# Analysis of the DOE Loan Program

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## Introduction

The Solyndra bankruptcy has, not unexpectedly, resulted in a wide range of reactions. On one end we have "This was a horrible investment and waste of taxpayers' money. We should shut down the whole program," and on the other end "Every investment has risks, and if you want success on a big problem there will be some minor setbacks. This is totally healthy and expected."

I found myself having conflicting reactions, with my rational side understanding the portfolio perspective, my business instinct telling me that Solyndra was a really bad investment, and my energy innovation advocate persona saying "That money could have doubled or tripled the size of ARPA-E for this year!"

All of these reactions lead us to a set of important questions that no one seems to have addressed. Is Solyndra representative of the other investments in the portfolio? Can I feel bad about Solyndra but still be positive about the rest of the portfolio? Are loan guarantees really a useful tool in the federal energy innovation arsenal? These are important questions, as the program continues to be a topic of discussion in ongoing budget negotiations.

In the spirit of the Energy Innovation Tracker[i] I have used publicly available information to get a sense of what the portfolio looks like. Starting with the list of DOE loan guarantees[ii] I reviewed DOE's description of each, and sought additional information by Googling around. My main purpose was to look at the technology and economic risk of the projects, and the corporate

structure and financial or the companies receiving the guarantees. I didn't look at whether the jobs claims were accurate, whether the money was being used as originally proposed, or check up on the status of the project to date.

This paper starts with a discussion of my approach to these questions, and provide some background on loan guarantees in general. The following section will look at the details of the DOE loan portfolio, and analyze its makeup. Finally, I offer my opinion on the health and effectiveness of this specific loan program, and discuss the potential usefulness of the loan guarantee programs in general.

Two quick notes. First, if you want to go straight to the data that I've compiled, its in a spreadsheet that you can download from my website[iii]. Second, if you find any mistakes in the spreadsheet please let me know at 'nearwalden' on gmail. I'd like to keep the data as accurate as possible.

## Perspective

At this moment in history, energy is an important topic global, national and local levels. While the global population grows, it also continues to advance economically, increasing the global ranks of the serious energy consumers. The new consumers, in turn, increase our use of, and dependence on, fossil fuels, with corresponding damage to the atmosphere, land and seas. Meanwhile, we seek to help the ranks of those living in energy poverty: more than a billion humans faced with economic, health and education challenges intensified by a lack of safe, affordable energy.

Nationally and locally we face these same issues, as well as serious, energy-related economic and security issues. How do we provide a reliable, reasonable-cost energy supply to our citizens and businesses, while reducing our environmental impact and dependency on other, often unstable, nations?

While our current technologies can slow the growth of these problems, they are not sufficiently advanced to allow us to reverse these problems at a bearable cost. In the case of wind, solar, biofuels, fuel cells, geothermal, batteries, and even nuclear, we can point to specific, but as of yet unmade, improvements that make each a game-changing energy technology. Similarly, we can point to theoretical strides in efficiency across our economy that would also be game changing. It is the profound benefits of these potential breakthroughs that make energy innovation a critical element of today's energy policy.

While some might debate specific points of the previous paragraphs, it is hard to argue with the local, national and global benefits of discovering a source of reliable, cheap, clean

energy. So while we invest around $4B annually at a federal level in direct energy R&D, I (and many others) believe that we need to invest much more.

But advocating for increased investment also carries an important responsibility to say how the money should be invested. Are taxpayers' dollars being invested effectively? Is government playing an appropriate role in the overall innovation system? How can we invest more intelligently, improving our chance of success with a given amount of investment?

In addition to looking at our investment in an economic and strategic sense, we also need to recognize the importance of the political and public perceptions of these investments. Especially in the current austerity, one that will likely persist for the foreseeable future, programs that don't pass the "smell test" will be vulnerable to defunding irrespective of the rational framework that supports their existence.

It is in this light that I started digging beneath the headlines of the DOE loan guarantee program. Its safe to say that, through the Solyndra bankruptcy, DOE's Loan Program has already damaged federal energy innovation in the public and political realms, while its benefits have largely remained invisible. Should we expect more Solyndra's? Are there hidden successes that aren't as visible as the failures? Is this a wise expenditure of energy innovation money? Is this loan program, as currently implemented, a valuable part of our innovation portfolio, or should energy innovation advocates be calling for it to be reformed, or even shut down? These questions are the focus of this paper.

## Loan Guarantees

Loan guarantees are not simple financial transactions, so it is worth understanding them in general before focusing on the specifics of the DOE program. Please note that this is a vastly simplified description of loan guarantees. In reality they are actually much more complex, involving numerous, important terms and conditions, such as where the guarantor sits in the pecking order of creditors if a company goes bankrupt.

A straightforward loan involves a lender and a borrower. The lender provides upfront capital, and the borrower pays it back over time, plus additional interest payments that provide a return to the lender, and also represent the risk of the borrower defaulting on the loan. In general, higher risk loans will demand higher interest payments.

In a simple loan guarantee, a third party assures repayment to the lender for some fraction of a loan, should the borrower default. As such, a loan guarantee de-risks the loan for the *lender*. Reducing the risk for the lender changes a perspective loan in two possible ways. First, a lender may be willing to make a loan that they would have normally rejected without the guarantee. In other words, they may have felt that the loan was too risky to make, but with a suitable guarantee, the risk is now low enough that they will make the loan. The second important change to the loan is in the cost to the borrower, as the interest rate of a loan reflects the perceived risk. A lower interest rate lowers the overall cost of the borrower's project. This can be particularly important in capital-intensive projects, such as a wind tower, where the cost to build the tower is reflected directly in the cost of the electricity it produces.

It is natural to wonder why the government doesn't just make direct loans to companies for interesting projects. The main reason is that if the government makes a loan for $50, then it

needs to have $50 in its budget that it can hand out. But if the government guarantees a loan, they don't have to pay out any money up front. Instead they have to keep a reserve in case some of the loans aren't paid back, in which case it falls to the government to pay off the lender. However, statistics would suggest that every borrower will default, so the government calculates its overall risk and sets aside a reserve to cover that amount, as opposed to the sum of all loans that are guaranteed. So if the government guarantees a collection of loans totaling $50, they may only need to take a reserve of $10 from the current budget, resulting in leverage of 5 times.

