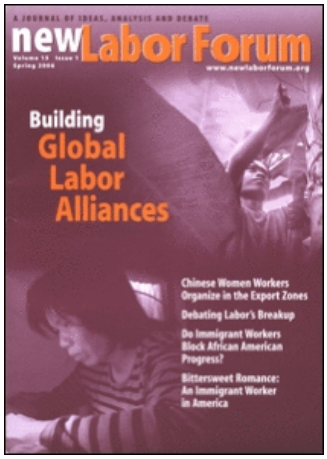

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THE ECONOMIC PROMISE OF RENEWABLE ENERGY

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The John Amos power plant near Charleston, West Virginia, looms over a neighborhood in Poca. It is consistently on the list of most polluting power plants, its coal burning making it eleventh in carbon dioxide release and twelfth in sulphur dioxide, in 2003. It also emits mercury and nitrogen oxide.

By George Sterzinger

THE ECONOMIC PROMISE OF RENEWABLE ENERGY

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 the ongoing but largely unaddressed deindustrialization of the domestic economy. We require a national energy policy that addresses these three goals simultaneously.

While public, corporate, and scientific opinion is coalescing around the need to "do something" about energy security and climate change, the initiatives are often developed in isolation, so that efforts to reduce energy security problems increase the risk of climate change and vice versa. The third challenge—addressing the way in which the energy sector drains the domestic economy of dollars, manufacturing capacity, innovative capability, and jobs—has not really been a part of the debate.

Unlike fossil energy, which is discovered, renewable energy is conceived and created in labs and universities, brought to commercial readiness by developers, manufactured as component parts, and assembled into finished products. In the end, renewable energy is manufactured energy. A national energy policy that provides energy security and stabilizes climate change will create a huge demand for renewable energy projects, which can, with the right set of policies, be used to revitalize the manufacturing sector and create the workforce to serve that 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 reindustrialization and economic de-

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velopment, there will be strong public support for renewable energy and the broader goals of energy security and climate stabilization.

Given this enormous potential, the challenge is to first understand why it isn't happening, and to use that understanding to put in place the policies that will allow it to happen. Not a single energy policy initiative has seriously addressed how to develop a domestic renewable industry that would revitalize the manufacturing sector.

The failure to develop a renewable energy industry has led to a lost capacity for innovation in U.S. industry, low wages, and lax environmental standards.

Over the past decade, our energy policy has been concentrated almost entirely on supporting the development of fossil fuel resources. To the extent renewable energy was supported, it was through a patchwork of state level requirements to install renewable energy projects combined with erratic federal incentives in the form of production tax credits. Absolutely no attention was paid to supporting the development of a full-fledged renewable industry. These efforts produced bursts of development followed by periods of no development at all. This start-and-stop approach precluded the growth of a strong domestic industry, and resulted in much of the equipment installed in the renewable projects coming from offshore.

Today, however, there is a growing recognition that achieving security and climate stability will require a massive development of renewable energy projects. But this new consensus still has not translated into an urgent demand for the creation of a 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 has been looked at as an industry in itself, involving the manufacture and assembly of component parts, and analyzed in terms of where the firms are located that could manufacture those parts. On a positive note, though, over the past four years, many states have moved in this direction, going beyond the installation of individual projects to the development of a renewable energy industry. These nascent state efforts should be used to push for the right set of federal policies to support the development of this industry.

Finally, the overwhelming reliance on market-based solutions to almost every domestic problem leaves little support for an active role for government in energy policy. This has to change. Climate stabilization and energy security are public values that will not be delivered by private free markets acting alone. The critical role for government is to mobilize private resources, ranging from universities to energy developers, to develop renewable energy technologies, and support the industry that can manufacture them. There are 2,000,000 new jobs at stake, 42,000 firms already active in the relevant industrial sectors, and over $160 billion in new investment to be made.

THE CURRENT CRISIS

The failure to develop a renewable energy industry has led to a lost capacity for innovation in U.S. industry, low wages, and lax environmental standards. In a worst case scenario, an energy policy defined solely in terms of establishing new energy projects could result in the mandatory installation of technologies supported by U.S. research and development, funded by U.S. taxpayers, but with components manufactured largely offshore under wage and environmental conditions that worsen global climate conditions. If this prevails, it would mean that the pursuit of environmentally superior renewable energy projects at home would go hand in hand with disastrous work and environmental conditions overseas. One possible way to control this outsourcing of work and its consequences, that would amount to a "gaming" of a "clean" national energy policy, would be to require that any production technology employed overseas seeking a federal incentive should be manufactured under conditions at least as clean as those of domestic generation, or face the adjustment of the delivered price to reflect the difference. But this is hardly ideal. The best option is to develop an efficient domestic renewable industry at least as vigorously as we pursue individual renewable projects.

