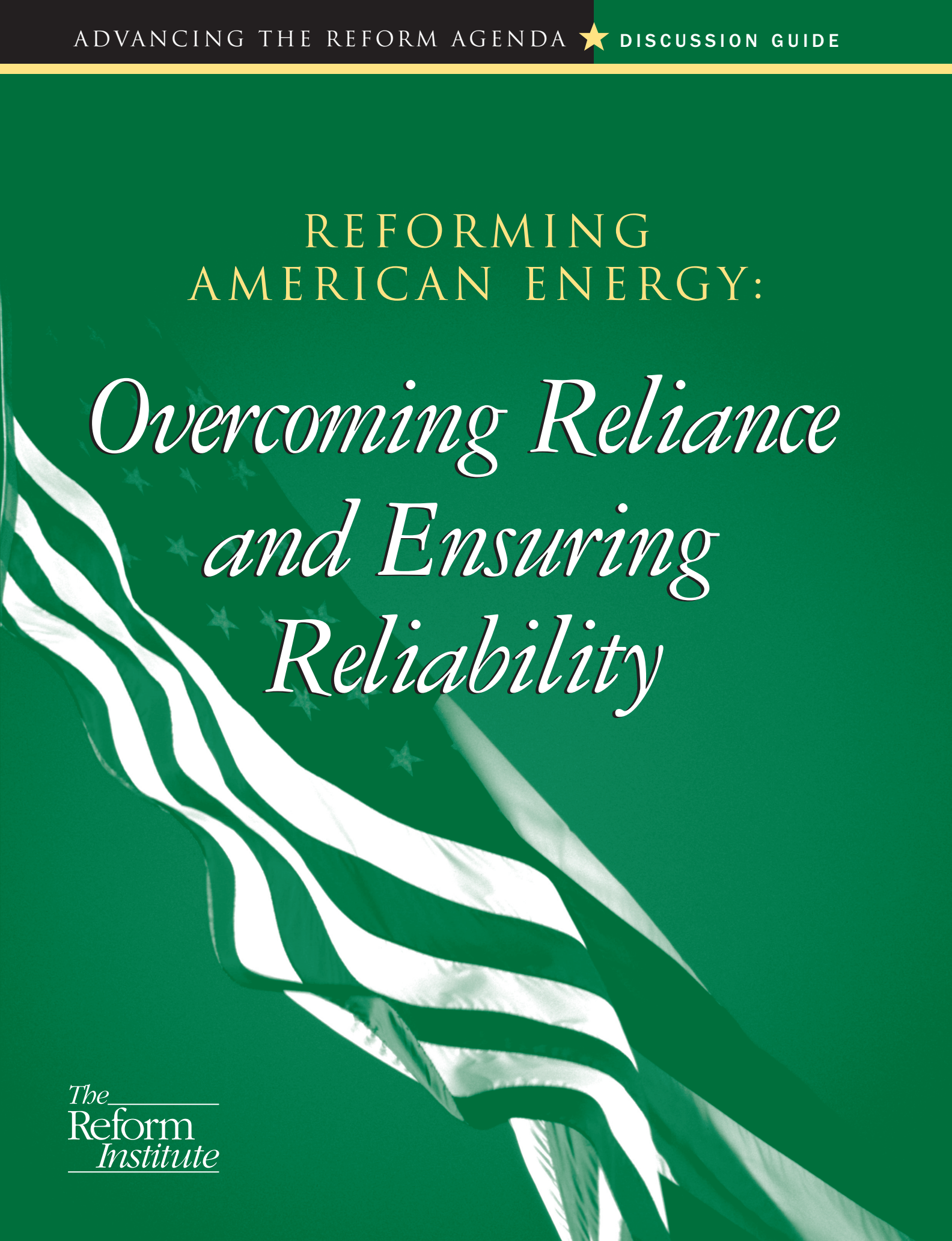
REFORMING AMERICAN ENERGY:

Overcoming Reliance and Ensuring Reliability



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REFORMING AMERICAN ENERGY:
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GENERATING IDEAS AND EXPLORING SOLUTIONS TO POWER OUR FUTURE: A MESSAGE FROM THE REFORM INSTITUTE

A confluence of factors is pushing the need for energy reform to the top of the national agenda. Volatile fuel prices will continue to impact the U.S. economy. Our reliance on oil from unfriendly regimes and politically unstable regions continues to fuel concerns over national security. In addition, growing apprehension about climate change is precipitating action to change energy producing and consuming practices in the United States. It is now generally recognized that energy reform will be critical for long-term economic growth, strengthening national security and resilience, and promoting environmental stewardship.

The Reform Institute is bringing its dedication to strengthening the foundations of our democracy and building a resilient society to the issue of energy reform. By achieving sustainability in our energy and environmental policies, the U.S. will become more resilient – able to confront the challenges it faces and emerge a stronger nation. Through innovation, collaboration and leadership we will not simply persevere, but prosper as well.

The United States needs a comprehensive energy strategy that addresses the complex challenges of the 21st Century. The first steps in devising such a strategy involve laying out the challenges in an objective manner and initiating a constructive dialogue among various and diverse constituencies. This report illustrates those challenges. In the spring of 2009, the Reform Institute will provide a constructive dialogue at a national energy symposium that will bring together a wide array of stakeholders to discuss the challenges involved and explore solutions. Bipartisan cooperation and leadership will be required to develop sensible, solutions-based reforms. This paper will help guide the discussions at the gathering.

Confronting this complex issue will require a level of leadership and national commitment that is rare in this age of political partisanship and gridlock. Only through fundamental reform that restores accountability, transparency and efficacy to the political process can we expect to set a new direction in energy policy.

The Nation must view this situation not as an insurmountable trial but as an opportunity. By advancing new technologies and processes to produce and utilize energy, we can create profitable new products and markets that will benefit American industry and our economy. In order to take full advantage of this opportunity, the United States must take the lead in transforming the global energy system. Exhibiting the necessary global leadership on this critical issue starts here at home. Only in an environment that encourages healthy debate and broad participation and cooperation will we successfully meet this challenge. The Reform Institute is committed to creating such an environment; this report is the first step.

Cecilia Martinez
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TABLE OF CONTENTS

ABBREVIATIONS

AEI	Advanced Energy Initiative
ANWR	Arctic National Wildlife Refuge
CAIR	Clean Air Interstate Rule
CARB	California Regulatory Board
CCS	Carbon Capture and Sequestration
CNG	Compressed Natural Gas
COL	Construction and Operations License
COOP	Continuity of Operations Plan
CSP	Concentrated Solar Power
CVT	Continuously Variable
DOE	Department of Energy
EGS	Enhanced Geothermal Systems
EIA	Energy Information Administration
EISA	Energy Independence & Security Act
EPA	Energy Policy Act
EPRI	Electric Power Research Institute
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FFVs	Flexible Fuel Vehicles
GHG	Green House Gas
GMESA	Gulf of Mexico Energy Security Act
HEVs	Hybrid-Electric Vehicles
ICE	Internal Combustion Engine
IEO	International Energy Outlook
ISO	Independent Systems Operations
ISTEA	Inter-modal Surface Transportation Efficiency Act
ITC	Investment Tax Credits
ITS	Intelligent Transportation Systems
LNG	Liquefied Natural Gas
MTBE	Methyl Tertiary Butyl Ether
NGVs	Natural Gas Vehicles
NHTSA	National Highway Traffic Safety Administration
NIMBY	"Not-in-my-Backyard"
NRC	Nuclear Regulatory Commission
OC	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OECD	Organization for Economic Cooperation and Development
OPM	Office of Personnel Management
PEM	Polymer Electrolyte Membrane
PHEVs	Plug-in Hybrid-Electric Vehicles
PUHCA	Public Utility Holding Company Act
PURPA	Public Utility Regulatory Commission
PNGV	Partnership for a New Generation of Vehicles
PTCs	Production Tax Credits
RES	Rechargeable Energy Source
RTO	Regional Transmission Organizations
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act- A Legacy for Users
TEA-21	Transportation Efficiency Act for the 21st Century
VMT	Vehicle Miles Traveled

EXECUTIVE SUMMARY

As the United States faces an energy reliance crisis that threatens the long-term welfare of the Nation, the Reform Institute espouses an approach to energy policy reform that considers all options available to reduce reliance on foreign sources. Energy policy must be developed even-handedly while maintaining the best interests of the Nation, regardless of political constituencies. The Reform Institute seeks to explore and express the realities of reducing reliance with clarity and concision. This paper illustrates the necessities and realities for achieving successful, diverse, and enduring future energy sources by offering a comprehensive review of all components of the U.S. energy portfolio, as well as the necessary policy considerations and realities of each.

The United States is in the midst of an energy *reliance* crisis. Whether the price of a barrel of oil is $150 or $30, American reliance and demand on foreign sources of energy present a profound threat to our long-term security. Calls for the United States to reduce the amount of imported oil are shortsighted in that they disregard the fact that this crisis is caused more by our need for oil than by the quantities we import. There is no simple or quick solution to restraining our reliance on foreign oil. An absolute transformation in how we use and produce energy will be required to reduce our reliance on foreign sources while ensuring a reliable supply of energy to meet the needs of 21st Century America.

Developing a sustainable energy system is critical to maintaining America's competitive edge and global leadership. Reliable energy has been essential to the Nation's ascendancy into a world power; it is the foundation upon which our industry and economy have been built. However, recent economic volatility, failed and inadequate policy directives, projected future demand for energy, and mounting global competition for the same "pot" of energy resources have amounted to a perfect storm that threatens our access to cheap and abundant energy and, therefore, our global standing. This confluence of perils evokes a greater global parity within the global marketplace – a more competitive and consequently less dominant status for the United States.

The good news – an enormous opportunity exists for the United States to take the requisite steps to reverse its downward energy spiral and reduce, if not eliminate, reliance on unfriendly foreign energy sources and strengthen national resilience. It is important that policy makers move quickly and comprehensively in the energy sector, setting aside partisan and parochial interests to put policy over politics for the long-term welfare of the Nation.

Developing a comprehensive energy policy with broad support will require placing all the options on the table and assessing them realistically. Generating more energy from renewable sources within the United States must be a major objective, but that goal cannot be attained overnight, nor should it be pursued exclusive of other objectives with greater impact. The U.S. must devise a way to bridge the gap between our current untenable situation and a brighter future; doing so will require tapping into the resources presently available to us.

The Reform Institute espouses that public problems are best solved through innovation and collaboration with the private sector. These principles should be applied to the energy policies of the United States. The Federal government should seek to incorporate policies that provide regulatory certainty to the business community, allow abundant access to our Nation's domestic energy resources, and allow for the promotion of proven breakthrough technologies. The three principles for energy reform should be as follows:

Regulatory Certainty: Reforming the energy sector begins by providing regulatory certainty to those who invest in and create energy related jobs.

Access to Resources: Expand efforts to explore for and produce domestic energy resources to reduce the Nation's growing reliance on foreign sources of energy.
Promotion of Proven Technologies: Our Nation's energy policy – and the federally-backed incentives it provides – should be based on merit, not political favoritism. Investments into proven technologies should be incentivized.

The United States is the most resourceful and innovative nation in the world. We possess our own wealth of resources, not the least of which is the industrial and innovative capacity needed to reform our energy sector and alleviate our reliance on foreign energy.

Driving Reform in Transportation Energy

Like the American energy dependence itself, the Nation will not achieve all necessary gains in the transportation sector either quickly or by employing a single approach. Energy efficiency in the transportation sector will be achievable only by chipping away at small percentages in every aspect of this sector. By combining gains in fuel economy for cars and trucks, reducing congestion, improving efficiency technology, and changing consumer behavior, the United States can reduce its consumption of energy resources in this sector as the means to achieve its national energy goals.

"Smart" Reform – Modernizing the U.S. Electrical Grid

Modernization of the aged U.S. electrical grid is imperative to energy reform and strengthening America's resilience against disruptive events. As electricity is the lifeblood of our modern society, the electrical power grid is the circulatory system that enables the flow of this vital current to all corners of the country. The grid is responsible for the transmission and delivery of electricity across thousands of miles of power lines from generation sites to points of energy consumption. The electrical grid as it is now was installed at a time when the current massive consumer demand could not have been foreseen. The dramatic increase in the number of new and larger homes, rising urbanization, and the widespread adoption of digital technology and other energy-thirsty devices has overloaded the electrical delivery system and driven up costs as utilities search for new sources of energy to meet demand. The electric grid is further burdened by public policies inhibiting the increase in domestic energy production. It has become a patchwork of energy-inefficient fixes mending an overburdened system. Grid modernization will be the foundation for transforming America's energy framework. Developing a next-generation electrical grid – commonly referred to as a "Smart Grid" – must be a national priority and a critical aspect of comprehensive energy reform.

The Nation's Energy Resources – Reducing Reliance

The United States and North America possess extraordinary energy resources ranging from an abundance of coal and natural gas, petroleum, uranium for nuclear fission, geothermal, and renewable resources. For the United States to achieve its national public policy goal of reducing reliance on energy resources from unfriendly foreign sources, it must choose to tap all available types of energy. Fossil fuels continue to be the predominant fuel source in the United States, with nuclear and renewable energy presently meeting only one-fifth of end-user demand. Energy policies that favor one political constituency or geographical region have resulted in the reliance crisis facing the Nation. Reviewing each energy resource available to the United States and distinguishing the benefits and hurdles to expanding their use will help to guide reform solutions and a comprehensive energy policy.

The future of energy in the United States is bright as technologies exist today that were not available even a decade ago. Harnessing innovation and entrepreneurship will require a comprehensive framework that sets a clear path for U.S. energy policy and provides regulatory

certainty for the energy industry. The energy investment landscape has been volatile with policies changing too frequently to truly encourage the long-term investments required to reform the sector.

Through innovation, collaboration and leadership the U.S. can achieve comprehensive energy reform that bolsters national security and resilience, enhances the economy, and promotes energy and environmental sustainability.