Of course it is possible for some chain of defaults, possibly due to some systemic risk, to cause more loans to default than can be covered by reserves. This may sound familiar, since it's a simplified version of what happened with government's guaranteed mortgages administered by Fannie Mae and Freddie Mac.

Another interesting aspect of loan guarantees is their impact on the risk assumed by the borrower. Usually the risk of the borrower is reduced, as a result of the decrease in their cost to borrow the money, as reflected in the interest rate. However, it is possible for a loan guarantee to *increase* the risk of the borrower when a loan guarantee allows them to take out a loan that they are unlikely to be able to afford. The latest US financial crisis has revealed many such stories, and it can also happen in the industrial world, when, for example, a company is given a loan to build a factory that is bigger than they can really afford.

One last general note about loan guarantees: the guarantor may be taking a significant "stake" in the future of a company, but does not necessarily get the same control as other stakeholders. For example, a major equity investor has voting rights relative to their share of the overall stock pool, and is likely on the board. As a guarantor, the federal government has no

voting rights, and legally can't be on the board. The government still has ways to have significant influence, but not through the formal corporate governance.

## *Success Criteria*

Generally speaking, a government loan guarantee program will target a worthy industry or technology that faces an economic disadvantage, with the goal of overcoming that disadvantage by lowering the cost of capital. In the case of clean energy, the goal is to help lower the cost of capital so that new technologies may compete more effectively in the market with fossil fuels. If everything works, the nascent technology will gain traction in the market, driving down its costs and allowing it to compete in the future without the benefit of public support. In popular "innovation economics speak," we're trying to get the new, desirable technology across the "valley of death".

Based on this description we can determine a number of characteristics that a successful loan guarantee program would need to exhibit.

1. *Clear goal.* Pushing a technology across the valley of death is very difficult. As such, it is important that investment dollars are focused on a small number of clear goals, and not dispersed across many areas so that individual organizations benefit, but there is no aggregate improvement at an industry or technology level.
2. *Additionality.* This term is used here as it is in the GHG management world[iv], and asks whether an action taken (say a loan guarantee or investment) actually results in a change of behavior. If a targeted project would have happened with or without a specified incentive, then the incentive is defined to have had no additionality. Typically, additionality is difficult to judge, especially since the recipients of

incentives are always likely to respond favorably to the question "if I give you some money, will you change your behavior?" However, in some cases it is clear that the activity would have happened with or without the incentive.

3. *Reasonable financial risk.* One of the tricky parts of a loan guarantee program is gauging an appropriate amount of risk for a given amount of reserve capital. Ultimately, if the reserve capital can't cover the cost of the failed loans, then the program will need to be bailed out. On the other hand, if the risk is far less than the capital reserve, then the excess reserve capital represents "dead capital" that is sitting idle and unavailable for other uses.
4. *Reasonable political risk.* When discussing a loan guarantee program in a highly visible and contentious area, such as energy policy, reasonable political risk is also a requirement. Failure at a political level not only jeopardizes future loan guarantee programs, but may spill over to other types of programs in the same area, or other loan guarantee programs in a different area.

## *Useful Scenarios*

Understanding what a loan guarantee does, we can describe some generic scenarios and understand the guarantee's impact in each case. The following scenarios are described from the point of view of the person receiving the loan:

1. *"I couldn't get the loan without the loan guarantee"*. In other words, the market determined that the loan was too risky, but the loan guarantor accepted enough of the risk that the market was now willing to make a loan.

2. *"I could get a loan, but the interest rate was too high to make the project financials work. With the guarantee the interest rate went down and the project can have a positive ROI."*
3. *"I could get a loan and the interest rate was fine, but the loan guarantee made the interest rate even better,"* or *"I didn't even need a loan for this project, but the guarantee made the interest rate was so low that it was silly not to take it."*

These scenarios translate directly to a statement of additionality, with scenarios 1 and 2 being additional, and scenario 3 providing no additionality. For example, if I say that a loan guarantee created 250 jobs, but the borrower was in scenario 3 above, it is clear that the project would have happened without the guarantee, undermining my claim that the loan helped lower unemployment.

We can also look at the risk to the guarantor in each of these scenarios. In scenario 3 the risk is likely low, as the market had already determined that a loan was safe, and lowering the interest rate will not make the loan riskier. In scenario 2 the risk is a higher, but still low reasonably low assuming the lender has properly captured the project's risk in its interest rates. Finally, in scenario 1 the guarantor is taking on significant risk: the market felt the loan was too risky, but the guarantor has decided to take on that risk anyway.

## *A Real Example*

Data provided in a recent NY Times article[v] shows a loan guarantee in action, providing a glimpse into the complexity of a real-world project. The article includes a chart[vi] (Figure 1) that

shows the projected profitability of a specific DOE Loan Program recipient, NRG's California Valley Solar Ranch project.

