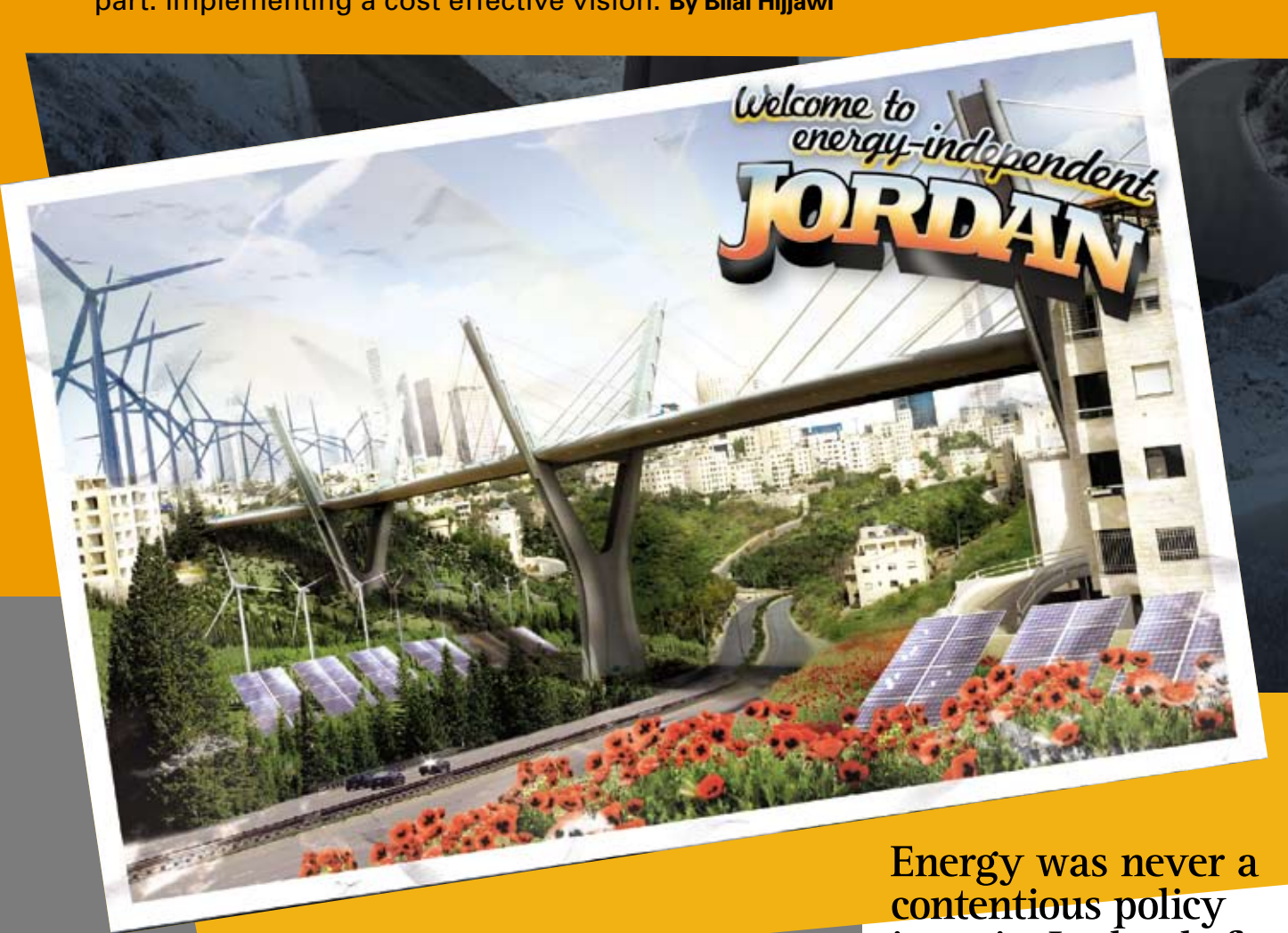
Ten Years Too Late?