KEY RECOMMENDATIONS

The following is a list of policy recommendations that flow from the findings of the discussion in this paper:

Transportation

- Congress and the president should develop a concise and comprehensive energy plan, including a strategy for transportation energy. Leaders must commit to such a course despite the temporary drop in energy commodity prices. The dramatic increase in energy prices in 2008 and the extreme pressures placed on the United States economy should serve as a warning regarding the Nation's reliance on foreign sources.
- The President should clearly delineate jurisdiction over transportation fuel economy. Agency rivalries that place territory over policy are detrimental to the transportation energy policies of the United States. Fuel economy for passenger vehicles is dictated by Title 49 of the United States Code. The National Highway Traffic Administration (NHTSA) at the U.S. Department of Transportation is the logical choice for developing and implementing such standards.
- Preference should be given to performance-based standards. The litany of technologies available to manufacturers for their use to achieve the public policy objectives of fuel economy standards should be left undisturbed without mandate. Picking a "winning" technology disturbs the free market and dampens innovation. The Federal Government should set goals to protect national security interests and let industry work however it deems most effective to reach those goals. Prescribing how the goals should be met constitutes undue interference in the free market.
- Provide incentives for private investment in transportation technologies, particularly "bridge technologies" that can utilize and enhance existing technologies, e.g., the internal combustion engine, while long-term technologies are being developed.
- Provide incentives for manufacture of energy-efficient vehicles by either lifting or significantly raising caps for volume tax credits. In the Energy Policy Act of 2005,[1] Congress included tax credits for manufacturers of hybrid and clean-burning-fuel vehicles. However, those incentives phased out for manufacturers upon sales of 60,000 units. Ensure that qualifying vehicles meet a certain fuel-economy level to avoid manufacturers using the energy efficiency gained from the added technology for fuel economy and not just enhanced horsepower.
- Continue to provide consumer tax credits for the purchase of energy-efficient vehicles that perform at improved fuel-economy levels. The Energy Policy Act also included tax credits for purchase of alternative-technology vehicles, and those tax credits were extended in the financial bailout bill passed by Congress in October 2008.
- Invest in battery technology with the objectives of ensuring that the best batteries in the world are made in the United States. The U.S. must avoid shifting its reliance on foreign oil to a reliance on foreign batteries.
- Continue to invest in federal programs dedicated to the development of technologies that are higher risk than manufacturers would engage. And continue to work with foreign governments through collaborative agreements to share advanced technology, as well as with states and municipalities to develop local programs for alternative energy vehicles on a smaller scale.
- Ensure incentives for private investment in transportation fueling stations and infrastructure.
- Automakers should be left to work toward the aggressive fuel-economy standards of the Energy Independence and Security Act of 2007 (EISA) without added state or federal regulatory uncertainty. This includes denying the request by the California Regulatory Board (CARB) to the EPA to allow CARB to regulate emissions – and thus fuel economy. Allowing this waiver would be a circumvention of Congressional will as set forth in EISA and an interference with manufacturers' ability to comply with fuel economy standards. A patchwork of fuel-economy regulations would delay significant energy conservation advancements over the next decade as regulations become paralyzed by litigation.

- Effectively enforce fuel-economy standards. Ensure that manufacturers are not circumventing standards or "gaming" the system.
- Work to modernize the electrical grid by providing incentives for the installation of smart technologies. This will improve vastly the capability and deployment of plug-in-hybrid-electric vehicles (PHEVs) and broaden the portfolio of resources utilized by the grid, thereby reducing U.S. reliance on foreign sources of energy and enhancing U.S. energy resilience.
- Address through the next surface transportation legislation and Federal Aviation Administration FAA reauthorization the problem of transportation congestion through substitution and efficiency methods such as telecommuting and intelligent transportation systems (ITS).

Electrical Grid Modernization

- Due to the multitude of public and private stakeholders involved with the electrical grid, modernizing the electrical grid will require a comprehensive stakeholder commitment. Policymakers should recognize this fact and bring all players in modernization to the table.
- Policymakers must address the Not-In-My-Backyard – NIMBY – problem, as it is a primary impediment to cost-effective progress with respect to deploying energy infrastructure. Americans must be educated about the infrastructure needed to integrate renewable and other sources of energy to reduce U.S. reliance on foreign sources.
- Congress should continue to signal to private industry and public energy stakeholders that modernization of the grid will continue to be the policy of the United States.
- The Smart Grid Task force that was started in 2007 at the Department of Energy (DOE), which was intended to identify and remove hurdles to the large-scale adoption of the smart grid, should be continued. This commission is established through 2020 and is intended to advise the Secretary of Energy in the demonstration, adoption, and implementation of the smart grid over this period. President Obama has embarked on a similar effort.
- Congress should continue to provide incentive via federal cost sharing for private investment in smart technologies.
- States should continue de-coupling electricity rates from production, and incentivize utilities to accept and utilize smart meters on residential homes and businesses. While merely a component of the Smart Grid, meters possess the same advanced energy consumption monitoring capability.
- Providing utilities carbon tax credits for the resulting emissions reductions realized downstream from their investment should reward investment in smart technologies.
- Increase federal investment in R&D for smart grid technologies. Prior to the 2009 stimulus package, the European Union was investing 10 times that of the United States in this area.
- Electricity regulators at all levels should serve as the bridge between utilities and the auto manufacturers to ensure that their investments are compatible with the future deployment of plug-in hybrid-electric vehicles.
- Set national goals by which new electrical appliances should be equipped to communicate with other smart grid technologies. Analysts suggest the societal benefit from adopting a modernized electrical grid returns five times the value of initial investments, but the benefits of energy efficiency and reliability are not directly beneficial to the utility companies that are required to power it, some consideration to incentivizing efficiency or profit sharing may expedite the adoption of a smart grid.
- Provide energy providers with carbon tax credits for investments in modernizing the grid as part of any climate change legislation.

Exploration and Production

- Pursue all options with respect to oil and natural gas exploration. The U.S. should at the very least maintain the status quo with respect to oil production. Alternative sources of energy likely will take at least a decade to be

integrated into the electrical and transportation sectors. Domestic oil production should serve as a bridge to those alternatives. For these reasons, Congress should oppose any drilling moratoria.

- Support the efforts with respect to demonstrating advanced coal technologies.
- Support efforts to modernize the U.S. electrical grid to enhance the ability of utilities to manage the electricity being generated by base-load plants thereby reducing the amount of power required to meet the demand of end users. Modernization of the grid would allow for a dramatic reduction in carbon emissions from coal-generation plants.
- Actively permit and encourage seismic inventory across the United States, especially along the Gulf Coast, in Alaska, and throughout the Mountain West where natural gas is known to be present. Seismic inventory will arm future generations with better information from which to assess the technical feasibility and cost of recovering natural gas domestically.
- Support the Alaska pipeline and all necessary infrastructures that would buttress the domestic natural gas industry. This support should include addressing the siting concerns that tend to retard the growth of other energy resources within the energy sector.
- Provide certainty with respect to climate change legislation to allow for the calculation of costs associated with bringing a nuclear plant on line.
- Develop a long-term plan to ensure that at the very least the status quo regarding the share of nuclear power within the U.S. energy portfolio remains constant – and does not erode from the natural de-commissioning of facilities – for the foreseeable future.
- Extend any tax credit already applicable for emissions-free renewable energy to emissions-free nuclear power – similar to the production tax credits (PTC) that provide a 1.9-cent per kilowatt-hour benefit for wind and geothermal energy.[2]
- Clarify the uncertain legislative environment by extending or making permanent PTC legislation, rather than allowing it to continue to expire every two years, expiring three times from 1998 to 2005.[3]
- Modify federal process for recycling spent nuclear fuel. Through reprocessing only short-lived fission products would require storage for an extended period while the remainder would be reused for energy generation.
- Adjust the federal nuclear regulatory process for licensing and re-licensing reactors to accelerate the growth of the nuclear industry.
- Avoid imposition of a windfall profits tax on energy providers. The Nation should learn from its mistakes as this policy previously failed when it was attempted in the 1980s. Corporations are not people and, as a result, any increase in tax simply will be passed along to the consumer.
- Extend or make permanent the investment tax credits (ITCs) that provide incentive for investment in solar technologies.
- Continue to allocate funds for research and development of solar photovoltaic technologies through the Department of Energy.
- Allow for appropriate pricing of integrated renewable electricity generation onto a modernized grid.
- Extend the production tax credits to all renewable energies and enact such policies in permanence or for an extended period.
- Expedite the process for sitting renewable energy facilities.
- Continue to support the research and development of enhanced geothermal systems (EGS).
- Encourage the development of commercial scale geothermal facilities in the western United States where shallow geothermal deposits are most accessible.

INTRODUCTION

A Reliance Problem

The United States is in the midst of an energy reliance crisis. Whether the price of a barrel of oil is $150 or $30, American reliance and demand on foreign sources of energy present a profound threat to our long-term security. Calls for the United States to reduce the amount of imported oil are shortsighted in that they disregard the fact that this crisis is caused more by our need for oil than by the quantity we import. There is no simple or quick solution to restraining our reliance on foreign oil. An absolute transformation in how we use and produce energy will be required to reduce our reliance on foreign sources while ensuring a reliable supply of energy to meet the needs of 21st Century America.

Our Nation is the largest user of energy in the world – consuming approximately 21 million barrels of oil per day – but less than a third of that oil is produced domestically. This delta has grown increasingly as a combination of shortsighted and often parochial energy policies, and endless court challenges have stymied the Nation's ability to pursue alternatives and diversify its energy portfolio. The growing disparity between domestically-produced sources of energy compared with the Nation's utilization of foreign resources has placed the United States at a severe disadvantage in foreign affairs. Demand for oil in the U.S. and globally is projected to increase dramatically once the global economy recovers, which will result in substantially higher prices as supply struggles to keep up with demand. Bottom line, the Nation's current energy posture is not sustainable.

Developing a sustainable energy policy and system is critical to maintaining America's competitive edge and global leadership. Reliable energy has been essential to the Nation's ascendancy into a world power; it is the foundation upon which our industry and economy has been built. However, recent economic volatility, failed and inadequate policy directives, projected future demand for energy, and mounting global competition for the same "pot" of energy resources have amounted to a perfect storm that threatens our access to cheap and abundant energy and, therefore, our global standing. This confluence of perils evokes a greater global parity within the global marketplace—a more competitive and consequently less dominant status for the United States.

This reliance on oil is centrally related to a host of concerns that fall under the umbrella of national security – to include economic and environmental security. While the price of a barrel of oil and hence that of a gallon of gas have retreated to pre-Hurricane Katrina levels, the increase in price was swift and dramatic, and to a certain extent unexplainable. This spike in retail gasoline prices in the summer of 2008 was a lesson to a nation that too long has consumed

beyond its means. The high price of oil presents a major economic risk to the United States as it creates inflationary pressure and increases the trade deficit. This exerts negative pressure on the dollar and tends to increase prices on commodities such as oil, and the cycle repeats.

Burgeoning industries of the United States, as well as India and China, have created a heightened demand for the precious energy reserves of the resource-wealthy countries. As the industry and innovation that made the Nation prosperous are challenged by the rapidly industrializing areas of the world, so too are the foundations of those industries. The U.S. now competes for the resources of the few – and often unfriendly – energy producing states against several aggressively industrializing countries that also are burdened by growing energy demands. This competitive demand for energy resources has emboldened and armed resource-wealthy polities with the political muscle that can be flexed and used as leverage to the detriment of industrialized democracies. This reliance threatens to continue its slow hemorrhage of the U.S. economy, thereby weakening our security and position of prominence in the world.

The bad news – the U.S. is on a path toward unsustainable dependence on over-extended resources as the expense of energy becomes too great to transfer abroad. Couple this expense with the imminent need to modernize critical energy delivery infrastructure – the U.S. electrical grid – that has suffered a disastrous neglect of investment over the past 30 years, and the Nation finds itself on the precipice of no longer being able to effectively power its growth.

The good news – an enormous opportunity exists for the United States to take the requisite steps to reverse its downward energy spiral and reduce, if not eliminate, reliance on unfriendly foreign energy sources and strengthen national resilience. It is important that the 111th Congress move quickly and comprehensively in the energy sector, setting aside partisan and parochial interests to put policy over politics for the long-term welfare of the Nation.

Developing a comprehensive energy policy with broad support will require the placement of all options on the table and assessing them realistically. Generating more energy from renewable sources within the United States must be a primary objective, but that goal cannot be attained overnight. Because of the inability of our leaders in the past to anticipate the current dilemma and develop long-term policies to facilitate the transition to alternative sources of energy, the Nation is substantially behind the curve. Thus, in addition to encouraging innovation, the U.S. must also devise a way to bridge the gap between our current untenable situation and a brighter future; doing so will require tapping into the resources presently available to us.

A comprehensive energy strategy that addresses short- and long-term issues can draw wide support and provide a reasonable blueprint for moving forward. Proposals to be addressed within a comprehensive framework include:

- Lifting barriers impeding environmentally-safe exploration of domestic natural energy resources;
- Setting national public policy and performance objectives for energy without mandating certain fuels or technologies;
- Accelerating the regulatory permitting process to enable new energy infrastructure;
- Unleashing the private sector by providing tax and other incentives for energy innovation and consumption; and
- Beginning with the modernization of the Nation's energy delivery infrastructure to a "smart" electrical grid – as it should be the centerpiece for energy policy and achieving energy resilience.

The United States is the most resourceful and innovative nation in the world. We possess our own wealth of resources, not the least of which is the industrial and innovative capacity needed to reform our energy sector and alleviate our reliance on foreign energy.

Unfortunately, as the summer of 2008 passed and the headlines changed from the high cost of oil to the struggling economy, much of the pressure for energy reform passed with it. The real tragedy of diverted public attention is that energy reform can and should be a significant catalyst for economic recovery. Policymakers need to realize that by providing incentives, exploring all options for energy, and quickly erasing the uncertainty hanging over the industry by enacting climate change legislation, the United States is poised for an explosion of investment, innovation, and job creation. First, however, policymakers must recognize the significant implications of U.S. reliance on foreign sources of energy on national security, the economy, and the environment. Considering energy policy purely through one lens or another without a willingness to explore all options available to the United States will lead to a la carte energy initiatives reminiscent of the past several decades and, hence, the status quo or worse.

Approach

Energy has been at the forefront of conversation and concern among American consumers over the past year, and it has become en vogue to discuss renewable wind and solar energy, plug-in hybrid electric vehicles, energy efficiency, geothermal energy, and nuclear power. But the realities of investing and deploying these energy resources, and their position within and share of the overall domestic energy portfolio often are ignored. The Reform Institute seeks to explore and express the realities of growing into energy resilience with clarity and concision. This paper illustrates the necessities and realities of a successful, diverse, and enduring future American energy portfolio.

As discussed in this paper, "energy" is understood as the ability to fuel the Nation's transportation sector and ensure a generating capacity sufficient to power residential, commercial, and industrial electrical needs. While this paper explores and advocates energy reform featuring a comprehensive approach, its focus is primarily on the transportation and electricity delivery sectors. The direct costs to the U.S. economy associated with the inefficiencies and excesses of these sectors amounts to hundreds of billions of dollars, with indirect costs substantially greater. In identifying the challenges associated with the major sources of energy available to the United States and formulating comprehensive energy reforms, policy makers should consider some basic principals to guide those reforms.

DEVELOPING A COMPREHENSIVE ENERGY POLICY WITH BROAD SUPPORT WILL REQUIRE THE PLACEMENT OF ALL OPTIONS ON THE TABLE AND ASSESSING THEM REALISTICALLY

Basic Principles for Energy Reform

Because energy policy is inextricably intertwined with national security, always present will be the colliding forces of free market principles and national public policy goals. Therefore, the Federal government should seek to incorporate polices that provide regulatory certainty to the business community, allow abundant access to our Nation's domestic energy resources, and allow for the promotion of proven breakthrough technologies.

