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ENERGIZING PROSPERITY
Renewable Energy and Re-Industrialization

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Introduction: Two cases of renewable energy and economic development

Nevada

In 2001, Nevada passed one of the most aggressive laws mandating the use of renewable energy. The law required that 5% of the renewable energy developed come from solar energy projects. Organized labor and environmentalists joined in support of this provision. Labor believed the solar projects would provide jobs in Nevada, but they also hoped that the legislation would be used to attract firms with breakthrough technologies to locate in the state. A successful demonstration of the breakthrough in Nevada would then open new world-wide markets and opportunities. Rather than use the set-aside to attract new firms, the state utility regulators and Nevada Power offered roughly 60% of the solar set-aside to one firm, Solargenix, for a project that used a concentrating solar power technology previously developed in the mid-1980s in California. Nevada awarded a long-term contract to the project at rates above other renewable energy resources and awarded tax rebates to it, as well. Shortly after securing

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the contract and tax rebates from Nevada, Solargenix sold out to a large Spanish company, Acciona S.A.

Solargenix had testified under oath that the project would provide 700 construction jobs to skilled local workers. After the takeover, Acciona used a Texas general contractor who brought in virtually all construction workers from out of state. Every piece of capital equipment, save one, was imported. This project—the largest in the world at the time and the first using the technology in more than 15 years—offered an opportunity for Nevada to secure more jobs and help local firms provide critical components to this newly reborn industry. Unfortunately Nevada failed to pursue the opportunity. No local firms got the chance. The one piece of capital equipment not imported, metal support structures, came from Arizona. Nevada got nothing but the bills.

That is not the end of the story. In addition to renewable energy, Nevada is the proposed site for at least three new, large coal-fired power plants. All of these plants use existing super critical boiler technology that cannot be "cleaned up" by removing carbon dioxide emissions. At this year's annual convention of the AFL-CIO, a resolution passed calling for support of the coal project proposed by Nevada Power. The reasons offered for the support stated that renewable projects did not offer well-paying jobs with benefits, that renewable energy developers did not reinvest in the state, that renewable firms were often foreign companies with no real commitment to Nevada, and that renewable energy was too expensive. The reasons offered for supporting the coal plant could be traced directly to how the state fared under the Acciona project.

Michigan

In September 2007, NextEnergy held a wind energy conference in Michigan. The conference focused on the potential of wind energy to revitalize the manufacturing base and the state role in supporting that effort. Speakers talked about how the wind technology now being deployed roughly compared to the car industry in the 1920s. In other words, wind is an infant industry with possibilities for significant improvements, improvements that could be made by Michigan firms and workers. To be successful, turning this potential into a thriving industry will require a mix of effective policies and private initiative and it will require enthusiastic support for those policies.

A major group of attendees were engineers working in the various industries that make up the supply chain of parts that are assembled into installed turbines. The improvements in wind technology will come from systematically working through and improving all the pieces they would engineer and supply—stripping out weight, evolving to more efficient designs, integrating better electronic controls. The list is endless and at this stage only dimly grasped.

At the conference lunch the Mayor of Grand Rapids made a plea to have 100% renewable energy supply the needs of his city. Now there are some technical reasons why this would not be appropriate, and they are the kind of technical details that are meat and potatoes for an engineer to correct. Rather than use the occasion to educate the rest of us, the engineers applauded, loudly. For them, the wind industry is translating into a vision of the future…their future.

These two stories foreshadow the opposite ends of how a national energy policy supporting a large national renewable energy deployment could affect economic development and job opportunities for the United States. They also illuminate how the success or failure in capturing these opportunities translates into either support or opposition for the basic energy policies. This Briefing Paper argues that federal energy policy must go beyond providing incentives for the development of renewable energy projects and provide for the development of a domestic renewable energy industry.

Energy policy

Today, the energy sector in the United States and the national energy policy that determines how it evolves leaves the country exposed to three major, interconnected threats: weakened national security, environmental calamity caused by climate change, and an ongoing but largely unaddressed de-industrialization of the domestic economy. National energy policy must address these three basic national goals simultaneously.

While public, corporate, and scientific opinion is coalescing around the need to "do something" about energy security and climate change, the third challenge—addressing de-industrialization—has not really been a part of the national energy policy debate. The United States continues to import fossil fuels, allows the technology advantage it enjoyed in renewables in the 1980s to move overseas, and fails to commercialize new breakthroughs even when the basic research and development has been done domestically. As a result, dollars flow out, manufacturing moves overseas, and innovation is lost.

Unlike fossil energy, which is discovered, renewable energy is conceived as basic science, created in labs and universities, brought to commercial readiness by developers, and then manufactured as component parts assembled into finished products. In the end, renewable energy is manufactured energy and is driven forward by cycles of technology innovation. A national energy policy that provides energy security and stabilizes climate change will create a huge demand for both more renewable energy and cycles of technology innovation. With the right set of policies and incentives, these priorities can be used to revitalize the manufacturing sector and create and train the workforce required by that expanded sector. The logic of this argument can be turned around: once the fostering of renewable energy is seen as the core of a broad program of re-industrialization and economic development, there will be strong public support for renewable energy and the broader goals of energy security and climate stabilization.

