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Discussion Draft: The Energy–Competitiveness Relationship
September 2007



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**Council on
Competitiveness**



Discussion Paper: The Energy–Competitiveness Relationship

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All projected data throughout this discussion draft, apart from chart 16, are based on the Energy Information Administration reference case. As presented in its *Annual Energy Outlook*, “the reference case assumes that current policies affecting the energy sector remain unchanged throughout the projection period. Some possible policy changes—notably, the adoption of policies to limit or reduce greenhouse gas emissions—could change the reference case projections significantly.”

The information and data referenced within this discussion draft was assembled from a wide range of public information, including government, non-governmental and industry trade association reports, press releases, on-line journals, news media articles, and U.S. government and multilateral institution data bases. This information is the best available to the Council staff at this time. This discussion draft does not represent the views of the Council membership nor those involved in the Steering Committee of the Energy Security, Innovation & Sustainability Initiative. It is intended solely for the purpose of informing discussion.

Introduction

The Energy-Competitiveness Relationship

The cost of energy is clearly impacting the competitiveness of the United States. But the story does not end there. The economic toll exacted by maintaining the current state of U.S. energy use, as well as the prospective windfall for transforming it, has not been adequately captured or communicated in the context of national competitiveness. A more fulsome understanding of the various ways in which energy is now impacting—and driving—U.S. competitiveness will add a valuable new dimension to the national debate. This understanding will add momentum to the case for energy system change, while also informing public and private sector understanding of the implications of policy and regulatory decisions.

This Discussion Draft is intended to outline a number of the ways in which energy in the 21st century is becoming an increasingly significant factor of competitiveness. At the **enterprise level**, it presents evidence of the increasing burden that energy now imposes on many businesses, but also reveals how some companies are rising to meet and capitalize on the challenge. At the **industry level**, it conveys the sense of enthusiasm and potential that many investors see in the dawn of a new energy future, as they pour tens of billions of dollars across the emerging “clean energy” value chain. Finally, the draft highlights the growing attention and resources that government leaders at the **regional and international level** are devoting to what they perceive as an extraordinary opportunity to address energy, environmental and economic goals in mutually reinforcing ways.

This paper is not intended to be comprehensive, but rather illustrative, designed to provoke thinking, raise awareness—and generate questions—about the transformation that is already playing out on the U.S. and global competitiveness landscape.

There remains much to explore and understand about the energy-competitiveness relationship.

To lead this effort, the Council on Competitiveness is conducting a series of high-level, expert Dialogues over the course of 2007–2008 that will seek to ask and answer such questions as:

- **How are the interrelated challenges of energy and climate change driving innovation in the economy, in industry and in enterprises?**
- **Are U.S. companies well positioned to succeed in the emerging global clean energy/technology market?**
- **How are energy price and supply concerns catalyzing change in business operational decisions and strategies?**
- **Are energy issues seen as a risk to shareholder value or revenues?**

The U.S. Energy Picture

In considering the energy–competitiveness relationship, it is helpful to ‘review the bidding’ in terms of how America sources and uses energy.

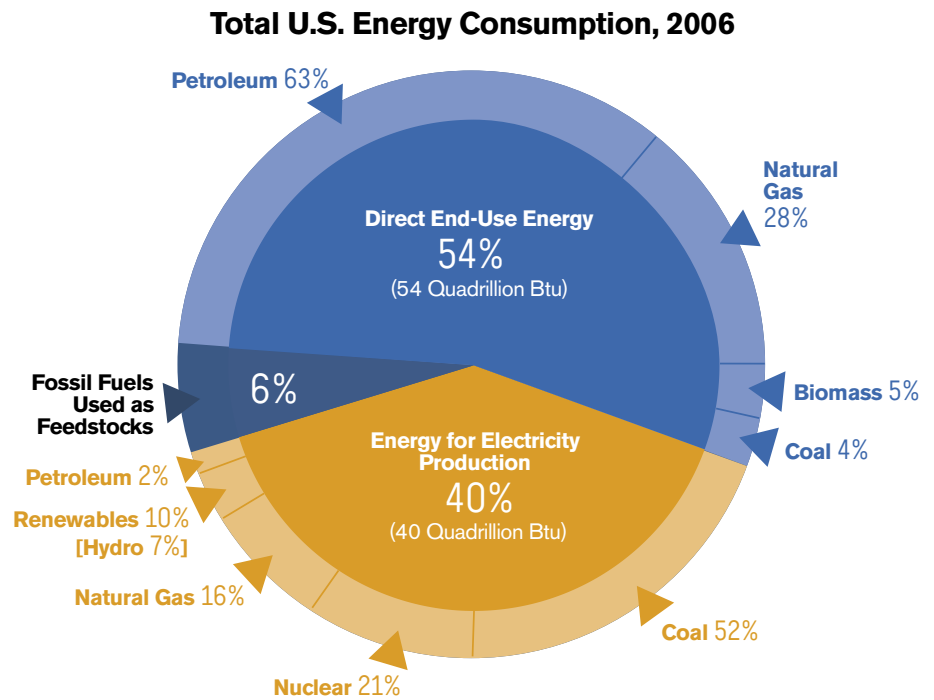
The United States presently consumes 25 percent of the world’s energy. Most of this energy is used either as fuel for vehicles or to generate electric power. To fuel the transportation sector the United States currently relies almost exclusively on petroleum. To fuel the power sector, the United States uses a range of energy sources, but chief among these is coal. A smaller proportion of U.S. energy consumption goes toward feedstocks for industrial production or to heat homes and buildings. Overall, fossil fuels account for 85 percent of U.S. energy consumption.

Did you know?

Of the 7 percent of total U.S. energy consumption attributed to renewable energy, 48 percent comes from biomass, 42 percent from hydroelectric power, 5 percent from geothermal energy, 4 percent from wind and only 1 percent from solar power.

1. America Consumes the Vast Majority of its Energy in the Form of Transportation Fuel and Electric Power

Source: Energy Information Administration



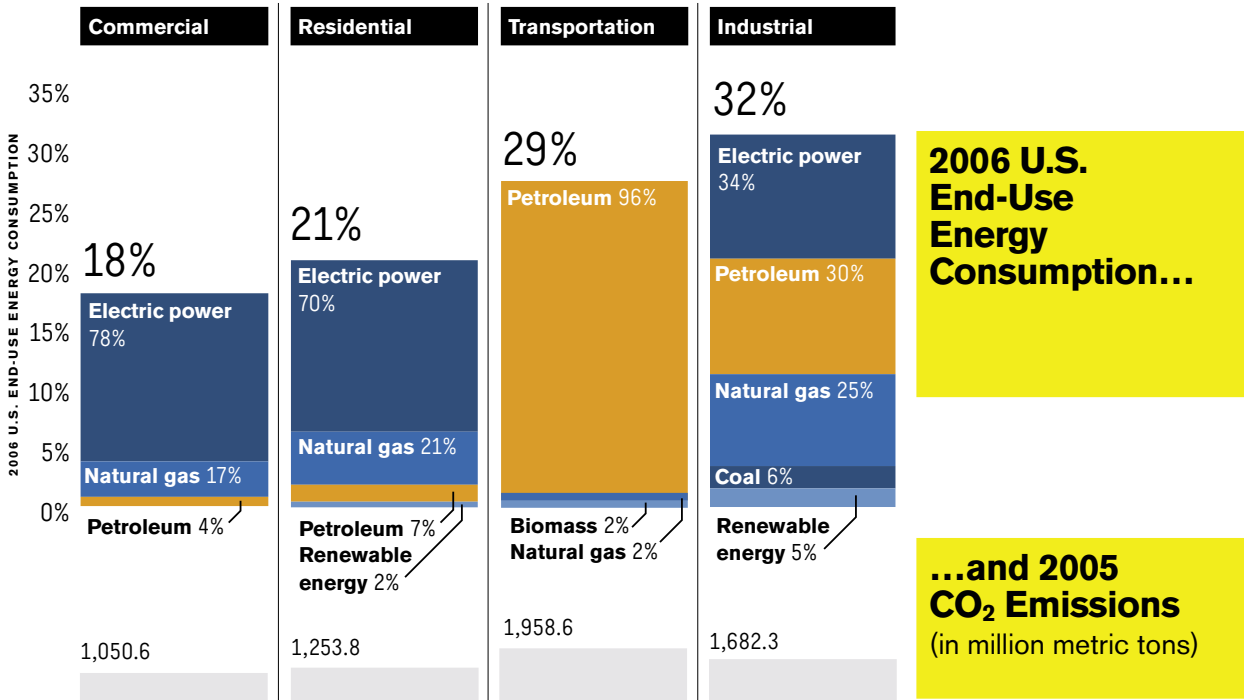
Total: 99.9 Quadrillion Btu

Direct End-Use Energy refers to all energy consumed by end users, excluding electricity and energy used for nonfuel purposes.

Energy for Electricity Production refers to all energy consumed at electric utilities to generate electricity, including energy losses from the generation, transmission and distribution of electricity.

2. U.S. End-Use Energy Consumption, By Sector

Source: Energy Information Administration



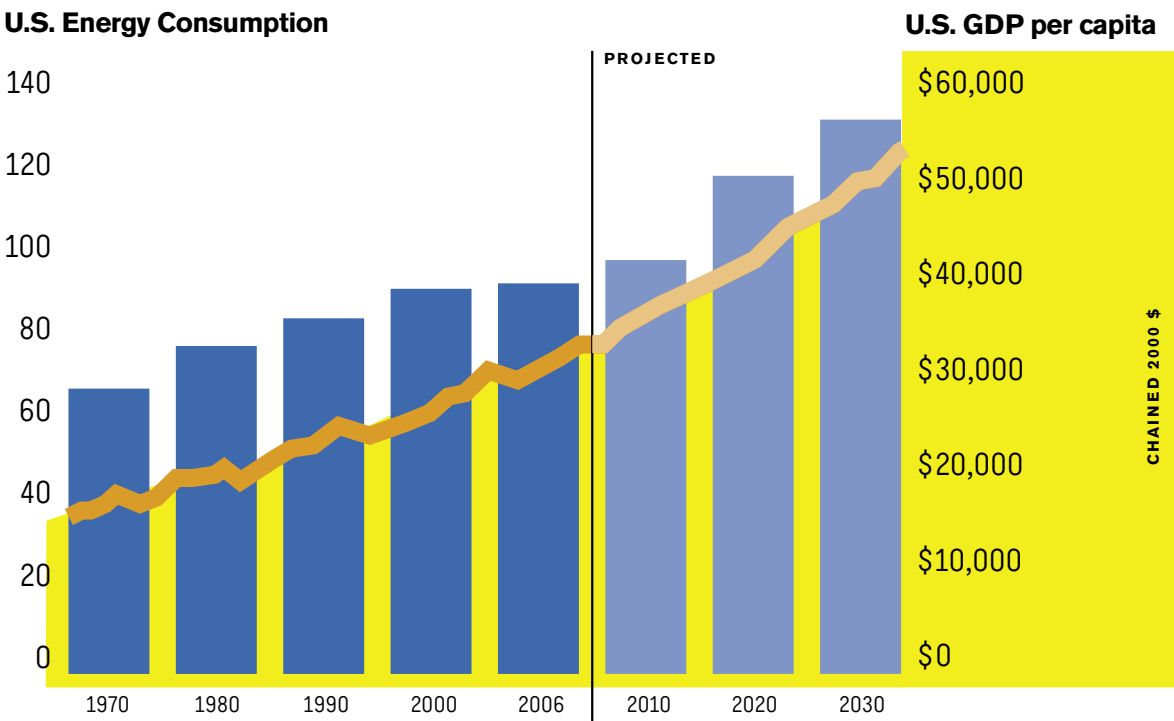
2006 U.S. End-Use Energy Consumption...

...and 2005 CO₂ Emissions
(in million metric tons)

As U.S. prosperity has increased, so has its demand for energy. The mix of how we use energy has remained fairly stable over the past several decades and is projected to remain this way for the foreseeable future.

