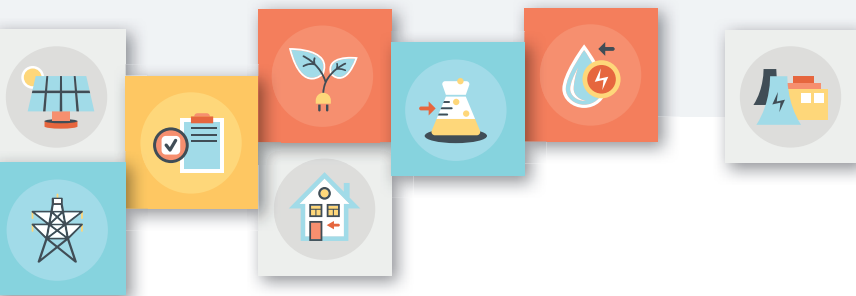
Designed to improve the overall architecture and assembly of the crystalline silicon solar panels, Solatics technology facilitates the use of crystalline silicon (c-Si) solar cells at a much lower cost per installed Watt. Targeting large-scale commercial customers such as electric utilities, water companies, waste companies and landfill owners, the Solatics offering includes reduced system cost, easier and faster installation, larger capacity and higher yield per acre, reduced BOS (Balance of System) costs, integrated-racking solar design, and overall lower installed cost compared to standard glass-metal solar panels. With its 'Direct Attachment' method, Solatics also solves waterproofing issues, static load limitations, unstable ground and drifting problems, surface penetration and wind related phenomena.

Company: Microgrid Israel

Project: Microgrid demonstration on Ma'ale Gilboa

The Microgrid Israel (MGI) project at “Kibbutz Ma'ale Gilboa” will serve as a benchmark and demo site for future Microgrid deployments, and as a model for commercial, regulatory and technological aspects for the Israeli power market. The project will demonstrate how integrating automation and intelligence systems to control local generation and consumption improves the campus overall energy performance and costs and sustainable operation. At the forefront of Microgrid related technologies, MGI is currently active in the government, academic, defense and commercial sectors."



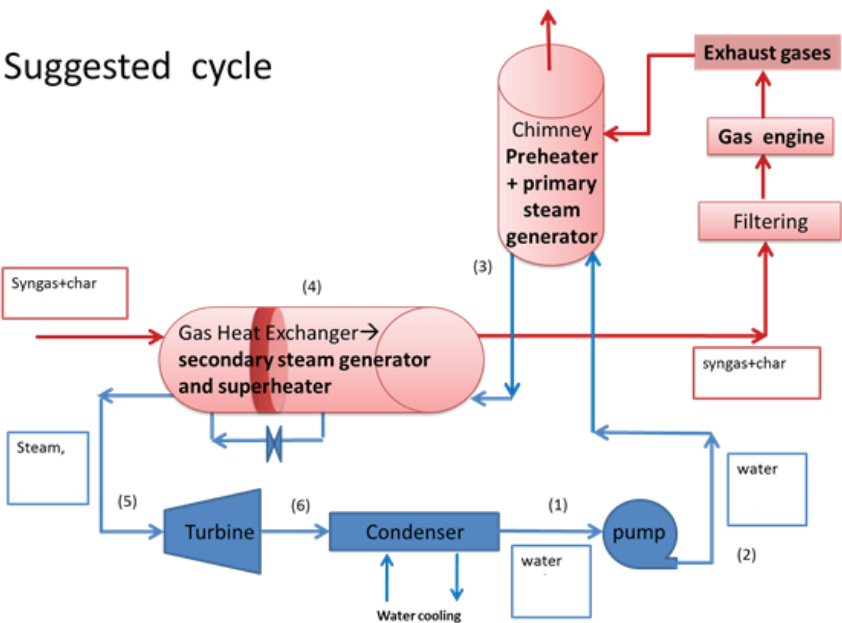


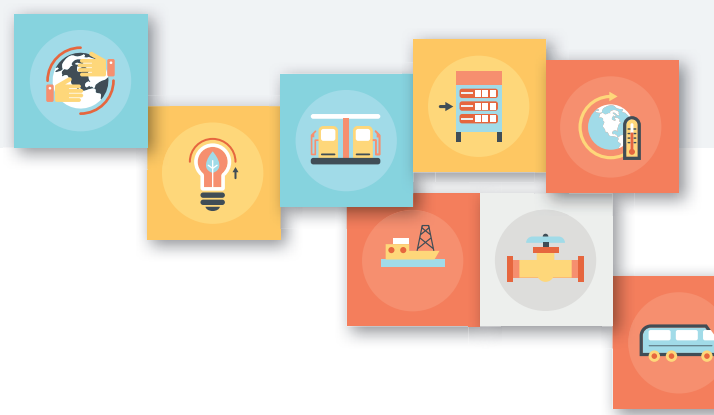
Company: Arava EC&T

Project: Planning and installing of a waste heat utilization system to increase small biomass facility efficiency

Arava EC&T is an Israeli, southern based company specializing in waste to energy projects. The company's vision is to minimize the carbon footprint by deploying local efficient gasifiers intended to transform solid organic waste into clean and sustainable energy. Arava is also a leading consultant to smart city projects.

The company identified a market failure in the biomass sector, specifically the lack of economic viability of small gasification facilities. Together with Rotem Industries' engineers, it is developing an innovative and unique Steam Module solution to utilize the residual heat from a gasification process in order to increase the economic viability of the system. This innovative technology will enable production of steam from the waste heat of the gasification reactor and the gas engine, in order to sell it to a local consumer, produce additional electricity, or generate cooling by means of an absorption-cooling system. The project is being executed in collaboration with Syntech BioEnergy.





