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THE FUTURE OF RENEWABLE ENERGY

In Association with



**Harvard
Business
Review**

THE FUTURE OF RENEWABLE ENERGY

For decades, many corporations sat on the sidelines of the push for clean energy. Although customers, employees, and public opinion were putting pressure on businesses to make more progress, mainstream investors were often a counterweight that set a high bar for sustainability investments, including energy innovation.

As distrust in business picked up speed, corporations and their investors upped their sustainability commitments. Today, according to a Harvard Business Review Analytic Services global survey of business leaders, companies are often at the head of the pack. Executives across industries and geographies are embracing renewable energy and pushing for energy innovation.

Approximately 70 percent of respondents believe that fossil fuels can't be made less harmful to the environment. They forecast—and want—alternative energy sources including wind and solar to grow significantly over the next 10 years. Moreover, some 90 percent of business leaders say their organizations currently have a climate change initiative in place or will within three years.

A distinct majority of corporations are investing in energy-efficient products and services even though customers may not yet be willing to pay much more for them. According to energy industry experts, business leaders realize that customers expect their companies to take energy efficiency and the environment seriously. Corporations are also spurred toward greater energy innovation by mainstream investors who are increasingly concerned about the sustainability risks in the companies they invest in.

And business leaders want government in the mix even as its role in the economy is the subject of debate, especially in the United States. Business leaders and energy sector experts are in agreement that government should play a significant role in driving energy innovation.

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NonRenewable's Fate

Currently, nonrenewable energy sources account for 85 percent of global energy use. Petroleum and coal represent more than 60 percent of that total. Business respondents believe that these percentages will change significantly by 2050. More than 80 percent say renewable energy sources will comprise 25 percent or more of the global energy production mix by 2050.

Almost half say it will make up more than 50 percent. These expectations are in line with many organization forecasts. The Solutions Project, for example, partners with governments and corporations to show how most of the world could be using 100 percent renewable energy by 2050. Andrew Winston, author of *The Big Pivot*, points out that the majority of new electrical generation being built in the US comes from solar and wind power, and that the share of renewable sources will only increase over time.

Solar heads the list of energy sources that business leaders believe can and should take the lead in the next decade. [figure 1](#) Nanotechnology places second, likely driven by its increasing role in making solar panels and lithium batteries less expensive and more efficient. Nanotechnology is also being used to make fuel cells more effective by reducing the amount of costly platinum needed as the catalyst for the chemical reaction that produces electricity in the cells. Wind energy and converting waste to energy also have strong promise in the minds of business leaders.