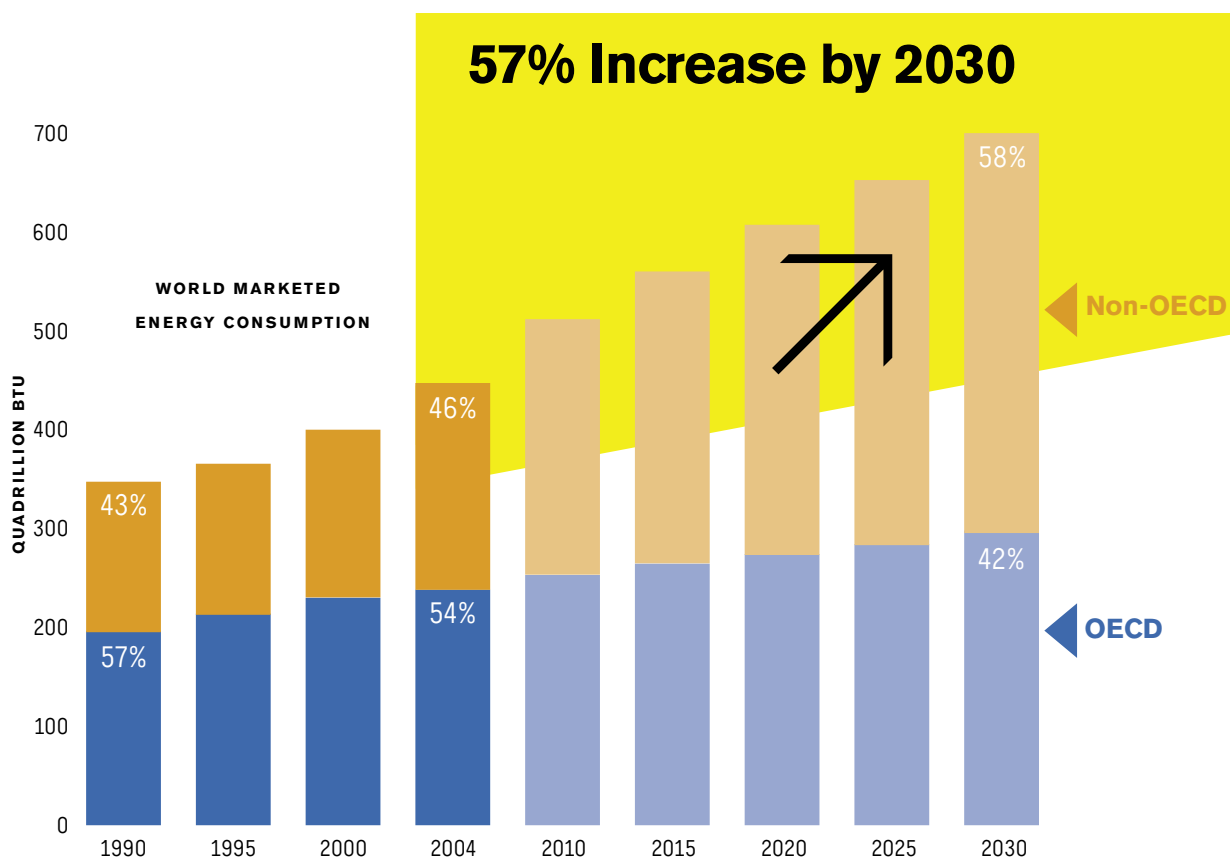
3. Population Growth Combined With Increasing Affluence Will Continue to Drive U.S. Demand for Energy

Source: Bureau of Economic Analysis & Energy Information Administration



4. The United States Is Not Alone in its Growing Appetite for Energy. Demand Is Projected to Grow in Both Developing and Developed Countries Alike

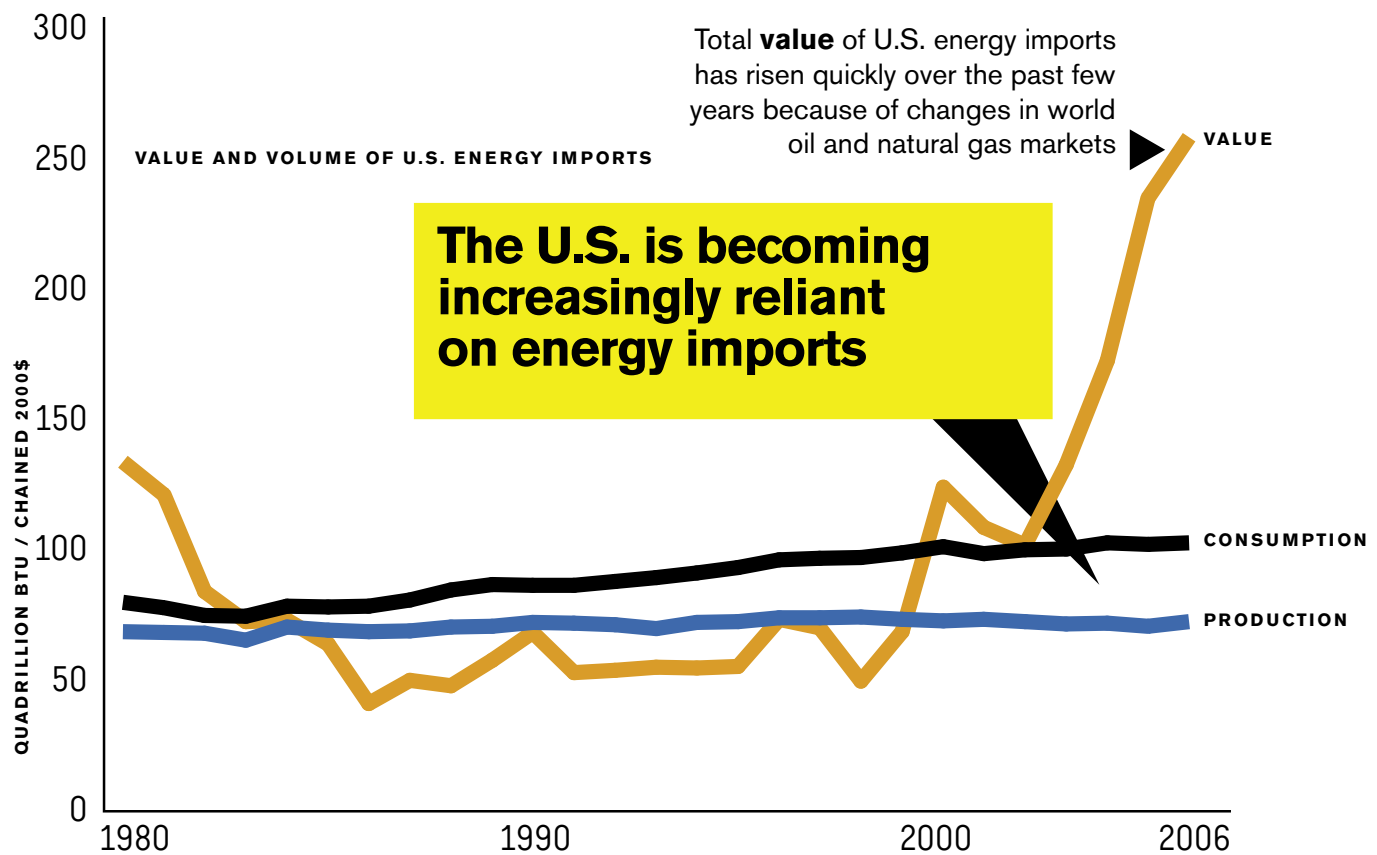
Source: Energy Information Administration



Higher economic and population growth rates are projected to contribute to high growth in energy demand in developing countries. Asia—particularly China and India—leads the pack with a projected 3.2 percent average annual growth rate (AAGR) in energy demand through 2030. Central and South America follows with a 2.4 percent AAGR and the Middle East and Africa are close behind with a 2.3 percent AAGR.¹

5. U.S. Energy Demand Exceeds Domestic Production

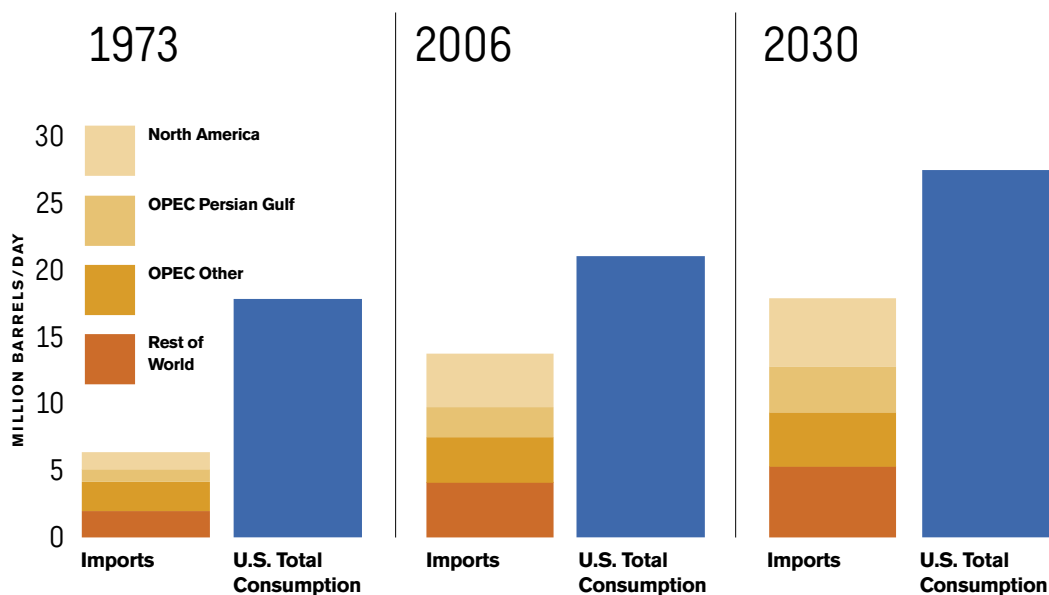
Source: Energy Information Administration



Just 50 years ago, the United States was able to produce the majority of the energy it consumed. That is no longer the case, particularly with respect to petroleum. Global energy supply and demand trajectories, combined with international tensions, a shift in global oil markets and extreme weather events, have created a period of supply and price volatility in energy markets.

6. U.S. Petroleum Consumption Will Continue to Rise... Along with Oil Imports

Source: Energy Information Administration



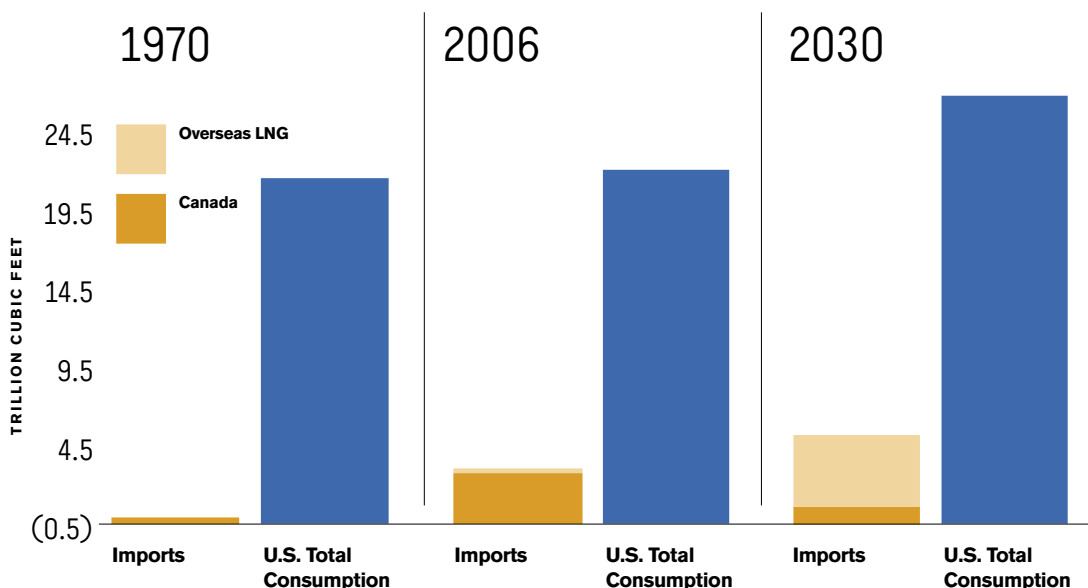
TOTAL U.S. PETROLEUM IMPORTS VS. CONSUMPTION

- * OPEC: Organization of the Petroleum Exporting Countries
- * OPEC Persian Gulf: Saudi Arabia, Qatar, Iran, Iraq, Kuwait and United Arab Emirates
- * OPEC Other: Venezuela, Nigeria, Algeria, Libya, Indonesia
- * North America: Mexico and Canada

Note: Total U.S. petroleum exports were .23 and 1.33 million barrels/day in 1973 and 2006, respectively, and are estimated to be 1.35 million barrels/day in 2030.

7. The U.S. Will Increasingly Source Natural Gas from Outside of North America

Source: Energy Information Administration

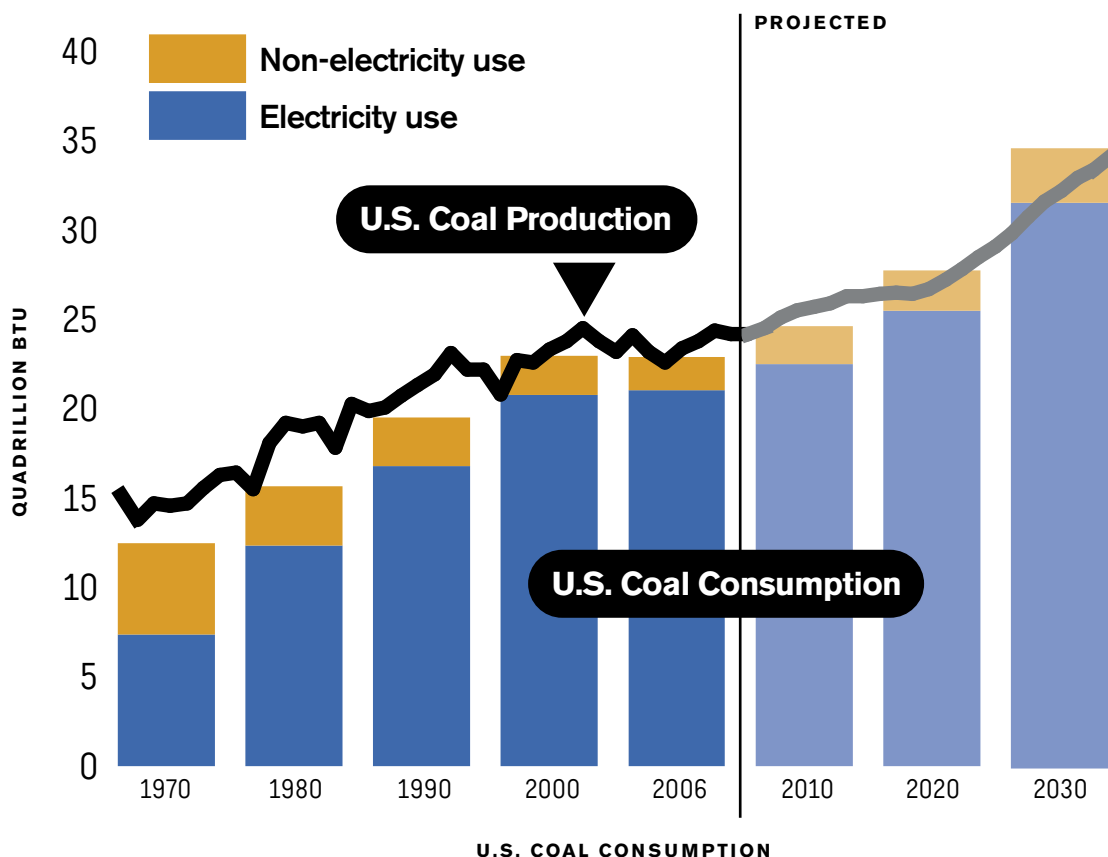


Overseas liquid natural gas (LNG) is predominantly imported to the U.S. from the Caribbean, Nigeria and Algeria.
 Note: In 1970 and 2006 U.S. net exports of natural gas to Mexico were 0.02 and 0.35 trillion cubic feet, respectively, and are estimated to be 0.25 trillion cubic feet in 2030.