Given this enormous potential, it is important first to understand why this is not happening and to use that understanding to adopt the policies that will allow it to happen. Over the past decade, energy policy concentrated almost entirely on supporting the development of fossil fuel resources. What support there was for renewable energy consisted of a patchwork of state-level requirements to install renewable energy projects combined with sporadic federal incentives primarily in the form of production and investment tax credits. Absolutely no attention was paid to supporting the development of a renewable industry to provide the projects. Federal energy policy almost completely neglected a critical step in the cycle of technology innovation—commercialization of new technology. These misaligned efforts produced bursts of development followed by periods of no development at all.[1] This start-and-stop process neglected important technology commercialization and precluded the development of a strong domestic industry. As a result, too much of the equipment required for new projects comes from offshore. Not a single federal energy policy initiative has seriously addressed how to develop a domestic renewable industry to revitalize domestic manufacturing.[2] Support for the commercialization of new renewable technologies has been abandoned in all but name.

Building a renewable energy industry

Looking forward, as we begin to take energy security and climate change concerns seriously, there is a growing recognition that achieving these goals will require a massive development of renewable projects. This new consensus has not translated into an urgent demand for the creation of a domestic renewable energy industry. Part of the responsibility for this neglect can be attributed to the lack of a strong national coalition calling for the creation of this new industry. It is only recently that renewable energy technologies have been viewed as an assembly of component parts and analyzed in terms of where the firms are located that could manufacture those parts. As a result, there has not been a strong demand for supports to develop the domestic industry, even from the people who would benefit from it and desperately need it. On a positive note, over the past four years many states have expanded their interest in renewable energy beyond installing projects to include the development of a renewable energy industry. These nascent state efforts need to be bundled together and used to push for the right set of federal policies to support the development of an industry to supply the renewable projects that will be needed.

Our nation's current energy policy is often described as "drain America first" because of our insistence on drilling more and more pristine areas of the United States for oil and natural gas. "Drain America first" could also describe the effects of our current policy on the domestic economy. The great challenge we face is to craft an energy policy that accelerates the development of technologies that can produce energy with little or no carbon emissions and increase our national security. Climate stabilization and energy security are public values that will not be delivered by private free markets acting alone. The critical

STEPS TOWARD A RENEWABLE ENERGY INDUSTRY

1. Climate stabilization and energy security will demand at least 18,500 MW of new renewable energy projects per year. There are between 70,000 and 110,000 firms active in the industries that could supply component parts for these renewable projects. A 10-year stabilization program would both provide and require 2 million full-time equivalent jobs that need training programs to develop the necessary skills.
2. Federal policy currently focuses on mandates and incentives to develop projects but neglects the industry necessary to supply those projects. This neglect will result in supply bottlenecks and labor skill gaps. Without a new energy policy, it is highly likely manufacturing will migrate overseas in search of cheap labor, lax environmental standards, or massive government supports.[3]
3. Support for the development of a domestic renewable energy industry and job-training program must be made a part of national energy policy. Federal incentives should allow states to cooperate in order to achieve greater gains for the nation as a whole. State-on-state competition is often a "zero-sum game;" one state's gain is another state's loss. Cooperation in support of federal policies can lead to gains for all states.
4. We must integrate technology innovation and commercialization programs to support world-class domestic manufacturing and labor productivity. Direct basic research and development to be as responsive as possible to the commercial opportunities to improve manufacturing efficiencies, reduce installed costs, and lower the delivered price of renewable energy.

role for government is to mobilize private resources, from universities to energy developers, to create and develop these new resources and support the industry that can manufacture them.

The failure to develop a domestic renewable energy industry has led to a lost capacity for innovation. Writing in a Congressional Research Service Report on basic research and technology transfer, Wendy Schacht observed, "The critical factor is the commercialization of the technology. Economic benefits accrue only when a technology or technique is brought to the marketplace where it can be sold to generate income or applied to increase productivity. Yet, while the United States has a strong basic research enterprise, foreign firms appear equally, if not more, adept at taking the results of these scientific efforts and making commercially viable products. Often U.S. companies are competing in the global marketplace against goods and services developed by foreign industries from research performed in the United States. Thus, there has been increased congressional interest in mechanisms to accelerate the development and commercialization processes in the private sector."[4] This observation applied to all sectors and technologies, but it takes on a new urgency for the development of carbon-free energy technologies. The research and development must be conducted, but the final step, commercialization, is critical and it is (at least so far) still neglected.

