



Loan Guarantees for Clean Energy Technologies: Goals, Concerns, and Policy Options

Phillip Brown
Specialist in Energy Policy

January 17, 2012

Congressional Research Service

7-5700

www.crs.gov

R42152

Summary

Government guaranteed debt is a financial tool that has been used to support a number of federal policy objectives: home ownership, higher education, and small business development, among others. Loan guarantees for new energy technologies date back to the mid-1970s, when rapidly rising energy prices motivated the development of alternative, and renewable, sources of energy. Recently, the Energy Policy Act of 2005 created a loan guarantee program for innovative clean energy technologies (nuclear, clean coal, renewables) commonly known as Section 1703. The American Recovery and Reinvestment Act of 2009 created Section 1705, a temporary loan guarantee program focused on deployment of renewable energy technologies and projects.

Loan guarantee authority for the Department of Energy Loan Programs Office (LPO) Section 1705 program ended on September 30, 2011, prior to which approximately \$16.15 billion of loans were guaranteed for a variety of clean energy projects. In August 2011, the high-profile bankruptcy of Solyndra, the first company to receive a Section 1705 loan guarantee, resulted in a congressional investigation and increased scrutiny of the DOE Loan Guarantee Program. As a result, Congress may decide to evaluate the use of loan guarantees as a mechanism for supporting the development and deployment of clean energy technologies. This report analyzes goals and concerns associated with innovative clean energy loan guarantees.

Fundamentally, loan guarantees can provide access to low-cost capital for projects that might be considered high risk by the commercial banking and investment community. There are many goals for using loan guarantees to support innovative energy technology commercialization and deployment. Commercializing new technologies that may increase the performance and reduce the cost of clean energy generation is one objective. Also, the potential global market for clean energy technologies and systems is substantial (trillions of dollars over the next 25 years by some estimates) and loan guarantees could help position U.S. manufacturers to supply product for this growing market. Loan guarantees may also result in near- and long-term job creation as well as contribute toward reducing emissions of various pollutants.

The high-risk nature of clean energy projects, however, raises some concerns about the use of loan guarantees as a mechanism to encourage the deployment of new technologies. First, loan repayment demands cash flow from development stage companies at a time when they may already have high cash flow requirements, so loan repayment obligations could actually increase the risk of default for certain projects. Second, at a project level, the government's potential return is not commensurate with the risk being assumed. Third, loan guarantees for clean energy technologies are essentially long-term commitments in a dynamic and evolving marketplace. As a result, technologies supported today could be obsolete in less than a decade, thereby increasing the risk of loan default. Finally, federally managed loan guarantee programs may be subject to certain pressures that could result in less-than-optimal decision making.

Should Congress decide to continue the use of government financial tools as a clean energy technology deployment support mechanism, it may wish to consider various policy options for future initiatives. Some policy options could include (1) using grants or tax expenditures instead of loan guarantees; (2) taking equity positions in new technologies and projects through a new government-backed venture-capital-like organization; (3) authorizing the use of flexible management tools such as stock warrants, portfolio management, and convertible equity; and (4) creating a dedicated clean energy financial support authority to manage federal clean energy deployment investments. Each of these policy options is explored and discussed in this report.

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Introduction

The federal government has a number of policy tools available to encourage the development and deployment of innovative clean energy technologies (see text box below). Some of these policy tools include (1) clean energy mandates, (2) carbon taxes, (3) carbon cap and trade, (4) environmental regulations, (5) loan guarantees, (6) grants, and (7) tax expenditures. In 2005, Congress passed legislation that provided loan guarantee authority to the Department of Energy (DOE) for innovative clean energy technologies. In 2009, Congress passed legislation that modified DOE's loan guarantee authority and created a temporary loan guarantee program for the deployment of clean energy technologies and the development of clean energy projects. In 2011, the high-profile bankruptcy, and subsequent loan default, of Solyndra resulted in a congressional investigation and subjected DOE's loan guarantee program to a high degree of scrutiny.¹

This report provides analysis of goals for and concerns about the use of loan guarantees as a mechanism to support the deployment of innovative clean energy technologies. A discussion of several policy options for Congress to consider is also provided, should Congress decide to debate the future of clean energy loan guarantee programs.

What Are "Innovative Clean Energy Technologies?"

Many different types of energy technologies could be considered "innovative" and "clean." The innovative aspect of new technologies typically refers to a new approach or method that can either increase the performance of energy generation technologies and/or reduce the cost of producing useable forms of energy, such as electricity or fuels. Typically, innovative technologies have been demonstrated to some degree but are not yet available in the commercial marketplace. The clean aspect of new energy technologies usually refers to the ability of a technology to reduce or eliminate the amount of emissions (e.g., carbon) per unit of energy produced. Renewable energy technologies such as solar, wind, geothermal, biomass, biofuels, and others are almost always categorized as "clean." However, advanced nuclear and clean coal technologies might also be considered "clean" based on their ability to reduce carbon emissions.

Background and History of Federal Loan Guarantees

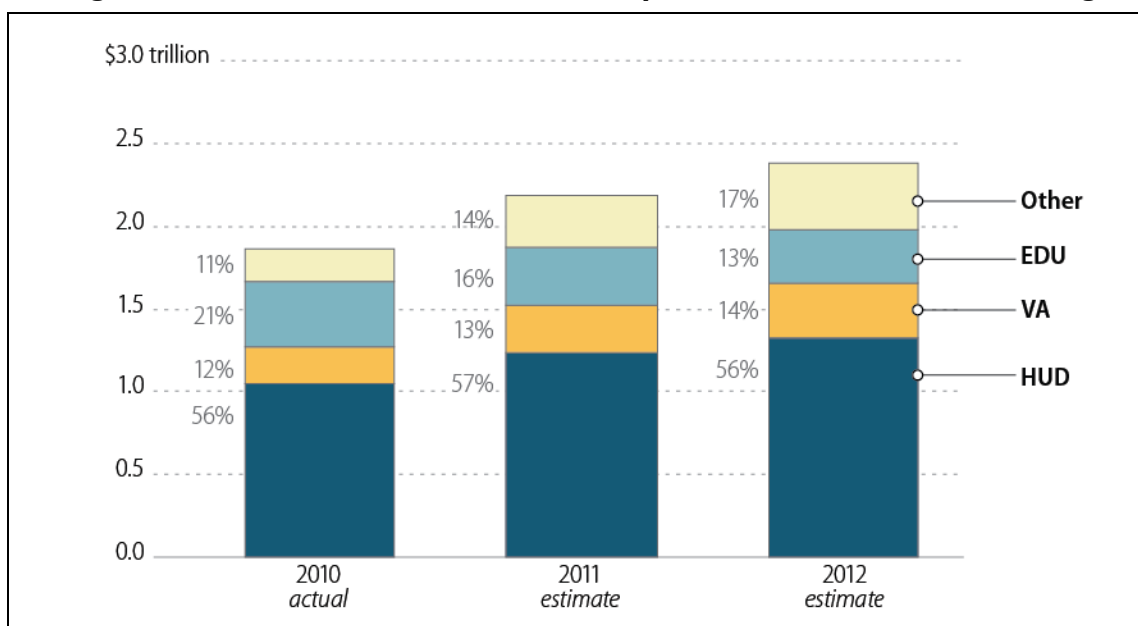
A loan guarantee might be defined as "a loan or security on which the federal government has removed or reduced a lender's risk by pledging to repay principal and interest in case of default by the borrower."² Historically, loan guarantees have been used as a policy tool for many different purposes, including home ownership, university education, small business growth, international development, and others. Today, 14 federal government agencies manage approximately 68 loan guarantee accounts that include approximately \$1.9 trillion of primary guaranteed loans outstanding in 2010 (see **Figure 1**).³ Primary guaranteed loan amounts include the total face value of the loans and not just the federally guaranteed portion of those loans.⁴

¹ For more information about the Solyndra bankruptcy, see CRS Report R42058, *Market Dynamics That May Have Contributed to Solyndra's Bankruptcy*, by Phillip Brown.

² Congressional Budget Office, "Loan Guarantees: Current Concerns and Alternatives for Control," August 1978.

³ Office of Management and Budget, "Analytical Perspectives, Budget of the United States Government, Fiscal Year 2012," Table 23-12 Guaranteed Loan Transactions of the Federal Government, available at (continued...)

