DETERMINING THE VALUE OF RENEWABLE ASSETS AFTER THE EXPIRATION OF POWER PURCHASE AGREEMENTS

by

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Executive Summary

The long lives of renewable energy assets complicate their economic valuation as long term projections of relevant variables such as operating performance, commodity prices, and policy are highly uncertain. Power purchase agreements (PPAs) remove much of the uncertainty by fixing the energy price and guaranteeing an off-taker for the asset's power output. However, wind and solar assets can have useful lives and generate electricity and provide financial returns for much longer than the term of the PPA. Despite that, little rigorous thought or analysis has been given to how to value the post-PPA life of a new project and how significant that value is. Assumptions and valuation methodologies are both firm and individual-specific. The lack of clarity into what the potential post-PPA options are and how valuable they are increases the risk associated with the asset class, and poses challenges for renewable energy development generally as well as for developers, operators and investors.

In general, an asset owner will have three options once its PPA expires: 1) renew the PPA; 2) continue operating the asset without a PPA; or 3) decommission the assets for scrap or to be refurbished for future use. Which course of action to take and what its value is are highly dependent on a number of variables that are difficult, if not impossible, to project decades into the future. In response, the market broadly uses four approaches: 1) use a metric like cash-on-cash returns that avoids assumptions about the long-term value of the asset; 2) assume the asset will be resigned to a PPA with similar terms and value; 3) assume it will continue operating without a PPA and project revenues by using a modeled forward price curve and some expected asset deterioration; or 4) assume the asset will be decommissioned after its PPA expires and there is no post-PPA value.

This paper investigates current post-PPA valuation methods, what options exist for a PPA-expired renewable energy asset, and uses the case of a hypothetical wind farm to illustrate the use of a method for bounding the uncertainty on the post-PPA value at the beginning of the asset's life. It finds that potential post-PPA options can significantly affect project values and internal rates of return and hence, merits further research and consideration by the market. Given the range of values demonstrated, additional research into how exposed different market participants are to this post-PPA value risk is also justified. The paper closes by establishing the similarity between the potential post-PPA options and traditional European-style long call options and suggesting that a traditional options valuation model may provide greater insight into how to value the post-PPA term of a renewable energy asset at the beginning of its useful life.

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Introduction

Renewable energy assets are, fundamentally, infrastructure investments characterized by high development costs and long lives.[1] They also tend to be "single purpose" in nature.[2] These factors conversely complicate and simplify how developers, financiers and potential buyers and sellers value renewable energy assets. Complicating valuations is the assets' long lives and the fact that relevant variables – e.g., operating performance, commodity prices, regulatory structure, power market dynamics, etc. – become more and more uncertain as financial projections extend into the future. On the other hand, the single purpose nature of these assets (i.e., power production) makes valuing their revenue streams relatively straightforward. Additionally, the vast majority of these assets enter service with a power purchase agreement (PPA) or some other form of hedged or contracted output in place. In the case of PPAs, 76% of domestic wind power capacity in 2014 and approximately 67% of new 2014 capacity was contracted this way.[3] This eases the valuation process as risk from commodity price fluctuations is dramatically reduced and 100% of the output has a guaranteed, well-rated off-taker (i.e., a utility) over the term of the PPA.

However, PPAs are fixed in their terms – typically 15 to 25 years[4] – and renewable energy assets may have useful lives longer than that. For example, UK wind turbines installed in the 1990s were found to operate at average capacity factors approximately 74% their original in the 19th year of operation.[5] It is not difficult to imagine that turbines installed today using the most advanced technologies may perform even better past 15 or even 20 years of operation. Their true useful lives will not be known until they are finally retired or repowered some decades into the future. Consequently, these assets possess real value in their post-PPA years but determining that value is a far less straightforward process than it is for the PPA-contracted years.

The post-PPA options that are available to asset owners will be dictated to a certain extent by the conditions of the PPA, but for the most part a decision must be made at the end of the contract to take one of three actions: 1) renew the PPA; 2) continue operating the asset on a merchant or quasi-merchant basis (meaning electricity sales are connected to contracted or wholesale power prices[6]); or 3) decommission the assets for scrap or to be refurbished for future use. Determining what course of

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[1] Mackay-Fisher, Kirsty. *Understanding infrastructure investments*. CEO Forum Group. http://www.ceoforum.com.au/articleprint.cfm?cid=6309&t=/KirstyMackayFisherBerkleyGroup/Understandinginfrastructureinvestments/.
[2] Ibid.
[3] US Department of Energy (DOE). 2014 Wind Technologies Market Report. August 2015.
[4] Windustry. *Community Wind Toolbox*. http://www.windustry.org/community_wind_toolbox_13_power_purchase_agreement.
[5] Staffell, Ian and Richard Green. *How does wind farm performance decline with age?* Renewable Energy 66 (2014) 775-786.
[6] US DOE. 2014 Wind Technologies Market Report.

action will be taken 15 to 25 years ex ante presents obvious problems for valuing the asset since the variables dictating that decision in the future are numerous and unknown. Wholesale power prices, PPA markets, decommissioning costs, the status of the land lease and interconnection agreements, policy incentives and many other variables will affect what decision will be made and what the value of that course of action will be.

Despite this uncertainty or perhaps due to it, a lack of thought and rigorous analysis has been paid to this topic. Recent transactions suggest current assumptions about the post-PPA valuation vary greatly between market participants with some simply assuming no post-PPA value, others assuming that wholesale power prices will continue to rise as they historically have, despite the potential proliferation of low marginal cost renewables, and finally, some that appear to avoid the issue of long-term asset life altogether.[7] It is often the case that the valuation depends largely on who is doing the valuing – conservative assumptions used by market participants like utilities may lead to vastly different values compared to those used by yieldco's[8] in recent years.

The aim of this paper is to demonstrate a method for estimating the post-PPA value of a renewable energy asset at the beginning of its useful life – in this case a hypothetical wind farm. Section 1 provides an overview of PPA structures, the current valuation approaches used by the market in regards to post-PPA value and a discussion of all the potential post-PPA options available to a wind or solar asset. Section 2 describes the model created for a hypothetical wind farm in the Great Lakes region of the United States and how the different possible post-PPA options are valued. Specifically, it discusses different operating performance variables and future market scenarios that determine the value of the project and its post-PPA options. Section 3 provides a discussion of the results derived from the model described in Section 2 and their implications. Section 4 introduces potential areas for additional research in light of the issues presented herein. Finally, a conclusion is provided in Section 5.

By doing so, this paper attempts to shed light on what variables are the most important to valuing the post-PPA life of a renewable energy asset, how much value there is in the potential post-PPA options of an asset, how different assumptions and scenarios affect valuations and what the implications of these findings are. While a definite estimate of the post-PPA value at the beginning of the asset's life is impossible to determine, a demonstration of how one determines the *range* of

[7] Konrad, Tom. *Are YieldCos Overpaying for Their Assets?* GreenTech Media. 15 June 2015. http://www.greentechmedia.com/articles/read/are-yieldcos-overpaying-for-their-assets.

[8] A yieldco is a dividend-growth public company that purchases renewable or conventional long-term contracted assets through equity issuances to produce reliable cash flows to distribute to shareholders.

potential values will provide the market with more certainty and clarity than it currently has. It is the hope of the author that the lessons learned from the methodology and findings laid out in this paper can assist developers, financiers, buyers and sellers as they attempt to value similar assets. Ultimately, this may benefit renewable energy generation development overall by lowering the risk associated with the investment class.

Section 1. Background

What is a power purchase agreement (PPA)?

A PPA is a long-term agreement between a power buyer (the off-taker) and the owner of an asset that produces electricity. The agreements are typically 15 to 25 years in length. The off-taker can be a utility, a large commercial & industrial customer, a power marketer, or even an individual homeowner in the case of rooftop solar. In the wind industry, utilities account for 69% of the off-take capacity.[9] The owners can be independent power producers (IPPs), asset management institutions or utilities themselves. As of 2014, IPPs account for 82% of capacity owned while utilities account for 16%.

