

FOCUS

# Deploying Technology to Achieve a Sustainable Europe

A Vision for the Energy Sector in 2050



THE BOSTON CONSULTING GROUP

The Boston Consulting Group (BCG) is a global management consulting firm and the world's leading advisor on business strategy. We partner with clients in all sectors and regions to identify their highest-value opportunities, address their most critical challenges, and transform their businesses. Our customized approach combines deep insight into the dynamics of companies and markets with close collaboration at all levels of the client organization. This ensures that our clients achieve sustainable competitive advantage, build more capable organizations, and secure lasting results. Founded in 1963, BCG is a private company with 66 offices in 38 countries. For more information, please visit [www.bcg.com](http://www.bcg.com).



# Deploying Technology to Achieve a Sustainable Europe

## A Vision for the Energy Sector in 2050

**T**he time has come for all the stakeholders in the European Union to change the way energy is produced and consumed. Current approaches are not sustainable, and they threaten the future economic and environmental viability of the region. Although the depth and breadth of the required changes are staggering, The Boston Consulting Group has concluded that current technologies can be deployed in a transformative way, shaping the landscape of the future to achieve enhanced efficiency and reduced emissions, and creating what we envision as a *Sustainable Europe*.

BCG has recently completed a comprehensive study of the energy sector in Europe, modeling several scenarios for its future. In this report, we summarize our findings, describing the challenges Europe will most likely face through 2050 and outlining BCG's vision for the road ahead.

Our study takes into account several recent actions and proposals by the European Commission: the expert discussions held by the Directorate-General for Energy and Transport; the European Strategic Energy Technology Plan; the “20/20 by

2020” targets, which call for the countries of the EU to achieve a 20 percent increase in energy efficiency and a 20 percent reduction in greenhouse gas emissions, and for renewable energy sources to account for 20 percent of overall energy consumption in the EU by 2020; and the goal of developing a competitive internal energy market.

In this report, we also provide guidance and insight on the implications of the evolving energy landscape for all major stakeholders, including policymakers, power producers, and power consumers. We hope that these stakeholders will be able to draw on our findings to inform their decisions and guide their short- and long-term strategies during this time of change and uncertainty.

### **Today's Reality in Energy: The Current Challenge and the Imperative of Change**

The EU's heavy dependence on fossil fuels places the region in a perilous situation. Only by reducing this dependence can the countries of Europe minimize the risk that their standard of living will plummet over the long term, as current energy sources become scarcer and costs

rise dramatically. By failing to take action today, the region jeopardizes its tomorrow—specifically, its economic competitiveness, the security of its energy supply, and its environmental sustainability in the future. Hence, reshaping Europe's energy sector is not an option to be considered but an imperative to be implemented. Stakeholders should expect and prepare for radical change in the face of real challenges.

**The age of cheap, abundant oil and gas has come to an end.** In recent decades, the world has witnessed unprecedented economic growth, with particularly spectacular growth rates achieved by emerging economies. Understandably, the demand for oil and gas has grown substantially as well, and efforts to quench the global thirst for energy will most likely continue to drive up prices for fossil fuels. Once considered a pessimistic and improbable projection, oil prices of \$100 per barrel have been not only realized but greatly surpassed. Unfortunately, such high oil prices have the potential to cap economic growth in Europe, where fossil fuels satisfy 79 percent of primary energy needs and 53 percent of the fuel supply is imported.

### **Irreversible damage to the environment is likely and expensive.**

The flip side of Europe's dependence on fossil fuels is an unsustainable level of greenhouse gas emissions. The body of evidence is steadily growing in support of the theory that, in this realm, inaction is more expensive than action. Also growing is the number of experts alerting the world to the dire need for change.

Responsible for just 14 percent of global greenhouse-gas emissions, Europe is incapable of solving the worldwide challenge on its own. Only a global response can tap the vast resources needed to reduce emissions to a level that scientists predict will be safe and will ensure environmental sustainability. Notably, certain developing countries—pressured by economic development—have registered very large increases in carbon dioxide emissions. In some cases, those emissions have more than doubled in recent years.

Since 1990, however, Europe has been the only developed region worldwide to reduce its level of greenhouse gas emissions—an achievement that positions the continent to lead the world and pave the way in shaping the future of energy production and consumption.