Figure 1. U.S. Federal Government Primary Guaranteed Loans Outstanding



Source: CRS analysis of Office of Management and Budget FY 2012 budget, Table 23-12 “Guaranteed Loan Transactions of the Federal Government,” available at http://www.whitehouse.gov/sites/default/files/omb/budget/fy2012/assets/23_12.pdf.

Notes: According to OMB Circular A-11 (Revised November 2011), federal loan guarantees include the full face value of outstanding loan guarantees. Full face value includes both the guaranteed and non-guaranteed portion of loan principal outstanding. Therefore, the actual amount of federal government liability may not be accurately reflected in this figure. Also, “Primary Guaranteed Loans” are calculated by summing the face value of all federal guaranteed loans and then adjusting downward to account for secondary loan guarantees.

EDU = Department of Education

VA = Department of Veterans Affairs

HUD = Department of Housing and Urban Development

The first large-scale use of federal loan guarantees occurred during the 1930s Great Depression, when loan guarantees were used as a mechanism to assist families with purchasing homes. Home purchase loan guarantees are designed to be actuarially sound by charging borrowers insurance fees, which are pooled and used to pay for program operating costs and probable losses associated with loan defaults. Loan guarantees have also been used for higher risk borrowers such as students or low-income families. These borrowers might be considered higher risk because of a greater likelihood of default or inadequate collateral to support a loan. As a result, the government bears a portion of the default risk when lending to these types of borrowers; therefore these loans generally include some degree of government subsidy.⁵

Concerns about budgetary reporting of loan guarantees resulted in the Federal Credit Reform Act of 1990 (FCRA), which was included in the Omnibus Budget Reconciliation Act of 1990 (P.L.

(...continued)

http://www.whitehouse.gov/sites/default/files/omb/budget/fy2012/assets/23_12.pdf.

⁴ OMB Circular A-11, November 2011.

⁵ Congressional Budget Office, “Loan Guarantees: Current Concerns and Alternatives for Control,” August 1978.

101-508). Prior to the enactment of FCRA, fiscal year cash flow accounting was used to report the budgetary costs of loan guarantees, and this approach did not accurately take into account the expected losses associated with loan guarantee programs. Therefore, the total cost of long-term loan guarantees was not adequately accounted for, and reported, in the short-term congressional budget window. FCRA mandated an accrual accounting approach for budget reporting and required that budgetary costs of loan guarantees be reported as the net present value of subsidy costs associated with long-term loan guarantees.⁶ The Office of Management and Budget provides guidance for calculating the credit subsidy cost to agencies that administer loan guarantee programs.⁷

Loan guarantees have also been used to finance relatively large (from \$10 million to over \$1 billion) energy and infrastructure projects. Programs for such projects typically consist of a small number of projects with large capital requirements. As a result, it is difficult for loan guarantee programs for these types of projects to be actuarially sound because there is not a large enough project pool to spread the risk. While federal credit guidelines require credit subsidy costs (much like a loan loss reserve) for loan guarantee projects be collected, these costs are typically paid for through federally appropriated funds.

Congress has two primary mechanisms for controlling federal loan guarantee programs. First, Congress can appropriate funds to pay for credit subsidy costs, and this approach can limit the amount of federally supported loan guarantees once the credit subsidy appropriation has been exhausted. Second, Congress can stipulate volume limits for loan guarantee programs. For example, Congress could limit the total value of loans supported by a certain program to \$20 billion.

Loan Guarantees for Innovative Clean Energy Technologies

Federal loan guarantee authorizations for demonstrating alternative energy technologies date back to the 1970s, when the Geothermal Energy Research, Development, and Demonstration Act of 1974 (P.L. 93-410) authorized loan guarantees for geothermal demonstration facilities.⁸ The Department of Energy Act—Civilian Applications (P.L. 95-238), which became law in 1978, authorized the Secretary of Energy to guarantee loans for alternative fuel demonstration facilities.⁹ In response to an energy price shock in 1979, Congress passed the Energy Security Act of 1980 (P.L. 96-294) that authorized \$20 billion to create a domestic synthetic fuels industry through the use of loans, loan guarantees, price guarantees, joint ventures, and fuel purchase

⁶ For more information about FCRA, see CRS Report RL30346, *Federal Credit Reform: Implementation of the Changed Budgetary Treatment of Direct Loans and Loan Guarantees*, by James M. Bickley.

⁷ Specific OMB credit subsidy guidance is as follows: “The subsidy cost is the estimated present value of the cash flows from the Government (excluding administrative expenses) less the estimated present value of the cash flows to the Government resulting from a direct loan or loan guarantee, discounted to the time when the loan is disbursed. The cash flows are the contractual cash flows adjusted for expected deviations from the contract terms (delinquencies, defaults, prepayments, and other factors).” For more information about OMB guidance for calculating credit subsidy costs, see OMB Circular No. A-11, Part 5—Federal Credit, November 2011, available at http://www.whitehouse.gov/sites/default/files/omb/assets/a11_current_year/s185.pdf.

⁸ Congressional Budget Office, “Loan Guarantees: Current Concerns and Alternatives for Control,” August 1978.

⁹ *Ibid.*

agreements. To execute this endeavor, the law established the quasi-public U.S. Synthetic Fuels Corporation (SFC), although the Department of Energy was authorized to fund projects prior to the official start-up of SFC.¹⁰ Five projects were supported by the SFC, only one of which utilized a loan guarantee. The Great Plains coal gasification project (located in Beulah, ND), which converts lignite coal into pipeline-quality methane (the primary component of natural gas), received a \$2.02 billion federal loan guarantee (approximately \$1.5 billion of the loan guarantee was actually used) to construct the plant.¹¹ Due to energy price declines in the mid-1980s, along with a denied request to restructure debt and institute price support mechanisms, the Great Plains project was not able to meet debt service requirements and subsequently defaulted on its loan obligations in August 1985.¹² After paying off the defaulted loan, DOE proceeded to sell the Great Plains facility, which was purchased by Basin Electric for an initial price of \$85 million.¹³ Basin Electric assumed ownership of the plant on October 31, 1988.¹⁴ Today, the Great Plains facility is operated by the Dakota Gasification Company, a subsidiary of Basin Electric.

The Energy Security Act of 1980 (P.L. 96-294) also resulted in the creation of the Office of Alcohol Fuels (OAF) within the Department of Energy. OAF was given the authority to guarantee loans for alcohol fuel projects and eventually guaranteed loans totaling approximately \$265 million for three alcohol fuel projects. Of the three projects that received DOE loan guarantees, one had to refinance its loan, one experienced technology performance complications, and one ceased operations.¹⁵

Most recently, loan guarantees have been used as a mechanism to encourage development and deployment of innovative clean energy technologies.¹⁶ The Energy Policy Act of 2005 and the American Recovery and Reinvestment Act of 2009 resulted in the creation of DOE's Loan Programs Office (LPO), which was chartered to administer clean energy loan guarantee initiatives.¹⁷ Loan guarantees for innovative clean energy technologies constitute a small but growing portion of federal direct loans and loan guarantees (see **Figure 2**).¹⁸

¹⁰ Mark Holt, "Energy policy: Is the U.S. ready for the 1990s?" Environmental and Energy Study Conference, April 18, 1988.

¹¹ U.S. Government Accounting Office, "Financial Status of the Great Plains Coal Gasification Project," February 21, 1985, available at <http://archive.gao.gov/d10t2/126322.pdf>.

¹² U.S. Government Accounting Office, "Status of the Great Plains Coal Gasification Project," November 2005, available at <http://www.gao.gov/assets/90/86915.pdf>.

¹³ Terms of the purchase agreement included revenue sharing that required Dakota Gasification to provide cash payments to DOE when natural gas sales prices exceeded a certain level. According to Dakota Gasification, \$391 million was paid to DOE through 2009 when the revenue sharing requirement expired. For more information see http://www.dakotagas.com/About_Us/Finance/index.html.

¹⁴ http://www.dakotagas.com/About_Us/History/1989-Present/index.html.

