

# Innovation & Industry Science

## The State of Israel - A Greenhouse for Vast Innovative Green Energy Solutions

- » Arava Power Company – At the Forefront of Israel's Solar Energy Revolution
- » Dorad Energy – Eco - Friendly Energy and Lower Electricity Prices
- » Standardization is a Core Factor for Increasing Israeli Exports



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*We pursue after solutions with sound market opportunity*

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Dear Readers,  
Conference Participants,

The latest developments at Better Place, with the so-called replacement of the CEO and founder, as well as the dramatic announcement that global giant Siemens is leaving the thermal-solar field, should send a clear message to all entrepreneurs in the field of alternative/renewable energy production.

**In the long term, no business can survive if it doesn't have new technological developments that can compete with the current technologies and/or be less expensive than the solutions in practice.**

The Government of Israel has recently launched several bombastic plans. One of them is the plan to decrease the global/national dependency on oil for transportation with a planned budget of NIS 1.5 billion until the end of 2020. For this purpose, the government has established The Directory of Oil Substitutes at the Prime Minister's Office. According to this plan, the government will also encourage private investments of NIS 4 billion in oil substitutes until 2015 and an additional NIS 10 billion until 2020. By the end of 2016, about 100 new start-ups should be established and 100 academic research groups, as well as 20 Israeli companies that will also be active abroad. Furthermore, the government is advancing the Green Growth plan with a planned budget of NIS 850 million, which will include investments in cleantech. In addition, huge amounts of money are being poured into this area by the chief scientists at the Energy and Water Ministry, the Environmental Protection Ministry, as well as at the Industry, Trade and Labor Ministry.

**On the other hand,** statistics show that 35% of those between the ages of 55-59 and 49% between 60-64 are unemployed. Statistics from September 2012 reveal that about 246,000 people were registered as unemployed [6.8% of the total workforce]; 108,000 were partly employed [3% of the total workforce]; and about 50,000 gave up looking for work due to factors such as their age [1.5% of the workforce].

**One may ask himself, how is all that data connected?**

Under these circumstances, it is unclear to me why the government does not impose a **compulsory quota** of hiring those highly experienced people or, as they are called, "gray haired", as a precondition for receiving any government support.

Consequently, at election time [but not only], as in every normal Western country, the welfare of the nation's citizens should be at the forefront of the election campaigns [as well as in Parliament Member's thoughts] and not military topics such as bombing of this or that country.

Last but not least, looking at all the technological innovations and the variety of promising local enterprises that are presented at the Fifth Eilat-Eilat Conference, one cannot but think of Israel in terms of the biblical phrase "The Land of Milk and Honey."

Yours,

Dipl.-Kfm. Uri Schlesinger

Editor & Producer - Eshel Initiating Production & Editing

Responses, suggestions, comments and enlightenments:  
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Dear Readers,  
Conference Attendees,

We are happy to welcome you to the Fifth International Eilat-Eilat Renewable Energy Conference.

The renewable energy market in Israel and abroad went through a difficult year. In Israel, it was a year in which

most of the quotas entered their final and exhausting stages with the government and regulation factors in order to implement the planned solar power stations. **After we build them, we will still not meet the government's goal of producing 5% renewable energy in 2014.**

We are eagerly awaiting the Kandel Committee's conclusions regarding the "grid parity", the regulator's decision regarding a "net metering" with no quotas [after the first hearing at the beginning of October] and the conclusions of the National Energy Master Plan, which we hope will regard renewable energy and energy efficiency as meaningful factors in the Israeli electricity market. **The sun is our most significant resource, but we tend to overlook it when we face the paradigms of the old world, which has not stopped looking for and depending on expendable energy resources.**

In regard to energy efficiency, the government offices have started to issue incentives and advertise appeals to encourage local authorities and industries to reduce electricity consumption. **This activity is still small in its scope, and the return on investment period does not encourage most electricity consumers to enter this field.**

The technological innovation that is supposed to be the leitmotif in all energy fields is too limited and is moving too slowly. We are waiting for more pioneer installations; shortened procedures, with the administration that will recognize the new term of 'experimental field' and mainly for many initiatives and ideas.

The Eilat-Eilat conference organizers regard the conference as a significant stage to encourage the presentation of innovation, meaningful information, moving governmental policy, strengthening of commercial connections and encouraging international market for Israeli companies.

The conference is a meeting place for the business, political and technological sectors that do not have the chance to meet in another informal and focused manner.

This year, in conjunction with the Industry, Trade and Labor Ministry, we organized a well-invested three-day conference. Here, we will be able to encourage and support entrepreneurs to present their technologies to investors from all over the world.

With patience, educated management, perseverance and mutual cooperation with the Israeli government, we will succeed in implementing the vision of turning Eilat-Eilat region into the 'Silicone Valley of Renewable Energy' and assist turning the Israeli energy field into a valid existence.

Regards,

Dorit Davidovich-Banet and Noam Ilan

The Eilat-Eilat Renewable Energy conference  
founders and chairs





# Israel's (Painfully Slow) Solar Revolution

▶ Arava Power Company continues to develop solar fields in the Arava and Negev, despite challenging government obstacles and setbacks | By Hannah Schafer

**K**IBBUTZ KETURA -- On a sunny October morning in the Arava, I walk through the Ketura Sun solar field at Kibbutz Ketura with Arava Power's CEO, Jon Cohen, and discuss the state of solar in Israel amongst the gleaming rows of blue panels, perfectly aligned at a 27 degree angle to best absorb the sun's rays. The only sounds that can be heard are the hum of trucks as they speed up and down Highway 90 and the occasional "moo" of a cow from the nearby cowshed.

Ketura Sun, Israel's first and only solar field, celebrated its first anniversary of operation this September. In its first year, the 4.95 MW installation performed better than expected, says Cohen, CEO of Arava Power Company. "The sun provided as expected," says Cohen, "The installation was even more efficient than

## Regulatory Recommendations:

- 1. HORIZON FOR INVESTORS:** Add an additional quota of 1000 MWs for solar energy.
- 2. BEDOUIN:** Create a separate quota for Bedouin fields so they can also participate in the solar revolution.
- 3. 20 PERCENT RENEWABLES:** Adopt the European Union goal of 20 percent renewables by 2020.

ground with us by now," says Cohen. Arava is Israel's leading solar developer and a pioneer in mid-size and large-size solar fields using photovoltaic technology. **Founded in 2006 by Kibbutz Ketura, David Rosenblatt and Yosef Abramowitz,** Arava Power seeks to supply Israel with hundreds of megawatts of solar energy through alli-

ances with kibbutzim, Negev Bedouin and other land owners, especially in the south of the country.

## The Next Step

Arava Power is now moving forward and preparing land and fencing for eight new PV solar fields and one rooftop system at different sites in the Arava and the Negev. All the projects fall within the existing 270 MW quota for medium sized installations set by the Public Utilities Authority (PUA) in 2010. In May, Arava Power made international headlines for their \$200 million financial close on the eight projects in partnership with Noy

"We are helping to fulfill David Ben-Gurion's vision of turning the Negev into the center of solar energy production."

our models had calculated and the machinery functioned perfectly."

## The Pioneers

It was no small feat to pioneer the first solar field in the State of Israel. Ketura Sun was five years in the making, as the Arava Power Company (APC) forged a path through new regulatory and statutory demands – and over 20 different government offices and agencies -- to build what many had deemed impossible. Now, a little over a year after the field was connected to the grid, Ketura Sun has already provided over 9 million kilowatt hours of clean and green renewable energy to Israel's national grid; and yet, Ketura Sun is still the only fully operational solar field in the State of Israel. "We imagined we'd have many brothers, sisters and cousins on the



Arava Power's 4.95 MW solar field has been operational for over a year with production levels that exceeded the company's expectations.



Photo by: Arava Power

The 40 MW solar field to be built by Arava Power at Kibbutz Ketura will supply one-third of Eilat's energy needs during peak usage and eliminate the need for diesel generators.



Photo by: Yaniv Cohen

"We imagined we'd have many brothers, sisters and cousins on the ground with us by now," Says Jon Cohen, CEO of Arava Power Company, at the Ketura Sun solar field.

"We can return a sense of security by rebuilding market certainty and setting new horizons to reinvigorate the industry. New quotas should be published immediately to enable the construction of hundreds of megawatts that Israel desperately needs. We should never have another summer of blackouts."

Infrastructure and Energy Fund, EDF Israel and Keren Kayemet L'Israel (KKL) providing the equity and Bank Hapoalim, Migdal, and Amitim providing financing.

"The financial close signifies yet another endorsement of Arava Power as the leading company in the Israeli solar industry," said **David Rosenblatt**, Co-founder and Vice Chairman at the time. "We are helping to fulfill David Ben-Gurion's vision of turning the Negev into the center of solar energy production."

"These installations are yet another step toward Israel's energy security and independence," adds Cohen, "Israel cannot afford to rely on external energy resources or to import expensive fossil fuels. We have a plethora of sunshine and near-perfect conditions for solar energy production. Israel should be leading the world in this field." He points east, to an enormous date plantation on the

other side of the highway. "Just beyond that date plantation is where we will build one of the largest solar fields in the Middle East," says Cohen.

Cohen is referring to Ketura Solar, Arava Power's 40 MW solar field, also to be built at Kibbutz Ketura. The project is in its final stages of preparation for financial close. The field, set to be one of the largest solar fields in the Middle East, will provide enough energy to meet one-third of the city of Eilat's peak energy demands and, in doing so, eliminate the need to rely on costly and polluting backup diesel generators. Arava Power is developing in parallel additional large solar fields.

### The Challenges Ahead

Despite these successes, many in the industry are concerned about the future of solar in

the Holy Land. The most recent tariff-cut by the PUA, together with numerous hold ups and road blocks that have typified the past two years, have left foreign investors far from convinced that they will continue to invest in Israel's solar industry. There are tens of projects that have been developed and are in place to receive tariff permit and financial close. The industry desperately needs additional quotas that would enable the deployment of hundreds of megawatts of green energy to the national grid.

"We can return a sense of security by rebuilding market certainty and setting new horizons to reinvigorate the industry. New quotas should be published immediately to enable the construction of hundreds of megawatts that Israel desperately needs. We should never have another summer of blackouts."

And what of the grid parity era? Cohen's vision is clear, "Grid parity offers huge potential for both the national economy and energy security. Rules, regulation and tariffs for grid parity must be clarified and brought to the operative stage quickly, to enable the industry to reach the grid parity era by early 2014. This is the role of the government and without their support and long-term vision, it is unlikely that the State of Israel will meet the very conservative 10% goal for renewables set for 2020."



דוראד אנרגיה  
Dorad Energy

# The Dorad Power Plant – Eco-Friendly Electricity

- ▶▶ More cost-efficient electricity for private and industrial customers will lead to a reduction in the price of production and will benefit all households; Using natural gas to produce energy is eco-friendly | By Eli Asulin\*

In November 2010, Dorad Energy Ltd. completed the financing arrangements for the construction of its electrical power plant, and in March 2011 the company started construction of one of the first and largest private power plants in Israel, located at the site of the Eilat-Ashkelon Pipeline Company Ltd. [EAPC], south of Ashkelon. Construction is slated for completion in the last quarter of 2013 with the start of commercial operation, at which time the company will begin sales of electricity to the market.

Private electric companies in Israel have only started to emerge in the last few years. The primary impetus was the discovery of natural gas along Israel's shores, enabling private manufacturers to set up combined cycle power plants which are fired primarily on natural gas. Combined cycle energy production has many advantages, including high efficiency [up to 60% gross thermal conversion efficiency, compared with 35%-45% for electricity produced in coal-fired plants], as well as lower construction, operating and maintenance costs compared with coal-fired power plants.

## The Combined Cycle – Efficiency and Flexibility in the Production Process

Dorad's power plant is expected to provide over 840 megawatts to the Israel power grid, an amount which will constitute about 7% of the total production capacity in the entire country.

The plant is based on combined cycle technology, arranged in two "blocks", each block consisting of six gas turbines with waste-heat boilers, plus one steam turbine. Each gas turbine is capable of producing up to 47 MW of electricity. To reach maximal production capacity, each gas turbine delivers its residual heat [i.e. hot gases emitted by the turbine exhaust] to a Once-Through Steam



Eli Asulin,  
CEO of Dorad Energy.

Generator [OTSG], which makes use of the residual thermal energy in the hot gases [at approximately 450° C] to produce high pressure steam.

This waste heat energy, which is also capable of being augmented by natural gas burners located in the transition duct between the gas turbine and the OTSG, is converted into steam at two pressures, in order to maximize the overall heat recovery; low-pressure [5 bar] steam at a temperature of 240° C and a rate of 15,000 kg/hr, and high-pressure [60 bar] steam at a temperature of 420° C and a rate of 40,000 kg/hr.

The steam produced by each OTSG is collected in steam headers and transferred to the steam turbine to produce additional electricity. The combined output from the steam turbines is capable of producing an additional 80 MW of electricity without supplementary duct firing, and up to 140 MW with duct firing.

