Review of Landfill Solar Pre-feasibility

City of Kalamunda

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Executive Summary

Context. The City of Kalamunda ('Kalamunda') engaged Enhar to review and expand upon the Pre-Feasibility Assessment (PFA) which analysed the opportunity for a medium-sized ground-mount solar-PV installation on a former landfill site, at Pioneer Park, Forrestfield, WA.

Key findings

Enhar affirms the key finding of the PFA, that the site is highly suitable for installation of a small solar farm. There are no show-stopping risks but several areas justify further work in a full Feasibility Study stage, especially financial modelling.

In particular, we note that:

- The integrity of the landfill cap[1] is to be ensured and preserved;
- A small solar farm (~800kW capacity) seems to offer the possibility of lowest cost and risk, and match Council's contestable load;
- A ballasted, non-penetrating mounting system is appropriate for the solar farm.

Sizing

Choosing the optimal system size is key. The PFA looked at three possibly system sizes (1, 3 and 5 MW) without settling on a preferred option. We suggest a solar farm with capacity of ~800kW as being a sweet-spot size, based on:

- Matching solar capacity to Council's contestable load (refer 4.3.2.2) for least commercial risk in selling energy;
- Reduction in project cost and risk (refer 9.1.1) through downsizing;
- Unconfirmed potential to exploit an option to achieve grid connection at very low cost and risk (see 5.4.2.3), suitable for a small (sub-1MW) solar farm;
- Size still remaining large enough to be worthwhile, and to make a substantial contribution to Council's energy needs.

Economics

The PFA's financial analysis assumed an off-take price of $110/MWh, including $30/MWh for reserve capacity payment, leaving $80/MWh attributable to the energy value. For an export scenario for the 5MW scenario for example where the solar farm generation is greater than the council load, we estimate an offtake of around $57/MWh would be feasible based on forecast market energy prices of about $45/MWh[2] (refer 6.2.1), plus ~$12/MWh for the reserve capacity payment.

[1] 'landfill cap' refers to the soil and clay layers that make up the ground surface, which covers (i.e. caps) the underlying landfill materials.

[2] Average of peak and off-peak

For energy offsetting however, where the generation from a solar farm matches the council consumption, we anticipate the total value would be about $87/MWh, including around $73/MWh for energy offset based on tariffs from recent electricity Kalamunda bills and $12/MWh for capacity payments.

In addition, the PFA's assumption for achievable LGC price are outdated and we have instead used recent forecasts (refer 6.2.3).

We consider that the solar generator could qualify for reserve capacity payments that would be worth about $16,700 per annum (refer 6.2.2), which is ~$12/MWh.

Using Kalamunda's provided spreadsheet model, the impact of changing assumptions about LGC and export price to Enhar's suggested values would mean NPVs were low or even negative for scenarios where the solar farm exports more than Council consumes.

Further independent financial modelling is necessary to verify the likely financial case of a solar farm. Notwithstanding, we consider there's a chance that a ~1MW solar farm might be financially viable if its operation is linked to the energy purchase at the contestable sites (refer 4.3.2.2) and latest technology is used including single axis tracking and bifacial modules, possibly with the addition of a battery.

Business model. Engaging a private developer via Power Purchase agreement is a potentially low-risk model. A private developer could lease the land and build and operate the solar farm, selling power the Council. This could de-risk the commercial operation of the solar project for the council. This model would ensure the council achieves many of the desired benefits without the complexity and cost of developing the project itself. This model is currently being trialled in Victoria by Nillumbik Shire council for a <5MW solar farm on a former landfill site.

Next steps

Siting a solar farm at Pioneer Park is technically viable. Choosing the optimal system size is a key challenge. The PFA looks at three possible system sizes (1, 3 and 5 MW) and requested Enhar review system size and business model options.

In preparing this review, and in particular reviewing the risks, it is apparent that many of the identified risks are reduced in line with reducing the system generating capacity. Further, we note that:

- There are two possible (unconfirmed) grid-connection options (see 5.4.2.3) suitable for a small (sub-1MW) solar farm which may avoid, or greatly reduce the uncertainty and costs associated with a new grid connection;
- The lowest-risk and simplest commercial arrangement for selling the energy is likely to be one that involves restricting generation to about that required to offset Council's contestable energy load of about 1250MWh/annum. This is discussed at 4.3.2.2.

These factors, combined, tend to suggest that Council should opt for a ~1MW solar farm to reduce cost and risks.

In addition to further work on the City owned solar farm scenario, the City may wish to investigate the willingness of State to allow the City to lease part of the site for a solar farm to a third party to develop the project and enter offtake with City.

Sweet spot size: Matching load

The indicated contestable Council load is 1250MWh/annum. That amount of energy could be generated by a fixed-tilt, un-shaded solar farm of about 700-800kW capacity, or around 600-700kW of single axis tracker. This size may well be the sweet-spot size for a council led solar farm at Pioneer Park, potentially connected using the existing generator grid connection (subject to confirmation that it is available).

This smaller-sized solar-farm option makes sense because of the degree that it avoids or substantially mitigates grid-connection risk and cost. If that alternative grid-connection pathway does not bear further scrutiny, then a larger (~5 MW) solar farm may be indicated so that the substantial grid-connection cost is spread across more generation capacity, subject to the other economic factors being suitable including offtake prices to justify the larger scheme.

Next steps

Suggested next steps are:

1. *Modelling.* Undertake more financial modelling to identify project sizing scenario which would deliver a viable return on investment*;*
2. *Community engagement.* Enhar will assess the community engagement package, when that is ready for review;
3. *Retail model.* Firm up possible retail model for energy sales as discussed at 4.3.2.2. This needs to be considered very early because the extent to which Council loads needs to be part of any contractual arrangement with a retailer has a large bearing on the selection of the appropriate solar generation capacity;
4. *Grid connection: existing generator connection.* If the discussions on retail model bear out the idea that a smaller-capacity solar farm may suit, then open a dialog with EDL Energy[3], current lease holders of the landfill-gas generator concession, to ascertain their appetite for possible productive use of the un-used existing grid connection (refer 5.4.2.3);
5. *Grid connect: new connection*. If, after discussions related to steps #2 and #3 above, a new grid connection is appropriate, then proceed with the quoted-for detailed connection enquiry process with Western Power (refer 5.4.2.1);
6. *Contaminated-site status.* The long-standing status of the site as '*Possibly Contaminated – Investigation Required*' needs to be resolved because a project approval will probably be delayed so long as that question mark remains (refer 3.3.2);
7. *Geotech study.* Because of the AECOM report's advice regarding the possible need for very costly site remediation work (refer 3.3.1), there will need to be a follow up geotechnical study to verify the extent to

[3] Energy Developments (EDL), https://edlenergy.com/

which any site remediation is actually required. This applies to the northern landfill cap section only.

The above steps could be incorporated into a full Feasibility Study stage of the project.

Based on the outcome of those seven steps, a clear sense of the options open, and appropriate further steps will become apparent.

Next steps - proposal

Based on the recommended downsized model, the following indicative scope and price guidance is provided for Enhar to perform many of the steps, above, to help firm up the feasibility of this proposed solar farm:

Step	Outline	Indicative cost (ex GST)
Perform financial modelling	Prepare a detailed financial model of the recommended downsized scenario.	$4,000
Further analyse retail energy arrangement	Engage with candidate energy retailers to further explore the feasibility of using the solar farm to offset Council contestable loads.	$2,900
Further analyse grid connection	Engage with EDL to flesh out the technical and commercial potential to re-use the existing generator connection.	$4,000
Review community engagement	Enhar will assess the community engagement package when this prepared by Council, as already agreed within the scope of this current review.	$0
Review site status	Enhar to assess any documents arising from future review/amendment of contaminated site status.	$800
Review Geotech study	Enhar to assess any documents arising from future review of Geotech situation.	$800
Reporting	Prepare supplementary report on the conclusions of the steps above.	$4,800
Total		$17,300

The above pricing does not include any site visits by Enhar.

This is based on the expectation that Council will separately arrange and fund:

- Community engagement;
- Review/amend contaminated sites status;
- Limited geotechnical review, limited to resolving what, if any, site remediation works are required in the area proposed for the solar farm.

New grid connection. This proposal does not consider alternative scenario where an entirely new grid connection is required. As discussed at 5.4.2.1, Western Power have quoted $33,860 to conduct a detailed study into the needs of a new grid connection. There's no way to accurately estimate the cost of a new grid connection until that study is performed.

The cost to deliver a full feasibility study would therefore be a total of $17,300 ex GST plus $33,860 ex GST for Western Power if needed.