Regulatory Certainty: Reforming the energy sector begins by providing regulatory certainty to those that invest in and create energy related jobs. Policy makers must commit to reforming the energy sector regardless of the temporary drop in energy commodity prices. And making incentives for private investment permanent through production, investment, and consumer tax credits can provide long-term incentive. Regulatory certainty also includes the need for policymakers to more clearly delineate jurisdictions of agencies to eliminate territorial disputes that paralyze progress in implementing energy policy.


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Access to Resources: A large reason for the dramatic increase in our Nation's reliance on energy resources derived from foreign sources is our unwillingness to increase our own domestic production. Simply put, to reduce our foreign dependence we can no longer be beholden to the special interest groups that have led us down the reliance path. We must take full advantage of domestically-produced energy. To this end, U.S. energy policy should feature an expansion into renewable energy by expediting the process for siting solar and wind turbine farms, as well as geothermal facilities. We address to the greatest extent possible the inhibiting force of our "Not-In-My-Backyard" – or NIMBY – problem as it threatens cost-effective progress with respect to deploying energy infrastructure. Consumers must be educated about the nexus between affordable and reliable energy and the need for appropriate infrastructure. But foremost, Americans should understand that infrastructure will be needed to integrate renewable and other sources of energy to reduce U.S. reliance on foreign sources.

Promotion of Proven Technologies: Our Nation's energy policy – and the federally-backed incentives it provides – should be based on merit, not political favoritism. But investments into proven technologies should be incentivized. It will be important to provide incentives for private investment in transportation technologies, particularly "bridge technologies" that can utilize the internal combustion engine while long-term technologies are being developed. In addition, policymakers should set national goals by which new electrical appliances should be equipped to communicate with other smart grid technologies. Analysts suggest the societal benefit from adopting a modernized electrical grid returns five times the value of initial investments, but the benefits of energy efficiency and reliability are not directly beneficial to the utility companies that are required to power it, some consideration to encourage efficiency or profit sharing may expedite the adoption of a smart grid.

PART 1

DRIVING REFORM *in Transportation Energy*

The U.S. transportation sector overwhelmingly is dependent on oil-based liquid fuels, with 96 percent of the automotive fleet reliant on petroleum.[4] Much of the impetus for the energy debate stems from the expense of this reliance in both economic and environmental terms. With nearly two-thirds of U.S. oil use imported from foreign sources, the cost of the U.S. transportation sector weighs heavily on the economy. Recent years have seen the economic impact of oil imports grow from 2002 – when oil imports represented 22 percent of the Nation's trade deficit – to 2007 – when oil imports accounted for more than 40 percent of the total deficit – approximately $295 billion.[5] There are significant concerns as to the sustainability of this dependence on foreign oil and a subsequent effort to develop a domestic fuel to power transportation fleet has ensued.

Of the 21 million barrels of oil consumed by the U.S. every day, two thirds is used by the transportation sector – 67 percent attributable to cars and light trucks; 17 percent by medium- and heavy-duty trucks; 10 percent by aviation, and most of the remainder by maritime, military, and rail, respectively. With more than 200 million cars and trucks on U.S. roads, the slightest percentage of improvement to the vehicles that Americans drive can drastically reduce the energy consumed and emissions produced from this sector. Transportation accounts for one third of all U.S. greenhouse gas (GHG) emissions, and represents the fastest-growing source of GHGs – accounting for nearly half of all emissions increases in the past 20 years.[6] In addition, transportation is the largest end-use source of the most prevalent greenhouse gas – carbon dioxide (CO2). The greenhouse-gas emissions from this sector are even higher when the processes for manufacturing transportation assets are considered.

Global Transportation Marketplace

The range of solutions to domestic – and international – transportation energy needs include the replacement of petroleum-based fuels with alternative sources, dramatic improvement in vehicle efficiency, and utilization of communications and other technologies that can relieve congestion and reduce vehicle idling. The first step toward identifying possibilities for reform within the transportation space is to analyze the current state of the transportation system in the United States and how it compares with systems in other countries. Global demand and trends must be factored into the reform equation. The consumption habits of the American system have an impact on the same energy resources as China, India, South Korea, and many others, and vice versa. So considering energy policy as it relates to transportation in a bubble is misguided and not constructive.

Demand Pressure

Over the next two decades, global demand for liquid fuels – predominantly petroleum – for transportation energy use is expected to outpace energy consumption by any other sector. The upward demand pressure is being caused by the continued dramatic increase in consumption among non-Organization for Economic Cooperation and Development (non-OECD) countries – the largest being China, India, South Korea, Russia, Iran, Brazil, and Australia/New Zealand. The projected average transportation energy use in the next two decades is approximately 450 percent higher than established industrialized nations, including the United States.[7]

When analyzing comparisons among established and emerging world economies and their individual transportation needs, it is important to understand what factors cause greater demand for transportation energy resources. For all economies, transportation is essential for the movement of goods and people. On the business level, transportation allows for employees to get to and from work, and for their products to be shipped to locations for consumer consumption. For consumers, transportation provides the means to pursue daily activities, including purchasing goods, attending school, and seeking medical assistance.

Transportation energy use is largely correlative to standards of living in that as transportation systems become more established, access to industry opportunities that lead to more jobs is enabled. This, in turn, enables consumers to purchase vehicles that require liquid fuels. Organization for Economic Cooperation and Development (OECD) countries,[8] which include most of North America and Europe, tend to be more advanced in their transportation systems as their infrastructure is interconnected and their development nears saturation. But the association between economic growth and transportation energy use is much stronger among non-OECD countries than more service-oriented OECD countries. According to an International Energy Outlook (IEO) 2008 reference case, from 2005 to 2030, OECD countries will increase transportation energy consumption by a rate of 28 percent of total gross domestic product (GDP) compared with non-OECD countries that will increase consumption at a rate of 58 percent of their GDP.[9]

Sustained economic growth relies heavily on the modernization of transportation systems. This explains why fast-growing countries such as China and India, in addition to making substantial investments in infrastructure, have been careful to keep price controls on transportation fuels to ensure low inflation and greater growth. Likewise have Middle Eastern and other oil-supplying countries that can afford to charge their own citizens lower fuel costs and offset the losses by setting higher costs for foreign purchasers. Therefore, consumers of these non-OECD countries do not share the incentive to keep consumption low, which places added demand pressure on a global shared supply of resources.

Over the next two decades, the annual rate of growth for transportation energy use among OECD countries is projected to be .7 percent, from 58.5 quadrillion Btu to 68.8 quadrillion Btu in 2030.[10] The overall liquid fuel demand in the United States will rise from 67 percent of total domestic demand to 73 percent during that same period. However, the rate of growth within North America has slowed as a result of multiple factors, including increased e-commerce and telecommuting activities resulting from increased broadband communications deployment.. But this dampening of consumption rate growth in North America is not a sufficient reduction in the national reliance on foreign sources of energy, and it certainly is not enough to offset the demand from energy-thirsty non-OEDC countries. According to an Energy Information Administration (EIA) report, "growing demand for transportation services in non-OECD countries is the most important factor affecting the projections for world liquids consumption." [11]

U.S. Transportation Energy Reform

Like the American energy dependence itself, the Nation will not achieve all necessary gains in the transportation sector either quickly or by employing a single approach. Energy efficiency in the transportation sector will be achievable only by chipping away at small percentages in every aspect of this sector. By combining gains in fuel economy for cars and trucks, reducing congestion, improving efficiency technology, and changing consumer behavior, the United States can reduce its consumption of energy resources in this sector as the means to achieve its national energy goals.

The basic U.S. policy objective should be to reduce the reliance on liquid fuels from foreign sources given the skyrocketing demand for such fuels by non-OECD countries. In addition to leading the world in energy conservation, the U.S. also should lead in innovation. By shifting to alternative energy sources as a substitute for liquid fuels, the United States can not only reduce reliance, but also stimulate economic growth by creating new markets and thus employment opportunities.

Congress took significant steps in transportation energy reform in 2005 and 2007 by passing the Energy Policy Act (EPA)[12] and the Energy Independence & Security Act (EISA)[13], respectively. While Congress focused primarily in EPA on tax credits for the manufacture and sale of fuel-efficient vehicles, as well as infrastructure tax incentives, EISA represents a significant evolution in the types of vehicles that will be sold in the United States. The new law reforms the current corporate average system that now requires manufacturers to produce a mix of vehicles that average to a certain fuel economy and replaces it with an attribute-based system – assigns a fuel-economy target correlative to the physical attributes of the vehicle, e.g., wheelbase footprint, weight, and other features. The law also sets a new fuel-economy standard of 35 miles per gallon for each manufacturer's combined fleet of cars and light trucks to be achieved by 2020. These standards will yield substantial reductions in oil reliance and emissions, but they will require manufacturers to make significant capital investments for retooling. Auto manufacturers should be provided with regulatory certainty without further state or federal regulation of fuel economy while they revamp their processes in order to achieve these standards.

LIKE THE AMERICAN ENERGY DEPENDENCE ITSELF, THE NATION WILL NOT ACHIEVE ALL NECESSARY GAINS IN THE TRANSPORTATION SECTOR EITHER QUICKLY OR BY EMPLOYING A SINGLE APPROACH

Alternative Energy Sources

The internal combustion engine (ICE) has been the primary propulsion system for vehicles in the United States and its preeminence will not evaporate overnight. However, enormous efficiency gains are now possible that will make the ICE itself more efficient via advanced fuels and technologies. The feasibility of these alternative energy technologies and fuels has two components: technological development and cost. The most common alternative technologies and fuels for the transportation sector are flexible-fuel vehicles, hybrid-electric vehicles, plug-in hybrid-electric vehicles, natural-gas vehicles, hydrogen vehicles, and bridge technologies, e.g., CVT transmissions, advanced materials for weight reduction, and boosters.

Flexible-Fuel Vehicles

Flexible-Fuel Vehicles (FFVs) – also commonly known as "dual-fuel" or "E85" vehicles – are vehicles equipped with an ICE and designed to run on a blend of fuels stored in a common tank. Ethanol is the predominant fuel blended with gasoline in the United States to be used by FFVs. The number of E85 FFVs (vehicles that run on a blend of 0 to 85 percent ethanol) in the U.S. domestic fleet has grown nearly 50 percent since 2005 to nearly 7.3 mil-

lion, and is fueled at over 1,800 E85 stations (representing only one percent of all fuel stations in the U.S.).[14]

Filling the void left by an additive used in gasoline prior to 2006 but banned by a majority of states – methyl tertiary butyl ether (MTBE) – when it was found to be a groundwater contaminate, ethanol was pushed forward by members of Congress from agricultural states as a biomass fuel that addresses climate change and GHG emissions. The U.S. has become the largest producer of ethanol in the world, with Brazil a close second. More than half of the gasoline used in the U.S. is blended with some percentage of ethanol.

FFVs are useful in that they replace a percentage of foreign oil in the transportation sector and help dampen reliance, and the use of ethanol also helps the U.S. agricultural sector and, therefore, the economy. However, the drawbacks of an ethanol-based transportation energy policy far outweigh the positives. Despite being touted as an emissions-reducing fuel, ethanol is produced using the type of feedstock that can variously affect the environmental benefit. For example, ethanol production requires large amounts of water. At this time there is no pipeline delivery system for gasoline and ethanol, so ethanol requires the use of more fuel and consequently the creation of more emissions to ship to local mixing stations, which present "not-in-my-backyard" (NIMBY) and safety problems. Finally, the significant increase in ethanol usage for transportation fuel has put pressure on consumer food prices and the global food supply. Until these drawbacks can be mitigated, FFVs that use ethanol as a primary blending fuel probably will not provide the answer to a sustained energy reliance reduction.

Electric Vehicles

Hybrid-Electric Vehicles (HEVs) are relatively new to the U.S. domestic vehicle fleet and have risen in popularity over the past few years as a result of federal tax incentives and rising gasoline prices. There were 246,000 HEVs sold in the United States in 2006,[15] more than half of the number sold in the previous seven years. HEVs combine conventional propulsion ICE systems with a rechargeable energy source (RESS) to extend the fuel economy capability of the vehicle and lower emissions. The RESS in HEVs work in conjunction with the ICE by alternating usage utilizing the RESS for idling and ICE for accelerating above a certain speed. HEVs also utilize the kinetic energy generated from the ICE to recharge the battery or contribute to powering the vehicle.

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Overall, HEVs have become widely available to and accepted by consumers. They provide on average 40 percent better fuel efficiency and reduce GHG emissions from vehicles. A continued expansion of HEV mix in the U.S. domestic fleet is an important component of a short-term energy policy. In the Energy Policy Act of 2005 (EPA), Congress provided a tax credit of up to $3150 for the purchase of HEVs and a volume tax credit for manufacturers for the first 60,000 HEVs sold and phased out thereafter. The purchase tax credit will

expire at the end of 2010 for vehicles fewer than 8,500 lbs.[16] Without federal tax incentives for production volume and consumer purchase, sustaining sales of HEVs will depend correlatively on the price of fuel as it relates to the added price of the RESS technology.

Plug-in hybrid-electric Vehicles (PHEVs) are distinguished from HEVs by the manner by which they draw power. Unlike HEVs that rely on batteries that capture kinetic energy from engine generation of the ICE, PHEVs draw on power from the electric grid and sustain motive power for a specific range – estimated 20 to 40 miles – without fossil fuel before relying exclusively on the ICE. There are no PHEVs for sale in the United States, but battery advances are making PHEVs more technologically feasible as previously high-energy costs and new government fuel-economy rules are bringing forward their development. The prospect of mass PHEV production remains at the core of the revitalization hopes of the U.S. automakers as several plan to introduce PHEVs to the North American market in 2010.

The benefits of advancing a large volume of PHEVs into the domestic fleet far exceed the mere reduction in foreign oil reliance – the goal on which this paper is premised. The widespread utilization of PHEVs in the United States also would dramatically reduce emissions from mobile sources[17] and serve to modernize the Nation's automobile and electric utility industries. Conceivably, through advanced electrical grid technology, PHEVs would be integrated into the electrical grid and charge through the nighttime hours. They would be utilized for morning transportation and connect to the grid during the daylight hours. During this period, the stored power in the PHEV batteries would be utilized for "spinning" capacity for utilities. PHEVs then would be used in the early evening hours – during peak electricity demand – to supply electricity to the grid at rate tariffs[18] or net-metered rates.[19] This cycle would repeat, as the vehicle would charge again during early morning hours at trough retail rates. This integration would allow utilities to reduce peak-time demand and lower costs.

