Transatlantic Cooperation for Sustainable Energy Security

A Report of the Global Dialogue between the European Union and the United States

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FEBRUARY 2009

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FOREWORD

We are in a decisive interval for the institutions of the Euro-Atlantic community and the 32 member states that belong to either the European Union or NATO, or both—with more yet to come, in and beyond 2009. Traditional concerns—security, economic, political, and societal—have become increasingly bundled into circumstances that cannot be addressed by any nation alone, however powerful, or any single institution, however influential. Under such circumstances, capabilities, too, need to be bundled for use through a comprehensive approach that combines hard and soft power into smart power, as well as the states and institutions that can best provide or even share them. Americans and Europeans must work together to develop these comprehensive approaches to today's challenges, and thus ensure that tomorrow's solutions are effective for them and the rest of the world.

It is with this belief that the Zbigniew Brzezinski Chair in Global Security and Geopolitics at the Center for Strategic & International Studies (CSIS) launched *A Global Dialogue between the European Union and the United States* in early 2008. The project examines five broad issues that represent serious challenges for the states of the Euro-Atlantic community but lend themselves especially well to ever-closer relations, consultation, and cooperation between the European Union and the United States:

- Issues of stabilization and reconstruction, and the problem of failing states;
- The dilemmas of climate change, including mitigation of its causes and adaptation to its impacts;
- The risks of energy scarcity and strategies for sustainable energy security;
- Challenges in the world economy and the new modalities of global economic governance;
- The need for strategic convergence and the formation of a Euro-Atlantic security strategy.

The paper that follows builds on the many contributions made by the participants in the two seminars of the project's Euro-Atlantic Working Group on Energy Security, held at CSIS in Washington, D.C., on July 8, 2008, and in London at Chatham House on September 15, 2008. I am thankful to each of them for taking the time to attend those meetings and to help in the development of this paper. I am especially grateful to my friends Franklin Kramer of the Atlantic Council of the United States and Robin Niblett of Chatham House, who cochaired the working group's activities. I am also particularly grateful to John Lyman of the Atlantic Council, who dedicated many hours to directing the work of the group and in taking on the challenging task of

helping to write this report. Erica McCarthy of the Atlantic Council and Derek Mix of CSIS also made important contributions in assisting the direction of the group's work.

As with two preceding programs on EU-U.S.-NATO relations completed by the Brzezinski Chair in the period 2004–2007, *A Global Dialogue between the European Union and the United States* is made possible by a grant from the European Commission. I am tremendously grateful for this continued support. I would also like to thank the Atlantic Council of the United States for its support of the activities of the Working Group on Energy Security. Finally, I also want to thank Julianne Smith for her leadership of the CSIS Europe Program to which this project is also linked.

Simon Serfaty
Zbigniew Brzezinski Chair in Global Security and Geostrategy
Center for Strategic and International Studies

EXECUTIVE SUMMARY

The world is energy short and carbon long. This report focuses on that juxtaposition and the means to achieve energy security in a world concerned over climate change and maintaining economic growth. The provision of a sustainable energy future will require a dramatic transformation of the world's energy supplies and consumption patterns. The current global financial crisis and accompanying economic downturn has made meeting this challenge significantly more difficult. Despite the current softening of energy demand, the world is facing a long-term tightening of conventional energy supplies and a need to address increasing environmental concerns that will require international cooperation on an unprecedented scale.

This will not occur unless the transatlantic community moves in concert to increase the efficiency of energy use and to develop and deploy the technologies required to meet the needs of both the developed and developing countries. Efficient and effective technologies, policies, and regulations will be required to sustain economic growth throughout the world. Without a high degree of global cooperation, the objectives of achieving secure, reasonably priced energy to foster economic prosperity will not be attainable. However, global cooperation will not occur without a significant increase in transatlantic cooperation. The world is looking to the developed countries to lead, and leadership of the transatlantic community is crucial. Neither Europe nor the United States will be capable of achieving the above objectives in isolation.

The report, along with a companion report focused on climate change, proposes a means by which the transatlantic community can effectively cooperate within itself and with other countries and international organizations by outlining 12 specific recommendations to governments on both side of the Atlantic, as follows:

1. The transatlantic community needs to maximize "common, compatible, and complementary" efforts to develop energy strategies, standards and regulations, research and development, markets, institutions, protection of infrastructure, and response to supply disruptions.
2. A Transatlantic Forum on Energy Cooperation (TFEC) should be formed that includes the United States, the European Union, NATO, and the nations of both the European Union and NATO. The TFEC should establish a close working relationship between Europe and the United States on energy security, including joint efforts that will:
3. focus on conservation and efficiency standards,
4. accelerate the development and commercialization of renewable energy technologies,

5. coordinate and accelerate the demonstration of clean coal technologies with carbon capture and storage,
6. support the development and deployment of safe, lower-cost nuclear power, focusing on nuclear waste and site issues, and international controls and regulation,
7. establish a Transatlantic Energy Research, Development, Demonstration, and Deployment Fund for joint research to accelerate the introduction on new technologies,
8. create a transportation initiative to halve oil consumption in transportation by 2030,
9. assess the future availability of oil and gas supplies and develop options, including alternatives.
10. The transatlantic community should take the lead to expand membership of the International Energy Agency.
11. The TFEC should hold a series of dialogues to establish a clear understanding of the appropriate role of military force and other security measures, and
12. should establish a permanent working group on adaptation to climate change.

By following these recommendations and those of the companion report, the transatlantic community can develop the legislative and policy framework required to develop a sustainable energy industry that can be emulated throughout the world. A number of major initiatives are already in place to address many of these issues. However, it is time for the transatlantic community to work together to ensure a secure, stable, and sustainable supply of energy.

INTRODUCTION AND RECOMMENDATIONS

The world is energy short and carbon long. This juxtaposition demands new ways of providing energy, protecting the environment, and developing new methods of international cooperation. The objectives are clear, but the means are not. Timing, scale, and market acceptance are critical issues toward which energy and climate policies are struggling. The challenge is further complicated by the need to avoid economic dislocations from sudden cost increases that could jeopardize jobs and economic growth.

The current global financial crisis has created significant constraints from which the U.S. and European energy industries are not immune. Money is exceptionally tight and will likely remain so for several years. This will dramatically slow the pace at which the U.S. and European energy industries can be transformed.

As a goal, we have told ourselves that:

> A global revolution is needed in ways that energy is supplied and used. Far greater energy efficiency is a core requirement. Renewables, nuclear power, and CO_2 capture and storage (CCS) must be deployed on a massive scale, and carbon-free transport developed. A dramatic shift is needed in government policies, notably creating a higher level of long-term policy certainty over future demand for low carbon technologies, upon which industry's decision makers can rely. Unprecedented levels of co-operation among all major economies will be crucial.[1]

This report focuses on the means to achieve those ends—particularly on the side of energy security and new methods of production. It fully accepts and briefly discusses the need for carbon pricing and other mechanisms to complement efforts in energy efficiency and energy production, but those issues are analyzed at greater length in a companion report to be released at a later date. Here, the fundamental focus is on energy security and on the expectation that the demand for energy will grow by 45 percent by 2030.[2] It proceeds on the premise that such growth cannot be accomplished, as has largely been the case until now, by a carbon-dominated energy supply—unless the adverse impacts of using carbon can be significantly reduced.[3]

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[1] International Energy Agency (IEA), *Energy Technology Perspectives 2008: Scenarios and Strategies to 2050* (Paris: IEA, 2008), p. 1.
[2] IEA, *World Energy Outlook 2008* (Paris: IEA, 2008), p. 78.
[3] IEA, *World Energy Outlook 2007* (Paris: IEA, 2007), p. 42.

The report proposes a means by which the transatlantic nations[4] can effectively cooperate, either directly or by acting in parallel, to help achieve sufficient energy supplies to meet transatlantic and global demand, at reasonable prices, and in an environmentally sound fashion. It builds on analyses by the International Energy Agency (IEA), the Intergovernmental Panel on Climate Change (IPCC), the United States, the European Union and European governments, and by responsible nongovernmental groups. The report's differentiating character is the specific recommendations it makes to sovereign entities on both sides of the Atlantic as to how to achieve broadly agreed-on goals.

The report recognizes that worldwide actions are both required and appropriate to achieve energy security. Nonetheless, the transatlantic nations are in a position to take the lead on many of those actions, and the report proposes how to do so.

It is particularly critical that the transatlantic community forge a strong bond on the actions required if it is to be effective at shaping global policy. The magnitude and financial and technological challenges of creating a sustainable energy future in a timely fashion are greater than either the United States or Europe can achieve on their own. A unified transatlantic community will be required to shape global policies. The current global financial crisis makes it even more critical that resources be applied to the most promising technologies and that the most effective and efficient policies, programs, and regulations are implemented. Extensive activities on both sides of the Atlantic indicate that a cross-pollination of ideas and experiences would be extremely beneficial and is required if financial and technical knowledge is to be used most effectively. The economies of the transatlantic community are mutually dependent and will only prosper over the long term when both have achieved sustainable energy security.

The report makes 12 specific recommendations:

1. The transatlantic community needs to take specific actions to maximize "common, compatible, and complementary" efforts in seven areas:

    Energy strategies

    Standards and regulations

    Research and development

    Markets

    Institutions

    Protection of infrastructure

    Response to disruptions

[4] While there are frequent references to the United States and Europe in the report, the key is action by the transatlantic community including Canada.

2. A Transatlantic Forum on Energy Cooperation (TFEC) should be formally established that includes the United States, the European Union, NATO, and the member states of both the European Union and NATO. The objective of the forum should be to establish common, compatible, and complementary energy strategies based on clear, achievable objectives and action plans.

   Numerous organizations currently exist that deal with some of the fundamental elements needed to create an overall strategy. However, none of them focuses on increasing mutual understanding or the establishment of a close working relationship between Europe and the United States. Such a relationship is essential for the development of sustainable energy strategies that will be required if global energy security is to be significantly improved by addressing physical, environmental, and economic concerns. Both Europe and the United States comprise numerous subregions (nations and states) that have differing interests that need to be reconciled to create broad, regional consensus on achieving difficult goals. Success in strengthening transatlantic cooperation can serve, therefore, as a powerful model for enhancing cooperation on a global basis.

   Establishment of this forum should be based on the following understandings:

   - The world needs to meet three major objectives—energy security, mitigation of climate change, and maintenance of economic competitiveness.
   - All major energy sources will be required to meet these objectives.
   - Policies and regulations need to provide long-term guidance to investors and consumers.
   - Transforming the energy sector will generate new and expanded industries and jobs.
   - The cost of the externalities associated with carbon-based fuels needs to be recognized in energy pricing.
   - The transatlantic community should seek to establish a common price for carbon and a complementary set of emissions trading regulations.

   The Forum should be a permanent body, as there will need to be regular reevaluation of strategic objectives and accompanying action plans, policies, and regulations as world events evolve.

3. The TFEC should focus on developing common conservation and energy efficiency standards designed to increase the rate of improvement in efficiency and to establish common energy efficiency standards where appropriate.

   Specific areas to be emphasized would include:

   - residential and commercial building codes,
   - common vehicle and fuel specifications, and

- common standards for lighting, appliances, and industrial equipment.

As part of this effort, a special working group should be formed to focus on creating more robust electricity transmissions systems and the development of "smart grid" technology.

4. The TFEC should establish a special working group to focus on the challenges of accelerating the development and commercialization of renewable technologies.

   Specific opportunities for the joint development and commercialization of renewable fuels technologies, such as biofuels, solar, wind, and hydrogen fuel cells, through public/private partnerships should be identified and financially supported by U.S. and European governments.

   Specific attention should be given to developing and implementing renewable portfolio standards (RPSs) and renewable fuels standards (RFSs), with the latter being coordinated with the Transportation Initiative described in recommendation 8 below.

   More robust transmission systems with storage and smart grid technologies should be built.

   This group should work with existing industry organizations in Europe, the American Council on Renewable Energy (ACORE) in the United States, and the International Renewable Energy Agency (IRENA), which is in the process of being established.

   The United States should formally join IRENA.

5. The TFEC should establish a joint program to coordinate and accelerate the demonstration of clean coal technology with carbon capture and sequestration (CCS).

   The United States and Europe should establish a $20-billion fund to support the demonstration and initial deployment of CCS projects under differing geophysical conditions over the next decade.

   The United States and Europe should establish compatible testing, measurement, monitoring, and reporting procedures for greenhouse gases (GHGs).

   Compatible incentive and tax policies, such as accelerated depreciation, could be developed.

6. The TFEC should support the development and deployment of safe, lower cost nuclear power, focusing on:

   Nuclear waste and site issues, particularly a global agreement on the handling of waste and the enrichment and reprocessing of fuels under the direction of the International Atomic Energy Agency (IAEA), including

   - rebuilding nuclear manufacturing and construction capability,
   - funding mechanisms to support the expansion of safe nuclear power, and
   - compatible incentive and tax policies such as accelerated depreciation.

Developing a common transatlantic position on the international controls and regulations for expansion of the world's utilization of nuclear power.

7. The TFEC should establish a Transatlantic Energy Research, Development, Demonstration, and Deployment Fund for joint research in order to accelerate the introduction of new technologies. Funding should be directed toward:

   technologies that would benefit from economies of scale and technologies strongly supported throughout the transatlantic community,

   technologies that would lead to an expansion of manufacturing and job creation throughout the transatlantic community, and

   potential second- and third-generation biofuels technologies, batteries and electric storage, smart grid technology and lighting, and wind and solar.