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GLOSSARY

ACR	Automatic circuit recloser. A device which allows a power circuit to be re-connected (*i.e.* 'closed') automatically, if appropriate, after a temporary failure condition on the line. The use of an ACR avoids the cost and time associated with manual circuit re-closing.
AEMO	Australian Energy Market Operator (https://www.aemo.com.au/). The organisation responsible for operating Australia's largest electricity and gas markets and power systems, including the National Electricity Market (NEM). AEMO is constituted jointly of both government (60%) and industry (40%) members.
ARENA	Australian Renewable Energy Agency (https://arena.gov.au). A government body charged with accelerating Australia's shift to affordable, reliable renewable energy. Mostly ARENA funds innovative clean energy ideas to get them to market.
Capacity factor	A figure of merit of generator performance, being the ratio of the annual average power output to the rated power output, expressed as a percentage. In Australia capacity factors range from about 14% up to about 20%.
CEFC	Clean Energy Finance Corporation.
EPC	Engineer, Procure, Construct. The EPC Contractor is the company who will design and build the project.
DNSP	Distribution Network Service Provider, i.e. the company providing the grid poles and wires. For Knox this is United Energy.
LGC	Large Generation Certificate, tradable certificates. 1 LGC is earned by generating 1 MWh from a renewable generator.
LGC	Large-scale generation certificate. An LGC is a tradable market security which embodies 1 megawatt hour (MWh) of clean-energy generation under the Renewable Energy Target (RET) scheme http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/Power-stations/Large-scale-generation-certificates.
NEM	National Electricity Market (https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM). The physical power network, and market framework of wholesale electricity in the five market jurisdictions: Queensland, NSW, Victoria, Tasmania and SA. NT and WA are not part of the NEM.
PPA	Power Purchase Agreement. See https://lawquarter.com.au/short-guide-power-purchase-agreements-ppa-australia/.
PFA	Pre-feasibility assessment.
Pool-price passthrough	A retail power pricing arrangement whereby the tariff paid by the consumer is based on the wholesale pool-price (*aka* spot price), plus a retail margin.

1. Introduction

1.1 Context

Enhar is pleased to provide this review and further development of the landfill-solar preliminary feasibility assessment[4] (the *pre-feasibility assessment*) commissioned, and provided to Council in May 2019. The study is for a solar farm to be located on the Dawson Ave former landfill in Forrestfield (*aka* Pioneer Park).

1.2 Scope

The RFQ[5] outlines the scope as follows:

> *The City's intent is that the pre-feasibility report is now updated to become a feasibility report. It is expected that the Consultant will undertake the following activities:*
>
> *a) Thoroughly review the report and identify issues that it believes are incorrect or not thoroughly detailed*
> *b) Review the risk register and identify mitigation strategies to mitigate the risks surrounding adoption of a feasibility study*
> *c) Firm up the assumptions made in the report*
> *d) Review and recommend a preferred market approach for the City of Kalamunda (which is considered in the commercial aspects of the report)*
> *e) Whilst a potential site for the Farm has been identified, review the substantive risks around this site and advise if it is fatally flawed.*
> *f) Identify other potential sites that may be appropriate for the project*
> *g) Engage as the authorised representative of the City with necessary Regulatory Agencies to firm up assumptions made*

The pre-feasibility assessment notes that proposed objectives of the solar farm project include:

- to offset all City of Kalamunda electricity greenhouse gas emissions.
- Lower energy costs for the City's operations
- Potential for community energy savings
- Revenue generation to contribute to the city's financial sustainability

1.3 Consideration of alternative sites

In relation to scope item f) an in-depth review of alternative sites was proposed by Enhar in a non-conforming bid. In discussions with the City of Kalamunda, the budget available did not cover an in-depth review of alternative sites. However, it was discussed that the City of Kalamunda team is reasonably confident that no other large land parcels are owned by the Council with equivalent potential for large scale solar farming.

Hence specific consideration of alternative sites has not been undertaken by Enhar by agreement[6]. The general suitability of Pioneer Park makes consideration of alternative locations much less of a priority and it is considered likely that the site presents the best opportunity available for a solar farm on Council owned land. See also Section 7.

[4] City of Kalamunda. 2019. *Solar Farm – Pioneer Park Pre-feasibility Assessment (March 2019).*

[5] City of Kalamunda, undated, 'Scope of Services – Solar Farm Feasibility Study'.

[6] Per Enhar's proposal, and re-affirmed pers com, Richard Keech and Demian Natakhan (Enhar) with Brett Jackson (Kalamunda) 2020-04-01.

2. General review of pre-feasibility study

2.1 Background information

A large part of the pre-feasibility assessment relates to background information, *i.e.* information of a general nature that helps support the case for a solar farm, or help inform the context for solar-farm operation. This includes:

- Solar PV technology;
- Existing large solar PV installations in WA;
- Renewable energy target and emissions reduction;
- Energy regulation;
- Energy markets.

Our review is in broad agreement with the pre-feasibility report in regards to the information provided on those background topics. No point-by-point scrutiny of those sections of the report is considered necessary.

2.2 Council energy consumption and emissions offsetting

Context. A key goal of any new Council-owned solar-generation facility is to help offset Council energy consumption and emissions. The PFA shows reported Council electricity consumption as below.

Table 2-1: Council consumption

Item	Consumption [MWh]
Contestable sites (qty 13)[7]	975 (CY2018)
Non-contestable sites (qty 86)	979 (12 months to August 2018)
Streetlights	2800 (12 months to August 2018)
Total	4754

The balance of contestable to non-contestable load is clarified at PFA Section 4.2, which indicates that five non-contestable sites are slated for re-classification to contestable. Those sites, together, consume about 275MWh/annum. So, the expectation is that the load profile is more like that shown below.

Table 2-2: Council consumption - adjusted

Item	Consumption [MWh]
Contestable sites (qty 18)	1250
Non-contestable sites (qty 81)	704
Streetlights	2800
Total	4754

Review comment. There was no consideration in the pre-feasibility assessment of known factors expected to influence Council energy consumption in the foreseeable future. Consideration of potential reduction in street lighting due to LEDs was mentioned. However, no future load profile was estimated (refer PFA Section 4).

[7] Threshold for contestability is 50MWh/annum per NMI as per https://www.erawa.com.au/gas/switched-on-energy-consumers-guide/can-i-choose-my-retailer

Review comment. The report says *"This calculation illustrates the City's total emissions from electricity consumption is about 3,400 tonnes of CO_2 per annum, with almost 60% from the street lighting system alone."* This implies that Council believes they are responsible for Scope 2 emissions associated with street lighting. However, emissions associated with street lighting are not the responsibility of Council. Under NGERS rules, responsibility for emissions rests with the party who has operational control[8]. In the case of street lights, that responsible party is understood to be the power distributor, not Council. Notwithstanding, Council have indicated[9] intention to offset streetlight emissions in any case (refer PFA Section 4.4).

However, it is noted that a larger-sized facility such as proposed in the PFA would provide an effective carbon offset that is comparable to the street lighting carbon footprint, enabling the City of Kalamunda to demonstrate to the wider community that it is tackling carbon emissions on a holistic scale.

Recommendation / Considerations. **If offsetting Council electricity load is important, then some further analysis of Council future energy load profile will be necessary. For example, factors that might influence future energy consumption are:**

- **New Council buildings;**
- **Energy-efficiency measures, including possible electrification of gas-fired loads;**
- **Electrification of council vehicle fleet.**

2.2.1 Emissions factor

Emission factor. The pre-feasibility assessment used an emissions intensity of 0.70kgCO_2(e)/kWh. The latest emissions factor is 0.69[10]. Emission intensity of grid power will continue to decline and this should be understood when estimating future emissions savings.

2.2.2 Alternative emissions-savings pathways

The pre-feasibility assessment does not consider possible alternative means of achieving effective emissions abatement. The most obvious alternative ways to achieve effective emissions reduction are:

- to purchase certified Green Power[11], either through your existing retailer or as an un-bundled arrangement;
- to enter into a power-purchase contract for renewable energy, possibly as part of a group power-purchase arrangement;
- to purchase emissions offsets.

It is beyond the scope of this assessment to consider these alternatives in detail. However, it should be noted that a local solar farm is only one way to achieve effective emissions reduction. It can be considered in the context of a range of measures to achieve carbon neutrality.

[8] https://www.ironbarksustainability.com.au/fileadmin/public/downloads/MAV_Ironbark_FAQ.pdf, pp 5

[9] Pers Com, Richard Keech (Enhar), with Brett Jackson (Kalamunda), 2020-04-03

[10] National Greenhouse Accounts – Emission Factors – August 2019.

[11] Green Power scheme, https://www.greenpower.gov.au/

3. Review Risk Register

3.1 Pre-feasibility Assessment

From PFA Section 11. Also refer PFA Appendix E.

Risks associated with this project are related to the possibility of not being able to achieve the **objective of developing and operating the solar farm** due to commercial viability, regulatory approvals, stakeholder management or other reasons.

Eight risk areas have been identified relating to:

1. Planning approval
2. Network access (grid connection)
3. Financial viability
4. Energy regulation
5. Technology/design
6. Construction
7. Operations
8. Stakeholders

Risk Management is the culture, processes and structures that are directed towards realising potential opportunities whilst managing adverse effects. To assist in evaluating the risks for the solar farm project a detailed risk analysis has been prepared at **Appendix E**.

A total of 17 risks have been identified within the eight risk areas referred to above. A summary of the risks ranked in descending order is provided in the following table.