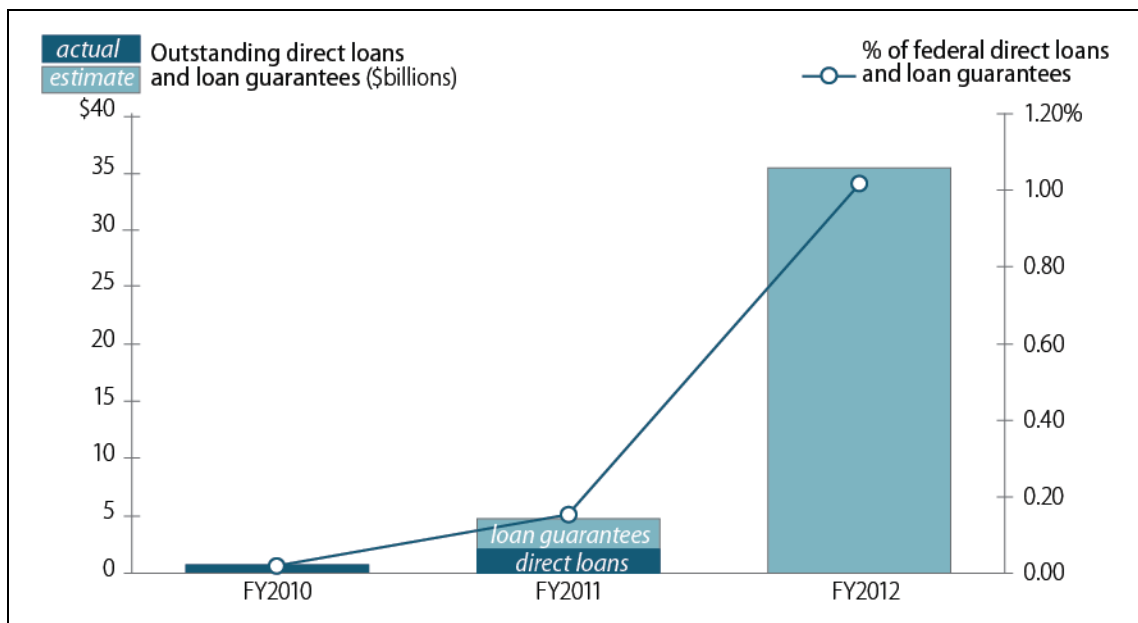
¹⁵ Mark Holt, "Energy policy: Is the U.S. ready for the 1990s?" Environmental and Energy Study Conference, April 18, 1988.

¹⁶ USDA manages a loan guarantee program, the Biorefinery Assistance Program, to assist emerging renewable transportation fuel production technologies. USDA's loan guarantee program is not the focus of this report. However, more information about the Biorefinery Assistance Program is available at http://www.rurdev.usda.gov/BCP_Biorefinery.html.

¹⁷ The DOE Loan Guarantee Program was initially operated by DOE's Office of the Chief Financial Officer. The Loan Guarantee Program was later merged with the Advanced Technology Vehicle Manufacturing loan program to form DOE's Loan Programs Office.

¹⁸ Loan guarantee projects that receive funds from the Federal Financing Bank (FFB) are classified as "Direct Loans" in the federal budget. Most funds for 1705 loan guarantee recipients came from the FFB and are in the "Direct Loan" budget category. It was therefore necessary to include direct loans and loan guarantees for this analysis in order to (continued...)

Figure 2. Federal Credit Programs for Innovative Clean Energy Technologies
(Direct loans and loan guarantees)



Source: CRS analysis of Office of Management and Budget FY 2012 budget, Table 23-11 “Direct Loan Transactions of the Federal Government,” and Table 23-12 “Guaranteed Loan Transactions of the Federal Government,” 2011 Direct Loan actual numbers were sourced from the Federal Financing Bank October 2011 activity report, available at http://www.treasury.gov/ffb/press_releases/2011/11-2011.shtml.

Notes: OMB data used for this figure is from the FY2012 budget, which was released in February 2011. Updated estimates for 2011 loan guarantees and 2012 loans and loan guarantees will be available in February 2012. Actuals and new estimates may be different than information provided in this figure.

Energy Policy Act of 2005

The Energy Policy Act of 2005 (EPACT 2005; P.L. 109-58), enacted on August 8, 2005, established loan guarantee programs for multiple energy technologies. EPACT 2005 enabled loan guarantees to be used in support of projects for (1) commercial byproducts from municipal solid waste and cellulosic biomass, (2) sugar ethanol, (3) integrated coal/renewable energy systems, (4) coal gasification, (5) petroleum coke gasification, and (6) electricity production on Indian lands, among others. Title XVII of EPACT 2005 created a new loan guarantee program for these innovative energy technologies.

Title XVII—Incentives for Innovative Technologies

Title XVII of EPACT 2005 authorized the Department of Energy to provide loan guarantees for eligible innovative technologies that are not yet commercially available.¹⁹ Projects eligible for federal loan guarantees, per Section 1703 of Title XVII, include a variety of technologies such as

(...continued)

accurately estimate the relative magnitude of DOE’s loan guarantee program activities.

¹⁹ Section 1701 of EPACT 2005 provides the following definition of commercial technology: “The term ‘commercial technology’ means a technology in general use in the commercial marketplace.”

renewable energy systems, advanced fossil energy technologies, advanced nuclear technologies, and many others.

Title XVII also stipulates that no loan guarantees shall be made to projects unless the cost of the project is paid for by either (1) appropriated funds, or (2) the borrower. The definition of “cost” is based on that provided in Section 502(5)(C) of the Federal Credit Reform Act of 1990.²⁰ No funds were initially appropriated to pay for costs of loan guarantees provided under Title XVII, therefore borrowers were expected to pay for all loan guarantee costs.

American Recovery and Reinvestment Act of 2009

The American Recovery and Reinvestment Act of 2009 (ARRA 2009; P.L. 111-5) modified Title XVII of EPCA 2005 in two ways. First, ARRA established Section 1705, a temporary loan guarantee program for deployment of renewable energy and electricity transmission systems. Section 1705 loan guarantee authority ended on September 30, 2011. Second, ARRA 2009 included a \$6 billion appropriation to pay for subsidy costs associated with projects authorized under the temporary Section 1705 program. This amount was reduced to \$2.435 billion after rescissions and transfers.²¹

DOE’s Loan Programs Office

To execute and administer federal credit programs for innovative energy technologies, the Department of Energy created its Loan Programs Office (LPO).²² LPO administers three loan programs:

1. *Section 1703*: loan guarantees for innovative clean energy technologies with high degrees of technology risk.
2. *Section 1705*: loan guarantees for certain renewable energy systems, electric power transmission, and innovative biofuel projects that may have varying degrees (high or low) of technology risk.
3. *Advanced Technology Vehicle Manufacturing (ATVM)*: direct loans to support advanced technology vehicles and associated components.²³

²⁰ FCRA Section 502(5)(C) provides the following definition for loan guarantee cost: “The cost of a loan guarantee shall be the net present value, at the time when the guaranteed loan is disbursed, of the following estimated cash flows: (i) payments by the Government to cover defaults and delinquencies, interest subsidies, or other payments; and (ii) payments to the Government including origination and other fees, penalties and recoveries; including the effects of changes in loan terms resulting from the exercise by the guaranteed lender of an option included in the loan guarantee contract, or by the borrower of an option included in the guaranteed loan contract.”

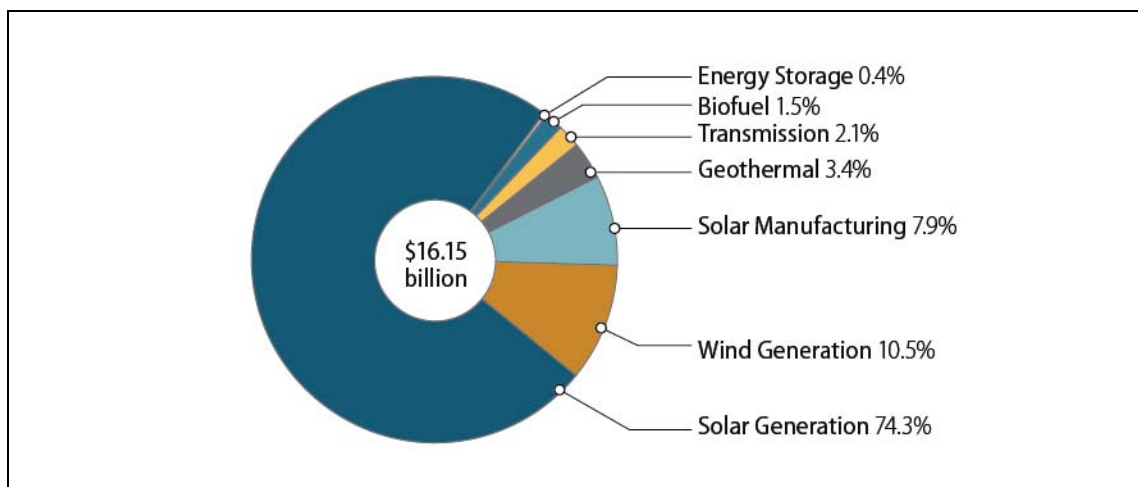
²¹ Appendix to the Budget of the United States Government—Fiscal Year 2012, Department of Energy detailed budget estimate, Office of Management and Budget, available at <http://www.whitehouse.gov/sites/default/files/omb/budget/fy2012/assets/doe.pdf>.

