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PTC, ITC, or Cash Grant?

An Analysis of the Choice Facing Renewable Power Projects in the United States

Mark Bolinger and Ryan Wiser
Lawrence Berkeley National Laboratory

Karlynn Cory and Ted James
National Renewable Energy Laboratory

Environmental Energy
Technologies Division

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1. Introduction

Renewable power technologies are inherently capital-intensive, often (but not always) with relatively high construction costs and low operating costs. For this reason, renewable power technologies are typically more sensitive to the availability and cost of financing than are natural gas power plants, for example.

In the United States, the bulk of renewable project finance in recent years has been provided by "tax equity investors" (typically large investment banks and insurance companies) who partner with project developers through highly specialized financing structures (Bolinger, 2009; Cory et al., 2008; Harper et al., 2007). These structures have been designed primarily to capitalize on federal support for renewable power technologies, which has historically come in the form of tax credits and accelerated depreciation deductions.

The number of tax equity investors active in the renewable power market has declined precipitously, however, as a result of the financial crisis that began unfolding across the globe in the summer of 2008. The resulting shortage and increased cost of project financing has, in turn, slowed the development of new renewable power projects, leading to layoffs throughout the entire industry supply chain.

In recognition of the fact that tax-based policy incentives are not particularly effective when tax burdens are shrinking or non-existent, Congress included several provisions in *The American Recovery and Reinvestment Act of 2009* ("ARRA 2009") designed to make federal incentives for renewable power technologies more useful. Among these provisions is one that allows projects eligible to receive the production tax credit ("the PTC", see Text Box 1) to instead elect the investment tax credit ("the ITC", see Text Box 2). Another provision enables ITC-eligible projects (which now include most PTC-eligible renewable power projects) to instead receive – for a limited time only – a cash grant of equivalent value. These two provisions (among others) could have a significant impact on how renewable power projects are financed over the next few years.

Text Box 1. The Federal Production Tax Credit (PTC)

As authorized by the Energy Policy Act of 1992 and amended over time, Section 45 of the Internal Revenue Code provides a 10-year, inflation-adjusted production tax credit for power generated by certain types of renewable energy projects, including wind, closed- and open-loop biomass, geothermal, landfill gas, municipal solid waste, qualified hydropower, and marine and hydrokinetic facilities. For wind, closed-loop biomass, and geothermal power, the inflation-adjusted credit stood at $21/MWh in 2008; the other eligible technologies receive half of the PTC's value (i.e., $10/MWh in 2008). Currently, wind projects placed in service before the end of 2012 will be eligible to receive the 10-year PTC, while the other renewable technologies have an additional year to come online (i.e., until the end of 2013).

Various rules and regulations surround the use of the PTC. For example, to qualify for the PTC, the power must be sold to an unrelated party. Furthermore, certain limitations exist on the use of the PTC in combination with other public sector incentives, including grants, tax-exempt bonds, subsidized energy financing, and other federal tax credits.

Text Box 2. The Federal Investment Tax Credit (ITC)

Section 48 of the Internal Revenue Code provides an ITC for certain types of commercial energy projects, including solar, fuel cells, and small wind projects (all of which are eligible for a credit equal to 30% of the project's qualifying costs), as well as geothermal, microturbines, and combined heat and power projects (all of which are eligible for a credit equal to 10% of the project's qualifying costs). The ITC for fuel cells and microturbines is subject to a dollar cap, while the other technologies are not currently capped. In general, the ITC is currently available to qualified projects that are placed in service prior to the end of 2016, though the geothermal credit has no expiration date, and the solar credit will (unless otherwise extended) revert to 10%, rather than expiring altogether, at the end of 2016.

The ITC is realized in the year in which the project begins commercial operations, but vests linearly over a 5-year period. Thus, if the project owner sells the project before the end of its fifth year of operations, the unvested portion of the credit will be recaptured by the IRS.

The purpose of this report is to both quantitatively and qualitatively analyze, from the project developer/owner perspective, the choice between the PTC and the ITC (or equivalent cash grant) for a number of different renewable power technologies.[1] Because the two credits are structured differently, and apply in different ways to different technologies, the choice between the two lends itself to quantitative financial analysis of the conditions under which either the PTC or the ITC would, at least in theory, provide greater financial value. Qualitative considerations may be equally important, however, particularly in instances where quantitative differences are modest.

This report proceeds as follows. Section 2 provides a brief summary of ARRA 2009, with some emphasis on those provisions designed to ease the liquidity crisis facing the renewable power sector. Section 3 describes the quantitative analysis methodology, as well as modeling results for wind, open-loop biomass, closed-loop biomass, geothermal, and landfill gas projects. Section 4 discusses a number of qualitative considerations that may play as important of a role as quantitative results in deciding between the PTC and the ITC (or equivalent cash grant). Section 5 concludes, and an Appendix provides supplemental tables that present quantitative analysis results conducted at different discount rates.

2. The American Recovery and Reinvestment Act of 2009

On February 13, 2009, the 111th Congress passed a stimulus package known as *The American Recovery and Reinvestment Act of 2009* ("ARRA 2009"), and President Obama signed the bill into law four days later. The new law, P.L. 111-5, has the potential to substantially impact the market for renewable energy technologies.

As a whole, ARRA 2009 focuses in two areas: 1) appropriations for government programs, and 2) tax-based incentives. Of the $787 billion package, more than $40 billion in spending is appropriated for clean energy initiatives. New and modified tax incentives targeting clean energy are estimated to cost an additional $20 billion.

Table 1 summarizes a select group of provisions contained in ARRA 2009 that could directly impact how renewable power projects are financed in the United States. Only the first four provisions are discussed in later sections of this report. Specifically, ARRA 2009 provides a multi-year extension of the PTC and allows PTC-eligible technologies to elect the ITC instead. It also allows projects to forego the ITC and instead elect a cash grant of equivalent value. Finally, for projects that take either the ITC or equivalent cash grant, ARRA 2009 removes the double-dipping penalty formerly triggered by the use of "subsidized energy financing."

The other provisions in Table 1 are not included in our analysis for a variety of reasons:

- We do not consider the one-year extension of bonus depreciation because we do not wish to limit our analysis to projects installed in 2009. The PTC/ITC choice is in place through 2012 for wind projects, and through 2013 for other technologies; bonus depreciation is available for only a fraction of this period. Furthermore, though it could help to motivate capacity additions in 2009, bonus depreciation will (as revealed by side analysis) have only a negligible impact on the choice between the PTC and the ITC (or cash grant).

[1] Others have analyzed this choice for just wind power alone; for example, see Karcher (2009).

- The extension of the carryback period for net operating losses from two to five years is not expected to have a material impact on the tax equity market, since this provision is limited to small businesses (as such, most tax equity investors will not qualify).
- The removal of tax-credit dollar caps on certain residential renewable energy applications and technologies, as well as commercial small wind, is not directly relevant to this analysis, which focuses primarily on larger, PTC-eligible technologies.
- The expanded loan guarantee program, as well as new Clean Renewable Energy Bonds (CREB) funding, should help projects obtain low-cost debt, but does not directly impact the choice of PTC, ITC, or cash grant.

For a more-comprehensive overview of how the various provisions in ARRA 2009 will affect renewable power projects, see Martin et al. (2009).

Table 1. Summary of Select Project-Finance-Related Provisions in ARRA 2009

Provision	Details from The American Recovery and Reinvestment Act of 2009
Extends the PTC In-Service Deadline	Extends the PTC through 2012 for wind, and through 2013 for closed- and open-loop biomass, geothermal, landfill gas, municipal solid waste, qualified hydroelectric, and marine and hydrokinetic facilities. In 2008, the inflated PTC stood at $21/MWh for wind, geothermal, and closed-loop biomass, and $10/MWh for other eligible technologies.
Provides Option to Elect the ITC in Lieu of the PTC	Allows PTC-qualified facilities installed in 2009-13 (2009-12 in the case of wind) to elect a 30% ITC in lieu of the PTC. If the ITC is chosen, the election is irrevocable and requires the depreciable basis of the property to be reduced by one-half the amount of the ITC.
Provides Option to Elect a Cash Grant in Lieu of the ITC	Creates a new program, administered by the Treasury, to provide grants covering up to 30% of the cost basis of qualified renewable energy projects that are placed in service in 2009-10, or that commence construction during 2009-10 and are placed in service prior to 2013 for wind, 2017 for solar, and 2014 for other qualified technologies. Applications must be submitted by October 1, 2011, and the Treasury is required to make payments within 60 days after an application is received or the project is placed in service, whichever is later. The grant is excluded from gross income and the depreciable basis of the property must be reduced by one-half of the grant amount.
Removes ITC Subsidized Energy Financing Penalty	Allows projects that elect the ITC to also utilize "subsidized energy financing" (e.g., tax-exempt bonds or low-interest loan programs) without suffering a corresponding tax credit basis reduction. This provision also applies to the new grant option described above.
Extends 50% Bonus Depreciation	Extends 50% bonus depreciation (i.e., the ability to write off 50% of the depreciable basis in the first year, with the remaining basis depreciated as normal according to the applicable schedules) to qualified renewable energy projects acquired and placed in service in 2009.
Extends Loss Carrryback Period	Extends the carryback of net operating losses from 2 to 5 years for small businesses (i.e., those with average annual gross receipts of $15 million or less over the most recent 3-year period). This carryback extension can only be applied to a single tax year, which must either begin or end in 2008.
Removes ITC Dollar Caps	Eliminates the maximum dollar caps on residential small wind, solar hot water, and geothermal heat pump ITCs (so now at the full 30%). Also eliminates the dollar cap on the commercial small wind 30% ITC. Credits may be claimed against the AMT.
Expands Loan Guarantee Program	Expands existing loan guarantee program to cover commercial (rather than just "innovative non-commercial") projects. Appropriates $6 billion to reduce or eliminate the cost of providing the guarantee; this amount could support $60-$100 billion in loans, depending on the risk profiles of the underlying projects.
Adds Funding for Clean Renewable Energy Bonds	Adds $1.6 billion in new CREBs for eligible technologies owned by governmental or tribal entities, as well as municipal utilities and cooperatives. With $800 million of new CREB funding previously added in October 2008, combined new CREB funding totals $2.4 billion.

3. PTC or ITC/Cash Grant: Quantitative Considerations

For many owners of PTC-eligible projects, the choice between the PTC and the ITC (or the equivalent cash grant) will depend, at least in part, on the relative financial value of each incentive. Relative value, in turn, will depend on two project-specific factors: installed project costs and expected capacity factor (i.e., production).

This section uses a simple cash flow model to quantitatively analyze this tradeoff between the PTC and the ITC (or equivalent cash grant) for a number of different PTC-eligible technologies, and over a wide range of installed project costs and expected capacity factors.[2] Since the ITC and the cash grant provide the same amount of financial value (at least in theory), separate quantitative analysis of the cash grant is not required (i.e., results would be essentially the same as those shown for the ITC).[3] There are, however, qualitative and financing-related considerations that might favor the cash grant; these are discussed in the next section.