Renewable energy and reindustrialization

Even before national energy goals are addressed, the development of an energy policy is shaped by a vision of the proper role of government. Goals like security, climate stabilization, and economic development attach a public dimension to energy decisions that do not exist in a purely private market. Generating energy while avoiding the production of carbon dioxide provides both energy and a public benefit. Technologies capable of providing the private and public goods should receive a reward or a financial return.[5] The public return provides an effective incentive to shape investors' decisions so that both the private and public benefits of these technologies can be

GOING BEYOND THE MARKET

The dominance of pure laissez-faire economics, where the solution for every economic problem is for government "to allow the market to work," has ultimately led to a very shriveled, passive role for government, i.e. to get the "price right" for consumers through some form of energy tax, and then let the market solve all other problems.

Even if the government decided to tackle energy security and climate stabilization, this passive approach would likely create an energy policy that relied on taxing energy consumption by the public while turning a blind eye both to our dependency on imports and the possibility of creating a renewable energy industry. This would seriously erode industry, incomes, and opportunities, accelerating the decline of working- and middle-class families. Again, draining America first.

The other serious problem with isolated "tax and market," consumer/price-oriented policies is that they rely on a long and potentially weak chain of actions and reactions that, it is hoped, will eventually lead to the discovery, development, and commercialization of carbon-free technologies but is unlikely to do so. This long chain begins by raising the price consumers face for using existing technology, but is aimed at providing an economic advantage to the new alternatives. A cap or tax is set, that is passed on to the appropriate price, other technology developers see that price increase, new technologies are developed to capture that advantage, consumers see that price and react, and carbon-free technologies move into the market. Each of those links is weak and can be effectively broken by market power and price discrimination.[6] The economic advantage will flow weakly through to the alternatives, and as a result could prove to be inadequate to overcome the difficult task of bringing major new alternatives into the commercial marketplace. In the final analysis, these consumer/price policies rely more on faith than they do on hard evidence that they will be able to produce the new technologies needed.

recognized. Under this view, the role of government is to devise the most efficient incentives to draw out private initiative and investment. Most economic transactions involve something being done for a principal by an economic agent where the interests and knowledge of the two parties, the principal and the agent, are not the same. With respect to energy policy, the government becomes the principal, and on behalf of society wants energy produced and used in a way that reduces carbon emissions, provides security, and enhances economic revitalization. The economic challenge and the proper role for the government is to provide the best set of incentives so that the private actions of the energy market agents provide energy that will also meet public goals. Here is the point of departure with past efforts: we should construct policies that reward the avoidance of carbon dioxide, and not add the cost of the carbon dioxide to the price of the kilowatt-hour (kwh) generated from coal, oil, or natural gas.

Revitalizing the domestic manufacturing sector can and should be a major goal of a new national energy policy. Combining energy policy with economic development will not happen automatically, however. At a minimum, national energy policy must combine incentives for both component manufacturing activity as well as for project development. This new domestic industry must also be efficient and technologically advanced. To support the ongoing improvement of the component industry, new policies should integrate manufacturing innovation and development into a domestic program to support component manufacturing. "Most innovation does not come from some disembodied laboratory," according to Stephen S. Cohen co-director of the International Economy at the University of California, Berkeley. "In order to innovate in what you make, you have to be pretty good at making it—and we are losing that ability."[7]

Every renewable technology relies upon a supply chain of component manufacturers. Major development efforts will strain existing supply chains and lead to bottlenecks. To some extent, the support for the development of a domestic renewable supply chain is similar to those provided for other projects but with important differences. To build a renewable industry, federal policies must build on cooperation among the states. State-on-state competition is often a zero-sum game. A major focus of federal policy must be to offer states a set of policies that will expand the total opportunities available to all of them. The policies should be aimed first at alleviating the potential for supply chain bottlenecks. A major program mandating an aggressive renewable development effort could lead quickly to shortages of critical components, price spikes, and delays in development. Industry participants must be integrated with research and deployment of advanced manufacturing techniques. The basis for the global competitiveness of the domestic renewable industry must be the continual improvement through cycles of technology innovation.

Manufacturing firms can step up and provide the components for wind, solar, biomass, and geothermal electric generation technologies. A brief review of currently existing wind electric generation technology illustrates this potential. In many regions of the country, modern wind turbines are considered to be economically competitive producers of electricity, and, like other renewable generation technologies, could reduce carbon dioxide emissions and displace anticipated imports of liquefied natural gas (LNG) with both security and environmental benefits. A major federal program such as the proposed Renewable Portfolio Standards supporting the development of a target of renewable technology ranging from 10% to 20% would encourage the development of wind projects.[8] The projects will predominantly be built, and the benefits of that development will be concentrated, in the west and high plains where the wind resource is strong and much of the land is open range and farmland. The installation of turbines will provide new jobs to these rural areas both during the construction period and for the life of the plants in operating and maintaining them. These direct jobs will in turn pump new income into these local economies, which will further stimulate other retail and service activities. Economic benefits are easily seen at the point of project development.