²² More information about DOE’s Loan Programs Office is available at <http://lpo.energy.gov/>.

²³ ATVM is a direct loan program and is not discussed in detail within this report. For more information about DOE’s ATVM program see CRS Report R42064, *The Advanced Technology Vehicles Manufacturing (ATVM) Loan Program: Status and Issues*, by Brent D. Yacobucci and Bill Canis.

As of December 2011, all finalized loan guarantee commitments have been for 28 projects within LPO's Section 1705 program, which equal approximately \$16.15 billion of federal loan guarantee commitments. LPO's Section 1703 program has issued conditional loan guarantee commitments to four projects with a total loan guarantee value of approximately \$10.6 billion.²⁴ **Figure 3** illustrates how Section 1705 loan guarantee commitments were distributed by technology types.

Figure 3. Section 1705 Loan Guarantees By Technology Category



Source: CRS analysis of DOE Section 1705 loan guarantee recipients.

Notes: Numbers may not equal 100% due to rounding.

New Technology Deployment vs. Project Finance

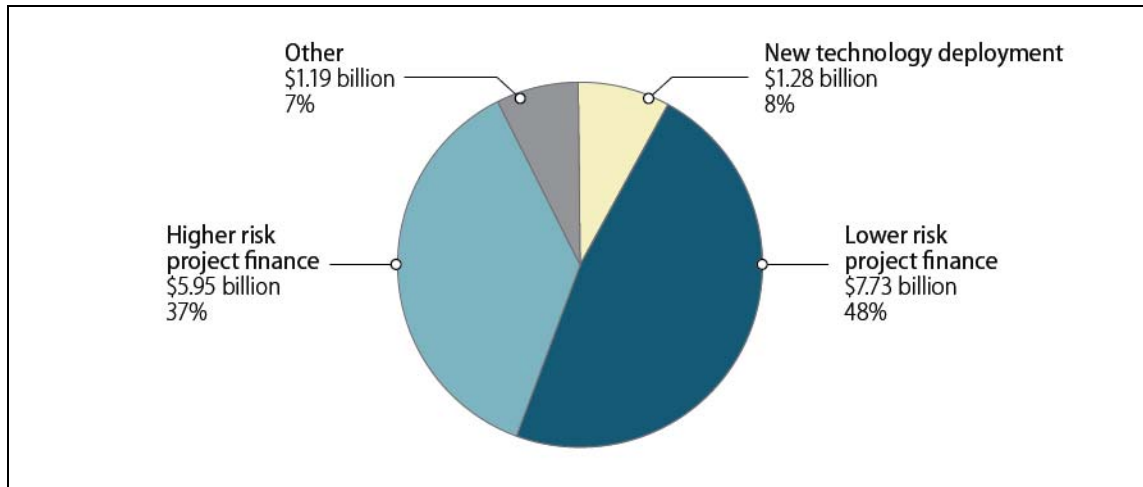
Two general types of financing activities can be supported by loan guarantee programs for innovative clean energy technologies. The first type of finance activity is categorized as “new technology deployment.” New technology deployment, for the purpose of this report, might include projects such as building a new manufacturing facility for a new energy technology (solar modules, wind turbines). Project finance includes projects that will use commercial, or near-commercial, technologies to generate electricity that will be purchased by a third party. Of the two financing types, new technology deployment projects are generally considered higher risk due to external technology and market dynamics that can significantly impact the financial performance of such projects. Project finance projects typically have lower risk profiles due to their ability to utilize contractual mechanisms (power purchase agreements, technology performance guarantees) as a means to minimize financial risk.²⁵ However, all project finance projects are not equal and the financial risk profile for these projects could be impacted by technology type, possible construction delays, and/or operations and maintenance characteristics.²⁶ **Figure 4** provides an assessment of the types of projects supported by DOE's Section 1705 loan guarantee program.

²⁴ Section 1703 conditional loan guarantee commitments are dominated by two nuclear electricity generation projects valued at \$2 billion and \$8.33 billion, respectively. For more information see https://lpo.energy.gov/?page_id=45.

²⁵ For a detailed comparison of manufacturing and electricity generation projects see CRS Report R42059, *Solar Projects: DOE Section 1705 Loan Guarantees*, by Phillip Brown.

²⁶ DOE LPO Section 1705 supported a number of solar electricity generation projects. However, technologies used for (continued...)

Figure 4. DOE Section 1705 Loan Guarantees
(New technology deployment and project finance)



Source: CRS analysis of projects that received loan guarantees from the Department of Energy Loan Programs Office, Section 1705 program.

Notes: Projects classified as “New technology deployment” include loan guarantees that supported manufacturing of new energy technologies. The “Lower risk project finance” category includes electricity or fuel production projects that use commercially available technologies (most of this category consists of solar photovoltaic and wind projects). Projects classified as “Higher risk project finance” include electricity generation and fuel production projects that use technologies that might be considered less commercial (most projects in this category use some type of solar thermal technology).

Goals for Clean Energy Loan Guarantees

One primary objective for providing federal loan guarantees for clean energy technologies and projects is to provide access to low cost financial capital that might not otherwise be available due to certain technology and market risks. Access to such capital may result in achieving certain policy objectives, assuming loan guarantee projects are successful and realize anticipated outcomes. Using loan guarantees as a mechanism for supporting U.S. clean energy technology deployment, project development, and system manufacturing can help meet various policy goals. Some of those goals are discussed below.

Commercialization of Innovative Technologies

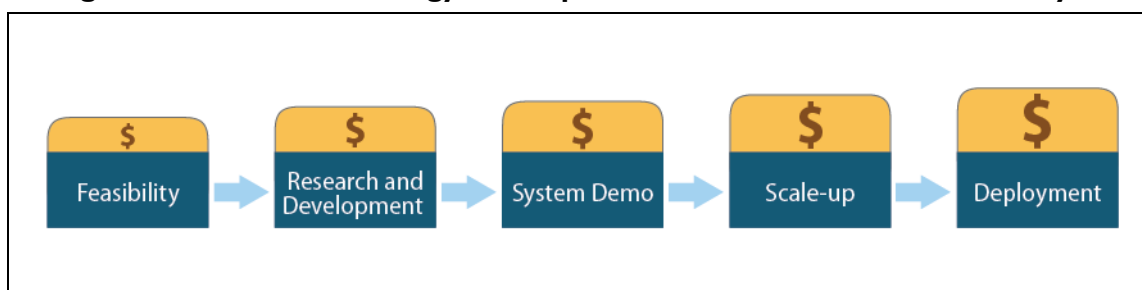
Renewable energy technologies typically follow a common commercialization development path. Development of new technologies generally consists of the following stages: (1) feasibility analysis, (2) research and development, (3) system demonstration, (4) system scale-up and operation, and (5) commercial deployment (see **Figure 5**). Various federal government incentives

(...continued)

these projects include commercially available solar photovoltaic modules as well as various concentrating solar thermal technologies. Solar thermal technologies might generally be considered less commercially available than solar PV technologies and, as a result, the technology performance risk of projects that use solar thermal technologies might be relatively high.

can be used to support every stage of technology commercialization. However, the focus of this report is on system scale-up and commercial deployment due to the high-risk nature of these activities and the large amounts of capital required. Typically as technologies move through the development life cycle, the cost to complete each subsequent development stage increases, and in some cases the cost increases can be substantial. System scale-up and operation, and commercial deployment, are usually the most costly development stages. Financing these development activities can sometimes be difficult because the capital requirements are large and the risks (technology performance, market dynamics) are usually high. Some people refer to this situation as the “valley of death” or the “chasm” that all new technologies might encounter as they move from demonstration to commercial deployment. Formulating and executing a plan to realize commercial deployment is a challenge in itself.²⁷ Financing that plan can further complicate new technology commercialization. By providing a source of low-cost capital for these development stages, loan guarantees could support the commercialization of new and innovative renewable energy technologies.