**Each of the two combined-cycle blocks in Dorad's power plant can produce approximately 420 MW [including duct firing], for a combined total of over 800MW for the entire plant, at an overall gross thermal efficiency of up to 51% [when not using duct firing].**

## The Heart of the Power Plant – The Production Turbines

Twelve LM6000 aeroderivative gas turbines are installed at the power plant in Ashkelon, produced by General Electric at its US-based factory in Evendale, Ohio, and packaged at the GE facility outside Budapest in Hungary. These turbines are meticulously inspected and tested in the factory before they are



Dorad 3-D presentation.



Dorad power plant.

shipped to Israel.

The two steam turbines, made by Skoda and manufactured in Pilsen in the Czech Republic can produce approximately 140 MW each. The generators which are connected to each of the gas turbines and the steam turbines are supplied by Brush [from their factory which is also located in Pilsen].

The dual-fuel gas turbines can operate on natural gas, but if there is any problem with gas supplies, the turbines can be switched immediately to gasoil [light fuel oil], without interruption. **The use of aeroderivative gas turbines also offers exceptional operational flexibility and reliability. They can be started up and synchronized to the national electricity network within two to three minutes, and they can reach full power in less than 10 minutes. This operational flexibility enables the Dorad power plant to provide a quick response in the event of any unexpected failure at one of the Israel Electric Corporation's [IEC] production units.**

Due to the modular design of the aeroderivative turbines which have been installed at the production site in Ashkelon, a failure in any individual gas turbine will not significantly affect the plant's overall production capacity. The time required for resolving the failure, no matter how major, is only 72 hours, which is the time needed to swap out one gas turbine with a replacement.

In addition, using multiple smaller units will enable Dorad to modulate the electricity production process, activating or stopping turbines to meet demand over a broad range, from 100 to 800 megawatts, while maintaining optimum efficiency, thus greatly boost the reliability of the national electricity grid.

In general, this configuration of turbines, in combination with an advanced computerized system for managing the power production process, offers great flexibility for dealing with various regulatory changes during the initial operating period until the competitive market, which is still in an early stage of development, achieves stability.

**Due to the projected electricity shortage during the coming summer peak demand period, and in recognition of the operating flexibility of the Dorad power plant, the IEC is considering advancing the plant's**

**connection to the electricity grid even before the final completion of the plant.**

### End-Users – Service, Innovation, More Efficiency and Low Prices

Dorad is a groundbreaking company in its field in Israel, from the initial project development stage, through financing, construction, and coordination with its customers and the National Electricity System Manager at IEC. The customers to whom Dorad will sell electricity include major entities in the Israeli economy, such as Mekorot, the Defense Ministry, Osem, Keter Plastic, the Isrotel chain of hotels, the 1MED data center, Gibor, Seven Star Hotel, Fattal Hotels, the Tamares chain of hotels and the Cargal Group and others. **Electricity will be supplied to them via the national electricity grid in the same way they receive it today; but the prices will be lower than those of IEC.** Dorad will make the remaining output available [i.e. that which is not dedicated to private consumers] to the National Electricity System Manager at IEC.

### About Dorad

**Dorad Energy Ltd.** is owned by the **Eilat-Ashkelon Pipeline Company Ltd. [EAPC]** – 37.5%; **Zorlu Energy** – 25%; **U. Dori Energy Infrastructures Ltd.** – 18.75%; and **Edelcom [wholly owned by Edeltech]** – 18.75%.

The overall investment in the power plant project in Ashkelon is estimated at more than NIS 4 billion.

The EPC contractor, who is in charge of engineering, procurement, construction, and commissioning the facility, is Wood Group, which employs a number of local Israeli contractors, including U. Dori, Koor Metals, Hagiva, Keren, GES and others.

Eilat Ashkelon Power Stations Services [EAPSS] will be responsible for the operation and maintenance of the power plant after it is placed in service, and Zorlu Operation and Maintenance will be responsible for the maintenance of the major equipment in the plant, including the gas turbines, waste heat boilers, and steam turbines.

### About Eli Asulin

B.Sc Mechanical Engineering – graduated with excellence from Ben-Gurion University. MBA from Ben Gurion-University.

19 years with the Israel Electric Corporation in various senior management positions; commissioned the first gas-fired combined-cycle plant in Israel; managed major overhauls for both conventional and combined-cycle plants. Trained operating and maintenance staff for combined-cycle plants.

46Years old, Married plus four children.

Avid cross-country biker and loves to spend his spare time at home with his children.

Dorad is in the final stages of establishing the IT system which will enable the management of metering data from the end-user customers and generation of customer billing at reduced rates, in accordance with the contracts signed with the customers. **The system will also be capable of providing a consumption forecast for every customer on a half-hour basis, in accordance with the criteria determined by the Public Utility Authority – Electricity.**

### The Market for Private Power Producers – The Start of a Long and Promising Future

The market for private power producers is still in the making, and it will be a while before we see an advanced, sophisticated competitive market. The time required to develop and construct a power plant is very long, taking between five to 10 years from the moment an entrepreneur starts out until a power plant begins to supply electricity. Israel is still in a state of transition from a monopolistic electricity market to a competitive one, and it appears that it will be another 10 years before this competitive market stabilizes.

### On a Personal Note...

During the twenty years in which I have been a part of the Israeli electricity market, I was part of and have witnessed significant changes in the electricity economy – entering the natural gas first time in Israel In 2004, building combine cycle with more than 57% efficiency, closing old and inefficient power plant, private power plant starting to be built – changes which will eventually lead to greater efficiency in the market and to competition that will benefit the entire Israeli population.

*\*CEO, Dorad Energy Ltd.*

# And Everything Goes Around Flexible, Energy-Saving, Innovative: Wire Race Bearings from Franke have Diverse Applications



Sascha Eberhard -  
Managing Director  
Franke GmbH.

- ▶ The variety of potential applications for Wire Race Bearings is unequalled. With the LEG 8 Franke has developed a new bearing element that could establish a place for itself as an interesting alternative on the large slim bearings market | By Gerhard Reininger

## Wire Race Bearings have Many Advantages

All Franke products have one thing in common: the rolling action does not take place between the rolling elements and mating structure, but rather smoothly on separately arranged race rings. This so-called Franke Principle brings many advantages: Franke *Wire Race Bearings* give design engineers almost unlimited possibilities for the configuration of the mating structure – in terms of styling and material options. Materials such as steel, aluminium, non-corrosive steel, ceramic, Teflon, plastic or brass can be combined on an application-specific basis. This means that requirements in terms of environmental protection, suitability for clean room and food use can easily be fulfilled. Franke products also accommodate customers' efforts to reduce energy consumption. With regard to free movement, a reduction in drive power by up to 30 % is possible compared to other bearings.

## High-Quality Materials Based on the Latest Research

Bearings must display high-quality material properties if they are to be used in the products of tomorrow. Franke uses coating processes based on the latest research whenever customers require. This includes special chemical and physical coating processes for the race rings and the connections, in order to achieve the desired properties. As a result, Franke bearings are particularly suited to challenging environments like clean rooms, vacuums, space travel, and food, medical and solar technology. Use of the latest lubricants represents another adjustment phase that is tailored to the particular application. Franke bearings can be operated individually with food, clean room and vacuum-suitable lubricants, low-temperature grease, chemical-resistant or particularly adhesive lubricants for underwater use.

## Special Developments for Medical Technology

Franke *Wire Race Bearings* offer an extensive range of special developments for medical technology. Customer-specific Franke bearings for computer tomographs are suitable for top speeds up to 300 rpm with a rolling circle diameter of 1,500 mm. Elastomer-mounted parts are used in these patented Franke Fluesterlager® bearings. In addition to smooth running and low rotational resistance, the bearings are characterized by low impact sound. The elastomer



LEG 8: Slim bearing with 2 wire races and 4-point-contact.



Light and compact design, available in diameters up to 30".

insulates the bearing noise and separates the housing parts – the inner ring is electrically isolated from the outer ring. The bearing is used for luggage scanners in the security technology sector as a double-row angular ball bearing design. This combines load capacity from all directions with the quiet running and precision of an axial or radial bearing.

## Franke Technology for the Clean Room

Franke clean room bearings must achieve results that far exceed standard requirements. For example, Franke clean room bearings are used in the illumination optics of wafer steppers for chip production.



These bearings are ideal for the extreme requirements imposed by the clean room, and by high temperature or vacuum applications. A lightweight but high-strength aluminium alloy with special coating is used for the bearing housing. Ceramic balls have proven to be excellent components for clean room bearings. A special lubricant with no particle emission ensures the bearing is suitable for clean room use.

### Franke Wire Race Bearings for Solar Drive Systems

Franke wire race bearings are used for the adjustment of heliostats to reflect solar radiation towards the power tower. Electricity is generated by solar heated water via hydroelectric turbines. Slewing gear units are used to turn the huge solar panels very slowly according to the position of the sun to ensure the maximum irradiation. The wire race bearings are directly integrated into the housing parts of the driving system.

### Franke as a Development Partner

Every movement task project has its own peculiarities. With experience gained from over 70 years of bearing design, Franke GmbH sees itself as a development partner for new innovative tasks and technical goals. Solutions are tested in cooperation with institutes and universities. Parameters like as load rating, rigidity, rotational resistance, material selection and running features are developed for all Franke special bearings in close cooperation with customers, in order to achieve optimum adjustment to the specific application.

### The LEG 8 is a Consistent Redevelopment of the Wire Race Bearing Technology

In the LEG 8 two race wires are combined into one. Instead of the four race rings you find in conventional *Wire Race Bearings*, the LEG 8 has just two. The four-point principle is maintained by the special

profile of the raceways. Like all Franke products the LEG is flexible. The preload can be adjusted individually using the open wires. The bearing will be used in solar trackers, packaging machines, winding machines in the textile industry, in robot handling and in medical technology.



"We are proud to introduce the LEG 8", Jörg Egelhaaf, Technical Director.

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## Producing Liquid Fuels out of CO<sub>2</sub> by use of Solar Energy



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# Methanol – Gaining Twice: Improving Both the Quality of Air as well as Providing a Reliable Electricity Supply

The houses of the city of Eilat and the clear blue waters of the Red Sea reveal themselves towards the end of the long Arava highway. The bay of Eilat is spread out before you in full splendor and your heart bursts. In this southern city, an exciting daily routine takes place, requiring a strong and robust electricity infrastructure. According to the Israel Electric Corporation [IEC], the average demand for electricity of an Eilat residence is 18% higher than that of a residence in the rest of the country. This is a considerable gap. In the small power station located near the city, one small industrial gas turbine and two diesel-fueled turbo-jet gas turbines generate electricity. The conversion of the power station to generation by methanol will contribute significantly to the improvement of Eilat's air quality and will maintain the reliability of the electricity supply to the city.

In 1965, IEC constructed a power station with an installed capacity of 6 MW in Eilat together with the first desalination plant of this type built in Israel. This power station operated for about 15 years, and was shut down in 1980. At the same time, due to Eilat's fast rate of development, gas turbine power stations and switching stations were built to improve the reliability of the electricity supply both to the city's residents and those of the Arava. In its early years, Eilat was an "electricity island" and it was only in the 1960s that the city was connected to the national electricity grid by the 110 KW high-voltage line. The peak local consumption in that period reached 5-6 MW. Presently, the generation capacity of the Eilat gas turbine power station stands at approximately 100 MW [a 16-fold increase in less than five decades].

Today, electricity to Eilat is supplied via two external high-voltage electricity lines from the center of the country. Due to Eilat's accelerated development in the last years, it has become ever more difficult for these lines to provide for the increasing demand. In order to meet the quality indexes and reliable electricity supply to which IEC has committed itself, the generation system and electricity supply to the city must be upgraded. To meet these requirements, the Company has been promoting the construction of an additional high-voltage line to reinforce and increase the transmission capacity to the city from the national grid. Erecting the line involves burying it in the Ramon Crater and this work will only be completed in 2016. Until then, the Company is forced to operate the turbo-jet/industrial gas turbines near the city during peak hours. Diesel oil is considered a relatively clean environmentally-friendly fuel compared to heavy fuel-oil and coal, but still pollutes more than natural gas. The Ministry of Environmental Protection understands the need for a reliable electricity supply to the city, especially due to the prevailing severe weather and the scope of the tourism trade. As a result, the Ministry has made an exception and permitted the operation of the diesel-fueled gas turbines, located in the desert areas near the city, for short periods, but for no more than 300 hours per year – a total that does not meet the demand. This authorization was granted to IEC by the Ministry of Environmental Protection even though the emissions of the diesel-fueled gas turbines are higher than those permitted in the regulations and may affect the air quality of the residents. As a consequence, the Ministry of Environmental Protection and its Minister supports the methanol-fueled operation of the Eilat gas turbines.

*Yaacov [Yasha] Hain, IEC's Deputy President and CEO*, who is leading the project, explains that the Ministry of Environmental Protection, aware of the environmental advantages in burning methanol, will permit gas turbine operation for longer periods of time, up to 2,000 hours a year – almost seven times more than permitted today, with diesel-fueled electricity generation.

## The Joint Initiative between IEC and Dor Chemicals

Dor Chemicals, the sole importer of methanol to Israel, began promoting the construction of a 500,000 tons-per-year methanol plant in Israel. As a result, explains Hain, IEC decided, as part of its environmental research and development activity in its Strategic Plan for Sustainable Development, to look into the implementation of methanol as an alternative to diesel to fuel the turbo-jet gas turbines, due to it being a significant emission-reducing fuel, and thus contributing to the improvement of the environment. These benefits must also be added to the fact that the cost of methanol per energy unit is somewhat lower than diesel.