A look into Jordan's renewable energy future

Oil was king for generations. But in the face of environmental concerns and high prices, Jordan is beginning to take renewable energy seriously. Now comes the hard part: implementing a cost effective vision. **By Bilal Hijjawi**



Energy was never a contentious policy issue in Jordan before 2003, but that all changed with the US invasion of Iraq

Look at our multibillion dollar real estate projects and tell me: How many were asked to introduce clean and sustainable energy systems? None

NO ONE CAN TELL YOU FOR CERTAIN WHAT will be the world's next dominant energy source. For the last century, oil has been the world's preeminent fuel. But that lynchpin certainty is giving way to a host of concerns over high prices, the impact of increasing carbon emissions and questions over whether supply will be able to meet demand growth, especially in the energy-hungry economies of Asia.

That said, Boeing won't be making solar airplanes anytime soon. Nor will private wind generators power every home on the planet. Not this century at least. Liquid petroleum gas (LPG) is an awfully useful option, but as with oil, there isn't enough of it to go around and prices has been spiking. Jordan relies on LPG from Egypt to power its electricity grid, but informed sources tell Venture that there isn't enough gas production capacity in Egypt to satisfy the current energy needs of its industrial clients.

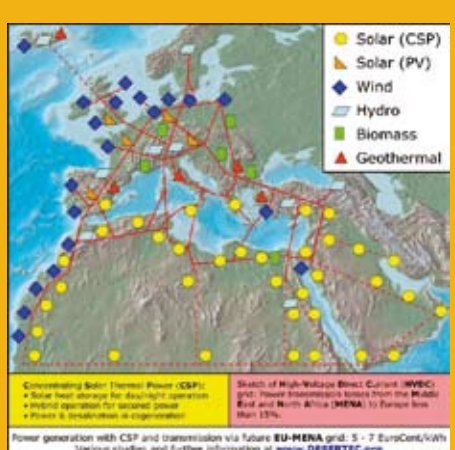
One thing is clear: industry needs a reliable alternative source of energy to power its future. But rather than a single source, the safest bet is in developing a mix of energy resources from hydrocarbon, nuclear and clean renewable energy. Jordan, with an estimated 180,000 tons of uranium deposits, is also seriously considering the feasibility of a nuclear energy program.

But for now, let's dream up the greener energy strategy. Wind farms could be placed on Jordan's western heights to harvest strong breezes elevating from the Jordan valley to supply electricity. Solar farms could capture sunshine from the Kingdom's sunny eastern deserts. Geothermal wells could also supply some energy from deep wells near

Regional Energy

The Mother of All Renewable Projects

TREC or The Trans-Mediterranean Renewable Energy Cooperation is the ultimate renewable energy vision. Still in research phase, this mega multi-resource project caters to the region and the world surrounding it. Founded in 2003 by the National Energy Research Center of Jordan (http://www.nerc.gov.jo), the Club of Rome and the Hamburg Climate Protection Foundation, the project is a massive logistical and political challenge. Its success or failure rests on selling TREC effectively on the basis of mutual interest to many countries with adversarial histories. However, the TREC idea is simple and wholesome: To share in the abundant natural clean energy resources of the Middle East, Europe and North Africa over a transcontinental grid.



Dr. Ayoub Abu-Dayyeh, President of Environmental Conservation and Sustainable Energy Society (CASE)

the Dead Sea. Biogas can be generated from landfills of Amman, Zarqa, Irbid and others. If introducing an alternative energy mix failed to satisfy growth in demand for energy, Jordan's existing gas-powered plants could fill in the supply gaps during peak electricity loads. Further, by tapping all available avenues to energy independence, our excess capacity could be exported—bringing some hard capital stability to the national budget.