Figure 5. Notional Technology Development and Commercialization Lifecycle



Source: CRS

Positioning U.S. Manufacturing for an Emerging Global Market

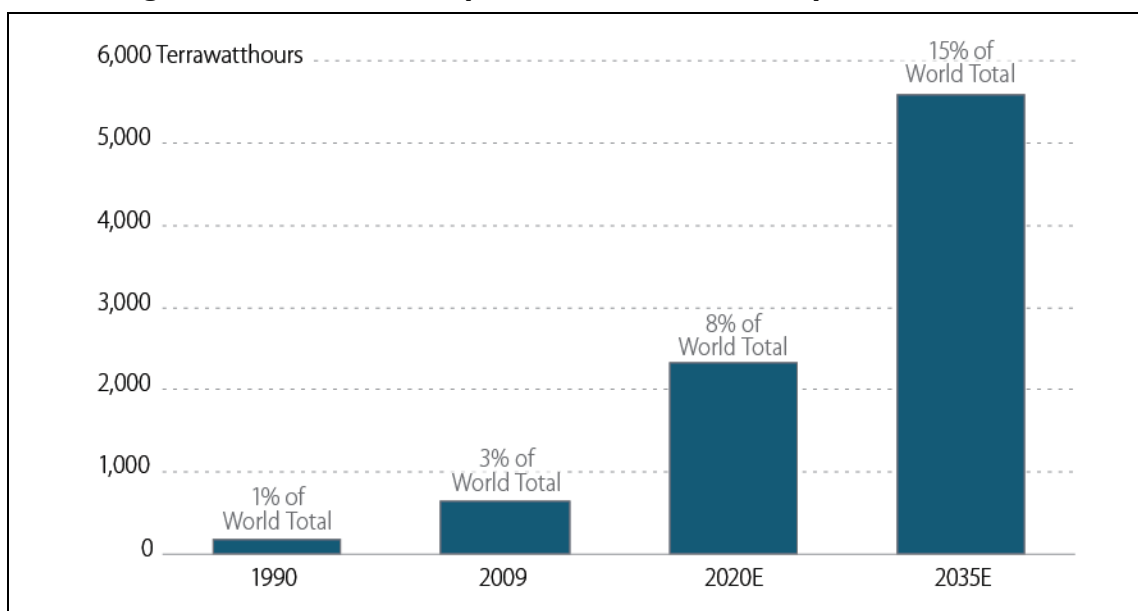
Global renewable energy use is expected to grow. For example, the International Energy Agency (IEA) estimates, under one scenario, that electricity generation from renewable energy will grow from 3% of global electricity in 2009 to approximately 15% by 2035 (see **Figure 6**).²⁸ In order to realize these projections, IEA estimates that approximately \$6 trillion of investment in renewable electricity generation will be needed between now and 2035.²⁹ As global renewable electricity markets expand, many countries may look to position themselves as leading manufacturers of renewable electricity generation systems and technologies. Loan guarantees for renewable electricity technology manufacturers could provide a source of low cost financial capital that might incentivize build-out of U.S. renewable energy manufacturing capacity. This capacity build-out could potentially result in economies of scale and make U.S. manufacturing cost competitive. If global markets expand as projected, U.S. manufacturers could be positioned to manufacture and export renewable energy technologies and systems for the global marketplace.

²⁷ For more information about commercialization challenges and potential strategies to address certain challenges, see Geoffrey A. Moore, *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers* (HarperCollins, 2002).

²⁸ International Energy Agency (2011), *World Energy Outlook 2011*, OECD Publishing.

²⁹ Ibid.

Figure 6. Global Electricity Generation from Non-hydro Renewables



Source: International Energy Agency, World Energy Outlook 2011.

Notes: IEA’s World Energy Outlook includes analysis for three different world energy scenarios: (1) Current Policies, (2) New Policies, and (3) the 450 scenario (referring to a limit on atmospheric carbon dioxide concentrations of 450 parts per million). This figure reflects IEA renewable electricity projections under the “New Policies” scenario.

Job Creation

Loan guarantees might result in job creation as a result of building and operating projects that utilize loan guarantee finance mechanisms and possibly through the expansion of new industries that establish a competitive position in the global marketplace. According to DOE’s Loan Programs Office, jobs related to fully committed Section 1705 loan guarantees include approximately 14,300 construction jobs and 2,400 permanent jobs.³⁰ Construction jobs are typically temporary in nature, while permanent jobs are functions required to operate projects over their respective lifetimes. Additional job creation might occur if projects supported by loan guarantees are successful and realize their commercial deployment goals and objectives. The number of jobs that might ultimately result from loan guarantee projects that become globally competitive is difficult to estimate at this time due to unknown market, technology, and policy variables that will likely determine future renewable energy market growth.

Reducing Greenhouse Gas Emissions

Deployment of clean energy technologies and projects could potentially support greenhouse gas reduction goals, for example, by increasing the total amount of electricity generation from low carbon sources. Emission reductions that are directly associated with projects supported by DOE loan guarantees will likely be modest due to the massive scale of the U.S. energy industry.

³⁰ Department of Energy Loan Programs Office, https://lpo.energy.gov/?page_id=45.

However, larger indirect emission reductions may be achieved as a result of future deployment of clean energy projects, should loan guarantee projects achieve their objectives.

Supply Chain Build-Out

On its website, DOE's Loan Programs Office emphasizes that loan guarantees provided by LPO are supporting some of the largest solar photovoltaic, solar thermal, and wind electricity generation projects in the world.³¹ Developing and constructing these large-scale projects may require domestic supply chains to support deployment of certain technologies. As a result, loan guarantees may support the build-out of a U.S. supply chain for clean energy technology, system, component, and logistics companies.³² This build-out may help position these companies for global clean energy opportunities.

Concerns About Loan Guarantees for Innovative Energy Technologies

While there are a number of goals and potential benefits associated with federal loan guarantees for innovative clean energy technologies and projects, there are also multiple concerns about loan guarantees as an incentive mechanism for clean energy. The Congressional Budget Office (CBO) released a background paper in 1978 regarding concerns about loan guarantees for new energy technologies. A brief overview of CBO's paper is provided in the text box at the end of this section.

Cash Flow Demand for Development-Stage Companies

A company that uses a loan guaranteed by the federal government to finance capital projects, or other business operations, has a legally binding requirement to pay back principal and interest to the loan issuer based on a defined repayment schedule. Additionally, loan agreements typically have certain conditions and covenants that may require a company to maintain minimum cash holding levels for certain cash accounts.³³ Therefore, a loan essentially results in a source of demand for a company's operating cash flow. For most development stage companies, managing cash flow is the essential financial management function that enables a company to operate and ultimately survive.

However, when development-stage companies with pre-commercial technologies use loans to finance new technology deployment (e.g., manufacturing facilities), the loan repayment requirements could potentially increase cash flow demands on a company and thus create liquidity challenges (see **Figure 7**). The significant cash flow demands during this stage of a company's development could result in a high risk of loan default. Many companies in this development stage do not have an established commercial presence in their respective markets

³¹ https://lpo.energy.gov/?page_id=45.