“At some point—perhaps in the next few years—OPEC will also be pumping at diminishing rates. ‘There may be a limit to supply,’ U.S. Energy Secretary Samuel Bodman told an international forum last month. ‘There is a perception of concern about what’s going to happen in the future.’”²

8. In the United States 92 Percent of Coal Is Used for Electricity Production

Source: Energy Information Administration



Energy Price and Supply Volatility Impacts the Bottom Line Across the U.S. Economy

Much has been said and written about America’s dependence on oil—and the facts are clear.

Since the 1950s, America’s use of oil has almost tripled. Currently 69 percent of this oil is used by the transport sector—passenger vehicles, trucking and shipping fleets, airlines and air cargo, as well as military transport. Virtually every sector of the economy requires transportation to function, and therefore each is very sensitive to oil prices—and these prices are close to record levels, even when adjusted for inflation.

“With gas prices close to \$3 a gallon, many [truckers] are seeking out lighter loads. ‘They’re asking what they’ll be carrying, hoping it’s not too heavy. That’s new,’ said Steve Rutledge, the president of a Houston-based trucking brokerage firm. ‘If it comes down to plastic bottles or lead pipes, they want to take the bottles’... Truckers, shippers, and brokers all have one concern in common these days—higher gas prices are eating into their costs and forcing them to raise prices.”³

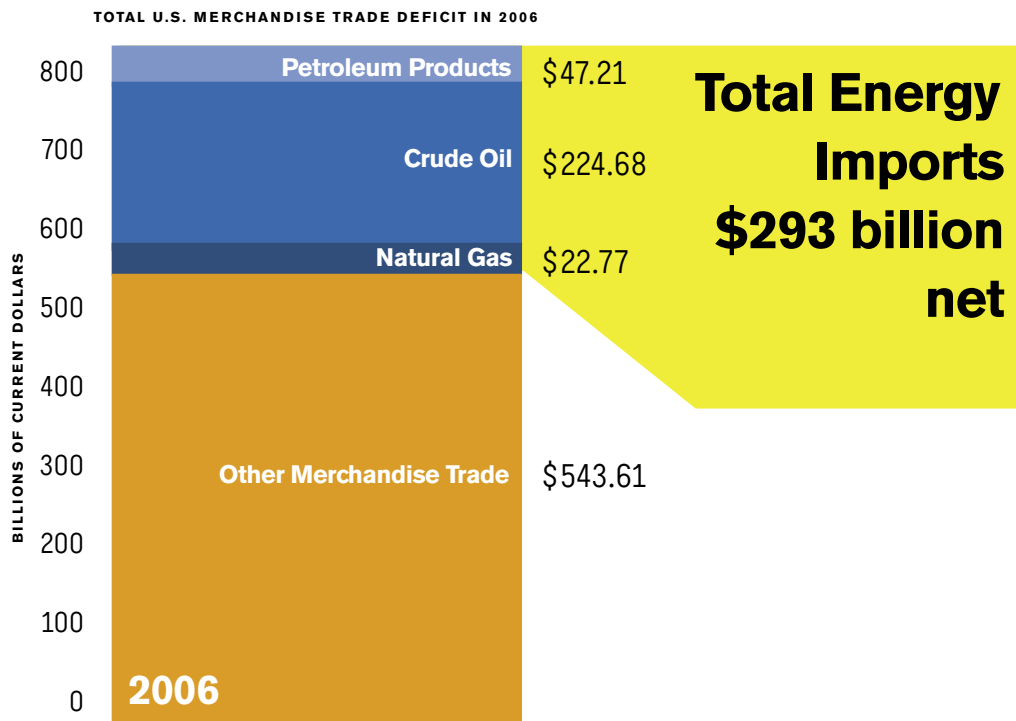
The effects of higher oil prices are rippling across the economy, impacting the U.S. Gross Domestic Product (GDP), trade deficit, Consumer Price Index (CPI) and the cost of doing business.

Recent price increases have chipped away at the rate of U.S. economic growth, lowering the GDP between 0.25 and 1 percent since 2004. According to a July 2006 study by the Congressional Budget Office (CBO), sustained at current levels, oil prices will result in a lower level of GDP over the next ten years and depress the U.S. standard of living as Americans trade more of their production to acquire the same barrel of oil.⁴

Oil imports reached \$272 billion in 2006, and now constitute 32 percent of the U.S. merchandise trade deficit.⁵ As the trend for higher oil prices is projected to continue, energy imports are expected to permanently increase the nation’s trade deficit.

9. Total Energy Imports Accounted for Over One-Third of the U.S. Merchandise Trade Deficit in 2006

Source: Bureau of Economic Analysis & Energy Information Administration



The CBO also reports that the average household's annual spending on energy goods and services rose by about \$1,700 between 2003 and mid-2006, and their saving rate dropped sharply. That trend continues in 2007.⁶ The U.S. Department of Labor has reported that gasoline prices surged at a 34.5 percent annual rate in the first quarter of 2007, accounting for 41 percent of the overall increase in the CPI for the first three months of the year.⁷

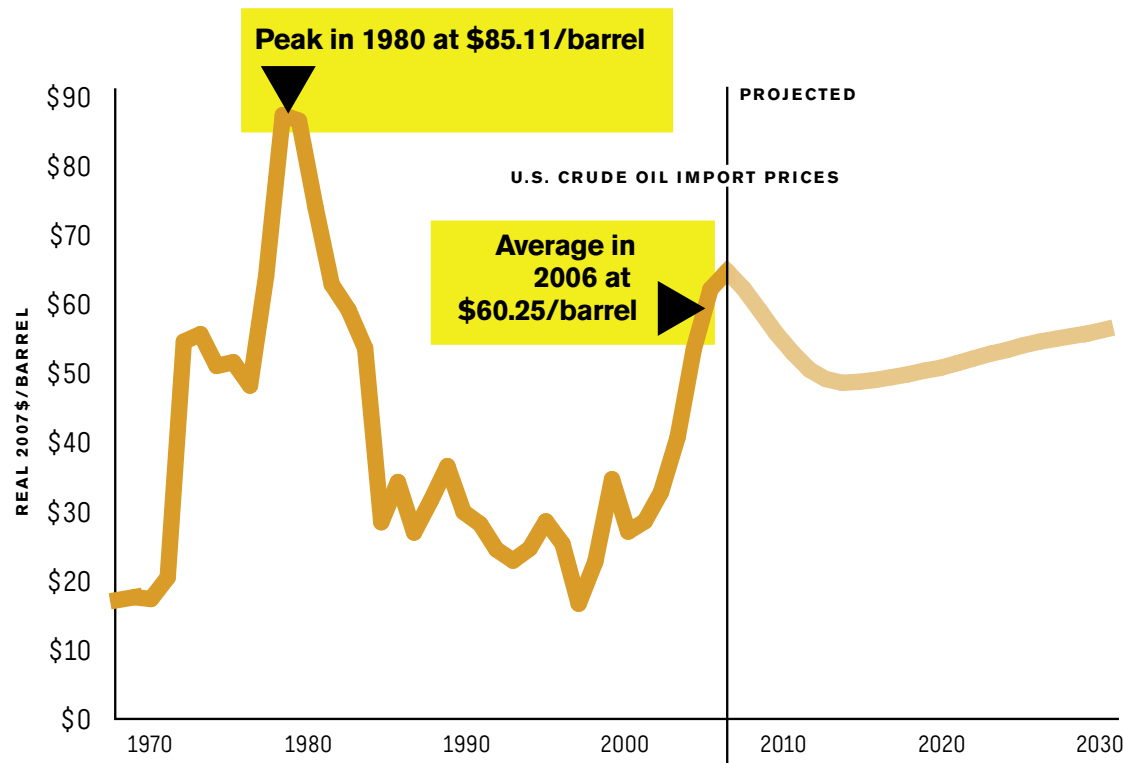
Consumers have been hit not only by higher gasoline prices, but also with higher foods costs as the nation's emerging biofuels industry has stoked demand for corn, putting upward pressure on corn prices. These increases, combined with the higher cost of energy inputs for fertilizers, food production and transport are raising grocery bills across the

country. The U.S. Department of Agriculture has reported that retail food prices are likely to climb by 2.5 percent to 3.5 percent in 2007, and some economists suggest this is a low estimate.⁸

According to the National Federation of Independent Business, the number of small businesses across the board raising prices nearly doubled in the first quarter of 2007, growing from just 8 to 15 percent. Owners blamed the hikes primarily on higher labor costs, but energy costs—from gas prices to heating and electricity bills—typically ran a close second.⁹

10. U.S. Oil Prices Are Close to Record Level, Even Adjusted for Inflation

Source: Energy Information Administration



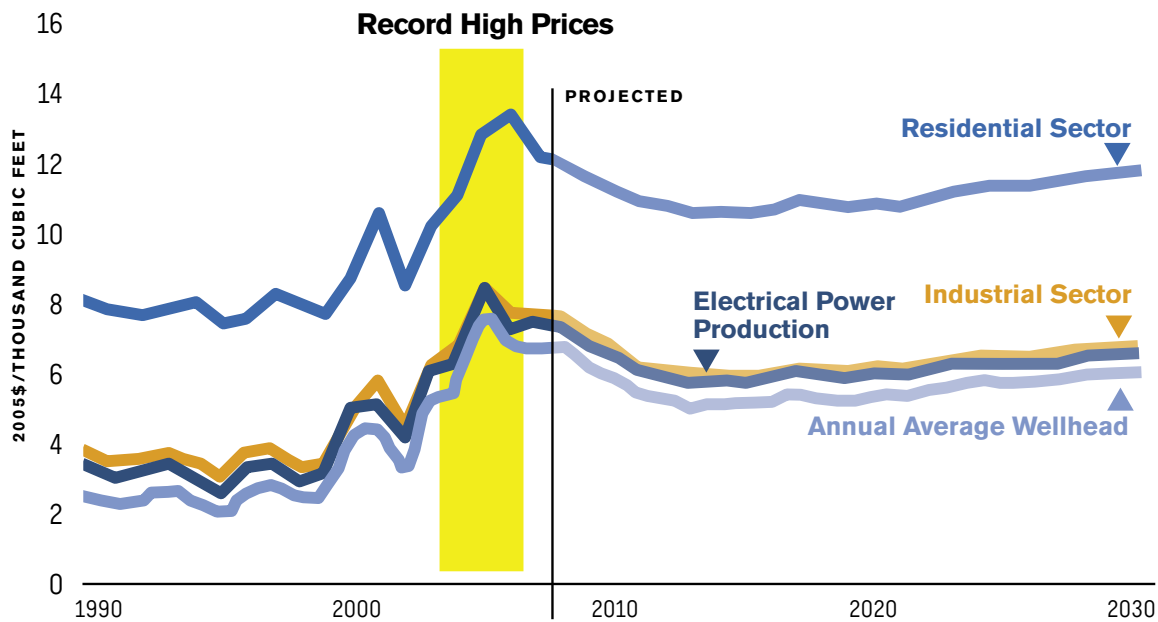
Some studies point to the potential for a significant economic slowdown—if not recession—if oil prices continue to climb. University of Maryland economist Robert F. Westcott, estimates that each \$10 increase in oil prices reduces household spending power by about \$35 billion, or about 0.4 percent. He calculates that a \$60 increase in oil prices (from \$60 to \$120 a barrel) would impose an extra \$210 billion cost on households “virtually overnight.” He projects that such a dramatic shock would likely end in a consumer-led recession.¹⁰

Oil price increases and supply volatility present a major competitiveness challenge for consumers and companies alike. But the economy does not run on oil alone.

Since 1950, the percent of U.S. economic activity coming from industries powered by electricity has risen from 20 to 60 percent.¹¹ High-growth service industries, including finance, insurance, software and information technology, depend upon affordable, reliable and high-quality power. Consumer demand for electronic and computing products and an ever-widening array of Internet-based services are driving record levels of power use in the residential sector.

11. Natural Gas Prices Are Also at Historical Highs

Source: Energy Information Administration



Natural gas prices have also been at a record high over the past few years, driving up both feedstock and electric power costs.

The ripple effect of rising oil and gas prices extends beyond the gas pump and the meter to impact the economy in less visible but very fundamental ways.

While constituting only 6 percent of U.S. energy consumption, industrial feedstocks play a major enabling role in the economy. Petroleum and natural gas are the primary sources of petrochemicals used to manufacture plastics, synthetic fibers, synthetic rubber and a multitude of industrial and consumer materials. Natural gas has been the dominant feedstock in the United States for manufacturing hydrogen, ammonia and methanol. These, in turn, are used in petroleum refining, fertilizer production and resins and glues used largely in building materials.