Modern wind turbines are also complex machines that require manufacturing components ranging from gearboxes to electronic controls to the high-tech carbon fiber composites used to make the turbine blades. When the analysis of economic benefits shifts from project development to component manufacturing, a completely different picture emerges. For wind alone, there are more than 43,000 firms active in the industrial sectors where components would be manufactured. When the analysis is expanded to include other renewable energy technologies like photovoltaic, biomass, and geothermal sources, the number of firms grows to between 70,000 and 110,000 firms. If renewable projects are used to stabilize carbon dioxide emissions for a decade, the new investment will exceed $160 billion, and more than 2 million full-time equivalent job-years—or 200,000 permanent jobs if spread evenly over the decade—will be created (a full-time equivalent job-year is 2,000 hours of required labor). While the firms are spread across every state, they are concentrated in the 10 states that have suffered the greatest manufacturing job losses over the past six years.[9]

As seen in **Table 1**, the potential for major renewable energy developments to offer new economic activity to the states hardest hit over the past decade is striking: 57% of the new jobs and 57% of the new investment will go to the 10 states that between them have suffered 57% of the job losses. Any major program to develop wind or any of the other renewable generation technologies would provide a potential burst of demand for new manufacturing activity and job creation in precisely the states and regions most in need of such a stimulus.[10]

A cap plus incentives

A cap on carbon emissions is a necessary part of a carbon stabilization policy, but it is not sufficient to achieve our energy goals. A critical challenge in any effort to stabilize carbon emissions must be to develop as many carbon-free (or reduced carbon) technologies as possible through a carefully managed portfolio of incentives that extend from research to commercialization to widespread commercial deployment. A cap with tradable emission rights simply will not accomplish this on its own.[11]

TABLE 1*

The top 10: New investment potential vs. manufacturing job loss

State	Number of full-time equivalent job-years (over 10 years)**	Average investment ($ billions)	2001 population	Rank in U.S.	Manufacturing jobs lost, Jan. 2001 - Aug. 2004	Rank in U.S.
California	95,616	$20.91	34,501,130	1	343,600	1
Texas	60,100	13.22	21,325,018	2	177,600	2
Illinois	56,579	8.84	12,482,301	5	145,600	7
Ohio	51,269	8.40	11,373,541	7	173,000	3
New York	47,930	9.93	19,011,378	3	148,500	6
Pennsylvania	42,668	7.92	12,287,150	6	161,200	5
Indiana	39,221	6.26	6,114,745	14	70,900	11
Wisconsin	35,133	5.53	5,401,906	18	67,500	13
Michigan	34,777	5.33	9,990,817	8	142,600	8
North Carolina	28,544	5.26	8,186,268	11	162,900	4
Total for top 10 states	491,837	91.61	140,674,254		1,593,400	
Total percent of U.S.	57.45%	57.34%	49.39%		57.16%	

* The data in this table have been revised since the original publication on February 13, 2008.

** The number of full-time equivalent job-years is computed over a 10-year horizon and thus not directly comparable in value to manufacturing jobs loss in the fifth column, which is presented to illustrate the distribution of job loss across states.

SOURCE: Renewable Energy Policy Project state manufacturing reports, available at www.REPP.org.

The experience of the Clean Air Act Amendments of 1990 shows that a cap works best when there is a known technological fix that has varying costs of implementation across the set of plants required to comply with the cap. In this type of case, since the low-cost plants meet the compliance requirements, they can sell the extra allowances to those plants that have higher costs of compliance. The Clean Air Act required electric generating plants to reduce sulfur dioxide emissions and scrubbing was the recognized technical fix to remove sulfur dioxide.[12] Scrubbings cost less per ton of sulfur dioxide removed on large coal pants than on smaller units, so plant owners would reduce emissions on large plants more than required by law and sell or transfer these excess allowances to smaller plants that could then avoid having to install scrubbers. As a result, the overall cost of meeting the national reduction goals was less than if every plant had to reduce emissions by a proportionate amount.

Under any cap program, the target allowance of emissions can either be allocated, that is given to existing plants, or they can be auctioned, that is sold to these plants. Auctioning or selling the allowances will actually be more regressive than a tax in terms of its impact on households across regions.[13] In a very real sense, auctioning carbon allowances amounts to a regional tax to solve a global problem. Under either an allocation or an auction, the cap will not fully translate into an economic advantage for new, carbon-free resources. A carbon-free technology will not receive an allowance to sell. Reducing carbon emissions to hit the cap will drive up costs, but those costs will not necessarily be reflected in the price of marginal units of electricity. Since compliance will vary by region, depending upon the intensity of coal use by region, carbon free resources in a region with low compliance costs will not "see" the price of a high-compliance region. In the case of the initial cap on sulfur dioxide and, later, nitrous oxide emissions, the cap was allocated among the set of plants responsible for the emissions. When new technologies like wind power were considered for development—technologies that could produce electricity with no sulfur dioxide or nitrous oxide emissions—these new technologies did not "earn" or obtain emissions credits to sell because, with rare exceptions, no credits were set aside for these technologies. The same principle would apply to new, carbon-free technologies under a carbon cap.

