100% renewables

Renewable Options Report – Final Report

Eurobodalla Council – Comparing PPA, EPC and PPP models

Date: July 2018

1 Executive summary of findings and recommendations

Eurobodalla Shire Council (ESC) has goals to reduce emissions from Council operations and to source more of its electricity from renewable energy sources. Council's goals are set out in its 2017-2021 Eurobodalla Emissions Reduction Plan and include:

- Reduce emissions by 25% by 2020 for council operations
- Reduce emissions by 80% by 2030 for council operations
- Source 100% of Council's electricity from renewable energy by 2030

This report was commissioned to assess options to meet the last of these goals, to source Council's electricity from renewable energy. Specifically, in response to approaches from developers and retailers of renewable energy, and to Council's own investigations, the purpose of this report is to investigate three possible contracting models that can underpin the sourcing of renewable energy to meet Council's electricity requirements. For all options assessed, one key objective of Council's is to source renewable energy at the same or lower cost than 'standard' grid electricity which is mainly derived from coal-fired generation.

The three contracting options that were assessed include:

1. Building, owning and operating a ~10MW solar farm in the local region via an Engineer, Procure & Construct model (**EPC**)
2. Investing in a renewable energy generator via a Public Private Partnership (**PPP**)[1]
3. Contracting renewable energy directly via a Power Purchase Agreement (**PPA**)[2]

A detailed discussion of the key findings, sensitivities, risks and recommendations is provided in the following section. This section provides a summary of the findings and recommendations for ESC.

1.1 Key findings and recommendations

1. In the current environment there are good prospects for Council to secure a high proportion of its operational electricity needs from competitively priced renewables over a medium to long term agreement. A PPA is the preferred / recommended approach for Eurobodalla Council to pursue, being the lowest-risk and easiest-to-implement option.
2. In the current renewable energy market there are numerous motivated vendors seeking long-term customers through Power Purchase Agreements (PPAs) and seeking to have their projects generate electricity by 2020 to take advantage of the renewable energy certificate income available (via the Renewable Energy Target). There is also a rapidly evolving market for PPAs that is streamlining the process for integrating renewable energy into regular electricity agreements at competitive rates.
3. The two build options assessed are economically marginal, and for this and other risk factors are not recommended at this time. However Council should continue to evaluate these opportunities for possible future development as technology costs continue to decline, the electricity market continues to evolve and the federal policy environment becomes clearer.
4. The option of sourcing renewable energy with regional partners, such as other local councils, should be considered in Council's decision making as larger-volume PPAs may attract more competitive pricing.

[1] The company proposing this approach is referred to here as ***PPP Developer***
[2] The company proposing this approach is referred to here as ***PPA Retailer***

The particular PPA offer that was assessed as part of this project is promising, however emerging models in this evolving market also warrant investigation, and could potentially considerably reduce long term investment risk, improve cost outcomes and also deliver against Council's renewable energy targets.

Recommendations and associated actions for Eurobodalla Shire Council in priority order are:

1. **Review and seek advice in the short term on the market for emerging bundled PPA models for electricity and LGCs that involve reduced risk and improved cost outcomes as compared to the options investigated in this report.**

   Associated Actions:

   - Approach and/or obtain advice on the Renewable Energy Hub and major retailers' latest offers and monitor the announcements of new PPA agreements especially with respect to councils.
   - Negotiate with ***PPA Retailer*** to see if there are improved terms and conditions available in a variant to their standard 'VGA' model.

2. **Seek to incorporate the purchase of large scale renewable energy from the start of the next electricity contract period using a shorter-term agreement where it is found to be financially viable and has no additional risk when compared to a regular retail contract.**

   Associated Actions:

   - Where possible, ensure that there is a mechanism for managing market price risk over the agreement term. This could include: the ability to approach the market to reprice or price match grid power costs during the term; purchasing of hedging solutions; requesting pricing that is sculpted to follow the forecast market price trajectory; or potentially increasing the proportion of renewable energy over time when prices may be more favourable.

3. **Consider forming a buying group or partnering with other councils in the region or state to increase the size of the electricity (including renewable energy) load to be contracted and the willingness of retailers to negotiate and price effectively.**

   Associated Actions:

   - Investigate support for a buying group with councils that have a similar contract expiry and renewable energy aspirations and targets.
   - If there is interest, set an opt in cut-off date that allows time to go to market and achieve supply for the next contract period (this may require lead time for a new project to be built).

4. **Sense check and revisit build and operate models (EPC and PPP) to test viability against other available options following market investigations.**

   Associated Actions:

   - Request repricing from ***PPP Developer*** at the time of understanding other option costs.
   - Approach a locally based EPC organisation and compare quotes with respect to build costs and expected generation output.

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2 Detailed Discussion of findings, sensitivities, risks and recommendations

2.1 Summary of the current situation for new renewable energy projects and agreements

In the current market, there are many renewable energy projects trying to achieve connection, financial close and generation commissioning dates that occur before 2020 so that they can take advantage of renewable energy certificate income available (via the Renewable Energy Target) while the current market remains highly priced. Many projects have motivated vendors looking for long-term customers (through Power Purchase Agreements or PPAs) with good credit ratings (such as councils) that will satisfy their financier's requirements in achieving a rapid financial close and reliable financial return.

Competition for customers has been a strong factor in the recent decline in PPA pricing available in the market along with continuing low-interest rates and declining technology costs.

The PPA market is also rapidly evolving in terms of innovative contractual arrangements and new marketplaces for customers and projects to engage. For example, in June 2018, a new Renewable Energy Hub was announced, a market place that seeks to match a large range of renewable energy projects with electricity retailer offerings and provide cost-effective and lower risk solutions for customers. Anecdotally we also understand some of the major retailers are also closely examining corporate PPA products that integrate renewable and grid power into a single agreement. These trends highlight a potential streamlining of renewable energy PPA processes that may allow businesses to more easily buy renewables at competitive rates.

The rapidly evolving market for renewables is such that, while the build options highlighted here (EPC and PPP) are marginal they should not be ruled out at this point without further discussion and assessment, and maintaining a watching brief of the underlying assumptions, particularly technology and implementation costs and long-term energy market forecasts.

The PPA model assessed from ***PPA Retailer*** looks promising but should continue to be evaluated or potentially optimised through negotiation to gain greater certainty of a long-term benefit. It is also suggested that the Renewable Energy Hub, council's procurement advisors and major retailers be regularly engaged to determine if other PPA options can be sourced at lower rates and with less price risk than this offer, given the fairly rapid rate of changes occurring in this market. This should include the option of sourcing renewable energy with regional partners, such as other local councils.

2.2 Key findings

The market for the purchase of renewable energy in Australia is relatively immature and is rapidly evolving. New, more customer-focussed models for renewable energy purchasing are being developed and these are moving beyond requiring consumers to invest in generation infrastructure and are becoming more like regular energy supply agreements.

At the same time declining technology costs, low interest rates and competitive pressure from large numbers of planned new projects are reducing the purchase price of renewable energy.

Construction of a large-scale renewable energy generation asset (such as **building a 10MW solar farm**) can help deliver long term electricity price certainty and hedge against market volatility. The longer

the electricity supply agreement, the lower average cost per megawatt hour. However, the build option reviewed here found that this:

- represents a relatively high cost, low margin, long term investment that requires management of the construction process with significant up-front costs before any benefit can be realised,
- has underlying technology costs that are on a downward trajectory (reducing asset value over time), and
- is less attractive to retailers as projects which they don't own generate lower margin revenue.

This suggests that build options only offer a marginal benefit in the short term, carry some delivery risk and should be a lower priority for investment until build and implementation costs reduce further.

A **PPP** offers potential revenue streams for council but there are a number of risks that warrant further analysis before the benefits of this option could be fully understood and recommended.

- The modelling provided by the potential private company partner for ESC was completed in a differently priced market to that which is currently being experienced.
- The model also suggests ambitious levels of output given the location and technology available.
- If modelled under current market conditions, with more realistic expectations about the amount of electricity generated and overlaid with the possibility of enforced curtailment as a semi-scheduled generator, then the likely benefit becomes less favourable.

Power Purchase Agreements offer a less direct investment in renewable energy in that there is no direct management of construction and only generated electricity is purchased with or without Large Scale Generation Certificates.

- The ***PPA Retailer*** model offers a high percentage of renewable energy and would be a strong step towards achieving renewable energy targets.
- The model can offer good pricing with a low retail margin but also exposes clients to spot market volatility when renewable generation is not covering consumption.
- It delivers only enough LGCs to cover obligations under the Renewable Energy Target (around 20% of load) and not an LGC per renewable energy megawatt hour generated (about 75% of load) offered by many other PPA variants.
- In addition, ***PPA Retailer*** clients would have to purchase these LGCs at an additional price to the renewable energy rate over a period until 2030, thus exposing ESC to further price risk where LGCs may revert to extremely low pricing from the mid-2020s.

New PPA models that achieve investment certainty, more effectively manage market risk, and deliver mutual financial reward are becoming available in the market as a result of developer and customer demand. Of particular note are the recent moves by major retailers to begin selling bundled electricity and LGCs in PPAs supplied from their existing portfolio of very large scale renewable energy projects. This includes to clients with smaller loads than previously contracted in combined renewable and regular grid power agreements.

2.3 Key sensitivities

Modelled outcomes showed key sensitivities in terms of input assumptions impacting relative performance of each of the investment opportunities investigated. Assumptions used are over the long term and are based on the best information currently available.

2.3.1 Key Sensitivity: Market pricing for electricity and Large Generation Certificates (LGCs)

Electricity market pricing inputs used in this analysis are based on current NSW wholesale futures available in June 2018 for electricity purchases in years from 2019 to 2021; and rely on Australian Energy Market Operator (AEMO) Fundamental analysis for years from 2022 to 2030.

As was experienced in the NSW market in 2017, actual pricing could depart substantially from the expected AEMO price path and the longer the time frame, the less reliable the data. The possible range of change is likely to be +/- 10 % in any given year, which could significantly alter investment outcomes over time.

Both the futures market and AEMO analysis are influenced by policy settings at Commonwealth level (such as the proposed National Energy Guarantee), the timing and scale of the retirement of current fossil-fueled generators and the replacement with new generation (whether solar, wind, storage, hydro – for example Snowy Hydro 2.0), as well as ordinary market issues such as scheduled maintenance, bidding behaviour and demand response.

LGC pricing is being dramatically impacted by the increased supply of certificates as a result of numerous large scale renewable power stations coming on line and beginning to generate from 2018 to 2020. For each megawatt hour of regular grid (mostly coal fired) generation replaced by renewable energy, an LGC is created. Retailers have an obligation to purchase these certificates for around 20% of the load they supply to their customers.

In the past 2 years certificates have been trading between $75 and $89 per certificate. However given the amount of LGCs to come onto the market the expectation is that these prices will halve by 2021 and be reduced to very low amounts of around $5 per certificate between 2025 and 2030.

There are two sides to a price drop in LGCs for ESC depending on how renewable energy is contracted. On the one hand, if receiving LGCs from a bundled offtake agreement then the value this represents decreases, and on the other hand if having to purchase LGCs from a retailer then the cost will be reduced. Again, depending on the model in use, ESC could receive all LGCs generated from their renewable energy load or simply receive or purchase the amount that covers their retailer's obligation.

2.3.2 Key Sensitivity: EPC costs

EPC costs have been taken from recent market examples of solar PV and typically are quoted in dollars per watt installed. The key components are hardware (including solar panels, mounting and inverters), labour (including civil works, electrical, maintenance and project management), and network connection.

These costs have been steadily dropping, especially with respect to hardware components. In 2017, EPC costs were between $1.60/W and $1.70/W fully installed. In 2018 costs have generally been in the range of $1.50/W to $1.60/W installed for large scale projects (above 5MW). The notable exception to this was received from ***PPP Developer*** in the PPP modelling suggesting cost of a $1.35/W with panels ten cents cheaper than locally sourced stock.

Maintenance can also be a sensitivity for EPC costs and varies in terms of what is included especially in terms of management staff costs. Sensitivity can be +/- $200,000 per annum and is naturally linked to the size of the project.

2.3.3 Key Sensitivity: Offtake agreement price

Depending on the investment model, ESC could be an offtaker, or receive revenue from an offtake agreement, or both.

Offtake pricing is driven by the cost of capital of the renewable energy project developer, the technology and EPC costs including connection and project management, and the competitive landscape. The offtake price represents the the total cost of the project including a developer margin and is quoted in dollars per megawatt hour of generation and often includes a CPI escalator or indexation.

Capital costs are benefiting from low interest rates available and a perceived increased willingness for banks and financiers to lend against renewable projects. Technology and EPC costs are coming down in price even though connection and project management fees are under upward pressure with electricity networks being inundated with applications and new models requiring additional legal fees, firming costs and administration. The competitive landscape is also exerting downward pressure with so many projects bidding to supply customers prior to 2020. Another aspect of the competitive landscape is the 'standard' grid power price (see market pricing sensitivity above). Renewable energy must be able to successfully compete against long term forecast pricing.

In 2017, offtake pricing was between $75 and $80 per megawatt hour and in 2018 prices of $65 to $75 per megawatt hour are available in the market. This puts pressure on investment solutions that rely on offtake revenue.

2.4 Risks and mitigation

Below are the major risks identified as relevant to all opportunities investigated.

2.4.1 Risk: Energy market disruption

Description:

The propensity for energy market disruption from not only new technology such as battery storage, but from policy settings, new retail offers, purchasing models and consumer behaviour, such as energy sharing, is significant. Especially in the context of multi-million dollar business decisions over terms of ten years or more.