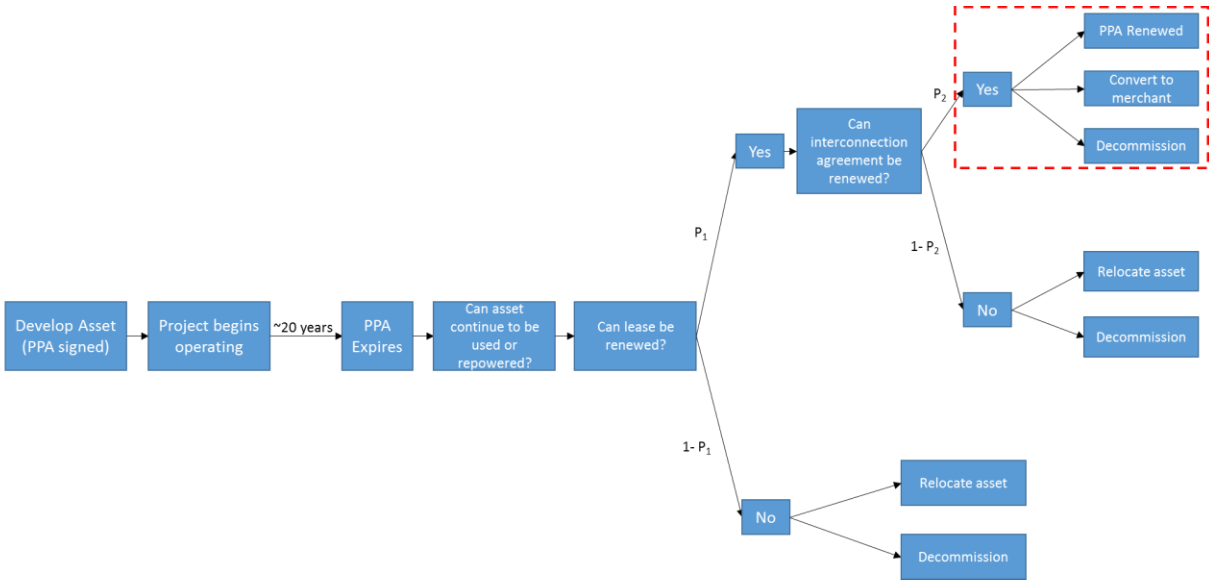
Under the terms of the agreement, the PPA buyer agrees to purchase 100% of the power output from a wind or solar asset at a pre-determined price. This price typically increases over time by some defined relationship to inflation or to utility rates depending on the technology and who the counterparties are. PPAs also include provisions addressing issues such as transmission, decommissioning, curtailment, milestones and defaults, credit, insurance and environmental attributes or credits (i.e., Renewable Energy Credits.)[10]

What happens after the PPA expires?

In the context of utility scale assets, several things may happen and these are determined by both the terms of the PPA, the condition of the asset and market conditions. Assuming both the land lease and interconnection to the power grid can be renewed, and assuming the asset is in suitable condition to continue generating electricity or be repowered (i.e., refurbished or repaired in some way), the investor will have three options: 1) the PPA will be renewed; 2) the asset will be converted to merchant or quasi-merchant status and may stay on the existing land or moved to a new lease – refurbishing of the asset may or may not be required in this case; or 3) the asset will be decommissioned and scrapped. If none of the mentioned conditions hold, then the asset will be decommissioned. In the case of rooftop solar, the PPA will often allow for the building owner to purchase the asset at the "fair market value."[11] Figure 1 illustrates the project lifecycle from development to post-PPA term.

[9] US DOE. 2014 Wind Technologies Market Report.
[10] Windustry. *Community Wind Toolbox*.
[11] Thumann, Albert and Eric Woodroof. *Energy Project Financing: Resources & Strategies for Success*. Fairmont Press. 2008.

Figure 1. Project Lifecycle



In the case of this report, we assume both the land lease and interconnection agreement can be renewed and the asset is still usable for power generation. This means we will not consider the probabilities of these events occurring when valuing the possible post-PPA options and consider only the red encircled portion of the figure. In reality, one would need to estimate these probabilities and apply them to the expected value of the possible options.

What variables must be considered in valuing a project both during and post-PPA value?

During the construction and operation of the asset, four sets of variables affect project valuation: start-up costs, operating performance, revenues and operating costs. An incomplete list for each category is presented below. In some cases, each variable listed is a function of several others not listed (e.g., wholesale power prices are determined by gas prices, supply and demand curves, policy, climate, power market structure, etc.)

Start-up	Interconnection charges, construction financing and costs, balance of system costs, community relations costs
Operating performance	Capacity factor, capacity factor degradation, curtailment, system renewable penetration, power output
Revenues	PPA price, PPA price escalator, wholesale power prices, REC prices, renewable and environmental policy and incentives, cost of capital, congestion charges
Operating costs	Land royalty/lease payments, decommissioning fund or bond payments, insurance, income and property taxes, variable operations & maintenance (O&M) costs, management costs

Once the PPA expires, there are a host of unknown costs associated with each option. For example, if the asset continues to operate, there will almost certainly be several transaction costs. The PPA (if re-signed) would need to be negotiated as would land leases and potentially interconnection agreements. If the asset needs to be refurbished or moved to a new location due to issues with the existing lease or changed climate conditions, additional costs would affect the value. Of course, the operating and revenue variables listed above would also continue to affect the value as the asset operates beyond its original PPA. Even if the asset does not continue to operate, decommissioning costs that far into the future are unknown as well.

How does the market currently value the post-PPA life of a renewable energy asset?

The limited publicly available information on current valuation of renewable projects post-PPA suggests there are four approaches. This section presents a brief description of each and a discussion of the benefits and drawbacks.

1) Use a metric like cash-on-cash returns (i.e., approximate annual project revenue/project cost or the inverse of payback period) to value assets. It allows the valuation to avoid assumptions about the long-term value of a wind or solar asset as it instead is focused on the project's ability to pay back its investment.[12] While useful in that it makes assumptions about the post-PPA value unnecessary in evaluating projects, this metric fails to account for inflation, depreciation, project lifetime and anything that happens after the payback period.[13]
2) Assume that electricity prices will continue to rise and that a PPA with similar terms will be resigned.[14] SolarCity, for example, assumes that each of its PPAs will be resigned after 20 years for another 10 years at 90% of the final year's rate.[15] In this case, the valuation necessarily assumes a steady increase in electricity prices and/or significant compensation for renewables through policy. However, the likelihood of this is difficult to estimate given that PPA prices continue to decline as technology costs fall and power system penetration of intermittent wind and solar resources grow.[16] We already see electricity markets with high wind penetration experience zero or negative electricity prices at some locations. If this situation becomes more common and barring the development of very efficient utility-scale battery storage, or very

[12] Konrad, Tom. *Are YieldCos Overpaying for Their Assets?*
[13] Ibid.
[14] Ibid.
[15] Hoium, Travis. *Behind the Curtain: SolarCity May Not Be the Rock Star It Claims to Be*. Motley Fool. 26 February 2015. http://www.fool.com/investing/general/2015/02/26/behind-the-curtain-solarcity-may-not-be-the-rockst.aspx.
[16] Konrad, Tom. *As SunPower and First Solar Go Public With Their YiledCo, a Look at the Risks*. Greentech Media. 19 June 2015. http://www.greentechmedia.com/articles/read/cafd-and-long-term-risks-for-yieldcos.

stringent policies implicitly or explicitly mandating more power generating capacity from renewables, it calls into doubt the assumption that wholesale and PPA prices will continue to rise during the time of day when solar and wind are generating. Furthermore, it may be the case that technology costs fall so far that an entirely new wind or solar asset will have a lower PPA price than a system that is 15 to 20 years old.[17]

3) Assume the asset will simply sell on a merchant or quasi-merchant basis. In this case, it is typical to take some long-term price projection from a source like Ventyx.[18] Even if these long term projections were accurate, many assumptions must be made about the operational performance of the asset and market structure decades into the future. For example, how will its capacity factor degrade? To what degree will the power output be curtailed by the system operator? How will O&M costs change with advanced ageing? What policy incentives will exist for these aged assets? How different will wholesale prices be at the time the asset is generating relative to the average price reflected by the forward price projections? Many of these questions also must be answered if the valuation assumes a PPA will be resigned.
4) Due to the uncertainties and questions discussed above, some conservatively assign the project zero value for the post-PPA years and effectively assume it will be decommissioned. Even then, assumptions must be made about what the future decommissioning costs and salvage value of the asset will be. As we will discuss later, decommissioning costs net of salvage value have extremely wide ranges.