Company: Tamuz Energy

Project: Steam generation using innovative solar collectors

Tamuz Energy has developed revolutionary low-cost distributed solar technology for generating high-value heat for industrial processes, steam generation and cooling applications. This proprietary system is:

- Modular and scalable
- Fit for rooftop or ground mounting
- Monolithic structure (simple installation)
- Delivers high temperatures, up to 300°C
- Optional: collectors with integral thermal energy storage
- Offers energy at a substantially lower price than fossil fuels in most countries, w/o incentives/subsidies.



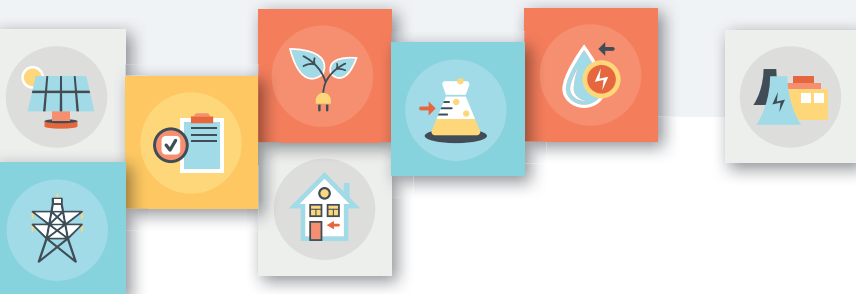
Manufactured using mature technologies within an existing global manufacturing base.

The solution provides cost effective renewable energy, reducing energy prices by up to 75%, without the need for government incentives, and with ROI down to just 2-5 years. Moreover, Tamuz-Energy's ahead-of-the-pack collector with integrated storage has no competitors in today's market. Tamuz Energy's innovative product opens up new possibilities, new markets, and new customers.

Tamuz Energy's first full-scale prototype was launched in Q1 2015 and is successfully operating with outstanding results.

A commercial demo system was launched in Q2-2016 in a commercial plant





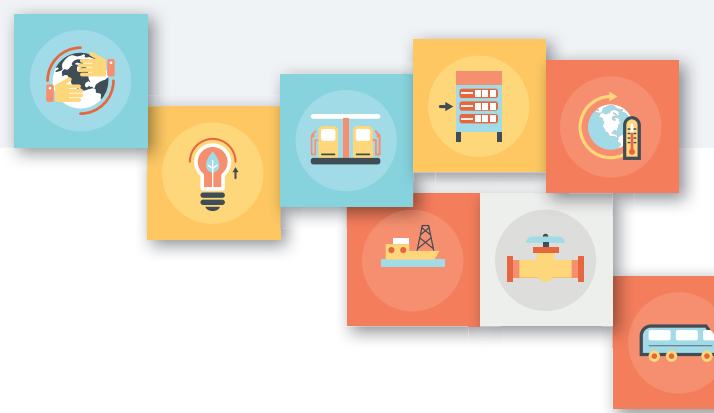
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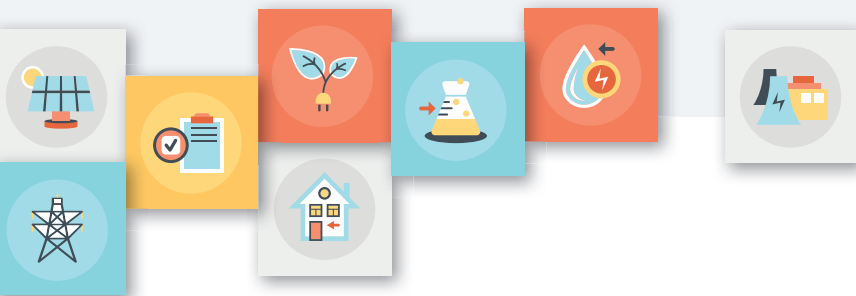
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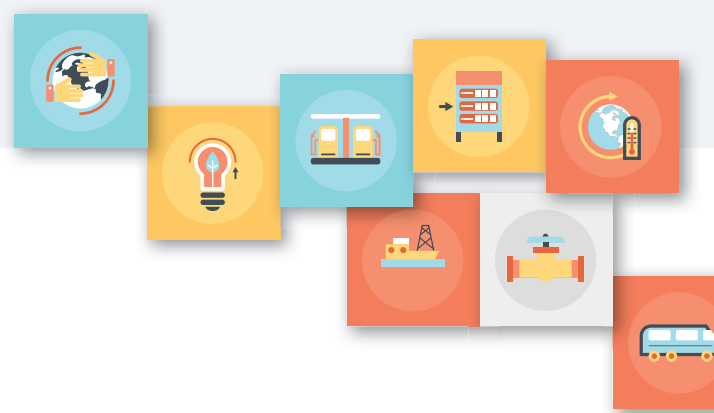
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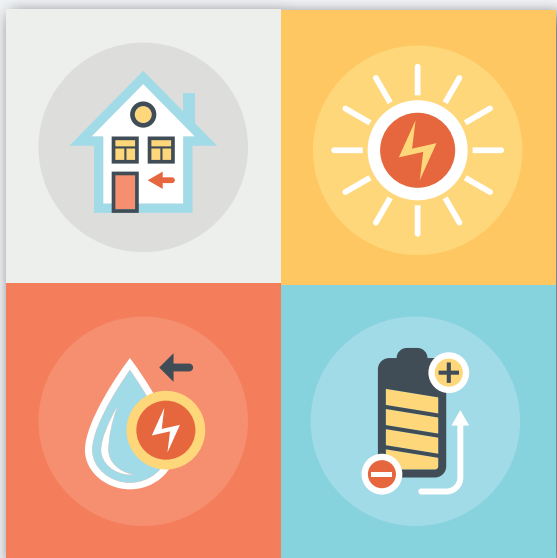
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