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Committee on Science, Space, and Technology
United States House of Representatives
Green Jobs and Red Tape: Assessing Federal Efforts to Encourage Employment
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Mr. Chairman and Members of the Subcommittee:

I am honored by your invitation to testify today. I am an economist and have recently joined NERA Economic Consulting as Senior Vice President. I will start with a brief word about my qualifications.

I have studied energy R&D and energy technology programs since the late 1970s, when as a member of the faculty at Caltech I participated in a major study of the economics of R&D supported by the National Science Foundation. More recently I was coauthor of a statement of principles for energy R&D policy with some of the most distinguished academic experts in the field. At the Congressional Budget Office I was deeply involved in all the issues of this hearing, as my Natural Resource and Commerce Division was continuously active in analyzing Federal R&D programs and industrial policy. I have published many papers in peer-reviewed journals on related subjects, and I was honored by the Association of Environmental and Resource Economists with their 2004 award for a "publication of enduring quality" for my pioneering work on emission trading. I taught environmental economics at the California Institute of Technology and economic theory at Caltech and Stanford University. I was Assistant Director for Natural Resources and Commerce at CBO and until recently I led the group at Charles River Associates that developed a pioneering set of economic models and used them in studies of

virtually every major proposal for climate and energy policies over the past decade.

My testimony today will take a broad view of the subject. I will address the common-sense economics of federal efforts to create green jobs through federal R&D funding and through the use of loan guarantees, standards, subsidies, regulations, and tax incentives to promote "green" technologies. My statements in this testimony represent my own opinions and conclusions and do not necessarily represent positions of my employer or any of its clients...

Summary

It is a fundamental error in policymaking and economics to design or justify federal support for new energy technologies as a jobs program. It subverts the entire purpose of government involvement in R&D, and is the greatest single cause of the continued failure of energy technology programs.

Some advocates claim that Federal spending on green technologies is a "triple winner;"[1] instead, it is at best a "triple also-ran." No single policy tool can at the same time and in a cost effective way develop new energy sources, protect the environment, and reduce cyclical employment. A closer look shows that current efforts to do these three things at once must, lead to doing none of them well or even adequately.

1. *Promoting new energy technology*: The federal government has a limited but vital role in the quest for new energy technology. But the right division of labor between public sector and private sector is absolutely crucial to success. Government should focus on basic and applied research. There, its intervention is essential; yet it is in these activities that the U.S.

[1] Jason Walsh, Josh Bivens and Ethan Pollack Rebuilding Green The American Recovery and Reinvestment Act and the Green Economy, Blue-Green Alliance and Economic Policy Institute, February 2011.

government traditionally allocates the smallest part of the Energy R&D budget. The policies promoting use of current green technology starve needed research in favor of demonstration and deployment of high cost current technology. The stimulus package tilted the balance still farther in the wrong direction.

2. *Cost-effective environmental protection:* Current programs to promote a Green economy actually raise the costs of reaching environmental goals. Well-designed environmental policies would provide incentives to choose least-cost means of compliance. In contrast, current green jobs policies mandate use of specific technologies; yet these may often not be the most cost-effective means to the desired end. Some current policies even use subsidies to tilt the playing field. If such schemes work at all, they do so by encouraging the choice of needlessly costly means while shifting the added costs onto the taxpayers.

3. *Stimulus:* To be efficient, energy R&D and investment incentives must be predictable, consistent, and sustained over a long period of time. But in a recession, fiscal policy experts all agree that the most effective jobs program spends its funds as quickly as possible and phases out the funding as the economy improves. Thus, energy research and investment are strikingly ill-suited to the task of leading the economy out of a down turn. The attempt to force these activities into so inapt a role is bound to frustrate the goals of both energy policy and economic stimulus.

Purposes of government intervention:

Efforts to use government spending to create "Green" jobs lose sight of the real objectives of government intervention in energy technology and R&D. Economists call these reasons "externalities," but they can be viewed simply as the problems that government intervention is

designed to solve. There are two areas in which markets cannot be expected to bring about the most socially desirable outcomes without some form of government intervention, and these are R&D and environmental protection. There is less complete agreement among economists about the appropriate role of government in dealing with the business cycle, but for my testimony today I will assume that a third policy goal, more rapid recovery from the recession, is also relevant. The **current mix of subsidies** for technology deployment through the use of loan guarantees, standards, subsidies, regulations, and tax incentives has only a haphazard relationship to these three externalities, and cannot do a good job of dealing with any of them.

