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Citation

Aldy, Joseph. 2011. A Preliminary Review of the American Recovery and Reinvestment Act's Clean Energy Package. HKS Faculty Research Working Paper Series RWP11-048, John F. Kennedy School of Government, Harvard University

Published Version

<http://web.hks.harvard.edu/publications/workingpapers/citation.aspx?PubId=8116>

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Faculty Research Working Paper Series

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Harvard Kennedy School

December 2011

RWP11-048

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A Preliminary Review of the American Recovery and Reinvestment Act's Clean Energy Package¹

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December 2011 Draft

Introduction

In December 2007, the U.S. economy began contracting and over the course of the following year, economic conditions deteriorated to an extent unseen in America since the 1930s. Between the start of the recession and February 2009, the economy lost about 4.6 million jobs (BLS 2011). Gross domestic product experienced a greater percentage decline over the fourth quarter of 2008 and the first quarter of 2009 than any six-month period since the late 1940s (BEA 2011). Bond markets revealed expectations of default for nearly four in ten investment grade corporate bonds (Summers 2009). By February 2009, consumer confidence had fallen to the lowest level recorded in the four-plus decades of surveying American consumers (Rooney 2009).

To stimulate the U.S. economy and provide a robust foundation for long-term economic growth, the American Recovery and Reinvestment Act of 2009 ("Recovery Act") provided a wide array of policy instruments. A payroll tax rebate increased household disposable income. An unemployment insurance extension targeted the most vulnerable. Bonus depreciation for new investment stimulated near-term business activity. State fiscal relief mitigated the contractionary nature of state balanced budget laws. To put the economy on a better footing for long-term growth, the Recovery Act made strategic investments in clean energy, education, and health care. The Recovery Act's stimulus equaled about

¹ This paper was written for the *Review of Environmental Economics and Policy*. The author served on the 2008-2009 Presidential Transition Team and as the Special Assistant to the President for Energy and Environment at the White House in 2009 and 2010. Kevin Carroll, Jud Jaffe, Matt Kahn, Lori Krauss, Jeff Liebman, Alex Mas, and Billy Pizer provided helpful comments on an earlier draft.

5.5% of GDP over 2+ years and represented the “boldest countercyclical fiscal action in American history” (CEA 2009, p. 1). The Recovery Act included more than \$90 billion in strategic clean energy investments intended to promote job creation and promote deployment of low-carbon technologies (CEA 2010a; Figure 1). In terms of spending, the clean energy package has been described as the nation’s “biggest energy bill in history” (New York Times 2009).

The strategic stimulus investment in clean energy served as the Administration’s first major step in implementing President Obama’s approach to advancing energy and climate policy. The short-term supply-side support for clean energy technologies made a significant down payment on the energy investment necessary to cut greenhouse gas emissions and reduce reliance on oil. The second step focused on ramping up R&D, through annual budgets and the Recovery Act, to improve the scientific foundation for new energy technologies. These first two steps complemented the President’s proposal for an economy-wide cap-and-trade regime to cut greenhouse gas emissions more than 80% by 2050 and finance R&D and lower effective labor taxes through allowance auctions (Office of Management and Budget [OMB] 2009).

The Recovery Act represented an unprecedented investment in clean energy; in comparison, the Clinton Administration proposed a Climate Change Technology Initiative with \$6.3 billion spread over five years. The Recovery Act’s \$90 billion in clean energy spending leveraged more than \$100 billion in private capital for investments in manufacturing, power generation, and the residential and commercial building sectors to advance the deployment of energy efficiency, wind, solar, geothermal, biomass, low-carbon fossil fuel, and other technologies. Tailoring of policies to the challenges posed by the financial crisis drove investment in renewable power. Extending tax credits and providing grants for wind power generation resulted in a 60% increase in wind capacity in two years – an investment three times greater than forecast without the Recovery Act. In contrast, energy loan guarantees have not had a meaningful impact on the power sector and are neither sufficient nor necessary to mobilize renewable investment.

To provide a preliminary assessment of the Recovery Act's clean energy package, this paper reviews the rationale, design, and implementation of the act. The first section surveys the policy principles for clean energy stimulus. The second section describes the process of crafting the clean energy package during the 2008-2009 Presidential Transition. The third section identifies the key elements of the Recovery Act's clean energy package. Then, the paper reviews the initial employment, economic activity, and energy outcomes associated with these energy investments. The fifth section provides a more detailed case study on the Recovery Act's support for renewable power through grants and loan guarantees. The final section concludes with lessons learned.

1. Policy Principles for Clean Energy Stimulus

Larry Summers spoke of the economic conditions that necessitated fiscal stimulus:

“Our policy approach started with a major commitment to fiscal stimulus. Economists in recent years have become skeptical about discretionary fiscal policy and have regarded monetary policy as a better tool for short-term stabilization. Our judgment, however, was that in a liquidity trap-type scenario of zero interest rates, a dysfunctional financial system, and expectations of protracted contraction, the results of monetary policy were highly uncertain whereas fiscal policy was likely to be potent” (Summers 2009).

Given weak aggregate demand and the already aggressive use of monetary policy tools, many economists considered the case for fiscal stimulus to be strong (Feldstein 2008; Stone and Cox 2008).

A well-designed fiscal stimulus aims to increase near-term economic output to make up at least some of the output gap without accelerating inflation. By increasing aggregate demand in the short-term through deficit spending, the government tries to shift some consumption and investment from the future, when the economy is expected to be closer to full utilization of its resources than the current

time period. Given this objective for fiscal stimulus, several policy principles can inform the design of a stimulus package.

A number of economists recommended “timely, targeted, and temporary” fiscal stimulus (the “3 Ts”; Summers 2008, Bernanke 2008, Stone and Cox 2008, Elmendorf and Furman 2008).² A timely package pumps resources into the economy when it is most in need, i.e., when there is a large output gap. A timely stimulus would have ideally begun in 2008 and legislative enactment likely represented the most significant “avoidable delay” for fiscal stimulus (Auerbach et al. 2010).