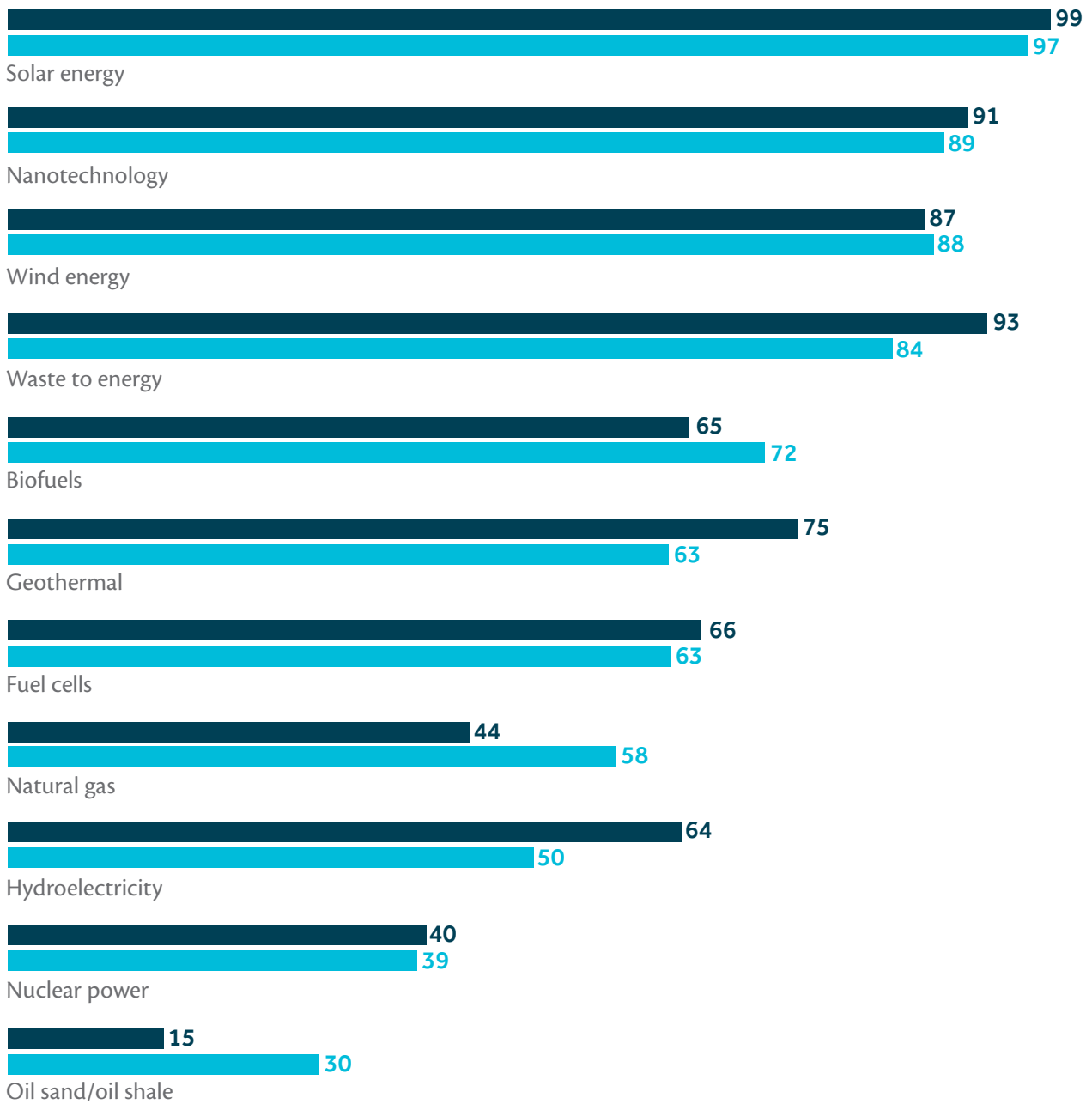
FIGURE 1

EXPECTED VERSUS DESIRED SOURCES OF ENERGY GROWTH

Percentage indicating which of the following they believe will increase and should increase in the next decade.

(INCREASE SIGNIFICANTLY, 9-10 ON A SCALE OF 1-10)

● DESIRED ● EXPECTED



SOURCE THE FUTURE OF RENEWABLE ENERGY

Although some respondents cite technologies that can make fossil fuels safer, such as converting CO₂ emissions into ethanol, nearly 70 percent don't believe that fossil fuels can ever be safe. Thus, only 30 percent say that energy from oil sands and shale will increase significantly in the next decade. A scant 15 percent believe it ought to.

Expectations differ between regions of the world. For example, biofuels and nuclear energy are more important in Asia and the Pacific Rim than in North America and Europe. Fuel cells are expected to play a bigger role in North America than in the rest of the world given the region's scientific and technology innovation resources.

