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Brave new world: Myths and realities of clean technologies

Don't be fooled by high-profile setbacks. The cleantech sector is gaining steam—with less and less regulatory assistance.

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The world is on the cusp of a resource revolution. As Stefan Heck and Matt Rogers argue,¹ advances in information technology, nanotechnology, materials science, and biology will radically increase the productivity of resources. The result will be a new industrial revolution that will enable strong economic growth, at a much lower environmental cost than in the past, thanks to the broad deployment of better, cleaner technologies and the development of more appropriate business models. But how do we reconcile this heartening prediction with recent challenges experienced by cleantech, the general term for products and processes that improve environmental performance in the construction, transport, energy, water, and waste industries? Over the past couple of years, many cleantech equity indexes have performed poorly; in

January 2014, the American news program *60 Minutes* ran a highly critical segment on the subject. The former chief investment officer of California's largest public pension fund complained in 2013 that its cleantech investments had not experienced the J-curve: losses followed by steep gains. It's been "an L-curve, for 'lose,'" he said.

So, is cleantech failing? In a word, no. Rather, the sector has experienced a cycle of excitement followed by high (and often inflated) expectations, disillusionment, consolidation, and then stability as survivors pick up the pieces. We've seen this before with other once-emerging technologies such as cars, railroads, elevators, oil, and the Internet. Much of cleantech is just leaving its disillusionment or consolidation phase. For example, in transport,

Tesla Motors is looking good, while Fisker went into bankruptcy in 2013. In energy, SunPower is making healthy margins, and SolarCity raised \$450 million in 2013, but more than a hundred other solar companies are now gone. The shakeout is brutal—and typical. It has weeded out weaker players, making the industry as a whole more robust. Despite this rough patch, annual growth is at double-digit rates.

It's also important to look beyond financial statements. Global wind installations, for example, have soared about 25 percent a year since 2006 (exhibit). And global commercial investments in clean energy have more than quintupled, from nearly \$30 billion in 2005 to about \$160 billion in 2012. Even countries with vast reserves of oil and coal—in the Middle East and Central Asia—recognize that they can't miss out and are developing substantial programs for renewables. Meanwhile, the average real cost per oil well has doubled, and new mining discoveries have been flat, despite high investment. And, clearly, new ways are needed to meet the needs of the 1.3 billion people who lack electricity and the 2.7 billion who rely on traditional biomass, such as wood and dung, for cooking.

Cleantech is no passing, unprofitable fad. The sources of underlying demand—a growing middle class around the world and resource constraints²—aren't going away, and cleantech could be pivotal in dealing with both. There are three major myths that undermine confidence in cleantech's future.

Myth 1: Deployment and influence will be marginal

This is not so, and we know that because we see what is actually happening. According to the International Energy Agency, renewables already accounted for 18 percent of global consumption in 2010, and they are growing faster than any other form of energy. Given the radically lower marginal costs of renewables, their position is even

more promising over the long term. In fact, the International Energy Agency predicts they will account for more than 60 percent of new power-plant investment to 2035.

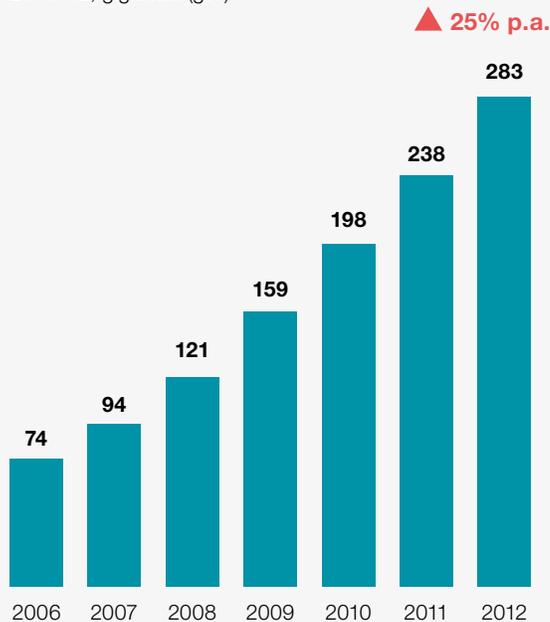
The effects of clean technologies will vary significantly by industry and geography. In some cases, they may truly transform markets, as light-emitting-diode (LED) technology is now doing in lighting. In cases where penetration rates are lower, they can still have a dramatic impact on industry structures and market dynamics. Among US electric utilities, for example, the traditional business model relies on putting capital in the ground. But the potential of distributed solar generation to meet the majority of new demand growth can upend that model entirely. As more people install solar panels on their roofs and add new capacity, demand will increase more slowly for utilities. Some utilities are responding to this by trying to get regulators to allow them to include investments in energy efficiency or renewables in their rate base. In addition, shale gas, which already makes up about 40 percent of gas production in the US (largely at the expense of coal-fired generation), has lowered the wholesale price of power, cutting into revenues and profit margins for deregulated utilities.