A targeted package directs resources to the economy in a way that maximizes the stimulus bang for the buck. Those most adversely impacted by the recession are likely to benefit more from a given stimulus dollar and have a higher marginal propensity to consume, which increases the effective multiplier for that stimulus dollar. The Congressional Budget Office (CBO) Recovery Act assessment showed that government purchase of goods and services (e.g., many components of the clean energy package), has the highest estimated GDP multipliers, followed closely by transfers to state and local governments (e.g., highway construction) and transfers to individuals (e.g., unemployment insurance), while tax cuts yield lower multipliers because some of the untaxed income is saved for future consumption (CBO 2009).

A temporary package reduces the risk that the stimulus pulse becomes a long-term increase in deficit spending. The perception of permanent larger future deficits could weaken business confidence and potentially increase long-term interest rates, which would counter the stimulus package’s intended effect in promoting economic activity (Summers 2008).

In addition to the 3-T principles for crafting fiscal stimulus generally, the design of a clean energy package should reflect policy principles specific to the objectives of the clean energy agenda.

Investments in clean energy should target various externalities, in particular, carbon dioxide (CO₂)

² Summers (2009) revised his stimulus principles to “speedy, substantial, and sustained” in light of the policy delay in 2008 and the depth and breadth of the recession.

emissions. While subsidies for zero-emitting sources and associated technology are not as efficient as taxing the emitting sources (Metcalf 2009b), the obvious policy constraint of a stimulus package focuses attention on subsidies. The public policy need to promote innovation due to the public good nature of knowledge suggests consideration of orienting stimulus funds to R&D as well. Effective targeting of subsidies to externalities requires the government to minimize resources for those projects that would have happened without public support (i.e., inframarginal subsidies) and resources for those projects that should never have happened (i.e., subsidies for projects that will very likely fail even with public support). Promoting a long-term transformation to a less polluting, more diverse and therefore more robust, energy economy also strengthens the foundation for long-term economic growth.

The challenge in crafting an effective fiscal stimulus reflects the effort necessary to weight these various principles. Some clean energy investments can be timely, substantial, and mitigate pollution externalities (e.g., grants for renewable power projects). Some clean energy investments, while substantial and combat climate change, would risk being neither timely nor temporary (e.g., nuclear power plant projects have licensing and construction timeframes on the order of a decade). In late January 2009, the Administration called on Congress to complete a stimulus package that would spend out 75% of the stimulus funds within 18 months (effectively by the end of Fiscal Year 2010). For some programs, this trade-off manifest in a longer “tail” for clean energy spending, i.e., stimulus activities occurring 18 months or more after passage of the Recovery Act, and for some others it meant exclusion from the stimulus package. In concert, these principles guided the design of the Recovery Act’s clean energy package such that it focused on investments that could drive job creation and economic activity, while reducing carbon pollution.

2. Crafting the Clean Energy Package

Given the state of the U.S. economy in Fall 2008, it became evident that a significant stimulus bill would be a high priority for the next Administration. The weekend after the 2008 election, the energy and environmental policy group met as the formal Presidential Transition Team launched, and we began working on economic stimulus, near-term executive actions and decisions, and legislative priorities.

President Obama decided that the economic recovery proposal should include strategic investments in clean energy. The question then turned to the necessary size of the overall stimulus proposal and the size and composition of the clean energy package. Over the course of the Fall of 2008, the depth and breadth of the economic recession and our understanding of what could constitute an appropriately-sized stimulus evolved. In October, public statements for stimulus called for legislation on the order of \$150-\$300 billion (Smith and Ferraro 2008; Feldstein 2008). By the end of the 2008, some economists called for a trillion-dollar stimulus bill (Kinsley 2008; Krugman 2009). The changing headline figure for the size of the stimulus posed a challenge of scaling up some policy options and identifying a larger set of investments that could deliver well-targeted boosts to aggregate demand.

Within the context of this moving target, policy teams worked together during the Presidential Transition in an analogous manner to the post-inauguration White House policy process. The economic team, what would become the National Economic Council, coordinated the efforts to compile, review, and integrate ideas for economic stimulus, and worked closely with the “shadow” OMB team on traditional stimulus measures. The Transition policy working groups that evolved into the Domestic Policy Council, the Office of Health Reform, and the Office of Energy and Climate Change took the lead on education, health care, and clean energy packages. Shadow OMB and Treasury teams worked with the policy working groups to score and evaluate authorities for various proposed investments and tax

expenditures. A shadow Council of Economic Advisers (CEA) team analyzed the proposals in terms of employment and economic activity.³

The energy and environmental working group evaluated a large number of policy proposals for economic stimulus. We identified campaign proposals that could be mobilized quickly. For example, extending the renewable power production tax credit, increasing the weatherization of low-income homes, ramping up energy R&D, advancing smart grid technology, and supporting clean coal technology reflected positions President Obama took during the campaign. We received many unsolicited ideas from NGOs, businesses, trade associations, academics, and private citizens. Several think tanks published their stimulus ideas (e.g., Hendricks and Goldstein 2008). During the Transition, we held many meetings with energy, environmental, and financial stakeholders to identify the areas of greatest need and ways to effectively address those needs.

In our assessment of stimulus proposals, we asked a variety of questions motivated by our stimulus policy principles. Are the projects “shovel ready?” Do implementing agencies have the staff, experience, and capacity to deploy new resources effectively and promptly, or should the Act enhance agency capacity? Will a ramp up of Federal support leverage private financing? Can the policies be implemented through existing authorities, or do we need new legislative authorities? Are these earmarks (which the President opposed)? How much bang for the buck, in terms of employment, economic activity, and changes in the energy system, are we getting? Do these policies reduce CO2 emissions?

As the economist on the Transition Team’s energy and environmental working group, I served as the liaison with the shadow economic agencies. This role involved undertaking the initial economic and budgetary vet of all ideas that came to our working group before we decided whether to run them by the appropriate shadow economic team staff. This evolved into an iterative process, especially with the

³ CEA employed a common framework to estimate employment impacts across proposed Recovery Act policies and served as the sole jobs scorekeeper for the Transition Team.

shadow OMB, as we would discuss how to map a given energy investment objective to a policy instrument and an existing authority (or identify the need for a new authority), assess the quarterly spend-out rate, and then score the potential appropriation. As a reflection of how quickly the stimulus target moved during this time, in one meeting with the shadow OMB, I was informed that “we were not spending enough” on the clean energy package, which at that time was smaller than the final version in the Recovery Act.⁴

In December 2008, Transition Team staff began to brief Congressional staff on initial details of the envisioned Recovery Act. We provided an overview of the clean energy package about a week before Christmas and subsequent staff-level negotiations continued over the next four weeks or so with energy and environmental appropriators and authorizers on spending provisions and Finance and Ways and Means staff on energy-related tax provisions. In our initial briefing for Congressional staff, we identified four thematic elements with specific policy highlights for the clean energy package:

- Efficiency: reducing government energy consumption through building retrofits; residential weatherization; state block grants;
- The Grid: deploying smart grid technology; enhancing transmission capacity in the Western Area Power Administration (WAPA);
- Transportation: supporting car battery manufacturing; investing in mass transit; accelerating replacement/retrofits of heavy-duty diesel engines; and,
- Clean Energy: promoting renewable power through production tax credits and loan guarantees; demonstrating carbon capture technology at coal plants.

