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Financial Assessment Tool to Assist Large Energy Consumers with Energy Contracting and Clean Energy Options, as well as Off-Site Renewables



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The author(s) confirm(s) that this document has been reviewed and approved by the project's steering committee and by its program leader. These reviewers evaluated its:

- originality
- methodology
- rigour
- compliance with ethical guidelines
- conclusions against results
- conformity with the principles of the [Australian Code for the Responsible Conduct of Research](#) (NHMRC 2007),

and provided constructive feedback which was considered and addressed by the author(s).

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Acronyms

AEMO	Australian Energy Market Operator
CEEM	Centre for Energy and Environmental Markets
CFD	Contracts for Difference
DER	Distributed Energy
DLF	Distribution Loss Factor
GHG	Greenhouse Gas Emissions
MLF	Marginal Loss Factor
NEM	National Energy Market
PPA	Power Purchase Agreement
UNSW	University of New South Wales

Executive Summary

A Growing Need for Renewable PPAs

Power Purchase Agreements (PPAs) with utility-scale renewable energy plants allow medium to large-scale electricity consumers to meet a proportion of their load demand using renewable electricity. This allows them to reduce their greenhouse gas (GHG) emissions, while at the same time reducing their exposure to volatile and peak prices in the National Electricity Market (NEM).

However, due to the structure of the NEM such agreements must be brokered through a retailer and involve several other parties. Hence, these agreements involve complexity around allocation of the benefits and risk associated with the renewable energy project, and the residual load that must be met via the retailer. There is therefore uncertainty around the financial case for projects, and how this compares to other options such as on-site projects. These conditions create significant barriers to the uptake of renewable energy PPAs.

Once a PPA has been entered into, there is also significant additional complexity for the energy consumer to track and report the financial and environmental outcomes of the project, including carbon certificates, and ensure that the terms of the contract are met.

As a result, UNSW has developed a PPA Tool Set to assist in the creation of cash flow models for Renewable PPAs. The PPA Tool Set consists of four Microsoft Excel workbooks, all of which are available on the Centre for Energy and Environmental Markets' website:

<http://www.ceem.unsw.edu.au/renewable-ppa-tool>.

The Renewable PPA Tool Series

The Renewable PPA Tool Set is intended to assist large energy users, energy consumers, buyers' groups and local government to:

1. Model Renewable PPAs under different scenarios and conditions, so to assess their financial benefits and risks, and therefore help meeting their renewables and emissions goals
2. Assist in the monitoring of Renewable PPAs, to ensure value for energy consumers

This project is supported by the CRC for Low Carbon Living and builds upon previous projects that involved over 50 stakeholder interviews, analysis of market survey data to distil participant drivers and preferences, six project case studies, and two stakeholder engagement workshops.

Introduction

PPAs with utility-scale renewable energy plants are growing in popularity amongst medium to large-scale electricity users. By allowing these electricity users to meet a proportion of their demand with renewable electricity, PPAs can reduce a user's GHG emissions and exposure to high, volatile wholesale prices in the NEM.

However, given that such agreements must be brokered through retailers, PPAs involve complexity around the allocation of the benefits and risks associated with renewable energy projects, and the residual load that must be met by the retailer.

The uncertainty around the financial case for projects, and how PPAs compare to other options (such as onsite renewables), is a significant barrier to the uptake of PPAs. Further, once a PPA has been entered into, there are additional complexities for the energy consumer to overcome. These additional complexities involve the tracking and monitoring of the project's financial and environmental outcomes, ensuring that the terms of the PPA contract are being met.

Can we assist energy users, energy consumers, buyers' groups and local government to better understand the complexities and risks associated with Renewable PPAs?

To allow different stakeholder groups involved with Renewable PPAs to better understand how they can allow medium to large-scale energy users to meet their cost and emissions goals, and to assist these stakeholders in PPA monitoring, a Renewable PPA Tool Set has been developed.

The CRC for Low Carbon Living is a national research and innovation hub that seeks to enable a globally competitive low carbon built environment sector and is supported by the Cooperative Research Centres (CRC) programme.

UNSW, Sydney is one of Australia's leading research and teaching universities and hosts the CRC for Low Carbon Living.

In collaboration with the CRC for Low Carbon Living, UNSW Sydney has worked to develop each of the four tools that make up the Renewable PPA Tool Set. All four tools, and a User Manual accompanying these tools, have been made available to the public through the website for UNSW's Centre for Energy and Environmental Markers (CEEM): <http://www.ceem.unsw.edu.au/renewable-ppa-tool>

Figure 1 Solar Panels



In particular, the Renewable PPA Tool Set allows energy users, energy consumers, buyers' groups and local governments to:

- Estimate the future costs of different energy and network supply contracts for large energy consumers, building on existing UNSW tariff analysis tools
- Assess potential on-site renewable energy deployment options in terms of technical and environmental performance, and financial viability
- Explore opportunities for off-site renewables deployment through different possible PPAs, and associated retailer tariffs
- Evaluate possible demand response options to increase the value of both on-site and off-site renewables deployment.

The tool can also be used as a monitoring instrument during the operation of an existing Renewable PPA in order to ensure compliance, emissions outcomes and financial value for the energy consumer.

UNSW worked with the CRC for Low Carbon Living to develop a Renewable PPA Tool Set for a range of PPA stakeholders.

