



THE NEW AGE OF RENEWABLE ENERGY

Renewable Energy Is Moving from Niche to Mainstream.
One of the Clearest Signs Yet: The Middle East Is Embracing It

By Jeffrey Ball

Near the town of Sweihan, in southern Abu Dhabi, construction is underway on what is slated to be the world's largest solar project, an expanse of metal and glass expected to cover three square miles. At Sakaka, in northern Saudi Arabia, plans are proceeding for a massive solar installation whose electricity appears likely to sell for less than 3 cents per kilowatt hour, one of the lowest prices in the world. Morocco, which has opened at the foot of the High Atlas mountains a solar project composed of hundreds of curved mirrors, each the size of a bus, says that within a decade the country will produce half its electricity from renewable sources.

Renewable energy is undergoing a revolution. It is surging in scale and plummeting in price, and in the process it is deepening geopolitical rifts, upending corporate business models, and reshaping global energy markets. No place illustrates renewable energy's unexpected rise and unpredictable ripples better than the Middle East and North Africa (MENA), a region in which several countries that for a century have produced epic power with energy from the ground are now finding compelling economic reasons to exploit energy from the sky. It is a shift that would have been unthinkable just a decade ago.

Geologists, investors, and policy makers have known for generations that this sandy patch of the planet brimming with buried fossil fuel also is blessed with vast supplies of wind and sunlight. What is changing is that they now see compelling financial reasons to care. A confluence of economic forces that they either didn't sense coming or hoped would sputter has power brokers in the MENA region gunning to exploit the money-making potential of a suite of energy sources previously dubbed alternative but now entering the mainstream.

The renewable-energy transformation, still in its early days, begs two questions.

◁ Men stand in front of a solar panel at the Mohammed Bin Rashid Al-Maktoum solar park, Dubai, Nov. 28, 2015.
Ashraf Alamra/Reuters

One is economic: who—which countries, industries, and individual companies—will win and lose in the diversification from energy that’s finite to energy that’s not? Another is environmental: will the renewable-energy ramp-up prove big enough to meaningfully help a planet that as a result of human activity has been heating up?

The answers will depend largely on finance and policy—which thus far have been economically inefficient and will have to become vastly more productive if renewable energy is to reach its economic and environmental promise.

Dirty Secret

The dirty truth about renewable energy is that it isn’t yet making much of an environmental difference. Whether it ends up protecting the planet—whether, that is, it significantly curbs carbon emissions—will depend on whether its costs decline far more radically than they have thus far. As such, a ruthless focus on wringing out excess cost should be the goal of policymakers who want to optimize renewable-energy sources and meaningfully increase their role in the greater economy.

History shows why cost will be key. Past energy transitions have been propelled by pushes: by broadly perceived crises such as wars, or oil embargoes, or threats to public health.

Japan enacted policies to increase its economy’s energy efficiency after World War II, which decimated the country’s infrastructure, forcing it to rebuild in a way that maximized the economic bang it squeezed from every energy buck.

France adopted nuclear energy as its main source of electricity generation following the Arab oil embargoes of the 1970s. The Organization of the Petroleum Exporting Countries (OPEC) embargoes of the seventies were geopolitical spasms that made oil, previously France’s main source of electricity, too risky a fuel on which to base an industrial economy. Germany, which at the time was powered in significant part by nuclear energy, began massive subsidies for the development of renewable energy in the wake of the 1986 Chernobyl nuclear disaster in Ukraine, an event that sent radioactive clouds over Germany.

Today, there is no such push.

For one thing, the world is awash in fossil fuel. In a tectonic shift from just a decade ago, the energy world is focused more on the specter of a peak in global oil demand than on a peak in global oil supply. The OPEC crude oil basket was selling in late January 2018 for about \$68 a barrel. Though that was up sharply from oil’s price a year earlier, it was still below the price oil averaged over the previous decade. That fact, combined with an increasing expectation that oil prices will remain low long-term, is threatening the treasuries of MENA economies that run on oil exports.