R&D

Government must play a role in R&D because it is impossible for researchers and innovators to capture for themselves the full value of the information that their activities provide to society. This spillover effect is a positive externality, but it also implies that without active government intervention there will be less R&D than is socially optimal. The market failures associated with R&D are greatest in the early stages of basic and applied research: as activity moves into demonstration of technologies and their commercial deployment there are increasingly effective ways to protect intellectual property – including patents, trade secrets, and in-house development -- for innovators and investors to appropriate an adequate share of the gains their innovations provide to society. Thus government's role should be greatest in funding of basic and applied research and fade away as projects move toward large scale demonstration.[2]

In all sectors of the economy except energy, U.S. government funding is concentrated in basic and applied research as theory and experience demonstrates that it should be. Energy R&D

[2] In support of this point, see Richard Newell, A U.S. Innovation Strategy for Climate Change Mitigation. The Brookings Institution Discussion Paper 2008-15 December 2008 p. 20 ff.

programs tend to take too few risks, because they concentrate funding on pre-selected potential "winners" that are carried forward long after they have ceased to warrant continued government support. In large part, these failings can be directly attributed to the widespread perception of energy technology funding as a "jobs" program.

A statement written by a number of the most distinguished experts in the economics of R&D described the kinds of policies that would be effective in promoting technological advances in energy: [3]

> Government R&D policy should encourage more risk-taking and tolerate failures that could provide valuable information. This can be accomplished by adopting parallel project funding and management strategies and by shifting the mix of R&D investment towards more "exploratory" R&D that is characterized by greater uncertainty in the distribution of project payoffs. The single greatest impediment to an R&D program that is directed at achieving a commercial objective is that it will be distorted to deliver subsidies to favored firms, industries, and other organized interests. The best institutional protections for minimizing these distortions are multiyear appropriations, agency independence in making grants, use of peer review with clear criteria for project selection, and payments based on progress and outputs rather than cost recovery.

The idea of parallel approaches is very important, and as I will discuss later it is rarely seen in Federal energy R&D. Studies of successful R&D show that a parallel approach, in which many early-stage, high-risk projects are funded with the expectation that most will fail, would be

[3] "A Statement on the Appropriate Role for Research and Development in Climate Policy" Kenneth J. Arrow, Linda Cohen, Paul A. David, Robert W. Hahn, Charles D. Kolstad, Lee Lane, W. David Montgomery, Richard R. Nelson, Roger G. Noll and Anne E. Smith. Economists Voice, February 2009, Vol 6, No. 1.

provide far more information than the current approach, and would increase the likelihood of breakthrough discoveries. .

The statement also emphasized that commitments must be long-term and stable:

> Policy commitments must be stable over long periods of time. Climate change is a long-run problem and will not be solved by transitory programs aiming at harvesting available short-run improvements in energy efficiency or low-carbon energy. A much more stable commitment to funding and incentives for R&D is required to do better than the limited results of energy R&D efforts in the 1970s and 80s.

What should be equally clear is that a series of temporary, politically unstable, targeted subsidies, financial incentives, or even mandates for deploying specific green technologies will not provide adequate incentives for the R&D that would bring about large-scale technological change.

Environmental and other externalities of energy production and use

Another rationale for energy R&D comes from externalities associated with energy production and use. Effective programs to address these externalities – such as the Clean Air Act Title IV program that through a cap and trade program put a price on sulfur emissions from utilities – created clear incentives for the private sector to develop and deploy new control technologies. One of the few things that most economists agree on is that a clear, credible, consistent and stable policy that puts a price on CO2 emissions will lead to cost-effective technology deployment and provide a demand-driven inducement to innovation. Federal support for energy R&D motivated by these externalities also needs to be concentrated on basic and applied research, as existing environmental regulations and new policies focused on the direct causes of

environmental concern – such as greenhouse gas problems – provide the incentives for innovators to take these research findings into commercial demonstration and deployment.