Hope vs. Reality

Sound good? Sadly, such majestic scenarios will have to wait for many years before effectively blunting our looming energy crisis. The trouble is with timing, capital, dedication and the availability of the renewable products (but we will get to that in a bit).

In retrospect, many Jordanian researchers believe government has been sitting on its hands far too long. "I'd say we are ten years late [coming up with a sustainable energy strategy]," said the CEO of a Jordanian industrial complex with substantial reliance on energy.

For better or worse, energy was never a contentious policy issue in Jordan before 2003. Beginning in 1990, Jordan enjoyed a discounted supply of oil from Iraq. Previous to that, Jordan paid for energy from fees paid by Saudi Arabia, for granting passage and securing oil shipments through the Tapline, an oil pipeline that transported oil to the Lebanese port of Sidon. Thus, the government had little incentive to mobilize a sustainable energy strategy. But that all changed with the US invasion of Iraq.

"The energy crisis was predicted a good few years back and there has been massive literature on the subject," said Dr. Ayoub Abu-Dayyeh, lecturer on Environment and Energy at the Zaytouneh University. "We still did very little to prepare ourselves," added Abu Dayyeh, who is also Founder and President of the Environmental Conservation and Sustainable Energy Society (CASE), and part of UNESCO's international committee on clean sustainable energy.

Professor Ayman Al Maaitah, Founder and Chief Technical Officer (CTO) of Millennium Energy Industries, said it wasn't easy for government to implement a Western-styled alternative energy strategy, but much could have been done to dampen the impact of today's energy crisis. "In 2005, we sat with the Minister of Energy at the time and I brought with me experts to explain how Jordan can modify its energy strategy. [The Minister] listened to us—but where is our renewable strategy today?"

The Rule of Efficiency

But experts also say that Jordan could have made significant progress even without a unified energy strategy. By enforcing existing best practices in energy efficiencyand provideing targeted incentives to business could have make a substantial difference.

Denmark makes an exemplary energy-efficient market model. According to a report published by Post Carbon Cities (www.postcarboncities.net), the Scandinavian nation is now self-sufficient in energy and, in fact, is exporting oil, gas and electricity. This amazing reality has evolved from 30 years of powerful regulations, incentives and development. One (albeit unusual) example of efficiency is the Danish Crown industrial slaughterhouse that recycles the waste of 50,000 pigs each week to heat the plant.

By 2020, the projected investment for developing conventional energy resources is about $10 billion dollars—while only $1 billion is projected for renewables.

"Look at our multibillion dollar real estate projects and tell me: How many were asked to introduce clean and sustainable energy systems?" asked Abu Dayyeh. "None."

As head of CASE, Abu Dayyeh has been lobbying government for several years to effectively enforce the mandatory thermal insulation code for Jordanian buildings. But he admitted that thus far it has been unsuccessful. "About 90 percent of our buildings will fail the insulation test. This means that more than 50 percent of the energy consumed to heat or cool buildings here is going to waste. Do you know what sort of economic burden this brings on the economy? Do the math!" This year, government introduced more stringent efficiency codes; but, Abu Dayyeh says there is no mechanism for enforcing them.

Abu Dayyeh then walked to a thermostat on his office wall, explaining: "At the Zaytouneh University we lowered the temperature of the halls and offices by two degrees only, to 22 degrees. This translated to savings between 30 and 40 percent on our diesel bill. Every degree or two over 19 or 20 degrees means you're spending 10 percent more energy than what is needed to keep you comfortable," he said. "I've been to government buildings where they keep the windows open while air conditioning is switched on."

Gearing up

This year, Jordan took a step forward by approving legislation that exempts renewable energy products from duties and taxes. Thus, hybrid vehicles, green building materials, thermostat controls and the like will be cheaper to acquire. "The exemption is a good baby step forward even if it is coming late," says Maaitah. "But what Jordan really needs is a clear and transparent long term strategy to reach tangible future results."

