

BY PATRICK DOYLE

## Can Amman Become a Cleantech Capital?

EDAMA means “sustainability” in Arabic. Hence the name of the EDAMA Association, a private sector-led organization backed by the Jordanian government and the U.S. Agency for International Development. EDAMA’s mandate is to maximize Jordan’s renewable energy generation; create a vibrant new sector of energy businesses; drive the research, development, and commercialization of Jordanian clean technologies; build awareness of sustainability issues; and advocate for policies that will make Jordan a model of energy efficiency, water conservation, and environmental stewardship.

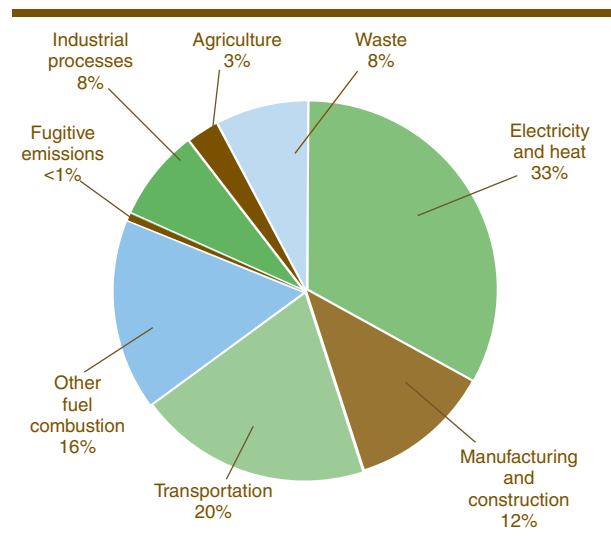
A key question for EDAMA is whether it can catalyze the creation of a vibrant “cleantech” market in Jordan. DAI was recently contracted to evaluate Jordan’s energy sector—focusing on renewable energy and energy efficiency technologies—and develop an action plan for EDAMA. Our analysis shows that meeting EDAMA’s mandate and Jordan’s goals will certainly be a challenge. But given the nation’s existing assets and a concerted effort to pursue policies, regulations, and standards favorable to renewable energy and energy efficiency, the cleantech sector is ripe with promise.

Jordan’s rapid economic growth and lack of conventional fossil resources has created an increasingly costly dependency on imported energy. Jordan imports 96 percent of its energy, amounting to 21 percent of total imports.<sup>1</sup> The kingdom relies almost exclusively on fossil fuels for energy, and while Jordan’s contribution to global warming—at approximately 4.2 tons per person—is below the world average of 5.8 tons per person, its emissions are growing rapidly, and it has high emissions per unit of economic output, ranking 32<sup>nd</sup> out

of more than 200 countries.<sup>2</sup> Jordan’s economic growth has caused electricity demand to rise by more than 10 percent annually in recent years, and expanding automobile ownership is also a large contributor to Jordan’s emissions (see Figure 1).<sup>3</sup>

Energy insecurity is also a growing threat to Jordan’s economic development. Because of rising oil prices, Jordan has been shifting electricity production from petroleum-based fuels to natural gas. But as natural gas becomes an exportable commodity across the globe via the expansion of liquefied natural gas facilities, and worldwide demand for natural gas increases (partly in response to climate change mitigation regimes), gas prices are likely to continue rising. Egypt recently

**FIGURE 1. JORDAN'S GREENHOUSE GAS EMISSIONS**



<sup>1</sup> Energy data from the U.S. Energy Information Administration. Import data from Jordan’s Department of Statistics.

<sup>2</sup> Climate Analysis Indicators Tool Version 6.0. (Washington, D.C.: World Resources Institute, 2009.)

<sup>3</sup> Electricity Regulatory Commission, *Annual Report*, 2007.

## From Albuquerque to Zafarana: The Scramble for Cleantech Business

National and local governments often find themselves in a bidding war to attract cleantech businesses to their regions.

In the United States, for example, the state of New Mexico recently won over two solar manufacturers—Schott of Germany and Signet of California—with \$130 million and \$185 million in tax incentives, respectively, and \$12 million to pay for infrastructure.

Meanwhile, in the Middle East, the Egyptian New and Renewable Energy Authority—which hopes to provide 3 percent of the country’s electricity needs through renewables by 2010—provided a substantial package of government incentives for the Zafarana wind projects on the Suez Gulf, including land; guaranteed loans for local investment costs; exemptions for power providers from all local taxes, customs, and import duties; free-of-charge grid connections; and long-term power purchase agreements with “must take” guarantees.

With these cost-reducing incentives, Zafarana power prices are 3.0 to 5.5 euro cent per kilowatt-hour, but it should be noted that the area’s annual mean wind speed of 8.5 meters per second is excellent, and exceeds that of any onshore location in Jordan.

cancelled a project to export natural gas to Jordan’s Aqaba industrial zone, and relying on Egyptian or other imported gas may expose Jordan to large cost increases in its power sector.

