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Committee on Oversight and Government Reform
Subcommittee on Regulatory Affairs, Stimulus Oversight, and Government Spending
United States House of Representatives
The Green Energy Debacle: Where Has All the Taxpayer Money Gone
November 2, 2011

Mr. Chairman and Members of the Subcommittee:

I am honored by your invitation to testify today. I am an economist and Senior Vice President of NERA Economic Consulting. I have studied energy technology programs since 1976, when I authored and testified here in the Rayburn House Office Building on a Congressional Budget Office study of synthetic fuels loan guarantees. Much 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, and I have helped to organize a series of workshops on the Green Economy that are taking place this year under the auspices of the US Council of International Business. When I returned to the Congressional Budget Office as Assistant Director, I was deeply involved in many issues relevant to this hearing because my Natural Resource and Commerce Division was responsible for analysis of Federal R&D programs and industrial policy. I have published many papers in peer-reviewed journals dealing with design and economic impacts of energy and environmental policies, 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 a Principal Lead Author of the IPCC Second Assessment Report's chapter that dealt with the costs of climate

change policy and I have led the development of a pioneering set of economic models that my colleagues and I have used in studies of virtually every major proposal for national and global climate policy. My testimony today will take a broad view of the issue of where the money for Green technology has gone. 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

The project failures and wasted money that will be discussed today are not isolated examples of improper execution of an otherwise worthwhile and potentially successful program. The entire concept of using stimulus money to create a Green Economy is unsound. To be effective, spending on energy R&D and investment incentives must be consistent and sustained over a long period of time, and projects must be put through a competitive and peer-reviewed selection process. This is exactly the opposite of what is needed in a recession, when fiscal policy experts all agree that the most effective jobs program expends funds as quickly as possible and phases out spending as the economy improves. This cycle of boom and bust is exactly what has caused the failure of past efforts to develop and deploy new energy technology, such as the Solar Initiative of the 1970s.

It is even worse when Green programs are authorized in a frenzy of spending that invites rent-seeking and political influence over the selection of projects. This process shortchanged basic

research where additional funds could be put to good use but on a slower and less politically profitable pace, and pushed funding into areas of energy technology demonstration and commercialization where the role of government should be smallest and where we have had a long history of immense failures.

The missions of the Department of Energy and the purposes of the Recovery Act are simply not consistent. Thus in some ways, it has been a good thing that, as the Inspector General's report indicates, DOE has only expended a small fraction of its allocated Recovery Act funds. The bad news is that actions taken thus far may have created a bow wave of future funding long after the need for stimulus has passed and with the same problems.

The other fundamental flaw in attempting to spend our way into a Green economy is that it creates enterprises whose continued existence demands continued infusions of government support to make up for the lack of market demand at prices sufficient to cover costs. Using taxpayer money to provide loans or loan guarantees to commercial energy projects that cannot raise capital from normal sources can only lead to waste of taxpayers' money. Projects with a high probability of producing commercial amounts of renewable energy or more energy efficient durable goods would be able to obtain private financing if their economics and management were sound. In contrast, projects that would leapfrog technology require much more than the slightly lower cost of capital offered by Government financing. This is the lesson of Solyndra, as revealed by the commentators who blame its failure on "a lack of supportive policies like a cap and trade system for carbon dioxide emissions." Loans, loan guarantees and direct funding of new energy technologies will amount to nothing more than pushing on a string unless Congress decides to put a price on carbon dioxide emissions or allows EPA to mandate adoption of those specific technologies.

Fundamental Causes of the Problems with DOE Loan Programs and Funding for Demonstration and Commercialization

The current effort to promote Green Energy is the most recent example of failed efforts at industrial policy that have recurred throughout my 35 year career in Washington. Using taxpayer money for loans or loan guarantees for commercial energy projects that cannot raise capital from the normal sources can only lead to waste of taxpayers' money. In today's sophisticated capital markets, with many energy concerns having capitalization many hundreds of times the size of the largest DOE loans and venture capitalists making aggressive investments in new technologies, the only plausible reason for inability to attract investors is that the fundamental economics or management of a project are seen to be unsound. Thus the DOE loan program either faces a huge problem of adverse selection -- any project that can make money on its own will not apply -- or it is being taken in by project developers who could finance the project and make money on their own but expect to make more money by securing the lower cost financing afforded by government loans.