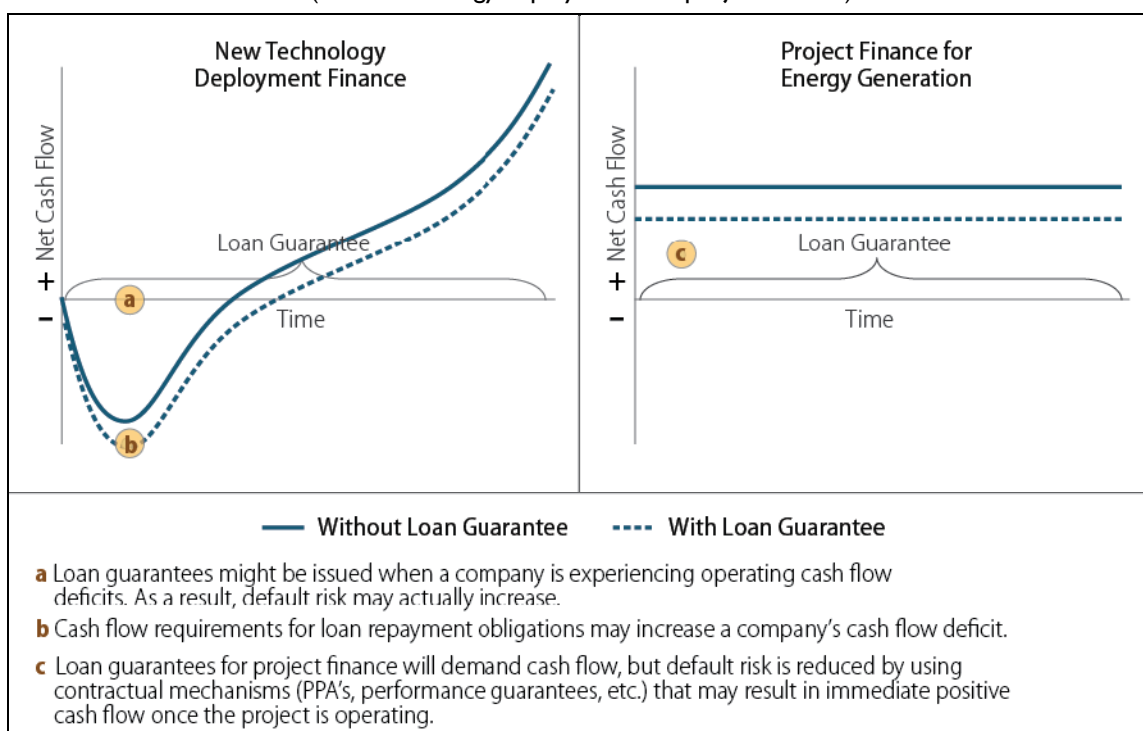
³² For information about the U.S. wind manufacturing supply chain, see CRS Report R42023, *U.S. Wind Turbine Manufacturing: Federal Support for an Emerging Industry*, by Michaela D. Platzer.

³³ For example, loan guarantee agreements may require recipients to maintain minimum balances in reserve accounts for debt service, operations and maintenance, among others.

and are spending substantial amounts of cash to develop a sales force, establish marketing and distribution channels, complete technology performance validation, and establish other core elements of a sustainable business operation. Additionally, many companies in this development stage will sell products at a loss as they work to achieve production economies of scale, which may or may not be realized. Using a loan as a means to finance a corporate asset, such as a manufacturing facility, during this development phase could potentially increase total cash flow demand and the likelihood of defaulting on the loan. In essence, loan guarantees may encourage the use of debt funding during risky development and deployment stages that might be more appropriate for equity investments.

Figure 7. Illustrative Cash Flow Profiles for Clean Energy Technologies

(New technology deployment and project finance)



Source: CRS

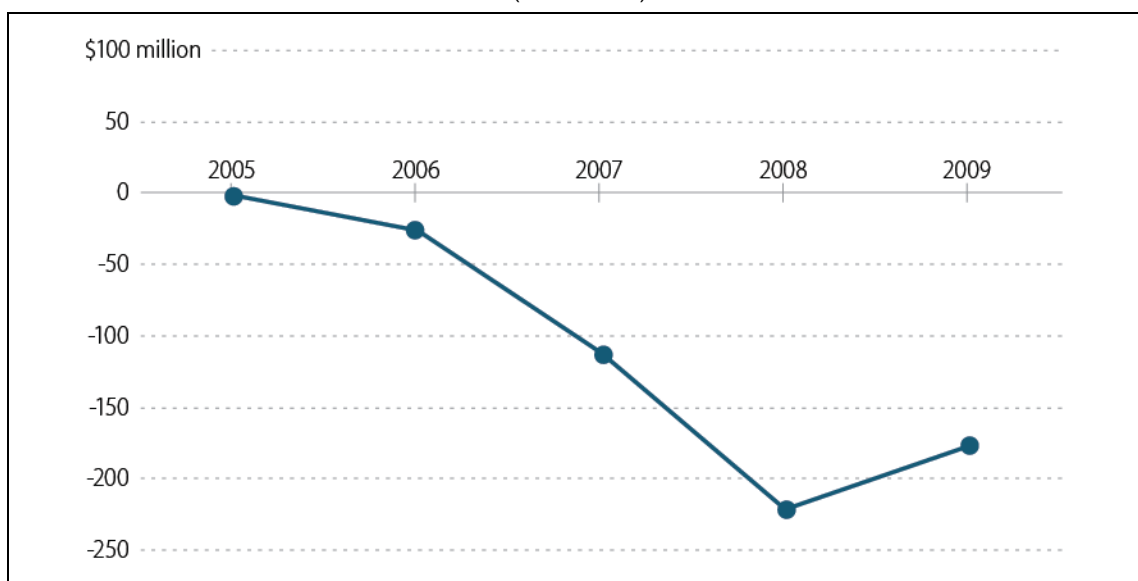
Notes: Net Cash Flow refers to operating cash flow minus debt service requirements. Funds from loans for corporate assets are typically used to build and construct a particular asset. Companies might not be able to use funds for long term loans to support short term operating cash flow deficits. However, the company receiving the loan must be able to generate positive operating cash flow to fulfill its debt service obligations.

Solyndra, which received a loan guarantee for a manufacturing facility, might be considered an example of a new technology deployment project with high cash flow demands. **Figure 8** shows Solyndra's actual operating losses from 2005 to 2009. Solyndra finalized its loan guarantee agreement in September 2009. Solar market conditions, which changed dramatically between 2009 and 2011, contributed to the company's negative operating cash flow during this period.³⁴ Several reports indicate that when Solyndra initially defaulted on its loan obligation in 2010 the

³⁴ For more information see CRS Report R42058, *Market Dynamics That May Have Contributed to Solyndra's Bankruptcy*, by Phillip Brown.

primary cause was due to cash flow issues that prevented the company from making a \$5 million payment per the terms of the loan agreement.³⁵ This example is not meant to show any cause and effect relationship between loan guarantees and bankruptcies or defaults. Rather, it illustrates the potential difficulty development stage companies might encounter when having to service debt obligations during periods of market uncertainty with high degrees of cash flow demand.

Figure 8. Actual Solyndra Operating Losses
(2005–2009)



Source: Solyndra SEC filing, available at http://www.sec.gov/Archives/edgar/data/1443115/000119312510058567/ds1a.htm#toc15203_8.

On the other hand, using loan guarantees as a way to finance renewable electricity generation projects may be less risky since these types of projects are generally supported by long-term power purchase agreements (PPAs) and other contractual agreements that may provide a stable source of revenue and positive cash flow (see **Figure 7**). Since the risk profile of such projects might be low, some critics of clean energy loan guarantees may question why a federal loan guarantee is needed for these projects. However, default risk for these types of projects does exist and can result from technology performance and operational cost risks.

Indeed, different companies have different cash flow requirements, and cash management is best assessed on a project-by-project basis. Also, federally guaranteed loans may demand less cash when compared to commercial loans since interest rates on guaranteed loans are typically lower than those available in the commercial debt market. Nevertheless, a loan guarantee can still result in an additional cash flow burden for a company that is operating in the early stages of commercial deployment.

³⁵ Deborah Solomon, “Solyndra Said to Have Violated Terms of Its U.S. Loan,” *Wall Street Journal*, September 28, 2011.

Government Risk/Reward Imbalance

Unlike corporate entities such as banks, private equity firms, and venture capital firms, the federal government is generally not designed to seek profits and financial returns. However, since taxpayer dollars are the source of federal financial incentive programs, when considering certain financial incentive policies it is worth considering how such policies will benefit the federal government, the country, and U.S. citizens. Loan guarantees are federal government commitments to fulfill the repayment obligations of certain loans in the event the borrower defaults. In essence, unless a loan guaranteed by the federal government defaults, the “cost” of the loan guarantee is essentially zero. However if a guaranteed loan defaults, then the federal government may be required to pay back principal and interest to the loan issuer, at which time the “cost” to the government could be as high as the total amount of principal borrowed for the loan.