**Despite Europe's limited successes in reducing emissions, a new strategy is required.** Any future strategy must take into account the interdependence of competitive economic growth, a secure energy supply, and a sustainable environment. Fortunately, the further development of technologies for energy production, storage, and efficiency can mitigate the existing

tradeoffs among those objectives. However, in the energy field, as in other infrastructure-intensive sectors—including the industries related to transport (railway, highway, airport infrastructure, and underground transportation)—it will take time for innovation and action to achieve results.

Redefining investment cycles, regulation, and behavior in any realm is a long and demanding endeavor. And development of appropriate technologies is a slow process. The urgency of the problem facing the EU's energy sector therefore demands a new, strategic approach—one that will facilitate rapid change, stimulate fast-paced innovation, and accelerate the development, demonstration, and commercial deployment of new technologies.

### **A Transformative Technology Strategy: A New Landscape**

The ultimate goal in Europe is to attain three objectives simultaneously: a competitive economy, a secure supply of energy, and a sustainable environment. These objectives are highly interrelated and mutually supportive, so no single objective can be attained over the long term without also attaining the others. To reach those goals, Europe will need to formulate a new, strategic approach to energy in the region—one that emphasizes the use of transformative technologies, carefully coordinates implementation across all the countries and stakeholders, and maps out contingency plans for this highly dynamic area.

**Only by adopting a flexible, comprehensive strategy for energy**

### **technologies can the EU meet all three of its objectives and overcome their inherent challenges.**

There is no golden hammer. No single technology can help the region simultaneously fulfill all three objectives, accommodate the realities faced by different countries and key sectors of the economy, and reduce greenhouse gas emissions to the extent required to achieve a sustainable environment. Instead, a set of several measures should be deployed.

In combination, these measures will concentrate action on three areas: achieving energy efficiency, deploying renewable energy sources, and using advanced thermal generation, which includes enhanced carbon capture and storage (CCS) and expanded capacity in nuclear power. Ideally, technological development in all these areas—supported by state-of-the-art infrastructure—will constitute the basis of the European energy sector in 2050.

If Europe decides to pioneer this uncharted territory in energy and does so successfully, it could turn a threat into an opportunity. Developing leading-edge technologies will enable the stakeholders in Europe to export new energy-related products, services, and know-how to the rest of the world. Such an export-based economy could fuel growth and would have the potential to create millions of jobs for highly skilled workers.

**Country stakeholders should assess and prioritize technology options.** Energy stakeholders across the EU must institute a process to prioritize the technology options according to their potential to

achieve the region's objectives. Such a process must take into account the constraints and costs of implementing the various technologies, as well as the specific objectives of each country. To help stakeholders begin to think about priorities for the near- and longer-term phases, we have developed a framework for evaluating available technology options according to their ability to meet the three major objectives of economic competitiveness, a secure energy supply, and environmental sustainability. (See Exhibit 1.)

**An implementation road map will align and focus efforts and stimulate action across Europe.** Europe's available technologies are at different stages of development. For most of those technologies, the development cycle will be an inherently slow process spanning years and possibly decades. In many cases, therefore, it will be quite a while before the new technologies become technically and economically viable for effective commercial deployment in the

transport, power, industrial, residential, and energy infrastructure and storage sectors.

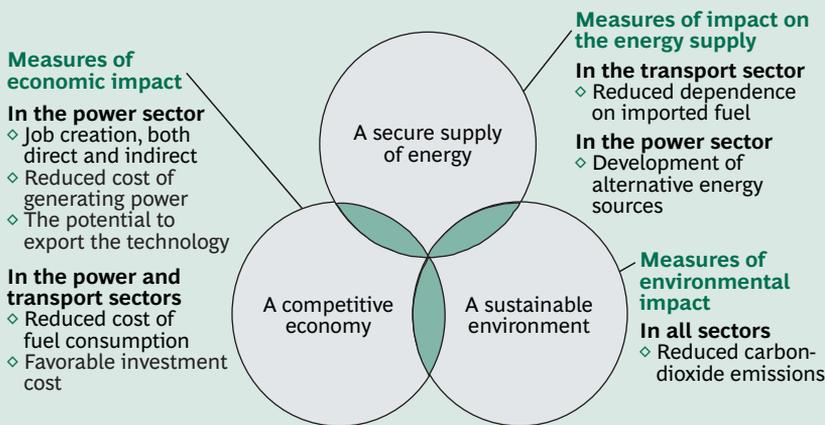
What is needed is a comprehensive and multipronged approach to implementation that focuses on the most promising technologies. (See Exhibit 2.) Such an approach offers the best way to minimize the effort and maximize the impact of the implemented technologies. A well-defined and common road map is crucial because it will help Europe allocate capital and resources on the broad scale that is needed to accelerate the development of energy technologies. In addition, a shared focus and implementation plan will help integrate the fragmented and disparate investment policies of the various countries.