Referring to chemicals as ‘the hidden backbone of the U.S. manufacturing sector’, a recent report by the National Association of Manufacturers (NAM) paints a troubling picture of how industries are faring with

“Jeff Uhlenburg, president of Donovan Heat Treating, is accustomed to high prices for the fuel that fires the forges at his metal finishing foundry in Philadelphia. But in 2002, when natural gas prices jumped from about \$5 per thousand cubic feet to more than \$18, monthly energy costs for his \$2.3 million business leapt from around \$30,000 to \$60,000. That was more than Uhlenburg could take. ‘That is like hemorrhaging,’ he says. ‘You are operating at a loss and you can only go on so long before you are finished.’”¹²

the sustained pressure of higher energy prices. According to the NAM, rising natural gas costs are driving U.S. chemical suppliers offshore. This is consequently having a ripple effect, as certain large manufacturers that source these chemicals are similarly relocating to remain competitive.¹³

According to the NAM, the main factor affecting the decision among chemical suppliers to leave the United States is the growing price of natural gas as compared to other parts of the world.

Dow Chemical is cited as a case in point. The company reports that in 2002, energy accounted for 29 percent of overall costs. By 2005 that number increased to 50 percent. The cost differential for energy expenditure is striking. Dow Chemical states that its energy costs would be cut almost in half if it moved its U.S. plants to Germany, dropping from \$12 to \$7 billion a year. By moving to the Middle-East, these costs would drop to \$1.5 billion a year. NAM reports that of the more than 80 new, large-scale chemical plants on the drawing boards now around the world, none is planned for the United States.¹⁴

Due to the cost of natural gas, many industries are seeking feedstock alternatives. For example, the ethanol industry, which uses natural gas in nearly all of the 115 ethanol plants in the United States, is now looking to alternatives such as biomass and manure.¹⁵ The higher price of natural gas is also causing a surge of interest in coal and nuclear power for electricity production. As of May 2007, U.S. power companies had announced plans to

construct as many as 150 new generating plants fueled by coal, which currently supplies about half America’s electricity,¹⁶ and as of August 2007, 17 companies are weighing license applications for more than 30 nuclear plants to be built in the United States.¹⁷

The cost and availability of energy has become a major factor in the development of certain industries outside of the United States.

Developing nations not only constitute huge and rapidly growing markets for basic goods such as steel, aluminum, copper, petrochemicals and paper, in some cases they are becoming the new centers for production for these energy-intensive industries as the potent combination of lower labor and energy costs makes them an attractive option for new investment.

With 24 percent of all known natural gas reserves, and gas prices in the realm of 30 percent lower than those of developed nations, Gulf Cooperation Council (GCC) countries, including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE, are rapidly expanding production capacity of steel, petrochemicals and aluminum.

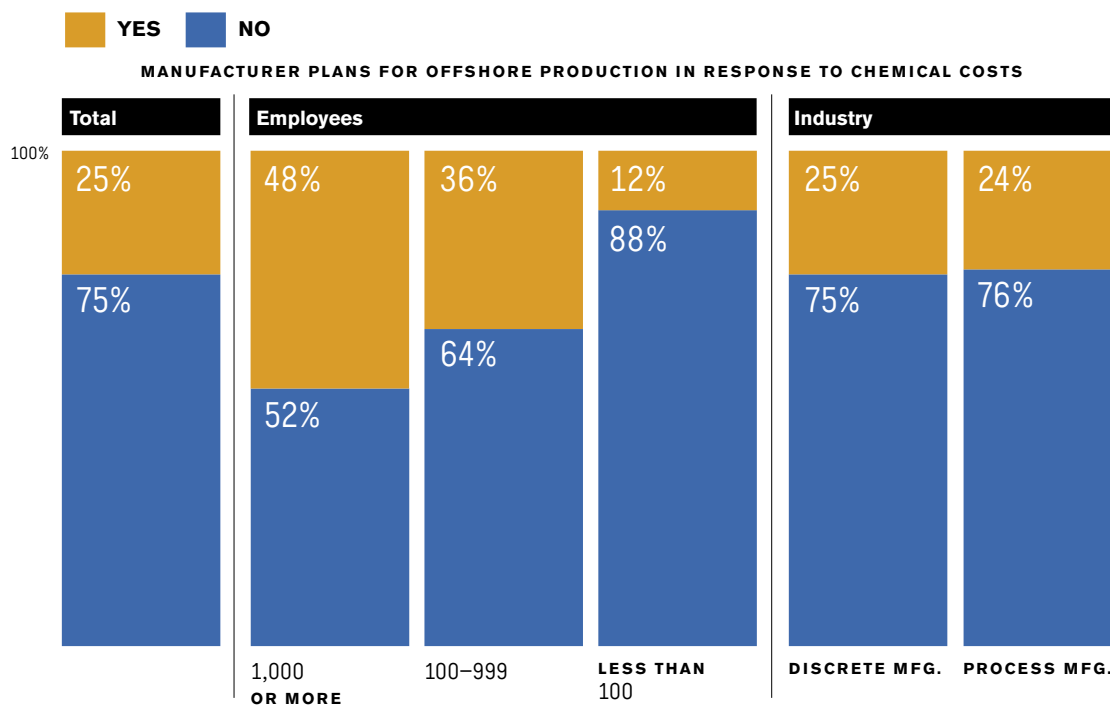
McKinsey & Co. reports that “companies in the region have announced plans to develop almost a quarter of the world’s capacity expansions over the next five years. In primary aluminum production, to cite just one opportunity, the region will probably boost its share of global production capacity to 13 percent, from 7 percent, over the next five years.”¹⁸

It is estimated that China, for instance, is adding steelmaking capacity at such a rapid rate that its production will rise from 5 percent of the worldwide total in 1995 to more than 30 percent by 2015. In the process, it will become a leading exporter.¹⁹ In turn, this means that China is demanding more of the raw materials required to make steel, putting an upward pressure on commodity prices that are felt around the world—including within the energy industry itself. U.S. industry executives are lamenting the higher cost to construct new power and nuclear plants due to the inflated cost of materials and finished components. For example, a top Siemens executive notes that the price of a new coal-fired power plant in the United States has risen 25–30 percent in the past year and a half.²⁰

12. Almost Half of Large U.S. Manufacturers Surveyed Report Plans to Move Production Offshore If Chemical Costs Continue to Rise

Source: AMR Research 2007

Q. If present cost and availability trends in the chemical industry continue, will you shift your production offshore?



“There’s massive inflation in copper and nickel and stainless steel and concrete,” said John Krenecki, president and chief executive of GE Energy. The uncertainty is not just in nuclear plants, he said; coal plant prices are now similarly unstable. “There’s real sticker shock out there.”²¹

Energy Has Become a Competitiveness Driver for Enterprises

The new realities around energy are driving companies to address their energy competitiveness in three important ways:

- By improving their own internal energy management practices
- By adapting their market offerings to reflect growing customer concerns about energy costs, consumption and carbon emissions
- By integrating the principles of sustainability into the core of their business models and strategies to create competitive differentiation and advantage

“Energy management is a critical part of our day-to-day operations.... Now more than ever, energy efficiency is just smart business.”

Rob Schasel, Director of Energy, PepsiCo ²²

Improving their own internal energy management practices

In an effort to achieve energy cost savings as well as enhance their operational efficiencies and risk management strategies, a number of leading companies and institutions have set ambitious goals to diversify away from traditional energy sources and toward renewable energy and/or set targets to reduce energy-related carbon emissions. They have increased investments in energy efficiency technologies, established internal energy metrics and initiated programs to drive similar practices through their supply chains.

- **Wal-Mart** is among the most prominent and certainly the largest company to demonstrate a strong commitment to taking charge of its energy future. In 2005 the company set an audacious goal of being supplied 100 percent by renewable energy. Wal-Mart plans to invest \$500 million in sustainability projects; eliminate 30 percent of the energy used in stores in seven years or less; and, with one of the largest trucking fleets in the world, they have set a goal of doubling new truck efficiency by 2015 and are deploying hybrid vehicles in their corporate vehicle fleet. The company predicts that these changes will produce net savings of at least \$494 million a year by 2020. The company has also undertaken measures designed to drive energy efficiency and other sustainable practices throughout its supply chain.²³

Did you know?

In a recent Hill & Knowlton survey of senior technology executives, more than three-quarters believe that companies need to create the position of a Chief Energy Officer (CNO) to help set and implement an energy strategy.²⁴

- **Microsoft, Google and HSBC** are examples of companies that have elected to build data centers alongside hydropower sources to better manage the growing electric power demand such centers require. According to Jonathan Koomey, a consulting professor at Stanford University and staff scientist at Lawrence Berkeley National Laboratory, energy consumed by data centers in the United States and worldwide doubled over 2000–2005,²⁵ and according to an August 2007 Environmental Protection Agency (EPA) study, the ever-multiplying computer facilities are projected to double their energy consumption again over the next five years.²⁶

- **PepsiCo and Coca-Cola** are examples of companies that have made significant commitments to improve their energy management this year. PepsiCo pledged to buy more than 1.1 billion KWH of renewable energy over the next three years, which consequently catapulted the company to the head of the EPA's list of top 25 green power purchasers.²⁷ Coca-Cola announced it is making a \$3 million dollar investment in energy

efficient lighting and air-conditioning as well as advancing its building automation system.²⁸

Such efforts are part of a growing trend. According to a study by Siemens and McGraw Hill Construction, by 2009 (if not sooner) the vast majority of the U.S. business community will have opted for some form of clean-energy technologies to improve building operations. The study indicates that rising energy costs were identified as a fundamental driver of green building in corporate America, with an overwhelming 75 percent of participants listing that trend as a major motivator.²⁹

- **Exxon Mobil** is representative of another steady trend in the business community: improved industrial energy efficiency. According to a company press release, Exxon Mobil had identified opportunities to improve energy efficiency at its refineries and chemical plants by 15 to 20 percent through its Global Energy Management System. The company's refining and chemical businesses have implemented more than half of these opportunities, with associated cost savings of approximately \$750 million per year.³⁰

“The relatively low cost energy savings and carbon emission reduction potential that could come from improving energy efficiency in buildings, transportation, industrial processes, etc. is still relatively under-explored.”

Asari Efiog, SRI/ Renewable Energy Analyst, Merrill Lynch³¹

While significant strides in industry efficiency have been made over the last two decades, a recent study by the EPA assessing the opportunities and challenges for energy efficiency in the industrial sector, points to a substantial margin for improvement.³²

Table 1: EPA Sector Industrial Energy Efficiency Assessment Summary

Source: U.S. Environmental Protection Agency

Sector	Opportunities				
	Cleaner Fuels	Combined Heat and Power	Equipment Retrofit/ Replacement	Process Improvement	Research and Development
Alumina and Aluminum	Low	Low	Medium	Medium	Medium
Cement	Medium	Low	High	High	Medium
Chemical manufacturing	Medium	High	Medium	Medium	Medium
Food manufacturing	Medium	High	Medium	High	High
Forest products	Medium	Low	Medium	High	High
Iron and Steel	Medium	Medium	Medium	Medium	Medium
Intergrated steelmaking	Low	Medium	High	Medium	High
EAF steelmaking	Low	Low	High	High	High
Metal casting	Low	Low	Medium	Medium	Medium
Metal finishing	Low	Medium	Medium	High	Medium
Motor vehicle manufacturing	Low	Low	Medium	High	Medium
Motor vehicle parts manufacturing	Low	Low	Medium	High	Low
Petroleum refining	Low	High	Medium	Medium	Medium
Ship building and Repair	Low	Low	High	High	Low

Low Medium High

Adapting their market offerings to reflect growing customer concerns about energy costs, consumption and carbon emissions

As enterprises seek to grow the business and drive their bottom line, they are adapting their market offerings to provide for an increasingly energy aware and climate conscious consumer—at the individual and enterprise levels.

- **Shell and Luminant** are among the power companies that are diversifying their portfolios and increasingly providing non-fossil based energy sources to produce electric power. The two companies announced in July 2007 plans to build the world’s largest wind farm in Texas, which will be more than four times the size of the largest wind farm currently in operation.³³
- **Toyota and General Motors** are among automakers seeking to bring alternative products to market. One of the industry forerunners, Toyota now offers three different hybrid vehicles, including the Prius. Describing the huge benefits to be derived in terms of lower oil consumption and reduced carbon emissions, General Motors CEO Rick Wagoner announced as a top priority program two new contracts designed to speed up the production of electric batteries for the Chevy Volt.³⁴

“The environment has become a fiduciary issue. The past twelve months have seen an almost weekly stream of stories and reports from large financial institutions—banks, insurance companies, and investment houses—talking about the risks of climate change, toxics, and other environmental issues to shareholders. And shareholders, especially pension funds and large faith-based institutional investors, are starting to hammer hard on companies to acknowledge, reduce, and report on their risk profiles in these areas.”

Joel Makower, Editor of Greenbiz.com ³⁵

• **Intel, Advanced Micro Devices and Sun Microsystems**

are among the computer chip manufacturers working to develop more efficient processors. As companies highly dependent upon computing power seek to control their energy costs, chipmakers no longer compete only on speed but also on performance per watt. To keep pace with growing customer demands for energy efficiency, eleven companies formed a new consortium, “The Green Grid,” earlier this year to lower the overall consumption of power in data centers around the globe. The organization is chartered to develop meaningful, platform-neutral standards, measurement methods, processes and new technologies to improve the energy efficiency performance of global data centers.³⁶

• **Citibank, Morgan Stanley, Bank of America and Goldman Sachs**

are among the leaders in the financial industry that are reorienting their product offerings and services to expand their business to include energy and carbon related projects.