How do options apply to renewable energy assets and their post-PPA value?

This paper takes the viewpoint of an investor evaluating the opportunity to purchase a wind farm from a developer at the beginning of its useful life. As discussed above, with this option to purchase the asset and its PPA, it may come the option to extend its life after the PPA expires. Assuming the investor has the ability to extend the project's lease with the landowner and to renew the interconnection agreement with the transmission company[19], when an investor purchases a PPA-contracted asset, it is also buying the options that come with the PPA's expiration. Once the project is purchased the owner also has bought the options to a) convert the asset to merchant operations or b)

[17] Konrad, Tom. *Are YieldCos Overpaying for Their Assets?*
[18] Ventyx is an enterprise software offered by ABB that provides forward power price projections.
[19] Whether interconnection agreements even expire appears to depend on where the asset is located. According to the Ameren's 2015 Annual Report, its interconnections have no expiration date (though they may be terminated with three years' notice.) On the other hand, in Pacific Gas & Electric's service territory the interconnection agreement must be re-applied for when the PPA expires. The investor also has the option, albeit an expensive one, to relocate the asset to a more attractive location if it is available or if it is not possible to renew the lease and/or the interconnection agreement.

to abandon the project once the original PPA expires. In case there are potential PPA off-takers, investors could also re-sign the PPA. Whereas today it is impossible to predict which choice will be more attractive, these options implicit in purchasing the asset and expiring 20 years after the signature of the original PPA have value and should be considered by potential investors when bidding on the project.

The two initial post-PPA options to abandon, or convert to merchant operations, have embedded a stream of other options that also have value. This is because the investor is not necessarily required to maintain the decision it made when the PPA initially expired. For example, if the asset is converted to merchant and continues to operate, the investor still has the option to re-sign it to a PPA if terms improve, or alternatively it can decide to abandon the project if it does not operate as anticipated, or if market conditions are unfavorable. The investor may even be able to idle the project but maintain lease operating expenses to continue owning the asset in order to have the option to restart it on either a PPA or merchant basis if market conditions improve.[20] Rather than facing a single choice once the PPA expires, the investor can decide at any point in time to idle, abandon or continue operating the asset. However, if the PPA is renewed the investor would not have these options again until the renewed PPA expires (assuming the asset continues to operate as expected.) This complexity is not reflected in the highlighted portion of Figure 1 or the analysis presented here but it would need to be considered for a comprehensive valuation.

Further value and optionality can be found in other places. For example, by operating the asset over the term of the PPA, the original investor is uniquely familiar with the asset's performance profile and operations. Once the PPA expires, it is likely able to operate the asset more profitably, renew the leasehold or interconnection agreement and overcome any other potential hurdles to continued operation than a new investor that purchases the asset at that point. In the same way, the original investor is ideally positioned to remove the existing asset from the location and develop an improved project there if the market allows it.

While this paper simplifies the above options into a single decision to abandon the project, renew the PPA, or continue operating it on a merchant basis for a specific number of years once the original PPA expires, there are obviously many more post-PPA options available to the investor when it purchases the asset that must be considered and valued appropriately. Rather than the simplified post-

[20] The ability to do this or not to do it may be determined by the terms of the original PPA.

PPA framework seen in Figure 1, a more accurate representation would have far more post-PPA branches and potential paths.

These potential post-PPA options have value and should be considered when bidding on a project at the beginning of its original PPA. Whether this value is marginal or materially changes the bidding strategy of an investor depends on their outlook, capabilities and risk profile. In the next sections, this paper will describe a hypothetical wind project and value different post-PPA alternative courses in order to shed light on how much potential value exists in these options and how this changes the present value[21] (PV) and internal rate of return[22] (IRR) of the project relative to the PPA term considered alone.

The PV of the project and the relative acceptability of projected IRRs will depend in part on what type of investor owns the asset. In this analysis, we focus on a hypothetical IPP owner but Utilities, Investment/Asset Management firms and "Green Energy" companies (see the Appendix for more detailed explanation) are also potential investors. The value of the project differs across these owners because of different costs of capital (see Section 2) and because different types of investors may be able to realize post-PPA options better than others. For example, if at the end of the PPA term it would be most profitable to redevelop the existing site with new equipment, an IPP or Green Energy owner would be better suited to realize the full value of that option than an Investment/Asset Management owner. That being said, for the purposes of this analysis, we assume the perspective of an IPP owner.

[21] Present value is the current value of a future stream of cash flows discounted according to a weighted average cost of capital. Net present value is the same except the cost of the investment is included in the calculation.

[22] Internal rate of return measures the profitability of investments. Specifically, it is the discount rate that makes the net present value of an investment zero.

Section 2. Methods

In order to value the hypothetical wind farm presented here, a quantitative model was created to predict the future cash flows of the project over its PPA term assuming the project is decommissioned after its PPA expires. The cash flows resulting from the post-PPA options of renewing the PPA or converting the asset to merchant were also estimated under three different market scenarios – Strong, Moderate and Weak – that differ according to the value wind generation has in each. For these post-PPA options, the decommissioning costs incurred at the end of the PPA term are deferred to the final year. In this way we can determine under what conditions it is profitable to extend the life of the project beyond its original PPA and how much value this creates for the project.

The cash flows are discounted using a discounted cash flow (DCF) valuation model. A DCF discounts the cash flows according to a discount rate or weighted average cost of capital (WACC) to convert future estimated cash flows to their present value. Figure 2 below presents the equation (where CF_t = the cash flows in year t.)

Figure 2. DCF Methodology[23]

$$DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_n}{(1+r)^n}$$

CF = Cash Flow

r = discount rate (WACC)

This method is preferred as free cash flows represent the intrinsic, enterprise value of the project. In other words, it is the fundamental value available to debt and equity investors in the project. The discount rate or cost of capital used depends on the assumed owner of the asset. The capital structures along with the cost of equity and debt for each asset class is assumed to be the asset class average as defined by Aswath Damodaran.[24] A description of the companies included in each owner category as well as the cost of capital calculations can be found in the Appendix. This paper examines PV only in the context where the prospective project owner is an IPP. However, as discussed in Section 2, who the project owner is can change the value of different post-PPA options. A screen shot of the DCF model for the PPA term is included in the Appendix.

In order to account for uncertainty around inputs for the project's performance and market conditions, a Monte Carlo simulation was used to determine the potential range of PVs and IRRs for the

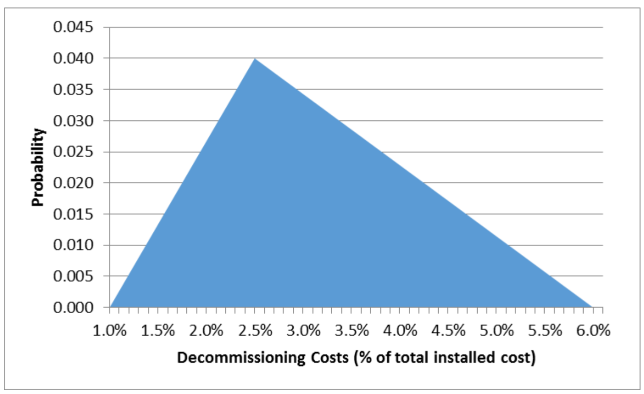
[23] Investopedia. *Discounted Cash Flow (DCF)*. http://www.investopedia.com/terms/d/dcf.asp.