*Mordechai [Modi] Reshef, the Northern Region Gas Turbines engineer responsible for the operation of the diesel-fueled turbo-jet gas power stations was appointed to head the project. Dr. Moshe Keren, Deputy Department Manager of the Business Development Unit in the IEC Engineering Projects Division was appointed to assess the initiative aspect and the economic viability of the project.*

The methanol initiative was established to study the implementation of methanol over varying periods of time. In the short term, the possibility of replacing diesel, as in the case of Eilat, where methanol is planned to be used until completion of the high-voltage power line work to improve the electricity supply capacity; in the long term, the possibility of exporting technology to convert diesel-fueled gas turbine power stations to methanol-fueled power stations.

## Methanol – A Fuel with Advantages

### Economic Advantages

Methanol is a synthetic alcohol and not a mined mineral. Therefore, it is clean from foreign materials and can be considered a noble fuel. "As for its market price", explains Dr. Keren, "methanol can be regarded as a commodity [its price is determined in the futures stock exchanges]". Methanol's world price is not influenced by fluctuations in the oil price. Methanol can be produced from a number of raw materials, such as: coal, natural gas, RDF, and oil distillates. Its price tends to be stable and should there be an increase in the tariff of one of the raw materials used to produce it, its variety of sources enables producers to use an alternative cheaper raw material, and thus minimizes the effect of the price increase. Lately, due to the increase of methanol production in China, its price has fallen and it is lower than diesel. This fact makes the use of methanol viable compared

to diesel, considering that double the quantity of methanol compared with diesel is required to produce the same caloric value.

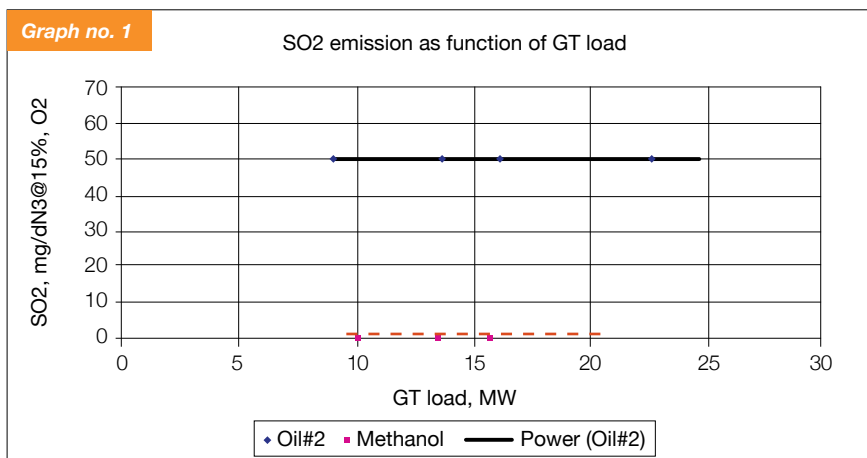
### Conveying Advantages

The conducting of natural gas to the power stations is by pipelines, but for the conveyance to be worthwhile, the quantity of natural gas must be large enough to justify the laying of pipelines. Therefore, in places that energy consumption does not justify laying of pipelines, there arises a need for other energy sources. A known alternative to gas piping is the use of Liquefied Natural Gas [LNG]. Converting natural gas to liquid reduces its volume by about 1,000 and enables easier transport. Nevertheless, to liquefy natural gas, there is a need to cool and store it in containers at ultra-low temperatures of minus 160° C. Storing and conducting LNG becomes a special challenge. Methanol provides an effective alternative solution in this aspect as well, as it is a liquid that can be stored and transported at room temperature, i.e. there is no need to cool it to extreme temperatures as is required to convert LNG.



Yaacov [Yasha] Hain, IEC's Deputy President and CEO

Yaacov [Yasha] Hain, IEC's Deputy President and CEO, who is leading the project, explains that the Ministry of Environmental Protection, aware of the environmental advantages in burning methanol, will permit gas turbine operation for longer periods of time, up to 2,000 hours a year – almost seven times more than permitted today, with diesel-fueled electricity generation. This is due to methanol being a significant emission-reducing fuel, and thus contributing to the improvement of the environment.



### Environmental Advantages

In the main environmental indexes and according to the Clean-Air Law of 2008, the emission indexes from burning methanol are much better than those from burning diesel. "It is no wonder that the Ministry of Environmental Protection and its Minister support the joint venture between IEC and Dor Chemical", states Engineer Reshef.

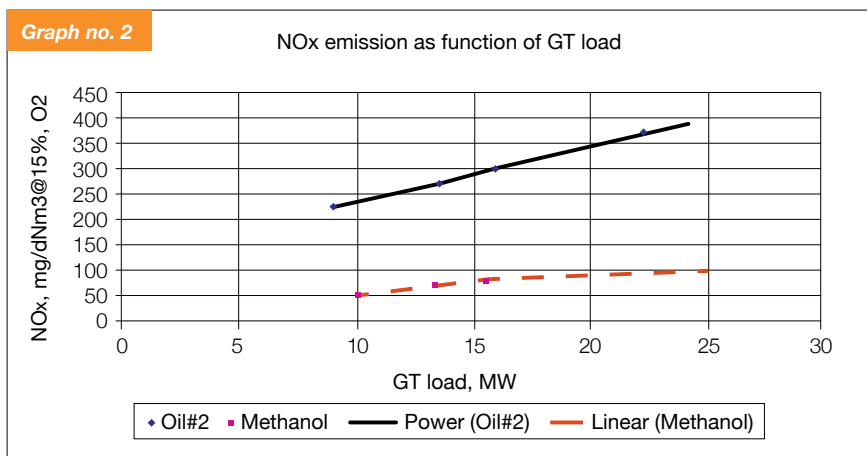
Methanol's undisputed advantage is that it does not contain sulfur, so that when burned, there are no sulfur dioxide [SO<sub>2</sub>] emissions, [see graph no. 1]. More important is the fact that methanol combusts at a significantly lower temperature than diesel, resulting in an 80% decrease in nitrogen oxide [NO<sub>x</sub>] emissions [see graph no. 2]. The index for particulates, emitted into the air during the methanol burning process, compared to diesel, is much better and the air-borne particulate quantity is almost nil [see graph no. 3].

These advantages make methanol a very environmentally-friendly fuel as far as air quality is concerned, and places it in very good standing compared to diesel, which in turn was considered a friendly fuel compared with other fuels, such as heavy fuel-oil.

### Occupational Health and Safety above All

This initiative is a first in which methanol is to be used as a raw material for electricity generation. For this reason, the constant emphasis on safety and health regulations in the workplace, customary at the IEC, is doubly important, as Engineer Reshef explains.

According to the law and before the Eilat methanol initiative was decided upon, a risk



evaluation analysis was executed and risk calculations for the different scenarios were carried out, such as burning of a methanol vessel, the container cracking, and a methanol leak, in various meteorological conditions. The risk circle did not exceed the area of the site in any of these scenarios.

Special safety precautions will be taken when adapting the diesel-storage vessel to methanol [2,000 cubic meter volume]. The dike (spill retainers) around the container will be hermetically sealed to prevent permeation into the ground in the event of leakage. In addition, a special floating ceiling will be installed in the container designated to prevent the evaporation of methanol into the environment. The installed fire-extinguishing equipment will be upgraded so that in the event of fire, a special alcohol-resistant foam will be ejected to blanket and stifle the flames within seconds.

Methanol must be handled skillfully. The drivers of the container trucks, the workers responsible for unloading the methanol at the generation site, and the workers responsible for storage in the location, will all undergo special training to learn how to handle this material and how to behave in an emergency. The fire-extinguishing array on site will be upgraded and exercises will be carried out with the Eilat-Eilat Fire Fighting Regional Association to practice and maintain the expertise and awareness needed.

As the gas turbine site is situated west of Eilat, the container trucks will arrive at the generation site directly from Road 12, without any need to enter the city.

As part of upgrading the electricity generation layout that operates the gas turbines with methanol, a new state-of-the-art control system will be installed at the site. This system



will monitor the methanol-fueled electricity generation process continuously. In case of a fault of any type, the flow of methanol to the turbines will be stopped immediately and if required, fire-extinguishers will be operated automatically.

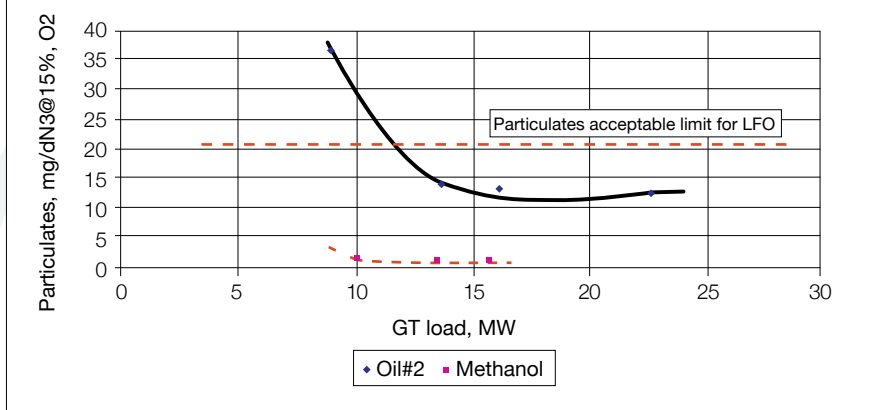
### The Export Potential

It is not always economic to transfer natural gas over long distances and at times, it is also not possible for practical and technical reasons. Therefore, in quite a few electricity-generation facilities throughout the world, in distant or isolated locations [e.g. islands], electricity is generated by fuels such as diesel or heavy fuel-oil. Having heard of the methanol initiative, currently being promoted by IEC and Dor Chemicals and beginning to pave its way throughout the world, many industrial companies the world over are beginning to follow this development closely.

According to Dr. Keren's assessment, the planned conversion technology for the turbo-jet gas turbines is new, but promising, so that the probability of the initiative's success is high. Consequentially, the joint partnership of this project between IEC and Dor Chemicals can become leverage for the initiative and can market the know-how [technical and regulatory] accumulated from conversion of the power stations fueled by diesel or similar fuel to modify them to use environmentally-friendly methanol as a fuel. This contributes to the importance of the initiative and transforms it into a stepping stone for the establishment of a leading novel technology.

Graph no. 3

Particulates emission as function of GT load



### Opening the Doors to Visitors

Due to the world's interest in the methanol initiative, delegations from all over the globe are expected to arrive in Eilat in the near future to study the initiative and its business potential. During the Eilat-Eilat Conference, and also following it, the participants and representatives of other businesses can visit the site located in Eilat and be suitably impressed.

In the future, after the completion of the methanol generation facility and its production from local natural gas, it may also become a source of Israeli export.

Visits may be coordinated with Engineer Reshef, the Project Manager: 972-57-7625878.



Methanol connection

### IEC Policy for Environmental Protection\*

- Integrating environmental considerations in all company activities and decision-making.
- Designing and operating facilities with emphasis on continuous reduction of environmental impact, taking into account principles of sustainability, while adopting the best proven and economic technologies.
- Adopting advanced proven technological covenants/agreements, even when laws and regulations do not exist.
- Intelligent use of raw materials and natural resources: land, air, water, and fuels.
- Reducing and recycling of garbage and by-products.
- Integrating landscaping considerations, both spatial and environmental, in planning new facilities and maintenance of existing plants.
- Maintaining an open and transparent dialog with the public, regarding plans with an environmental impact.
- Reducing greenhouse gases, in the spirit of international treaties in which Israel plays a part, by increasing efficiency of power stations, increasing fuels and environmentally-friendly energy sources, and encouraging electricity saving.
- Joint activity with environmental groups (state, public, international) including participating in environmental studies, developing and promoting advanced technologies.
- Implementing environmental values in the organization's culture, increasing environmental awareness and commitment by company workers, and integrating environmental issues in community activity.

\* IEC Environmental Report for 2011; July 2012; p. 7.

# Matalon Energy Sources LTD – Auto Controlled Sun-Trackers for Solar Panels



►► Innovative, efficient solar energy systems with sun trackers; High ROI; Producing the system components in Israel | By Iris Wiss and Avi Avramov

Established in September 2009 by Yair Matalon, who holds 100% of its issued shares, Matalon Energy Sources is currently generating solar energy from 2 operational facilities, with a capacity of over 150,000 kWh per year.

Since its inception, the company has been developing patents in the renewable energy field, mainly in the sun tracker section and in the concentration of light to solar panels. The company registered 2 patents involving sun trackers in combination with concentration of light onto solar panels.

Like many other companies, Matalon has channeled its resources into commercial facilities for the generation of revenue, as well as into R&D for future products.

The company won the Israeli government bid for developing new technologies in the renewable energy field and signed a contract to develop and build a solar sun-tracker field for the purpose of testing its technology. All the above is financed by the company [50%] and by the Israeli government [50%], at a total of \$550,000.

**This project will generate additional electricity to the national grid, estimated at around 300,000 KWh per year.**

In addition to this project, the company moved its manufacturing facility of solar panels from China to Israel. This move gives the company the ability to integrate its sun tracker with the manufacturing of solar panels in Israel at the same plant, making it one device in one manufacturing facility.

