CHALLENGE AND OPPORTUNITY:
CHARTING A NEW ENERGY FUTURE

Energy Future Coalition
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The Energy Future Coalition is a broad-based, nonpartisan alliance that seeks to bridge the differences among business, labor, and environmental groups and identify energy policy options with broad political support. The coalition aims to bring about changes in U.S. energy policy to address the economic, security and environmental challenges related to the production and use of fossil fuels with a compelling new vision of the economic opportunities that will be created by the transition to a new energy economy.

CHALLENGE AND OPPORTUNITY:
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EXECUTIVE SUMMARY

Energy is the linchpin of our economic future – in the U.S. and throughout the world. The stability of global markets, the capacity of developing countries to meet the aspirations of their growing populations, the health of the Earth's environmental systems, and our children's future quality of life – all will be affected by how we produce and use energy. Much is at stake in getting energy policy right.

Abundant, affordable energy has enabled developed societies to achieve unprecedented prosperity. Without it, developing countries cannot hope to rise out of economic poverty and social instability. But our old energy ways cannot be sustained if we are to meet the world's future needs responsibly. American leadership, innovation, and investment are needed to develop and deploy the next generation of energy solutions that will create new jobs and economic growth that will be critical to our future standard of living. The Energy Future Coalition seeks to accelerate this transition and chart a new course for energy policy.

We know that change will not come easily, nor will it occur overnight. To achieve it, the U.S. must address three overarching challenges:

- We must reduce the world's dependence on oil, helping to free consumers from the economic, political, and environmental risks that it entails.

- We must take steps to control the emissions from the burning of coal, oil, and natural gas that are affecting the global climate.

- And we must recognize that helping developing nations to grow can be both a boost for them and in the best interest of the United States. Extending access to modern energy services to poor people around the world can demonstrate American leadership and create new markets at the same time.

We aim at ambitious but achievable goals – cutting U.S. oil consumption and carbon emissions each by a third from current levels over the next 25 years, and sharply increasing access to modern energy services in the developing world. Because of the enormous inertia in energy systems, we recognize that these goals will be extremely difficult to reach. The proposals in this report will not get us there by themselves. But we have to begin now if we are to get there at all.

Much of the benefit of our recommendations is foundational – creating the institutions and enabling technologies needed to achieve these goals over the longer term. And by using market mechanisms to quicken the pace of technology change, these foundation steps can begin the transition and bring the targets within sight.

Most of all, we know that hurrying our energy future must be a broadly shared objective. The Coalition therefore recruited participants from a wide range of constituencies with a stake in U.S. and global energy policy – business, labor, environmental groups, farmers, and public policy officials – Republicans and Democrats alike. What we found was a broadly shared vision of both the opportunity and the need for change. Together we agreed – or narrowed differences – on some realistic first steps toward a new energy future, leaving "ideal solutions" aside. Together we are now beginning a program of public education and advocacy to speed far-reaching and long-term change.

As a result of our first nine months of work together, here is what we believe can and must be done – starting right now:

The United States can begin to release the transportation sector from its dependence on oil and reduce its carbon emissions, using technology that increases automobile efficiency and makes greater use of biofuels – alternative fuels produced from biomass. These are important steps in themselves and will help prepare the way for the hydrogen economy to come. Specifically:

- Automobile manufacturers and consumers should be given tax incentives to bring much larger volumes of vehicles with advanced fuel-saving technologies that deliver increased fuel economy into the U.S. market.

- The Department of Defense should conduct a competition, or "fly-off," of novel processes to convert biomass, especially from cellulose, to fuels and other products at commercial scale. This, together with increased funding of R&D on biomass production and conversion, will result in substantially increased use of biofuels.

- Existing R&D programs on fuel cells and hydrogen should be accelerated to lay the foundation for further reductions in carbon emissions and the use of oil. Addressing infrastructure needs is critically important.

The electric utility and coal industries can position themselves to respond efficiently to the challenge of climate change. We believe a two-pronged strategy is essential:

- First, because coal is likely to be used as a major source of electricity, both here and abroad, for years to come, it is essential to demonstrate that carbon dioxide can be captured efficiently and sequestered reliably. Federal efforts to prove the effectiveness of geologic sequestration – the long-term disposal of carbon dioxide emissions in deep underground repositories – should be greatly accelerated. Construction of new power plants using advanced gasification technology, and policies to create incentives for their use, are also important components of a strategy to manage carbon emissions from electricity production and

transportation. These steps will show whether the production of electricity from coal can be harmonized with the need to mitigate global warming emissions.

- Second, we should make both the delivery and use of electricity more efficient, reducing the cost and environmental effects of generation. We recommend federal co-funding of state and utility energy efficiency programs, tied to verifiable results. These programs have developed innovative, cost-effective ways to save energy. And we urgently recommend the development and deployment of a digitally controlled, fully networked transmission system that can accommodate decentralized generation. Such a system would not only improve efficiency, but also would have important benefits for reliability, physical security, and adaptability of the system to 21st century demands.

Private-sector investment and know-how can be brought to bear on the problem of extending modern energy services to the billions of people in developing countries who now lack them. Government development assistance programs play an essential role, but the private sector can best mobilize the capital and technology needed to build the energy infrastructure in the developing world. We recommend that:

- A new financial instrument – the Global Development Bond – be created to securitize investments in large numbers of clean energy projects in developing countries, much as Fannie Mae has securitized the mortgage market here at home.

- Leading U.S. energy companies form a new Council on Energy and Development with labor and NGO partners to tap American technology and expertise in support of energy partnerships for developing countries.

- New guidelines for national and multinational lending agencies be written to encourage the flow of private funds to low-carbon energy projects.

Government policies can be better aligned to stimulate innovation in solving energy problems, especially by the private sector. We support the use of market-based incentives to encourage innovation and support new directions in energy production and use. As these incentives begin to take effect, we also recommend ending policies that are counterproductive:

- Agricultural export subsidies should be replaced with regulatory and financial incentives to encourage the production and use of ethanol and other bio-derived petroleum substitutes. If adopted worldwide, such a step would eliminate a key barrier threatening the current Doha round of international trade negotiations. Farmers should make more money, not less, for helping to hurry the energy future instead of flooding world markets with their surpluses and undercutting their counterparts in the developing world.

- The Environmental Protection Agency should examine whether changes in fuel regulations – allowing greater use of biofuels – could reduce the level of toxic air emissions produced by transportation fuels.

These recommendations are strategic, not comprehensive: They focus on what's important and what we can say "yes" to. Collectively, they will cost no more than the energy proposals that have recently been the focus of congressional attention – and in the long run they will have a large impact on the fundamental challenges at hand. These proposals are not aimed at pending energy legislation; rather, they seek to build on those efforts and current government initiatives and reach further. We believe they will also lead to economic growth and create new jobs.

Other programs and policies that are already part of the public debate also deserve vigorous support – to increase the supply of renewable energy, broaden the availability of efficient mass transit, and support the use of natural gas, to take but three important examples. There was broad agreement within the Coalition that a market-based program will soon be needed to limit U.S. greenhouse gas emissions, but there was not consensus on how and when that should begin. Resolving those questions remains a high priority.

As a whole, the proposals in this package do what we set out to do – to point the U.S. purposefully and practically in the direction of a safer, more stable, and less polluting energy future. They are not only good things to do; they are also things that can get done. Lastly, they are the beginning of our work together, not our destination. Our commitment to continue this collaboration and our understanding of how to do it are perhaps the most notable achievements of the Energy Future Coalition.

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TABLE OF RECOMMENDATIONS

	Transportation Working Group
Recommendation: Consumer tax credit	Incentives for purchase of vehicles with advanced fuel-saving technologies, tied to energy and greenhouse gas emissions metrics.
Recommendation: Conversion tax credit	Tax credit for investment in existing facilities to produce vehicles with advanced fuel-saving technologies, or their components, tied to energy and greenhouse gas emissions metrics.
Recommendation: Fuels standard	EPA-moderated collaborative process on cleaner fuels for advanced vehicles. Endorsement of Bioenergy Working Group recommendations.
Recommendation: Fuel cell research	Acceleration of development program, with focus on stationary applications, low-carbon hydrogen, and hydrogen storage.
Recommendation: Promote conservation	Federal, state, and local policies to encourage mass transit and reduce vehicle-miles traveled.
	Bioenergy and Agriculture Working Group
Recommendation: Fly-off of competing technologies	Competition managed by DOD to demonstrate 5-10 technologies at commercial scale for converting biomass to petroleum substitutes; 5 years, $1 billion.
Recommendation: Shift export subsidies	Provide incentives for energy crops. USTR propose shifting funds from agriculture export subsidies to bioenergy subsidies.
Recommendation: Enhance R&D	Triple bioenergy R&D to $500 million/year and broaden its focus.
Recommendation: Government policies	Continue and expand existing incentives. EPA assess effects of replacing gasoline aromatics with biofuels.
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Option #1: Enhance R&D	Increase R&D funding, esp. on capture and sequestration.
Option #2: Tax credits	Financial incentives to reduce capital cost of advanced technology to competitive levels.
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Option #3: Carbon limits	Discussion continuing of how to achieve carbon reductions over time with minimal effect on coal industry.

	Smart Grid Working Group
Recommendation: Define goals	DOE set goals, vision for performance of advanced electricity transmission and distribution system.
Recommendation: Performance standards	Voluntary performance standards for grid security, reliability, efficiency, and interconnection.
Recommendation: Deployment fund	21st Century Electricity System Security and Modernization Fund to deploy smart grid technologies.
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Recommendation: Investment incentives	Federal co-funding for state, utility spending on energy efficiency above a per-capita minimum; estimated cost $1.8 billion/year.
Recommendation: Expand Energy Star	Double the budget ($60 million) and expand the products covered.
Recommendation: Efficiency training	Training program for building industry and industrial energy managers.
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Recommendation: Private-sector leadership	Business, labor, NGO Council on Energy and Development to follow up on Johannesburg partnerships and mobilize capital for global energy development.
Recommendation: Global Development Bonds	New class of securities for sustainable energy investments in developing countries, leveraging tax incentives, risk insurance, and matching funds.
Recommendation: Rural Energy Fund	Pilot program to aggregate capital for proven "best practices" to alleviate energy poverty in developing world.
Recommendation: Revise lending guidelines	Extended-term financing by export credit agencies for low-carbon energy technologies.
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INTRODUCTION

American leadership is needed to chart a new energy future for the U.S. and the world – one that will responsibly address three great and overarching challenges:

- The political and economic security threat posed by the world's dependence on oil.
- The risk to the global environment from climate change.
- The lack of access of the world's poor to modern energy services and other basics they need for economic advancement.

These are difficult problems, discussed in detail below ("Why we need to act"). The world's energy systems are vast and complex, and like giant supertankers at sea, take a long time to respond to a change in course. But the participants in the Energy Future Coalition, no matter what their affiliation or position on the political continuum, dismissed the notion that the challenges are too large and intractable to affect: It is clear that we need to act, and we need to act in coalition.

The Coalition seeks to persuade America's leaders of all parties, in government and the private sector, to speed the pace of change and the adoption of new energy technologies through policies that encourage innovation, investment, and long-term planning. Developing and deploying the next generation of energy solutions will create new jobs and spur economic growth.

Energy is the linchpin of our economic future – in the U.S. and throughout the world. The stability of global markets, the capacity of developing countries to meet the aspirations of their growing populations, the health of the Earth's environmental systems, and our children's future quality of life – all will be affected by how we produce and use energy. Much is at stake in getting this right.

We aim at ambitious but achievable goals – cutting U.S. oil consumption and carbon emissions each by a third from current levels over the next 25 years, and sharply increasing access to modern energy services in the developing world. By accelerating the pace of technology change and by using economic signals and market mechanisms to influence the world energy sector, we can begin the transition and bring those goals within sight.

Because the carbon dioxide emitted today will warm the planet for a century or more, we must get started immediately. Because energy systems are costly and fundamental

building blocks of the global economy, societies will need time to adjust capital investment strategies and harness the benefits of existing assets. And because the transformation will be so large, there must be a shared commitment to an energy future that looks very different from the system of today.

The deadlock over U.S. energy policy has deep roots. Vested interests in industry have been powerful economic and political players, protecting the status quo and brooking little interference from outside. Similarly, the environmental lobby has proven itself able to block proposals it opposes, but less successful advancing initiatives it favors. As a consequence, little progress has been made in forging the coalitions necessary for breaking the gridlock and leading to change on the necessary scale and timetable.

America's inability to develop a far-sighted, purposeful energy policy is a reflection of the political climate as well. Too often, complex energy issues have been reduced to pithy sound bites. Every decade or so, "comprehensive" energy policy is enacted, but with few exceptions, these measures do little but affect energy practice on the margin, and our strategic interests are kicked down the road.

A broad-based, cooperative coalition for change is the missing, indispensable ingredient in transforming a strategic energy vision into reality. Longtime antagonists who are willing to work together and think openly can create a shared vision for a new energy future.

In the interest of U.S. national and economic security, the time has come to set aside deadlocked issues and rise to the imperative of crafting a long-term, strategic approach to energy. Being strategic does not mean being comprehensive; it means focusing on what's important. It means setting clear goals to address specific challenges – dependence, climate, poverty – and crafting the necessary policies and practices to realize those ends.

The key challenges can be overcome with a blend of carefully targeted policy interventions that build on the power of the market, public-private partnerships in financing and technology development, and, perhaps most important, the development of a political coalition that abandons traditional assumptions and brings together energy interests that have previously engaged mostly in conflict – business, labor, and environmental advocates.

Practical steps, begun today with American leadership, could stimulate economic growth, create new jobs, and yield numerous other benefits. But the first step is to define what it is we want to accomplish. Three ambitious but achievable 25-year goals should guide our energy policies:

First, we should address the dependence issue by cutting U.S. oil consumption by a third, setting an example for the rest of the world and breaking the grip of the global oil cartel.

Second, to take on the climate issue, we should cut U.S. carbon emissions by a third, as stimulus toward a worldwide reduction of two-thirds by the end of the century.

Finally, we should develop, use, and export energy technologies and institute trade policies that can sharply reduce the number of the world's poor who lack access to modern energy services and markets, give billions of people a chance, stimulate economic growth, and create new markets for American goods and services.

Market mechanisms can help to capture the economic, environmental, and security interests we must address simultaneously and comprehensively.

Energy-related assets are long-lived, and change comes slowly to them. Changes aimed at reducing oil use or carbon dioxide emissions are so fundamental, they will in most cases require replacement of existing capital stock – whether power plants, industrial equipment, or automobiles – to switch fuels, capture emissions, increase efficiency, or redesign production. Sudden changes that force premature retirement of these assets can be expensive, wasteful, and disruptive, especially to key sectors of the labor force. Well-designed policies and incentives to accelerate the turnover of capital stock will encourage investment in new technologies that increase productivity, reduce emissions, and stimulate economic growth and job creation.

Both public and private leadership will be needed to put together the technological innovation and political will to transform the American and world energy systems. Many U.S. companies – particularly those with operations in other countries – are prepared to embark on aggressive and innovative greenhouse gas reduction strategies. But without a market signal to justify their course, they wait. Meanwhile, investments in carbon-intensive facilities like coal-fired power plants are held back in the U.S. by the specter of carbon costs in the future, which are surely coming.

The most practical and efficient way to constrain carbon would be an economy-wide market mechanism – as a first step toward worldwide limits. Over time, such limits would provide powerful incentives for investment in renewable energy, efficiency, and other low-carbon options. There was broad agreement within the Coalition that carbon must be controlled and that some sort of market-based management program will soon be needed. But a broad consensus on how and when such a program should begin has so far not been reached, nor is there a political consensus today that can make it happen.

America's quality of life is tied to the beauty and abundance of its natural resources, their prudent use, and the values we derive from enjoying and protecting our mountains, lakes, rivers, and lands. The more we protect these resources for the long term, the more certain it is that our children will inherit the world as we know it today.

America's standard of living is tied to the productivity of its businesses and their workers. The more productivity rises, the better off we all are.

These economic and environmental values need not conflict with each other. The way to pursue them both is through innovation and investment in products and processes that will be more productive and less wasteful of energy.

That kind of investment and innovation will create new jobs and get us back on a path of strong economic growth – without destroying the landscapes and ways of life we cherish. It will make us more secure as a nation and less dependent on unstable regions of the world. It will reduce the environmental burden created by our industrial society, including the threat of global warming that could radically alter the climate we depend on and the world we leave our children. And it will stimulate American leadership in technology that can bring economic opportunity not just to the U.S., but to the billions of people around the world who now lack electric lights or refrigerators or any of the other "conveniences" that in the modern world have become essentials.

The proposals in this package would move the U.S. purposefully and practically in the direction of a safer, more stable, and less polluting energy future. They are not only good things to do; they are also things that can get done.

Other programs and policies that are already part of the public debate also deserve vigorous support – to increase the supply of renewable energy, broaden the availability of efficient mass transit, and support the use of natural gas, to take but three important examples. The future role of nuclear power remains unclear: Its enormous potential to produce carbon-free electricity is clouded by continuing concerns about safety, proliferation, and management of its waste, as well as cost. These issues, as well as the emergence of new technologies to address them, are the focus of a soon-to-be-completed *MIT Study on the Future of Nuclear Power*, co-chaired by John Deutch and Ernest Moniz, and as a result, the Coalition elected not to address the topic independently.

This new course – investing in a new energy future – is an economic opportunity for America. It is also responsible leadership – to turn away from policies that damage our earth and our health, that compromise our children's future, and to develop the clean energy sources we've got.

This is a time of opportunity – a major technological revolution is beginning in energy, with great potential markets. And the reality is that where America goes, others will likely follow. America's example for good or for ill sets the tempo and the direction of action far beyond its borders and far into the future. The world is watching to see what next step we take and whether American can-do will chart a new course for everyone.

As Americans, we do best at turning crisis into opportunity. The American people deserve an energy policy that sees beyond today. The old foot-dragging politics of parties, interest groups, and industries must give way to a concrete long-range energy program. Let us begin to plan our way out of today's energy, economic, and environmental problems. We challenge our leaders to respond to these ideas.

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ABOUT THE ENERGY FUTURE COALITION

The Energy Future Coalition is an independent initiative, funded by private foundations, that seeks to bring about change in U.S. policy to address three great challenges related to the production and use of energy:

- The political and economic security threat posed by the world's dependence on oil.
- The risk to the global environment from climate change.
- The lack of access of the world's poor to the modern energy services they need for economic advancement.

The Coalition seeks to connect those challenges with a vision of the vibrant economic opportunities that will be created by a transition to a new energy economy.

From the beginning, the Coalition adopted the following statement of principles to guide its actions:

1. The Coalition will be a diverse, inclusive, and non-traditional partnership of business, labor, nonprofit organizations, and individuals.
2. The Coalition will be non-partisan.
3. The Coalition will encourage policy options that emphasize technological innovation without constraining consumer choice.
4. The Coalition will educate and advocate on the benefits of clean, affordable, and sustainable energy production and use, both in the United States and abroad.
5. The Coalition recognizes that the transition to a new and sustainable energy economy will take years – indeed, decades – to achieve, and will also pursue shorter-term objectives.

Background: U.S. energy policy for the past 30 years has failed to adequately address the clear risk to our economy and national security of our dependence on oil. It has also neglected the threat of climate change and the need to bring electricity and modern fuels to the earth's 2 billion people who lack them – in effect, guaranteeing their continued poverty.

Exploratory meetings in late 2001 considered whether this pattern of policy failure could be altered. A strong consensus emerged on the need for change, and on the opportunity to present a new vision that links security, environment, and economics – one that could knit together a diverse set of constituencies with a common interest in a more sustainable future. With support principally from the Turner Foundation and the Better World Fund, this inquiry evolved into a six-month scoping process, examining how a major new

campaign could be organized with partners from the philanthropic world, the private sector, and non-governmental organizations.

The first six months of 2002 were devoted to a careful assessment of the concept. The team consulted with more than 150 individuals from business, labor, government, academia, and the NGO community, as well as other funders. In the course of that scoping process, the Coalition hosted a series of policy roundtables featuring such speakers as Amory Lovins of the Rocky Mountain Institute, Sir Mark Moody-Stuart, former Chairman of Royal Dutch/Shell, John Holdren of Harvard and Robert Socolow of Princeton, and Ferdinand Panik, the head of fuel-cell vehicle development for DaimlerChrysler.

The consultation process examined whether there is an opportunity to present a compelling new technology-based vision of what the energy economy can become, to stimulate debate about it in the press, among policy makers and with the general public, and to prevail, over time, in achieving policy change that will spark a revolution in energy technology. The planning team found considerable enthusiasm for such a change in direction and a recognition of the business opportunity it presents.

The Coalition's analysis of past efforts to affect U.S. energy policy found them to be too academic, too narrow, or too sectoral, and for the most part uninformed by practical political experience. To remedy these problems, the Coalition decided to focus on practical political coalition building, aimed at breaking the gridlock that has prevented substantive advances in energy policy for the past three decades. There was, in fact, widespread acceptance of the notion that it is necessary to engage new partners in the business and labor communities and avoid reenacting battles that have been fought in the past, or that clearly divide along partisan lines.

The second half of 2002 focused on creation of the six Working Groups that have shaped the recommendations in this report and that are briefly described below. The Coalition also joined with the National Academy of Engineering in hosting a day-long Symposium on Energy Futures, featuring distinguished experts in the field.

As the Working Groups met and deliberated over a nine-month period, it was heartening to see the open and constructive dialogue among diverse participants, each of them advocates for their own interests but operating within the context of the three challenges identified by the Coalition. Participating without compensation in a common effort to identify new paths forward, they were more collegial and less divided than, in many cases, either they or others expected.

Governance: The Energy Future Coalition is guided by a Steering Committee and by a bipartisan Advisory Council of distinguished policy experts and industry leaders. The following individuals serve on the Coalition's Advisory Council:

- **Henri-Claude Bailly,** Principal, RCG, Boston, MA
- **Scott Bernstein,** President, Center for Neighborhood Technology, Chicago, IL
- **Norman Brownstein**, Chairman of the Board, Brownstein Hyatt & Farber, Denver, CO
- **Roxanne J. Decyk,** Senior Vice President, Shell Oil Co., Houston, TX
- **Mohamed El-Ashry,** CEO, Global Environment Facility, Washington, DC
- **Paul Gorman,** Executive Director, National Religious Partnership for the Environment, Amherst, MA
- **Patrick R. Gruber,** Chief Technology Officer, Cargill Dow, Minnetonka, MN
- **Ted Halstead,** President and CEO, New America Foundation, Washington, DC
- **Dale W. Jorgenson,** Professor of Economics, Harvard University, Cambridge, MA
- **Chansoo Joung,** Managing Director, Goldman Sachs, New York, NY
- **Philip LaRocco,** Executive Director, E+Co, Bloomfield, NJ
- **Jonathan Lash,** President, World Resources Institute, Washington, DC
- **Charles J. McDermott,** Chair, CEO Coalition to Advance Sustainable Technology, Boston, MA
- **Ralph R. Peterson,** Chairman and CEO, CH2M HILL Cos., Denver, CO
- **Howard (Bud) Ris,** President, Union of Concerned Scientists, Cambridge, MA
- **John B. Ritch III,** Director General, World Nuclear Association, London, UK
- **Jamal Saghir,** Director, Energy and Water Development, World Bank, Washington, DC
- **Erik Sten**, Commissioner, City of Portland, Portland, OR
- **Kathryn D. Sullivan,** President and CEO, Center of Science & Industry, Columbus, OH
- **Michael J. Sullivan,** General President, Sheet Metal Workers' International Association, Washington, DC
- **S. Lynn Sutcliffe,** Chair, Praxair Energy Solutions, Somerset, NJ
- **Linda K. Trocki,** Principal Vice President, Bechtel National, San Francisco, CA
- **Mark Van Putten,** President, National Wildlife Federation, Reston, VA
- **J. Craig Venter,** Chairman, Institute for Biological Energy Alternatives, Rockville, MD
- **R. James Woolsey,** former Director of Central Intelligence; Vice President, Booz Allen Hamilton, McLean, VA
- **Kurt E. Yeager,** President, Electric Power Research Institute, Palo Alto, CA

The Coalition's Steering Committee consists of the following individuals:

- **Frances Beinecke,** Executive Director, Natural Resources Defense Council
- **Charles B. Curtis,** former Deputy Secretary of Energy; President, Nuclear Threat Initiative
- **Susan Eisenhower,** President, The Eisenhower Institute
- **Maggie Fox,** Deputy Executive Director, Sierra Club
- **Michael V. Finley,** President, Turner Foundation
- **Robert W. Fri,** former Deputy Administrator of EPA and of the Energy Research and Development Administration; Visiting Scholar, Resources for the Future
- **C. Boyden Gray,** White House counsel to former President Bush; Partner, Wilmer, Cutler & Pickering
- **F. Henry Habicht II,** President, Global Environment and Technology Foundation; Deputy Administrator of EPA under former President Bush
- **Martin S. Kaplan,** Senior Partner, Hale and Dorr; Trustee, V. Kann Rasmussen Foundation
- **Thomas E. Lovejoy,** President, The H. John Heinz III Center for Science, Economics and the Environment; former Chief Scientist and Counselor, Smithsonian Institution
- **John Peterson Myers,** former Director of the W. Alton Jones Foundation
- **John D. Podesta,** White House chief of staff under former President Clinton; Visiting Professor of Law, Georgetown University Law Center
- **Gerald M. Shea,** Assistant to the President for Governmental Affairs, AFL-CIO
- **Timothy E. Wirth,** President, United Nations Foundation; former U.S. Senator from Colorado

Working Groups: The Coalition created Working Groups in six areas. Two subject areas were chosen principally because of their importance to the problem of oil dependence (Transportation, and Bioenergy and Agriculture). Two more were chosen because of their potential to reduce carbon emissions (The Future of Coal, and End-Use Efficiency). The Smart Grid Working Group was formed because of the security risk the grid presents and the opportunity that can follow for increased efficiency and distributed generation. The International Working Group was formed to explore how best to disseminate in developing countries energy solutions developed in the U.S. and how to increase access by the world's poor to modern energy services. A brief description of each follows:

- **Transportation:** Manufacturing incentives to encourage the mass production of advanced technology vehicles, such as hybrid electrics – combined with consumer incentives to buy them – would accelerate the deployment of high-efficiency cars and trucks, while spurring technological progress (e.g., in power electronics) that will prepare the way for additional advances, including hydrogen fuel-cell vehicles, in the future.
    - *Team leader – Dennis R. Minano, former Vice President, Environment & Energy, and Chief Environmental Officer, General Motors*

- **Bioenergy and Agriculture:** Leaders in the chemical and biotech industries – companies like DuPont, Cargill Dow, and Genencor – are developing new technology to make ethanol from almost anything that grows or that once grew – corn stalks, prairie grass, rice straw, sawdust, even this paper. Put American farmers to work on growing crops for energy, get the auto industry enthused about marketing advanced-technology cars and trucks, and the U.S. can cut its use of gasoline substantially. More importantly, the rest of the world can do it, too.
    - *Team leader – Brent Erickson, Vice President, Industrial & Environmental Section, Biotechnology Industry Organization*

- **The Future of Coal:** Coal is a domestically abundant fuel that is used to produce more than half of the electricity generated by U.S. power plants. Its high carbon content, however, is a contributor to the build-up of carbon dioxide in the atmosphere. With the right technology, it may be possible to capture those emissions and literally bury them – pump them into leak-free formations like those that have held oil and gas underground for millions of years. Widespread use of this process would make the abundant coal resources in the U.S. (as well as China, India, and Australia, among others) a low-carbon option.
    - *Team leaders – Gen. Richard Lawson, USAF (retd.), former President of the National Mining Association, and David Hawkins, Director, The Climate Center, Natural Resources Defense Council*

- **Smart Grid:** The nation's electric power grid is antiquated, fragile, and inefficient. Running today's digital society through yesterday's grid is like running the Internet through a switchboard. A serious accident or an act of sabotage could cripple major regions for days or weeks – with huge economic costs. Rewiring the grid with advanced computer controls would allow power to be distributed more efficiently, safely, and resiliently and would facilitate the spread of distributed generation (e.g., fuel cells, solar panels).
    - *Team leader – T.J. Glauthier, President and CEO, The Electricity Innovation Institute (an affiliate of the Electric Power Research Institute); former Deputy Secretary of Energy*

- **End-Use Efficiency:** Federal support for innovative state-based energy efficiency programs would stimulate the adoption of efficiency measures economy-wide, reducing carbon emissions and cutting consumer costs.
    - *Team leader – Roger C. Dower, President, Forest Stewardship Council – U.S.; former President, eNERGYSolve (an energy services company), and economist with the Congressional Budget Office and the World Resources Institute*

- **International:** U.S. leadership on advanced energy technologies is the first step toward promoting their adoption in the developing world. The second step is attracting more private-sector financing for the deployment of modern energy services to the 2 billion poor who now lack them. New financing instruments could assist in that process.
    - *Team leaders – Henri-Claude Bailly, longtime international energy consultant, and Jefferson B. Seabright, former Executive Director of the White House Climate Change Task Force and Director of Energy, Environment & Technology at US AID*

Next Steps: With this report, the Coalition is turning from its intensive policy development phase to begin an 18-month public education program that will energetically promote broad public discussion of the need for a new direction in U.S. energy policy.