The January staff-level negotiations included several long, intense meetings as we went through every detail of the proposed clean energy package. In this productive back-and-forth, we discussed

⁴ I have found no written evidence that any OMB official or staffer has ever uttered these words in the past.

policy priorities, spending levels, the applicability of existing authorities, and the need to draft new authorities. The general approach, energy priorities, and many specific proposals included in our initial December presentation were reflected in the clean energy package of the Recovery Act signed into law. The staff from the authorizing committees identified provisions in the 2005 and 2007 energy bills that we could employ and/or modify to achieve several of our policy priorities. In the case of the energy loan guarantee program, we worked with Hill staff to expand the program to support conventional renewable technologies in addition to innovative technologies covered by the existing section 1703 program. In some cases, we had an extensive discussion on the feasibility of spending a given level of resources on specific programs in a prompt manner. For example, appropriators raised questions about the rate of spend-out in a ramped-up weatherization program (which did spend out slowly in 2009). On some issues, Hill staff recommended alternative existing authorities to meet our desired policy priority. For example, in lieu of channeling all state energy monies through the State Energy Program, we agreed to split funding between this program and the Energy Efficiency and Conservation Block Grant program, which could deliver monies directly to local entities and set aside some funds for competitive grant purposes.

While the enacted version of the Recovery Act reflected our four major energy themes of efficiency, transportation, the grid, and clean energy, the grid-related stimulus provisions involved significant work with Congressional staff. Per the suggestion of Hill staff, we used, with some modifications, the smart grid provisions in Title XIII of the 2007 energy bill to advance the smart grid proposal. Some renewable power advocates in the stakeholder community called for an “interstate transmission highway system” of electricity transmission to enable remote renewable power resources to be brought to market (e.g., AWEA 2008). While some likened this investment in transmission to the investment in the Eisenhower interstate highway system, there are some fundamental differences that are important in the stimulus context. Unlike freeways, which rely almost exclusively on public

financing, transmission has a well-established history of private financing with regulated economic returns through the setting of transmission fees on consumers' utility bills. For those regions in which public financing is relevant, as a result of the presence of Federal power marketing administrations, we worked to enhance the borrowing authority for WAPA and Bonneville to increase transmission capacity. Expanding the transmission system is constrained much more by siting (NIMBY) and cost-allocation issues than it is about the availability of financing. Thus, increasing monies for transmission may not necessarily overcome these non-financial constraints, and certainly not in a relatively short stimulus timeframe. While we discussed various ways in which Federal funds could be used to drive innovative thinking among states to resolve siting and cost-allocation issues, the lack of an existing legislative authority and the absence of a consensus around the design and effectiveness of such an idea rendered it moot.

The House of Representatives introduced H.R. 1, the American Recovery and Reinvestment Act of 2009, on January 26 and passed the bill on January 28. About two weeks later, after principal-level negotiations with the Senate resulted in a smaller bill, the House and the Senate passed the conferenced version of the bill, and President Obama signed the Recovery Act into law on February 17, 2009.

3. Elements of the Clean Energy Package

The Recovery Act provided more than \$90 billion in public spending and tax expenditures in support of clean energy activities (CEA 2010a). Support for renewable power generation exceeded \$25 billion and appropriations and tax expenditures dedicated to energy efficiency investments were nearly \$20 billion (Figure 1). Financing for transportation activities, including high-speed rail and mass transit (\$18.1 billion) and advanced vehicles, fuels, and battery technologies (\$6.1 billion), amounted to about \$24 billion. Grid modernization appropriations for smart grid deployment and borrowing authority for two power marketing administrations to finance transmission capacity topped \$10 billion. The

remaining funding for clean energy targeted carbon capture and storage technologies, job training, and clean energy manufacturing. The Recovery Act clean energy package employed a variety of policy instruments to promote the deployment of new technologies, including grants, tax credits, subsidized bonds, R&D, etc. (Table 1).

The significant resources put new demands on a number of government agencies. In particular, the Department of Energy received Recovery Act appropriations for clean energy activities in excess of \$35 billion, which is more than triple the Department's Fiscal Year 2009 appropriation focused on civilian energy (i.e., excluding national defense-related activities and clean-up of Cold War era facilities). The focus on commercial technology deployment also required a reorientation of a department traditionally focused on science, applied research, and demonstration projects.

Some of the Recovery Act activities encountered delays and obstacles to prompt implementation. For example, competitive grant programs required time to draft Funding Opportunity Announcements, time for applicants to submit funding applications, and time for agency staff to evaluate applications and make grant decisions. The Recovery Act also included transparency provisions that demanded enhanced reporting and communication by implementing agencies and recipients of Recovery Act funds. While these provisions are critically important for accountability and evaluation of the effectiveness of Recovery Act programs, they also require time and resources to implement well.⁵ Some Recovery Act programs, such as the State Energy Program, operate through the states, and the relevant staffing in a number of states had been cut prior to enactment of the Recovery Act as these states addressed their budget problems. The Recovery Act applied Davis-Bacon labor compensation rules to the Weatherization Assistance Program, which operates through state and local agencies. These rules require contractors and subcontractors to be paid local, prevailing wages, which

⁵ The websites www.recovery.gov and energy.gov/recovery-act provide extensive data on Recovery Act implementation, including some data on outcomes that could inform future research.

necessitates a formal determination of the local, prevailing wage. This process delayed the roll-out of weatherization funds until the Fall of 2009.