[24] Damodaran Online. http://pages.stern.nyu.edu/~adamodar/New_Home_Page/. 2016.

PPA term and potential post-PPA outcomes. 1000 simulations each were run to value the PPA term and the two post-PPA options under the three different market scenarios (for a total of 6 different post-PPA valuations.) In both post-PPA options, it is assumed the project operates for another ten years before retiring in Year 30. The transaction costs associated with re-signing the PPA or converting the project to merchant are assumed, for lack of a better alternative, to be negligible. In reality, transaction costs would certainly be incurred, particularly if the asset needs to be relocated. In this case, we assume there is no relocation of assets required. As discussed in Section 1, there are far more options available to the investor once the PPA term has expired that provide potential value. For the sake of simplicity and conciseness, the range of options was limited in this study.

The uncertainty surrounding unknown variables affecting cashflows is characterized with a triangular probability distribution function. The optimistic and pessimistic estimates serve as the upper and lower bounds of the distribution, while a third value serves as the "most likely" parameter. For example, the model assumes decommissioning costs have a range of 1% and 6% of total installed cost and a most likely value of 2.5% (see Figure 3.)

Figure 3. Decommissioning Costs Probability Distribution



Post-PPA Market Scenarios

As mentioned previously, three market scenarios were created that affect the post-PPA valuation of the model (they do not change PPA term value.) These scenarios – Strong, Moderate and Weak – reflect the relative level of support for wind generation in terms of variables like power supply and demand, gas prices, market structure, storage development, wind penetration, policy incentives and compensation for renewables (such as capacity payments.) The factors listed in Table 1 below provide more detail.

Table 1. Post-PPA Market Scenarios Defined

Market Factors	*Strong*	*Moderate*	*Weak*
Wind Penetration	Low	Med	High
Power Supply	Low	Med	High
Power Demand	High	Med	Low
Policy Support/Compensation	High	Med	Low
Gas Prices	High	Med	Low
Battery Storage Development	High	Med	Low

In the model, these scenarios are defined in terms of wholesale power prices and annual curtailment as they serve as effective proxies for the variables listed. The distributions for power prices and curtailment are shown in Table 4 below.

Table 2. Market Scenario Inputs (prices are nominal)

Market Scenario Inputs		Pessimistic	*Variable Distributions* Most Likely/Fixed	Optimistic
Strong Market	Wholesale Power Prices	$40.0	$50.0	$60.0
	PPA Prices		$50.0	
	Curtailment	5.00%	2.50%	0.00%
Moderate Market	Wholesale Power Prices	$20.0	$30.0	$40.0
	PPA Prices		$30.0	
	Curtailment	10.0%	7.50%	5.00%
Weak Market	Wholesale Power Prices	$0.0	$10.0	$20.0
	PPA Prices		$10.0	
	Curtailment	15.0%	12.5%	10.0%

In the Strong market scenario, power prices reflect the assumption that pricing will be similar to the project's PPA-contracted price in Year 20. Some combination of strong incentives, high demand and relative lack of supply would produce prices in this range. Annual curtailment is similar to what it is in MISO today reflecting strong investment in transmission capacity and/or an ability for additional renewable capacity to store generation such that peak production prices are not depressed. On the other end of the spectrum, the Weak scenario reflects a market where policy support and demand for renewables is low and one where significant existing development has led to depressed power prices and increased curtailment of these resources. It should be noted that both wholesale prices and PPA prices in the post-original PPA term are fixed in the model. There is no wholesale price growth or PPA escalator. Ultimately, the ranges for these variables and the likelihood of any one scenario occurring over the other are highly speculative. This paper aims to show the range of possibilities without speculating on exactly where the market will be 20 years from now.

Wind Farm Model Inputs and Descriptions

The model values a hypothetical wind farm of 60 2.5 MW turbines (150 MW nameplate capacity) in the Great Lakes region beginning operations at the beginning of 2016 with a 20 year PPA. The PPA price is $35/MWh with the PPA escalator varying from 1% to 3%. The installed cost is $1,500/MW or $225 million and the tax rate is 35%. The Great Lakes region was chosen as it is a viable location for current and future wind projects and a significant amount of data exists for existing wind farms there. The DCF values the project from the viewpoint of a potential acquirer who has a take it or leave it option to invest in the project today. Issues around permitting, interconnections, PPA negotiation, construction financing, etc. are not considered as it is assumed the project's construction is complete. Effectively, it is a contracted and imminently operational wind farm being considered for purchase. Table 5 summarizes its inputs. Additional variables are described below with further detail and supporting citations for some inputs in the Appendix.

Table 3. Model Inputs

	Variable Distributions		
Revenue & Performance Inputs	**Pessimistic**	**Most Likely/Fixed**	**Optimistic**
Nameplate Capacity (MW)		150	
Capacity Factor	25.0%	38.0%	42.0%
Capacity Factor Degradation (per yr)	2.40%	1.60%	0.80%
PPA Price Base ($/MWh)		$35.0	
PPA Price Escalator	1.00%	2.00%	3.00%
O&M ($/MWh)	$15.00	$9.00	$5.0
O&M Increase (per yr)	3.00%	2.00%	1.00%
Decommissioning Cost (% installed cost)	6.00%	2.50%	1.00%

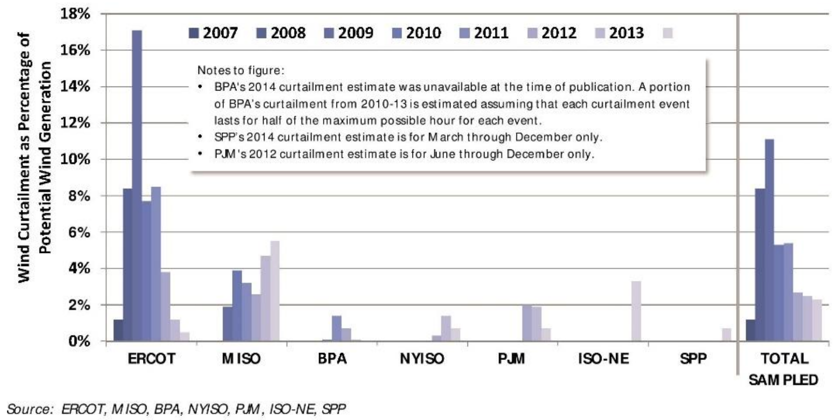
Depreciation and Tax Credits

Because typical renewable projects do not have the tax liabilities or operating income base to fully realize the benefits of the tax credits and depreciation tax shield created, it is assumed that the project owner is able to use these credits and tax shields elsewhere in their businesses. Specifically, any production tax credits (generated at the rate of $23/MWh for the first 10 years of operation) are added to the project's post-tax income regardless of the tax liability created by the project itself. Any excess depreciation tax shield (a five-year accelerated depreciation schedule is used here) is simply added to post-tax income. This allows us to capture the entire value generated by the project.