8. The TFEC should create a Transportation Initiative to:

   Develop action plans to halve oil consumption in transportation by 2030, by

   - increasing automotive and truck fuel efficiencies,
   - assessing the effectiveness of financial and tax incentives to accelerate the transformation of the community's motor vehicle fleet,
   - guiding the shifts to hybrid and all electric vehicles, including national electric power requirements for capacity, transmission, and "smart grids," and
   - evaluating and cooperating on the development of advanced biofuels and the development of compatible RFSs, and

   Develop programs that would assist other major economies, such as China and India, to develop more efficient and effective transportation systems.

9. The TFEC should assess the future availability of oil and gas supplies to the transatlantic community. The forum should develop a range of options for living in a world with tighter supplies and fewer major suppliers, including an assessment of opportunities for engaging Russia and Iran as reliable energy suppliers.

10. The transatlantic community should take the lead in expanding the International Energy Agency (IEA) into a global organization of petroleum and natural gas consumer nations that includes major economies such as China and India.

    The reconstituted IEA should establish regular dialogues with the major exporting and producing nations, particularly OPEC and Russia, to establish greater transparency regarding production capabilities and consuming country policies and capabilities to address energy security and climate change.

11. The TFEC should hold a series of dialogues to establish a clear understanding of the appropriate role for military force and other security measures and the specific responsibilities of NATO, national governments, and the European Union in addressing energy security issues.

12. A permanent working group on adaptation to climate change should be formally established within the TFEC framework to develop common and coordinated adaptation strategies based on clear achievable objectives and response plans. Within a few years, this forum should be expanded to include a number of other major economies.

1 KEY CHARACTERISTICS OF ENERGY MARKETS

There are four key characteristics of the energy markets in which the transatlantic nations participate that provide the basis for this report's recommendations. First, transportation both in North America and Europe is heavily oil based. Demand in the global oil market has grown over the past decade in important part because of the growth of emerging countries such as China and India, and this trend is expected to continue. Oil sources have been expanded, but there are a variety of real and potential instabilities in the market ranging from geopolitical considerations to price volatility. There are also serious questions of the availability of supply, primarily because it is not clear that investment by oil producers will be adequate.

The International Energy Agency projects that oil consumption will rise worldwide by 37 percent by 2030 under its "reference scenario" assumptions.[1] By 2030, oil demand is projected to rise 12 percent in Europe, 20 percent in North America, and 80 percent in developing countries, as seen in Table 1. The projection for continuing growth in demand and constrained supply for oil creates important energy security questions. The IEA's November 12 release of *World Energy Outlook 2008* indicates that world oil production and demand are now expected to be closer to 106 MB/day[2] versus the 116 MB/day indicated in *World Energy Outlook 2007*.[3]

Second, carbon-based energy provides most of the energy required for the nontransportation energy areas of electricity production, heating, and industrial power. Figure 1 illustrates the extent to which carbon-based fuels will continue to dominate the energy sector under the IEA's reference case, which assumes no dramatic changes in policies.[4]

Continuing growth in the demand for electric power is expected to drive much of the growth in energy requirements as 2 billion people in the world are currently without electricity and electric power usage continues to grow even in the developed countries. Table 2 indicates that the global growth in electricity demand is expected to increase by 42 percent between 2005 and 2015 and by a further 40 percent by 2030. In the Organisation for Economic Co-operation and Development (OECD) region of North America and Europe, electricity demand growth will be slower but will still increase by 18 percent in the 2005–2015 period and by a further 22 percent by 2030. In the

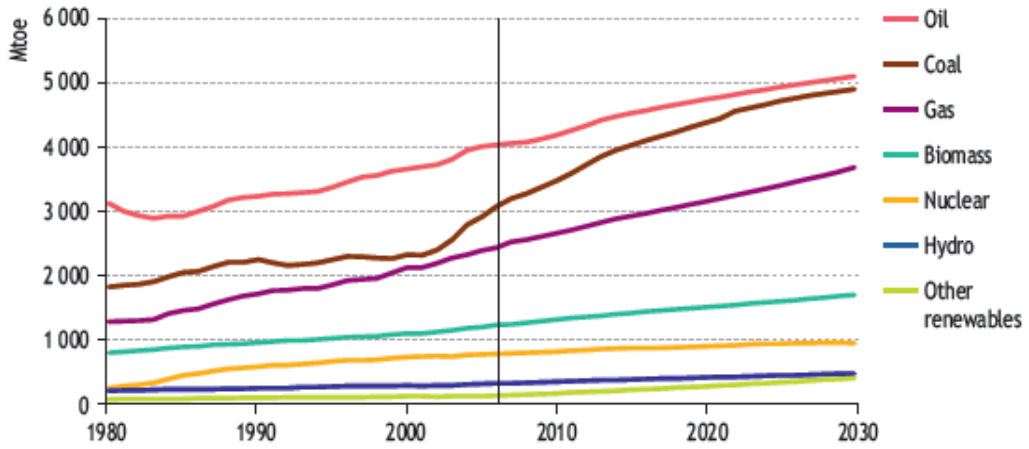
[1] IEA, *World Energy Outlook 2007*, p. 73.
[2] IEA, *World Energy Outlook 2008*, pp. 93 and 103.
[3] IEA, *World Energy Outlook 2007*, pp. 80 and 82.
[4] IEA, *World Energy Outlook 2008*, pp. 93 and 103.

Table 1. World Primary Oil Demand in the Reference Scenario (Million barrels/day)[5]

	1980	2000	2006	2010	2015	2030	2006-2030*
OECD	**41.8**	**46.0**	**47.3**	**49.0**	**50.8**	**52.9**	**0.5%**
North America	20.9	23.4	24.9	26.2	27.7	30.0	0.8%
Europe	14.7	14.2	14.3	14.5	14.7	14.7	0.1%
Pacific	6.3	8.4	8.1	8.3	8.3	8.1	0.0%
Transition economies	**9.4**	**4.2**	**4.5**	**4.7**	**5.1**	**5.6**	**0.9%**
Russia	n.a.	2.6	2.6	2.8	3.0	3.3	0.9%
Developing countries	**11.3**	**23.1**	**28.8**	**33.7**	**38.7**	**53.3**	**2.6%**
China	1.9	4.7	7.1	9.0	11.1	16.5	3.6%
India	0.7	2.3	2.6	3.1	3.7	6.5	3.9%
Other Asia	1.8	4.5	5.5	6.2	6.9	8.9	2.0%
Middle East	2.0	4.6	6.0	7.0	7.9	9.5	1.9%
Africa	1.3	2.3	2.8	3.1	3.4	4.8	2.2%
Latin America	3.5	4.7	4.8	5.2	5.6	7.1	1.6%
Int. marine bunkers and stock changes	2.2	3.6	4.1	3.7	3.9	4.5	n.a.
World	**64.8**	**77.0**	**84.7**	**91.1**	**98.5**	**116.3**	**1.3%**
European Union	*n.a.*	*13.6*	*13.8*	*13.8*	*14.0*	*13.8*	*0.0%*

* Average annual rate of growth.

Figure 1. World Primary Energy Demand by Fuel in the Reference Scenario[6]



[5] Ibid., p. 80.
[6] Ibid., p. 80.

Table 2. World Electricity Demand in the Reference Scenario (TWh)[7]

	1980	2000	2005	2015	2030	2005-2030*
OECD	**4 738**	**8 226**	**8 948**	**10 667**	**12 828**	**1.5%**
North America	2 385	4 140	4 406	5 227	6 390	1.5%
Europe	1 709	2 700	2 957	3 467	4 182	1.4%
Pacific	645	1 386	1 585	1 973	2 257	1.4%
Transition economies	**1 098**	**1 015**	**1 099**	**1 381**	**1 729**	**1.8%**
Russia	n.a.	607	647	792	968	1.6%
Developing countries	**958**	**3 368**	**4 969**	**9 230**	**15 180**	**4.6%**
China	259	1 081	2 033	4 409	7 100	5.1%
India	90	369	478	950	2 104	6.1%
Other Asia	129	575	766	1 306	1 927	3.8%
Middle East	75	371	501	779	1 228	3.6%
Africa	158	346	457	669	1 122	3.7%
Latin America	248	626	734	1 116	1 700	3.4%
World	**6 794**	**12 609**	**15 016**	**21 278**	**29 737**	**2.8%**
European Union	*n.a.*	*2 524*	*2 755*	*3 179*	*3 786*	*1.3%*

* Average annual rate of growth.

transatlantic community, much of the existing electric generating capacity is 40 to 50 years old and will need replacing in the coming decades. This represents both an investment challenge and an opportunity to deploy significantly more efficient and cleaner generating technologies.

Currently, in both North America and Europe, carbon-based fuels are key to meeting total energy demand, with renewables and waste providing only 3.2 percent and 4.5 percent respectively and nuclear energy only 9.0 percent and 14.3 percent respectively (see Figures 2 and 3). How to meet these increasing demand requirements while avoiding highly negative climate impacts is a crucial consideration.

[7] IEA, *World Energy Outlook 2007*, p. 93.

Figure 2. Share of Total Primary Energy Supply in 2005: United States (2,340 Mtoe)[8]

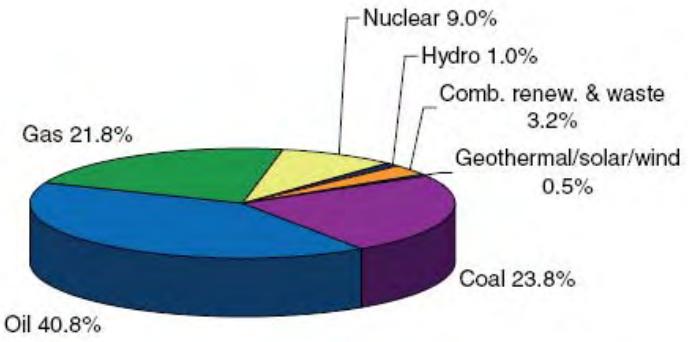
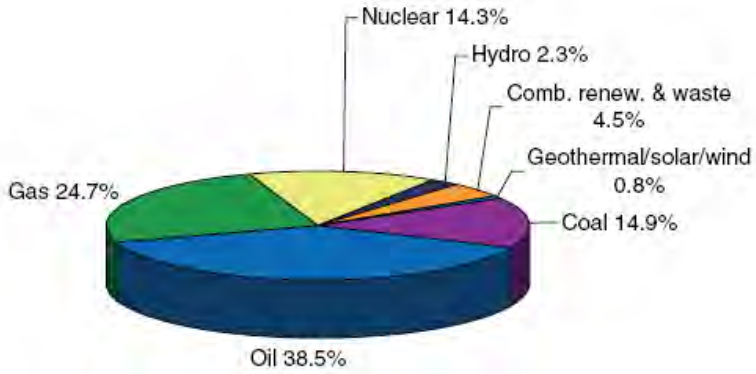


Figure 3. Share of Total Primary Energy Supply in 2005: Europe (1,760 Mtoe)[9]



Third, governmental spending is relatively insubstantial in terms of supporting energy research and development. Any serious effort to stem climate change and increase energy security will require a significant expansion of funding for basic research, development, and demonstration (RD&D) projects to identify potential deployment options. The IEA notes that energy-related RD&D has declined as a percentage of total government RD&D budgets over the last 15 years. In the United States and Europe, government energy RD&D spending remained below 0.06 percent of GDP in 2005. The IEA estimates that total private-sector spending on energy RD&D runs between four and six times government spending and provides industry with much of the technological advances required for deployment. However, very substantial increases in government spending on energy RD&D would greatly increase industry's technology platforms

[8] IEA Statistics, "Share of Total Primary Energy Supply in 2005: United States," http://www.iea.org/Textbase/stats/graphresults.asp?COUNTRY_CODE=US.
[9] IEA Statistics, "Share of Total Primary Energy Supply in 2006: IEA Europe," http://www.iea.org/Textbase/stats/graphresults.asp?COUNTRY_CODE=18.

for investment. This is particularly necessary to advance technologies that could eventually be critically needed, such as energy storage for electricity and transportation, third-generation biofuels, advanced nuclear technology, and clean coal technologies with CCS. For all of these technologies the market alone may not bring forward timely solutions, and all are likely to require decades to develop without government support.

Fourth, as the IEA has stated, there needs to be a "global revolution" in energy production and use. That is a broadly accepted conclusion, and groups and individuals, including leading business and national security figures, the new U.S. president, and the European Commission, have all called for significant changes in energy production to meet the goals of sufficient, reasonably priced, and sustainable energy.

The nature and scope of the required changes are reflected in Figures 4 and 5 from the IEA, that indicate the major technologies that will be needed to meet a global goal of reducing carbon emission to reach an objective of holding the rise in greenhouse gas (GHG) emissions to 450 parts per million, consistent with a projected 2- to 3-degree Celsius rise in temperatures.

As the figures demonstrate, achieving sufficient, reasonably priced, and sustainable energy will require very substantial change from today's energy markets and production mechanisms especially in terms of improving energy efficiency, which must account for 40 percent of emissions reductions in the BLUE Map target scenario. The alternative policy scenario assumes that all policies currently under consideration by governments will be implemented, reducing energy demand growth by half of a percent per year such that total demand would be 11 percent below the business-as-usual reference case in 2030.

