



# Solar Projects: DOE Section 1705 Loan Guarantees

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Since Solyndra, a solar system manufacturing company that received a \$535 million loan guarantee from the Department of Energy (DOE), filed for bankruptcy in September of 2011 there has been much congressional interest in better understanding the characteristics of renewable energy projects, specifically solar projects, that have received DOE loan guarantees. The objective of this report is to provide Congress with insight regarding solar projects supported by DOE's loan guarantee program, the risk characteristics of these projects, and how other DOE loan guarantee projects are either similar to or different from the Solyndra solar manufacturing project.

## Key Points

- DOE's Loan Programs Office (LPO) administers three separate loan programs: (1) Section 1703<sup>1</sup> loan guarantees, (2) Section 1705<sup>2</sup> loan guarantees, and (3) Advanced Technology Vehicle Manufacturing (ATVM) loans.
- To date, all loan guarantees for solar projects have been provided under LPO's Section 1705 program.
- LPO's Section 1705 program has closed transactions that guarantee approximately \$16.15 billion of loans for renewable energy projects. Roughly 82% (\$13.27 billion) of Section 1705 loan guarantees have been for solar projects.
- Solar projects supported by Section 1705 loan guarantees generally fall into one of two categories: (1) solar manufacturing, or (2) solar generation. Each category has different financial, operational, and technology risk characteristics.
- Four solar manufacturing projects, including Solyndra, have received loan guarantees totaling \$1.28 billion, which is approximately 8% of the total dollar value of loans guaranteed under the Section 1705 program.
- Twelve solar generation projects have received loan guarantees totaling \$11.99 billion, which is approximately 74% of the total dollar value of loans guaranteed under the Section 1705 program.
- Solar manufacturing projects might generally be considered more risky than solar generation projects because solar generation projects have contractual mechanisms (power purchase agreements, performance guarantees, service agreements, etc.) that allow these projects to manage many project financial risks.
- One solar manufacturing project might be considered somewhat similar to Solyndra, only because the project aims to manufacture solar panels that use the same materials as those used by Solyndra (copper indium gallium selenide—CIGS). However, the company's manufacturing approach, products, and markets are distinctly different from those of Solyndra.

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<sup>1</sup> Section 1703 of the Energy Policy Act of 2005 (P.L. 109-58).

<sup>2</sup> Section 1705 of the Energy Policy Act of 2005 (P.L. 109-58). Section 1705 was created by amending the Energy Policy Act of 2005 through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

- All LPO solar manufacturing projects will have to address and manage the same market risks that may have contributed to Solyndra's bankruptcy. These risks include (1) declining solar module prices; (2) competition from new and established solar manufacturing competitors; and (3) subsidy/incentive reductions in international (mostly European) markets.

## Background—DOE Loans Program

The Department of Energy Loan Programs Office (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)*: loans to support advanced technology vehicles and associated components.

According to LPO's website, all renewable energy manufacturing and electricity generation projects supported by loan guarantees have used the Section 1705 program.<sup>3</sup> DOE's loan guarantee authority originated from Title XVII of the Energy Policy Act of 2005 (P.L. 109-58). The American Recovery and Reinvestment Act of 2009 (P.L. 111-5) amended the Energy Policy Act of 2005 by adding Section 1705. Section 1705 was created as a temporary program, and 1705 loan guarantee authority ended on September 30, 2011. DOE received appropriated funds to pay for credit subsidy costs<sup>4</sup> associated with Section 1705 loan guarantees, which, after rescissions and transfers, was \$2.435 billion.<sup>5</sup> From an industry perspective, Section 1705 loan guarantees were very attractive as they provided an opportunity to obtain low-cost capital with the required credit subsidy costs paid for by appropriated government funds.<sup>6</sup>

LPO has guaranteed approximately \$16.15 billion of loans for renewable energy projects. Roughly 82% (\$13.27 billion) of the value of Section 1705 loan guarantees support solar projects (see **Figure 1**). The remaining 18% of Section 1705 loan guarantees support a variety of projects for biofuel production, energy storage, wind generation, transmission, and geothermal electricity. The focus of this report is on solar projects supported by Section 1705.