"We can, and in fact do, lower the manufacturing costs, as well as control the complete design stage, improve the product as a whole

combined system, and lower maintenance costs," says the founder and managing director, Yair Matalon.

## Current Goals and Financial Policy

- Our main goal is to give investors the highest rate of return in any renewable energy system that we install and provide.
- Our motto is "Keep it simple."
- Our job is to do it at the best price for the customer.
- Our privilege is to provide the highest return on investment [ROI] in the shortest time, and with the lowest maintenance costs.

## Our People – Our Light

The staff, comprised of six persons, is the company's central resource. All are committed to a steady, long-term relationship with the company's future employees and its clients.

In 2013 the company plans to add four more positions to its workforce, setting the stage for a combined workforce of 10 people.

These targets and commitments will assure the company's shareholders, the managers, the employees and the customers a long-term relationship and a guarantee of high-quality products as well as the highest rate of return for investors in commercial renewable energy projects.

## Our Sun-Trackers

Based on simple physics, this self-propelled, stand-alone, self-controlled system gives



Yair Matalon, CEO of Matalon Energy Sources at the Yavne testing site.

a customer up to 50% more accumulated energy, on a yearly basis, than any other static construction. All this, with the lowest cost per watt compared to any other sun tracking device.

We do not base our system on any controller, electronic device, battery nor external power supply. Our tracker uses the solar panels themselves as controllers, as well as a power source, to operate the sun tracking device. This simple, self-controlled patent continues to work on any cloudy or sunny day, from sunrise to sunset.

As our customer, whether you are a small residential client or a large commercial enterprise, you will attain the same common objectives that we have – to maximize your investment at the lowest cost. We will provide you with the tools to reach your goals.

## The Bottom Line

This is a turnkey project, from start to end, which includes panels, trackers, inverters and electric wires and switches at a cost of \$1.50 per installed watt.

No matter where you are located, you will get 50% more accumulated energy than any of your neighbors.

## Our Sun-Tracker Products

1. M3900 – built for a 500-watt system
2. M4900 – built for a 1,000-watt system
3. M6900 – built for a 1,500-watt system
4. M8900 – built for a 2,000-watt system

## Contact Details:

Yair Matalon; 0503443843;  
yairmatalon@gmail.com;  
www.matalon-ltd.com



Innovative approach to sun concentration on solar panels.

# Standardization – An Economic Growth Engine

► The Standards Institution of Israel contributes directly to the opening of markets abroad for Israeli products and the increase of Israeli exports | By Uri Schlesinger

Standardization has a direct economic influence on all the activities, fields and sectors of the Israeli economy, says **Daniel Goldstein, Director General of the Standards Institution of Israel [SII]**. To strengthen his statement, he cites a number of independent studies conducted by various parties in other developed economies in the world.

The OECD and the United States Chamber of Commerce [USCC] estimate that standardization and conformity assessments [inspections to verify that a product and/or service meet the standard requirements] jointly influence 80 percent of global commerce. A study conducted by the German Institute for Standardization, Deutsches Institut für Normung [DIN], showed that standardization produces roughly 1% of GDP. Similar results were obtained in studies by other leading standards institutions: A study by the British Standards Institution [BSI] revealed that standardization contributes approximately 2.5 billion pounds to the economy and an increase of 13% in work productivity.

Israel's economy, says Goldstein, is no different from these developed economies. According to his estimation, standardization adds about 1% to Israeli GDP as well. This estimation is especially true with respect to fields in which Israel has a clear advantage over other countries, such as water treatment, irrigation, agriculture and cleantech.

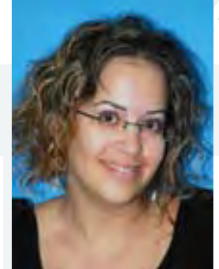
In this context, **Helen Atarot, Director of the Standardization Division of the SII**, explains that there are a number of projects in several fields, dealt within the framework of the international standardization arena, where Israeli participation has the potential to increase Israel's commerce and export. **Two of the institution's flagship projects are in the fields of water and energy.** In 2006, the year in which the SII's project of participation in water international standardization



Daniel Goldstein, Director General of the Standards Institution of Israel.



Helen Atarot, Director of the Standardization Division of the SII.



Dr. Michal Philosoph, project manager in the field of energy and environmental protection at the Standardization Division.

activities began, Israeli export in the water field was estimated at \$600 million; in late 2010, it was \$1.7 billion [approximately 4.2 times more than in 2006].

"We can reasonably assume," says Atarot, "that if the work in standardization has contributed 1% added value to exports, then the widespread work of the Israeli Standards Institution in the water field contributed at least \$200 million to Israeli export in that field in 2011."

## The Green Standardization Nation

Abroad, Israel is known as a Start-Up Nation, partly due to its innovation and product development and its novel and advanced systems as well as services in the field of water specifically and cleantech in general. The SII has set the goal of supporting Israeli industry and Israeli technological initiatives by establishing local standards for Israeli developments. The next step, of course, is to bring these local standards to the attention of the International standards writers and to influence international standards through Israeli involvement in international standardization committees.

"At the SII," says Atarot, "we make sure that Israeli progress in technology and innovation

is accompanied by suitable standards. Using the international standardization platform makes it possible to turn the developments, requirements and procedures developed in Israeli companies [and implemented in the local standards] into global requirements, thus giving Israeli exporters of products and services an advantage over their rivals abroad."

## The Water Project

Up until 2006, the year in which the water project started at the SII, directed by Yaron Ben-Ari, the institution's work in this area was limited and had only 20 representatives of Israeli companies. At the time, Israel was branded abroad as a groundbreaking country in the field of irrigation. It was clear that the management of the irrigation board on the International Standards Committee would be handed over to Israelis. Success came along. About 90% of all international standards developed by the irrigation international committee were actually Israeli standards that had been developed following technological advances in the Israeli industry. The Israeli standards that became international standards boosted the local irrigation industry and 'put Israel prominently on the map of world technology'.

Today, 160 representatives from various in-

dustrial plants in the water field are involved in this project. In the past four years, the project has been joined by many representatives from start-up companies who realized the role of standardization in encouraging the marketing of products, systems and services in the local and global markets.

The SII, through representatives from the industry, serves as a member with a leading role on many international committees in the water field, such as the Committee for Recycling Treated Waste Water or the Committee for Water Security – meaning not only protecting water resources in the event of a terror attack or a war but also in cases of natural disasters or operational mishaps. A proposal was recently put forth for a new standard on Bio Early Warning Systems [BEWS], which supports a number of Israeli technologies developed for treatment purposes through prevention and immediate warning of contamination of water resources.

Standardization proposals are in development stages in the field of water loss [as a result of pipeline leakage] and water desalination. On these two subjects, no international standardization exists. According to Atarot, international standardization will be based on Israeli technology and will turn the systems, requirements and work regulations developed by Israeli companies into an international measure of the right course of action. Without a doubt, these standards will give Israeli companies an advantage in international markets and tenders.

Another important development, says Atarot, is adding the SII to a strategic committee run by the International Organization for

“the energy project was launched in 2009 at the SII.” Up until then, the number of Israeli standards on energy was limited, and Israeli activity on international standardization committees in the field of energy was virtually nonexistent. This project’s uniqueness, compared with the water project, lies in the fact that its work is done on two levels:

**1. Israeli participation on international standardization committees.** The SII takes part in international standardization committees affiliated with two standardization organizations: ISO, which deals with standardization in all fields, and the International Electro-technical Commission [IEC], which focuses on standardization in the electric field and deals, inter alia, with standardization for energy facilities connected to the power distribution network, such as wind turbines and photovoltaic cells.

Delegates from 15 Israeli companies in the energy field represent Israel on international committees in these two standardization institutions. The Israeli representatives participate in committees that deal with standardization in the fields of solar energy, wind energy, bio-energy, electric vehicles, etc.

A new committee was recently set up in ISO on biogas [gas made up mostly of methane and produced by the breakdown of organic matter in the absence of oxygen]. The committee will focus on preparing international standards that will refer to the quality of the gas that is produced, the installation of small/ medium/ large apparatuses and the transport of gas from the production site. Israel is represented on this committee by staff from two Israeli companies.

equipment and household equipment, as well as green building were announced [**the complete list of Israeli standards in energy and the environment is available on the SII website [www.sii.org.il](http://www.sii.org.il)**].

Daily reality shows that these standards are implemented in all sectors of the Israeli economy. Testing is conducted according to these standards, and some standards are mentioned in laws and regulations of various government offices [to enforce the demands of the law]. The goal is to achieve uniformity in systems, prerequisites and work regulations in order to raise the level of quality and safety of products as well as services by using Israeli standards.

“Our goal is that local work will complement international activity and that the international committees will adopt Israeli standards in as many fields as possible as it has in the irrigation field,” says Philosoph.

## Opening a Gateway for Local Companies

One of many examples for the encouragement of commerce and export is the participation of Israeli representatives in the IEC/TC88 international committee, which deals with standardization for wind turbines. The committee sets numerous international standards in the field, among which is certification of wind turbines. Although there is an international standard on the subject, it applies to wind turbines of all sizes, and its requirements are mostly not suitable for small wind turbines. Local manufacturers of small wind turbines that are marketed abroad must meet the requirements of this standard with all that the inherent implications. The fact that there is no unique international standard for the certification of small wind turbines makes the product, the process of certification and the possibilities of entering international markets more expensive. The SII recently submitted a proposal to head a task force that would prepare international standardization designated for the certification of small wind turbines, based on the experience and technology of the local industry.

“It is clear that if this kind of standardization is developed,” says Philosoph, “it will help the local industry with the trade, marketing and sales of local wind turbines in international markets.”

## Increasing Israeli Involvement in Standardization

To increase the participation of local companies, as well as professionals, in international standardization in the field of energy, the SII hosted a conference last October. At the event, Atarot said that **the participation of Israeli representatives in international standardization committees is the catalyst that leads to the technological promotion of companies and to an increase in Israeli exports.**

Abroad, Israel is known as a Start-Up Nation, partly due to its innovation and product development and its novel and advanced systems as well as services in the field of water specifically and cleantech in general.

Standardization [ISO]. The purpose of this committee is to determine the policy and strategy for water-related international standardization. **Including Israel on this prestigious committee, whose members represent standards institutes in 10 countries, such as the US, China, Japan, Germany, England and France, is an indication of the appreciation for the standardization work of the SII and the technological capacities of the local industry.**

## The Energy Project

“Following the success of the water project,” says Dr. Michal Philosoph, project manager in the field of energy and environmental protection at the Standardization Division,

In IEC, the SII recently attained an important achievement of chairing a new standardization committee, IEC/TC 117, on Solar Thermal Electric Plants [producing power from solar thermal energy]. This is Israel’s first time heading an international committee of this scope.

**2. Setting Israeli standards in the energy field.** To date, some 100 Israeli standards have been publicized in the energy field and roughly 120 Israeli standards in the field of environmental protection. Out of this number, In 2011 alone, approximately 70 Israeli standards dealing with solar systems, photovoltaic cells [including mechanical installation and electric installation which include safety], wind turbines, energy efficiency of industrial

# Fast, Effective and Unique Solutions to Protect Green Intellectual Property Assets



▶▶ Personal touch, integrity and loyalty to our customers are part of our DNA | By Uri Schlesinger

!! An Austrian company applied for a cleantech patent in Israel using a local patent attorneys firm. For unknown reasons, the application was handled by several patent attorneys in that firm, each with his own agenda and strategy, slowing the prosecution process almost to an halt. The Austrian patent attorneys office that handled the case for the Austrian company heard about our firm and decided, after a year of prosecution by the other firm, to retain our services and let us handle the case", recounts **Amit Zuckerstein** and **Eyal Shilon\***.

The minute we got the case, we realized that we had to take a new approach to extricate it from the entanglement it was in. We decided not to start a new string of, what might seem endless, correspondence with the Examiner of the case," recounts Zuckerstein. "Instead, we conducted an interview with the Examiner to find out directly what, in his opinion, were the obstacles that prevented the registration of the patent. After we got to the root of the problem, we were able to explain and argue our claims, so that within a month of receiving the case to our office, the patent was granted."

Shilon and Zuckerstein explain the rapid allowance: "It was mostly our thorough understanding of the cleantech industry and particularly the essence of the technology behind the patent application. In addition, we were able to identify the 'blind spots' of the examiner, where the Examiner could not recognize or understand the innovation of the technology, and so we were able to simplify and justify the arguments." Shilon adds, "Our firm is a boutique firm, so naturally our work method is not an 'assembly line'. There is no generic process in our firm with predetermined steps when applying for a patent. We examine each case personally, every step and request, and decide according to the nature of the case and the



Eyal Shilon [left] and Amit Zuckerstein [right].

client upon the most effective, quick, cost-effective and recommended path for this case and this client".