By integrating transportation onto the grid, PHEVs would allow for the storage and use of previously unreliable intermittent renewable energy (e.g., hydro, solar, wind). For PHEVs to be worthy of public and private investment, the electricity sources feeding the grid must be diversified, including the inclusion of nuclear and renewable capability. Otherwise, a significant increase in peak supply would be needed to meet the peak base-load needs of widespread PHEV usage, requiring the generation of more electricity from coal-fired power plants in the absence of viable alternatives, which likely would result in less of a total decrease in emissions.[20]

FOR PHEVS TO BE WORTHY OF PUBLIC AND PRIVATE INVESTMENT, THE ELECTRICITY SOURCES FEEDING THE GRID MUST BE DIVERSIFIED

For the full benefits of PHEVs to be realized, utilities and the auto industry must better collaborate and understand one another to ensure that their investments are compatible and not misplaced. There must be uniformity of revenue generation across what is currently a fractured regulated retail grid. While the states' rights regulatory construct remains favorable to a federal grid system, there must be some uniformity of engineering and financing to ensure a consistent revenue-sharing expectation between consumers of PHEVs and utilities regardless of geographical location. In addition, utilities must accept smart-metering technology as a step toward lower carbon emissions. To this point, states must decouple revenue from consumption and reward utilities for conservation.

While the promise of this technology is enormous, the barriers to deployment are daunting. Battery technology is not where it

needs to be – heavy and cost prohibitive – to make PHEVs a viable mass-volume reality before 2020. PHEVs may very well be the long-term answer for reducing domestic reliance on foreign sources of energy and modernizing the U.S. electrical grid, but investment in them should be considered a seed planted for future fruit. The Obama Administration took a step in this direction with the American Recovery and Reinvestment Act, which provides $2 billion for an advanced battery grant program and $400 million for a new electric transportation grant program.[21]

Natural Gas Vehicles

Natural gas vehicles (NGVs) represent the largest growing fleet of alternative-fueled vehicles in the world – 7 million worldwide and growing by 30 percent annually[22] – and show promise as a short-term and smaller-scale transportation energy solution. NGVs have been around for several decades and operate on compressed natural gas (CNG) in a manner very similar to gasoline vehicles. Stored on board, compressed natural gas is channeled through stainless steel lines and into a pressure reduction regulator before being injected into the engine. Natural gas is fossil fuel-like petroleum, but it burns cleaner than either gasoline or diesel, thereby reducing GHG emissions.

The benefits of increased NGV deployment in the U.S. fleet are obvious. Natural gas is the least expensive transportation fuel available – equivalent to $1.25 per gallon – and it is almost entirely available domestically. While there currently are only 130,000 NGVs in the U.S. domestic vehicle fleet, they are responsible for a disproportionate displacement of petroleum. In 2007 alone, NGVs in the United States displaced approximately 250 million gallons of gasoline and diesel.

Most of the growth in NGVs is occurring in the high-fuel-use municipal fleets that leave and return to the same site for fueling, e.g., buses, waste trucks, delivery vehicles, and airport and maritime port vehicles. The EPA estimates that in addition to the oil displacement benefits of natural gas, the use of natural gas in vehicles could reduce carbon monoxide emissions by 90 percent and carbon dioxide by 25 percent. Evidence of this emissions reduction was demonstrated in 2008 by the Port of Los Angeles-Long Beach's move to NGVs in response to toxic levels of air pollution at the port. LAX Airport also has made the switch to NGVs.

Ninety-eight percent of the natural gas used in the United States is produced in North America, which contributes to its benefit of reducing the reliance on unfriendly sources of petroleum. But despite the advantages of natural gas as a transportation energy source, the fuel carries with it several limitations: the infrastructure necessary for delivery and storage, and the lack of fueling stations – only 1,200 natural-gas fuel stations in the U.S. compared with 180,000 gasoline stations. For the purpose of vehicle use, natural gas storage onboard is problematic due to the size of the gas storage cylinders – the fuel tank is four times larger than a gasoline tank. The size of the storage containers is more acceptable for medium- and heavy-duty trucks, but inhibits the range of the vehicles.

NGVs represent a limited but short-term bridge solution to reducing reliance and GHG emissions. The federal government should continue to encourage the purchase of NGVs for federal fleets and Congress should extend the consumer and fueling-station-owner tax credits granted in the Energy Policy Act to promote the sale of natural gas. NGVs displace foreign oil and reduce emissions, so their use should be expanded and encouraged, but they are not the definitive long-term transportation fuel replacement solution. Rather, they are an important part of it.

Hydrogen Vehicles

Hydrogen is the simplest, lightest, and most abundant element in the universe – accounting for greater than 90 percent of all matter.[23] It is colorless, odorless, and non-toxic, and its chemical composition is a single proton and a single electron.[24] Hydrogen can be extracted from virtually any compound and used as a source

of energy to propel an automobile or generate electricity for a power plant, and an equivalent quantity contains "three times the energy of a pound of gasoline."[25]

So how does a hydrogen fuel cell work as a transportation application? Unlike a battery, a fuel cell captures and uses electric energy in direct correlation with hydrogen supply, and thus the fuel cell never runs down its charge. Technically, a fuel cell consists of a polymer electrolyte membrane (PEM) surrounded by two electrodes. Hydrogen is fed through one electrode while oxygen is channeled through the other. This process generates electricity, water, and heat. This electricity is used to power an electric traction motor.[26]

The benefit of pursuing hydrogen as a transportation energy resource is found in its abundance, as virtually any energy resource can be used to provide this fuel. However, because hydrogen is the lightest gas in the universe, producing fuel storage capacity for a car or truck with a range of 300 miles that utilizes it for motive power can be extremel challenging.

Thus, hydrogen can be carried on-board motor vehicles in the form of traditional transportation fuels (e.g., gasoline, diesel, natural gas, and biofuels) and extracted through a reformer process to create transportation energy. The fuel also can be supplied off-board through fueling stations, but this requires massive infrastructure, delivery, and storage capabilities. The on-board versus off-board distinction raises a primary policy dilemma that is part of the analysis being done at DOE and in the private sector.

The federal government has recognized the promise of hydrogen in the transportation sector for more than a decade. First, by President Bill Clinton in the Partnership for a New Generation of Vehicles (PNGV) that was established in 1993 at the Department of Energy and worked to advance technological development initiatives that included hydrogen fuel cells. But on January 3, 2003, President George W. Bush renamed PNGV the "FreedomCAR" initiative and focused the program primarily on hydrogen fuel cell vehicles – a complementary program to the existing Hydrogen Fuel Initiative designed to accelerate the pace of R&D on hydrogen production and delivery infrastructure. The FreedomCAR program was funded by Congress at an average level of $93 million per year from FY2003 through FY2006.[27]

On August 8, 2005, President Bush signed the Energy Policy Act in which Congress included a provision[28] that required the Secretary of Energy to transmit to Congress a coordinated plan for U.S. Department of Energy's (DOE) hydrogen and fuel cell programs. EPA also included a consumer tax credit of $8000 for passenger fuel cell cars and $40,000 for commercial vehicles that expires in December 2014. In addition, the President announced in 2006 his Advanced Energy Initiative (AEI) meant to accelerate research on technologies that show promise in reducing near-term oil use and to reinforce his Hydrogen Fuel Initiative.

DOE responded to the President and Congress by producing a Hydrogen Posture Plan that integrated infrastructure development, technology for hydrogen production, and the fuel cells for both transportation and stationary applications. The goal as set forth in the plan is to develop a system of hydrogen production, storage, and delivery, and utilize it commercially for automobile and energy industries by 2020. Federal funding for the FreedomCAR program and hydrogen fuel-related R&D rose sharply from $99 million in FY2006 to a requested $158 million in FY2009.[29]

The benefits of the use of hydrogen are clear. By utilizing an abundant, clean, and reliable fuel that is translatable to energy generation in both the transportation and stationary energy sectors, the United States would be able to reduce dramatically our reliance on foreign sources of energy while simultaneously cutting GHGs to a small fraction of current emissions levels. Hydrogen fuel cells for the transportation sector represent a promising long-term substitution for petroleum and coal as energy

sources, but the commercial realization remains 15-20 years in the future. The remaining barriers to commercial deployment include ensuring safe production, delivery, and storage, given the different properties of hydrogen compared with other fuels. There also is the "chicken and egg" problem – whether the production of hydrogen fuel-cell vehicles will drive infrastructure investment, or vice versa. Furthermore, the weight and cost have been prohibitive.

Congress must choose whether to continue its emphasis on the development of a commercially viable hydrogen fuel-cell vehicle, diversify its efforts to include PHEVs, or stand aside and provide incentives for private industry to develop the technology that most responds to market demand.

Bridge Technologies and Fuels

Policymakers should not ignore other available technologies that exist to make vehicles more fuel efficient, including continuously variable transmissions (CVT),[30] lean-burning fuels that require less volume with more energy produced, technologies that can combine hydrogen and the ICE to improve fuel economy, and the utilization of lighter but durable materials that can lower weight in the vehicle without compromising safety. Congress has recognized some of these options for improved fuel economy, including consumer tax credits for vehicles with ICEs that utilize advanced lean-burn technology to improve efficiency. And most recently in section 651 of EISA, Congress authorized $80 million for DOE to establish an R&D program to reduce the weight of vehicles through, among other ways, affordable lighter-weight materials.[31]

Transportation Efficiency

Fuel economy[32] and fuel efficiency[33] must be addressed simultaneously. As previously discussed, Congress passed EISA in 2007 to require a significant increase in motor vehicle fuel economy over the next decade. Those gains will not be realized until the required targets are met and new cars and trucks with better fuel economy performance replace vehicles already in the U.S. domestic fleet – approximately 14 years after that time. Meanwhile, the next policy steps to reducing energy demand and emissions are to increase transportation capacity and reduce both vehicle miles traveled (VMT) and the time vehicles spend idling in traffic.

The core component of any transportation policy is mobility, which provides access for citizens to goods and services, as well as employment. But congestion in the Nation's transportation system has increased steadily as passenger and freight travel has increased. Former U.S. Department of Transportation Secretary Norman Mineta pointed out that "Congestion is one of the single largest threats to our economic prosperity and way of life. Whether it takes the form of trucks stalled in traffic, cargo stuck at overwhelmed seaports, or airplanes circling over crowded airports, congestion is costing America $200 billion a year."[34] Road and highway gridlock alone causes an annual $78 billion in hidden taxes on the American economy and productivity – resulting in 3.7 billion hours of travel delay and 2.3 billion gallons of fuel wasted each year, while aviation delays account for $9.4 billion in lost commerce.[35]

During the gasoline price spikes of 2005 and 2008, private industry moved quickly to identify efficiencies in their businesses. An example can be found in the aviation industry, which is limited in its energy substitution options, given the nature of jet fuel, so the best chance for fuel economy increases can be found in efficiency gains. The industry has focused most recently on installing "winglets" on the wings of their 737 airplane fleets (currently 2,500 planes worldwide), but plan to expand their use to larger planes.[36] These wing extensions reduce air resistance, thereby improving efficiency. The savings per airplane is estimated at 100,000 gallons of fuel per plane per year. Another private initiative underway is the United Parcel Service's effort to reduce idling by its 90,000 trucks by software that provides drivers the most efficient route that effectively eliminates left turns.[37]

Increasingly, Congress has recognized the threat posed by congestion in the past few surface transportation bills. President George W. Bush signed the most recent on August 10, 2005, titled "The Safe, Accountable, Flexible, Efficient Transportation Equity Act - A Legacy for Users" (SAFETEA-LU). This legislation reauthorized all surface transportation programs through FY2009.[38] In the 111th Congress, which commenced in January 2009, the reauthorization of SAFETEA-LU, or better known as the "highway bill," will be at the forefront of policy development and debate.

In light of the struggling economy, the Obama Administration promises to use transportation funding as a means to stimulate jobs and commerce. But any effort to distribute funds to states for transportation projects must be done in partnership with the states. As set forth in Secretary Mineta's National Strategy to Reduce Congestion on America's Transportation Network, the Nation must approach transportation efficiency in a comprehensive manner. Any plan must include the utilization of technologies, including: communications capabilities that can improve system management and driver awareness; investment by the private sector in transportation infrastructure; and working with states on projects to deploy tolling, expand mass transit, expedite critical infrastructure projects, modernize the Nation's air-traffic-control system, and expand telework.

Among the plethora of measures that can be taken to improve transportation efficiency, Congress also should consider expanding its Intelligent Transportation Systems (ITS) program to better utilize telecommunications capabilities. ITS encompasses a broad range of communications technologies – both wireless and wire-line – and electronics that can be integrated into transportation infrastructure and onboard vehicles to relieve congestion, improve safety and enhance American productivity, as well as provide homeland security capabilities to aid for surveillance or evacuation efforts. ITS is made up of more than a dozen technology-based systems, including, among many others: sensors embedded in roads to notify drivers of icy conditions thereby avoiding accidents; electronic toll collection; accident warning signage; onboard GPS re-routing capabilities; electronic emergency signals to expedite emergency response; traffic enforcement cameras; and intersection technologies that notify drivers that lights are about to change in order to avoid accidents that congest traffic.

TELECOMMUTING — OR WORK PERFORMED OUTSIDE OF THE TRADITIONAL ON-SITE WORK ENVIRONMENT — HAS BECOME MORE POPULAR AS BOTH A TRANSPORTATION SUBSTITUTION CAPABILITY IN THE PUBLIC AND PRIVATE SECTORS AS WELL AS A NATIONAL SECURITY STRATEGY FOR CONTINUITY OF OPERATIONS

Given the projected future increases in congestion, some policymakers believe the cost-benefit analysis for government-sponsored ITS projects is favorable in the next few years. Congress has funded ITS efforts originally authorized at $659 million in *the Intermodal Surface Transportation Efficiency Act* (ISTEA) for fiscal years 1992 through 1997 with additional funds appropriated for a total of approximately $1.2 billion. The Transportation Efficiency Act for the 21st Century (TEA-21) authorized a similar amount ($1.3 billion) through FY2003. In 2005, the Congress enacted SAFETEA-LU, which ended the ITS Deployment Program at the close of FY2005, but continued ITS research at $110 million annually through FY2009.[39] In addition to authorized ITS funding, ITS projects are eligible for regular Federal-aid highway funding.

As Congress considers highway funding legislation over the next few years, major recognition should be given to the ITS applications available to reduce congestion.


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Transportation Substitution

While efficient mobility is imperative to a functioning transportation system, efficiency can be improved further by substituting the need for mobility through improved access capabilities via the utilization of telecommunications capabilities. By making transportation of individuals and goods more efficient and thereby less energy intensive, the United States will lessen its reliance on foreign sources of transportation energy while simultaneously reducing future GHG emissions.

For the period 1992 through 2005, vehicle miles traveled (VMT) by Americans increased 33 percent. But since 2005, VMT has tailed off and flattened, if not declined,[40] as a result of many factors, including a slowing in economic growth, more access through mobility substitution primarily via broadband technologies, a flattening of the global oil supply, and the removal of thousands of vehicles from the roads due to Hurricane Katrina.