There is another way of viewing the DOE loan program, and indeed the entire collection of current Recovery Act programs that provide direct funding, loans or other forms of government financial support to the production of specific forms of energy or the adoption of energy efficiency measures. They are a partial, likely ineffective, and far more costly substitute for putting a price on carbon dioxide emissions.

The Administration has attempted to justify its Green jobs and investment programs as a means of providing cost-effective environmental protection. It is exactly the opposite. Current programs to promote a Green economy actually increase the costs of achieving environmental goals, by promoting specific technologies whether or not they are the most cost-effective solutions. Well-designed environmental regulations provide incentives to choose least-cost means of compliance; tilting the playing field through loan guarantees and other forms of subsidy, if it works at all,

does so by distorting incentives so that more costly means are adopted at the taxpayers' expense.

Lack of policies to create market demand: The basic problem with the attempt to substitute front end funding or loans is that there is no sustained market demand for costly Green technology unless policymakers finally choose to put a substantial price on carbon dioxide emissions. An underlying regulatory system or market based policy such as a carbon tax must be in place unless the favored Green technologies are to be subsidized forever, like corn-based ethanol. We can see this dynamic clearly in commentary on the Solyndra affair that cites "expectations of government policies to promote solar energy" and "failure to enact comprehensive climate legislation" as reasons for the failure of the company. What this means is that there is no market at a price that will make it possible to service their loans. I by no means want to understate the importance of efforts to identify and correct the poor management that occurs when investors can gamble with the government's money, but the problem that loans cannot solve the problem of a lack of credible policy commitments to create a market demand is more fundamental.

Other reasons for up front funding: To avoid admitting this inevitable result of investing in production of uneconomic renewable energy or electric cars, a whole mythology has developed about a "valley of death," "learning by doing" and the impossibility of getting private investment to demonstrate new technologies. These justifications all share one characteristic: they are "infant industry" arguments. They all claim that if the government just puts enough money in at the start, the technology in question will be able to take off on its own and be weaned from any form of government support. The theoretical support for these claims is weak, and the empirical evidence is all negative. My first experience in testifying before the U.S. Congress was 35 years ago, when I testified on a CBO study that I had authored on "Synthetic Fuels Loan Guarantees" -- an idea that is not succeeding any better now than it did then. We have seen huge failures over the past 35 years when the U.S. government has tried to take on the role of venture capitalist in funding massive demonstration projects -- the Northern Great Plains Coal

Gasification Project, the Synthetic Fuels Corporation, and the Clinch River Breeder Reactor are probably the biggest.

It is claimed that some highly capital intensive projects will have low operating costs and therefore could continue in operation without further government support if only the initial "capital barrier" were overcome. This may be true of an individual project, but if an entire technology has this characteristic, as for example wind energy, then to get continued investment in additional capacity it will be necessary to provide continued subsidies.

Department of Defense projects: The importance of market demand for energy produced by projects grown in the hothouse by means of Federal loans and up-front funding is highlighted by comparing projects of that have taken place in the Department of Defense. Projects in DoD create their own demand, as long as the energy produced meets required technical specifications. Thus the cost of biofuels produced in projects funded by DoD does not prevent them from being used in military equipment once they are available, but the same is not true if the project has to convince independent private buyers to purchase them. The same is seen in the choice of solar arrays by the Department of the Navy, which the DoD Inspector General criticized for failing to examine the economics and cost of alternatives.[1] The Navy can install those solar arrays as long as there is sufficient Recovery Act funding to pay for them, but in the real economy solar arrays have to compete with other renewable energy sources, not to mention traditional ones. Thus the DoD experience tells us nothing about how to stimulate greater innovation and deployment of technologies in the economy as a whole.