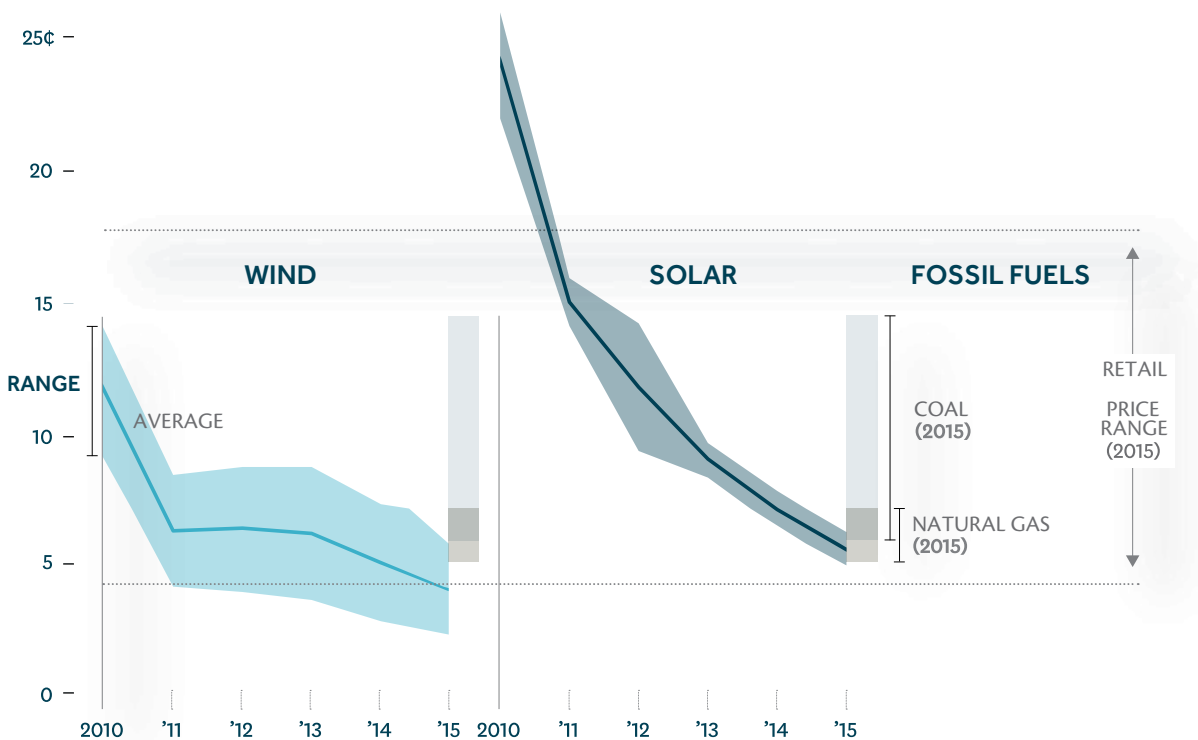
Wim Thomas, chief energy advisor to Shell International, points out that the growth of energy sources depends on the needs of a given region. Developing countries, for example, are still building their manufacturing bases and may turn to nonrenewable energy sources because of their low cost

and availability. Rural areas in developing economies may quickly adopt solar energy and micro grids as a more cost-effective alternative to building traditional power grids across their respective countries.

Although some respondents cite technologies that can make fossil fuels safer, such as converting CO₂ emissions into ethanol, nearly 70 percent don't believe that fossil fuels can ever be safe.

Declining prices for renewable energy will also play a role. According to Winston and analysis from Lazard, the cost of building and operating renewable energy plants has declined by 65 percent to 85 percent over the past seven years. Companies can now contract for electricity from renewable energy sources at a price below the retail price they currently pay for fossil-fuel-heavy, grid-based energy. [figure 2](#)

FIGURE 2
PRICE OF RENEWABLE ENERGY IN A STEEP DECLINE
COST RANGE IN CENTS PER KILOWATT-HOUR



SOURCE U.S. ENERGY INFORMATION ADMINISTRATION; LAZARD. NOTE WIND, SOLAR, AND FOSSIL FUEL RANGES DEPICT UNSUBSIDIZED LEVELIZED COSTS OF ELECTRICITY (THE COST PER KW-HOUR OF BUILDING AND OPERATING A POWER-GENERATING FACILITY OVER ITS SERVICE LIFE). RETAIL PRICES ARE THE PRICE RANGE OF ENERGY FROM THE GRID FOR COMMERCIAL AND INDUSTRIAL CUSTOMERS.

Thomas also believes that public opinion should be factored into growth projections in addition to industry dynamics and technical considerations. He advises Shell on the development of scenarios factoring in these variables. The company's current thinking includes two scenarios that look ahead to 2100: oceans and mountains.