Curtailment

A significant issue for wind farms in the Midcontinent Independent System Operator (MISO) region is curtailment. The average curtailment from 2007-14 is 3.63% of estimated potential generation and this percentage has grown in recent years (see Figure 3 below.)[25]

Figure 4. Estimated Wind Curtailment by Region as % of Potential Generation[26]



The example of ERCOT demonstrates how significant transmission upgrades are to the efficient off-take of wind generation – curtailment peaked in 2008 at over 17% of estimated potential generation before multibillion dollar transmission investments from the Competitive Renewable Energy Zones (CREZ) project brought the rate down to less than 1% in 2014.[27] PPAs vary in whether producers are compensated for curtailed generation. It is often the case that it depends on whether the curtailment is due to constraints imposed by the system operator or from the off-taker not requiring the power.[28] For the purposes of this model, it is assumed the PPA terms stipulate the asset owner is compensated for both actual and potential production including hypothetical PTC income (this effectively means curtailment does not impact the value of the asset during the original PPA or any re-signed PPA term.) Curtailment issues affect only the post-PPA value of the asset if a PPA is not resigned (i.e., if it is merchant.). If the PPA is re-signed, then the degree of curtailment depends on the market scenarios. Given that wind penetration is expected to increase and the high cost of additional transmission

[25] US DOE. 2014 Wind Technologies Market Report.
[26] Ibid.
[27] US Energy Information Administration. *Fewer wind curtailments and negative power prices seen in Texas after major grid expansion*. 24 June 2014. http://www.eia.gov/todayinenergy/detail.cfm?id=16831.
[28] Windustry. *Community Wind Toolbox*.

investments, the Strong market scenario has a curtailment similar to today's MISO range of 0% to 5%. The Weak scenario reflects the upper range seen in ERCOT with a range of 10% to 15%.

Renewable Energy Credits (RECs) and Other Incentives

In addition to revenue from power sales and production tax credits, renewable energy projects may earn income by selling RECs. These are property rights to the environmental or social qualities of renewables generation produced at the rate of one REC/MWh.[29] Due to the lack of clarity into REC markets and how they will develop in the future, we assume there is no REC revenue associated with this project. Similarly, the model ignores any potential marginal income from generation capacity payments, as closing prices and changes to rules determining the power generation capacity of intermittent resources is determined (relative to nameplate capacity) is largely unknown.

Operations & Maintenance

All operating expenses were consolidated in the estimate of O&M costs. This was done to simplify the model and because reliable estimates of variables like land royalty payments or decommissioning fund payments were not readily available, whereas total O&M costs are well recorded. While some component of O&M is fixed, an average variable rate was assumed for simplicity. The appendix provides further information on the variable ranges for O&M and the per year increase.

Decommissioning Costs

At the end of a project's life it will be sold as scrap or refurbished for further use. There is considerable uncertainty around the decommissioning costs and what value aged wind turbines would have in the marketplace, either as scrap or for specific component reuse. In one proposed wind project in Illinois in 2015, decommissioning costs net of estimated salvage revenue ranged from $36,955 to $265,812 per turbine.[30] The range of 1% to 6% of total installed cost used in the model reflects this range with the most likely value of 2.5% equaling approximately $94,000 per turbine.

The transaction costs associated with re-signing the PPA and converting it to merchant are assumed, for lack of a better alternative, to be negligible. In reality, transaction costs would certainly be incurred, particularly if the asset needs to be relocated, but the lack of available information makes speculating on them difficult. We assume there is no relocation of assets required.

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[29] US EPA. *Renewable Energy Certificates (RECs).* 13 August 2015. http://www3.epa.gov/greenpower/gpmarket/rec.htm.
[30] Testimony provided by Energy Ventures Analysis. *EVA's Decommissioning Estimates for Pleasant Ridge Wind Farm*. 6 January 2015. http://www.livingstoncounty-il.org/wordpress/wp-content/uploads/2015/01/UCLC-Exhibit-114-Hewson-EVAs-Decommissioning-Estimate.pdf.

Section 3. Results and Analysis

PPA Term Valuation

Assuming an IPP owner's discount rate, the project's PV has a range of $226 million to $259 million with a mean and median of $243 million. Assuming the investment cost is equal to the installed cost of $225 million, the IRR has a range of 5.04% to 7.92% with a mean and median of 6.55% and 6.56%, respectively.[31] This compares favorably to the IPP's discount rate of 5.02%. However, this does not begin to capture the full value of the project as it ignores the value of possible post-PPA options. Next we will examine the value of possible post-PPA alternatives in order to understand if they materially change the value of the project.

Table 4. PPA Term Valuation Summary ($ '000s)

	Mean	Median	Min	Max
PV	$ 243,344	$ 243,388	$ 225,824	$ 258,853
IRR	6.55%	6.56%	5.04%	7.92%

Valuation of Potential Post-PPA Alternatives

Across the six different post-PPA scenarios modeled (i.e., Strong, Moderate and Weak market scenarios for merchant and PPA-resigning options), the post-PPA PV ranges from a loss of $5.42 million (or -2.16% of the total PV) to an incremental gain of $25.6 million (or 10.2% of the total PV.) In terms of IRR, the incremental gain represented by the post-PPA options ranges from -0.39% to positive 1.42%. While this is a large range, the small downside and large potential upside of the post-PPA option stands out. It may be that the downside is underestimated because the model ignores underperformance penalties the asset may incur if it is a merchant unit.[32] It also could be that the Weak market scenario overestimates prices and negative pricing is a consistent feature of future power markets. That being said, in that case it would be an easy choice for the asset owner to abandon the project. These results confirm that there is potentially significant value in potential post-PPA options and it should be accounted for by potential investors. Next we will examine the scenario results and their implications.

Table 5. Post-PPA Term Valuation Range ($ '000s)

	Min	Max
PV	$ (5,418)	$ 25,644
% of Total Value	-2.16%	10.16%
IRR	-0.39%	1.42%

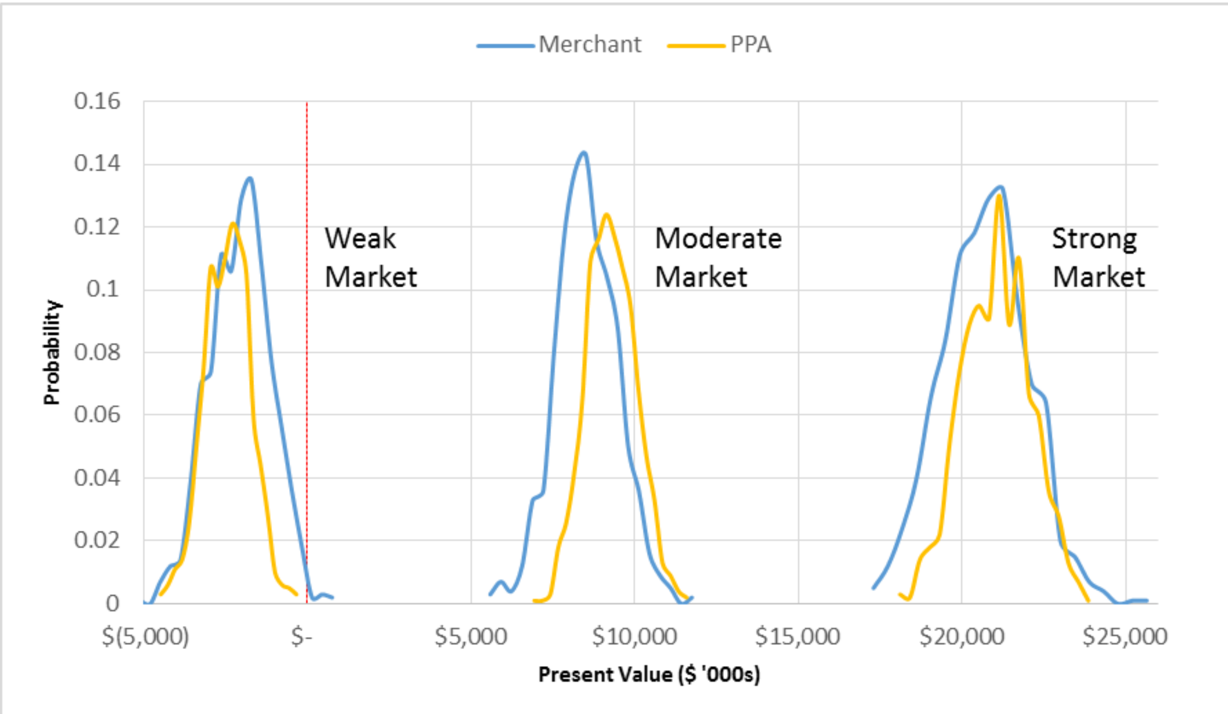
Market Scenario Analysis

The figure below displays the distribution of PVs and IRRs for both potential post-PPA options – merchant operation and a resigning of the PPA – across the three market scenarios. As would be