Telecommunications technology advances and broadband availability have been keys to substituting mobility. The promise of this substitution lies in the forms of employment telecommuting, video conferencing to limit business travel, and electronic shipment of documents, including business and healthcare. These applications serve utilities that go beyond transportation substitution. For example, a September 2005 RAND study indicates that the wide use of electronic health records would save the healthcare system alone nearly $81 billion – much coming from shared medical test results rather than redundant and unnecessary tests.[41] But this promise requires robust, secure, and ubiquitous telecommunications networks, including broadband, wire-line, and wireless access.

Telecommuting

Telecommuting – or work performed outside of the traditional on-site work environment – has become more popular as both a transportation substitution capability in the public and private sectors as well as a national security strategy for continuity of operations (COOP) of the government and businesses in the event of a terrorist attack or natural disaster. By enabling employees to work from home or a site more convenient for them, telecommuting – or "telework" – among other things reduces traffic congestion, lowers

fuel consumption and GHG emissions, and improves national security. Private industry has led the way on telework as an employee benefit and cost-savings measure. Telework lends itself to improving both traffic efficiency and substitution by eliminating a percentage of VMT while not adversely affecting economic growth.

For federal employees, the Office of Personnel Management (OPM) defines "telework" as "work arrangements in which an employee regularly performs officially assigned duties at home or other work sites geographically convenient to the residence of the employee."[42] The landmark legislation affecting telework in the federal government was signed into law in 2000, and sponsored by Congressman Frank Wolf (R-VA) as part of that year's highway bill.[43] The provision required each executive agency to establish a policy under which eligible employees may telecommute to the maximum extent possible without diminished employee productivity. The law also requires that the percentage of teleworking employees increase by 25 percent each year.

As of 2004, of the 1.7 million federal employees in the 82 agencies, 752,337 had been deemed eligible for telework, which was an increase from 521,542 in 2001. But unfortunately, of these eligible employees, only 140,694 actually teleworked, further complicating a weak classification for what constitutes "telework."[44]

Congress revisited telework in 2007 in an aggressive bill introduced by then-Senator Ted Stevens (R-AK). Recognizing the difficulty of overcoming workplace culture and management hurdles, the bill sought to take a dramatic step by inverting the eligibility presumption, thereby deeming all federal employees eligible unless determined expressly otherwise by their managers. The bill also would have raised the bar on what is considered "telework." Unfortunately, this bill has not been signed into law. That said, President Obama has indicated that telework will be something that his Administration will address. The biggest hurdles that must be overcome are a change in culture among managers across the federal government and better promotion of telework as an option to employees.

PART 2

SMART REFORM— *Modernizing the U.S. Electrical Grid*

Modernization of the aged U.S. electrical grid is imperative to energy reform and strengthening America's resilience against disruptive events. As electricity is the lifeblood of our modern society, the electrical power grid is the circulatory system that enables the flow of this vital current to all corners of the country.

The grid is responsible for the transmission and delivery of electricity across thousands of miles of power lines from generation sites to points of energy consumption. The electrical grid as it is now was installed at a time when the current massive consumer demand could not have been foreseen. The dramatic increase in the number of new and larger homes, rising urbanization, and the widespread adoption of digital technology and other energy-thirsty devices has overloaded the electrical delivery system and driven up costs as utilities search for new sources of energy to meet demand. The electric grid is further burdened by public policies inhibiting the increase in domestic energy production. It has become a patchwork of energy-inefficient fixes mending an overburdened system. Grid modernization will be the foundation for transforming America's energy framework. Developing a next-generation electrical grid – commonly referred to as a "Smart Grid" – must be a national priority and a critical aspect of comprehensive energy reform.[45]

The increase in demand for electricity and other sources of power is vastly outpacing the increase in power supply. The challenges and opportunities of the new century dictate that the Nation not rely on an outmoded electrical grid system that is nearing the end of its design cycle. It is static in its design, inefficient, and limiting to a nation that seeks to expand its use of renewable energy resources. Most importantly for the purpose of this paper, the aged grid is incapable of introducing new and renewable energy generation sources (e.g., solar, wind, hydro) at a capacity that justifies building new generation plants. These alternative sources of energy will be essential to the future of the United States in providing capabilities, e.g., transportation, that will substitute for the foreign oil on which is too heavily relied on.

This paper briefly explains but does not attempt to explore the complexities and intricacies of electricity generation, delivery, and regulation, as much literature has been written on the subject matter. Rather, the focus is on considerations for modernization of the grid to yield the greatest impact on alleviating the Nation's reliance on foreign sources of energy and creating a more resilient energy system.

Regulation

Prior to the Oil Embargo of the early 1970s, vertically integrated utilities were permitted under

the Federal Power Act and the Public Utility Holding Company Act (PUHCA) to operate as monopolies in exchange for electricity generation and delivery to consumers within certain service territories.[46] But as costs and populations grew, technologies were developed, and the oil crisis occurred, the appetite in Congress for competitive electricity generation peaked. Consequently, in 1992, Congress passed the Public Utility Regulatory Policies Act (PURPA) of 1978 to supplement electric utility generation and provide more efficient and fair rates to consumers.[47] PURPA required utilities to purchase power generated from qualifying plants for the same cost saved from not having to generate the electricity.[48] By doing so, Congress opened electricity generation to competitive market forces regulated by states at the retail level and the Federal Energy Regulatory Commission (FERC) at the wholesale level. The grid is broken up into regional markets and operated by voluntary Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs), which are responsible for moving electricity transmission over large interstate areas. This pro-competition approach to electricity markets harnessed through efficient regulation is the pathway to future energy.

Generation

The electrical power system in the United States contains more than 16,924 electric generating units with more than 1,075 Gigawatts of generating capacity[49] involving more than 300,000 miles of transmission lines[50] and 500,000 miles of distribution lines.[51] The grid is the largest machine in the world responsible for delivering energy from massive generation sources that derive power from coal, nuclear fission, oil, natural gas, hydro, geothermal, solar, and wind sources. Electric power originates at these generation stations, travels along massive high-voltage power lines to sub-generation transmission stations, and is ultimately distributed to the energy cnsumer – or end-user.

Electrical energy is ordinarily consumed immediately subsequent to its generation, as it cannot be stored. Consequently, supply of electricity generation must be produced at a capacity sufficient to meet peak demand, which can fluctuate during the course of a day – peaking typically in the evening hours as consumers return home from daily activities. An inability to meet peak end-user demand can result in power failures, which cost the U.S. economy more than $100 billion each year.[52] Considering the consumers that rely on consistent and uninterrupted power – e.g., hospitals, manufacturers, technology firms, police stations, and military institutions – the consequences of inconsistent power and power blackouts jeopardize the Nation's economic and security interests.

In order to meet the oscillating demand for electricity, differing types of power plants are employed for different means. Power plants that are able to provide consistent low cost power are used to meet the base energy demand, while power plants that can rapidly shift production to meet demand fluctuations are used to meet peak energy demand. Because of the size and scope of base-load power plants, planning for new base-load facilities takes several years.

Base-load power plants are large power plants that run at a constant rate to meet the minimum amount of required energy for a region – typically supplying low cost energy. Nuclear, coal-fired, and geothermal generation facilities are the most common types of base-load power plants, while hydroelectric power can be employed for base-load generation as long as water levels are high enough to allow for prolonged consistent generation. Additional types of power plants – intermediate and peaking plants – are less economical but more readily dispatched during times of peak demand. Natural gas electricity generation is often employed as an intermediate power plant – generating electricity throughout the day and adjusting to meet demand peaks before shutting down at night. Peaking plants are often the least economical, but employing them adds power reliability to the grid.

The deficiencies of the current electrical grid are inherent in its design. It is an inef-

ficient push system that offers little incentive to either the utility provider or consumer to monitor and conserve energy consumption. The existing grid does not possess the capability to provide incentives to consumers either to reduce consumption or improve environmental impacts through the utilization of more renewable resources. Making the electrical grid more efficient would mean delivering the same amount of usable electricity to the consumer but requiring less costly initial energy input to do so; that equates to utilities selling the same output at a lower price. Left without incentive, utility companies have little choice but to retain inefficient generation, transmission, and distribution systems to maintain profit margins. The perpetuation of this business model provides little incentive for a more efficient system of electricity distribution, both for the consumer and the utility company.

Despite the popular sentiment that renewable energy should play a significant role in the U.S. energy portfolio, the fact remains that coal and nuclear plants provide approximately 70 percent of the electricity in the United States, and will continue to shoulder the bulk of generation for the foreseeable future. But the United States must begin to plan for the next generation of base-load power plants while concurrently modernizing the grid. Planning for the next generation of new base-load power plants utilizing domestic resources must happen now.

However, advocates of renewable energies must develop a niche for each energy source within the base-load peaking-plant dynamic. Intermittent sources – like more variable solar and wind power – do not lend themselves well to base-load generation, but geothermal and hydroelectric power can meet the base demand provided that there are ample resources available. In the current system, natural gas – used to meet 20 percent of the U.S. annual electricity demand – is utilized for peak demand and extended electrical generation. This carves out an intermediate position for natural gas sandwiched between base-load and peak power sources, due to the plentiful nature of natural gas reserves and the volatility of its price. Generally, the higher the cost of an energy source, the more suitable that source is as a peak-power resource. This base-load structure serves to allow reliable electricity to consumers and lessens the Nation's reliance on expensive energy by using the most expensive fuels only when necessary.

Nimbly Addressing NIMBY

One of the predominant barriers to expanding electricity delivery infrastructure and building the requisite energy production to reduce the Nation's reliance on foreign sources of oil has little to do with energy at all. A recurrent impediment is the problem of "not-in-my-backyard" – or NIMBY. The issue of NIMBY is one of the primary challenges facing President Obama and the 111th Congress as they seek to address energy policy. NIMBY opposition increasingly surrounds new undertakings to site power generation facilities, power-line placement, wind turbines, and other energy infrastructure, and the longer the siting process takes the more likely NIMBY opposition will grow. At a time when the country most needs to move toward clean and safe nuclear power, modernize the electrical grid, and build renewable energy generation facilities, it has become increasingly difficult to site necessary energy infrastructure where it is most appropriate and beneficial. Instead, infrastructure more prevalently is being located where it is least controversial to local political constituencies. This path of least resistance is a cultural impediment to energy reform.

NIMBY is a perplexing problem for any policymaker to address in that the public generally lacks understanding of the nexus between affordable, reliable energy and the need to build infrastructure to produce and deliver it. Not to be confused with environmentalism, which ordinarily bases opposition to infrastructure on arguments pertaining to adverse effects to the climate or wildlife, NIMBY often is based on the premise of environmental concerns that actually are masked defenses of personal

property value. Unfortunately, NIMBY tends to occur most frequently in highly populated urban centers where energy consumption and the need to meet that demand are the greatest.

Congress attempted to deal with this problem narrowly in the Energy Policy Act of 2005 by making clear federal preemptive authority for siting of liquefied natural gas port terminals and backstop interstate transmission line siting authority.[53] But declaring federal authority over siting is not necessarily the answer. If the U.S. is to achieve its energy goals over the coming decades, policymakers must confront the NIMBY problem head on and engage in a dialogue with the American public about the consequences of NIMBY obstruction to progress.

Essential to addressing NIMBY concerns is gaining public confidence that decisions regarding energy infrastructure will be made in the national interest and not those of narrow special interests. A comprehensive energy strategy developed in an open and bipartisan process with input from all sectors of society and accompanied by educational outreach to the public regarding America's energy needs and the best ways to alleviate them – along with fundamental governance reforms that restore the trust of voters in the political process and elected leaders through greater transparency and accountability – will go a long way toward addressing NIMBY.

National Security Vulnerability

Understanding the need to reform the U.S. electrical grid requires recognition beyond both the institutional and cultural aversion to such reform and the direct expense of unreliable power delivery. Rather, a full understanding of its vulnerability requires an appreciation for the national security vulnerability created by the outdated grid. The U.S. electrical grid in its current condition is a double-headed snake with respect to national security in that it not only is highly inefficient in its delivery capability (thereby utilizing more natural gas and other energy that could be used to replace foreign oil use in other sectors), but it also presents a vulnerability to terrorism and natural disaster. The network's age and vulnerability have been demonstrated by massive cascading blackouts, where the failure of one utility results in a spike of electricity demand from an adjacent utility to such an extent that the latter shuts down to avoid damage to itself.

POLICYMAKERS MUST CONFRONT THE NIMBY PROBLEM HEAD ON AND ENGAGE IN A DIALOGUE WITH THE AMERICAN PUBLIC

An example of a massive cascading blackout and evidence of the fragility of the grid was demonstrated by a 2003 power outage that affected approximately 50 million people throughout the northeastern United States and parts of Canada. In August 2003, a sagging high-voltage power line near Cleveland, Ohio came into contact with trees that had not been trimmed by the local utility. That simple contact caused a cascade of blackouts, more than 265 power plants and 500 generating units shut down, and full power was not restored for a period of nearly two weeks.[54]

The United States is at a crossroads as reliance on foreign sources of energy and vulnerable critical infrastructures become significant liabilities to national security and resilience. The current electrical grid is outmoded and inefficient and the demand for reliable electricity is increasing at a rate that overburdens the current electrical system. The consequences of the increasing number of power fluctuations and failures illustrate a microcosm of the chaos that looms over the economy and national security should a deliberate attack on the electrical grid or a natural disaster occur.

A Resource in Itself – Efficiency and Conservation Gains

In addition to facilitating electricity generation from more renewable sources, an upgraded grid and associated "smart" devices connected to it

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will contribute substantially to enhanced efficiency, which will significantly reduce foreign reliance and greenhouse emissions by requiring fewer generating plants to be built. "Smart" appliances and "smart meters" connected to the grid via its two-way communications capabilities will reduce stress on the grid, particularly during periods of peak demand, alleviating the need for the most expensive and GHG-emitting peak generating units to come online. In this regard the Smart Grid can be viewed as an energy alternative on par with sources such as wind and solar – making grid modernization a smart alternative.

The demand response capabilities of the Smart Grid will also empower consumers and promote energy conservation. Providing consumers with real-time information on their energy usage and motivating them to conserve will mobilize America's greatest resource – its people – in addressing its energy challenges.

Reforming the Grid

Reforming the electric power grid is central to the Nation's ability to diminish reliance on overseas energy sources, ensure the reliable flow of electricity, and reduce GHG emissions. Its reform is less a function of delivering more power and more a function of communicating how much power is needed. In dealing with providing the requisite capacity for the industrial sector and consumers, policymakers have pursued simultaneous parallel efforts – reforms to meet the growing demand of electricity through expanding the use of renewable energy, natural gas, and cleaner coal and reducing consumption through conservation via initiatives such as the fuel-efficiency requirements of the Energy Independence and Security Act of 2007 (EISA). While both policies are necessary elements of electricity – and energy – reform in the United States, they ignore a lurking behemoth – the need to modernize the electrical delivery system.