4. Initial Impacts of the Recovery Act and Clean Energy Package⁶

The Recovery Act represented the largest economic stimulus in U.S. history. Through the end of 2010, the Federal government made about \$350 billion in spending outlays, \$260 billion in tax reductions, and obligated another \$125 billion of spending. The level of economic activity was 2.3 to 3.2% higher at the end of 2010 than it would have been in the absence of the Recovery Act according to the Council of Economic Advisers (CEA 2011). Independent analyses estimate that the Recovery Act increased the level of economic activity in this range, with some private sector estimates as high as 3.1%, and the high-end CBO forecast at 3.6% (CEA 2011). Employment levels were about 2.5 to 3.5 million higher at the end of 2010 than they would be in the absence of the Recovery Act according to CEA. CBO and private sector forecasts yield a very similar range as well (CEA 2011).

The clean energy package plays an important role in the Recovery Act's job creation. CEA (2010a) estimated that the entire clean energy package would support about 720,000 job-years through the end of 2012, representing about 10% of Recovery Act's 2009-2012 employment impact. Not surprisingly, the largest sources of job creation in clean energy are in renewable energy, energy efficiency, and transit, the categories of activity that received the largest share of stimulus funds (Table 2).

The Recovery Act leveraged significant "co-investment" from the private sector, state and local governments, and non-profits and universities. In the CEA (2010b) review of leveraging through the Recovery Act, about \$46 billion in clean energy investments leveraged more than \$100 billion in private

⁶ This preliminary Recovery Act assessment runs through December 2010.

sector and non-Federal government clean energy spending. This represents more than 37% of all leveraged co-investment identified in the Recovery Act by CEA.

The leveraging of non-Federal resources for clean energy investment takes several forms. Department of Energy cost-sharing grants for smart grid projects mobilized more than \$4.5 billion of co-investment from a \$3.4 billion Recovery Act expenditure. The Recovery Act's clean energy manufacturing tax credit, with a total tax expenditure cap of \$2.3 billion, supported 183 manufacturing facilities with a co-investment of as much as \$5.4 billion.⁷ Clean Renewable Energy Bonds, by providing interest subsidies through the tax code, leverage investment in renewable power for public and quasi-public utilities.

These energy investments have begun to drive changes in the energy system. The Weatherization Assistance Program encountered some initial delays, but the program weatherized nearly 300,000 homes in 2010 (triple the annual average over 2003-2007), and the Department of Energy expects to weatherize approximately 600,000 homes with Recovery Act funding.⁸ The Act increased the per residence spending cap from \$2,500 to \$6,500 to account for changes in material costs over time and to provide resources for more extensive energy efficiency improvements. While a variety of engineering-based studies suggest that the weatherization program's efficiency improvements could meaningfully reduce energy consumption and energy bills, additional economic research could better estimate the potential energy-related benefits of the weatherization program.

President Obama set an ambitious goal to double non-hydroelectric renewable power generating capacity within three years based on the Recovery Act.⁹ The EIA (2009) "no stimulus" reference case forecast wind capacity to grow from about 25,000 megawatts in 2008 to 29,300

⁷ Department of Energy Press Release. "Fact Sheet: \$2.3 Billion in New Clean Energy Manufacturing Tax Credits," January 8, 2010.

⁸ Department of Energy Press Release. "Secretary Chu Announces Major New Recovery Act Milestone: 300,000 Homes Weatherized," January 19, 2011.

⁹ President-Elect Obama's Speech on American Recovery and Reinvestment, January 8, 2009, http://change.gov/newsroom/entry/dramatic_action/, accessed August 8, 2011.

megawatts in 2010 and reach 40,000 megawatts no sooner than 2030. The Recovery Act promoted renewable power through tax credits, grants, loan guarantees, and accelerated depreciation. By the end of 2010, U.S. wind generating capacity increased about 60% over two years to 40,000 megawatts, tripling the investment forecast under business as usual (Figure 2). Wind power generation increased from 55 billion kilowatt hours in 2008 to 95 billion kilowatt hours in 2010 and is forecast to exceed 115 billion kilowatt hours in 2011 (EIA 2011). Likewise, grid-connected photovoltaic solar power capacity in 2010 is triple end-of-2008 capacity, and double the amount of growth in solar capacity forecast in the “no stimulus” reference case (Figure 3; EIA 2009).

In addition to the objective of spurring job creation, the clean energy package focused on investments that would reduce CO₂ emissions. While total power generation in 2010 was nearly identical to generation in 2008 (EIA 2010, 2011), 2010 power sector CO₂ emissions fell nearly 4.5% below 2008 levels (6% below 2005 levels).¹⁰ Some of this decline reflected coal-to-gas fuel switching, but total fossil fuel power generation declined 1.6% reflecting the increasing share of renewable power over this two-year period.¹¹ The increasing share of renewable power reduced power sector emissions by about 2%, representing 43 MMTCO₂ fewer emissions in 2010.

5. Case Study: Promoting Investment in Renewable Power

The Recovery Act dedicated the largest share of the clean energy package to support renewable power generation. This section describes and compares the design and performance of the two primary Recovery Act policies focused on promoting renewable power: the 1603 grant program and the 1705 loan guarantee program.

¹⁰ The author estimated 2010 power sector CO₂ emissions based on reported 2010 power generation by fuel type and 2009 average CO₂ intensity by fuel type.

¹¹ Nuclear power generation was virtually unchanged over 2008-2010.

The prospects for renewable power investment in late 2008 were poor due to three market obstacles. First, project developers faced uncertainty regarding the status of the production tax credit (PTC) for wind, geothermal, and most other forms of renewable power and the investment tax credit (ITC) for solar power projects that were set to expire on December 31, 2008. In October 2008, these tax credits were extended for one year for wind, for two years for most other renewables, and for seven years for solar. While the PTC has subsidized wind power since 1992, the three occasions in the 2000s when the credit lapsed, investment in new wind generating capacity collapsed (Metcalf 2009a). The PTC provides a tax credit of 2.2¢/kWh of wind generation for the first ten years of a facility's operation.¹² Solar projects are eligible for an ITC that is equal in value to as much as 30% of investment costs. The one-year extension in late 2008 provided the wind industry a brief reprieve, but it would not spur much new investment in projects with year-plus development cycles.