For another thing, many people don’t regard climate change as a threat so immediate that they need to pay dearly to address it. A global poll by the Pew Research

Center in 2015 found that, in China, the world's largest greenhouse-gas emitter, only 18 percent of people thought climate change was a "very serious problem" and only 15 percent said they believed climate change would harm them personally. In the United States, the world's second-biggest emitter, the numbers were higher but still short of a majority: 45 percent and 30 percent, respectively. In the Middle East, which has higher per-capita carbon emissions than any other region, the results were similarly blasé: 38 percent of people thought climate change was a very serious problem and 27 percent said it would hurt them personally. These are not numbers that suggest climate change is broadly seen as a crisis.

Because of this lack of a push—because "old" energy is plentiful and because most people don't see climate change as an imminent threat to their livelihoods—the challenge for those who care about unlocking renewable energy's vast potential is to create a pull. The challenge is to slash the cost of renewable energy so it competes with fossil fuels on price. That is starting to happen. Electricity from new solar and wind projects has become less expensive than electricity from new fossil-fueled power plants in certain places that have particularly prolific renewable resources, including some parts of the Middle East, and in markets that have particularly high conventional-energy costs, such as California.

However, renewable energy will have to scale up far more if it is to contribute meaningfully to curbing climate change. That will require a ruthless redesign of a variety of financing mechanisms and government policies, many of which were hatched to help incubate renewable energy but are proving unsustainably expensive. To matter to the planet, the renewable-energy push must be more than sincere. It must also be smart.

Renewable Realities

The energy economy is almost inconceivably large. What most people think of as renewable energy is only beginning to register in it. The International Energy Agency (IEA) calculates that renewable sources provide about 15 percent of global energy and about 24 percent of global electricity, up from 13 percent and 19 percent, respectively, in 2000. But the biggest source of renewable energy is old and polluting: biomass, a category that encompasses everything from dung to wood to grass, that is burned mostly in developing countries, and that is used mostly to produce heat. The biggest source of renewable electricity is dams, and they also are environmentally controversial. Around the world, from Egypt's Aswan High Dam to Ethiopia's Gibe III Dam to China's Three Gorges Dam, massive hydroelectric dams have threatened ecosystems and communities' livelihoods even as they have dramatically boosted energy access.

Wind and solar, the renewable sources widely seen as the greenest, together provide less than 2 percent of global energy and only about 5 percent of global electricity. But they are growing fast. They account for the majority of renewables' growth since 2000, and they will account for the majority of renewables' growth over the next quarter century, the IEA projects.

The extent of that future growth will depend largely on policy, because public policy in the energy world drives private investment. If public policy were wielded aggressively to make fossil fuels costlier and renewables cheaper, renewables could account for as much as 29 percent of global energy, and as much as 63 percent of global electricity by 2040, the IEA projects.

Other observers are even more bullish. Thomson Reuters predicts that, by 2025, solar will be "the primary source of energy on our planet." If such a future materialized, the effect on the global economy would be profound and uneven, impacting everyday life in ways large and small. The effect on the environment would, however, be beneficial and real. Some would like it and some would not. Either way, it would constitute arguably the biggest energy transformation in human history.

The Rise of Renewables

The rise of wind and solar, typically seen as a triumph of technology, is more about scale. Technological advances have markedly improved the efficiency with which wind turbines and solar panels convert breezes and sunshine into electricity. But this sector has grown largely because its costs have dropped.

What has slashed its costs most dramatically are increases in manufacturing capacity and in operational know-how. The transformation of wind and solar power from experiments into explosive industries can be broken down broadly into three stages.

The first stage might be called the Age of Necessity. The use of windmills goes back a millennium or more; the first wind turbine built to produce electricity was installed in 1887 in Scotland. The first photovoltaic, or solar, cell—"photovoltaic" refers to the chemical process by which a semiconducting material converts sunlight into electricity—was developed in 1954 in the United States at Bell Labs. At first, these technologies were expensive, and so they were used where no other source of power was readily available. Early electricity-producing wind turbines were built on isolated farms, on mountaintops, and on islands. Early solar panels were used in rural villages and in space.