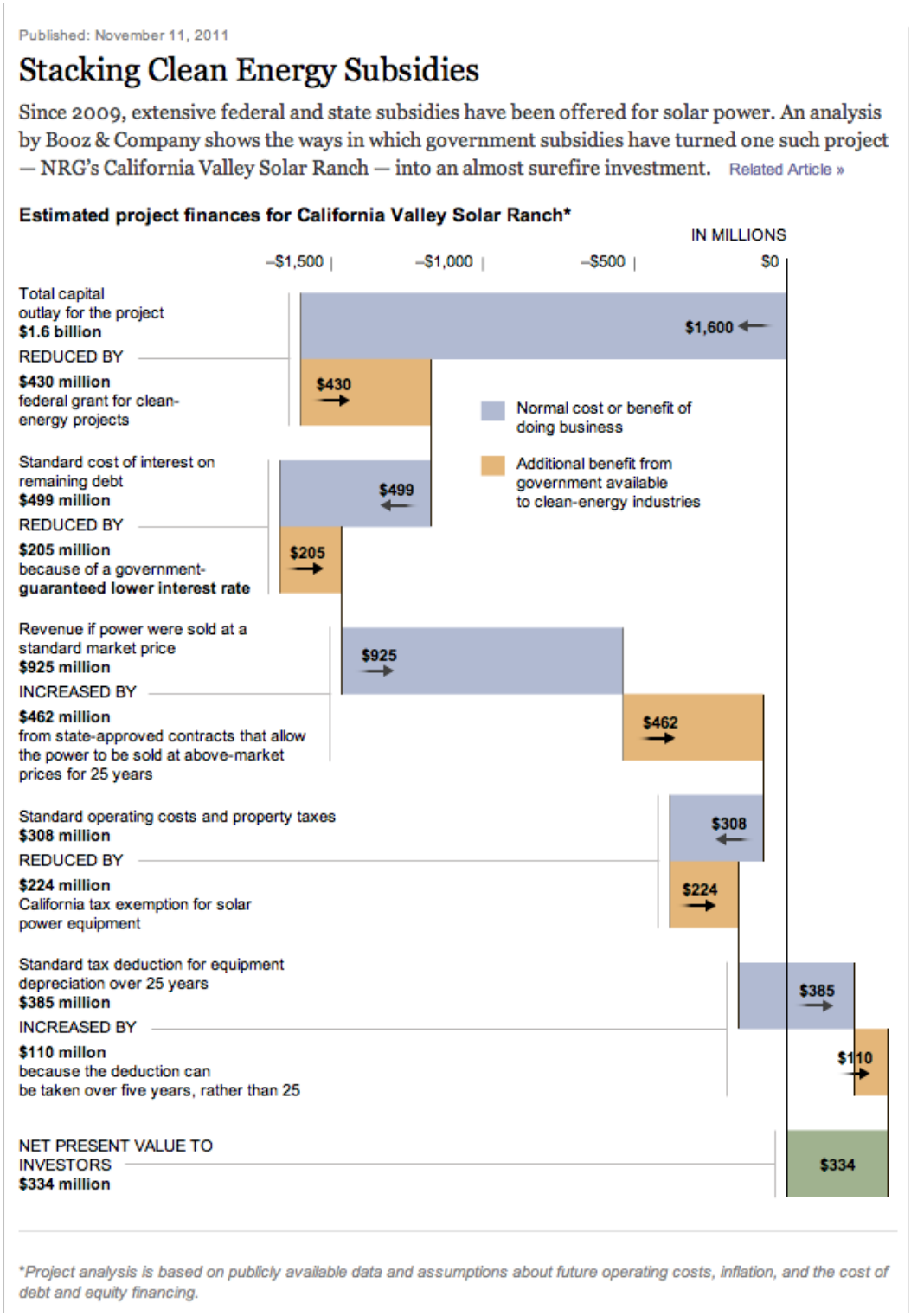


**Figure 1: NY Times - Estimated Project Finances**

In this case the capital required to build the solar facility is $1.6B, and the DOE loan guarantee has been calculated to lower that cost by $205M over the life of the loan. In addition to the guarantee, this project is benefiting from a number of other state and federal clean energy programs, and has already signed a long-term Power Purchase Agreement (PPA), meaning that it has a committed, long-term customer for its electricity.

While no data is provided in this article to evaluate the overall loan portfolio, we have enough information to look at the other three criteria.

Given that NRG is a very large, public company, the project had a long-term customer contract, and the project appears to be profitable even without the loan guarantee, this seems to match Scenario 3: a project that could have already gotten a loan at a reasonable cost, but was happy to have the interest rate lowered through a DOE loan guarantee.

In the case the loan guarantee was likely not a key in determining if the project would go forward or not, so this guarantee was not additional. Financial risk of this project looks very low, possibly too low for this type of loan program. Political risk in this case is moderate. While the NYT article does not shine a favorable light on the loan guarantee, it has also not resulted in the widespread scrutiny of the Solyndra loan.

Overall, you could say that this particular loan guarantee had little risk for the government, but also little upside, as claims of being a key to the project's success, and resulting jobs, are not easily justified.

## The Data

The DOE Loan Program was funded and began operation in 2007 under President Bush, and the first loan guarantee was made to Solyndra in 2009 under the Obama administration. The Program has a website[vii] that describes the program and lists all of the projects for which it has guaranteed loans.

The program consists of three separate sub-programs: Section 1703[viii] ("...support innovative clean energy technologies that are typically unable to obtain conventional private financing due to high technology risks. In addition, the technologies must avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases."), Section 1705[ix] ("...authorizes loan guarantees for certain renewable energy systems, electric power transmission systems and leading edge biofuels projects that commence construction no later than September 30, 2011."), and ATVM[x] ("...loans to support the development of advanced technology vehicles and associated components in the United States.").

The program guarantees up to 80% of a loan, and has participated in 38 loans to date, guaranteeing a total of $35.9B. A number of loans got initial approval but did not end up passing their final review, so were not funded. Also, a number of projects have been sold after the loan was guaranteed.

I have summarized the loans in a spreadsheet that you can download in Excel format (http://www.nearwalden.com/blog/files/DOE-loans-20111210.xlsx) and here in PDF (http://www.nearwalden.com/blog/files/DOE-loans-20111210.pdf). In addition to the information from the website, I've included additional information about the borrowing companies and the projects. I have used only public sources for this analysis.

One note: if a company is a wholly owned subsidiary of another company, the corporate financial information reflects that of the parent company. This is based on the assumption that the parent company would not allow a wholly subsidiary to default on a major loan. However, it is always possible for the parent to spin out the subsidiary or project, at which point the analysis needs to be redone.

The spreadsheet shows the following information about the loan program. Note: all statistics include Solyndra and Beacon Power except the jobs figures.

- The total amount guaranteed is $35,905M, for an average guarantee size of $944M.
- The largest loan was $8.33B to Georgia Power Company (23.3% of the total), and the smallest was $17M to energy giant AES (0.05% of the total).
- The subprograms break down as follows:
    - 1703: 4 projects totaling $10.6B
    - 1705: 28 projects totaling $16.1B
    - ATVM: 6 projects totaling $9.1B
- The DOE Loan Program Office claims 9,719 full time jobs created, 18,995 construction jobs created, and 33,000 "jobs saved" (all at Ford). These numbers do not include the Solyndra or Beacon Power estimates. Assuming the loan guarantees were fundamental in creating these jobs, the jobs cost out as follows:
    - $581K guaranteed per job (all categories)
    - $1.25M guaranteed per full time or construction job (i.e., ignoring Ford jobs)
    - $3.69M guaranteed per full time job (i.e., not counting Ford or temporary construction jobs)