The second investment obstacle reflected the challenge project developers faced in taking advantage of tax credits. A start-up company, a foreign corporation, or other businesses with little income tax liability necessary to claim tax credits would go to the "tax equity" market in order to use a PTC or ITC. Raising tax equity involved entering into a financial partnership with a passive partner that provides equity and in return would claim the tax credits, accelerated depreciation benefits, and other tax benefits against its taxable income. Given the size of the required income tax liability, large financial corporations (e.g., AIG and Lehman Brothers) typically provided tax equity to renewable project developers. During the financial crisis, the number of tax equity suppliers and the amount of tax equity fell by more than half (U.S. PREF 2010), while the cost of tax equity to project developers, reflected by the return on tax equity paid to the supplier, increased from about 7% to 15% (Schwabe et al. 2009). Thus, a tax credit extension could have had a very limited impact on renewable investment in a shrinking tax equity market.

¹² The PTC is indexed to inflation. It is lower for some other types of renewable power.

The third investment obstacle was the tightening credit market. In meetings during the Presidential Transition, several project developers claimed that they could not raise new project debt for conventional wind farm development. The question is whether this reflected: (a) general credit tightening across the economy that could be addressed through Federal Reserve or Treasury (TARP) operations; (b) the shrinking tax equity market; or (c) lender risk aversion specific to large, long-tenor projects, such as power plants.

In response to these economic challenges, the Recovery Act extended the PTC for three years and created two new programs to spur renewable power investment: the 1603 grant program and the 1705 loan guarantee program. The 1603 grant represented a subsidy for investment in new renewable generation capacity. Under the Recovery Act, a developer for a PTC-eligible project could choose among the PTC, a 30% ITC, or a 1603 cash grant equal to 30% of investment costs (and solar developers could choose between the ITC and a 1603 cash grant).

The Recovery Act's 1705 loan guarantee program represented a modification of the existing section 1703 energy loan guarantee program created in 2005. The new program supported conventional renewable power, transmission, and biofuel projects, as well as innovative technologies eligible for loan guarantees under the 1703 program. The Recovery Act appropriated \$6 billion to the 1705 program so that the Federal government would pay for the credit subsidy associated with loan guarantees.¹³ By providing loan guarantees, this program could make debt capital available and lower the costs of debt for commercial renewable project developers.

The 1603 grant and related tax credit extensions have been successful on several dimensions. First, the extension of the tax credits enabled longer-term planning by removing uncertainty about Federal support.

¹³ After Congressional rescissions in June 2009 and August 2010, the 1705 program had \$2.5 billion in appropriations.

Second, thousands of renewable power projects entered into service and claimed the grant in 2009 and 2010 (Table 3). The 1603 grant program supported investment in every state and enabled nearly 12,500 megawatts of capacity. In contrast, the 1705 loan guarantee program closed on only eight projects through December 31, 2010; four of these focused on renewable power generation (the balance are for manufacturing facilities and energy storage). The 1705 loan guarantee program did not close on any deals on renewable power generation in 2009, when wind investment experienced its best year to date. Renewable project sponsors that have a conditional commitment or a closed deal for a 1705 loan guarantee are expected to claim a 1603 grant or an underlying tax credit.

Third, the 1603 grant program processes applications with a lean administrative team in a timely and transparent manner. With a small team of Treasury and Energy staff (Table 3),¹⁴ the 1603 grant program typically makes decisions on grant applications within four to six weeks, and is required to do so legally within 60 days of receipt of an application (Martin. et al 2009). In contrast, the 1705 program involves many more staff and takes six months or more to evaluate and work with a project developer before reaching a loan guarantee decision. This difference in timing reflects fundamental differences in the approaches of these two policies. The 1603 grant program confirms that a given project qualifies for a grant – i.e., it employs an eligible renewable technology and that it has entered into service – and then awards a grant. In the 1705 loan guarantee program, the government effectively becomes another financial partner in a project and the staff must negotiate extensive term sheets with project sponsors. Many issues can complicate this effort – e.g., local, state, and Federal permitting and licensing reviews, finalizing engineering, procurement, and construction contracts, status of long-term power purchase agreements, lifetime project monitoring, etc. – that are by definition resolved when a project enters into service and can be considered for a 1603 grant.

¹⁴ While Treasury administers the 1603 grant program, the Department of Energy assists Treasury in reviewing applications.

Fourth, the 1603 grant served as an important way to address the problems posed by the shrinking tax equity market. Since renewable project developers did not need to turn to financial firms to monetize tax credits,¹⁵ the 1603 grant enabled incremental investment that would have otherwise been constrained by the tax equity market. In an assessment of every wind project that applied for the 1603 grant in 2009, Bollinger et al. (2010) estimate that about 2,400 megawatts of wind capacity came online as a direct result of the 1603 grant option for project developers, representing about one-quarter of the 2009 wind capacity investment. Some project developers chose the PTC, especially those with taxable income and for wind projects expected to operate with a high capacity factor (Martin et al. 2009, Bollinger et al. 2009).

From a budget-scoring perspective, the incremental cost of a grant option relative to the underlying PTC and ITC was only \$5 million over 10 years (Joint Committee on Taxation 2009). Interestingly, given the higher than expected rate of 1603 grant take-up in 2009 and 2010, the Joint Committee on Taxation (JCT 2010) scored a 1-year extension of 1603 at about \$3 billion cost in addition to the PTC already extended by the Recovery Act. JCT's 2010 reassessment suggests that the 1603 grant program targets marginal investment in renewable power that would not occur if project developers had to seek out a tax equity partner.

In contrast, the 1705 loan guarantee program has not had a meaningful impact on the U.S. power sector. The pipeline of quality renewable power projects in the 1705 program did not materialize, and the program has focused its efforts on a small number of large wind and solar projects. A failure to elaborate explicit loan guarantee program energy and investment policies that would inform priority setting in case-by-case review of applications has also undermined program effectiveness. The loan guarantee program also poses long-term fiscal risk to the Federal government, especially if project defaults in the future occur with a greater frequency or with less recoverable value than currently

¹⁵ Developers may still need a tax equity partner to maximize the value of accelerated depreciation and, if eligible, bonus depreciation.

expected and thus exceed the resources set aside under the Recovery Act to guarantee the 1705 program project debt.¹⁶ While the 1603 grant and underlying tax credits were necessary for renewable generation investment, the loan guarantees were not sufficient and do not appear to be necessary for the vast majority of renewable generation projects.