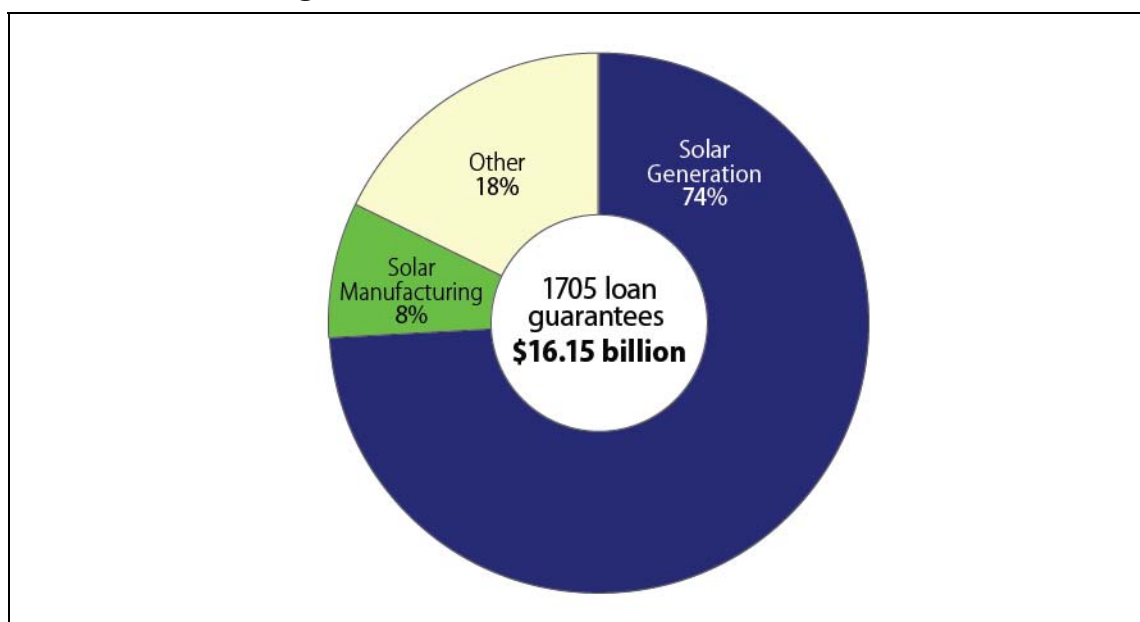
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<sup>3</sup> Department of Energy Loans Program Office website, [https://lpo.energy.gov/?page\\_id=45](https://lpo.energy.gov/?page_id=45).

<sup>4</sup> DOE's LPO provides the following definition of credit subsidy cost: "Credit Subsidy Cost has the same meaning as 'cost of a loan guarantee' in section 502(5)(C) of the Federal Credit Reform Act of 1990 (2 U.S.C. 661a(5)(C)), which is the net present value, at the time the Loan Guarantee Agreement is executed, of the following estimated cash flows, discounted to the point of disbursement: (1) Payments by the Government to cover defaults and delinquencies, interest subsidies, or other payments; less (2) Payments to the Government including origination and other fees, penalties, and recoveries including the effects of changes in loan or debt terms resulting from the exercise by the Borrower, Lead Lender or other Holder of an option included in the Loan Guarantee Agreement." See [https://lpo.energy.gov/?page\\_id=64](https://lpo.energy.gov/?page_id=64).

<sup>5</sup> Department of Energy 2012 budget appendix, available at <http://www.whitehouse.gov/sites/default/files/omb/budget/fy2012/assets/doe.pdf>.

<sup>6</sup> Section 1703 loan guarantees required the loan guarantee recipient to pay the credit subsidy cost.

**Figure 1. DOE Section 1705 Loan Guarantees**

**Source:** Department of Energy Loan Programs Office website, [https://lpo.energy.gov/?page\\_id=45](https://lpo.energy.gov/?page_id=45).

**Notes:** “Other” projects include biofuel production, energy storage, wind generation, transmission, and geothermal electricity.

Solar projects supported by Section 1705 loan guarantees generally fall into one of two categories: (1) solar manufacturing, or (2) solar generation. Each project category typically has different market, customer, financial, and technology risk characteristics. Solyndra is categorized as a solar manufacturing project. The following sections discuss the different characteristics and risk profiles for the two project categories.

## Solar Manufacturing Projects

The Department of Energy has committed to guarantee four loans totaling \$1.28 billion for solar manufacturing projects, approximately 8% of the value of all loans guaranteed under Section 1705 (see **Table 1**). Solar manufacturing projects supported by 1705 are generally for scaling up manufacturing capacity for new solar technologies that may offer cost, performance, or other discriminators in the solar marketplace. Solyndra falls into this category.

**Table 1. Solar Manufacturing Projects Supported By DOE's 1705 Loan Guarantee Program**

Project	Loan Guarantee Amount	Technology
I366 Technologies	\$150 million	Silicon solar wafer manufacturing process that may reduce silicon waste by as much as 50% compared with current processes.
Abound Solar	\$400 million	Proprietary manufacturing process for thin-film cadmium telluride (CdTe) photovoltaic modules.
SoloPower	\$197 million	Copper indium gallium selenide (CIGS) photovoltaic cell and module manufacturing using a proprietary electrochemical fabrication process.
Solyndra Inc.	\$535 million	Cylindrical CIGS photovoltaic cell and module manufacturing for commercial rooftop applications.
<b>Total</b>	<b>\$1,282 million</b>	

**Source:** DOE loan guarantee program website, [https://lpo.energy.gov/?page\\_id=45](https://lpo.energy.gov/?page_id=45). Company web sites.