Our current energy policy is often described as "drain America first" because of our insistence on drilling more and more pristine areas of the country for oil and natural gas. But "drain America first" could also describe the effects of our current policy on the domestic economy more broadly. Ill-conceived efforts to fix the problem can be as bad as the problem itself. A case in point is what has become perhaps the most popular fix today—the call for an oil or gasoline tax to prevent sending petrodollars to "terrorists" and to perhaps help finance other federal projects, including balancing the federal budget. The laissez-faire economic model we follow has reduced the role of government to that of merely getting the "price right" for consumers through some form of energy tax, and then letting the market solve all other problems. According to a recent survey of climate change initiatives in the *New York Times*, most economists now call for some type of carbon tax in order to get the price right: "Global warming can be seen as a classic 'market failure' and many economists, environmental experts and policy makers agree that the single largest cause of that failure is that in most of the world, there is no price placed on spewing carbon dioxide into the world."[1]

Our current energy policy is often described as "drain America first" because of our insistence on drilling more and more pristine areas of the country for oil and natural gas.

Thus, Thomas Friedman, writing from the bully pulpit of the *New York Times* op-ed page, has repeatedly called for gas taxes, and recently for a floor price on gasoline of $3.50 per gallon that includes both the "actual" price plus a tax. Friedman seems blissfully unaware of the po-

tential for his floor price to become an "actual price support" for OPEC. In addition, Friedman is either ignorant or unconcerned that every $1 tax on gasoline and diesel will raise $200 billion in taxes. Assuming businesses can pass on the tax, every $1 would cost each household $2,500 per year. This type of tax is actually quite inefficient in spurring the development of new technologies compared to a more direct approach that provides incentives for technology development. However, it is also important to recognize that any significant gas tax (or oil tax or carbon tax) might seriously erode family incomes and, at a time of serious concern about the economic health of the middle class, would be almost certain to produce a tidal wave of opposition not just to the tax but quite possibly to the larger goals the tax is nominally intended to secure.

Goals like security, climate stabilization, and economic development attach a public dimension to energy decisions that would not exist in a purely private market.

The other serious problem with these 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 pay for using existing technology, with the intention of providing an economic advantage to the new alternatives. A cap on carbon emissions or a tax is set, that is added to the price; technology developers see that price increase and develop new technologies to capture that advantage; consumers see that price and react; and carbon-free technologies move into the market. Each of these links is weak and can be effectively broken by market power and price discrimination. The economic advantage will not flow through to the alternatives, and even if it did, will not be enough of an incentive to bring major new alternatives into the marketplace. In the final analysis, these pricing policies rely more on what some have called "faith-based economics" than they do on hard evidence they will be able to produce the new technologies needed.

A NEW ENERGY POLICY

There is an alternative approach, one that first acknowledges the role of government before addressing national energy goals. Goals like security, climate stabilization, and economic development attach a public dimension to energy decisions that would not exist in a purely private market. 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. In the proposed new energy policy, the government becomes the principal, and on behalf of society wants energy produced and used in a sustainable way. Thus, the proper role for the government would be to provide the best set of incentives to energy market agents so that their private actions provide BTU's of energy that will

also meet public goals. One way to think about federal incentives is that they represent public investment, the role of which is to steer private actors towards providing those public benefits they otherwise would not.

THE POTENTIAL FOR REINDUSTRIALIZATION

While revitalizing the domestic manufacturing sector can and should be a major goal of a new national energy policy, it will not happen automatically. At a minimum, a national energy policy must combine incentives for component manufacturing as well as for project development. Domestic manufacturing firms can provide the components for wind, solar, biomass, and geothermal electric generation technologies. The new policies should strongly support innovation in 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."[2]

A brief review of currently existing wind electric generation technology illustrates the promise of reindustrialization offered by a renewable energy industry. 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 CO2 emissions and displace anticipated imports of liquefied natural gas (LNG), with both security and environmental benefits. A major federal program supporting the development of a target percentage of renewable technology would encourage the development of more wind projects. The projects will predominantly be built—and the benefits of this 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. The new income thus pumped into these local economies will further stimulate retail and service activities.