Mitigation:

- Limit the duration of investment and ensure flexibility of contracts.
- Frame investment decisions around portions of the energy portfolio and diversification rather than trying to come up with a single investment decision to cover all aspects or all consumption in one go over a long term.

2.4.2 Risk: Reliability of market price forecasting and price risk

Description:

Market forecasting has low reliability and electricity prices can respond rapidly and dramatically to the many drivers of price change, thus making long term decision making susceptible to market price risk and wide cost and benefit variations.

Market forecasting is not an exact science and suffers from multiple influences on pricing in both short and long term markets. Weather events, the cost of input fuels, the supply and demand balance, changing generation profiles, coal fired generator ageing and retirement, evolving consumption profiles with respect to peak and off-peak times of use, policy settings such as the National Energy Guarantee and the Renewable Energy target, major projects such as Snowy Hydro 2.0 and the timing of its delivery, battery storage, the introduction of electric vehicles, network tariffs and settings to allow energy sharing are just some of the considerations for forecasters. Even when all of these issues are somehow quantified and ascribed timing, market pricing can then be influenced by market power of major generators and retailers with their own interests who buy and sell and can change market prices in each five minutes right up to years in advance. All this results in forecasting that can never be fully reliable.

Mitigation:

Enter contracts that have mechanisms that can respond to, and hedge against, fluctuating pricing and adverse price movements, according to the risk appetite of the organisation.

Liaise with retailers and advisers that actually trade in the market and get their perceptions of the key drivers and price trajectory over the short and long term. Their opinions may be biased or incorrect but if they are the people trading in the market then their views will likely be reflected in their decisions and will influence pricing accordingly.

2.4.3 Risk: Duration risk due to long term commitment

Description:

Commitment to long term investment decisions and strategies will often be adversely affected by changes in the investment environment that are either known or unknown or are unexpectedly mild or severe.

In the case of renewable energy investment, project developers often require ten-year or longer agreements to enable development costs to be spread over time, achieve adequate revenue to cover financing and maintain competitive end user pricing. Consumers must then make the decision regarding whether the price offered represents good value based on what is forecast in terms of market pricing.

Typically, the consumer will make assumptions about their long-term electricity consumption, perhaps also about the market cost of energy including LGCs and other environmental certificates and how renewable energy may compare to regular grid supplied energy.

The longer the term, the more likelihood of changes challenging assumptions, impacting outcomes and increasing exposure to risks.

Mitigation:

- Where possible, make shorter term investments based on known information.
- In a renewable energy sense this could also mean:
  - Pursuing contract flexibility to allow repricing or market price matching during the contract term.
  - Testing the market for non-renewable energy over the longest possible term to create a benchmark for decisions.
  - Exploring pricing options that reference the market price rather than fixed or flat pricing over a long term. This could include price 'sculpting' where prices are varied over time to follow the forecast price trajectory.
  - Investigating possible hedging options available to remove or reduce adverse cost outcomes.
  - Being aware of long-term organisational plans that may impact energy consumption.
  - Before making purchase decisions, reviewing the electricity futures markets which are traded up to 3 years in advance i.e. they show the market's current view of what electricity prices would be for each year up to 3 years ahead.
  - Reviewing options for divestment or on-selling of excess energy and catering to these in contracts.

2.4.4 Risk: Lack of retail competition and take up

Description:

The retail landscape in NSW is currently dominated by major retailers that are also large generators ('gentailers'). They have been very active in the purchasing of large scale renewable projects or their output over recent times. That said, they also have significant investment in coal fired generation and long-term coal contracts that source cheap local coal. Thus far these major retailers have not been actively pursuing renewable energy supply agreements or retailing renewable energy outside of rooftop solar. The three major retailers likely have less than 20 large scale PPAs that are in planning, but many projects will have approached them to assist with retailing their generated output.

To date, these retailers have shown only moderate interest in entertaining large scale renewable energy projects and this has been in part due to the fact that they are in a very strong position in terms of not having to pursue this market. They also know that under electricity market rules all projects whether customer-owned or not must have a retailer to invoice and sell energy to an end user.

Naturally, an organisation that has executed an agreement with a renewable energy project is keen to ensure that a retailer can perform retail services and also provide the balance of the load outside of the renewable generation. A large retailer looks at this in terms of whether they can make margin on this transaction. If there is a large renewable component upon which the retailer can't make a margin and they also have to manage risk of intermittent supply on a small amount of grid energy, then they would likely be not interested.

In recent times there have been some agreements made where the proportion of renewable energy against the entire load of a customer is small, typically less than 20%, and this is because there is still 80% or more energy upon which they are making their regular margin.

This issue is non-existent if the retailer has their own project and they are selling electricity and making margin on both the renewable and the regular grid power. Also, if they have negotiated supply from a large renewable project at discounted rates, then there is opportunity to make as much, if not more, margin than from regular grid power.

There are many smaller retailers that are more accepting of renewable projects, however, they represent a greater counterparty risk especially if entering a long-term deal. So, whilst their pricing and terms may be more palatable, they represent more risk for customers.

Mitigation:

- Mitigation in this case results from a change in attitude of retailers towards offering their own renewable energy and regular grid power in a single longer-term contract.
- Major retailers have employed more staff in what they call 'new business' roles that appear to be more willing to negotiate internally for take up of renewable energy.
- Some customers are willing to limit their initial purchase of renewable energy so that there is no actual or perceived disadvantage to their regular grid contract pricing with a view to purchasing more renewable energy when it becomes cheaper.

2.5 Recommendations / Priorities and next actions

Considering the immaturity and evolving nature of the renewable energy market in Australia, it is clear that a best fit renewable energy investment solution for ESC would need to facilitate long term risk and cost management in an uncertain market, whilst also delivering on renewable energy supply objectives.

If also incorporating the objective of reducing cost against 'standard' grid electricity, then this becomes a difficult task for any investment strategy, owing to an electricity market that is subject to a myriad of drivers and is declining in price from recent market highs.

Of the three options reviewed, a PPA model is seen as potentially the lowest risk and easiest-to-implement investment strategy. Whilst the ***PPA Retailer*** model has its merits in terms of renewable energy coverage and achieving targets, without further investment in a risk management product, it may offer too much exposure to the volatile wholesale market and for too long a duration. The additional risk management investment required then erodes any cost advantage.

The tenure of current PPAs has in fact reduced from fifteen and twenty years in recent times, to now being typically ten years, with even shorter agreement periods of 4-8 years emerging[3]. This is in line with the decline in cost of hardware and installation and the willingness of financiers to allow projects to proceed with less certainty regarding long term offtake customers. However, in a market that is so rapidly evolving, the risks for electricity consumers inherent even in a ten-year investment appear to be increasing with the speed of change and the pace of disruption in the energy market.

Emerging models such as the Renewable Energy Hub for PPAs, novatable renewable energy agreements with market matching mechanisms, and retailer arrangements that are very recently beginning to fully integrate renewable and regular grid energy, all warrant investigation. These models could considerably reduce long term investment risk, improve cost outcomes and also deliver against renewable energy targets.

In consideration of the above, suggested recommendations and associated actions for Eurobodalla Shire Council in priority order are:

[3] Advice from ESC based on discussions with TFS Green

1. **Review and seek advice in the short term on the market for emerging bundled PPA models for electricity and LGCs that involve reduced risk and improved cost outcomes as compared to the options investigated in this report.**

   Associated Actions:

   - Approach and/or obtain advice on the Renewable Energy Hub and major retailers' latest offers and monitor the announcements of new PPA agreements especially with respect to councils.
   - Negotiate with ***PPA Retailer*** to see if there are improved terms and conditions available in a variant to their standard 'VGA' model.

2. **Seek to incorporate the purchase of large scale renewable energy from the start of the next electricity contract period using a shorter-term agreement where it is found to be financially viable and has no additional risk when compared to a regular retail contract.**

   Associated Actions:

   - Where possible, ensure that there is a mechanism for managing market price risk over the agreement term. This could include: the ability to approach the market to reprice or price match grid power costs during the term; purchasing of hedging solutions; requesting pricing that is sculpted to follow the forecast market price trajectory; or potentially increasing the proportion of renewable energy over time when prices may be more favourable.

3. **Consider forming a buying group or partnering with other councils in the region or state to increase the size of the electricity (including renewable energy) load to be contracted and the willingness of retailers to negotiate and price effectively.**

   Associated Actions:

   - Investigate support for a buying group with councils that have a similar contract expiry and renewable energy aspirations and targets.
   - If there is interest, set an opt in cut-off date that allows sufficient time to go to market and achieve supply for the next contract period (this may require lead time for a new project to be built).

4. **Sense check and revisit build and operate models (EPC and PPP) to test viability against other available options following market investigations.**

   Associated Actions:

   - Request repricing from ***PPP Developer*** at the time of understanding other option costs.
   - Approach a locally based EPC organisation and compare quotes with respect to build costs and expected generation output.

3 List of acronyms and terminology

Acronym	Meaning / Stands for/….
AC/DC	Alternating current/Direct current
AEMO	Australian Energy Market Operator
CFD	Contract for Difference – problematic for NSW local governments
COAG	Council of Australian Governments
CPI	Consumer Price Index
DA	Development Approval
DNSP	Distribution Network Service Provider (e.g. Essential Energy)
EPC	Engineer Procure and Construct
EPCM	Engineer, Procure, Construct and Maintain
ESC	Eurobodalla Shire Council
FiT	Feed-in-Tariff
IRR	Internal Rate of Return
LGC	Large-scale Generation Certificate
MWh, kWh	Megawatt-hour, kilowatt-hour – units of energy
MW, kW, W	Megawatts, Kilowatts, Watts – units of power
NEG	National Energy Guarantee
NEM	National Electricity Market
NPV	Net Present Value
O&M	Operation and maintenance
OLG	Office of Local Government
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PR	Performance Ratio
PV	Photovoltaic
REC	Renewable Energy Certificate
RET	Renewable Energy Target
SAT	Single Axis Tracking
SCoC	Social Cost of Carbon
SPV	Special Purpose Vehicle
VGA	Virtual Generation Agreement
WHS	Workplace Health & Safety

Term	Meaning / description in the context of renewable energy projects
Contract for Difference	A financial derivative contract in that its value is derived from another market. In the case of renewable energy, this means the wholesale electricity market. Typically, the contract is between a renewable energy project developer and another party. Both parties agree on a price level that is usually set at a cost per MWh that the renewable energy project requires to finance its development and achieve a return on investment. When the renewable project generates electricity into the market, it receives the wholesale market price. If the wholesale price it receives is above the agreed price, then the other party will be paid the difference by the project. If the wholesale price is below the agreed price, then the other party will pay the project the difference. This ensures that the project is guaranteed revenue for generated electricity at the agreed price. CFDs are commonly used as the basis of a “virtual PPA” where no actual

	electricity is delivered to the customer, instead only a financial transaction occurs, completely separate to any agreement for electricity supply.
Counterparty	The other party in any financial transaction or agreement. Typically, there will be a buying counterparty or entity that is paired with a selling counterparty or entity. Both parties will have obligations for delivery outlined in an agreement or contractual transaction.
Counterparty risk	The risk that a counterparty cannot meet its obligations for delivery in a financial transaction or agreement. Often based on creditworthiness of a party. Government entities such as state governments, government agencies, departments and councils, will typically present a low counterparty risk compared to commercial organisations.
Derivative Investment	A financial investment that is made in, or using, a derivative. Derivatives are Financial Services Products that use another market to determine their value. To cap their wholesale electricity purchase costs, most energy retailers will invest a financial derivative known as a $300 Cap for which they pay a fee per MWh. If the wholesale market price rises above $300/MWh (it can go above $14000/MWh) and the retailer has purchased a $300 Cap the cost the retailer pays for electricity is capped at $300. The cost of the Cap fluctuates depending on the wholesale electricity price and the likelihood of the market rising above $300/MWh. In summer, caps are more expensive when the likelihood of price spikes are higher. A Contract for Difference is also a derivative.
Engineer Procure and Construct	Typical agreement underpinning the implementation of a renewable energy project.
Feed-in-Tariff	A rate in $/MWh offered by a retailer for renewable energy exported to the grid, typical in many retail energy supply agreements.
Firming	Firming is the mechanism by which an intermittent or fluctuating electricity load can be made firm in terms of volume. Typically, this volume will be specific to consumption of the energy user (which may also fluctuate) but can also be a fixed MWh amount. Renewable projects can use financial or physical firming products to guarantee delivery of a set amount of MWh of electricity even in times of low or no generation. A financial product may be a derivative or simply enable a substitute energy purchase from the wholesale market or another renewable project. A physical product could be pumped hydro generation or gas fired generation that could be deployed at short notice to physically deliver against a shortfall in renewable generation. Retailers can offer a firming service by directly purchasing the balance of grid power from the wholesale market if a customer wishes to integrate renewable energy into their energy mix. Retailers will charge a premium for this service as they will not know how much electricity to buy in advance, for example on a day that is windy versus a day of no wind where a customer has wind generation incorporated into their electricity purchases.
Grid Connection Agreement	Application must be made, and agreement reached with the distributor to connect a renewable energy generator to the grid.
Hedging	A risk management technique involving investing to reduce adverse price movements in a commodity or asset.
Large-scale Generation Certificate (LGC)	An LGC represents one MWh of electricity generated from an eligible renewable energy plant under the Renewable Energy Target. Liable parties such as electricity retailers must purchase and surrender LGCs in proportion to their market share.
Merchant Projects	Projects that sell their output either totally or in part into the wholesale market without having an offtake agreement with an end user customer.