No.	Risk Ref.	Risk Area	Identified Risk	Residual Risk Rating
1.	4.	Financial Viability	Not able to generate sufficient revenue through offtake arrangements for the project to be viable.	Extreme (20)
2.	6.	Financial Viability	Electricity prices vary from business case financial model and do not generate sufficient revenue.	Extreme (16)
3.	9.	Energy Regulation	Unable to achieve a licence for electricity retailing.	**High (15)**
4.	5.	Financial Viability	Federal government policy affects the pricing and future of Large-scale Generation Certificates.	**High (12)**
5.	15.	Operations	Changes in law and policy result in changing the competitive electricity market.	**High (12)**
6.	16.	Stakeholders	Inadequate information provided to, and engagement of, the community leading to opposition to the City undertaking the solar farm project.	**High (12)**
7.	17.	Stakeholders	Lack of engagement with airport safety regulators results in air navigation concerns from glint and/or glare due to the proximity of the solar farm to Perth Airport.	**High (12)**
8.	1.	Planning Approval	Planning approvals needed for the project to proceed not achieved by not meeting all statutory planning and environmental requirements.	**High (10)**
9.	8.	Energy Regulation	Unable to achieve a licence for electricity generation.	**High (10)**
10.	10.	Technology/Design	The technology and design do not perform to project business case requirements.	**High (9)**
11.	12.	Construction	The procurement and selection of the Engineering Procurement and Construction (EPC) contractor is inadequate.	**High (9)**
12.	13.	Construction	Project management is inadequate resulting in time delays, cost overruns and construction defects.	**High (9)**
13.	2.	Network Access	Not able to obtain agreement with Western Power to connect to the electricity network.	**Medium (8)**
14.	3.	Network Access	The cost of connection and use of the electricity network make the project unviable.	**Medium (6)**
15.	7.	Financial Viability	Unable to secure affordable project funding.	**Medium (6)**

There are two (2) 'Extreme' risks determined through this process that could fundamentally affect the project from proceeding, which are:

1. Ability to enter offtake agreements to sell the electricity generated
2. Future electricity prices

A further ten (10) 'High' risks have been identified that require further evaluation as follows:

1. Obtaining a retail licence

2.	Price and further legislative arrangements of Large-scale Generation Certificates
3.	Changes in law and policy affecting the electricity market
4.	Stakeholders (community)
5.	Stakeholders (Airservices Australia and CASA)
6.	Planning and environmental approvals
7.	Obtaining a generation licence
8.	Technology and Design
9.	Design and construction procurement
10.	Construction project management

The controls and treatment of the risks are provided in the detailed risk analysis. The City needs to continue to evaluate these risks and decide whether or not to accept them prior to proceeding with the project. Further evaluation should be undertaken during the feasibility stage to gain more certainty around the risks before deciding to proceed with the project.

3.2 Analysis

Many of the identified risks pose a different risk rating depending on *when* the risk is manifest. For example, a risk which manifests prior to construction contract might lead to project cancellation. However, a comparable risk, if manifest after letting of the construction contract poses a much greater financial and operational consequence associated with a stranded asset and high sunk costs.

One particular risk element not discussed in the PFA, but mentioned in the analysis below, is the possibility of excessive generator curtailment. This is discussed in the analysis of risks #10 and #16, below. For future consideration, it might need to be called out as its own separate risk category.

3.2.1 Risk: Unsatisfactory off-take agreement

Statement of risk. Not able to generate sufficient revenue through offtake arrangements for the project to be viable.

Original risk rating: Extreme

Assessment of risk. This risk is very real because it's difficult to have long-term confidence about likely off-take agreements, especially if the energy is to be sold to third parties. However, the situation would be very different if Council scale the project to match their own daytime load, and execute the project such that Council effectively buys its own energy, with little left over to sell. In this scenario, the risk to the retailer intermediary is clear and manageable, so off-take agreement should be straightforward.

Possible mitigation. Operate the solar farm at a scale such that Council can guarantee purchase of most of the generation.

3.2.2 Risk: Fall in tariff

Statement of risk. Electricity prices vary from business case financial model and do not generate sufficient revenue

Original risk rating: Extreme

Assessment of risk. This is essentially the same risk as risk #1, above.

Possible mitigation. As per risk #1, above.

3.2.3 Risk: Failure to get licence to sell retail energy

Statement of risk. Unable to achieve a licence for electricity retailing.

Original risk rating: High

Assessment of risk. The most likely operating scenarios would not involve the need for the City of Kalamunda to obtain a retail licence for the solar farm.

Possible mitigation. Do not operate in a way that requires a retail licence.

3.2.4 Risk: LGC policy uncertainty

Statement of risk. Federal government policy affects the pricing and future of Large-scale Generation Certificates.

Original risk rating: High

Assessment of risk. The situation with LGCs is well understood. LGC price can reasonably be expected to contribute only a small amount to the project's income, and only then in the early stages. Although the broad parameters of the LGC market and regulation are well understood, the actual LGC price is variable and uncertain. Notwithstanding the uncertainty, the downside risk to the project is low because LGC income is relatively small. Risk is rating is re-assessed as low.

Possible mitigation. Not required.

A potential long-term upside scenario could be considered where Federal legislation emerges during the project lifetime leading to higher LGC prices and/or reintroduction of a carbon price. This would be a separate exercise and is not considered a gap in the PFA.

3.2.5 Risk: Unfavourable regulatory change

Statement of risk. Changes in law and policy result in changing the competitive electricity market.

Original risk rating: High

Assessment of risk. WA's Energy Transformation Strategy[12] is likely to somewhat level the playing field in terms of access to market for energy. So, risk is more likely to lessen with time.

Possible mitigation. Risk is lessened by choosing a market model which does not depend on selling energy on the open market to other consumers.

3.2.6 Risk: Community objections

Statement of risk. Inadequate information provided to, and engagement of, the community leading to opposition to the City undertaking the solar farm project.

Original risk rating: High

Assessment of risk. The risk is real because of the lack of precedents for solar farms within the greater urban area. The nature of the site lends itself readily to screening from neighbours.

Possible mitigation. Screening off the solar farm is appropriate.

3.2.7 Risk: Glint and glare – airport

Statement of risk. Lack of engagement with airport safety regulators results in air navigation concerns from glint and/or glare due to the proximity of the solar farm to Perth Airport.

Original risk rating: High

Assessment of risk. This poses a risk at the planning-approval stage only. The location of the site away from any of the air traffic approach paths is helpful. Precedents of other solar farms in proximity to airports provide some confidence that this is a low risk. This risk is a subset of risk #8, below.

Possible mitigation. Engage with stakeholders early in the process is important. Use of a single-axis-tracking mounting system (refer 5.3.5) reduces glint and glare issue.

[12] https://www.wa.gov.au/organisation/energy-policy-wa/energy-transformation-strategy

3.2.8 Risk: Denied planning approval

Statement of risk. Planning approvals needed for the project to proceed not achieved by not meeting all statutory planning and environmental requirements.

Original risk rating: High

Assessment of risk. This risk is manageable and moderate because none of the elements appear to be unique or particularly contentious. The site does not have high environmental or amenity value. It is a pre-contract risk, so worst case is project cancellation.

Possible mitigation. Planning approval risk is best managed by engaging appropriate professionals in the pre-contract phase.

3.2.9 Risk: Denied generator registration

Statement of risk. Unable to achieve a licence for electricity generation.

Original risk rating: High

Assessment of risk. This risk is manageable and moderate because none of the elements appear to be unique or particularly contentious. It is a pre-contract risk, so worst case is project cancellation.

Possible mitigation. Risk is best managed by engaging appropriate professionals in the pre-contract phase. Early engagement with Western Power is advisable.

3.2.10 Risk: Performance falls short

Statement of risk. The technology and design do not perform to project business case requirements.

Original risk rating: High

Assessment of risk. Risk of the system being unable to meet its target is actually low because the performance (energy yield) can be estimated with reasonable confidence. However, delivered performance may suffer if generation is deliberately curtailed by the network operator. Re-assess risk rating to Moderate.

Possible mitigation of yield-potential risk. Risk is best managed by engaging appropriate professionals in the pre-contract phase, and by applying a small risk margin in performance assumptions.

Possible mitigation of curtailment risk. Risk is best managed by matching output to Council load.

3.2.11 Risk: EPC selection

Statement of risk. The procurement and selection of the Engineering Procurement and Construction (EPC) contractor is inadequate.

Original risk rating: High

Assessment of risk. Industry experience with solar farms is sufficient to lessen uncertainty related to EPC contractor. Re-assess risk as moderate.

Possible mitigation. When ranking candidate EPC contractors, reputation and prior similar experience should be rated highly when determining value for money.

3.2.12 Risk: Project management

Statement of risk. Project management is inadequate resulting in time delays, cost overruns and construction defects.

Original risk rating: High

Assessment of risk. Project management of construction is part of, and the responsibility of the EPC contractor. So, this risk is really a subset of risk #11.

Possible mitigation. Per risk #11.

3.2.13 Risk: Grid connection – unable to connect

Statement of risk. Not able to obtain agreement with Western Power to connect to the electricity network.

Original risk rating: Medium

Assessment of risk. This risk is manageable and moderate because none of the elements appear to be unique or particularly contentious. It is a pre-contract risk, so worst case is project cancellation. Extended time delays for grid connection approval are a potential risk which can be mitigated through early commencement of connection application with Western Power and use of experienced consultants.

Possible mitigation. Apply for grid connection and engage paid response from Western Power early so that connection approval is confirmed prior to other key project decision points. Reluctance by distributor to permit a connection is likely to be proportional to project's rated power output. Lower-power system likely to be lower risk. The use of a reputable inverter brand with well proven performance on the Western Power network will reduce risks.

3.2.14 Risk: Grid connection – too costly

Statement of risk. The cost of connection and use of the electricity network make the project unviable.

Original risk rating: Medium

Assessment of risk. Cost of achieving grid connection is, indeed, a significant potential hurdle. Attempts to de-risk this through engagement with Western Power during this review have had little success. An option to consider is to use the existing sub-1MVA connection point and scale the plant accordingly.