Moreover, it should be noted that even if the world is successful at achieving the 450 ppm (parts per million) stabilization case, countries will still be required to take major steps to adapt to resulting changes in climate. Furthermore, the 450 ppm stabilization case is based on emissions peaking before 2015.[10] Unfortunately, the pattern is already set for the next decade, and we are not on a path to reach such an objective. Hence, global warming is likely to exceed the temperature increases associated with the 450 ppm objective for 2050. Little attention has been given to the need to develop adaptation programs along with mitigation programs in the discussion of future global climate agreements. It is recommended that TFEC undertake a serious discussion of the challenges and potential strategies and actions that are likely to be required for adaptation to climate change.

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[10] IEA, *Energy Technology Perspectives 2008*, p. 80.

Figure 4. Comparison of *World Economic Outlook 2007* 450 ppm Case and the BLUE Map Scenario, 2005–2050[11]

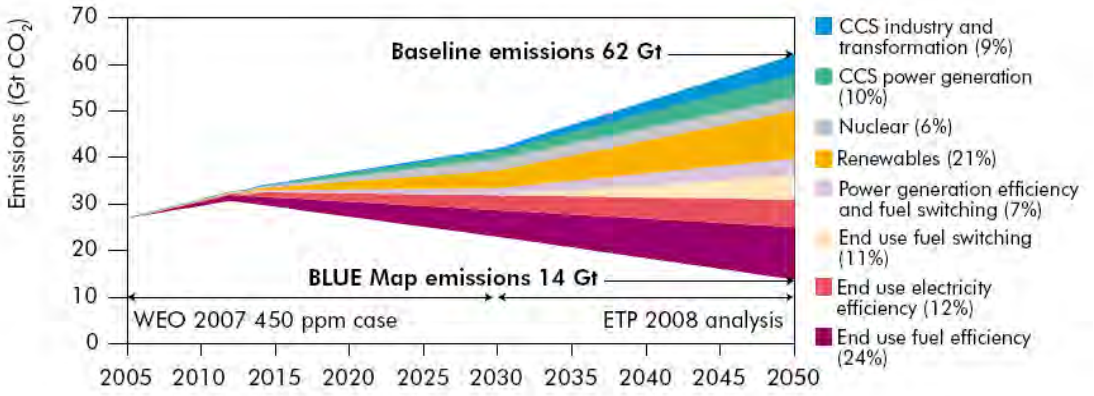
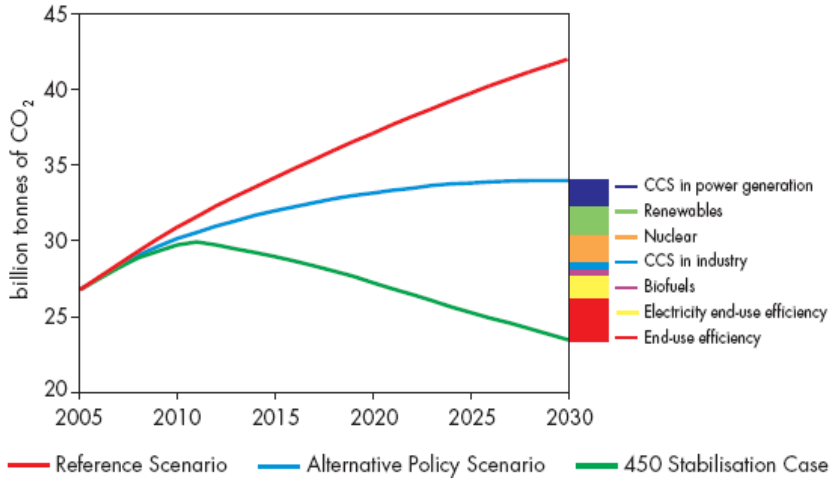


Figure 5. CO_2 Emissions in the 450 Stabilization Case[12]



[11] Ibid., p. 64.
[12] IEA, *World Energy Outlook 2007*, p. 209.

2 RECENT EUROPEAN AND U.S. POLICY DEVELOPMENTS

European and U.S. energy policy has been evolving rapidly over the past four years. Today on both sides of the Atlantic there is common agreement on the need to achieve sustainable energy security. In Europe, as well as in the United States, this is now understood to include the security of energy supplies, the reduction of carbon emissions, and the maintenance of economies that remain globally competitive. Policies are continuing to evolve on both sides of the Atlantic as policymakers wrestle with the complexity of meeting environmental challenges while providing adequate and affordable supplies of energy in a world that has become less secure.

The process for converting policies into legislation involves many voices in both Europe and the United States. In Europe, as in the United States, different levels of government control different parts of the energy agenda. The Council of Ministers, the European Commission, and national governments all set goals, which are implemented through directives from the Commission, legislation from the European Parliament, and national legislation. National parliaments are required to adopt European Parliament acts but can modify them to meet national circumstances and will also pass their own legislation. In the United States, public debate drives the congressional debate that results in national legislation that has to be signed into law by the president. Individual states have to follow the national law but are able to adopt their own, as well as supplemental, legislation unless limited by the national legislation.

Recent European Policies

Following the U.S. government's decision in 1997 not to ratify the Kyoto Protocol, the United States and the European Union largely avoided serious dialogue on energy issues. Through 2005, the European concern over climate change remained the linchpin of EU energy policy. However by January 2007, the European Commission released "An Energy Policy for Europe," which noted "the point of departure for a European energy policy is threefold: combating climate change, limiting the EU's external vulnerability to imported hydrocarbons, and promoting growth and jobs, thereby providing secure and affordable energy to consumers."[1] The new European policy statement reflects the major concerns driving emerging U.S. energy policies. Through 2006, Europe had clearly taken the lead in responding to climate change by "adopting targets and

[1] Commission of the European Communities, "An Energy Policy for Europe," Brussels, January 10, 2007, p. 5.

putting a price on carbon through the Emissions Trading Scheme."[2] Disputes between Russia and Ukraine over gas prices in early 2006, as well as a growing concern over the long-run availability and price of hydrocarbon supplies, were major factors leading to the debates that caused the European Commission to focus on a broader set of issues. Europe's early experiences with their Emissions Trading Scheme also caused them to become focused on the real cost of carbon abatement and the complexity of implementing an effective set of regulations.

In November 2007, the Commission released "A European Strategic Energy Technology Plan (SET-Plan)." This plan identifies technology as being essential to Europe achieving its energy policy objectives and notes that Europe needs "a dedicated policy to accelerate the development and deployment of cost-effective low carbon technologies." According to the Commission, technology was underfunded, with public expenditures for energy technologies amounting to only 2.5 billion euros per year; this level was only one-quarter the rate of public expenditures on energy in 1980. The Commission recognized the difficulty of overcoming the "valley of death" for low-carbon technologies associated with the reluctance of businesses to invest in new technologies that "are generally more expensive than those they replace."[3] To overcome this barrier the Commission identified a twin-track approach: "reinforced research to lower costs and improve performance; and pro-active support measures to create business opportunities, stimulate market development and address the non-technical barriers that discourage innovation and the market deployment of efficient and low carbon technologies."[4]

The SET plan specifically identifies a number of technologies that are key to meeting the 2020 targets:

- Making second generation biofuels competitive with fossil fuels
- Enabling the commercial use of technologies for CO_2 capture, transport, and storage
- Doubling the generating capacity of the largest wind turbines
- Commercializing large-scale photovoltaic and concentrated solar power
- Enabling a single, smart electric grid to accommodate renewables and decentralized energy sources
- Bringing to mass market more efficient energy conversion and end-use devices and systems
- Maintaining competitiveness in fission technologies, together with long-term waste solutions

The plan also identifies technologies that will be critical to reaching the 2050 targets:

- Bringing the next generation of renewable technologies to market competitiveness

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[2] Commission of the European Communities, "A European Strategic Energy Technology Plan (SET-Plan): Towards a Low Carbon Future," Brussels, November 22, 2007, p. 4.
[3] Ibid. p. 3.
[4] Ibid. p. 5.

- Achieving a breakthrough in cost efficiency of energy storage technologies
- Commercialization of hydrogen fuel cell vehicles
- Preparing for the demonstration of Generation IV fission reactors
- Completing construction of the International Thermonuclear Experiment Reactor (ITER) fusion facility and preparing for demonstration
- Elaborating on transition strategies toward the development of trans-European energy networks
- Achieving breakthroughs in research for energy efficiency

By January 2008, President Jose Manuel Barroso of the European Commission formally proposed that the European Union cut greenhouse gas emissions by 20 percent, produce 20 percent of its energy from renewable sources, and increase energy efficiency by 20 percent, all by the year 2020. During the remainder of 2008 Europe moved steadily forward toward developing legislation to support these objectives. Renewable portfolio standards that vary by country were agreed on and were finalized by the end of the year. In addition, a schedule for reducing greenhouse gas emissions from vehicles was established.

On November 13, 2008, the European Commission presented a Second Strategic Energy Review that provides proposals to boost EU energy security. Key proposals include steps to reduce the expected level of energy imports by up to 26 percent compared to developments before the 20/20/20 initiative. The proposals focus on:

- Infrastructure needs and diversification of energy supplies
- Oil and gas stocks and crisis response mechanisms
- Energy efficiency
- Making the best use of the European Union's indigenous energy resources.[5]

Analysis has recently been presented by the Centre for European Security Strategies (CESS) in Munich-Berlin that indicates it would be possible to freeze net energy imports (including of natural gas) at current levels if all the recommendations in the March 2007 summit and in the November 13, 2008, "EU Energy Security and Solidarity Action Plan" were implemented. This suggests that member states should be cautious about signing additional long-term contracts, especially those with "pay and take" provisions that prevent reselling Russian gas to third parties.

[5] Communication from the EU Commission, MEMO/08/703, "EU Energy Security and Solidarity Action Plan: 2nd Strategic Review," November 13, 2008.

This potential outlook also implies that some of the discussed gas pipeline into Europe may not be realistic.[6]

The terms for a global climate agreement including an emissions trading plan are still being hotly debated, as the potential impact on nations and industries has become apparent. Originally, the Commission was pressing for the full auctioning of emission allowances as a source of financial support for renewable industries. However, there has been considerable pressure to allow the granting of some free allowances, especially for industries that could be competitively impacted by "carbon leakage" from non-EU industries. On December 17, 2008, the EU parliament approved final emissions legislation that grants free emissions allowances for a number of industries pre-2013. In 2013, the percent of emissions subject to auctioning will rise. This legislation gives relief to eastern European electricity producers that rely on coal, to those that produce steel and paper, and to other industries throughout Europe.[7] The legislation also allows EU countries to utilize Clean Development Mechanism (CDM) credits from outside the European Union to meet a major portion of their emission reduction requirements.[8] At the same time, tougher emission caps on the energy and manufacturing industries have been set for the post-2013 period.

Europe has also developed a number of action plans to support a step change in the efficiency of energy supply and use. These include energy efficiency plans, the Freight Logistics Action Plan, building efficiency requirements, and directives on eco-design and energy labeling. In addition, European private industry is being encouraged to set up strategic alliances "for industry to share the burdens and benefits of research and development."[9] At the community level a Framework Programme for research and the Competitiveness and Innovation Framework Programme (CIP) have been established to foster community-wide cooperation on technology through co-funding and the creation of European public-private partnerships.

The European Union's struggles over the past year to develop implementation plans reflect the divergence of economic interests at both the national and industry levels. Europe's difficulties have been exacerbated by the fact that the European Union is made up of some nations that have done a great deal to tackle energy and climate issues and some that have been less effective.

These many actions reflect European determination to move forward on achieving 20/20/20 energy objectives by 2020 and to take a leadership position in the December 2009 Copenhagen discussions on global climate change obligations.

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[6] Frank Umbach, "The Energy and Climate Policy of the EU: Implications of the 2nd Strategic Energy Review of November 2008 and of its March Summit 2007," presentation at the Conference on European Energy and Climate Policies and Strategies for Poland, CIR-KAS, Warsaw, December 16, 2008.
[7] Jonathan Stearns, "EU Reaches Climate Accord with Industry Concessions," Bloomberg.com, December 17, 2008.
[8] "EU Parliament Approves Climate Change Package," Agence France-Press, December 17, 2008.
[9] Ibid.

Recent U.S. Policies

In the United States, significant legislation has also been passed that reflects changing energy policies. In August 2005, the *Energy Policy Act of 2005* was signed into law. This represented the first major energy legislation in 13 years and provided significant tax incentives and loan guarantees for a wide range of energy production. Tax reductions totaling $14.5 billion were provided for nuclear power, fossil fuel production, various forms of renewable electricity production, clean coal facilities, alternative motor vehicles and fuels, and Clean Renewable Energy Bonds (CREBs). In addition, the legislation required the U.S. Department of Energy (DOE) to report on a number of subjects to determine the potential for transforming the energy industry through the greater utilization of renewable energy supplies and the potential of demand response and time-based pricing of electricity. Public electric utilities were required to offer net metering at the request of customers in order to expand consumers' use of renewable electric power. The passage of this legislation indicated a major shift in the public's interest in supporting a new energy paradigm.