The second stage in the development of wind and solar power could be dubbed the Age of Subsidy. Spurred largely by environmental sentiment—first by opposition to nuclear power's waste and proliferation threats and then by concern about fossil fuels' climate consequences—European governments began around the early 1990s

to roll out generous incentives to encourage the use of wind and solar. No longer were renewable energy's disciples targeting just remote spots that lacked other energy options. Now they were aiming to provide greener, though more-expensive, alternatives to towns and cities served by modern electricity grids.

It was this Age of Subsidy that turned wind and solar power from a science project into a global industry. The transformation began in northern Europe—in Denmark for wind and in Germany for solar. These countries promulgated a subsidy they called a “feed-in tariff,” in which producers of electricity from wind turbines or solar panels were guaranteed contractually that, for a lengthy period—typically 20 years—they could sell, or feed in, to the power grid their renewable energy at a price higher than conventional electricity was fetching.

The feed-in tariffs socialized much of the cost of renewable energy, broadening it from individual investors to entire nations. They all but guaranteed renewable-energy investors predictable, long-term profits.

The European feed-in tariffs had two powerful effects. They enriched investors across Europe—not just bankers and lawyers, though they were among the beneficiaries, but also farmers, and business owners, and pensioners. In the process, by harnessing economic self-interest, European subsidies dramatically broadened the political constituency gunning for renewable energy. They also globalized the renewable-energy industry, attracting ambitious players from far beyond Europe who then expanded the renewable-energy market internationally. Chief among those players were savvy entrepreneurs from China.

China, the world's most populous country, had become by the late 1990s the world's factory floor, building everything from televisions to t-shirts and selling them around the globe at prices that undercut companies in myriad end markets. Starting in the mid-2000s, China turned its sights to renewable energy, which policymakers and top corporate officials decided would be a strategic and lucrative industry. They believed China was well-positioned to dominate it, and that in the process it could produce vast numbers of Chinese jobs.

In the decade since then, all levels of government in China—central, provincial, and municipal—have rolled out an increasingly coordinated and aggressive slate of policies to help the wind and solar industries. More than any other factor, it is this Chinese support that has transformed renewable energy from a European oddity into a global powerhouse.

Initially the Chinese incentives were all but exclusively for manufacturing: particularly in the case of solar panels, to build factories in China to make products for export to the West. But as the Chinese renewable-energy manufacturing industry grew, China expanded its support in two ways that have reshaped the global renewable-energy

market, and that offered lessons for other countries, including those in the MENA region, that are eager to jump aboard the renewable-energy bandwagon.

First, after the global financial crisis in 2008 prompted many European governments to ratchet back the renewable-energy subsidies they were offering, the very European subsidies that had propelled the growth of China's renewable industry in the first place, China launched feed-in tariffs of its own. It did so in an explicit bid to birth a vast new domestic market for China's renewable-energy industry, a market that would more than replace the Western one whose subsidy-fueled growth was slowing.

Second, China boosted government spending on renewable-energy research and development. It reasoned that China would grow its renewable-energy equipment industry over the long term only to the extent it developed the industry's innovative abilities. China's investment in renewable-energy innovation is little understood in the West, because its results at this point are hard to quantify. Nevertheless, a Stanford University study of the Chinese solar industry that I led in 2017 documented mounting evidence that China is narrowing the renewable-energy innovation gap with the West.

Today, China is a major player in the wind and solar sectors. Four of the world's top ten manufacturers of onshore wind turbines in 2016 were Chinese-based companies, according to Bloomberg New Energy Finance. And China produced 72 percent of all the crystalline solar panels sold globally in 2017, estimates IHS Markit, a data-analysis firm.