The government's economic burden from relying heavily on hydrocarbon energy sources is massive. Currently, about 96 percent of Jordan's energy is imported and most is based on conventional energy sources. According to Jordan's 2020 energy strategy published by the Ministry of Energy and Mineral Resources, the government estimated in 2005 that Jordan's energy bill stood at 20 percent of the gross national product.

"Our energy account in GNP is probably more than what is stated and is rising fast," says Al Maaitah. The same government report projects annual growth in electricity consumption between 2007 and 2020 at a rate of 7.4 percent.

And that growth is coming at a time when oil looks to be sticking above $100 per barrel. Since January, the number of options to buy crude oil for $200 on the New York Mercantile Exchange has increased ten-fold.

As government energy subsidies become untenable, the cost will increasingly be paid by consumers, industry and commerce. This is making Jordan much less attractive to foreign and domestic investment.

But even facing these challenges, the government's new energy strategy still favors developing conventional power sources like shale oil fuel, which is available in commercial quantities in Jordan. By 2020, the projected investment for developing conventional energy resources is about $10 billion dollars—while only $1 billion is projected for renewables.

The relatively high cost of building solar energy projects is now justifiable

It takes two to tango

Most of Jordan's power generation and distribution was privatized in 2007, but this doesn't mean the future of sustainable clean energy rests in the hands of the private sector alone.

"Government will have to subsidize the retail rate difference between conventional and renewable energy to encourage more investment in renewables," says George Tadros, an Egyptian Canadian energy expert and Vice President of Asia Energy, an Italian company co-bidding for wind energy tenders in Jordan.

Eric Baer, Head of JD Energy & Infrastructure, a subsidiary of Jordan Dubai Capital (JDC), the largest investor in Jordan's energy generation and distribution said, "Since most governments directly subsidize renewable energy in some form and Jordan isn't offering as such, there is some uncertainty about how these projects will be financed."

Baer also said he hopes to see sustainable energy tenders that reflect existing market conditions and realistic expectations as well as provisions for more flexibility, authority and scope to private sector companies. "So that they [the private sector] can propose efficient and optimal solutions to meet energy needs… providing further clarity on the legislative framework is also very important."

If the government's current and future tenders are filled, Jordan would have more than 300 megawatts (MW) of clean energy by 2020. The Jordanian government has set two alternative energy milestones: The first, set for 2015, is to renewably produce seven percent of the total energy mix. By 2020, the benchmark is ten percent. Most of those goals are centered on wind energy.

"The current official 2020 projections for the portion of renewables in the energy mix will eventually rise and this will have to happen in tandem with the incremental rises in the price of energy worldwide," said Mohanned Khalifeh, an engineer and energy expert who is consultant to one of Jordan's largest energy groups [Full disclosure: Khalifeh is also a partner in the group that owns *Venture*].

However, Al Maaitah remains skeptical. He explains that while it is true that more advanced nations are now targeting a 20 percent threshold in their energy mix by 2020, some are surpassing their set targets already, and aggressively pushing for higher future objectives. He cites Jordan's earlier experiment with producing renewable energy. "We've managed to produce less than a one percent portion of renewables in the energy mix when the original plan called for three percent by 2007," he said.

India successfully implemented a renewable energy program. In 2007, the subcontinent won the prestigious Energy Globe World award for introducing the Solar Loan Program. The four-year program, started in 2003, finances solar home power systems. Supported by the United Nations and Shell, it installed more than 16,000 solar systems. The program was a big hit in rural areas that were outside the electricity grid and inspired similar programs in Tunisia, Morocco, Indonesia and Mexico.

In 2003, Khalifeh got involved in the first wind power tender in Jordan, but the project was eventually scrapped due to the high differential per kilowatt be-

tween conventional and wind energy rates. "Had we predicted the rise in conventional energy prices we would have done the project, but who could [have done that] at the time. No one," he said.