Possible mitigation. Apply for grid connection early so that a costed works contract is available for consideration prior to other key project decision points. Engage with EDL to determine availability of existing sub-1MVA connection point (refer 5.4.2.3). If available, consider scaling down the plant to use existing connection point.

3.2.15 Risk: Funding

Statement of risk. Unable to secure affordable project funding.

Original risk rating: Medium

Assessment of risk. The PFA outlines pathways for funding. Availability of grant funding should not be assumed. Interest-rate environment is conducive to affordable debt funding if required. Some project models put the funding risk on third parties. Re-assess risk as low.

Possible mitigation. Not required.

3.2.16 Risk: Operational management

Statement of risk. Inability to effectively operate and manage the solar farm resulting in cost, quality, time and licencing impacts.

Original risk rating: Medium

Assessment of risk. Operational solar-farm management is not expected to be problematic. Main operational risk relates to excessive curtailment, which is covered at risk #10.

Possible mitigation. Get good advice in preparation of operating procedures. Use experienced operators.

3.2.17 Risk: Poor equipment selection

Statement of risk. The specification of the technology does not consider latest R&D of solar technology.

Original risk rating: Low

Assessment of risk. The necessary technology is mature and widely deployed, globally. Proper operation is not dependent upon achieving performance at the limits of technological capability. Risk is low.

Possible mitigation. Not required.

3.3 Additional risks

In addition to the risks already identified in the PFA, there are other risks associated with the site.

3.3.1 Site remediation

Risk. The 2015 Master Plan for the site[42] by AECOM (the 'AECOM report') indicated an estimated cost of $20 - $30 million associated with site remediation works, required before re-development could proceed. If any significant fraction of that cost is required prior to a solar farm development, then it could significantly delay a solar-farm project.

Analysis. See discussion at 5.3.5. There needs to be more work done to confirm whether extensive site remediation works are required. However, there seems to be good reason for thinking that likely remediation costs would only be a very small fraction of the $20 - $30 million figure.

A risk rating of moderate is appropriate. The risk can be resolved and removed during the planning phase of the project. The solar farm financial case should be separated from any remediation cost, since any remediation not genuinely triggered by the solar farm so should be budgeted and funded separately.

3.3.2 Contaminated site situation

Risk. The site has been classified 'Possibly Contaminated – Investigation Required' [40,13,24]. There is a risk that the lack of certainty about the contaminated-site status could hold up development approval of a solar farm.

Analysis. Refer section 5.6.6.1. Priority needs to be given to preparing a Contaminated Site and Environmental Management Plan, and to resolving the status of the site. The on-going management of the landfill site is likely to be in-keeping with installation of a surface-mounted solar farm at the site.

A risk rating of moderate is appropriate. The risk can be resolved and removed during the planning phase of the project.

[13] Email, Richard Keech (Enhar), with Cameron Chisholm (Kalamunda), 2020-07-21.

4. Market approach

4.1 Scope

Kalamunda's scope of services included a requirement to:

> *Review and recommend a **preferred market approach** for the City of Kalamunda (which is considered in the commercial aspects of the report)*

Market approach touches on funding, operation and governance. The commercial aspects of the Pre-feasibility assessment are covered in Section 7 (Funding) and Section 8 (Financial Evaluation). The operating model of a solar facility is addressed in Section 9 (Governance).

4.2 Summary of PFA commercial aspects

4.2.1 Funding

The main points in the PFA's consideration of funding (Section 7) are:

- *Grant funding.* ARENA[14] (Federal Government) exists to support development, demonstration and pre-commercial deployment projects;
- *Debt / equity funding.*
  - CEFC[15] Federal government agency providing finance for projects with good potential to reduce emissions;
  - Bright Energy Investments. A commercial non-bank lender working to fund large renewable projects in WA;
  - WA Treasury Corporation (WATC). Another source of affordable non-bank finance which is available to Council.

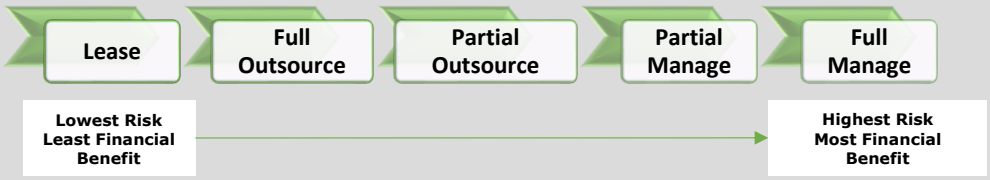
4.2.2 Operating model

The main points in the PFA's consideration of operating models (part of Section 9 – Governance) are that the following broad operating models might apply:

The project governance models considered are:

1. Lease – site is leased to a solar developer to build, operate and retail electricity
2. Full Outsource – the City finances but contracts the building, operation and retailing
3. Partial Outsource – the City finances and builds but contracts the operation and retailing
4. Partial Manage – the City finances, builds and operates but contracts the retailing
5. Full Manage – the City finances, builds, operates and retails.

The progression of these options is illustrated below.



The risk of the progression can be defined in the increasing involvement of the City to oversee and manage the risks and potentially be rewarded with lower energy costs should the risks be managed effectively.

Other than leasing the City could enter a power purchase agreement to procure electricity for its contestable sites.

[14] Australian Renewable Energy Agency (ARENA) – www.arena.gov.au

[15] Clean Energy Finance Corporation (CEFC) – www.cefc.com.au

The PFA concludes its analysis of operating model as follows:

> The energy industry is not core business for the City and the more the involvement the greater distraction the project will be to the City's core operations and expose it to the complex energy sector and consequent risk. Mitigation through outsourcing is an effective means of diluting the risk whist still obtaining the most benefits.

4.3 Assessment

4.3.1 Funding

Enhar broadly agrees with the PFA's analysis on funding options. However, the project may lack sufficient novelty to qualify for ARENA funding since it could not be said to be a (product) *development, demonstration or pre-commercial deployment project*.

4.3.2 Operating models

Enhar broadly agrees with the PFA's analysis on operating model. In particular, we agree that it is appropriate for Kalamunda to favour the lower-risk *lease* or *outsource* options, including power purchase agreement option.

Getting paid for energy generation. The PFA does not make clear that there are, broadly, two separate approaches to being paid for energy generation in a scenario where the generator is owned by Council:

- Market price,
- Fixed-price power purchase agreement (PPA).

Market price. Selling the generated energy of the solar farm on the WEM open market[16] is likely to be problematic because of uncertainty about price obtained. Most market generators on the WEM sell their energy under long-term off-take arrangements, leaving their excess generation available for sale on the so-called 'balancing market'.

PPAs. The long-term contracts for purchase of energy are called power purchase agreements (PPAs). If Council's solar farm depends on a selling the energy to a third party, then a contractual PPA would be the legal instrument for selling most or all of that energy.

Strategy: Load-matched generation. The choice of operating model for a solar farm needs to be considered in the context of Council's own contestable energy load. It is highly likely that solar-farm-generated energy, which is in excess of that which matches Council's own demand, will be less valuable. This is because of the commercial complexity and risk involved with needing to sell the energy to a third party, and the competition from other larger solar farms generating at lower cost.

4.3.2.1 Ownership scenarios

Enhar agree that the solar farm could be viable in either Council-owned or under third-party ownership and operation. However, we don't see any scenario requiring creation of a new retail licence as being appropriate because of the complexity and overheads associated.

Hands-off approach. A feasible approach would be to offer the solar-farm project to the market along with Council's contestable electricity loads, such that:

- Council pays a recurring contracted amount, in return for
- Both:
  - Construction and operation of the solar-farm, and
  - Provision of the Council's contestable energy supply.

[16] Description of market here https://www.canstarblue.com.au/electricity/understanding-wa-energy-market/

In this scenario, there would be an expectation that the net cost to Council should be not more than Council's current contestable energy costs. Council might perhaps leave the design of generation capacity of the installation to the proponents, so long as a specified minimum amount of solar energy is supplied to the Council. This would give the proponents commercial flexibility depending on their appetite for generating and selling excess energy, and any portfolio of other offtakers they may secure.

Hands-on approach. Council might engage an EPC contractor to construct the solar farm. De-coupled from that, Council could separately enter into commercial arrangements with an electricity retailer to both:

- Buy all the energy from the solar farm, and
- Sell energy to Council, to cover Council's contestable loads.

In this scenario, the avoided energy costs would be expected to cover the funding and operating costs of the solar farm.

Private developer with Power Purchase agreement. This is being demonstrated by Nillumbik Shire Council (in Victoria) at present who have offered a former landfill site for lease with a long-term PPA commitment from Council. Private developers will build and operate the solar farm, de-risking the commercial operation of the solar project for the council. This model would ensure the council achieves the desired benefits without the complexity and cost of developing the project itself.

4.3.2.2 Retailer engagement

The suggested market approach to sell the energy from the solar farm is to engage with one of the current contestable electricity retailers[17] and enter into simultaneous, linked contracts to both:

- Sell the solar-generated energy to the retailer;
- Buy energy from the retailer for Council's contestable sites.

This approach reduces the risk to the retailer, and is more likely to lead to a suitable long-term off-take agreement to underpin the solar farm's financial viability. An arrangement such as this could give long-term certainty to electricity contract arrangements for Council's contestable sites.