Offtake Agreement	An agreement between a renewable energy generator and an electricity retailer to buy the power generated by a renewable energy project.
Power Purchase Agreement	An agreement between an electricity retailer and an energy user to purchase renewable energy.
Public Private Partnership	The Local Government Amendment (Public Private Partnerships) Act 2004 defines a PPP as an "arrangement between a council and a private person for the purposes of: (a) providing public infrastructure or facilities (being infrastructure or facilities in respect of which the council has an interest, liability or responsibility under the arrangement), or (b) delivering services in accordance with the arrangement, or both".
Special Purpose Vehicle	A legal entity or limited company, typically with a narrow purpose set up by a parent company or companies. The SPV will have secure obligations even if the parent organisation(s) go bankrupt or insolvent.
Spot Market	A spot market trades commodities like energy for immediate delivery i.e. they trade on the spot immediately. The National Electricity Market (NEM) facilitates the exchange of electricity between generators and retailers. All electricity supplied to the market is sold at the 'spot' price. Generators are paid for the electricity they produce, and retailers pay for the electricity their customers consume. Power supply and demand is matched instantaneously. Where intra-day electricity consumption increases above the expected 'baseload', more generators are brought on selling at higher and higher prices to instantly satisfy demand.
Wholesale prices	Prices without retailer margins. In Australia in the National Electricity Market there is a wholesale market for each state and territory. Wholesale pricing is available for registered market participants to purchase on the Spot Market or on the Futures or Forward Market.

4 Background

In 2017, Eurobodalla Shire Council (ESC) developed the 2017-2021 Eurobodalla Emissions Reduction Plan which sets out Council's strategy to minimise greenhouse gas emissions from Council operations. The outcomes ESC achieved over the past ten years have demonstrated that emission reductions can deliver both strong environmental and economic benefits.

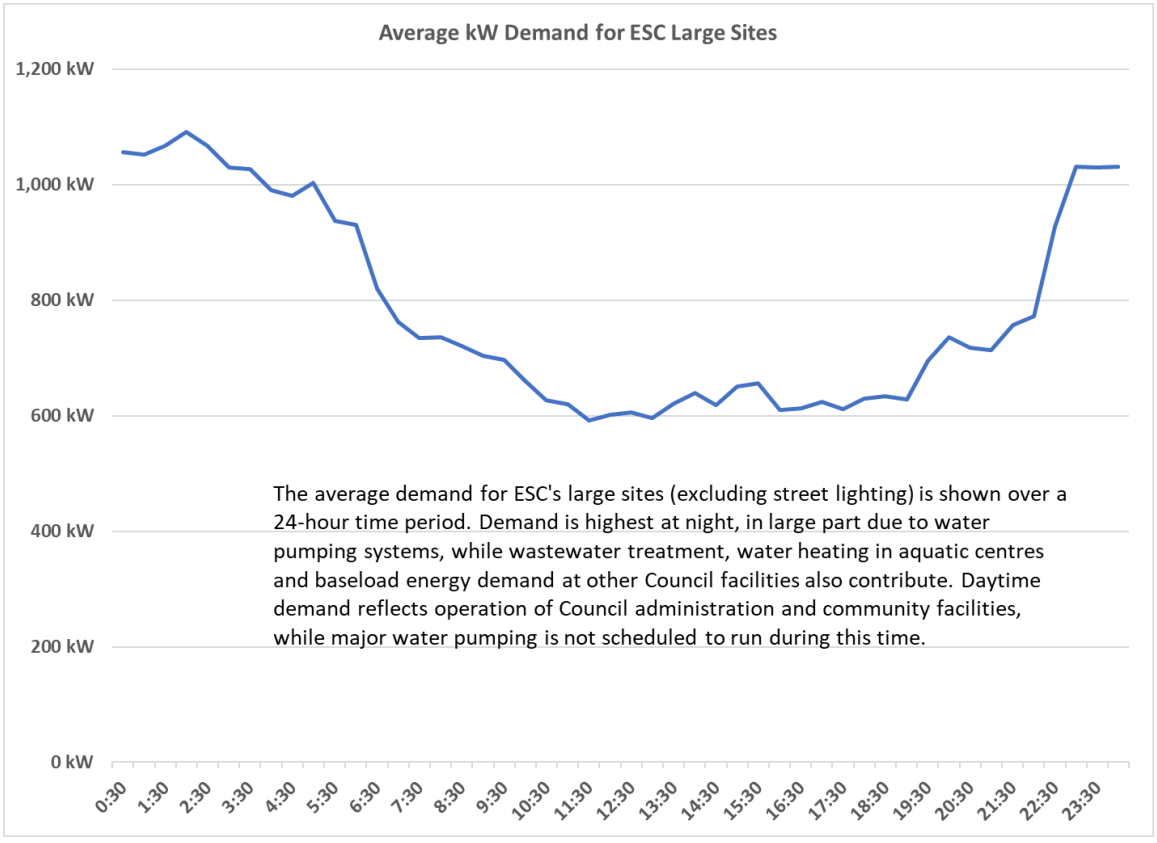
Key actions for Council to reduce emissions include energy efficiency, renewable energy, reducing methane pollution from landfill, decarbonising the fleet and developing an adaptation strategy. The following are ESC's targets for emissions reduction:

- Reduce emissions by 25% by 2020 for council operations
- Reduce emissions by 80% by 2030 for council operations
- Source 100% of Council's electricity from renewable energy by 2030

The purpose of this report is investigate possible contracting models that can underpin the sourcing of 100% renewable energy to meet Council's electricity requirements.

4.1 ESC's electricity consumption

In 2016/17 ESC consumed 10,785 MWh of electricity. The provision of major water pumping and street lighting services means that a significant proportion of Council's electricity is consumed at night time, with these two categories of asset using around one third of all ESC's electricity. Other significant energy using equipment such as wastewater treatment and leisure centres will have demand over a 24-hour period, while other facilities' demand will tend to be mainly in the daytime. Average electricity demand for Council's major facilities over a 24-hour period is illustrated below.



ESC'S AVERAGE ELECTRICITY DEMAND FOR LARGE SITES IN 2016-17

5 Scope of works

100% Renewables Pty Ltd was engaged by Council to investigate the following three renewable energy options:

1. Building, owning and operating a ~10MW solar farm in the local region
2. Investing in a renewable energy generator via a Public Private Partnership
3. Contracting renewable energy directly via a Power Purchase Agreement

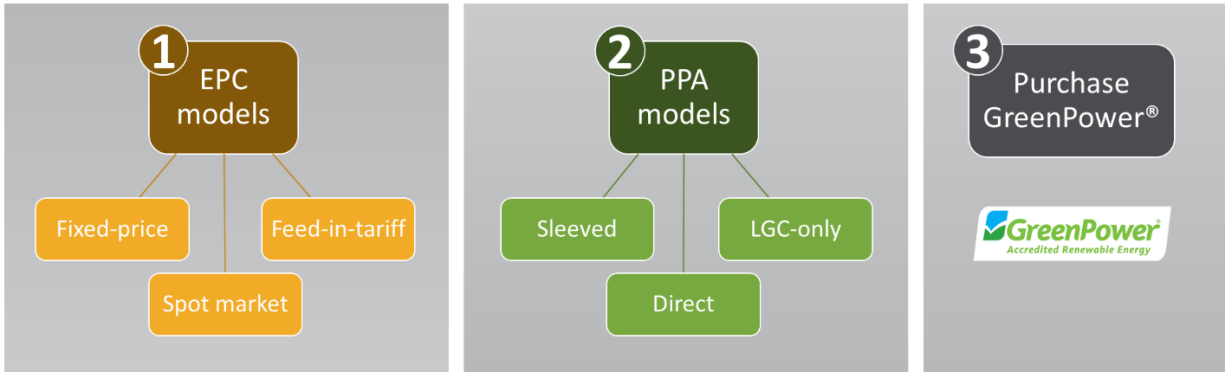
6 Reaching 100% renewable energy

There is no official definition of what a 100% renewable energy target means, but a lot of organisations interpret it to be when the amount of renewable energy purchased is equal to or more than what is consumed. The renewable energy can either be generated onsite or offsite. As long as the renewable energy supply meets or exceeds the energy consumption of Council, ESC has reached its 100% renewable energy goal.

There are a few methods Council can employ to increase its renewable energy contribution. It can

1. build, own and operate a solar farm under an Engineer, Procure, Construct (EPC) model (or as a part-owner under a Public-Private Partnership as proposed by a developer and evaluated here), and enter into an agreement to be an offtaker or customer of the plant, and/or
2. enter into a Power Purchase Agreement (PPA) with a renewable energy generator for Council's energy needs, and/or
3. purchase GreenPower® and/or Large-scale Generation Certificates for Council's energy needs

There are various sub-models of EPC and PPA models, which can be seen in the graphic below.



OPTIONS FOR REACHING 100% RENEWABLE ENERGY

EPC models are discussed in greater detail in section 7, with a PPP model discussed in section 8. PPA models are discussed in section 9. GreenPower® purchases are relatively straightforward and won't be dealt with in depth in this report.

7 Building, owning, operating a 10 MW solar farm - EPC model

Building and owning a solar farm is an **Engineer, Procure, Construct (EPC) model** where Eurobodalla Shire Council (ESC) invests capital and directly or indirectly project manages the construction of the renewable energy asset. An EPCM model adds maintenance of the asset to the project characterisation; for the purpose of this report, EPC is used.

Under an EPC model, there is greater interest in the technical aspects as ownership is transferred to Council upon commissioning or after an agreed period of operation. Council subsequently takes on the management and risk of ongoing performance.

While there are many styles of EPC contracting, here we outline three that cover the majority of currently used approaches.

From an AEMO perspective, renewable energy plants are classified as *a scheduled generating unit*, *non-scheduled generating unit* or *semi-scheduled generating unit* depending on the extent to which they will be participating in central dispatch.

- **Scheduled** – The generating unit participates in central dispatch. Plant size is greater than 30 MW.
- **Non-Scheduled** – The generating unit does not participate in central dispatch. Between 5 MW and 30 MW if some or all energy is sold in the NEM. Less than 30 MW if energy output is purchased by a local retailer or a customer located at the same connection point. However, 'local use' means that no more than 50% of the electricity supplied can be exported to the network.
- **Semi-Scheduled** – The generating unit will participate in central dispatch in specified circumstances. Greater than 30 MW. However, AEMO can – at its discretion – classify the renewable energy plant as a scheduled generator.

For ESC to increase its level of renewable energy under this model it may also need to be an offtaker and/or to retain Large-scale Generation Certificates (LGCs) resulting from the renewable energy generation.

7.1 Types of EPC contracts

7.1.1 EPC and sell fixed priced off-take including LGCs

Model Name	EPC - and sell fixed priced off-take including LGCs
Basic Description	Construction agreement is EPC. Generation from the plant is exported to market to supply a third party offtaker. The generation is sold through a separate agreement at an agreed fixed price per megawatt hour as council cannot offer as a contract for difference (CFD). A retailer needs to pass through or sleeve this separate agreement. Typically, the offtake price will be at a discount to market. LGCs would be optional to sell/purchase. If not sold ESC can use the LGCs to offset obligations or retire them to claim the carbon reduction and renewable energy generation. Given that the size of the solar farm is greater than 5 MW AC generation, the project will likely need to be registered as a semi-scheduled market generator with AEMO.
Agreements	• EPC Agreement

	• Off-Take Agreement • Registration as semi-scheduled market generator
Agreements and counterparties	**EPC Agreement:** EPC Company and Council. **Off-Take agreement:** Council as generator. Off-taker could be a corporate, a retailer or an aggregator (another council or ESC itself could be offtakers but only through a retailer otherwise model would involve a CFD). **Registration as semi-scheduled market generator:** Council and AEMO
Duration	EPC open until construction and defects/initial maintenance complete. The off-take agreement will be aligned with financing where possible i.e. if the underlying financing is 15 years then ideally the off-take agreement will be for 15 years. Registration as semi-scheduled market generator is an annual renewal. The project life will be 30 years or more and will require inverter upgrades at periodic intervals (say 14 and 28 years).
Costs	• Capital cost • Inverter replacement cost • O&M cost • AEMO registration as a semi-scheduled market generator (currently $20,000 pa) • Retailer pass through margin $/MWh • Loan finance (if applicable; this analysis assumes equity funding)
Benefits	• Sale of PV output to offtaker • Reduction in electricity prices compared with standard retail agreement • Reduced LGC obligation • Surplus LGCs if LGCs created exceed the obligation amount
Risks	1. Retailers may not want to be party to off-take. 2. AEMO increases fees for semi-scheduled market generators. 3. Semi-scheduled generators can be directed by AEMO to curtail or stop generating when there is network congestion thus limiting generation output. 4. Wholesale market prices increase significantly and agreed off-take price is at a significant discount to market thereby Council foregoes revenue 5. Off-take term is shorter than financing if applicable 6. Regular retail price or competing off-take price falls below off-take price – no one takes up off-take or off-take needs to operate at a loss
Mitigants (that respond to each identified risk)	1. As market matures more retailers will want to participate. Legislation may drive obligations for retailers. Alternative is to take spot market revenue until off-take can be achieved. 2. Make contingency for fee increases 3. Look at differences in obligations in becoming a scheduled generator if off take is in place. 4. Build in sufficient buffer when offering fixed for floating prices. Calculation of breakeven point will inform when this makes project unprofitable. 5. Negotiate longest duration possible and offer discounts for longer terms. Negotiate multiple offtake deals.