While the public shows a strong and consistent preference for new, clean energy technologies, the details of energy policy are so complex that public officials can get away with giving lip service to the new and subsidies to the old. A public education campaign can use the context and leverage of the political campaign season to encourage debate on new directions and a mandate to pursue them.

The Coalition hopes that its proposals, together with those of other energy policy initiatives, will become part of the political dialogue, change the national conversation about energy, attract strong public support, and create the enabling conditions for legislative change.

Several of the Working Groups will continue to meet, with the continuing objective of bridging disagreements or refining proposals. This report marks the first milestone of our work together, not our destination. Our commitment to continue this collaboration and our understanding of how to do it are perhaps the most notable achievements of the Energy Future Coalition.

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

SUMMARY OF RECOMMENDATIONS

TRANSPORTATION WORKING GROUP

Will technology make a difference?

Technologies that improve vehicle efficiency can have a significant impact on both oil consumption and greenhouse gas emissions in the transportation sector. The transportation sector accounts for approximately two-thirds of U.S. oil consumption and about 27 percent of total U.S. energy demand. More importantly, the transportation sector is 95 percent dependent on petroleum – a fact that makes the American economy particularly vulnerable to fluctuations in oil prices and disruptions in supply.

About 60 percent of transportation-related oil consumption is for passenger cars and light trucks. The Energy Information Administration forecasts that the total number of miles traveled each year by light-duty vehicles (cars and light trucks) will increase by over 55 percent by 2020, resulting in a nearly 53 percent increase in fuel use, even with a 6 percent projected increase in fuel efficiency by that date.

The transportation sector accounts for one third of U.S. CO_2 emissions. Notably, greenhouse gas (GHG) emissions from the transportation sector are projected to increase at a higher rate in the next two decades than emissions from any other sector, including the electricity sector.

Investment and innovation in advanced technology can tackle this problem. Indeed, it is already poised to do so. Hybrid vehicles, for example, use more efficient engines and electric motors to achieve high efficiency without any sacrifice in performance. New clean diesel technologies promise significant improvements in efficiency and environmental performance, compared to earlier diesel engines. Fuel-cell-powered vehicles would take these advances one step further, but they remain years away from mass production and even further from widespread penetration of the fleet.

The Transportation Working Group includes members from the three major U.S. automakers, the United Auto Workers, and two leading environmental groups. It conducted an intensive review of the best ways to bring these technologies more quickly and in greater volumes into the marketplace and, based on that review, recommends the following set of policies:

Initiative 1: Establish incentives for manufacturing and purchasing advanced technology vehicles

Already, U.S. manufacturers are preparing to produce and market a range of more efficient advanced technology vehicles. But without external incentives, the transition to the broad manufacture and consumer acceptance of hybrids will be slow, too slow to help significantly on the issues of dependence and climate in the necessary timeframe. To accelerate the deployment of these vehicles into the marketplace, the Working Group recommends a mix of manufacturing and consumer incentives that will partially offset the higher purchase price of these vehicles and reduce manufacturers' capital needs as they retool to produce these vehicles. These incentives should, though, be sharply targeted. The Group recommends that, to qualify for either incentive, a vehicle must, at a minimum, meet performance criteria relating to fuel use.

Initiative 2: Ensure the availability of clean fuels for advanced vehicles

Promoting advanced vehicle performance may require improved transportation fuels, especially clean fuels for advanced technology vehicles, biofuels, and hydrogen for fuel cell vehicles:

1. Clean Fuels for Advanced Technology Vehicles. Advanced technology vehicles that operate on gasoline or diesel fuel will require cleaner fuels than those currently available. The Working Group recommends an EPA-moderated collaborative process to identify fuel properties that should be in place when these new technologies reach the market

2. Biofuels. A key strategy for reducing consumption of gasoline and reducing greenhouse gas emissions is to increase the use of biofuels such as ethanol and bio-diesel. The Working Group supports the recommendations of the Bioenergy and Agriculture Working Group with respect to the expansion of biofuels.

3. Hydrogen. See below.

Initiative 3: Invest in the aggressive development of fuel cells

Widespread deployment of fuel cell technology for motor vehicles will require an aggressive program of development and commercialization. Additionally, the deployment of fuel cell technologies demands the development of the infrastructure to supply hydrogen for fuel cell-powered motor vehicles, as well as a vastly expanded capability to produce hydrogen – preferably from renewable, or other carbon-free or low-carbon energy sources.

To meet these objectives, the Working Group recommends:

1. Acceleration of current programs to develop fuel cell powered motor vehicles.

2. Commercialization of fuel cells in stationary applications, as an essential first step in developing a fuel cell suitable for motor vehicle use.

3. An aggressive program to demonstrate a variety of options for:
    a. producing hydrogen for fuel cell use from renewables or other carbon-free or low-carbon sources, and
    b. transporting, storing, and delivering hydrogen to the vehicular fuel cell.

Initiative 4: Reduce vehicles miles traveled

Overall fuel use will increase if vehicle-miles traveled (VMT) increase faster than efficiency. Without effective measures to constrain growth of VMT, incentives for efficiency alone may not be sufficient to attain the Energy Future Coalition's objectives for reduction in petroleum use and CO_2 emissions in the transportation sector. The Working Group recommends a range of measures be considered to reduce VMT, especially policies to increase use of mass transportation.

BIOENERGY AND AGRICULTURE WORKING GROUP

Why biomass?

Petroleum substitutes from biomass (organic matter such as wood, crops, or animal wastes) could substantially reduce the United States' dependence on oil, while at the same time helping to reduce the risk of climate change. Biomass remains a highly undervalued and underutilized energy asset in the U.S. and around the world. Many forms of biomass can contribute to energy solutions, including grain crops, oilseeds, and animal wastes, but biomass containing cellulose in particular is widely abundant: indeed, cellulose has been estimated to make up half of all the organic carbon on the planet.

Pulp and paper mills already use waste materials to produce large amounts of energy for their own use – 1.5 percent of total U.S. consumption – and with advanced technology could double that. Advances in genomics and industrial biotechnology promise to convert cellulosic biomass to fermentable sugars that can be used as feedstocks for a new type of "carbohydrate crude oil." This conversion of biomass to liquid fuels and other products will provide new markets for farmers and stimulate rural economic development in the U.S. and throughout the world.

Starch from corn and other grain crops has been the principal feedstock for ethanol production and will continue to be for some time. This pathway has been an essential interim step for developing an ethanol infrastructure but offers only modest benefits in terms of oil displacement and greenhouse gas emissions, due to the substantial fossil fuel inputs required to grow corn and convert it to alcohol. The benefits of cellulose conversion are dramatically larger; indeed, a conventional internal combustion engine

operating on cellulosic ethanol produces fewer greenhouse gas emissions on a life-cycle basis than a fuel cell operating on hydrogen from fossil fuels.

The Bioenergy and Agriculture Working Group includes members from the biotechnology industry, chemical manufacturers, the agriculture and forest products industry, universities, and environmental groups. The Working Group recommends the following four initiatives to speed widespread market acceptance of renewable alternatives from biomass:

Initiative 1: Accelerate commercialization of cellulosic biomass conversion through a "fly-off" of competing technologies.

Novel processes capable of efficiently converting cellulose into fuel promise to unlock a vast store of energy hidden on the farm and dramatically expand U.S. ethanol production and reduce this country's dependence on oil. Yet the rapid commercial application of these technologies has not occurred. The agriculture and forestry industries remain reluctant to invest the necessary resources to bring these technologies to commercial scale because to do so entails much risk.

Because of the significant national security benefits that may result from reduced oil dependence, the Bioenergy and Agriculture Working Group recommends that Congress authorize and direct the Department of Defense to conduct a competition, or "fly-off," with the objective of building 5 to 10 commercial-scale demonstration plants within 5 years. The purpose should be to test the viability of various conversion processes applicable to diverse and abundant feedstocks, producing different end products – e.g., ethanol, chemicals, electricity, hydrogen, and other bio-based products. A one-time appropriation of $1 billion should be provided to carry out the competition, and the Department should be given wide latitude to disburse those funds for maximum impact.

Initiative 2: Increase and broaden federal funding for bioenergy R&D.

Currently, the U.S. government provides $150 million in annual federal funding for bioenergy. Of this total, about $48 million is spent on biomass-based fuels and $24 million on biomass-based power. These expenditures reflect neither the magnitude of the problems we currently face nor the significance of the opportunities presented by these technologies.

The Bioenergy and Agriculture Working Group recommends that the federal government triple the current level of bioenergy R&D funding to $500 million per year, and, in order to maximize the impact of that R&D spending, (a) increase the importance of technical (vs. political) considerations in allocating R&D funds, (b) allocate funds to technology areas that have a large potential for R&D-driven impacts, and (c) increase the representation of applied fundamentals in the biomass R&D research portfolio.

Initiative 3: Provide incentives to stimulate new markets for biomass.

Sustainable farming systems yield rich productive soil, clean water, clean air, and intact wildlife habitats. Additionally, these conservation practices sequester carbon, capture methane, and reduce nitrous oxide emissions. Crops that can be used to generate clean, renewable energy provide an opportunity to diversify farming operations and make more efficient use of land without sacrificing sound conservation standards. However, financial incentives, such as subsidies for bio-based products and the use of carbon credits to offset greenhouse gas emissions, are needed to develop markets for these crops. The redirection of agricultural export subsidies toward this end worldwide would have the additional benefits of removing a key barrier that threatens the current Doha Round of international trade negotiations, and enabling farmers in the developing world (who are now severely disadvantaged by those subsidies) to compete on a level playing field.

The Bioenergy and Agriculture Working Group recommends that:

1. The U.S. should accelerate the development and implementation of new incentive payment programs that reward producers for applying and maintaining conservation systems and for producing bioenergy commodities to support this national strategy. Reliable, cost-effective accounting systems for measuring carbon fixation in soils should be pursued to enable carbon trading.

2. The National Research Council should be directed to assess the impacts of shifting domestic farm subsidies from food and fiber crops to conservation, energy crops, and the bioenergy industry.

3. The U.S. Trade Representative should propose as a response to the current deadlock over agricultural issues in the Doha round of trade negotiations that participating countries begin to replace their export subsidies of agricultural crops with incentives for conservation and biomass feedstocks and support for bio-based products.

Initiative 4: Use government policy to increase the use of bio-derived products and reflect their societal benefits.

The economic trend toward greater use of bio-derived petroleum substitutes, which began 20 years ago, is rapidly picking up speed: Ethanol is blended with gasoline for octane and air quality reasons at a volume of nearly 2 billion gallons per year. A myriad of bio-based products – including pharmaceuticals, paints, plastics, and chemicals – have entered the market. While a program to limit emissions of greenhouse gases would best speed these new technologies forward and reflect the benefit to society of averting climate change, it may be a decade or more before such a system has a significant impact on the market. Interim steps are warranted to begin a transition sooner.

The Bioenergy and Agriculture Working Group recommends the following steps:

1. Programs to ensure a growing market for fuels and electricity from renewable energy (a "renewable fuels standard" and a "renewable portfolio standard") should be adopted, and the existing tax incentives for the production of renewable energy (principally from wind) should be expanded to include environmentally acceptable waste biomass.

2. Several million cars and trucks already in the U.S. fleet are fuel-flexible – capable of using gasoline or ethanol interchangeably. Automakers should continue to receive incentives under federal fuel economy standards for the production and sale of these vehicles, and the program should be modified to ensure greater use of alternative fuels, such as high-ethanol blends.

3. The tax treatment provided to ethanol under current law should also be provided to any other transportation fuel derived from biomass with equivalent or better environmental performance based on a full fuel-cycle analysis.

4. The Department of Agriculture should develop and implement a system for labeling products on the basis of their bio-based content, and government procurement policies should encourage the purchase and use of bio-based products and fuels.

5. The Environmental Protection Agency should conduct an assessment of the role that ethanol, ETBE, and other fuel additives could play in displacing oil and accelerating the use of renewable fuels, and of their potential effect on air quality, water resources, and public health if more widely used.

6. EPA should make greater efforts to promote increased use of alternative transportation fuels as a potentially cost-effective strategy for achieving additional NOx emission reductions in ozone non-attainment areas.

THE FUTURE OF COAL WORKING GROUP

What is the "Future of Coal"?

Coal is a domestically abundant fuel (250 years of reserves in the U.S. have been proven). It is the dominant fuel in the U.S. power sector, accounting for 56 percent of the U.S. electricity sector's energy use. However, in the absence of emission control devices, coal combustion is a significant source of air emissions, including sulfur dioxide, nitrogen oxides, particulate matter, and mercury. Moreover, coal is the most carbon-intensive fossil fuel; according to the Energy Information Administration, its combustion accounts for 83 percent of the electricity sector's CO_2 emissions, and 32 percent of total U.S. CO_2 emissions.

Continuing coal use while significantly reducing emissions of CO_2 from coal would require the application of carbon capture and sequestration systems not in use at today's electric generating plants. While the Working Group members have a range of views on when and how CO_2 emissions should be reduced, there is agreement that accelerated availability and deployment of advanced, competitive carbon capture and sequestration systems for use in generation of electricity and production of hydrogen (for transportation and industrial use) would expand the options for responding to the challenge of global warming in a timely manner. The Working Group includes members from the coal industry, major electric utilities, universities, and environmental groups.

Progress to date

The Future of Coal Working Group has spent the last six months productively discussing policy options that would harmonize the continuing use of coal in the United States and other nations with the need to reduce air emissions, and particularly CO_2 emissions, created by coal combustion. The Working Group discussed approaches that could enable the long-term use of coal in a way that achieves substantial economic and environmental benefits. The Working Group members believe that environmental and coal interests are not incurably adverse. There is a common interest in developing advanced coal technology and deploying that technology throughout the U.S. and the world.

The key remaining challenge for the Working Group is to identify a set of policies that will accelerate the development and use of technologies for coal conversion and carbon capture and sequestration, both nationally and internationally and be designed to avoid significant adverse economic and environmental consequences for society. The Working Group is committed to continue its search for common ground on this issue with the realization that crafting such a framework among the diverse members of the Working Group is a significant challenge.

The discussions within the Working Group have focused on three areas:

- An aggressive RD&D program. In order to accelerate the availability, and lower the cost, of carbon capture and sequestration technologies, the Working Group discussed options to substantially increase federal support for research, development, and demonstration projects.

- Incentives for early adoption of carbon capture and sequestration technologies. The Working Group examined financial incentives to cover the cost differential between conventional technology and systems that are readily capable of capturing CO_2. Incentives for geologic sequestration of captured carbon (e.g., providing a credit for every ton of CO_2 sequestered) were also examined. Regulatory incentives to allow recovery of technology investment costs through rate structures were also discussed. Going forward, it will be critical to create a framework in which developers of new plants have the right incentives to ensure that new long-lived capital plant investments are built for carbon capture and sequestration, or are at least compatible with future carbon capture and sequestration requirements.

- Policies to reduce GHG emissions structured to support development and use of cost-competitive carbon capture and sequestration technologies. The Working Group examined options for the reduction of GHG emissions, including a concept that would link the start date for carbon limits to a finding that it is technically and economically feasible to deploy carbon capture and sequestration technology at the requisite scale.

Further consideration

The Future of Coal Working Group has spent the last six months in productive and open discussions about how to design policies for the sector that can attract support from a diverse array of key constituencies. All sides agree that successful resolution of the issue of managing carbon emissions from coal is vital to resolving conflicting societal, economic, and environmental concerns brought on by coal use. All sides are hopeful that, with adequate government policies and private-sector actions, carbon capture and sequestration technologies, including IGCC and geological sequestration, can be developed, demonstrated, and commercially implemented, at reasonable cost and on a schedule that accommodates environmental needs.

The Working Group is committed to continuing these discussions.

SMART GRID WORKING GROUP

What is a Smart Grid, and why is it important?

The term "smart grid" refers to an electricity transmission and distribution system that incorporates elements of traditional and cutting-edge power engineering, sophisticated sensing and monitoring technology, information technology, and communications to provide better grid performance and to support a wide array of additional "digital age" services to consumers.

The potential benefits of a smarter power delivery system are substantial. An upgraded grid could boost the economy, reduce the impact of energy production and consumption on the environment, and enhance the security of the network. A scenario prepared by the Electric Power Research Institute (EPRI) suggests that transformation of the power grid over the next 20 years could result in substantial increases in productivity and GDP growth, reduced carbon emission, and increased national security.

A smart grid should not be defined by what technologies it incorporates, but rather by what it can do:

A smart grid would be "self healing" and more secure from physical and cyber threats. The nation's electricity transmission and distribution system is a critical element of the nation's infrastructure. Yet we have allowed a lack of critical investment and surging

demand for high quality, digital-grade electricity to stress the electrical infrastructure. EPRI estimates that power outages and power quality disturbances cost businesses in the U.S. at least $50 billion per year. Add to this the threat of a terrorist attack, and the need to upgrade the grid becomes paramount. Technology upgrades in the areas of transmission system monitors, information systems, and power flow controls would enable the grid to be "self healing" by permitting grid controllers to anticipate and instantly respond to system problems in order to avoid or mitigate power outages, power quality problems, and system damage. This would benefit high-tech consumers and others who require a stable and reliable power supply.

A smart grid would facilitate the use of new energy technologies like solar power and fuel cells.
Distributed energy resources – fuel cells, microturbines, and renewable generation – are emerging options for homes, offices and factories, but the grid does not accommodate them easily. Enabling such use of distributed generation will lead to improved reliability and power quality, reduced electricity costs, and less pollution. Use of these technologies can be encouraged through the development of "plug and play" interfaces that will enable customers to use distributed generation with a minimum of technical or regulatory difficulty.

A smart grid would give consumers greater control of the electricity use in their homes and businesses.
Simple, effective interfaces between the grid and the energy management systems of buildings and other loads will enable residential, commercial, and industrial consumers to manage electricity use in a manner that improves efficiency and reduces consumer costs.

A smart grid would increase efficiency and reduce power costs.
Grid upgrades that increase the amount of power that can be moved through the transmission grid and that optimize those power flows will reduce waste and maximize use of the lowest-cost generation resources.

The Smart Grid Working Group includes members from electric utilities, the International Brotherhood of Electrical Workers, state regulatory agencies, and consumer groups. To hurry the adoption of national electrical grid enhancements and to obtain the benefits of a smart grid, the Working Group recommends the following three initiatives:

Initiative 1: Develop a national vision statement and demonstration program for the 21st century grid

A key first step in the transformation of the U.S. electricity grid must be the development of a widely shared, compelling vision and strategy for actualizing the grid of the 21st century. The Department of Energy (DOE) should be charged with leading a multi-stakeholder process to expand and clarify the vision of the advanced electricity grid of the 21st century. To support this effort, DOE should conduct a regional and local program of demonstration projects in partnership with the private sector for early deployment of the new technology components of the smart grid throughout the country. The

demonstration program would be designed to field-test the new technologies that will be the building blocks of the smart grid, train the labor force to install and work with these systems, and build a broad base of constituents who are familiar and comfortable with the new technologies and what they can do.

Initiative 2: Establish national grid performance standards

A needed second step is the development of national grid performance standards that would guide future grid investments. If an appropriate technical body, such as the North American Electric Reliability Council (NERC), developed such standards, they would serve as a reliable guidepost for infrastructure planning within the industry. Additionally, state and federal rate regulators would be very likely to support utility expenditures to bring its system up to new national performance specifications, thus facilitating recovery of costs through regulated rates.

The Smart Grid Working Group recommends the enactment of legislation that would encourage NERC to develop specifications for transmission and distribution system performance. Appropriations should be made available to fund the work by NERC. This policy proposal is not based on any predetermination about which technologies are the most appropriate for development or deployment. Instead, the development of performance standards is intended to specify what capabilities the grid is expected to have.

Initiative 3: Enact federal and state incentives to promote investments in smart grid technologies

Widespread deployment of smart grid technologies, and grid upgrades in general, will require very substantial capital investments by the entities that own transmission and distribution facilities. In the 1950s a national approach to financing the interstate highway system was adopted and transformed the nation's transportation infrastructure. The Working Group recommends that a parallel effort be undertaken, in the form of a "21st Century Electricity System Security and Modernization Fund," to help support the costs of initial deployment of the new, smart grid technologies for the nation's electricity transmission and distribution system. Federal and state governments should work with the electricity industry, customers, and other stakeholders to develop a specific funding mechanism for this initiative.

In addition, regulatory policies at both the federal and state levels concerning transmission and distribution rates must provide adequate incentives for investments in innovative technologies. Supplemental federal tax incentives for innovative grid investments should also be available in circumstances where rate incentives alone may be insufficient.

END-USE EFFICIENCY WORKING GROUP

Why energy efficiency?

Despite the maxim, "A penny saved is a penny earned," it is often forgotten that energy efficiency remains the cheapest and cleanest way to meet our expanding energy needs. Increasing the energy efficiency of the U.S. economy promises to reduce our dependency on oil, slow the pace of global climate change, make industry more profitable, create employment, and improve U.S. competitiveness. Indeed, efficiency improvements already have had an impact. Since the 1970s, when concerted federal, state and private efforts began to utilize energy efficiency measures and technologies, slow and steady progress has taken place. In 2002, the United States used 45 percent less energy per unit of GDP than in 1973. While a variety of shifts in the economy have contributed to this change, the implementation of effective energy efficiency programs has played an important role.

These advances only suggest the broader potential of efficiency programs. EPRI estimates that a $4.2 billion annual investment in energy efficiency would reduce U.S. peak demand by 6.4 percent, or 45,000 megawatts. Building new generation capacity to generate that same 45,000 megawatts would cost $8.5 billion annually and result in increased carbon emissions of 100 million tons a year. A combination of new and expanded policies and programs to advance energy efficiency could reduce national electricity use by as much as 15 percent in 2010 and 30 percent in 2020.

It certainly appears that a "rational" economic player would make significant investments in efficiency, yet any number of market flaws and failures conspire to prevent the optimal level of investment. Energy is still relatively cheap, particularly in the United States. Further, electricity is rarely priced to reflect its true marginal costs. Accordingly, for some companies and individual consumers, the rate of return from energy efficiency measures may be low, leading to underinvestment. In other cases, companies and households simply lack information about the financial benefits of energy efficiency.

Consistent with the goal of the Energy Future Coalition to hurry the arrival of a more energy-efficient future, the End-Use Efficiency Working Group – comprised of small and large business consumers, efficiency analysts, organized labor, and state and local officials – recommends the adoption of the following three proposals:

Initiative 1: Provide federal co-funding to expand state and utility energy efficiency programs

States and local communities have been laboratories for energy efficiency implementation. We can and should nurture them. About 20 states have adopted public benefits funds – a small electricity surcharge used to fund energy efficiency programs. Total funding for utility and other state-based energy efficiency programs increased from about $0.9 billion in 1997 to $1.1 billion in 2000, mainly due to adoption of public benefit funds. In 2003, it is estimated that funding for utility and state-based energy

programs increased to around $1.45 billion. Energy efficiency programs in leading states such as California, Connecticut, Minnesota, and Wisconsin reduced electricity use in 2000 by 5-7 percent.

However, there is considerable variation among the states with respect to funding of energy efficiency programs, and overall energy efficiency funding is still well below the levels reached in the mid-1990s before the utility restructuring "wave" hit. Nineteen states (or the major utilities in these states) are spending at least $4 per capita on energy efficiency programs, based on the best information currently available. By comparison, 25 "lagging" states and the District of Columbia spend less than $1 per capita on energy efficiency programs, with very little impact on electricity demand.

The End-Use Efficiency Working Group proposes the U.S. government make targeted aid available to the states that would encourage the states and/or individual utilities to initiate or expand their energy efficiency programs. Specifically, the Working Group proposes a two-tiered co-funding strategy that rewards strong programs, encourages lagging states to catch up, and holds both accountable to performance measures.

- For state or utility programs already funded above the level of $8 per capita , the federal government should contribute $1 for each $1 the state or utility spends on energy efficiency above the threshold of $8 per capita. These programs would be required to show they are reducing electricity use among all their customers by at least 0.5 percent each year, in order to receive federal co-funding. The cost of this incentive to the federal government is estimated at $675 million per year.

- For programs already funded above the level of $4 per capita, the federal government should contribute $2 for each $1 the state or utility spends on energy efficiency programs above the threshold of $4 per capita and below $8 per capita. These programs would be required to show they are reducing electricity use among all their customers by at least 0.25 percent each year, in order to be eligible for federal co-funding. These funds would be available only for a five-year window. The cost of this incentive to the federal government is estimated at $1.1 billion per year.

Initiative 2: Expand the federal ENERGY STAR programs

The federal ENERGY STAR labeling programs inform consumers of high-efficiency appliances, office equipment, lighting products, and other devices. The programs also work with manufacturers to increase the availability of efficient products. In addition, the ENERGY STAR new homes and commercial buildings programs are increasing energy efficiency of both homes and commercial buildings, using a whole-building approach. These programs are having a significant impact on energy efficiency and are very cost effective, saving consumers and businesses more than $75 on their energy bills for each federal dollar spent, according to EPA. It is estimated that cumulative adoption of ENERGY STAR products and buildings reduced electricity use in buildings in 2001 by 84 billion kilowatt-hours (nearly 4 percent).

The End-Use Efficiency Working Group believes that the ENERGY STAR programs should be expanded first to increase their scope (i.e., cover more product and building types) and to increase the level of promotion, technical assistance, and training. The Working Group recommends doubling the budget for the ENERGY STAR programs (currently around $60 million per year) over a two- or three-year period, in conjunction with the major expansion proposed in state and utility efficiency programs. The Working Group estimates that the incremental energy savings by 2015 could be on the order of 45-90 billion kilowatt-hours per year (1-2 percent).

Initiative 3: Expand and improve energy efficiency training programs

Training is critical to ensuring that energy-efficient products are installed and used properly. For example, training building managers in commercial buildings is needed to realize the savings potential from energy management and control systems. Similarly, training contractors who install heating and air conditioning systems can increase the number of units that are sized and installed properly. There is a need to improve a broad range of skills among professionals who have a significant impact on the energy performance of our homes, commercial buildings, and factories. If this is not done, high-efficiency systems will fail to achieve the energy savings of which they are capable. In response to this problem, a number of well-designed energy efficiency training and certification programs have been developed, but these worthy efforts are still relatively limited geographically.

The Working Group recommends setting a national goal of upgrading the energy-related skills of a large fraction of the architects, builders, contractors, building operators, and industrial energy managers in the United States by the end of the decade. To meet this ambitious goal, federal funding for energy efficiency-related training and certification should be increased by $25-50 million per year. The funds would be used to greatly expand the reach and impact of worthy energy efficiency-oriented training and certification programs that already exist and also to develop and implement new training and certification programs where needed.

INTERNATIONAL WORKING GROUP

Why does access to energy matter?

Supporting the economic development of developing countries is not only the right thing for the United States to do; it is in the best long-term economic and security interests of our nation. In this era of globalization, economic performance around the world affects the performance of the U.S. economy. And because poverty is such a long-term destabilizing force, U.S. national security compels an enlightened approach to international development.

But the poorer countries of the world will continue to stagnate or decline if they do not have access to affordable energy. And, if that energy is not clean, it will prove unsustainable for the countries in question and whole world. Since we share one global climate system, we find our environmental destiny bound up in the energy choices made by these developing countries. Given these circumstances, it clearly behooves us to promote the availability of abundant, reliable and clean energy the world over.

The International Working Group includes members from the financial industry, energy providers, the AFL-CIO, and NGOs. It assessed a large number of possible unilateral and multilateral initiatives that could achieve this goal. Based on this initial assessment, the Working Group formulated five major initiatives. These are summarized below.

Initiative 1: Create a coalition of leaders from U.S. industry, government, labor, and NGOs to alleviate energy poverty in the world

Energy emerged as a top priority for all countries during the preparatory process for the 2002 World Summit on Sustainable Development in Johannesburg, South Africa. Participants focused on meeting the needs of the two billion poor people who do not have access to modern energy services. The United States, the European Union, individual EU members, and several international agencies announced large-scale international energy development partnerships. All of these programs address the challenge of moving from small-scale, demonstration-type projects that have been typical in developing countries to large-scale projects capable of providing clean energy to millions of people.

The International Working Group recommends the creation of a U.S. Council on Energy and Development to monitor, encourage, and influence the development of the energy partnerships announced in Johannesburg and to seek sufficient funding and resources to ensure that these ambitious goals are met. Specifically, the Council would aim to:

- Improve the understanding of international energy poverty and security issues in the U.S.;
- Seek strong U.S. government involvement and funding for the energy partnerships;
- Perform periodic reviews of the overall progress made by various partnerships and offer recommendations;
- Focus on priority countries in which to identify and overcome barriers to clean energy development and to improve coordination among various aid and investment activities; and
- Mobilize private-sector resources for investment.