Federal support for basic R&D falls into an entirely different category than loans and spending to promote adoption of current renewable energy and energy efficiency technologies. Basic and applied research is where the need for government intervention is greatest and where the U.S. government now allocates the smallest part of the Energy R&D budget. The use of Recovery Act

[1] Office of the Inspector General, Department of Defense, "The Department of the Navy Spent Recovery Act Funds on Photovoltaic Projects That Were Not Cost-Effective" Report No. D-2011-106 September 22, 2011.

funding to promote green technology is short-changing basic and applied research and instead supporting demonstration and deployment of excessively costly current technology.

Providing needed stimulus to the economy is the third reason given to justify Recovery Act funding of DOE R&D projects and support for commercial applications. This is where the DOE programs are particularly unsuitable. The effort to move hundreds of billions of dollars into "shovel ready" energy projects was, as Inspector General Friedman has described clearly, was wide open to waste and abuse. As he has testified, the Department of Energy had nothing like the capacity to select, fund and manage the amount of money it was given in the Recovery Act and there was nothing like a sufficient number of projects ready to fund.

I would put the basic problem more broadly: The missions of the Department of Energy and the purposes of the Recovery Act are not consistent. To be effective, spending on energy R&D and investment incentives must be consistent and sustained over a long period of time. This is exactly the opposite of what is needed in a recession, where fiscal policy experts all agree that the most effective jobs program spends the funds allocated to job creation as quickly as possible and phases out the funding as the economy improves. If possible, job creation should also provide needed services or infrastructure *if* those programs can be ramped up and down without harm – which of course energy technology development cannot.

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," which, simply put, is a catchall term for the types of 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 Recovery Act programs have 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 to a smaller fraction of the investment as projects move toward large scale demonstration.[2]

A new rationale for replacing private investment with government funding has appeared recently, which is the claim that businesses are sitting on large amounts of retained earnings and refusing to invest in projects that should, by someone's standards, be profitable at current interest rates. This claim can be used to rationalize just about any incursion of government into what are

[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.

normally the realms of private business, be it R&D or commercial production of energy, but it fails to inquire whether doing so will just make the problem worse. It is at least equally plausible that greatly expanded regulatory programs affecting the financial sector and labor markets and uncertainties about future tax burdens and environmental regulations are making the risks of any kind of investment higher and the costs lower. Policies that expand the role of government even further into the economy will so increase the political risk of investing in the U.S. as to make the claim a self-fulfilling prophecy.

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 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

[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.

> 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.

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

It is worth commenting that Solyndra does not appear to have any characteristics of an "informative failure." Those occur early in the R&D process, and help to weed out technical approaches that appeared good on paper but could not meet cost or performance goals. The whole point of parallel research is to find that out before $500 million or more is invested in commercial production.

But the parallel process is rarely seen in Federal energy R&D. One reason is that managers do not want failures on their record, even if "failures" are important sources of information in a strategy of forming a portfolio of high risk, high potential payoff projects. Another is that Members of Congress will not allow funding to projects under their protection to be terminated, no matter how soundly the project fails to meet its objectives.

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. Short term stimulus and long term investment incentives are not compatible objectives.

Environmental and other externalities of energy production and use

Another rationale for loans and direct funding to energy technology demonstration and commercialization 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 the most effective policy to stimulate innovation and deployment of new technologies is putting a price on CO2 emissions in a sustainable manner that can be reliably expected to remain in place for decades to come. Such a price 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.

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. Economists differ seriously about the best strategy to pursue to address an economic downturn like the one we have faced. All agree that monetary policy in some form is necessary, but many are critical of using fiscal policy (i.e. 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 the specific fiscal measures that end up being selected 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.