Under the oceans scenario, energy demand soars as developing markets boom and free market economics dominate. Concerns about CO2 emissions are on the back burner due to lack of government policy. But public pressure continues and cost improvements result in renewable energy and solar becoming the dominant source by 2070. In the mountains scenario, global policy addresses reducing greenhouse gas emissions, delaying the shift away from fossil fuels. Policy focuses on creating compact cities and overhauling energy in transportation. Carbon capture and storage increase in importance, and natural gas becomes the main source of energy in 2030.

Jane Nelson, director of the Corporate Responsibility Initiative at the Kennedy School of Government at Harvard University, underscores the need to understand the nuances of energy development, including the role of natural gas. "Natural gas often gets lumped into the category of fossil fuels," she says. "To me, it is an absolutely necessary transitional energy source."

Energy's Chain Reaction

The value chain in the energy industry is a complex

web of utilities, energy and technology companies, governments and regulatory agencies, NGOs, and other public organizations. Understanding the speed and trajectory of renewable energy growth requires pinpointing where in the value chain—power generation, transmission, storage, and consumption—disruption or radical change is likely to occur and what impact it will have on the other links in the chain.

When people change how they want to consume and pay for energy, that will be the catalyst that drives change across the value chain.

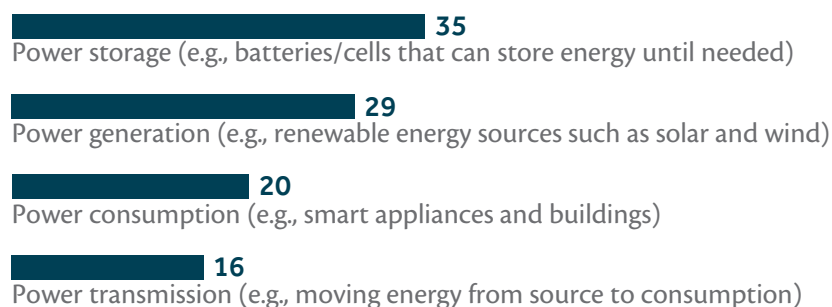
Respondents see the greatest forces of change emerging in power generation and storage, likely driven by technologies such as solar and wind energy generation and batteries that allow customers to store and sell what they don't use. [figure3](#)

Energy industry experts, however, point out that technology itself may not be the major driver of change. To understand how the industry will evolve, executives should follow the money, which often leads to energy consumption: When people change how they want to consume and pay for energy, that will be the catalyst that drives change across the value chain.

FIGURE 3

WHERE WILL DISRUPTION OCCUR?

Percentage indicating in which part of the energy value chain they believe the greatest disruption will occur during the next 10 years.



N=185

SOURCE HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, DECEMBER 2016

For example, Richard Schmalensee, dean emeritus of the MIT Sloan School of Management, says that customer concerns about utility pricing will be a major driver. “As more consumers and businesses switch to solar energy, utilities are forced to raise their prices since they have roughly the same fixed costs that are now distributed among fewer customers,” he says. “Utility customers are starting to challenge the price increases, and several U.S. states are looking into the issue.” As utility prices increase, Schmalensee points out, more customers will adopt alternative energy sources which will drive demand for energy storage devices and “smart” technologies to improve the efficiency of energy consumption.

An executive at SolarCity, the largest provider of distributed solar generation projects in the U.S. and recently acquired by Tesla, believes that consumption is the fulcrum of change. With the growth of solar energy, an increase in the number of electric cars, and the declining cost of batteries, energy will be among the largest examples of the sharing economy in the world. As the executive put it, “Customers will be able to efficiently generate and store energy as well as buy and sell it on a much greater scale in the next decade, creating a ‘democratization’ of energy that doesn’t exist today.”

“Integrating data produced by machines with other sources such as weather forecasts, service reports, and demand statistics will enable analytics to predict and prevent failures, drive cost savings, and efficiently match supply and demand.”

DIETMAR SIERSDORFER, CEO, SIEMENS, MIDDLE EAST AND UNITED ARAB EMIRATES

Gregory Unruh, Arison Professor of Values Leadership at George Mason University and expert in sustainability strategies for business, adds that the energy industry should be seen in terms of ‘systems.’ Examples include gasoline and combustion engines potentially being replaced by electric motors and batteries. Systems lead to consumption as the heart of change. Philips Lighting is a case in point.