	6. Get robust market pricing advice, and don't proceed if this is a likely outcome. Sell project if already constructed.
Case example	Majority of PPAs in market. Announced Project off-take agreements. Newcastle Council
Suitable for councils	Yes

7.1.2 EPC and receive spot market revenue

Model Name	**EPC and receive spot market revenue**
Basic Description	This model requires that Council registers as a generator, likely a semi-scheduled market generator (less than 30 MW generation) market participant. Generation will be sent to market via an export meter. Spot market revenue will be received from AEMO.
Agreements	• EPC Agreement • Registration as semi-scheduled market generator
Agreements and counterparties	**EPC Agreement:** EPC Company and Council. **Registration as semi-scheduled market generator:** Council and AEMO
Duration	EPC open until construction and defects/initial maintenance complete. Registration as semi-scheduled market generator is an annual renewal. The project life will be 30 years or more and will require inverter upgrades at periodic intervals (say 14 and 28 years).
Costs	• Capital cost • Inverter replacement cost • O&M cost • AEMO registration as a semi-scheduled market generator (currently $20,000 pa) • Loan finance (if applicable; this analysis assumes equity funding)
Benefits	• Spot price revenue • LGC revenue
Risks	1. AEMO increases registration fees for semi-scheduled market generators. 2. Semi-scheduled generators can be directed by AEMO to curtail or stop generating when there is network congestion thus limiting generation output. 3. Market price is low and provides lower than expected revenue for daytime generation. 4. Project finance may be difficult if there are no off-takers
Mitigants (that respond to each identified risk)	1. Review viability of other models and cost to change. If viable make change. 2. Look at differences in obligations in becoming a scheduled generator if off take is in place. 3. Review viability of other models with long-term fixed pricing. 4. Council becomes off-taker through embedded network arrangement
Case example	All merchant sellers of renewable energy
Suitable for councils	Yes

7.1.3 EPC and receive feed-in-tariff

Model Name	EPC and receive feed-in tariff (FiT)
Basic Description	This contract model involves an EPC contract for construction and a retail agreement for electricity supply. Registration as a non-scheduled generator is typically not required under a feed-in tariff arrangement (and FiTs are not typically designed for generation at this level). Feed-in tariffs are being published at higher rates in the current market and form part of most large user retail electricity agreements. Some retailers are willing to simply pass through the market rate that they achieve for the exported energy, and if this is possible, it would be a great outcome for Council. A feed-in tariff model for exporting generation to the grid is the most straightforward of methods to manage and monitor. LGCs created could be used to offset 100% of LGC obligation annually, and if there are excess LGCs, the council could elect to retire or sell.
Agreements	• EPC agreement • Retail electricity agreement with feed-in tariff clause
Agreements and counterparties	**EPC Agreement**: EPC Company and Council. **Electricity Retail Agreement**: Retailer and Council
Duration	The feed-in tariff is tied to the retail agreement in terms of duration and so would need to be reset each time a retail agreement expires. If the rate was not at the level that Council desired another model for generation could be pursued at that time.
Costs	• Capital cost (metering to allow import and export) • Inverter replacement cost • O&M cost • Retailer pass through margin $/MWh • Loan finance (if applicable)
Benefits	• FiT for PV output • Reduced LGC obligation • Surplus LGCs if LGCs created exceed the obligation amount
Risks	1. No retailer wants to offer FiT for this much generation. 2. FiT rate is low.
Mitigants (that respond to each identified risk)	1. Ensure negotiation begins well before existing contract expiry. Alternative is to prepare to utilise another model. 2. Show exact modelling for output generation to try to negotiate best rate possible.
Case example	Regular retail agreements
Suitable for councils	Yes

8 Investing in a renewable energy project via a PPP

A Public-Private Partnership (PPP) is an "*arrangement between a council and a private person for the purposes of:*

> *(a) providing public infrastructure or facilities (being infrastructure or facilities in respect of which the council has an interest, liability or responsibility under the arrangement), or*
>
> *(b) delivering services in accordance with the arrangement, or both*".

Public-Private Partnerships can be complex and risky. For that reason, changes have been made to the Local Government Act 1993 (the Act) by the Local Government Amendment (Public–Private Partnerships) Act 2004. The changes introduce a Part 6 in Chapter 12 of the Act with new requirements for all councils in NSW, including county councils, when entering into PPPs.

The Act provides that the Director-General of the Department of Local Government (Director General) may from time to time issue guidelines requiring specified procedures and processes to be followed by councils when PPPs are being used or considered for the delivery of infrastructure and services.

The Department of Local Government (DLG) is not intending, through these Guidelines, to approve or not approve projects. The intent is rather to examine whether or not the procedures and processes that are followed by councils are appropriate for the delivery of the particular project. Responsibility for projects remains with councils.

Any council entering into a PPP must submit an assessment of the project to be carried out under the PPP to the Department before they enter an arrangement. The General Manager must certify that this assessment has been carried out in accordance with the PPP guidelines.

8.1 Proposed PPP with *PPP Developer*[4]

Model Name	**Proposed PPP with *PPP Developer***
Basic Description	Proposed is a 30 MW solar farm that would be owned by a Special Purpose Vehicle (SPV), with ESC (25%) and ***PPP Developer*** (75%) as investors. The cost of the solar farm would be ~$40M, and therefore a ~$10m investment would be required in the SPV by ESC. The SPV would take the ~$10m as a stakeholder loan and pay back the loan at a proposed rate of 7% p.a. Any additional SPV profit could be distributed to investors proportionally. SPV revenue from electricity generation would be at wholesale spot pricing rates or through negotiation of PPA off-take agreements. Revenue could also come from the creation and sale of LGCs. Electricity from the solar farm will be offered via a PPA to ESC, though it appears that all LGCs are sold to create revenue for the project. The current proposal is that 10% of output (~30% of ESC demand) is supplied by the proposed 30 MW farm. This means that the remaining 90% of the farm's generation (electricity plus LGCs) will be available for sale into the grid via off-take agreements or simply at spot market rates.

[4] The model outlined and assessed here is as proposed by ***PPP Developer*** prior to ESC's initial request for advice / guidance from the OLG. An alternate structure has been outlined subsequent to the OLG's information (6 July 2018, via email) that seeks to overcome some of the key issues noted, in particular relating to s358 of the Local Government Act and the Tendering Guidelines.

	To determine the viability of this model there are considerations that need to be addressed outside of financial cost benefit. These are: 1. Will this form of PPP be acceptable/appropriate under the Local Government Act and guidelines? 2. Clarify with ***PPP Developer*** if the PPA involve a derivative investment by ESC? 3. Clarify with OLG if subsequent SPV PPAs with other off-takers will be able to use a derivative or CFD if ESC is a part-owner of the SPV? This cost-benefit analysis will make the assumption that the PPP is acceptable under the Local Government Act and PPAs will be able to be offered either not using a derivative or by the SPV independently of council restrictions.
Agreements	• Joint Venture Agreement for PPP and SPV • Loan agreement for SPV • Lease Agreement for Land • Grid Connection Agreement • EPC Agreement • PPA Off-Take Agreement • Registration as Semi-scheduled generator • SPV EPC agreement
Agreements and counterparties	**Joint Venture Agreement for PPP and SPV:** ESC and ***PPP Developer*** **Loan agreement for SPV:** SPV and ESC (Could be contained within Joint Venture Agreement); **Lease Agreement for Land:** SPV or EPC Company and landowner**;** **Grid Connection Agreement:** EPC /SPV and Essential Energy **EPC Agreement:** SPV and EPC company (Could be ***PPP Developer***); **PPA Off-take agreement:** Initially ESC, SPV and Retailer. Additional Off-takes could be a corporate, or a retailer or another council; **Registration as semi-scheduled generator:** SPV and AEMO
Duration	30 years for PPP and SPV. EPCM open until construction and defects/ initial maintenance complete. Loan is listed as 25 years in ***PPP Developer*** model but may be varied to suit. The off-take agreement will be aligned with financing where possible i.e. if the underlying financing is 15 years then ideally the off-take agreement will be for 15 years. Registration as semi-scheduled generator is an annual renewal. The project life will be 30 years or more and will require inverter upgrades at periodic intervals (say 14 and 28 years).
Costs	**For ESC** • Capital cost/loan finance cost • PPA (electricity and LGC) costs • Legal/advice costs **For SPV** All EPC costs, trading costs registration costs • Site selection and geotechnical survey, land remediation and access, vegetation management plan analysis • Preliminary system design and yield calculations via PVSyst or similar • DA and approval

	• Network Connection augmentation agreement via DNSP preliminary inquiry through to final agreement • Construction • Hardware, software and O&M • Land Leasing Costs • Inverter replacement cost • O&M cost • AEMO registration as a semi-scheduled generator (currently ~$20,000 pa) • Retailer pass through margin $/MWh • Loan finance **For *PPP Developer*** • Capital cost/loan finance cost • Preliminary development costs e.g. site leasing, Network Connection enquiries and negotiations
Benefits	**For ESC** • Stakeholder Loan revenue • Potential profit from SPV • Potential Electricity cost savings • Reduced LGC cost • LGC Revenue from surplus LGCs over obligation • Physical hedge against market price increases – if prices increase SPV makes more profit, PPA performs better **For SPV** • Sale of electricity to grid • Sale of PV output to offtaker • Streamlined DA **For *PPP Developer*** • Stakeholder Loan revenue • Potential profit from SPV
Risks	1. PPP may not be appropriate under Office of Local Government advice 2. SPV is not profitable resulting from either high construction or generation costs or loan interest rate and competition in market/low market pricing squeezing revenue. 3. Financing unavailable as a result of PPP restriction 4. Retailers don't want to be party to off-take. 5. AEMO increases registration fees for semi-scheduled generators. 6. Off-take terms risk loss by SPV 7. SPV unable to offer CFD arrangements with retailers/offtakers 8. Solar farm is delayed or produces lower than expected output 9. Counterparty risk: Rio ***PPP Developer*** 10. Councils electricity load decreases below expectations 11. Length of tenor of agreement -market regulation and pricing subject to significant change.
Mitigants (that respond to each identified risk)	1. Lobby and request interpretation by OLG prior to executing a binding agreement. Seek legal and financial advice as to going against OLG PPP Guidelines

	2. Review terms of loan and construction agreements to ensure profitability. SPV should potentially hedge against market volatility and price decline. 3. Investigate alternative financing methods and use above advice to clarify needs. Present revenue model to potential financiers. 4. As market matures more retailers will want to participate. Legislation may drive obligations for retailers. 5. Ensure financial model incorporates contingency for price increases 6. Ensure that SPV negotiates aggressively on price and terms to maximise margin. If permitted, SPV undertake market price hedging contracts. 7. Clarify if this is a genuine risk and develop products that don't involve derivatives, alternatively only rely on spot market revenue. 8. Incorporate firming of supply products into PPA – i.e. performance guarantees or hedges that deliver $ or elec. 9. Perform appropriate creditworthiness checks. If required use an independent financial services organisation to complete due diligence. 10. Ensure ESC penalties for this are minimised in PPA negotiations (e.g. penalties for shortfall charge if total consumption is lower than allowable variance). 11. Investigate a shorter term agreement. Balance term against renewable energy and environmental commitments. Potentially build in sculpting of pricing/indexation to PPA(s). Note that any additional PPAs will likely be increasing in profit for SPV if market declines and both ESC PPA and SPV will have improved outcomes if market pricing is higher.
Case example	None in Australia. ACT Gov has in effect a PPP/PPA where they underwrite solar pricing
Suitable for councils	Yes potentially

9 Purchasing renewable energy via an offsite PPA

9.1 Background information on Power Purchase Agreements

A **Power Purchase Agreement (PPA)** is a model whereby the cost of a power generation asset is paid off over a long-term, based on the purchase of generated power at a cost per megawatt hour. The rate per megawatt hour covers all costs including financing, construction and maintenance, and does not require capital investment by ESC. The PPA project developer owns the generation asset and in effect leases the land on which it is constructed and ensures generation performance.

- In principle, where a PPA is sought, the financing contract or off-take agreement is centred around the delivery of a volume of electricity over a term. Therefore, as a customer of a PPA, there is less concern about the technical aspects of the solar plant and more focus on the price and supply of delivered volume.
- Nonetheless, under a PPA model, there is still the necessity to ensure competence in the supplier's ability to design, install, comply with WHS, environmental, operational, administrative authorities and any other procedures and rules governing access and activity at any site. The delivered asset remains the property of the PPA provider, and it is their obligation to maintain the plant to meet or better performance measures (performance risk under a PPA would sit with the owner / developer and not ESC; if required firming clauses regarding cost and supply could be built into a PPA as for the PPP model outlined above).
- Over the short term, a PPA offers the benefit of no substantial up-front costs and less risk regarding technology, development cost and performance of sub-contracting counterparties.

9.2 Bundled versus LGC-only Purchase Agreements

Power Purchase Agreements can be undertaken for power only (the 'black' portion), the green attributes of the power (the 'LGCs'), or for both ('bundled'). Organisations wanting to achieve 100% renewable energy can either enter into a bundled or an LGC-only agreement. A bundled agreement is likely to achieve a cheaper price for the LGCs than an LGC-only agreement.

Entering into an LGC-only PPA means that no load balancing needs to be undertaken, whereas a bundled agreement means that the energy needs of Council will have to be balanced with energy produced from renewable energy generators. Given that streetlighting and water pumping and other offpeak or 24/7 demand makes up a high proportion of Council's consumption and occurs outside of solar hours, Council would also need to use a non-solar resource like wind or hydro.

Load balancing can be a balance of the power generated including intermittencies with Council's load through a regular contract, or could be taken at spot with a hedge contract. Alternatively, there can be a financial contract to firm up the renewable load amount, but there would still need to be a balance or firming contract for the rest. Some retailers would offer separate pricing for the renewable and non-renewable portions, others will offer a blended price that assumes some intermittency of generation.