- All of the projects are located in the US, and are distributed among time zones as follows:

| Region | Projects | Loans ($M) |
|---|---|---|
| East | 8 | $9,390 |
| Central | 6 | $2,732 |
| Mountain | 1 | $91 |
| West | 19 | $15,868 |
| Hawaii | 1 | $117 |
| Multi-region | 3 | $7,707 |

- Of the companies receiving loans, 24 were public (or wholly owned by a public company) and received guarantees value at $29.52B. The remainder, 14, were private, and received guarantees of $5.98B.
- Nine of the loans were secured by a foreign company, or by a wholly owned subsidiary of a foreign company, representing $7.57B of the loans. The remaining 29 projects ($28.33B) were US corporations.
- The corporate revenues of the companies receiving guarantees are shown in the following table. The first line includes some pre-revenue private companies with no publicly reported data, but that are believed to be very small. The last line includes post-revenue, established private companies for whom no public data is available.

| Annual Rev. ($M) | Projects | Loans ($M) |
|---|---|---|
| Under $100M | 14 | $3,593 |
| $100M - $999M | 3 | $686 |
| $1B - $9.99B | 7 | $6,719 |
| $10B - $99.9B | 8 | $14,204 |
| Over $100B | 3 | $7,698 |
| Unknown | 3 | $3,005 |

- The sizes of the loans break down as follows:

| Size | Projects | Loans ($M) |
|---|---|---|
| Under $100M | 7 | $468 |
| $100M - $199M | 7 | $972 |
| $200M - $299M | 1 | $245 |

| | | |
|---|---|---|
| $300M - $399M | 3 | $1,030 |
| $400M - $499M | 2 | $865 |
| $500M - $599M | 2 | $1,064 |
| $600M - $699M | 1 | $646 |
| $700M - $700M | 2 | $1,467 |
| $800M - $899M | 1 | $852 |
| $900M - $999M | 1 | $967 |
| Total under $1B | 27 | $8,577 |
| $1B - $1.99B | 8 | $11,091 |
| $2B - $3B | 1 | $2,000 |
| $5B - $6B | 1 | $5,907 |
| $8B - $9B | 1 | $8,330 |

- The following table shows the main business function of the projects.

| Business Activity | Projects | Loans ($M) |
|---|---|---|
| Electricity generation | 20 | $22,536 |
| Grid infrastructure | 3 | $403 |
| Manufacturing plant | 11 | $10,678 |
| Fuel production | 3 | $2,237 |
| R&D | 1 | $50 |

- The following table shows the main energy technology of the projects.

| Energy Technology | Projects | Loans ($M) |
|---|---|---|
| Solar | 17 | $14,555 |
| Wind | 3 | $388 |
| Geothermal | 3 | $546 |
| Grid | 3 | $403 |
| Biofuels | 2 | $237 |
| Vehicles | 6 | $9,129 |
| Nuclear | 2 | $10,330 |
| Coal | 1 | $245 |
| Buildings | 1 | $72 |

## Analysis

The facts in the previous section provide a baseline view of DOE's Loan Program, but they don't yet answer some of the most common questions about the program. Are the failures to date an anomaly, or will others fail? What's DOE's overall strategy? Did these loans really make a difference?

In the next few sections we'll look at these, and at some other interesting questions that arise from the data.

### *Strategy?*

When I started this project I expected to spend some time gathering data on each individual loan, and then the next step would be to break the loans into categories. I figured that the three loan programs (1703, 1705 and ATVM) would provide an initial structure, and then projects in each group would reveal some common themes, providing a basis for analysis. It didn't work out that way.

My work on the Energy Innovation Tracker (EIT) should have probably prepared me better. That project revealed that the DOE has put chips on every number, spreading budget across the full gamut of technologies, innovation phases, and use cases.

The Loan Program portrayed a similar breadth of investments, with the exception of a focus on solar electricity generation projects in the southwestern US. Together these 13 guarantees made up a little over a third of the total dollars. Beyond the solar generations projects, the rest were spread across a wide variety of technologies, and were random in the sizes of the loan guarantees, as well as in the sizes of companies who received them. (Question: how

did energy giant AES only walk away with a $17M loan guarantee, roughly 1/50 of the average and 1/400 of the largest loan?)

So like EIT's energy innovation budget analysis, this study reveals little about the Department's vision for a future, American, clean energy infrastructure. Instead it probably reveals more about the process by which projects were solicited and selected. One gets the impression of a selection process with a very limited number of viable projects to choose between. This is reinforced by reports of high pressure with the Obama administration to get guarantees done in a short period of time.

One also gets the impression of a selection process with outside influences. Without questioning the legitimacy of those influences, one has to wonder if it was chance that the only US car company to get a guarantee was also the only US car company to refuse bailout funds, that the only university to be involved is the endowment of an elite, Ivy League school, and that a number of projects were previous recipients of more than one round of DOE funds.

Why only one nuclear plant, one steel mill (Russian-owned), and one building efficiency project (half French-owned)? Did the money run out after one project each in these areas? Were these the only applicants in these categories? Or were other factors in play to single these companies out? It is not my goal to fuel conspiracy theories; instead, I raise these questions because I couldn't avoid them asking them myself as I dug into the details of these loans.

To me, the main issue here comes back to one of strategy. With the exception of desert solar, the DOE's energy strategy appears to be to invest in every option and hope that something breaks through. While this is a possible strategy, is it really the best we can do, or is it just the best strategy that doesn't force the agency to make any hard decisions? For example, what is the proposed role of nuclear energy? On the one hand DOE has implied it is important, given the

allocation of almost 1/4 of the loan guarantee dollars. On the other hand the DOE loan program is supporting just one project, signaling that it is not viewed as a broad-based solution.

Like a risk-averse gambler, the DOE spreads its innovation bets broad and thin, hoping to not lose big, while diminishing any chance of serious upside. Until DOE provides a more focused strategic framework, investments such as the DOE Loan Program are destined to fall short of their potential impact.

### *Risk*

The most obvious question raised by the Solyndra and Beacon Power bankruptcies is how many of the other projects are at risk.