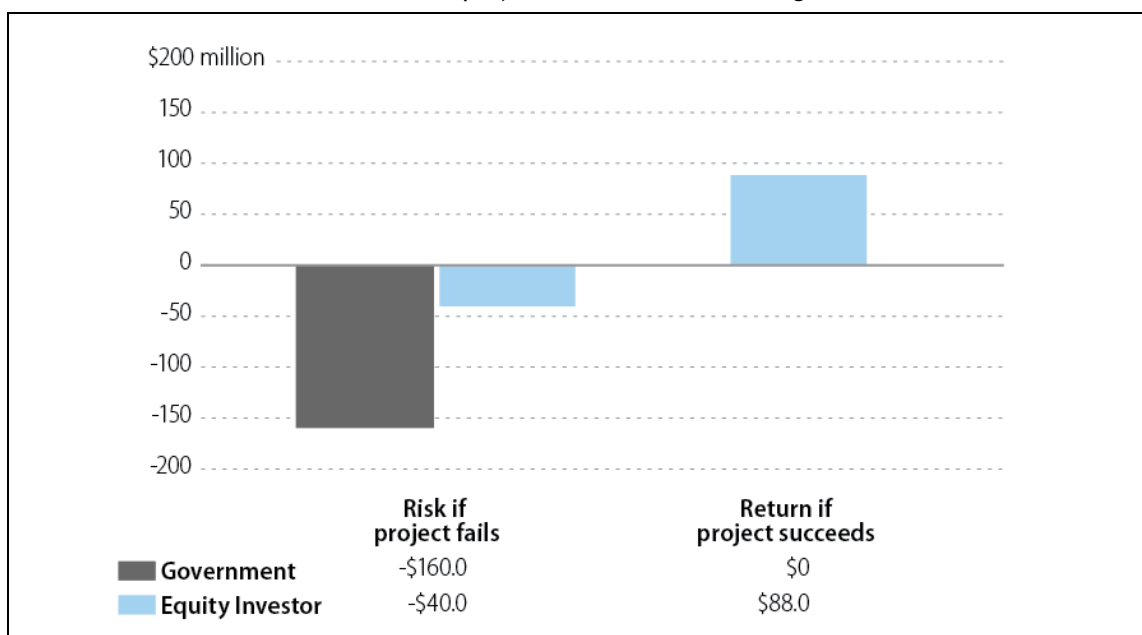
In financial terms, the federal government is risking an amount equal to the amount of principal guaranteed, yet the potential direct financial return to the government is essentially zero (See **Figure 9**). Financial return for the government is zero because the loan may be issued either by a commercial debt provider, who receives loan interest payments, or by the Federal Financing Bank (FFB).³⁶ FFB loans have low interest rates that are generally equal to Treasury debt.³⁷ Therefore, FFB is typically not making any money on an interest rate spread. Rather, FFB may use the interest received from federally guaranteed loans to pay down the Treasury debt used to source the loan funds.

³⁶ For more information about the Federal Financing Bank, see the FFB website at <http://www.treasury.gov/ffb/index.shtml>.

³⁷ FFB may charge a small premium of 1/8th of 1% to cover charges associated with servicing loans.

Figure 9. Risk/Reward Profile for a Loan Guarantee Project

Example: hypothetical solar module manufacturing project
 \$200 million total project cost; 80% federal loan guarantee



Source: CRS project finance analysis of a hypothetical solar module manufacturing facility. For a description of the model, project parameters, and financial assumptions used for this analysis, please contact the author directly.

Notes: It is important to note that the simplified example loan guarantee analysis in this figure is based on certain model input parameters and project finance assumptions. Using a different methodology, model inputs, and assumptions could produce very different results. The analysis is illustrative in nature and is not intended to predict real-world outcomes, which will differ based on actual project and market characteristics. Also, this analysis assumes that the example project defaults on its loan immediately following all loan disbursements. Losses to the government could be less if the project operated for a certain period of time, during which principal and interest payments were made. Numbers in this chart are on a Net Present Value basis.

The loan guarantee example illustrated in **Figure 9** does not take into account potential U.S. government benefits associated with job creation, a potentially larger tax base, and increased exports if the project succeeds. These benefits could be substantial, yet they are very difficult to accurately quantify and include in this type of analysis. As such, quantifying these potential benefits is beyond the scope of this report. Nevertheless, at the individual project level, some might perceive the government’s risk/reward profile to be somewhat out of balance. Charging “credit subsidy costs” to projects that receive loan guarantees is one way the federal government attempts to mitigate the risk of losses associated with loan guarantees. However, under Section 1705, all credit subsidy costs for loan guarantees were paid for by appropriated funds. As a result, risk of loss to the Section 1705 Loan Guarantee Program is effectively reduced, yet the federal government is assuming all risks associated with loan defaults under the program.

Long-Term Commitments in a Dynamic Marketplace

Loans for renewable energy projects typically have a payback period of between 20 and 30 years, where the borrower is typically required to make periodic (monthly, quarterly) principal and interest payments based on terms and conditions of the loan agreement. Loan guarantees may

cover the entire duration of a loan agreement. Especially for corporate finance activities that might support new technology manufacturing projects, the long-term nature of loans, and loan guarantees, is somewhat in contrast with the rapidly evolving renewable energy technology landscape. Innovation is occurring in the energy marketplace through venture capital investments in new energy technologies and federal government energy innovation programs. For example, the Department of Energy manages the SunShot Initiative, which “aims to dramatically decrease the total costs of solar energy systems by 75% before the end of the decade.”³⁸ Successful future renewable energy technology innovations could, theoretically, make current technologies obsolete. As a result, technologies that may be commercially viable today could become outdated in less than a decade. The dynamic nature, and potential technology obsolescence, of renewable energy markets could introduce a certain amount of risk associated with using long-term loan guarantee commitments as an incentive mechanism for certain types of renewable energy projects. Furthermore, the amortized payback schedule of most debt instruments increases the risk to the government of principal losses associated with loan defaults that result from technology obsolescence.³⁹

Pressure to Approve Loan Guarantees

A federally managed loan guarantee program for large clean energy projects essentially performs several banking-like functions. Financial analysis, market analysis, company due diligence, and other activities must be managed by such programs to facilitate sound financing decisions on the part of the federal government. However, government-managed loan guarantee efforts may be subject to certain pressures that might not be experienced by commercial banks. For example, Section 1705 was a temporary program, and loan guarantee authority under Section 1705 ended on September 30, 2011. Evaluation and proper due diligence of large, in some cases more than \$1 billion, loan guarantee projects can take considerable amounts of time. Furthermore, there are certain project finance variables (executing power purchase agreements, supply agreements) that may not be within the immediate control of the Loan Programs Office. Therefore, having a pre-defined deadline for making loan guarantee commitments, along with a desire to expedite funding for technology deployment projects, may have adverse results. Projects that received loan guarantees may not be the best projects to have supported; rather these projects may have been in a better position to meet the deadlines associated with Section 1705 loan guarantee authority.

³⁸ For more information about DOE’s SunShot Initiative, see <http://www1.eere.energy.gov/solar/sunshot/about.html>.

³⁹ Loans are typically amortized over a certain number of years. Generally speaking, initial debt service payments usually include more interest than principal in the early years and more principal than interest in later years. For the loan guarantee analysis described in **Figure 9**, roughly 38% of the debt principal is repaid after 10 years (loan tenor for the example analysis is 20 years). Therefore, approximately 62% of the principal will be repaid in the second half of the project.

Energy Project Loan Guarantee Concerns: Congressional Budget Office 1978

In August of 1978, the Congressional Budget Office (CBO) published a background paper titled: "Loan Guarantees: Current Concerns and Alternatives for Control." At that time, Congress had passed several laws that authorized the use of loan guarantees for energy projects. In its paper, CBO expressed several concerns about the use of loan guarantees for supporting such projects as well as concerns about the budgetary treatment of federal credit programs. As discussed previously in this report, the Federal Credit Reform Act (FCRA) was later enacted to improve budgetary treatment of direct loans and loan guarantees. However, other concerns outlined by CBO in its working paper may still be relevant today. Following is a brief discussion of some of CBO's concerns.

- *Risk Evaluation by Lenders:* When commercial lenders originate loans that are guaranteed by the government, these lenders may be more concerned with the adequacy of the loan guarantee agreement than by the actual risk of the project. As a result, projects may not receive an adequate amount of due diligence by the lender, therefore increasing the federal government's risk exposure.
- *Partial Guarantees May Only Provide A Partial Solution:* One way to improve lender risk evaluation is to require that lenders provide a certain portion of the loan principal in the form of a non-guaranteed loan. This would, in theory, increase the amount of scrutiny of loans by lenders. However, a small non-guaranteed loan requirement could potentially be absorbed by the lending organization by writing off losses against tax liabilities. Furthermore, the ability of lenders to securitize and sell the government-guaranteed portion of the loan could result in fees and returns that offset the risk of the non-guaranteed loan commitment.