In this report, we are detailing four PPA options:

1. Sleeved (Bundled)
2. Direct (Bundled)
3. Virtual (Only a financial contract – no LGCs or electricity is being delivered)
4. LGC-only purchase agreement

Only the sleeved, direct and LGC-only options will allow ESC to achieve 100% renewable energy.

9.3 The PPA market in Australia

The PPA market is evolving rapidly in Australia partly due to increased appetite of consumers for renewable energy and partly due to the cost differential between regular grid power and long-term PPA prices. Many corporations and councils that endured increased pricing in recent years are seeing opportunities for not only cost saving but also for hedging against market price volatility.

At the same time, project developers are highly motivated to achieve off-take agreements to satisfy financing needs and also take advantage of current market pricing for electricity and LGCs. These market conditions and the fact that there are more projects in planning than there is load in NSW suggests that there is competitive pressure driving agreement negotiations. Innovative models that are beneficial to both project developers and energy users are emerging.

Retailers, many of whom have taken out long-term off-take agreements with very large renewable energy projects at low prices, are also now actively seeking longer-term supply agreements with their customers. These deals benefit from having pre-existing generation assets and reduced counterparty risk. They also potentially offer good blended pricing of retail and renewable energy.

With the alternative of a regular grid contract also at lower pricing than in recent years customers are more demanding of project developers to reduce delivery and price risk, and where possible make their PPA more like a regular electricity supply agreement. This has seen the development of innovations that assist in reducing exposure to declines in market pricing through market matching or indexing clauses in agreements, caps and floors around price levels and ability to renegotiate retail portions of load during a PPA term.

Below are outlined four PPA models that are prevalent in this evolving marketplace, but this is not an exhaustive list. Most models endeavour to give price surety and tenure to developers to satisfy their financing needs and most also ensure delivery of as firm a load as possible for customers.

9.4 Types of offsite Power Purchase Agreements

9.4.1 Sleeved PPA

Model Name	Sleeved PPA
Basic Description	A sleeved PPA is similar to a regular grid power agreement, but instead of regular generation from coal-fired and other sources, the underlying electricity generation is from a specific renewable energy project. The customer has an agreement with the retailer for both renewable and standard grid power. Underlying this agreement, the retailer has a renewable energy supply agreement with a project developer either at a fixed rate or using a contract for difference. The retailer then sells the electricity including a margin to the customer and manages the risk of fluctuations in generation of the project. The customer typically pays either a risk included rate for all power or separate rates for renewably generated electricity and regular grid power.
Agreements	Retail Electricity Agreement inclusive of a sleeved PPA
Agreements and counterparties	**Sleeved PPA Agreement**: Retailer and Council (Typically combined with retail agreement. There is also an underlying agreement **between project developer and retailer, typically a CFD**, to which the Council would not be a party.
Duration	Term will likely be 10 or 15 years for the renewable component of the sleeved PPA. If the retail agreement is a separate agreement, the term for the retail component may not necessarily be ten years. The retailer may agree to a shorter term for the retail component. This then requires entering subsequent retail agreements until the end of the PPA term.
Costs	No upfront costs but each retail agreement will be subject to market pricing, so cost will not be known for the retail component unless there is a fixed price for ten years.
Benefits	Lower cost for power than traditional retail agreement.
Risks	Retailers may not be interested in taking on a sleeved PPA after the initial retail term.
Mitigants (that respond to each identified risk)	Lock in a longer-term retail agreement potentially with a transparent market matching clause (a clause that lets the client set a standard review or request a review of pricing according to a timetable and the retailer agrees on a transparent methodology for resetting prices relevant to the prevailing market).
Case example	City of Melbourne
Suitable for councils	Yes

9.4.2 Direct (or 'sell side') PPA

Model Name	Direct (or 'sell side') PPA
Basic Description	A direct PPA involves a customer buying electricity directly from a renewable energy project developer (typically at a fixed price) over a term of 7, 10 or 15 years. This kind of PPA requires a retailer to pass through the terms of the agreement between the developer and customer and then also risk-manage any fluctuations in generation against a required amount of megawatt hours of electricity. Typically, the agreement will incorporate a performance guarantee or 'firming' clause that reduces the risk management required by the retailer. Retailers have in the past agreed to this type of PPA where the volume of renewable energy is only a small part of the customer's overall electricity load. This is because, in effect, they are receiving no margin on the small amount of renewable energy and are still making a margin on most of the overall load supplied by regular grid power. The retailer also must reconcile and bill for the renewably generated electricity.
Agreements	Direct PPA Agreement (assumes a retail agreement will be in place to supply balance of load and to cover retail invoicing of renewable power))
Agreements and counterparties	**Direct PPA Agreement**: Project developer and customer **Retail electricity agreement**: (incorporates PPA price) Retailer and Council.
Duration	PPA agreement: 7-15 years, typically ten years. Retail electricity agreement: 1-10 years
Costs	No upfront costs but each retail agreement will be subject to market pricing, so cost will not be known for the retail component unless there is a fixed price for ten years.
Benefits	Lower cost for power than traditional retail agreement.
Risks	Retailers may not be interested in taking on a Direct PPA.
Mitigants (that respond to each identified risk)	Request that projects provide PPA offers that incorporate a retailer offer and that they are willing to work with any retailer.
Case example	Sun Metals, Nectar Farms, Westpork
Suitable for councils	Yes

9.4.3 Virtual PPA

Model Name	Virtual PPA
Basic Description	A virtual PPA decouples the link between a grid power supply agreement and renewable energy generation in that a virtual PPA does not require the physical delivery of electricity. A virtual PPA is a stand-alone financial derivative agreement that guarantees a fixed price return for the project developer. The customer and the developer agree on a 'strike price' and agree to settle the difference between that strike price and the spot electricity market. If the spot market price rises above the strike price, then the customer receives a payment from the project developer (who would have sold the generated power into the spot market and received revenue for it). If the spot market price falls below the strike price, then the customer would be required to pay the difference. This payment would guarantee that the project developer would not receive anything less than the strike price for each megawatt hour generated and would offer income opportunities for the customer of up to the market cap of $14,200 per megawatt hour, less the strike price value. This form of contract is also known as a contract for difference and may require Australian Financial Services Licence to deal in this derivative product. There is a Ministerial Order for preventing councils from directly investing in derivatives and so Council would need to take a position on whether this form of PPA or a variation of it would be acceptable for investment. If a virtual PPA was to be used to meet 100% renewable energy target, an additional PPA for LGCs would have to be undertaken (separate agreement, but could be bundled).
Agreements	PPA Agreement (financial-only, no retail agreement)
Agreements and counterparties	PPA Agreement (financial-only): Project developer and customer
Duration	PPA agreement: 7-15 years, typically ten years.
Costs	Difference between strike price and market price (when strike price is above market price) multiplied by consumption
Benefits	No Retailer is required Income available when market price is above strike price
Risks	1. Exposure to low-value spot market pricing 2. Reputational and financial penalty of breaching ministerial order if a council
Mitigants (that respond to each identified risk)	1. May be possible to purchase a further hedging derivative that increases in value as price drops below strike. 2. Councils should not use this model unless they receive legal advice that suggests it is possible to enter this form of contract.
Case example	UNSW, UTS
Suitable for councils	No, and also not suitable for meeting 100% renewable energy

9.4.4 LGC-only Purchase Agreement

Model Name	LGC-only Purchase Agreement
Basic Description	An LGC-only PPA is relatively simple because Council would only purchase the green attributes of renewable energy generation and would not be concerned with balancing energy demand with the output from a renewable energy generator. There is little risk in matching the number of LGCs purchased to the electricity consumed in any given year. It also means that there will be little or no change to the retail electricity agreement. However, Council may be able to achieve a better price through a bundled PPA, and striking a deal with a renewable energy generator for LGCs-only may not be sufficient for a new renewable energy project to get off the ground.
Agreements	LGC Purchase Agreement
Agreements and counterparties	**LGC Purchase Agreement:** Council and LGC Owner (Likely a renewable energy project or aggregator)
Duration	Single transaction or ongoing quarterly or annual purchase
Costs	Negotiable, typically referenced to forward market pricing
Benefits	Easy to operate, can be GreenPower®-accredited, achieve renewable energy targets at low cost with straightforward investment
Risks	1. Market volatility and likely rapid price decline 2. Fine print clauses in retail agreements and retail appetite for small amounts of LGCs surrendered. (if retiring LGCs this is not applicable)
Mitigants (that respond to each identified risk)	1. After 2020, it is likely to be a buyer's market and ESC should be able to aggressively negotiate on price. Assumption can be made that costs will be very low, and this should be verified by professional advice and market pricing when agreeing price levels. 2. Ensure review of existing and upcoming retail contracts prior to any transaction. If tendering/negotiating for electricity, ensure LGC surrender is a supply requirement
Case example	Two models exist in terms of surrendering LGCs: 1. retire them and achieve gains towards renewable energy goals 2. offset retailer RET cost obligations as a result of energy consumption
Suitable for councils	Yes

9.5 Proposed Virtual Generation Agreement offer by *PPA Retailer*

Model Name	***PPA Retailer* Virtual Generation Agreement**
Basic Description	***PPA Retailer*** offers electricity pricing from "Virtual Generation Agreements" (VGAs) with renewable energy projects combined with hedges against wholesale price volatility for the supply of electricity when the projects are not generating. A combined wind and solar PPA is offered for a defined portion of ESC's total load. Outside of solar or wind generation hours, ***PPA Retailer*** procure the remaining energy needs from the wholesale market on ESC's behalf and charge ESC the wholesale rate. Any excess generation not consumed can be sold back to the wholesale market or sold to ***PPA Retailer*** at a fixed rate. If the generation asset is operating, i.e. the wind is blowing and the sun is shining, then it should be possible to cover, on average, around 76% of ESC's required load. However, if there is a lack of wind and light, e.g., a cloudy day with no wind, then more electricity will need to be bought on the wholesale market. If this happens to be a highly priced peak demand day, then this could prove to be very expensive. To balance this risk somewhat, the generated renewable energy will at other times be surplus to the total ESC consumption and the excess would be sold into the market. ***PPA Retailer's*** aim is to try to have around the same amount of instances and load per calendar quarter where electricity is sold into the market as is bought from the market. In ***PPA Retailer's*** latest proposal (13 June 2018), where the renewable coverage is 76% of total load, 23% is expected to be exported to the grid and a total of 23% will also be expected to be bought from the grid. To further manage exposure to spot market risk, ***PPA Retailer*** have developed their "Ceiling" product. This product puts a cap on wholesale market pricing paid by the customer but comes at a price of around $4 to $6 per megawatt hour. This approach to risk management avoids the use of derivatives products which should be suitable for Councils. Substantial reliance on wind generation can be risky in Q1 and Q2 of calendar years as wind can be unreliable at these times and it may substantially under-deliver versus the ESC load[5]. As ESC is essentially operating as a wholesale market participant, ***PPA Retailer*** charges a security deposit based on their deposit requirements

[5] The aim is that excess generation on high wind / solar days balances out the extra electricity that is bought from the market on low wind / solar days or periods. In Q1 and Q2 there is seasonally less wind blowing and this presents a higher risk that the amount of excess generation is not enough to cover the electricity required on low or no wind days. Corresponding seasonal increases in solar helps this situation in summer during the day but does not mitigate the risk entirely.

	from AEMO. This is currently estimated at over $125,000 and needs to be paid up front (typically in the form of a Bank Guarantee). Importantly, ***PPA Retailer*** have also proposed a bundled offer combining pricing for LGCs and electricity in the one rate. They have also sculpted what was a flat PPA price over 10 years to more closely reflect the shape of the forward price curve. This is a great innovation compared to other long term PPA agreements that incorporate an annual CPI escalation. The pricing of the VGA reflects the underlying PPA that ***PPA Retailer*** has with a renewable energy project and the expected spot market rate.
Agreements	Power Purchase Agreement (with VGA and underlying hedges)
Agreements and counterparties	**Power Purchase Agreement:** ESC and ***PPA Retailer***
Duration	10 years
Costs	**For ESC** • VGA Rates • Variable Wholesale electricity costs • Hedging Costs • LGC Costs • Security Deposit • Legal/advice costs
Benefits	**For ESC** • Large percentage of renewable energy • De-escalating renewable energy costs • Potential electricity cost savings over standard grid power
Risks	• Retail market declining below VGA pricing within 10-year term • Exposure to wholesale market pricing • Intermittent generation
Mitigants (that respond to each identified risk)	• Negotiate best possible terms and pricing • Hedge without using derivatives • More accurately model peak and off peak load matching
Case example	Various ***PPA Retailer*** Customer announcements re wind farm projects
Suitable for councils	Yes

10 Cost-benefit analysis of EPC, *PPP Developer*, and *PPA Retailer*

For each of the options requiring cost-benefit analysis by ESC, models were developed to outline costs and benefits based on available NSW market pricing and/or actual proposals to Council.

The PPP and EPC options involve the building of solar PV assets and deriving income from the sale of electricity and all options have underlying PPAs in some form.

Where a new generation asset is built for Council, contractual arrangements must cover site preparation, gaining appropriate approvals, construction and ongoing maintenance with all aspects needing to be factored into negotiations and financing.

Under all three models there may be a requirement for a retailer to transact and bill the end user (ESC) all or part of the energy, and to provide the balance of load when the renewable energy is not generating or is not generating at full capacity.

Council as a customer will need to assess its preferred approach and use of capital and preferred debt or equity position.

10.1 Summary of cost-benefit analysis for each option

The main outcomes for each of the three options assessed are summarised here to provide a ready insight to the costs and benefits of each.