The PTC-eligible technologies examined include wind, open-loop biomass, closed-loop biomass,[4] geothermal, and landfill gas. Other PTC-eligible technologies, including municipal solid waste, qualified hydroelectric, and marine and hydrokinetic power, are not analyzed here, in part because of difficulties assessing representative installed cost and performance characteristics. Solar technologies, meanwhile, are not included in the analysis because they are not currently eligible for the PTC, and already receive the 30% ITC – i.e., solar technologies do not face this choice (though they are eligible to elect the cash grant instead of the ITC).

For each combination of installed project cost and capacity factor, the cash flow model calculates the present value of the PTCs generated by the project over 10 years. It adds this PTC value to the present value of after-tax depreciation benefits, and expresses the combined present value as a percentage of installed project costs. It follows the same process for the ITC: combining the present value of the 30% ITC (or cash grant) and after-tax depreciation benefits, and expressing the total as a percentage of installed costs. The only methodological difference between the PTC and ITC analysis is that the Internal Revenue Code requires that the "depreciable basis" of a project (i.e., the amount that is depreciated) be reduced by one half the value of the ITC (or equivalent cash grant). So in this case, with a 30% ITC or cash grant, the depreciable basis is reduced by 15%; this basis reduction does not apply to the PTC.

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[2] For each technology, the range of installed costs and capacity factors analyzed is based on the authors' experience, as well as technology assumptions used in California's Renewable Energy Transmission Initiative and the Western Renewable Energy Zones effort. Because this analysis is general in nature, project developers and investors are encouraged to conduct their own analysis of the PTC/ITC tradeoff, specific to their own particular circumstances.

[3] Results would not be *exactly* the same because ARRA 2009 requires that the Treasury Department disburse grants within 60 days of when the grant application is received or when the project is placed in service, whichever is later. This means that the grant option could provide slightly more value than the ITC on a present value basis, due to the time value of money. For example, a project placed in service in April 2009 may need to wait a full year (i.e., until it files its 2009 tax return) in order to fully realize the value of the ITC, as opposed to just 60 days for the grant.

[4] Section 45 of the Internal Revenue Code defines closed-loop biomass as "any organic material from a plant which is planted exclusively for purposes of being used at a qualified facility to produce electricity." Meanwhile, open-loop biomass includes agricultural livestock waste (e.g., manure), agricultural crop by-products and residues, forest-related by-products and residues, and non-hazardous solid wood waste.

Modeling results are expressed on a net basis in Tables 2 through 6, by subtracting the PTC-derived results from the ITC-derived results. Thus, for each combination of installed cost and capacity factor, a positive value means that the ITC is more financially advantageous (i.e., that electing the ITC will provide benefits that amount to a larger percentage of installed costs than they do under the PTC), while a negative number means that the PTC is more advantageous. For example, in Table 2 below, a wind project that costs $2,000/kW and expects a 30% capacity factor results in +1.3% net value, which means that electing the ITC instead of the PTC will provide greater value by an amount equal to 1.3% of installed project costs (i.e., the ITC provides $26/kW greater value in this case). Conversely, a wind project that costs $1,700/kW and expects a 40% capacity factor results in -10.4% net value, which means that sticking with the PTC will provide greater value by an amount equal to 10.4% of installed costs (i.e., the PTC provides $177/kW greater value in this case).

Results presented in Tables 2 through 6 reflect the use of a 7.5% nominal discount rate. Because the results are sensitive to choice of discount rate (e.g., the ITC is provided in year one, while the PTC is a 10-year stream), an Appendix also presents results using both a 5% and a 10% nominal discount rate.[5] Finally, all modeling runs assume a federal income tax rate of 35% and a state income tax rate of 8%, for a combined rate of 40.2% (reflecting the deductibility of state tax payments from federal taxable income).

3.1 Wind

Table 2 presents results for a wind project over a range of installed costs from $1,500/kW to $2,500/kW, and for capacity factors ranging from 25% to 45%. Because installed costs are expressed on a per-unit (i.e., $/kW) basis in the analysis, the results in Tables 2 through 6 are not influenced by nameplate capacity (that said, nameplate capacity can certainly influence per-unit installed costs in the presence of economies of scale). The analysis assumes that 90% of the project is depreciated using a 5-year MACRS schedule, while another 5% is depreciated using a 20-year MACRS schedule. The remaining 5% of installed project costs are not considered to be depreciable, which also makes them ineligible for the ITC (i.e., the ITC will only apply to 95% of installed costs). Wind is eligible for the full PTC (i.e., $21/MWh in 2008), which is assumed to escalate at 2%/year.[6]

[5] The range of discount rates examined – i.e., from 5% to 10% – is intended to reflect typical project-level returns over a 10- to 20-year period. That is, renewable power projects might expect to generate an unleveraged after-tax internal rate of return of roughly 5% over a 10-year period, increasing to around 10% over a 20-year period (note that these are project-level returns, and that different investors in a project may earn more or less than the project as a whole). Rather than choose either 5% or 10%, the body of this report uses a 7.5% nominal discount rate as a middle-of-the-road compromise; results using both 5% and 10% are included in an Appendix.

[6] In 2008, the PTC's inflation adjustment factor stood at 1.3854. We escalate this inflation factor by an assumed 2%/year for 11 years (2009 through 2018), and round it to four decimals (per convention). We then multiply the resulting "inflated" inflation adjustment factor in each year by the stipulated base year value of $15/MWh, and round to the nearest dollar (also per convention), to arrive at the inflated or nominal value of the PTC in each year. For those technologies that receive half of the PTC's value, we follow the same procedure, but start with an un-inflated PTC value of $7.5/MWh, rather than $15/MWh.

Over the full range of project costs and capacity factors presented, the PTC provides more value than the ITC in about two-thirds of all cases analyzed.[7] Intuitively, projects with higher capacity factors and lower installed costs favor the PTC over the ITC (i.e., a higher capacity factor means that more PTCs are generated, while lower installed costs mean that the value of those PTCs will add up to a higher percentage of installed costs). Under most capacity factor assumptions, projects that cost $1,500/kW or less are likely to receive more value from the PTC, while projects that cost more than $2,500/kW are likely to be better off with the ITC. In between these two cost extremes, capacity factor is a more important determinant.

Table 2. Net Value of ITC for Wind (7.5% Nominal Discount Rate)

		Total Installed Project Cost ($/kW)										
		$1,500	$1,600	$1,700	$1,800	$1,900	$2,000	$2,100	$2,200	$2,300	$2,400	$2,500
Net Capacity Factor (%)	25%	-1.0%	0.4%	1.7%	2.8%	3.8%	4.7%	5.5%	6.3%	7.0%	7.6%	8.2%
	26%	-1.9%	-0.4%	0.9%	2.0%	3.1%	4.0%	4.9%	5.7%	6.4%	7.0%	7.6%
	27%	-2.8%	-1.3%	0.1%	1.3%	2.4%	3.3%	4.2%	5.0%	5.8%	6.4%	7.1%
	28%	-3.8%	-2.2%	-0.7%	0.5%	1.6%	2.7%	3.6%	4.4%	5.2%	5.9%	6.5%
	29%	-4.7%	-3.0%	-1.5%	-0.2%	0.9%	2.0%	2.9%	3.8%	4.6%	5.3%	6.0%
	30%	-5.6%	-3.9%	-2.4%	-1.0%	0.2%	1.3%	2.3%	3.2%	4.0%	4.7%	5.4%
	31%	-6.5%	-4.7%	-3.2%	-1.8%	-0.5%	0.6%	1.6%	2.5%	3.4%	4.1%	4.9%
	32%	-7.4%	-5.6%	-4.0%	-2.5%	-1.2%	-0.1%	1.0%	1.9%	2.8%	3.6%	4.3%
	33%	-8.3%	-6.4%	-4.8%	-3.3%	-2.0%	-0.8%	0.3%	1.3%	2.2%	3.0%	3.8%
	34%	-9.3%	-7.3%	-5.6%	-4.1%	-2.7%	-1.5%	-0.4%	0.7%	1.6%	2.4%	3.2%
	35%	-10.2%	-8.2%	-6.4%	-4.8%	-3.4%	-2.2%	-1.0%	0.0%	1.0%	1.9%	2.7%
	36%	-11.1%	-9.0%	-7.2%	-5.6%	-4.1%	-2.8%	-1.7%	-0.6%	0.4%	1.3%	2.1%
	37%	-12.0%	-9.9%	-8.0%	-6.4%	-4.9%	-3.5%	-2.3%	-1.2%	-0.2%	0.7%	1.6%
	38%	-12.9%	-10.7%	-8.8%	-7.1%	-5.6%	-4.2%	-3.0%	-1.8%	-0.8%	0.1%	1.0%
	39%	-13.8%	-11.6%	-9.6%	-7.9%	-6.3%	-4.9%	-3.6%	-2.5%	-1.4%	-0.4%	0.5%
	40%	-14.8%	-12.5%	-10.4%	-8.6%	-7.0%	-5.6%	-4.3%	-3.1%	-2.0%	-1.0%	-0.1%
	41%	-15.7%	-13.3%	-11.2%	-9.4%	-7.8%	-6.3%	-4.9%	-3.7%	-2.6%	-1.6%	-0.6%
	42%	-16.6%	-14.2%	-12.1%	-10.2%	-8.5%	-7.0%	-5.6%	-4.3%	-3.2%	-2.2%	-1.2%
	43%	-17.5%	-15.0%	-12.9%	-10.9%	-9.2%	-7.7%	-6.2%	-5.0%	-3.8%	-2.7%	-1.7%
	44%	-18.4%	-15.9%	-13.7%	-11.7%	-9.9%	-8.3%	-6.9%	-5.6%	-4.4%	-3.3%	-2.3%
	45%	-19.3%	-16.8%	-14.5%	-12.5%	-10.7%	-9.0%	-7.6%	-6.2%	-5.0%	-3.9%	-2.8%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

As shown in Tables A1 and A2 of the Appendix, the PTC looks slightly more attractive assuming a 5% discount rate than it does in Table 2 (because future PTCs are not discounted as heavily), and slightly less-attractive assuming a 10% discount rate (for the opposite reason).

3.2 Open-Loop Biomass

Table 3 presents results for an open-loop, direct-combustion solid biomass project over a range of installed costs from $3,000/kW to $5,000/kW, and for capacity factors ranging from 60% to 90%. The modeling assumes that 60% of the project is depreciated using a 5-year MACRS schedule, while another 35% is depreciated using a 20-year MACRS schedule (again, 5% of

[7] Obviously, this proportional result is highly dependent on the range of installed project costs and capacity factors examined. For example, if the installed cost range started at $1,800/kW (rather than $1,500/kW) and the capacity factor range stopped at 40% (rather than 45%), then the percentage of all combinations favoring the PTC over the ITC would drop from 65% down to 39%. Although the authors are comfortable that the ranges examined in Tables 2-6 are relevant (rather than superfluous), the reader should keep in mind the influence that these ranges have on the proportion of results that favor one credit over the other.

installed project costs are neither depreciable nor eligible for the ITC). Open-loop biomass is eligible for only half of the PTC's value (i.e., $10/MWh in 2008), which is assumed to escalate at 2%/year.