A solar farm design which ensures that solar generation matches daytime Council loads as closely as possible will likely lead to the best financial outcomes.

If the solar-farm sizing followed an approach of load-matched sizing, then a much smaller solar-farm (*i.e.* smaller than the 5 MW currently proposed) would be appropriate. For discussion of down-sized solar generator see Section 9.1.

[17] https://www.erawa.com.au/electricity/switched-on-energy-consumers-guide/contacts-and-more-information

5. Site suitability review

5.1 Scope

Kalamunda's scope of services included this requirement:

> *Whilst a potential site for the Farm has been identified, review the substantive risks around this site and advise if it is fatally flawed*

5.2 Review of PFA

5.2.1 Context

The main conclusion of the siting assessment of summed up as follows:

> *As Zone 1 meets the area requirement for a 5 MW solar farm, and that it presents an efficient use of underutilised reserve with the potential use of a contaminated landfill site, it is proposed that Zone 1 (North Pioneer Park) be selected as the location of the solar farm.*

(refer PFA Section 5.3).

This relates both to the:

- Necessary generation capacity to exceed Council needs; and
- Suitability of the site.

5.2.2 Review commentary

We broadly agree with the conclusion in regards to both the appropriate solar-generating capacity and the choice of location for installation. Key factors are:

- Total Council loads are about 5 GWh/annum, including street lighting;
- The north zone of Pioneer Park has a size (land area) that can fit solar with about 5 MW capacity;
- Assuming a reasonable generation capacity factor of 18%, solar on the site can generate about 8 GWh net, in a typical year, which exceeds Council's annual load by about 60%.

The choice of optimal size of generation is challenging and discussed further at Section 9.

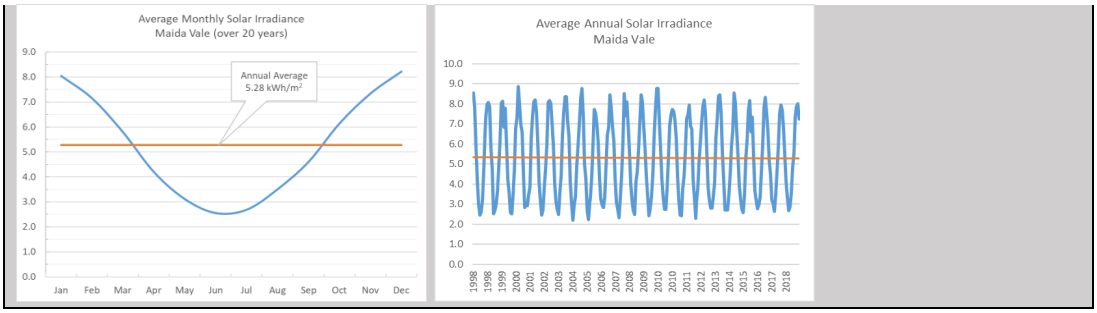
5.3 Land physical suitability

5.3.1 Solar irradiation levels

5.3.1.1 From PFA Section 5.1

> The solar irradiance is based on the kWh/m^2 at the Madia Vale weather station that is approximately 2 km from the Pioneer Park site. The solar irradiance at this site has averaged 5.28 kWh/m^2 per annum over the last 29 years[18]. The monthly average for solar irradiance is at its highest in December at 8.22 kWh/m^2 and the lowest in June at 2.55 kWh/m^2. The highest solar irradiance month in the last 29 years was December 2000 at 8.86 kWh/m^2 and lowest in July 1996 at 2.11 kWh/m^2.
>
> The solar farm location at Pioneer Park is about 2 km from the Maida Vale Weather Station on Hawtin Road. The next closest weather station is at Perth Airport. Both sites have similar levels of solar irradiation.
>
> The charts below show the different levels of solar irradiance throughout the year. The first chart is the average for each month over the last 20 years and the second chart shows the annual variation over that period with the high points being December in each year and the low point is June.

[18] (Bureau of Meteorolgy, 2019)http://www.bom.gov.au/jsp/ncc/cdio/wData/wdata?p_nccObsCode=203&p_display_type=dataFile&p_stn_num=009182



5.3.1.2 Review commentary

The review of solar irradiation within the PFA is minimal. The following additional analysis is provided.

Average yield

The site at Forrestfield experiences excellent solar irradiation. Solar PV at this location is capable of yielding 1.70GWh/annum per MW of installed capacity[19]. This corresponds to a generation capacity factor[20] of 19.4% in an average year.

Seasonal variation

The ratio of summer yield to winter yield is 2.28, *i.e.* the average daily output in the best month of an average year is 2.28x the case in the worst month.

The worst month is further from the average than the best month, i.e. The average month is 1.67x the worst month, and the best month is 1.36x the average month.

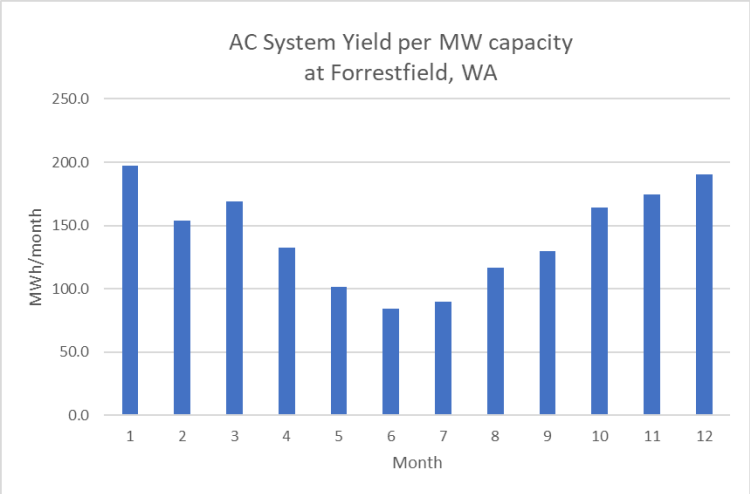


Figure 5-1: General PV yield potential at Forrestfield

Year-to-year statistical analysis

[19] Based on analysis using pvwatts.nrel.gov, using site data for Perth Airport. Assumptions, zero losses for shading, soiling, availability. North-facing, 20degree slope. Inverter efficiency 96%. DC:AC ratio 1.2. Net system losses 6.8%.

[20] For explanation of *capacity factor*, see Glossary.

Based on a statistical analysis of solar radiation at Perth Airport, it is possible to draw some conclusions about likely variation in solar PV yield from year to year. We used BoM solar radiation data for the last 30 years[21] and conclude that:

- We can say with 90% confidence that the annual output will be in the range +/- 3.7% from the average;
- The variation of individual months is much greater. June has the greatest variation in output, with the 90% confidence interval variation +/- 16.0%. December has the lowest variation (+/- 7.5%);
- There is a slight upward trend in annual solar radiation, estimated to be 0.56% per year.

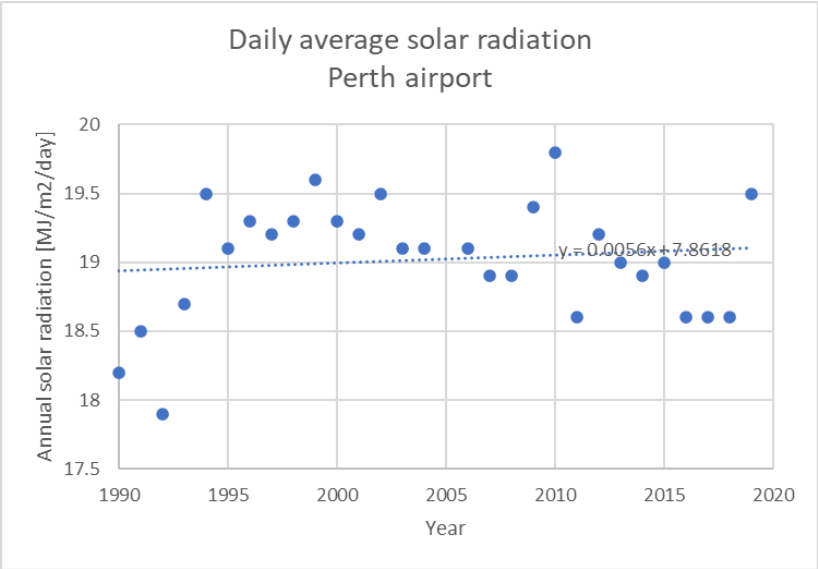


Figure 5-2: Solar radiation at Perth Airport over 30 years

5.3.2 Optimum scale of land area suited to target generation scale

5.3.2.1 PFA

Refer PFA Executive Summary

Three options have been analysed in relation to the scale of the solar farms based on the level needed to offset emissions based on contestable sites only (1 MW), contestable and non-contestable sites and including streetlighting (3 MW), and all consumption plus excess capacity to sell electricity for revenue generation (5 MW). The sizing also relates to site constraints and capacity for the City to fund (a 100 MW solar farm costs approximately $150 million to develop).

5.3.2.2 Analysis

If the goal is simply to offset Council's annual electricity consumption (with or without streetlights), then we can say with confidence that the land area of the site greatly exceeds the minimum required to host PV sufficient achieve the goal.

Minimum sufficient generation capacity. In the case where the goal is to offset only Council's average electricity consumption, including street lights (4.75GWh), then a 2.8MW capacity solar farm would be sufficient in an average year.