Within less than two years, it became obvious that additional legislation was necessary. After considerable debate, the *Energy Independence and Security Act of 2007* was passed in December. The legislation covers over 900 separate provisions that detail policies to improve energy security in nine basic areas:

- Improved vehicle fuel economy
- Increased production of biofuels
- Improved standards for appliances and lighting
- Savings in buildings and industry
- Savings in government and public institutions
- Accelerated research and development
- Carbon capture and sequestration
- Improved management of energy policy
- International energy programs

The legislation includes numerous components to increase energy efficiency. Corporate average fuel economy (CAFE) standards for vehicles and light trucks are to increase by 50 percent by 2020, and new electric lighting standards are set, as are new energy requirements for federal buildings. Additionally, financial support is provided for a full range of renewable technologies and for seven major projects to demonstrate the viability of carbon capture and storage technologies. The bill also notes a "sense of Congress" that by January 1, 2025, renewables should provide "not less than 25 percent of the total energy consumed in the United States and continue to produce safe, abundant and affordable food, feed and fiber."

The 2007 bill contains no direct references to climate change, although support for numerous technologies that would reduce carbon emissions is central to the legislation. Moreover, the debate over controlling greenhouse gas emissions was being pursued though a separate set of legislative proposals. While none of the legislation proposed in 2008 to limit carbon emissions was enacted, both presidential candidates ran on platforms supporting strong cap and trade legislation to reduce greenhouse gas emissions to between 50 to 80 percent below 1990 levels by 2050.

Barack Obama released a relatively detailed energy plan in August during his campaign for president. At the time, oil prices were extremely high and there were a number of short-term proposals to relieve the economic impact on consumers. With the subsequent dramatic drop in oil prices, it is probably more appropriate to look at the medium- and longer-term proposals that remain highly likely to be pushed by his administration. These include:

- Implementing a cap and trade program to reduce greenhouse gas emissions to 80 percent below 1990 levels by 2050. All pollution credits are to be auctioned to provide funding for the transition to a new energy, low-carbon economy.
- Making the United States a leader on climate change mitigation, with the understanding that countries like China, India, and Brazil must not be far behind in making their own binding commitments.
- Investing in basic research, technology demonstration, and aggressive commercial deployment to secure the U.S. energy future and to create 5 million new jobs.
- Making cars, trucks, and sport utility vehicles (SUVs) more fuel efficient by

  Increasing fuel economy standards 4 percent per year, while protecting the financial future of domestic automakers

  Investing in advanced vehicles and putting 1 million plug-in electric vehicles on the road by 2015

  Mandating that all new vehicles be flexible fuel vehicles

  Developing the next generation of sustainable biofuels and infrastructure

  Establishing a national low-carbon fuel standard
- Promoting the supply of domestic energy, through

  Implementing a "use it or lose it" approach to existing leases

  Promoting responsible domestic production of oil and natural gas

  Prioritizing the construction of the Alaska Natural Gas Pipeline

  Increasing the application of enhanced oil recovery (EOR) technology
- Diversifying energy sources, through

Establishing a Federal Renewables Portfolio Standard (RPS) that would require 25 percent of U.S. electricity to be from renewable sources by 2025

Developing and deploying clean coal technologies

Promoting safe and secure nuclear energy

- Committing to increased energy efficiency, reduced energy use, and lower costs by

Reducing electricity demand by 15 percent from DOE's projected 2020 levels

Setting national building efficiency goals

Overhauling federal efficiency standards

Reducing federal energy consumption

Flipping incentives to energy utilities by decoupling profits from increased energy usage

Investing in a smart grid and establishing a Grid Modernization Commission

Weatherizing 1 million homes annually

Building more livable and sustainable communities[10]

While the policies proposed during the presidential campaign will be reshaped by congressional debate in 2009, there are expectations that many of the basic elements listed above will make their way into final legislation. As in Europe, regional and industrial situations differ such that the economic impacts of implementation will vary significantly depending on the final legislation. This will be particularly true for cap and trade legislation to reduce greenhouse gas emissions. Given the paradigm shifts that have occurred within the United States, the basic energy policy issues being actively debated have become very similar throughout the transatlantic community. This paradigm shift has been driven to a significant extent by the activities and legislative changes in a number of states. Thus, 2009 has become an opportune time for the transatlantic community to work together to develop common, compatible, and complementary strategies for establishing sustainable energy security for the regions.[11]

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[10] Barack Obama, "Barack Obama and Joe Biden: New Energy for America," campaign speech, March 8, 2008, http://www.barackobama.com/pdf/factsheet_energy_speech_080308.pdf.

[11] During the last several years, there have been a number of U.S.-EU multinational meetings that have been instrumental in bringing the transatlantic community closer together on energy issues. These include, but are not limited to, the June 2007 33rd G-8 Summit in Heiligendamm; the September 2007 Major Economies Meeting in Washington, D.C.; the December 2007 UN Climate Change Conference in Bali; the March 2008 U.S.-EU Climate Change, Clean Energy and Sustainable Development meeting in Washington, D.C.; the June 2008 EU-U.S. Summit in Ljubljana; and the December 2008 COP14 United Nations Climate Change Conference in Poznan.

3 TRANSATLANTIC ACTIONS TO ACHIEVE ENERGY SECURITY

There are seven key actions that the transatlantic nations can take to achieve energy security. Overall, they need to maximize "common, compatible and complementary" efforts, so as to help each other achieve economies of scale, inbed best practices, provide a predictable policy and regulatory environment for the many companies that are invested and operate on both sides of the Atlantic, and set benchmarks for other developed economies and for emerging economies. Specifically, that would include developing common, compatible, and complementary energy strategies, standards and regulations, incentives, research and development, markets, institutions, and protection of infrastructure and response to disruptions. A key component should be the establishment of a Transatlantic Forum on Energy Cooperation.

Common, Compatible, and Complementary Strategies

Historically, many major transformations have evolved over time through changes brought about primarily by the pressures of market forces. Unfortunately, the daunting nature of the transformations required to adjust the world's energy markets to provide adequate, accessible, and affordable sustainable energy in a world facing tightening resources and rapidly changing climatic conditions does not allow the luxury of relying solely on historical processes. Market mechanisms will remain a powerful means of creating change, but other forcing mechanisms will also need to be employed to overcome many existing institutional and cultural forces that have arisen over time.

The complexity associated with national attempts to achieve secure, reasonably priced, and environmentally sustainable energy is exacerbated by the growing recognition and acceptance of the world's interconnectedness. Neither Europe nor the United States will be capable of achieving the above objectives in isolation. Without a high degree of global cooperation among all countries, the joint objectives of achieving secure, sustainable, reasonably priced energy to foster economic prosperity will not be attainable.

These issues also require countries to focus on questions, such as:

- What energy resources and technologies will be economically available?
- What increase in funding is required for RD&D?
- What incentives and financing support is required to accelerate the commercialization of new technologies?

- What should be the role of government versus private industry?

Given the combined pressures of tight energy supply and the need to dramatically cut GHG emissions, the world's challenge is to determine the resources and technologies required and to make investments that will dramatically alter the world's existing supplies and usage of energy on a scale and within a timeframe to make a difference. It cannot be overemphasized that scale, timing, and market acceptance are critical parameters. As noted by the IEA this will require "unprecedented levels of co-operation among all major economies."

The successful implementation of energy security and climate change remediation strategies in both Europe and the United States will also depend on recognition of the interdependency of financial markets, which has a major impact on the cost and financing of new investments and ongoing businesses worldwide. Similarly, investment capital costs are being significantly impacted by the global demand for resources. Despite the current economic downturn, long-term supply and demand pressures on basic resources should be expected to maintain upward pressures on prices for internationally traded fuels and other energy-related commodities. The development of energy remediation strategies in Europe and the United States should, therefore, have beneficial economic effects. Research, development, and deployment should also create new and expanded industries and create new jobs.

The nations on either side of the Atlantic are uniquely positioned globally to provide the technological support, financing, and legislative and regulatory developments necessary to advance energy security. There is, however, no single forum for these nations to meet, discuss, and then generate implementation of common, compatible, and complementary energy strategies. Given the commonality of the energy challenges they face and the important contributions both sides must make to cutting global GHG emissions, a critical first step for international cooperation is to create a Transatlantic Forum on Energy Cooperation. Such a forum would consist of the United States, the European Union, NATO, and the member states of both the European Union and NATO. The European Union cannot be the sole partner for the United States because it does not control much of Europe's energy policy, which is done at the national level—though, of course, it has important direction and influence on certain aspects. While it is also true that many states in the United States have been developing their own climate policies, in the energy arena the federal government is most dominant—and is likely to become increasingly so.[1] Establishing a transatlantic forum is a crucial first step to developing common strategies and policies.

A transatlantic forum would be a place where strategies and implementation plans from both sides of the Atlantic could be developed and made compatible. It could be a place where the transatlantic nations develop their energy security requirements within the context of worldwide markets and demands. By way of example, the new administration in the United States could

[1] Interaction with state governments would also be invaluable, particularly with respect to discussions on electric power and the expansion of renewables, where states have developed renewable portfolio standards.

refine the strategic objectives and action plans that have been incorporated in the U.S. Department of Energy's FY 2009 budget to create a more comprehensive approach to transforming the nation's energy sector. Similarly, within the past year Europe has developed a European Strategic Energy Technology Plan (SET Plan) that is continuing to be refined through parliamentary debate. As described earlier, the plan sets broad objectives and some priorities but does not entail a detailed action plan and investment program to reach objectives; however, those could be considered and enhanced within a transatlantic forum.

The Transatlantic Forum on Energy Security would not replace existing institutions like the IEA, the European Energy Charter, or industry organizations such as the American Council on Renewable Energy (ACORE). Rather it would draw on the strengths of such organizations to develop a greater mutual understanding of issues and the identification of opportunities that could lead to a robust and comprehensive set of strategies, policies, and regulations that could be broadly supported by governments and legislative bodies throughout the transatlantic community.

Establishing and agreeing on an interrelated set of strategic objectives will ultimately require similar structural changes in the way energy is supplied and used throughout the transatlantic community.[2] Moreover, the transformation of the energy sector will entail considerable testing of new policies, regulations, and enforcement mechanisms, as well as the deployment of many new technologies that are promising but not yet proven. The bedrock critical requirement for transatlantic energy security will be to establish common, compatible, and complementary energy security strategies. The specifics of those strategies are discussed in the sections below.

[2] On both sides of the Atlantic, there are wide variations among cities, states, and regions in resource and economic conditions that will dictate differing approaches to implementation. Both the United States and Europe have undertaken a number of activities to reduce the levels of greenhouse gas (GHG) emissions and are currently engaged in numerous discussions on increasing their energy security. In the United States, GHG emissions levels in the United States grew by 14 percent between 1990 and 2000 but remained virtually unchanged between 2000 and 2006. Today, there is a vigorous debate over the need to reduce greenhouse gases substantially and to lower the country's dependence on foreign oil supplies for transportation. Numerous initiatives have been undertaken at federal, state, and city levels. Similarly, in Europe there are numerous initiatives at the EU Commission, country, and city levels to lower GHG emissions. Throughout the transatlantic community there is growing recognition that the energy sector will need to be radically transformed in order to achieve energy security and to reduce the impact of climate change. While substantial progress has been made on developing energy policies, neither region has yet developed a clear, coherent set of strategies, policies, and action plans for the long term.

Common, Compatible, and Complementary Standards and Regulations

Legislation and Regulations

The IEA has stated that an acceleration of commercial deployment of new forms of energy generation and supply depends on a major shift in government policies and regulations to provide industry with a higher level of certainty over long-term policy support for the future demand for low-carbon technologies. Government failure to establish predictable policies and regulations slows down the pace and magnitude of new investments. Governments will need to utilize the efficiency of market forces to accelerate the transformation of energy markets and meet the dual objective of increasing energy security and mitigating the potential impacts of climate change. The level and pace of investments that are primarily made by private investors responding to market opportunities and government policy and regulations determine the behavior of energy markets. However, it will be government policies, regulations, and incentives, coupled with monitoring and enforcement that will substantially affect the magnitude and pace at which energy structures are transformed by new technologies and society's willingness to alter lifestyles and consumption patterns.

Both the United States and Europe have historically depended on a mixture of free-market principles and regulation to create the economic forces to shape their economies. The development of common strategies and compatible legislation would encourage investments in similar technologies enhancing the potential for technological breakthroughs and encouraging economies of scale, both of which will be needed to accelerate the pace of cost reductions. Compatible and complementary policies can also serve to reduce the potential for "beggar thy neighbor" policies that can divert resources away from countries with the greatest need and from technologies with the greatest potential. Investment needs are tremendous, and it is highly desirable for investments to flow to industries and technologies that have the greatest potential to enhance energy security and reduce carbon emissions. There is often a failure to recognize when policies and regulations need to be reevaluated. Regular reevaluations will be particularly critical in the coming years owing to the anticipated pace of new technology developments and shifting assessment of resource availability.

Compatible legislation will also be particularly important for carbon trading to be effective at establishing pricing for carbon allowances that will result in an actual reduction in GHGs. It is critical that the cost of externalities associated with carbon-based fuels be recognized in energy pricing so as to place all energy supply choices on a level playing field. While arguments can be made for using either a carbon tax or an emission- trading scheme, politicians in both Europe and the United States appear to have settled on utilizing the latter. It will be vital for the U.S. and European systems to be compatible.