Initiative 2: Create Global Development Bonds

Approximately $50 billion per year is spent for overseas development assistance by all the countries that make up the Organization for Economic Co-operation and Development (OECD). This sum represents less than 0.5 percent of the aggregate GDP of those countries. Clearly, this formal aid funding does not reflect the potential of the

OECD nations to provide capital resources for the purposes of sustainable development. By creating a new category of bond to support global development, the U.S. government could mobilize many billions of dollars in private capital investment for clean energy in developing countries. The net effect would be a significant acceleration in economic, social and environmental advancement around the world.

The International Working Group recommends the creation of a new category of U.S. investment security, called Global Development Bonds, which would encourage a stronger flow of U.S. capital investment to developing countries for critical investments in clean energy and other sectors. These bonds would be to international clean energy development what municipal bonds are to local government finance or what corporate bonds are to business finance – a homogeneous category within which qualified issuers can raise funds for broadly designated purposes as defined in law and overseen by a designated regulatory body. The Working Group recommends the adoption of an innovative package of legislation and rules capable of bringing this vision to reality.

Initiative 3: Create a Global Rural Energy "Best Practices" Fund

More than half the world's population lives in rural areas. Approximately 90 percent of them – some 2.8 billion – live in the developing world. Most of these people depend on wood, dung, and crop residue for fuel and rely on primitive and inefficient technologies to convert them. For many, this combination barely allows the fulfillment of the basic human needs of nutrition, warmth, and light, let alone the possibility of harnessing energy for productive uses and income generation which might assist in alleviating their poverty. Modern, commercial energy sources, such as electricity and petroleum-based fuels (kerosene or LPG), generally provide only a small part of the energy consumed by rural households, mainly because of supply and affordability constraints.

The International Working Group advocates the creation of a Global Rural Energy "Best Practices" Fund that supports and expands proven successes of financing and delivering affordable modern energy services to rural areas in developing countries, with the goal of providing financing for the delivery of basic energy services to 100 million unserved rural households (0.5 billion persons) over the next 10 years. The Fund should (1) replenish, deepen and build on the successful pioneering work undertaken by foundations, NGOs, companies, multilateral, bilateral and government programs; (2) "reward" best practices; and (3) lay the groundwork for the successful design and implementation of larger efforts.

Initiative 4: Revise OECD lending guidelines to provide extended-term financing for low- and no-carbon energy investments

The lack of project financing is one of the most significant barriers to the implementation of clean energy projects in both the developing and developed world. Given the importance of bringing more clean energy to the market, there is a need to identify new and innovative models for public-private cooperation on clean energy finance.

Export Credit Agencies (ECAs) in OECD countries collectively lend more than four times the annual budget of the World Bank for a wide variety of capital projects, goods, and services. These ECAs follow a common set of guidelines that set out the terms and conditions for various aspects of ECA lending, including interest rates, term, eligibility, etc. Currently, export credit agency lending guidelines for energy projects restrict national export credit agencies to 10-year loans – with the exception of nuclear power projects, which are entitled to 15-year money.

The International Working Group proposes that the U.S. Export-Import Bank convene a task force of government agencies and private-sector stakeholders to develop a proposal for revising OECD guidelines to permit extended-term financing for low- and no-carbon energy projects. Such a revision would acknowledge the public good associated with low- and no-carbon technologies, while making a range of clean energy technologies competitive with fossil fuel technologies and helping stimulate more rapid commercialization of climate-friendly technologies.

Initiative 5: Develop a standardized finance protocol for end-use efficiency projects

One of the most significant barriers to widespread implementation of clean and proven energy-efficient technologies in international markets is the lack of commercially viable and sustainable project financing for energy efficiency projects. The problem is not caused by a lack of available funding capacity, but rather by an inability of these projects to access existing funds due to the transaction costs associated with relatively small projects.

The International Working Group proposes that a standardized project financing protocol be developed for energy efficiency investments that:

- Will be adopted by international financial and governmental stakeholders.
- Can be "tailored" to meet the many different needs of local markets.
- Becomes the guide to train local banks on the intricacies of financing energy efficiency projects.
- Creates sustainable financing for these projects by local banks in international markets.

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

WHY WE NEED TO ACT

1. The political and economic security threat posed by the world's dependence on oil.

Since the OPEC embargo of 1973, the problem of oil dependence has been the nation's most important energy challenge. The Department of Energy was created in large part to respond to that challenge, but to little effect. Each of the last seven U.S. presidents has pledged to steer the nation toward greater energy security, but the problem has only grown worse. Imports, which supplied 35 percent of total U.S. oil consumption in 1973, have surpassed 50 percent and are projected to reach 60 percent by 2010. The direct cost of these imports reached $100 billion in 2000, to which must be added part of the cost of military involvement in the Persian Gulf. It is also clear that too often the riches from the oil trade have trickled down to those who would do harm to the U.S. and its friends. The cost of maintaining access to Persian Gulf oil thus must be measured in both dollars and lives.

Four conceptual problems complicate the public debate about oil in U.S. energy policy. The first of these is thinking of the problem simply as U.S. dependence on imported oil from unstable political regions. In fact, the problem is the whole world's dangerous dependence on oil from such regions. While a quarter of U.S. imports are from the Persian Gulf, other key trading partners are substantially more dependent on that volatile part of the world – Japan, for example, buys 75 percent of its oil from that area – and China's economic growth is also rapidly increasing its dependence on the Persian Gulf.

Further, oil is priced worldwide, no matter where the oil comes from. Oil is like any other commodity – the last unit sold determines its price. Thus, diversification of U.S. supply does not answer the price volatility problem. The United States could shift all of its purchases to relatively safe political sources, such as Canada and Mexico, and it would not be protected from a price shock – whether caused by politics, war, or terrorism. The only spare production capacity globally is in the Middle East. This means, for example, that if a terrorist sets off a dirty bomb in the Saudi port of Ras Tanura, the price of oil would spike everywhere in the world, dramatically impacting the U.S. economy. Strategic stockpiles of petroleum can only partially and temporarily mitigate the problem of supply disruption and even less the risk of soaring prices. The only answer is to reduce demand and diversify supply – away from oil. Thus, the emphasis on efficiency, biofuels, and hydrogen in this report.

A second conceptual problem concerns the potential of domestic production – i.e., the notion that increased drilling activity could substantially reduce U.S. exposure to international oil supply risks. Of the one trillion barrels of world reserves, only four percent are to be found in the United States, and fully two-thirds are in the Persian Gulf.

Increased drilling in the U.S. might temporarily slow the growth of oil imports, but alone would not eliminate them or even reverse for long the trend toward increased dependence.

The third conceptual problem about oil concerns the role of fuel economy in vehicles. The transportation sector is 95 percent dependent on petroleum. Oil demand can be reduced through improved fuel economy and other measures to reduce the number of vehicle-miles traveled, but the sector's dependence on a single fuel – and its vulnerability to disruption and price spikes – can only be mitigated, not solved, for some time to come. Fuel economy improvements thus must be pursued in conjunction with the introduction and rapid acceptance of alternative fuels, alternative-fuel vehicles, and alternative modes of transport. Indeed, higher fuel economy is important in part because it amplifies the benefits of alternative fuels – stretching the ability of vehicles to use such fuels.

A fourth conceptual problem involves looking for solutions outside the transportation sector, from greater efficiency and increased use of renewable energy sources like wind and sunlight. These steps – however desirable they may be in their own right – would not have a substantial effect on U.S. oil consumption. Two-thirds of U.S. petroleum use is for transportation, and that is where the problem must be addressed. Almost no electricity is produced from oil in the U.S. – it comes instead from coal, natural gas, nuclear, and hydropower. Increasing the use of renewable energy for electricity and reducing the energy consumption of buildings and industrial processes thus would have a substantially greater impact on other energy sources than on oil.

2. The risk to the global environment from climate change.

Preventing climate change is at its core an energy challenge. Globally, fossil fuel production and use accounts for nearly 60 percent of the emissions that are causing the Earth's atmospheric blanket of greenhouse gases to thicken and trap more heat. In the United States, fossil fuels contribute an even larger – 85 percent – of these emissions. The sources are oil (42%), coal (36%), and natural gas (22%) – split almost equally between use in transportation, industry, and buildings.

Of all the threats to the world's environment, the prospect of climate change looms largest. There is almost complete consensus in the scientific community that our climate is changing and warming; the remaining uncertainty is mostly about how fast and how much this will impact the globe.

Continuing a recent pattern, last year was the second warmest year in recorded history, according to NASA scientists who monitor global air temperatures. Warren Washington, chairman of the National Science Board and chief of the Climate Change Research Group at the National Center for Atmospheric Research in Boulder, Colo., says "it's clear that we're in the midst of a rapidly changing climate that has accelerated in the past 25 years." Researchers using a new climate model at Britain's Hadley Centre for Climate Prediction and Research suggest that temperatures may rise by 10 degrees F. by the end of the

century – a major climate change that would have widespread effects on the environment, the global economy, and public health.

The likely consequences of increased concentrations of carbon dioxide in the atmosphere have been well documented – rising temperatures and sea levels, altered precipitation patterns, increased storm intensity, and the destruction or migration of important ecosystems. Most unsettling, however, is the growing scientific concern that climatic changes may not happen gradually, as has been commonly assumed. In a recent report, the National Research Council warned:

> "Recent scientific evidence shows that major and widespread climate changes have occurred with startling speed. For example, roughly half the north Atlantic warming since the last ice age was achieved in only a decade, and it was accompanied by significant climatic changes across most of the globe…. Abrupt climate changes were especially common when the climate system was being forced to change most rapidly. Thus, greenhouse warming and other human alterations of the earth system may increase the possibility of large, abrupt, and unwelcome regional or global climatic events."

In the face of this uncertainty, and of the risks entailed, the responsible course is to change direction and avoid making matters worse. For example, increased energy efficiency and increased use of renewable energy – tools to reduce carbon emissions – are readily available today, and their use would grow with appropriate economic incentives. Technologies for capturing and sequestering carbon dioxide emissions from power plants offer another promising option, as do alternative fuels and advanced vehicles.

The earth's climate cannot be protected unless all countries take on binding commitments to limit their emissions and control carbon. Emissions of greenhouse gases are increasing faster in developing countries than in rich ones, and in a relatively short time the developing world will produce the majority. To help maintain stability in the world's climate system, China, India, Brazil, and others must, as their economies and populations grow, fuel their development with economically competitive clean energy options. However, they are likely to do so only if the U.S. leads with innovation, investment, and example.

Most countries, including the United States, have ratified the UN Framework Convention on Climate Change, but implementation has been much more problematic. American initiatives are needed that start quickly, yet leave sufficient time for the private investment required to achieve the treaty's objective: stabilization of greenhouse gases in the atmosphere at levels that prevent dangerous human interference with the earth's climate.

3. The lack of access of the world's poor to the modern energy services and other basics they need for economic advancement.

Of the world's six billion people, a third enjoy the kind of energy on demand that Americans take for granted (e.g., electricity at the flick of a switch), and another third have such energy services intermittently. The final third – two billion people – simply lack access to modern energy services. The energy-deprived are the world's most impoverished, living on less than $2 per day. Without electricity their chances for development and a better life are almost nonexistent. And their ranks will grow: Nearly all of the world's population growth is occurring at the lowest levels of income and wealth.

For these very poor people, especially in rural areas, obtaining even a meager amount of energy normally comes at high cost, with health-threatening exposure to indoor air pollution and the drudgery of the daily battle to gather fuel, in increasingly environmentally destructive ways. Equally important, the poor lack the benefits of modern energy services: lights to read by, refrigeration to store medicines, transportation to get products to market, let alone telecommunications and information technology – prerequisites for economic growth and poverty alleviation.

For most developing countries, the necessity of obtaining oil for the transportation sector saps precious foreign exchange and transfers scarce dollars abroad, away from critical social needs like education and health that are unlikely to attract private investment. Many developing countries also suffer from misdirected energy subsidies to both consumers and investors, including the use of government resources to underwrite inefficient energy monopolies and the capture of benefits by urban elites at the expense of the rural poor. This mismanagement of energy resources contributes to impoverishment and inequity, breeding unrest and violence, and making the delivery of sustainable energy more difficult.

Reliable and affordable energy is critical to the functioning of all economies, and clean energy is critical to sustainable development. The world is looking at a tripling of energy use by 2050 as the economies of China, India, and other developing nations increase economic output. If that growth occurs using outdated and polluting energy sources, climate-altering emissions will grow dramatically. Over the next 30 years, China and India alone will account for two-thirds of the increase in total world coal demand, and the power plants they will build will be used for the next 50 years at least.

Climate change affects the poor disproportionately. Half of all jobs worldwide depend directly on natural resources potentially affected by human-induced climate change – fisheries, forests, and agriculture. For example, 70 million people in Bangladesh live in crowded lowlands near the sea, and very large populations in Indonesia and Malaysia are similarly threatened by rising sea levels. In Africa, we can already see agricultural productivity diminished by drought, less availability of potable water, and intensifying hunger and malnutrition. Mass flight from such conditions could destabilize fragile governments and erode investments in poverty reduction. Thus, the problems of oil

dependence, climate change, and economic development must be addressed together if they are to be solved at all.

The United States can make an enormous difference – and advance its own national interests – with policy, regulatory, investment, and resource assistance to developing countries. In addition, by providing international leadership in energy technology and policy, we can create potentially enormous new markets for American products. Thus, helping developing nations to grow can be both a boost for them and for us as well.

In the 1990s, a number of models for financing and delivering rural energy services emerged. These models, initially funded by private foundations, the Global Environment Facility, bilateral aid agencies and multilateral development banks, have helped demonstrate, at a limited scale, various approaches for financing and delivering affordable rural energy services. Some of these models have been successful and continue slowly to increase their impact. Others clearly failed. The challenge now is to scale up the programs that work and encourage the flow of private capital into sustainable energy development, so that the energy choices that are made in one place don't undermine environmental gains elsewhere.

Put another way, U.S. leadership in making clean energy affordable in the developing world will advance our own self-interest by reducing the risks of oil dependence and climate change, and may benefit us directly by creating new markets for American goods and services as these economies grow.

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

ASSESSMENT OF COSTS AND BENEFITS

Overview: The Coalition has focused on practical and politically attractive steps that will address the overarching challenges of reducing oil dependence, controlling greenhouse gas emissions, and bringing energy to developing countries. We believe these kinds of changes, aimed toward these ends, would strengthen the domestic economy and create additional American jobs.

Because of the enormous inertia in energy systems, we recognize that our goals – cutting U.S. oil consumption and carbon emissions each by a third from current levels over the next 25 years, and sharply increasing access to modern energy services in the developing world – will be extremely difficult to reach. The proposals in this report will not get us there by themselves. But we have to begin now if we are to get there at all.

Much of the benefit of our recommendations is foundational – creating the institutions and enabling technologies needed to achieve these goals over the longer term. And by using market mechanisms to quicken the pace of technology change, these foundation steps can begin the transition and bring the targets within sight.

In all likelihood, our goals will not be achievable unless and until there is an economic benefit to reducing greenhouse gas emissions. There was broad agreement within the Coalition that carbon must be controlled and that some sort of market-based management program will soon be needed; a similar recommendation was recently made by an unusual partnership of eight major utilities and CERES, a coalition of investors, and environmental groups. But a broad consensus on how and when such a program should begin has so far not been reached, nor is there a political consensus today that can make it happen.

In the meantime, policy change to speed the development and deployment of innovative technologies that will make our goals more achievable and affordable is a prudent and responsible course of action for the nation.

If our recommendations are as successful as we expect, they will have the following effects over the next 25 years:

Oil dependence: U.S. consumption of oil would be reduced by 3 million barrels per day – about 15 percent of current U.S. consumption, comparable to total U.S. imports from the Persian Gulf. This result would be obtained by:

- Introducing new technology that could economically produce more than 50 billion gallons per year of ethanol. This would be the result of a successful

demonstration program of cellulosic biomass conversion. If all this production replaced gasoline in the transportation sector, it would displace 2.6 million barrels per day of oil.

- Facilitating the adoption of hybrid electric and other advanced fuel-saving technologies in the automotive sector. Because these options will be introduced gradually, because consumer acceptance remains unproven, and because the fleet takes about 15 years to turn over, we have attributed savings of only 400,000 barrels per day of oil to this initiative. If the entire fleet became 25 percent more efficient in this time frame, the additional fuel savings would be at least 1.2 million barrels per day.

Climate change: U.S. emissions of carbon would be reduced by 180 million tons per year, or about 10 percent of total U.S. greenhouse gas emissions in 2001. This result would be obtained by:

- The biofuels and automotive recommendations outlined above.

- Exploiting the opportunities for reducing electricity use through co-funding of state and local efficiency programs as envisioned by the End-Use Efficiency Working Group. These steps would cut electric demand by 225 billion kilowatt-hours per year, which would reduce carbon emissions by 40 million tons per year, assuming no change in the mix of fuels used to generate electricity.

- Note that credit is taken here for the potential deployment of carbon capture and sequestration technology for coal-based electricity generation. Development of this technology will not result in widespread deployment unless an economic benefit is created for reducing carbon dioxide emissions. Illustratively, however, adoption of this process by 10 percent of existing coal-based electricity generation would reduce carbon emissions by 60 million tons a year.

- Even though the Coalition's goals in these two areas focus on U.S. impacts, similar actions by other countries would greatly increase the benefits for the U.S. as well as for the world as a whole.

Economic growth: These initiatives are intended to stimulate private investment on an economically attractive basis. While it is difficult to estimate their aggregate impact on the economy, it is clear that the benefits of this stimulation are large. For example:

- In a recent report, the National Research Council estimated that the cost to the nation's economy of oil dependence is $5 per barrel. This cost includes two macroeconomic effects. One is the exposure to price volatility that creates economic losses as oil prices fluctuate. The other is the cost of the artificially high oil price supported by the OPEC cartel. Avoiding this cost on 3 million barrels per day would save the nation $5.5 billion per year. Other studies suggest savings in the same range.

- The End-Use Efficiency Working Group calculates that its proposed reduction of 225 billion kilowatt-hours of electricity demand would cut consumers' electric bills by some $15 billion per year.

- Analysts differ on the appropriate cost to assign to the potential damages of climate change, but a modest estimate of the damages would be $10 to $25 per ton of carbon. Using this metric, cutting carbon emissions by 180 million tons per year would be worth $1.8 billion to $4.5 billion annually.

Other, less predictable benefits would flow from:

- Creating a more reliable and secure electricity system. The Electric Power Research Institute estimates that power outages and power quality disturbances cost businesses in the U.S. more than $120 billion a year. Simply reducing the cost of electricity outages, and using a more conservative impact estimate of $50 billion a year, would more than justify investment in the smart grid. The benefits of that investment should also include increased efficiency of power distribution and increased capacity for end-use conservation.

- Creating new markets for American products. This is a direct effect of encouraging economic development abroad – e.g., by creating the financing tools proposed by the International Working Group. In addition, ending predatory pricing of agricultural products by redirecting farm subsidies to producing energy benefits would increase rural income in the developing world by billions of dollars annually. Gaining experience on carbon capture and sequestration technologies would position the U.S. to participate in the global market for carbon control. Developing biorefineries for the conversion of biomass to petroleum substitutes would similarly create worldwide market opportunities.

Job creation: These economic benefits would stimulate job creation indirectly, and our proposals would also have direct effects on employment:

- Based on analyses performed by the New Growth Initiative for the recently announced labor-backed Apollo Alliance for energy independence, the biofuels and energy efficiency investments described above could produce over one million jobs in the U.S. economy by 2015, jobs that would stay in the U.S. because the investments must be made here.

- Additionally, our recommendations lay the basis for preserving and ultimately increasing employment in the automotive, coal, and power technology industries. U.S. automakers would be more competitive in future domestic and international auto markets. And maintaining coal as a viable fuel in a carbon-constrained world is crucial to the jobs picture in this industry, which has been shedding jobs for decades.

The long-term job benefits of positioning the U.S. to compete effectively in the emerging automotive and coal gasification markets are very large. According to New Growth Initiative estimates, a strong and competitive automobile industry could create 500,000 jobs over the next 30 years. Similarly, the clean coal export market, according to a General Accounting Office report, represents a potential of some 600,000 jobs for power equipment industries.

It is also important to recognize that these job benefits arise from a substantial restructuring of the U.S. energy industry. This transition might result in some job losses in this sector or other sectors. Assistance for any displaced workers would be appropriate – a process that would be easier if the U.S. is creating new energy jobs at the same time.

Costs and benefits: The cost to the government of deploying biorefineries and advanced vehicles and co-funding state and local efficiency programs would be about $30 billion. This package also includes recommendations for federal expenditures on technology research demonstrations that will lay the groundwork for future progress. We give highest priority to research on hydrogen fuels, fuel cells, and carbon capture and sequestration, along with a major effort to demonstrate new gasification technology for the production of electricity from coal. The cost of these recommendations is $30-40 billion. These costs are similar to the cost of energy incentives and research programs that are being considered in Congress.

Given the quantifiable economic benefits outlined above of at least $22 billion per year, the entire program would pay for itself with approximately three years' worth of benefits, and we feel confident the benefits are, if anything, considerably underestimated.

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

APPENDIX A:

WORKING GROUP REPORTS

MEMBERS OF THE TRANSPORTATION WORKING GROUP

Chair: **Dennis R. Minano**

Denny Minano retired last year after a 30-year career at General Motors, the last 10 as Vice President for Environment and Energy and Chief Environmental Officer. Under his leadership in 1994, GM published its first annual Environmental Report on the performance of GM facilities and products, demonstrating a corporate commitment to public accountability on energy and the environment. Denny is a member of the Keystone Center Board of Trustees and is Co-Chair of the Board's Science and Public Policy Committee. He is a graduate of the University of Dayton, Ohio, and earned a law degree from the University of Detroit Law School, where he also served as an adjunct professor of environmental law. He began his GM career in 1971 as an attorney involved in marketing, product liability, energy and environmental law. During 1995 -1996, he also served as vice president for GM Communications, helping to integrate communication with business strategy.

Members:

Loren K. Beard, Senior Manager, Energy Programs, Environmental & Energy Planning, DaimlerChrysler Corporation

John T. Bozzella, Executive Director, Governmental Affairs, Ford Motor Co.

Susan M. Cischke, Vice President, Environmental & Safety Engineering, Ford Motor Co.

Mark Gainsborough, Vice President, Fuels, Shell International Petroleum Co.

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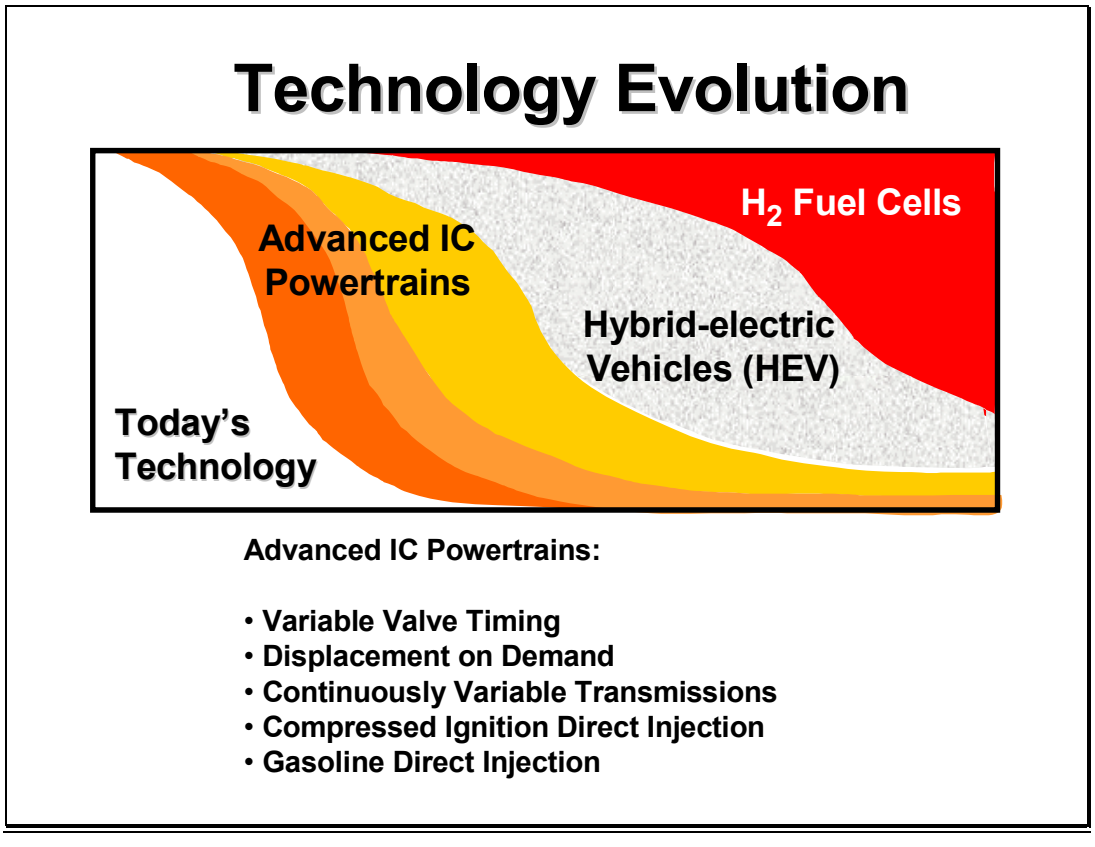
CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

REPORT OF THE TRANSPORTATION WORKING GROUP

I. THE TRANSPORTATION WORKING GROUP

The Transportation Working Group, chaired by Dennis R. Minano, has conducted a focused review of the technological potential for advanced vehicles, barriers to their penetration into the U.S. market and policies that can accelerate their prompt and widespread deployment. This report contains the Working Group's findings and recommendations.

The working group began by reaching consensus on a vision for the evolution of automotive technology:



The Working Group was guided by the following principles in developing its recommendations:

- Responsible, credible use of public resources that contributes to public good
- Measurable, sustainable progress toward improved environmental conditions
- Acceleration of market-based trends and of existing government/manufacturer programs
- Synergy with other transportation-related initiatives

From these principles, the Working Group developed its recommendations, which include following key initiatives:

- A program to provide tax incentives for manufacture of advanced fuel-saving technology vehicles in the U.S., and for consumers to purchase those vehicles.
- A fuels recommendation that ensures continued improvement in emissions from current vehicle systems, availability of the fuels that will be necessary for certain types of advanced vehicles, and support for biofuels.
- Specific government research to accelerate development of a workable and economic fuel cell technology for motor vehicle use.
- Federal, State and local policies that will move more efficient vehicles into the marketplace and reduce vehicle-miles traveled.

II. TRANSPORTATION SECTOR BACKGROUND

The transportation sector accounts for about 27 percent of total U.S. energy demand. Energy demand for transportation is projected to grow at an average annual rate of 2 percent to 40.4 quadrillion BTU in 2020. The transportation sector also accounts for approximately two-thirds of U.S. oil consumption. About 60 percent of transportation-related oil consumption is for passenger cars and light trucks. Vehicle-miles traveled by light-duty vehicles (cars and light trucks) is expected to increase by 2.3 percent per year through 2020 (about 55 percent).[1] The Energy Information Administration (EIA) projects about a 53 percent increase in fuel use by such vehicles over that period (2001-2020), even with a 6 percent increase in new light-duty vehicle fuel efficiency by that date.

Because of U.S. dependence on imported oil and the political volatility of the Middle East, there is a strong link between transportation energy policies and U.S. energy security. This vulnerability has been a major driver of energy policy for the past three decades.

Finally, the transportation sector accounts for 33 percent of U.S. CO_2 emissions. Notably, GHG emissions from the transportation sector are projected to increase at a higher rate in the next two decades than emissions from any other sector, including the electricity sector.

[1] U.S. Energy Information Administration, *Annual Energy Outlook 2003*.

III. VEHICLE EFFICIENCY

A. The Opportunity

Today's automobiles convert roughly 12 to 20 percent of the energy value of fuel into useful energy and attain about one-third of their theoretical maximum energy conversion efficiency. Major reductions in oil consumption and GHG emissions in the transportation sector can be realized by deploying cost-effective technologies that improve vehicle efficiency. Great opportunities to improve vehicle efficiency across the nation's fleet exist through a substantial increase in the production of advanced vehicles that consumers want and can afford.

Some improvement in efficiency can be obtained through improving engine efficiency, reducing vehicle weight, reducing aerodynamic drag, and reducing rolling friction. Cleaner diesel technologies promise significant increases in fuel economy and major improvements in environmental performance, compared to earlier diesel engines.

An even larger opportunity for improvement is through the high-volume applications of breakthrough powertrain technologies that dramatically increase fuel efficiency. Hybrid vehicles, for example, capture and use energy otherwise lost in braking and combine small, efficient heat engines with electric motors to maintain performance while boosting fuel economy. Fuel cell-powered vehicles also have substantial promise – for example, when operated on hydrogen fuel derived from natural gas, a fuel cell vehicle emits about half as much CO_2 on a "well-to-wheel" basis as a conventional gasoline automobile.[2] Fuel cell vehicles using hydrogen derived from renewables or other carbon-free sources will be essentially carbon-free.