In determining risk I looked for projects that fall within scenario 1 from the earlier discussion: projects that would have been unable to get financing from the broader market without the federal guarantee. To determine if it was a scenario 1 project, I used three criteria:

1. The government has a larger stake in the company than any other creditor or investor (i.e., more to lose if the company were suddenly worth nothing)
2. The company or technology lacks a credible track record that would normally be required to justify a major loan
3. The company has serious, existing financial woes that are not alleviated by the loan

Based on these criteria and the data I had gathered, there are 9 projects (in addition to Solyndra and Beacon Power) that would have been highly unlikely to secure financing without the government's support:

1. Red River Environmental Products, LLC (wholly owned subsidiary of ADA Environmental Solutions) ($245M)
2. 1366 Technologies ($150M)
3. Abound Solar ($400M)
4. Brightsource Energy ($1.6B)
5. Kahuku Wind Power, LLC (wholly owned subsidiary of FirstWind) ($117M)
6. Nevada Geothermal Power Company, Inc. ($98.5M)
7. Record Hill Wind ($102M)
8. Solar Reserve, LLC ($737M)
9. US Geothermal ($97M)

These nine projects represent $3.4B in total loan guarantees. In addition to these nine there are four other projects whose risk is notable, but difficult to measure due to the lack of publicly available data:

- Two projects (Sage Electronics and SoloPower) are undergoing a large growth in manufacturing capacity, but there is insufficient data on current revenue and profits to determine if sufficient demand exists to justify such a large increase.
- Two projects (Tesla Motors and Fisker Automotive) are investing in manufacturing capacity for new electric cars with no history of demand. Both of these companies, however, have valuations that are much larger than the loan, which indicates a lower risk for the government.

Finally, the Vehicle Production Group LLC project is probably very risky as well, but the loan is relatively small, and the product is appealing due to its feel-good application and innovative approach. Since I have no data on the possible market, I left it off the list.

## *Project Discussion*

This section will dive deeper into the individual projects. I have roughly grouped them by technology to organize the discussion.

### Nuclear

The loan portfolio includes only two nuclear projects, one to help finance a new nuclear electricity generation plant, and the second to increase production capacity for nuclear fuel. Both guarantees were to large companies with billions in annual revenues, and together they represented almost 1/3 of the total amount of guarantees ($10.33B).

I have to admit that I'm not sure what to make of these two projects and their risk. My sense is that they are scenario 3 (would have happened anyway without a loan guarantee), so that these were low-risk selections, but also had minimal impact while tying up a good fraction of the total pool. As mentioned earlier in the strategy discussion, it is also difficult to put these guarantees in the context of the apparent apathy in the federal government towards nuclear power. Are these loans a sign of warming to the technology, or were these projects singled out for some other reason?

By similar reasoning, a hard turn away from nuclear energy in the US could make these investments suddenly quite risky.

## Clean Tech Manufacturing

Five projects are involved in the expansion of clean tech manufacturing capabilities, representing about $1.6B in guarantees (I didn't include the five automotive manufacturing projects, which I will discuss later, or Solyndra, which would have been in this category if it was in business). One is involved in carbon manufacturing, one in energy efficient glass, and the other three in solar technology.

All of these projects made my list of risky projects, with four of them getting loans that I felt would have been unattainable without the federal guarantee, and one (Sage Electronics) where I had insufficient information to determine the overall risk. A big concern in each of these projects is the major increase in manufacturing capacity and the associated costs, combined with other factors such as insufficient product track record or limited company capital. The bet is that increased sales and potential for decreased product cost can overcome the increase in operating costs that comes with more facilities and associated staff, and a large loan to pay off.

I have serious doubts whether a loan guarantee is the best way for the federal government to assist these companies. It would seem like these companies would value an increase in customer activity over a decrease in their loan amount. We'll return to this point again in the last section.

## Grid Projects

There were originally three grid projects, but one (Beacon Power) has since gone bankrupt. Of the two remaining projects, one is a (very) small loan guarantee for a subsidiary of AES, and the other is a new transmission line in Nevada.

The AES loan is unusual just because it's such a small amount ($17M) to such a large company ($14B/year revenue), meaning that this is almost surely a scenario 3 project that would have happened with or without the loan guarantee.

From the data available the transmission line loan looks logical. Supporting the installation of large amounts of solar in the Southwest means that the power has to get somewhere, so using a loan guarantee to lower the break even point for the transmission line project in that region makes sense. In addition, the investors should have a pretty good idea of new sources and the demand they match up to, so the risk here should be fairly low.

### Wind

The portfolio contains three wind projects, representing a total loan guarantee of $388M. Two of the projects are in New England, and the third is in Hawaii. I identified two of the projects as risky due to their ownership and lack of underlying assets (Record Hill Wind and Kahuku Wind).

Granite Reliable has the large, global asset manager, Brookfield Asset Management as a primary investor, and has two long-term PPAs, so I would classify it as either scenario 2 or 3.

I was unable to find a record of PPAs for either of the other two projects. Record Hill Wind has a number of investors, including the Yale endowment, but its sole assets appear to this one project. Kahuku Wind is a wholly owned subsidiary of First Wind, which tried, unsuccessfully, to go public in 2010. First Wind has over $550M in debt and ongoing losses, and admits that it may be at risk of default[xi]. The US Treasury Department and DOE had already invested more than $113M in First Wind prior to this loan guarantee.

## Biofuels

The DOE guaranteed loans to two biofuels projects for a total of $237M. Both are cellulosic ethanol plants that plan to use corn waste (stalks, cobs, leaves, etc) as a primary input.

There are two potential risks with these projects. The first is the technology risk, since these are employing new techniques that have not previously been deployed at scale. Presumably these are fairly small risks, since it should be possible to test these technologies at smaller scale. The second risk is a major change in US ethanol requirements and subsidies. While these projects should be a lower risk than corn-based ethanol plants, a loss in subsidies and ethanol volume requirements would surely have an impact for these projects in terms of distribution, market acceptance, etc. In addition, such changes would likely impact POET, LLC, owner of one of the projects since it is purely invested in biofuels.

On the other hand, the two companies involved (Abengoa of Spain, and POET, LLC) are large and well established.

## Geothermal

The loan portfolio includes three geothermal projects, with a total guarantee of $533M. The largest guarantee was to Israel-based Ormat, through its US subsidiary, which has been in business since 1994. This project has a PPA in place for the three geothermal plants that it is building.