The company recently began offering a lighting service. “Originally, Philips only had a product focus, and the goal was to manufacture light fixtures and bulbs as inexpensively as possible and sell them at the best price,” he says. “Now Philips is selling a ‘lighting service’ where a customer pays a fee that covers everything: fixtures, lightbulbs, and power. The new ‘system’ is fundamentally changing how lighting and electricity are paid for, which drives significant change in how it is generated, used, and managed. To maximize profits, Philips has a big incentive to lower its costs by making the system as energy efficient as possible.”

Data is the crux of change, according to Dietmar Siersdorfer, CEO of Siemens in the Middle East and United Arab Emirates. “Data creates transparency and enables better decision making,” he says. “Integrating data produced by machines with other sources such as weather forecasts, service reports, and demand statistics will enable analytics to predict and prevent failures, drive cost savings, and efficiently match supply and demand.”

Before dramatic change can happen, however, there will need to be significant improvements in transmission, according to Scott Nyquist, a senior partner at McKinsey & Company. “To bring some wind and solar projects to market, new energy transmission capabilities will be needed beyond what is currently available,” he says. “In the U.S., you would have to replace much of the existing grid. In other parts of the world, you have to start from scratch. That isn’t likely to happen for another 10 to 15 years.”

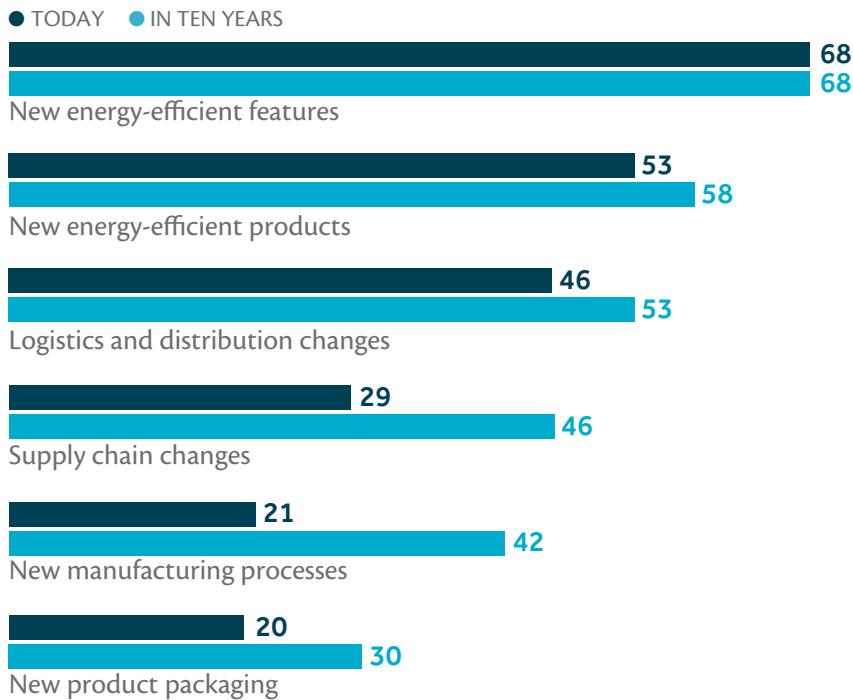
Products as a Proof Point

Businesses are putting their money where their mouths are through investments in energy-efficient products and services. Nearly 70 percent of respondents say their companies developed energy-efficient product features in the past three years, and a similar number plan to do so in the next decade. More than 50 percent of companies have developed new products based on energy efficiency in the last three years, and almost 60 percent say they are planning to develop new energy-efficient products in the next 10 years. [figure 4](#)

FIGURE 4

WHAT ARE BUSINESSES DOING?

Percentage indicating which of the following changes their organization has made to its products/services to reduce energy costs today and in the next 10 years.



N=185

SOURCE HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, DECEMBER 2016

Energy industry experts say that these investments can be viewed as a public stance on the part of corporations since customers have not yet shown a strong propensity to pay more for energy-efficient products and services. “Energy is still cheap in much of the world,” says Schmalensee. “Although many consumers support energy efficiency, they aren’t always willing to pay much more for energy-efficient products. You have to credit many business leaders for thinking ahead and trying to stay in sync with customer expectations.”