Given the promise of these technologies, the Transportation Working Group has put together a set of tools that would help bring technologies to the market that can ultimately reduce our oil dependence and the CO_2 emission impact of cars and trucks, while both satisfying the needs of the consumer and advancing employment opportunities in the U.S. auto industry. We recommend the adoption of a comprehensive set of consumer and manufacturer incentives, supplemented by policies that advance the availability of cleaner fuels and biofuels, and reduce vehicle-miles traveled, and by a research, development, and demonstration program for fuel cells and their necessary hydrogen infrastructure.

B. Incentive Program For Advanced Fuel-Saving Technology Vehicles

U.S. manufacturers are preparing to produce and market a range of more efficient advanced fuel-saving technology vehicles. But, without external incentives, the transition to the large-scale manufacture and broad consumer acceptance of these vehicles will be slow – too slow to help significantly on the issues of oil dependence and climate in the necessary time frame. Getting millions, not thousands, of advanced

[2] See Argonne National Laboratory for General Motors, et al., *Well-to-Wheel Energy Use and Greenhouse Gas Emissions of Advanced Fuel/Vehicle Systems – North American Analysis*

technology vehicles on the road quickly must be the objective. To accelerate the deployment of these vehicles into the marketplace, the Working Group recommends and supports significant incentives that primarily focus on lowering consumer costs for advanced fuel-saving technology vehicles, as well as incentives for U.S. manufacture of these vehicles. The recommended consumer and manufacturer credits complement each other: The consumer credit will increase market penetration of advanced vehicles, resulting in lower unit costs once mass-market volumes are achieved. The availability of the investment tax credit for manufacture of advanced vehicles will reduce manufacturers' capital needs as they retool to produce these vehicles.

1. Consumer Incentives

The Working Group recommends significant consumer incentives for the purchase of advanced vehicles. There are two bases for this recommendation: First, in the early years of production, advanced technology vehicles are likely to be more costly – even after taking into account fuel savings on a full life-cycle basis – than comparable conventional vehicles. Accelerating the market penetration of these vehicles will require a "buy down" of the initial cost of the vehicle through tax credits or other incentives during the early years of production and marketing in order to make the costs to consumers of these vehicles comparable to traditional vehicles. Second, this "buy down" may also be necessary to offset early buyers' concerns that they are investing in untried technologies with uncertain residual value.

For these reasons, the Transportation Working Group believes that well-designed performance-based consumer incentives are an essential element of any strategy directed at the large-scale penetration of advanced vehicles into the U.S. automobile market. Two key components of such incentives are (1) establishing a "performance metric" that spells out minimum standards that vehicles must meet to qualify for the tax credit, and (2) scaling of the credit (i.e., setting minimum and maximum levels of the credit, and spelling out how the credit increases as performance improves) so as to maximize efficiency gains from the credit.

The Working Group discussed a number of potential elements of the performance metric, as well as the eligibility of specific technologies for the credit. We recommend a performance metric that ensures, at a minimum, that this next generation of vehicles is more efficient, uses less fuel, and emits less CO_2 than current vehicles. The Working Group did not reach a conclusion at this time on specific additional elements for the performance metric (such as improvement in air quality or overall reductions in GHG emissions). There was also general agreement that hybrid and fuel cell vehicles would be able to qualify for the credit, but not on whether specific additional technologies should qualify.

Consumer Tax Incentive Recommendations:
After analyzing a range of various energy policy mechanisms and the related impact on our nation's energy consumption, the Working Group recommends the enactment of substantial Federal tax credits for consumer purchases of advanced

technology vehicles that provide added fuel economy gains relative to other vehicles in their segments. The Transportation Working Group has modeled the impact of consumer credits and confirmed that tax credits that buy down a substantial portion of the increased incremental costs of advanced technology vehicles will significantly accelerate market penetration beyond current projections. Congress is currently considering a number of such tax credit proposals. Although Working Group members all support enactment of consumer incentives this year, the Working Group has not reached a conclusion at this time on a full set of performance criteria for qualifications for this incentive.

2. Manufacturer Incentive

While consumer credits are a key policy tool to advance our nation's transportation energy goals, we believe that there is also an important role for manufacturer incentives in accelerating the introduction of fuel-saving technologies into the marketplace, building capacity for domestic production of these technologies, and preserving and expanding U.S. employment as these technologies gain market acceptance. The facility conversion credit recommended below would preserve and renew the existing capital base; provide an equitable transition for working families and communities; sustain existing jobs and tax base; minimize dislocation; and reduce infrastructure costs. The program would be designed to assist firms early in the product life cycle by increasing return on product-development investment, directing benefit to cash flow, and enabling more rapid technology turnover. Importantly, the credit would apply to firms throughout the supply chain.

The Transportation Working Group's members all support enactment of manufacturer incentives this year. As with the consumer credits, the Working Group has not reached a conclusion at this time on a full set of performance criteria for the credit.

Facility Conversion Credit Recommendation:

Automobile manufacturers and component suppliers are eligible to receive a facility conversion tax credit for capital investment to re-equip or expand an existing manufacturing facility to produce advanced fuel-saving technology vehicles or to produce components specially designed for those vehicles. The amount of the credit would be set as a substantial percentage of the capital investment directly related to production of vehicles (or components for vehicles) that meet statutory performance criteria. The credit should be increased for facilities that produce vehicles (or components for vehicles) that exceed the performance criteria. A facility that produces both advanced vehicles and conventional vehicles would receive credit for the portion of the investment attributable to production of advanced vehicles.

In order for the manufacturing credit to be fully effective as an incentive, alternative minimum tax relief will need to be provided, or a transferable tax credit (or similar mechanism) must be provided.[3]

C. Fleet Purchase Programs

We recommend that federal, county, and state governments adopt fleet purchase requirements that place an emphasis on integrating advanced technology vehicles with the highest environmental benefits into government-owned vehicle fleets, such as departments of public works, forests and parks, social service agencies, and the Postal Service. For example, federal and state fleet purchase requirements under the Energy Policy Act of 1992 could be modified to provide added flexibility to include hybrids and fuel cell vehicles in meeting fleet requirements. Similarly, incentives could be developed to encourage private-sector operators of vehicle fleets, such as rental car companies, delivery services, and airport shuttle services, to be early procurers of large numbers of these vehicles. The purchasing power of governmental agencies and private-sector fleet operators across the country will help jump-start the market for advanced technologies, propel a high volume of these vehicles into the marketplace in the early years, and expose a wide range of consumers to these new options sooner than they might otherwise be.

D. Additional State and Federal Incentives

The consumer tax incentives proposed as part of this package can be replicated at the state level, to provide further financial appeal to consumers to purchase and drive environmentally superior vehicles. In addition, some states are discussing proposals to exempt sales and/or excise taxes on hybrid and fuel cell vehicle purchases. We encourage states to explore this option as well, with the benefits of cleaner air, reduced fuel consumption, and lower greenhouse gas emissions.

IV. CLEAN FUELS POLICIES

The Working Group considered three aspects of transportation fuel policies that are critical to meeting the Energy Future Coalition's objectives for the transportation sector: clean fuels for advanced vehicles, biofuels, and the utilization of hydrogen for fuel cell vehicles. The Working Group's recommendations for advanced vehicle fuels and biofuels are discussed below. The hydrogen fuel recommendations are made in the fuel cell section of this report.

[3] The consumer and manufacturer tax incentives recommended above may need to include a number of ancillary provisions, including provisions relating to phase-out of the credits, inclusion of buses and other heavy duty vehicles, and treatment of alternative fuel vehicles.

A. Clean Fuels for Advanced Technology Vehicles

Since the beginning of lead phaseout through RVP control, the introduction of reformulated gasoline, and sulfur reductions, the auto and oil industries have worked together to provide clean, affordable fuels both for private and commercial transportation in the U.S. The oil industry has been a proactive and integral partner in these efforts.

Further improvements to existing fuel quality are a key enabler of improved emissions performance of highly efficient new engine technologies. Because advanced engine technologies that run on gasoline or diesel fuel in most cases will require cleaner fuels than those currently available to meet the ultra-low sulfur standards promulgated by EPA, advances in powertrain technology and advances in fuel quality must be considered in tandem. Adoption of these enabling fuel quality parameters must be considered in conjunction with any policy to advance engine technologies.

Through efforts such as the World Business Council on Sustainable Development, both the automotive industry and the oil industry have recognized that continued improvements in fuels, including sulfur reductions, should accompany advanced vehicle technology.

The 2002 World-Wide Fuel Charter, supported by over 60 automakers worldwide, details some of the fuel parameters that the auto industry feels are needed. Fuels of the quality outlined in Category IV of the Charter could be considered as a template to begin discussions on the nature of clean fuels to support clean-burning, efficient internal combustion engines as a bridge to the hydrogen fuel cell of the future. The auto industry and NGO members of the Transportation Working Group recommended that EPA initiate a rulemaking to incorporate the Category IV requirements of the Charter into EPA's fuels standards under the Clean Air Act. The petroleum industry member of the Working Group was of the view that the matter was not ripe for a rulemaking. As a result, the Working Group agreed to recommend an EPA-moderated collaborative process to identify (1) fuel quality properties that must be available when the new technologies reach the market and (2) the extent to which EPA fuel quality rulemakings will be necessary to ensure this availability. The auto industry, the petroleum industry, and environmental organizations would be included in the collaborative process.

> **Clean Fuels Recommendation:** Collaborative efforts can identify fuel properties that are critical to enabling new fuel-efficient technologies. The Working Group recommends an EPA-moderated collaborative process to identify (1) fuel quality properties that should be in place coincident with the projected market entry of the advanced vehicle technologies, and (2) any fuel quality rulemakings that may be necessary to enable widespread sales of these technologies in the market. Examples of these fuel properties might include "sulfur-free," low aromatics, narrowly defined density, and other properties to enable the success of advanced energy-efficient diesels and their after-treatment systems, and "sulfur-free," volatility-controlled gasoline with additives and other properties such as are necessary to ensure the success of direct-injection gasoline engines and their after-treatment systems.

B. Biofuels

A key strategy for reducing consumption of gasoline and GHG emissions is to increase the use of biofuels, such as ethanol and bio-diesel. These fuels can have a significant effect on gasoline displacement but now account for less than 2 percent of vehicle fuel consumption. In order to make significant increases in the use of biofuels, issues of vehicle cost and readiness, fuel supply and cost, refueling infrastructure, and range will need to be overcome.

Biofuels Recommendation:

Since ethanol can have its greatest impact on petroleum displacement through the deployment of E-85-capable[4] vehicles, an E-85 distribution infrastructure should be encouraged. The Department of Energy, through regulatory authority embodied in the Energy Policy Act of 1992, has designated B-20, a 20% blend of biodiesel in conventional diesel fuel, as an alternative fuel. While some diesel engines and fuel systems are able to run on the fuel without modification, others are not, so the fuel should continue to be considered as an alternative fuel. The EPA, through its regulatory authority, or an industry consensus body such as ASTM, should set appropriate standards for B-20.

The Working Group also supports the recommendations of the Bioenergy and Agriculture Working Group with respect to transportation fuels.

V. AGGRESSIVE DEVELOPMENT OF FUEL CELLS

Accelerating the widespread deployment of fuel cell technology for motor vehicles requires an aggressive program for development and commercialization of the technology itself, for the infrastructure to supply hydrogen, and a vastly expanded capability to produce hydrogen – preferably from renewable, or other carbon-free or low-carbon energy sources.

Cost is a very substantial challenge for use of hydrogen as a transportation fuel in the near term. The changeover to hydrogen-powered cars will involve developing infrastructure to produce, transport, and store hydrogen, as well as the transition of the automobile fleet to fuel cell technologies. One estimate is that the infrastructure alone will cost $100 billion in the U.S. over a period of a decade or more.

A. Fuel Cell Technology

Hydrogen-powered fuel cells represent a critical technology for advanced vehicles. They convert the chemical energy in hydrogen into electric energy without combustion and with only water as a byproduct, thus eliminating pollution at the point of use. Their

[4] E-85 is a blend of 85 percent ethanol, 15 percent gasoline.

emissions of greenhouse gases and other pollutants are generally lower, although this depends on how the hydrogen is produced.

Because fuel cells produce electric power without combustion, far less waste heat is produced; conversion efficiency is at least twice that of combustion engines. Further, hydrogen can be produced from a variety of sources, thus offering the potential of significantly reduced oil imports for any given level of overall vehicle-miles traveled.

Fuel cell technology is fundamentally solid state in nature. Fuel cell vehicles will involve far fewer moving parts; they are fundamentally simpler mechanically than conventional or (especially) hybrid vehicles. Scientists draw a direct comparison between fuel cell technology and microelectronics technology, and suggest the same potential for cost reduction over time.

Because the power plant in a fuel cell vehicle is connected to the drive mechanism by wire rather than a mechanical transmission, fuel cell vehicles offer almost unimaginable design flexibility. Designers have already begun to illustrate the opportunities associated with needing only one or two basic platforms to enable dozens or more body and duty types. Further, the opportunity for radically different body designs offers the potential for consumer excitement and acceptance well beyond that of any advanced combustion technology vehicles. This latter point is especially significant when taking into account the need to create accelerated acceptance of new vehicles if the performance of the overall fleet is to be materially affected within the next few decades.

B. Hydrogen Infrastructure

Today, most hydrogen is produced in a few large, centralized plants and its use is generally confined to industrial gas and refinery markets. Creating a distribution infrastructure to serve vehicle fueling needs will be a great challenge. At present, the cost of transporting hydrogen gas is so high that centralized large-scale production to supply fuel cells is not a feasible option. Rather, the most practicable approach to meeting distribution needs in the near term may be through distributed (i.e., on-site) technologies. In the longer term, other production and distribution systems may emerge.

C. Program Participation and Funding

The benefits of a fuel cell vehicle program will extend well beyond the automotive sector and should involve energy companies and utilities, and might reasonably involve other energy-intensive industries as well. To date, however, major energy companies and utilities have not taken an interest in fuel cell technology or hydrogen fueling infrastructure development commensurate with their considerable financial resources. Realistically, though, the technical challenges and financial cost of rapidly accelerating the deployment of fuel cell vehicle technology are beyond the likely capabilities of the private sector acting alone. Consequently, government has recognized and accepted the need to provide assistance to the private sector in this undertaking.

The Department of Energy currently manages a $100 million per year (five-year) program focused on hydrogen and fuel cell vehicles. The President has proposed to more than double this budget, and various legislative drafts appear sympathetic to this objective. However, it is not clear that appropriations will match the request, nor that the amount is sufficient in any case.

Fuel Cell Recommendations: The Working Group recommends:

(1) Acceleration of current federal and state programs to develop fuel cell powered motor vehicles. A dedicated national demonstration and infrastructure development program is needed. We particularly encourage teaming among large and small companies, and finding ways to encourage major energy companies to join the effort. DOE's efforts to foster renewable resources within its hydrogen supply infrastructure programs are also appropriate, in our view.

(2) Support for aggressive programs to demonstrate a variety of options for –

a. Producing hydrogen for fuel cell use from renewables or other carbon-free or low-carbon sources, including biomass, and
b. Transporting, storing, and delivering hydrogen to the vehicular fuel cell. A particularly pressing need is advanced hydrogen storage technologies for vehicular application. Hydrides and so-called nanofibers represent very promising technologies that offer the potential to significantly improve energy-to-weight ratios relative to compressed hydrogen. These technologies will simultaneously mitigate safety concerns.

(3) Attention to stationary as well as vehicle applications by DOE and other programs to foster fuel cell development. Transportation markets will be the most economically challenging of all fuel cell applications, given 100 years of engineering refinement and cost reduction that have been applied to automotive internal combustion engines. Stationary markets such as critical power applications (where the power source must be clean and not subject to spikes or interruption) promise to offer appropriate near-term opportunities for fuel cell commercialization. Program developers should incorporate these interim markets into a coherent plan for bringing forward fuel cell technology for the transportation sector.

Fostering these stationary applications and linking renewable technologies into the hydrogen supply pathway will require the active involvement and support of the electric utility industry. Utilities are positioned either to assist or to impair the emergence of distributed technologies. Current retail rate design methodology in many states penalizes utilities if they lose retail sales to distributed generation. The lack of nationwide technical standards for interconnecting distributed generation and varying regulatory requirements raise transaction costs to users of these technologies. Widespread deployment of these technologies will require resolution of these issues.

VI. REDUCING VEHICLE-MILES TRAVELED

Without effective measures to constrain growth of vehicle-miles traveled (VMT) and to replace petroleum-based fuels with biofuels, incentives for efficiency alone may not sufficiently reduce petroleum use and CO_2 emissions in the transportation sector.

EIA's *Annual Energy Outlook 2003* models a case in which the fuel economy of new light-duty vehicles increases 19 percent (to 28.7 miles per gallon) in the 2001-2025 time frame. This would result in an increase of 4.6 miles per gallon for the new light-duty fleet. Notwithstanding this gain in new car fuel economy, fleet-wide fuel use still increases by 66 percent over this period.[5] While EIA's projections do not reflect the level of market penetration of biofuels sought by the Bioenergy and Agriculture Working Group, they nonetheless underscore the need for large improvements in fuel efficiency and the value of considering VMT policies in any strategy to address fuel consumption and emissions in the transportation sector.

An advantage of VMT reduction is that it can affect the cars and trucks on the road today, providing both near- and long-term benefits in addition to increases in fuel economy and minimizing the impact of the time it takes (15 years or more) to turn over the on-road fleet. A range of policies should be considered to address VMT. First, transit systems can be expanded, including increasing local public transit options such as inner-city bus routes and inner-city rail. The use of transit should be encouraged: employees can be encouraged to increase their use of telecommuting in lieu of driving, employers can provide mass transit tax benefits equivalent to workplace parking space subsidies, and carpooling can be encouraged. However important, these programs will have only modest effects in curtailing projected increases in VMT in the near term. For example, doubling the rates of carpooling and transit use would reduce oil consumption by about 0.3 and 0.1 million barrels per day, respectively (about 1.5 percent and 0.5 percent of oil use).[6] Any success with these programs to reduce vehicle-miles traveled may produce correspondingly modest GHG reduction benefits.[7]

Additional options include support for inter-city rail services such as Amtrak and development of new high-speed rail linked to car sharing services. Zoning and other development policies can reduce the need for driving. More effective intermodal passenger transportation systems can be developed so that air transportation is used for long-haul inter-city transportation, and trains and buses are used for short-haul trips or for trips from hub airports to ultimate destinations. With respect to commercial trucking, policies can also promote intermodal freight transportation, in which trucks deliver freight to trains for more efficient long-distance transport.

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[5] EIA, *Annual Energy Outlook 2003*, tables A7, F3.

[6] Schaper and Patterson, *Factors that Affect VMT Growth*, 1998.

[7] There is significant opportunity to recognize benefits in reduced fuel use, reduced VMT, and reduced emissions if hybrid technology or alternative fuels are applied in mass transit. For example, one automaker that markets a hybrid-electric bus has determined that, if hybrids replaced the 13,000 conventional transit buses in the nine largest U.S. cities, nearly 151 million liters of diesel fuel per year could be saved. See www.gmability.com. If conventional buses were replaced by natural gas fleets, more than double that amount of diesel fuel could be saved.

Recommendations: The Working Group recommends support by government agencies at the federal, state, and local levels of a range of policies to reduce VMT, including:

- Expanding high load-factor public transit, by measures such as providing states more flexibility in the use of highway trust funds for mass transit projects, increasing the number of inner-city bus and rail routes, and expanding tax benefits for transit passes.
- Funding high-speed inter-city rail service.
- Promoting telecommuting, carpools, and employee mass transit incentives.
- Large-scale demonstration projects of intermodal passenger transportation modeled on European systems (air to trains to bus).

MEMBERS OF THE BIOENERGY AND AGRICULTURE WORKING GROUP

Chair: **Brent Erickson**

Brent Erickson is Vice President for Industrial and Environmental Biotechnology at the Biotechnology Industry Organization (BIO). Previously Brent served for four years as environmental representative for the American Petroleum Institute (API). Prior to working at API, he served in the U.S. Senate as legislative director to former Senator and assistant Republican Leader Alan K. Simpson (R-WY). Brent also worked on the Senate Environment and Public Works Committee for the late Senator John Chafee (R-RI). Prior to working on Capitol Hill, he worked at the Department of Energy's Laramie Energy Technology Center.

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REPORT OF THE BIOENERGY AND AGRICULTURE WORKING GROUP

Why Biomass?

Sustainably produced biomass is a highly undervalued and underutilized energy asset in the U.S. and around the world. Many forms of biomass can contribute to energy solutions, including grain crops, oilseeds, wood residues, and animal wastes, but biomass containing cellulose in particular is widely abundant: indeed, cellulose has been estimated to make up half of all the organic carbon on the planet. A source of stored solar energy, biomass has the theoretical potential to supply a very large share of the world's energy needs – by one analysis, as much as 60 percent of the total worldwide energy use in 2000.

Advances in genomics and industrial biotechnology are making it possible to convert cellulosic biomass to fermentable sugars that can be used as feedstocks for a new type of "carbohydrate crude oil." These petroleum substitutes could contribute in a major way to reducing the nation's dangerous dependence on oil, while at the same time helping to address the climate change issue: The use of sustainably produced bio-derived fuels and products contributes little in the way of net greenhouse gas emissions, as the carbon dioxide released during combustion is offset by the carbon dioxide absorbed by the biomass as it is grown. Other methods of biological energy production are also under development. These include production of hydrogen from algae and even the creation of synthetic microorganisms to consume carbon dioxide and produce methane or hydrogen.

The Bioenergy and Agriculture Working Group believes that it is uniquely positioned to contribute to the Coalition's goals through the accelerated development of bio-derived substitutes for oil and gas, including chemicals, plastics, a wide range of other bio-based products, hydrogen, and electricity in addition to fuels. The technology for producing these substitutes is poised for widespread deployment into the marketplace once the conversion processes have been demonstrated to be economically competitive at commercial scale.

Market opportunities alone will eventually lead to widespread use of these bio-products; however, government intervention can greatly accelerate their market penetration and is easily justified by the potential benefits in terms of reduced oil dependence and greenhouse gas emissions. After 100 years of oil dominance, this government support will help overcome the infrastructure advantages that fossil sources now enjoy.

Accelerated development of industries that convert biomass to liquid fuels, polymers, and chemicals will provide new markets for farmers and stimulate rural economic development in the U.S. and throughout the world. In essence, the ability to convert cellulosic biomass to other products will allow farmers to harvest an additional cash crop from every field they plant. Wheat farmers, for example, could sell their straw along with their wheat. Rice straw, now a waste disposal problem, could become a source of revenue.

Starch from corn and other grain crops has been the principal feedstock for ethanol production and will continue to be for some time. This pathway has been an essential

first step toward developing an ethanol infrastructure, and government support for continued growth of the industry is vital as a bridge to the future. The efficiencies of crop production and ethanol conversion continue to increase.

Using cellulose will increase the amount of ethanol that can be produced from grain because more of the plant will be used. Obtaining energy and other products from cellulose also avoids the consumption of food crops for industrial applications. Thermochemical processes have the potential of converting a still wider range of biomass feedstocks, including abundant animal wastes and sewage, to clean renewable fuels – even gasoline. Pulp and paper mills already use waste materials to produce large amounts of energy for their own use – 1.5 percent of total U.S. consumption – and with advanced technology could double that.

Starch-based ethanol has limited benefits in terms of oil displacement and greenhouse gas emissions, due to the substantial fossil fuel inputs required to grow grain and convert it to alcohol. The benefits of cellulose conversion are dramatically larger; indeed, a conventional internal combustion engine operating on cellulosic ethanol produces fewer greenhouse gas emissions on a life-cycle basis than a fuel cell operating on hydrogen derived from fossil fuels.

In general, the environmental attributes of biomass production and use will depend on the particular crop, the method of cultivation and harvest, the location, and other factors, as well as the energy conversion and emissions control technologies used. Relevant issues include the protection of wildlife and biodiversity; soil quality and erosion; air and water quality; forest health; and appropriate use of genetically modified organisms. Incentives for increased use of biomass should take these issues into account.

Finally, our focus on bioenergy is not meant to imply that other renewable energy resources, such as solar, wind, and geothermal, are less worthy of attention. We support increased R&D, incentives to stimulate new markets, and using government policy to capture societal benefits for other renewable energy resources as well. Use of these resources will also enhance the sustainability of bio-based conversion processes.

To hurry the future of widespread market acceptance for renewable alternatives from biomass, the Working Group recommends the following steps, discussed in detail below:

1. Accelerate commercialization of cellulosic biomass conversion to fuels, chemicals, electricity, hydrogen, and other products through a competition, or "fly-off," of innovative technologies.
2. Increase and broaden federal funding for bioenergy R&D.
3. Provide incentives to stimulate new markets for biomass. Develop measurement tools to support carbon trading based on agricultural practices. Propose in international trade negotiations the gradual replacement of export subsidies of agricultural crops with incentives for conservation and biomass feedstocks and support for bio-based products.
4. Use government policy to increase the use of bio-derived products and reflect their societal benefits.

1. Prove out and sort out technologies at commercial scale

Technologies that can enable a significant growth in the use of biomass are nearing the point where they can enhance national security, significantly reduce greenhouse gas emissions, and boost the economic viability of many industries. These technologies include the application of breakthroughs in biotechnology, significant advances in conversion technologies, modeling and control technologies, increased understanding of impacts on and management of eco-systems, and many more. Yet the efficient and rapid commercial application of these advances has not occurred. Much of the reason can be captured in a single word – risk. Between concept and commercialization there is very high risk all along the way – financial risk, technical risk, market risk, policy risk, regulatory risk.

When technologies can have major positive impacts on national and societal goals and can, if brought to maturity, create viable new products or even new industries with all the associated jobs and benefits, government intervention is justified. Bio-based energy and bio-based products, like other clean energy alternatives, represent such a group of technologies, and there are some reasonable and needed policies that could make the difference between success and failure.

The agriculture and forestry sectors of the economy are positioned to supply a significant portion of the nation's energy, fuel, and chemical needs, and the knowledge and technologies to achieve that success are increasingly becoming available. For example, the pulp and paper industry, which already meets half of its own internal requirements for heat and power with waste biomass, could become a net exporter of renewable electricity by replacing its aging boilers with more efficient gasifiers. However, due to the risk-averse nature of these sectors and their current financial difficulties, it may be decades before these opportunities will be realized in a major way. What is needed is an aggressive program to significantly reduce the risks so that the best processes for converting biomass to end-use products can be determined and pursued by industry.

There are two primary pathways to achieving this goal, and both need to be pursued:

1) Fermentation/enzymatic conversion of cellulose.
2) Thermal conversion of biomass, including animal wastes, through gasification, pyrolysis, depolymerization and other thermal processes.

A well-focused and adequately funded program to take these pathways to the point of becoming low-risk commercial choices should be pursued on grounds of national security. This may be the only way that the U.S. can have – in years, as opposed to decades – a significant supply of renewable, sustainable, indigenous fuels, chemicals, and other products for which we now are currently dependent on imported oil or limited natural gas reserves. These dispersed industries providing fuels and power will also benefit homeland security in the event of natural disasters or terrorist attacks. Toward that end, alternative process routes should be allowed to compete, involving different technologies and feedstocks, and commercial plants built to quickly determine the best technologies, bring them to an acceptable risk level, and facilitate their deployment.

The Department of Energy's research investments in next-generation "biorefineries" have been sufficient to build pilot-scale facilities, but not enough to allow companies to overcome the risks of construction and operation of first-of-a-kind commercial-scale production plants. These plants typically will cost $100 million to $300 million each, although some technologies, such as thermal processing, may cost less. Government support is needed for first-generation facilities, so that second-generation facilities can attract conventional financing, and third-generation facilities can compete without the need for subsidies.

Both accelerated commercialization and increased R&D are needed. The former stimulates technological development that can only be gained through commercial-scale application, validates techniques for efficient harvest and conversion, begins realization of societal benefits, and shapes the agenda for additional R&D. The latter provides a strong fundamental basis for process design and improvement, opening up new pathways that can substantially lower cost and increase production.

Recommendation

The Department of Defense (DOD) should be authorized and directed to conduct a one-time procurement "fly-off," with the objective of building 5 to 10 commercial-scale demonstration plants within 5 years. The purpose should be to test the viability of various novel conversion processes applicable to diverse and abundant feedstocks, producing different end products – e.g., ethanol, syngas, chemicals, electricity, hydrogen, and other bio-based products, even gasoline. DOD should conduct the competition in consultation with the Departments of Energy and Agriculture and the Environmental Protection Agency, operating through the Defense Advanced Research Projects Agency (DARPA) and the U.S. Army Tank-automotive & Armaments Command (TACOM). A one-time appropriation of $1 billion should be provided to carry out the competition, and DOD should be given wide latitude to disburse those funds for maximum impact – e.g., combining direct grants for engineering and design work with loan guarantees and off-take agreements to ensure construction and operation.