Even energy security is dealt with most efficiently by programs that directly increase domestic production of crude oil and reduce consumption oil consumption in a balanced way. The ideal in terms of cost-effectiveness is an import fee, not a set of targeted subsidies and mandates for costly or technologically unavailable substitutes for oil.[4] Production of more fossil fuels is a direct and -- on an appropriate scale -- more cost-effective way to reduce oil imports than promotion of non-petroleum fuels through regulation (Renewable Fuels Standards) or subsidies (ethanol).

Many of the environmental consequences of energy production and use are already extensively regulated. Greenhouse gas emissions have not been regulated until now, but are the subject of proposed EPA regulations and much legislation. Development of new -- and indeed radically new -- energy technologies is critical to our ability to reduce greenhouse gas emissions sufficiently to stabilize temperatures at some level without unacceptable economic harm. For other externalities, this is less clear. Development of new technologies for production and use of fossil fuels or other forms of energy is already motivated by a perceived need for more cost-effective options for compliance with policies that address other externalities.

Recovery

Recovery from the recession is a policy problem distinct from either R&D or energy externalities, and requires its own distinct toolkit. Economists differ seriously about the best strategy to pursue to address an economic downturn like the one we have faced. All agree that

[4] D. Bohi and W. D. Montgomery. Oil Prices, Energy Security, and Import Policy. With Washington, DC: Resources for the Future, 1982.

monetary policy in some form is necessary, but many are critical of using government spending to stimulate the economy because of the long-term consequences of increased debt and the difficulty of making the spending be effective and timely. Too often fiscal measures are so slow to get money into the economy that they only ramp up funding after the economy is well on its way to recovery, so that rather than reducing unemployment deficit spending ends up increasing inflationary pressures. Moreover, temporary stimulus programs create constituencies that lobby to keep the spending going long after stimulus is no longer needed.

The basic principles of public finance for reducing cyclical unemployment are to choose methods of spending that get money into the economy as quickly as possible. Public works projects that have already been chosen as desirable investments by passing through the authorization process are good candidates. But the projects must be ones that can be ramped up quickly and also ramped down without waste or diminishing their value or effectiveness. Technology development that requires this kind of long term and stable funding does not satisfy these criteria.

Another basic principle is that the stimulus comes from spending, and many different programs offer the same opportunity for job creation if they receive the money. Thus job creation does not serve to justify one form of spending over another. Choosing which among many competing uses of funds should be the recipient of stimulus funding is not different from normal authorization and appropriations, except for the need for speed to avoid missing the window when stimulus is needed. A program that cannot pass a normal cost-benefit test has no business being chosen as a recipient of stimulus funding.

Why Energy R&D and Green Economy programs achieve none of the policy goals well

There is no such thing as a "triple winner" in economic policy. Economists have long observed that as many different instruments are required as there are distinct externalities. Using one policy instrument to address three different market failures assures that none will be addressed well or cost-effectively.

Energy R&D failures are largely attributable to an inability to resist treating technology investment as a jobs program

R&D is carried out by governments, for-profit and not-for-profit entities, and national and multinational institutions. These institutions perform a wide variety of R&D as illustrated in Table 1. This suggests that the problem of appropriability is greatest in basic research, important in applied research, and smaller in development and later stages of demonstration, commercialization and deployment.

Perhaps the most striking feature of the government's energy spending is the relatively low priority that it accords to R&D in general and basic and applied research in particular. In fact, in terms of total spending, deployment subsidies dominate. The following figure shows the relative resource commitments and the relatively modest role of basic and applied research in the Federal program. Thus even before the stimulus package, Federal funding was highly biased toward development where the private sector is capable of handling a much larger role if the technologies being advanced to that state promise to be commercially successful. Federal funding for this stage has been needed largely because too many unpromising technologies are advanced beyond basic and applied research.