China's production of wind and solar power is equally massive. In 2016, according to REN21, a global renewable-energy consortium, China added 23.4 gigawatts of wind-power capacity, or 43 percent of all wind capacity added globally that year, bringing China's total installed wind-power capacity to 169 gigawatts, or 35 percent of the world total. Similarly in 2016, China added 34.5 gigawatts of solar-power capacity, or 46 percent of all solar capacity added globally that year, bringing its total installed solar-power capacity to 77 gigawatts, or 25 percent of the world total, according to REN21.

Critical Mass in the Age of Viability

The upshot is that, though wind and solar energy represent a tiny percentage of total global energy, they have achieved critical mass. They have arrived at a third stage, one with massive ramifications for the global economy: the Age of Viability.

What has ushered in renewable energy's Age of Viability is an extraordinary, and extraordinarily fast, decline in renewable-energy prices. Driven first by Europe and then by China, the Age of Subsidy scaled up renewable energy. Those subsidies slashed renewable energy's prices to levels that, in some locations and in some circumstances, now are lower than the prices of electricity produced by coal, natural gas, and nuclear power.

Wind and solar still are subsidized in major markets. And the wind and solar industries have assembled powerful lobbying machines gunning to preserve the subsidies. But many leading economies—the United States, and many countries in Europe, and even China itself—are reforming their renewable-energy subsidies in a bid to make them more economically efficient.

Yet something strange is happening: despite the rationalization of these subsidies, the percentage of electricity that these countries generate from wind and solar continues to grow. In 2016, wind and solar together accounted for nearly 20 percent of electricity generation in Germany, the world's fourth-largest economy; nearly 15 percent in the United Kingdom, the fifth-largest economy; and 20 percent in California, which if it were a country would be the world's sixth-largest economy.

The Age of Viability, though just starting, already is transforming global energy markets. Among the signs of that transformation, four stand out: a trade war over solar equipment between China and the United States; havoc that renewable energy is wreaking on the utility industry's century-old business model; a conversion of certain powerful renewable-energy skeptics into boosters; and the pace at which renewable-energy prices continue to fall. All these developments would, a decade ago, have been inconceivable.

Trade fights between China and the United States are hardly new. Yet a trade fight over solar panels reflects a new world order. It began six years ago, when the U.S. government slapped tariffs on imported Chinese solar products, siding with a group of companies that manufactured solar cells and solar panels in the United States. The companies alleged Chinese exports violated World Trade Organization rules, asserting that the Chinese government was subsidizing them too heavily and that Chinese manufacturers were selling them in the United States at below their production cost, a practice intended to grab market share and known in trade circles as "dumping." China denied both allegations, and it imposed tariffs of its own on U.S.-made polysilicon, an important raw material in the solar manufacturing process.

This geopolitical tit-for-tat is only intensifying. In January 2018, U.S. President Donald Trump imposed yet another round of tariffs on imported solar products. The supposed justification for his decision wasn't even that China is violating international trade rules; it was merely that Chinese competition is hurting U.S. solar firms.

It is a farcical fight. Evidence shows that the U.S. tariffs actually are stunting, not expanding, U.S. solar manufacturing. It also suggests the tariffs are raising U.S. solar prices, slowing solar's growth. None of this comes as much of a surprise; the politics of tariffs often are more about slogans than about substance. It does, however, emphasize the need for a new policy approach to renewable energy, one that recognizes the industry's global footprint and that seeks above all to cut renewable energy's cost.

Just as renewable energy in the Age of Viability is deepening tensions between geopolitical superpowers, it is upending the utility industry, a behemoth that once delivered returns so reliable it was seen as boring. Now the utility industry is besieged, forced by competition from renewable energy to scramble to remake itself.

Nowhere is this more evident than in Europe, where two of the continent's largest power generators, RWE AG and E.ON SE, saw their profits decimated by the flight of consumers who installed solar panels on the roofs of their homes and businesses and began to generate their own power. As a result, RWE and E.ON each split into two. The details of their breakups differ, but the upshots are broadly similar: one entity now focuses on old energy sources, particularly coal and gas, and the other now focuses on building a business in renewables.