Clean coal under a carbon cap

Carbon permits from a cap on carbon dioxide emissions from electric generation should be allocated largely to the present set of coal-fired generators, plants concentrated in the Southeast and Midwest regions of the country. The cap would limit emissions below current levels and provide the owners of existing plants with a powerful incentive to seek out more efficient "clean coal" technologies and make the development of new, conventional coal plants prohibitively expensive. Existing coal plants burn coal in a boiler and use the steam to turn turbines. Older plants typically turn between 25% and 30% of the energy into electricity, while newer plants turn between 30% and 40% of the energy in coal into electricity.[14] Clean coal is a new technology which first turns coal into gas and then uses the gas to produce electricity in a modern combined cycle plant. Combined cycle plants essentially use the energy of the coal twice, and are expected to be between 45% and 55% efficient in turning the energy in coal into electricity and will therefore produce more kilowatt-hours as a result.[15] Clean coal is 20% to 30% more efficient in producing electricity from coal than traditional generation technologies. A carbon cap plus federal programs to buy down the cost differential between clean coal and traditional coal generation could provide strong incentives to rebuild or replace the least efficient of the 335,000 megawatts (MW) of existing generation. A new combined cycle coal plant is expected to be about 25% more expensive than a traditional coal plant. Since that higher efficiency would mean a reduction in the carbon dioxide emissions per kilowatt hour (kwh) generated, it would be appropriate for the government to provide an incentive, a public return, for the avoidance of carbon dioxide. One way to do this would be for the government to "buy down" the incremental cost of the clean coal technology. Under a carbon cap, there would be a strong incentive to replace the least-efficient and most carbon-intensive generation units with more-efficient generation units. There would be a strong incentive to build new, clean coal plants, which this type of federal incentive would enhance. This rebuilding could channel billions of dollars of new construction and related economic stimulus into areas that support traditional coal-fired generation. If the total electric generation remained constant, the increased efficiency could lead to a 20% or greater reduction in carbon dioxide from these plants.

The other effect of the cap would be to make new coal-fired plants much more expensive since they would have to purchase carbon dioxide permits from existing plants. In the absence of a cap, there has been an explosion of proposed new coal plants: 154 plants are on the drawing board and would increase U.S. coal-fired power by one-third. But under a cap these new plants would have to purchase carbon emission rights from existing plants, and the economics of building them would change radically. Indeed, under a cap and trade program, the more new coal plants that are proposed, the greater the demand becomes for carbon dioxide allowances; the more expensive the required allowances, the less feasible the new coal-fired plants become.[16]

A national energy policy

Government support for basic science, research and development, and technology commercialization is critical for rapid cycles of technology innovation. These levels of support should not only be directed at projects and the final technologies that can provide project development. Parallel support should also be directed to develop a competitive renewable energy industry. Rapid technology innovation can significantly drive down the cost of renewable energy. In addition, cycles of technology innovation can be a major source of competitive advantage for domestic firms.

To coordinate and meet these challenges, technology development and project deployment should be coordinated through one government agency. An agency independent of the Department of Energy, a Clean Energy Investment Authority, should be given the authority and the responsibility to manage the security threat and develop a plan to stabilize carbon emissions at some mandated level.

This agency should be able to fund and direct research and development efforts in order to respond to industry needs. It should have a budget to actively pursue the commercialization of important, breakthrough technology advances. It should be given a portfolio of incentives and be charged with using them to move the energy sector toward meeting the core goals of the energy policy.

Basic science and research and development

First, federal support must be given for basic science to encourage the technological breakthroughs that can both provide energy and also satisfy security and climate concerns. Research and development efforts to improve manufacturing technology should be integrated into the domestic component industry to assure that the industry is efficient and technologically advanced. Ultimately, the role for government in any climate stabilization program should be to stimulate private industry to commercialize and produce as many carbon-free technologies as possible. There is a critical need to connect the basic research efforts to the needs of the industry participants. According to one study: "Despite the potential offered by the resources of the federal laboratory system, the commercialization level of the results of federally funded research and development remained low through the 1980s. Studies indicated that only approximately 10% of federally owned patents were ever used. There were various reasons for this, including the fact that many of these technologies and patents had no commercial application. A major factor in successful transfer is a perceived market need for the technology or technique. However, because federal laboratory research and development is generally undertaken to meet an agency's mission or because there are insufficient incentives for private sector research that the government deems in the national interest, decisions reflect public sector, rather than commercial needs."[17]