What's more, modern wind turbines are 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 16,000 firms active in the industrial sectors where components would be manufactured. When the analysis is expanded to include other renewable energy technologies like photovol-

Currently existing wind electric generation technology illustrates the promise of reindustrialization offered by a renewable energy industry.

taic, biomass, and geothermal sources, the number of firms grows to more than 42,000. In the course of a decade, the new investment will exceed $160 billion, and create more than 2,000,000 full-time equivalent jobs (a full-time equivalent job is 2,000 hours of required labor). While the firms would be spread across every state, they would be concentrated in the ten states that have suffered the greatest manufacturing job losses over the past six years.[3]

As can be seen in the table below, the potential for major renewable energy developments to offer new economic activity to the states hardest hit over the past decade is striking: 65 percent of the new jobs and 57 percent of the new investment will go to the ten states that have suffered 55 percent of the total job losses. Any major program to develop wind or any other renewable technology would provide a potential burst of demand for new manufacturing activity and job creation in precisely

In the course of a decade the investment in renewable energy will create more than two million jobs …

TABLE 1

The Top Ten: New Investment Potential Versus Manufacturing Job Losses in the United States

State	Number of Potential New Jobs	Average Investment ($ billions)	2001 Population	Rank in U.S. in population	Manufacturing Jobs Lost, Jan. 2001–May 2004*	Rank in U.S. in number of jobs lost
California	95,616	$20.90	34,501,130	1	318,000	1
Texas	60,100	$13.22	11,373,541	7	165,500	3
Illinois	56,579	$9.93	21,325,018	2	169,600	2
Ohio	51,269	$8.84	9,990,817	8	129,300	8
New York	47,930	$8.40	12,482,301	5	131,500	6
Pennsylvania	42,668	$7.92	6,114,745	14	63,500	13
Indiana	39,221	$6.26	12,287,150	6	155,200	5
Michigan	34,777	$5.53	5,401,906	18	68,300	10
North Carolina	28,544	$5.33	19,011,378	3	130,500	7
Missouri	22,796	$5.26	8,186,268	11	156,600	4
10 State Total	524,558	$91.59	140,674,254		1,488,000	
% U.S. Total	**65%**	**57%**	**50%**		**55%**	

those states and regions most in need of such a stimulus.[4]

REGULATIONS AND INCENTIVES

THE ALTERNATIVE TO A PUNITIVE TAX IS A POLICY that offers incentives to other technologies. For example, the alternative to a dollar a gallon tax on fossil fuel, which would make ethanol attractive, is to provide a dollar incentive to ethanol. Under the Renewable Fuel Standard, that incentive would cost at most $7.5 billion as opposed to the $200 billion tax.

A cap on carbon emissions, not a tax, is a necessary part of a carbon stabilization policy, but it is not sufficient. The challenge is to develop as many carbon-free (or reduced carbon) technologies as possible through a carefully managed portfolio of incentives. A cap with tradable emission rights simply will not accomplish this on its own.[5]

The experience of the Clean Air Act Amendments of 1990 show that a cap works best when there is a known technological fix whose cost of implementation varies across the plants that are required to comply with the cap. Since the low-cost plants meet compliance requirements, they can sell the extra allowances to those plants that have higher costs of compliance. For instance, the Clean Air Act required sulfur dioxide emissions to be reduced over all electric generating plants, and a technique called scrubbing was the recognized technical fix to remove SO2. Scrubbing cost less per ton of SO2 removed from large coal pants than from 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.

One of the critical and often overlooked aspects of cap regimes is that the cap would first be allocated or assigned among the plants most responsible for the carbon dioxide emissions. In the case of the cap on sulfur dioxide, and later, nitrous oxide emissions, the cap was allocated among the set of plants responsible for those emissions. When new technologies like wind power were considered for development—technologies that could produce electricity with no sulfur dioxide or nitrous oxide emissions—they did not "earn" or obtain emissions credits to sell, with rare exceptions. The same principle would apply to new carbon-free technologies under a carbon cap.

A cap on CO2 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 to below current levels, make the development of new, conventional coal plants prohibitively expensive, and provide the owners of existing plants with a powerful incentive to seek out more efficient "clean coal" technologies. Existing coal plants burn coal in a boiler and use the steam to turn turbines, and, at most, turn 40 percent of the energy in coal into electricity.

The alternative to a punitive tax is a policy that offers incentives to other technologies.

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.

A cap on carbon emissions, not a tax, is a necessary part of a carbon stabilization policy.