DOD is well suited for a competitive technology demonstration program on a compressed time scale, and the results of this program on national security would be significant. A substantial shift from oil to bio-derived renewable fuels, combined with accelerated adoption of advanced, fuel-efficient vehicles, could substantially reduce or even eliminate U.S. dependence on unstable sources of foreign oil. Within a short time, the fly-off would prove whether America's farmers and foresters can grow our way out of the continuing "energy crisis" and bring substantial environmental benefits as well.

2. Increase and broaden federal R&D

The current level of funding for bioenergy research and development is inadequate. U.S. federal expenditures for applied energy technology R&D generally are about what they were (in real terms) just before the first oil price shock of 1973-74. Bioenergy R&D funding should reflect the magnitude of the problems and opportunities addressed by these technologies in terms of national security, environmental protection, and economic development. Funds available should be large enough to pursue alternative technical paths in parallel, as well as the different stages of development (innovation-focused, commercialization-focused, and applied fundamental research).

The Department of Energy spends about two-thirds of the $150 million in annual federal funding for bioenergy, with most of the remaining third overseen by the USDA. Of the total spent on bioenergy, about $48 million is spent on biomass-based fuels and $24 million on biomass-based power.

In 1997, the Energy Research and Development Panel of the President's Committee of Advisors on Science and Technology recommended a tripling of the R&D effort on biomass and noted that the payoff could be enormous. The panel suggested the following strategy:

"Accelerate core R&D on advanced enzymatic hydrolysis technology for making ethanol from cellulosic feedstocks, with the goal that, between 2010 and 2015, ethanol produced from energy crops would be fully competitive with gasoline as a neat fuel, in either internal combustion engine or fuel cell vehicles;

"Coordinate this development with the biopower program so as to co-optimize the production of ethanol from the carbohydrate fractions of the biomass and electricity from the lignin using advanced biopower technology."

The panel offered a "ballpark" estimate that success in this effort, together with the introduction of highly efficient hybrid electric vehicles, could reduce U.S. oil imports by 10 million barrels a day in 2030 – imports that would otherwise cost $75 billion a year, if oil were priced at $20 per barrel.

The Biomass Research and Development Act was enacted in 2000 to establish an intensive and focused R&D program, national in scope, to reduce processing costs for producing fuels, chemicals, and electricity from biomass to the point that these technologies become cost-competitive with conventional fossil resources. The legislation identified fundamentals-inclusive, innovation-targeted research as the sole viable means of addressing the technological challenges of biomass conversion and use and authorized $49 million per year over a five-year period. However, Congress has since appropriated little or no additional money for the programs, which have experienced only modest growth in gross funding and even less growth in net funding after earmarks.

Increased activity is needed in a broad range of R&D directions, encompassing innovation and applied fundamentals, analysis, and demonstration and commercialization. Several external advisory groups have identified specific high-priority research tasks, in such areas as crop production, harvesting, transportation, and storage; processes for the fragmentation of biomass into purified feedstock streams; development of enhanced enzymes and chemical catalysts and genetically enhanced microbes to make conversion faster and cheaper; and optimization of overall system design. As one example of an under-funded area of inquiry, advances in biotechnology could have dramatic, even revolutionary impacts on both feedstock production and biomass processing. Bringing these biotechnology breakthroughs to bear in the biomass field is a critically important opportunity, with applications that range all the way from the tasks listed above to the use of microbes to capture carbon dioxide and produce hydrogen, being pursued by the DOE Genomes to Life program.

Also needed is research directed toward increasing fundamental understanding of the science, in a context that is responsive to applied needs at the levels of both problem selection and experimental design. A successful model of this approach is research sponsored by the National Institutes of Health that targets disease prevention through better understanding of underlying causes and mechanisms. Advances in "applied fundamentals" provide understanding that enables innovation, but this area has been particularly neglected to date. Such research also reduces the risk, time, and cost associated with scale-up and commercial application of new technologies.

Recommendations

The federal government should, as part of an overall increase in funding for renewable energy research and development:

1. Triple the current level of bioenergy R&D funding to $500 million per year, in order to:

    a. Reflect the magnitude of problems and opportunities potentially addressed by this technology;
    b. Allow alternative technical paths to be aggressively pursued in parallel; and
    c. Allow innovation-focused research, commercialization-focused activities, and elucidation of applied fundamentals to be aggressively pursued in parallel.

2. Maximize the impact of R&D spending by:

    a. Increasing the importance of technical considerations in allocating R&D funds (reducing the share of legislative earmarks);
    b. Allocating funds to technology areas that have a large potential for R&D-driven impacts, taking advantage of new tools and approaches as they become available; and
    c. Increasing the representation of applied fundamentals in the biomass R&D research portfolio.

3. Provide incentives to stimulate new markets for biomass

Farmers and ranchers produce more than food and fiber. Today, the agricultural sector is increasingly being recognized for the full array of environmental and energy services it can provide to society through the use of sustainable farming systems – rich productive soil, clean water and air, and important landscape features such as riparian buffers, wetlands, woodlands, and diverse wildlife habitats. With many of these same management practices, carbon is sequestered, methane is captured, nitrous oxide is reduced, and large quantities of biomass can be produced to generate clean, renewable energy.

Farmers operate businesses, and they respond to market forces, migrating to production systems and crops that offer potential for profit. The emergence of energy crops provides a new market niche and an opportunity to diversify farming operations and make more efficient use of land – even marginal land – without sacrificing sound conservation standards. However, financial incentives are needed to develop markets for these crops and increase the return to farmers until demand becomes more established and profitability can be demonstrated.

One such incentive would be the use of carbon credits to offset greenhouse gas emissions. The proper management of agricultural lands, grasslands, wetlands, and forests, including the sustainable production of biomass for energy, can sequester carbon in natural sinks, thereby helping to offset the industrial release of CO_2. Certain agricultural land management techniques, such as no-till farming, offer the potential to restore large volumes of carbon to soils. Additional research is needed, particularly to develop cost-effective tools for quantifying how much carbon is sequestered in such sinks and determining the robustness of the sinks over time.

The cultivation of energy crops, more efficient use of organic waste as bioenergy, and improved cropping practices that sequester carbon can all be planned as components of a conservation system. All producers should be eligible to participate in incentive-based conservation/energy programs. Incentives should be structured to reward farmers for applying and maintaining best management practices and systems that achieve both conservation and energy goals.

The development of new markets for bio-based products through a redirection of agricultural export subsidies could also offer a way through the current impasse over these subsidies in the Doha round of international trade negotiations – an impasse that threatens both the success of the round and the further expansion of global trade. Export subsidies, while helping to support the production of a limited number of food and fiber commodities, distort global markets and hit developing countries especially hard.

A recent World Bank study found that full elimination of all agricultural protection and production subsidies in industrialized countries would increase global trade in agriculture by 17 percent, with agricultural and food exports from low and middle-income countries

rising by 24 percent. As a result, total annual rural income in these countries would rise by about $60 billion.

President Bush said on May 21, "We must also give farmers in Africa, Latin America, and Asia and elsewhere a fair chance to compete in world markets. When wealthy nations subsidize their agricultural exports, it prevents poor countries from developing their own agricultural sectors. So I propose that all developed nations, including our partners in Europe, immediately eliminate subsidies on agricultural exports to developing countries so that they can produce more food to export and more food to feed their own people."

Countries that now use export subsidies to sustain their domestic farming operations can achieve the same result by using those resources instead to create new markets for energy crops through the development of a bioenergy and bioproducts industry. Market forces will select the most efficient feedstocks and provide sufficient incentives to producers. This shift in direction will encourage production and reduce the costs of bio-derived petroleum substitutes, while alleviating distortions in world markets and removing trade barriers to farmers in developing countries.

Recommendations

1. A new national strategy is needed that links production agriculture, energy, and conservation policy and goals.

2. The U.S. should accelerate the development and implementation of new incentive payment programs that reward producers for applying and maintaining conservation systems and for producing bioenergy commodities to support this national strategy. Reliable, cost-effective accounting systems for measuring carbon fixation in soils should be pursued to enable carbon trading.

3. The National Research Council should be directed to assess the impacts of shifting domestic farm subsidies from food and fiber crops to conservation, energy crops, and the bioenergy industry and report back to Congress within 12 months. This report would evaluate the effect of such action on energy supply, national security, and the environment, as well as on economic conditions in rural America and the developing world. U.S. trade officials should encourage the European Union, Japan, and other countries to undertake similar assessments.

4. The U.S. Trade Representative should propose as a response to the current deadlock over agricultural issues in the Doha round of trade negotiations that participating countries begin to replace their export subsidies of agricultural crops with incentives for conservation and biomass feedstocks and support for bio-based products.

4. Use government policy to capture societal benefits

The economic trend toward greater use of bio-derived petroleum substitutes began 20 years ago and is rapidly picking up speed: Ethanol is blended with gasoline for octane and air quality reasons at a volume of nearly 2 billion gallons per year. A myriad of bio-based products – including pharmaceuticals, paints, plastics, and chemicals –have entered the market. A recent report by the consulting firm McKinsey and Co. predicted that industrial biotechnology will capture 20 percent of the $280 billion worldwide chemical market by 2010. Cargill Dow built a $300 million facility to produce polymers from corn starch, and DuPont has similar plans; both plan next to use cellulosic feedstocks.

A program to limit emissions of greenhouse gases would speed these new technologies forward. Attaching an economic penalty to carbon dioxide emissions (reflecting the benefit to society of averting climate change) would favor all renewable alternatives, including those from biomass. However, it may be a decade or more before such a system has a significant impact on the market, and interim steps are warranted to begin a transition sooner. As a transition strategy, a "renewable fuels standard" and "renewable portfolio standard," such as those being considered by Congress as part of pending energy legislation, would serve to stimulate demand for renewable products until market dynamics take over and make such support unnecessary. Other such near-term steps include the following:

- The existing renewable energy production tax incentives should be broadened to include environmentally acceptable waste biomass, including animal wastes, not just purpose-grown crops. Power generation using these feedstocks should meet applicable emissions standards.

- Several million cars and trucks already in the U.S. fleet are fuel-flexible – capable of running on gasoline or ethanol interchangeably. Automakers should continue to receive incentives under federal fuel economy standards for the production and sale of these vehicles, and the program should be modified to ensure greater use of alternative fuels, such as high-ethanol blends.

- The tax treatment provided to ethanol under current law should also be provided to any other transportation fuel derived from biomass with equivalent or better environmental performance based on a full fuel-cycle analysis.

- The Department of Agriculture should develop and implement a system for labeling products on the basis of their bio-based content, and government procurement policies should encourage the purchase and use of bio-based products and fuels. Industry standards should be required to ensure quality and validate product performance.

- Increased biofuels use in the transportation sector could provide important air quality benefits in areas not meeting clean air act health standards. EPA should work with the states to design programs to increase biofuels use in these areas. These programs could include financial incentives and requirements to further reduce emissions from the vehicle sector that are designed to encourage biofuels use as a compliance method. Another concept discussed by the working group would encourage EPA to examine whether and under what conditions a program for trading of compliance obligations between the stationary and vehicle sectors could improve air quality and encourage increased use of biofuels. In California, summertime NOx offsets can cost as much as $50,000/ton. These offsets could potentially be supplied more cheaply by fleet operators of buses, trucks, taxis, and delivery vans, who could generate credits by switching their fleets to natural gas, ethanol, hybrid, or even fuel cell-powered vehicles.

- EPA should conduct an assessment of the role that ethanol, ETBE, and other fuel additives could play in displacing oil and accelerating the use of renewable fuels, and of their potential effect on air quality, water resources, and public health if more widely used. For example, there would be a significant public health benefit from reducing gasoline aromatics (benzene, toluene and xylene), which are highly toxic (either carcinogenic or mutagenic), the largest single contributors to fine-particle pollution (accounting for as much as one-third), highly photochemically reactive to sunlight (and thus large contributors to ozone), hard on catalytic converters, and the most carbon-intensive portion of a gallon of gasoline. The health benefits alone of eliminating these air toxics potentially run to hundreds of billions of dollars.

  For these reasons, EPA should undertake an assessment of what cost-effective steps could be taken to reduce air toxics and report to Congress within 12 months on:

  - The net air quality and public health effects of ethanol-blended fuels compared to gasoline, considering volatility, distillation temperature, sulfur, alkylates, aromatics, and other highly reactive gasoline compounds, as well as emissions of carbon monoxide, carbon dioxide, nitrous oxides, and aldehydes.

  - The effects on air quality, water resources, and public health of reducing the level of toxics in gasoline by replacing gasoline aromatics with ethanol, ETBE, or other fuel additives.

  - The effects on air quality of increasing or eliminating the maximum percentage of ethanol or ETBE that can be blended with gasoline, subject to vehicle manufacturers' warranties.

  In conducting this assessment, EPA should take into account the findings of its Blue Ribbon Panel for Reviewing the Use of MTBE and Other Oxygenates in Gasoline.

MEMBERS OF THE FUTURE OF COAL WORKING GROUP

Co-Chair: **Gen. Richard L. Lawson, USAF (retd.)**

Dick Lawson is Chairman of Energy, Environment and Security Group Ltd. He retired as a four-star general of the U.S. Air Force in December 1986, having served as Deputy Commander-in Chief of the U.S. European Command in Stuttgart, Germany, and as Chief of Staff, Supreme Headquarters Allied Powers, Europe. After his military service, Dick served for 13 years as President and CEO of the National Mining Association, previously the National Coal Association. He also serves on the Board of Directors of the National Energy Foundation, the United States Energy Association and as Vice Chairman of the Atlantic Council.

Co-Chair: **David G. Hawkins**

Dave Hawkins is Director of the recently created Climate Center at the Natural Resources Defense Council. Previously head of NRDC's air and energy program, he joined NRDC as an attorney in 1971 and worked on air pollution issues until 1977, when he was appointed Assistant Administrator for Air, Noise, and Radiation at the U.S. Environmental Protection Agency in the Carter administration. Dave returned to NRDC in 1981 and worked primarily on reauthorizing the Clean Air Act, including the development of a national program to combat acid rain. He has an undergraduate degree from Yale College and a law degree from Columbia University.

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Jacqueline Bird, Director, Ohio Coal Development Office

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THE FUTURE OF COAL WORKING GROUP: REPORT OF THE CO-CHAIRS

The Future of Coal Working Group of the Energy Future Coalition is working to identify policy options that would allow the United States and other nations to reconcile future use of the planet's significant coal resources with current and future programs to reduce air emissions from coal, including greenhouse gas (GHG) emissions. The Working Group, which includes representatives from key constituencies in this area, discussed approaches that could enable the long-term use of coal in a way that achieves substantial economic and environmental benefits. The Working Group members believe that environmental and coal interests are not incurably adverse and that there is a common interest in (a) developing and demonstrating technologies that will allow "near-zero" emission use of coal, and (b) deploying those technologies widely in the U.S. and around the world.

The key remaining challenge for the Working Group is to identify a set of policies that will accelerate the development and use of technologies for coal conversion and carbon capture and sequestration, both nationally and internationally, and be designed to avoid significant adverse economic and environmental consequences for society. The Working Group is committed to continue its search for common ground on this issue with the realization that crafting such a framework among the diverse members of the Working Group is a significant challenge.

I. What is the "Future of Coal"?

Coal is a domestically abundant fuel (250 years of reserves in the U.S. have been proven). It is the dominant fuel in the U.S. power sector, accounting for 56 percent of the U.S. electricity sector's energy use. However, in the absence of emission control devices, coal combustion is a significant source of air emissions, including sulfur dioxide, nitrogen oxides, particulate matter, and mercury. Moreover, coal is the most carbon-intensive fossil fuel; according to the Energy Information Administration (EIA), its combustion accounts for 83 percent of the electricity sector's CO_2 emissions, and 32 percent of total U.S. CO_2 emissions. The Working Group discussed only the issue of managing air emissions from the use of coal, not the important environmental, health, and safety issues associated with coal production.

Continuing coal use while significantly reducing emissions of CO_2 from coal would require the application of carbon capture and sequestration systems not in use at today's electric generating plants. While the Working Group members have a range of views on when and how CO_2 emissions should be reduced, there is agreement that accelerated availability and deployment of advanced, competitive carbon capture and sequestration systems for use in generation of electricity and production of hydrogen (for transportation and industrial use) would expand the options for responding to the challenge of global warming in a timely manner.

A. Technology Needs

The Working Group discussed the status of advanced technologies for managing greenhouse gas emissions from coal, with a range of views presented. Among the materials discussed was a research and development program drafted by the Coal Utilization Research Council, the Electric Power Research Institute, and the Department of Energy. This program aims to demonstrate technologies that would achieve "near-zero" levels for conventional and CO_2 emissions from coal-based gasification and combustion systems between now and 2020. The Working Group members discussed but did not resolve, differing views on the funding priorities, funding levels, timing, performance objectives, and additional policies needed to accompany such an R&D program.

Carbon capture technologies. Before CO_2 from power plants can be sequestered, it must be captured, probably as a relatively pure gas. DOE estimates that the cost of carbon capture accounts for about three-quarters of the total cost of a carbon capture, storage, transport, and sequestration system using current technologies. Thus, driving down the cost of carbon capture will be a key in reducing the overall cost.

To date most work on carbon capture has focused on gasification technology, but recently methods to capture carbon from advanced combustion-based steam plants have been examined. Various studies have identified gasification with pre-combustion capture of CO_2 as one of the most promising and cost-effective options. One advantage of gasification technologies is that CO_2 exits the gasifier in a concentrated stream, which eases its capture for sequestration. Flue gas carbon separation technologies (e.g., absorption, adsorption, low-temperature distillation, gas separation membranes, and mineralization) can separate CO_2 from other flue gases after combustion, but current cost estimates for such approaches are high compared to estimates for pre-combustion capture methods. Additional experience in full-scale operation of such systems is likely required both to bring down costs and to reduce the uncertainty in current cost estimates.

Sequestration technologies. There are a number of options for geologic sequestration – the long-term disposal of CO_2 emissions in deep underground repositories – including brine formations, unmineable coal seams, basalt formations, and depleted oil and gas reservoirs. Before a massive sequestration program is implemented, it will be necessary to acquire real-world experience with injection of large amounts of CO_2 into a variety of geologic formations. There are also options to enhance CO_2 uptake and storage in terrestrial and ocean systems, although the Work Group members expressed a range of views on the effectiveness and acceptability of these approaches.

B. Existing Coal Fleet

While coal-fired power plants account for the majority of power generation in the U.S., the fleet of coal-fired generators in the U.S. is relatively old. As aging plants require upgrades, repowering, or replacement to meet current market and regulatory conditions, utilities will need to make choices about what fuel and technology to employ. Over the

past decade, the great bulk of the new generating capacity built in the U.S. has been natural gas-fired. In 2000, for instance, EIA reports that about 22,000 MW of natural gas-fired capacity was added, while coal-fired generation grew by about 500 MW. Nonetheless, EIA projects that coal will continue to account for half of U.S. electricity generation through 2020.

EIA's reference case forecasts assume that coal will remain a major component of U.S. electricity generation. EIA's forecast, which assumes continuation of current policies, projects that between now and 2025 only a small amount existing coal capacity will be retired, capacity factors at existing plants will increase, and a limited amount of new coal capacity will be built.

The timing of technology developments and policy actions will be key factors in determining whether new coal generating capacity – and the capacity that is used to replace existing units retired because of age, economics, or regulatory requirements – will be conventional coal plants, or coal plants that either are equipped with carbon capture systems or are designed to allow economical retrofitting for carbon capture after construction.

C. International Development of Coal Capacity

Coal is an abundant fuel elsewhere in the world as well. Coal fuels more than one-third of global electricity production, and growth in energy demand is particularly strong in coal-dependent areas such as China and India. The amount of new coal capacity projected for other countries dwarfs that expected in the U.S. in the next decades. Over the next 30 years, China and India alone are expected to account for two-thirds of the increase in total world coal demand, principally for electricity.

Advanced technologies that allow the competitive use of coal consistent with air pollution and climate change policies thus have the potential to be deployed not only in the U.S. but around the world as well. However, to induce use of carbon capture and sequestration technologies, policy measures are likely to be needed to overcome existing market barriers. Given the leverage that such technology can enjoy in global markets, the need to promote international deployment of this technology deserves particular attention. The opportunity and need to deploy these technologies around the world only serves to heighten the need to mount real world demonstrations of these technologies, fund research needed to drive down their operational and capital costs and come up with innovative policies to promote their deployment.

II. Working Group Approach

The discussions within the Future of Coal Working Group have focused on three areas:

- An aggressive RD&D program. In order to accelerate the availability, and lower the cost, of carbon capture and sequestration technologies, the Work Group discussed options to substantially increase federal support for research, development and demonstration projects.

- Incentives for early adoption of carbon capture and sequestration technologies. The Working Group examined financial incentives to cover the cost differential between conventional technology and systems that are readily capable of capturing CO_2. Incentives for geologic sequestration of captured carbon (e.g., providing a credit for every ton of CO_2 sequestered) were also examined. Regulatory incentives to allow recovery of technology investment costs through rate structures were also discussed.

- Policies to reduce GHG emissions structured to support development and use of cost-competitive carbon capture and sequestration technologies. The Working Group examined options for the reduction of GHG emissions, including a concept that would link the start date for carbon limits to a finding that it is technically and economically feasible to deploy carbon capture and sequestration technology at the requisite scale.

There is broad agreement within the Working Group that it is important to design incentives and policies that will encourage all countries to promote development and use of technologies that are effective in managing carbon emissions. It is also clear to the Group that advanced technologies must be developed and deployed globally in order to achieve significant reductions in carbon emissions at costs that stakeholders find acceptable.

A. Research, Development and Demonstration Program on Carbon Capture and Sequestration Technology

The federal government has supported a multibillion-dollar clean coal R&D program over the past two decades. DOE's Clean Coal Technology (CCT) program has focused on developing cost-effective means to reduce conventional pollutant emissions from coal combustion. In recent years the Department of Energy's research efforts have also included modest programs related to carbon capture and sequestration. The DOE CCT program has been structured as an industry cost-share program, and the industry contribution to date has been on the order of 60 percent of the $5.7 billion committed.

Some members of the Working Group support an expanded and accelerated research, development and demonstration program that would build on the existing DOE CCT program and the roadmap developed by DOE, EPRI, and the Coal Utilization Research Council, with adjustments as needed to accelerate the development and demonstration of carbon capture and sequestration technologies. Other members of the Working Group

believe that a broad, publicly funded R&D program must be accompanied by policy measures to limit GHG emissions in order to spur development and use of advanced technologies in a timely and cost-effective manner.

B. Early Deployment of Carbon Capture and Sequestration Technology

There is already experience with some elements of a full-scale integrated power production, carbon capture and sequestration system. Statoil has an ongoing geologic carbon sequestration project under the North Sea. CO_2 is being injected into the Weyburn oil field in Canada and into many oil fields of the Permian Basin in the U.S. The injection of waste gases and waste fluids into deep saline formations is an accepted practice that has been going on for decades in many parts of the U.S. Further, some technologies that are compatible with carbon capture and sequestration technologies exist today. For instance, gasification plants are in widespread commercial operation in the industrial sector. However, important issues remain regarding integration of these components and public acceptance of sequestration technologies. Finally, these technologies are not economically competitive with conventional technology under current market and policy conditions in the U.S., although opportunities to achieve substantial performance improvement and reductions in cost appear large. While projections for new coal capacity in the U.S. are quite uncertain, most projects that have been announced still are based on conventional technology.

While differing on the means, the Work Group members agree that it is important to provide developers of new coal plants with incentives to select designs that either incorporate carbon capture technology or are compatible with future carbon capture and sequestration requirements. Well-designed policies could provide assurance that today's investments are not "stranded" by the later adoption of a GHG regulatory regime. With regard to the existing coal fleet, a similar set of incentives would help to inform investment decisions about pollution controls, repowering, and plant replacement. The Working Group discussed a number of options for transition measures to facilitate investment in advanced technologies but did not achieve consensus on specific recommendations at this point.

One important benefit of early deployment of carbon capture and sequestration technologies would be to reduce the uncertainty about costs and efficacy of different approaches. One approach discussed by the Working Group is a policy that would provide a stable regulatory regime for a period adequate to recover investments for plant designs that meet agreed upon performance standards, including carbon capture and sequestration. While recognizing the value for business planning of greater certainty regarding the level and schedule for future GHG emission limits, some members of the Working Group are not ready to support addressing those issues now, absent greater assurance that a program will be designed to limit the impacts on costs and energy supplies to levels they believe are acceptable.

C. GHG Emission Limits

The Working Group discussed GHG emission limits and other ways to ensure substantially reduced emissions over the long term, using advanced carbon capture and sequestration technologies. The Working Group has not reached consensus on the timing and content of such policy measures. Some members want to ensure that economically attractive control technologies are available before any carbon constraints are imposed. Other members believe that policies to limit carbon emissions are essential to spur development and use of advanced technologies in a timely and cost-effective manner.

III. Further Consideration

The Future of Coal Working Group has spent the last six months in productive and open discussions about how to design policies for the sector that can attract support from a diverse array of key constituencies. All sides agree that successful resolution of the issue of managing carbon emissions from coal is vital to resolving conflicting societal, economic, and environmental concerns brought on by coal use. All sides are hopeful that, with adequate government policies and private-sector actions, carbon capture and sequestration technologies, including IGCC and geological sequestration, can be developed, demonstrated, and commercially implemented, at reasonable cost and on a schedule that accommodates environmental needs.

As described above, the key open issues within the group relate to the uncertainties and contingencies of future technology development, and the costs associated with various proposals. Some participants are concerned that a GHG emission regulatory policy could impose unacceptable economic and societal costs if the suitable technology is not available "on time." Others are concerned that making such regulatory requirements conditional would blunt their effectiveness as a driver for technology development or unduly delay reductions in GHG emissions.

The Future of Coal Working Group is committed to continuing these discussions.

MEMBERS OF THE SMART GRID WORKING GROUP

Chair: **T. J. Glauthier**

T.J. Glauthier is President and CEO of the Electricity Innovation Institute, an affiliate of the Electric Power Research Institute, established in 2001 to conduct strategic, breakthrough R&D in energy-related science and technology. Prior to joining E2I, T.J. was Deputy Secretary and Chief Operating Officer of the U.S. Department of Energy from 1999 to 2001. From 1993 to 1998, he was Associate Director for Natural Resources, Energy and Science for the Office of Management and Budget. Immediately prior to joining the Clinton Administration, T.J. spent three years as Director of Energy and Climate Change at the World Wildlife Fund. His experience also includes 20 years of management consulting, most of it with Temple, Barker & Sloane. He is a graduate of Claremont Men's College and the Harvard Business School.

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REPORT OF THE SMART GRID WORKING GROUP

The proposals of the Smart Grid Working Group promise important economic, security, and environmental benefits by promoting substantial upgrades to the performance of the transmission and distribution network that connects electricity generators and consumers. A robust, secure electricity grid that can meet customers' ever-increasing demands is an essential foundation for the growth of our economy.

These proposals, outlined in detail below, contain three key elements: (1) a national vision statement of the capabilities that the 21st century electricity network should deliver, and a program of demonstration projects to field-test those new grid technologies on an expedited basis; (2) a robust set of technical performance standards addressing reliability, availability, security, and power quality as a benchmark for implementation; and (3) a 21st Century Electricity System Security and Modernization Fund and other federal and state incentives to stimulate investments in deployment of the new technologies by transmission and distribution facility owners to meet these new performance standards.

I. Why a Smart Grid?

As the U.S. economy has moved into the digital age, electricity's role as an enabler of economic productivity has become even more important. The transmission and distribution network forms the critical link between electricity generation and consumers. However, the technological sophistication of the electricity grid has not kept pace with the growing demand for high-quality, high-value services to end-users.

The potential benefits of an enhanced power delivery system are enormous. An upgraded grid can support the provision of important new services to consumers, including better ability to manage energy use and energy costs, and better support for use of distributed generation. A scenario prepared by the Electric Power Research Institute (EPRI) suggests that transformation of the power grid over the next 20 years could result in substantial increases in productivity and GDP growth, reduced carbon emission, and increased national security.

A. What is a "Smart Grid"?

The term "smart grid" refers to an electricity transmission and distribution system that incorporates elements of traditional and cutting-edge power engineering, sophisticated sensing and monitoring technology, information technology, and communications to provide better grid performance and to support a wide array of additional services to consumers. A smart grid is not defined by what technologies it incorporates, but rather by what it can do. The key attributes of the 21st century grid include the following:

- The grid will be "self-healing." Sophisticated grid monitors and controls will anticipate and instantly respond to system problems in order to avoid or mitigate power outages and power quality problems.

- The grid will be more secure from physical and cyber threats. Deployment of new technology will allow better identification and response to manmade or natural disruptions.

- The grid will support widespread use of distributed generation. Standardized power and communications interfaces will allow customers to interconnect fuel cells, renewable generation, and other distributed generation on a simple "plug and play" basis.

- The grid will enable consumers to better control the appliances and equipment in their homes and businesses. The grid will interconnect with energy management systems in smart buildings to enable customers to manage their energy use and reduce their energy costs.

- The grid will achieve greater throughput, thus lowering power costs. Grid upgrades that increase the throughput of the transmission grid and optimize power flows will reduce waste and maximize use of the lowest-cost generation resources. Better harmonization of the distribution and local load servicing functions with interregional energy flows and transmission traffic will also improve utilization of the existing system assets.