It is clear that cap-and-trade systems become complex to implement. There has been much analysis of the adverse impacts associated with providing too loose an allocation of allowances, the

acceptance of credits under the Clean Development Mechanism for projects that would have occurred regardless, and the limited positive impact on GHG levels when only a few industries are covered by regulations. Likewise, it is equally clear that imposing very tight emission caps and full auctioning of emission allowances can lead to cost increases that could result in severe economic penalties to many industries and to particular producers.

The objective should be to achieve affordable energy prices that will allow for the introduction of new technologies and a reduction in greenhouse gases. Accordingly, the introduction of carbon constraints will need to be managed so that existing energy suppliers can meet new costs and investment requirements without causing sudden, sharp economic disruptions to existing customers. In Europe, this is particularly relevant for the eastern European countries that are heavily dependent on inefficient coal plants for electric power. Industry in the United States is also struggling with the potential of various cap-and-trade systems to have widely differing economic impacts across the country.

Europe has been working to design an emissions pricing scheme that would work throughout Europe. In the United States, a proliferation of state and regional emission proposals has led most industry to support federal regulations that would remove the confusion and economic disadvantages that would be associated with geographic variations in carbon costs. In both the United States and Europe, developing the implementation details for such a scheme will involve many complex tradeoffs that will require a serious dialogue between the industries and the legislatures designing the rules. Such a scheme potentially could be more effectively regulated the closer it is applied to the primary energy sources where there are fewer parties. In order for both the introduction of necessary technology and investment and for international carbon trading to be most effective, the transatlantic community should seek to establish a unified carbon price, even if some of the procedures and industry allocations differ between the United States and Europe.

The world has just witnessed the suddenness with which the global economy can be impacted by financial instruments and policies that inevitably reach across national borders. The trading of emissions credits takes place in global financial markets. The economic impact on industries and national economies, as well as the ultimate success of efforts to reduce GHG, will depend on establishing a complementary set of emissions trading regulations.

Efficiency Standards

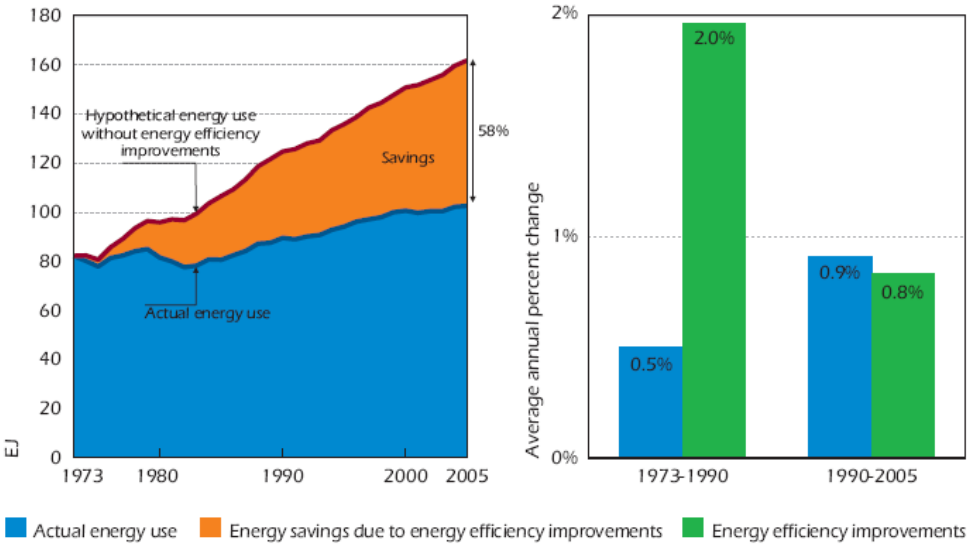
There is clear consensus that early focus should be given to reducing energy demand growth through energy efficiency and conservation. Numerous analyses[3] have indicated negative to

[3] See, for example, McKinsey & Company, "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" U.S. Greenhouse Gas Abatement Mapping Initiative, Executive Report, New York, December 2007, p. 20.

extremely low near-term marginal costs associated with many such investments and significant potential cost savings in the longer term.

On a global basis, the IEA estimates that one-third of the total emissions reductions required could be obtained largely using existing efficiency technologies. Moreover, achieving such efficiencies could offset 45 percent of projected energy demand growth through 2050.[4] History tells us that this is not unreasonable given the past impact of energy savings on total energy requirements over the 1973 to 2005 period (see Figure 6).

Figure 6. Long-term Energy Savings from Improvements in Energy Efficiency, All Sectors (IEA-11)[5]



Buildings and Appliances

Significant efficiencies could be obtained today if regulations were established to enforce standards for buildings and appliances based on existing technology. This could be quickly implemented for all new construction by altering building codes. This has already been done for some government buildings in the United States and Europe and could be expanded to all new

[4] IEA, *Energy Technology Perspectives 2008*, pp. 73, 75.

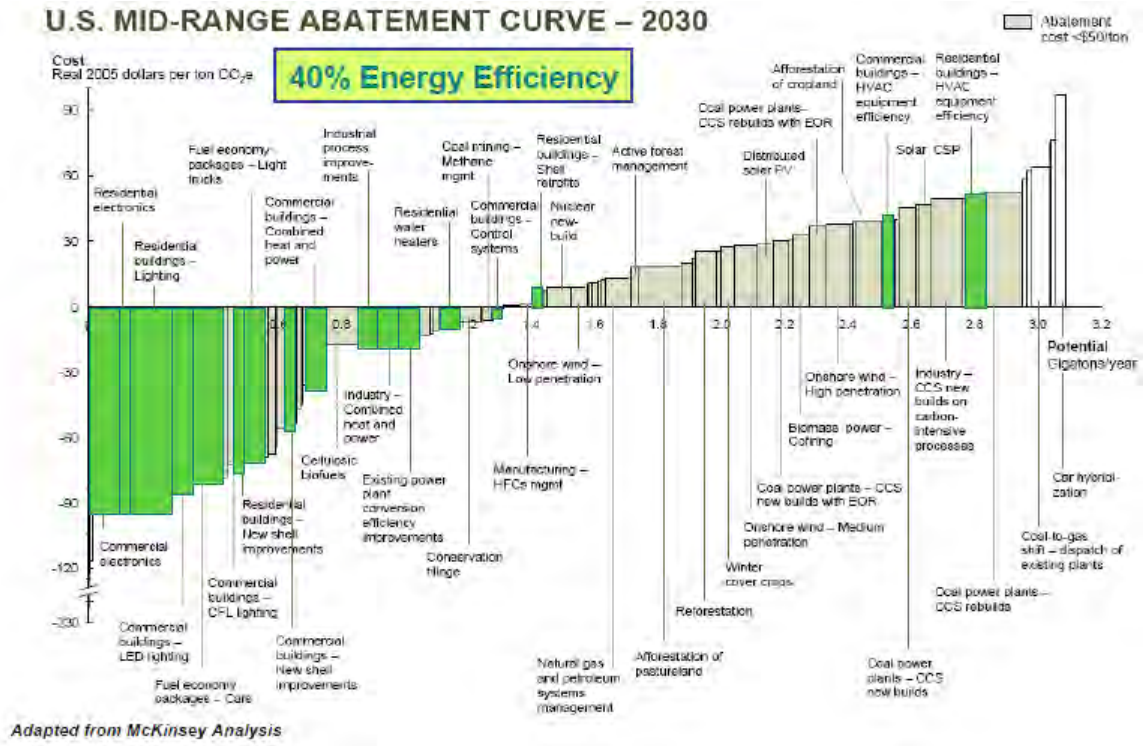
[5] IEA, *Worldwide Trends in Energy Use and Efficiency: Key Insights from IEA Indicator Analysis* (Paris: IEA, 2008), p. 26. This group represents the countries for which the IEA has complete times series with detailed data for energy and energy-consuming activities covering the period 1973 to 1998, and in some cases to 2000 and 2001. The countries include Australia, Denmark, Finland, France, Germany, Japan, Italy, Norway, Sweden, the United Kingdom, and the United States. When their aggregate results are presented, the group is referred to as IEA-11. Together these countries accounted for 83 percent of IEA total final energy consumption in 2000.

buildings, including residential. Changing residential codes would have the added advantage of eliminating developers' reluctance to incorporate energy efficacy in new construction. RD&D efforts are underway to enhance the potential for significant further improvements in the efficiency of lighting and appliances and building designs that could be built into codes as they become available for broad deployment.

An October 22, 2008, report by the Alliance to Save Energy (www.ase.org) identified the need to address the issues raised by split incentives that make it difficult to obtain the energy efficiency savings theoretically possible in the commercial and residential sectors that account for roughly 35 to 40 percent of total energy demand in the United States and Europe. This split arises from the conflicting economic interest currently existing between tenants and landlords and between builders and buyers reflecting the disconnection between those making the investments in efficiency improvements and those receiving the benefits. Another major impediment is related to the financing costs associated with making energy efficiency improvements and the turnover of capital required to replace inefficient equipment and construction designs.

The tremendous potential for implementing energy efficiency at reasonable cost is illustrated in the following chart that the Alliance to Save Energy adapted from an analysis prepared by McKinsey Consulting for the United States. Similar savings are also probably available for Europe.

Figure 7. U.S. Mid-Range Abatement Curve, 2030



Smart Grids

Conservation entails relatively minor cost if any for the end user, although it will require behavioral and life-style changes. While price increases for energy are a major motivator, the installation of advanced controls and information technology can make it much more convenient for individuals and households to conserve.

Both the United States and Europe need to develop "smart grids" to enable power companies to manage demand through time-of-day pricing that will reduce peak loads and allow the more efficient movement of power.[6] A major upgrading of the electrical transmission and distribution systems in both the United States and across Europe will be required. The U.S. system has not seen significant investment in 20 years, and numerous new grid connections and storage facilities will need to be established to enable the expansion of renewable power and to meet expected growth in demand for electricity. The system across Europe also needs many more inter-country connections and storage facilities. The European Commission is currently considering unbundling regulations, partly to address the Commission's perception of underinvestment in distribution as a result of weak competitive incentives. However, it is unclear what impact unbundling, by itself, would have on investments to upgrade the transmission system.

Utility rate regulators should establish rate schedules to incentivize power providers to make the investments required to connect renewables and to enable consumers to manage their electricity usage so as to even out demand loads, thereby reducing total investment requirements for expanding power capacity. A single-minded determination of rate regulators to avoid rate increases will lead to deterioration in service through an underinvestment in transmission capacity and greater long-term cost to consumers. It is recommended that regulations allow rate increases that can provide a return on the capital costs associated with new technology that can eventually translate into consumers' efficiency gains. In addition, rate increases should be gradually introduced to enable improvements to transmission grids. With the introduction of smart grids the eventual reduction in required capacity additions could offset much of the increased cost of transmission services. Regulators would need to balance generating and transmission rate schedules to reflect the improvements in generating efficiencies.

Rate structures for electric utilities should be modified to allow profits to be generated when consumers reduce their peak load demands for generating capacity as a result of programs undertaken by the utilities. Creating incentives for utilities to increase the efficiency of electricity consumption will not only reduce energy demand and emissions, but will also allow for a more efficient utilization of capital, which has become even more important with the current financial crisis.

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[6] An eventual transition to plug-in hybrid vehicles could also serve to smooth out peak loading requirements and lower the average costs of electricity.

In both the United States and Europe the required upgrading and expansion of transmission systems to enable a greater utilization of renewables and the implementation of smart grid technologies would be assisted by the establishment of federal and EU-wide transmission standards. In both regions, this would require a realignment of central versus state and national authorities. Undertaking such a realignment of authorities would result in a considerably more robust electric power sector throughout the transatlantic community.

Both the United States and Europe would benefit from engaging in a regular examination of policies and programs to improve energy efficiency and conservation in both the public and private sectors focused on the electric power sector. Establishing a joint forum for such a regular review would greatly expand the opportunities to develop more effective policies, programs, and regulations. The development of common standards for energy efficiency would provide a significantly larger market for products that would encourage the faster development of efficiency technologies throughout the transatlantic community. With the faster adoption of more efficient products and industrial processes, costs will be reduced, increasing the overall competiveness of the transatlantic community, which is expected to bear a disproportionate share of the global cost of reducing GHGs.

Renewable Portfolio Standards

The European Commission has made a Renewable Portfolio Standard a central part of their 20/20/20 energy policy to have a 20 percent reduction in GHG emissions, a 20 percent improvement in efficiency, and a 20 percent use of renewables by the year 2020. In order to implement this policy on renewables the European Union has had to negotiate a different target for each of the 27 member states. This was required as every nation has differing potential to expand and utilize renewable energy resources. Renewable fuels, which currently make up 8.5 percent of EU energy, include sources like wind, wave, tidal, solar, geothermal, hydroelectric, biomass, and biofuels. Targets range from 10 percent for Malta to 47 percent for Sweden.

The United States has not adopted a federal renewable portfolio standard, although such a standard has been adopted by a number of individual states. The *Energy Independence and Security Act of 2007* (EISA) makes an explicit reference to a goal of achieving 25 percent of total primary energy demand from renewables by January 1, 2025.[7] It is recommended that the United States develop a specific set of standards for each state that would result in obtaining the overall 25 percent goal by 2025. The U.S. Congress would have to consider whether or not the attainment of these targets should be legally binding, as in Europe. In either case, the establishment of specific targets should be used in the development of action plans for each state.