Option	EPC	PPP	PPA
ESC ownership / stake	100%	25% proposed via SPV, or simple loan if this is not feasible	0%, power purchase only
Estimated capital investment or loan upfront	$16 million for a 10 MWp solar farm	$10 million investment or loan for 25% of a solar farm	Minor, advisory services to source electricity
Significant potential revenue / savings streams	Electricity cost savings, LGC income	Electricity cost savings, LGC income, profit share, interest on loan	Electricity cost savings
Significant recurrent costs	O&M, AEMO registration fees, inverter replacement	O&M, AEMO registration fees, inverter replacement, management of SPV	Contract management
Estimate internal rate of return	4.36% to 4.44% for base case of two models, not including a social cost of carbon	2.47% estimated by 100% RE with adjusted assumptions. 7.58% estimated by ***PPP Developer*** modelling.	Modest electricity cost savings
Likely scale of renewable energy sourced by ESC	30% of load-matched daytime load, balance to spot market or offtaker /retailer	30% of load-matched daytime load, balance to spot market or offtaker /retailer	>50% of total indicated by ***PPA Retailer***

10.2 Cost-benefit assessment for a 10 MW EPC option

As described above there are a few options available in terms of treatment of the output from a solar farm and Council being a customer of the solar farm.

A 10 MW plant will generate more than ESC consumes and will produce energy during the daytime rather than on a 24/7 basis. Two options were modelled that deal with a 10 MW solar farm and ignore complexities that would be associated with sourcing up to 100% renewable energy (***PPA Retailer*** option does this by sourcing from more than one RE project). These options are:

- EPC with spot market revenue for most of the output, and a fixed price offtake for a fraction of the generation that aligns with Council's daytime usage – this is estimated at 20% of the plant output which would meet around 30% of Council's electricity demand,
- EPC with spot market revenue for all of the output

The main EPC and offtake/spot market revenue assumptions for this model are tabulated below.

Item	Amount	Notes
Capital cost on a $/W basis	$1.60/W	Comparable to expected costs for similar projects
Size in MW	10 MW	Per ESC brief, producing 15,768 MWh at 18% capacity
Capital cost	$16,000,000	Reflective of similar sized projects in 2018.
Fixed Price $/MWh solar to offtaker & spot market	$70/MWh	Reflects current market, assumed this can be obtained for the life of the plant. Includes LGCs to 2030
Retailer 'sleeved' margin $/MWh	$2/MWh	Reflects current market, assumed this can be obtained for the life of the plant.
Inverter cost initially	$1,000,000	$0.10/W
Replacement years 12-16 as % of initial inverter cost	75%	Rough estimate
Replacement year 26-30 as % of initial inverter cost	50%	Rough estimate
O&M cost year 1	$150,000	Rates used by others vary from $5-20/MWh
O&M escalation rate	2.00%	Annual rise
Discount Rate %	7%	Per Treasury financial analysis guidelines
Annual loan repayments	$ -	15 year finance term is assumed, 4% interest
Annual opportunity cost	$ -	15 year finance term is assumed, 2% opportunity cost
AEMO plant registration cost $ pa	$20,000	This is assumed fixed for the project life but could change

Grid pricing (and retailer margin) assumptions are tabulated below.

Grid Power Pricing				
Wholesale Price (AEMO fundamentals)			Calendar Year Retail Price	
Financial Year	$MWh Wholesale		Peak	Off Peak
2019	$	74.00	$ 84.56	$ 64.93
2020	$	63.00	$ 72.24	$ 55.47
2021	$	62.00	$ 71.12	$ 54.61
2022	$	68.00	$ 77.84	$ 59.77
2023	$	74.00	$ 84.56	$ 64.93
2024	$	76.00	$ 86.80	$ 66.65

2025	$ 73.00	$ 83.44	$ 64.07
2026	$ 72.00	$ 82.32	$ 63.21
2027	$ 70.00	$ 80.08	$ 61.49
2028	$ 68.00	$ 77.84	$ 59.77
2029	$ 66.00	$ 75.60	$ 58.05
2030	$ 65.00	$ 74.48	$ 57.19

LGC pricing for obligation amounts and for surplus LGCs that can be sold on the spot market are tabulated below.

LGCs (obligation)		Surplus LGCs	
LGC CAL Yr	**$/MWh**	**LGC CAL Yr**	**$/MWh**
2020	44	2020	61.6
2021	30	2021	42
2022	25	2022	35
2023	20	2023	28
2024	10	2024	14
2025	5	2025	7
2026	5	2026	5
2027	5	2027	5
2028	5	2028	5
2029	5	2029	5
2030	5	2030	5

There will be sensitivity around these assumptions that will affect the outcomes for the project. These are summarised below.

Description / assumption	**Base Parameter**	**Base Case**	**Worse Case x**	**Better Case x**
Annual % drop in output	0.50%	0.5%	0.8%	0.5%
Capital cost	$16,000,000	1	1.1	0.95
Inverter cost at construction	$1,000,000	1	1.1	0.95
O&M cost year 1	$150,000	$150,000	$200,000	$100,000
AEMO plant registration cost $ pa	$20,000.00	$20,000	$25,000	$15,000
Wholesale electricity prices to 2030	Per 10-year forecast	1	0.9	1
LGC pricing	Per 10-year forecast	1	0.9	1
Surplus LGC pricing	40% higher than obligation amount, $5/LGC floor price 2026-30	1	0.9	1
Offtake price and retailer pass-through	$70/MWh + $2/MWh	1	0.9	1
Spot price	$70/MWh	1	0.9	1

10.2.1 EPC w/spot market revenue+20% offtake agreement for 30% of ESC demand

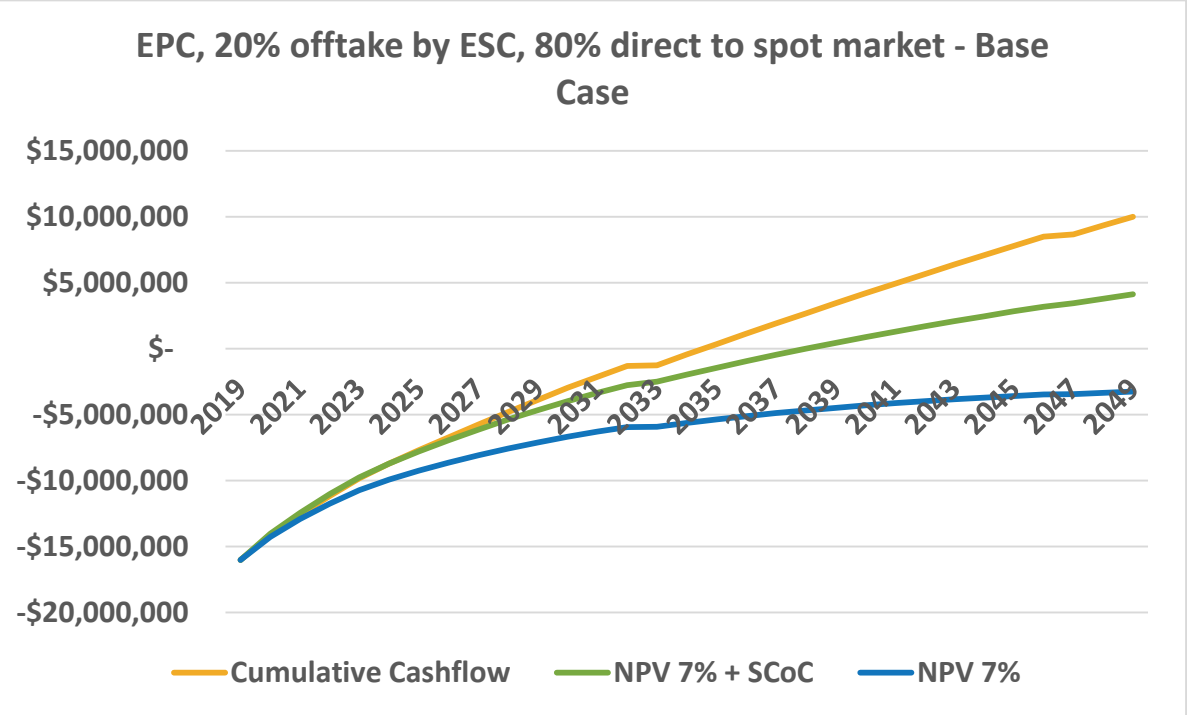
In addition to electricity spot market revenue ESC will have surplus LGCs above its obligation which can be sold (it is assumed these can be sold on the spot market at a premium to long term LGC forecast pricing), and is forecast to have electricity savings compared with the market (wholesale + retailer margin 10-year forecast using AEMO fundamentals) for the 30% fraction of its load that is met with a renewable energy retailer agreement.

For simplicity (and to reflect unknown wholesale pricing past a 10-year period) it is assumed there are no savings past 2030 (also no higher costs for solar compared with standard retail based on the grid).

For the analysis a Social Cost of Carbon (SCoC) is also included in the business case to illustrate the change this makes to the net present value of the project. This draws on analysis and recommended Social Cost of Carbon by the US EPA[6], converted to Australian dollars. Grid carbon intensity is assumed to decrease by 2% year on year. The 30-year average discounted SCoC derived from this data is \$28.44/t CO_2-e, from a starting point of \$18.68/t CO_2-e in 2020 (first year of revenue following a 2019 build).

The resultant net present value (NPV) and internal rate of return (IRR) over a 30-year project life from 2019 for the three scenarios is summarised below for both of the EPC models.

EPC with spot market revenue + 20% offtake agreement to meet 30% of ESC demand			
Financial metric	Base case	Worse case	Better case
Net present value, 7% discount, incl SCoC	\$4,130,617	-\$484,876	\$5,710,517
Net present value, 7% discount, excl SCoC	-\$3,256,454	-\$7,556,792	-\$1,676,104
Internal rate of return, excl SCoC	4.36%	0.80%	5.62%



[6] https://www.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf

10.2.2 EPC with spot market revenue for all of the output

In this model the above assumptions are also applied with the exception of savings to Council's retail electricity. Spot market revenue and sale of LGCs at forecast spot market prices are the only sources of income. On the whole this model produces outcomes that are comparable to the above model, as summarised below.

EPC with spot market revenue for all of the output			
Financial metric	Base case	Worse case	Better case
Net present value, 7% discount, incl SCoC	$4,233,841	-$395,131	$5,814,191
Net present value, 7% discount, excl SCoC	-$3,152,780	-$7,467,048	-$1,572,430
Internal rate of return, excl SCoC	4.44%	0.87%	5.70%

Both analyses show that if we monetize the damages caused by greenhouse gas emissions then the proposed project has a positive net present value in the base case. Without accounting for this social cost of carbon the project may not generate a positive return even under favourable conditions. This outcome reflects changing market conditions where wholesale price forecasts have continued to decline and where expected offtake and spot market prices for generation are trending downwards. Continued improvements in renewable energy project delivery and technology costs can help to offset these factors.

10.3 Cost-benefit assessment *PPP Developer* PPP

The initial business case supplied by ***PPP Developer*** indicates that an internal rate of return of 7.58% can be achieved over a 30-year project life, after tax and depreciation, and almost 10% before these expenses are taken into account.

So on the face of it the financial performance appears attractive. The analysis methodology appears sound, so a key focus here has been on whether or not the underpinning assumptions are reasonable. The main assumptions for the project are tabulated below, with comments noted where there is a difference to what we would expect in the current market.

System Information (by *PPP Developer*)[7]		Comment
Panel Brand	Talesun	NA
Panel Size (W)	340	NA
System Size (kW)	30000	NA
Project Cost ($/W)	$1.35	Low compared with other current projects where $1.60/W is typical without SAT
Project Rights Cost	$5,700,000	NA
System Cost	$40,600,208	Based on observed prices a turnkey price of $48 million may be possible (other projects at this cost/W do not have SAT)
Decommissioning costs	$0	NA
Inverter replacement budget	$1,200,000	In other projects we have seen inverter replacement at ~50% more than this over a project life
Replacement Year 1	10	NA
Replacement Year 2	20	NA
Depreciation Period	20	NA
Exported Energy	90%	NA
PPA Off-take	10%	Equates to ~30% of ESC demand
Export Income ($/MWh)	$76.16	Average of a 30-year wholesale market forecast price that is above the simple average of an AEMO-fundamentals based 10-year forecast of $69.25/MWh
Fixed PPA Income ($/MWh)	$80.00	Financial cashflows indicate this is power-only, not including LGCs though this may be an oversight at this early stage. Price is higher than ESC can expect to pay for daytime energy over the next 10 years

[7] These assumptions reflect those provided in ***PPP Developer's*** model provided at the commencement of this project. Follow-up queries were sent to ***PPP Developer*** by ESC after an initial review by 100% Renewables. Their response stands by some of their assumptions regarding capital cost, O&M costs and yield, and changes other such as offtake pricing (lowering revenue) and inverter replacement costs. The net effect would be a modest reduction in their estimate of the project's financial return. The sense-check by 100% Renewables (below) remains as originally modelled and reflects our understanding of the current market and technology cost and performance in Australia.