U.S. 2006 Distribution of Total R&D Funding By Source and Stage and Energy R&D Funding in Stimulus Package

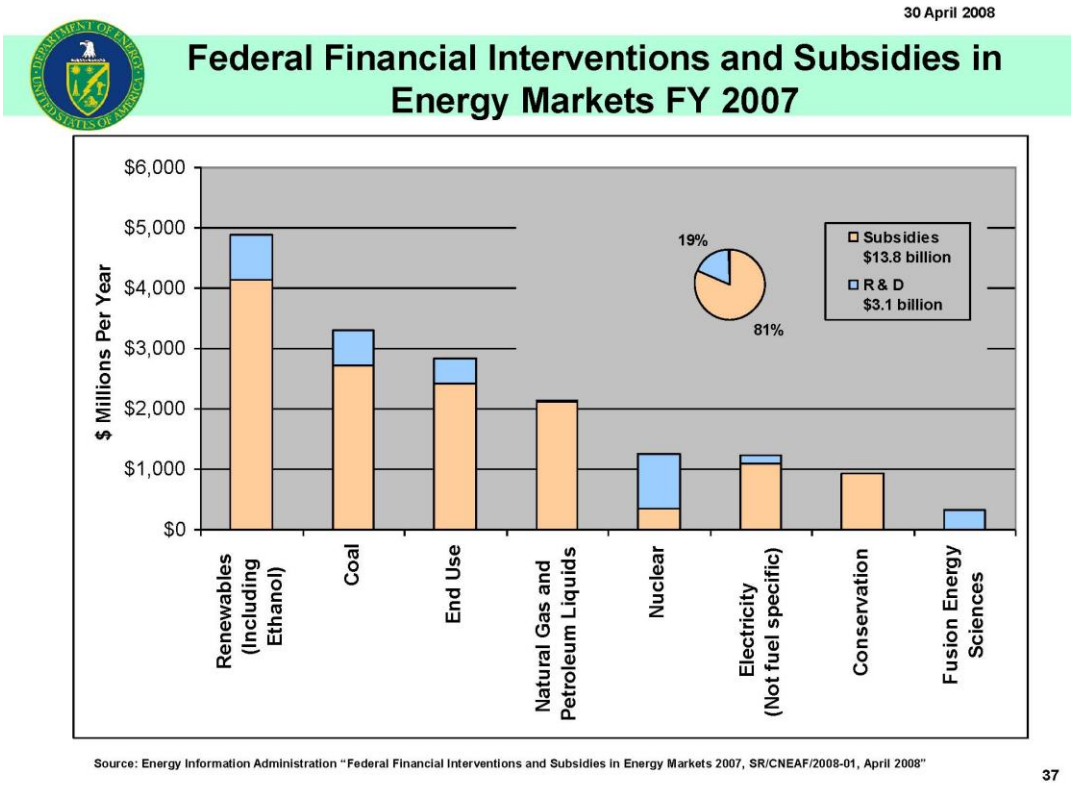
	Basic research	Applied research	Development	Total*
Industry	5%	20%	76%	$223.4B
Government	59%	33%	16%	$94.2B
Total	$61.5B	$74.7B	$204.3B	$340.4B
Energy R&D In Stimulus Package**	17%		83%	$7.9B

*Totals include $22.9B funded by universities and other nonprofit

**At least $33B of the energy portion of the stimulus package (over 80%) is for deployment

Source: National Science Board, 2008

Demonstration and deployment subsidies tilt the balance further away from basic and applied research:



These funding patterns can be attributed to three serious failings in the total energy technology program:

- Large scale demonstration projects that provide "jobs" in politically influential regions drain funds from basic and applied research,
- Deployment subsidies that benefit specific constituencies are rationalized as creating "jobs" even if the technologies are not cost-effective, and
- Failing projects are not cancelled because of the "jobs" involved.

And each of these failings arises because of favoring "jobs" over the most effective way of promoting technological advance.

It is not surprising, therefore, that energy R&D had a long history of waste and failure. Cohen and Noll describe a dynamic based on incentives of executive agency staff and Congressional incumbents that leads to the conclusion that R&D programs will investigate too few risky alternatives in the early stages of research, commit prematurely to large scale demonstration, and continue to fund large scale projects long after their failure has become evident.[5] This is exactly the opposite of the stable, long-term research program required to stimulate breakthrough research and introduce game-changing technologies.

Newell, in the study cited earlier, expands on this point:

> A number of specific market problems have been suggested as rationales for technology deployment policies. These market problems include information problems related to

[5] Linda R. Cohen, and Roger G. Noll (With Jeffrey S. Banks, Susan A. Edelman, and William M. Pegram). The Technology Pork Barrel. Washington, D.C.: The Brookings Institution, 1991.