These plants essentially use the energy of the coal twice, and can be up to 55 percent efficient in turning the energy in coal into electricity, producing more kWh (kilowatt hours) as a result. Thus, clean coal is over 20 percent more efficient than traditional generation technologies. Since a new combined-cycle coal plant is considered to be about 25 percent more expensive than a traditional coal plant, the government could buy down or pay the cost differential to the plant owner as an incentive to build the more expensive but lower CO2 emission plant.

This rebuilding could channel billions of dollars of new construction and related economic stimuli into areas that currently support traditional coal-fired generation. If the total electricity generation remained constant, the increased efficiency could lead to a 20 percent or more reduction in CO2 from these plants. Thus, a carbon cap plus federal incentives could help rebuild the 335,000 MW of existing generation.

The other effect of a carbon cap would be to make new coal-fired plants much more expensive since they would have to purchase CO2 permits from existing plants. At present, 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. Under a cap plan, 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 proposed, the greater the demand for CO2 allowances, the more expensive the required allowances, and the less feasible the new coal-fired plants would become.

CRITICAL AREAS FOR FEDERAL SUPPORT

GOVERNMENT SUPPORT IS CRITICAL IN THREE stages: basic science and R&D, initial technology commercialization, and commercial deployment. To meet these challenges the functions should be gathered in one place. An independent agency, 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. It should be given a portfolio of incentives, and be charged with using them to move the energy sector towards meeting the core goals of the energy policy. Financial assistance should also be provided to projects and manufacturing firms that satisfy the following criteria: reduced carbon emissions; reduced energy security risks; capital investment made available to increase component manufacturing capability; and jobs created primarily in the United States.

Basic Research and Development

First, federal support must be provided for basic science to encourage the required technological breakthroughs. R&D efforts to improve

manufacturing technology should be integrated into the domestic component industry. 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 CO2 to the price of the kWh generated from coal, oil, or natural gas directly through a tax or indirectly through a cap, we should construct policies that reward the avoidance of CO2 entirely. The avoidance of CO2 is a public benefit, which should be provided a reward or a financial return—an effective incentive to shape investors' decisions. For example, using production tax credits to spur investment in wind generation draws out $2 of private investment for every dollar of tax credits. The ratio of public to private investment will vary by technology and by the type of incentive used. 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.

Commercializing New Technologies

The 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."[6] 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 towards the theoretical limit of 60 billion gallons. Despite the importance of moving this and many other new technologies out of labs and into the energy marketplace, there is only one functioning program at the federal level to support this type of activity.

Incentives for Deployment of Proven Technologies

For commercially proven technologies, such as wind turbines and clean coal, the federal government should offer a public return to augment the private return, and provide a powerful incentive for industry to move towards those technologies. 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.

Any program to accelerate the develop-

ment of renewable projects will place an increased demand for parts on relevant industrial sectors, which could lead to crippling supply bottlenecks and skill gaps in the workforce. This needs to be anticipated and prevented through support for increased manufacturing capacity and workforce training. To gauge the likelihood of this new demand overwhelming the capability of these sectors, one should compare the new demand to the unused capacity in each of these sectors. For wind and photovoltaic technologies, the analysis of the likely new demand versus the available, unused industrial capacity revealed that over half the sectors would face incremental demand much higher than their unused capacity. There are over 42,000 firms active in the sectors which could manufacture renewable energy components, mostly located in states that have suffered the greatest job losses over the past decade. Unless these sectors develop new manufacturing capacity, they will be unable to supply the necessary parts, causing a supply bottleneck. Moreover, this industry will create two million full time equivalent jobs, and since renewable technologies are new, most of these jobs will require a trained workforce that does not currently exist. Further, efforts to expand domestic manufacturing and workforce development should tie back into the basic research so that the industry that emerges is productive and efficient.

The incentive policy for proven technologies 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 investment of $16 billion in total investment per year. 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. 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. The production tax credit is well known to leverage 2 dollars 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

There are over 42,000 firms active in the sectors which could manufacture renewable energy components, mostly located in states that have suffered the greatest job losses over the past decade.

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.

It is increasingly clear today that public and professional opinion is coalescing around the need to make energy security and climate stabilization the basic goals of a new national energy policy. Such a policy that also 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. ■

Notes

1. "Cost of an Overheated Planet," S. Lohr, *New York Times*, C-1, 12/12/06.

2. "Goodbye Production (and Maybe Innovation)," Uchitelle, *New York Times*, 12/24/06.

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

4. Ibid.

5. 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*, 13 August 2004, Vol. 305).

6. M. Chepeka, Manager, Marketing Communications, Iogen Corporation Ethanol Producers Magazine, November 2006, online.