In the near term, technologies that have already been proved, such as onshore wind power and small hydropower, will make the greatest contribution to overcoming the energy challenge through 2020. Over

the longer term—the period between 2020 and 2050—new emphasis should be placed on technologies that advance CCS and alternative fuels for transportation. Throughout both phases, from now until 2050, certain technologies will warrant priority investments and resource allocation. These include biomass-fired power production, which involves burning wood and agricultural residues such as plant husks and livestock waste; wind power; and new generations of solar power. Also, a large set of technologies will improve energy efficiency throughout the economy:

- ◇ *The Power and Industrial Sectors.* Implementing the CCS approach at the 1,000 largest stationary sources of carbon dioxide emissions—fossil-fuel-burning power-generation and industrial-manufacturing facilities—could reduce emissions at those sources by 50 percent annually.<sup>1</sup> Also, the use of wind power is projected to avert a cumulative total of 5.9 gigatons of carbon dioxide emissions by 2050, while more energy-efficient industrial machinery, such as advanced motor systems, are expected to achieve substantial energy efficiency.
- ◇ *The Transport Sector.* Much of the passenger car fleet in Europe is expected to rely on second-generation alternative fuels, which could be derived from the inedible parts of food crops and other sources. Also, the use of hybrid engines will grow as the technology improves.

### Exhibit 1. Europe Can Prioritize Technologies by Their Ability to Support Three Major Objectives

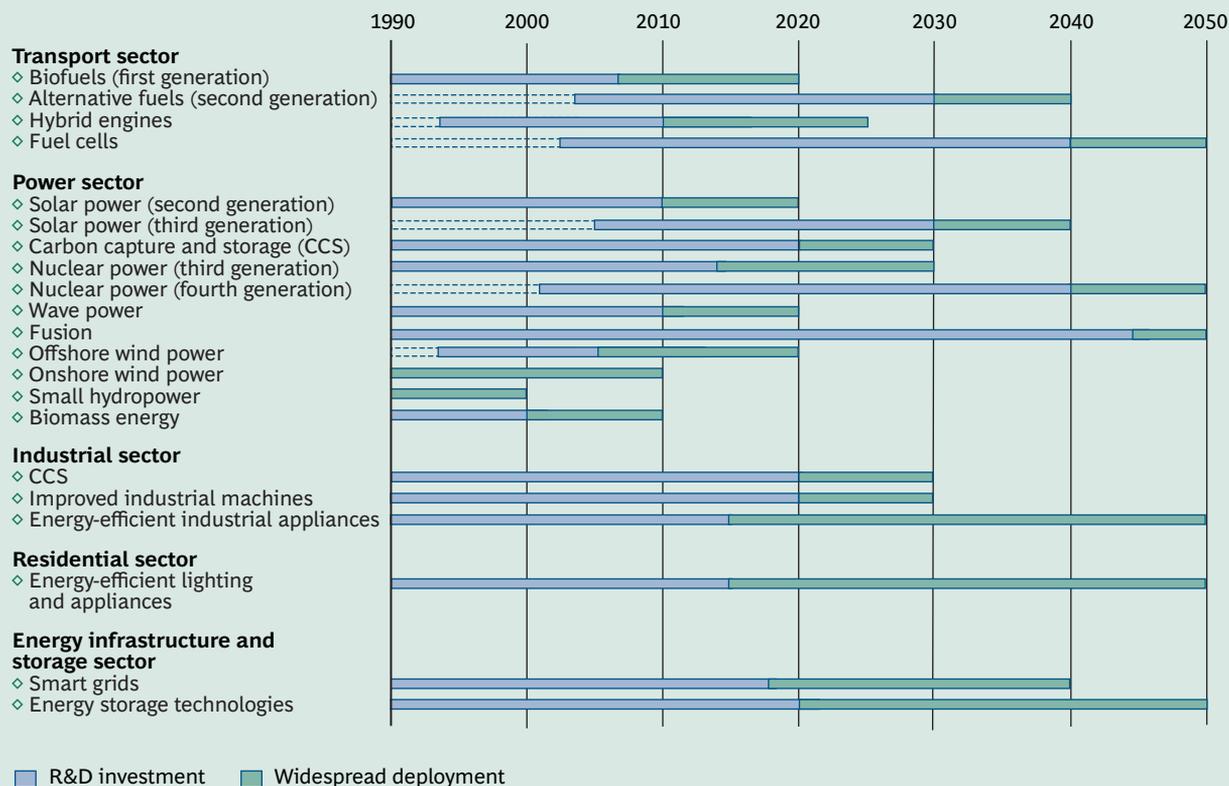


Source: BCG analysis.