The ITC is more attractive than the PTC in every combination over the range of project costs and capacity factors presented in Table 3, despite biomass having a high capacity factor (at least relative to wind). These results are consistent with expectations, given that biomass only receives half of the PTC's value, yet has a relatively high installed cost and is eligible to elect the full 30% ITC. This basic outcome – i.e., the ITC always providing more value than the PTC – still holds true in all but two of the combinations examined when a discount rate of 5% is used (see Table A3 of the Appendix), and becomes more pronounced under a 10% discount rate (see Table A4 of the Appendix).

Table 3. Net Value of ITC for Open-Loop Biomass (7.5% Nominal Discount Rate)

		Total Installed Project Cost ($/kW)										
		$3,000	**$3,200**	**$3,400**	**$3,600**	**$3,800**	**$4,000**	**$4,200**	**$4,400**	**$4,600**	**$4,800**	**$5,000**
Net Capacity Factor (%)	**60.0%**	8.6%	9.5%	10.2%	10.9%	11.5%	12.1%	12.6%	13.0%	13.4%	13.8%	14.1%
	61.5%	8.3%	9.2%	9.9%	10.6%	11.3%	11.8%	12.3%	12.8%	13.2%	13.6%	13.9%
	63.0%	7.9%	8.8%	9.6%	10.3%	11.0%	11.6%	12.1%	12.5%	13.0%	13.4%	13.7%
	64.5%	7.6%	8.5%	9.3%	10.1%	10.7%	11.3%	11.8%	12.3%	12.7%	13.1%	13.5%
	66.0%	7.2%	8.2%	9.0%	9.8%	10.4%	11.0%	11.6%	12.1%	12.5%	12.9%	13.3%
	67.5%	6.9%	7.9%	8.7%	9.5%	10.2%	10.8%	11.3%	11.8%	12.3%	12.7%	13.1%
	69.0%	6.5%	7.5%	8.4%	9.2%	9.9%	10.5%	11.1%	11.6%	12.1%	12.5%	12.9%
	70.5%	6.2%	7.2%	8.1%	8.9%	9.6%	10.3%	10.8%	11.4%	11.8%	12.3%	12.7%
	72.0%	5.9%	6.9%	7.8%	8.6%	9.3%	10.0%	10.6%	11.1%	11.6%	12.1%	12.5%
	73.5%	5.5%	6.6%	7.5%	8.3%	9.1%	9.7%	10.3%	10.9%	11.4%	11.9%	12.3%
	75.0%	5.2%	6.2%	7.2%	8.0%	8.8%	9.5%	10.1%	10.7%	11.2%	11.6%	12.1%
	76.5%	4.8%	5.9%	6.9%	7.8%	8.5%	9.2%	9.8%	10.4%	10.9%	11.4%	11.9%
	78.0%	4.5%	5.6%	6.6%	7.5%	8.3%	9.0%	9.6%	10.2%	10.7%	11.2%	11.7%
	79.5%	4.1%	5.3%	6.3%	7.2%	8.0%	8.7%	9.4%	10.0%	10.5%	11.0%	11.4%
	81.0%	3.8%	4.9%	6.0%	6.9%	7.7%	8.4%	9.1%	9.7%	10.3%	10.8%	11.2%
	82.5%	3.4%	4.6%	5.7%	6.6%	7.4%	8.2%	8.9%	9.5%	10.0%	10.6%	11.0%
	84.0%	3.1%	4.3%	5.4%	6.3%	7.2%	7.9%	8.6%	9.2%	9.8%	10.3%	10.8%
	85.5%	2.7%	4.0%	5.1%	6.0%	6.9%	7.7%	8.4%	9.0%	9.6%	10.1%	10.6%
	87.0%	2.4%	3.7%	4.8%	5.7%	6.6%	7.4%	8.1%	8.8%	9.4%	9.9%	10.4%
	88.5%	2.1%	3.3%	4.5%	5.4%	6.3%	7.1%	7.9%	8.5%	9.1%	9.7%	10.2%
	90.0%	1.7%	3.0%	4.1%	5.2%	6.1%	6.9%	7.6%	8.3%	8.9%	9.5%	10.0%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

3.3 Closed-Loop Biomass

Table 4 presents results for a closed-loop, direct-combustion solid biomass project. Few (if any) closed-loop biomass projects are operating in the United States today, which makes it a challenge to establish representative cost and performance ranges. However, because most of the differences between open- and closed-loop biomass are likely to impact the fuel cycle rather than installed costs or capacity factor, we have simply maintained the same assumptions that we used above for open-loop biomass. That is, installed costs range from $3,000/kW to $5,000/kW, capacity factors range from 60% to 90%, and depreciation consists of 60% 5-year MACRS and 35% 20-year MACRS.

The one notable difference between open- and closed-loop biomass – and the principle reason that we have included closed-loop in our analysis – is that open-loop is only eligible for half of the PTC ($10/MWh in 2008), while closed-loop is eligible for the full PTC (i.e., $21/MWh in 2008). As shown in Table 4, this difference has a profound impact on the modeling results, with the PTC providing more value than the ITC in roughly three-quarters of all combinations of installed costs and capacity factors. The percentage of all cases favoring the PTC over the ITC increases to roughly 90% under a 5% discount rate (Table A5 of the Appendix), but the choice is more evenly split assuming a 10% discount rate (Table A6 of the Appendix).

Table 4. Net Value of ITC for Closed-Loop Biomass (7.5% Nominal Discount Rate)

		Total Installed Project Cost ($/kW)										
		$3,000	$3,200	$3,400	$3,600	$3,800	$4,000	$4,200	$4,400	$4,600	$4,800	$5,000
Net Capacity Factor (%)	60.0%	-5.1%	-3.3%	-1.8%	-0.5%	0.7%	1.8%	2.8%	3.7%	4.5%	5.3%	5.9%
	61.5%	-5.7%	-4.0%	-2.4%	-1.0%	0.2%	1.3%	2.3%	3.2%	4.1%	4.8%	5.5%
	63.0%	-6.4%	-4.6%	-3.0%	-1.6%	-0.4%	0.8%	1.8%	2.8%	3.6%	4.4%	5.1%
	64.5%	-7.1%	-5.3%	-3.6%	-2.2%	-0.9%	0.3%	1.3%	2.3%	3.2%	4.0%	4.7%
	66.0%	-7.8%	-5.9%	-4.2%	-2.8%	-1.4%	-0.2%	0.8%	1.8%	2.7%	3.5%	4.3%
	67.5%	-8.5%	-6.6%	-4.9%	-3.3%	-2.0%	-0.8%	0.3%	1.4%	2.3%	3.1%	3.9%
	69.0%	-9.2%	-7.2%	-5.5%	-3.9%	-2.5%	-1.3%	-0.1%	0.9%	1.8%	2.7%	3.5%
	70.5%	-9.9%	-7.8%	-6.1%	-4.5%	-3.1%	-1.8%	-0.6%	0.4%	1.4%	2.2%	3.1%
	72.0%	-10.5%	-8.5%	-6.7%	-5.1%	-3.6%	-2.3%	-1.1%	-0.1%	0.9%	1.8%	2.6%
	73.5%	-11.2%	-9.1%	-7.3%	-5.6%	-4.1%	-2.8%	-1.6%	-0.5%	0.5%	1.4%	2.2%
	75.0%	-11.9%	-9.8%	-7.9%	-6.2%	-4.7%	-3.3%	-2.1%	-1.0%	0.0%	1.0%	1.8%
	76.5%	-12.6%	-10.4%	-8.5%	-6.8%	-5.2%	-3.8%	-2.6%	-1.5%	-0.4%	0.5%	1.4%
	78.0%	-13.3%	-11.1%	-9.1%	-7.3%	-5.8%	-4.4%	-3.1%	-1.9%	-0.9%	0.1%	1.0%
	79.5%	-14.0%	-11.7%	-9.7%	-7.9%	-6.3%	-4.9%	-3.6%	-2.4%	-1.3%	-0.3%	0.6%
	81.0%	-14.7%	-12.4%	-10.3%	-8.5%	-6.9%	-5.4%	-4.1%	-2.9%	-1.8%	-0.8%	0.2%
	82.5%	-15.4%	-13.0%	-10.9%	-9.1%	-7.4%	-5.9%	-4.6%	-3.3%	-2.2%	-1.2%	-0.2%
	84.0%	-16.0%	-13.6%	-11.5%	-9.6%	-7.9%	-6.4%	-5.1%	-3.8%	-2.7%	-1.6%	-0.7%
	85.5%	-16.7%	-14.3%	-12.1%	-10.2%	-8.5%	-6.9%	-5.5%	-4.3%	-3.1%	-2.0%	-1.1%
	87.0%	-17.4%	-14.9%	-12.7%	-10.8%	-9.0%	-7.5%	-6.0%	-4.7%	-3.6%	-2.5%	-1.5%
	88.5%	-18.1%	-15.6%	-13.3%	-11.4%	-9.6%	-8.0%	-6.5%	-5.2%	-4.0%	-2.9%	-1.9%
	90.0%	-18.8%	-16.2%	-13.9%	-11.9%	-10.1%	-8.5%	-7.0%	-5.7%	-4.5%	-3.3%	-2.3%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

3.4 Geothermal

Table 5 presents results for a geothermal project over a range of installed costs from $3,000/kW to $6,000/kW, and for capacity factors ranging from 70% to 95%. The modeling assumes that 75% of the project is depreciated using a 5-year MACRS schedule, while the rest of the project's costs are, for tax purposes, either expensed or depleted (Bolinger et al., 2001), and are therefore ineligible for the ITC. Geothermal projects are eligible for the full PTC (i.e., $21/MWh in 2008), which is assumed to escalate at 2%/year.

Because the 30% ITC[8] applies to only 75% of installed costs, the PTC provides more value in nearly all cost and capacity factor combinations examined. The PTC's superiority becomes

[8] Note that some confusion remains over the ability of geothermal to access the 30% ITC and equivalent cash grant. Geothermal has long been eligible for a 10% ITC, and in 2004 gained the ability to elect either the full PTC or a 10% ITC. This choice has been in place ever since then, and suggests that geothermal may now be limited to a 10%,

unanimous under a 5% discount rate (see Table A7 in the Appendix), but falls to about 90% of all cases examined under a 10% discount rate (see Table A8 in the Appendix).