The development of realistic portfolio standards requires a deep understanding of the potential of various renewable technologies as well as an appreciation for the investment and timing challenges associated with restructuring energy structures and consumption habits. It is

[7] *Energy Independence and Security Act of 2007*, Section 806.

recommended that the United States join the Europeans and others in establishing and actively participating in the International Renewables Energy Agency that is in the process of being established.

Transportation Standards

The use of a Renewables Fuels Standard has been proposed for Europe. Initially this standard was based on using 10 percent biofuels by 2020 provided there were no adverse impacts on food production. However, there are growing concerns related to the appropriateness of this target. Moreover, the advances in the development of second- and third-generation biofuels, as well as oil from algae, are creating more options. Again, in the United States, the EISA of 2007 did provide targets for increasing the use of renewable biofuels to 36 billion gallons per year by 2022 provided that 21 billion gallons per year are "advanced biofuels" not based on corn. The year 2022 target of 36 billion gallons would represent about 20 percent of current vehicle fuel consumption. As in Europe, the appropriateness of consuming up to 16 billion gallons of corn-based ethanol is being reconsidered.

The United States and Europe share a common interest in transforming vehicle and fuel technologies, as well as in developing more efficient inter-modal transportation networks. The key in the near term will be to focus on low-carbon fuel standards. Both the United States and European Union would benefit from the development of common standards that would broaden the market for new technologies and enhance manufacturers' ability to reach economies of scale to reduce the cost of new vehicle and fuel technologies. It is recommended that the transatlantic community cooperate in assessing the potential for the development of advanced renewable biofuels for utilization in ground, aviation, and marine transportation. In addition, both the United States and Europe could benefit from the sharing of experiences and assessments of different policy approaches to shift traffic toward mass transit and rail. It is recommended that the TFEC would be the appropriate forum in which to discuss how to accelerate the transformation of transportation throughout the transatlantic community. A good case could be made for eventually expanding meetings of the Forum's Transportation Working Group to include other nations interested in developing more efficient and economical transportation systems.

Common, Compatible, and Complementary Incentives

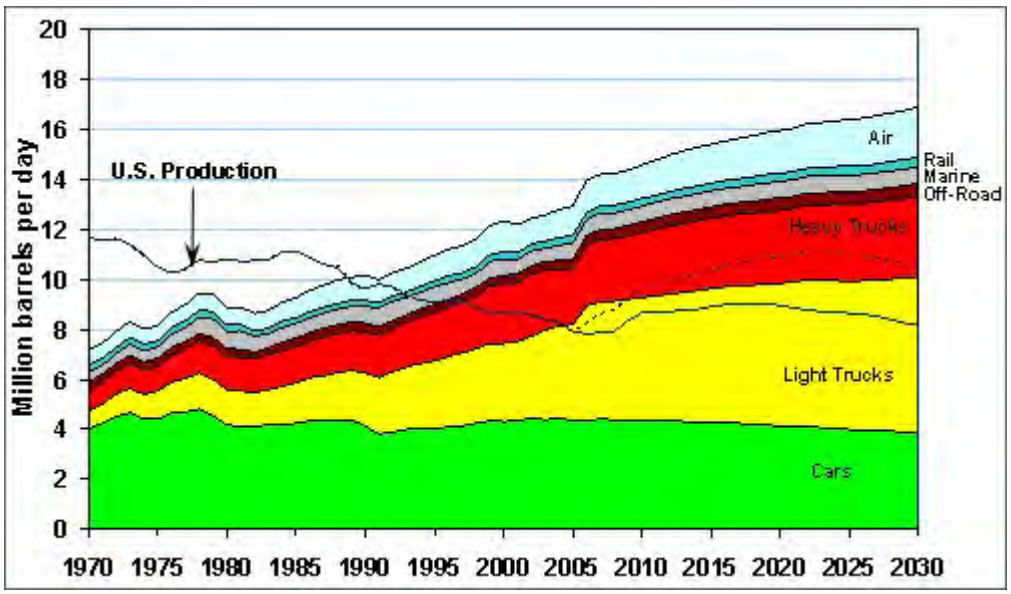
Reluctance to establish programs with incentives that remain in place for long enough to provide investors with a reasonable expectation of financial returns is a major barrier to achieving energy security for both the United States and Europe. This impacts not only investments in individual projects, like renewable power, but also the highly capital-intensive investments required to build plants for capital goods and the infrastructure to support emerging technologies in the power sector. As noted earlier, ultimately it is industry that has to make the investments, and unclear and unfunded policy decisions will serve to slow the pace of new investments.

Automobile and Trucking Industry

The need for the automobile and trucking industries to substantially retool plants is now becoming ever more apparent. However, the pace at which these investment should be made and the eventual financing requirements are not yet agreed on and are probably much larger than generally thought. If a quick turnover of the types of automobiles is desired, then retooling must proceed very quickly and the current support of $25 billion in loan guarantees, set for in the *Energy Independence and Security Act of 2007*, for plants older than 20 years is now known to be insufficient. Similarly, European manufacturers will require support if they are to retool in the current financial market conditions. It is recommended that the European Union and the United States substantially increase financial support of their automotive and trucking industries to enable the retooling of manufacturing capacity to produce significantly more efficient vehicles.

Given an energy security goal of dramatically reducing oil import levels, the magnitude of the challenge for the United States is illustrated by the figure below that compares projected oil demand for transportation with U.S. petroleum production. While Europe remains a net importer of petroleum, demand has not been growing. Nevertheless Europe's energy security would also be enhanced by a reduction in oil imports for transportation.

Figure 8. U.S. Petroleum Production and Consumption, 1970–2030[8]



[8] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Fact #516, April 28, 2008, The Petroleum Gap," *Fact of the Week*, www1.eere.energy.gov/vehiclesandfuels/facts/2008_fotw516.html.

Electric Power

Governments also need to address a number of issues related to the electric power sector. There are substantial reasons to believe that neither energy security nor climate change goals can be achieved without relying on a combination of greatly enhanced use of renewables, an expansion of nuclear power, and the deployment of clean coal power with carbon capture and storage (CCS) on a massive scale, all on top of efficiency gains.[9] Without all three sources, electric utilities are likely to be unable to replace facilities that need to be retired and meet the projected demand increases through 2050, even with the realization of major improvements in plant and consumer efficiencies.

The continued rapid expansion of the renewable segment of the energy market will depend on the enactment of predictable, clear, and well-funded programs to continue providing incentives for the generation of renewable power that will allow a payout on investments. Despite considerable debate, it is now clear that the commercial development of renewable technologies will be critical to meeting energy security and carbon reduction objectives. In addition, "green jobs" associated with the rapid expansion of renewable industries can provide a major stimulus to economies on both sides of the Atlantic at a time of slowing economic growth and increasing global competition in areas of traditional manufacturing.

In May 2008, the U.S. Department of Energy released a report indicating wind power alone had the potential to provide 20 percent of U.S. electricity production by 2030. Today, wind power provides only 1 percent of the country's power, and capacity would have to expand from about 20 gigawatts to over 300 gigawatts by 2030. This will require improved turbine technology, major changes to transmission systems, and an expansion of markets. Concentrating solar power is another technology that the DOE believes has the potential to become cost competitive with base load power by 2020. Photovoltaic technologies also have the potential to become important in the residential and commercial sector. Numerous other renewable power technologies are being developed but are unlikely to have a major impact over the next few decades.

The financial case for renewable power will also clearly be improved by the enactment of limitations on carbon emissions that establishes a predictable cost for carbon. However, even with this incentive, transmission grid limitations and insufficient interconnections will slow the ability of the power utilities to expand renewables. A total transformation of the electric transmission systems to create smart grids and the necessary interconnections will take decades. However, with bottlenecks already starting to appear in some areas, there needs to be an immediate increase in investments in the national grids throughout the transatlantic community. This is necessary to enable the current low penetration of renewable power to continue growing rapidly and is also critical to enable consumers to increase their energy efficiency.

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[9] IEA, *Energy Technology Perspectives 2008*, p. 40.

Despite uncertainty over regulatory direction and the price for carbon, investors worldwide made investments for renewables (power and fuels) of about $150 billion in 2007. This is only a fraction of the investment levels needed, and in 2008 it is being depressed by the current worldwide financial crisis. The establishment of the International Renewable Energy Agency has the potential to facilitate access to reliable information on the potential for renewable energy that should support the industry's access to financing.

Nuclear power, however, is deployable today. A significant question is the future costs of nuclear power. Despite a number of projects pending in both the United States and Europe, a major problem is the huge investment cost ($5 billion to $6 billion) per plant. In the United States the *Energy Policy Act of 2005* provided subsidies for the deployment of the first eight plants but does not deal with the ongoing need to support additional plants in an industry where each nuclear investment represents a substantial portion of the utility's capital. If the first plants were to be built with minimal regulatory or technological problems, it would be possible in the United States to add 40 or more plants over the next 20 years, although some analyses suggest 20 to 30 is a more realistic number.

While regulations have been simplified, licensing and permitting still remains a long process. In addition, the storage and handling of nuclear waste and concerns over nuclear proliferation remain an issue in many communities in both the United States and Europe. The challenge is that an expansion of nuclear capacity may be required for the growth in base load demand within the transatlantic community—and is seen as part of the solution in a number of major countries like China and India.

In Europe, the formerly strong antinuclear movements in a number of countries, such as Germany, Spain, and Italy, are showing signs of weakening with the growing political realization that the joint objectives of achieving energy security, reducing GHGs, and maintaining economic growth will require the utilization of all forms of low-carbon energy. The industry has shown that it can operate safely, and new plant designs have further eliminated the safety and operational concerns associated with the plants of 20 to 40 years ago. In Europe, France has always been the leader in utilizing nuclear power, which provides over 80 percent of France's electric power. The United Kingdom has recently announced a program to significantly expand nuclear power. Numerous other countries, such as Finland, Ukraine and Bulgaria, are building plants, and Slovakia is planning two new nuclear plants. Currently, 17 countries in Europe are operating nuclear power plants.

While Europe has been heavily divided over the need to expand nuclear power, now is the time for the transatlantic community to come together and accept the need to maintain a safe nuclear industry as an element of base-load electric power compatible with intermittent renewables. Attention now needs to be focused on financing the expansion of nuclear power and on the rebuilding of manufacturing capacity and the workforce to construct, operate, and maintain nuclear facilities. In addition, financial support for the research and development of advanced nuclear technologies required to reduce the output, toxicity, and life of nuclear waste, as well as to

reduce the potential for weapons-grade materials, needs to be maintained and probably increased. Clearly, any new global agreement on climate change mitigation should also consider incorporating nuclear power as qualifying for emission credits under the Clean Development Mechanism. This was omitted from the 1995 Kyoto Protocol.

It should be noted, however, that even a doubling of nuclear capacity would, by itself, not be adequate to meet demand and reduce carbon requirements. Accordingly, much is riding on renewable energy (as discussed above) and, very importantly, on the demonstration and deployment of clean coal technologies. This is a very challenging technological, business, and political problem. Leading studies indicate climate stabilization will not be possible without CCS. This technology will need to be paired with newer coal power plant designs based on pre-combustion capture of carbon emissions and on Integrated Gasification Combined Cycle (IGCC) designs. In the United States, the Department of Energy is focusing in the near term on pre-combustion capture while working to reduce the costs and improve the reliability of the IGCC designs that are typically 10 to 20 percent more expensive than pulverized coal plants. Today there are only six coal-capable IGCC plants in operation (three in Europe, two in the United States, and one in Japan). When carbon capture and storage is added to an IGCC plant, costs could be 35 to 85 percent higher, depending on the plant site and location of the geological formation for storage.

In several countries, technology associated with CCS has been used by the oil and gas industry for Enhanced Oil Recovery (EOR) projects, and in Norway CCS is practiced commercially with a deep saline formation. It appears that the storage aspect of employing CCS will be technically manageable, although a very substantial pipeline network would ultimately be required in the United States to remove carbon emissions from cement kilns, steel mills, and other industrial facilities, as well as from coal-fueled power plants. However, a recent study indicates that CCS might only require additional pipelines equaling 10 percent of the existing natural gas pipeline network by 2050,[10] although others have suggested that the pipelines could equal the natural gas pipelines.

As for nuclear, the financing of the huge investment costs for individual IGCC plants with CCS will be nearly impossible without government support until the technology is proven to be reliable and costs are predictable. Electric utilities are inherently very conservative and risk averse, owing to their obligation to run a highly reliable service. It is likely that at least 20 more IGCC plants will need to be successfully deployed before utilities will feel comfortable relying on the technology. These plants will take at least five to eight years to design and build. While industry usually manages deployment investments, government support for financing and technology risks will be required. Without such support, there will be very long delays in determining if clean coal technology with CCS will be economically viable.

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[10] J.J. Dooley et al., "Comparing Existing Pipeline Networks with the Potential Scale of Future U.S. CO_2 Pipeline Networks," *Science Direct* (2008).

Europe and the United States should consider establishing a joint program that would coordinate the identification and support of major projects to test the viability and economics of deploying clean coal technologies with CCS under varying geological conditions. The regular exchange of technical data and operational experience would accelerate the ability to assess the potential to rely on this technology as an economically viable means of reducing carbon emissions. The European Union has recently announced that 10 billion euros (US$13.6 billion) would be made available for undertaking major CCS projects. In the United States, the *Energy Independence and Security Act of 2007* included $1.2 billion in funding for seven projects to test the costs and feasibility of commercial deployment. The funding for such activities in the United States needs to be increased to allow for a more robust program. It has been suggested that at least $20 billion will be required to prove the commercial deployability of clean coal technology with CCS. With the recent commitments from the European Union, it would be appropriate to consider the establishment of a joint program that would allow for a systematic testing of a wider range of approaches than would be available to either region working independently.