Without concerted action, the United States will not only forego these types of performance enhancements, but will also risk deterioration of the current system. In recent years, investment in transmission infrastructure, for instance, has steadily declined.

B. Reducing Customer Exposure to Costly Outages and Service Disruptions

The National Academy of Engineering has hailed the U.S. electrical system as the supreme engineering achievement of the 20th century because of its ubiquitous impact in improving the quality of life down to the household level. In the 21st century, its role as a key enabler of the digital society promises equally significant implications. However, the electricity system is in serious need of upgrading if the benefits of interconnection are to be fully realized at both commercial and individual consumer levels. The potential benefits of these grid upgrades are illustrated by the cost of power disturbances to today's economy: EPRI estimates that power outages and power quality disturbances cost businesses in the U.S. more than $120 billion a year.

The lack of critical infrastructure investment and the growing demand for high quality, digital-grade electricity has taxed the electrical infrastructure to its limit. Most credible forecasts predict that this underinvestment in the transmission system will continue. Additionally, microprocessor-based technologies have radically altered the nature of the electrical load, resulting in electricity demand that is incompatible with a power system

created to meet the needs of an analog economy. This has led to unprecedented electricity reliability problems, as well as inadequate power quality responsible for tens of billions of dollars in losses to industry and society annually.

Technology upgrades in the areas of transmission system monitors, information systems, and power flow controls will enable the grid to be "self healing" – that is, grid controllers will collect diagnostic information about the grid in real time and will be able to use sophisticated controls to minimize the number of customers affected by any problems, and minimize the duration of any problems. A self-healing grid integrates real-time information from embedded sensors with distributed intelligence and automated control, enabling the system to respond automatically to disruptive events and attacks to the system. Development of a self-healing transmission and distribution system – capable of automatically anticipating and responding to disturbances, while continually optimizing its own performance – will be critical for meeting the future electricity needs of an increasingly digital society.

C. Increasing Security of the Electricity Infrastructure

In the current environment, the nation's concern about terrorism is heightened. The nation's electricity transmission and distribution system is one of the most essential parts of the country's infrastructure, because it supports and powers virtually every other sector of the economy. It is vitally important that the electricity grid be capable of real-time management and instant correction in order to minimize the risk of disruption and the time for recovery, if a terrorist attack on the system does occur. This will require the ability to monitor the status of the grid on a real-time basis, to instantly recognize and diagnose any unusual events on the system, and to respond intelligently with adaptive changes in power flows, generating unit operations, and load management.

The smart grid capabilities described above, including the use of real-time monitors, power flow control technology, and sophisticated communications and information technology, will allow grid controllers to rapidly identify and respond to grid problems caused by intentional damage to facilities or other forces. Sophisticated monitoring will give grid controllers the information needed to identify and assess multiple simultaneous problems on the grid in real time. Solid state power flow control devices and fast simulation computer systems will permit problem areas to be "islanded," limiting the size of the area where service is disrupted, and permit power flows to be redirected around damaged facilities.

D. Supporting Widespread Use of Distributed Energy Resources

The new grid infrastructure must support easy, flexible use of distributed energy resources – fuel cells, microturbines, and renewable generation – in homes, offices and factories. Use of small-scale on-site generation (or storage) can be encouraged through the development of standardized interfaces for both power and communications systems. Such "plug and play" interfaces (similar to the standardized interfaces that allow computer and telecommunications equipment to be connected by consumers) will enable

residential, commercial, and industrial customers to use distributed generation for self-generation or sales to the grid with a minimum of technical or regulatory difficulty. Standardized interfaces for both power and communications systems will avoid high costs associated with case-by-case engineering or safety analysis.

A grid that supports widespread interconnection and use of distributed generation by both suppliers and consumers will lead to improved reliability and power quality, reduced electricity costs, and greater customer choice and control. Moreover, use of distributed generation can produce important environmental benefits – distributed generation may reduce the need for construction of new transmission and distribution facilities, and some technologies (e.g., renewable energy resources, fuel cells) have emission and climate benefits relative to typical central station power plants.

E. Enabling Smart End-Use Energy Management

A smart grid will provide both communications and power to enable "smart" buildings, motors, appliances, and other "smart" loads through a customer portal – a set of devices and software that enables intelligent equipment within a facility to communicate with other systems over a wide area access network. Simple, effective interfaces between the grid and the energy management systems of buildings and other loads will enable residential, commercial, and industrial consumers to manage electricity use in a manner that improves efficiency and reduces consumer energy costs, while at the same time enhancing customer control of electrical equipment. Grid-related communications capabilities will allow customers to schedule energy use to take advantage of real-time electricity pricing, incentive-based load reduction signals, or emergency load reduction signals. For example, sophisticated space conditioning equipment will be able to receive a variable electricity price signal and automatically adjust the air conditioning or heating to effectively reduce peak loads and maintain comfort.

Smart grid capabilities are even more valuable to customers who have both energy management systems and distributed generation resources interconnected to the grid. They will, for example, be able to reconfigure workplaces with a combination of fuel cells, energy management systems, and other technology advances to produce economic gains like those produced by the introduction of electricity a century ago.

F. Cost Savings Due to Greater Transmission Grid Throughput

Enhanced grid operation will give customers access to less expensive power sources. The smart grid will increase throughput on existing lines by providing more effective power flow control. This increased line capacity reduces congestion (which requires more expensive units to run instead of lower-cost units) and thereby lowers generation costs to consumers.

The ability to increase grid throughput (and the ability to support widespread distributed generation) also relieves pressure to site and build long-line transmission lines, thus avoiding the environmental and aesthetic problems caused by such projects.

G. Enabling Productivity and Jobs Growth in the Economy

The combined effect of all the benefits cited above is much more than just the sum of the parts. Just as the introduction of electricity to the nation's homes, offices, and factories a century ago transformed the way we live and work, a fundamental transformation of our electricity infrastructure will enable significant advances in the nation's growth and productivity. These changes can support dramatic new flexibility and benefits, just as the national highway system has transformed our transportation patterns, and the Internet and mobile phones have transformed our communications and business practices.

Electricity underpins every aspect of the modern economy. Yet we have allowed a lack of critical investment and surging demand for high quality, digital-grade electricity to stress the electrical infrastructure. There are tremendous potential economic and environmental benefits from the changes described above – from increasing power quality and reliability to homes and businesses, from implementing a secure, self-healing grid, from enabling widespread usage of fuel cells, renewable energy and other sophisticated energy management systems at customer sites, and from eliminating congestion bottlenecks through real-time dynamic management of the grid.

A scenario prepared by the Electric Power Research Institute (EPRI) suggests that transformation of the power grid over the next 20 years could support substantial increases in productivity and GDP growth rates, while at the same time reducing energy intensity and carbon emissions. These productivity and related improvements depend on a highly reliable digital power infrastructure in which workers can perform existing and completely new functions quickly, accurately and efficiently. In this sense, power reliability and quality are enabling technologies – they are necessary to unleashing and expanding the digital economy, and to achieving its manifold economic and quality-of-life benefits for the nation in the 21st century.

II. Proposal

To obtain the benefits of a smart grid, an aggressive research, development, demonstration, and deployment effort is needed. Deployment will be the biggest challenge, because deployment will require an extensive investment. The key, therefore, is to provide ample support and inducement for transmission and distribution facility owners to invest substantial resources in upgrading the performance of the grid using smart grid technologies.

To achieve these goals, the Smart Grid Working Group proposes a three-part program:

- A compelling vision statement and demonstration program for advanced grid technologies. The Department of Energy (DOE) should be charged with leading a multi-stakeholder process to expand and clarify the vision and goals statement for the future system, specifying in clear, customer-oriented perspectives the characteristics of the advanced electricity grid of the 21st century. To support this effort, DOE should conduct a regional and local program of demonstration

projects in partnership with the private sector for early deployment of the new technology components of the smart grid throughout the country.

- National performance standards for the future electricity grid. To guide the private sector and the regulatory agencies in supporting investments in innovative technologies, an appropriate technical or reliability standards organization (e.g., the North American Electric Reliability Council) should be tasked with developing grid performance standards that, if implemented, will assure grid security, reliability, availability and power quality.

- A 21st Century Electricity System Security and Modernization Fund and other federal and state incentives to promote deployment of smart grid technologies. Installing these new technologies to meet the recommended performance standards will require investment of tens of billions of dollars. To support the initial deployment of these technologies, a trust fund like the Highway Trust Fund should be established. A process to design the new trust fund must include the participation of the federal and state governments, the industry, customers, and other key stakeholders. The resulting trust fund will have to meet standards of equity in both funding and spending, be competitively neutral, and include a sunset provision. In addition, regulatory policies at both the federal and state levels concerning transmission and distribution rates must provide adequate incentives for investments in innovative technologies.

D. Vision Statement and Demonstration Program for the 21st Century Grid

A key first step in the transformation of the U.S. electricity grid is the development of a widely shared vision and strategy for the grid of the 21st century – a clear and compelling statement for customers, regulators, and utilities of what the new, 'smart grid' is and what benefits it will provide. To support this vision, and to build widespread support and confidence in the component technologies, there should be a public-private partnership program of local and regional demonstration projects of these new, innovative grid technologies and systems.

Recommendation – Articulate a National Vision of the 21st Century Grid

The Working Group recommends that DOE coordinate a process involving the industry and labor, which will have to build and operate the new grid, and customer groups and other stakeholders, including public officials and regulators at local, state, and federal levels, to articulate a common vision and strategy for the grid and a clear statement of system requirements and benefits that will result.

Recommendation – Demonstration Program for Advanced Technologies

A public-private partnership program is needed to support early deployment and demonstration of these innovative technologies. The Department of Energy should coordinate this effort, with appropriate Congressional authorization and funding, in

partnership with the utility industry, key customers, labor representatives, and local and state agencies. The demonstration projects will bring real benefits in power reliability, security, and system flexibility that will enhance local and regional economic development. The demonstration program would be designed to field-test the new technologies that will be the building blocks of the smart grid, train the labor force to install and work with these systems, and build a broad base of constituents who are familiar and comfortable with the new technologies and what they can do.

E. National Grid Performance Standards

Establishing a robust set of technical performance standards addressing reliability, availability, security, and power quality can provide an indirect means of fostering investment in innovative grid technologies, since federal and state authorities will turn to these standards in determining the proper measure to embody in pertinent regulations. In the electric power industry, standards bodies such as the North American Electric Reliability Council (NERC) and the Institute of Electrical and Electronics Engineers (IEEE) typically develop such technical standards.

The standards envisioned by the Working Group are performance standards, not technology specifications. This policy proposal is not based on any predetermination about which technologies are the most appropriate for further development or deployment. Those choices will need to be made on a case-by-case basis, with the investors' particular circumstances in mind. Instead, the development of performance standards is intended to specify what capabilities the grid is expected to have, in terms of interconnectivity with energy management systems and distributed resources, ability to respond promptly to facility problems, and to optimize throughput in normal operating conditions.

Thus, for example, a performance standard might require that the grid be able to meet particular performance standards exceeding those now in existence, or that performance be measured in a manner that is more appropriate to 21st century needs. For example, System Average Interruption Frequency Indices (SAIFI) or System Average Interruption Duration Indices (SAIDI) are utilized in some jurisdictions today to measure performance, but higher levels of SAIFI and SAIDI - or a measure other than SAIFI and SAIDI – might be more appropriate for 21st century needs. Some state regulations currently authorize deviations from the SAIFI and SAIDI within certain levels. Recalibrating these indices or requiring tighter deviation standards from existing indices would bolster system performance requirements. The national standards may build on existing state standards for quality of service.

Deployment of a smart grid may actually enable the cost-effective measurement of grid performance in a manner that is not feasible today. A smart grid will be more closely monitored and have an integrated communications backbone, allowing measurements to be made and reported in a manner that is not cost-effective today.

While the standards developed by NERC and IEEE are not binding as a matter of federal law,[8] they do carry great weight in shaping infrastructure planning within the industry. As importantly, state and federal rate regulators are very likely to support utility expenditures to bring its system up to new national performance specifications, thus facilitating recovery of costs through regulated rates. This approach of NERC-developed national performance standards avoids state-federal tensions that might be engendered by, for instance, the establishment of performance requirements in federal regulation.

These organizations use an expert-based consensus process to develop standards, enhancing the legitimacy within the industry of the standards that are developed. One consequence, however, is that the process for developing standards can be quite time-consuming. Also note that NERC activities, to date, have focused on transmission but not distribution issues.

Recommendation – Develop Grid Performance Standards

The Working Group proposes legislation that would encourage NERC to develop specifications for grid performance on a specified schedule (e.g., within 2 years), with input from the National Association of Regulatory Utility Commissioners and its members. Appropriations would be made available to fund the work by NERC. The model for the legislation would be the Congressional practice of requesting the National Academies to undertake analyses with appropriate funding.

NERC is fundamentally a transmission organization today, working with the regional reliability councils. It is possible that transmission performance standards may be developed readily through that established system of consensus. The development of distribution-level performance standards should be accomplished by the same body to ensure compatibility. NERC, however, may require time to develop collaborative, consensus-building models for working with states, utilities, and other stakeholders on distribution issues, and therefore may require more time to develop distribution system performance standards.

F. 21st Century Electricity System Security and Modernization Fund and Investment Incentives

To obtain the substantial economic and security benefits of widespread deployment of smart grid technologies throughout the nation will require tens of billions of dollars in capital investment in the nation's transmission and distribution systems. However, currently the owners of those systems are under financial pressure from their lenders and shareholders to limit spending and minimize cost exposure, and from regulators and ratepayers to concentrate their investments in areas that resolve relatively near-term concerns.

[8] Congressional energy legislation currently under consideration would transform NERC and give the standards it develops the force of federal law.

Given these limitations, which will continue to confront the electricity sector for the foreseeable future, a major new investment vehicle must be developed to spur the deployment of the new, smart grid technologies and thereby deliver the longer-term economic and productivity benefits and jobs that will result from a transformed, 21st century electricity infrastructure for the nation. In many respects, this priority is analogous to the circumstances confronting the country in the 1950s when a national approach to financing the interstate highway system was adopted. That decisive event transformed the nation's transportation infrastructure and brought immense economic benefits to the country. We now need a National Electricity Superhighway and are proposing a parallel way to begin the investment to deploy it.

Various proposals for specific mechanisms to fund such a trust fund for the electricity infrastructure have been explored. These have included approaches such as: fees to electricity customers on the power delivered at the ultimate point of sale; fees on electricity transported through the transmission and distribution system; funds raised through emissions fees and auctions; monies raised by special government-backed financial instruments; and general government revenues.

The Working Group has not recommended any one specific mechanism for financing the 21st Century Electricity System Security and Modernization Fund, but rather recommends that the key government and stakeholder groups engage to develop the details of a program that will fulfill the goals of establishing and funding the trust fund that will benefit the nation. The recommendation below identifies some of the key issues of equity and administration that must be addressed in that process for the trust fund to ultimately be broadly supported and successful.

In addition, it is important that other regulatory and economic incentives also support the widespread deployment of smart grid technologies. In virtually all cases, rates for transmission and distribution are set pursuant to a cost-of-service regime, under which utilities are authorized to recoup investment costs and earn an allowed return by customarily seeking rate authority to reflect substantial new investments in transmission and distribution upgrades. Despite this authority, however, transmission investment levels have declined over the past two decades. Accordingly, the Working Group includes recommendations below regarding federal and state rate incentives.

Recommendation – 21st Century Electricity System Security and Modernization Fund

The Working Group recommends that a new funding mechanism be established in the form of a "21st Century Electricity System Security and Modernization Fund" to help support the costs of initial deployment of the new, smart grid technologies for the nation's electricity transmission and distribution system. The new smart grid system will bring great benefits to the nation in terms of energy reliability, homeland security, economic development, productivity, and jobs. The deployment costs, while dwarfed by the benefits, will also be significant, potentially running into tens of billions of dollars.

Hence, this program requires a national priority and broad, public support for its initial deployment.

The Smart Grid Working Group recommends that federal and state governments work with the electricity industry, customers, and other stakeholders to develop a specific funding mechanism for the 21st Century Electricity System Security and Modernization Fund. These discussions should consider the full range of viable options, including a customer fee on electricity delivered at the ultimate point of sale, and broader-based general sources of government funding. The final decisions on a funding mechanism and on the design of the trust fund must meet a number of tests of equity and fiscal discipline, including the following:

- The funding mechanism for the trust fund must be equitable in raising funds from various government sources, customers, or other entities in some general proportion to the benefits that various stakeholders will ultimately receive from the new electricity infrastructure and associated economic gains;

- The funding mechanism for the trust fund should be competitively neutral (e.g., applying comparably to all ownership classes of utilities or utility customers, and to wholesale and retail market participants equitably);

- The funding flowing from the trust fund must be available to all types of owners of transmission and distribution facilities;

- The uses of the fund must be focused on the strategic investments needed to significantly improve the electricity infrastructure's security, reliability, and power quality for customers;

- The use of monies flowing from the trust fund should be overseen by appropriate State or local officials, so that investments reflect the local and regional needs of the system;

- The use of monies from this fund should not be impeded by regular budget and appropriations processes, so whatever funds are obtained for this purpose will be dedicated and fully available; and

- The trust fund must contain a sunset provision – its purpose is to support the initial deployment of the new technologies, not to serve as a permanent funding system.

Recommendation – Incentive rates at FERC for grid enhancement

FERC, either by direction of Congress or on its own initiative, should adopt ratemaking standards for jurisdictional transmission rates that provide incentives for investment in the transmission grid. If feasible, these incentives should be structured as performance-based rates, with a utility's return based on specified grid performance criteria. In areas where such performance measures cannot be developed, the policy could be framed as an incentive return on equity for grid investments, in the context of a rigorous evaluation of technology upgrades and demand-side options.

Both FERC and Congress have expressed recent interest in such incentive rates. FERC has recently proposed to adopt new rate incentives (1% added to return on equity) for investment in transmission facilities approved through a regional transmission organization's planning process. Pending energy legislation also includes a requirement that FERC conduct a rulemaking on incentive rates for transmission investments.

Recommendation – Incentive rates at State commissions for transmission and distribution system enhancement

State regulators should adopt ratemaking standards for the transmission and distribution components of rates under their jurisdiction that provide sufficient incentives for system enhancements reflecting innovative technologies, using performance-based rates keyed to meeting specified performance criteria where possible. Congress should enact a new federal rate standard through an implementation scheme similar to that adopted in the Public Utilities Regulatory Policy Act (PURPA), requiring each state to conduct a public proceeding to decide whether or not to adopt incentive rates for transmission and distribution system enhancements.

MEMBERS OF THE
END-USE EFFICIENCY WORKING GROUP

Chair: **Roger C. Dower**

Roger Dower became President of the Forest Stewardship Council – U.S. in October 2002. His previous work includes serving as President of the eNERGYSolve Corporation, where he managed the marketing of energy services to industrial, commercial and institutional clients; as Director of the World Resources Institute's Climate, Energy, and Pollution Program; and as head of the Energy and Environment Unit at the Congressional Budget Office. He is the author of numerous books, articles and publications related to energy and environmental policy. Roger holds both a B.S and M.S. in Resource Economics from the University of Maryland.

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REPORT OF THE END-USE EFFICIENCY WORKING GROUP

Finding ways to use energy more efficiently can not only reduce dependency on oil and retard the growth of emissions that contribute to climate change, it also can save consumers money, contribute to greater profitability of businesses and industries that use energy as a primary input, create employment, and improve U.S. competitiveness. Efficiency can be a powerful tool in any effort to accomplish sweeping changes in the use of fossil fuels, to make industry more profitable, and to tame the emissions challenges of the 21st century.

Efficiency improvements have had a substantial impact on U.S. energy use. Since the 1970s, when concerted federal, state, and private efforts began to utilize energy efficiency measures and technologies, slow and steady progress has taken place. In 2002, the United States used 45 percent less energy per unit of GDP than in 1973. The breaking of the linkage between energy use and GDP growth is at least partly due to the more efficient use of energy. The oil price shocks of the 1970s and early 1980s spurred significant leaps forward in efficiency. However, even in the last 10 years, when energy prices generally have been stable, growing sophistication about power and energy use and the desire to control energy-related costs has led to significant advances in energy efficiency. Federal, state and local energy efficiency policies and programs stimulated a portion of these energy efficiency improvements (Geller 2003).

These state and municipal programs have taken a variety of approaches to promoting energy efficiency, including using federal ENERGY STAR programs, tax incentives, grants, training, certification policies, and educational programs.

The LEED (Leadership in Energy and Environmental Design) program – a voluntary, consensus-based national standard for developing high-performance, sustainable buildings – a product of the US Green Building Council – is just one example of a private-sector energy efficiency program used widely but differently in different states and localities. The State of Oregon is providing tax incentives for LEED buildings, while the City of Portland is providing grants to developers. New York City has adopted a tax credit approach. The City of Seattle has passed an ordinance requiring all municipal buildings to meet LEED standards. This diversity among state and municipal programs reflects the fact that different states and municipalities have a multitude of policy tools at their disposal and face different political and market circumstances. The diversity also reflects a healthy level of policy experimentation at the state and local level.

What these diverse programs have in common is a strong record of effectiveness. Cumulatively, programs run by states and utilities are reported to have saved 1.7 percent of electricity use nationally by 2000. But energy efficiency programs in leading states such as California, Connecticut, Minnesota, and Wisconsin reduced electricity use by 5 to 7 percent in 2000, according to the American Council for an Energy-Efficient Economy

(York and Kushler 2002). Efficiency programs in the leading states save 0.5% to1.0% of electricity use annually.

During the California energy crisis, state energy efficiency programs contributed to critically needed reductions in energy use. Relative to 2000, electricity consumption fell about 6 percent, and peak demand declined more than 10 percent, after adjustment for economic growth and weather conditions. Even after the crisis and its resulting high prices abated in 2002, electricity consumption was 3.2 percent lower and peak demand 4.5 percent lower than in 2000, again adjusted for economic and weather conditions (NRDC and SVMG 2003).

Corporations also have used energy-efficiency techniques and technologies to improve profitability and competitiveness, make savings in industrial processes, cut electricity bills, and assist in making voluntary carbon reduction commitments. For example, DuPont has kept its energy use flat since 1990, even as the company increased its production by 35 percent (DuPont 2003). Toyota estimates that energy efficiency measures the company implemented in its production processes saved the company 2 billion yen (approx. $172 million) in FY2001 and reduced carbon dioxide emissions by 4 percent from the previous year (Toyota 2003). IBM pledged to reduce its energy use and its carbon dioxide emissions by 4 percent per year during 1998-2004. In the end, its exemplary energy efficiency efforts yielded a 4.6 reduction in both energy use and emissions in 2000 and a 6.8 percent reduction in 2001.

In addition, Chicago, Portland, San Francisco, Seattle, Austin, and other cities have promoted energy conservation as a tool to reduce costs and increase efficiency. For example, Portland has reduced energy use by 24 percent since 1992, saving the city more than $12 million. A sewage gas-powered fuel cell, LED traffic signals, and high-performance heating and lighting have been among the technologies accounting for their success.

These advancements only begin to suggest the broader potential of efficiency programs. The Electric Power Research Institute (EPRI) estimates that a $4.2 billion annual investment in energy efficiency would reduce U.S. peak demand by 6.4 percent or 45,000 megawatts (MW) (EPRI 2001). Building generation to serve that same 45,000 MW would cost $8.5 billion annually and result in increased carbon emissions of 100 million tons a year. A combination of new and expanded policies and programs to advance energy efficiency could reduce national electricity use by about 15 percent in 2010 and more than 30 percent in 2020 (Geller 2003; Nadel and Geller 2001).

Improving the energy efficiency of homes and businesses will lead to a net increase in jobs due to the labor required to manufacture, sell, and install energy efficiency measures. For example, analysts have estimated that increasing energy efficiency and renewable energy use in all sectors of the U.S. economy could lead to a net increase of about 770,000 jobs (equivalent to a 0.44% rise in employment) by 2010 (Laitner, Bernow, and DeCicco 1998). Studies done at the regional level, both in energy-producing and energy-

importing states, confirm that improving the efficiency of electricity use leads to a net increase in jobs (Nadel *et al.* 1997; SWEEP 2002).

An estimated 25 to 30 percent of total U.S. energy consumption is used for building operating systems, including heating, ventilation, and air conditioning (HVAC) systems (NEMI 2003). HVAC/energy retrofits could reduce this energy consumption while creating jobs. In 2002, the potential market in the United States for HVAC/energy retrofits was estimated to be on the order of $180 billion, of which only 2 percent is realized each year. There are millions of hours of work available in the United States in the current HVAC/energy retrofit market, enough to support thousands of workers. A 40 percent increase in demand for high-quality implementation of HVAC/energy retrofits is an aggressive but realistic target. (NEMI/FMI 2002).

It certainly appears that a "rational" economic player would make significant investments in efficiency, yet any number of market flaws and failures conspire to prevent the optimal level of investment. There are many reasons for this market failure and a long history of neglect of this potentially cheapest of energy supply options. Energy is still relatively inexpensive, particularly in the United States. Further, electricity is rarely priced to reflect its true marginal costs. As a result, U.S. electricity markets shelter consumers from price signals that might encourage greater investments in energy efficiency.

For some companies and individual consumers, the rate of return from energy efficiency measures may be low, leading to underinvestment. Even for some companies for which the rate of return might be high, the expenditures involve capital outlays, while the returns show up in the form of reduced operating expenses, thus masking the payoff from the investment. Also, energy represents a relatively small fraction of the total cost of production for most businesses and industries, and reducing energy costs is not a high priority. In other cases, companies and households simply lack information about the financial benefits of energy efficiency; they do not realize the potential of energy efficiency investments to free up funds for other uses unrelated to energy.

The End-Use Efficiency Working Group has developed the following three proposals to boost the use of energy efficiency programs and to stimulate more successes that will call attention to the benefits of energy efficiency to the U.S. economy and the environment:

1. Provide federal co-funding to expand state and utility energy efficiency programs.
2. Expand the federal ENERGY STAR program.
3. Expand and improve energy efficiency training programs.

This paper discusses the three proposals in greater detail below.

1. Provide federal co-funding to expand state and utility energy efficiency programs.

States and local communities have been laboratories for energy efficiency projects, using federal resources and their own resources, often raised through the development of a

public benefits fund. In some cases, utilities and local governments implement state programs. In other cases, state agencies or third-party program administrators are the implementers. Public benefit funds have become the primary source of funding for utility and state energy efficiency programs. About 20 states have adopted a small electricity surcharge to fund energy efficiency programs and other public benefit activities (Kushler and Witte 2001). Total funding for utility and other state-based energy efficiency programs increased from about $0.9 billion in 1997 to $1.1 billion in 2000, mainly due to adoption of public benefit funds (York and Kushler 2002). In 2003, it is estimated that funding for utility and state-based energy programs increased to around $1.45 billion (ACEEE 2003).

The states that lead in funding and innovating through their energy efficiency programs involve large sectors of their economies and utilize a variety of programs that are effective in advancing efficiency, disseminating information, and capturing significant economic and environmental benefits. Each dollar of state program funding typically leverages $3 to $4 of investment in energy efficiency measures. As noted previously, energy efficiency programs in states such as California, Connecticut, Minnesota, and Wisconsin reduced electricity use in 2000 by 5 to 7 percent (York and Kushler 2002).

However, there is considerable variation among the states with respect to funding of energy efficiency programs, and, overall, energy efficiency funding is still well below the levels reached in the mid-1990s before the utility restructuring "wave" hit. Nineteen states (or the major utilities in these states) are spending at least $4 per capita on energy efficiency programs, based on the best information currently available.[9] The three largest states in the country (California, New York, and Texas) are included in this group. A number of other states (*e.g.*, Florida, Idaho, and North Dakota) are close to spending $4 per capita.

By comparison, 25 "lagging" states and the District of Columbia spend less than $1 per capita on energy efficiency programs, with very little impact on electricity demand. Thirty-five states and their utilities were spending less than 0.5 percent of their revenues from retail electricity sales on energy efficiency programs as of 2000; 29 of these states spent 0.1 percent of revenues or less (York and Kushler 2002). These states are producing more pollution than would be the case if they had stronger energy efficiency programs, thereby adversely affecting regional and national efforts to reduce air pollution and greenhouse gas emissions. Also, higher electricity demand growth in the states with minimal or nonexistent efficiency programs can diminish electric system reliability at the regional level.