Table 5. Net Value of ITC for Geothermal (7.5% Nominal Discount Rate)

		Total Installed Project Cost ($/kW)										
		$3,000	$3,300	$3,600	$3,900	$4,200	$4,500	$4,800	$5,100	$5,400	$5,700	$6,000
Net Capacity Factor (%)	70.0%	-14.9%	-11.9%	-9.5%	-7.5%	-5.7%	-4.2%	-2.8%	-1.6%	-0.6%	0.3%	1.2%
	71.3%	-15.4%	-12.5%	-10.0%	-7.9%	-6.1%	-4.5%	-3.2%	-2.0%	-0.9%	0.0%	0.9%
	72.5%	-16.0%	-13.0%	-10.5%	-8.3%	-6.5%	-4.9%	-3.5%	-2.3%	-1.2%	-0.3%	0.6%
	73.8%	-16.6%	-13.5%	-10.9%	-8.8%	-6.9%	-5.3%	-3.9%	-2.7%	-1.6%	-0.6%	0.3%
	75.0%	-17.1%	-14.0%	-11.4%	-9.2%	-7.3%	-5.7%	-4.3%	-3.0%	-1.9%	-0.9%	0.0%
	76.3%	-17.7%	-14.5%	-11.9%	-9.7%	-7.7%	-6.1%	-4.6%	-3.3%	-2.2%	-1.2%	-0.2%
	77.5%	-18.3%	-15.1%	-12.4%	-10.1%	-8.1%	-6.5%	-5.0%	-3.7%	-2.5%	-1.5%	-0.5%
	78.8%	-18.9%	-15.6%	-12.8%	-10.5%	-8.6%	-6.8%	-5.3%	-4.0%	-2.8%	-1.8%	-0.8%
	80.0%	-19.4%	-16.1%	-13.3%	-11.0%	-9.0%	-7.2%	-5.7%	-4.3%	-3.1%	-2.1%	-1.1%
	81.3%	-20.0%	-16.6%	-13.8%	-11.4%	-9.4%	-7.6%	-6.0%	-4.7%	-3.5%	-2.4%	-1.4%
	82.5%	-20.6%	-17.1%	-14.3%	-11.9%	-9.8%	-8.0%	-6.4%	-5.0%	-3.8%	-2.7%	-1.7%
	83.7%	-21.1%	-17.7%	-14.8%	-12.3%	-10.2%	-8.4%	-6.8%	-5.4%	-4.1%	-3.0%	-2.0%
	85.0%	-21.7%	-18.2%	-15.2%	-12.7%	-10.6%	-8.7%	-7.1%	-5.7%	-4.4%	-3.3%	-2.3%
	86.2%	-22.3%	-18.7%	-15.7%	-13.2%	-11.0%	-9.1%	-7.5%	-6.0%	-4.7%	-3.6%	-2.5%
	87.5%	-22.9%	-19.2%	-16.2%	-13.6%	-11.4%	-9.5%	-7.8%	-6.4%	-5.1%	-3.9%	-2.8%
	88.7%	-23.4%	-19.7%	-16.7%	-14.1%	-11.8%	-9.9%	-8.2%	-6.7%	-5.4%	-4.2%	-3.1%
	90.0%	-24.0%	-20.3%	-17.1%	-14.5%	-12.2%	-10.3%	-8.6%	-7.0%	-5.7%	-4.5%	-3.4%
	91.2%	-24.6%	-20.8%	-17.6%	-14.9%	-12.6%	-10.7%	-8.9%	-7.4%	-6.0%	-4.8%	-3.7%
	92.5%	-25.2%	-21.3%	-18.1%	-15.4%	-13.1%	-11.0%	-9.3%	-7.7%	-6.3%	-5.1%	-4.0%
	93.7%	-25.7%	-21.8%	-18.6%	-15.8%	-13.5%	-11.4%	-9.6%	-8.0%	-6.6%	-5.4%	-4.3%
	95.0%	-26.3%	-22.3%	-19.0%	-16.3%	-13.9%	-11.8%	-10.0%	-8.4%	-7.0%	-5.7%	-4.5%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

3.5 Landfill Gas

Table 6 presents results for a landfill gas project over a range of installed costs from $1,000/kW to $3,000/kW, and for capacity factors ranging from 60% to 90%. The modeling assumes that 95% of the project is depreciated using a 15-year MACRS schedule (i.e., 5% of project costs are neither depreciable nor eligible for the ITC). Landfill gas projects are eligible for half of the PTC's value (i.e., $10/MWh in 2008), which is assumed to escalate at 2%/year.

Although landfill gas, like open-loop biomass, receives only half of the PTC, the modeling results for these two technologies are starkly different. For landfill gas, the relative value of the PTC and ITC is fairly evenly split among the cases examined, whereas for open-loop biomass,

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rather than a 30%, ITC or cash grant. Section 1102 of ARRA 2009, however, explicitly allows geothermal – as a PTC-eligible technology – to elect a 30% ITC in lieu of the PTC.

Additional confusion surrounds Section 1603 of ARRA 2009, which provides for the new federal cash grant program. In one part of Section 1603, geothermal is included (again, through reference to PTC-eligible technologies as defined in Section 45) among those technologies that are eligible to elect a 30% cash grant. In another part of this same section, however, geothermal is listed as being eligible to elect a 10% cash grant.

Because several tax lawyers have expressed opinions that geothermal will, in all likelihood, be eligible to elect either the 30% ITC or the 30% cash grant, we have used 30% in our analysis (though the reader should not consider this to be legal advice). This is also a conservative assumption in this case, given that the PTC provides more value across almost every combination modeled (see Table 5), even when compared to a 30% ITC. In other words, the PTC would simply look that much better if a 10% ITC were instead used as the point of comparison.

the ITC provided greater value than the PTC in *all* scenarios examined. This difference is due to the relatively low installed cost of landfill gas, assumed to range from $1,000-$3,000/kW, compared to $3,000-$5,000/kW for biomass.

Table 6. Net Value of ITC for Landfill Gas (7.5% Nominal Discount Rate)

		Total Installed Project Cost ($/kW)										
		$1,000	$1,200	$1,400	$1,600	$1,800	$2,000	$2,200	$2,400	$2,600	$2,800	$3,000
Net Capacity Factor (%)	60.0%	-17.2%	-10.3%	-5.3%	-1.6%	1.3%	3.6%	5.5%	7.0%	8.3%	9.5%	10.5%
	61.5%	-18.2%	-11.1%	-6.1%	-2.3%	0.7%	3.0%	5.0%	6.6%	8.0%	9.1%	10.1%
	63.0%	-19.2%	-12.0%	-6.8%	-2.9%	0.1%	2.5%	4.5%	6.2%	7.6%	8.7%	9.8%
	64.5%	-20.3%	-12.8%	-7.5%	-3.6%	-0.5%	2.0%	4.0%	5.7%	7.2%	8.4%	9.4%
	66.0%	-21.3%	-13.7%	-8.3%	-4.2%	-1.0%	1.5%	3.6%	5.3%	6.8%	8.0%	9.1%
	67.5%	-22.3%	-14.6%	-9.0%	-4.9%	-1.6%	1.0%	3.1%	4.9%	6.4%	7.6%	8.7%
	69.0%	-23.4%	-15.4%	-9.8%	-5.5%	-2.2%	0.5%	2.6%	4.4%	6.0%	7.3%	8.4%
	70.5%	-24.4%	-16.3%	-10.5%	-6.1%	-2.8%	-0.1%	2.2%	4.0%	5.6%	6.9%	8.1%
	72.0%	-25.4%	-17.2%	-11.2%	-6.8%	-3.3%	-0.6%	1.7%	3.6%	5.2%	6.5%	7.7%
	73.5%	-26.5%	-18.0%	-12.0%	-7.4%	-3.9%	-1.1%	1.2%	3.1%	4.8%	6.2%	7.4%
	75.0%	-27.5%	-18.9%	-12.7%	-8.1%	-4.5%	-1.6%	0.7%	2.7%	4.4%	5.8%	7.0%
	76.5%	-28.6%	-19.7%	-13.5%	-8.7%	-5.1%	-2.1%	0.3%	2.3%	4.0%	5.4%	6.7%
	78.0%	-29.6%	-20.6%	-14.2%	-9.4%	-5.6%	-2.7%	-0.2%	1.8%	3.6%	5.0%	6.3%
	79.5%	-30.6%	-21.5%	-14.9%	-10.0%	-6.2%	-3.2%	-0.7%	1.4%	3.2%	4.7%	6.0%
	81.0%	-31.7%	-22.3%	-15.7%	-10.7%	-6.8%	-3.7%	-1.1%	1.0%	2.8%	4.3%	5.6%
	82.5%	-32.7%	-23.2%	-16.4%	-11.3%	-7.4%	-4.2%	-1.6%	0.5%	2.4%	3.9%	5.3%
	84.0%	-33.7%	-24.1%	-17.2%	-12.0%	-7.9%	-4.7%	-2.1%	0.1%	2.0%	3.6%	4.9%
	85.5%	-34.8%	-24.9%	-17.9%	-12.6%	-8.5%	-5.2%	-2.6%	-0.3%	1.6%	3.2%	4.6%
	87.0%	-35.8%	-25.8%	-18.6%	-13.3%	-9.1%	-5.8%	-3.0%	-0.8%	1.2%	2.8%	4.3%
	88.5%	-36.8%	-26.7%	-19.4%	-13.9%	-9.7%	-6.3%	-3.5%	-1.2%	0.8%	2.5%	3.9%
	90.0%	-37.9%	-27.5%	-20.1%	-14.6%	-10.3%	-6.8%	-4.0%	-1.6%	0.4%	2.1%	3.6%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

4. PTC or ITC/Cash Grant: Qualitative Considerations

Although the relative financial value of each credit, as described in the previous section, is no doubt one of the most important considerations in choosing between the PTC and the ITC (or equivalent cash grant), it is by no means the only factor. A number of other, more-qualitative considerations might also play important roles in driving the decision, particularly when the quantitative difference is modest. These include the following:

- **Option to Elect Equivalent Cash Grant:** As mentioned earlier, ARRA 2009 not only enables PTC-eligible projects to elect a 30% ITC, but also allows projects eligible for a 30% ITC to elect a cash grant of equivalent value instead. Given the widely publicized lack of tax equity investors active in the market today, this cash grant option – which reduces or perhaps eliminates the need for such tax investors – could be significantly more valuable to project owners than the 30% ITC, even though the grant and the ITC provide, in theory, essentially the same amount of value. In other words, the medium by which the value is delivered – i.e., cash instead of a tax credit – is likely to have some intrinsic value of its own in today's difficult financial environment. The fact that "cash is king" might drive some PTC-eligible projects towards the 30% cash grant option, even if the PTC promises a higher expected value. This may be especially the case if the cash grant allows the project developer to access less-expensive debt or equity capital than might otherwise be available were the ITC

or PTC used; these considerations were not factored into the previous analysis, and could potentially drive developers and investors more strongly towards the cash grant.