A modernized grid will serve as the enabling mechanism for bringing alternative fuels on line, providing incentives for the first time for utilities and consumers to conserve, and improving energy efficiency thereby reducing emissions. Central to reforming the grid should be the deployment and utilization of an advanced electrical system upgraded with communications overlays – the pairing of which often is referred to as the "Smart Grid." By combining these capabilities into a single technology, the Smart Grid offers energy providers the ability to optimize and regulate electricity supply and demand, and to measure costs and reliability. The Electric Power Research Institute (EPRI) envisions the Smart Grid as a power system that can incorporate millions of sensors interconnected through an advanced communication and data acquisition system that can provide utilities with real-time analysis.[55] More plainly, the Smart Grid lets utilities understand end-user demand and manage supply more effectively and efficiently, while allowing consumers to understand when electricity is more or less expensive.

Modernization of the electrical grid may be the most significant step that policymakers can take toward reducing foreign energy reliance. President George W. Bush recognized the priority of modernization as his Department of Energy (DOE) Secretary created a Federal Smart Grid Task Force "to ensure awareness, coordination and integration of the diverse activities of DOE's Office of Electricity Delivery and Energy Reliability and elsewhere in the Federal Government related to Smart Grid technologies, practices, and services."[56] DOE

also has launched an education effort to ensure that policymakers and consumers better understand the benefits of the Smart Grid. This push toward modernization likely will continue as President Obama already has begun to organize policy leaders to move forward with a grid overhaul.

Developing the future electrical grid is a function of increasing the information available for the management of the grid. The improved management capabilities offered through the enhanced communication and information technology capacities of the Smart Grid would provide a greater ability to avoid power inadequacies, create a more robust and resilient grid, and allow for the greater integration of new and advancing electrical generation technologies. The recommendation to create a grid industry, one whose business is in the power-lines, is an effort to establish an advocate for grid modernization, one that would combat the impediments and hurdles opposing grid infrastructure and prevent this recurring neglect of grid infrastructure.

The United States has an opportunity over the next decade to reshape and renew the aged and underfunded electrical grid through commitments to infrastructure improvement, energy reform, and strengthening national resilience. No matter how many power plants are built, and whether they are nuclear, coal, or renewable facilities, the Nation will have nothing without the proper transmission infrastructure in place to support them. The U.S. needs to replace the current analog grid with a digital grid that is compatible with the digital society of the 21st Century. In focusing their efforts on the advancement of the electrical grid, policymakers should provide regulatory certainty, consistency, and transparency to promote efforts on enhancing the grid.

The hurdles to modernization of the grid, however, are many. First, the grid is subject to a litany of public and private stakeholders, including a patchwork of regulations imposed at all levels of government. Because of the size and breadth of the electrical grid, it is frequently subjected to different sets of legislation upon differing levels of state, local, and federal jurisdiction. Accordingly, growth has been encumbered through bureaucratic and balkanized regulations as well as institutional and external opposition. The implementation of the Smart Grid is a process that will take several years and require a coordinated effort among these stakeholders.

MODERNIZATION OF THE ELECTRICAL GRID MAY BE THE MOST SIGNIFICANT STEP THAT POLICYMAKERS CAN TAKE TOWARD REDUCING FOREIGN ENERGY RELIANCE

Second, the cultural development of NIMBY too frequently serves to obstruct the necessary energy reforms required to meet the infrastructure needs of future electricity demand. The future of the electrical grid relies on the resolution of these inhibiting forces. Americans must better understand the nexus between infrastructure and affordable and reliable electricity, and the national security consequences of impeding such development.

Third, there exists little economic incentive for utility companies to address inefficiencies of the current "static" grid. Intuitively, making the grid more efficient would result in providing the same amount of electricity to the consumer but reducing the amount of unneeded supply that is currently generated to ensure reliability. The current electricity rate structure rewards electricity providers for the amount of electricity that is used thereby lacking in incentive to conserve. Some states have begun to address this problem by "de-coupling" or disassociating utility revenues from the sale of electricity, which has created a power-line industry and opened the grid to greater competition. Utilities should be provided with the incentive to move toward the use of efficient generation and transmission, and treat efficiency as some refer to as a "fifth fuel."

And finally, legislative and regulatory uncertainty often serves as a barrier to stakeholders looking to invest in the grid. A perfect example is impending climate change legislation, as utilities and private industry are apprehensive about investments in expensive systems that may serve to affect their bottom line at the same time that they may face a tax on carbon emissions at the federal and state levels. Congress and the President must continue to provide clear and consistent legislative and regulatory signals that modernization of the grid will be the policy of the United States. The government should support efforts to enhance the grid and remove barriers, including carbon tax credits for investment and assistance in siting infrastructure. Congress took a step forward in the Energy Policy Act of 2005 by requiring states to consider implementing smart-metering technologies for residential and small commercial customers.[57] Congress again sent a signal in EISA when it declared that the modernization of the grid is national policy. EISA also provides federal incentives in the form of federal funding for investment in the Smart Grid. In addition, President Obama signaled his support by including $11 billion for smart grid initiatives in the 2009 economic stimulus bill. These actions combined with initiatives by the President and DOE should be continued and increased in scope.

The process and result of modernizing the U.S. electrical grid would have enormous impact on national security and the economy. Modernization would provide incentive to consumers to install advanced appliances that communicate with smart meters attached to their homes that communicate energy needs and price and empower the consumer as to what price the energy they utilize would be. This consumer empowerment provides incentive to use energy when demand and electricity prices are lower, flattening energy demand curves, and increasing the robustness of the electrical grid. In addition, plug-in hybrid electric vehicles (PHEVs) hold enormous promise for substituting their use of petroleum for fuel with domestically produced energy sources that supply the grid. The onboard batteries of these vehicles may have the potential to store electricity and supply it back to the grid as needed during peak-demand hours, which means fuels such as natural gas can be used for other purposes thereby reducing U.S. reliance on foreign sources of oil. Finally, by reforming the base-load and peaking dynamic, modernization would allow for the integration onto the grid of more diverse generation sources, e.g., renewable resources. All of these benefits of modernization would create jobs at a time when the country most needs workforce expansion.

PART 3

The Nation's Energy Resources – REDUCING RELIANCE

The United States and North America possess extraordinary energy resources ranging from an abundance of coal and natural gas, petroleum, uranium for nuclear fission, geothermal, and renewable resources. For the United States to achieve its national public policy goal of reducing reliance on energy resources from unfriendly foreign sources, it must choose to tap all available types of energy. Fossil fuels continue to be the predominant fuel source in the United States, with nuclear and renewable energy presently meeting only one-fifth of end-user demand. Energy policies that favor one political constituency or geographical region have resulted in the reliance crisis facing the Nation. Reviewing each energy resource available to the United States and distinguishing the benefits and hurdles to expanding their use will help to guide reform solutions and a comprehensive energy policy.

Coal

Approximately half of the electricity transmitted and consumed in the United States is generated from coal. It is an abundant domestic resource – the U.S. has more than a quarter of the world's proven recoverable coal reserves, greater than any other nation. Compared to the Nation's other available natural resources, coal is the most plentiful – accounting for 94 percent of domestic fossil-fuel reserves.[58] In 2006, the U.S. had more than 600 coal-fired power plants providing electricity to the Nation's end users. About 92 percent of that coal is used for generating electricity while the remainder is either exported or used in the production of steel, plastics, cement, paper, and some coal-based fuels.[59]

As evidenced by coal's permeation of energy and industry, coal has been a major component in the development of the Nation. However, after decades of near unfettered utilization of coal, the environmental impact of extracting and utilizing coal has prompted legislation to reduce the various effects of coal mining and burning on the climate. Coal – like other fossil fuels – must be recovered from the earth. However, the utilization of it produces more carbon emissions than its fossil-fuel counterparts. Beyond carbon emissions, burning coal releases a variety of other chemical substances like sulfur, nitrogen oxide, sulfur dioxide, mercury, and other molecules.

Devising a practical way to factor the cost of carbon and other greenhouse gas emissions into the energy producing equation has become a top priority of the Obama Administration and supporters of climate-change regulation in addressing energy and environmental sustainability concerns. Emissions credit trading is the process of limiting the amount of GHG emissions a generation plant may produce and requiring plants that would exceed that boundary to purchase equivalent "credits" from generation sources that do not reach that emissions ceiling. Proponents

see emissions trading – or cap-and-trade – as a market-based method of weaning the Nation off emissions-producing generation sources while funding emission-free generation. To limit chemical emissions, President George W. Bush instituted a regional interstate emissions trading program – the Clean Air Interstate Rule (CAIR).[60] CAIR, however, was vacated by a later court decision, *North Carolina v. EPA*.[61] Broad emissions programs similar to CAIR face many logistical obstacles, one of which is the need to show interstate promulgation of the emissions of individual generation sites in order to set federal emissions limits. President Obama expressed his commitment to pursuing an economy-wide emissions-trading program as part of his overall energy agenda in his effort to reduce GHG emissions by 80 percent by the year 2050.[62]

Reconciling the Nation's wealth of coal resources with a program to reduce the Nation's carbon emissions will require the commercial demonstration of the feasibility of the advancing technologies of carbon capture and sequestration (CCS) and coal gasification (clean coal). CCS is the process of capturing carbon emissions and storing them within geological formations. If proven practical, CCS has the potential to keep coal and other fossil fuels as viable options for the domestic future energy portfolio. CCS has been illustrated on a smaller scale but it has yet to be shown to be reliable and fiscally reasonable to explore on a large scale. Furthermore, concerns exist about the long-term storage of these emissions, especially in the quantities envisioned, and whether the emissions necessitate a dedicated pipeline or can be otherwise managed. The pilot-scale CCS power plants are being built and tested internationally in the hopes of addressing some of these questions; however, it will take years to demonstrate their feasibility on a commercial scale. President Obama has suggested supporting five domestic power plants for the demonstration of CCS.[63] Depending on the commercial feasibility of CCS and the scope of emissions legislation, the integration of CCS may keep an abundant American resource as a viable option for future energy, or it will make the cost of coal unprofitable and ultimately encourage the adoption of other electrical generation sources.

Gasified coal – another method of utilizing coal for energy generation but with fewer emissions – is most frequently viewed as too expensive to employ for the majority of energy generation. The process consists of turning coal into a synthetic gas and removing the impurities that would become pollutants when coal is burned. These power plants would emit 90 percent fewer pollutants than their predecessor plants of the 1970s.[64] If the cost feasibility of gasified coal or CCS demonstrates their potency within an emissions-restricted market, coal would remain a method of base-load power generation. But regardless of the feasibility, it is in the long-term economic interests of the Nation to lessen its dependence on coal and diversify the electrical sector.

While CCS and gasification hold some promise for sustaining coal as a long-term energy resource, the demonstration processes for these methods will be lengthy. With immediate pressure to reform the Nation's energy sector, it is likely that the position of coal in the U.S. energy portfolio will erode as alternative resources are brought into the forefront. Coal faces persistent opposition from environmental groups for its emissions production and land requirements for the mining process. With the Nation looking to withdraw from its reliance on foreign oil, a dichotomy is materializing as coal is uniquely positioned both as the predominant means of electrical generation and as a significant producer of GHG emissions. Environmentalists note that replacing the oil-dependent transportation sector with an electrified transportation sector would increase the demand for electricity thereby – absent the widespread integration of alternative energy into the electrical grid – increasing coal generation and emissions.

Congress addressed the need for advanced coal technologies in the Energy Improvement and Extension Act of 2008 in which it allowed

for a 30 percent investment tax credit for coal technologies and gasified coal investments as well as adding a tax credit for CCS, while extending the excise tax on coal.[65] In the Obama Administration, coal likely will find itself under consistent scrutiny as the President himself has made comments indicating that the result of his policies will mean fewer new coal companies, spelling bankruptcy for many.[66]

Natural Gas

The United States utilizes natural gas as a vehicle fuel as well as for electricity generation, residential heating, and the production of raw materials for use in products such as paints and medicines. In 2006, it was used to meet approximately 20 percent of the annual electrical demand in the United States. More than 96 percent of the Nation's natural gas usage is recovered in North America, and approximately 80 percent is derived from this country. Estimates in 2006 of North American natural gas resources suggest a 120-year supply at comparable rate of use.[67]

Aside from being a substantial domestic resource, natural gas produces the least emissions of any of the fossil fuel resources. On average, it is 30 percent cleaner than burning oil and 50 percent cleaner than burning coal.[68] Despite the relative improvement, natural gas is not a renewable resource and is responsible for approximately 20 percent of the carbon emissions in the United States, which may deter support within the environmental community for expanded natural gas utilization within the future energy sector.

Many believe that natural gas is misused in its current role. With currently only one percent of domestic natural gas employed by the transportation sector, advocates see the use of natural gas in this sector as an opportunity to displace petroleum from foreign sources used for transportation energy. They point out that natural gas is both cleaner and readily available as a short-term substitute for other fossil fuels, and that the role of natural gas within the electricity sector could be replaced through the greater utilization of renewable resources – seemingly a net gain.

Whatever the role of natural gas within the energy sector, a growth in domestic natural gas infrastructure must precede the growth in domestic demand for natural gas. Recent years have seen greater demand for natural gas, which has concurrently placed upward pricing pressure on the resource. The cost of natural gas averaged $2.28 per thousand cubic feet from 1990 to 1999, but faced with increasing demand, averaged $7.26 per thousand cubic feet in 2005.[69]

ASIDE FROM BEING A SUBSTANTIAL DOMESTIC RESOURCE, NATURAL GAS PRODUCES THE LEAST EMISSIONS OF ANY OF THE FOSSIL FUEL RESOURCES

The natural gas supply that cannot be recovered domestically is imported – primarily from Russia and OPEC nations – in the form of liquefied natural gas (LNG). But many of the same nations on which the United States is already reliant for petroleum dominate the world LNG markets. Even without expanding the share of natural gas within the American energy sector, by 2025 as much as 15 percent of natural gas used will be from LNG imports. While pursuing an expansion of natural gas utilization would provide the benefit of a cleaner-burning domestic energy source, continued advancements in domestic infrastructure must be ensured to enable North American production and delivery and avoid an increased reliance on natural gas imports from nations that do not share the interests of the United States. The United States must not trade a foreign oil reliance for a for a foreign LNG dependence.

Nuclear

Nuclear power currently provides nearly 20 percent of electricity in the United States. By using Uranium (U-235) rods as fuel, nuclear

power is generated by fission – a process of splitting an atom to release energy in the form of heat. This heat is used to heat water and produce steam that drives turbines and drive generators.[70] The facilities produce emission free, consistent power from a domestic fuel to address the base-load electrical demand.