1. For more about CCS, see *Carbon Capture and Storage: A Solution to the Problem of Carbon Emissions*, BCG report, June 2008.

## Exhibit 2. A Comprehensive Road Map Would Focus Effort on Promising Technologies

A road map for developing and introducing key technologies



Sources: BP; European Strategic Energy Technology Plan; International Energy Agency; Primes energy-system model; European Commission; Community Research and Development Information Service for Science, Research and Development (CORDIS); Generation IV International Forum; European Atomic Energy Community.

- ◊ *The Residential Sector:* Appliances and lighting systems that require lower levels of power consumption will contribute to significant reductions in greenhouse gas emissions.
- ◊ *All Sectors.* Smart grids will use advanced sensing, communication, and control technologies to monitor, generate, and distribute electricity more effectively, economically, and reliably.

**Well-formulated contingency plans will be vital for addressing uncertainty about the future.** Nu-

merous variables limit the accuracy of any vision that seeks to forecast the landscape for Europe's energy sector. The uncertainty is pronounced because technological innovation typically develops as a result of unexpected breakthroughs rather than according to a predictable evolution. To minimize the risk of error, the stakeholders in Europe should adopt a comprehensive and flexible plan that encompasses all the relevant players, sectors, and factors. For example, in a country that relies heavily on the levers of efficiency and demand management, the use of alternatives such as ad-

vanced thermal generation could be increased should the country start to miss its targets owing to the difficulty of implementing these types of measures. Similarly, in a country that depends on CCS technology, the use of renewable fuels or nuclear generation could be increased to meet targets should the CCS technology fail to be commercially available by the expected dates.

Furthermore, the road to a new landscape for the energy sector will be plagued with unpredictable barriers. The best way to handle such uncertainty is to develop

contingency plans that can respond to even the most pessimistic scenarios and thus ensure that Europe's goals are not jeopardized.

## Future Scenarios: Beyond Extinction or Utopia

Many people see energy choices in extreme terms. Some believe that we humans will do nothing to change our current path of energy production and consumption and thus will become extinct as a species; others contend that we will devise energy solutions that will bring us into a utopian world. Neither of these outcomes seems realistic. In fact, it is reasonable to model several alternative futures.

We have found in our analysis that the different scenarios envisioned for 2050 and their underlying choices are best illustrated using a decision tree. At the root of the decision tree, Europe, facing a choice between inaction and action, can choose either to let business carry on as usual or to implement a series of measures that will transform the energy sector. (See Exhibit 3.)

We compared three take-action scenarios, all of which are capable of reducing carbon dioxide emissions by at least 60 percent: promoting enhanced energy efficiency and renewable energy sources, pursuing advanced thermal generation, and a combination of the first two scenarios, which we call Sustainable Europe. Our comparisons, which were based on the impact that these scenarios could have on economic competitiveness and the security of the energy supply, considered also how the burden of change would be distributed across key sectors in Europe.

BCG developed this comparison in collaboration with the Institute of Communication and Computer Systems of the National Technical University of Athens; it also drew on two sophisticated models used by the European Commission: Primes and Prometheus. Our own scenario modeling encompassed a large number of assumptions—namely, directives by the European Commission, macroeconomic variables, and BCG inputs—and applied them to all 27 EU member states.

**Business as usual will lead to a catastrophic outcome.** Operating in a business-as-usual scenario, Europe—and the world—would likely see the atmospheric concentration of greenhouse gases, especially carbon dioxide, rise to dangerous levels. This shift, scientists theorize, could contribute to a rise in global temperature, resulting in environmental damage that could be irreversible and could give rise to both human and economic disasters around the world. The longer the world waits to act, the harder it will be to reverse the environmental trend.

**The optimal solution is a balanced, comprehensive approach.** Each of the three take-action scenarios that we assessed is capable of achieving at least a 60 percent reduction in carbon dioxide emissions, but each does it in a distinct way. The scenario targeting enhanced energy efficiency and renewable energy sources is focused on managing demand, so energy supply and demand in 2050 will look quite different than they do today. In contrast, the advanced thermal-generation scenario focuses on supply. It concentrates on expanding existing nuclear capacity in nuclear-powered

countries and on making a strong push to develop CCS technology for power generated through fossil fuels. Under this second scenario, the structure and mix of energy supply and demand in 2050 will look very similar to the current reality, but energy sources will be supplemented by the new approaches.

