

Testimony on Solar Energy Technology and Clean Energy Jobs

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Performing Due Diligence on Green Energy Investments

Madam Chairman and members of the Committee, thank you for the opportunity to testify before your Committee as you consider the important question of the role of public investment in alternative energy sources, such as solar power, and the impact of that investment on our economy.

An aggressive push for public investment in alternative energy programs is underway in the United States and in some other countries. The appeal of proposals for such programs is easy to understand. They promise both increased employment and other economic benefits and improvements in environmental quality. As a lawyer and economist who studies regulatory

programs, I cannot speak to the technical details of converting sunlight to electricity but I can make suggestions on issues you should consider as you exercise oversight in determining when and where to invest public money in such programs. I suggest five questions about investments in alternative energy programs, the answers to which I believe will help you distinguish among potential programs seeking support. These questions are drawn from my research, together with my coauthors William Bogart of York College, Andrew Dorchak of Case Western Reserve University, and Roger Meiners of the University of Texas at Arlington.¹

UUQuestion 1: What is the *net* increase in jobs and energy produced by an investment?

Much of the green jobs literature generally, and the alternative energy literature in particular, reports estimates of gross employment impacts of public investments in new technologies and mandates in the alternative energy sector.² However, the relevant number from a public policy point of view is not the gross number of jobs but the net. Shifting energy production away from existing forms of energy will destroy jobs in those areas, just as investing in new forms of energy production will create jobs in the new areas. Only by assessing the net job creation can you effectively weigh the employment merits of a proposed investment.

¹ *Green Jobs Myths* (with William T. Bogart, Andrew Dorchak, & Roger E. Meiners), 16 MISSOURI ENVIRONMENTAL LAW & POLICY REVIEW 326-473 (2009); *Green Jobs: Boom or Bust?*, PERC REPORTS (Summer 2009) (with William T. Bogart, Andrew Dorchak, & Roger E. Meiners) (reprinted in RANGE (Winter 2010)); *Advocating Autarky: A Flaw in Green Jobs Policy Proposals as They Pertain to Renewable Energy* (with William T. Bogart, Andrew Dorchak, and Roger E. Meiners), 5 TEXAS JOURNAL OF OIL, GAS, & ENERGY LAW 155-164 (2010); THE MYTH OF GREEN JOBS (with William T. Bogart, Andrew Dorchak, & Roger E. Meiners) (Cato Institute, forthcoming 2010) (tentative title).

² United States Conference of Mayors, U.S. METRO ECONOMIES: CURRENT AND POTENTIAL GREEN JOBS IN THE U.S. ECONOMY, 2008; American Solar Energy Society, RENEWABLE ENERGY AND ENERGY EFFICIENCY: ECONOMIC DRIVERS FOR THE 21ST CENTURY, 2007; Center for American Progress, GREEN RECOVERY: A PROGRAM TO CREATE GOOD JOBS AND START BUILDING A LOW-CARBON ECONOMY, 2008; United Nations Environment Program, GREEN JOBS: TOWARDS DECENT WORK IN A SUSTAINABLE, LOW-CARBON WORLD, 2008.

When the impact on current employment is considered, some of the new green jobs will turn out to be substitutes for existing jobs. For example, one of the goals in promoting an increase in solar-powered electric generation is to reduce our reliance on coal-fired electricity generation, since a key benefit of solar-power is to reduce emissions by reducing reliance on coal. Such a shift will certainly increase employment in producing, maintaining, and operating solar power plants but it will also reduce employment in coal mining and processing, coal transportation, and operation of coal-fired power plants. Whether the net impact on employment overall is positive or negative will depend on the relative labor intensity of energy production in the respective sectors at the margin of added or subtracted production. There is no question, however, that the net employment impact of the shift from coal to solar power is smaller than gross impact of the investment in solar power. Moreover, the shift is likely to produce quite different regional impacts in different parts of the United States, shifting jobs away from regions with extensive coal reserves and power generation facilities and toward regions with more sun.

There is evidence to suggest this is a significant concern with respect to investments in green jobs. Spanish researcher Gabriela Calzada examined employment impacts of such investments in Spain and found a loss of 2.2 jobs for each new job gained.³ Care is therefore necessary to ensure that efforts to promote new technologies do not reduce overall employment.

Question 2: What is the impact of the investment on labor productivity?

In general, the labor intensity of energy production – the labor required per unit of energy produced – is much higher in solar and other renewable energy sources than in conventional energy production. That is, any given amount of energy produced generally requires more labor

if the energy is produced from solar or wind than if it is produced by a coal or natural gas fired power plants. Many advocates for public investment in renewable energy point to this higher labor requirement as a *benefit* because it will tend to increase employment. For example, if we were able to switch much of our electricity production to solar away from the current mix of technologies, more people would be employed in electricity production than are so employed today.