It's important to remember, too, that the cleantech space is diverse; it cannot be painted with a broad brush. We looked at 16 important clean technologies³ and found that while every single one has made progress over the past decade, some are moving much faster than others. Just over half of them—advanced building technologies, advanced agriculture, food life-cycle optimization, grid analytics, grid-scale storage, intelligent transport, next-generation vehicles, solar photovoltaics (PVs), unconventional natural gas, and water treatment—could become truly disruptive to the incumbent industries. The others have enormous potential and could well succeed, but without disrupting the status quo.

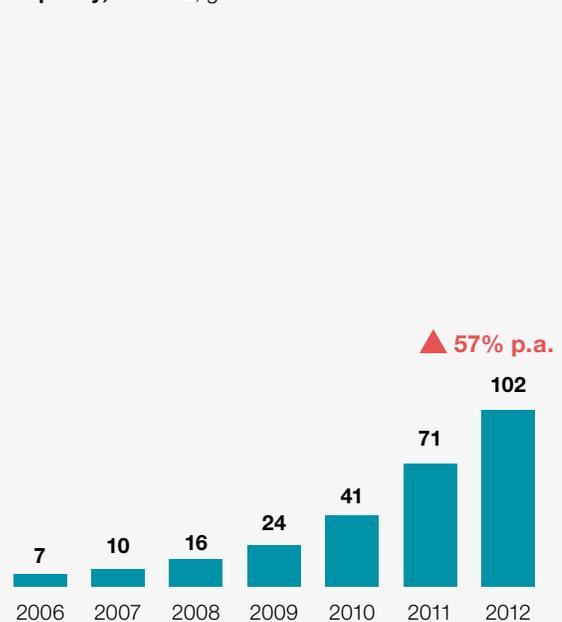
Exhibit

Many clean technologies have seen a high rate of growth in installed capacity since 2006.

Global cumulative installed wind capacity, 2006–12, gigawatt (gW)



Global cumulative installed solar-photovoltaic capacity, 2006–12, gW



Source: Bloomberg; Dow Jones; *Global Market Outlook for Photovoltaics 2012–2017*, European Photovoltaic Industry Association, May 2013; Factiva; Global Wind Energy Council; Thomson Reuters Datastream

Myth 2: Technologies have underdelivered

Profit margins have certainly been squeezed in some areas. For instance, Chinese production of solar panels has pushed many higher-cost producers in the Europe and United States out of business. In other cases, limited access to capital and decreasing subsidies have slowed deployment. And many big incumbents have scaled back their cleantech investments.

Yet cleantech has far exceeded expectations in many areas; technological innovation and manufacturing improvements have driven prices down. Costs for onshore wind, solar PV, and lithium-ion batteries have all fallen faster than many industry watchers anticipated, for example, and are continuing to drop. The cost of electricity from onshore wind facilities

is half what it was 15 years ago, thanks to technological innovation and business-model changes. In the lighting market, LED gained market share as manufacturing costs and prices fell; over the past five years, the cost of super-efficient LED lights has fallen by more than 85 percent. We estimate that the cost of electrical storage has fallen by roughly half, from \$1,000 per kilowatt-hour to \$500 per kilowatt-hour, since 2009. Similar shifts are taking place in less prominent sectors, such as water reuse, waste separation, and anaerobic digestion.

Total installed costs that US residential consumers pay for solar PV have also been falling fast, from nearly \$7 per watt of peak system capacity in 2008 to less than \$4 in 2013. We think that could be as little as \$1.60 by 2020 (see “The disruptive potential

of solar power,” on page 42). The bottom line: cleantech is getting more economically competitive.

Myth 3: The sector depends on regulatory support

Four critical elements—cost, access to capital, the go-to-market approach (broadly defined),⁴ and regulation—typically must come together to create successful cleantech businesses.

As the industry matures, the relative importance of these factors is changing: regulation is becoming irrelevant in many cases as clean technologies find their competitive footing. LED lighting is one example: in 2013, LED light sources accounted for the majority of the sales of several large lighting manufacturers, even in markets where incandescent bulbs are still widely available. That figure could rise to more than 80 percent by 2015.