- In 2006, Morgan Stanley announced plans to invest roughly \$3 billion in carbon credits and energy projects to reduce greenhouse gas emissions during the next five years.³⁷
- Goldman Sachs chose to focus its efforts on the renewable energy sector in 2006, investing \$1.5 billion in this area—a 50 percent increase above its originally planned commitment.³⁸

- In May 2007, Citigroup announced plans to spend \$50 billion on climate-change issues over the next 10 years, saying the financial-services institution should do more to curb its involvement with businesses that contribute to global warming. The company reportedly will invest in and finance more than \$31 billion [of the \$50 billion] in clean energy and alternative technologies.³⁹

• **NASDAQ, Clean Edge, KLD and Merrill Lynch**

are among financial institutions to recently establish stock market indices in renewable energy, clean technologies, climate change and energy efficiency. Renewable energy stocks performed well overall in 2006, with many clean energy sectors globally seeing compounded annual growth rates over 30 percent.⁴⁰

- The NASDAQ Clean Edge U.S. Index (CLEN), which began in May of 2006, tracks the performance of technology manufacturers, developers, distributors and/or installers in advanced materials, such as bioplastics and silicon-based materials; energy intelligence, such as conservation and automated meter reading; energy storage and conversion, such as advanced batteries; and renewable electricity generation and renewable fuels.
- The KLD Global Climate 100 Index (GC 100) is composed of a wide ranging mix of 100 global companies that demonstrate the greatest

potential for mitigating the social and economic consequences of climate change. Representing sectors from energy, utilities and industry to consumer products, the index focuses on public companies in renewable energy, future fuels, clean technology and efficiency.

- The Merrill Lynch Energy Efficiency Index (EEI), launched in mid-2007, tracks 40 companies in four sectors estimated to benefit from increased energy efficiency—including the automotive, building materials, capital goods and semiconductors industries.

Integrating the principles of sustainability into the core of their business models and strategies to create competitive differentiation and advantage

The sustainability movement has been underway for several decades. In the last several years, a veritable cottage industry has sprung up to support the efforts of companies seeking to fully embrace the concept of sustainability. Although originally fueled by the environmental community and other

'stakeholder' pressures, it is increasingly driven by very practical and serious concerns about how to effectively address the growing costs and risks of energy and climate change.

- **General Electric, DuPont and IBM** are among a growing number of companies seeking to capitalize on the opportunity side of the energy and climate change equation.
 - Characterizing the renewable energy business as its fastest growing, GE Energy Financial Services announced in May 2007 that it will double its investments in wind, solar, biomass and geothermal energy by 2010.⁴¹
 - DuPont, a company that has been on the sustainability path since the early 1990's, today attributes \$5 billion of its \$29 billion in revenue to the sale of sustainable products.⁴²
 - In March 2007, IBM announced the creation of a new business unit, "Big Green Innovation," to provide management systems and consulting services to help companies deal with water management, alternative energy and green operations.⁴³

"Global warming, we judge, is likely to prove one of those tectonic forces that—like globalization or the aging of populations—gradually but powerfully changes the economic landscape in which our clients operate and one that causes periodic sharp movements in asset prices. We consider that climate change poses many challenges but also presents many business opportunities. Firms that recognize the challenge early, and respond imaginatively and constructively, will create opportunities for themselves and thereby prosper. Others, slower to realize what is going on or electing to ignore it, will likely do markedly less well."

Energy Is Driving Investment, Transforming Industries and Creating New Global Markets

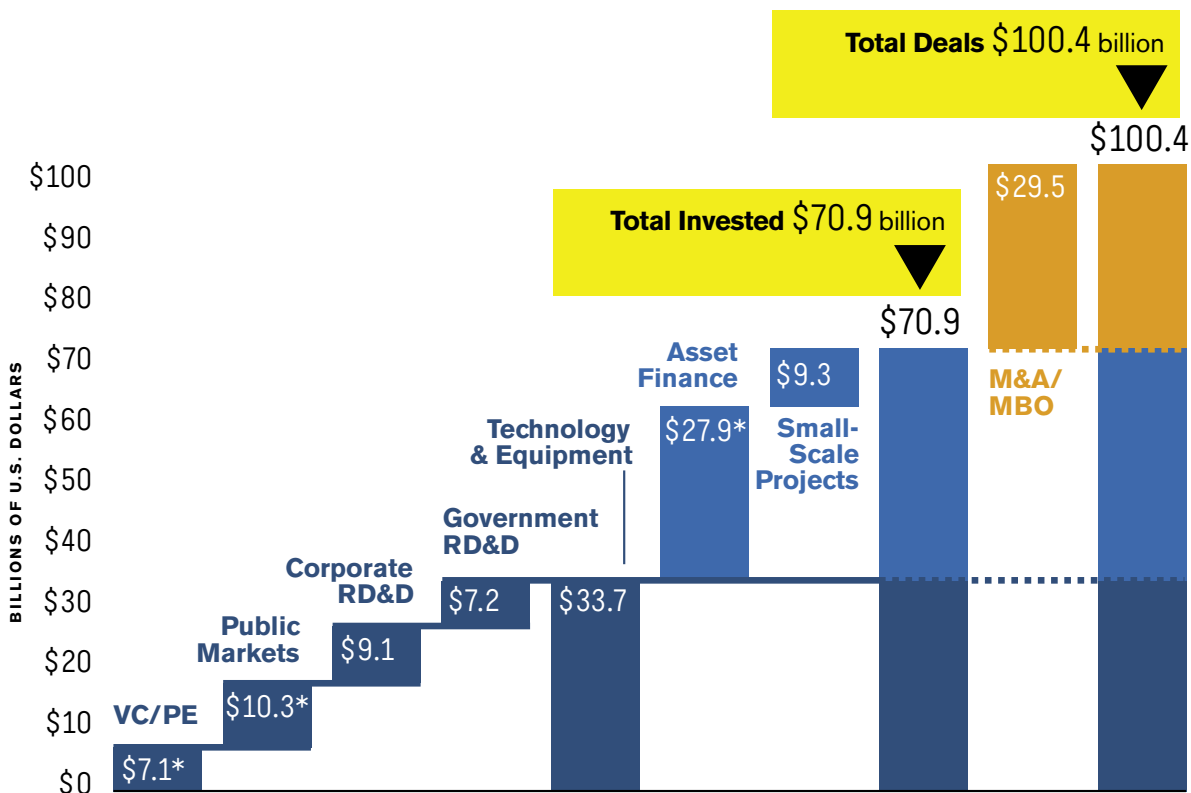
Energy is driving investment, reshaping industries and markets, and creating a new generation of value and supply chains.

Driving Investment

Sustainable energy is no longer a niche sector and is rapidly becoming big business around the world as large capital investments are pouring into renewable energy technologies.

13. Global Investment in Sustainable Energy, 2006

Source: New Energy Finance



Note: Grossed-up values based on disclosed deals. Figures marked * are based on NEF Desktop database; all other figures are based on industry estimates derived from various sources.

“According to the International Energy Agency the breathtaking figure of \$16 trillion will be invested in the energy sector until 2030. Due to skyrocketing oil prices, the need to reduce the dependence on foreign fossil fuel imports and national security considerations, investments will have to go more and more into smart renewable energy technologies.”

Christian Unger, Head of Energy at Bank of Austria⁴⁵

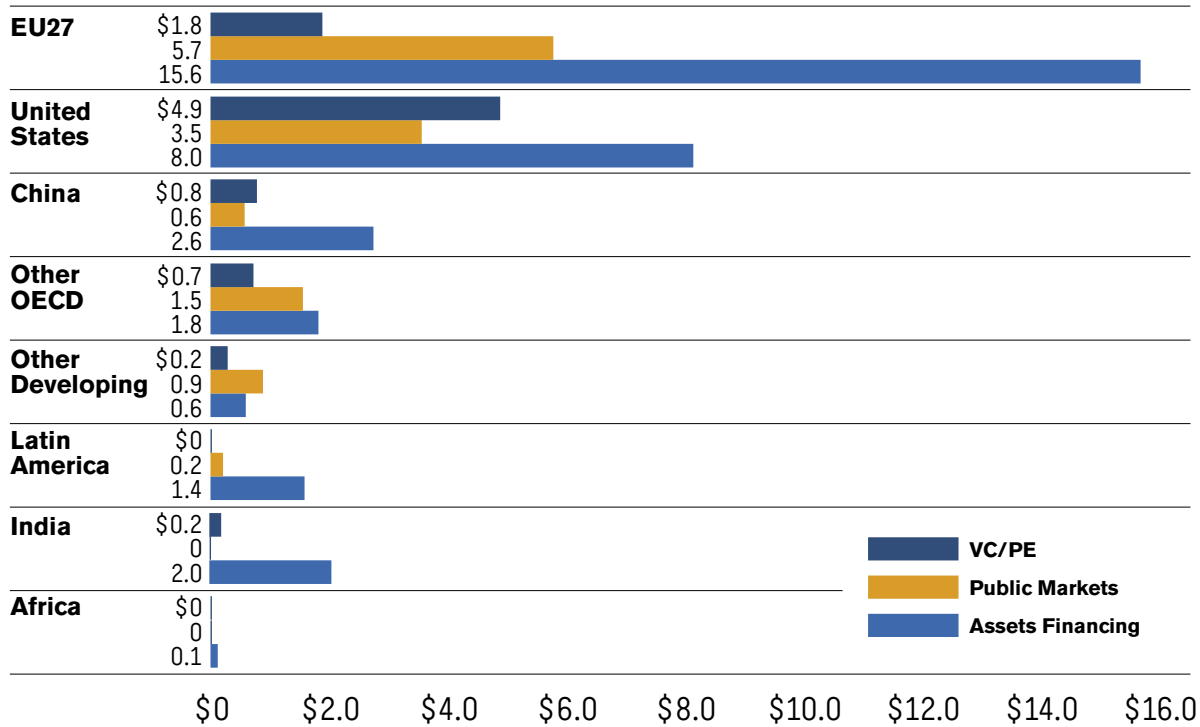
While still heavily influenced by government incentives, sustainable energy is rapidly becoming an attractive proposition in its own right, as investors see both short and long-term rewards. The increasing amount of new capital coming from established business actors highlights the sector’s shift into the mainstream.

According to the United Nations Environment Programme’s Global Trends in Sustainable Energy Investment 2007 report, worldwide investment capital flowing into sustainable energy more than doubled from 2004 to 2006. It rose from \$28 billion in 2004 to \$50 billion in 2005 to \$71 billion in 2006, and a similar trajectory has continued so far in 2007. The sectors with the highest levels of investment were wind, solar and biofuels.⁴⁶

The recent surge of investment in clean energy solutions has evoked comparisons to the dot.com boom of the late 1990s. Market observers see a notable difference between the two phenomena noting that clean energy is attracting a higher volume of investment over a more sustained period of time—a difference that may suggest a parallel more akin to the sustained surge in IT investment that began in the early nineties and continued throughout the decade.

14. Global Investment in Sustainable Energy, by Type and Region, 2006 in Billions

Source: SEFI, New Energy Finance



Note: Grossed-up market values based on disclosed deals. VC/PE figures: (disclosed deals and total deals), include PE buy-outs, investor exits made through OTC market offerings, OTC and PIPE deals. Public Market figures: (IPOs, Secondaries, Convertible and Other) represent location of exchange on which a company raises money, not the location of the company; includes investor exits made through Public Market offerings. Asset Financing figures: (total deals), represent total investment and so include new build and refinancing of clean energy projects; acquisitions of projects are not included.

Investment is growing in all regions, but developing countries are increasingly capturing market share.

The bulk of new investment in sustainable energy is still going mostly to OECD countries, with the U.S. and EU together accounting for more than 70 percent of investment in 2006. However, investment in developing countries is growing quickly, jumping from 15 percent (\$4.2 billion) in 2004 to 21 percent (\$15 billion) in 2006, with China claiming almost two-thirds of the flow.⁴⁷

A new Ernst & Young Index has deemed the United States as ‘the most attractive place to invest’ in renewable energy in 2007 but at the same time projects that China and India will achieve this status by 2012.⁴⁸

In 2006, the United States was the largest single global destination for venture capital and private equity investment with \$4.9 billion of new money into clean energy companies and projects invested in the United States—largely concentrated in solar and biofuel start-ups.⁴⁹

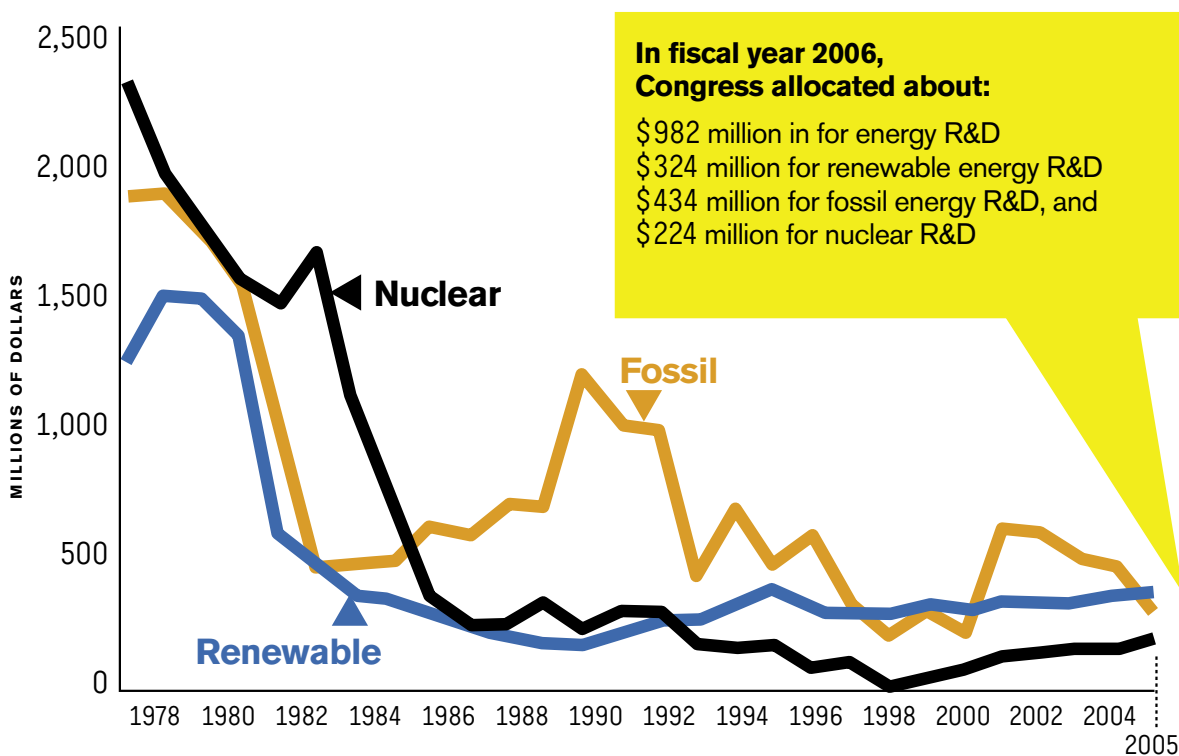
The European Union, on the other hand, attracted the most significant public market investment in 2006, attracting \$5.7 billion compared to America’s \$3.5 billion, reflecting a higher degree of market maturity for Europe’s clean energy sector.⁵⁰

The Asia-Pacific region holds top place for government investment, including national investments in R&D as well as funding from multilateral institutions. According to a new report from Lux Research, the Asia/Pacific region is leading in 2006 government funding (38 percent), corporate R&D spending (34 percent) and scientific publications (38 percent).⁵¹ China and India are also receiving the majority of the billions of dollars that the United Nations is investing in renewable energy technologies and production in developing economies through its Carbon Development Mechanism (CDM).