> energy-efficiency investment decisions, knowledge spillovers from learning during deployment, asymmetric information between project developers and lenders, network effects in large integrated systems, and incomplete insurance markets for liability associated with specific technologies (Newell 2007b). Although such problems are often cited in justifying deployment policies, these policies in practice often go much farther in promoting particular technologies than a response to a legitimate market problem would require. Therefore, while conceptually sound rationales may exist for implementing these policies in specific circumstances, economists and others tend to be skeptical that many of them, as actually proposed and implemented, would provide a cost-effective addition to market-based emissions policies. Critics also point out deployment policies intended to last only during the early stages of commercialization and deployment often create vested interests that make the policies difficult to end.
>
> … the most notable failures in government energy R&D funding (e.g., the Synthetic Fuels Corporation, Clinch River Breeder Reactor) tend to be associated with large-scale demonstration projects—using up large portions of limited R&D budgets in the process (Cohen and Noll 1991). The recent experience with the FutureGen Initiative for clean-coal power tends to reinforce this perspective.[6]

The nature of the electoral process biases authorization and appropriation processes against basic and applied energy research. Supporting R&D projects that yield large, but diffuse, net benefits and those only after a long time, is a poor re-election strategy. However, when an R&D project reaches a large enough scale, it begins to have distributive significance. At that stage, the project may become politically relevant to legislators interested in re-election (Cohen et al 1991).

[6] Newell, ibid.

Energy R&D managers also exhibit an unwillingness to propose a sufficiently wide range of risky alternative approaches to achieve real breakthroughs. High-risk approaches with high potential may not come to their attention, since in the early stage of R&D there are significant agency problems in communicating the nature and potential of an approach (Cohen et al 1991). Career advancement is also more likely to come from successful projects rather than accumulation of useful information about approaches that do not work. This limits the set of alternatives considered for funding and leads to far too little risk-taking in government R&D and too narrow a view of possible avenues of approach.

This dynamic introduces a series of perverse incentives.

> First, it encourages officials to move technologies too swiftly to the phase of large-scale demonstration. As a result, these projects often run into technical problems that could have been resolved much more cost-effectively at a smaller scale, and to end up having chosen the wrong route overall.
>
> Second, congressional involvement has often led to poor projects surviving long after they should have been terminated. Representatives gain electoral credit for continued funding of local facilities and lose almost no electoral credit because the funding is accomplishing nothing.
>
> Third, the excess resources that demonstration projects consume, either because they are launched prematurely or because they linger too long on political life support, are likely to crowd out more valuable earlier phase research. In effect, projects at the early stage of development are not politically appealing because further work on them is not expensive enough to have distributive significance.

Fourth, the rush to demonstration may distort the selection of technologies toward those that are more mature rather than toward those that are more promising. Where there is path dependency in technology selection such distortions may have long-term consequences.

In addition to the effects of the high political discount rate on a premature rush to demonstration at high cost, choosing the location and design of projects by earmarking to benefit influential constituents is unlikely to lead to the choice of the best qualified and most cost-effective organization to carry out an R&D project.

All of these characteristics are found in the expanded set of programs that were introduced in the stimulus package and are rationalized as a program to create a "Green Economy." The history of energy R&D suggests that they will not promote technological advance effectively and that they will lead to waste of taxpayer's resources.

Green energy subsidies raise the cost of environmental policy

Cost-effective environmental policies lead to a choice of technologies that achieve the goals of the policies at minimum cost. A price on pollution – like the price of sulfur or NOx allowances – motivates every emitter to choose methods of reducing emissions that cost less per ton removed than the price of allowances. With a fixed cap on emissions, the allowance market causes the price of allowances to adjust until sufficient investments are made in pollution control that the cap is achieved. Introducing mandates for specific "Green" solutions, such as a Renewable Portfolio Standard or credits for manufacturing renewable energy equipment, only forces utilities to choose more costly renewable energy technologies over less costly solutions, because the cap will be met in either case.