At a minimum, the programs in Europe and the United States should incorporate compatible testing, measurement, and monitoring procedures so that results can be relied on by utilities undertaking deployment. Closer cooperation under a joint program could also lead to the development of compatible incentive and tax policies, like accelerated depreciation, which could encourage a faster pace of deployment.

Common, Compatible, and Complementary Research and Development

The IEA's *Energy Technology Perspectives 2008* makes clear the need for vast increases in energy-related research and development. The report states that the goal of halving today's global greenhouse gas emissions of 27 gigatons (2005) to hit the 450 ppm target in 2050 would require a cut in CO_2 equivalents of 48 gigatons from the business as usual case by 2050. The United States and Europe would have to achieve almost an 80 percent reduction in greenhouse gases by 2050, while developing countries would have to reduce emissions by over 50 percent. This is a departure from the "business as usual" case and would allow global emissions to be reduced by 50 percent below current levels, which would get us to the 450 ppm target. The world is not yet on this path.

The IEA report identified 17 basic technologies (see Table 3) that could contribute to achieving nearly all of the reductions in GHG emissions that are required to achieve a 450 ppm target. There has not yet been an international agreement on such a goal. Implementing these technologies would very substantially improve energy security by reducing the dependency on foreign oil for transportation, by employing clean coal technologies and carbon capture and sequestration technology to remove CO_2 from carbon-based fuels, and by increasing the supply of renewable energy.

Table 3. Key Technology Roadmaps[11]

Supply side	Demand side
■ CCS fossil-fuel power generation	■ Energy efficiency in buildings and appliances
■ Nuclear power plants	■ Heat pumps
■ Onshore and offshore wind	■ Solar space and water heating
■ Biomass integrated-gasification combined-cycle and co-combustion	■ Energy efficiency in transport
	■ Electric and plug-in vehicles
■ Photovoltaic systems	■ H_2 fuel cell vehicles
■ Concentrating solar power	■ CCS in industry, H_2 and fuel transformation
■ Coal: integrated-gasification combined-cycle	■ Industrial motor systems
■ Coal: ultra-supercritical	
■ Second-generation biofuels	

Any serious effort to stem climate change and to increase energy security will require a significant expansion of funding for basic RD&D projects to identify potential deployment options. While there is general consensus that overall RD&D funding should be greatly expanded for these 17 basic technologies, some of these are especially critical if there is to be a timely transformation of the energy sector. In addition, many will require deployment support through loan guarantees and other programs.

In the transportation sector, for example, focus should be placed on the development of second- and third-generation biofuels, on the development of electric and plug-in vehicles, and on a more rapid increase in energy efficiency in transport. In the electric power sector, focus should be given to renewables including wind and solar, reducing the cost and speeding the deployment of nuclear power, and lowering the costs of clean coal technology and CCS that will be critical in the deployment of new plants that will be needed to maintain base load power production.[12] On the demand side, the early development and deployment of smart grids is also crucial to enable greater efficiencies in electric power consumption and to the introduction of plug-in electric vehicles. Breakthroughs in lighting and solar space and water heating are also needed.

Again the *Energy Security and Independence Act of 2007* identified and provided incentives for activities in all the above areas, but the level of support is insufficient. In Europe the European Union also has RD&D programs for many of the same areas, but the programs are relatively small and funding is again insufficient. European funding may increase with the recent establishment of the European Energy Research Alliance.

While national programs in place should be continued, the United States and the European Commission should consider establishing a Transatlantic Energy Research, Development,

[11] IEA, *Energy Technology Perspectives 2008*, p. 46.

[12] Wind power probably needs less support for R&D funding, although it continues to require support for deployment, as discussed above.

Demonstration, and Deployment Fund, under the auspices of the TFEC, for joint research to accelerate the introduction of new technologies. The Fund could be directed to concentrate on technologies that would benefit from economies of scale and on technologies strongly supported throughout the transatlantic community. Other criteria could be to focus on technologies that would lead to an expansion of manufacturing and job creation throughout the transatlantic community.

Common, Compatible, and Complementary Markets

Transportation and Oil

The use of oil to meet over 70 percent[13] of energy requirements for transportation fuels creates a major energy security challenge for the United States. Europe has a similarly high reliance on oil for transportation, though it does not have the same balance of payments burden as the United States, owing in part to lower overall demand for transportation fuels.

Both Europe and the United States could significantly increase their energy security and reduce their carbon emissions by dramatically reducing their demand for oil. Reducing the U.S. and European dependency on oil will require us to lower demand through higher fuel economy standards, financial and tax incentives, alternative fuels, and changes to transportation modes.

Europe and the United States should focus on a transportation strategy designed to reduce oil demand through increased efficiency and fuel switching. Transatlantic cooperation could play a key role in enabling such a transformation of the transportation sector through the commercialization of new technologies such as biofuels, including alternatives for non-light duty vehicles (trucks, airplanes, shipping), electric vehicles including hybrids, plug-in hybrids and plug-in electric vehicles, as well as the development of much more efficient batteries and fuel cell vehicles. Considerable activities are currently being undertaken by private industry to advance such technologies with limited government financial and regulatory support. The airline industry is one such example. Private industry will have to deliver the new technologies, but governments will need to design forcing mechanisms to encourage an accelerated adoption of the new technologies. Volatile oil prices have clearly awakened the automobile industry to the need for the introduction of new technologies, but government and legislatures have been slow to recognize the necessity of accelerating the pace and magnitude of change required.

Priority should be given to supporting fuel and vehicle technologies that have the potential to be deployed on a massive scale without major infrastructure investments.[14] A major change in transportation will require advanced biofuels with minimal additional distribution costs and

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[13] IEA, *World Energy Outlook 2008*, p. 99.

[14] Fuels requiring special infrastructure, such as first-generation ethanol, compressed natural gas (CNG), and hydrogen, should be encouraged for distributed markets and fleet applications.

electric vehicles (hybrid, plug-in hybrid, and all electric). The spike in oil prices in 2006–2008, led to an explosion of entrepreneurial interest in such technologies.

There is now a concentrated push by the major car manufacturers as well as numerous entrepreneurs to focus on the development of battery technologies to allow the production of plug-in electric vehicles and hybrid vehicles. These technologies have the potential to multiply existing fuel efficiencies, with some hybrid designs capable of providing over 90 miles per gallon of liquid fuel. Standard hybrid and plug-in hybrid electric vehicles can have significant impact, and all electric vehicles become increasingly effective as more electricity is produced with newer clean coal technologies.[15]

A number of manufacturers are in the running to produce the lithium ion batteries required. Initially it was thought that batteries would be limited to providing electric power for 40 miles of travel before switching to liquid fuels. However, some manufacturers are now talking of providing battery driven cars with a 100-mile range. Given that the average vehicle in the United States is driven less than 40 miles per day, many vehicles could run almost exclusively on battery power. Similar results would be expected in Europe. Even on longer trips, hybrid vehicles should be able to provide significant increases in fuel economies beyond what is available today, although this will require numerous changes in engine and vehicle designs that are currently under development. Some entrepreneurs are even proposing battery swapping, as well as the development of fast charge battery technology that would allow recharging at service stations on longer trips.

Numerous demonstration plants are being built to prove the feasibility of scaling conversion techniques to produce second-generation cellulosic biofuels from various plant materials that will not compete with food production. Global companies like BP are also working on technology to produce more complex molecules, such as butanol, that have higher fuel content than ethanol. The production of oil from algae is also showing considerable progress as both a vehicle and aviation fuel. The liquefaction of coal is another proven technology that would need to be paired with CCS. All of these approaches have the potential to replace a significant volume of petroleum. However, for these technologies to make a difference would require deployment on a massive scale.

Ultimately, the challenge will be accelerating the pace at which these new technologies can be deployed on a large enough scale to significantly reduce the transatlantic community's dependence on imported oil. The move toward electric vehicle power also places a high premium on improving transmission systems and the development of smart grids. This is likely to take decades.

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[15] Stanton W. Hadley and Alexandra Tsvetkova, "Potential Impacts of Plug-in Hybrid Electric Vehicles on Regional Power Generation," Oak Ridge National Laboratory, Oak Ridge, Tenn., January 2008; and Electric Power Research Institute (EPRI), "The Power to Reduce CO_2 Emissions: The Full Portfolio," discussion paper, EPRI 2007 Summer Seminar, Palo Alto, Calif., August 2007.

The magnitude of the task is often either not recognized or has been used as reason for moving slowly. In the United States, a goal of reducing oil consumption by 50 percent, or 11 million barrels a day, would reduce the U.S. trade deficit by several hundred billion dollars a year. With the current automotive fleet turning over every 15 years, such a change could only occur over several decades even with a combination of doubling vehicle efficiencies and the substitution of new fuels for a major portion of new vehicle sales. This suggests that the targets set in the *Energy Independence and Security Act of 2007* to increase CAFE standards to 35 mpg and to utilize 36 billion gallons of biofuels by 2022 will be insufficient to create a rapid reduction in oil demand.

Policies to accelerate the transformation of transportation should include and not be limited to:

- Setting a higher earlier target for CAFE standards
- Providing the automobile industry with financial support
- Significantly increasing government RD&D support
- Providing consumers tax incentives to purchase more efficient vehicles and tax disincentives to purchase less efficient vehicles
- Establishing programs to accelerate vehicle replacement
- Utilizing government fleet purchases at federal, state, and city levels to adopt more efficient and less carbon-intensive technologies

In addition, long-term programs should be established to encourage the infrastructure investments required to accelerate the shifting of road freight transit to rail and improvements to consumer-oriented mass transit.

Europe would also benefit from further reducing oil demand for transportation and from the same new vehicle and fuel technologies that will be needed in the United States, although European fuel taxation policies have long encouraged a more efficient utilization of oil, and mass transit systems are well developed in much of the European Union.

On a global basis, a move by the transatlantic community to significantly reduce its oil demand over several decades is likely to be offset in the near term by a continuing growth in oil consumed for transportation in the developing countries. However, by the middle of the 21st century, the IEA projects that global oil demand will be lower than today's level, even though this would still require accessing nonconventional supplies such as deep ocean and Arctic fields. The November 12 release of the IEA's *World Energy Outlook 2008* concludes that conventional oil production is likely to plateau at closer to 100 million barrels a day[16] rather than the 130 million barrels a day discussed in the recent past.

As noted earlier, the establishment of a forum for transatlantic cooperation on automotive and truck technologies is strongly recommended. This is crucial so that common standards can be

[16] IEA, *World Energy Outlook 2008*, p. 103.

developed for the increasingly global automotive and truck industries to invest and operate effectively in a world of new technologies and energy sources. With a growing diversity of potential fuels, the potential increases for bottlenecks to arise not only between Europe and the United States, but also globally in the absence of common standards. In addition, global trade will be enhanced only if there is common agreement on manufacturing specifications that enables the ready acceptability of products.

In the transportation sector, the recent sharp rise in oil prices to over $140 per barrel and their sudden drop to below $50 per barrel has presented a unique opportunity to finance the cost associated with a faster adoption of increased auto and truck fuel efficiencies. If gasoline and diesel federal fuel taxes were to be raised at a rate substantially below the rate at which vehicle efficiencies are increased, consumers would benefit and funds could be raised to support the transformation of the transportation sector.

For example, the *Energy Independence and Security Act of 2007* requires vehicle mileage efficiencies to be improved by 40 percent to 35 mpg by 2020. With the recent drop in crude oil prices, gasoline and diesel fuel prices have declined substantially from above $4.00 per gallon. Increasing federal excise taxes by $0.60 per gallon on petroleum-based fuels over a 10-year period would increase the cost of gasoline and diesel by about 20 to 30 percent, roughly half the rate of the efficiencies required by the increase in CAFE standards. A $0.06 price per year increase in the federal excise tax would allow a predictable and gradual increase that could be absorbed by consumers, as new vehicle efficiencies would more than offset the tax increase. It would also provide an additional market incentive to replace existing vehicles with significantly more efficient vehicles. When combined with sales tax incentives, similar to those recently introduced in France to purchase significantly more efficient vehicles, the turnover of the existing fleet would be accelerated. Ideally, the existing target of an average fleet CAFE standard of 35 mpg in 2020 could also be increased. Average fuel efficiencies in Europe currently run 40 mpg and are being raised to 49 mpg.

With the United States currently consuming about 185 billion gallons a year of petroleum-based vehicles fuels, each $0.06 increase in the excise tax would raise $11.4 billion dollars that could be set aside to finance the transformation of the transportation sector through support for RD&D on vehicle and fuel technologies, to support the retooling of automotive manufacturing capabilities, for road and bridge infrastructure, and for mass transit and railroads to reduce the inherent demand for automotive and truck traffic. Over time, the incremental revenue gains would lessen as overall demand for petroleum-based fuels would diminish. Revenues from the federal fuel excise tax should be set aside for transportation and not blended into the general revenue accounts.