In light of the multiple instruments promoting renewable power, the total financial support result from government policies per ton of CO₂ abated can inform assessments of the economic efficiency of the sum of renewable policies. The share of a project financed by taxpayers or ratepayers (through higher electricity rates under a state renewable electricity standard) would likely exceed 60% for renewable projects receiving tax benefits, grants, loan guarantees, and above-market rates due to state renewable mandates. This raises questions about the efficiency and the bang-for-the-buck of renewable-related promotion policies that further research should explore.

The investment tax credit and 1603 grant covers 30% of the investment costs (and if a developer opts for the PTC instead of the ITC or grant, then it likely expects present value benefits of the PTC to exceed 30% of investment cost). Accelerated depreciation benefits could amount to as much as 10% of project costs. The average subsidy under the 1705 loan guarantee program is assumed to be 14% (OMB 2011). The value of state renewable electricity standards varies significantly across the nation. For example, the Shepherds Flat, Oregon wind farm secured an above-market rate for selling into the California market equal to about 10% of project cost (Memorandum to the President 2010). Some states have much higher tradable renewable electricity credit prices (e.g., Northeast credits trade near \$60/MWh) and the implicit subsidy from a state renewable mandate could be well above 10%. The effective cost per ton of CO₂ abated will vary with the emission intensity of the power generation displaced by the new renewable source. The government estimated that the cost per ton abated for selling wind power from Shepherds Flat into California would be about \$130 per ton of CO₂, about four

¹⁶ The Federal government's track record with energy credit programs, such as with the Rural Utility Service losses associated with nuclear power plant projects, illustrates that this is a real possibility.

times the social cost of carbon used by the U.S. government (Memorandum to the President 2010, Interagency Working Group on the Social Cost of Carbon 2010).

6. Lessons Learned

The experience with the Recovery Act's clean energy package provides a variety of lessons for the design and implementation of economic stimulus and for energy policy more broadly.

Significant Job Creation. The clean energy package has played an important role in the Recovery Act's creating and saving of millions of jobs throughout the economy. Given the dismal outlook and the limits to monetary policy in late 2008, a significant stimulus was necessary. A major fiscal push can create a significant number of jobs, including resources allocated to support the deployment of clean energy technologies.

Leveraging Private Investment. The Recovery Act's clean energy package was effective in leveraging private sector investment. This can increase the payoffs in terms of aggregate demand and clean energy outcomes. In an environment in which the business sector undertook a dramatic deleveraging during the financial crisis, such public sector leveraging through grants and tax credits can increase economic activity. In addition, this approach improves the quality of the projects by engaging both public and private sector investors that bring their own due diligence in undertaking the clean energy activities.

Match Investment Timing to Economic Needs. By their nature as *strategic*, the identified strategic investments in clean energy did not move as quickly as the near-term, automatic provisions of the Recovery Act, such as tax rebates, unemployment insurance extensions, etc. Representing the tail of Recovery Act spending, some clean energy programs started slowly as a result of the need to identify high-quality projects to support, to develop rules for the implementation of new programs, and to assure consistency with applicable constraints, such as Davis-Bacon Act labor compensation rules. In the

context of the depth and breadth of the financial crisis and economic recession, a sustained stimulus pulse with strategic investments ramping up more aggressively in 2010 helped sustain aggregate demand as some of the near-term provisions of the Recovery Act declined. The design of stimulus packages to address future recessions should map the timing, duration, and size of various elements of the package to the economic need.

Challenge of Stimulus in an Uncertain Regulatory Environment. The Administration's clean energy policy strategy focused on near-term supply-side investments through the Recovery Act with long-term demand for clean energy expected through comprehensive energy and climate legislation. Confidence about the availability of a future market in which to sell goods and services is the cheapest form of economic stimulus (Summers 2010). Given the extent of the public-private co-investment in the clean energy package, businesses could have benefitted considerably by the regulatory certainty that energy and climate legislation would have provided. The combination of a stimulus package and a well-designed greenhouse gas cap-and-trade program could have driven more investment during this time of weak aggregate demand. In a world with only the clean energy fiscal stimulus, the uncertainty about the prospect of Clean Air Act greenhouse gas regulation likely imposes a drag on the potential economic activity in the energy space.

Need for Rigorous Evaluation. The Recovery Act represents the largest energy spending bill in U.S. history. The broad array of policy instruments and significant variation in how states and local governments implement the Recovery Act's energy-related funds provides opportunities to understand the effectiveness of various deployment policies. Rigorous program evaluation could assess the effects of various instruments on incremental investment, evaluate the impact of technology deployment on energy outcomes, and investigate the cost-effectiveness of multiple instruments, including whether the total government subsidy for a given activity is socially excessive. Let me offer three suggestions. First, to evaluate the effects of new technologies on energy outcomes (e.g., energy use), field

experiments could be structured in coordination with local agencies and utilities. For example, field experiments could assess the impacts of smart meters on energy consumption and weatherization on energy demand.¹⁷ Second, some competitive grant and tax credit programs reflected decisions based on quantitative scores of project proposals. In a number of cases, such as the 48C clean energy manufacturing tax credit and ARPA-E funding decisions, the Department of Energy reported that the number of good-quality projects exceeded the amount of available resources. The proposal score data could be used to structure a regression discontinuity empirical design to investigate the effects of receiving Federal support on incremental investment and private sector leveraging (what some describe as government “crowding in” of private capital). Third, the decentralized implementation of several Recovery Act programs, including the State Energy Program, Weatherization Assistance Program, and the Energy Efficiency and Conservation Block Grant program, may yield natural experiments at state and local levels. The Department of Energy collects some relevant data (and some are available through www.recovery.gov), but some of the data will require outreach to state and local governments.

Grants Deliver More Benefits Per Dollar of Government Expenditure than Tax Credits for Renewable Power. It is difficult to identify a public policy rationale for a renewable program design that results in the creation of a tax equity market and a 7+% cut for large financial firms on every dollar of tax expenditure associated with renewable projects. Using the tax code to support renewables has introduced this transaction cost of monetizing tax credits through the tax equity market for many project developers. Under the Recovery Act 1603 grant, developers receive more of the government tax expenditure than before, and the government does not face a materially higher risk of fraud. (It’s not easy to fake a renewable power project sending electricity to the grid.) This option to take a grant in lieu of a tax credit, while intended to address the contraction of the tax equity market during the

¹⁷ As CEA Chief Economist in 2009, Michael Greenstone proposed Recovery Act implementation with field experiments to enable rigorous program evaluation. Few agencies enthusiastically embraced this proposal.

financial crisis, could be continued for as long as the government decides it is socially desirable to provide support for renewables through the tax code.