[21] Monthly mean daily global solar exposure, http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=203&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=009021

Possible alternative goals. Given the available land, it might be possible to broaden the goal of the generation beyond offsetting only Council annual electricity consumption. Given Council's stated electrical load, table 5-1 below shows the solar capacity required for several other thresholds. This assumes Council consumption is evenly spread across the year.

Table 5-1: Generation sufficiency based on 4.75GWh Council load

MW capacity required	Sufficient for generation to:	Scaling[22]
2.79	equal load in an average year	1.00
2.87	exceed load in 90% of years	1.03
4.66	equal load in the worst month of an average year	1.67
5.24	exceed load in the worst month in 90% of years	1.88

5.3.3 Land topography suited to solar array

We can say with confidence that the general topography of the land presents no problems to solar generation. The site is not affected by shading and is sufficiently flat and level for ground-mounted solar installation.

5.3.4 Ease of access for construction and maintenance traffic

Vehicular access to site is straightforward. We do not anticipate any issues.

5.3.5 Geotechnical compatibility of landfill cap with solar frames/ballast

Based on the Pioneer Park Masterplan[42] (the 'AECOM report', 2015) the key points are:

- Dawson Avenue landfill was closed in July 1997 and rehabilitated for recreational use as Pioneer and Dawson Avenue Parks;
- The landfill was compacted to a density of at least 1t/m^3 (10kPa) and levelled;
- **The Site was capped with clay, to a uniform thickness of 500 mm, and covered in top soil, to a minimum depth of 300 mm**;
- Landfill Gas and Power Pty Ltd began extracting gas in 1996 following closure of the Site. The flow from Dawson Avenue landfill was incorporated with gas drawn from the Brand Road landfill to the power generators;
- Gas generation steadily declined to the point where only part time operation of a 600kW generator was possible. Presently, it has become uneconomic to pursue this generation, and so this is being replaced with a gas flaring facility.

The unstable ground condition at the north end of the site led to cessation of the organised sports at the site[23]. However, the 23 years that have elapsed since closure of the landfill give some reason for confidence that the subsidence should have stabilised sufficiently to host surface-mounted solar.

The AECOM report details remediation work (page 31) as shown below. It is clear that AECOM took the view that the entire landfill cap would need to be re-engineered and significant civil works undertaken. However, it is not clear what basis they had for forming that view.

[22] Scaling of generator capacity, relative to that sufficient to offset average annual generation

[23] A date of closure of the sports facility could not be determined.

Remediation Works

The following requirements will need to be undertaken within a 1-2 year period and will cost approximately $20 million to $30million depending on the amount of remediation and time required.

Table 9 Overview of Approach

Project Stage	Task
Project Preliminaries	- Project establishment and administration - Project kick off meeting - Development of Health and Safety Plan (HSP) and Safe Work Method Statements (SWMS)
Preliminary Site Investigation	- Review of previously completed site investigations and site history information - Preparation of Environmental Management Plan for the remediation of the site
Removal of top soil to expose capping	- Mobilisation of earth moving equipment - Disposal of excavated material
Remediation of failed capping	- Installation (where required)
Installation of web stabilisation material	- Installation
Clean fill laid	- Mobilisation of earth moving equipment
Service and sewer conduit installed	- Installation
Irrigation Installed	- Installation - Testing
Lighting installed	- Installation - Testing
Turf installed	- Installation - Establishment time

Figure 5-3: Remediation works description from AECOM report

More recently, Talis conducted a review[24] of the situation at, and prior studies of Pioneer Park. With respect to the landfill cap (*i.e.* the location of the planned solar farm) their conclusions (pp 67) are:

> *Landfill Cap:*
>
> ** Limited soil investigations were completed with no clear characterisation of the landfill cap across the Site;*
>
> ** During a targeted investigation, landfill waste was encountered across the south-eastern extent of Pioneer Park, which previously was thought not to be have been subject to landfilling; and*
>
> ** Large portions of the Site appear to be adequately capped, with steep and undulating embankments present within the central and southern portion of the Site, west of Dawson Avenue. Both fly tipped and exposed landfill waste is present across the portion of the Site, west of Dawson Avenue. Putrescible waste mass can result in settlement, causing undulating surfaces.*

Geotechnical. Further geotechnical work will be needed to confirm the suitability of the current landfill cap to host the solar farm. However, we see the AECOM scenario of full replacement of the landfill cap as being very unlikely.

Framing and mounting system. Siting the solar farm on landfill cap requires a non-penetrating mounting solution. This can be achieved either with:

- A fixed-tilt ballasted mounting system such as used at Wollert. This would consist of frames with about 24 panels each as shown in Figure 5-4 below; or
- A ballasted single-axis tracking system such as that available from Alion[25],[26], as shown in Figure 5-5 below.

The choice between the single-axis-tracking system and the fixed-tilt system is a trade-off between yield, simplicity, and capital cost.

[24] Talis Consultants Pty Ltd, June 2020, 'Summary of Works Completed', TE20040

[25] https://reneweconomy.com.au/alion-energy-solar-tracker-scores-first-deal-for-difficult-solar-farm-locations-40716/

[26] https://www.alionenergy.com/products/alion-storm-tracker/

Analysis by Enhar of comparative economics of tracking systems is that the return on investment and cost of energy are significantly better from tracking systems.

A tracking system with concrete ballast of high albedo can maximise bi-facial gains compared to fixed-tilt, which further improves the economics.

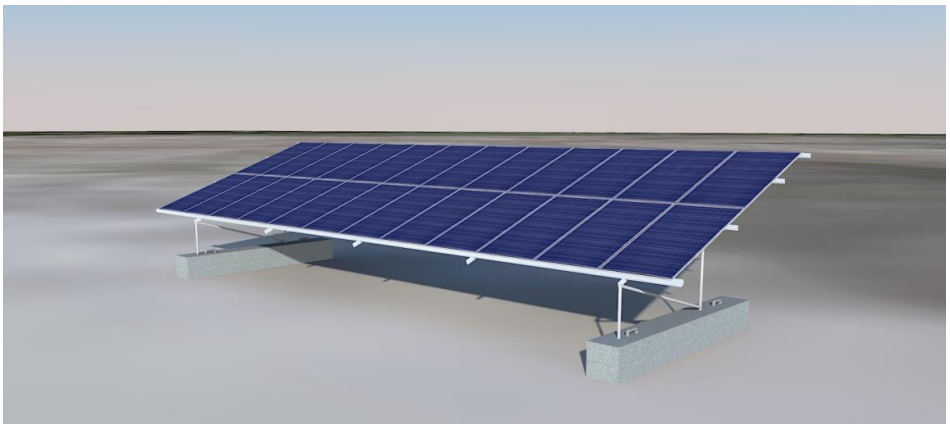


Figure 5-4: Fixed, non-penetrating solar array mounting frame

Figure 5-5: Tracking, non-penetrating solar array mounting system from Alion

5.4 Grid connection

5.4.1 PFA

The PFA's assessment of the grid connection situation is at Section 6.5 and summarised as follows (from Executive Summary):

> Access to the Western Power electricity network has been considered with the Forrestfield substation 3.5 km away following the existing 22 kV high voltage overhead distribution line. The City would need to pay for connecting to the network and annually for using this existing line. The line usage component based on the larger 5 MW solar farm is about $69,000 each year indexed over 25 years. Should the Net Present Value (NPV) of the cash flow ($1.5 million) be greater than building a new more direct feeder line for a distance of 1.8 km, it could be considered as an option to include in the upfront project cost rather than making annual line usage payments. Western Power need to assess the capacity of its network to meet the load placed on it by the solar farm and this could cause augmentation (upgrade) costs to be incurred. This is one of the next steps to be undertaken in the project and is an unknown factor now.

Following an enquiry request in 2019, advice from Western Power was as follows:

> Further to your Enquiry Notification lodged with Western Power, we are pleased to advise you that we have completed a high-level desktop enquiry in relation to your proposed connection of a 5MW solar PV generator located at 120 Dawson Avenue in Forrestfield WA 6058.
>
> We are pleased to provide you with the following information:
>
> i. A desktop assessment notes that the connection located at 120 Dawson Avenue, Forrestfield, WA 6058 with existing NMI 8001245644-6 is LV (415V) connected. The nearest distribution 22kV feeder close to customer's site is FFD 506.0 435 DUNDAS RD feeder.
>
> ii. At a high level, **there is no known major distribution network issues with the proposed 5000kVA exporting Solar PV system** at 120 Dawson Avenue, Forrestfield, WA 6058.
>
> iii. Your proposed connection of 5000kVA exporting Solar PV system is **deemed as non-competing for capacity on the Transmission Network**. **However, there is a potential transmission protection (weak infeed) issue**.
>
> iv. The impact of your connection to the network and connection options will be assessed further during a Preliminary Assessment following receipt of your application.
>
> 43 (Western Power, 2019) Connections – Planning Your Project https://westernpower.com.au/connections/planning-your-project/
>
> Solar Farm Pioneer Park - Pre-feasibility 53
>
> v. The requirements of the Technical Rules and the Generator Connections User Guide will apply to your generator. The web links are shown below:
>
> Technical Rules: https://www.erawa.com.au/electricity/electricity-access/western-powernetwork/technical-rules/technical-rules
>
> User Guide:
>
> https://westernpower.com.au/media/2238/guidelines-for-connection-of-generators.pdf
>
> vi. To progress your application for generation connection you are required to submit an Access Application form which can be obtained from the Western Power website using the following web link:
>
> https://www.westernpower.com.au/connections/new-connections/
>
> The application lodgement fee payable is $5,000 plus GST. Upon receiving your Application form and fee, Western Power will assess the application for completeness and provide you an initial response which could include a processing contract to undertake a Preliminary Assessment if you wish us to do so.