THE CONSTRUCTION OF THESE [NUCLEAR] FACILITIES REPRESENTS AN EXTRAORDINARY OPPORTUNITY TO BRING BACK THE MANUFACTURING AND CONSTRUCTION JOBS ASSOCIATED WITH BRINGING NEW NUCLEAR FACILITIES ON LINE

Nuclear industry growth has been slowed over the past 30 years by concerns with cost, nuclear waste and safety to the extent that no new nuclear plant ordered after 1977 has been completed and brought on line in the United States. Internationally, the nuclear industry has found great success in France and Japan, providing 70 percent of their electricity, at the same time the industry has been completely decommissioned in Italy and Denmark.[71]

Opponents of nuclear power have fueled their movement for decades by arguing that nuclear power plants and their waste are dangerous. This opposition existed long before the Three Mile Island incident in 1979, an event that led to no loss of life. The facts simply do not support the opposition arguments, as the technological advancements that have occurred to address issues pertaining to waste management, cost, and safety have been significant. Advancements include the inclusion of multiple redundant monitoring and control systems for the management of each nuclear reactor, which itself is contained within steel-reinforced concrete that is typically more than three feet thick, capable of maintaining its integrity and containing nuclear radiation even in the worst postulated accident.[72] In addition, the type of nuclear reactors used in the tragedy at Chernobyl that was primarily used to produce plutonium for nuclear weapons – are no longer employed in the United States.

Nuclear-waste management remains an issue at the forefront of the nuclear expansion debate. The radioactive material from the nuclear fission process – the spent fuel – is then typically placed in a large pool and eventually stored in cordoned areas onsite while a long-term storage solution is determined among federal and state stakeholders. There is significant debate as to the responsibility of the government in the management and storing of nuclear waste. The Federal government has proposed a single deep geological storage reserve for spent fuel in Nevada at Yucca Mountain as a substitute to the national security threat posed by storage onsite at nuclear facilities.

The idea of storing radioactive waste in Yucca Mountain is controversial, as opponents argue that natural environmental incidents, e.g., earthquakes, erosion, make the site unsuitable. But proponents of the site argue that opponents are using fear as a means to their objective of thwarting nuclear expansion. They argue that nuclear storage would be safe – particularly if U.S. nuclear energy producers move toward eliminating the "once through" cycle of fuel and begin to recycle the spent fuel produced by fission. This is done by re-enriching highly purified uranium from spent fuel.[73] Therefore, much of the "waste" that would be stored ultimately at Yucca Mountain would be non-radioactive fission products. While the development of reprocessing and advanced nuclear fuel-cycle technologies will require added funding, the benefits of being able to use nuclear waste to create more clean electricity certainly is worth significant attention by Congress.

Despite DOE's plan to begin accepting fuel at Yucca Mountain by January 31, 1998, and billions of federal tax dollars spent, political and legal challenges have dampened progress. No date has been set as to when Yucca Mountain will open, if at all. In fact, Nevada Senator Harry Reid indicated shortly after

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becoming Majority Leader of the United States Senate that "Yucca Mountain is dead. It'll never happen."[74]

In the present political climate the prospect for the expansion of the domestically produced, reliable, and cleaner nuclear power is directly linked to the demand for reduced GHG emissions. Hampered by decades of NIMBYism based on fear generated by the anti-nuclear movement, growth in nuclear power generation has remained idle. A factor that can overcome the NIMBY problem is an embracement of technology by a younger generation that is more concerned about GHG and less fearful of technology. An added constraint to expansion of nuclear power is the lack of certainty pertaining to climate change legislation. It will be difficult for any construction of new nuclear power plants to occur until the costs associated with carbon regulation can be factored into the construction and operation of generating facilities.

Forty of the 104 existing nuclear reactors will require re-licensing or de-commissioning over the next 30 years. Thus, by choosing not to act on expanding nuclear power generation in the United States, Congress effectively will reduce the percentage of clean energy produced for domestic use. In the unlikely occurrence that Congress moves proactively and expands nuclear power by permitting 30 new 1-Gigawatt (GW) plants during the same period, rising demand for electricity between now and 2038 still would outpace the added energy supply created by the new plants and result in nuclear losing portfolio share – down from 20 to 15 percent of the U.S. energy supply.[75] Taking this one step further, in order for nuclear power to shoulder 40 percent of all energy consumed in the United States by 2050 the construction of more than 400 new 1-GW plants would be required.[76] Growing at such a rate would require expediting the licensing process. After identifying and receiving approval for an appropriate site, the design plans for a new nuclear power plant must be reviewed and approved by the Nuclear Regulatory Commission (NRC) before commencement of construction. While the NRC has modified its licensing process to offer a combined construction and operation license (COL), further steps to streamline this process should be considered.

Constructing large-scale nuclear power plants is a decade-long process that requires legislative and financing commitments to assure investors planning for new plants, and regulators must receive assurances that they will not be on the hook for cost overruns that have plagued construction projects in the past. The cost of creating a new nuclear facility per megawatt capacity has been shown as competitive to the correlative costs per energy output of both coal and natural gas.[77] But as decades have passed since a new nuclear facility has been brought on line, those interested in building new facilities remain prepared to move forward, but share a reluctance to be the first to do so.

The reliance reduction and environmental benefits of expanding nuclear power in the United States are stipulated as nuclear should be central to meeting these national security goals. But an additional significant benefit would be the creation of new jobs and industries. Throughout the 2008 presidential campaign, then-Senator Obama spoke frequently of his desire to reduce the national reliance on foreign sources of energy by creating "green-collar jobs" in the United States. Nuclear power holds the promise of fulfilling this campaign pledge. Of the four domestic manufacturers once capable of producing nuclear reactors – General Electric (GE), Westinghouse, ABB Combustion Engineering, and Babcock & Wilcox – only GE and Westinghouse remain, but even they have seen an erosion in their manufacturing capabilities for nuclear.[78] The construction of these facilities represents an extraordinary opportunity to bring back the manufacturing and construction jobs associated with bringing new nuclear facilities on line.

Domestic Oil

Oil – like coal and natural gas – is a fossil fuel resource, meaning that it is drawn from organic material within the Earth and when burned, it and its derivative fuels produce carbon and other chemical emissions. The United States consumes greater than 20 million barrels of oil a day, one third produced domestically and the rest received as imports from foreign sources – predominantly Mexico, Canada, Saudi Arabia, Russia, Iran, and Venezuela.[79] Roughly two thirds of oil used in the U.S. is for gasoline, diesel, or jet fuel.[80] As of 2007, a small percentage of oil was used to generate two percent of the electricity supply in the United States while the rest was utilized industrially, as well as residential power.[81]

The reliance of the United States on foreign sources of oil primarily is a function of the demand of the American transportation sector. Because 96 percent of the transportation sector is oil reliant, the U.S. becomes subject to international factors affecting the price of oil that are out of its control.[82] Price volatility is a function of increasing global demand for oil, particularly by the rapidly industrializing nations of China and India. This market dynamic would be acceptable if the United States were capable of meeting its own demand for oil domestically, but it is not. This has left the U.S. in the reliance crisis on which this paper is based. As the dramatic spike in oil and gas prices demonstrated, the U.S. economy becomes fragile at a certain price point, a fact that demands the attention of U.S. policymakers to begin the process of replacing foreign oil.

While many legislative efforts are made to diminish the role of oil within the United States, parallel efforts should be made to increase the domestic production of all energy sources on which America is reliant. Drilling moratoriums and a federal refusal to allow exploration in the Arctic National Wildlife Refuge (ANWR) over the past few decades have impeded the growth of the oil industry within the United States. While some opponents of oil exploration may argue that inhibiting domestic growth of oil production will put pressure on price thereby driving efforts to replace it with alternative sources of energy, this logic fails as domestic oil has been replaced with oil from unfriendly nations.

Oil exploration became a major issue during the 2008 presidential campaigns as the Congressional moratorium on offshore drilling

was set to expire. The slogan of "Drill Baby Drill" became a rallying cry of those supportive of exploration as gas prices exceeded $4 per gallon. Congress ultimately yielded to public pressure and let the moratorium expire, but likely will re-impose a ban. The focus of the push for drilling primarily involved oil and gas resources that are undiscovered in both the Outer Continental Shelf (OCS) within the territorial limits of the United States and the Arctic National Wildlife Refuge – or ANWR. Oil in the United States can be found mostly off the Gulf and West coasts in OCS and on the Alaskan slope.[83] There are approximately 574 million acres of the U.S. OCS that are precluded from exploration. This area represents 85 percent of all OCS area offshore of the lower 48 states with estimated resources of 18 billion barrels of oil and 76 trillion cubic feet of natural gas.

Most states have jurisdiction and control of royalty revenues for energy resources recovered up to three nautical miles offshore, though Florida and Texas control areas in the Gulf that stretch farther out – ranging up to 10 miles. Seaward of this border is federal territory to 200 nautical miles. In 1985, the Outer Continental Shelf Lands Act (OCSLA) was amended to allow for revenue sharing for the three nautical miles seaward of the state-federal border. Currently, states get a small fraction of the total offshore federal receipts, which were over $6 billion in FY 2005. The Gulf of Mexico Energy Security Act (GMESA) passed in December 2006 allowed for a more advantageous royalty-sharing arrangement for certain states in exchange for the leasing of previously off-limits areas in the Gulf.[84] Beginning in FY2007, revenues from new areas of production and leasing made available by the deal (the 181 Area and the 181 South Area) were divided as follows: 37.5 percent to "Gulf producing states" (Texas, Louisiana, Mississippi, and Alabama), 12.5 percent to a conservation fund for state lands, and 50 percent to the Federal Treasury. Beginning in FY2016, this sharing arrangement will apply to all leases in the Gulf provided that leases are dated subsequent to the enactment of GMESA; the state share of revenues from areas not opened up directly as a result of this bill will be capped at $500 million per year.

EXPLORATION IN ANWR SHOULD BE PART OF ANY COMPREHENSIVE ENERGY PLAN THAT SETS THE U.S. ON A CLEAR PATH TOWARDS RENEWABLE ENERGY WHILE USING DOMESTIC OIL PRODUCTION TO BRIDGE THE GAP BETWEEN OUR PRESENT PERILOUS POSITION AND A RENEWABLE FUTURE

ANWR – located on the North Slope of Alaska in the northeastern quadrant of the state – has become a symbol for the national debate over domestic oil exploration. Opponents of exploring in ANWR contend that the environmental damage caused by extracting oil there would be extensive. Proponents of exploration claim that once online ANWR wells could produce 2 million barrels of oil per day for a period of 25 years, which would offset roughly what the U.S. imports from Saudi Arabia and Kuwait combined during that period.

Unlike the NIMBY problem, in this case it is not local residents that are leading the opposition. The Alaska congressional delegation is unanimous in its support to open ANWR to exploration, anticipating the jobs and revenue that would follow. In light of the growing threat to the U.S. economy and security posed by our dependence on foreign oil and considering technological advancements that allow for the exploration and extraction of oil while leaving a minimal environmental footprint, policy makers should contemplate permitting exploration in ANWR. Exploration in ANWR should be part of any comprehensive energy plan that sets the U.S. on a clear path towards renewable energy while using domestic oil production to bridge the gap between our present perilous position and a renewable future.

Renewable Energy

Renewable sources of energy currently provide less than 10 percent of the electricity generated in the United States. While there are many emerging renewable energy technologies, this paper concerns itself with the frontrunners – solar, wind, geothermal, and hydroelectric – and the government's role in encouraging the adoption of these technologies.

Renewable energy generally requires high preliminary capital investments and maintenance costs, which are offset by the absence of fuel costs. With the exception of hydroelectric power, which is typically the cheapest price per kilowatt-hour of all the electricity sources, renewable energy has not been able to compete with the energy prices available through fossil fuel utilization. For this reason, as well as concerns with reliability, renewable energy has been slow to be adopted on a commercial scale.

Solar Power

Despite being a popular topic of recent conversation, the reality of solar power is that it accounts for less than one percent of all energy consumed in the United States.[85] It is used mostly to provide power at times of peak demand, but it is an intermittent or variable form of energy generation and, thus, its growth as a reliable energy source is tied predominantly to the modernization of the electrical grid. As a Smart Grid is implemented, its improved energy-management capabilities will allow for the integration of solar power in greater capacity on both a large scale and consumer level.

Solar power in the United States is commonly split into two methods, photovoltaic and concentrated solar power (CSP). The difference between these methods is photovoltaic cells convert sunlight directly into electrical current whereas CSP generation focuses light with lenses or mirrors and uses the heat of the focused light to heat a fluid that powers a turbine. Neither method shoulders a significant load of the Nation's current electricity demand, but hold promise of a broader role in the future.

Concerns of intermittency are a greater issue for solar photovoltaic power than they are for solar CSP. Once heated, the hot fluid can be stored and its thermal energy used to generate electricity during the evening hours of peak consumption. Even as an intermittent source, solar electrical generation – both through photovoltaic and CSP – are able to contribute to the overall capacity of the electrical grid.

Historically, solar power has been cost-prohibitive, as investment recovery periods have exceeded energy costs saved by end-users, although some studies suggest that cost parity with conventional energy sources can be achieved by 2015.[86] Still, photovoltaic cells are a developing technology and are currently expensive to produce, requiring costly flawless silicon crystals for their production. The cost of solar energy averages around 20 to 30-cents per kilowatt-hour of generated electricity as opposed to the 6 to 7-cent per KWh of traditional electrical generation.

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Congress has taken legislative efforts to make solar power more appealing, they extended the investment tax credits (ITC) within the "Energy Improvement and Extension Act of 2008," lengthening the 30 percent investment tax credit for solar electricity generation through 2016. In addition, the American Recovery and Reinvestment Act temporally allows energy projects to claim a grant in place of a ITC or PTC at a value of 30 percent of

the project cost for projects that begin construction in 2009 and 2010.[87] Further legislation has illustrated the DOE's interest in using solar power to lessen the role of natural gas within the electrical sector.[88] These are positive legislative efforts for nurturing solar energy through a phase where it cannot otherwise compete with other generation sources; still the near term goals for solar powered electrical generation are in research and development. To this end Congress allocated $1.5 billion for DOE Energy Research and Development for the fiscal year 2007 and $1.9 billion for the fiscal year 2008.[89]

As energy prices spiked during the summer and fall of 2008, solar power became increasingly more credible as an alternative energy option. But as national gasoline price averages have fallen to sub-$1.50 levels, absent policy mandates for increased renewable energy use the rush for investment into solar power likely will subside. Without cost-effective extended electrical storage capabilities, solar electrical generation is best suited to provide energy, as it is available throughout the day and via the use of stored thermal energy from CSP to provide energy during the early evening hours of peak electrical demand. This availability is much the same as the current utilization of natural gas for many utilities. Within a Smart Grid, solar power can be integrated, as it is available, both from utility CSP plants and on a consumer level, with privately owned photovoltaic arrays connected to the grid.