## The Personal Touch

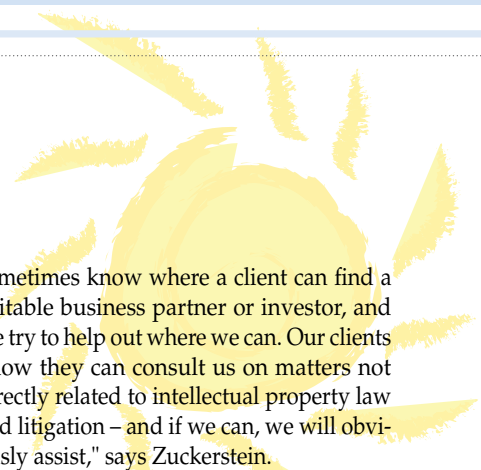
"As we are a boutique firm, the work method we developed includes one of the partners meeting with the client, not only at the first meeting but throughout the process. We, the partners, understand the unique demands of our clients and translate them into the 'patent language' used in patent attorneys firms, all the while explaining the process to our clients in plain language. The same partner who first met with the client will accompany him during the entire process, whether it is related to patent applications, legal processes or court litigation," explains Shilon. These standards ensure that not only one

pair of eyes approves any given decision or documents. At the office there is always a second person to check every document that goes out, whether it is one of the partners or one of the patent attorneys, depending on the nature of the procedure. If it is a procedure that patent attorneys don't handle, it means that both partners have consulted on it. Every action is scrutinized by the other partner, the one who was not initially in charge of it. "This unique way of doing things is part of our DNA," the partners say. "We do not give up on it, even though that is not common in the business."

## Creative Thinking and Customized Solutions

"A client in the cleantech industry, a wind turbine manufacturer, came to us one Thurs-





Our firm is a boutique firm, so naturally our work method is not an ‘assembly line’. There is no generic process in our firm with predetermined steps when applying for a patent. We examine each case personally, every step and request, and decide according to the nature of the case and the client upon the most effective, quick, cost-effective and recommended path for this case and this client.

day afternoon, a day before he was going to present his invention at a convention,” recounts Zuckerstein.

A basic rule in patent law is that in order to receive patent rights, an application must be filed with the patent office before the invention is revealed publicly. This rule has very few exceptions, most of them not relevant in that case. It was obvious that if this client had presented his invention at the convention, he would have risked losing all rights to his invention.

“We understood the delicate situation the client was in. We canceled all our appointments for that day and dedicated our time to the client,” Zuckerstein continues. “Within the short time we had, we analyzed, together with the client, the innovative nature of his invention and its technological issues. Since we are up to date with technological developments in the cleantech field, both in Israel and around the world, we were able, even within that very limited time, to formulate a ‘security net’, so to speak, in order to protect the client’s invention and the technology, as well as future research directions and developments. Late that night, we electronically filed the application with the USPTO” [US Patent and Trademark Office].

The Paris Convention allows applying for a patent in each of the member states within one year from the date of filing of the priority application in a member state. This means that the client potentially gained protection for at least another year in every one of the other 173 member countries.

“Despite the tight schedule and the unusual work done on the case, we didn’t charge the client any exceptional rate because we understood his plight,” says Shilon. “We feel a sense of camaraderie with our clients and truly want them to succeed.”

### Professionalism and Integrity

“It is very important to us,” stress the partners, “not to have to ‘invent’ the technology for the clients. If an inventor comes to our office with an invention that we do not think will obtain patent rights, we will not begin the process

and drag him through a lengthy, costly and complicated process.”

“The statistic that we’ve been seeing over the last few years is that 7 out of 10 meetings end after explaining to the client that his chances of obtaining patent rights for his so-called invention are low,” says Zuckerstein. “We may lose potential revenue, but professionalism and integrity are the foundation of our work, and that’s where we do not make compromises.”

### Assisting Clients

“Owing to our good understanding of the cleantech industry in Israel and abroad, we

sometimes know where a client can find a suitable business partner or investor, and we try to help out where we can. Our clients know they can consult us on matters not directly related to intellectual property law and litigation – and if we can, we will obviously assist,” says Zuckerstein.

The partners are scheduled to make a business trip to Germany during November and will, among other activities, meet with venture capital funds on behalf of their clients to try to raise money for their ventures. However, on this subject the partners clarify: “Since the protection of the intellectual property of our clients is the core of our business, we generally do not go on endeavors to find potential partners or investors for our clients before their intellectual property is fully protected.” They stress: “That is just an opening for unnecessary future disputes.”

*\* Advocates Eyal Shilon and Amit Zuckerstein are the partners of Shilon Zuckerstein & Co., Advocates and Patent Attorneys specializing in intellectual property, patents, trademarks, copyright and more.*

### Start-Ups, Patents and Success Chances\*\* ...

Academic studies have shown:

1. There is a direct and positive correlation between patent registration and the chances of securing finances through venture capital funds, the number of financing rounds that the company successfully carries out, the total amount of investment in the company/venture, the success in making an exit and the lifespan of the company.
2. An empirical study of 535 financing rounds carried out by 173 companies revealed that, on average, 21% of the increase in a company’s worth was due to the company’s patent portfolio.
3. The chances of entrepreneurs being able to market their invention depend greatly on the existence of a patent application and its merit.
4. A high-quality patent significantly increases the financial cycle of the company two to three years following the submission of the application. The rate of increase depends on the quality of the application.
5. The wider the scope of the protection offered by the patent, the greater the company’s worth.
6. The marginal revenue of a company/venture may increase twofold due to the right patent strategy in the research and development stages.
7. The stock value of a company increases with an increase in the number and quality of patents in its intellectual property portfolio.
8. Intellectual property is often the only significant property owned by small companies.
9. Small companies in the software industry that have patents have a higher chance of securing finances. Investing in patents in the early stages of a venture is very important.
10. Patent portfolios are a critical factor in the process of evaluating a company’s worth. Companies that make acquisitions of start-ups begin by looking at the intellectual property portfolio of the company [the patents and patent applications submitted by the company are evaluated, as well as the rights to those patents and the company’s obligations in relation to the patents].

*\*\*Further information can be found on the website of Shilon Zuckerstein & Co. [www.israelip.co.il](http://www.israelip.co.il)*

# Solar Systems of Sahar GN Ltd

▶▶ Innovative, high-efficiency, low-cost solar thermal device on a par with fossil fuel systems

By Robert Roach, PhD

Sahar GN Ltd., a privately owned company, has been designing and building automatic lines and production machines for the hot water solar industry for the last 15 years. The company is now introducing a new line of solar thermal collectors suitable for industrial applications requiring heated working fluid up to 200°C. This new line of low-cost, high-efficiency devices promises to push the envelope of solar thermal devices to be on a par with fossil fuel systems.

## High Efficiency

Sahar aimed at high efficiency from the start by physically modeling the entire system. Sahar developed specialized algorithms so that system sizing, along with flow friction and heat transfer, were included with loss mechanisms to optimize the amount of heat that could be brought to the working fluid. The result was that the proof of concept module 2-axis collector rendered 88% of its collected energy to the working fluid at 90°C. The beta unit, with a 22 square meter collector and 1-axis, returns up to 25% more energy to the working fluid than competitive units. PV panels were added to make it a stand-alone unit.

## Low Cost

Part of the optimization also included the price of some subsystems. It was realized early on, for example, that solar tracking adds considerable cost to the system. By

limiting the maximum temperature to 200°C, Sahar was able to increase the diameter of the receiver. The increased radiation loss is compensated by the increased efficiency of the longer exposure of the fluid to the concentrated energy. The larger diameter also lowers the tracking accuracy requirement considerably enabling one to use very low-cost tracking, which ultimately lowers the cost per kW thermal.

Attention was also paid to the manufacturing processes of the unit so that only the simplest of methods are required to make all the parts. In fact, all but two key parts can be manufactured at the site. Labor costs are reduced because system assembly can be done with simple tools. Furthermore, the cost of shipping was considered so that unit parts can be shipped as needed with high container solidity.

Taken together, Sahar has thus designed one of the most efficient and low-cost solar thermal systems. Since over 60% of industrial processes that use heated working fluids use temperatures below 200°C [nearly 80% for food, tobacco and mining industries], the Sahar devices should merit serious consideration for integrators for such processes. Further, the Sahar systems could be used for solar air conditioning systems, water condensation and purification, vegetable drying, hot water for hotels, hospitals, cleaning, and a host of other applications.

## Extras

Attention to cost included looking for effective ways to minimize the cost of cleaning. The design calls for the parabolic trough to be turned upside down at night or when not in use. Doing so significantly reduces the amount of dust that settles on the surface [by more than half] and significantly diminishes dew formation on the reflective surfaces [to near zero]. Thus the frequency of cleaning should be about 1/3 that used in a trough system that does not have this feature.



Giora Nir, Sahar's CEO.



Another feature of the Sahar system is the protection from high winds. Many systems have reinforced, heavy structures to prevent damage or torsion during periods of strong winds. In Sahar's design, an open structure under the receiver greatly reduces the aerodynamic forces on the trough during high winds. The system is calculated to withstand 150 km/hr winds.

## End Users Example – Breweries

Depending on the process, breweries generally require a large supply of water heated to 165°C. Currently, few breweries in the world use solar heating. Those that do are using low-cost flat panel systems that can heat the water to around 85-90°C. The remaining temperature rise is attained by using fossil fuel. With the Sahar units, such breweries could not only significantly diminish the fossil fuel usage to simply back-up status, but the flat panel systems could also be replaced with about half the number of systems. The price would likewise be about half, since the Sahar system costs about the same as a flat panel system of the same collection area. But the efficiency of the system is double plus over 30% more energy collection, as this is a sun following system.

## Next Steps

Besides the beta site facility, which has been in operation for the past six months, Sahar is currently setting up joint projects with three other companies.

One is to provide hot water to create steam for a turbine to produce electricity.

One is to provide preheated water for a cafeteria that uses steam cooking.

And a third project provides thermal energy for a desiccant-based water from air device.

According to Sahar's CEO, Giora Nir, the company wants to license the technology and to provide expertise in setting up a production facility to the licensee. The technology is currently undergoing a patent process in Israel, the US, Europe and a number of other countries.

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Beta site facility at kibbutz Beerot Yitzchak.

# Telemenia -- A Global Power Provider



Gabon 70MW gas based power plant.

▶▶ Building advanced, sustainable power plants all over the world | By Edi Koren\*

A reliable, accessible supply of electric power is a basic requisite for economic growth. Both governmental and industrial sectors are investing heavily to dramatically increase power generation and transmission capabilities, relying on experienced Engineering Procurement and Construction [EPC] companies to deliver this much-needed electric power with topnotch technology and performance in record times.

Telemenia Ltd. [www.telemenia.com] has been a significant player in the power supply industry for the last 50 years. Since the late 1970s, Telemenia has been fully engaged in the design, construction, and commissioning of natural gas, diesel, heavy fuel oil [HFO], hydropower, and biomass-based power plants throughout the world. The company boasts a remarkable record of installing and commissioning power plants and power-generating units in four continents and over 50 countries, with thousands of mega-watts installed and over 700MW of pipeline projects. Telemenia is now also an independent power producer [IPP], developing its own power projects and supplying the generated power to the grid in South America, Europe, and Africa.

Building on its vast experience and reputation in the international market, Telemenia is a leading EPC contractor for gas-based power plants, ranging from a few mega-watts to hundreds of mega-watts. The company's close collaboration with top international manufacturers, out-of-the-box, flexible business approach, and unsurpassed technical capabilities are the keys to Telemenia's leading position.

## The Challenges

For the potential developer, there are a number of risk-bound parameters that may affect the successful and profitable development of a power plant, such as time to generation, security of costs, financing and, ultimately, supply of fuels and the evacuation of the generated power in a safe and continuous mode.

Telemenia's business approach is built around the concept of minimizing those risks for the developer. Telemenia's proven record of shorter delivery times compared to the industry's standard means reduced risks and prompt start of generation, resulting in early cash flow generation and enhanced profitability. The company's commitment to be "always on time, always on budget" means that the developer is assured of no budget overruns, sustaining the project's profitability, and boosting earnings.

In emerging economies, the assurance of fuel supply and power lines infrastructure are often a cause for concern. Telemenia delivers power plants capable of working on a multi-fuel scenario, giving the developer the extra flexibility to operate the plant under any fuel supply constraint, as well as the ability to build and deliver high-voltage power lines and connect to existing/new substations to secure the delivery of the generated power to the grid.

## The Scope of Supply

Telemenia's flexible business approach means a full range of development opportunities, such as simple EPC structures, BOT or BOO. The company also offers an EPC Package, in which Telemenia assists the developers [governmental or private] in securing the required project financing [on behalf of the developer], taking



Edi Koren, Telemenia's vice president for business development.



Izak Elyashiv, Telemenia's Managing Director.



advantage of Telemenia's strong and long-standing cooperation with leading financial institutions.

Telemenia's scope of delivery includes natural gas-based power plants using both gas engines and gas turbines, [depending on the size of the project], mode of operation, and local conditions. In both cases, the company delivers turnkey projects, including the relevant generation equipment, infrastructure [foundations, access roads, buildings and related services], centralized power plant control and connection to the grid [whether internal or external], fuel storage and conditioning, etc. As part of its social involvement, Telemenia is proud of its support of the local communities: building schools, housing, and medical care centers for the benefit of the local population.