Years ago, Europe implemented very much higher fuel excise taxes, which has driven its consumers to demand much more efficient vehicles. Unfortunately, in Europe the revenue from fuel excise taxes has largely been used for general purposes, and it would be difficult to restructure the use of these funds. However, for a variety of reasons the transportation sector in Europe is

already more efficient than that in the United States. Despite this, Europe, like the United States, still needs to significantly improve vehicle efficiencies.

Natural Gas

The natural gas sector represents one area where the U.S. and European situations are considerably different. Today the United States is relatively secure in its supplies of natural gas, owing to a recent increase in access to supplies associated with shale, coal bed methane, and better drilling technology that has diminished what was a growing concern over the availability of gas supplies. Projects to import large volumes of liquefied natural gas (LNG) to meet demand have essentially been placed on hold, and gas prices have fallen by half from a peak of $14/MCF. This is still significantly higher than prices in the 1990s. On a thermal equivalent basis, natural gas remains relatively cheap versus oil in the United States.

In contrast, Europe is anticipating a growing reliance on imports with diminishing domestic production and an increasing dependency on Russian supplies that already meet 26 percent of Europe's total gas demand. In the fourth quarter of 2008, Russian gas supplies are now costing 364 euros per thousand cubic meters (the equivalent of over $14/mcf). On November 12, 2008, Russia announced that this price would decline in 2009 but did not provide specifics other than to note that natural gas prices in its contracts with European consumers were tied to oil prices with a six- to nine-month time lag. This should cause prices to fall closer to current U.S. prices in the first half of 2009.

Russia's growing external assertiveness over the last several years has led to a major European debate over the reliability of Russian supplies and Europe's growing exposure to unilateral Russian actions that could impact both availability and prices. This first became very apparent with the 2006 dispute over Ukrainian gas supplies and in August 2008 with Russia's invasion of Georgia. More recently, the problem has been underscored with the December 2008/January 2009 dispute with Ukraine on prices and transit fees, which lead to a cutoff of supplies to a number of eastern European countries. These disputes have raised very important questions regarding the reliability of Russian gas supplies.

It should be recognized, however, that Russia's gas supplies to Ukraine have been heavily subsidized for the past 10 years, relative to European price levels, although Ukraine's transit fees have likewise been below market. Russia's efforts to bring gas prices for Ukraine closer to what it charges Europe has met resistance since there are both economic and political dimensions at play. Regardless of the reasons, natural gas flows have been adversely affected several times underscoring the importance of the reliability issue.

The Russia-Georgia conflict also heightened concerns. The Baku-Tbilisi-Ceyhan (BTC) Pipeline that was intended to provide an alternative to Russian pipelines was closed for nearly a month after an explosion in August 2008. There is disagreement on whether this explosion was related to the Russia-Georgia conflict or whether the incident was coincidental. Russia did continue with its gas shipments to Armenia via Georgia throughout the war, and there were no interruptions to the

gas trade. Nevertheless, the Russia-Georgia conflict, as well as the disputes in Ukraine over pricing, has unsettled many in Europe regarding their heavy dependency on Russian gas.

The European Commission recognizes that the existing rigidities caused by national energy companies and the limited availability of interregional pipeline connections and storage facilities severely reduce Europe's flexibility to meet regional supply shortfalls. This is also a major issue with the European electric power grid. As will be discussed below, efforts to diversify gas supplies are proving difficult.

Events of the last several years confirm that Russia's strategy is to control not only its own resources, but also the flow of hydrocarbons between Central Asia and Europe by offering attractive acquisition prices to Central Asian gas producers and launching the pipeline projects that aim at keeping the flows of the Central Asian gas transit via Russia. Europe's failure to develop a unified energy policy has also allowed Russia to make a number of purchases of assets in natural gas infrastructure and markets within Europe and proposed alliances in North Africa that potentially might weaken Europe's ability to diversify gas supplies. The European Union does have plans to increase the number of LNG terminals and to expand the development of unconventional gas and natural gas storage facilities in order to increase supply flexibility. Nevertheless, the remarkable level of energy security that was enjoyed by Europe over the last four decades is now in jeopardy.

Russia is the world's primary producer of gas and the largest holder of gas reserves. Russia is also the second-largest producer and exporter of oil, although it is the sixth-largest holder of reserves. Many investors are skeptical of going into Russia due to a perception that major foreign hydrocarbon investments in the country have not produced desired returns in recent years due to nationalization of projects. With the recent reduction in petroleum investment, Russian oil production is now projected to decline in 2009.

Russia has moved to lock up control over the flow of gas from Central Asia by contracting for gas from Turkmenistan, Tajikistan, and Uzbekistan, offering market-based prices, controlling local gas markets, and excluding all but China. As a sign of increasing competition for the Central Asian gas, however, China has built an oil pipeline from Turkmenistan and is currently building the Central Asian–China gas pipeline to move Turkmenistan, Uzbekistan, and Kazakhstan gas to Xinjiang.

Since 2000, efforts have been ongoing to have Russia ratify the Energy Charter Treaty and the associated Energy Charter Transit Protocol described earlier. However, Russia has been reluctant to provide third-party access to Russian pipelines, and in September 2007 the European Union tied Russian membership in the World Trade Organization (WTO) to Russia's adherence to the Energy Charter Treaty. A report to the Energy Charter Conference on the draft Transit Protocol was to be prepared by the end of 2008.

Russia has two new gas pipelines on the drawing board to supply Europe (South Stream and Nord Stream). Europe has revived discussion of building the Nabucco pipeline from the Caspian

through Georgia and Turkey, bypassing Russia. However, this line is in direct competition with Russia's South Stream gas pipeline that would need to come from Azerbaijan, Turkmenistan, and Iran. The economic viability of both projects will depend on the ability of the pipeline sponsors to develop a common interest. With the continuing division of interest, there is a strong possibility that the Caspian states will find it more attractive to send their gas to China. This scene has become more complicated with Iran's recent proposal to supply gas through Turkey directly to Europe and the announcement of the Russia-Iran-Qatar natural gas alliance.

Moving Iranian gas into Europe would likely require a solution to the Iranian nuclear weapons problem. If there is a change in Iranian approach, it may become possible to trade access to European gas markets and a guarantee of nuclear fuel supplies for a cessation of Iranian uranium enrichment.

Within Russia, the gas industry is likely to change as there are firms, other than Gazprom, that want to share in the gains created by the export trade. However, with Gazprom's monopoly on natural gas exports, such firms may have to obtain a greater share of Russia's internal markets. It is expected that Russian domestic gas prices will be liberalized and move toward market prices by 2011. In this way a greater flow of Russia's gas imports from Central Asia will move into the Russian domestic market. With Gazprom's production predicted to diminish, and China's interest in Siberian gas supplies, Russian domestic demand may reduce the long-term availability of gas for export to Europe.

The European Commission is continuing to focus on achieving several goals at once, namely energy security, combating climate change, and increased economic competitiveness. In order to effectively balance Russia's control over a major portion of Europe's gas supplies, some tradeoffs may be required. With a growing dependency on natural gas, Europe's energy security will depend ultimately on maintaining a diversified portfolio of energy supplies that includes a substantial portion of coal and nuclear power in addition to oil, natural gas, and renewables.

Both the United States and Europe have a common interest in developing an effective response to Russia's recent more aggressive positions. Both the United States and Europe will be better served by having Russia operating within a framework compatible with our view of democracy and acceptable trade practices. The recent financial crisis should have brought home to Russia that they are closely connected to the global economy. This may provide an opportunity for the transatlantic community to join together in stressing the value of Russia working as a real partner with Europe. Russian strategic leverage may have increased, but the United States and Europe still have some commercial leverage. Specifically, dialogues with Russia should include:

- Western oil and gas technology transfer to Russia
- Cooperation on nuclear power
- Coordination on improving energy efficiency in Russia and the European Union
- The ability to improve Russian energy productivity through training and attendance at Western technical institutions.

Ultimately, the Unites States and Europe have a mutual interest in establishing energy security for Europe.

Another area of concern in dealing with Russia is assessing its commitment to undertaking actions to reduce the impact of climate change. Energy efficiency is very low in Russia and the gas pipeline infrastructure is in desperate need of maintenance to reduce methane leaks. Failure to improve both situations would adversely impact global efforts to mitigate climate change through a reduction in GHG emissions.

Common, Compatible, and Complementary Institutions

There is a growing consensus that, within 5 to 10 years, the global oil markets will become significantly tighter.[17] This conclusion is based on a concern over the resource base and increasing evidence that reserve additions are not offsetting decline rates. There are other concerns over the inadequate level of investments in upstream capacity as a result of nationalization and nationalism and changing producing country policies. Accompanying these physical supply concerns, there is a belief that OPEC is becoming increasingly reluctant to create excess capacity in a world where developed countries are striving to reduce oil consumption. Until the recent drop in world oil prices, revenues were significantly greater than countries' ability to spend wisely, and there were growing concerns over their sovereign wealth funds becoming exposed to financial sanctions.

The IEA's recent in-depth analysis of world oil production has led to the conclusion that conventional oil supply will plateau in the next 20 years and that world oil demand will only grow to 100 MB/day by 2030 with no growth in demand in the OECD countries and continuing growth in the developing countries.[18]

At the same time, many of the producing countries are heavily subsidizing internal energy prices, particularly for oil, and flaring gas resources at a time when most countries are finding the recent volatility in petroleum prices extremely difficult to manage. By subsidizing domestic oil prices through price controls, oil demand is not being curtailed by normal market mechanisms and the world's supply and demand pressures are continuing to increase. BP recently estimated that over 90 percent of the recent growth in oil demand has been from countries subsidizing petroleum. Much of this demand growth has been in consuming counties like China and India where the government is trying to simultaneously manage inflationary pressures and the need to adjust to world market prices. However, oil demand growth rates have been highest in the producing countries that have the financial resources to use market prices to encourage the more efficient

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[17] See, for example, Paul Stevens, *The Coming Oil Supply Crunch* (London: Chatham House, 2008).
[18] IEA, *World Energy Outlook 2008*, p. 93.

utilization of oil and to use other financial policies to subsidize consumers.[19] Under current policies, producing countries are accelerating a declining ability to increase exports.

Under these conditions, the growing tightness in world oil markets makes it essential that producing and consuming countries develop a clear understanding of each state's policies and the long-term ability to rely on one another. Consuming and producing countries should engage in a series of dialogues to establish greater transparency regarding production capabilities and emerging consuming country policies and capabilities to address energy security and climate change. At the same time, the security interests of the major developing economies should be protected by formally including countries like China and India in the IEA's system for coping with oil supply disruptions.

The IEA was founded as an OECD oil and gas consumer organization, and has assumed broader roles over the years. It now advises OECD countries on supply security for oil, gas and electricity, as well as on environmental policy, particularly on efficiency, technologies, and CO_2.

The transatlantic community needs to take the lead in expanding the IEA into a global organization of major energy consumers. This would require a revision to the IEA's relationship to OECD or a modification of the OECD charter. The revised IEA would then be in a position to lead the proposed dialogues with the producing states. This has become even more important now that Russia, Iran, and Qatar are discussing setting a mini-OPEC for natural gas that will control 60 percent of world gas reserves.

Common, Compatible, and Complementary Infrastructure Protection and Disruption Response

The world's increased international trade in oil and natural gas has left everyone more susceptible to disruptions to pipelines and sea-lanes, through areas such as the Straits of Malacca or Hormuz, that could easily be disrupted by terrorist incidents. Military power can patrol but not prevent disruptions. Any major disruption to sea-lanes would immediately and dramatically escalate tanker prices from a simultaneous increase in the cost of longer voyages (with a shortage of tankers to make such voyages) and significantly higher insurance rates. Today, the world's maintenance of oil stockpiles represents a major "insurance" that would be available to soften the magnitude of such an event. Possible new approaches would be to consider initiating a global insurance arrangement to assist those economically hurt by major supply disruptions or expanding criminal jurisdiction so that the perpetrators of attacks could be appropriately brought to justice. In today's world of interdependence, the role for sanctions needs to be carefully considered as they will impact the entire global price and supply situation, although there will still be instances where they will be appropriate.

[19] Ibid.

NATO and the European Union have been reassessing their role in relation to energy security. While the role of the European Union is still unclear, NATO has determined that it should concentrate on the protection of infrastructure. At the April 2008 NATO Summit in Bucharest, there was agreement that NATO should undertake support and protection of critical energy infrastructure, including maritime surveillance. In this regard, NATO has recognized a need to increase cooperation with the European Union, which is working on civil emergency mechanisms, although defining compatible roles for NATO and the European Union is still undergoing development. The one aspect that is clear is that military capability may provide a valuable resource to cope with some individual and specific threats to energy supplies, but it will have a limited capacity to deal with the broader issues impacting energy security. In recognition of this, recent discussion in NATO regarding energy security has refrained from referencing Article 5, which obligates members to militarily support other members in the event of attack.

NATO and the European Union need to hold a series of dialogues to establish a clear understanding of the appropriate role for military force and as to the specific responsibilities of each in addressing energy security issues. These discussions should recognize that the United States does not have the gendarmerie capabilities that are crucial to energy security in many countries. An agreement on the potential and limits of actions to address various threats to transatlantic energy security needs to be specifically identified.

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This report was significantly enhanced by input and participation by all members of the working group. However, all participants have not endorsed all recommendations. In addition, participants served as individuals and not as representatives of their governments or organizations.

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