5.4.1.1 PFA Assumptions

At Section 8 of the PFA (Financial Evaluation), the assumed grid connection costs for a 5MW generator are:

- $100k for planning/connection charges, and
- $400k for grid augmentation costs.

5.4.2 Analysis

5.4.2.1 Detailed enquiry request

Enhar made a further enquiry request with Western Power (WP) in an attempt to learn more about the potential of the local grid to cope with the input from the solar farm, and specifically:

- What's the 'weak infeed issue' referred to in the previous advice from Western Power;
- Indicative connection costs; and
- Any other factors likely to have a bearing.

Unfortunately, Western Power's fee to respond to the enquiry request was not viable within the current project stage and the work has been put on hold. What has been learned in the process is[27] that:

- the preliminary assessment, quote by WP, at $33,860 (ex GST), appears to be the minimum necessary expenditure to start de-risking the connection-related aspects of the project;
- cost for connection application likely to be ~$150k, which would get things to the point of a having a costed works contract for the actual grid connection;
- preliminary assessment involves work that would normally be done as part of connection application. So, it brings forward that work and reduces the cost of the connection application
- if the project were not to progresses straight through to connection application, or delays led to the connection offer lapsing before commencing construction, there could be a subsequent cost to re-work the application;
- WP would apply a 'revenue offset' on the cost of the connection works, *i.e.* an amount which is effectively WP's contribution to the cost of the connection works in lieu of future network income associated with the connection.

So, there's unfortunately no scope for WP to provide any further specific advice around grid connection without proceeding to a paid-for preliminary assessment.

Likely connection costs. The PFA's assumed cost of connection application of $100k is likely to be optimistic. The PFA's assumed cost of grid connection works (for 5MW) of $400k is plausible but there's high uncertainty about this cost. It's not possible to make any meaningful estimates about likely cost of connection for the PFA's two smaller connection scenarios until after WP conduct their connection study.

It is likely however that the cost of connection is likely to be relatively similar for a 3MW vs a 5MW. If the connection cost is relatively similar then there is an economy of scale benefit with the larger 5MW system. Other economic factors may outweigh this benefit however so a smaller solar farm may be the most economic overall.

5.4.2.2 Other factors

Generator size thresholds. Western Power confirm[28] that generators less than 10MW only require supervisory control arrangements on a case-by-case basis, depending on local grid requirements. Above 10MW, supervisory control is always required.

[27] Pers Comm, Richard Keech (Enhar), Chris Chew (Western Power), 2020-07-16.

[28] Pers com, Richard Keech (Enhar) with Chris Chew (Western Power), 2020-05-05.

Generator registration. Intermittent generators more than 5kW capacity need to register as a *Non-Scheduled Generator* in the WEM (MR2.29.4(a))[29]. This does not present a problem for the project, assuming grid connection approval.

Western Power key documents are:

- guidelines for connection[30] of generation;
- approved technical rules[31].

5.4.2.3 Alternative connection option

For a new 5 MW connection, it is clear from above that connection-related costs (connection application plus connection contract works) are uncertain, but a figure of $500k is plausible. This cost is normal for this type of project. Notwithstanding, any options to reduce this cost will help the project economics.

A possible alternative grid-connection pathway (not considered in the PFA) is to explore re-using the existing connection provided for the un-used, landfill-gas generator, and scaling the solar farm to suit. This existing grid connection is at the part of the site known as 170 Dawson Ave (refer Figure 5-8 below). If the solar-farm operator could take on the operation of the existing generator grid connection, and feed it with solar energy, then it might be an elegant solution to greatly reduce the risk and cost associated with grid connection.

Using a smaller grid connection (than the 5 MW discussed in the PFA) may align with some other factors which also tend to suggest a smaller generator may be more appropriate (refer 4.3.2.2).

The following is known about the existing landfill-gas grid connection (PFA section 10.1):

- Landfill Gas and Power Pty Ltd began extracting gas in 1996 following closure of the Site. The flow from Dawson Avenue landfill was incorporated with gas drawn from the Brand Road landfill to the power generators.
- Landfill Gas and Power Pty Ltd initially installed a 1.1 MW of generation, increasing to 2 MW in 1997 at the combined sites.
- **Gas generation steadily declined to the point where only part time operation of a 600 kW generator was possible. It became uneconomic to pursue this line of works and was replaced with a gas flaring facility.**
- Landfill Gas and Power PTY Ltd has been acquired by EDL energy who now hold the lease over the power generator. The current lease with the City of Kalamunda expires on 25 November 2021 with a further option of 5 years available to EDL.
- The next application round to AEMO, to allow EDL to continue to sell electricity generated, applies for 1 October 2020 to 1 October 2021. However, in the next application EDL will be applying for capacity in 1 October 2021 to 1 October 2022, which is not covered in the current lease term.
- In relation to the proposed solar farm project, EDL advise they have not identified any issues with the solar farm proceeding and the impact on their operation other than the connection point which will need to be considered further if the project goes ahead. Communication should be maintained with EDL as the project advances.

[29] WEM Rules, https://www.erawa.com.au/cproot/21337/2/Wholesale-Electricity-Market-Rules-2-July-2020.pdf

[30] https://westernpower.com.au/media/2856/guidelines-for-connection-of-generators.pdf

[31] https://www.erawa.com.au/electricity/electricity-access/western-power-network/technical-rules/approved-technical-rules

Figure 5-6: Grid connection for existing landfill-gas generator

Possible complications with this scenario are:

- the existing connection point is on a different parcel of land (170 Dawson) to the landfill (120 Dawson). For this scenario to work, the regulatory compliance of having the solar farm effectively spanning two land parcels will need to be checked;
- to use the existing connection and high-voltage transformer, would require a longer low-voltage cable path than would be ideal.

Another, similar, hypothetical grid-connection option, for a smaller-capacity solar farm, would be to use the existing un-used kiosk transformer setup (including ring-mains unit and switchgear) which is located at the south corner of the northern landfill cap close to the Dawson Ave fence (see Figure 5-7 below). Initial direct inspection of this transformer suggests that it could potentially accommodate a generator rated at about 450kW (would need to be confirmed)[32]. Western Power reference for the existing transformer is DSTR5109444. Connection to pole ID S124176. This is possibly associated with existing meter NMI 8001245644-6 referred to at 5.4.1. This grid connection is on the 120 Dawson Ave land parcel. The disadvantages of it are:

- small rated capacity; and
- it is not subject to any existing approved generator connection, so using it would not avoid the grid-connection-application process, though it may simplify it.

[32] Based on observation of 630A/phase rating of existing load switch

Figure 5-7: Existing, un-used transformer equipment on site and adjacent to landfill

5.5 Land economic suitability

The PFA indicates that the land has no apparent better prospects for productive use than for a solar farm. The 2015 Pioneer Park Reserve Master Plan[42] identified significant and costly ($20 - $30 million) site remediation works which would be necessary before alternative productive use of the site could be achieved. It remains to be seen how much site remediation would be required prior to a solar farm. However, it's unlikely to be anywhere near the price range indicated above. This is a question that will need to be considered and resolved in the planning stage of any development project.

5.6 Planning and environmental

5.6.1 PFA

The PFA addresses matters of planning and environment in Section 10.3.

Planning Approvals

Advice was obtained from the City's approval services who advised:

- Lot 300 (120) Dawson Avenue, Forrestfield is reserved (R41156) Parks and Recreation under the MRS and is owned by the City of Kalamunda for the purpose of recreation.
- It is understood that the City, under the legislation, is entitled to a section 6 exemption under the *Planning and Development Act 2005* for public works in respect to both local and region planning schemes, assuming the works fall within the definition of a public work. However, the solar farm may not sit within a particular definition of the *Public Works Act 1902*. The only classification under the Act the use might fall under is:
  (y) any building or structure of whatsoever kind which, in the opinion of the Governor, is necessary for any public purpose;
- Whether the use is entitled to section 6 exemption or not, does not preclude the requirement for a building permit.
- Where there is doubt the WAPC would likely advise that development approval is required.

Prior to proceeding to final determination about the need for a planning approval is required. It is noted that other solar farms planning in Western Australia had obtained approval from JDAP, however, the proponents are solar developers and not the local government in those instances.
The site is currently zoned Parks/Reserve and Bush forever. There are environmentally significant issues and land use implications which will need to be considered in the development of the site. A Contaminated Site and Environmental Management Plan(s) associated with the development of the site would need to be approved by the Department of Water and Environmental Regulation. The development of the site must adhere to numerous state and local policies and strategies.

Environmental Investigations

As referred to above, approvals will be required from the Department of Water and Environmental Regulation (Contaminated Sites Branch) and Department of Health with respect to development on Pioneer Park. Consultation with these regulators should occur early to avoid delays to the project to allow the required site investigations to be undertaken.
The following outlines the indicative approach within an environmental investigation which will be required for the redevelopment of Pioneer Park. The scope of work needs to consist of a review of previous investigations including identification of data gaps and reporting of the investigation findings.