The other two projects made my list of risky loans due to the financial condition of their parent companies. The first, Nevada Geothermal, operates 77 geothermal plants with 4GW. However, it recently had a $20M market cap and only $9M cash, balancing a $157M of debt, [leading to speculation of upcoming financial problems[xii]. Similarly, the second, US

Geothermal, recently had a market cap of $32M and $9.6M in cash, and has been delisted from the New York Stock Exchange. Combined, these two companies received loan guarantees of over $190M.

## Solar Energy

Solar energy generation represented the largest group of related guarantees, with 13 grants totaling $13.3B. Other than the Cogentrix project at $90.6M, the projects received guarantees in the $800M to $1.6B range. Similarly, other than the Cogentrix project that is located in Colorado, the others are in the American southwest.

One project, "Project Amp," is a distributed generation project, while the remaining projects are all large, centralized facilities.

I identified only two of these projects as risky. The first, Brightsource, was listed due to the lack of historical profits. The project does have a PPA in place, and the company is attempting to do a $250M IPO, which would help its financial stability. However, the company's profitability is still in question: ["The company has amassed losses of $265.6 million since it was founded, including $88.4 million in the first six months of this year, according to the new filing. It expects losses to continue for the foreseeable future."[xiii]

The second risky project involves a $773M guarantee to Solar Reserve, LLC. Very little information is available about the four year-old company, and this is the first at-scale deployment of the technology, which was spun out from United Technologies.

Ten of the projects are run by very large energy public companies (annual revenue greater than $5B). Two of these projects were sold from First Solar during the loan review

process. Most likely all of these projects would have occurred independent of the loan guarantee program.

Overall this is the most "coherent" set of grants that were made, making a clear statement of support for large-scale solar energy in the southwestern US. But with that comes systemic risk. As noted in the next section, a change in the energy policies of California could put most projects in this group at risk.

I was unable to uncover documentation of the expected cost/kWH of the electricity these projects would generate. It would be very interesting to know if the lower cost of capital provided by the loan guarantee played a substantial role in making these project viable, or if they were more dependent on other government policies. I suspect that many of them are similar to the Desert Solar project highlighted by the NY Times, where the loan guarantee was a small fraction of the overall subsidies to the project, and in the end was not a deciding factor in the estimated profitability

## Automotive

While solar energy represented a "coherent" investment by the DOE, the 6 project, $9.1B automotive portfolio may be the least coherent.

To start, why did automotive giants Ford and Nissan take large loan guarantees ($5.9B and $1.4B respectively)? Presumably the answer is a) because they could, and b) because the government wanted it give them to them for some reason. Both projects were for plant re-tooling that had to take place no matter what. It is possible that these guarantees were part of a separate negotiation, such as the latest round of EPA CAFE standards.

Next on the list is the $730M loan guarantee to a Russian-owned, Michigan-based steel mill. While no one will argue against financial support for the Detroit area, it is hard to see how this loan fits within DOE's strategic envelope (I know, lighter steel makes cars more efficient, but so do lots of other things).

The next loan is for $50M of R&D to "support the development of the six-passenger MV-1, a factory-built wheelchair accessible vehicle that will run on compressed natural gas". First I'll note that this is a really interesting project, and that it deserves government support. Then I'll add that R&D is the probably the last thing a loan guarantee should be used for, as it is the farthest from actual revenue generation.

Finally, we have two loan guarantees to upstart electric automakers Tesla Motors and Fisker Automotive, who basically split $1B. I understand the desire to support the US car industry, though question why DOE is taking the lead in doing that. I also understand DOE's desire to catalyze the market for electric cars, though question whether funding whole new car companies is the right way to do it (as opposed to a company focused on electric drive trains, for example). I worry about the fact that their product lines are very high-end focused, and about the ongoing, global automobile manufacturing consolidation, where even mid-tier companies like Volvo can no longer stand on their own.

Proponents will say that these companies are well funded and have market values well above the size of their guaranteed loans. They are right, and that's the reason I didn't list these as risky investments. However, I believe that ten years from now neither of these companies will be a stand-alone, independent company, and the only question is whether their financial journey results in the DOE being paid back.

## *Failure Modes*

There's no doubt that the Solyndra and Beacon Power bankruptcies are an ongoing PR issue for the DOE Loan Program, and it raises the question of what other things can go wrong.

It's clear that opponents of the program, whether driven by political or philosophical differences, are looking hard for evidence of serious wrongdoing in the program's operation. Nothing I have encountered suggests one way or another whether they will find anything, so I have nothing to add to that discussion. However, I have identified five scenarios that could result in further political and financial damage, independent of some form of malfeasance.

### Continued Bankruptcies

With two bankruptcies to date, an obvious question is whether defaults could add up to the point that the program exceeded its budget and had to be bailed out.

As discussed earlier, I've flagged nine ongoing projects as "risky", representing loan guarantees of just over $3.5B. With the two companies having already failed, suggesting that it would not be a surprise for losses could approach $4B. Furthermore, an unexpected loss or two could drive the total up quickly.

I have looked into how the government manages reserves for these loans, and it is complex. I believe, based on federal budgets, that the reserve is in the neighborhood of $5B to $7B, in which case the program is unlikely to get to the point where it needs to be bailed out. However, ongoing bankruptcies within the portfolio will continue to bring negative attention to the program and continue to weaken its support.

### Foreign Default

One surprise for me in the data was the number of loans that were made to foreign-owned companies. Each of these guarantees were to an American subsidiary, and supports a project that is supposed to be wholly implemented in the US. I personally am not against these loans on principle, but only to the extent that the foreign companies take their role in these guarantees seriously.

These projects represent a liability to the program overall: if a foreign-owned company were to default on a loan there, would be a serious economic, PR and political blow to the program. How likely is that?

To date the DOE Loan Program has made 8 loan guarantees with a value of just under $7.5B to projects that are run by companies that are wholly owned subsidiaries of foreign corporations. Three of them are to Spanish-owned Abengoa, who has a huge investment in the US, but could possibly be susceptible to EU financial woes and changes in Spain's energy policy. Nissan and Areva are very large companies, and unlikely to let their loans default. Nevada Geothermal and Ormat are smaller companies (revenue under $500M) so may be riskier, and Severstal is big, but a possible risk given the state of politics in Russia.