The same structural threat faces utilities in the United States, and they are responding in part by fighting the change and in part by embracing it. In several U.S. states in which large numbers of customers are defecting to rooftop solar systems, utilities are lobbying to restrict rules that let those consumers sell power they generate back into the electricity grid. These so-called net-metering policies have underpinned the economic allure of rooftop solar systems in the United States; rolling them back almost certainly would slow renewable energy's growth. Meanwhile, some of these same utilities are trying to enter the renewable-energy business.

Nowhere in the world, however, are these twin trends in renewable energy—the boost in support from erstwhile utility foes and the drop in price—as striking as in the Middle East.

Middle Eastern Moves

The Middle East long has been the world's poster child for energy excess. The region is among the last in the world to burn large amounts of oil to produce electricity; most countries abandoned that practice decades ago, deciding to save oil for transportation, a use for which no mainstream alternative to petroleum so far has taken hold. Everything in the Middle East that consumes energy—power plants, factories, houses, consumer appliances, cars, and trucks—tends to be notoriously inefficient.

None of this is an accident; it is the result of policy choices by the region's rulers, who for decades have subsidized their citizens' consumption of fuel and electricity as part of a grand political deal that has ensured the governments' continued power. The Middle East has just 3 percent of the world's population. But in 2016, the IEA says, the region doled out some 30 percent of the \$260 billion spent globally on fossil-fuel consumption subsidies. The region is home, according to the World Bank, to five of the ten countries with the highest per-capita carbon dioxide emissions.

Things in the Middle East, however, are changing. Though still high by global standards, fossil-fuel subsidies in the region have fallen significantly over the past two years. Several countries, including Oman, Saudi Arabia, and the United Arab Emirates (UAE), have raised prices for gasoline and diesel fuel. And the region is beginning to embrace renewable power.

What is motivating the Middle East is what has always driven energy transformations: economics. In the case of the region's net oil and gas exporters, such as Saudi Arabia, it is the need to reduce runaway domestic fossil-fuel consumption and thus maximize oil to sell, even at today's relatively depressed prices, on the global market. In the case of the region's net energy importers, such as the UAE, it is the allure of a domestic energy source that is becoming cost-competitive with foreign fossil fuel.

The IEA expects that, from 2016 through 2022, renewable-energy generation will grow faster in the MENA region than in any other part of the globe. The IEA forecasts a compounded annual growth rate for renewable-energy production in the MENA region, 9.1 percent, that is nearly twice the 5.2 percent rate it forecasts for the world. And that regional average encompasses higher rates for certain countries: 64 percent for Saudi Arabia, 63 percent for the UAE, 31 percent for Jordan, and 16 percent for Morocco.

Two caveats are crucial to keep in mind. First, these forecasted growth rates start from a baseline that approximates nil. Today, according to the IEA, renewable energy of all sorts accounts for approximately 0 percent of the MENA region's total energy demand and 2 percent of its electricity generation. That 2 percent of power production comes almost exclusively from dams; wind and solar contribution to the region's electricity mix rounds to naught.

The second caveat is deep uncertainty about whether MENA governments will follow through with the finance and policy reforms likely to be necessary to unlock the region's vast wind and solar potential. The IEA says that, by 2040, renewable energy could account for between 3 percent and 16 percent of the region's total energy demand and between 8 percent and 50 percent of the MENA region's total electricity generation. That range is cavernous. One end represents a continuation of the status quo. The other represents a radically new energy future.

Which future materializes will depend almost exclusively on the trajectory of wind and solar. Anecdotally and rhetorically, the signs are bright. A slate of large renewable-energy projects—particularly solar—now under construction in the region has drawn robust investor interest. Seemingly every few months bring an announcement that yet another MENA project has been awarded through competitive auction to investors who have contracted to build it, operate it, and sell its electricity at a price that sets a new world-record low.