LGC Income (levelised) ($/MWh)	$13.29	The assumed LGC price drops away quickly to $10/MWh in the model, and this gives this average rate. It goes to 2032 but should stop at 2030
Total revenue ($/MWh)	$89.83	This is derived from the above inputs
Solar performance		**Comment**
Solar yield (80% P.R)	1,656 kWh/kWp	kWh/kWp per year. This figure seems very high for the location, and a figure closer to 1,400 kWh/kWp per year or less may be closer to expectations
Total Solar Yield inc tracker	1,987 kWh/kWp	Based on 20% uplift with SAT which is reasonable
Degradation (p.a)	0.4%	Average is double this level so this low rate would need to be supported with data confirming panels are close to best in market
Finance		**Comment**
PPA/REC Esc	2.5%	Proposed that the PPA rises with CPI, whereas other PPA models are offering de-escalation, meet-the-market or similar
Revenue		**Comment**
LGC Revenue	Calculated	The spreadsheet shows 100% of LGCs are sold, which implies the ESC PPA is for power-only. If adjusted to include 90% LGCs sold then the model's revenue is lower.
Operating expenses		**Comment**
AEMO (est)	$8,000 pa	Our information suggests $20,000 is closer to the likely annual fee
O&M	$300,000 pa	This equates to $5-6/MWh or $10/MW. Most literature suggests around $10/MWh+ as a guide or >$20/kW for a SAT system

A summary view of these notes is that the model as proposed tends to understate costs and overstate income, and as such the likely performance of the project will be lower than this in terms of overall returns.

To quantify the potential impact of different (more conservative) assumptions we re-adjusted the ***PPP Developer*** model with the assumptions in the table below.

System Information (by *PPP Developer*)		**Comment**
System Cost	$48,000,000	Based on $1.60/W turnkey costs
Inverter replacement budget	$1,800,000	50% higher than indicated
Export Income ($/MWh)	$69.25	Simple average of current AEMO-fundamentals based 10-year forecast, then $65/MWh thereafter
Fixed PPA Income ($/MWh)	$70.00	Reflects current offers in the market inclusive of LGCs

LGC Income (levelised) ($/MWh)	$15.57	Simple average alternate forecast used in EPC model
Solar performance		**Comment**
Solar yield (80% P.R)	1,400 kWh/kWp	Fairly conservative yield in kWh/kWp per year but reflective of actual performance v design or expected yield
Total Solar Yield inc tracker	1,680 kWh/kWp	Based on 20% uplift with SAT which is reasonable
Degradation (p.a)	0.8%	Average panel degradation rate
Finance		**Comment**
PPA/REC Esc	0.0%	Consistent with other models and a likely point of difference to other options for ESC
Revenue		**Comment**
LGC Revenue	Calculated	Adjusted to include 90% LGCs sold
Operating expenses		**Comment**
AEMO (est)	$20,000 pa	
O&M	$500,000 pa	Around $10/MWh per guidance from literature and under $20/kW

The result of these changed assumptions is a project that has an internal rate of return of just 2.47%. This is lower than the EPC case evaluated above, though this was assumed to be equity-financed and therefore has no borrowing costs.

There is likely a balance in the assumptions that could improve the return, and from ESC's perspective there would (have to) be savings to expected electricity prices for the proportion of Council's demand met via the PPA. The true return may lie between this conservative value and that indicated by ***PPP Developer's*** modelling.

Further discussion around some of the assumptions that may make or break the business case and that ***PPP Developer*** may be best placed to control (ESC saves on electricity and moves towards meeting its targets, project capital cost, proven degradation from proposed panels) or seek further advice on (solar yield, wholesale market forecasts) is warranted. This can be sought in parallel with ongoing dialog with the OLG regarding their view of the project and requirements on ESC to satisfy their guidelines for PPPs.

10.4 Cost-benefit assessment PPA *PPA Retailer*

Pricing supplied by ***PPA Retailer*** (13 June 2018) is applied to 5,560 MWh of energy demand, roughly half of ESC's actual demand.

As there are no upfront costs the primary comparison is between ***PPA Retailer's*** model and what ESC would be able to receive for electricity pricing under standard procurement processes.

Reflecting the above description of ***PPA Retailer's*** model, their underlying assumption is that 5,000 MWh per year will be sourced under their renewable energy offer, and the remaining 560 MWh would be spot-market exposed.

We have taken the bundled renewable energy pricing as given (which de-escalates over time) and adjusted their assumed wholesale market pricing to reflect our forecast to 2030 based on AEMO fundamentals[8]. From this a simple averaged price over the period to 2028 is calculated.

Period	Term	Total Load (in MWh)	Green Supply - (MWh)	Green Price - $/MWh[9]	Remaining Load (MWh) (spot market exposed)	Spot Price $/MWh	Generation Weighted Price $/MWh
2019	Yr1	5560	5000	$83.60	560	$74	$ 83.54
2020	Yr2	5560	5000	$80.96	560	$63	$ 80.03
2021	Yr3	5560	5000	$78.31	560	$62	$ 77.27
2022	Yr4	5560	5000	$75.57	560	$68	$ 75.31
2023	Yr5	5560	5000	$72.92	560	$74	$ 73.43
2024	Yr6	5560	5000	$70.28	560	$76	$ 71.06
2025	Yr7	5560	5000	$67.63	560	$73	$ 68.28
2026	Yr8	5560	5000	$64.89	560	$72	$ 65.71
2027	Yr9	5560	5000	$62.24	560	$70	$ 63.13
2028	Yr10	5560	5000	$59.60	560	$68	$ 60.55
					Generation-type weighted price to 2028		**$71.83**

The total cost of this proposal over the period to 2028 is $3,993,728.

[8] Sourced from Energy Statement of Opportunities 2017, AEMO Forecast. Primarily demand-based data. Prices derived from wholesale markets and perceived drivers. Ref: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities

[9] The ***PPA Retailer*** proposal has separate LGC prices and elec prices. These were combined to provide the bundled price for the renewable energy proportion shown here. Their offer is for 5,560 MWh however some of this will be wholesale price exposed. 5,000 MWh is assumed to come from renewables with 560 MWh on the spot market at the forecast average rate. This 560 MWh will also require LGCs which are costed at the same rates as used in modelling of other scenarios modelled in this work.

This cost to 2028 can be compared with the expected cost/MWh of grid power, drawing on the same wholesale market forecast, organised into peak and offpeak pricing and applying a retail margin.

Grid Power Pricing				
Wholesale Price (AEMO fundamentals)		Calendar Year Retail Price		
Financial Year	$MWh Wholesale	Peak $/MWh	Off Peak $/MWh	Weighted $/MWh cost for 65%:35% Split of offpeak to peak, plus LGCs
2019	$74.00	$84.56	$64.93	$80.80
2020	$63.00	$72.24	$55.47	$70.14
2021	$62.00	$71.12	$54.61	$66.39
2022	$68.00	$77.84	$59.77	$71.09
2023	$74.00	$84.56	$64.93	$75.80
2024	$76.00	$86.80	$66.65	$75.70
2025	$73.00	$83.44	$64.07	$71.85
2026	$72.00	$82.32	$63.21	$70.90
2027	$70.00	$80.08	$61.49	$69.00
2028	$68.00	$77.84	$59.77	$67.09
			Volume-weighted price to 2030	**$71.88**

The total cost of this proposal over the period to 2028 is $3,996,333.

Hence the two offers appear to have near-identical costs over a 10-year period. Annual costs for each offer are tabulated below.

	Standard retail agreement			***PPA Retailer* proposal**			
Year	Cost for 5,560 MWh of 'Standard' power	Cost for 1,112 LGCs (20% of power)	**Total 'standard' cost to ESC**	***PPA Retailer*** price for 5,000 MWh	***PPA Retailer*** price for 1,000 LGCs	Cost of balance of contract from Spot + added LGCs	**Total annual cost for *PPA Retailer* offer**
2019	$399,211	$50,040	**$449,251**	$385,000	$33,000	$46,480	**$464,480**
2020	$341,048	$48,928	**$389,976**	$374,000	$30,780	$40,208	**$444,988**
2021	$335,760	$33,360	**$369,120**	$363,000	$28,560	$38,080	**$429,640**
2022	$367,485	$27,800	**$395,285**	$351,500	$26,330	$40,880	**$418,710**
2023	$399,211	$22,240	**$421,451**	$340,500	$24,110	$43,680	**$408,290**
2024	$409,786	$11,120	**$420,906**	$329,500	$21,890	$43,680	**$395,070**
2025	$393,923	$5,560	**$399,483**	$318,500	$19,670	$41,440	**$379,610**
2026	$388,636	$5,560	**$394,196**	$307,000	$17,440	$40,880	**$365,320**
2027	$378,061	$5,560	**$383,621**	$296,000	$15,220	$39,760	**$350,980**
2028	$367,485	$5,560	**$373,045**	$285,000	$13,000	$38,640	**$336,640**
Total			**$3,996,334**				**$3,993,728**

On the face of it, the current pricing by ***PPA Retailer*** indicates that there may be a modest cost saving to ESC through a PPA that could see a large proportion of Council's energy supplied under a PPA without the use of derivative products or the need to become a generator. On this basis the proposal

merits further consideration but does not yet represent a clear benefit to ESC over the long term. The magnitude of the spot market risk merits further investigation in particular, taking into account pricing based on Council's total volume and expected generation profiles of ***PPA Retailer's*** generation offtake portfolio, ESC's aggregate profile and spot market pricing. The costs of the ***PPA Retailer*** proposal are 'front-ended', so ESC will see higher costs than the market forecast in the first 4 years, and lower-than-forecast costs in the final years, making the 10-year forecast an important factor to track and assess carefully in coming months. The need for inclusion of a Ceiling product to hedge against this risk can then be considered more clearly – on current advice this will erode the potential benefit indicated by this analysis and lead to marginally higher costs for electricity. In addition, the proposed pricing includes LGCs to Council's obligation amount (our understanding) so the implications of this on Council's renewable energy target would also require further clarification.

11 Appendix: Co-benefits of renewable energy plants

Apart from displacing energy generation based on fossil fuels, the development of renewable energy plants has a number of other benefits. Common co-benefits are the following:

MAIN CO-BENEFITS OF RENEWABLE ENERGY PLANTS

Co-benefits	Description
Economic development and innovation	Renewable energy plants can attract other investments
Job creation	The building and operation of a renewable energy plant creates jobs
Local value creation	Renewable energy plants enhance the value of a locality
Protecting the environment and scarce resources	Renewable energy based on wind and solar does not require water to generate, unlike coal and gas-fired power stations
Health benefits of renewable energies	Most forms of renewable energy do not release harmful substances during power generation
Biodiversity	Switch from monocultural arable land to more diverse plant species, limited use of pesticides
Social inclusion	For instance, of indigenous groups
Education and training	Knowledge transfer
Affordable electricity	Renewable energy is cheaper on a lifecycle cost basis as opposed to fossil fuel-based generation

100% Renewables engaged with other councils that have or are in the process of building similar-sized solar PV plants. Most notably, we had conversations with the City of Newcastle and the Sunshine Coast Council. Across all co-benefits listed above, local job creation, economic development and innovation, education and training, and other benefits to land use were pointed out to be the most prominent. The following tables showcase the co-benefits of customer-scale solar plants as seen from the councils' perspective.

CO-BENEFITS OF COUNCILS CUSTOMER-SCALE SOLAR PV PLANTS – CITY OF NEWCASTLE

Co-benefits	City of Newcastle
Local job creation	➤ Temporary increase in workers for the duration of the build ➤ 1-2 local jobs for maintenance, first response, and cleaning of panels
Education and training	➤ The plant will be set up with a viewing platform so that tours can be run. ➤ Education will revolve around how the plant works and how it relates to the sustainability plans of council. ➤ There will also be research opportunities in partnership with CSIRO (performance of plant, sited on landfill site, interaction with grid). ➤ The City of Newcastle will also play an advocacy role and assist other local governments with their renewable energy project developments.
Economic development and innovation	➤ Slight economic benefit to surrounding businesses during construction of plant
Other co-benefits	➤ Construction of a solar farm will activate a site which currently has very limited practical applications.

CO-BENEFITS OF COUNCILS CUSTOMER-SCALE SOLAR PV PLANTS – SUNSHINE COAST COUNCIL

Co-benefits	Sunshine Coast Council
Local job creation	➤ During construction, Downer and council developed a local industry participation plan to ensure that local businesses and workers were appropriately supported to become involved with the project[10]. At any one time during the construction phase, up to 100 people were employed on site by the lead contractor, Downer. ➤ O&M phase: 1-2 local people (subcontractors to Downer) are servicing the plant (first responders).
Education and training	➤ Not quantified/ qualified
Economic development and innovation	➤ Council is striving to become Australia's most sustainable region and the Sunshine Coast Solar Farm is part of its plan to achieve that vision. ➤ The Sunshine Coast hopes to leverage the solar farm to develop a 'Clean Tech' hub in the region. This hub provides opportunity to further develop this industry sector, encourage increased external investment in the region, and help drive increased and sustainable employment.
Other co-benefits	➤ There will be approximately 36,000 tree and shrub seedlings planted around the boundaries of the solar farm which is one of the largest revegetation projects to be undertaken on the Sunshine Coast. ➤ Council is also investigating the potential for sheep & goats to graze under the solar farm.

CO-BENEFITS OF COUNCILS CUSTOMER-SCALE SOLAR PV PLANTS – CITY OF FREMANTLE

Co-benefits	City of Fremantle
Local job creation	➤ Temporary increase in workers for the duration of the build ➤ 1-2 local jobs for maintenance, first response, and cleaning of panels
Education and training	➤ N/A
Economic development and innovation	➤ Not quantified yet
Other co-benefits	➤ Construction of a solar farm will activate a site which currently has very limited practical applications.