For these reasons, there is a rationale for adopting federal policies to "raise the bar" on energy efficiency programs nationwide and to ensure (or encourage) that all states are

[9] These states are: Connecticut, Massachusetts, Rhode Island, New Jersey, Vermont, Maine, Wisconsin, Hawaii, New York, California, Washington, Minnesota, Iowa, Oregon, Texas, Montana, New Hampshire, Utah, and Nevada. The top 10 states (in order: Connecticut, Massachusetts, Rhode Island, New Jersey, Vermont, Maine, Wisconsin, Hawaii, California, and New York) were spending at least $8 per capita on utility and public benefits energy efficiency programs as of 2000 (York and Kushler 2002).

implementing reasonably well-funded efficiency programs. In addition to the environmental and electric sector benefits, consumers and businesses in "lagging" states would benefit from expanded energy efficiency programs through lower energy bills over the long run, insofar as those programs result in reduced investments in new power plants and transmission and distribution facilities, and reduced fuel purchases.[10]

Some energy efficiency advocates have proposed a national public benefit trust fund to provide matching funds to states for energy efficiency programs and other public benefits activities. Specifically, efficiency advocates have proposed a surcharge of 0.2 cents per kWh (totaling about $7 billion per year) for the fund (Nadel and Geller 2001; UCS 2002). All states and utilities would pay into the fund, but they would get the money back if they expanded or continue energy efficiency programs and other public benefit activities. Under such an approach, individual states would decide how to spend the money. This policy would give states and utilities a strong incentive to initiate or expand energy efficiency and other public benefits efforts. It is estimated that this policy would reduce national electricity use by 300 billion kilowatt-hours per year (7 percent) by 2010 and over 800 billion kilowatt-hours per year (16 percent) by 2020 (Nadel and Geller 2001).

The national public benefit trust fund concept has not gained much political support, however. Many policy makers view it as a new tax, even though the money would get recycled to state and utility public benefit programs rather than deposited into the Treasury and used for governmental expenditures in general. None of the energy bills introduced in the 107th and 108th Congresses included the public benefit trust fund concept.

Recommendation

To encourage maximum innovation, the End-Use Efficiency Working Group proposes a "carrot" to encourage states and utilities to initiate or expand their energy efficiency programs. Targeted aid to the states would accelerate these programs and is particularly important in a period when many states are facing severe fiscal problems and state funding for energy efficiency programs is being threatened. In order to maximize the impact of this proposal and to avoid a high level of "free riders," the proposed program would require states and utilities to reach certain benchmarks of energy efficiency program expenditures and electricity savings before they could tap these federal funds.

Specifically, this proposal would provide federal co-funding for state or utility energy efficiency programs funded above the level of $8 per capita.[11] In addition, utilities would be required to show they are reducing electricity use among all their customers by at least 0.5 percent each year, in order to be eligible for federal co-funding. In other words, the

[10] This is true whether these states have above-average or below-average electricity prices. Energy efficiency improvements are more cost effective than supply-side expansion even in states with relatively low electricity prices (SWEEP 2002).

[11] Some utilities collect information on the number of *households* they serve, but not the number of individuals. For this reason, the benchmark might be converted from a per capita funding level to a per household – *e.g.,* $20 per household.

program would incorporate not only a program spending benchmark but also a performance benchmark. Those states and utilities already meeting these criteria would be eligible for the federal co-funding, as would new states and utilities that join the current leaders.

The federal funds would have to be used for efficiency programs within a certain time period – *e.g.,* within two years after they are received. Also, current federal funding for energy efficiency programs – *e.g.,* funding for low-income weatherization or state energy offices, would not be counted towards a state's qualification for the new federal funds.

The proposed co-funding level is a federal contribution of $1 for each $1 the state or utility spends on energy efficiency programs above a threshold of $8 per capita (or $20 per household, whichever unit is preferred). For example, New Jersey spent $13.20 per capita on utility energy efficiency programs in 2000. If it maintained this funding level, the proposed program would award the state an additional $5.20 per capita (about $43 million) per year, thereby increasing the state's available resources for energy efficiency programs to $18.40 per capita.

In order to encourage lagging states to increase funding for efficiency programs, the proposed federal program would incorporate lower benchmark levels and matching levels, but these would be available for only a limited period of time. We suggest providing a federal match of $2 for each $1 the state or utility spends on energy efficiency programs, above a threshold of $4 per capita and below $8 per capita (or between $10-20 per household, whichever is preferred). Also, states or utilities would have to demonstrate that efficiency programs are reducing electricity use by at least 0.25 percent each year in order to qualify for federal funds. This lower threshold would remain in effect only for the first five years of the program. During this period, states and utilities spending more than $8 per capita would also qualify for the smaller federal match for their expenditures above $8 per capita.

As noted above, some states have statewide energy efficiency programs funded through public benefit charges. These states, if they meet the eligibility criteria, could apply for and receive the co-funding. The funds obtained could then be used for state-based or utility-run energy efficiency programs, whichever the state prefers. In states that do not qualify, individual utilities (either investor-owned utilities, municipal utilities, or rural electric coops) still could qualify if they met the eligibility criteria.

For example, utilities in Texas now spend a little less than $4 per capita on energy efficiency programs. Under the proposed program, if the Texas utilities did not increase their collective spending per capita and also did not meet the efficiency performance benchmark, the state would not qualify for federal co-funding. On the other hand, an individual utility in the state (*e.g.*, the Austin municipal utility) could qualify on its own. This approach would provide utilities with a financial incentive to operate well-funded, effective efficiency programs even if their neighboring utilities (or their state) do not. However, a utility in a qualifying state would not be separately eligible for additional federal funds.

Because part of the proposal requires a state or utility to demonstrate that it is meeting a specified electricity savings benchmark, there would need to be guidelines on the computation of such savings, reporting requirements, and even auditing provisions. It would be logical to have the Department of Energy promulgate the necessary guidelines and implement the reporting and auditing functions. The savings evaluation guidelines could make use of well-established energy efficiency evaluation tools such as the *International Performance Measurements & Verification Protocol* (DOE 2001).

States receiving federal co-payments should also be encouraged to establish threshold funding levels for certified and recognized training programs consistent with state needs to train workers in the arts and sciences of energy management systems.

Determining the potential impact and cost of this proposal is difficult because it is an incentive policy. However, assuming that states representing 60 percent of the nation based on population qualify at the higher tier and that the average expenditure on efficiency programs in these states is $12 per capita (excluding federal co-funding), then the cost to the federal government would be about $675 million per year ($4 per capita x 168 million people).[12] With the federal co-funding, the total spent on efficiency programs in these states would rise to about $2.7 billion per year ($16 per capita x 168 million people). By comparison, the utilities with the highest per capita expenditures on energy efficiency (*i.e.,* utilities in Connecticut and Massachusetts) spent $15-20 per capita on energy efficiency programs in 2000.

In addition to the above estimated costs, there would be an additional cost if many states and utilities qualified under the lower threshold during the first five years. Again, for purposes of illustration, assume that states representing 40 percent of the country qualify at the lower level and that, on average, their energy efficiency funding rises to the level of $9 per capita. In this case, the program's additional cost to the federal government would be about $1.1 billion per year during this five-year period ($5 per capita x 2 x 112 million people). However, adopting the lower tier would result in approximately $1.7 billion more per year spent on energy efficiency programs. Adding this sum to the $2.7 billion estimated above results in an overall annual federal and state expenditure of about $4.4 billion. And because of the leveraging effect of energy efficiency programs, the total investment in energy efficiency measures would equal $13-18 billion per year.

As noted above, states and utilities with well-funded energy efficiency programs typically reduce their electricity use by 0.5% to 1% per year. Assuming the proposed policy leads to efficiency programs that save 0.75% per year on average in 60 percent of the country and 0.3% per year on average in an additional 20 percent of the country, the overall savings for the country as a whole would be 0.51% each year. After 12 years of implementation, the proposed program could cut national electricity use by about 5 percent, or about 225 billion kilowatt-hours per year, from projected national levels of

[12] States and individual utilities representing about one-third of the country already would qualify given their program expenditures and savings levels as of 2000.

electricity use in 2015.[13] This estimate incorporates the total energy savings resulting from state and utility energy efficiency programs implemented during 2004-2015, not just the incremental savings from this policy.

Saving this amount of electricity in 2015 would mean that households and businesses would avoid approximately $15 billion in electricity bills. The electricity savings would result in approximately 100 fewer medium-size (300 MW) power plants or their equivalent by 2015, meaning less need to build costly and contentious new power plants. In addition, the risk of future power shortages and electricity price spikes would diminish.

States that lead in this area may also include in their programs innovative incentives to use renewable energy technologies or distributed generation. Examples abound that should be models for other states' efforts.

Combined Heat and Power

Combined Heat and Power (CHP), or cogeneration, is the coincident production and use of electrical or mechanical power and thermal energy. The recovered thermal energy may be used for industrial process/space heating and/or refrigeration/space cooling via an absorption chiller. CHP, considered the most viable and economic use of distributed generation (DG), offers many benefits: modern equipment is environmentally friendly; use of available heat (thermal energy) increases fuel-use efficiency; it diversifies electrical supplies to the end-user and enhances energy security; and on-site generation alleviates T&D load pocket constraints.

Recognizing the opportunity to improve the efficiency of power generation and to mitigate the associated air pollution, NYSERDA initiated a CHP Applications program area to demonstrate the use of DG technologies in a variety of CHP applications with a goal of making clean and efficient on-site generation (DG-CHP) a viable option for New Yorkers. The CHP Applications program area is stimulating the DG-CHP marketplace in New York State by demonstrating high-efficiency CHP systems in industrial, agricultural, institutional, commercial, and residential applications which serve as models for others to replicate. This program area also addresses hurdles to widespread deployment of CHP imposed by disjointed siting and permitting regulations, utility interconnection rules, and standby service tariffs.

NYSERDA's DG-CHP solicitations have been highly successful. In the past two years, NYSERDA has solicited DG-CHP projects through three rounds of funding, receiving nearly 300 proposals, of which more than 70 CHP demonstration projects, 18 CHP feasibility studies, and nearly 30 product development projects were selected for funding. NYSERDA has invested $40 million in over 100 DG-CHP projects, feasibility studies, and product development applications and has leveraged nearly $100 million in co-funding. In spite of a high attrition rate attributable to market hurdles, the 60 active demonstration projects are expected to install over 60 megawatts of new electricity generating capacity.

[13] This estimate assumes some degradation of savings from measures installed in the early years.

2. Expand the federal ENERGY STAR programs.

The federal ENERGY STAR programs are having a significant impact on energy efficiency and are very cost-effective, saving consumers and businesses more than $75 on their energy bills for each federal dollar spent (EPA 2002). The ENERGY STAR labeling programs inform consumers of high-efficiency appliances, office equipment, lighting products, and other devices. The programs also work with manufacturers to increase the availability of efficient products. In addition, the ENERGY STAR new homes and commercial buildings programs are increasing energy efficiency of both homes and commercial building using a whole-building approach.

As of 2001, consumers purchased more than 750 million products with the ENERGY STAR label, and EPA's ENERGY STAR programs improved billions of square feet of building space. It is estimated that cumulative adoption of ENERGY STAR products and buildings reduced electricity use in buildings in 2001 by 84 billion kilowatt-hours (nearly 4 percent) (EPA 2002). DOE's ENERGY STAR programs are providing additional energy savings, and recently the DOE and EPA programs have begun close coordination, which should make both programs even more effective.

Collaboration with regional, state, utility, and local energy efficiency programs is key to the programs' success. Numerous states, utilities, and municipalities promote ENERGY STAR products, homes, and commercial buildings as part of their energy efficiency programs. In some cases, this involves information dissemination and training. In other cases, state, utility, and municipal programs provide financial incentives to encourage the adoption of ENERGY STAR devices or buildings. Many states, utilities, and municipalities use ENERGY STAR performance levels as benchmarks within their programs; this has helped to standardize efficiency programs throughout the nation.

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation whose mission is to use innovation and technology to solve some of New York's most difficult energy and environmental problems. Through the efforts of NYSERDA's public-benefit funded New York Energy $mart programs, ENERGY STAR has become an integral element of New York's efforts to promote energy efficiency.

For example, in 2002 more than 190,000 old room air conditioners were replaced with energy-efficient ENERGY STAR models through the "Keep Cool" program, a joint effort of NYSERDA's New York Energy $mart program, the Long Island Power Authority, and the New York Power Authority. Working with nearly 600 appliance dealers, the Keep Cool program provides consumers with cash "bounties" when they purchase a new ENERGY STAR room air conditioner and turn in their old room air conditioner to be recycled. The Keep Cool program in 2002 alone resulted in a 57-megawatt peak load reduction.

NYSERDA also administers the New York ENERGY STAR Labeled Homes (NYESLH) Program. This market-based program seeks to transform the way energy efficiency services are delivered to the 1-4 family new construction market.

New York ENERGY STAR Labeled Homes are nationally recognized for using 30 percent less energy than conventional new homes. They are built to higher standards for energy efficiency, incorporating proven energy-saving technologies, advanced building practices and traditional craftsmanship. Program credibility is further enhanced through a strong relationship with the New York State Builders Association - Research and Education Foundation (NYSBA-REF), a non-profit subsidiary of the New York State Builders Association, which promotes building construction research and educational opportunities for the building industry. The program also puts a high priority on construction quality.

The ENERGY STAR programs should be expanded first to increase their scope (i.e., cover more product and building types) and to increase the level of promotion, technical assistance, and training. Also, a new ENERGY STAR program is just getting under way in the area of promoting high-quality home energy retrofits. This effort needs expansion as well. ENERGY STAR could work to incorporate the apprentice training programs of the Department of Labor or those sponsored by trade unions. Expanding the ENERGY STAR programs would be especially important if state and utility energy efficiency programs grow. This will enable the federal programs to increase their assistance and cost-shared activities with state, utility, and local efficiency programs, activities such as training builders in construction of ENERGY STAR homes, training commercial building owners and managers, and promotion of ENERGY STAR products.

Recommendation

The annual budget for the federal ENERGY STAR programs is currently about $60 million. The Working Group recommends doubling the budget for the ENERGY STAR programs over a two- or three-year period, in conjunction with the proposed major expansion of state and utility efficiency programs. We estimate that the incremental energy savings by 2015 could be on the order of 45-90 billion kilowatt-hours per year (1-2 percent), assuming that some of the energy savings are already counted under the expansion of state and utility efficiency programs.

3. Expand and improve energy efficiency training programs.

Training is critical to ensure that energy-efficient products are installed and used properly. For example, training building managers in commercial buildings is critical for realizing the savings potential from energy management and control systems (Dodds, Baxter, and Nadel 2000). Also, training contractors who install heating and air conditioning systems can increase the number of units that are sized and installed properly. If this is not done, high-efficiency heating systems and air conditioners will not save as much energy as they could. In addition, architects and builders need training in energy-efficient building design and construction.

A number of well-designed energy efficiency training and certification programs have been developed, including programs for HVAC contractors and for commercial building operators. Much of the energy efficiency training now occurring is being conducted through federal, regional, trade union state and/or utility energy efficiency programs. For example, both DOE and EPA are helping to train commercial building owners and managers through their efficiency programs. DOE has also developed a variety of energy efficiency courses and training materials for industrial energy managers. Many utilities with energy efficiency programs offer training to builders and building managers; some are training contractors as well. Regional and state energy efficiency organizations such as the Northwest Energy Efficiency Alliance, Northeast Energy Efficiency Partnerships, and energy efficiency programs in Wisconsin are training and certifying building operators, building designers, and building contractors (Putnam et al. 2002; Foster et al. 2002). In addition, a new training and certification program known as Home Performance with ENERGY STAR has been developed for contractors who conduct home retrofits. The Paper, Allied-Industrial, Chemical and Energy Workers International Union (PACE) is promoting a set of skill standards for manufacturing workers in coordination with the Manufacturing Skill Standards Council (MSSC) that can be a model.

In part because these training efforts are still relatively limited geographically, the overall level of awareness and skill in energy efficiency techniques in the United States is still far below what it should be. Most air conditioning systems are not sized or installed properly, most air distribution systems installed in new buildings are not sealed properly, and most buildings are not well designed from the perspective of overall energy performance. And in industry, there is still tremendous energy savings potential that could be realized from improved operation and management of pumping systems, compressed air systems, and the like. In short, there is a need to improve a broad range of skills among professionals who have a significant impact on the energy performance of our homes, commercial buildings, and factories.

Recommendation

We recommend setting a national goal of upgrading the energy-related skills of a large fraction of the architects, builders, contractors, technicians, building operators, and industrial energy managers in the United States by the end of the decade. To meet this ambitious goal, federal funding for energy efficiency-related training and certification should be increased by $25-50 million per year. The funds would be used to greatly expand the reach and impact of worthy energy efficiency-oriented training and certification programs that already exist (i.e., not to "reinvent the wheel") and also to develop and implement new training and certification programs where needed.

These efforts should be implemented in collaboration with regional, state, trade union utility, and local energy efficiency programs. Federal dollars would be used for "training the trainers," sharing the cost of on-the-ground training and certification programs (possibly limited to help with start-up costs), and developing and testing new training techniques and certification programs. The dispersed network of energy efficiency

programs should provide the actual training and certification, again in conjunction with the expansion of state and utility energy efficiency programs called for above. State programs should be informed of the wide range of certified programs available, including the U.S. Department of Labor Bureau of Apprentice Training (BAT) certified programs. In addition, state, utility, and local energy efficiency programs should educate consumers and businesses in order to increase the demand for well-trained, certified builders, contractors, etc.

Training and certification programs should also be developed and implemented in partnership with industry and trade associations (where this is not already occurring). For example, in 1997, the HVAC industry and other parties (including DOE and EPA) developed a national certification program for HVAC technicians known as North American Technician Excellence (NATE) program. Efforts are under way to improve the energy efficiency content of NATE certification (Foster et al. 2002). Also, the National Energy Management Institute (NEMI) and the International Training Institute (ITI) train and certify energy management technicians. The unionized sheet metal industry currently dedicates over $55 million per year to training technicians; the industry has over 70,000 certified HVAC mechanics in the United States and Canada. The set of initiatives proposed here would increase the number of individuals certified by such efforts and would encourage and supplement these model programs.

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MEMBERS OF THE INTERNATIONAL WORKING GROUP

Co-Chair: **Henri-Claude Bailly**

Henri-Claude is a Principal of RCG in Cambridge, Massachusetts, and Senior Advisor to the President of International Resources Group in Washington, DC. He also serves on the board of directors for nextep SA, a French energy management services company, and the Alliance to Save Energy. Henri-Claude was Chairman of the Board of Hagler Bailly, an international management and economic consulting firm to the energy and utility industries that merged with PA Consulting Group in October 2000. He served as Hagler Bailly's chief executive officer from the firm's founding in 1980 until April 1999.

Co-Chair: **Jefferson B. Seabright**

Jeff is a partner with Green Strategies, a Washington, D.C.-based consulting firm focused on energy and environmental issues. Jeff joined the Agency for International Development in 1993, later serving as its Director of Energy, Environment & Technology. He moved to the White House in 1999 as Executive Director of the Climate Change Task Force and subsequently joined Texaco as Vice President for Policy Planning. He earned a Master's degree in International Relations from the London School of Economics, and serves on the Boards of the Keystone Center, the National Renewable Energy Laboratory, and the Houston Advanced Research Center.

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REPORT OF THE INTERNATIONAL WORKING GROUP

Enormous energy challenges face the world, particularly developing countries and countries with economies in transition. Addressing these challenges will require bold new initiatives that target governance, investments, resources and technologies. The Energy Future Coalition's International Working Group evaluated more then two dozen proposed unilateral and multilateral initiatives that could address the need for clean, affordable and reliable energy – especially for two billion of the world's poorest people who now lack access to modern energy services. Based on this assessment, the Working Group recommends five major initiatives, listed below.

Proposed Major Initiatives

MAJOR THEME	UNILATERAL (US) INITIATIVE	MULTILATERAL INITIATIVE
Improve the Energy Policy and Governance Framework	1. U.S. Council on Energy & Development	
Support Investment Toward Sustainable Energy	2. Global Development Bonds	3. Global Rural Energy Fund 4. Clean Energy Lending Guidelines 5. Energy Efficiency Finance Protocol

1. ***A coalition of leaders from U.S. industry, government, labor, and non-governmental organizations (NGOs) to alleviate global energy poverty.***

2. ***A new class of investment securities to tap private capital markets for sustainable energy development.***

3. ***A donors' fund to invest in replicable and successful models to alleviate energy poverty – by scaling up "what works."***

4. ***Lending guidelines that will put the power of export credit agencies behind low- and no-carbon energy investments.***

5. ***A standardized finance protocol for end-use energy efficiency projects.***

These five initiatives are described in detail in the balance of this paper.

1. U.S. COUNCIL ON ENERGY & DEVELOPMENT

A coalition of leaders from U.S. industry, government, labor, and NGOs to alleviate energy poverty in the world

The proposal is to create a non-governmental entity ("Council") to serve as the focal point in the United States to monitor, encourage, and influence the development of the energy partnerships announced in Johannesburg and to seek sufficient funding and resources to ensure that the ambitious goals set in Johannesburg are met. The Council might also focus more broadly than the Johannesburg partnerships. It might seek to expand the existing Peace Corps program in the energy and environmental arenas; existing peer-to-peer partnerships for energy management; and bilateral energy and environmental planning collaboratives with China, India, Indonesia, Brazil and Russia. The Council would also play an important role in improving public awareness in the United States of energy poverty and energy sustainability issues which affect nearly one half of the world's population.

Background: Advancing international energy development and trade and international cooperation on climate change are prerequisites for the world's poor to attain the benefits of globalization and, ultimately, for the United States to retain them. Current U.S. efforts toward these ends must be better focused and coordinated and must exploit the synergies that can arise from improved public-private collaboration.

The benefits of such improved policies to the U.S. private sector would include: a more friendly global business environment; an opportunity for progressive global corporate citizenship (sharing of benefits of globalization); the leveraging of corporate resources with public-sector funding; an opportunity to influence public policy-making in regard to development assistance and global climate change; and potential new long-term market opportunities.

The benefits to the U.S. public sector would include improved economic and social development opportunities in "hot" regions of the world, with concomitant benefits to U.S. national security and economic interests; more effective deployment of public-sector resources; leveraging of public-sector resources with private-sector funding and know-how; and opportunities to influence corporate strategy and policy, particularly as it relates to global climate change issues.

The benefits to the world's poor in developing and transition economies would include access to income-generating opportunities and improved public health. Clean, affordable and accessible energy provides refrigeration for vaccines in remote clinics; heat, light, and communication for schools, orphanages and hospitals; and power to run water pumps and wastewater treatment plants, providing direct and indirect employment opportunities.

During the preparatory process for the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, energy emerged as a top priority for all countries. Participants focused on meeting the needs of the two billion poor people who

do not have access to modern energy services. The U.S. government supported the development of partnerships and initiatives for energy production in developing countries

The U.S. focus on increasing access to modern energy services is linked to the Global Village Energy Partnership, a global initiative led by the UN Development Program and the World Bank. This partnership involves industrialized and developing country governments, private corporations, and non-governmental organizations. It has set ambitious ten-year goals that include providing access to modern energy services to at least 400 million previously unserved people, reaching 50,000 new communities, and training a cross-section of small business enterprises and institutions to develop and implement village energy projects and programs. The U.S. intends to provide about $20 million toward the initiative in 2003, but its future commitment is unclear.

The Europeans also announced a variety of energy initiatives in Johannesburg. The European Union launched an Energy Initiative for Poverty Eradication and Sustainable Development, focused on providing access to sustainable energy in developing countries. The UN Environmental Program introduced the third major energy initiative in Johannesburg: The Global Network on Energy for Sustainable Development aspires to create 10 "sustainable energy centers" in developing and developed countries to promote the research, transfer and adoption of green and cleaner energy technologies in the developing world. Focusing on policy development, this initiative aims to improve global access to knowledge on sustainable energy, synthesize partners' disparate experiences, and provide advice and support to private and public decision-makers.

The Johannesburg partnerships, numbering 21 in all,[14] signal a new phase in global energy development. All address the challenge of moving from small-scale, demonstration-type projects that have been characteristic of developing countries to large-scale projects capable of providing clean energy to millions of people.

Objectives: The U.S. Council on Energy & Development would aim to:Improve the understanding of international energy poverty and security issues in the U.S.;

- Seek strong U.S. government involvement and funding for the energy partnerships;
- Perform periodic reviews of the overall progress made by various partnerships and offer recommendations;
- Focus on priority countries in which to identify and overcome barriers to clean energy development and to improve coordination among various aid and investment activities; and
- Mobilize private-sector resources.

Council initiatives might include expanding the existing Peace Corps program in the energy and environmental areas, expanding existing peer-to-peer partnerships for energy management, and expanding bilateral energy and environmental planning collaboratives with China, India, Indonesia, Brazil and Russia.

[14] http://www.johannesburgsummit.org/html/sustainable_dev/p2_protecting_energy1.html.

Discussion: The proposed Council would be a non-governmental, non-partisan coalition built initially on the foundation of the International Working Group.[15] Initially at least, membership would be limited to private and non-government entities that invest in, provide funding for, or have expertise with initiatives and projects which mitigate energy poverty.[16] Ideally, organizations would be represented by their most senior executives. Examples of possible Council members include:

- U.S. private sector: Oil and gas companies, electric utilities, construction and energy services companies, equipment manufacturers; financial institutions, etc.
- U.S. labor organizations.
- NGOs: Non-profit organizations working on energy poverty, private foundations.

Recommendation: The Energy Future Coalition, together with the National Academies, should take the lead in organizing and hosting a high-level organizational meeting to marshal the support and actions needed to create the Council. In anticipation of this meeting, the International Working Group will prepare a background discussion paper, which would discuss alternative organizational models and outline possible strategies, plans and budgets.

[15] The United States Energy Association, in its report *Toward an International Energy Trade and Development Strategy,* proposed a similar initiative in October 2001. That report was prepared by the USEA Trade and Development Committee, which was then chaired by Henri-Claude Bailly, co-chair of the International Working Group. The Board of Directors of the USEA, which includes several leading U.S. corporations (e.g., GE, ConocoPhillips, ChevronTexaco, AEP, Pepco, Keyspan, Bechtel), trade associations (e.g., Electric Edison Institute, American Petroleum Institute) and government agencies, unanimously supported creation of the Council.

[16] As such, the Council would not be a "grass-roots" or "any-one-can-join" organization. Only organizations that could make things happen would be invited to join. There are probably no more than 100 such organizations in the U.S.

2. GLOBAL DEVELOPMENT BONDS

A new class of investment securities to tap private capital markets for sustainable energy development

This initiative envisions the creation of a new category of U.S. investment security, Global Development Bonds, to mobilize a higher flow of U.S. capital investment to developing countries for critical investments in clean energy and other areas.

Discussion: Global Development Bonds (GDBs) would need to be established by federal legislation that would define a set of government incentives and treatments. These bonds would enjoy certain credit enhancements – such as tax benefits, risk insurance, and matching funds – from the U.S. government, subject to the funds being used in designated countries ("Qualifying Countries"), and for specified "sustainable development" purposes ("Qualifying Uses").

The analogies are many: GDBs would be to international development what municipal bonds are to local government finance, what corporate bonds are to business finance, what pollution control bonds are to environmental finance, and what mortgage-backed securities are to housing finance – a homogeneous category within which qualified issuers can raise funds for broadly designated purposes as defined in law and overseen by a designated regulatory body.

The following investor incentives are proposed:

- Investors are concerned about whether the return on their investments will be commensurate with the risk of sustainable development projects. GDB bondholders would receive a multi-year series of tax credits to encourage them to invest and leave their money at work – e.g., 10% in the first year and 5% per year for years two through six. Bondholders would thus receive a 35% return from the tax credits alone. This incentive would be attractive for individual investors.

- Investors are also concerned about unpredictable political risks. Investors are concerned about unpredictable political risks. GDB issuers would receive "automatic" political insurance from the Overseas Private Investment Corporation (OPIC). That is, OPIC would be required to establish certain criteria for a GDB to qualify, whereupon it would be entitled to a standard OPIC insurance package - more like reinsurance, a limited tie to protection by the U.S. government. This insurance would be especially attractive to institutional investors - trusts, pension funds, insurance companies, and others - that have a fiduciary duty to protect the capital of their clients.

- Many deals in developing countries face an economic chasm between the rate of return investors demand (e.g., 20% or more a year) and the return that the project or business can achieve (e.g., 10% or less). To help reduce this gap, GDB issuers might be given matching funds from the U.S. government at zero- or low-percent

interest, thus doubling the funds available and reducing the average cost of capital. This funding could be provided by the Administration's proposed Millennium Challenge Account, giving that program a market-oriented strategy and leveraging private-sector capital.

The net effect of these three incentives – tax credits, risk mitigation, and matching funds – would attract U.S. investors to GDBs as a more viable way of putting their capital to work in developing countries.

Qualifying Countries

The U.S. maintains a list of Most Favored Nation trading partners. As a basis for the GDB program, it is suggested that the government establish a list of Most Favored Nation "development" partners.

Qualifying Uses

The determination of Qualifying Uses will spark a debate over the sometimes-competing goals of economic development, environmentally clean development, poverty-focused development, or other priorities. The central theme of Qualifying Uses should be clean energy and sustainable development, as defined from time to time.

Qualifying Issuers

As a U.S. government-supported security, GDBs would need to be issued by U.S. registered entities subject to U.S. laws and tax regulations. As described below, OPIC and/or the Securities and Exchange Commission will need to put forth a regulatory definition of "qualifying" issuers of GDBs, or establish an entity to award GDB licenses to approved issuers.