Solar manufacturing projects typically have to manage several market risks in order to succeed. Each project must successfully scale-up its manufacturing capacity; produce technologies and products that are differentiated based on cost, performance, and/or other parameters; compete with companies that offer commercially proven products; and navigate a dynamic marketplace that has experienced dramatic cost reductions and new market entrants over the last several years.

One solar manufacturing project (SoloPower) might possibly be considered somewhat similar to Solyndra, only because the project aims to manufacture solar panels that use the same materials as those used by Solyndra (copper indium gallium selenide—CIGS). However, SoloPower's manufacturing approach (electrochemical), products (thin-film PV on a flexible substrate), and markets (residential and commercial rooftops) are distinctly different from those of Solyndra.

Nevertheless, each LPO-supported solar manufacturing project will have to address and manage the same market risks that may have contributed to Solyndra's bankruptcy. These risks include (1) declining solar module prices; (2) competition from new and established solar panel manufacturers; and (3) subsidy/incentive reductions in international (mostly European) markets. The success or failure of each respective project will likely be determined by the ability of each solar manufacturing project to differentiate its product in the solar marketplace, deliver expected cost and performance objectives, and convince buyers to accept some degree of new technology risk.

## Solar Generation Projects

LPO has guaranteed twelve loans totaling \$11.99 billion for solar generation projects, approximately 74% of loans guaranteed under the Section 1705 program (see **Table 2**). These projects are generally large solar electricity generation projects that use commercially proven technologies or technologies that have some operational history from pre-commercial demonstrations.

**Table 2. Solar Generation Projects Supported By DOE's 1705 Loan Guarantee Program**

Type	Project (Company)	Loan Guarantee Amount	Technology
CSP	Mojave Solar (Abengoa)	\$1,200 million	Parabolic trough concentrating solar power.
CSP	Solana (Abengoa)	\$1,466 million	Parabolic trough concentrating solar power.
CSP	Genesis Solar (NextEra)	\$852 million*	Parabolic trough concentrating solar power.
CSP	Crescent Dunes (Solar Reserve)	\$737 million	Power tower concentrating solar power with thermal storage system.
CSP	Ivanpah (Brightsource)	\$1,600 million	Power tower concentrating solar power.
CPV	Cogentrix	\$90.6 million	Concentrating photovoltaic electricity generation technology.
PV	Antelope Valley (Exelon)	\$646 million	FirstSolar thin film solar panels along with a new type of inverter technology.
PV	Mesquite Solar I (Semptra)	\$337 million	Crystalline silicon photovoltaic solar modules from Suntech.
PV	Desert Sunlight (NextEra)	\$1,460 million*	FirstSolar thin film solar panels.
PV	California Valley Solar Ranch (NRG Energy)	\$1,237 million	Crystalline silicon photovoltaic solar modules from SunPower.
PV	Agua Caliente (NRG Solar)	\$967 million	FirstSolar thin film solar panels.
PV	Project Amp (Prologis)	\$1,400 million*	Rooftop photovoltaic panels on 750 warehouse buildings owned by ProLogis, Inc.
<b>Total</b>		<b>\$11,993 million</b>	

**Source:** DOE loan guarantee program website, [https://lpo.energy.gov/?page\\_id=45](https://lpo.energy.gov/?page_id=45).

**Notes:** CSP = concentrating solar power; CPV = concentrating photovoltaic; PV = photovoltaic.

\* DOE provided a partial guarantee.

Unlike solar manufacturing projects, solar generation projects generally do not have to deal with market risks. Rather, these projects typically have to manage operation and execution risks. One specific risk associated with these solar generation projects is their ability to perform and operate at large scale. Many of the power generation projects that have received loan guarantees use technologies that have been demonstrated either commercially or at a pilot scale. However the size of each project is quite large and in some cases will be the largest project either nationally or globally to use its respective technology.