[10] Ten local companies who were sub-contracted to included:

- Carruthers (Yandina) and Bebrock (Kunda Park) completed the earthworks
- SMEC Sunshine Coast (Birtinya) completed the geotech work, with South East Soil Testing (Nambour) and Geotech (S.C.) (Warana)
- GHD (Sunshine Coast) provided Town Planning Services
- Forde Brothers Fencing (Maroochydore) completed the switchyard fencing
- Calty Constructions (Kunda Park) built the maintenance building
- Vickers Concreting (Maleny) provided the foundation slabs for maintenance and control buildings
- Regional Drilling (Buderim) drilled 15,000 screw piles into the ground which support the solar panel tables

12 Appendix: Electricity market factors affecting the case for large-scale renewables

Any business case for renewable energy needs to be assessed within the context of available pricing of non-renewable or standard grid power rates. Notwithstanding the environmental and other benefits gained, for a business case to be viable it should make financial sense for decision makers.

The below analysis provides context for assessing the possible financial benefits to council where solar PV costs less than what council would likely pay for grid power. This includes discussion of the electricity market and the Large-scale Renewable Energy Target.

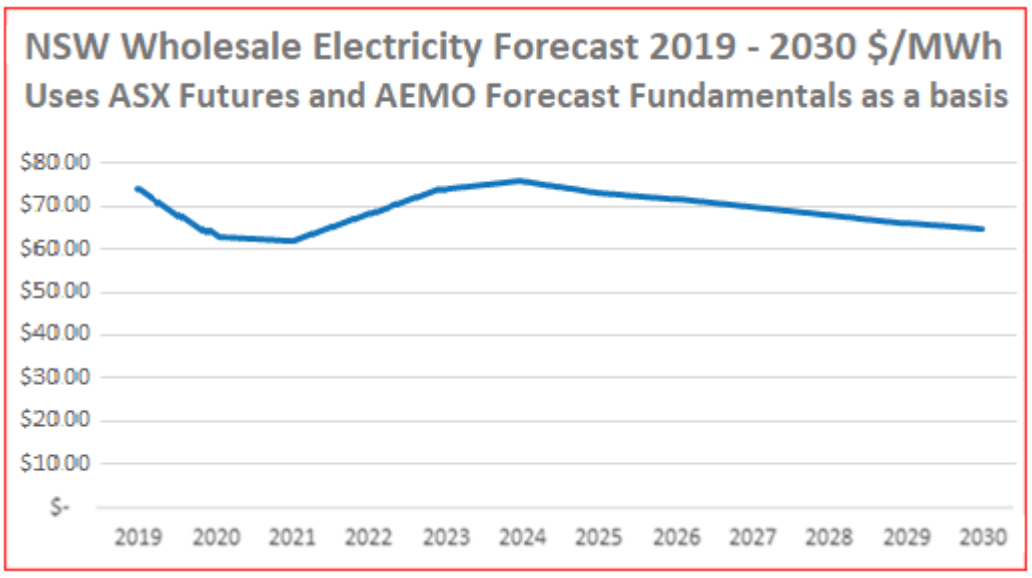
12.1 The electricity market

The electricity market in 2017 saw significant volatility and unprecedented high pricing, and many of the price drivers at play will continue to influence power costs in future years. Comparing renewable energy pricing to this inflated market has prompted increased interest from consumers.

However, large-scale projects that often take over 18 months to begin generating and have lives of 25 years or more require an assessment beyond the contemporary market. These projects require assessment against long-term forecasts. Owing to recent volatility, even energy industry experts are finding it difficult to develop a reliable case.

What is clear is that over time the cost of renewable energy technology is declining and that for the first time in the NSW market, there appears to be a consistent price differential favouring renewable energy over standard grid power.

Using the Australian Energy Market Operator's (AEMO's) forecast influences on demand in the electricity market, the following price trajectory for wholesale power is a possible outcome.



Underlying this price path are the following drivers:

- Retirement of Liddell coal-fired power station in 2022 exerting upward pressure on pricing before exit.
- Declining gas pricing as a result of new entrant supply available from 2019.

- Incorporation on Snowy Hydro 2 and potentially more generation from Tasmania providing additional supply in the order of 3,500 to 4,500 MW from 2024.
- Increased proliferation of renewable generation with reducing technology costs and greater output.

If there is a relatively consistent and overall decline in standard grid power pricing, then it is likely that renewable energy will be more cost-effective in the initial years and then less so in the later years of a contract for its supply. However, if at the conclusion of the contract the renewable energy asset becomes the property of Council, then it may only require ongoing maintenance costs to continue generating at very low cost into the future.

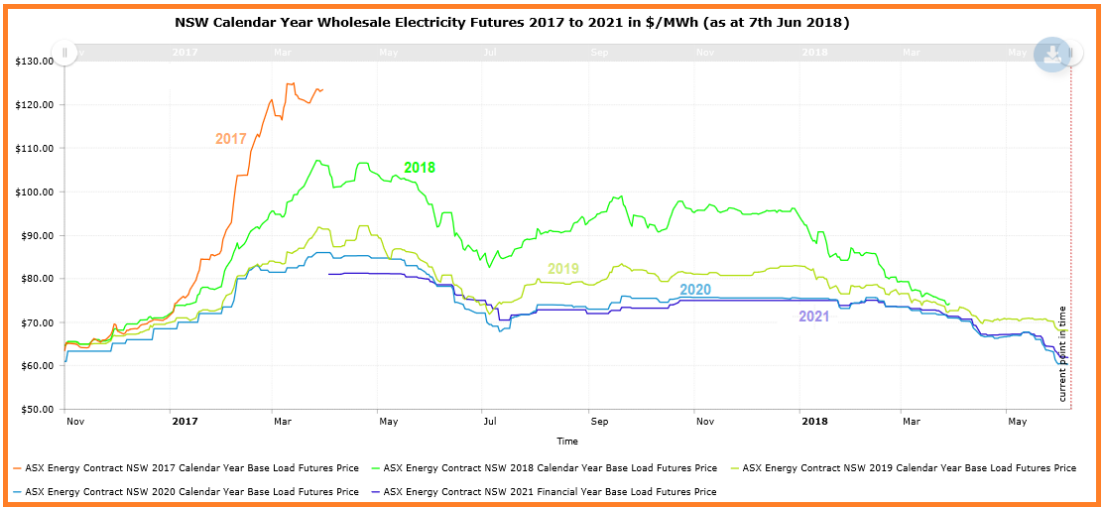
Discussion of a generating asset in the current market must also consider the likelihood of achieving a network connection. In the case of rooftop and small-scale generation, most networks in NSW agree to connect through standard metering arrangements, and it would be unusual not to achieve a connection in a relatively short time frame.

In the case of mid and large-scale generation, networks are currently being swamped by applications to connect. This can result in the connection process being drawn out for many months or in some cases, for example in some regions of the Essential Energy Network in country NSW, a refusal to connect where the network is at capacity. With the increase in large scale and behind the meter PV there is a future risk (within the 30-year life of a solar project) that the grid may become saturated with PV during peak production times and there will be constraints placed on generators or negative pricing. This could particularly be the case if the asset is a semi scheduled generator as these can be requested to curtail by the market operator.

If considering a renewable energy project in Eurobodalla, connection limitations are important to address with the network operator. University of New South Wales (UNSW) has recently faced this issue where they had their own available land for a renewable energy development in the Riverina, however Essential Energy was unable to accept connection. The end result being that UNSW had to source a project built on someone else's land, possibly at higher overall cost.

Given the current market conditions and available pricing in the NSW wholesale futures market, it is possible that the next retail electricity contract will be priced at a premium to the existing contract across all times of use.

The below chart shows the trend in Calendar Year electricity futures in NSW.



Clearly a downtrend has been in operation since the market highs in 2017. Rates following 2020 may see a slight upswing, as noted above, with the exit of Liddell power station in NSW in 2022.

12.2 The LRET and its influence on the business case

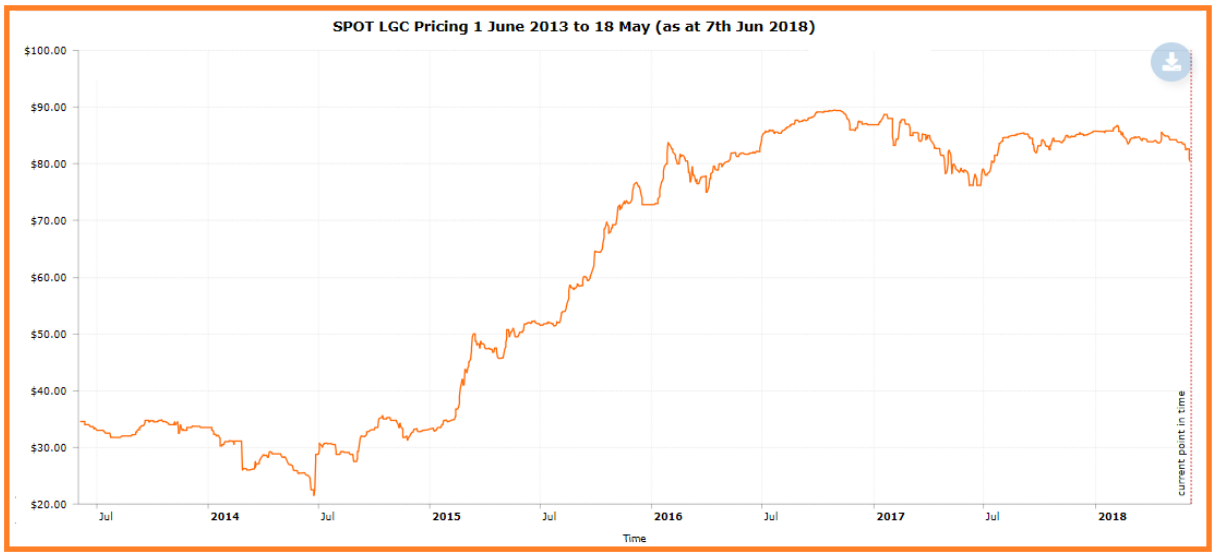
In the current market, many renewable project developers are competing to apply for network connections and construct generation assets in short order to take advantage of higher electricity market pricing, combined with high prices for Large-scale Generation Certificates (LGCs). These certificates are created when a large-scale project generates 1-megawatt hour of renewable energy that would otherwise have been majority coal-fired or non-renewably generated grid energy.

LGCs also make up around 8 to 10 percent of costs to energy consumers as retailers are obligated under the Renewable Energy Act to ensure that a percentage of their electricity sold to clients is sourced from renewable generation. This means that the retailer must surrender certificates to a government set percentage value annually, with the percentage increasing each year to in excess of 20% of their load under management by 2020.

The cost to retailers purchasing these certificates is passed on to consumers via their electricity bills. Alternatively, where large customers have access to their own LGCs, either by purchasing them on a secondary market or where a large-scale renewable energy project is willing to sell to them directly, the retailer may allow self-surrender by customers of an amount of LGCs equivalent to their load obligation.

As LGCs do trade on a secondary market after being created and have an associated penalty per megawatt hour for retailers if the required volume is not surrendered, they effectively have a notional market cap. The penalty translates to an after-tax market cap of around $90 per megawatt hour as the retailer could elect to pay the penalty rather than purchase certificates if they were priced above this value.

Chart of LGC 'Spot' Market pricing (Data Source: Green Energy Markets)



Over recent years where long-term energy policy (including the Renewable Energy Target that drives the amount of LGCs required to be purchased by retailers) has been far from certain, the appetite for investment in large-scale renewable energy has been low, with developers and financiers concerned about the uncertainty of returns.

The outcome of lower investment in renewable generation resulted in a short supply and has seen LGC pricing increase to around penalty levels over the last two years. This not only provides an incentive for renewable energy project developers but provides a driver for Council and energy consumers to investigate ways of reducing LGC costs.

Many organisations have considered purchasing LGCs directly from project developers who have been motivated vendors. The aim being to self-surrender or resell LGCs in the secondary market to achieve a discount overall against what their retailers would otherwise charge them as a result of their Renewable Energy Target obligations.

In the context of purchasing electricity from a large-scale project, developers have recently been bundling the sale of LGCs and renewable electricity in a single rate per megawatt hour. For Council, this has cost-saving implications both if electing to purchase supply from an off-site renewable energy project or if generating its own electricity and LGCs from a large-scale on-site project. Estimates of savings appear below in Calculating Financial Benefits.

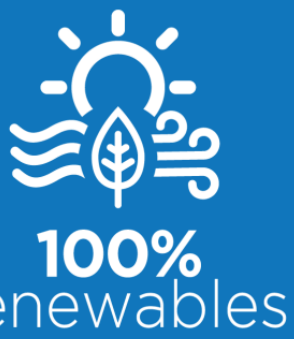
Importantly, continued uncertainty regarding energy policy is impacting LGC pricing especially with respect to the life of the Renewable Energy Target scheme and whether the Federal Government's proposed National Energy Guarantee will be enacted.

The proposed National Energy Guarantee (NEG) scheme comprises two central components:

1. a reliability guarantee, which requires retailers to source a specified proportion of the electricity they sell to customers in the National Electricity Market (NEM) from reliable (i.e. dispatchable and typically non-renewable) generation; and
2. an emissions guarantee, which requires retailers to ensure that, on average, the electricity they supply customers falls below a specified emissions intensity threshold.

The NEG is currently being debated by COAG – the Council of Australian Governments that includes members from each of the states and territories. States in which the Labour party holds a majority are pushing back on the proposed scheme. Where the scheme is reported to be in doubt of becoming legislated, the pricing for LGCs typically increases. Where the NEG is reported to be more likely to come to fruition, LGCs decline in value as there would be doubt cast on the longevity of the Renewable Energy Target as the NEG may supersede the earlier policy.

The possibility of the NEG becoming a reality, combined with the increased number of large-scale renewable energy projects planned that would all be creating LGCs, has led some consultants to suggest that the price of LGCs will decline rapidly towards zero by the mid-2020s. This concept of lower value LGCs in coming years is another consideration when assessing the business case for a long-term renewable energy project.



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