For its part, the United States is just beginning to stem a steady decline in public investment in energy related R&D. According to a recent U.S. Government Accountability Office (GAO) report, the U.S. Department of Energy’s (DOE) total budget authority for energy R&D dropped by over 85 percent (in real terms) from 1978 to 2005, peaking in the late 1970s but falling sharply when oil prices returned to lower levels in the mid-1980s.⁵²

15. U.S. Government Funding Fell Off Sharply over the 1980s and 1990s

Source: GAO analysis of DOE data



Note: Budget authority is in real terms, adjusted to fiscal year 2005 dollars to account for inflation. Excludes DOE program management costs and indirect facilities costs of DOE laboratories.

Transforming industries

Industry lines are blurring and collaborations across sectors is growing as companies work to meet or ‘make’ market needs related to energy.

- **BP, DuPont, Shell, Volkswagen, Dow Chemical, ADM and Tyson Foods** are among the companies that are working cross-industry in an effort to develop bio-based fuels, feedstocks and materials.
 - DuPont, with its biotechnology and bio-manufacturing capabilities, and BP, with its fuels technology expertise and market know-how, are partnering to develop, produce and market advanced biofuels.⁵³
 - Iogen, a biotechnology company, is cooperating with Royal Dutch/Shell and Volkswagen to study the economic feasibility of producing cellulosic ethanol on an industrial scale.⁵⁴
 - ADM, a bio-energy and agricultural processing company and Metabolix, a bioscience firm, are jointly producing the world’s first biobased and fully biodegradable plastic,⁵⁵ and Dow Chemical has recently teamed up with one of Brazil’s largest ethanol players Crystalsev, to manufacture plastic from sugar cane.⁵⁶
 - Tyson Foods, the world’s largest chicken producer and meat processing company, formed Tyson Renewable Energy to turn its animal fat into biofuels—first working with ConocoPhillips to create the biodiesel fuels⁵⁷ and more recently in a joint venture with Syntroleum to form Dynamic Fuels LLC to produce synthetic fuels made from renewable feedstocks.⁵⁸
- **Ford and Google** are both collaborating with utilities in deploying plug-in hybrid-electric vehicle (PHEVS) technologies, presaging a blending of the transportation, information and electricity sectors.
 - Ford is teaming up with Southern California Edison to examine the future of plug-in hybrids in terms of how home and vehicle energy systems will work with the electrical grid to bring PHEVs to market and act as a solution to concerns about powering vehicles and homes, as well as reducing the growing strain on the energy grid.⁵⁹
 - Google has partnered with A123Systems and Hymotion to convert a small fleet of Toyota Prius hybrids into plug-in hybrids, and has worked with Pacific Gas and Electric Company (PG&E) to demonstrate how such vehicles can also provide power back to the electrical grid when needed.⁶⁰
- **Honda** is an example of a company that is diversifying out of its traditional sector boundaries and moving into the energy industry. Describing itself as ‘the first automaker to enter into solar cell business’, Honda recently established a wholly owned solar subsidiary in an effort to provide heat and electricity for the home as well as create an infrastructure for a hydrogen fuel-cell-powered car.⁶¹

“[Bioplastics] is the emerging business [opportunity of this company],” says K. Scott Portnoy, Cargill’s corporate vice president. “This is all part of diversifying and spreading our bets.”

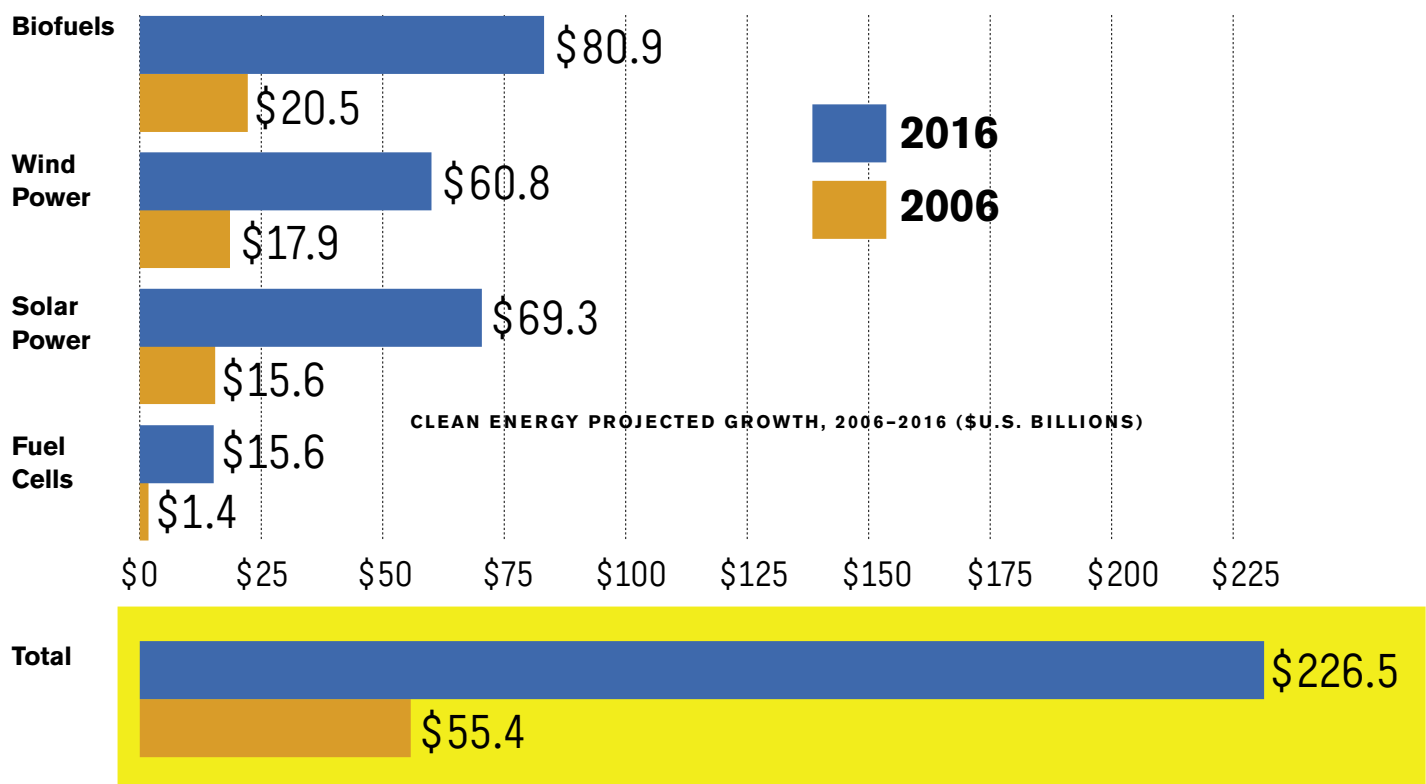
“If I were Archer-Daniels-Midland or Cargill, I’d be looking at the same areas,” says Charles O. Holliday Jr., chairman and CEO of DuPont Co., which is itself moving into crop-derived chemicals.⁶²

Creating new global markets

Investments in new energy echnologies, manufacturing, products and services are spawning major new market opportunities.

16. The Global Clean Energy Market Is Set to Quadruple in the Next Decade

Source: Clean Edge, Inc.



Concerns over global warming has led to the emergence of a carbon market.

Efforts to limit greenhouse gas emissions, and in particular carbon dioxide, have led to the establishment of cap-and-trade programs, designed along the lines of the program developed by the United States to control sulphur emissions from coal-burning power plants. Some are government sponsored trading programs, such as the European Trading Scheme (ETS) launched in 2005, or the UN's Clean Development Mechanism (CDM) established under the auspices of the Kyoto Protocol. Some are voluntary, like the U.S.-based Chicago Climate Exchange. These initiatives have given birth to a global carbon market, sized at \$30 billion in 2006 by the World Bank.⁶³ Growth in both voluntary and government-managed markets is projected to be strong over the coming decades, with some estimates pegging the global market at \$100 billion in just three years.⁶⁴

Energy Is Becoming A Factor In U.S. Regional Competitiveness

The competition is on. Perceiving a clean energy future as offering an opportunity to create jobs, support the local economy, enhance energy security and be responsible stewards of the environment, state government leaders are striving to attract new investment to establish their regions as centers of energy-related innovation.

Even cities are now ranked as to their attractiveness. *SustainLane Government*, an online resource center that offers sustainability tips to state and local government, has ranked Austin, San Jose, Berkeley and Greater Boston respectively as the top five hotbeds for the influx of cleantech capital, deep R&D, and real-world opportunities for field-testing and prototyping.⁶⁵

Sustainable energy, it seems, is fast becoming a driver of regional economic development.

States are exercising their comparative advantages.

- **Geography:** Washington and Oregon are leveraging their geography and existing electricity grid to provide reliable wind and hydroelectric power to meet the surging regional demand for electricity.⁶⁶
- **Infrastructure:** Texas, with its access to a huge energy market, is at the center of a nationwide fuel-distribution network, with extensive storage facilities, pipelines and rail and water connections, enabling it to leverage its regional competencies to attract new energy investment. Texas also has a successful history in the wind-energy business, which boomed after the 1999 passage of a state law that requires a certain amount of the electricity sold by utilities in the state to be generated from renewable sources. More recently, the state has again taken the initiative by easing the construction of transmission lines for wind farms, sending a clear signal to investors.
- **Talent:** California, which draws upon a strong existing Silicon Valley semiconductor engineering base and IT venture networks, has found that the emerging need for clean technology is a good fit with the skills and companies in the area.

States are forging public-private partnerships, creating programs and making investments to increase their attractiveness to U.S. and foreign companies.

- Wisconsin Governor Jim Doyle has committed \$50 million in state funding to match a \$125 million grant that the University of Wisconsin has received from the Department of Energy to create the Great Lakes Bioenergy Research Center (GLBRC) on the University of Wisconsin-Madison campus. The Governor characterized the center as an economic engine that will translate new discoveries into high-paying jobs.⁶⁷
- In his 2007 State of the State address, Ohio Governor Ted Strickland called for a \$1 billion investment in alternative and renewable energy technologies over four years in an effort to ensure that “energy will be an economic development leader in Ohio.” As a center of advanced energy technology, the state hopes to take the lead in embracing the opportunities afforded by “new industries, new technologies, and a new economy.”⁶⁸

- Vermont has created a program to bring environmental engineering firms to the state and help those already there to expand with the goal to transform Vermont into a state where growth is driven by green business.⁶⁹

In the absence of federal action, many states and regions have devised regulations and policies to act as market drivers to stimulate investments in a range of new energy technologies and related manufacturing.

- By 2006, forty-five states had enacted legislation or developed initiatives to stimulate the deployment of renewable energy technologies. Thirty-nine states established interconnection and net metering rules that require electric power companies to connect renewable energy sources to the power transmission grid. Twenty-two states established renewable portfolio standards requiring or encouraging that a fixed percentage of the state’s electricity be generated from renewable sources.⁷⁰
- In August 2006, California Governor Arnold Schwarzenegger signed “landmark” legislation known as “AB 32” which requires the California Air Resources Board (CARB) to develop regulations and market mechanisms that will ultimately reduce California’s greenhouse gas emissions by 25 percent by 2020. Mandatory caps will begin in 2012 for significant sources and ratchet

down to meet the 2020 goals. This was followed by an Executive Order in January 2007 that established Low Carbon Fuel Standard (LCFS) for transportation fuels sold in California. By 2020 the standard will reduce the carbon intensity of California’s passenger vehicle fuels by at least 10 percent.⁷¹

Evoking the concept of ‘co-opetition’, even as states take energy-related initiatives to support their own economic development, they are working across state boundaries to address the shared challenge of global warming.