BCG's vision for 2050 is Sustainable Europe, the third take-action scenario, which encompasses the measures of the other two. This comprehensive approach provides the greatest flexibility, managing both demand and supply at once. Another advantage of the scenario is that the risk of its not being achieved is much lower than that of the other scenarios. Although implementing the Sustainable Europe scenario will be challenging, our analysis shows that the risk of not achieving the desired results is moderate when compared with the risk of not achieving the results in the other two scenarios.

We have concluded that focusing on only one scenario would be suboptimal, given the economic, technological, and environmental interdependencies and their associated risks. But with a broader approach, the EU can harvest the low-hanging fruit in all areas—energy efficiency and renewable sources as well as alternative-fuel development—while pursuing the transformative technologies so critical to the long term. Measures of each scenario's impact illustrate the benefits of the Sustainable Europe scenario. (See Exhibit 4.)

**The EU must set targets for 2050.** Given medium-term projections for energy demand and carbon dioxide emissions, we conclude that Europe could reduce its emissions by 60

percent relative to 1990 levels if it could set and meet the following targets for 2050:

- ◇ Doubling of the present targets in energy efficiency, aiming for a 40 percent increase
- ◇ Movement toward a power sector that emits no greenhouse gases
- ◇ Reduction of emissions in the transport sector by 40 percent
- ◇ Reduction of fossil fuel consumption by 40 percent

Although those targets are very aggressive, we believe that if Europe can undertake a well-directed and flexible effort, the region will have the potential to meet them by 2050.

### Implementation Strategy: The Road to a Sustainable Europe

To successfully implement the Sustainable Europe strategy, Europe-

an governments—collaborating closely with all energy-sector stakeholders—must focus on those measures that are capable of having significant impact on these energy-policy objectives: economic competitiveness, security of the energy supply, and environmental sustainability.

Such measures can be implemented in four broad categories, namely, financial resources, market mechanisms, regulations and standards, and education and communications. (See Exhibit 5.)

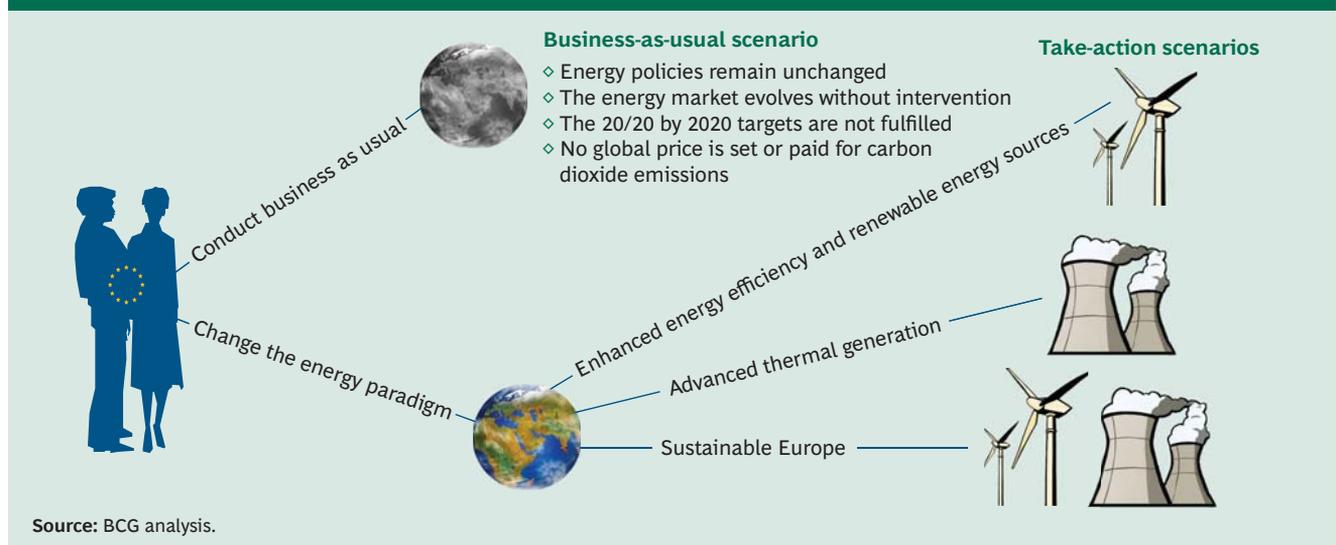
### The allocation of financial resources must be focused and improved.