Most solar generation projects reduce market risk through the use of power purchase agreement (PPA) contracts with entities (often electric utility companies) that agree to purchase a project's electricity at defined prices for terms usually between 20 and 25 years. As a result, the focus shifts to risks associated with performance of the selected technology over the contract period (generating enough electricity to meet revenue objectives) and the operations and maintenance (O&M) costs of the project during its lifetime (keeping O&M costs low to enable cash flows that

can adequately service debt and other financial obligations). However, performance guarantees and O&M service agreements are typically used to manage these project-level risks.<sup>7</sup>

Furthermore, it is important to recognize that three different technology types are represented by the twelve solar generation projects supported by 1705 loan guarantees. As indicated in **Table 2**, the three technology types include (1) photovoltaic (PV); (2) concentrating solar power (CSP); and (3) concentrating photovoltaic (CPV). PV technology is generally considered to be the most commercially viable of the three technology types, as the overwhelming majority of global solar installations use PV. CSP technologies might be considered less commercial when compared to PV, although parabolic trough CSP systems do have some commercial operating history. CPV technology might be considered the least commercially viable of the three technologies, and the Cogentrix project supported by 1705, at 30 megawatts of generating capacity, will be the largest utility-scale CPV project in the world.<sup>8</sup> Generally speaking, projects that use technologies that may not be fully commercialized (CSP and CPV) will be higher risk than projects that use commercially proven technology (PV).

## Risk Profile: Solar Manufacturing vs. Solar Generation

For the purpose of this analysis, risk might be defined as dynamic external (market, competition, cost, etc.) and internal (technology, performance, operation) factors that can impact a project's ability to meet its financial obligations. It is important to recognize how risk characteristics of solar manufacturing and solar generation projects are different. Solar manufacturing projects typically have to manage several types of risk: market, technology, competitor, and others. Solar generation projects, on the other hand, generally need to only manage operation and execution risks. **Table 3** provides a side-by-side comparison of risks for solar manufacturing and solar generation projects. Solar manufacturing projects might generally be considered more risky than solar generation projects because solar generation projects can use contractual mechanisms to manage many project financial risks.

**Table 3. Risk Comparison: Solar Manufacturing and Solar Generation Projects**

	Solar Manufacturing	Solar Generation
Market risk	Projects must constantly manage changing market dynamics such as demand levels, manufacturing capacity levels, subsidies/incentives, etc.	Generally not an issue once the project is operating. Most generation projects reduce market risk through the use of power purchase agreements (PPA) for electricity generated.

<sup>7</sup> A performance guarantee is essentially a contractual agreement between the technology provider and the project owner whereby the technology provider guarantees, based on certain conditions, a specified amount of electricity generation for a defined time period. If the technology performs below the levels guaranteed in the agreement, the project developer can typically seek liquidated damages as compensation for underperformance.

<sup>8</sup> DOE loan guarantee program website, <https://lpo.energy.gov/?projects=cogentrix-of-alamosa-llc>.

	Solar Manufacturing	Solar Generation
Competition risk	Projects must monitor and respond to competitors with regard to technology improvements, cost reductions, and other factors.	Once a PPA is established with an electricity customer, competition risk for the project is reduced.
Cost risk	Solar manufacturing projects must keep pace with industry cost trends in order to maintain competitiveness in the marketplace.	To some degree, generation projects must manage operation and maintenance (O&M) costs in order to achieve financial projections. O&M cost risks might be managed through the use of O&M service agreements.
Technology/performance risk	Projects must ensure that the new and innovative technologies being manufactured are able to meet or exceed technology performance targets.	Many generation projects use commercially proven technologies that have minimum technology risk. Some 1705 projects are using technologies that are not fully commercialized, which may present some degree of technology performance risk. Technology and performance risks can be managed through performance guarantee agreements.
Customer acceptance risk	Solar manufacturing projects must actively work to convince potential customers to accept the new and innovative technology being manufactured. To some degree, this can be managed through sales agreements. However, in some cases sales agreements may not be contractually binding.	For projects that have established power purchase agreements, the customer acceptance risk is typically eliminated. Unlike solar manufacturing projects, solar generation project customers are purchasing electricity, not a particular technology.
Operation/execution risk	Projects must execute their construction and scale-up plans as well as their operational plans in order to achieve revenue and cost targets.	Generation projects have some degree of operation and execution risk as they need to operate in a manner that achieves revenue and cost targets. Further, many 1705 projects are the largest in either the country or the world for their respective technology types. The large-scale nature of these projects creates uncertainties that can result in operation and execution risk.

Source: CRS.

## Conclusion

Each solar project supported by Section 1705 has a unique set of project, technology, and risk characteristics that require constant management. It is important to recognize, however, that Section 1705 solar projects fall into one of two categories: (1) solar manufacturing, or (2) solar



generation. Risk characteristics for each category are distinctly different and solar manufacturing projects are generally considered higher risk than solar generation projects because the latter can use contractual mechanisms to reduce market, project, and financial risks. Whether or not Section 1705 solar projects will succeed is beyond the scope of this report. However, each Section 1705 solar manufacturing project will have to address the same market dynamics that may have contributed to Solyndra's bankruptcy. Ultimately, the success or failure of all Section 1705 solar projects will likely be determined by the ability of each project's management team to adapt to market dynamics and manage project risks.

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