Harvard’s Nelson goes so far as to say that the notion of businesses ignoring energy issues in the face of short-term profit is a mischaracterization. “Many major enterprises around the world are looking at energy and sustainability challenges over 15 to 30 year time periods, depending on the energy sector,” she says. “And they are planning investments along similar time frames.”

For example, Nelson says that almost every major corporation has a sustainability strategy in place that includes energy efficiency or innovation. Corporations are also setting targets and reporting on sustainability

progress. These targets are increasingly set against benchmarks established by leading scientific organizations that calculate the level of progress needed to improve environmental performance over time. Most important, companies are investing in innovations to become more efficient in their use of energy.

The SolarCity executive points out that many businesses are tackling their own energy efficiency. Google recently announced that 10 percent of its electricity is comes from alternative energy sources. Walmart has committed to 100 percent renewable energy and has outfitted many of its stores with solar panels. Energy generated on-site from alternative fuel sources can also provide resiliency in the event of blackouts or cyber attacks on the grid, and this executive believes this benefit can only grow as technology allows more buying, selling, and transfer of power across the grid.

Businesses are also embracing the challenge of climate change. Nearly 50 percent of respondents say their organizations have climate change initiatives in place. Within three years, the number is expected to jump to more than 90 percent. Although concerns about climate change are global, American companies are somewhat less concerned about it than are companies in other parts of the world.

Many organizations are lowering the bar for investments in climate change initiatives, which is another measure of their public stance on the environment, says Nyquist. “In some cases, CEOs are pushing the hurdle rates of their energy investments as low as the cost of capital when the brand and sustainability benefits are substantial,” he observes. “These CEOs want to show their customers and the public that they are pushing the envelope as far as they can.”

The Pressure from Investors

A decade ago, executives would often gnash their teeth over investor reluctance to support investments in sustainability, including energy efficiency. The situation has changed considerably. More than 60 percent of respondents agree that investors are focused on sustainability-related risks in the companies they invest in, including their own.

Mainstream investors have come to realize that sustainability drives business value, according to Unruh. From an energy perspective, investors are assessing that

value on three levels. The first is growth opportunities such as energy-efficient products. The second is managing energy-related risks, including reputational damage, environmental impact, and potential regulatory compliance shortfalls. Finally, investors are scrutinizing whether companies are successfully lowering their operating costs through energy efficiency and innovation. Long-term investments such as bonds are also going under the microscope.

“If a company is offering bonds to finance a large fossil-fuel-driven factory over 20 or 30 years, investors will shy away,” says Unruh. “Factories could easily become stranded assets depending on regulations.”

On the opposite side of the coin, investors are pumping substantial amounts of money into energy innovation. Bank of America, for example, announced in 2015 that it was increasing its investments in low-carbon companies and industries from \$50 billion to \$125 billion. Goldman Sachs made a similar announcement in 2015, saying it would up its investments in clean technologies from \$40 billion to \$150 billion by 2025.