This is not a benefit, but a cost. Ignoring productivity confuses ends (goods and services valued by consumers) with means (labor). If one form of energy requires more labor to produce than another, it is less efficient with respect to labor. (Of course, the efficiency with respect to capital must also be considered.) If the cost of energy increases as a result of this less efficient production, then the net benefits of energy production available to the citizens of the United States decrease. An analogy would be if we used less machinery and more shovels in building roads. More people would be employed building the roads due to the labor-intensive method of production, but the net cost to the taxpayers would be higher per mile of road built. Moreover, because energy is part of the cost of production of virtually all goods and services, many goods will become more costly and American producers will become less competitive in world markets. There is evidence that this is a significant concern, with current estimates showing solar energy to be considerably more expensive per unit than conventional alternatives because of standby power generation needs.⁴ We should not therefore favor technologies because they are inefficient users of labor or capital.

³ Gabriel Calzada Álvarez, *Study on the effects on employment of public aid to renewable energy sources* (2009) available at <http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf>.

⁴ Gilbert E. Metcalf, *Federal Tax Policy Towards Energy*, Report 142, MIT Joint Program on the Science and Policy of Global Change (2007) available at http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt142.pdf at p. 21-22.

Moreover, increasing the labor efficiency of new technologies like solar energy is critical to making these technologies commercially viable without subsidies. For example, one promising development in solar photovoltaic technology was the recent separate announcements by two companies, Dow Solar and United Solar Ovonic, of products integrating solar cells into roofing shingles, a development which promises to cut installation costs significantly by allowing installation by regular roofers rather than specialized installers. Because these products increase labor efficiency, they would be ranked as less desirable under many green investment schemes that feature high-levels of labor use. If we want solar energy to succeed in the market place without requiring permanent subsidies, we must ensure that we reward improvements in efficiency of labor use rather than subsidize the inefficient use of labor.

We must also take care to minimize what economists refer to as the “dead weight losses” that are an inevitable consequence of increased public expenditures. Many green energy proposals assume that spending public money is a costless means of promoting additional economic activity. Such public expenditures must be paid for with an equivalent increase in tax revenue, now or in the future. All taxes induce some degree of tax avoidance behavior among those able to do so. As a result, the cost of a tax generally exceeds the revenue yielded by the tax. That is the “deadweight loss.” Because avoidance actions are a wasteful but unavoidable part of any tax policy, they must be considered in evaluating the net benefits of any program that relies on increased public expenditure. Since deadweight losses are generally excluded in the calculations done by proponents, including it will likely reduce the net benefit of proposed expenditures below proponents’ estimates.

It is particularly problematic that these issues are simply ignored in the literature promoting such programs. Fortunately, Congress has available to it the resources of the Government Accountability Office, Congressional Budget Office, and committee staff. An

important step forward in Congressional oversight of alternative energy programs would be to commission an analysis of the appropriate assumptions which should be used in evaluating proposals and then require benchmarking of future studies against the results of that analysis.

Question 3: What are the assumptions underlying predictions of costs and benefits?

Many advocates for green energy expenditures claim that their programs will have a large impact because of the added jobs and other benefits created as those hired into green jobs spend their paychecks, creating additional economic activity in the businesses where those paychecks are spent. These estimates are derived from a technique known as economic multiplier analysis.

Multipliers are based on the idea that increases in activity by one firm will lead to increases in activity by other firms. For example, the contractor for a new football stadium buys concrete, the concrete subcontractor buys new tires for its trucks, all the firms' workers go out to dinner, and so forth. Unfortunately, multipliers are difficult to observe directly and so must be estimated by indirect means. This is usually done with a modeling technique known as input-output analysis.

While the details of constructing an input-output analysis are both technical and tedious, the key problems with relying on such models to estimate the impact of alternate energy spending are relatively straightforward. To conduct an input-output analysis requires construction of a matrix of relationships between different economic activities. More road construction means more demand for cement, more demand for cement means more demand for diesel fuel to run cement trucks and more work for cement plant workers, more demand for diesel means higher sales of fuel and more work for cement plant workers means they will spend more in retail establishments, and so forth. These relationships can be estimated statistically

using industry-level data. Properly used, input-output analysis can provide useful estimates of the impact of a project like construction of a highway.