Grants and Tax Credits Are Significantly More Effective than Loan Guarantees. Some advocates for energy loan guarantees pose the question: Can renewable project sponsors raise debt? The question should be: Can these sponsors raise debt at a cost that makes the economics of the project work? Project risk affects the cost of debt, and therefore the risk-return balance for equity investors, but a loan guarantee is not the only way to alter this risk-return balance. Providing certain government financing – through a production tax credit or an investment tax credit or cash grant – can increase a projects' returns by lowering the amount of private sector capital that needs to be raised for a project. Thousands of renewable projects have moved forward with Recovery Act grants and tax credits and lowered CO2 from what they would have been otherwise, illustrating that these instruments are sufficient to mobilize incremental investment. In contrast, the Recovery Act appropriated \$6 billion for energy loan guarantees and 22 months later Congress had rescinded about 60% of this appropriation and the Department of Energy had closed on only eight projects, illustrating that these credit instruments are neither necessary nor effective.

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Table 1. Illustrative Clean Energy Package Policy Instruments

Instrument	Example	Score
Cost-shared grants	Smart grid grants support 100 projects with total investment costs in excess of \$8 billion.	\$3.4 billion
State block grants	Energy Efficiency and Conservation Block Grants support energy audits, energy efficiency retrofits, transportation programs, etc. by state, local, and tribal governments.	\$2.7 billion
Tax credits	Tax filers could claim 30% of the cost of residential energy efficiency investments up to a maximum of \$1500.	\$2.0 billion
Subsidized bonds	To finance renewable projects, government-owned utilities issued no-interest Clean Renewable Energy Bonds that provide bondholders with a tax credit in lieu of interest.	\$1.6 billion
Loan guarantees	The Section 1705 program provided loan guarantees for conventional and innovative renewable power projects, and related manufacturing and transmission.	\$2.5 billion*
R&D	Supports a competitive program focused on high-risk/high-reward energy innovation through the Advanced Research Projects Agency – Energy (ARPA-E).	\$400 million
Federal infrastructure	The General Services Agency financed hundreds of Federal facilities retrofits through the High Performance Green Buildings program.	\$4.5 billion

* The Recovery Act initially appropriated the Section 1705 program \$6 billion, but Congress rescinded \$3.5 billion to finance the 2009 “cash-for-clunkers” program (Public Law 111-32) and the 2010 state fiscal aid bill (Public Law 111-226).

Table 2: Clean Energy Jobs by Category

Category	Total Job-Years through 2012
Energy Efficiency	179,000
Renewable Generation	192,900
Grid Modernization	80,600
Advanced Vehicles and Fuels	37,000
Transit	158,200
Carbon Capture	26,500
Green Innovation and Job Training	32,200
Clean Energy Manufacturing	9,500
Other	3,700
Total	719,600

Source: CEA 2010a, p. 38.

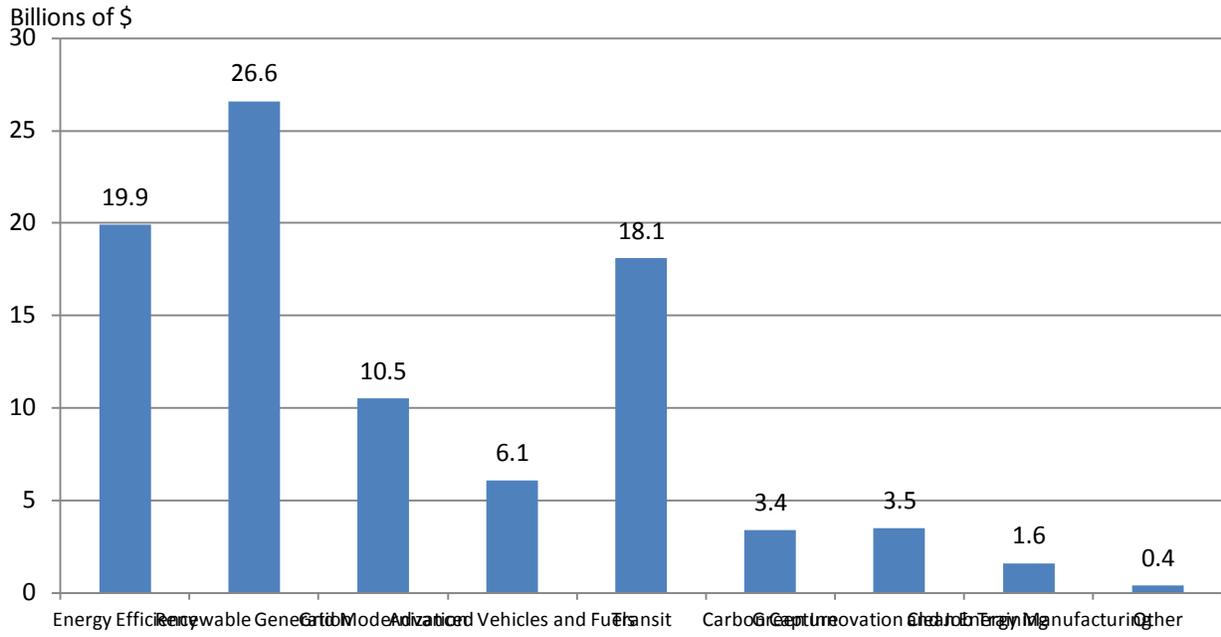
Table 3. Summary of 1705 Loan Guarantee Program and 1603 Grant Program through December 31, 2010

	1705 Loan Guarantee	1603 Grant
Staff	100-200 FTE DOE staff and contractors	5 Treasury FTEs, 15 DOE FTEs
Determination of receipt	Discretionary, reflecting deal characteristics and negotiations with sponsor	Standardized, subject to eligible technology entering into service
Typical length of review	6+ months	4-6 weeks
Total number of projects	8	4,750
Number of wind projects	2	252
Number of solar projects	1	4,404
Number of geothermal projects	1	28
Number of biomass projects	0	29
Number of other technology projects	4	37
Number of states with supported projects	8	48 states plus DC and Puerto Rico
Total capacity installed (MW)	~1,161	~10,000
Total investment supported	~\$4.7 billion	~\$20 billion

Sources: Memorandum to the President 2010, Department of Energy Loan Programs Office website (lpo.energy.gov), and Department of the Treasury website (www.treasury.gov/initiatives/recovery/Pages/1603.aspx).

