

## Solar power unto the nations

**Luz, which developed technologies to harness solar energy, went bankrupt 16 years ago. Founder Arnold Goldman is back with Luz II. "Globes" talked to the man who went into cleantech before it became a buzzword.**

Merav Ankori 28/10/2007

He looks like a member of the Amish sect, with a white beard covering his entire face but no moustache. His face is radiant, and he frequently uses philosophical terminology. His name is Arnold J. Goldman, and he was one of the pioneers of cleantech in Israel, long before that concept assumed its current dimensions. The truth is that he himself did not realize back then that he was dealing in "cleantech."

Goldman (64) is the founder of Luz International, which since it was founded in 1984, has designed, developed, built, financed, and operated nine solar power plants in California's Mojave desert. It was a pioneer in proving that solar energy is a reliable way to produce electricity commercially, even at times of peak consumption. The building of the plants came against the backdrop of the oil crises, chiefly that of 1979, following the toppling of the Shah of Iran, as alternative energies looked like the way to freedom from the dependence on Arab oil. The fears of an oil shortage have not materialized for the time being, although most researchers now believe that the world's oil reserves are dwindling rapidly.

These nine plants are still operating, supplying 350 megawatts of power to Southern California. But Luz International, the company that deployed them on the plains of Nevada, was less fortunate. In 1991, despite being the sole commercial developer of thermal electricity in the US, it went bankrupt after failing to secure the necessary funding for the construction of its tenth power plant. The collapse of Luz International led in turn to the closure of Luz Israel, affecting the livelihood of hundreds of employees and their families.

Goldman has maintained a low profile since then. Far from the limelight, he set up a company whose name indicates its direction more than anything else: Luz II. With a name like that of a film sequel, Goldman has defined it as the next generation in solar energy. Luz II is a subsidiary of BrightSource Energy Inc. of Oakland California, which is owned by Goldman - a similar relationship to that between Luz International and Luz I. The other partners are venture capital fund VantagePoint Venture Partners, and private investors, some of whom also invested in the original Luz.

But it's not just the investors that go back a long way with Goldman. The moment he returned to business and set up the company, his former employees followed him. 15 of Luz's founding team, all of whom have been given a place of honor on the company's website, came from Luz I, most of them R&D engineers. Until the first significant financing round in 2006, they worked on a voluntary basis in addition to their own paid jobs, in the belief that the business would succeed and that then they would have a place and a reward for their efforts. "I believe that people have to show integrity and commitment in the way they act within the company," says Goldman in an exclusive interview with "Globes" explaining how he managed to retain his team, after his previous company went bankrupt.

In the first two years of its existence up to 2006, Luz II received \$1 million in investment from a number of UK angels and Goldman himself. "The efforts focused principally on the development of a technological vision, and it was important to us to have investors that would go the distance with us so that we could realize it," explains Goldman. In October 2006, the company raised \$16.5 million at a value of \$49.5 million after money in a financing round led by US venture capital funds VantagePoint and Draper Fisher Jurveston (DFJ). JP Morgan and a large US energy company whose name Goldman will not disclose also invested in that round.

After this round, the company's volunteer staff became paid employees and most of them resumed the roles they filled in Luz I, among them Israel Kroizer, Luz Industries Israel CEO and Luz II president. Kroizer was the first engineer to join the original Luz back in 1980 and returned to a similar role in Luz II. Last May, the company raised more than \$30 million, of which \$10 million came from existing investors, and the rest from a leading investment bank that has remained in the shadows.

So what difference is there between Luz I and the next generation Luz II? Goldman claims that Luz II's technology is more advanced and that the other companies in the field use "old technology." Another difference is that Luz II plans to set up a solar energy field with a production capacity of 400 megawatts - more than the combined capacity of all of the nine plants it previously built.

"One of the crucial decisions we made while working on the concept for Luz II, was to take a different technological direction from the one we led in Luz I," explains Goldman. "We adopted a lot of ideas from it but we feel that we exhausted most of that technology's capabilities during Luz I's existence, and we now want to move on. The previous technology was based on a field of parabolic mirrors (designed to return light. M.A.) with a metal pipe running between them. The new technology has a field of mirrors aimed at a power tower in which the energy is produced. Each field has a number of towers depending on its size. We didn't invent the technology - neither here nor at Luz I - but we have managed to make optimal use of the idea while adding new dimensions to it."

Goldman explains that the new generation of the technology delivers greater efficiency so that "we're starting at a level 30% better than we achieved with the old technology and that's even before the future increase in efficiency which will make us even more attractive." According to his data, the team also achieved improvements at Luz I, bringing costs down by 50% from 1984 through 1991. "It was a tremendous achievement, but we were already close to exhausting the capacity for improved efficiency," he says. "This is also the company's ethos today - lower prices. In the next technology, we will be able to make an extremely competitive reduction in costs, in contrast with prices of conventional energy."

Goldman arrived in Israel with his wife and three children in 1977, "with the intention of staying here for two to three years." The goal was to bring to fruition a research project he started 16 years earlier, "and then I intended to return to the US," he says. The thesis he wrote back then dealt with the utilization of sunlight to produce energy and was based, in his words, on a philosophical outlook. "I observed the effect of the sun's power on the earth on a global scale," he explains, "and I wanted to use the

sun's rays in order to produce energy for a range of needs. I completed my research here by 1979 and then I established the first Luz."

*Globes: What is the origin of the name?*

*Goldman:* "Because the research also included Jewish philosophy, I chose a name for the company that corresponded to the previous name for Bet El and which appeared in Jacob's dream as stated in the verse "And he called the name of the place Bet El but the name of that city was first called Luz." (Genesis 28:19). I identified with this connection."