The consortia bidding for these projects are international, experienced, and well-funded.

A Widening Sun Belt

Buoyed by this market response, governments in the region are falling over each other to pledge increasingly ambitious national renewable-energy targets. From west to east, the ambition extends from Morocco, to Egypt, to Israel, to Jordan, to Saudi Arabia, to the UAE, to Oman. If all this enthusiasm pans out, it will constitute a momentous advance for clean energy.

Among the most ambitious players in the region is the UAE, which imports most of the natural gas it burns to produce electricity and thus is hungry for a homegrown energy source. In 2013, the emirate of Abu Dhabi opened the MENA region's first large-scale solar project, the 100-megawatt first phase of a development called Shams, which in Arabic means sun. Since then, the UAE has upped the ante with a series of steadily larger and more cost-competitive solar projects. The latest is Sweihan, expected to be the largest solar project in the world and to come online in April 2019. It has a planned capacity of 1.2 gigawatts, an estimated price tag of \$872 million, and a contract to sell electricity for 2.42 cents per kilowatt-hour, a price so low that it turned heads around the globe when it was announced.

The assortment of players in the UAE deal is instructive. A consortium of lenders, led by some of the largest banks in Japan, France, and Abu Dhabi, is raising \$650 million in debt for the project. Another \$220 million in project equity is coming cumulatively from the Abu Dhabi Water & Electric Authority, the emirate's state-owned power utility, which is administering the project, and from Chinese solar manufacturer JinkoSolar and Japanese construction firm Marubeni Corp., which together are building the solar farm. In January 2017, the UAE announced that it "aims to increase the contribution of clean energy in the total energy mix to 50 percent," though how much of that would come from which renewable sources isn't clear.

Saudi Arabia, the world's preeminent petroleum-fueled power, is pursuing renewable energy for a different reason: it wants to minimize the copious quantities of oil it burns domestically to produce electricity, thereby increasing the amount of black gold it can peddle to the world. The kingdom announced a series of renewable-energy plans in recent years that failed to materialize, largely because of domestic infighting over who would control the process.

Now, under Crown Prince Mohammed Bin Salman, the on-again, off-again drive appears to be on again. In April 2016, Crown Prince Mohammad announced "Vision 2030," a plan to reduce the Saudi economy's reliance on oil. Plenty of international observers doubt whether the kingdom can afford the capital projects that the plan

envisions at a time of soft oil prices; the International Monetary Fund, among others, has expressed skepticism.

Nevertheless, as part of the implementation of the vision, the kingdom announced in early 2017 a National Renewable Energy Plan that targets the installation of 9.5 gigawatts of renewable-energy capacity by 2023. That is small by global standards; China, the world's largest renewable power producer, added 58 gigawatts of wind and solar capacity in 2016 alone. Still, the Saudi target, if met, would begin to meaningfully diversify an economy overwhelmingly dependent on fossil fuel.

Saudi Arabia's articulation of a firm long-term renewable-energy target has mobilized the market. In October 2017, the kingdom held an auction in which companies bid for the contract to build and operate the first solar project envisioned by the new national plan: the 300-megawatt solar project near the town of Sakaka. Just months after Abu Dhabi's power authority participated in the winning bid for the Sweihan project in the UAE, a separate UAE entity, a renewable-energy company called Masdar, joined with EDF, the French electricity company, in a winning bid to build, run, and sell the power from the Saudi solar project.

The Masdar group bid at 1.79 cents per kilowatt hour, 26 percent lower than its UAE sibling, the Abu Dhabi Water & Electric Authority, had bid in the bigger UAE project. Had Saudi officials accepted it, it would have been a record low solar price. But in January 2018, Saudi authorities passed over the Masdar group's bid, short-listing instead two slightly more-expensive ones: a 2.36-cent bid from Acwa Power International, a Saudi-based power producer, and a 2.66-cent bid from a consortium involving Japan's Marubeni.