- **Performance Risk:** The receipt of PTCs is dependent upon project performance, whereas the receipt of the ITC (or the equivalent cash grant) is not. The results of the analysis in Section 3 are only applicable if the project actually performs as expected (i.e., in accordance with the assumed capacity factor). If the project under-performs, then the ITC election will, in hindsight, look relatively more favorable than suggested by Section 3. Although the technologies analyzed in this report are relatively mature, some developers and project owners will nevertheless prefer the certainty offered by the ITC over the performance risk inherent in the PTC – even if the PTC promises a higher expected value.[9]

- **Tax Credit Appetite:** Before it will invest in a project that receives the 10-year PTC, a tax equity investor must be reasonably assured of having a tax base sufficient to fully absorb all of a project's tax benefits over the coming decade. In today's turbulent economic times, some tax investors have had difficulty gaining comfort with such a long-term projection. With the ITC, the need to forecast future tax appetite is greatly reduced, in that the full credit is realized in the project's first year (though depreciation deductions will still occur over a multi-year period). On the other hand, the concentration of the ITC in the project's first year means that a proportionally larger tax base (than is required for the PTC) is needed in that first year in order to fully absorb the ITC. Of course, if a project elects the 30% cash grant in lieu of the ITC, then tax credit appetite and tax equity investors become much less important (though may still be needed in order to make efficient use of allowable depreciation deductions).

- **Liquidity:** The fact that the ITC (or equivalent grant) is realized in year one, rather than being spread over time like the PTC, leads to a relatively more illiquid investment. Once the project owner realizes the ITC (or equivalent grant), the credit (or grant) is unavailable to potential buyers of the project. Yet because the ITC (or equivalent grant) vests linearly over a 5-year period, the investor must hold on to the project for at least five years in order to fully realize its value. With the PTC, on the other hand, credits are realized (and vest) in real time over a 10-year period as the project generates power. Thus, the sale of a PTC project can occur at virtually any time (ignoring the influence of depreciation recapture), and will transfer any remaining PTCs to the new owner (for example, if an owner sells a PTC project in its third year, the buyer will still benefit from seven years of future PTCs).

- **Subsidized Energy Financing:** Prior to passage of ARRA 2009, the value of both the ITC and the PTC were reduced proportionally (with the PTC reduction limited to a maximum of 50%) by the amount of a project's installed costs that was financed using "subsidized energy financing" (e.g., government-sponsored low-interest loan programs). ARRA 2009 removed this "double-dipping" penalty for the ITC, but not for the PTC. As such, any PTC-eligible project that can secure "subsidized energy financing" may be better off electing the ITC (or equivalent cash grant) rather than sticking with a diminished PTC.

[9] It is worth noting that this statement, like the rest of this report, reflects the perspective of project developers and investors. Adopting a public policy or societal perspective might very well lead to the opposite conclusion – i.e., that an incentive that rewards performance (e.g., the PTC) rather than investment (e.g., the ITC) is preferable.

- **Power Sale Requirement:** In order to be PTC-eligible, the qualifying renewable power must be sold to an unrelated party. Thus, behind-the-meter applications (i.e., projects installed on the ratepayer, rather than utility, side of the meter to displace purchased power) are generally not eligible for the PTC (unless they are owned by a third party who sells the power to the ratepayer). The ITC does not impose a power sale requirement, making it a more widely applicable incentive.

- **Owner/Operator Requirement:** With the exception of open- and closed-loop biomass projects, the project owner must also operate the project in order to claim the PTC. This requirement effectively rules out the option of lease financing, since in a leasing arrangement, the owner and operator are separate entities. The ITC, on the other hand, does not require the owner and operator to be the same entity, which opens the door to a variety of leasing structures, including sale/leasebacks and inverted pass-through leases.

5. Conclusions

The quantitative analysis in Section 3 reveals that only two of the five technologies modeled clearly favor one credit over the other: open-loop biomass receives more value from the ITC in every combination of installed cost and capacity factor modeled, while geothermal overwhelmingly receives more value from the PTC (regardless of whether the ITC equals 10% or 30%). The other three technologies – wind, closed-loop biomass, and landfill gas – are more evenly split between the two credits, though with a slight preference for the PTC (particularly in the case of closed-loop biomass). If, however, one subscribes to the view that most projects are likely to fall towards the middle of the installed cost and capacity factor ranges modeled rather than at the extremes, then Tables 2, 4, and 6 demonstrate that the difference between the PTC and ITC for these three technologies is likely to be rather modest in most cases, regardless of which credit provides more value.

As such, qualitative considerations may play as much or more of a role in driving the choice of PTC or ITC (or equivalent cash grant). This is particularly the case for wind, closed-loop biomass, and landfill gas, for which quantitative analysis did not reveal a clear winner. Although investment liquidity favors the PTC, all other qualitative considerations discussed in Section 4 favor the ITC. These include the option to elect an equivalent cash grant, no performance risk, more immediate use of tax base (if the equivalent cash grant is not elected), no penalty for subsidized energy financing, no power sale requirement, and the availability of leasing structures.

In combination, therefore, the quantitative and qualitative factors addressed in this report suggest that most wind, open- and closed-loop biomass, and landfill gas projects may benefit more from the ITC than they will from the PTC. Furthermore, based on qualitative considerations alone, it is reasonable to expect those projects that begin construction in 2009 or 2010 to elect the equivalent cash grant rather than the ITC itself.

Exceptions might include those wind, closed-loop biomass, and landfill gas projects with extremely low installed costs and/or high capacity factors, both of which quantitatively favor the

PTC. Likewise, unless qualitative considerations overwhelm quantitative, geothermal is likely to opt for the PTC over the ITC.

Ultimately, though, the choice of PTC, ITC, or cash grant will have to be made on a project-by-project basis. Individual project characteristics can vary considerably, and might not be adequately captured by the general analysis presented in this report. Moreover, project developers and investors may place considerably more emphasis on qualitative rather than quantitative considerations (or vice versa), or may weigh certain qualitative considerations more heavily than others. Whatever the outcome, the mere fact that this choice of federal incentives now exists (albeit temporarily) is undoubtedly a positive development for renewable project finance in the United States, as it enables each project to choose the incentive that best fits its needs.

References

Bolinger, Mark. 2009. *Financing Non-Residential Photovoltaic Projects: Options and Implications.* LBNL-1410E. Berkeley, Calif.: Lawrence Berkeley National Laboratory.

Bolinger, Mark, Ryan Wiser, William Golove. 2001. *Revisiting the "Buy versus Build" Decision for Publicly Owned Utilities in California Considering Wind and Geothermal Resources*. LBNL-48831. Berkeley, Calif.: Lawrence Berkeley National Laboratory.

Cory, Karlynn, Jason Coughlin, Charles Coggeshall. 2008. *Solar Photovoltaic Financing: Deployment on Public Property by State and Local Governments.* NREL/TP-670-43115. Golden, CO: National Renewable Energy Laboratory.

Harper, John, Matt Karcher, Mark Bolinger. 2007. *Wind Project Financing Structures: A Review & Comparative Analysis*. LBNL-63434. Berkeley, Calif.: Lawrence Berkeley National Laboratory.

Karcher, Matt. 2009. *The American Recovery and Reinvestment Act: ITC vs. PTC for Wind Projects*. Briefing from Deacon Harbor Financial, February 23, 2009.

Martin, Keith, Eli Katz, John Marciano, Ken Hansen. 2009. *How the Final Stimulus Bill Will Affect Renewable Power Projects*. Briefing from Chadbourne & Parke, February 16, 2009.