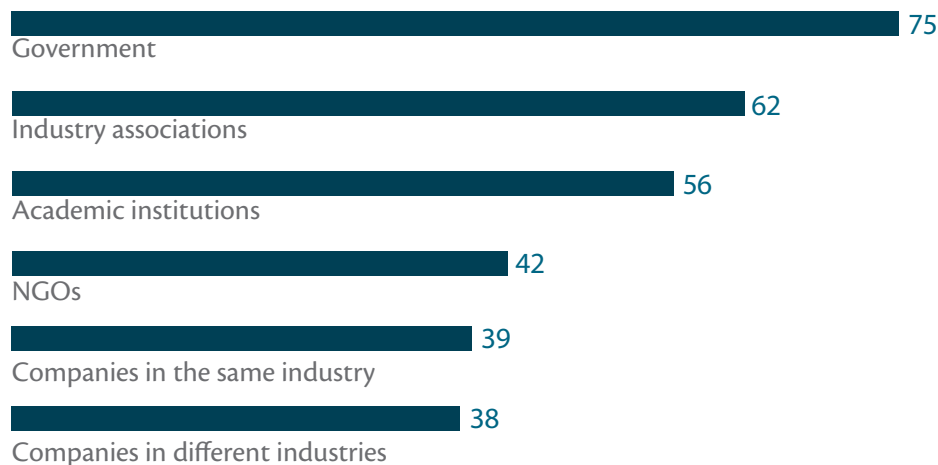
The Power of Partnerships

Although their commitment to renewable energy and the environment is strong, many businesses realize that they can’t go it alone. More than 40 percent of companies are collaborating with governments, academic institutions, industry associations, NGOs, other companies, and even competitors. [figure 5](#)

FIGURE 5

WHO ARE COMPANIES COLLABORATING WITH?

Percentage indicating which of the following types of organizations their company collaborates with when trying to improve energy use.



N=185

SOURCE HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, DECEMBER 2016

Executives are also bullish about renewable energies. The majority want solar, nanotechnology, wind, and converting waste to energy to increase significantly in the next decade and expect that they will.

Although collaborating with government is most common, partnerships between companies and industry associations, academic institutions, NGOs, and even competitors are burgeoning according to Nelson. She points to a number of business-led coalitions including We Mean Business, which pulls together companies and investors to address a range of climate related policy proposals and business commitments; the Oil & Gas Climate Initiative, World Business Council for Sustainable Development; university-based energy research centers in partnership with companies such as those at Stanford and MIT; and industry coalitions in many sectors from consumer goods to the utility and automotive sectors.

In the energy industry, many experts praise the Rocky Mountain Institute as a model. “Rocky Mountain identifies opportunities, brings companies and experts together, and then shares the learnings,” says Nyquist. “By bringing all the key players together, Rocky Mountain is essentially at the center of making the energy market.”

Academic institutions also play a major role, says Siersdorfer. “Developing a global talent pool of

young engineers with appropriate qualifications and interest in energy technology sciences is critical,” he says. “Siemens works with schools and universities around the world to provide internships, training, and site visits to ensure that there will always be a new generation of scientists and innovative thinkers who are keen to make a difference.”

Unruh says companies should collaborate with government because their competitors can and do. Ford and GM are prime examples. The 2009 U.S. government auto industry bailout stipulated levels of fuel efficiency that Ford and GM vehicles needed to reach. Then the companies worked closely with the government to set those fuel efficiency standards for the entire industry. This left other companies out in the cold, including Volkswagen. Volkswagen eventually placed its bets on clean diesel, but it couldn’t meet the high standards and allegedly covered up the shortcomings.

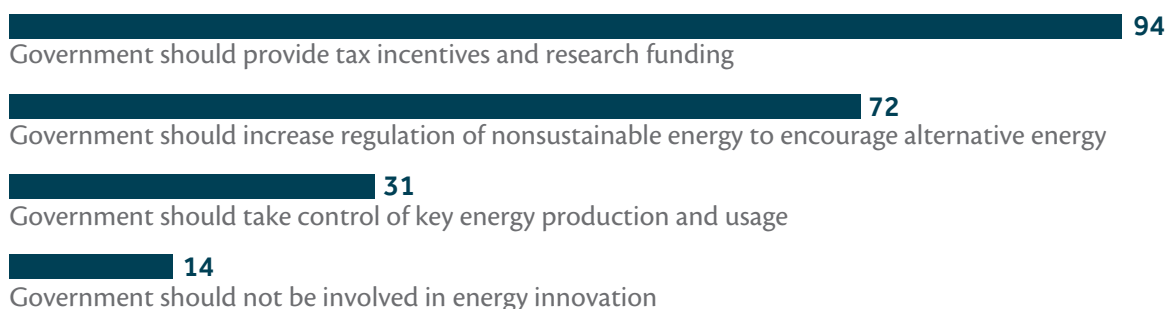
Strong Support for Government

Only a tiny minority of respondents—14 percent—strongly agree that governments should not be involved in energy innovation. The vast majority—more than 90 percent—believe governments should provide tax incentives and fund research. More than 70 percent say governments should increase regulation of traditional, nonrenewable energy sources to encourage energy innovation. [figure 6](#)

FIGURE 6

WHAT SHOULD GOVERNMENT DO?