Saudi officials were expected to pick a winner in early 2018. Either deal will mark another remarkably inexpensive solar project in the Middle East.

Big and Clean?

The test now is whether this first trickle of Middle East renewable-energy projects turns into a torrent. That will depend on finance and policy. Unlike in Europe, where renewable-energy projects have relied on feed-in tariffs, or in the United States, where they have depended on tax breaks, those in the MENA region generally have relied so far on competitive auctions, in which the winners have obtained low-cost financing through government participation in the projects. The question is whether, in the Middle East and beyond it, this model is scalable.

With a typical fossil-fueled energy project, the bulk of the costs are for the fuel that needs to be bought over the several decades during which the project produces power. In a renewable-energy project, the fuel is free, which means the majority of the costs come upfront, in building the plant. As a result, renewable energy depends heavily on low interest rates, which are rising.

Other questions loom. One is transparency: in some Middle East renewable-energy projects, the seemingly rock-bottom winning bids have masked adders that will end up raising the price consumers pay for the renewable electricity. Another is longevity: whether, if oil prices stay low, governments in the region will decide to use the money with which they have been bankrolling renewable energy for something else.

If governments are serious about expanding renewable energy, they will need to do more than declare targets and hold high-profile auctions. They will have to undertake politically painful economic reforms. Structural change will be necessary to mobilize the vast amounts of private capital that will be key to financing any meaningful clean-energy transformation. Four economic reforms, all focused on liberalizing energy markets, would prove particularly useful.

First, governments should accelerate their phase-out of fossil-fuel subsidies both to electricity producers and to consumers. These subsidies, rampant in the region, artificially advantage more-polluting energy sources over less-polluting ones. More to the point in the context of Middle Eastern economic realities, they incentivize the waste at home of hydrocarbons that could fetch higher returns if sold abroad.

Second, governments should introduce more market competition in the supply of electricity, which now remains, in most countries in the region, administered by the state. As the experience of less-regulated energy markets, particularly in Europe and the United States, has shown, market competition tends to turbocharge renewable-energy development. That frenzy can imperil fossil-fuel market leaders, forcing them to adapt quickly or risk being squashed. But early signs suggest savvy fossil-fuel giants can shift and survive.

Third, governments should move to integrate power markets and electricity grids, among countries in the Middle East as well as between them and the wider world. This will not be easy. The saga of Desertec, a German-led consortium that tried unsuccessfully over the past decade to engineer a massive project to ferry renewable electricity from North Africa to Europe, underscores the technical and political challenges. But, in Europe and the United States, open energy markets and interconnected grids have been important in maximizing renewable-energy penetration and in mitigating renewable-energy costs. Technology for long-distance electricity transmission is fast improving, and many countries in the MENA region have common and compelling economic reasons to try to make more-integrated markets work.

Fourth, as they move to build up domestic renewable-energy industries, governments should resist the allure of protectionism. Whether as tariffs or as laws mandating that renewable-energy equipment be made in a country in order to be installed there, policies that coddle manufacturers unable to compete without the help prove unsustainable. They stymie broader renewable-energy employment in

the country that implements them, and they raise the cost of renewable energy both there and around the world.

Nearly two decades ago, as the global renewable-energy push was just beginning to gain steam, Sheikh Zaki Yamani, who was Saudi Arabia's oil minister during the Arab oil embargoes of the 1970s, pithily framed the endgame he thought the trend would prompt. "The Stone Age came to an end not because we had a lack of stones," he told the *Telegraph*, "and the Oil Age will come to an end not because we have a lack of oil."

Yamani's comment sounded to many like a note of caution for his country and his region—a swath of the planet blessed, and in important ways cursed, with groaning subterranean stores of fossil fuel. Today, there is no stronger sign of how far renewable energy has come than that it is taking root in Yamani's backyard. Time will tell whether, in a part of the world in which new seeds have tended to grow slowly, this one withers or thrives.