Appendix: Results of Analysis Conducted at 5% and 10% Nominal Discount Rates

Table A1. Net Value of ITC for Wind (5% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$1,500	$1,600	$1,700	$1,800	$1,900	$2,000	$2,100	$2,200	$2,300	$2,400	$2,500
25%	-3.7%	-2.0%	-0.6%	0.7%	1.8%	2.8%	3.7%	4.6%	5.3%	6.0%	6.7%
26%	-4.7%	-3.0%	-1.5%	-0.2%	1.0%	2.0%	3.0%	3.9%	4.7%	5.4%	6.1%
27%	-5.7%	-4.0%	-2.4%	-1.1%	0.2%	1.3%	2.3%	3.2%	4.0%	4.7%	5.4%
28%	-6.8%	-4.9%	-3.4%	-1.9%	-0.7%	0.5%	1.5%	2.5%	3.3%	4.1%	4.8%
29%	-7.8%	-5.9%	-4.3%	-2.8%	-1.5%	-0.3%	0.8%	1.8%	2.6%	3.5%	4.2%
30%	-8.8%	-6.9%	-5.2%	-3.7%	-2.3%	-1.1%	0.0%	1.0%	2.0%	2.8%	3.6%
31%	-9.9%	-7.9%	-6.1%	-4.5%	-3.1%	-1.8%	-0.7%	0.3%	1.3%	2.2%	3.0%
32%	-10.9%	-8.8%	-7.0%	-5.4%	-3.9%	-2.6%	-1.4%	-0.4%	0.6%	1.5%	2.3%
33%	-11.9%	-9.8%	-7.9%	-6.2%	-4.7%	-3.4%	-2.2%	-1.1%	-0.1%	0.9%	1.7%
34%	-13.0%	-10.8%	-8.8%	-7.1%	-5.6%	-4.2%	-2.9%	-1.8%	-0.7%	0.2%	1.1%
35%	-14.0%	-11.7%	-9.7%	-8.0%	-6.4%	-4.9%	-3.7%	-2.5%	-1.4%	-0.4%	0.5%
36%	-15.0%	-12.7%	-10.7%	-8.8%	-7.2%	-5.7%	-4.4%	-3.2%	-2.1%	-1.1%	-0.1%
37%	-16.1%	-13.7%	-11.6%	-9.7%	-8.0%	-6.5%	-5.1%	-3.9%	-2.8%	-1.7%	-0.8%
38%	-17.1%	-14.6%	-12.5%	-10.6%	-8.8%	-7.3%	-5.9%	-4.6%	-3.4%	-2.4%	-1.4%
39%	-18.1%	-15.6%	-13.4%	-11.4%	-9.6%	-8.1%	-6.6%	-5.3%	-4.1%	-3.0%	-2.0%
40%	-19.2%	-16.6%	-14.3%	-12.3%	-10.5%	-8.8%	-7.3%	-6.0%	-4.8%	-3.7%	-2.6%
41%	-20.2%	-17.6%	-15.2%	-13.1%	-11.3%	-9.6%	-8.1%	-6.7%	-5.5%	-4.3%	-3.2%
42%	-21.2%	-18.5%	-16.1%	-14.0%	-12.1%	-10.4%	-8.8%	-7.4%	-6.1%	-4.9%	-3.9%
43%	-22.3%	-19.5%	-17.0%	-14.9%	-12.9%	-11.2%	-9.6%	-8.1%	-6.8%	-5.6%	-4.5%
44%	-23.3%	-20.5%	-18.0%	-15.7%	-13.7%	-11.9%	-10.3%	-8.8%	-7.5%	-6.2%	-5.1%
45%	-24.3%	-21.4%	-18.9%	-16.6%	-14.5%	-12.7%	-11.0%	-9.5%	-8.2%	-6.9%	-5.7%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A2. Net Value of ITC for Wind (10% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$1,500	$1,600	$1,700	$1,800	$1,900	$2,000	$2,100	$2,200	$2,300	$2,400	$2,500
25%	1.1%	2.4%	3.6%	4.6%	5.4%	6.3%	7.0%	7.6%	8.3%	8.8%	9.3%
26%	0.3%	1.7%	2.8%	3.9%	4.8%	5.6%	6.4%	7.1%	7.7%	8.3%	8.8%
27%	-0.5%	0.9%	2.1%	3.2%	4.2%	5.0%	5.8%	6.5%	7.2%	7.8%	8.3%
28%	-1.3%	0.1%	1.4%	2.5%	3.5%	4.4%	5.2%	6.0%	6.7%	7.3%	7.8%
29%	-2.1%	-0.6%	0.7%	1.8%	2.9%	3.8%	4.7%	5.4%	6.1%	6.8%	7.4%
30%	-2.9%	-1.4%	-0.1%	1.1%	2.2%	3.2%	4.1%	4.9%	5.6%	6.3%	6.9%
31%	-3.8%	-2.2%	-0.8%	0.5%	1.6%	2.6%	3.5%	4.3%	5.1%	5.7%	6.4%
32%	-4.6%	-2.9%	-1.5%	-0.2%	0.9%	2.0%	2.9%	3.7%	4.5%	5.2%	5.9%
33%	-5.4%	-3.7%	-2.2%	-0.9%	0.3%	1.4%	2.3%	3.2%	4.0%	4.7%	5.4%
34%	-6.2%	-4.5%	-2.9%	-1.6%	-0.4%	0.7%	1.7%	2.6%	3.5%	4.2%	4.9%
35%	-7.0%	-5.2%	-3.7%	-2.3%	-1.0%	0.1%	1.1%	2.1%	2.9%	3.7%	4.4%
36%	-7.8%	-6.0%	-4.4%	-2.9%	-1.6%	-0.5%	0.6%	1.5%	2.4%	3.2%	3.9%
37%	-8.7%	-6.8%	-5.1%	-3.6%	-2.3%	-1.1%	-0.0%	1.0%	1.9%	2.7%	3.4%
38%	-9.5%	-7.5%	-5.8%	-4.3%	-2.9%	-1.7%	-0.6%	0.4%	1.3%	2.2%	2.9%
39%	-10.3%	-8.3%	-6.5%	-5.0%	-3.6%	-2.3%	-1.2%	-0.2%	0.8%	1.7%	2.5%
40%	-11.1%	-9.1%	-7.3%	-5.7%	-4.2%	-2.9%	-1.8%	-0.7%	0.3%	1.1%	2.0%
41%	-11.9%	-9.8%	-8.0%	-6.3%	-4.9%	-3.6%	-2.4%	-1.3%	-0.3%	0.6%	1.5%
42%	-12.7%	-10.6%	-8.7%	-7.0%	-5.5%	-4.2%	-2.9%	-1.8%	-0.8%	0.1%	1.0%
43%	-13.6%	-11.4%	-9.4%	-7.7%	-6.2%	-4.8%	-3.5%	-2.4%	-1.3%	-0.4%	0.5%
44%	-14.4%	-12.1%	-10.1%	-8.4%	-6.8%	-5.4%	-4.1%	-2.9%	-1.9%	-0.9%	0.0%
45%	-15.2%	-12.9%	-10.9%	-9.1%	-7.5%	-6.0%	-4.7%	-3.5%	-2.4%	-1.4%	-0.5%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A3. Net Value of ITC for Open-Loop Biomass (5% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$3,000	$3,200	$3,400	$3,600	$3,800	$4,000	$4,200	$4,400	$4,600	$4,800	$5,000
60.0%	7.0%	8.0%	8.9%	9.6%	10.3%	10.9%	11.5%	12.0%	12.5%	12.9%	13.3%
61.5%	6.7%	7.7%	8.5%	9.3%	10.0%	10.7%	11.2%	11.7%	12.2%	12.6%	13.0%
63.0%	6.3%	7.3%	8.2%	9.0%	9.7%	10.4%	10.9%	11.5%	12.0%	12.4%	12.8%
64.5%	5.9%	6.9%	7.8%	8.7%	9.4%	10.1%	10.7%	11.2%	11.7%	12.2%	12.6%
66.0%	5.5%	6.6%	7.5%	8.3%	9.1%	9.8%	10.4%	10.9%	11.5%	11.9%	12.3%
67.5%	5.1%	6.2%	7.2%	8.0%	8.8%	9.5%	10.1%	10.7%	11.2%	11.7%	12.1%
69.0%	4.7%	5.8%	6.8%	7.7%	8.5%	9.2%	9.8%	10.4%	10.9%	11.4%	11.9%
70.5%	4.3%	5.5%	6.5%	7.4%	8.2%	8.9%	9.6%	10.1%	10.7%	11.2%	11.6%
72.0%	3.9%	5.1%	6.1%	7.0%	7.9%	8.6%	9.3%	9.9%	10.4%	10.9%	11.4%
73.5%	3.5%	4.7%	5.8%	6.7%	7.6%	8.3%	9.0%	9.6%	10.2%	10.7%	11.2%
75.0%	3.1%	4.4%	5.4%	6.4%	7.2%	8.0%	8.7%	9.3%	9.9%	10.5%	10.9%
76.5%	2.8%	4.0%	5.1%	6.1%	6.9%	7.7%	8.4%	9.1%	9.7%	10.2%	10.7%
78.0%	2.4%	3.6%	4.8%	5.7%	6.6%	7.4%	8.2%	8.8%	9.4%	10.0%	10.5%
79.5%	2.0%	3.3%	4.4%	5.4%	6.3%	7.1%	7.9%	8.6%	9.2%	9.7%	10.2%
81.0%	1.6%	2.9%	4.1%	5.1%	6.0%	6.8%	7.6%	8.3%	8.9%	9.5%	10.0%
82.5%	1.2%	2.5%	3.7%	4.8%	5.7%	6.6%	7.3%	8.0%	8.7%	9.2%	9.8%
84.0%	0.8%	2.2%	3.4%	4.4%	5.4%	6.3%	7.0%	7.8%	8.4%	9.0%	9.5%
85.5%	0.4%	1.8%	3.0%	4.1%	5.1%	6.0%	6.8%	7.5%	8.1%	8.8%	9.3%
87.0%	0.0%	1.4%	2.7%	3.8%	4.8%	5.7%	6.5%	7.2%	7.9%	8.5%	9.1%
88.5%	-0.4%	1.1%	2.3%	3.5%	4.5%	5.4%	6.2%	7.0%	7.6%	8.3%	8.8%
90.0%	-0.8%	0.7%	2.0%	3.1%	4.2%	5.1%	5.9%	6.7%	7.4%	8.0%	8.6%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A4. Net Value of ITC for Open-Loop Biomass (10% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$3,000	$3,200	$3,400	$3,600	$3,800	$4,000	$4,200	$4,400	$4,600	$4,800	$5,000
60.0%	9.8%	10.6%	11.3%	11.9%	12.4%	12.9%	13.4%	13.8%	14.1%	14.5%	14.8%
61.5%	9.5%	10.3%	11.0%	11.6%	12.2%	12.7%	13.2%	13.6%	13.9%	14.3%	14.6%
63.0%	9.2%	10.0%	10.8%	11.4%	12.0%	12.5%	12.9%	13.4%	13.7%	14.1%	14.4%
64.5%	8.9%	9.8%	10.5%	11.1%	11.7%	12.2%	12.7%	13.1%	13.5%	13.9%	14.2%
66.0%	8.6%	9.5%	10.2%	10.9%	11.5%	12.0%	12.5%	12.9%	13.3%	13.7%	14.0%
67.5%	8.3%	9.2%	9.9%	10.6%	11.2%	11.8%	12.3%	12.7%	13.1%	13.5%	13.9%
69.0%	8.0%	8.9%	9.7%	10.4%	11.0%	11.5%	12.0%	12.5%	12.9%	13.3%	13.7%
70.5%	7.7%	8.6%	9.4%	10.1%	10.7%	11.3%	11.8%	12.3%	12.7%	13.1%	13.5%
72.0%	7.4%	8.3%	9.1%	9.8%	10.5%	11.1%	11.6%	12.1%	12.5%	12.9%	13.3%
73.5%	7.1%	8.0%	8.9%	9.6%	10.3%	10.8%	11.4%	11.9%	12.3%	12.7%	13.1%
75.0%	6.8%	7.7%	8.6%	9.3%	10.0%	10.6%	11.2%	11.7%	12.1%	12.5%	12.9%
76.5%	6.5%	7.4%	8.3%	9.1%	9.8%	10.4%	10.9%	11.5%	11.9%	12.4%	12.7%
78.0%	6.1%	7.2%	8.0%	8.8%	9.5%	10.2%	10.7%	11.2%	11.7%	12.2%	12.6%
79.5%	5.8%	6.9%	7.8%	8.6%	9.3%	9.9%	10.5%	11.0%	11.5%	12.0%	12.4%
81.0%	5.5%	6.6%	7.5%	8.3%	9.0%	9.7%	10.3%	10.8%	11.3%	11.8%	12.2%
82.5%	5.2%	6.3%	7.2%	8.0%	8.8%	9.5%	10.1%	10.6%	11.1%	11.6%	12.0%
84.0%	4.9%	6.0%	6.9%	7.8%	8.5%	9.2%	9.8%	10.4%	10.9%	11.4%	11.8%
85.5%	4.6%	5.7%	6.7%	7.5%	8.3%	9.0%	9.6%	10.2%	10.7%	11.2%	11.6%
87.0%	4.3%	5.4%	6.4%	7.3%	8.1%	8.8%	9.4%	10.0%	10.5%	11.0%	11.5%
88.5%	4.0%	5.1%	6.1%	7.0%	7.8%	8.5%	9.2%	9.8%	10.3%	10.8%	11.3%
90.0%	3.7%	4.8%	5.9%	6.8%	7.6%	8.3%	9.0%	9.6%	10.1%	10.6%	11.1%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A5. Net Value of ITC for Closed-Loop Biomass (5% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$3,000	$3,200	$3,400	$3,600	$3,800	$4,000	$4,200	$4,400	$4,600	$4,800	$5,000
60.0%	-8.4%	-6.5%	-4.7%	-3.2%	-1.9%	-0.6%	0.5%	1.5%	2.4%	3.2%	4.0%
61.5%	-9.2%	-7.2%	-5.4%	-3.9%	-2.5%	-1.2%	-0.1%	1.0%	1.9%	2.8%	3.6%
63.0%	-9.9%	-7.9%	-6.1%	-4.5%	-3.1%	-1.8%	-0.6%	0.4%	1.4%	2.3%	3.1%
64.5%	-10.7%	-8.6%	-6.8%	-5.2%	-3.7%	-2.4%	-1.2%	-0.1%	0.9%	1.8%	2.6%
66.0%	-11.5%	-9.4%	-7.5%	-5.8%	-4.3%	-3.0%	-1.7%	-0.6%	0.4%	1.3%	2.2%
67.5%	-12.3%	-10.1%	-8.2%	-6.5%	-4.9%	-3.5%	-2.3%	-1.2%	-0.1%	0.8%	1.7%
69.0%	-13.0%	-10.8%	-8.9%	-7.1%	-5.5%	-4.1%	-2.9%	-1.7%	-0.6%	0.3%	1.2%
70.5%	-13.8%	-11.5%	-9.5%	-7.7%	-6.1%	-4.7%	-3.4%	-2.2%	-1.1%	-0.2%	0.8%
72.0%	-14.6%	-12.3%	-10.2%	-8.4%	-6.8%	-5.3%	-4.0%	-2.8%	-1.6%	-0.6%	0.3%
73.5%	-15.4%	-13.0%	-10.9%	-9.0%	-7.4%	-5.9%	-4.5%	-3.3%	-2.2%	-1.1%	-0.2%
75.0%	-16.2%	-13.7%	-11.6%	-9.7%	-8.0%	-6.5%	-5.1%	-3.8%	-2.7%	-1.6%	-0.6%
76.5%	-16.9%	-14.5%	-12.3%	-10.3%	-8.6%	-7.0%	-5.6%	-4.3%	-3.2%	-2.1%	-1.1%
78.0%	-17.7%	-15.2%	-13.0%	-11.0%	-9.2%	-7.6%	-6.2%	-4.9%	-3.7%	-2.6%	-1.6%