Although Jordan’s scarcity of fossil and water resources is often considered a burden, it could force the country to become an early adopter of advanced energy and water technologies and propel Jordan into a position of technology leadership. The levelized costs<sup>4</sup> of renewables are still higher than fossil fuels in most cases, but fossil fuel prices are highly volatile and price forecasts highly uncertain (although rapid rises are possible as the global economy recovers).

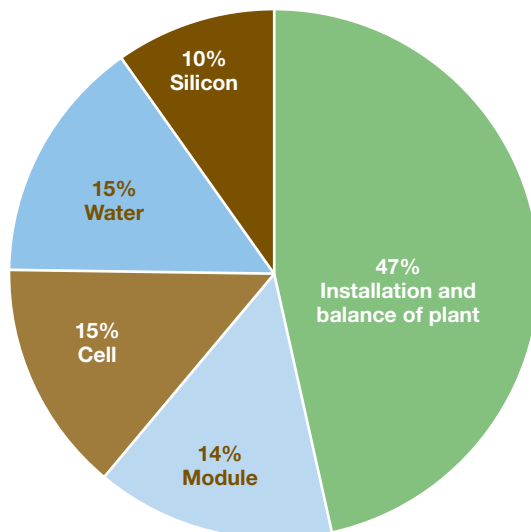
Jordan has significant strengths, including solar and wind resources, a developed electricity grid, strong legal and intellectual property protections, a market-friendly economy, a skilled workforce with 77,000 registered

engineers—and significantly more science and business graduates—and a population notably fluent in English. So it is well positioned to participate in the expanding cleantech industry. However, Jordan has a limited footprint in energy or water technology manufacturing and service provision.

Enacting policies to promote renewable energy and energy and water efficiency is therefore critical to driving Jordanian market transformation. In Jordan as elsewhere, reliance on fossil fuels developed over centuries; cleaner technologies generally require government support to be competitive. As global energy demand increases, fossil fuels will become scarcer, and prices will likely reach levels that make renewable technologies competitive even without subsidies. However, Jordan’s National Electric Power Company has not yet been able to agree to the high prices offered in at least one large-scale solar thermal plant proposal, and is still working to agree on the price for power from its planned first large-scale wind plant. Cleantech prices will likely decrease in coming years, but in evaluating long-term generation investments, the assumptions about long-term fuel prices are critical.

Given the volatility of fossil fuel prices and the likelihood of impending price increases, Jordan must invest now to reduce its dependence on oil and natural gas. But to establish a cleantech “cluster” with export potential, substantial public and private sector efforts will be needed. Jordan is more likely to develop a cleantech

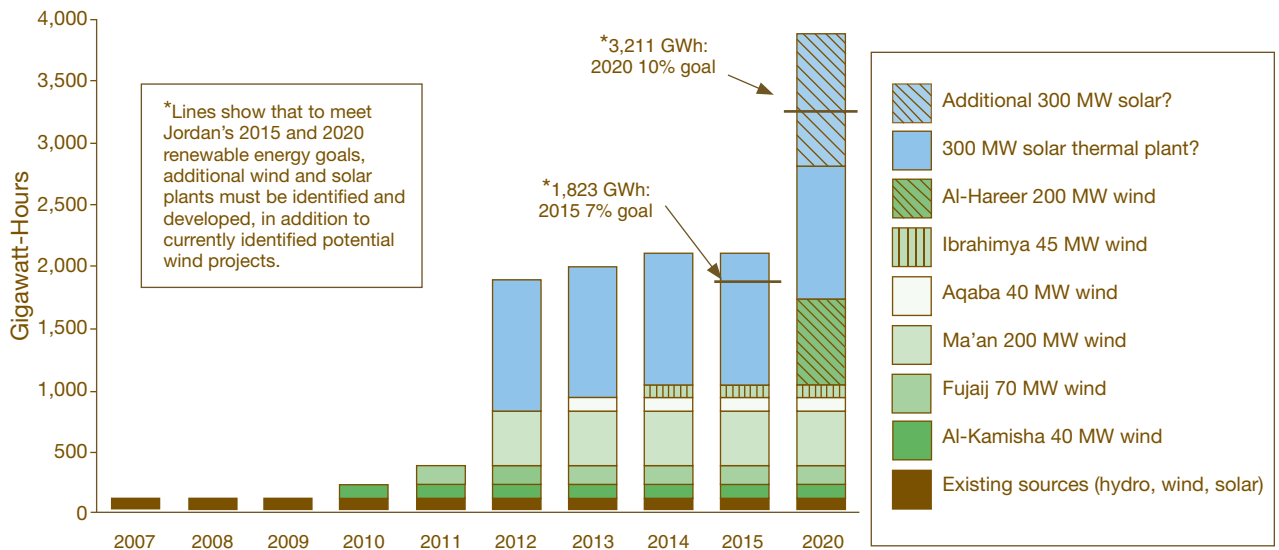
**FIGURE 2. SOLAR PV MODULE COST BREAKDOWN**



Source: RBC Capital Markets

<sup>4</sup> Calculating the levelized cost of power takes into account all costs—investment, fuel, operations, and disposal—and allows comparison of different energy-generating systems.