Percentage who agree with the following statements about the government’s role in supporting energy innovation.



N=185

SOURCE HARVARD BUSINESS REVIEW ANALYTIC SERVICES SURVEY, DECEMBER 2016

As an example of the potential of regulations driving energy innovation, Winston cites the U.S. congressional act passed during the George W. Bush administration that set new requirements on the amount of energy a lightbulb needs. “Many people decried the act and said that government went too far,” he recalls. “But the bill gave companies enough time to innovate, and we ended up with significant growth in sales of compact fluorescents and LEDs, and Philips and others developed some incandescent bulbs that met the new energy efficiency standard as well.” Schmalensee believes that governments can play a major role by making bets that can test the business viability of a new technology at scale. The solar panel manufacturer Solyndra is an example. The U.S. government funded the solar energy company in the early 2000s with loan guarantees, tax incentives, and other support.

The company’s novel technology proved to be uncompetitive, however. “The company folded, which was an important lesson learned,” he says. “The government demonstrated that the technology at the time wouldn’t work at scale. Businesses aren’t likely to take big gambles on unproven technologies. That’s where the government can step in and help demonstrate to the market if something does or doesn’t work.”

The SolarCity executive notes that government-sponsored green banks can support the development of renewable energies. Similar to development banks in developing markets, green banks can help companies and consumers fund the installation of new, energy-efficient technologies. Green banks can make loans to consumers and businesses to improve energy efficiency, to both augment and encourage further private investment.

Conclusion: A Firm Stance

Business leaders around the globe have moved off the sidelines and straight into the quest for renewable energy. They are no longer giving short shrift to sustainability in the face of short-term profit, needs and the majority are taking firm stances in support of everything from climate change to energy-efficient products.

Executives are also bullish about renewable energies. The majority want solar, nanotechnology, wind, and converting waste to energy to increase significantly in the next decade and expect that they will. Energy from oil sands and shale needs to decline, and the vast majority of business leaders believe that fossil fuels can’t be made safer for the environment.

The majority of businesses are investing in energy-efficient features for existing products and services as well as new energy-efficient products. Customers don’t always reach more deeply into their pockets for these products, but corporations understand customer expectations and are preparing for the future.

Investors have also jumped into the fray and see energy efficiency and innovation as a source of business value that factors into their investment decisions. And the majority of business leaders see a major role for government in driving the world toward cleaner and more efficient energy.

As Nyquist observes: “Energy is a completely different conversation today than it was 10 years ago.”

METHODOLOGY AND PARTICIPANT PROFILE

A total of 185 respondents drawn from the HBR audience of readers (magazine/enewsletter readers, customers, HBR.org users).

SIZE OF ORGANIZATION

Twenty-eight percent were in organizations with 10,000 or more employees; 5 percent were in organizations with 5,000-9,999 employees; 22 percent had 1,000-4,999 employees; 29 percent were in organizations with 100-999 employees; and the remaining 16 percent were from organizations with 50-99 employees.

SENIORITY

Twenty-two percent of respondents were executive management or board members; 30 percent were senior management; 36 percent were middle management; and 12 percent came from other grades.

KEY INDUSTRY SECTORS

Twelve percent were in manufacturing; 11 percent were in government/nonprofit; 10 percent were in technology, education, or energy/utilities; 9 percent were in healthcare/pharmaceuticals; 8 percent were in financial services; and 8 percent were in business/professional services. Other sectors were each represented by 6 percent or less of the respondent base.

JOB FUNCTION

Eighteen percent of respondents were in general/executive management; 10 percent each were in sales/business development, engineering, or operations/production/manufacturing; 7 percent were in finance/risk, consulting, or strategic planning. Other functions were represented by 5 percent or less of the base.

REGIONS

Thirty-six percent of respondents were located in North America; 27 percent were from Europe; 25 percent were from Asia/Pacific; and 12 percent were from the rest of the world.