79.5%	-18.5%	-15.9%	-13.6%	-11.6%	-9.8%	-8.2%	-6.7%	-5.4%	-4.2%	-3.1%	-2.0%
81.0%	-19.3%	-16.6%	-14.3%	-12.3%	-10.4%	-8.8%	-7.3%	-5.9%	-4.7%	-3.5%	-2.5%
82.5%	-20.0%	-17.4%	-15.0%	-12.9%	-11.0%	-9.4%	-7.8%	-6.5%	-5.2%	-4.0%	-3.0%
84.0%	-20.8%	-18.1%	-15.7%	-13.6%	-11.7%	-9.9%	-8.4%	-7.0%	-5.7%	-4.5%	-3.4%
85.5%	-21.6%	-18.8%	-16.4%	-14.2%	-12.3%	-10.5%	-8.9%	-7.5%	-6.2%	-5.0%	-3.9%
87.0%	-22.4%	-19.5%	-17.1%	-14.9%	-12.9%	-11.1%	-9.5%	-8.0%	-6.7%	-5.5%	-4.4%
88.5%	-23.1%	-20.3%	-17.7%	-15.5%	-13.5%	-11.7%	-10.1%	-8.6%	-7.2%	-6.0%	-4.8%
90.0%	-23.9%	-21.0%	-18.4%	-16.2%	-14.1%	-12.3%	-10.6%	-9.1%	-7.7%	-6.5%	-5.3%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A6. Net Value of ITC for Closed-Loop Biomass (10% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$3,000	$3,200	$3,400	$3,600	$3,800	$4,000	$4,200	$4,400	$4,600	$4,800	$5,000
60.0%	-2.3%	-0.8%	0.5%	1.7%	2.8%	3.8%	4.7%	5.5%	6.2%	6.9%	7.5%
61.5%	-3.0%	-1.4%	0.0%	1.2%	2.3%	3.3%	4.2%	5.0%	5.8%	6.5%	7.1%
63.0%	-3.6%	-2.0%	-0.5%	0.7%	1.9%	2.9%	3.8%	4.6%	5.4%	6.1%	6.7%
64.5%	-4.2%	-2.5%	-1.1%	0.2%	1.4%	2.4%	3.4%	4.2%	5.0%	5.7%	6.4%
66.0%	-4.8%	-3.1%	-1.6%	-0.3%	0.9%	2.0%	2.9%	3.8%	4.6%	5.3%	6.0%
67.5%	-5.4%	-3.7%	-2.2%	-0.8%	0.4%	1.5%	2.5%	3.4%	4.2%	4.9%	5.6%
69.0%	-6.0%	-4.3%	-2.7%	-1.3%	-0.1%	1.0%	2.0%	3.0%	3.8%	4.6%	5.3%
70.5%	-6.6%	-4.8%	-3.2%	-1.8%	-0.6%	0.6%	1.6%	2.5%	3.4%	4.2%	4.9%
72.0%	-7.2%	-5.4%	-3.8%	-2.3%	-1.0%	0.1%	1.2%	2.1%	3.0%	3.8%	4.5%
73.5%	-7.9%	-6.0%	-4.3%	-2.9%	-1.5%	-0.3%	0.7%	1.7%	2.6%	3.4%	4.2%
75.0%	-8.5%	-6.6%	-4.9%	-3.4%	-2.0%	-0.8%	0.3%	1.3%	2.2%	3.0%	3.8%
76.5%	-9.1%	-7.1%	-5.4%	-3.9%	-2.5%	-1.3%	-0.2%	0.9%	1.8%	2.6%	3.4%
78.0%	-9.7%	-7.7%	-5.9%	-4.4%	-3.0%	-1.7%	-0.6%	0.4%	1.4%	2.3%	3.1%
79.5%	-10.3%	-8.3%	-6.5%	-4.9%	-3.5%	-2.2%	-1.0%	0.0%	1.0%	1.9%	2.7%
81.0%	-10.9%	-8.9%	-7.0%	-5.4%	-4.0%	-2.6%	-1.5%	-0.4%	0.6%	1.5%	2.3%
82.5%	-11.5%	-9.4%	-7.6%	-5.9%	-4.4%	-3.1%	-1.9%	-0.8%	0.2%	1.1%	2.0%
84.0%	-12.1%	-10.0%	-8.1%	-6.4%	-4.9%	-3.6%	-2.3%	-1.2%	-0.2%	0.7%	1.6%
85.5%	-12.8%	-10.6%	-8.6%	-6.9%	-5.4%	-4.0%	-2.8%	-1.6%	-0.6%	0.3%	1.2%
87.0%	-13.4%	-11.2%	-9.2%	-7.4%	-5.9%	-4.5%	-3.2%	-2.1%	-1.0%	-0.0%	0.8%
88.5%	-14.0%	-11.7%	-9.7%	-8.0%	-6.4%	-4.9%	-3.7%	-2.5%	-1.4%	-0.4%	0.5%
90.0%	-14.6%	-12.3%	-10.3%	-8.5%	-6.9%	-5.4%	-4.1%	-2.9%	-1.8%	-0.8%	0.1%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A7. Net Value of ITC for Geothermal (5% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$3,000	$3,300	$3,600	$3,900	$4,200	$4,500	$4,800	$5,100	$5,400	$5,700	$6,000
70.0%	-18.7%	-15.4%	-12.7%	-10.4%	-8.4%	-6.7%	-5.2%	-3.8%	-2.6%	-1.6%	-0.6%
71.3%	-19.4%	-16.0%	-13.2%	-10.9%	-8.8%	-7.1%	-5.6%	-4.2%	-3.0%	-1.9%	-1.0%
72.5%	-20.0%	-16.6%	-13.8%	-11.4%	-9.3%	-7.5%	-6.0%	-4.6%	-3.4%	-2.3%	-1.3%
73.8%	-20.7%	-17.2%	-14.3%	-11.9%	-9.8%	-8.0%	-6.4%	-5.0%	-3.7%	-2.6%	-1.6%
75.0%	-21.3%	-17.8%	-14.9%	-12.4%	-10.2%	-8.4%	-6.8%	-5.3%	-4.1%	-2.9%	-1.9%
76.3%	-22.0%	-18.4%	-15.4%	-12.9%	-10.7%	-8.8%	-7.2%	-5.7%	-4.4%	-3.3%	-2.2%
77.5%	-22.6%	-19.0%	-15.9%	-13.4%	-11.2%	-9.2%	-7.6%	-6.1%	-4.8%	-3.6%	-2.6%
78.8%	-23.3%	-19.6%	-16.5%	-13.9%	-11.6%	-9.7%	-8.0%	-6.5%	-5.2%	-4.0%	-2.9%
80.0%	-23.9%	-20.1%	-17.0%	-14.4%	-12.1%	-10.1%	-8.4%	-6.9%	-5.5%	-4.3%	-3.2%
81.3%	-24.6%	-20.7%	-17.5%	-14.9%	-12.5%	-10.5%	-8.8%	-7.2%	-5.9%	-4.6%	-3.5%
82.5%	-25.2%	-21.3%	-18.1%	-15.3%	-13.0%	-11.0%	-9.2%	-7.6%	-6.2%	-5.0%	-3.9%
83.7%	-25.8%	-21.9%	-18.6%	-15.8%	-13.5%	-11.4%	-9.6%	-8.0%	-6.6%	-5.3%	-4.2%
85.0%	-26.5%	-22.5%	-19.2%	-16.3%	-13.9%	-11.8%	-10.0%	-8.4%	-7.0%	-5.7%	-4.5%
86.2%	-27.1%	-23.1%	-19.7%	-16.8%	-14.4%	-12.3%	-10.4%	-8.8%	-7.3%	-6.0%	-4.8%
87.5%	-27.8%	-23.7%	-20.2%	-17.3%	-14.9%	-12.7%	-10.8%	-9.1%	-7.7%	-6.3%	-5.2%
88.7%	-28.4%	-24.3%	-20.8%	-17.8%	-15.3%	-13.1%	-11.2%	-9.5%	-8.0%	-6.7%	-5.5%
90.0%	-29.1%	-24.8%	-21.3%	-18.3%	-15.8%	-13.6%	-11.6%	-9.9%	-8.4%	-7.0%	-5.8%
91.2%	-29.7%	-25.4%	-21.9%	-18.8%	-16.2%	-14.0%	-12.0%	-10.3%	-8.7%	-7.4%	-6.1%
92.5%	-30.4%	-26.0%	-22.4%	-19.3%	-16.7%	-14.4%	-12.4%	-10.7%	-9.1%	-7.7%	-6.4%
93.7%	-31.0%	-26.6%	-22.9%	-19.8%	-17.2%	-14.9%	-12.8%	-11.0%	-9.5%	-8.0%	-6.8%
95.0%	-31.7%	-27.2%	-23.5%	-20.3%	-17.6%	-15.3%	-13.2%	-11.4%	-9.8%	-8.4%	-7.1%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A8. Net Value of ITC for Geothermal (10% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$3,000	$3,300	$3,600	$3,900	$4,200	$4,500	$4,800	$5,100	$5,400	$5,700	$6,000
70.0%	-11.6%	-9.0%	-6.9%	-5.0%	-3.5%	-2.1%	-0.9%	0.1%	1.1%	1.9%	2.7%
71.3%	-12.2%	-9.5%	-7.3%	-5.4%	-3.8%	-2.5%	-1.2%	-0.2%	0.8%	1.6%	2.4%
72.5%	-12.7%	-10.0%	-7.7%	-5.8%	-4.2%	-2.8%	-1.6%	-0.5%	0.5%	1.4%	2.1%
73.8%	-13.2%	-10.4%	-8.2%	-6.2%	-4.6%	-3.1%	-1.9%	-0.8%	0.2%	1.1%	1.9%
75.0%	-13.7%	-10.9%	-8.6%	-6.6%	-4.9%	-3.5%	-2.2%	-1.1%	-0.1%	0.8%	1.6%
76.3%	-14.2%	-11.4%	-9.0%	-7.0%	-5.3%	-3.8%	-2.5%	-1.4%	-0.4%	0.6%	1.4%
77.5%	-14.7%	-11.8%	-9.4%	-7.4%	-5.7%	-4.2%	-2.8%	-1.7%	-0.6%	0.3%	1.1%
78.8%	-15.2%	-12.3%	-9.9%	-7.8%	-6.0%	-4.5%	-3.2%	-2.0%	-0.9%	0.0%	0.9%
80.0%	-15.7%	-12.8%	-10.3%	-8.2%	-6.4%	-4.8%	-3.5%	-2.3%	-1.2%	-0.2%	0.6%
81.3%	-16.2%	-13.2%	-10.7%	-8.6%	-6.8%	-5.2%	-3.8%	-2.6%	-1.5%	-0.5%	0.4%
82.5%	-16.8%	-13.7%	-11.1%	-9.0%	-7.1%	-5.5%	-4.1%	-2.9%	-1.8%	-0.8%	0.1%
83.7%	-17.3%	-14.2%	-11.6%	-9.4%	-7.5%	-5.9%	-4.4%	-3.2%	-2.1%	-1.1%	-0.2%
85.0%	-17.8%	-14.6%	-12.0%	-9.8%	-7.9%	-6.2%	-4.8%	-3.5%	-2.3%	-1.3%	-0.4%
86.2%	-18.3%	-15.1%	-12.4%	-10.2%	-8.2%	-6.5%	-5.1%	-3.8%	-2.6%	-1.6%	-0.7%
87.5%	-18.8%	-15.5%	-12.8%	-10.5%	-8.6%	-6.9%	-5.4%	-4.1%	-2.9%	-1.9%	-0.9%
88.7%	-19.3%	-16.0%	-13.3%	-10.9%	-8.9%	-7.2%	-5.7%	-4.4%	-3.2%	-2.1%	-1.2%
90.0%	-19.8%	-16.5%	-13.7%	-11.3%	-9.3%	-7.6%	-6.0%	-4.7%	-3.5%	-2.4%	-1.4%
91.2%	-20.3%	-16.9%	-14.1%	-11.7%	-9.7%	-7.9%	-6.3%	-5.0%	-3.8%	-2.7%	-1.7%
92.5%	-20.8%	-17.4%	-14.5%	-12.1%	-10.0%	-8.2%	-6.7%	-5.3%	-4.0%	-2.9%	-1.9%
93.7%	-21.4%	-17.9%	-15.0%	-12.5%	-10.4%	-8.6%	-7.0%	-5.6%	-4.3%	-3.2%	-2.2%
95.0%	-21.9%	-18.3%	-15.4%	-12.9%	-10.8%	-8.9%	-7.3%	-5.9%	-4.6%	-3.5%	-2.5%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A9. Net Value of ITC for Landfill Gas (5% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$1,000	$1,200	$1,400	$1,600	$1,800	$2,000	$2,200	$2,400	$2,600	$2,800	$3,000
60.0%	-22.2%	-14.4%	-8.9%	-4.7%	-1.4%	1.2%	3.3%	5.1%	6.6%	7.8%	9.0%
61.5%	-23.4%	-15.4%	-9.7%	-5.4%	-2.1%	0.6%	2.7%	4.6%	6.1%	7.4%	8.6%
63.0%	-24.6%	-16.4%	-10.5%	-6.2%	-2.7%	-0.0%	2.2%	4.1%	5.7%	7.0%	8.2%
64.5%	-25.7%	-17.4%	-11.4%	-6.9%	-3.4%	-0.6%	1.7%	3.6%	5.2%	6.6%	7.8%
66.0%	-26.9%	-18.3%	-12.2%	-7.6%	-4.0%	-1.2%	1.2%	3.1%	4.8%	6.2%	7.4%
67.5%	-28.1%	-19.3%	-13.0%	-8.3%	-4.7%	-1.8%	0.6%	2.6%	4.3%	5.7%	7.0%
69.0%	-29.3%	-20.3%	-13.9%	-9.1%	-5.3%	-2.4%	0.1%	2.1%	3.9%	5.3%	6.6%
70.5%	-30.4%	-21.3%	-14.7%	-9.8%	-6.0%	-2.9%	-0.4%	1.6%	3.4%	4.9%	6.2%
72.0%	-31.6%	-22.2%	-15.6%	-10.5%	-6.6%	-3.5%	-1.0%	1.2%	3.0%	4.5%	5.8%
73.5%	-32.8%	-23.2%	-16.4%	-11.3%	-7.3%	-4.1%	-1.5%	0.7%	2.5%	4.1%	5.4%
75.0%	-33.9%	-24.2%	-17.2%	-12.0%	-7.9%	-4.7%	-2.0%	0.2%	2.1%	3.7%	5.1%
76.5%	-35.1%	-25.2%	-18.1%	-12.7%	-8.6%	-5.3%	-2.6%	-0.3%	1.6%	3.2%	4.7%
78.0%	-36.3%	-26.1%	-18.9%	-13.5%	-9.2%	-5.9%	-3.1%	-0.8%	1.2%	2.8%	4.3%
79.5%	-37.4%	-27.1%	-19.7%	-14.2%	-9.9%	-6.4%	-3.6%	-1.3%	0.7%	2.4%	3.9%
81.0%	-38.6%	-28.1%	-20.6%	-14.9%	-10.5%	-7.0%	-4.2%	-1.8%	0.3%	2.0%	3.5%
82.5%	-39.8%	-29.1%	-21.4%	-15.7%	-11.2%	-7.6%	-4.7%	-2.3%	-0.2%	1.6%	3.1%
84.0%	-40.9%	-30.0%	-22.2%	-16.4%	-11.8%	-8.2%	-5.2%	-2.7%	-0.6%	1.2%	2.7%
85.5%	-42.1%	-31.0%	-23.1%	-17.1%	-12.5%	-8.8%	-5.8%	-3.2%	-1.1%	0.7%	2.3%
87.0%	-43.3%	-32.0%	-23.9%	-17.9%	-13.1%	-9.4%	-6.3%	-3.7%	-1.5%	0.3%	1.9%
88.5%	-44.5%	-33.0%	-24.7%	-18.6%	-13.8%	-10.0%	-6.8%	-4.2%	-2.0%	-0.1%	1.5%
90.0%	-45.6%	-33.9%	-25.6%	-19.3%	-14.4%	-10.5%	-7.4%	-4.7%	-2.4%	-0.5%	1.2%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value