Reshaping the European energy landscape and promoting faster technological development and innovation will require a revised allocation and an increase in financial resources. Short-term priorities should include increasing R&D spending and developing new business and financing models that actively engage the private sector.

**A new set of market mechanisms will favor the development of clean energies and penalize polluting players.** One central measure for shaping the future energy landscape is a consistent fiscal policy that provides favorable treatment for more efficient and cleaner technologies and thus encourages both the supply and demand sides—that is, power producers as well as power consumers—to behave in ways that are more environmentally friendly. Expanding the definitions of pollution limits and penalizing polluters that fail to meet new, more stringent standards will be crucial to attaining the new goals.

**A regulatory framework will enhance the business environment and harmonize cross-border initiatives.** Because investors are reluctant to invest in projects with lengthy development cycles, Europe must promote a secure and stable business environment while it embarks on the long and unpredictable process of reshaping its energy

## Exhibit 3. Europe Must Select the Path It Will Pursue



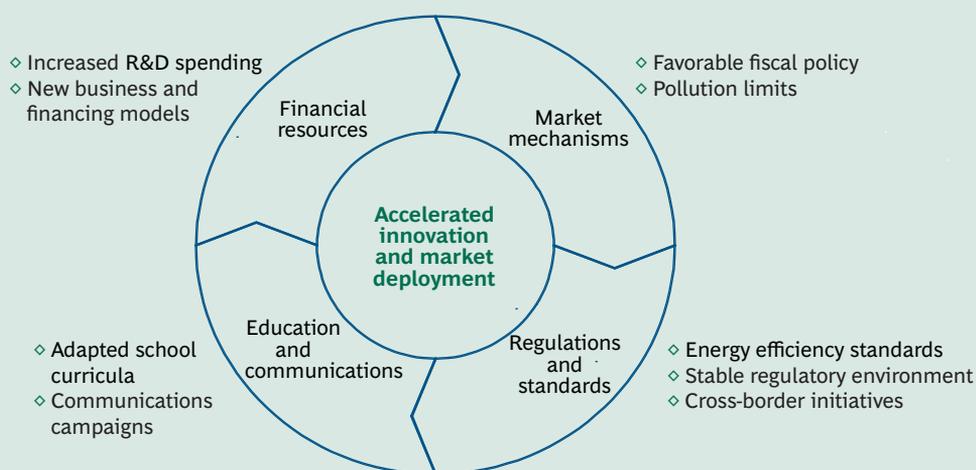
## Exhibit 4. The Sustainable Europe Scenario Outperforms All Others

	Measures of impact	Units	Business-as-usual scenario	Take-action scenarios		
				Enhanced energy efficiency and renewable energy sources	Advanced thermal generation	Sustainable Europe (combines all take-action scenarios)
<b>A sustainable environment</b>	Greenhouse gas emissions	Tons (millions)	5,128	2,231	2,231	2,231
	Renewable energy as a percentage of demand	Percent	21.5	43.3	33.1	37.9
<b>A competitive economy</b>	Price of energy per megawatt hour	Euros	105	124	136	119
	Energy as a percentage of GDP	Percent	8.1	10.0	9.8	9.4
	Employment in energy sectors	Jobs (millions)	0.9	1.7	1.3	1.5
	Export potential	Relative impact	Limited	Medium	High	Very high
<b>A secure supply of energy</b>	Volume of imports	Tons of oil equivalent (millions)	1,375	789	969	884
	Foreign bill	2005 euros (billions)	635	422	532	444
<b>Other measures</b>	Ease of implementation	Relative impact	Not applicable	Very difficult	Medium	Difficult
	Risk of not achieving results	Relative impact	Not applicable	Very high	High	Moderate

■ Best ■ Second best ■ Second worst ■ Worst

Sources: Primes energy-system model; BCG analysis.

## Exhibit 5. Four Types of Measures Will Advance Europe's Energy Objectives



Source: BCG analysis.

landscape. To establish the ideal business environment, Europe needs to enforce binding targets and set appropriate standards for energy efficiency.