## Success Stories

The company's most recent projects include the 70MW Alenakiri power plant in Libreville and the 105 MW Port Gentile power plant -- both in Gabon. In both cases, Telemenia won the relevant international tenders based on a combination of reputation, fast delivery time, cutting-edge technology and competitive pricing. The Alenakiri power plant consists of four MAN engines of 17.5MW each, operating on either natural gas or diesel. This power plant was built in two phases of 35MW over a period of 18 months, including a complete substation and power lines to connect to the national grid. As part of its social commitment, Telemenia is building a large housing project for the local community.

In Port Gentile, Telemenia is building a 105MW project in two phases of 52.5MW, consisting of six MAN 17.5MW gas engines capable of working with gas or diesel. The first phase will be completed in a record time of 12 months, including massive civil works to raise the power plant's ground level five meters from its original level due to the large amounts of water in the vicinity.

## Telemenia's Advantage

Telemenia's team of seasoned engineers and technicians, its strong collaboration with the industry's leading manufacturers, and its vast experience in developing projects in the international arena are the keys to the company's prominent status as a leading EPC, making Telemenia the ideal partner for the construction and delivery of gas-based power plants based on topnotch technology, unsurpassed reliability and fast delivery time.

\*Edi Koren is Telemenia's vice president for business development.

# Capital Nature Calls Out to Entrepreneurs and Researchers to Invest their Time, Efforts and Minds in Promoting Green Energy

▶ An innovative framework for developing renewable energy technologies

| By Shirley Sheffer\*

Capital Nature is an investment firm focused on funding and accelerating early stage Renewable Energy ventures in Israel. Capital Nature brings a framework that supports the full life cycle to technologies: funding academic research, incubation, follow on investments, and field testing of innovative new technologies.

Capital Nature is focused solely on one field – Energy. Its team brings decades of diverse experience in marketing, business development, investment, financial, and working with government and regulation. Its strategic partners - industrial leaders like Elbit Systems, Rafael, and Ormat, as well as others [such as Direct Insurance, Proseed and Consensus, Ben-Gurion University, Renewable Energy Initiative Eilat Eilat, and Shibolet Advocates] are high-touch with the portfolio including access to technological know-how and international markets, as well as the opportunity for later stage financing. All these position Capital Nature to turn early stage ventures to significant players in the global market.

The first two companies are already operating in Capital Nature's Eilat center [located in Israel's Arava], and an additional company is

currently being established. All are working on developing cutting edge technologies in the Renewable Energy space.

**Solariphy** – Two experienced high-tech entrepreneurs that have identified a very innovative technology in the Technion that enables a dramatically more efficient conversion of the sunlight to electric energy, and are now commercializing it.

**GEM Solar** – Serial high tech entrepreneurs who partnered to develop a unique innovative technology for optimizing silicon wafer production.

The first of the academic research projects are also being launched these days with Prof. Yoel Sasson, Dr. Yossi Paltiel and Dr. Nir Keren [all from the Hebrew University in Jerusalem].

In addition to housing an R&D center for the portfolio companies, the Technology Center in the Arava also operates a Test & Validation site. Eight companies are already using the Test & Validation site, which is being expanded to include a standardization laboratory in cooperation with the Standard Institution of Israel along with TUV, a global leader in testing and certifying green energy solutions.



Capital Nature Test and Validation Site.

While Capital Nature works closely with over 15 academic institutions to identify technologies that can be commercialized into economically viable companies within 1-4 years – such research is scarce. The multi-disciplinary nature of such research as well as the length of time required to mature groundbreaking "Green" technologies in that space, has created a situation where a relatively small group of researchers address this critical exciting space. We call scientists to join in.

Capital Nature is also eager to recruit companies to its portfolio. We urge entrepreneurs to consider the Energy space. Whether better monetizing Renewable Energy technologies, introducing energy storage solutions, addressing Smart Grid issues, or offering additional Energy Efficiency solutions - we believe the opportunities are there. We are confident that the Energy space will prevail for start-up companies as well as investors in the long run: the need is acute, governments in both western and developing countries are allocating budgets into projects in the space, and while it takes time and resources, significant success stories in the 5-8 years future are inevitable.

\* VP Investments, Capital Nature



Solar Panels in the Arava.

# More Energy in Utility Installations

▶▶ SolarEdge will reveal its new 850kW utility inverter, specifically designed to work with power optimizers, at the Eilat - Eilat Conference

As energy prices soar while PV module prices constantly decrease, renewable energy prices are approaching grid parity. This encourages governments around the world to lower subsidies for renewable energy, which poses a new challenge for investors in utility-scale installations. They must produce the most power from a given area, while minimizing the installation and maintenance costs in order to maximize profits from their investment.

## Up to 25% More Energy with Module-Level MPPT

Perfectly designed PV plants avoid shading and strive to provide module uniformity through pre-sorting. But mismatch cannot be completely avoided, as each module provides maximum power at a different combination of current and voltage. In fact, mismatch is a natural state that exists between PV modules from their outset. Module mismatch can be caused by module damage during transportation, temperature variance, partial shading, unequal soiling, etc. As PV installations age, uneven module degradation occurs, resulting in an increasing mismatch between modules. Traditional inverters track the maximum power point [MPP] collectively for a whole string of modules, receiving an average system output in which weaker modules hamper the output of stronger modules in the array. Module-level power optimizers, on the other hand, track MPP individually for each module, allowing it to work at its optimal current and voltage and guaranteeing that modules produce maximum power at all times. Module-level power optimizers are already the preferred choice for residential and commercial installation owners. This proven technology is ideal for utility installations as well, as elimination of mismatch-related power losses can account for up to 5% more energy over system lifetime.

## Up to 70% BoS Cost Reduction through Design Efficiency

The design flexibility enabled by module-level power optimizers allows for longer strings, which reduce the expenses on wiring, combiner boxes, fuses and other balance of system [BoS] components in utility installations by 50%-70%. In a specific 1MW installation,



Figure 1: Screenshot from the SolarEdge Monitoring Portal -- Physical layout of a portion of a 1.63 MWp installation in the Netherlands. Specific location of each module on the roof is shown with its specific energy level, for fast and easy troubleshooting and increased system production.

including 4,320 modules of 270W each, two designs were compared: leading traditional 1MW inverter vs. SolarEdge SE850k + 3 SE50k inverters. The SolarEdge system has a total of 63% fewer cables and 1/4 of the combiner boxes, **resulting in 62% reduction of cable and combiner box cost.**

## Increased System Uptime and Superior Safety

Module-level electronics also enable high resolution performance monitoring and accurate troubleshooting for enhanced maintenance and increased system uptime. Moreover, module-level electronics automatically shut DC voltages down whenever AC voltage is shut down or inverter is disconnected. This ensures maximum protection of the property and of installers, system maintenance personnel and firefighters.

## SolarEdge Utility Scale Offering

SolarEdge Technologies, a leading global provider of module-level power optimizer systems, will be presenting at the Eilat-Eilat Renewable Energy Conference the new power optimization solution for utility-scale installations. The solution revolves around a newly developed SE850k inverter that is specifically designed to work with SolarEdge power optimizers, maintaining a fixed string voltage at all times. This enables the 850kW inverter to continuously operate at the optimal voltage for DC/AC conversion, resulting in superior efficiency [up to 98.2%] and reliability. This also guarantees maximum design efficiency and inverter cost effectiveness, in addition to all other benefits provided by module-level optimization. The SolarEdge utility offering allows for increased energy output while reducing installation and maintenance costs, resulting in shorter payback times on large system investments.



CEO Zohar Hadass.

# Redivivus can Make Energy Out of Many Types of Agricultural Cuttings, at Almost any Place

▶▶ The concept and technology are commercially proven; Redivivus Energy is looking for a strategic investor and strategic partners around the world | By Uriel Sahlev



Rural forest residue and urban wood waste, pits, palm fronds, corn stalks and peels are just a few sources of a massive amount of waste that farms, kibbutzim and municipal councils in Israel and abroad have to deal with. Authorities are forced to dig deep into their wallets to dispose of this litter.

Two Israeli entrepreneurs, brothers Zohar and Yuval Hadass, have developed an innovative concept that has been proven effective in dealing with this challenge. The essence of the concept is the use of the above-mentioned residue as raw material for generating electricity, heat and/or steam. The brothers offer a tailor-made solution, carried out according to the customer's needs and the raw material at hand.

## Recycling Waste and Turning it Into Money – How does it Work?

Redivivus Energy [redivivus means "recycling" in Latin] is based on known gasification technology. Redivivus turned it into efficient, clean and innovative technology. This development is based on a hybrid reactor – a gasifier pyrolysis system – which converts the raw materials it is fed into Syngas. This Syngas is used for direct combustion or, alternatively, to produce steam or is fed directly into a generator that produces electricity.

CEO Zohar Hadass explains that this method eliminates the need for using expensive and polluting fuels, replacing them with clean, cost-efficient and sustainable energy.

## Target Customers for the Production of Heat or Steam

Various types of factories, such as preserved food factories and food processing factories, Paper and Tires plants, require steam; Bread and pastry industries as well as greenhouses need heat. "We can provide both heat and steam using our systems," explains the engineer Yuval.

To produce heat, the gas emitted from the gasifier is directed into a burner, which produces an open flame. To produce steam, the burner is connected to a steam boiler.

### Advantages of Redivivus Energy System

- Low-cost green energy system .
- Quiet and eco-friendly.
- Compact footprint - Getting carbon credit.
- Reduction of cutting waste volume by 70%.
- Dramatic reduction of transportation cost of the cutting waste.
- High efficiency, up to 91% on some gasifier models.
- Low capital cost.
- Low Operations & Maintenance costs.
- Simple: Easy to operate, easy to load, simple to start.
- Zero tar/ effluent system.

## Target Customers for Electricity

Producing energy from biomass is worthwhile in remote and isolated locations to which conveying a power line is very expensive. For instance, in remote areas in Africa, an entire village can be illuminated by using waste from banana plantations; and in desert areas, palm frond waste could be used to propel the pumps that are used to extract water from wells.

Furthermore, in places that are not connected to the main grid such as in Asia and in South America, the Redivivus system can be used to produce electricity in areas that grow fruit trees, olives, Jatropha, bananas, eucalyptus, pine trees, palm trees and more.

Local councils and landfills that have a large quantity of wood residue can install a Redivivus system and produce electricity directly from the site of the waste.

## Briquettes

As part of the concept, Redivivus Energy has developed a modern alignment to produce briquettes [energy bars], which is capable of providing a solution for almost any kind of wood residue/ biomass. Briquettes are produced by crushing biomass and reducing its volume [by 70%] and moisture content [to 12%]. Briquettes significantly reduce the costs of transport, clearing and burial. Briquette can also be used as fuel for a gasifier.

## Leveraging the Company's Activity – Seeking a Strategic Investor

Redivivus focuses on small and medium-sized systems. Given the great interest in the concept and technology, which have proven to be successful, the Hadass brothers are looking for a strategic investor for this enterprise to expand the scope of the company's activity. Funding is planned for marketing and presentation of a "working system" in exhibitions around the world, as well as using additional investments for R&D [as further elaborated].

## Distributors in Target Countries

Redivivus is seeking well-known and well-established distributors in South America, Africa, Eastern Europe, Australia and the Far East.

## Research and Development – The Future

The company is upgrading its products and services using R&D in the following areas:

Producing liquid fuel, using the Fischer –Tropsch process, to facilitate the storage and/or transport of gas, as well as energy produced from gasifiers.

Improving the efficiency of the system and increasing the energy produced from a given amount of raw material.

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Ohad [left] and Raanan [right].

# Microalgae Oil as Feedstock for Biofuels

► UniVerve Ltd. is preparing for the establishment of its first commercial farm in Israel; UniVerve seeks funding for the farm and for the company itself in order to develop its business overseas

UniVerve is an advanced renewable energy company striving for market leadership in the rapidly emerging biofuels industry. UniVerve offers a complete and cost-effective process to supply microalgae oil as feedstock for renewable transportation fuels. Along with bio-crude oil, UniVerve's process delivers valuable nutrient-rich biomass for a wide range of additional markets. The heart of UniVerve's technology is a patented V-shaped growing and harvesting system, which allows modular scalability, high biomass yield/m<sup>2</sup>, low energy consumption and easy construction, operation and maintenance.

Early this year UniVerve was chosen #1 in the Oil Substitutes Category at the 1<sup>st</sup> National Conference for Green Growth, organized by the Israeli Ministry of Environmental Protection.

UniVerve's process will be deployed on microalgae production farms to be established by UniVerve, solely and in strategic joint ventures, and through technology licensing to independent oil and/or biomass producers, who will benefit from controlling and saving cost of their raw materials, as well as saving part of their raw material price hedging costs. UniVerve's flexible business model generates revenue on multiple tracks, thus mitigating business risks, including a license fee, royalties, consulting fee and equity [to be decided on a case by case basis].

UniVerve was established in 2009 by Ohad Zuckerman and Ra'anah Herzog, who

combine deep knowledge of the biofuel markets and technology with vast experience in the development of innovative processes in life science industries and proven success in building and managing multinational companies. Their sincere concern about the influence of the oil economy on the geopolitical situation and on climate change made them decide to promote the global use of biofuels by propelling the establishment of microalgae oil production farms. UniVerve's solution resulted from their analysis of the cost and productivity-drivers of the process.