The Renewable PPA Tool Set

The Renewable PPA Tool Set consists of a series of Microsoft Excel workbooks that assist in the creation of cash flow models for Renewable PPAs. Multiple workbooks are used to allow the tool to be implemented in Microsoft Excel despite the large amount of data required. The user can choose between creating models using predefined templates (via the Renewable PPA Yearly Templates version), or start from scratch using the modelling framework in the Renewable PPA Yearly Framework version.

The four tools that make up the Renewable PPA Tool Set are briefly summarised below. The User Manual (also available through the CEEM website) provides more detail about each of the tools.

1) PPA Modelling Tool – Renewable PPA Yearly Framework and Templates

This tool uses detailed modelling for replicating Renewable PPA contracts using one year of data. It can be used for detailed forecasting and scenario modelling of future PPAs, for bill replication, and for monitoring current PPA contracts to show compliance.

The *Renewable PPA Yearly Framework* workbook sets out a framework for modelling renewable energy PPA contracts on a yearly basis. Users can define contracts between parties and add clauses with cashflow implications to them. Models can be defined on a scenario basis, allowing users to explore the impact of changes in contracts or other factors such as NEM prices, load profile, or renewable generation.

The *Renewable PPA Yearly Templates* workbook utilises the Yearly Framework workbook but adds an additional user interface that allows users to choose between PPA templates which have predefined contract structures. The user retains the ability to edit the details of each template such as how the PPA volume is determined, the PPA price, and other key variables.

2) PPA Risk Analysis Tool

This is a simplified modelling tool that allows the estimation of costs during the whole PPA contract period. Several parameters can be adjusted, including: Consumer Price Index (CPI), Marginal Loss Factor (MLF), generator downtime and curtailment (by month and year), and future NEM price. By adjusting each of these parameters, the tool allows the user to assess the potential risks of the project over its lifetime under different scenarios.

3) PPA NEM Data Tool – NEM Price Data

This workbook provides the user with access to historical NEM wholesale price and volume data in a format compatible with the *Renewable PPA Yearly Framework* and the *Renewable PPA Yearly Template* workbooks.

4) PPA Renewable Energy Data Tool – NEM RE Generation Data

This workbook provides to user with access to historical solar and wind farm data in a format compatible to the *Renewable PPA Yearly Framework* and *Renewable PPA Yearly Template* workbooks. This workbook allows users to scale the solar and wind data to model farms of different sizes.

Outcomes

The Renewable PPA Tool Set was made publicly available on the UNSW CEEM website on 13th May 2019. Since being released, the website page containing the tools has been viewed 385 times by 296 unique visitors.

Once the inputs for the *Renewable PPA Yearly Templates* or *Renewable PPA Yearly Framework* worksheets have been satisfied, the user is able to access the model outputs from each of these tools via the 'Output – Bills' tab. The 'Output – Bills' tab has been formatted such that the tool's outputs cash flow and volume outputs can be accessed in multiple ways, and easily comparable to the user's current electricity bills. The meaning of each output field is summarised by *Table 1: Renewable PPA Tool Set – Outputs* below:

Output Field	Description of Output
Tariff Bill Table	Summarises the results associated with the entire duration of the profiles provided by the user, and a per month summary of the costs associated with tariffs
PPA and Associated Costs Table	Summarises the results associated with the entire duration of the profiles provided by the user, and a per month summary of the costs associated with PPA and associated costs
Carbon Abatement Table	Summarises the results associated with the entire duration of the profiles provided by the user, and a per month summary of the costs associated with carbon abatement
Volume and Cost Columns	Summarises the results for volume, as given on the 'Clauses' tabs
Effective Rate Column	The average cost per unit volume.
DLF Column	Summarises which factors DLF is applied to. Allows the user to cross check that DLF was applied as expected
MLF Column	Summarises which factors MLF is applied to. Allows the user to cross check that MLF was applied as expected
Load Plots	Allows user to view average weekly profiles from the 'Inputs – Profiles' tab on a seasonal basis

Table 1: Renewable PPA Tool - Outputs

In addition to publicly releasing the Renewable PPA Tool Set, the project team ran a Renewable PPA Tool workshop in late May 2019. The workshop was held at the UNSW CBD campus, and was attended by approximately 30 people. The purpose of the workshop was to showcase each of the tools, and to provide workshop attendees with a live demonstration of how each tool can be used.

The Renewable PPA Tool Workshop also allowed the project team to interact with potential tool users, and get their feedback on the tool's functionality and capabilities. Some of the feedback received for the tool is outlined below:

- The Renewable PPA Tool Set is end-user centric, could a developer-centric tool set be created in the future?
- The Renewable PPA Tool Set allows the user to analyse one renewable energy project at a time. Can the tool be updated to allow users to analyse multiple renewable energy projects at the same time?
- Is the Renewable PPA Tool Set going to be updated in the future, to include new generation data as new renewable energy projects come online?
- Will there be an online platform where different users can upload different templates they have created?
- Will the demand response capabilities of the Renewable PPA Tool Set be improved in the future, potentially in relation to load shifting?

The project team envisages that the queries raised by workshop participants could be addressed by student projects in the future.

Conclusions

A Renewable PPA Tool Set was successfully developed and made publicly available via the CEEM's website. The Renewable PPA Tool Set allows energy users to model new Renewables PPA projects, and to monitor current PPAs.

As a result, the Renewable PPA Tool Sets energy users in meeting their energy cost and emissions goals, ensuring they are maximising value from PPA contracts for off-site renewable projects.