There are also good reasons why the basic and applied research programs of DOE cannot be ramped up completely. This delay is built into the system of funding basic and applied research in order to assure the quality and relevance of research. There is not a reserve army of the best-qualified researchers in the world drawing unemployment and waiting for funding for energy R&D to increase. To increase the amount of work being done on energy R&D, those researchers have to be drawn away from other fields. New projects will have to go through a sequence of requests for proposals, proposal writing, review -- including peer review if a good outcome is expected --negotiation and finally funding. All these steps are there to make sure that R&D funding goes to the best qualified researchers and to projects that are relevant to the problem at hand. Sacrificing these steps to shovel out money subverts the entire process.

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

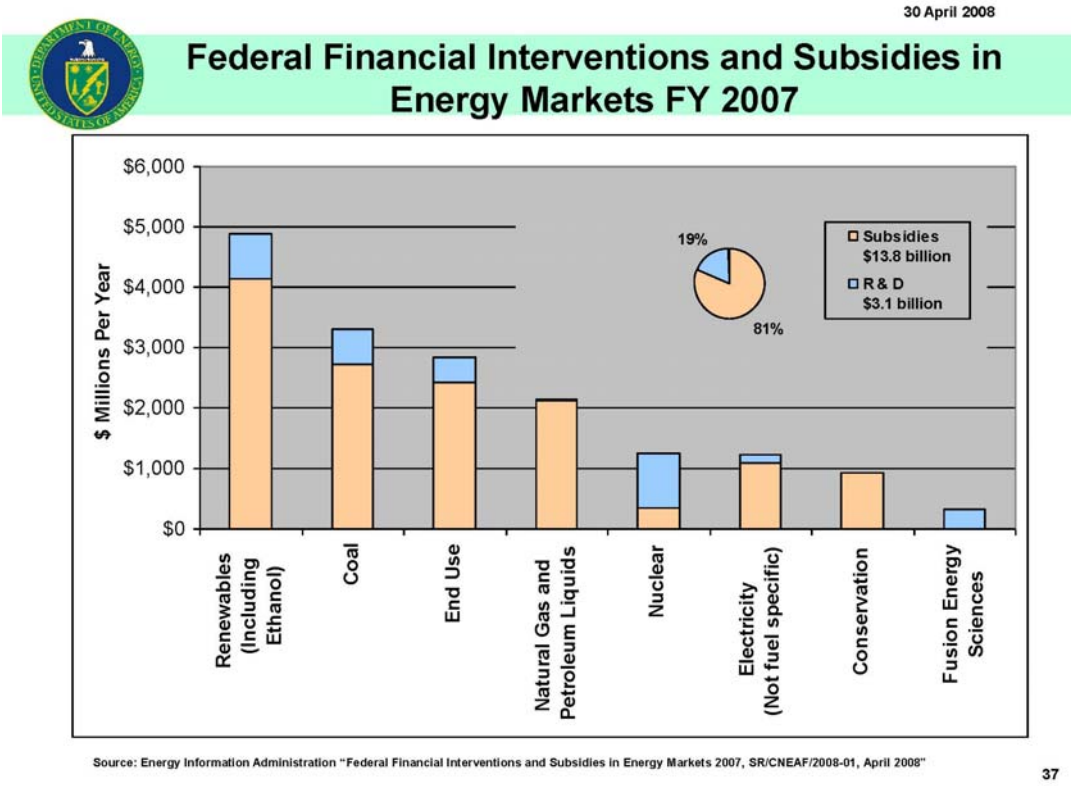
	Basic research	Applied research	Development	Total*
Industry	5%	20%	76%	$223.4B
Government	59%	33%	16%	$94.2B
Total	$61.5B	$74.7B	$204.3B	$340.4B
Energy R&D In Stimulus Package**	17%		83%	$7.9B

*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.[4] 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 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

[4] 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.

> 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.[5]

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).

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.

[5] Newell, ibid.

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.

These characteristics are found in the Recovery Act projects that are the subject of this hearing. The history of energy R&D suggests that they were likely from the beginning to be ineffective in promoting technological advance and to lead to waste of taxpayer's resources.