**Education and communication must be focused on energy-related sectors.** A highly skilled talent pool will be needed to meet the demand for enhanced development of energy and new energy technologies. The work force shortage that the energy sector is currently experiencing is predicted to worsen, seriously undermining the region's ability to adopt the Sustainable Europe scenario. Europe must therefore take steps to develop the work force through appropriate education initiatives. Beyond the classroom, ongoing public communications and awareness campaigns are needed to continuously stimulate changes in behavior among consumers at large.

### **All Stakeholders Must Work to Change the Way Business Is Done**

All stakeholders stand to gain from the success of the Sustainable Europe strategy. And it is equally true that the stakeholders—as well as the entire population of Europe—will lose if they continue on the same path. Therefore, all stakeholders must change the way things are done.

**EU policymakers will need to focus on transforming the energy sector through technology.** The EU's future role in the energy sector should cover three tasks: coordinating new technology initiatives at a central level, supporting and advancing a new energy landscape across the EU, and developing the human

capital necessary to achieve the Sustainable Europe strategy.

Given the international nature of the challenges, a strong central unit at the highest level of the EU will be crucial to coordinate, control, and

### **Europe needs to enforce binding targets and set standards for energy efficiency**

support the implementation of national plans. This EU regulatory-policy body should set the pace of change and define general policies, targets, and priorities. It should promote initiatives and flagship programs that span national boundaries. Additionally, it should lead the creation of pan-European technology clusters and platforms that will support the pooling of resources and the sharing of risk.

**National governments will need to implement plans that focus on the realities in their home countries and take into account the private sector.** National governments will have a fundamental role to play in realizing the Sustainable Europe strategy. It will be their duty to design and execute plans that both reflect the specific realities unique to their country and also meet the set targets.

Such plans will encompass increased public investment, the definition of new energy policies and technology priorities, and actions taken to improve existing conditions in the energy market—such as subsidies—in order to diminish risk and stimu-

late investment. National governments should monitor progress on a regular basis so that they can revise measures and resource allocations appropriately. They should also actively engage the private sector in the campaign for a transformation in the energy sector.

**Power utilities must assess and fine-tune their offerings and investment strategies.** In light of the changes in their business environment, power utilities will need to review their portfolio strategy and the timing of their investments in R&D. Renewable energy sources will account for a greater percentage of the production mix, and the key technologies will shift. Power utilities need to ask themselves whether, in light of the new technological needs, their current R&D budget is adequate.

Power utilities must also assess the adequacy of their regulatory strategy. They need to determine whether they are doing enough to influence the outcome of likely changes such as new quotas for emissions-trading schemes, fuel-switching trends that favor electricity, and the implementation of investment recovery and risk-sharing mechanisms for the new technologies. They must determine whether their current strategy would allow them to manage the transition to a regulatory environment that could resemble the one in California, where utilities see their profits rise or fall on the basis of their ability to achieve energy efficiency.

Furthermore, power utilities need to look across the value chain at new opportunities such as those related to storage and intelligent transmission of power, which currently are

the responsibility of logistics operators. The utilities should also take steps to anticipate changes in the nature and intensity of competition and to leverage regulatory changes in order to improve their brand image.

**Oil and gas companies will need to determine how and when to refocus a part of their business.**

Executives at oil and gas companies need to begin exploring several questions now, among them the following: What are we doing to mitigate the adverse effects of mandated efficiency-oriented policies and fuel-switching trends? Is our current R&D strategy aligned with future technology needs? How well is our company positioned to access projects in the new technologies?

In the near term, oil and gas companies must be ready to revise their strategies in light of predictable shifts in regulation that will require cleaner fuels or changes in taxation mechanisms. The only outstanding issues are the timing and direction of this shift.

In the longer term, the transformation in the energy sector should reshape the way portfolio managers of oil and gas companies think about their core business. The importance of new fuels will increase with the introduction of the second- and third-generation offerings.

In addition, fuel-switching trends will affect the relative attractiveness of specific segments. Finally, gaining access to oil and gas sources, as well as transport and refining assets, will become increasingly competitive and dictate stricter hedging and portfolio strategies.

**Original equipment manufacturers (OEMs) in many industries must assess their clients' needs and their own capabilities to deliver energy-efficient products.** The appearance of new business opportunities and clients will accompany the

**A technology-driven transformation of the energy sector could shape a positive future**

shift in key technologies. In general, more and more clients will seek to upgrade their equipment with new versions that enable reduced levels of emissions and consumption. To a certain extent, such upgrades will be imposed by new regulatory standards.

At the same time, OEMs must also evaluate how closely their product-development strategy is aligned with projected trends in demand. Once these companies bring these factors into alignment, they can determine which of their existing skills they can transfer to new ventures—and which new skills they will need to develop or acquire.