Commercializing new technologies

Beyond the science and basic research and development phase, government must also support efforts to bring promising new technologies into the commercial marketplace and support their efforts to prove themselves. The following statement from Iogen, one of the private companies trying to commercialize cellulosic ethanol technologies, illustrates this point: "Financing poses a significant challenge to commercialization of cellulose ethanol. A cellulose ethanol biorefinery goes beyond a lender's 'normal' lending risk. Because it involves 'new' and 'unproven' technology at a commercial scale, normal project financing is not available without a third party guarantee. Risk-sharing in the form of government grants and loan guarantees, such as those developed by the U.S. government, are critical to commercialization. Once this is overcome, ongoing challenges to improve efficiency and effectiveness of production will occur as in any industry, and will be successfully resolved through research, development, experience and expertise."[18] Cellulosic ethanol is critical to moving the production of ethanol much beyond the 7.5 billion gallons per year that is required under the Renewable Fuel Standard of the Energy Policy Act of 2005. If commercialized, this technology could make a tremendous contribution to energy security, moving the potential production of ethanol from 7.5 billion annual gallons toward the maximum potential of 60 billion gallons.[19]

Again, Wendy Schacht writing in a Congressional Research Report on technology transfer observes that: "In the recent past, American companies faced increased competitive pressures in the international marketplace from firms based in countries where governments actively promote commercial technological development and application. In the United States, the generation of technology for the commercial marketplace is primarily a private-sector activity. The federal government traditionally becomes involved only for certain limited purposes. Typically these are activities which have been determined to be necessary for the 'national good' but which cannot, or will not, be supported by industry."[20] Clearly, the mandates of a national energy policy rise to this threshold condition. Despite the importance of moving this and many other new technologies out of the labs and into the energy marketplace, there is only one functioning program at the federal level to support this type of activity."[21]

Incentives for deployment of proven technologies

For commercially proven technologies, such as wind turbines and clean coal technologies that can provide energy with important public benefits as well, the federal role

FEDERAL POLICIES TO SUPPORT A RENEWABLE INDUSTRY

- Sustained deployment—Any manufacturer adding or expanding production lines that provide component parts to qualified renewable energy technologies will be eligible for credit guarantees for debt covering up to 80% of the cost of the manufacturing activity. These guarantees will be allocated first to industrial sectors with the greatest chance of experiencing a supply bottleneck.
- Manufacturer participation—Manufacturers entering the supply chain will be included as participants in setting both targets for improvements and the research agenda in the commercialization and research programs.
- Commercialization—Renewable industry associations should set critical targets or benchmarks for improvements in the performance of supply chain components. Any manufacturer undertaking the initial commercialization of a process that is judged capable of supplying components to meet those targets will be eligible for federal cost sharing of up to 50% of the cost of the commercialization.
- Basic science and research and development—Some fixed portion of research funds will be directed to institutions to pursue an agenda reviewed by renewable industry representatives. The overview of these funds will also require assessing the usefulness of the research as measured by indicators such as patents and patents brought to commercial deployment.

should include offering a public return to augment the private return and provide a powerful incentive for industry to move toward those technologies. A direct public return is both a complement to a cap and a more direct link between private initiative and the development of carbon-free technologies. Here is the point of departure with past efforts: Rather than add the cost of the carbon dioxide to the price of the kwh generated from coal, oil or natural gas directly through a tax or indirectly through an auctioned cap, we should construct policies that reward the avoidance of carbon dioxide entirely. The avoidance of carbon dioxide is a public benefit, which should be provided a reward or a financial return. The public return provides an effective incentive to shape investors' decisions so that both the private and public benefits of these technologies can be obtained. The public return will draw out private initiative and investment. For example, by one estimate, using production tax credits to spur investment in wind generation draws out $2 of private investment for every dollar of tax credits.[22] The ratio of public to private investment will vary by technology and by the type of incentive used. For example, an alternative to the production tax credit could be a credit guarantee from the Treasury for qualified projects. The government "cost" of a credit guarantee is the expected cost of the risk the project will default. If that default is low, the credit guarantee could leverage many more dollars of private investment for each dollar of public return.

Beyond projects: Building a renewable energy industry

For the electric sector, and the renewable energy sector in particular, the incentives should be extended beyond project development to the component manufacturing industry. This is critical to the success of the effort. In order to assure the manufacturing sector is capable of providing for projects without crippling bottlenecks and skills gaps in the workforce, support should be provided for increasing manufacturing capacity and for workforce development.

Any program to accelerate the development of renewable projects will place an increased demand for parts on the industrial sectors where the parts can be manufactured. To gauge the likelihood of this new demand overwhelming the ability of the industrial sector to produce the necessary parts, the Renewable Energy Policy Project (REPP) compared the new incremental demand to the unused capacity in each of these sectors. For wind and photovoltaic technologies, this analysis revealed that over 50% of the sectors would have incremental demand much greater than the unused capacity.[23] In other words, unless these sectors develop new manufacturing capacity, they will be unable to supply the necessary parts and this will create a bottleneck. According to a labor calculator model developed by REPP, a program to install 18,500 MW of renewable energy per year for 10 years to stabilize the emissions of carbon dioxide from our electric sector will create 2 million full-time equivalent jobs. Since renewable technologies are new, most of the jobs related to the installation and operations and maintenance will require a trained workforce that does not now exist; however, many of the component manufacturing jobs will use skills close to those already possessed by existing workers in those industries. The transition of the workforce in these cases may require less training.