## From R&D to Scale-Up and Commercialization

Oil produced by the company was found suitable for biofuels by the bio-chemical lab of Ben-Gurion University of the Negev. Green City, an Israeli biodiesel producer, produced good quality biodiesel from UniVerve's oil, and the biomass was well accepted by animal and fish growers as Captive Bred [closed system growers of saltwater fish]. Once UniVerve reached outdoor proof-of-concept and began to scale up its process, it also started with business development in Israel, Asia, Africa and Europe [discussions are at various stages].

After screening potential locations for its first farm in Israel, it focused on a prime location in the sunny Negev area that has vast land and access to a brackish water aquifer, on which UniVerve's selected microalgae strains grew successfully. UniVerve agreed with the



landowners on the terms of cooperation and entered into discussions with off-takers and selected candidate EPCs. Negotiation with the landowners, with oil off-takers and with biomass off-takers are in advance stages, with the signing of term-sheets imminent. During the pilot period [2013-4], the final scale-up will take place, samples of oil and biomass will be sent to off-takers, so comprehensive agreements will be signed. Commercial scale-up is expected to begin by 2014-5. UniVerve will also use this farm for training farm establishment teams of overseas clients.

## The Farm

A full-scale farm is planned to be constructed over a 6-year period - a 1-year pilot for biomass acclimatization and propagation, followed by 5 years of commercial scale-up.

After the 2<sup>nd</sup> commercial year, the decision regarding the final size of the farm will be made. This point of evaluation [POE] will be based on the actual productivity on-site during three consecutive years, the consistency of the biomass composition and technological issues, including up-scaling. In order to mitigate the potential risk of lower biomass productivity than anticipated [similar to any other agribusinesses], UniVerve's financial model includes three scenarios. Each scenario is based on a particular biomass yield and, accordingly, particular biomass composition. [UniVerve has the necessary agro-technical knowledge to influence the biomass composition by implementing a customized nutritional and growth regime.]

**The farm, which will generate income from day one, is expected to generate IRR of 20-30%, depending on the final biomass yield on site.**

UniVerve stands out from other players in the sphere, as it simultaneously combines a simple, flexible and scalable process, based on a high-yield and low-energy patented growing and harvesting system, with a winning business model. This positions UniVerve at the forefront of this budding industry, with the prospect of emerging as a global market leader.

**Ra'anah and Ohad will be happy to elaborate on UniVerve's technology, its business model and plans for growth, as well as specifically about the farm's financials, and will be available for meetings in Eilat during the Eilat-Eilat Conference.**

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# The Solar-Energy Revolution: A Bridge over Troubled Waters

▶ Solar lighting in municipal areas is cost effective to install, easy to implement and saves electricity costs | By Itsu Gross\*



Itsu Gross, Vice President of Marketing and Business Development.

Slowly but surely, a revolution is taking place. Similar to technical revolutions during the last decade, such as wireless phones, satellite broadcasts, Wi-Fi and GPS, which were able to free people from limiting infrastructures, the revolution of **Outdoor Lighting** is spreading rapidly. It began with the reduction of electricity bills by replacing existing lighting fixtures such as incandescent bulbs and mercury bulbs with LED [Light-Emitting Diode] bulbs. **The second phase**, involving solar energy, is taking place in newly developed areas such as bicycle paths and the extensions of developed urban areas. By doing so, municipalities are reducing electricity bills as well as the cost of infrastructure. The Eilat Regional Council is one example of a leading public authority that supports, encourages and implements alternative-energy solutions. Eilat Regional, implements solar lighting on the road leading to the Maale Shacharut School at Kibbutz Yotvata, the access road and parking lots of

the Regional Council and at the intersections in Timna Park.

## 2012 – a Historic Milestone

**The year 2012 will be remembered as a turning point for LED-based outdoor lighting in general and LED lighting and solar-energy-based lighting in particular.** This is the result of a courageous move by the Israeli government, the same month – February 2012 – that the Eilat/Eilat Conference took place, in a meeting of the Interior and Environment Committee. At this meeting, the committee was made aware of the waste of power over recent years and adopted the data of The Union of Local Authorities in Israel [ULAI]. The data showed that **approximately 45% of the budget, reserved for public electricity, are spent on outdoor lighting.** Efficiency in the electrical consumption of outdoor lighting, at a conservative estimate of 30% per year, will be achievable in a short period of 2-5 years. This decision makes solar outdoor lighting in

Israel the best solution for urban complexes and remote infrastructure, and is a historic milestone in turning the wheels of the revolution and internalizing this technology.

The solar light revolution began in 2012 and has what is necessary for success throughout the years and for generations to come: It is well suited to Israel's weather [sun, wind and dust], it is very simple highly reliable with virtually no maintenance, it has fast return on investment [ROI] with a clear economic advantage, ideological fulfillment, ease of adaptation, and technological maturity.

## Saving Costs

Saving money has always constituted the main drive to the success of any revolution. *In the long run, solar lighting saves more than any other technology in costs of electrical consumption.* This is only one aspect of saving, and not the primary one. *In the short run, solar lighting saves up to 70% of infrastructure costs in new projects,* and allows immediate leverage and diversion of resources to improve the quality of life, including education, welfare, sports parks and bicycle paths. In addition, **solar lighting, since it is independent of electrical infrastructure, encourages local authorities to provide immediate lighting to remote areas,** far from electrical infrastructure, which, for budgetary reasons, they had refrained from providing.

## Independent Energy Sources

The principle of independence of the geopolitical situation and the supply of oil and gas from Arab countries, which have become increasingly radical following the Arab Spring, supports solar solutions. The most tangible



Reservations, i.e: Park Timna.



Parking area.



Roads and streets.



Roads and streets.





Bus stop [Kibbutz Yahel].

evidence is the gas pipeline between Egypt and Israel, which was shut down as a result of the actions of terrorist groups, directly affecting the economy and security of Israel. Reducing reliance on imported materials for energy production is important for the world, and especially for Israel. Replacement of this kind of energy is possible with the use of an unlimited resource that exists in abundance in the region - the sun.

Furthermore, oil, coal and gas are limited materials. Changing to solar electric infrastructure, solar lighting in particular, allows the reduction of dependence on these materials in the future. While Israel is on the road to becoming a gas superpower in the coming years, a gradual transition to solar power will enable Israel to preserve the natural-gas deposits as a valuable resource for a long period, while increasing the economic strength of the country and its people.

### Advantages of Solar Lighting

Adaptation and ease of implementation are essential conditions for a revolutionary process to be accepted and succeed. The convenience that derives from the use of solar lighting exists on several levels: first **ease of application**. The bottleneck in the development of lighting based on electrical-power infrastructure is massive bureaucracy that may require months or even years until deployment in the field. As opposed to this, solar lighting with its non-cable infrastructure is a refreshing change, that allows the rapid acquisition of the required permits. The absence of cables provides modularity and flexibility and allows relatively easy transport from place to place, the expansion of roads,

the illumination of new paths in existing areas and bicycle paths. In addition, the absence of cables allows minimal discomfort to the residents during the implementation and application of lighting changes in time, waste and aesthetics as opposed to the result of uprooting the existing infrastructure and excavation of an alternative one.

**Security** is one of the main advantages of the solar solution. Solar-energy-based lighting ensures the illumination of Israeli cities in the event of a crash of the electrical infrastructure. In addition, it reduces the energy consumption of the country and thus prevents the exposure of Israeli residents to the presence of energy storage in the country, both in times of peace, and certainly during war, and reduces our dependence on the world while increasing our national resilience. The security resulting from solar lighting is reflected on a day-to-day basis. The use of low-voltage lighting, [12V/24V] allows a safe environment in sensitive public areas such as playgrounds, kindergartens, gas stations, among others. In addition, the ease of installation and independence of electrical infrastructure allow ordinary citizens to illuminate, at low cost, dangerous areas such as dark intersections and winding paths, thus increasing the security of the general public.

### Solar Light Shows Commitment for the Environment

The presence of pole-based solar LED lights, symbolizes more than anything the policy of the community and the local/regional council that encourages the usage of alternative energy. In doing so, the local authority shows

its commitment to the global effort to reduce air pollution by reducing oil production and the burning of coal, helps eliminate greenhouse gas, prevents unnecessary damage to nature and the landscape, avoids unnecessary excavation and prevents the use of limited materials in the ground.

In addition, the presence of a solar light pole and the pleasant light it spreads symbolizes for the residents of the area renewal of progress and caring. When the residents see innovative soft lighting, which operates entirely on solar panels without electricity, lighting up their entire neighborhood, the bicycle paths and green areas, when they realize that a playground is illuminated with safe power that avoids the risk of electric shock to their children, when they feel safer thanks to the deployment of solar lighting in dark places, the residents are aware of the genuine concern of the local authority for their welfare. The presence of a solar-light pole proves to all the wisdom of the local authority, channeling public funds for the benefit of the public and making them better and healthier.

*\*The author, Mr. Itsu Gross, is Vice President of Marketing and Business Development at "Green City Technology Ltd". A leader in solar-energy-based solutions for urban lighting for roads, driveways, parking lots, parks, bicycle paths, schools, kindergartens, playgrounds and sports facilities.*

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# Threats and Opportunities Posed by Electric Cars

► Electric cars are shaking up the car industry; Are they going to be part of the mainstream? | Avner Barnea\*



Avner Barnea.

In a surprise move, American-Israeli electric car company Better Place announced in early October that its founder Shai Agassi would be replaced as CEO by Evan Thornley, the current CEO of Better Place Australia. Is it the end of this business initiative in Israel?

Will consumers eventually trade their petrol-powered cars for newly rechargeable models? Electric transport would seem to be in our future. But how long will investors have to wait for the venture to pay off?

## The Near Future

For the next 10 or so years, the purchase price of an electric vehicle will probably exceed the price of an average petrol-fuelled family car by several thousand dollars. The difference is due mainly to the cost of designing vehicles that can drive for extended distances on battery power and to the cost of the battery itself. What's more, the infrastructure for charging the batteries of a large number of electric vehicles isn't in place, nor is the industry to produce them on a large scale. In any case, it seems that for now, consumers aren't exactly clamoring for battery-powered cars.

## Push from Governments

Optimists are speculating about generous support by governments. They think that concern over energy security, fossil-fuel emissions and long-term industrial competitiveness will motivate governments by creating incentives to change the market to battery-powered vehicles. In fact, governments in many countries are starting to act in this way. In some countries, such as Israel, electric vehicles already make economic sense because buyers get substantial tax breaks from the government. Business models designed to make electric vehicles more attractive to

buyers are key success factors of this new venture.

## Changing the Automotive Industry

Sooner or later, I predict, electric vehicles will take off, changing several sectors profoundly and could dramatically remodel the fortunes of the automotive and utilities' sectors and generate the rise of a battery industry.

The concerns are high for companies in these industries. In the near future, executives should determine how to garner revenues. Planning should also begin on building markets and demands and on programs and ways to build capabilities if early adoption creates a sustainable market.

Electric vehicles pose an enormous threat to incumbent automakers as the automakers will have to reinvent their businesses to survive. Competitors face significant entry barriers, including such as manufacturing scale, customer management, and capital. Incumbent automakers are not staying behind and build strategic alliances to offer attractive designs of electric vehicles to the consumers.

However, electric vehicles open up opportunities for incumbent automakers. Auto executives will need to consider develop new strategies for electric vehicles. The plans of the automakers, for example, must include an evident understanding about the way they will prioritize R&D across the vehicle platforms, from hybrids to plug-in hybrids, to battery-electric models and cars powered

by internal combustion engines.

Automakers should also consider how their relationships with the battery makers will develop, as well as the role of technology standards will play in fitting batteries into vehicles. Battery makers will try to secure the value implied in owning core skills, including innovation in batteries and in the new features they could make possible.

## Major Factor – Battery Costs

The economics of electric vehicles starts with the batteries, whose cost has been declining by 10 percent annually. Analysts predict that it will continue to fall over the next years as production volumes rise. Still, the price of electric cars would be quite high.

Subsidies could help bridge the difference. Business innovation could address costs too. Innovators are considering similar models to cover the battery's upfront cost and recover the subsidy by charging for services.

To attract buyers, electric vehicles of various kinds such as hybrids, plug-in electric hybrids, or all-electric cars must be cheaper to operate than petrol-fueled ones. The difference between the total lifetime costs of a car with an internal combustion engine and an electric car will depend for some time on the difference between the price of petrol and the cost of the battery and of recharging it or the cost of leasing a battery and of recharging services. Oil prices have fluctuated wildly over the past four years, and electricity prices vary throughout the world.

## Hugh Investments are Needed

The growth of electric vehicles also requires an infrastructure, such as recharging stations. China and Australia are speeding up plans to build charging facilities, and Hawaii has announced plans to build as many as 100,000 charging stations for electric vehicles by 2012 and a few other US states are already following. Investments in capabilities to manufacture the vehicles are needed as well. China and the United States have committed large investments to help companies manufacture batteries and for government programs to encourage car makers to produce

if about 10 percent of all cars on the roads were battery-electric or plug-in vehicles, running solely on electric power. That would mean sales of six million to eight million electric vehicles a year by 2020, which would change car sectors dramatically.