**FIGURE 3. JORDAN'S PROJECTED RENEWABLE POWER OUTPUT BASED ON PLANNED WIND AND LARGE-SCALE SOLAR PLANTS**



Source: Graphic/analysis: DAI. Data: Enabling Activities for the Preparation of Jordan's Second National Communication to the UNFCCC Dissemination Workshop, 20/11/2008. For wind production, capacity factors taken from presentation. For solar production, assumes a 40 percent capacity factor for solar (thermal) plant; a PV plant would likely need to have much higher total capacity due to lower capacity factors.

cluster by focusing on smaller, distributed generation than by focusing solely on developing utility-scale solar and wind projects. In 2007, the German photovoltaic (PV) industry alone employed 42,000 people; by 2030, if solar generation advances as expected, up to 10 million full-time jobs around the world will be created by the development of solar power, more than half in the installation and marketing of systems.<sup>5</sup> While focusing on solar PV power may not generate an immediate, large international investment in the upstream manufacturing portions of the solar PV value chain—silicon purification, for example, or cell and water production—downstream Jordanian companies will benefit. As shown in Figure 2, almost 50 percent of the value lies in plant design and installation.

Jordan's numerous solar hot water companies have been progressive in researching new applications such as combined solar-thermal/absorption-chiller equipment. Jordan should capitalize on this niche by moving up the value chain into solar thermal equipment manufacturing. Jordan should also build both skills-based (blue collar) and knowledge-based (white collar) expertise in the solar industry. One promising initiative led by the South Company for Construction and Development, for example, plans to develop a combined industrial park for the manufacture of solar panels, research and development of solar applications, and vocational training.

Supporting cleantech and leveling the playing field means using both carrots and sticks: financial incentives to overcome hurdles to energy efficiency and renewable investments, and penalties imposed on high greenhouse gas-emitting technologies to penalize fossil fuels for their environmental consequences. The incentives can be grants, rebates, renewable energy and energy efficiency credits, production and investment tax credits, convertible and direct loans, loan guarantees, on-lending facilities, and carbon credits. Incentive programs should target specific points in the value chain—from the manufacturer, installer, or construction contractor to the end user occupant or equipment purchaser—for maximum impact at lowest cost.

Jordan's recent push for tariff and tax exemptions for renewable energy and energy efficiency equipment should reduce prices. However, additional incentives—such as tax deductions or credits for corporate and personal income taxes—would do still more to create a commercial and residential cleantech market. Until recently, the government maintained below-cost power prices for consumers; however, as fuel costs rose because of reduced access to below-market-price oil and gas, Jordan began to reduce subsidies for power and fuel, and current prices are high enough to encourage efficiency investments by large domestic power users (which pay high tariffs to subsidize lower-volume users). Still, further steps toward market liberalization and decreased regulation are advisable.

<sup>5</sup> According to the European Photovoltaics Association.

DAI's analysis for EDAMA and the Jordanian government includes numerous recommendations. Among them:

- Enact incentives for increasing energy efficiency and adopting renewable technologies; review the potential roles and new business models of energy service companies, power distribution companies, and equipment suppliers; and recommend the best consumer incentives for the Jordanian market.
- Publish position papers on electricity sector regulatory needs, taking into account local resource diversity requirements and the promotion of off-grid and customer-sited facilities, as well as the promotion of large-scale solar and wind in Jordan.
- Determine what parts of the solar value chain Jordan should focus on, with special reference to export potential and the impacts of Jordan's new tariff and tax policies for alternative energy products.
- Reduce the barriers to energy efficiency finance and to the establishment of an energy services industry by developing awareness among domestic financial institutions and establishing a coalition of banks interested in energy efficiency finance.
- Establish a cleantech incubator that would provide business support, market assessments, and business plan development for early-stage cleantech companies.
- Develop research and development and training centers on energy and water technologies—including wind data mapping and assessment and wind industry services classes—and an energy manager certification program.
- Mandate energy efficiency standards for new public buildings and energy efficiency goals for existing public buildings.
- Support incentives for cleantech companies at the state and local levels, such as reduced power prices and land costs, and infrastructure upgrades.
- Improve Jordan's National Innovation System by enforcing intellectual property protections and enacting laws encouraging scientists to patent and license the technologies they develop.

These are promising times in the energy, water, and environment sector, in the Middle East as in much of the world. Globally speaking, new technologies and new businesses are constantly emerging in the still-embryonic cleantech industry. Within Jordan, the situation is rapidly changing as the country's entrepreneurial people pursue ways to invest in improving Jordan's energy, water, and environmental productivity. There are many actions that Jordan's private sector can take to build cleantech enterprises, increase awareness, and enhance access to finance for new technologies. But to facilitate these actions and meet its own ambitious goals, the Government of Jordan must act aggressively in the policy, regulatory, and standards arenas to create markets and attract investment in renewable energy and energy efficiency. In the long run, these investments will pay off for Jordanian society as a whole through cleantech-fueled economic growth; increased productivity in the energy, water, and environment sector; and improved energy and environmental security. EDAMA will seek to play a catalytic role in this process.

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