[31] PV and IRR values were derived from separate simulations. As a result, the upper and lower range bounds may not align exactly.
[32] These fines are penalties charged to the generator by the system operator for failing to deliver the agreed power supply. This is significant for intermittent resources like wind and solar.

expected given its exposure to price risk, the merchant option tends to have a greater standard deviation or risk and thus larger potential upside and downside than the PPA resigning option. The only exception is in the Moderate Scenario where the potential upside of the resigned PPA is greater than the merchant option.

Figure 5. Post-PPA Option Value Distributions



At the same time, the differences between resigning the PPA and converting the unit to merchant in each scenario are not very significant. The table below summarizes the incremental IRR gains for the project. As can be seen, the difference between options within a scenario are small. It is certainly the case that the model does not account for all of the value derived from a PPA relative to a merchant unit – for example, a PPA can eliminate overhead costs associated with marketing and dispatching the unit's output – but it remains the case that intra-scenario differences are not large.

Table 6. Incremental IRR Gains

Incremental IRR		Mean	Median	Min	Max
Strong Market	PPA	1.10%	1.10%	0.86%	1.39%
	Merchant	1.09%	1.09%	0.83%	1.42%
Moderate Market	PPA	0.54%	0.54%	0.36%	0.75%
	Merchant	0.50%	0.50%	0.34%	0.71%
Weak Market	PPA	-0.15%	-0.15%	-0.35%	0.00%
	Merchant	-0.13%	-0.13%	-0.39%	0.05%

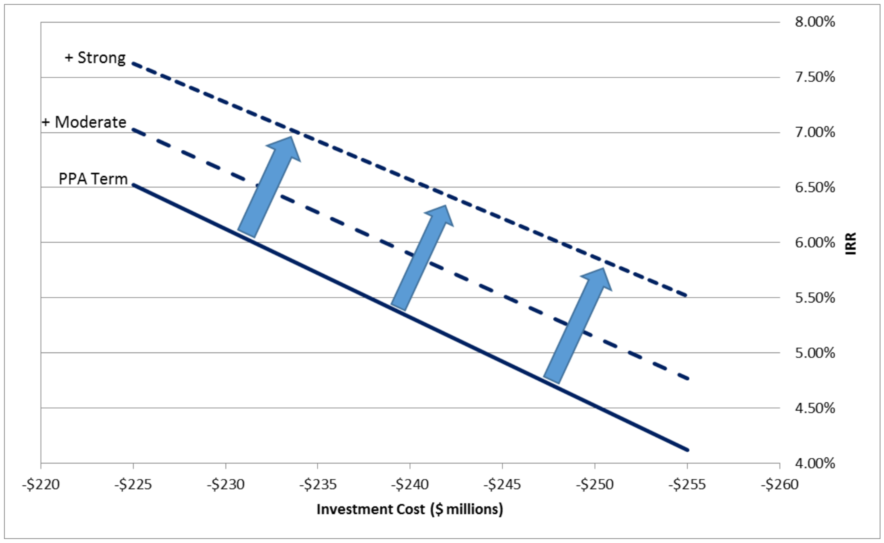
More significant than any potential difference between resigning the PPA and converting the asset to merchant operations is the fact that the payoffs from the possible post-PPA options exhibit large potential upside (effectively unlimited as they are directly correlated with power prices) and limited downside. This is because if the Weak Market Scenario were to occur and the asset generated negative value as a PPA-operating asset or as a merchant operating asset, it would be decommissioned. This means the outcomes estimated under the Weak Market Scenario would essentially not be realized.

The data also shows that the incremental IRR associated with the possible post-PPA options in both the Strong and Moderate Market Scenarios is large enough to materially affect investment decisions. This is particularly the case for potential investors with costs of capital above that of IPPs. For example, “Green Energy” companies (see Appendix) have a cost of capital of 6.74%. This would make the project’s PPA term an unlikely investment as its mean IRR is 6.55%. However, both the Strong and Moderate market options would increase the project’s IRR above the Green Energy cost of capital making it a potentially attractive investment if a Green Energy investor thinks these scenarios are realistic outcomes (in this case, it is the only way the project would be attractive on a stand-alone basis.)

Of course, IRR is a fluid metric that changes with the cost of investment which we have fixed here at the total installed cost. In competitive bidding situations, investors with lower costs of capital can potentially increase the cost of investment to outbid those with higher costs of capital (e.g., IPPs vs. Green Energy companies.) This is one of the key advantages yieldco’s wielded over competitors for renewables projects in previous years.[33] However, by valuing the post-PPA options in situations where lower cost investors are not, higher cost actors can better compete as potential project IRRs would increase. The figure below plots IRR against investment cost for the PPA term and shows how the curve shifts to the right with the Moderate and then Strong market scenario (assuming the project operates as a merchant unit.)

[33] Project Finance International. *Yieldcos reprice renewable equity*. PFI Yearbook 2015. http://www.pfie.com/yieldcos-reprice-renewable-equity/21176767.fullarticle.

Figure 6. Investment Cost vs. IRR



For example, if the investment cost is bid up to $235 million from $225 million, the project's PPA term mean IRR falls to 5.69%. This would effectively eliminate Investment/Asset Management investors from the process with their 6.23% cost of capital. However, if the Asset Management firm believed the Moderate market scenario is likely, then the value derived from that option would increase the project's mean IRR 0.55% to 6.25% (above its cost of capital) meaning they could potentially compete for this project against an IPP or other low cost investor. In this way, appropriately valuing the post-PPA option can become a competitive advantage for potential investors. That being said, the ranges of incremental value presented here are highly speculative and require more rigorous analysis in order to be reliably used in large investment decisions. The point is that if there are good reasons for believing the Moderate or Strong Market Scenario (or some similar scenario) is likely, then there is significant value in the post-PPA options that should be accounted for by the potential acquirer.

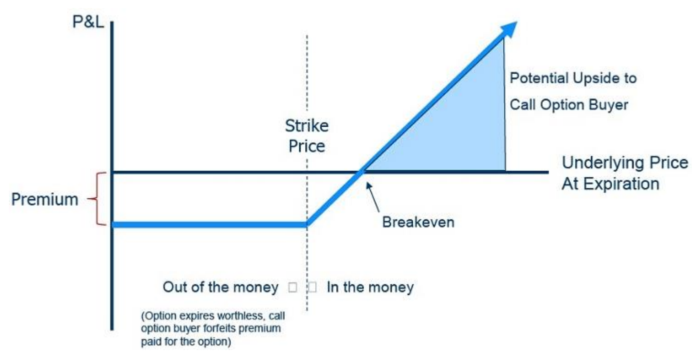
Additional Considerations & Implications

There are potentially broad implications for company values and investor portfolios due to the different market approaches used in valuing the post-PPA term of renewable assets. For example, given that the potential value can represent approximately 0% to over 10% of the asset's value, it may be that significant unaccounted for risk exists on companies' balance sheets if they and the market use aggressive assumptions about the post-PPA term value. For example, the market price of renewable asset owners might be affected by incorrect assumptions regarding the long-term value of its assets. As mentioned in Section 1, SolarCity argues its valuation should be based off the assumption that its residential solar PPAs will be resigned at the end of their terms to another 10 year PPA at 90% of the original PPA’s value. As such, it is likely that a significant portion of the company’s value is represented by speculative assumptions about the future. If these assumptions prove to be false, then the value of the company and shareholders and creditors could suffer significantly. That being said, exactly how much of SolarCity’s or similar companies’ value is represented by this post-PPA value and how a negative mark-to-market adjustment in the future would affect its value is uncertain. It is also not immediately clear whether this risk is inordinately held by certain classes of investors and what the effect would be on them and the broader financial system if the assets are systematically overvalued. On the other hand, it could also be the case that the Strong Market scenario occurs and the market systematically undervalued these assets. In that case, many of these companies may be undervalued which would represent a long-term financial arbitrage opportunity for investors.