- In late 2005, governors of seven Northeast states entered an accord, the Regional Greenhouse Gas Initiative (RGGI), scheduled to take effect in 2009. It is intended to reduce carbon dioxide pollution to 10 percent below current emissions by 2019.⁷²
- By May 2007, California, Arizona, New Mexico, Oregon, Washington and Utah all signed onto the Western Regional Climate Action Initiative, an Memorandum of Understanding to establish a regional emissions cap and develop a market-based cap-and-trade system to address climate change.⁷³

“Mr. Peter Darbee [Chairman, CEO & President of PG&E], a former investment banker and financial expert who brings an outsider’s perspective to the inbred utility industry, cuts across those lines, pointing to a potential advantage for business in California [because of pledges to curb carbon emissions by 2020]: predictability. ‘The incentives really aren’t there for the creation of new technologies and investments to reduce carbon dioxide unless mandatory caps are put in place,’ he said. ‘Now, that creates an element of certainty’”⁷⁴

The Global Competitive Landscape

These recent U.S. initiatives, while bold, are not unique. Countries around the world have also been implementing policies and regulations designed to enhance their energy efficiency, reduce their dependence on fossil fuels, and curb their greenhouse gas emissions.

Brazil, Denmark, Germany, Japan, Spain and France have all sustained long-term efforts using mandates and/or incentives to deploy advanced energy technologies that are providing, or are expected in the future to provide, significant amounts of energy. These efforts are producing results. A December 2006 GAO study cites the following examples:

- By 2005, Brazil had eliminated its need to import crude oil for gasoline by using mandates and price subsidies to stimulate the development of an ethanol industry that uses domestic sugarcane.
- Similarly, Denmark’s stimulation of renewable energy resulted in it accounting for approximately 28 percent of electricity supply in 2005.
- To develop a sustainable energy supply and protect the environment, Germany established a goal to increase the share of renewable energy to meet at least 4.2 percent of its total energy

requirements by 2010 and 10 percent by 2020. The 2010 target was exceeded in 2005, when renewable technologies accounted for 4.6 percent of consumption.

- To reduce its reliance on imported energy, Japan initiated a 10-year program subsidizing the cost of residential solar systems. As a result, solar systems were installed on more than 253,000 homes and the price of residential solar systems was cut by more than one-half.
- Spain, supported in part by a European Union program to promote cleaner energy technologies, is successfully operating a 320-megawatt coal gasification plant—the largest such plant in the world—designed to run more efficiently with fewer emissions than conventional coal-fired plants.
- France leads the world in deploying an advanced Generation III nuclear reactor—the European Pressurized Reactor—which is designed to be safer, more efficient and less susceptible to terrorist attacks than older reactors and will also generate nearly 80 percent more electricity.⁷⁵

Table 2: Many Countries Have Set Targets to Diversify the Energy Consumed for Electricity Production with Cleaner, Renewable Sources

Source: New Energy Finance, International Energy Agency and Brazil National Plan 2030

National Renewable Power Production Targets, Selected Countries

	“Green Electricity” Target Proportions	Status
Spain	29.4% by 2010; 12%* of TPES by 2010	17.2%*
Italy	25% by 2010; no national target for 2020	16.5%*
France	21% by 2021; no national target for 2020	11%*
EU-25	20% TPES by 2020	20%*
Germany	12.5% by 2010; 20% by 2020	10.4%*
United Kingdom	10.4% by 2010; 20%** by 2020	4.1%*
Brazil	43.3%** by 2030, 25.4%** by 2030 excl. hydro	80%–90% hydro only; 37%* of TPES; 2% excl. hydro
China	15% of TPES by 2020	7.7%* of TPES
United States	15% by 2020 (investor-owned utilities only)	10%*, >5% excl. hydro
India	10% by 2012; 15% by 2032	5.9%* of TPES
Japan	3% by 2010 (excl. geo & hydro); 7% by 2010 (incl. geo & hydro)	3% incl. geo & hydro, 2% excl.
Russia	Absence of national renewable energy strategy	18.9%*; 3.6% of TPES, 1.2% excl. hydro

TPES: total primary energy supply including transportation fuel

* Including large hydro

**Strategic goals, not binding targets

Note: Table shows most recent publicly available data.

A growing number of countries and regions worldwide have been pronouncing new commitments and expanding existing targets to rein in their overall energy consumption and greenhouse gas emissions and improve national energy efficiency and productivity.

In addition to taking steps to rebalance their national energy portfolios, European Union leaders have set region-wide goals to advance their sustainable energy and combat global warming. In 2006 the EU Commission issued a “Green Paper” outlining a broad energy strategy, and followed up this year with specific proposals to reach these goals, including: completing the internal market for electricity and gas; setting a 20 percent target for renewables in the EU’s overall energy mix by 2020 (current target is 10 percent for 2010); increasing energy efficiency by 20 percent by the same year; and setting an obligation for each member state to have at least 10 percent biofuels in their transportation mix by 2020.⁷⁶

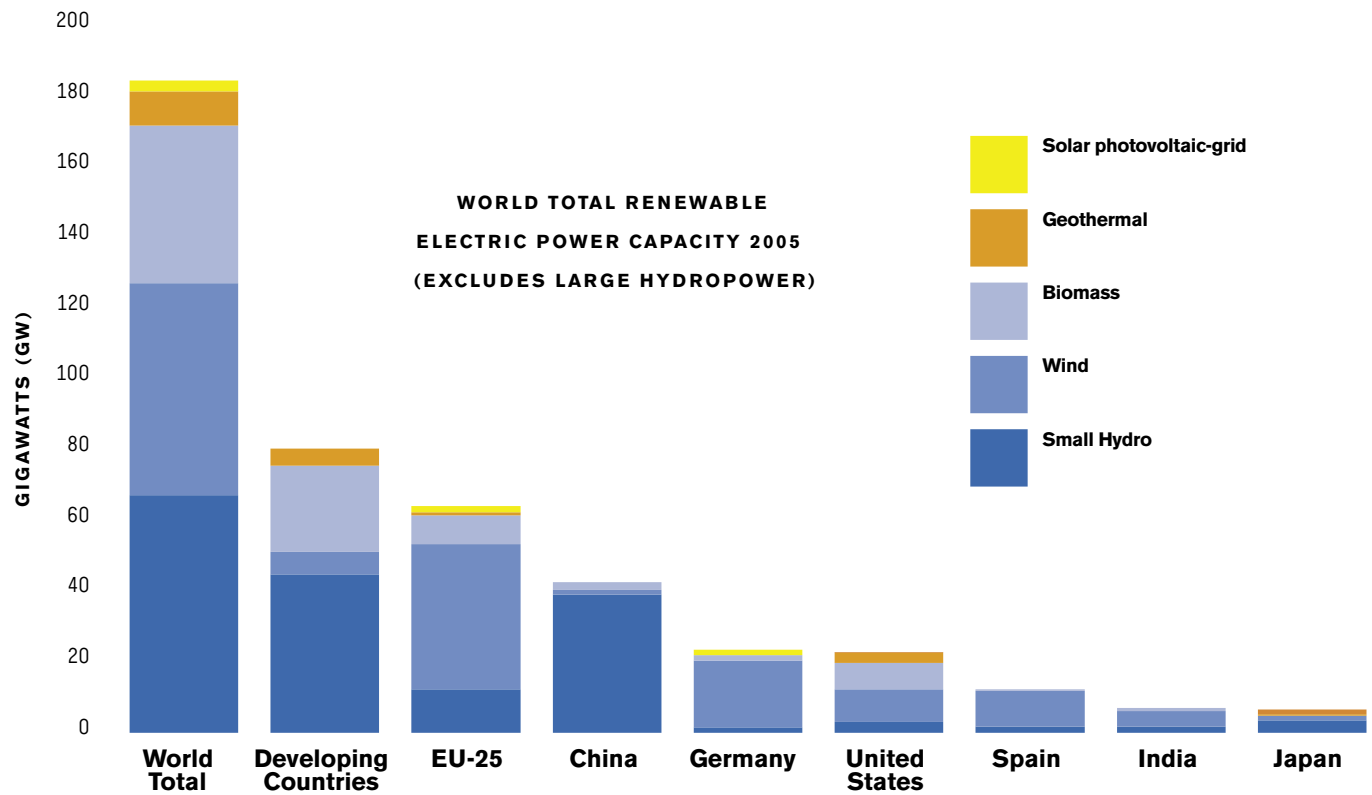
- China has recently released a comprehensive climate plan and has set targets to be reached by 2010 of producing 10 percent of its energy supply through renewable energy, increasing its energy efficiency by 20 percent and reducing its energy intensity by 20 percent from 2005 levels.
- China has pledged to invest almost \$6 billion to triple its wind power generation capacity by 2010. According to a report by the Global Wind Energy Council, “China will reach 15,000 megawatts of wind power capacity by 2020, making it the world’s largest wind energy producer.”⁷⁷
- Brazil is now priming itself to be capable of producing enough ethanol to replace 10 percent of worldwide gasoline consumption by 2025.⁷⁸
- Portugal is striving to supply 45 percent of its energy with renewables in the near future in hopes of becoming “Europe’s leading renewable energy producer.”⁷⁹
- India says it will reduce its emissions by 25 percent by 2020.
- The EU aims to cut greenhouse gas emissions by 20 percent from 1990 levels by 2020, and some member states have set even more ambitious targets:
 - Germany has pledged to cut carbon dioxide emissions by 40 percent by 2020.
 - The UK plans to reduce its greenhouse gas emissions by 60 percent by 2050.
 - Norway is aspiring to be the first ‘zero-emission’ state in the world by 2050.
- Japan, the fourth largest global emitter of greenhouse gases, has a ‘vision’ of reducing not only its own but also global greenhouse gas emissions by 50 percent by 2050.⁸⁰

There is a growing concern that the U.S. may be falling behind in the commercialization and manufacturing of new energy technologies relative to other regions and major countries in the world.

Although the U.S. has spent hundreds of millions of dollars over the past three decades on basic and applied R&D on renewable and alternative energy technologies, it has been outdistanced by other nations in terms of the commercial development of several of these important technologies.

17. In 2005, The EU’s Capacity to Produce Clean, Renewable Electric Power Was Almost 3 Times Greater Than in the United States

Source: Ren21



Global “Snapshots”

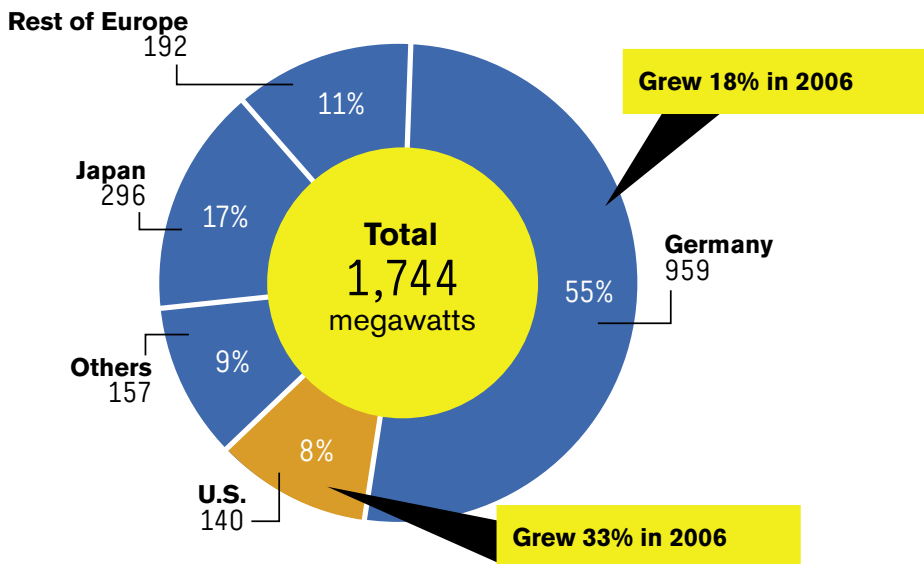
Solar Power

Although solar power is the least commercialized technology, and PV still accounts for a small percentage of electricity generation worldwide, this renewable sub-sector is now an \$11 billion market that is growing by more than 25 percent a year.⁸¹

A decade ago, U.S. solar power manufacturers captured the entire domestic market and 40 percent of the world market. By 2003, these shares had dropped by 73 percent and 14 percent respectively. After years of growth, shipments from U.S. manufacturers fell by more than 10 percent, while shipments grew by 41 percent from Europe and by 45 percent from Japan.⁸² Though currently lagging behind Japan and Germany in market size, the U.S. solar industry has seen a surge in activity in recent years.

18. Germany Dominates the Global Market for Solar Photovoltaic Installations, 2006 in Megawatts

Source: Solarbuzz.com



Did you know?

Oil-rich but windswept Texas overtook California as the leading wind-power state.

Wind Power

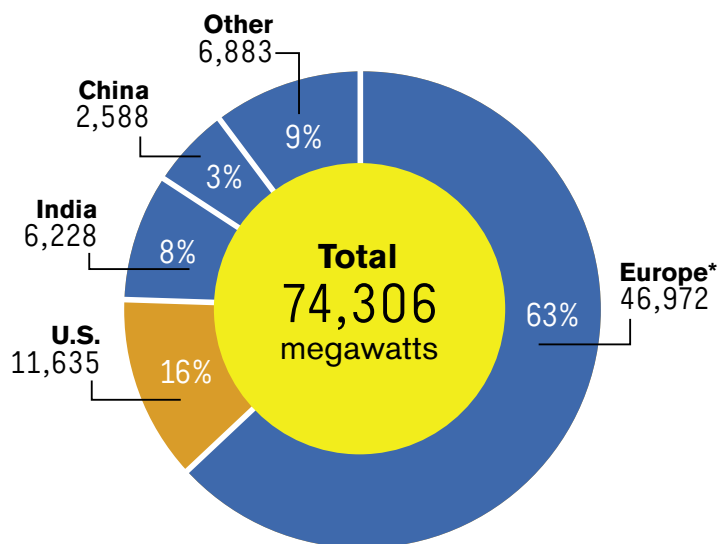
Wind is the fastest-growing source of electricity in many countries. Wind energy has exhibited steady global growth of more than 20 percent per annum over the past 15 years.⁸³

Although the wind power industry has until recently been most active in EU member countries, installations are rapidly coming on line in the United States, Canada and newer markets in Asia and South America.