Solar provides evidence both for and against the need for continued regulation. Given budget concerns, a number of countries have canceled or reduced subsidies, and growth has slowed. But the larger point is that solar is still growing. For example, Germany has cut its feed-in tariffs to encourage renewables production, and its strategy of *Energiewende*—a long-term effort to deploy renewables, move away from fossil fuels, and phase out nuclear power—has had some troubles. But the use of renewables continues to grow. Globally, solar installations have risen by 57 percent a year, on average, since 2006. One lesson is that sudden changes in regulation can create peaks and valleys in demand, and that isn't helpful to establish an industry on a sound footing. But the point is that while regulation can be and has been helpful to launch clean technologies, it is no longer critical in many sectors.

The reason isn't only that these technologies continue to advance, although that is the case. What's more interesting is the increased sophistication of business models, financing, and

management practices. There are, for example, significant innovations in how cleantech companies are getting access to lower-cost sources of capital, such as cleantech bonds and third-party financing.

And business-model innovations are all over the cleantech map. Water-treatment companies are creating leasing options that reduce capital outlays for filtration technology to encourage its faster deployment. Car-sharing services save millions of tons of carbon in Europe and the United States by making auto ownership more efficient. There are initiatives to use waste products from one industry as feedstock for another; some brewers, for example, are using spent grain as a fuel source for their steam boilers. So far, every company involved has reported increased profits and decreased carbon emissions. A whole new industry has been created around using IT to reduce energy consumption. Some companies, such as C3 Energy, sell electric-utilities software as a service, which analyzes the data generated across their electrical networks to help improve grid operations and asset utilization, thereby increasing profits. Green businesses, in short, are benefiting from better, more creative management practices.

Partnerships and progress

The big guns are taking note. For example, there are power-train partnerships, like Daimler and Tesla's, between the biggest global car giants and small but rapidly growing electric-car companies. The US Department of Defense is working with renewable producers on off-site energy production, and the European oil major Total has taken a controlling investment in SunPower. Such partnerships should help get offerings to market much faster, while giving the smaller firms access to lower-cost capital.

Advanced building technologies, having proved their economic worth and utility, are proliferating—and they are standard for new construction in some markets. So are smart water sensors. The price and energy requirements of water-treatment

technologies have fallen, and investment is strong. Smart-grid hardware has been deployed widely in the past decade, and as users figure out how to use big data and analytic tools, it will become much more important, as witnessed by Google's recent acquisition of Nest Labs for \$3.2 billion. For the first time, next-generation vehicles show signs of becoming this-generation vehicles.

We are witnessing the maturation of an industry and the adoption of proven management practices. Successful cleantech companies are making their offerings competitive by focusing on excellence in operations, marketing, sales, and distribution. The principles that apply to any manufacturing business, such as reducing procurement costs and improving productivity through lean manufacturing, are increasingly important for clean technologies as well. The same can be said for practices such as customer segmentation, channel access, and pricing. As these businesses continue to scale up, there will be additional opportunities for improvement.



Trends can accelerate, slow down, or even reverse. But it's unlikely that all these technologies will fail, and many are now at the stage where management practices, and not regulation or subsidies, are the defining factor for success. Those that do succeed could be highly disruptive to incumbents, even (or especially) entrenched ones. Big changes in resource use and business models are just around the corner.

To be sure, some cleantech companies will go bust, and some technologies will not make the cut. But these ups and downs are simply the nature of business—part of progress. Notwithstanding the failures of individual companies, cleantech is not going away, either on the ground or as an investment opportunity. And that's no myth. ■

¹ For more on this argument, see Stefan Heck and Matt Rogers, "Are you ready for the resource revolution?," *McKinsey Quarterly*, March 2014, mckinsey.com. This summarizes some of the ideas in Heck and Rogers's new book, *Resource Revolution: How to Capture the Biggest Business Opportunity in a Century*, first edition, New York, NY: New Harvest, April 2014.

² See Richard Dobbs, Jeremy Oppenheim, and Fraser Thompson, "Mobilizing for a resource revolution," *McKinsey Quarterly*, January 2012, and *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011, both available on mckinsey.com.

³ Advanced building technologies, agriculture (seeds, pesticides, drought resistance), biopower, grid analytics, next-generation vehicles, solar photovoltaics, unconventional natural gas, waste recycling, wind, advanced biofuels and bio-based chemicals, carbon capture and storage, food life-cycle optimization, grid-scale storage, intelligent transport, smart water sensors, and water treatment.

⁴ The broad go-to-market approaches encompass the wide range of activities (such as marketing, sales, distribution, pricing, and channel management) needed to get products and services to customers and also include the business models companies use, partnerships with established players, and the set of product offerings available.

The authors wish to thank Jason Baum, Stefan Heck, and Sean Kane for their contributions to this article.

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