Section 4. Suggestions for Additional Research

In addition to the implications for company valuations and shareholder and creditor portfolios mentioned at the end of Section 3, the results offer insight into potential next steps for more appropriately valuing the potential post-PPA options of a renewable energy asset at the beginning of its useful life. We demonstrated that the payoff of the possible post-PPA options exhibits limited downside and potentially unlimited upside. Given that extending the life of the asset beyond the original PPA likely requires some future investment cost to renew the lease or interconnection agreement, repower the asset or even move it, the payoff structure resembles that of holder of a European call option. A call option is "a security that gives the holder the right to buy another asset…for a set price (the 'exercise' or 'strike' price) on a certain date."[34] The option holder pays a premium to hold it. A call option's profit and loss diagram is shown in Figure 7 below. As the price of the underlying asset increases, the value or payoff of the option which gives the right to buy the asset at the strike price increases. If the underlying value of the asset is less than the strike price, then the option would not be exercised by its owner thus limiting the downside of the option to the premium paid for it.

Figure 7. Long Call Option Profit Loss Diagram[35]



In the case of a PPA-contracted wind or solar asset, the owner has the option but not the obligation to invest in renewing the PPA or converting the asset to merchant operations (assuming conditions related to interconnections, leases, asset quality, etc. discussed previously are met) after the original PPA expires – this is analogous to the asset the call option holder has the right to buy. The investment cost for extending the life of the asset after the original PPA is analogous to the strike price of the call option. As the future market for renewables improves, the underlying price of the post-PPA asset increases just as it does with a traditional call option. The payoff is limited on the downside as the

[34] Credit Suisse. *Registration Statement No. 333-180300-03*. Filed with the SEC. May 21, 2013. http://www.sec.gov/Archives/edgar/data/1053092/000089109213004721/e53788fwp.htm.
[35] Ibid.

owner would unlikely invest in extending the asset's life at the end of the original PPA if doing so was unprofitable. Even if the owner did exercise the option, the opportunity to decommission the asset would remain to limit further downside. In this way, the owner of the renewable asset owns an option to purchase the post-PPA value of the asset once its original PPA term expires.

The value of a call option is determined by the following factors: the price of the underlying asset, the price's volatility, the strike price, the time to expiration of the option, interest rates and dividends paid (in the case of the underlying asset being a stock which does not apply to our case.) The table below describes how the value of the option is related to these factors.

Table 7. Option Value Factors[36]

Factor	Option Value
Increase in asset price	Increases
Increase in strike price	Decreases
Increase in variance	Increases
Increase in time to expiration	Increases
Increase in interest rates	Increases

Different assumptions about the stochastic process followed by the underlying sources of uncertainty could be made to produce alternative option values. This way, investors would have a clearer sense of what price (or premium) should be paid today for the potential post-PPA value of a PPA-contracted asset. However, applying option valuation techniques would imply collecting more data and making several assumptions. It would require the value of the asset today (i.e., the value of the post-PPA term in Year 0), the price that will need to be paid to extend the project's life after the PPA has expired, an understanding of how interest rates will change over the PPA term and the variance of the underlying factors determining the possible post-PPA option values. The only known variable is the time to expiration which is the PPA term. All others would be speculative.

These challenges suggest valuing the potential post-PPA options using Option Valuation techniques from the financial world would have limitations. However, viewing them as options and valuing them as such may provide another lens or data point in the valuation process to more properly value a renewable energy asset over its entire lifetime. This could have benefits for investors, energy developers and the success and growth of renewable energy more broadly.

[36] Damodaran, Aswath. Option Pricing Theory and Applications. NYU Stern. http://people.stern.nyu.edu/adamodar/pdfiles/option.pdf.

Section 5. Conclusion

Renewable energy assets are long-lived assets that, like any other long-lived infrastructure investment, can be difficult to value. PPA contracts simplify the valuation process by removing commodity price risk but the life of the asset can extend well beyond the term of the PPA. Despite this, there is little agreement and a lack of rigorous analysis conducted by the market to properly understand how to value the post-PPA life of an asset and what that value may be. Assumptions and the range of value vary tremendously on both a firm and individual-specific level.

This paper explored the many potential post-PPA options a wind or solar farm has, how the market currently values these options, what factors determine their value and explored a framework and method for valuing these options in the case of a newly constructed, hypothetical wind farm project. It found that potentially significant value – up to 10% of total project PV – exists in the possible post-PPA options that can materially impact valuations and investment decisions. Ultimately, this merits a more thorough examination by the market particularly since valuation methodologies and assumptions are different across different market participants. Significant questions remain around the risk this issue may create for the valuation of renewable energy asset owners, equity and debt holders in these companies and renewables development more broadly.

The paper also found that the payoff structure of the potential post-PPA options is similar to that of European call options. Given that, it proposes exploring the use of options valuation techniques to value the potential post-PPA options. Obstacles would have to be overcome around applying a formula designed to value options for stocks and other highly-traded securities to illiquid, long-lived infrastructure investments with highly uncertain future values and underlying volatility. Ultimately, better methods can and should be developed to value the post-PPA term of renewable energy assets.

Appendix

Model Inputs Detail

Performance Inputs

- Turbine capacity – According to the 2015 Wind Technologies Market Report[37] (WTMR), the average capacity of newly installed turbines is 1.9MW. 2.5MW is a realistic size as can be seen from turbines currently available on the market.[38]
- Turbines – This number was dictated by the nameplate capacity.
- Nameplate capacity – 150MW is a size typical of many wind farms being built today.
- Capacity Factor and Capacity Factor Degradation- The range of 25% to 42% reflects the range given in the 2015 WTMR for projects in the Great Lakes region. The approximate average given in the report is 35% which compares to 38% for the model (exact statistics are not available as much of the data is confidential, according to the report.) For capacity factor degradation, the model relies on research from Iain Staffel at the Imperial College London which demonstrates that 1990s vintage projects in the UK have capacity factors that degrade at the rate of 1.6% per year.[39] Given that our project is vintage 2016, this is a conservative estimate.

Revenue Inputs

- PPA price base – According to the 2015 WTMR, PPAs executed in 2014 in the Great Lakes region have a generation-weighted average levelized price of $34/MWh with a range in the mid $30’s to nearly $50. The hypothetical project’s price of $35/MWh reflects this distribution.
- PPA price escalator – PPAs typically have an escalator tied to the Year 1 price with a normal range of 2-4%.[40] It is often tied to the Consumer Price Index, local utility rates and/or some combination of another factor. This project’s range of 1% to 3% is similar to the referenced range.

Cost Inputs

- Installed cost ($1500/kW) – According to the 2015 WTMR, this is within the documented range for projects of 150MW, projects using 2.5MW turbines and projects located in the Interior of the US.