Despite recent progress, the United States still lags behind other countries that have spent decades nurturing wind power with government policies. For example, Denmark, which has long had national requirements for utilities to buy renewable energy, now generates 19 percent of its electricity from wind power—the highest percentage in the world. Denmark’s support of wind energy has also created a thriving domestic wind turbine industry, with Danish wind turbine manufacturers capturing 40 percent of global sales in 2004.⁸⁴

19. Europe Leads the World in Wind Power Total Global Installed Wind Turbine Capacity, 2006 in Megawatts

Source: BTM Consult ApS via BP Statistical Review of World Energy, 2007



*Major European producers

While the United States has quadrupled its wind-power capacity since 2000, China has seen a seven-fold increase over the same period and expects to catch up to the United States in terms of total capacity within three years. In fact, China presently has the largest market in the world for small wind power projects and has reportedly prepared for large-scale development of wind power production, including specialized training of personnel to design and operate wind farms.⁸⁵

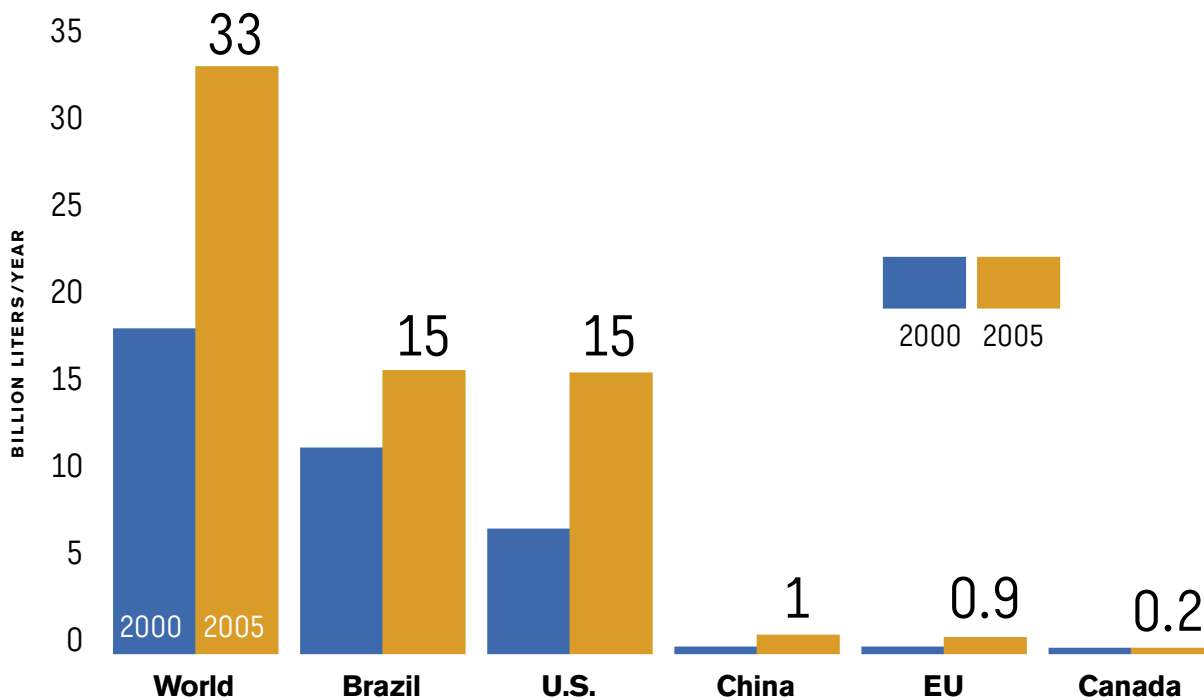
Biomass

The use of crops or other kinds of biomass to make fuels such as ethanol and biodiesel for transportation has garnered substantial support in several parts of the world—predominantly Brazil, America and the European Union.

In 2005, global ethanol production was 9.66 billion gallons, of which Brazil produced 45.2 percent (from sugar cane) and the United States 44.5 percent (from corn). Global production of biodiesel (most of it in Europe), made from oilseeds, was almost one billion gallons.⁸⁶

20. The United States and Brazil Lead the World in Biofuel Production

Source: Ren21 Renewables Global Status Report 2006 Update



- Biofuels accounted for 3 percent of worldwide transportation fuels in 2006. In Brazil sugar-based ethanol already comprises 40 percent of all Brazilian transport fuel, whereas in the United States it is around 2 percent.⁸⁷
- In 2005, 1.43 billion bushels of corn—nearly 13 percent of the U.S. corn crop—were used to produce ethanol. Ethanol is blended in 30 percent of the U.S. gasoline and is produced primarily in the Midwest.⁸⁸
- While the U.S. has caught up to Brazil's level of ethanol production, Brazil remains the world's top exporter and presently has an edge over the United States for future production because ethanol can be produced more cheaply with sugar cane than the corn used by U.S. farmers.
- Biodiesel has grown at a substantially faster pace than ethanol in recent years. With 80 percent of global biodiesel capacity, Europe has the largest concentration of biodiesel plants worldwide.⁸⁹

The interest in biomass extends to the production of materials and feedstocks, which are emerging as an attractive, if still nascent, alternative to petroleum and natural gas based inputs. Interest in the use of agricultural products and wastes to develop commercial and industrial materials is growing throughout the world. Although traditional fossil-based chemicals remain substantially cheaper, price and supply volatility has bolstered the economic rationale for making materials such as plastics, foam and lubricants from biomass. Chemical and agricultural companies see similar opportunities for growth ahead.

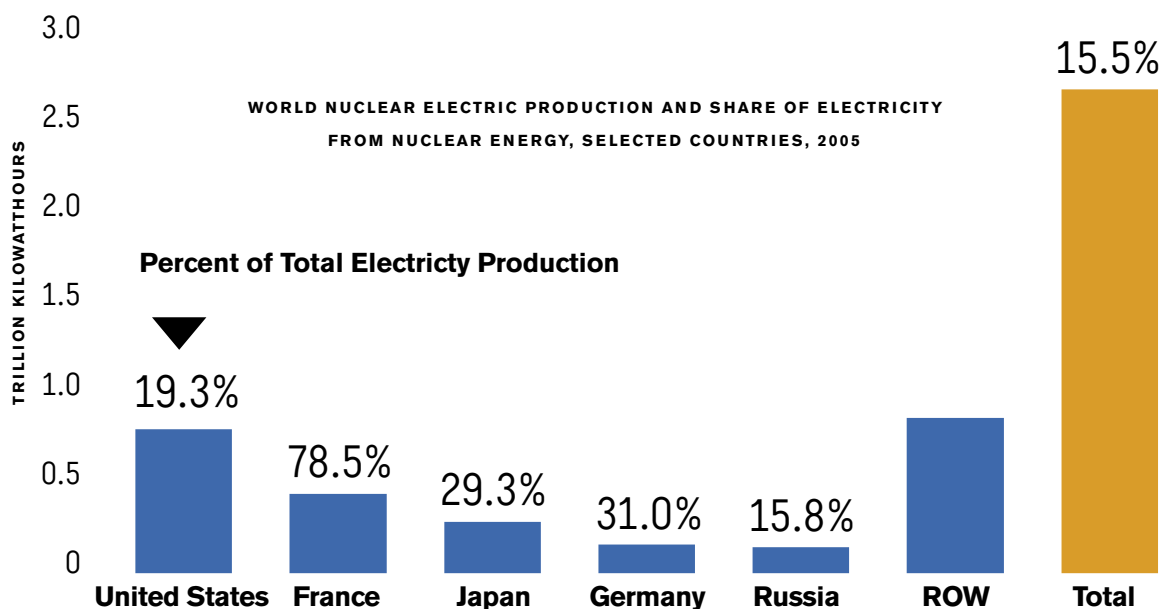
Nuclear Energy

Nuclear energy experienced its heyday in the 1970s with the oil crisis provoking a surge in nuclear power plants orders and construction. However, later that decade, the world economic slowdown combined with the declining price of fossil fuels curtailed growth of nuclear energy demand. As this took effect, accidents at Three Mile Island in the United States and at Chernobyl in the former Soviet Union, raised serious concerns among the public about the safety of this source of energy. The overall effect was a significant slowing of nuclear energy's growth in the 1990s.

Nuclear power plants provided about 16 percent of the world's electricity production in 2006. In total, 16 countries relied on nuclear energy to supply at least one-quarter of their total electricity.⁹⁰ As of July 2007, 30 countries worldwide were operating 438 nuclear reactors for electricity generation—with almost a quarter of these in the United States.⁹¹ Whereas no new nuclear plants have been built in the United States since the late 1970s, some countries—primarily Japan, France, China and India—have continued to push ahead strongly with reactor construction, and according to the Nuclear Energy Institute, there are presently 31 new nuclear plants under construction in 12 countries.⁹²

21. The United States Produces More Nuclear Energy Than Any Other Country

Source: Energy Information Administration and International Atomic Energy Agency



Conclusion

Energy and the environment have emerged as among the most potent forces reshaping the global economy in the 21st century. As this Discussion Draft seeks to present, the impact of these forces is being felt in many ways and generating a range of responses from governments and private sector actors.

Government, business and civic leaders around the world are grappling with a profound new reality: economic growth and prosperity cannot be pursued in isolation from other vital goals such as energy security and sustainability. Conversely, the latter two goals cannot be successfully reached without effectively meeting the needs and economic aspirations of global citizens. Business must go on, economic growth must occur—but in new ways and likely on new terms.

There is an opportunity to align these responses in a way that helps achieve multiple goals. The United States can strengthen its competitiveness by adopting and deploying sustainable energy solutions. Private sector demand for sustainable energy solutions can contribute to the goal of achieving energy security in an environmentally responsible manner. But we are not there yet.

Business leaders today are confronted with a complicated array of choices and decisions. Regulatory and policy environments are evolving rapidly but somewhat differently in the United States and abroad—around carbon emissions, energy efficiency requirements and renewable portfolio standards—to name a few. The timing, nature and even location of business investment decisions are being affected. Some business leaders are placing their bets, while others await a more certain future.

The situation calls for action. The Council on Competitiveness will work to support the mutually reinforcing goals of energy security and competitiveness by shaping a public-private action agenda to drive private sector demand for sustainable energy solutions.

Glossary of Key Terms

Asset financing: all money invested in energy projects, whether from internal company balance sheets, debt finance or equity finance.¹

Biofuels: liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation, including ethanol and biodiesel.⁵

Biomass: organic nonfossil material of biological origin constituting a renewable energy source.⁶

Capacity: also known as installed capacity; the maximum output, commonly expressed in megawatts, that a power generation unit, electrical apparatus or heating unit is rated by the manufacturer to be able to supply. The average amount of electricity or heat produced from a facility is generally lower than its installed capacity due to equipment malfunctions and fluctuations in ambient conditions. Total capacity is the sum of maximum outputs for all relevant facilities.²

Clean-energy technology: includes technologies in energy intelligence, ex. smart grids and conservation; energy storage and conversion, ex. advanced batteries and fuel cells; renewable electricity generation and renewable fuels, ex. solar photovoltaics and ethanol; and advanced materials that enable other clean-energy technologies and/or reduce the need for petroleum based materials, ex. bioplastics and nanotech materials.³

Clean technology: also known as cleantech; encompasses knowledge-based technologies, products and services which optimize the use of natural resources while reducing ecological impact and adding economic value by significantly lowering cost and improving profitability.⁴

Commercial sector: consists of service-providing facilities and equipment of businesses, governments, and other private and public organizations, including institutional living quarters. Common uses of energy are space and water heating, air conditioning, lighting, refrigeration, cooking and running other appliances and equipment.⁷

Feedstock: raw material required for an industrial process, including natural gas, petroleum and coal.⁵

Industrial sector: consists of all facilities and equipment used for producing, processing, or assembling goods for activities such as manufacturing; agriculture, forestry, fishing and hunting; mining and oil and gas extraction; and construction. Overall energy use is largely for process heat and cooling and powering machinery. Fossil fuels are also used as raw material inputs to manufactured products.⁷

Mergers & Acquisitions: any combination of two companies in which all assets and liabilities are absorbed by the buyer; specifically with existing equity purchased by new corporate buyers in companies developing energy technologies or operating energy projects.¹

OECD countries: the 30 current members of the Organization for Economic Cooperation and Development (OECD) are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.⁵

Petrochemicals: organic and inorganic compounds and mixtures that include but are not limited to organic chemicals, cyclic intermediates, plastics and resins, synthetic fibers, elastomers, organic dyes, organic pigments, detergents, surface active agents, carbon black and ammonia.⁶

Photovoltaic and solar thermal energy (for electric utilities): energy converted at electric utilities into electricity by means of solar (photovoltaic) cells or concentrating (focusing) collectors from electromagnetic waves radiated by the sun.⁵

Public markets: all new equity investment in quoted companies developing and manufacturing sustainable energy technologies, and building and operating clean energy power generation capacity.¹

Renewable energy resources: energy obtained from sources that are essentially inexhaustible (unlike, for example, fossil fuels, which are in finite supply). Renewable sources of energy include conventional hydroelectric power, wood, waste, alcohol fuels, geothermal, solar and wind.⁷

Residential sector: consists of living quarters for private households. Common uses of energy include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a variety of other appliances.⁸

Transportation sector: consists of all vehicles whose primary purpose is transporting people and/or goods, including automobiles; trucks; buses; motorcycles; trains, subways, and other rail vehicles; aircraft; and ships, barges, and other waterborne vehicles.⁷

Venture capital and private equity: all equity invested by venture capital and private equity funds into companies developing sustainable energy technologies or providing services to the sector.¹

Glossary Notes

- 1 Global Trends in Sustainable Energy Investment 2007. United Nations Environment Programme and New Energy Finance Ltd.
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