Go Solar, Go Wind

When deciding how to develop Jordan's future power generation, it comes down to two questions. The first is which system will deliver the most even and dependable supply within its environment. The second is which technology will be least disruptive to customer needs and requires the least backup investment to sync with existing strategies.

Al Maaitah expresses his astonishment that Jordan's renewable strategy has such small provisions for developing solar energy. "All the renewable energy generated in Germany is 25 times Jordan's total consumption of electricity; solar energy alone is ten times our electricity. But we have five times the solar intensity of Germany; so you tell me if solar energy wouldn't make a great difference."

Maaitah earned his PhD in aeronautical engineering and worked briefly at NASA on aerofoil design, which is directly related to the design of blades in wind turbine blades. He said that wind energy is feasible for some locations, but requires a large grid to support the rapid fluctuation in output. "If I was in Europe I'd opt for wind energy; but here, why mine for gold when you have it in your backyard?" He explained that solar energy is more consistent and easier to store.

Millennium has laid out plans focused on concentrated solar power plants. Maaitah says his company has already identified Jordan-appropriate technology and vendor-partners. Soon they will build a 30 kilowatt pilot for demo purposes.

"The relatively high cost of building solar energy projects is now justifiable," Al Maaitah said. "At current electricity rates, which are based on subsidized gas supplies through our quota agreement with Egypt, the cost of solar energy might sound expensive, but not if you compare the cost to gas and oil rates internationally, especially when their future prices are taken into consideration."

The cost of installing modern solar technology today is roughly $3.9 million per MW (based on a calculation of Nevada's $250 million 64 MW solar farm now under construction) compared to $1.2 million for wind. Al Maaitah however believes the solar cost is lower than that, estimating it at $2.8 million per MW when mixing old and new solar technology. "This is a one-time capital cost," said Al Maaitah. "And running costs are minimal." Conventional gas-powered plants are much cheaper to build, but they are also very expensive to run and maintain, he added.

Al Maaitah, whose company is currently applying for international patents related to improving existing solar-based water heating and cooling systems, suggested a solution to Jordan's energy problem. "During peak loads Jordan consumes about two gigawatts (GW) of electricity, but this only happens for one to two hours daily," he said. "So a one GW plant can almost end our dependence on conventional energy. Whenever the load surges, gas-powered plants can take over and feed the grid the power difference."

The Jordanian landscape is solar-friendly; there are swaths of empty desert in proximity to population centers. "A 1 GW solar energy plant built at a cost of $2 billion will require only 25 square kilometers of land," Maaitah said.

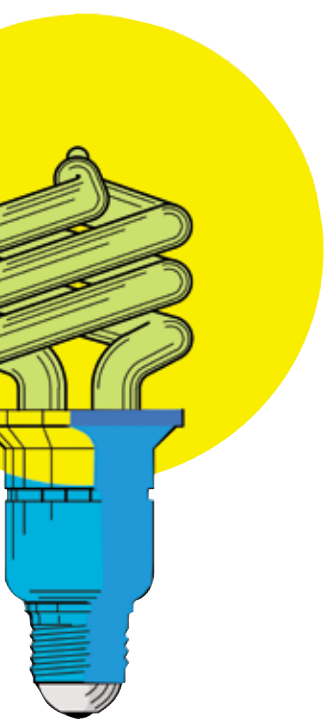
As with any power source, local conditions and potential drawbacks must be accounted for. "As nice as this might sound, solar panels will be collecting more dust and therefore will require more frequent cleaning to realize their optimal performance," Said Khalifeh. Indeed, one study on the effect of dust on solar panels in the UAE's arid deserts found that performance strongly depends on the season of the year and the frequency of air and water jet cleaning. When questioned on this point, Maaitah dismissed it as a minor concern, saying that Jordan's semiarid deserts are more hospital to solar.