Table A10. Net Value of ITC for Landfill Gas (10% Nominal Discount Rate)

Net Capacity Factor (%)	Total Installed Project Cost ($/kW)										
	$1,000	$1,200	$1,400	$1,600	$1,800	$2,000	$2,200	$2,400	$2,600	$2,800	$3,000
60.0%	-13.0%	-6.8%	-2.4%	0.9%	3.4%	5.5%	7.2%	8.6%	9.8%	10.8%	11.7%
61.5%	-13.9%	-7.6%	-3.1%	0.3%	2.9%	5.0%	6.8%	8.2%	9.4%	10.4%	11.3%
63.0%	-14.9%	-8.4%	-3.8%	-0.3%	2.4%	4.6%	6.3%	7.8%	9.0%	10.1%	11.0%
64.5%	-15.8%	-9.2%	-4.4%	-0.9%	1.9%	4.1%	5.9%	7.4%	8.7%	9.8%	10.7%
66.0%	-16.7%	-9.9%	-5.1%	-1.4%	1.4%	3.6%	5.5%	7.0%	8.3%	9.5%	10.4%
67.5%	-17.6%	-10.7%	-5.7%	-2.0%	0.9%	3.2%	5.1%	6.6%	8.0%	9.1%	10.1%
69.0%	-18.6%	-11.5%	-6.4%	-2.6%	0.4%	2.7%	4.6%	6.3%	7.6%	8.8%	9.8%
70.5%	-19.5%	-12.2%	-7.1%	-3.2%	-0.2%	2.3%	4.2%	5.9%	7.3%	8.5%	9.5%
72.0%	-20.4%	-13.0%	-7.7%	-3.8%	-0.7%	1.8%	3.8%	5.5%	6.9%	8.1%	9.2%
73.5%	-21.3%	-13.8%	-8.4%	-4.3%	-1.2%	1.3%	3.4%	5.1%	6.6%	7.8%	8.9%
75.0%	-22.3%	-14.5%	-9.0%	-4.9%	-1.7%	0.9%	3.0%	4.7%	6.2%	7.5%	8.6%
76.5%	-23.2%	-15.3%	-9.7%	-5.5%	-2.2%	0.4%	2.5%	4.3%	5.8%	7.1%	8.3%
78.0%	-24.1%	-16.1%	-10.4%	-6.1%	-2.7%	-0.1%	2.1%	3.9%	5.5%	6.8%	8.0%
79.5%	-25.0%	-16.9%	-11.0%	-6.6%	-3.2%	-0.5%	1.7%	3.6%	5.1%	6.5%	7.6%
81.0%	-26.0%	-17.6%	-11.7%	-7.2%	-3.8%	-1.0%	1.3%	3.2%	4.8%	6.2%	7.3%
82.5%	-26.9%	-18.4%	-12.3%	-7.8%	-4.3%	-1.4%	0.9%	2.8%	4.4%	5.8%	7.0%
84.0%	-27.8%	-19.2%	-13.0%	-8.4%	-4.8%	-1.9%	0.4%	2.4%	4.1%	5.5%	6.7%
85.5%	-28.7%	-19.9%	-13.7%	-9.0%	-5.3%	-2.4%	0.0%	2.0%	3.7%	5.2%	6.4%
87.0%	-29.7%	-20.7%	-14.3%	-9.5%	-5.8%	-2.8%	-0.4%	1.6%	3.4%	4.8%	6.1%
88.5%	-30.6%	-21.5%	-15.0%	-10.1%	-6.3%	-3.3%	-0.8%	1.3%	3.0%	4.5%	5.8%
90.0%	-31.5%	-22.3%	-15.6%	-10.7%	-6.8%	-3.8%	-1.2%	0.9%	2.6%	4.2%	5.5%

Positive (and unshaded) means the ITC (or equivalent cash grant) provides more value
Negative (and shaded) means the PTC provides more value