This is not so with respect to projects intended to change the relationships on which the analysis rests, however. Input-output analysis relies on two key assumptions, neither of which can be made for alternative energy spending. The first assumption is called constant coefficients production, which means that the ratios of outputs to inputs in various industries are *constant* regardless of the scale of production or the time period. This eliminates the possibility that inputs may be substituted for each other, either because of technical progress or because of changes in factor prices. For example, a typical assumption would be that if a dollar of energy was required to produce \$10 of steel at the time the input-output table was created, then this relation will continue to hold. In reality, if the price of energy increases, the relation is likely to change as higher energy prices induce steel producers to change production techniques to reduce the energy used per unit of steel. Since alternative energy proponents concede that green energy costs more per unit than conventional fuels,⁵ the ratio of energy costs to production is *not* constant and this assumption is violated.

The second key assumption necessary to conduct an input-output analysis is that the relationship between prices of the various factors of production is constant. This is particularly important because, for modeling convenience, the relation between inputs and outputs is calculated using dollar values rather than physical quantities. Doing so is appropriate only if the physical quantities and the monetary values have a constant ratio, in other words if there are fixed prices over time. That is unlikely to be the case for alternative energy programs since a key

⁵ For example, CENTER FOR AMERICAN PROGRESS, GREEN RECOVERY: A PROGRAM TO CREATE GOOD JOBS AND START BUILDING A LOW-CARBON ECONOMY, (2008), *available at* http://www.americanprogress.org/issues/2008/09/pdf/green_recovery.pdf, notes that \$1 million

justification for public support for green technology is that oil and coal will become more expensive, either for technological reasons or because of a tax based on carbon dioxide emissions. Because of the pervasive role of energy, such changes would alter factor prices throughout the economy, making an input-output analysis an inappropriate method for evaluating the impact of the program.

The proper method for evaluating such proposals is to make public the data, assumptions and models used to generate the estimates of costs and benefits. Doing so would expose problems in all three areas, by harnessing the expertise in modeling, in technology, and in data analysis that exists throughout the United States. Gaining the benefit of critiques from the wider population would mean that decisions are made based on the strongest analysis. Making data, models, and studies widely available in advance would ensure that Congress would benefit from exposing such proposals to what software expert Eric Raymond termed the “bazaar” approach in his landmark study of open software standards, *The Cathedral and the Bazaar*,⁶ and what University of Tennessee law professor Glenn Harlan Reynolds termed “an army of Davids” in his book by that name.⁷

Question 4: Does a proposed expenditure create jobs that add value?

One consistent problem in the larger green jobs literature and in the narrower alternative energy literature is that they count all jobs as benefits rather recognizing that some are costs. The purpose of any business, regardless of how green, is not to *use* resources but to *produce* a good or service, desired by consumers, that can be sold for more than the cost of production. For a

spent on solar energy will currently produce considerably less energy than \$1 million spent on oil. (p. 6).

⁶ ERIC S. RAYMOND, *THE CATHEDRAL AND THE BAZAAR* (2001).

⁷ GLENN HARLAN REYNOLDS, *AN ARMY OF DAVIDS* (2006).

given level of output, businesses that use more resources are less efficient – have higher costs – than those using fewer resources. Many jobs created in response to government mandates or to take advantage of government programs are not benefits of the program but rather costs. These costs may be worth incurring as the price of the benefits a program produces, but they must be counted as costs not benefits in assessing the program’s net value.

For example, the Conference of Mayors’ green jobs report includes the hiring of more lawyers and administrators of regulations as *benefits* of green jobs spending.⁸ While as a law professor, I am always pleased to see more job opportunities for my students, as an economist I know that all such expenditures cannot qualify as a benefit rather than a cost to society. Such claims are analogous to claiming that the need to hire more police as a result of a new criminal law is a benefit. By making labor the end, rather than treating labor as the means to production of environmentally friendly goods and services, the literature makes a fundamental error in economic logic. Promoting inefficient use of labor will steer resources towards technologies, firms, and industries that will be unable to compete in the marketplace without ongoing subsidies. Dooming the environmentally friendly sector to an unending regime of subsidies is fiscally irresponsible and harmful to any efforts to build a competitive and environmentally friendly economy.

Question 5: How are technologies that receive public investment being chosen?