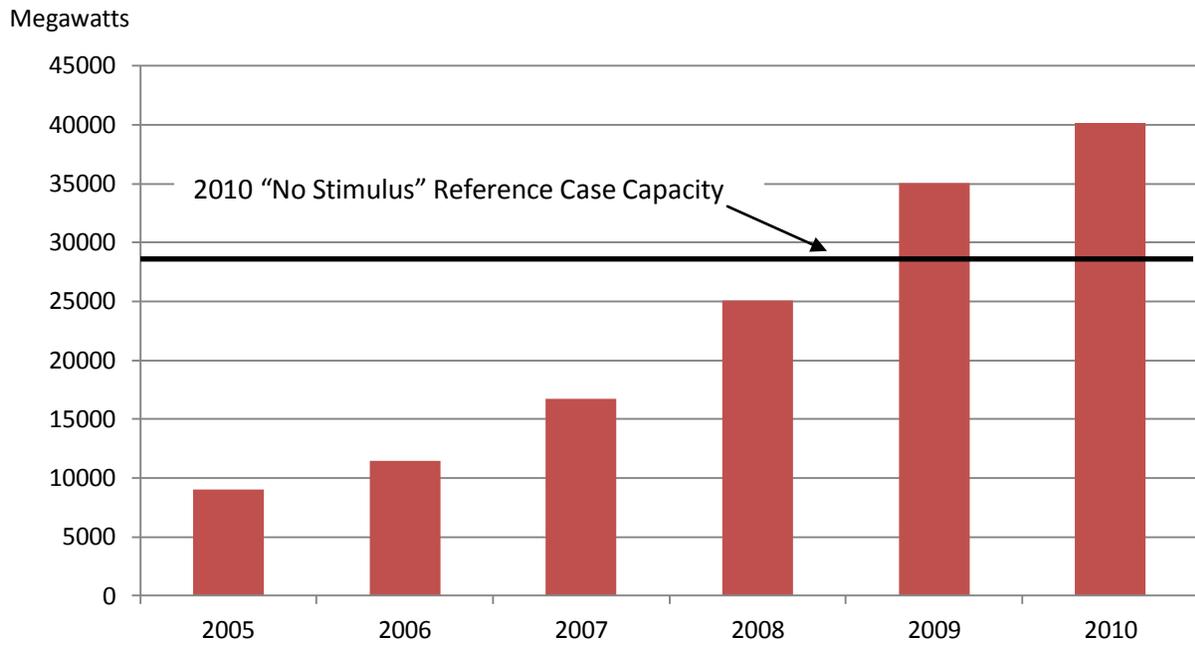
Notes: The 1705 loan guarantee figures represent those projects for which the Federal government has closed on the loan guarantee through December 31, 2010.

Figure 1. Appropriations and Estimated Tax Expenditures by Category of Clean Energy



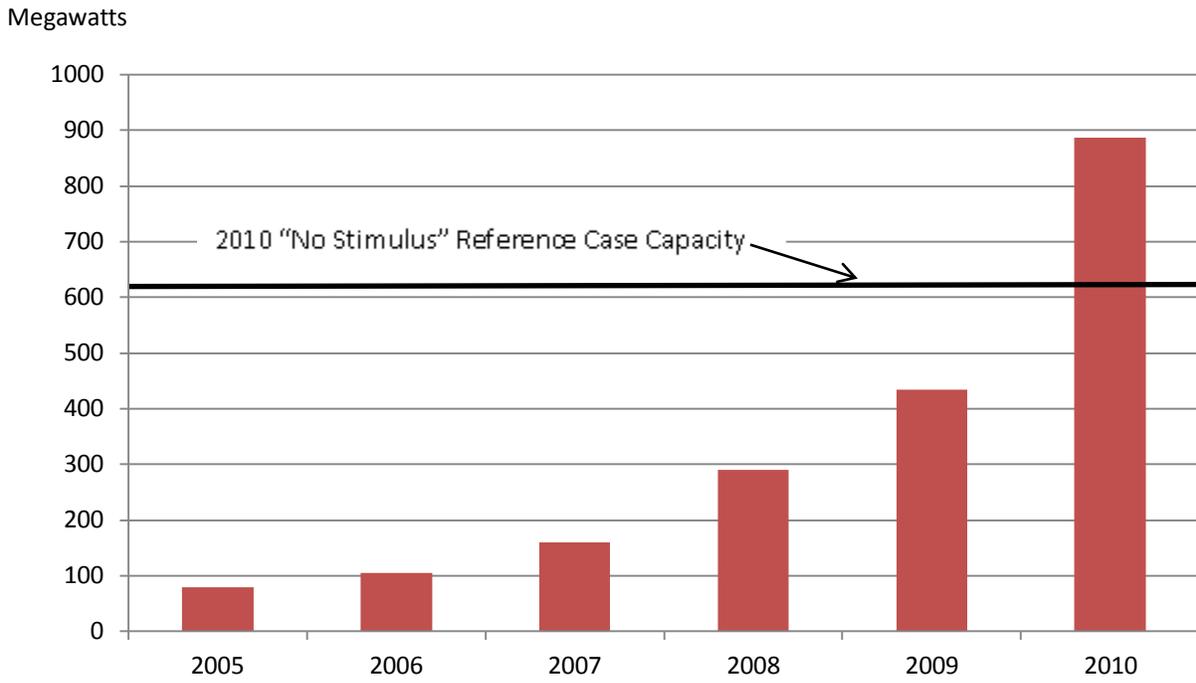
Source: CEA 2010a, p. 36.

Figure 2. Cumulative Installed Wind Power Capacity, 2005-2010



Sources: AWEA 2010, 2011; EIA 2009.

Figure 3. Cumulative Installed Grid-Connective Solar PV Power Capacity, 2005-2010



Sources: SEIA 2011; EIA 2009.