## Parent is "Too Big to Fail"

Many of the projects in the energy generation part of the portfolio are setup as Limited Liability Corporations (LLCs). Most of these LLCs appear to have no assets other than the project themselves, but are generally funded by large and/or heavily financed organizations. The following shows some of projects:

- Abengoa Bioenergy of Kansas, Abengoa/Mojave Solar, Abengoa/Solana (all subsidiaries of Abengoa of Spain)
- AES Energy Storage (subsidiary of AES)
- Cogentrix (wholly owned by Goldman Sachs)
- Desert Sunlight and Genesis projects (wholly owned by NextEra)
- California Valley Solar Ranch and Agua Caliente (wholly owned by NRG)

As discussed in the last two sections, I haven't conceived of these projects as having any real risk, based on the assumption that the LLC that is operating the project would ensure that the project does not default on the US Government's loan guarantee. On the other hand, these projects are organized as separate corporations, so it is conceivable that the larger parent companies could restructure and wash their hands of one of these projects, leaving the DOE with the bill. We've already seen a number of these projects change ownership, so this may not be as far fetched as it appears.

The DOE may have guarded against this in structuring the guarantees, which would be great. I'd be interested in data from anyone who can describe whether this is a realistic possibility or not. In the meantime,

## California Change of Heart

A number of people have highlighted another problem scenario. Five billion dollars of solar projects in California have signed power-purchase agreements with California utilities, who, in turn have committed to be long-term customers of the guaranteed project. These power

purchase agreements certainly reduce the risk of these projects -- having a long-term, committed customer greatly reduces the risk of any company.

But these power purchase agreements aren't necessarily permanent. In particular, a political shift in California could ease the pressure on the state's utilities, who might face serious temptations to break their contracts in search of cheaper alternatives. To understand the potential impact of a policy shift in California, we can again turn to the NY Times analysis, which shows just how invested the state is in these projects. A revolt by California electricity users over their high rates, or a shift in support from the states could make a significant hit to the portfolio.

There are similar bets in Colorado, Arizona, et al. but these are not as concentrated.

## Policy Shifts

As noted in the last section, there are a number of other projects whose success is tied to federal energy policy:

- Two nuclear projects with dependencies on the permitting process
- Two ethanol projects with dependencies on ethanol subsidies
- Two electric car projects with dependencies on electric car subsidies

Shifts in these, or other policies, could seriously impact the potential of these projects.

## Summary

As you would expect, there are some other projects that have the potential to fail on their own, as Solyndra and Beacon Power have. In addition to these risks, the program also faces potential risks from foreign ownership, fluid corporate structures, and state and federal energy policies.

## Summary and Looking Forward

I started the project with little knowledge or opinion of the DOE Loan Program, other than the news and analysis of the government's role in Solyndra's bankruptcy. But in the process of better understanding loan guarantees and the DOE portfolio, two things have become clear to me.

First, the current program has serious flaws, and is, overall, not an effective use of energy innovation funds. As a result, I would urge proponents of energy innovation to not offer blind support for the DOE Loan Program, as it is likely to have ongoing issues that could result in serious public and political damage to itself, and could spill over into other energy innovation programs.

Second, there may be a place for loan guarantee programs in today's energy innovation policy toolkit, but it should be applied to a very narrow spectrum of projects, and, as such, will never be a major tool.

The last two sections of this note will examine the current program, and will provide a framework for thinking about future programs.

### *Grading the DOE Loan Program*

I will grade the current instantiation of the DOE Loan Program based on the success criteria laid out in the beginning of this document, three level scale of Good, Fair and Poor. Given the lack of financial data on some of the projects and companies, and the inherently subjective measure of the grades, grading with more granularity would not be productive.

1. *Clear goal:* **POOR/FAIR**. As covered in the strategy discussion, there is no clear, written goal for the overall program, and that manifested itself in the program portfolio where a majority of the projects are related to, at most, one or two other projects in the portfolio. The one positive exception is the third of loan guarantees that were applied to solar energy generation projects. These 13 projects were more coherent in purpose, loan structure and expected results. So while I gave the overall portfolio a **POOR** rating, limiting the scope to just the electric generation projects, I would give the program a **FAIR**.

2. *Additionality:* **POOR**. Though additionality is difficult to measure exactly, more than half of the dollars of loan guarantees were given to projects, run by very large companies, within the core business of these companies, and in many cases, already heavily subsidized by state and federal programs. As such, it becomes difficult to argue that the loan guarantees caused a change in behavior by these companies. Beyond these projects, there is a smaller number of projects with a viable argument for additionality, either because the projects couldn't have gotten funding without the loan guarantee (see next section on financial risk), or are competing against entrenched technologies with cost of capital advantages. Based on these two categories of projects, I give this a grade of **POOR**.

3. *Reasonable financial risk:* **POOR**. The DOE project portfolio is heavily weighted at both ends: a large pool of projects that are very risky and have a high likelihood of default, and a pool of projects that have almost no risk, and are unnecessarily tying up

capital reserves. Given the PPAs and assuming the DOE did their financial due diligence, the solar energy generation projects is the only group that exemplifies an appropriate financial risk for a loan guarantee program. Overall I give this program a grade of **POOR** for financial risk.

4. *Reasonable political risk:* **POOR**. Given the ongoing fallout from the Solyndra bankruptcy, the program is already doomed to be politically neutral at best. However, looking at the list of serious risks that still loom for this program, it is highly likely that this program becomes a clear, long-term political liability for those looking for federal investment in energy innovation. This program gets a clear grade of **POOR** for political risk.

The DOE loan program has billions of federal, energy innovation budget dollars tied up in a program that a) with the possible exception of solar energy generation, will not move any technology appreciably forward, b) is likely to result in billions of dollars of losses, and c) will likely grow as a political liability to other energy innovation efforts. This is in stark contrast to ARPA-E, a program that has a clear strategy and goals, is clearly making a difference, and is a political asset. And ARPA-E is existing on less per year than will likely be lost in the Solyndra bankruptcy alone.

Obviously these two programs are operating on different stages of the energy innovation life cycle, but it is still instructive to see what a well-directed, thoughtful program looks like compared to one that lacks a guiding strategy and leadership.

## *Future Loan Programs*

The final questions of this paper are whether a DOE Loan Program could ever be really effective by the standards that I've presented, and, if so, what would it look like?