A performance-based emission standard does not achieve the broad cost-minimization that an emission trading system would do, but it does provide an incentive for regulated entities to choose the method of compliance with the standard that minimizes cost. A good example is the the reformulated gasoline standard, which allows flexible choice of fuel components as long as the required emission performance is achieved. Adding a set of renewable fuel standards on top of the reformulated gasoline emission standards only increases the cost of meeting the emission standards, because the renewable fuel standards require that gasoline already compliant with emission standards be replaced with a much more costly alternative fuel that in some cases actually makes compliance with the emission standard more difficult.

This is a general phenomenon. Regulations or incentives that deal directly with the emissions, or more generally the externality, in question are always more cost-effective than incentives or subsidies that tilt the playing field in favor of one set of technologies that would not have been chosen as an environmental solution without the subsidies. And the cost is absorbed by the taxpayer.

Energy R&D and technology investment have none of the characteristics of the optimal policy to create jobs in a recession

First, they ignore the timing of proposed policies relative to the business cycle. One of the first principles of fiscal policy to counter recessions is to make sure that funds are expended quickly, and the most common political mistake is to authorize spending that will only hit its peak after the economy is well on the way to recovery. That mistake in timing means that the opportunity to help the economy out of the recession is missed, and that when spending does occur it fuels inflation and drives out other, more productive investments. Current regulatory programs and subsidies and loan guarantees for green technology fail this test. Even if some spending in these

programs did ramp up quickly, most of the expenditures would still largely be made after even pessimists think the economy will be well on the way to recovery. In that case, workers supported by green technology subsidies will have to be drawn away from other jobs, just as the mandated investment will be drawn away from other areas where it would contribute to economic growth. The total result is no net job gain and an overall drag on the economy.

Even if the expenditures for green technology were timely, they cannot take credit for the benefits of economic stimulus. As even Green Jobs advocates admit, about the same job benefits can be expected to come from any additional stimulus spending, so that job benefits do not differentiate between different kinds of spending. This kind of job analysis is a sheer waste of time and resources, because every proposal for more expenditure can make identical claims. In a slack economy, any increase in spending will create some jobs. The way to get the most out of fiscal stimulus is by putting additional spending into the areas in which a temporary funding increase provides the greatest return to the economy overall, and that does not include R&D or investment that requires stable and permanent incentives.

Conclusion: What About the Green Economy

There are serious reasons of public policy for federal support of basic and applied research that could lead to breakthroughs in energy technology and for policies that deal with environmental protection and global climate change. Very specific kinds of measures are appropriate for each. Federal R&D funding deals with the market failure in R&D that leads to less than optimal R&D effort across the board in the economy. Programs like Title IV sulfur trading deal cost-effectively with SOx emissions, and a carbon tax could address greenhouse gas emissions at lower cost than any set of subsidies and standards. But even the best-designed regulatory programs have costs, as I have discussed in four previous appearances before House and Senate

Committees in the past two months. They do not create additional jobs for the economy as a whole, but they do raise energy costs and lower worker compensation and the standard of living of the average household. Ideally, environmental and climate policies will be designed so that the benefits of addressing various forms of pollution and global climate change will exceed their costs.

Energy R&D has the potential of leading to future technologies that can lower the cost of energy, but R&D has a cost as well. R&D requires both money and, more importantly, an adequate supply of qualified scientific researchers. Shifting the direction of research toward energy diverts dollars and researchers away from other fields, unless there is both a net increase in total R&D funding and additional investment in education and training.

What, then, is the purpose of programs to promote a "Green Economy?" The vast majority of "Green Economy" funding is not going to basic and applied research, it is going to loan guarantees, standards, subsidies, regulations, and tax incentives for demonstration and, mostly, deployment of current technology. Environmental regulations and climate policy already address the externalities that provide a reason for government intervention. They provide incentives for private businesses to adopt clean energy or "green" technologies and practices **when they are cost-effective** ways of complying with environmental regulations and policies, and leave them free to do otherwise when green is not cost-effective. Therefore, federal funding and standards to promote adoption of green technology are unnecessary to achieve the environmental goals that have been accepted in public policy. For the economy as a whole, these large expenditures and requirements only serve to increase the cost of achieving the goals of environmental policy by predetermining which technologies will be favored. They do, of course, increase investment in favored technologies, but they do so at the expense of investment in more

cost-effective alternatives and the consumer who always pays the bill.