**Auto manufacturers will need to expand their product range to meet consumer demand and regulatory requirements.** As fuel prices increase, the demand for “gas-guzzlers” is likely to decline while demand for so-called green cars is likely to increase. Moreover, improvements in public transportation and continuous urbanization might put negative pressure on drivers in general and increase the share of small cars in Europe’s passenger-car

fleet. These changes raise an important question for automakers: Are the current product selections and R&D strategies adequate given the expected evolution of demand and their competitors’ strategies?

Automakers must also understand the potential impact of changes in public opinion. Those that opt for inaction in energy efficiency could lose their traditional customer base while first movers might be able to leverage growing awareness in order to build competitive advantage.

---

**T**he energy problem that Europe is facing is real, and it is dire. But a technology-driven transformation of the energy sector could shape a powerful and positive future for the continent: a future that ensures a competitive economy, a secure supply of energy, and a sustainable environment.

Such a transformation would have far-reaching implications for all major sectors of the economy, influence political and market forces, and require profound changes from all stakeholders. But it could also position Europe as a world leader in energy know-how and afford its businesses and countries a major competitive advantage.

With so much on the line, policy-makers, power companies, and power consumers alike should examine the driving forces and likely consequences of such a transformation in Europe in order to make better choices, avoid costly mistakes, and explore new opportunities for the continent and, ultimately, their businesses.



## About the Authors

**Luis Gravito** is a senior partner and managing director in the Lisbon office of The Boston Consulting Group. You may contact him by e-mail at [gravito.luis@bcg.com](mailto:gravito.luis@bcg.com).

**Ramón Baeza** is a senior partner and managing director in the firm's Madrid office. You may contact him by e-mail at [baeza.ramon@bcg.com](mailto:baeza.ramon@bcg.com).

**Alexandre Gorito** is a principal in BCG's Lisbon office. You may contact him by e-mail at [gorito.alexandre@bcg.com](mailto:gorito.alexandre@bcg.com).

**João Conceição** is a project leader in the firm's Lisbon office. You may contact him by e-mail at [conceicao.joao@bcg.com](mailto:conceicao.joao@bcg.com).

## Acknowledgments

The authors would like to thank their many colleagues at The Boston Consulting Group who contributed to this report, especially Maurice Berns and Oliver Steen, for their insights and helpful discussions. We would also like to thank Barry Adler, Katherine Andrews, Gary Callahan, Mary DeVience, Angela DiBattista, Elyse Friedman, Corry Leigh, Lynne Smith, and Sara Strassenreiter for their contributions to the editing, design, and production of this report.

## For Further Contact

We hope that this report will prove both informative and thought provoking. If you would like to discuss it, please contact one of the authors.

BCG's Energy practice sponsored this report. For inquiries about the Energy practice, please contact its global leader:

### **Iván Martén**

*Senior Partner and Managing Director*  
BCG Madrid  
[marten.ivan@bcg.com](mailto:marten.ivan@bcg.com)

For a complete list of BCG publications and information about how to obtain copies, please visit our Web site at [www.bcg.com/publications](http://www.bcg.com/publications).

To receive future publications in electronic form about this topic or others, please visit our subscription Web site at [www.bcg.com/subscribe](http://www.bcg.com/subscribe).

© The Boston Consulting Group, Inc. 2008. All rights reserved.  
7/08



# BCG

THE BOSTON CONSULTING GROUP

Abu Dhabi	Cologne	Lisbon	New Delhi	Stockholm
Amsterdam	Copenhagen	London	New Jersey	Stuttgart
Athens	Dallas	Los Angeles	New York	Sydney
Atlanta	Detroit	Madrid	Oslo	Taipei
Auckland	Dubai	Melbourne	Paris	Tokyo
Bangkok	Düsseldorf	Mexico City	Philadelphia	Toronto
Barcelona	Frankfurt	Miami	Prague	Vienna
Beijing	Hamburg	Milan	Rome	Warsaw
Berlin	Helsinki	Minneapolis	San Francisco	Washington
Boston	Hong Kong	Monterrey	Santiago	Zurich
Brussels	Houston	Moscow	São Paulo	
Budapest	Jakarta	Mumbai	Seoul	
Buenos Aires	Kiev	Munich	Shanghai	
Chicago	Kuala Lumpur	Nagoya	Singapore	<a href="http://bcg.com">bcg.com</a>