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[37] US DOE Energy. 2014 Wind Technologies Market Report.
[38] For example, the GE 2.5MW – 100: http://www.ge.com/in/wind-energy/2.5-MW-wind-turbine; the Nordex N100: http://www.nordex-online.com/en/produkte-service/wind-turbines/n100-25-mw.html; the Goldwind 2.5MW PMDD: http://www.goldwindamerica.com/technology-capabilities/2-5-mw-pmdd/; and the Kenersys K100: http://www.kenersys.com/K100-2-5MW.20.0.html.
[39] Staffell, Ian and Richard Green. *How does wind farm performance decline with age?*
[40] Solomon Energy. *How Does a Developer Set the PPA Price?* 2015. http://www.solomonenergy.com/blog/wp-content/uploads/2015/07/2015-07-21-Where-Does-the-PPA-Price-Come-From.pdf.

- O&M – According to the Wind Technology Market Report, the average O&M for projects installed since 2010 is $9/MWh. The hypothetical model's range of $5 to $15 with a most likely value of $9 reflects this average O&M and the range reported in the paper. Again, specific data points cannot be referenced as the report states some are confidential.
- O&M annual change – According to the Wind Technology Market Report, O&M's compound annual growth rate for projects built in 2009 is 2.20%. Since our model was completed at the end of 2015, a most likely rate of 2.00% is conservatively assumed here with a range of 1.00% to 3.00% given by increasing/decreasing the most likely value by 100%.

<u>Tax Inputs</u>

- Tax rate – The current marginal tax rate for the US is 35%.[41]
- Production tax credit – Wind projects are eligible for either an investment tax credit (ITC) or a production tax credit (PTC.)[42] The PTC is applied to this model. For every MWh of power generated, the project owners receive a $23 credit on any current tax liability. This can be applied to tax liabilities associated with the wind project or one associated with other tax liability generating assets.
- PTC eligibility – Ten years is the federally mandated maximum length a wind project is eligible for the PTC.
- Depreciation schedule – Since being established in 1986, MACRS (Modified Accelerated Cost Recovery System) allows renewable energy projects to be depreciated on a five year schedule.[43] This is also known as the 200% declining balance recovery method.

[41] Department of the Treasury Internal Revenue Service. *Instructions for Form 1120*. Cat. No. 11455T. 21 January 2016.
[42] National Renewable Energy Laboratory. *PTC, ITC, or Cash Grant?* NREL/TP-6A2-45359. March 2009.
[43] Dorn, Derek. *MACRS Depreciation and Renewable Energy Finance*. US Partnership for Renewable Energy Finance. http://www.ourenergypolicy.org/wp-content/uploads/2014/01/MACRSwhitepaper.pdf.

DCF Model Screen Shot

Free Cash Flow Valuation ($'000s)											
Calendar Yr		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Asset Yr		1	2	3	4	5	6	7	8	9	10
Revenues		$ 14,717	$ 15,854	$ 15,934	$ 18,853	$ 11,982	$ 17,311	$ 17,963	$ 14,582	$ 16,466	$ 18,243
- O&M		3,746	3,720	4,909	4,316	4,304	4,744	6,187	3,584	6,207	3,762
Operating Income		10,970	12,134	11,025	14,537	7,677	12,567	11,776	10,999	10,259	14,481
- Depreciation		10,970	12,134	11,025	12,960	7,677	6,480	-	-	-	-
Income Before Taxes		-	-	-	1,577	-	6,087	11,776	10,999	10,259	14,481
- Taxes		-	-	-	552	-	2,131	4,122	3,850	3,591	5,068
+ Tax Credits		9,671	10,246	10,110	11,745	7,283	10,326	10,418	8,269	9,117	9,928
Income After Taxes		9,671	10,246	10,110	12,770	7,283	14,283	18,072	15,418	15,786	19,341
+ Depreciation		10,970	12,134	11,025	12,960	7,677	6,480	-	-	-	-
+ Excess Depreciation Tax Shield		43,410	8,353	3,701	-	1,849	-	-	-	-	-
- Decommissioning Cost Net of Taxes		-	-	-	-	-	-	-	-	-	-
Free Cash Flow		64,052	30,733	24,836	25,730	16,810	20,763	18,072	15,418	15,786	19,341
Present Value		60,990	27,865	21,442	21,152	13,158	15,476	12,826	10,419	10,158	11,851
Total Value	**241,583**										
IRR	**6.40%**										
Annual Depreciation		$ 135,000	$ 36,000	$ 21,600	$ 12,960	$ 12,960	$ 6,480	$ -	$ -	$ -	$ -
Project Absorbed Depreciation		10,970	12,134	11,025	12,960	7,677	6,480	-	-	-	-
Excess Depreciation		124,030	23,866	10,575	-	5,283	-	-	-	-	-

Free Cash Flow Valuation ($'000s)											
Calendar Yr		2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Asset Yr		11	12	13	14	15	16	17	18	19	20
Revenues		$ 19,568	$ 16,045	$ 16,791	$ 14,102	$ 18,731	$ 17,763	$ 14,400	$ 18,624	$ 17,794	$ 15,986
- O&M		6,294	6,270	5,756	2,477	3,631	3,485	3,660	4,289	5,773	3,360
Operating Income		13,274	9,775	11,034	11,624	15,101	14,278	10,740	14,334	12,021	12,626
- Depreciation		-	-	-	-	-	-	-	-	-	-
Income Before Taxes		13,274	9,775	11,034	11,624	15,101	14,278	10,740	14,334	12,021	12,626
- Taxes		4,646	3,421	3,862	4,069	5,285	4,997	3,759	5,017	4,207	4,419
+ Tax Credits		-	-	-	-	-	-	-	-	-	-
Income After Taxes		8,628	6,354	7,172	7,556	9,815	9,281	6,981	9,317	7,814	8,207
+ Depreciation		-	-	-	-	-	-	-	-	-	-
+ Excess Depreciation Tax Shield		-	-	-	-	-	-	-	-	-	-
- Decommissioning Cost Net of Taxes		-	-	-	-	-	-	-	-	-	5,119
Free Cash Flow		8,628	6,354	7,172	7,556	9,815	9,281	6,981	9,317	7,814	3,088
Present Value		5,034	3,530	3,794	3,806	4,708	4,239	3,036	3,858	3,081	1,159
Total Value	**241,583**										
IRR	**6.40%**										
Annual Depreciation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Project Absorbed Depreciation		-	-	-	-	-	-	-	-	-	-
Excess Depreciation		-	-	-	-	-	-	-	-	-	-

Asset Owner Descriptions

The four potential owners of renewable energy assets analyzed here are Green Energy, Investment/Asset Management, IPP and Utility. The companies included in these categories and their financial data used to calculate the cost of capital below are taken from the website of Aswath Damodaran.[44] Examples of these companies are below however many more are included in the Damodaran calculations.

Green Power

- Nacel Energy Corp., Vivint Solar, 8Point3 Energy Partners LP, TerraForm Power Inc., and NextEra Energy Partners LP

Investment/Asset Management

- Green Energy Group Inc., Leaf Clean Energy Co., Janus Capital Group, KKR & Co., and Apollo Global Management LLC

IPP

- Calpine Corp., Dynegy Inc., Genie Energy Ltd., Atlantic Power Corp., and NRG Energy Inc.

Utility

- TECO Energy Inc., DTE Energy Co., PG&E Corp., Dominion Resources Inc., and SCANA Corp.

Cost of Capital Calculations

Table X. Cost of capital calculations

r_f	2.50%			
r_m	6.00%			
Tax Rate	35.0%			
	Green Energy	Utilities	IPP	Investment/Asset Management
Debt/Value	57.07%	41.35%	45.49%	45.49%
Levered Beta	1.62	0.55	0.80	1.17
Cost of Equity	12.22%	5.80%	7.30%	9.52%
Cost of Debt	4.02%	3.52%	3.52%	3.52%
WACC	6.74%	4.35%	5.02%	6.23%

[44] Damodaran Online. http://pages.stern.nyu.edu/~adamodar/New_Home_Page/. 2016.

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