## Downstream Businesses – Service Providers

Executives should consider the development of the downstream business, too. One question is whether utilities, petrol stations, car companies or other third parties own the recharging infrastructure and the real estate it occupies? To meet the challenge of

sectors and have an impact on several others. Companies that act decisively and in a timely manner will probably enjoy significant gains; those that don't, will not survive. However, timing is critical: Jumping in too early or too late will be costly. As the electric vehicle is becoming a reality, it will change the competitive landscape of many sectors in the car market, and those attached to it.

After years of stagnation, the electric car has shaken the the car market. To meet the challenge, all players involved in this market have to strengthen their strategic competitive intelligence capabilities to be able to assess where this market is heading. There is a critical need to broaden perspectives and to look forward to 10- 15 years henceforth. In order to survive, car manufacturers, battery suppliers and other suppliers of services have to make sure they do not miss the coming changes. Implementing this proposal will improve significantly their decision-making process. Tactical intelligence may not be useful in strategy development, one piece at a time, but used in the aggregate, it can provide an insightful picture into where competitors and the marketplace seem to be heading. Thus competitors' and market insights are critical factors in successful planning.

Electric vehicles would enter the mainstream if about 10 percent of all cars on the roads were battery-electric or plug-in vehicles, running solely on electric power. That would mean sales of six million to eight million electric vehicles a year by 2020, which would change car sectors dramatically.

larger numbers of more fuel-efficient vehicles, including electric ones.

Of course, consumers may decline to buy electric vehicles for any number of reasons. The distance drivers can go before recharging, for example, may undermine acceptance. However, I assume, on a more fundamental level, electric vehicles will go to mainstream as a step determined by government action to make petrol more expensive; to reduce the cost of producing, buying or operating electric vehicles; or some other combination of these approaches.

## The Breakpoint to the Mainstream

There is a little point in trying to predict how many electric vehicles of one kind or other will be on the road in any given year because so many factors are unpredictable. Governments could aggressively promote the use of electric vehicles, for example, and then lose tax revenues when drivers spend less money on petrol. Besides, it is too early to say how the rate of adoption by consumers in different segments will grow or how costs will be optimized. Electric vehicles would enter the mainstream

charging vehicles and of a "smart" charging infrastructure, utilities must plan and invest now for the required technologies, costs, infrastructure partners, and must structure accurate business models. They should also think about how the supply chain for electric vehicles differs from the present one.

## Conclusions

In my opinion, electric vehicles will become a reality. That will change the competitive landscape of the automotive, battery, and utilities

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Delek Group

# Definitions from Delek Dictionary\*

**Alcohol fuels; Biofuels** Fuels made from renewable resources such as crops and organic waste products. Methanol and Ethanol are two types of alcohol fuels used in cars. Ethanol can be produced from a variety of renewable resources, most commonly corn and sugar cane. Methanol can be made from renewable resources also, but today, methanol is primarily made from natural gas. Alcohol fuels are high octane, burn cleaner than regular gasoline and produce less carbon monoxide.

**Alternative energy; Alternative fuels** Sources of energy not based on the burning of fossil fuels or the splitting of atoms. The renewed interest in the field derives from a desire to prevent pollution. Alternatives include: wind power, solar power, geothermal, tides, and hydroelectric power.

**Biodiesel** A clean-burning alternative fuel, produced from domestic, renewable resources containing no petroleum. Biodiesel is derived from vegetable oils or animal fats that conform to ASTM D6751 specifications for use in diesel engines.

**Biogas** Methane or fuel made from animal excrement.

**Biomass** Organic non-fossil material of biological origin constituting a renewable energy source.

**Biomass to liquid [BTL]** The term BtL is applied to synthetic fuels made from biomass through a thermo-chemical route. The objective is to produce fuel components that are similar to those of current fossil-derived petrol [gasoline] and diesel fuels and hence can be used in existing fuel distribution systems and standard engines. They are also known as synfuels. Although the processes for producing BtL are well known and have been applied using fossil-feedstocks such as methane [GTL] or coal, commercial biofuels based on these technologies are not currently available. Biomass to Liquid is one of the most promising processes available in the fuel sector. The greatest advantages of the resulting synthetic biofuel lie in the high biomass yield [up to 4000 liters per hectare]; its high potential to reduce CO<sub>2</sub> emissions [over 90%]; and its high quality, which is not subject to usage limitations in today's engines or those of the foreseeable next-generation.

**Chain reaction; Nuclear energy** A reaction that stimulates its own repetition, in particular when the neutrons originating from nuclear fission cause an ongoing series of fission reactions.

**Clean technology; Clean-energy** Technologies that are highly energy efficient, such as the co-generation of heat and power, renewable energy sources, etc. The term "clean energy" also refers to the identification, design and implementation of clean energy policy and technology solutions aimed at delivering environmental and economic benefits.

**Compressed natural gas [CNG]** CNG is natural gas that is compressed to facilitate its delivery to places where it is difficult to establish a pipeline. The volume of CNG after compression is less than

1% of its volume at standard atmospheric pressure. CNG is stored and distributed in cylindrical or spherical pressurized containers at a pressure of 200-248 bar [2900 -3600 psi]. Once reconstituted, the gas is appropriate for use in the same applications as natural gas.

**Compressed natural gas vehicles [CNG cars]** CNG is natural gas under pressure, and consists primarily of methane [85%-95%] with trailing amounts of ethane, propane, and butanes. It is used as an alternative "cleaner" fuel for vehicles. CNG cars are abundant in Argentina, Brazil, India, Pakistan, Italy, Iran and the US.

**Conventional energy sources** Includes mostly fossil fuels [oil, gas, coal] and excludes alternative energy such as wind and solar.

**Energy** Energy comes in a variety of forms, some of which are easily convertible and can be changed to another form useful for work. Most of the world's convertible energy comes from fossil fuels that are burned to produce heat, which is then used as a transfer medium to mechanical or other means in order to accomplish tasks. Electrical energy is usually measured in kilowatt-hours, while heat energy is usually measured in British thermal units [Btus].

**Energy source** Any substance or natural phenomenon that can be consumed or transformed to supply heat or power. Examples include petroleum, coal, natural gas, nuclear, biomass, electricity, wind, sunlight, geothermal heat, water movement, and hydrogen in fuel cells.

**Ethanol** Also known as ethyl alcohol or grain alcohol. A fuel for motor vehicles that can be used on a standalone basis, as an alternative to gasoline or as an octane-boosting, pollution-reduction additive to gasoline. Many types of biomass can be used to create ethanol, including corn, a variety of starches, sugars, used vegetable oils, agricultural waste and others. Advanced bioethanol technology allows fuel ethanol to be made from cellulosic [plant fiber] biomass, such as agricultural forestry residues, industrial waste, material in municipal solid waste, trees and grasses.

**Flexible-Flex fuel vehicle [FFV]** A dual-fuel vehicle [colloquially called a flex-fuel vehicle] is an alternative fuel vehicle with an internal combustion engine designed to run on more than one fuel, usually gasoline blended with either ethanol or methanol fuel, and both fuels are stored in the same common tank. Flex-fuel engines are capable of burning any proportion of the resulting blend in the combustion chamber as fuel injection and spark timing are adjusted automatically according to the actual blend detected by electronic sensors. Flex-fuel vehicles are distinguished from bi-fuel vehicles, where two fuels are stored in separate tanks and the engine runs on one fuel at a time, for example.

**Fuel cells** A fuel cell operates like a battery. Unlike a battery, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied. A fuel cell consists of two electrodes sandwiched around an electrolyte.

Oxygen passes over one electrode and hydrogen over the other, generating electricity, water and heat.

**Gas [G]** A non-solid, non-liquid combustible energy source that includes natural gas, coke-oven gas, blast-furnace gas, and refinery gas.

**Gas composition; Composition of natural gas** Refers to the typical components of natural gas; methane [70-90%, usually over 90%], nitrogen [5-15%], propane, and butane [less than 5%], with the remainder composed of hydrocarbon compounds. Gas composition also refers to its caloric value.

**Gas to liquids [GTL]** The conversion of natural gas to a liquid form so that it can be transported easily. Typically, the liquefied gas is converted back to natural gas prior to consumption. The conversion of natural gas into liquid fuels is an attractive option to achieve commercialization of abundant gas reserves. GTL technology is capable of converting natural gas into clean liquid products. Gas can also be converted into clean burning synthetic diesel fuel.

**Geothermal energy** Heat from within the earth. The word derives from the Greek words geo [earth] and therme [heat]. It is possible to use the steam and hot water produced inside the earth to heat buildings or generate electricity. Geothermal energy is a renewable energy source because the water is replenished by rainfall and heat is continuously produced inside the earth.

**Green power** Generic term for any type of energy considered to have a lower environmental impact than commercially-produced energy.

**Independent power producer [IIP]** An entity that owns facilities to generate electric power for sale to utilities and end users. May be privately-owned facilities, cooperatives such as rural solar or wind energy producers, and non-energy industrial concerns capable of feeding excess energy into the system. Often built to supply energy to specific industrial plants. For example, in Israel, the Ashkelon IIP was built to provide electricity to the Ashkelon desalination facility.

**Land fill gas [LFG]** The gas that is generated through the decomposition of organic material at landfill disposal sites. The average composition of landfill gas is approximately 50% methane and 50% carbon dioxide and water vapor by volume. The methane percentage, however, can vary from 40% to 60%, depending on several factors including waste composition [e.g. carbohydrate and cellulose content]. The methane in landfill gas may be vented, flared, combusted to generate electricity or useful thermal energy on-site, or injected into a pipeline for combustion off-site.

**Liquefied natural gas [LNG]** An odorless, colorless, non-corrosive and non-toxic product of natural gas consisting primarily of methane [ $\text{CH}_4$ ] that is in liquid form at near atmospheric pressure. It is liquefied by reducing its temperature to 260 Fahrenheit or - 161 degrees Celsius. With a volume just 1/600 of its original size, LNG is safe, easy, and efficient to transport, store, regasify and supply.

**Methanol [ $\text{CH}_3\text{OH}$ ]** A light volatile alcohol eligible for blending with gasoline.

**Natural gas [NG; natgas]** Natural gas is a combustible mixture of hydrocarbon gases consisting primarily of methane [70-90%] but can also include ethane, propane, butane and pentane. It is colorless, shapeless and odorless in its natural form and is a much cleaner source of energy than fossil fuels like oil and coal.

**Nuclear energy** All nuclear energy generated today is produced from a process called fission, which involves the splitting of the nucleus of a heavy atom [a uranium atom, for example] into two or more lighter nuclei. The fission process itself is not what produces electricity; rather, it produces massive amounts of heat, which is used to generate steam. The steam drives large turbines that

rotate generators, and they produce electricity.

**Passive solar energy; Passive solar heating/cooling; Passive solar architecture; Passive solar system** Passive solar heating presents the most cost effective means of providing heat to buildings. Generally, the amount of solar energy that falls on the roof of a house is more than the total energy consumed within the house. Passive solar applications, when included in initial building design, adds little or nothing to the cost of a building, yet has the effect of realizing a reduction in operational costs and reduced equipment demand. It is reliable, mechanically simple, and is a viable asset to a home.

**Photovoltaic energy; Photovoltaic system; Photovoltaic solar energy** A technology used to convert light directly into electricity. Solar cells, also called photovoltaics [PV], convert sunlight directly into electricity. Solar cells are often used to power calculators and watches. They are made of semiconducting materials similar to those used in computer chips. When sunlight is absorbed by these materials, the solar energy knocks electrons loose from their atoms, allowing the electrons to flow through the material to produce electricity. This process of converting light [photons] to electricity [voltage] is called the photovoltaic [PV] effect. Solar cells are typically combined into modules that hold about 40 cells; about 10 of these modules are mounted in PV arrays that can measure up to several meters on a side.

**Solar energy** Energy produced from the sun. There are two primary methods for creating solar energy;

1. Photovoltaic, the conversion of sun light directly into electricity. The main advantage of this system is that medium-and small -sized facilities can be established, such as roof tops, and electricity can be produced relatively easily at points that are distant from the grid. The main disadvantage is the high cost of this technology.
2. Thermal-solar technology, the concentration of the sun's tremendous heat energy to conventional steam turbines. This technology operates at high efficiency and is thus relatively cheaper than other solar technologies. However, it requires vast expanses of land.

**Sustainable energy** Sustainability is a broad concept referring to the need to balance the satisfaction of near-term interests with the protection of the interests of future generations, including their interest to a safe and healthy environment.

**Water power** The harnessing of the energy in flowing water or a waterfall for the production of energy.

**Wave power; Wave energy** The direct extraction of energy from the surface motion of ocean waves or from pressure fluctuations below surface.

**Wind energy** The electric energy generated through the harnessing of wind power. Harnessing the wind is highly dependent on weather and location. Indeed, wind turbines generate electricity very irregularly, because the wind itself is inconsistent. Therefore wind turbines always need backup power from fossil fuels to keep the electricity grid in balance. Natural gas turbines are probably the best way to do this as they are able to start up quickly, as opposed to coal-fired plants which need to be maintained in a very inefficient standby mode if they are to respond to large fluctuations in power demand, when wind generators stop suddenly. Wind power is thus clearly not reducing the dependence on imported fuels such as natural gas and may even enhance the use of natural gas. The average wind velocity of the earth is around 9 m/sec. The power that could be produced when a wind mill is facing a wind of 16 km/h is around 50 watts.

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