The green energy literature calls for massive shifts in power generation technologies. The literature is selectively optimistic about favored approaches (wind, solar, biomass) and pessimistic about disfavored ones (coal, nuclear). The danger is that we will construct a “sustainable” energy sector that relies on public subsidies to exist rather than based on success in

the marketplace. Even groups favoring public investment in alternative energy have found a significant reliance on public subsidies. For example, during a prior debate over renewable energy tax credits, a study done for the American Wind Energy Association and the Solar Energy Research and Education Foundation estimated that if the investment tax credit for solar/photovoltaic projects and the production tax credit for wind energy was not renewed, then those industries would lose 77 percent of their jobs.⁹ It is important that Congress avoid creating subsidy-dependent industries. That this is a potential danger can be seen from the shift of renewable energy projects to the United States from abroad by companies seeking those benefits. For example, American subsidies for renewable energy projects were so attractive in 2008 that BP dropped plans to build wind farms and other renewable projects in Britain, shifting its renewable programs to the United States where government incentives for clean energy projects provided what a company spokesman called “a convenient tax shelter for oil and gas revenues.”¹⁰ We must avoid choosing technologies that will fail to develop into viable industries, a difficult task. Based on prior predictions of viability by proponents, there are reasons to worry about this with respect to solar energy in particular. For example, in 1986 Amory Lovins of the Rocky Mountain Institute said that commercial viability of wind and solar technology was only 1 to 3 years away; in 1983, Booz, Allen & Hamilton reported in a study done for the Solar Energy Industries Association, American Wind Energy Association, and Renewable Energy Institute that “The private sector can be expected to develop improved solar and wind technologies which will begin to become competitive and self-supporting on a national level by the end of the decade [i.e.

⁸ Conference of Mayors, *supra*, at 16.

⁹ Navigant Consulting, *Economic Impacts of the Tax Credit Expiration*. Prepared for the American Wind Energy Association and the Solar Energy Research and Education Foundation, 13 February 2008, Navigant Consulting, Bedford, MA.

¹⁰ Terry Macalister, *Blow to Brown as BP scraps British renewable plan to focus on US*, THE GUARDIAN (7 November 2008).

by 1990] if assisted by tax credits and augmented by federally sponsored R&D.”¹¹ This earlier optimism suggests we train a skeptical eye on optimistic predictions today.

An alternative model for spurring private sector innovation and investment in alternative energy technologies like solar power is for Congress to provide prizes, modeled on the Ansari X Prize for spaceflight. My former colleague at Case Western Reserve University Law School, Prof. Jonathan Adler, has argued that a prize approach would resolve many of the difficulties Congress faces in choosing which technology to back. While cautioning that prizes are not a panacea, Adler argues that prizes induce innovation in the same way that the patent system does, while imposing costs only when they produce results.¹² Similarly, as Thomas Kalil of the University of California at Berkeley, and a former official of the Clinton administration, explained, prizes offer a means to “help to blend the best of public purpose and the creativity, energy, and passion of private sector entrepreneurial teams”¹³ without committing the government to choosing a particular recipient or strategy. Prizes “allow the government to establish a goal without being prescriptive as to how that goal should be met or who is the best position to meet it.”¹⁴ Since, by definition, we do not know what will be the successful technology that delivers a new energy source, prizes offer the advantage of not precluding any promising directions for innovation.

¹¹ These, and additional, examples are collected at IER, *Will Renewables Become Cost Competitive Anytime Soon?*, <http://www.instituteforenergyresearch.org/2009/04/01/will-renewables-become-cost-competitive-anytime-soon-the-siren-song-of-wind-and-solar-energy/>.

¹² Jonathan H. Adler, *Eyes on a Climate Prize: Rewarding Energy Innovation to Achieve Climate Stabilization*, available at <http://www.law.upenn.edu/cf/institutes/plee/workshops.html>.

¹³ Thomas Kalil, *Prizes for Technological Innovation*, Hamilton Discussion Paper 2006-08, The Brookings Institution (December 2006), at 5.

¹⁴ Kalil, *supra*, at 6.

Conclusion

Our energy future is a subject of vital importance to our nation. Congress should have the best information available to analyze potential strategies for meeting the challenges that lie ahead. Even with the best information possible, our energy future contains many unknowns. In 1870, coal heated people's homes, natural gas provided light, electricity had little practical application, and gasoline was a waste product of kerosene refining. The great energy policy debates of that era concerned whether the world would run short of coal. No one in 1870 would have predicted that coal would become almost entirely an industrial fuel in plentiful supply, that natural gas would be used primarily to generate electricity and provide residential heat, that electricity would be in widespread use in homes and industry, or that gasoline would become an expensive commodity. We know as little about our energy future as our predecessors did about theirs and so we must put a premium on strategies that can adapt to new information, new circumstances, and new ideas.

In making its energy policy choices, Congress ought to exercise due diligence in reviewing both the methods and the predictions offered in support of particular technologies and strategies. I hope the material I provided today will assist you in making those choices.

Thank you for giving me the opportunity to testify today. I would be happy to answer any questions.