With 28 years behind him in energy-related international businesses, Tadros explained that all renewable sources, be it wind, solar, biogas or geothermal, vary widely in their energy constants (energy variation). "The various environmental factors that are present at a certain time—position of sun, humidity, wind, heat, etc—impact the efficiencies of these systems greatly."

The technology driving wind turbines, however, has been advancing faster and delivering more efficient systems. By the kilowatt (KW) produced, wind power beats solar in cost, said Tadros. He added that Jordan completed its wind atlas and wind potential is looking quite promising.

Wind power now receives more investment annually than hydropower or nuclear energy

Professor Ayman Al Maaitah, CTO
Millennium Energy Industries



According to Khalifeh, wind generators can now reach three MWs in capacity. Furthermore, the technology is moving quickly. A wind generator that comes online in 2010 will produce between 8 to 12 MW. Regardless, the cost per MW will depend on the wind speed averages and the conditions the turbines operate under. Per kilowatt wind turbine costs in Europe are lower than in Jordan because they get more electricity output.

"Our average wind speed is seven meters per second—while in Europe it's ten to twelve, and when you double the speed of wind you multiply output capacity by eight times. This means the same wind turbine in Europe would produce 2.5 times our capacity," said Maaitah.

The global density of smaller residential and commercial solar systems is growing fast and, naturally, they make better sense inside cities. The European Photovoltaic Industry Association (EPIA), estimates 2007 growth in the global solar energy market at over 40 percent, including large power plants, private net-connected systems and off-grid (2.3 GW of capacity).

According to the Renewable Energy Global Status Report 2007, $66 billion was invested in new renewable capacity, an increase from $55 billion in 2006. The increase was mainly in wind and solar, but wind has seen the highest growth, clocking 20 GW of growth last year and an increase of 30 percent over 2006. Wind power now receives more investment annually than large hydropower or nuclear energy. The report adds that investment in solar was $10 billion in 2007, up 20 percent from 2006. Today, installed global wind power capacity surpasses 100 gigawatt (GW), feeding 150 million people in residences.

Mind the Queue

Even if Jordan is ready for a substantial commitment to renewables, the odds aren't good that the specialized equipment needed could be deployed in short order. "As a smaller market, Jordan tends to get less attention from major equipment suppliers in these market conditions and therefore has to make a stronger effort to attract them," said Baer.

Everywhere the race to install more capacity in renewable energy is heating up. India, which has a Ministry for Non-Conventional Energy Sources and already is the fifth largest capacity user of renewable energy, has set its eyes on a new global standard, with a 50 percent portion in its energy mix by 2020.

"The spike in demand [for equipment] has created an interim effect in renewable energy that pushed prices up to meet the new demand. Eventually this will drive new production and bring prices down," says Saad Abu Odeh, CEO of Kingdom Electricity, which partners with JDC on various energy projects. "Renewables will have to be commoditized before they drop in cost and become competitive with conventional sources."

RIDING THE RENEWABLE ENERGY SHOCK

The most famous venture capitalist of his generation, John Doerr, explains what it will take to score the untold treasures of the green-tech boom.

If you ask VC John Doerr how the boom in green tech compares with the infotech boom-and bust-that preceded it, he'll grab a pen and paper and draw this chart:

	Internet	Green Tech
Made Of	Bits, Pixels	Atoms, molecules
What is At Stake	Finding Friends on FaceBook	Life on the Planet
Capital Needed	LOW Google needed $25 million	HIGH Hundreds of millions
Time to success	QUICK 3 to 5 years	LONGER 5 to 10 years
Market Potential	LARGE Billions	ENORMOUS Trillions

In other words, green-tech companies won't be built in garages.