Furthermore, the goal of loan guarantee programs is to reduce the lender's risk. CBO highlights the fact that "while such guarantees reduce the risk of loss to lender and borrower, they cannot reduce the project's risk of economic failure." As a result, loan guarantees shift default risk from the lender and borrower to the federal government. The CBO paper also notes that loan guarantees are typically attractive to policy makers due to their perceived low cost. However, not truly understanding the full costs and effects of the federal government assuming long-term contingent liabilities could result in undesirable outcomes. The subsidy cost requirement, per FCRA, is a way to address full accounting for the true costs of loan guarantee programs. However, DOE's Section 1705 loan guarantee program is the largest amount of loan guarantees ever provided to support the deployment of innovative clean energy technologies. Only time will tell if subsidy cost estimates were adequate to compensate for actual losses associated with project defaults under the program.

Policy Options

Should Congress decide to debate the use of loan guarantees, or other government financial tools, as a clean energy deployment support mechanism, several policy options might be explored as a means to achieve clean energy policy objectives. As discussed earlier, a primary goal for loan guarantee programs is to provide a source of capital to projects that may not be able to secure low cost financing in the commercial market. Should this continue to be the fundamental objective of this type of incentive mechanism, the following discussion explores some policy options that Congress may also choose to consider.

Grants or Tax Expenditures Instead of Loan Guarantees

Grants for innovative clean energy technologies are a policy tool that could be used to incentivize commercialization and deployment of such technologies. Instead of appropriating funds to pay for loan guarantee subsidy costs, Congress could appropriate funds for a grant program that would provide financial assistance to projects that commercialize new energy technologies. The grant program could be structured in such a way that requires projects receiving federal grants to have secured all other necessary funding before receiving grant funds. Congress could also utilize tax expenditures as a financial mechanism for incentivizing the deployment of innovative clean

energy technologies. Production tax credits and investment tax credits are two mechanisms currently used to incentivize renewable energy projects.⁴⁰ Companies receiving a federal grant or tax incentive would not be required to repay the grant amount or tax expenditure and, as a result, may not experience additional cash flow demands associated with loan repayments. In theory, using funds in this manner could be just as effective as using appropriated funds for subsidy costs. However, in practice different incentive mechanisms may be more useful depending on market characteristics and the financial credit environment. Using grants and tax expenditures as incentive mechanisms would limit the federal government's exposure to project failures. However, a drawback to this approach may be that using grants or tax expenditures, compared with loan guarantees, may not be perceived as providing an opportunity to leverage government funds.⁴¹

Equity Positions

One option Congress could explore is setting up a structure in which the federal government can assume equity positions in innovative clean energy technologies and projects. Since initial commercial deployment of new technologies is high risk in nature, equity investments, arguably, might be more appropriate than loans or loan guarantees for this stage of the technology commercialization life cycle. Equity positions might serve to alleviate the cash flow demands associated with loans and may also provide the federal government with an opportunity to participate in the return upside if a project is successful. Thus, equity positions in clean energy technologies may serve to balance the federal government's risk/return profile. Making these types of high risk investments may require the federal government to operate much like a venture capital firm, where a portfolio of equity positions are taken in high risk/high return investments. The overall goal would be that successful projects should more than compensate for project failures. Congress could create a clean energy venture capital-like entity that would have the funding, charter, and authority needed to invest in commercial deployment of innovative clean energy technologies. However, this approach raises concerns about the federal government assuming a venture capital-like function and how such an organization may improve or hinder the existing venture capital and private equity community. Furthermore, equity positions in companies also raise concerns about the federal government control of industry. However, federal government equity positions are not unprecedented. Financial support in return for such positions has been provided recently to auto companies, banks, and others. In those instances, this type of financial assistance was done under what might be considered emergency circumstances and not without controversy.⁴²

⁴⁰ For more information see CRS Report R41227, *Energy Tax Policy: Historical Perspectives on and Current Status of Energy Tax Expenditures*, by Molly F. Sherlock.

⁴¹ An example of the potential leverage opportunity associated with loan guarantees is DOE's Section 1705 program. Approximately \$2.5 billion, after rescissions and transfers, of credit subsidy costs were appropriated and the program supported a loan value of approximately \$16.15 billion.

⁴² The federal government provided financial assistance in return for equity positions as part of the Troubled Asset Relief Program (TARP), for more information see CRS Report R41427, *Troubled Asset Relief Program (TARP): Implementation and Status*, by Baird Webel.

Flexible Financial Management Tools

Should Congress decide to continue using loan guarantees as a support mechanism for clean energy deployment, providing authority for loan programs to use certain flexible financial management tools may be an option to consider. Financial tools that might be used by federal loan programs may include the following:

- *Warrants:* A stock warrant provides the holder of that warrant the opportunity to purchase a company's stock at a certain price sometime in the future. As part of a loan guarantee agreement, the federal government could possibly receive warrants from companies that receive loan guarantees. These warrants would provide the federal government with an opportunity to participate in the financial return of successful projects and balance the risk/return profile of individual projects. The use of warrants could be a way for the federal government to recover appropriated credit subsidy costs used for loan guarantee projects.⁴³
- *Portfolio management:* Portfolio management is intended to ensure that gains from certain projects would offset, and possibly exceed, losses from other projects. Currently, innovative clean energy technology loan guarantees are managed on a project-by-project basis and there is no opportunity to reduce the risk of losses through portfolio management. A portfolio management approach, along with financial tools such as warrants, may serve to reduce the overall financial risk of loan guarantee programs.
- *Convertible preferred equity:* To reduce the initial cash flow demands associated with loans and loan guarantees, Congress might consider the use of a convertible preferred equity instrument as a way to fund innovative clean energy projects. The concept would be, for example, for the federal government to provide the necessary funding needed for a new project and, in return, receive a controlling preferred equity position in the project or company.⁴⁴ Once the project, or company, has achieved positive cash flow that would allow for adequate debt service, the preferred equity is converted into debt, which is then repaid based on a determined repayment schedule. This approach would give the federal government a high degree of management control of the project during its start-up phase, a clear incentive for the project/company to realize positive cash flow as soon as possible, and a reasonable loan repayment schedule to recover the investment. Furthermore, this approach may reduce cash flow demand during the initial start-up phase of projects. Although, as discussed in the "Equity Positions" section above, this approach raises concerns about the level of federal government control.

Clean Energy Financial Support Authority

Should Congress decide to continue supporting development and deployment of clean energy technologies, creating an organization to manage various forms of federal financial support for

⁴³ Typically warrant holders are not entitled to seats on a company's board of directors, and are not able to vote on corporate affairs issues.

⁴⁴ Preferred equity may also have certain rights such as dividend preferences as well as common stock conversion multiples. Preferred equity rights vary on a company-by-company basis.

such endeavors may be a policy option to consider. The organization could be given authority to utilize various financial tools to manage a portfolio of clean energy deployment investments. This new organization could be located within an existing federal agency or it could be an independent body. If Congress were to decide to locate this new organization within an existing federal agency, it may want to evaluate the most appropriate federal agency to be chosen. The Department of Energy is where the current clean energy deployment loan guarantee program resides and DOE may be the appropriate agency for such a program. However, Congress may want to consider the U.S. Treasury as another option for locating a new clean energy financing authority as Treasury may offer existing finance, banking, and investment expertise that could potentially manage an organization with a variety of financial investment tools.

Legislative Action

In the 112th Congress, the Clean Energy Financing Act of 2011 (S. 1510) proposes to create a Clean Energy Deployment Administration (CEDA) within the Department of Energy. As proposed in S. 1510, CEDA would be able to use financial tools such as direct loans, loan guarantees, and insurance products to support clean energy technology manufacturing and deployment. The bill allows for a portfolio management approach as a way to manage financial risk. S. 1510 also allows the use of “alternative fee arrangements” such as profit participation, stock warrants, and others as a way to potentially reduce the amount of upfront cash fees.

Author Contact Information

Phillip Brown
Specialist in Energy Policy
pbrown@crs.loc.gov, 7-7386