Having looked at this particular loan program in detail, I believe that it would be possible to design a loan program that would get my support as an important tool in the energy innovation effort. However, I also believe that in the current policy environment we are unlikely to be able to craft such a program. In short, we should not give up on loan guarantee programs, but, at best they should be a small part of the overall DOE investment in innovation.

What would a successful program look like? The first two criteria shouldn't be a surprise, since I used them to evaluate the current program.

4. In any given technology or industry, the program should only invest if it can focus enough in that technology or industry to make a difference to the advantage of the side we want to win.
5. The program should only invest in projects where the financing can make a difference in the success of the program, but should not invest in projects that are so risky that they couldn't get private investment without government backing.

Looking at these criteria it appears that I'm trying to target a very thin slice of projects, and I am. Risky, but not too risky. Financially stable, but not too financially stable. In other words, Goldilocks projects.

Fortunately, I believe that these criteria help us make a broad distinction about the types of projects that are candidates to be supported with loan guarantees (alternate fuels, electrical

generation and transmission), and ones should not be considered at all (product companies, either for increased manufacturing or R&D).

For product companies, it is very, very difficult to pick Goldilocks projects. The reason is that building a manufacturing plant isn't enough; you need customers to buy the products at prices that are profitable compared to your cost to design and make them. On one end of the spectrum you have large companies who, by their nature, have to make product capacity bets on a regular basis. A government loan guarantee is always welcome, but would not be enough for them to actually change their plans. On the other end of the spectrum we have small companies with little or no sales history for their products. Maybe the demand isn't as high as everyone thought, or maybe (as Solyndra found) the market for your products is at a price that isn't profitable.

Ultimately, this comes down to the fact that manufacturing is one step removed from actually selling products and making money to repay a loan. As a result, risk and the impact of lower cost of capital are much more difficult to gauge, and it becomes nearly impossible to find that thin slice of companies that are a great fit for loan guarantees. This is evidenced in the DOE Loan Portfolio, where the only manufacturing company that isn't very large or very small is Sage Electronics.

Another argument against loan guarantees for manufacturing companies is that the government can much better support these companies by being an early customer for their products. Having large, early customers builds faith in a new technology or company, and, like a loan guarantee, makes it cheaper for a company to raise additional funds.

Fuel, energy generation, and transmission projects can, in certain conditions, be much easier situations in which to evaluate the impact of a loan guarantee. If someone produces

electricity in a region through a novel technique, it is easy to get hard data on the what customers are currently paying for electricity. Based on that you can determine the cost difference between the existing technique and a proposed technique and understand if an alternative technology can be competitive (in general, new technologies will cost more than older, established ones, until there is sufficient capacity and know-how required to drive the per-unit price down). Furthermore, the accuracy of cost estimates for technologies such as solar, wind, nuclear and geothermal is usually quite good, since there is experience that supports accurate predictions for the performance and ongoing costs of a new installation.

By lowering the cost of capital, the impact of a loan guarantee can be directly translated into a lower cost per unit, and making it possible to determine how much the guarantee can close or eliminate the price gap. The result is high confidence in determining whether a) the loan guarantee will positively impact the competitiveness of the new technology, and b) barring major shifts in the economics and politics of energy, the project can operate at a profit. In other words, we can determine whether criteria 1 and 2 above can be met.

While loan guarantees may be a good fit, it is important to balance against the other mechanisms that the government has for supporting energy companies through these early stages. Many of these are on display in the NY Times example, and also have proven track records. A comparison of these different support methods for energy startups would be a useful study.

In summary, I believe that it is possible to design a program that targets a specific energy technology (wind, solar, biofuels, nuclear, clean coal, etc), and uses loan guarantees to lower the cost of delivered energy. In contrast to other potential loan guarantee programs, a focused

program that meets these criteria can be a successful and effective use of federal energy innovation dollars.

While this may sound encouraging for the future of energy loan guarantee programs, I don't believe that the DOE is well positioned to create a successful program as described above. First, lacking an overall energy strategy, the DOE lacks a framework in which to make clear choices. Furthermore, the agency lacks the political inclination to make the necessary hard choices. It naturally has enough detractors, and disenfranchising the technologies that aren't funded will only grow the pool of people who would fight such an approach.

Furthermore, as the NY Times article shows, there are many other programs that are helping to get projects across the valley of death. And from an opportunity cost perspective, there are programs, such as ARPA-E, with proven track records, and where a small incremental investment, relative to the size of the DOE Loan Program, would have a huge impact.

*Conclusion: Loan guarantees are not a good fit for all types of projects. Even for the programs for which a loan guarantee is a good fit, until DOE has a clear energy strategy for the United States and has the political will to carry out that strategy, other programs will be more effective than loan guarantees in driving energy innovation.*

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[i] Energy Innovation Tracker - http://www.energyinnovation.us/

[ii] List of DOE Loan Program guarantees - https://lpo.energy.gov/?page_id=45

[iii] The data for this paper is available in Excel format - http://www.nearwalden.com/blog/files/DOE-loans-20111210.xlsx, or in PDF format - http://www.nearwalden.com/blog/files/DOE-loans-20111210.pdf

[iv] Definition of 'additionality' - http://en.wikipedia.org/wiki/Clean_Development_Mechanism#Additionality

[v] NY Times article highlighting one renewable energy project's finances - http://www.nytimes.com/2011/11/12/business/energy-environment/a-cornucopia-of-help-for-renewable-energy.html?pagewanted=all

[vi] Graph from above NY Times artcle - http://www.nytimes.com/interactive/2011/11/11/business/energy-environment/Stacking-Clean-Energy-Subsidies.html?ref=energy-environment

[vii] The DOE Loan Program Office website - https://lpo.energy.gov/

[viii] DOE Loan Program section 1703 website - https://lpo.energy.gov/?page_id=39

[ix] DOE Loan Program section 1705 website - https://lpo.energy.gov/?page_id=41

[x] DOE Loan Program ATVM section website - https://lpo.energy.gov/?page_id=43

[xi] FirstWind IPO article - http://gigaom.com/cleantech/headwinds-too-strong-for-first-wind-ipo/

[xii] Nevada Geothermal article - http://www.nytimes.com/2011/10/03/business/a-us-backed-geothermal-plant-in-nevada-struggles.html?pagewanted=all

[xiii] BrightSource IP article - http://www.marketwatch.com/story/four-new-underwriters-line-up-in-brightsource-ipo-2011-10-12