Federal incentives represent the public investment made to obtain the public benefits related to the production of energy. As stated earlier, once climate stabilization and energy security become basic goals of energy policy, they add a public dimension to every energy decision. The role of the public investment is to steer private actors to take up the challenge of providing those public benefits they would not under purely private decisions.

The incentive policy should be reviewed and adapted over time to maximize private investment for every dollar of public incentives. Roughly speaking, a program of renewable energy development would require $16 billion in total investment per year.[24] The goal of the Clean Energy Investment Authority should be to attack both ends of this equation: to pursue research, development, and deployment to reduce the cost of renewable energy, and to reduce the target cost of $16 billion per year. The Authority should also develop a portfolio of public incentives that elicits the best private response, thereby leveraging the greatest private investment per dollar of public incentive. There are a variety of ways to provide private developers a public return: production tax credits, investment tax credits, credit guarantees, and clean renewable energy bonds (types of bonds that offer tax exemptions in lieu of interest payments). Projects developed using these bonds would only have to repay principal and not interest, which would provide them with an economic advantage. As noted, the production tax credit for wind leverages $2 of private investment for every dollar of public return. A credit guarantee program offers a much greater leverage potential, but many of the existing programs have been heavily discounted in the financial community because lenders were worried that the recovery of funds in the event a technology failed would be contentious and delayed by legal disputes. Developing a portfolio to maximize leverage is important. For example, if the overall leverage were 1:3, the cost to the public for a $16 billion per year program would be $4 billion per year. If that leverage could be raised to 1:5, the public cost would drop to $2.7 per year, while achieving exactly the same level of total investment. Of course, as the installed cost of renewable technologies goes down, any increased leverage will further reduce the public cost.

Conclusion

It is increasingly clear that public and professional opinion is coalescing around the need to make energy security and climate stabilization basic goals of an evolving new national energy policy. An energy policy that leads to the development and installation of renewable fuels and electricity and supports the development of a new domestic industry would galvanize parts of the public that have been content thus far to sit on the sidelines. State development agencies, manufacturers, unions, and even the investment community would jump into the debate and could provide the critical push to break a decades-long stalemate on energy policy.

—**George Sterzinger**, *executive director of the Renewable Energy Policy Project, has more than 20 years experience in energy policy and regulation and clean technology commercialization. In the late-1980s, as Commissioner of the Vermont Department of Public Service, he initiated state efforts to secure an advanced gasifier that could use waste wood to power an advanced turbine generator. Mr. Sterzinger also worked extensively with the Corporation for Solar Technologies and Renewable Resources to establish a solar development zone in Nevada. He did the feasibility study for that project and wrote the initial RFP that secured an agreement with Enron to develop up to 100 MW of PV capacity and sell the output at 5.2 cents per kilowatt hour. He has also worked with the Nevada AFL-CIO to advance the use of solar energy in the state. In recognition of these efforts, last year the AFL-CIO named him a "Friend of Nevada Working Families."*

Endnotes

1. The Production Tax Credit for wind has been on again and off again since the 1980s. Since then, it has been renewed for periods as short as one year and has even been allowed to lapse. Here are the rough numbers of installations by year (from 1998 to 2004): 1998 – 300 MW; 1999 – 2000+ MW; 2000 – 0 MW; 2001 – 6000+ MW; 2002 – 1800+ MW; 2003 – 6000+ MW; 2004 – 1700 MW.

2. In June 2007 a major energy bill introduced by the majority Democratic leadership in the Senate, S-1419, contained no proposal to support the development of renewable energy industry. In July 2007 the Senate proceeded to add a series of amendments to HR 6. One of these amendments introduced by Sherrod Brown (D-Ohio) provided for the first time a series of incentives to support the growth of the renewable energy industry.

3. The Renewable Energy Policy Project (REPP) developed a model to show where the demand created from a national renewable development program could provide a stimulus for the development of new manufacturing enterprises to provide the component parts for those technologies. In the current framework, REPP assumes that the United States commits to developing 18,500 MW of a basket of commercial renewable energy each year for 10 years. The analysis and methodology is explained in a series of reports available at www.repp.org. The most recent reports focus on specific states but run off the national program.

4. *Industrial Competitiveness and Technological Advancement: Debate Over Government Policy.* Updated August 3, 2006, Wendy H. Schacht, Specialist in Science and Technology Resources, Science, and Industry Division, Congressional Research Service, Washington, D.C.