Luz II is setting up its first pilot at the Rotem industrial park in Dimona, and it will begin operating in 2008. The pilot passed a notable milestone in its progress at the beginning of last month with the delivery of the first consignment out of a total of 1,640 mirrors that will be installed in it, and which will then generate 6 MW of thermal energy. A series of solar plants like these with 100MW and 200MW capacities will be built worldwide by 2010, and Luz II recently filed an official application (through its parent BrightSource) for approval to build a new solar energy power plant in the Mojave Desert, a move that will cost \$10-20 million, which the company will finance from the proceeds of its recent financing round.

"We filed an application for a permit to set up a power plant with a 400 MW production capacity in California," says Goldman. "This entails not just a substantial financial investment in the power plant, but also in almost all aspects of its design, including related issues such as gas emission levels and the organization of the solar energy field." This is the first application to build a solar power plant in California since 1989. Other companies, it should be stressed, among them Israeli company [Solel Solar Systems](#), have reported their involvement in major projects, but none of them has filed an official application, that is to say taken an actual step, as Luz has done. It should be noted that it takes about a year to obtain a permit for a plant and about two to three years to build it. This means that it will take between three and five years until the plant begins operating. "The current field should produce more than all the plants we built in seven years activity in Mojave," says Goldman.

The background to Luz II is more favorable today. The phrases "clean energy" or "alternative energy" do not merely represent a green trend among environmental activists, but a huge area of investment that attracts billions of dollars to a range of fields. 16 years ago, Luz did not have it that easy. Back then there were no incentives to infrastructure companies to use solar energy power plants nor any environmental awareness of the advantages this energy could offer.

Goldman established Luz during a period which was also critical in international politics. The Yom Kippur War was a turning point. "Until then," explains Kroizer, CEO of Luz Industries Israel, "the Western world treated the Arab states as primitive countries which had no understanding whatsoever of the value of their own resources. From the moment the Arab world imposed the oil embargo in the wake of the Yom Kippur War, it was clear that the story had changed. Until the war, the price of oil was around \$2 a barrel, and following it the price jumped to \$10 a barrel, and

then they started talking alternative energy out of purely political considerations; they wanted to end the dependence on Arab countries as oil suppliers."

In 1970-1980, the US Congress spearheaded an extensive legislative change, and set out a policy called the Public Utility Regulatory Policies Act (PURPA). "This policy supported the transition to alternative energy, not strictly in the sense of clean energy," Kroizer says. "The issue was efficiency," Goldman points out.

To switch to alternative energy, energy companies were supposed to spend some of their of their budgets on the building of solar energy power plants, something which they were naturally reluctant to do. Goldman offered to provide the finance for the building of the power plants, and in return the energy companies would undertake to purchase electricity from him for 30 years. The moment they were relieved of the financing burden, the willingness to cooperate was much greater. "We were the pioneers of this form of work model in the US," says Goldman, "and we were preceded in this solely by the aircraft industry." Luz I's intention was to become established in California and then move on to other regions in the US. But falling oil prices harmed federal motivation to support alternative energy projects. Luz I could no longer meet the conditions of the market and had to declare bankruptcy in 1991.

During the 13 years from the time Luz I closed to the establishment of Luz II in 2004, Goldman led various ventures in the Internet, medicine and other fields. Once an entrepreneur always an entrepreneur - he was one of the founders of Electric Fuel, which later became [Arotech Corporation's](#) (Nasdaq: [ARTX](#); TASE: [ARTX](#)), which currently has a market cap of \$45 million.

He had other career changes too. Before entering the solar energy field, he co-founded and served as VP engineering at Lexitron, the company which developed the world's first word processor and which was acquired by Raytheon Inc. (NYSE: RTN) in 1977. These were not software programs but micro-computers, and Lexitron was the first company to use a video screen in word processing, as early as the end of the 1970s. After his temporary foray into medicine and the Internet, Goldman returned to his great entrepreneurial love, clean energy.

*What is your vision for the company?*

"That it will be a leading and large player in solar energy worldwide. In the past we were a big fish in a small pond, because we controlled 90% of the global solar energy market, but it was a very small market. Today we want to be a big fish in what is now becoming a large sea and will become even bigger. We want to be modest and not make noise, but we very much believe in what we're doing, and we're deeply committed to our vision. We're practical people, not speculators," Goldman stresses.

## **Luz II - a technological overview**

"The concentration of the sun's rays is relatively low, otherwise we'd all be roasted," explains Kroizer. "So in order to reach high temperatures, we have to concentrate the rays. To produce electricity efficiently, you need high temperatures. The more concentrated the rays are, the greater the efficiency in electricity production." Kroizer

adds that there several methods for concentrating electricity, and the question is what method should be used to concentrate the sun's rays.

Luz I's method was to concentrate the rays using parabolic mirrors arranged in a trough form with a glass coated metal tube running between them. A fluid, normally thermal oil, passes through the tube and is heated to a temperature approaching 400 degrees centigrade. The oil creates steam which is used to produce electricity.

Luz II aims to reach higher concentrations of sunrays, so its design calls for the mirrors in the field to be trained on a tower, generating a concentration ten times that of the parabolic trough. The higher temperatures make the electricity production more efficient. The steam is produced in the production tower. "We've now managed to produce at a temperature of 550 degrees and we plan to reach 700 degrees in the future," says Kroizer.

According to him, the company is not attempting to invent new components but instead create compatibility between as many systems as possible in one application. "Only conventional suppliers will work with us on the new technology, and they will make the adjustments to the equipment, based on the technical specifications we give them. This is where we can contribute our expertise in cost efficiency."

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