The United States appears to be making positive movement in advancing and integrating solar power within the energy sector. The extension of the ITCs for eight years is a proactive step and should provide some greater legislative clarity for the time being. While much effort and grant funding is appropriated for the purpose of improving the expenses related to solar power generation, the tangential needs for its greater integration are in the modernization of the electrical grid.

Wind Power

Wind power in the United States will be a necessary component of a comprehensive energy policy focused on reducing reliance on foreign sources of energy. Like other renewable energy capabilities, as well as nuclear power, the utilization of wind power holds promise for replacing coal-generated electricity in the United States thereby reducing GHG emissions. But while it has become increasingly popular to discuss wind power as a primary solution for substituting other forms of energy, it is important to remain cognizant that the power of wind in the United States is currently harnessed to meet less than one percent of the Nation's electricity demand – only a small fraction of the overall capacity for wind-generated electricity.

Wind in the United States reaches productive – or useful for energy generation – speeds predominantly across the Midwestern Corridor and off the coasts. As the first offshore wind generation facilities in the Nation are currently under construction, growth of land wind generation capacity grew by 46 percent in 2007.[90] This growth is attributable to signals sent by policymakers in the form of production tax credits.[91] Wind projects recently have tracked correlatively with the status of these PTCs – as Congress approved PTCs, investment in wind power grows, but as PTCs approach their expiration many projects are modified to be smaller and their construction expedited to benefit from the credits. From 1998 through 2005, Congress extended PTCs four times and let them expire thrice. This uncertainty is an impediment to consistent expansion of wind power.[92] PTCs for renewable energy sources were recently extended through 2012[93] but should be made permanent if the United States seeks to achieve a more diverse energy portfolio.

Wind power – like solar – is an intermittent energy resource and its utilization is limited absent a cost-effective method of electricity storage. Its variability has been an obstacle to its integration as a base-load electricity resource as heavy fees currently can be levied by regional transmission managers for failure by wind providers to provide supply when demand is needed. Such fees should not be imposed as they contradict federally mandated policy

against non-discriminatory access. Properly distributed without discrimination and with sufficient incentives, though, wind holds the potential of meeting as much as 20 percent of the U.S. energy demand without posing detrimental effects from its variability.

DESPITE PRODUCING LESS THAN ONE PERCENT OF THE NATION'S TOTAL ELECTRICITY, THE UNITED STATES GENERATES MORE GEOTHERMAL ELECTRICITY THAN ANYWHERE ELSE IN THE WORLD

Harnessing wind to the extent needed to aid in reducing reliance on foreign sources of energy requires that several obstacles be traversed, including the fact that wind power primarily can be generated in locations that are not within reasonable proximity to urban centers – where most electricity is consumed. While some argue the necessity of a nationalized electrical grid superhighway to achieve greater transmission and utilization of renewable energy such as wind power, the requisite advancement in infrastructure to enable transmission from these remote sites to urban areas would require approximately 20,000 miles of transmission lines at a cost estimated at $60 billion.[94] Wind is most appropriately utilized where regionally appropriate.

Wind power becomes even more appealing if the transportation sector moves toward plug-in hybrid electric vehicles (PHEVs). With the appropriate modernization of the grid, PHEVs likely would be predominantly charged during the early morning hours of the day when wind power is more plentiful and electricity demand is otherwise low.

Geothermal

Geothermal energy – or heat drawn from the Earth – is a clean, safe and reliable power source that has potential for base-load generation. However, there are limitations on expanding geothermal electricity generation in a cost-efficient manner. Geothermal power plants use high temperatures (300 to 700 degrees Fahrenheit) within dry steam wells or hot water wells to spin turbines in a process similar to that which occurs in coal-fired and nuclear power plants.[95] Despite producing less than one percent of the Nation's total electricity, the United States generates more geothermal electricity than anywhere else in the world. In a current boom in geothermal development, more than 100 new geothermal plants are being developed in the western United States – primarily in Nevada, California and Oregon.

The recent growth of the geothermal industry is attributable to the Energy Policy Act of 2005, which included geothermal energy as eligible for production tax credits previously only available to wind energy.[96] Congress again revisited geothermal energy in EISA of 2007 in which the Secretary of the Department of Energy is authorized to distribute grants to support R&D and commercial applications to expand geothermal energy production from hydrothermal systems.[97]

Accessibility to usable geothermal sites is the major hurdle. In areas across the Midwestern United States, the expense of creating a geothermal facility, drilling and pumping water into a deep enough well for the geothermal energy to gasify it for use in a turbine would be much greater than geothermal plants near tectonic fault-lines – across California and Nevada especially – where geothermal energy is most readily accessible. Advancing technologies called enhanced geothermal systems (EGS) can render a greater portion of the United States open to geothermal power.[98] Like wind energy, many of the optimal locations for the siting of geothermal power plants are great distances from urban centers where most end-user consumption of energy occurs and face high infrastructure costs for the transmission of electricity generated by the geothermal process.

Hydro Power

Hydroelectric power is the leading source of renewable generation in the United States,

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providing nearly seven percent of the electricity consumed.[99] Hydroelectric power generation meets 19 percent of the global energy demand, an increase of 3 percent since 2003.[100] Typically, hydroelectric power facilities dam a river and employ the downward force of gravity on the reservoir of dammed water to spin the turbines for electrical generation. While construction costs can be prohibitively high, the resulting hydroelectric power generation is inexpensive and reliable. With significant reserves of water, hydroelectric power facilities are able to adjust their power generation output capacity in order to meet fluctuating electricity demand. This allows hydroelectric power to serve both the base-load and peak demands, if necessary. Without direct emissions, hydroelectric facilities were one of the first sources of emission-free electricity to be widely adopted in the United States.

Though there are both limitations and detriments to hydroelectric power. The construction of hydroelectric facilities can commonly result in vast adverse ecological impacts – both up- and downstream from the dam – that can limit the potential for siting appropriate future hydroelectric generation facilities. There also are concerns that the water reservoir produces methane emissions from decaying organic material. Though this may be the case, these potential emissions are difficult to quantify and thus unlikely to be regulated as part of climate change legislation.

Because of the expansive impact on local ecosystems caused by the creation of a reservoir, growth within the hydroelectric industry is impeded by the prevalence of communities developed along waterways. Notwithstanding NIMBY opposition, the fiscal and societal costs associated with the development of large-scale hydroelectric plant can be too great when population relocation is required.

Congress extended tax credits to existing and new hydroelectric power plants in Title XIII of the Energy Policy Act of 2005 at a credit rate of half of that allowed for wind generation. These qualified tax credits were renewed in Title I of the Energy Improvement and Extension Act of 2008. These tax credits are appropriate, as hydroelectric power should be pursued to the extent that it is cost efficient. However, it is

likely that the growth of hydroelectric power will be outpaced vastly by growth in electrical demand. So while hydroelectric power should be employed as a part of a diverse domestic energy portfolio, these facilities will shoulder a successively smaller portion of end-user electricity demand.

In addition to traditional hydroelectric generation, Congress has begun to explore the promise of marine and hydrokinetic renewable energy technologies. Hydrokinetic power can be generated from the flow or velocity of water as opposed to the structures of damns. This technology can be used with less intrusion on ecosystems and without the infrastructure costs. Congress addressed hydrokinetic power in EISA of 2007 in which it directs the Secretary of DOE to establish an R&D program authorized until FY2012 to expand marine and hydrokinetic renewable energy.

CONCLUSION

ACHIEVING *Comprehensive Energy Reform*

Over the coming months the new Congress and President will continue to address energy and environmental issues. As they proceed policy makers must take heed not to duplicate the same parochial and political policy decisions that have left the Nation in its current reliance crisis. To be clear, this is a bipartisan affliction that has plagued the Nation for decades. This policy trend is unsustainable and for the future of America it must stop. Simply expanding the use of renewable energy or pursuing more offshore drilling will be insufficient to meet even the projected growth of energy demand, let alone reduce the reliance on energy from foreign sources. Energy policy must be developed with stakeholders engaged equitably in the process while keeping with the best interests of the Nation regardless of political constituencies. Congress and the President should approach energy policy with an open mind and with contemplation of all energy resources available. Anything short of this approach will be insufficient and a perpetuation of the status quo. Sweeping energy reform will require a fundamental shift from decades of piece-meal energy policymaking.

The future of energy in the United States is bright as technologies exist today that were not available even a decade ago. Harnessing innovation and entrepreneurship will require a comprehensive framework that sets a clear path for U.S. energy policy and provides regulatory certainty for the energy industry. The energy investment landscape has been volatile with policies changing too frequently to truly encourage the long-term investments required to reform the sector. To this end, energy reform and climate change legislation should be considered in tandem. Comprehensive reform featuring energy policies that focus on the advancement of revolutionary changes to the auto fleet, an increase in renewable energy, and an expansion of nuclear power will reduce reliance on foreign energy, create jobs and dramatically reduce greenhouse gas emissions. Equally important, modernization of the U.S. electrical grid should be the centerpiece for energy reform as the benefits that flow from an advanced Smart Grid will be enormous – including catalyzing the transformation of American energy and advancing resilience and reliability in our energy supply.

In order to optimize the innovative alternatives available to address America's energy challenges, collaboration among a diverse array of interests will be required. Bipartisan cooperation will be essential in Washington to develop reasonable yet far-reaching policies. Public-private partnerships will be required to erect the energy infrastructure needed to meet national goals, including genuine collaboration between state and federal authorities, utilities, and energy providers in implementing a Smart Grid. And the American people must be deeply engaged in the process.

ENERGY POLICY MUST BE DEVELOPED WITH STAKEHOLDERS ENGAGED EQUITABLY IN THE PROCESS WHILE KEEPING WITH THE BEST INTERESTS OF THE NATION REGARDLESS OF POLITICAL CONSTITUENCIES

Only through strong leadership will the United States attain comprehensive energy reform that effectively utilizes the diverse array of resources throughout the country. As policymakers look to address national goals of energy sustainability and reduced reliance they should consider all options. From these Congress should work to develop and diversify the Nation's energy portfolio by harnessing wind power through the Midwest region; capturing solar power through New Mexico and surrounding states; exploring for natural gas and oil from Alaska and offshore reserves; developing clean coal from West Virginia, Pennsylvania, and Colorado; extracting geothermal energy through much of the west where the Earth's crust is thin; and continuing the generation of cheap, efficient, and reliable hydroelectric power where it is available. Moratoriums on energy exploration should be avoided at all cost, as they are obstructions to a greater national security. Congress should work to expand drilling while demanding environmental safeguards. Further, nuclear power is clean and should be a major component in the future energy policy of the United States. Policymakers should stop playing politics and move quickly to bring dozens of new facilities online in the coming decade. By combining enhanced nuclear generation with a modernized grid that allows greater integration of renewable energy sources, the United States can become more efficient and open new markets for consumer goods that hold promise to revitalize the economy and revolutionize the transportation sector.

Through empowering innovation, fueling collaboration, and exploring solutions with farsighted leadership the U.S. can achieve comprehensive energy reform that bolsters national security and resilience, enhances the economy, and promotes energy and environmental sustainability. This paper illustrates the wide array of energy resources available to the United States and how working to expand each is the most efficient and effective way to address the Nation's reliance crisis. Each of these resources as discussed has its benefits and hurdles, and none taken solely is the answer to the current crisis. But pursued together, they form a more diverse American energy portfolio that can meet consumer energy demand and fuel an economic renaissance in the United States. But by not doing everything, the Nation will continue to do nothing to resolve its reliance crisis.

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The Reform Institute is a nonpartisan, not-for-profit educational organization working to strengthen the foundations of our democracy and build a resilient society. The Institute formulates and advocates valuable, solutions-based reform in vital areas of public policy, including **homeland and national security, energy and environmental progress, economic opportunity and competitiveness, immigration policy, and governance and election reform.**

A defining characteristic of the United States has been our resilience – the ability to prevail in the face of seemingly insurmountable adversity and to emerge as a stronger nation. This was accomplished by tapping into the unrivaled resources of the nation, the American people being chief among these, and uniting the public in a common cause. Such resilience, though, cannot be taken for granted. It must be nurtured by strengthening the economy, infrastructure and democratic institutions of the U.S. and empowering her citizens in order to be prepared to confront the next challenge. Allowing every American to realize their full potential will make the U.S. the strong, resilient nation it must be to confront the challenges that lie ahead.

As an independent, 501(c)3 public policy organization, the Institute is committed to advancing a policy agenda that engages Americans, especially centrists and independent-minded voters repelled by the partisan gridlock in Washington, in building a more resilient America. The most complex and persistent issues facing the U.S. include establishing a true focus to our homeland security policy that places a premium on enhancing our ability to rapidly respond to and recover from catastrophes while fostering a quick return to a state of near normalcy; developing a comprehensive energy strategy that promotes energy resilience and long-term sustainability; strengthening our economy so that it can continue to be an engine for growth and opportunity in the face of a changing global economy, intensified foreign competition and the aging of the populace; fixing the dysfunctional immigration system through comprehensive immigration reform that balances improving security with acknowledging the importance of immigration to our economy and society; and instituting reforms to the political process that restore Americans' confidence in their government and create an environment conducive to the bipartisan cooperation and leadership that the nation needs.

Political reform is essential to achieving national resilience. Since its founding in 2001, the Institute has been a leader in promoting governance and election reform, recognizing that resolving the most intractable problems confronting our society will require fundamental reform at the core of our democratic system. Such an agenda includes promoting open, fair and competitive elections; reducing the influence of special interests in our politics; advancing accountability and transparency in government; and encouraging a political discourse that rises above blatant partisanship at the federal, state and local levels. Such reforms will encourage more active political participation on the part of the citizenry and produce a more effective government capable of dealing with critical issues.

Governance reform must also encourage significant change in how the public sector interacts with other sectors of society. The challenges of the new century will require a government that is able to serve as a catalyst for focusing the spirit and industriousness of the American people towards overcoming crucial problems. This will require an efficient and responsible government that inspires the populace and supports rather than constrains innovation and enterprise. Effective leadership, combined with more openness with the public and increased collaboration with the private and non-profit sectors, will make America more resilient.

The Institute's work is informed and advanced by a broad base of reformers from across the ideological spectrum, including business leaders, policy experts, and retired and current elected officials and, most importantly, average Americans who are tired of politics as usual. The Institute's distinctive network is reflected in the members of our Advisory Committee – a bipartisan group of notable academics, experts, business leaders and public officials. The Advisory Committee is a "sounding board" for the Institute in its research and development of policy solutions. The committee does not have a governing role with the organization.

The Reform Institute's Board of Directors is chaired by **Paul Bateman** (Klein & Saks Group) and includes **Charles Kolb** (Committee for Economic Development), **Lawrence Hebert** (Dominion Advisory Group), and **Pam Pryor**. In addition, **Cecilia Martinez** serves as Executive Director.

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