Silicon Valley has long been a world apart, with its free-flowing capital, huge appetite for risk, and quick ability to turn a thought into the thing. Now the Valley is applying its gifts to green technology. "We're talking about nothing less than the reindustrialization of the whole planet," Doerr says. So the biggest mistake any investor or company could make would be to remain inside the Valley's rarefied air, ignoring the incumbent energy companies that control distribution, have near-total market share, and shape regulations to their benefit. The new green-tech bunch has already stubbed some toes in its first dealings with the real world. First Solar Inc. stumbled in European markets because it uses toxic cadmium, which triggered a regulatory avalanche (it has since recovered). Tesla's electric car missed its ship date by a year because it couldn't orchestrate the complexities of its supply chain.

Those that make it in green tech will need to abandon the idea that Silicon Valley already knows everything it needs to know to remake the world. They'll need to understand transmission grids and enter the battles over where they're located. They'll need to confront the massive water requirements for biofuels. They'll need to grapple with the infrastructure required for carbon sequestration. Most important, they'll need to work hard to shape the federal policies and carbon-market structures that will make or break their businesses.

That's why Doerr has taken several of his entrepreneurs to California's state capitol Sacramento in the last couple of years to persuade legislators to pass mandatory carbon reductions. And it's why he funds companies run by people who have not only two or three advanced degrees but also an understanding of such arcana as fuel-supply chains and congressional politics. "They're going to be more nimble as we get more change," Doerr says. And it is why a company must prove itself before it's ready for an IPO. "Companies ideally will be in production, at scale, with contracts and guaranteed revenue."

Green tech isn't a bubble destined to burst. Energy is as necessary as water and food, with $5 trillion in annual revenues.

The most promising companies are already deftly working within the establishment. For instance, Chena Power, a little geothermal-energy firm in Alaska, partnered with United Technologies to take advantage of its political and marketplace clout. Verenium, a cellulosic-ethanol company, imported its top executive from conventional power production for his connections and wisdom.

Green tech isn't a bubble destined to burst. Energy is as necessary as water and food. In fact, it's the biggest business in the world, with $5 trillion in annual revenues. Demand for alternative energy is exploding, and it will not only create fortunes but also save the planet. Anyone who doesn't get the differences between the last new thing and the next one will watch this "mother of all markets," as Doerr calls it, pass them by.

Energy

The Tribulations of a Jordanian Industrialist

The steep rise in the cost of gas has fallen hardest on energy-intensive industries in Jordan. As a result, *Nuqul Group*, the region's largest tissue paper manufacturer, is getting squeezed out of its home base of Jordan. The company believes it has a win-win solution, but it will only work if the government is a willing partner.

By Bilal Hijjawi

Salim Karadsheh, CEO of the Nuqul Group

'We can't compete,' is a common refrain these days amongst Jordanian champions of industry. From cement to paper, energy-intensive industries in Jordan are rapidly losing their competitive edge to energy-subsidized neighboring markets.

A recent study by the Jordan Chamber of Industry estimates that domestic industry pays from 200 to 900 percent energy multiples over their counterparts in Egypt, Saudi Arabia and Syria (see comparison table).

"One has to ask himself how domestic industries will cope with an average of 500 percent in overcharged costs over those in Saudi Arabian and Egyptian markets," said Salim Karadsheh, CEO of the Nuqul Group, Jordan's largest private industrial concern. "Even if current rates are reined, any future inflation will be on top of, not in replacement of, the currently felt levels."

Energy Cost Comparison Table

	Egypt	Saudi	Syria
KEROSENE	939%	704%	528%
DIESEL	939%	845%	604%
HEAVY FUEL	703%	405%	471%
ELECTRICITY	241%	217%	338%

Jordan Energy Prices as Multiple of prices in Neighbouring Countries

Source: Jordan Chamber of Industry

According to 2006 statistics, domestic industry accounts for more than 13 percent of GDP and employs about 250,000 Jordanians. This number doubles when indirect jobs are calculated—in related sectors like transportation, government, finance and others.

> "One has to ask himself how domestic industries will cope with an average of 500 percent in overcharged costs over those in Saudi Arabian and Egyptian markets"

THE NUQUL DEBACLE

Nuqul is a regional industry heavyweight. Their most recent facilities investment is now at risk because of spiking energy costs in Jordan.