Implementation Options: There remains a need to conduct a carefully considered feasibility study and prepare an implementation plan before launching the GDB concept. The following are two illustrative scenarios: A regulated "open market" of prospective issuers, and a partially insured market focused on commercial bankers.

(a) Regulated Open Market

In this first illustration of implementation possibilities, OPIC is expanded to establish and oversee the GDB program.

- Principal Agency: The principal implementing agency for GDBs would be OPIC. It would issue approvals or licenses to issuers of GDBs, which would trigger qualification for the tax credits, award of OPIC insurance, and matching funds from the Millennium Challenge Account (perhaps now managed by OPIC expressly for the GDB program).

- Program Models: There are many existing programs that could serve as models, or at least consideration, for designing the structure for implementing GDBs. These include but are not limited to OPIC's existing programs, the Small Business Investment Company (SBIC) program of the Small Business Administration, the oversight of traded securities by the SEC, and the relationship of the U.S. Treasury to Fannie Mae and the other Government-Sponsored Enterprises (GSEs).

- On-going Regulation and Oversight: The regulatory function could be performed by OPIC or a newly created agency, similar to the SEC's regulation of traded stocks and bonds. Alternatively, the SEC itself might perform this function. In any case, there will be a need for the kind of "loose-tight" regulation that the SEC applies, requiring certain reporting and adherence to accounting and ethical standards, but in such a way as to allow the markets to allocate capital.

In practice, a prospective GDB issuer would retain legal counsel to advise on obtaining the OPIC license, and secure the services of an investment banker to underwrite the bonds. Having the funds in hand, the issuer would carry out its business in the pre-designated developing countries in accordance with its plan and in conformity with all regulatory and reporting requirements. The issuer's success in meeting its financial objectives would determine if and to what extent the capital markets would invest in the issuer's bonds in the future. That is, normal capital market forces would be allowed to work, within a regulated space.

(b) Focus on Commercial Banks

Another approach would be to provide a limited amount of government insurance against loss in order to access more widely available capital. The best portion of the international capital market in terms of cost, liquidity and consistency of availability of funds is the highest rated part of the market, generally AAA, AA and to a degree A-rated paper. BBB bonds and high-yield bonds are not only more expensive, but often there are periods where no bonds can effectively be sold. Bonds that are guaranteed by the U.S. government would be easy to sell but would leave the government on the hook dollar for dollar and would create the need for a major infrastructure to regulate and monitor the credit risk being assumed.

- Agency: OPIC or another agency would be authorized to offer a certain amount of loss protection insurance against a specified portfolio of clean energy development loans. U.S. financial intermediaries (probably banks) would set up wholly owned but off-credit subsidiaries funded with an appropriate amount of equity – Global Development Banking Trusts ("GDBTs").

- Raising and Lending Funds: The GDBTs would seek an allocation of loan insurance from the government. Armed with this insurance and some equity, the GDBT would issue bonds that could be rated AAA, AA or A by the major rating agencies and on that basis could raise significant amounts of capital at costs only

slightly higher than Treasury securities. The money could then be lent directly to borrowers for projects ("Qualifying Uses") as a dollar-for-dollar match with a commercial lender – either the bank that sponsored the GDBT or an unaffiliated entity.

- Bond Ratings: Any lending losses would go against both the equity and the loan insurance before the bondholders suffered any loss. The bond rating would be based on the portfolio of loans (quality, diversification, etc.) as well as the amounts of equity and loan insurance relative to the bonds being raised. Obviously, because the rating is forward-looking, the regulatory agency would need to promulgate restrictions on the kinds of loans that the issuers could make.

The benefits of this structure are that: (i) it builds on existing bank infrastructure to make credit judgments on the individual loans, (ii) GDB funds are supplemented by profit-oriented lenders, providing more capital at lower costs to the borrowers; (iii) assuming the lenders (with the help of the rating agencies) exercise responsible credit judgment, the GDBT should recover all of its capital and a return, allowing the loan portfolios to grow over time with little or no cash out of the government's pocket; and (iv) depending on the creditworthiness of the individual loans, the markets should be willing to raise and lend multiples of the amount of the insurance, thus maximizing the impact of government support.

Potential Impacts: Approximately $50 billion per year is spent by all OECD countries together for overseas development assistance, which represents less than 0.5% of the aggregate GDP of those countries. Clearly, this formal "aid" funding does not reflect the potential of the OECD nations to advance capital resources for the purposes of development.

By creating a new category of Global Development Bonds, the United States would benefit in several ways. It would leverage private-sector funds in a way that foreign aid now does not. It would improve the effectiveness of dollars flowing overseas, because the funds would flow through many competing channels, seeking best applications through market forces. It would improve the efficiency of moving money into key developing countries for environmentally-sound development, because the private sector works faster and at much lower overhead cost than government. And it would open up new export opportunities for U.S. clean energy and other businesses and help restore American esteem in the international community.

Other OECD nations may choose to implement a GDB program as well. Just as there are hundreds of mutual funds, real estate investment trusts, leasing companies, mortgage-backed securities funds, and other special-purpose investment methods and vehicles, dozens or hundreds of GDB funds could emerge from a successful GDB program, deploying many billions of dollars in capital investment to the developing countries. The net effect would be a significant acceleration in economic, environmental, social, and human advancement around the world.

Recommendation: OPIC and USAID should convene a task force of government agencies, commercial lenders, and other interested parties to support and explore the various options for establishing and managing GDBs, including, but not limited to, the implementation scenarios outlined above. Determining how to design the program to best meet the needs of stakeholders, and to ensure it achieves the intended outcomes, should be the focus of these planning efforts. The goal should be a structure for GDBs that would maximize the use of private-sector capital while limiting the exposure of the government to loss.

3. GLOBAL RURAL ENERGY "BEST PRACTICES" FUND

A donors' fund to invest in replicable and successful models to alleviate energy poverty – by scaling up "what works"

A Global Rural Energy "Best Practices" Fund is needed to support and scale up proven successes for financing and delivering affordable modern energy services to rural households, businesses, and communities in developing countries. Such a fund could replenish, deepen and build on the successful pioneering work undertaken by foundations, NGOs, companies, multilateral, bilateral and government programs; "reward" and build on best practices; and lay the groundwork for the successful design and implementation of larger efforts.

Background: More than half the world's population lives in rural areas. Approximately 90% of them – some 2.8 billion – live in developing countries. The vast majority of these people depend on traditional fuels of wood, dung and crop residue and commonly employ primitive and inefficient technologies to convert them. For many, this combination barely allows the fulfillment of the basic human needs of nutrition, warmth and light, let alone the possibility of harnessing energy for productive uses and income generation that might assist in alleviating their poverty.

Modern, commercial energy sources, such as electricity and petroleum-based fuels (kerosene or LPG), generally provide only a small part of the energy consumed by rural households, mainly because of supply and affordability constraints. Access to these modern sources is often more costly and difficult than for higher-income urban dwellers. The net result is that the rural poor have to pay significantly higher prices for inferior basic energy services, making their economic prospects dim.

Three key factors constrain access by the poor[17] to modern rural energy services: (1) availability of capital; (2) adequate rural-based financial and service infrastructure; and (3) affordability of the energy services. The first two factors inhibit the delivery of modern rural energy services to the top 10 to 20 percent of the rural households that could afford such services without any support subsidies. The remaining 80 to 90 percent of rural households require, in addition, some initial financial assistance or subsidy to overcome the affordability barrier. In most developed countries and in many developing countries, rural electrification was initially supported by government subsidies or, alternately, by cross-subsidies from urban, commercial and industrial electricity consumers. Subsequent economic development in the rural areas allowed for the eventual elimination of these start-up subsidies and resulted in sustainable financial rural electrification systems.

[17] Access is defined to include (a) household energy services such as lighting, television and radio; (b) energy services for social needs such as schools, health clinics and community centers; and (c) energy services for income generating activities such as sewing machines, tools, refrigeration, telephones, computers, etc.

In the 1990s, a number of models for financing and delivering rural energy services emerged. These models,[18] initially funded by foundations, the Global Environment Facility (GEF), bilateral aid agencies and multilateral development banks, have helped demonstrate, at a limited scale, various approaches for financing and delivering affordable rural energy services. A number of these models have been successful and continue slowly to increase their impact. A number of others have clearly failed.

For the models that have succeeded, the single greatest barrier to rapid scale-up has been the availability of financing at the local level to expand operations. In most cases, these models are successful because of dedicated local entrepreneurs and stakeholders working in isolated rural areas. The projects are initially financed with external, often international, sources of funds. Once this initial funding is expended, the local entrepreneurs/promoters are unable to easily access follow-on funding either because there is a scarcity of local capital, or because the infrastructure to deliver local capital for rural energy service projects does not exist. The transaction costs are prohibitive for available financing options in the capital city or internationally, and rural entrepreneurs are unlikely to know about them in the first place. As a result, many successful or "best practice" rural energy service models have had only limited impacts, confined to the initial financing they may have received primarily for demonstrating the concept.

Lessons Learned: There are a number of lessons learned from the operations of these emerging financing mechanisms. These include:

- Each country's needs and capabilities are unique and require analysis to determine the most appropriate financial intermediation support.
- It is less clear that stand-alone institutional and technical capacity building efforts have been successful. Programs and funds that do not establish and use institutional frameworks for self-sustaining finance often end up replacing and replicating the traditional, often inefficient, central government financial flows.
- Concessional financing/subsidies will be necessary for some time. Nonetheless, funds should be operated on commercial terms by independent agencies operating with transparent and clear rules and operating procedures. Government and political influence must be kept to a minimum.
- Determining the credit capacity of the host enterprise, or the ultimate borrower if it is an energy service provider or a leasing firm, is critical. All evaluations must include a credit analysis by an independent organization with either no stake in the outcome, or a risk-adjusted stake in the outcome. Most funds do require a significant portion of project costs to come from either the host or the energy service provider; this equity should be on a first-loss basis.
- Models from the U.S. usually are not directly applicable. For example, revolving funds that rely on the highly efficient U.S. capital markets and on the high

[18] Financing Energy Services for Small-Scale Energy End Users (FINESSE); Renewable Energy and Energy Efficiency Fund (REEF); SOLUZ-Dominican Republic and Honduras; Solar Electric Light Fund (SELF) –Vietnam, Sri Lanka and China; AREED; CREED; BREED; Energy Services Delivery Project – Sri Lanka; Rural Energy Development Project- Indonesia; RAPS/NUON/South Africa/ KwaZulu Natal; Grameen Shakti – Bangladesh; etc.

technical capacity of the borrowing municipalities will not work in developing economies without serious initial support and intervention.

Objective: Establish a Global Rural Energy "Best Practices" Fund that has the principal objective of providing financing for the delivery of basic energy services to 100 million unserved rural households (half a billion persons) over the next 10 years, focusing on the productive use of these energy services for income generation. Assuming an average capital investment of $500 per rural household, a total investment of $50 billion over 10 years or an average of $5 billion per year is needed.

To achieve its objectives, the Fund should:

1. Secure, catalyze, and direct funds from public- and private-sector sources to finance both the capital investments and subsidy support needed to overcome initial financial constraints.
2. Identify and help implement the basic governance, rule of law, banking and investment policies that are necessary to attract, support and protect rural energy service investors, developers and enterprises and ensure reliable energy services to consumers.
3. Support existing or develop effective local credit institutions and energy service companies that can efficiently and profitably finance and deliver modern rural energy services.
4. Promote the replication of successful models for provision of rural energy services across the developing world.

The Fund must be market-driven and based on an established demand for capital and services and not proposal-driven, as is the case with funding from the GEF. The Fund should focus on assisting and scaling up proven models and help replicate such models elsewhere. It should help replenish funding for successful activities that are established in the field, thereby allowing such operations to expand delivery of their services. The Fund must be designed to move financial resources quickly and efficiently from the global level down to the local level while simultaneously assuring fiduciary responsibility.

Such a Fund would build on and leverage successful models implemented by a range of actors (UNF, USAID, World Bank, etc.) that are emerging in a number of developing countries. It would raise funds from the private sector to finance capital investments and from the public sector to support the initial subsidies needed to overcome institutional and income constraints. It would work in association with other initiatives such as the Global Village Energy Partnership to complement the implementation agenda. Additionally, it would work with partners to help foster the policy and regulatory environment that will support the implementation of independent rural energy services. *The Fund should also:*

- Work with participating local credit and micro-credit institutions, energy service providers, local governments and NGOs to implement the pilot programs.

- Recognize and address the need for a "social safety net" subsidy for the very poor. Identify the need for rural-based human and institutional infrastructure and develop plans to address this need.

- Work with the active bilateral, multilateral, NGO and private-sector entities that are currently trying to address the issues of rural energy services to help leverage scale-up programs.

Recommendation: The U.S. government should contribute seed money of $50 million for a pilot phase of the Global Rural Energy Fund that supports scale-up of working models for rural energy services and demonstrates the market demand for financing and the value of support for emerging "best practice" programs.

To prepare for that pilot program, the Energy Future Coalition will establish a working group of key stakeholders drawn from successful rural energy service projects to draft a proposal for the Fund's pilot phase; identify potential institutional partners; identify best practice models to support; and identify potential funding for the pilot phase.

4. SUSTAINABLE ENERGY LENDING GUIDELINES

Lending guidelines that will put the power of export credit agencies behind low- and no-carbon energy investments

OECD lending guidelines should be revised to acknowledge the public good associated with low- and no-carbon technologies and their large capital requirements (and relatively low operations and maintenance costs). Extended-term financing would make a range of clean energy technologies more competitive with fossil fuel incumbent technologies, and help stimulate more rapid commercialization of climate-friendly technologies.

Background: The lack of project financing is one of the most significant barriers to the implementation of clean energy (end-use efficiency, large grid-connected renewables, and small-scale distributed generation) projects in both the developing and developed world.

There are several finance barriers to greater market acceptance of clean energy technologies and project financing, including:

- High transaction costs (small projects)
- High capital costs (relative to traditional alternatives)
- Inability to capture life cycle benefits
- Lack of standardization/syndication (e.g., with energy efficiency)

In the area of energy efficiency, facility owners are not willing to use their own capital funds to pay for energy savings versus capital improvements, and there is a general lack of familiarity in the banking and finance community with the valuation of "negawatts." Large-scale renewable projects are often disadvantaged by high up-front capital costs, even though they are often highly competitive on a life-cycle basis (without consideration of externalities). Distributed generation at the community level is also disadvantaged in financial markets due to lack of creditworthiness and high transaction costs.

Given the scale and importance of the challenge to bring more clean energy to the market, there is a need to identify new and innovative models for public-private cooperation on clean energy finance. Toward that end, two related strategies should be pursued:

1. Bring environmental considerations into mainstream decision-making of public and private financial institutions, and
2. Encourage public international financial institutions (IFIs) to use the leverage they exert over private financial flows (through their co-financing, risk mitigation, and policy advice) to support environmentally and socially sustainable development.[19]

[19] These goals are articulated in WRI's *International Financial Flows and Environment Project*.

The range of possible initiatives in this arena is enormous: tax code revisions, a "Tobin tax" on international financial flows to support clean energy investments, global subsidy reforms and guidelines, debt relief for clean energy funds, etc. The challenge is to winnow the range of possibilities to actionable initiatives that can win support.

This initiative focuses on one proposed effort to address these barriers: revision of export credit agency guidelines.

Export Credit Agencies (ECAs) in OECD countries collectively lend more than four times the annual budget of the World Bank for a wide variety of capital projects, goods and services. In order to prevent "beggar thy neighbor" predatory policies, OECD member countries negotiated and adopted in the 1970s a set of lending guidelines for ECAs. These guidelines set out the terms and conditions which apply to various aspects of ECA lending, including interest rates, term, eligibility, etc.

Currently, export credit agency lending guidelines for energy projects restrict national export credit agencies to 10-year loans – with the exception of nuclear power projects, which are entitled to 15-year money. This special status for nuclear projects was justified at the time on the grounds that nuclear plants are very capital-intensive, and therefore require a longer amortization schedule to be competitive with fossil fuel alternatives.

The same logic, however, applies to the full range of renewable and advanced energy technologies, and extended-term financing would be equally helpful to them. The intention of this proposal would not be to constrain lending for "traditional" projects (which would remain eligible for 10-year loans). Nor is the intent to remove the 15-year exception for nuclear plants.

Some additional analysis of the costs and benefits is required. Key issues to consider in providing extended-term financing include:

- The definition of what is included in the low- and no-carbon category: Would a coal gasification plant qualify if it had the capacity to capture and sequester carbon dioxide?
- Possible variability in term: Should there be a sliding scale to permit longer-term finance for the lowest-carbon projects?

Recommendation: The U.S. Export-Import Bank should convene a task force of government agencies and private-sector stakeholders to develop a proposal for revising OECD guidelines to permit extended-term financing for low- and no-carbon energy projects. The task force should conduct an analysis of the benefits, costs, and impact of the proposal to engage likely supporters in the NGO, labor and business community and build a coalition of support to advocate for U.S. leadership on this issue.

5. ENERGY EFFICIENCY FINANCE PROTOCOL

A standardized finance protocol for end-use energy efficiency projects

One of the most significant barriers to widespread implementation of clean and proven energy-efficient technologies in international markets is the lack of commercially viable and sustainable project financing for energy efficiency projects (EEPs). The problem is not caused by a lack of available funding capacity, but rather an inability of EEPs to access existing funds due to a "disconnect" between traditional asset-based lending to corporations versus cash-flow based project financing to EEPs. No immediate solution is in sight because energy efficiency markets are not developed enough to motivate local banks to invest in setting up an EEP lending infrastructure.

This proposal envisions the development of an International Energy Efficiency Financing Protocol (IEEFP) that becomes the "blue print" for local and regional financial institutions to finance end-use energy efficiency projects in international markets.

Background. The lack of project financing is one of the most significant barriers to the implementation of energy efficiency projects, services and technologies ("EEPs") around the world because most facility owners, especially large energy-consuming industrial plants, are not motivated or willing to use their own capital funds to pay for energy projects versus capital improvements needed for their core business.

Ironically, the lack of project financing is not necessarily caused by a lack of money because in many countries, but rather the inability of EEPs to access available funding from local banks due to a "disconnect" between established methods of financing and the special financing intricacies of EEPs. The problem is compounded by the small dollar size of EEPs, which creates a perceived small market size by the banking industry and lack of interest on their part to invest the time and resources to learn how to finance EEPs.

As the International Finance Corporation concluded in one of its studies, there is a shortage of debt financing, particularly for small to mid-size infrastructure and EEPs, in emerging markets. While the problems associated with providing local financing are very country-specific, having local banks with personnel that are trained and experienced in financing EEPs is not specific to any one country.

To help address climate change goals through increased capital formation and investment in energy efficiency investments, this proposal envisions the development of a project financing protocol that:

- Will be adopted by international financial and governmental stakeholders.
- Can be "tailored" to meet the many different needs of local markets.
- Becomes the guide to train local banks on the intricacies of financing EEPs.
- Creates sustainable financing for EEPs by local banks in international markets.

A standardized method or "protocol" for financing EEPs around the world could be promoted by multilateral development banks and tailored to each country for utilization by local banks. The ultimate objective is to have long-term financing of EEPs readily available to facility owners, project developers, and vendors from the local banking industry on a "cash flow" lending basis.

Service providers, energy efficiency manufacturers, NGOs and financial entities, as well as US investors, will have new investment opportunities in sustainable development if this concept is realized.

Recommendation: Form a dedicated Task Force, comprised of experienced international energy efficiency project developers, lenders and legal staff, to:

- Create an IEEFP in a form similar to the current International Performance Measurement and Verification Protocol (IPMVP) used and promoted in international markets to measure savings in energy efficiency projects;
- Engage with international financial institutions and other stakeholders to obtain international consensus and support; and
- Develop an implementation plan, including training for use by bank personnel at financial institutions around the world.

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

APPENDIX B:

STRUCTURE OF THE ENERGY FUTURE COALITION

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

ADVISORY COUNCIL

The following individuals serve on the Energy Future Coalition's Advisory Council:

- **Henri-Claude Bailly,** Principal, RCG, Boston, MA
- **Scott Bernstein,** President, Center for Neighborhood Technology, Chicago, IL
- **Norman Brownstein**, Chairman of the Board, Brownstein Hyatt & Farber, Denver, CO
- **Roxanne J. Decyk,** Senior Vice President, Shell Oil Co., Houston, TX
- **Mohamed El-Ashry,** CEO, Global Environment Facility, Washington, DC
- **Paul Gorman,** Executive Director, National Religious Partnership for the Environment, Amherst, MA
- **Patrick R. Gruber,** Chief Technology Officer, Cargill Dow, Minnetonka, MN
- **Ted Halstead,** President and CEO, New America Foundation, Washington, DC
- **Dale W. Jorgenson,** Professor of Economics, Harvard University, Cambridge, MA
- **Chansoo Joung,** Managing Director, Goldman Sachs, New York, NY
- **Philip LaRocco,** Executive Director, E+Co, Bloomfield, NJ
- **Jonathan Lash,** President, World Resources Institute, Washington, DC
- **Charles J. McDermott,** Chair, CEO Coalition to Advance Sustainable Technology, Boston, MA
- **Ralph R. Peterson,** Chairman and CEO, CH2M HILL Cos., Denver, CO
- **Howard (Bud) Ris,** President, Union of Concerned Scientists, Cambridge, MA
- **John B. Ritch III,** Director General, World Nuclear Association, London, UK
- **Jamal Saghir,** Director, Energy and Water Development, World Bank, Washington, DC
- **Erik Sten**, Commissioner, City of Portland, Portland, OR

- **Kathryn D. Sullivan,** President and CEO, Center of Science & Industry, Columbus, OH
- **Michael J. Sullivan,** General President, Sheet Metal Workers' International Association, Washington, DC
- **S. Lynn Sutcliffe,** Chair, Praxair Energy Solutions, Somerset, NJ
- **Linda K. Trocki,** Principal Vice President, Bechtel National, San Francisco, CA
- **Mark Van Putten,** President, National Wildlife Federation, Reston, VA
- **J. Craig Venter,** Chairman, Institute for Biological Energy Alternatives, Rockville, MD
- **R. James Woolsey,** former Director of Central Intelligence; Vice President, Booz Allen Hamilton, McLean, VA
- **Kurt E. Yeager,** President, Electric Power Research Institute, Palo Alto, CA

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

STEERING COMMITTEE AND STAFF

The Coalition's Steering Committee consists of the following individuals:

- **Frances Beinecke,** Executive Director, Natural Resources Defense Council
- **Charles B. Curtis,** former Deputy Secretary of Energy; President, Nuclear Threat Initiative
- **Susan Eisenhower,** President, The Eisenhower Institute
- **Maggie Fox,** Deputy Executive Director, Sierra Club
- **Michael V. Finley,** President, Turner Foundation
- **Robert W. Fri,** former Deputy Administrator of EPA and of the Energy Research and Development Administration; Visiting Scholar, Resources for the Future
- **C. Boyden Gray,** White House counsel to former President Bush; Partner, Wilmer, Cutler & Pickering
- **F. Henry Habicht II,** President, Global Environment and Technology Foundation; Deputy Administrator of EPA under former President Bush
- **Martin S. Kaplan,** Senior Partner, Hale and Dorr; Trustee, V. Kann Rasmussen Foundation
- **Thomas E. Lovejoy,** President, The H. John Heinz III Center for Science, Economics and the Environment; former Chief Scientist and Counselor, Smithsonian Institution
- **John Peterson Myers,** former Director of the W. Alton Jones Foundation
- **John D. Podesta,** White House chief of staff under former President Clinton; Visiting Professor of Law, Georgetown University Law Center
- **Gerald M. Shea,** Assistant to the President for Governmental Affairs, AFL-CIO
- **Timothy E. Wirth,** President, United Nations Foundation; former U.S. Senator from Colorado

Energy Future Coalition staff

Reid Detchon is the Executive Director of the Coalition. He was formerly Director of Special Projects for the Turner Foundation; Principal Deputy Assistant Secretary for Conservation and Renewable Energy during the previous Bush administration; Assistant to Vice President Bush for Communications; and Legislative Director for former U.S. Sen. John C. Danforth.

- Robert W. Fri drew on advice from an exceptionally able team of economic advisers in assessing the costs and benefits of the proposals contained herein. From Resources for the Future, Fellow Billy Pizer and Senior Fellows Raymond Kopp and Richard Morgenstern contributed important insights. The analysis was also assisted by counsel from Everett M. Ehrlich, Senior Vice President and Director of Research, Committee for Economic Development, and information from Bracken Hendricks, director of the New Growth Initiative at the Institute for America's Future, and Joel S. Yudken, Sectoral Economist and Technology Policy Analyst in the AFL-CIO Public Policy Department. The end product is not meant to represent the specific views of any one of them.

- Robert R. Nordhaus led a similarly gifted group of attorneys and policy analysts at Van Ness Feldman, including Douglas W. Smith, Shelley N. Fidler, Janet M. Anderson, and Kyle W. Danish. They supported five of the six working groups.

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    - Pete Myers, partnership development.
    - Kevin Kelly and previously Ann O'Hanlon, communications and research.
    - Mary Jane Rota, special assistant.

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CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

FUNDERS

The following foundations have generously supported the efforts of the Energy Future Coalition to date:

- ***Turner Foundation***
- ***Better World Fund***
- ***V. K. Rasmussen Foundation***
- ***Homeland Foundation***
- ***United Nations Foundation***
- ***Wallace Global Fund***
- ***J. M. Kaplan Fund***
- ***James M. Cox Foundation***
- ***Surdna Foundation***
- ***Tides Foundation (Changing Horizons Fund)***

CHALLENGE AND OPPORTUNITY: CHARTING A NEW ENERGY FUTURE

COALITION EVENTS

Feb. 20, 2002	Roundtable with: **Amy Myers Jaffe** *Wallace Wilson Fellow for Energy Studies* *James A. Baker III Institute for Public Policy, Rice University*
Feb. 28, 2002	Roundtable with: **Sir Mark Moody-Stuart** *Chairman. Business Action for Sustainable Development* *Former Chairman, Royal Dutch/Shell Group*
Mar. 12, 2002	Roundtable with: **Amory B. Lovins** *CEO, Rocky Mountain Institute*
Apr. 16, 2002	Roundtable with: **Patrick R. Gruber** *Vice President, Chief Technology Officer, Cargill Dow LLC*
Apr. 29, 2002	Roundtable with: **John P. Holdren** *Teresa and John Heinz Professor of Environmental Policy* *John F. Kennedy School of Government, Harvard University*
May 22, 2002	Roundtable with: **Robert H. Socolow** *Professor, Department of Mechanical and Aerospace Engineering* *Princeton University*
June 4, 2002	Roundtable with: **Ferdinand Panik** *Fuel Cell Project Director* *DaimlerChrysler Corporation*
June 18, 2002	Roundtable with: **George D. Thurston** *Associate Professor, Department of Environmental Medicine* *New York University*

Sept. 23, 2002 — Roundtable with:

Dominique Lallement
Manager, Energy Sector Management and Assistance Program
World Bank

Griff Thompson
Director, Office of Energy, Environment, and Technology
U.S. Agency for International Development

Paul H. Loeffelman
Director of Environmental Public Policy, American Electric Power
Representative of E7

Dec. 2, 2002 — **Symposium on Energy Futures: Opening New Pathways for Innovation in Energy Technology and Policy**
Co-hosted with the National Academy of Engineering

Speakers:

Ged R. Davis
Vice President, Global Business Environment
Royal Dutch/Shell Group

James R. Schlesinger
Chairman, The Mitre Corporation

Robert W. Fri
Visiting Scholar, Resources for the Future

George Bugliarello
Chancellor, Polytechnic University

Hamilton O. Smith
Scientific Director, Institute for Biological Energy Alternatives

Robert W. Shaw, Jr.
President, Arete Corporation

George C. Eads
Vice President, Charles River Associates

T. J. Glauthier
President, Electricity Innovation Institute

Ernest J. Moniz
Professor of Physics, Massachusetts Institute of Technology
Former Under Secretary of Energy

Frank Loy
Former Under Secretary of State for Global Affairs

John D. Podesta
Visiting Professor of Law, Georgetown University Law Center
Former White House Chief of Staff

Raymond J. Kopp
Senior Fellow, Resources for the Future

Ted Halstead
President and CEO, The New America Foundation

Jan. 8, 2003 — Roundtable with:
Philip J. Deutch
Managing Director, Perseus, LLC

Clint "Jito" Coleman
President and CEO, Northern Power Systems

Mark A. Farber
President and CEO, Evergreen Solar

Jan. 29, 2003 — Roundtable with:
Ernest J. Moniz
Professor of Physics, Massachusetts Institute of Technology
Former Under Secretary of Energy

John B. Ritch III
Director General, World Nuclear Association

Feb. 13, 2003 — Roundtable with:
Sir Philip Watts
Chairman, Committee of Managing Directors
Royal Dutch/Shell Group of Companies

June 5, 2003 — Roundtable with:
Richard L. Sandor
Chairman and Chief Executive Officer
Environmental Financial Products, LLC

Richard B. Stewart
Emily Kempin Professor of Law
New York University