5. Sterzinger, G. "Rethinking the Production Tax Credit," *Public Utilities Fortnightly*, July 2006.

6. As an example, the Clean Air Act Amendments capped sulfur dioxide emissions. Coal-fired electric plants had to either reduce their emissions or buy allowances from a generator that over complied. This trading set a price for sulfur dioxide allowances of between $150 and $500 per ton. However, this price did not translate to an economic advantage for sulfur-dioxide-free generation technologies like wind. A technology such as wind power that produced electricity with no sulfur dioxide emissions received no allowances. In addition, even though the cost of compliance did raise the cost of traditional coal generation, the cost of sulfur dioxide removal never translated to an equivalent price advantage for sulfur-dioxide-free generation. First, the cost per kwh for removing sulfur dioxide is diluted by the total sales of the utility. The reduction required may have affected only 25% of the generation, but its cost would be averaged through all sales. Second, costs of compliance were kept from the most price sensitive electric sales. Arguments were made that the sulfur dioxide scrubbing costs were fixed and not variable in nature, tilting the allocation of costs heavily toward basic residential and small business customers and away from large users. Finally, utilities protected their compliance strategies once the costs were "sunk" by avoiding other options.

7. Uchitelle, Louis, "Goodbye production (and maybe innovation)," *New York Times*, Dec. 24, 2006.

8. The 100th Congress is working toward major, new energy legislation. The Senate bill did not support an RPS. However, the House bill passed on 8/4/2007 did call for a 15% RPS. The final bill negotiated in conference committee dropped the RPS.

9. These results are taken from the REPP state reports available at www.repp.org. See endnote 2 for a complete explanation.

10. REPP Technical Report: *Analysis of Wind Generation Technology.* Available at www.repp.org.

11. In order for a complex issue like climate stabilization to gain public awareness and acceptance, one needs to provide the public with a clear explanation of the problem and a solution that they can understand and believe will work. While there are many ways to stabilize carbon emissions, the "wedge" analysis developed by Pacala and Socolow offers an interesting model to understand this issue (Pacala,

S. and R. Socolow, "Stabilization wedges: Solving the climate problem for the next 50 years with current technologies," *Science*, August 13, 2004, Vol. 305).

12. Air scrubbers, wet scrubbers, and gas scrubbers are commonly used to help control emissions of sulfur into the atmosphere. This is of particular interest to those involved with electric power generation via combustion of coal. The gases that are emitted from the combustion process are passed through tanks containing a lime substance (often a limestone slurry) that can capture and neutralize the sulfur dioxide.

13. The cost of compliance will be a direct function of the amount of carbon produced per kwh generated. Carbon intensity varies considerably by region. For example, the northwest region has hydro reserves which produces electricity with no carbon emissions. The cost of complying for this region will be low relative to a region with a high percent of coal fired generation. More than 50% of the carbon dioxide emissions from electric generation come from the coal regions in the United States such as Appalachia and the industrial belt of Ohio, Michigan, Indiana, Illinois, and Pennsylvania.

14. *Efficient Heat Rate Benchmarks for Coal-Fired Generating Units*, Draft, B.F. Roberts, Economic Sciences Corporation, Lessly Goudarzi, OnLocation, Inc.

15. Parkinson, G., "OEMs Getting Ready for Coal Gasification," *Turbomachinery International*, May/June 2004.

16. A recent article in the *Wall Street Journal* (Smith, R. "New power plants fueled by coal are put on hold," July 27, 2007, p. 1) notes that many of the 154 plants first reported by the National Technology Energy Laboratory have been cancelled or delayed in part due to deteriorating plant economics. These cancellations have occurred without any real legislative progress toward a cap on carbon emissions.

17. "Technology Transfer: Use of Federally Funded Research and Development." Updated April 24, 2007, Wendy H. Schacht, Specialist in Science and Technology Resources, Science, and Industry Division, Congressional Research Services, Washington, D.C.

18. M. Chepeka, Manager, Marketing Communications, *Iogen Corporation Ethanol Producers Magazine*, Nov. 2006, online.

19. *Breaking the Biological Barriers to Cellulosic Ethanol: A Joint Research Agenda,* Energy Information Agency, Department of Energy, 2006

20. *Industrial Competitiveness and Technological Advancement: Debate Over Government Policy.* Updated August 3, 2006, Wendy H. Schacht, Specialist in Science and Technology Resources, Science, and Industry Division, Congressional Research Services, Washington, D.C.

21. *Industrial Competitiveness and Technological Advancement: Debate Over Government Policy,* Updated August 3, 2006 Wendy H. Schacht, Specialist in Science and Technology Resources, Science, and Industry Division.

22. Currently the Production Tax Credit provides a $.02 tax credit per kwh generated for the initial 10 years of the project's life. Assuming an industry average annual production, the present value of 10 years of tax credits is roughly one-third of the total installed cost of a turbine. Hence, it is assumed that every dollar of public support will draw out $2 of private investment.

23. See REPP, "State Reports for California, Michigan, and Massachusetts." Available at www.repp.org.

24. These calculations are shown in detail in the REPP "State Reports for California, Michigan, and Massachusetts." REPP calculates the cost for a blend of already commercial renewable technologies to achieve one "wedge" of carbon stabilization. According to the REPP calculations, this requires 18,500 MW per year at a cost of $16 billion per year. REPP assumes a 10-year program to calculate total investment cost.

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