Established in Jordan in 1958, the Group now has activities spanning the entire Arab world and a total regional production capacity of 160,000 tons of tissue paper annually, which makes them the largest producer in the region. In Jordan, Nuqul makes 55 percent of this production capacity.

The company directly owns and manages 17 plants in the region and employs 5000 employees, with 10 plants and 3000 employees based in Jordan. Their manufacturing lines produce tissue paper, absorbent products, foam, mattresses, food, packaging material, aluminum and stationary.

But regional market demand has been rising for the company's Fine tissue brand line, which is one of the region's best selling brands. An expansion plan was devised and based on their initial location feasibility study Jordan didn't have the energy edge that other markets offered for tissue paper manufacturing, an energy–dependent industry. "What tilted the scale were the assurances of gas supplies, provided by the Jordanian government and the Egyptian Jordanian gas company Fajer; the company then decided to expand further in Jordan," said Karadsheh.

Nuqul held a ceremony to announce their receipt of assurances in the form of signed letters of intent, the exchange of draft contracts and the signing of study contracts. "With gas supply assurances available to us we opted for building the bigger manufacturing facility at a cost of $73 million," he said. It became Nuqul's new paper mill, Al Snobar, the largest in the Middle East and North Africa.

Nuqul Group's preference is to keep the manufacturing base in Jordan, even if profits take a minor hit.

Accordingly, the company was to invest in a gas pipeline extension to the main natural gas network which is linked with Egypt's natural gas fields. Nuqul went forward, acquiring a $17 million electricity generator and built it next to its new industrial complex.

"We generate our own electricity and efficiently recapture the wasted thermal energy, a by-product from generation, to dry the manufactured paper... this way the company saves about $14 million in its energy bill every year," said Karadsheh.

But the promised natural gas did not flow to the mill, reportedly due to supply problems. Thus, without proper gas supplies, their investment model fell apart. Nuqul ended up with unutilized investments and huge losses.

The company estimates their energy bill has climbed from $11 million to $26 million in the past three months.

NUQUL'S PROPOSED SOLUTION

So how does Nuqul plan to deal with this systemic hurdle? "We presented a solution whereby we will donate our $17 million power station to the Jordanian utility and we would still finance the gas pipeline to our site. In return we buy our electricity from the utility, which now owns and operates our donated generator; and the utility worries about the supply of gas," he explained.

Nuqul carried out complex analysis to prepare a solution that can save the company $14 million on their current energy bill and last month it presented it to government. The solution would save government about $13 million of capital spent on importing petroleum products from Saudi Arabia, which Nuqul is using now.

"We further demonstrated how this proposal is environmentally cleaner and can generate further income from selling our carbon rights," said Karadsheh. The values of those rights are derived from the application of a global environment program through which companies can sell their reduced CO2 emission to other countries. With the conditions presented in this proposal Nuqul says it would continue its operations in Jordan.

The company has made plans to shift their investments abroad already. "The move will cost us about $10 million but the savings in running costs [will] exceed this. We operate similar plants in Egypt; our costs there are $45 per ton while in Jordan it exceeds $300. We sell our production for $1,400 and the industry typically generates 5 to 7 percent profit. The energy cost differential alone between Jordan and Egypt is 18 percent."

The CEO says the concerned electric utility in Jordan was immediately sold on the proposal and government is closely studying it. He concludes that the Group's preference is to keep the manufacturing base in Jordan, even if profits take a minor hit.

Naturally, keeping Nuqul's factories working has substantial economic rewards. Jobs stay in Jordan, the business generates foreign exchange from exports, which currently account for 86 percent of the company's production capacity. Government gets its income tax, sales tax and more capital for investment through social security contributions. "The model can be adopted by others—thus extending the benefits to industry, employment, budgets, environment and Jordan's attraction as a base for investments," said Karadsheh.