- Preliminary Site Investigation
  - Review of previously completed site investigations and site history information
  - Data gap analysis
  - Development of a Conceptual Site Model

- Preparation and provision of a Preliminary Site Investigation Report
- Detailed Site Investigation
  - Groundwater well installation (where required) and groundwater sampling
  - Limited soil sampling within surface capping materials
  - Laboratory analysis of soil and groundwater samples
- Ground Gas Investigation
  - Installation (where required) of ground gas wells
  - Monitoring at ground gas wells
- Fauna Investigation
  - Review of previously completed site investigations and site history information
  - Data gap analysis
  - Development of a Conceptual Site Model
  - Preparation and provision of a Preliminary Site Investigation Report
- Vegetation Survey
  - Vegetation and flora surveys would need to be undertaken between September and the end of November (spring)
  - Reports for survey
- Geotechnical Report
  - Review of previously completed site investigations and site history information
  - Data gap analysis
  - Development of a Conceptual Site Model
  - Preparation and provision of a Preliminary Site Investigation Report
  - Development of detailed Sampling and Analysis Plan outlining requirements for site investigation

Local Government Act

Section 3.59 of the Local Government Act 1995 requires a local government to prepare, advertise and consider submissions on a business plan related to major land transactions or major trading undertakings before commencing with that undertaking.

A major land transaction involves the leasing of land if the transaction would result in the transaction exceeding 10% of the City's operating expenditure (approximately $6 million) or $10 million whichever is the lesser amount as detailed in regulation 8A of the Local Government (Functions and General) Regulations 1996. Therefore, if the value of any lease over the life of the lease is greater than $6 million the City would need to comply with the requirements of section 3.59.

A major trading undertaking is an activity carried on by a local government with a view to producing a profit and is more than $5,000,000 per annum in expenditure as detailed in regulation 9 of the Local Government (Functions and General) Regulations 1996. The cash flow model does not show expenditure in any year greater than $5 million, however, this is on the basis that Western Power's Network Access charges are not included as part of the City's expenditure as they will be paid for by the retailer from the revenue received from selling the electricity to customers. This needs to be confirmed prior to entering into the project.

Should the solar farm require a business plan under section 3.59(3) of the Local Government Act 1995, the Local Government (Functions and General) Regulations 1996 specifies the business plan is to include:

1. an overall assessment of the major trading undertaking or major land transaction;
2. its expected effect on the provision of facilities and services by the local government;
3. its expected effect on other persons providing facilities and services in the district;
4. its expected financial effect on the local government;
5. its expected effect on matters referred to in the local government's current plan prepared under section 5.56;
6. the ability of the local government to manage the undertaking or the performance of the transaction; and
7. any other matter prescribed such as joint venture arrangements.

Further consideration must be given to section 3.58 of the Local Government Act 1995 if the proposal is to lease the land for the purpose of a solar farm to a solar developer.

Leasing land is regarded as a disposition under section 3.58 and if the lease is not provided to the highest bidder at auction or through a tender, the local government must advertise its intention to lease the property and consider any submissions before agreeing to enter into the lease. The details to be advertised are outlined in section 3.58.

5.6.2 WA Government policy on renewable facilities

Since the preparation of the PFA, the WA Government has issued "*Position Statement: Renewable Energy Facilities*"[33]. This document serves as a key point of reference for considering the impact of government planning and environment policy on the project. This document should be used to determine any future scope of planning assessments for a permit for a solar farm at the site.

5.6.3 Site context

The Pioneer Park site has been reviewed to check for factors with the potential to impact its use for solar. A key resource used was the PlanWA interactive map (dplh.wa.gov.au/planwa). The Pioneer Park site consists of three parcels of land as shown below.

Figure 5-8: Pioneer park site consists of three land parcels

Table 5-2: Land parcels

Address	Parcel ID Number	Lot/Reserve	Area [m2]	Lot type
120 Dawson Ave	11561011	300/41156	515,772	1, Reserve 3R
170 Dawson Ave	1175579	12588/44545	600	1, Reserve 3R
110 Dawson Ave	196311	1/-	5,360	1

[33] Department of Planning Lands and Heritage, *Position Statement: Renewable Energy Facilities*, March 2020. https://www.dplh.wa.gov.au/policy-and-legislation/state-planning-framework/position-statements/position-statement-renewable-energy-facilities

Total aggregate surveyed site area is 521,732m^2 (52.2ha)

5.6.4 Land zoning

Reserve. The entire site is classified as Reserve – mostly Type 3R, with a minor part of Type 1

Within the local planning scheme (LPS)[34], the site has land use classification 'Parks and Recreation'[35].

Enhar engaged with Kalamunda on the question of the suitability of the site for with respect to zoning[36]. The key relevant advice is shown here:

> *DPLH has confirmed a DA would be required to be submitted on the proposal for approval under the MRS, with the application informed by the provisions of DPLH position statement on renewable energy facilities.*
>
> *As discussed a creek line (Crumpet Creek) traverses the northern quadrant of Pioneer Park. Where development applications are received on sites encumbered by a waterbody, the City is required to refer the proposal to the Department of Water and Environmental Regulation (DWER) as an advice agency. Whilst the responsible authority isn't bound by the comments received by DWER, it is required to give due regard to the submission. I have attempted to obtain some preliminary comments from DWER, however their response has been that any comments would be formally provided through the referral process of the DA. Should DWER have any concerns with the solar farm, from experience their concerns would be appeased through appropriate management plans (i.e. details of any chemicals kept on site & their storage/use etc.). Given any subsequent development application would be subject to several referral agencies (DWER, DFES etc.) acknowledgement to this would be sufficient with the due diligence.*

5.6.5 Protected planning designations

The PFA gives no consideration to absence or low occurrence of protected planning designations including Aboriginal Heritage, significant landscape overlays, protected flora and fauna *etc*.

Bush Forever. Parts of the site have remnant scrub vegetation. The site is a designated Bush Forever site, per State Planning Policy 2.8 '*Bushland Policy for the Perth Metropolitan Region*'[37]. More information from Urban Bushland Council[38]. The scope of sections protected by this policy are shown in light green in Figure 5-9 below.

Table 5-3: Protected planning designations

Item	Name
Site Number	440
Name	Pioneer Park Bushland
File Number	809/02/01/0077

[34] https://kalamunda.wa.gov.au/building-development/planning/regulations/lps3

[35] https://www.dplh.wa.gov.au/getmedia/c42780d1-8413-4355-a327-8dd1d9a337ff/Map-05-Forrestfield-Locality

[36] Zoom meeting 2020-05-15, Enhar with Kalamunda, and email correspondence – Ivana Lazarus (Kalamunda) with Richard Keech (Enhar) 2020-07-02.

[37] https://www.dplh.wa.gov.au/spp2-8

[38] https://www.bushlandperth.org.au/campaigns/bush-forever/

Figure 5-9: Portions of site subject to 'bush forever' protection

Bushfire-prone area. The site is within a designated bushfire-prone area (BPA). The impact of this on the design and grid connection is being assessed. Figure 5-10 below shows the extent of the BPA in yellow.

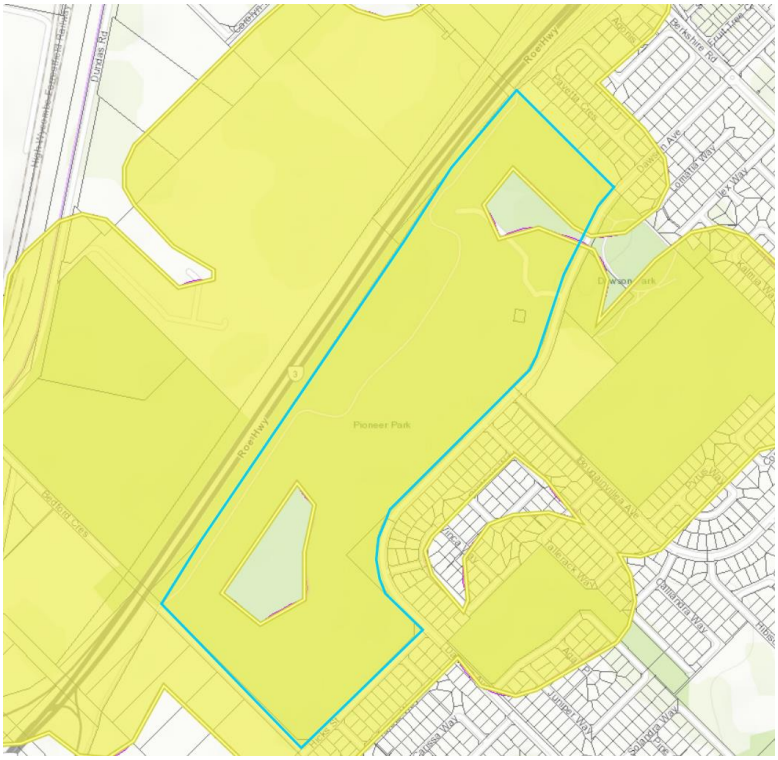


Figure 5-10: Designated bushfire-prone areas shown in yellow

Cycle path. A fully paved cycling path runs within the site for the entire length of the site on the side near the freeway. The path skirts around the remnant scrub (Bush Forever-protected). The bicycle path is shown in red in the figure below.

Figure 5-11: Bicycle path shown in red.

Drainage. The drainage from the site is indicated from the following diagram.

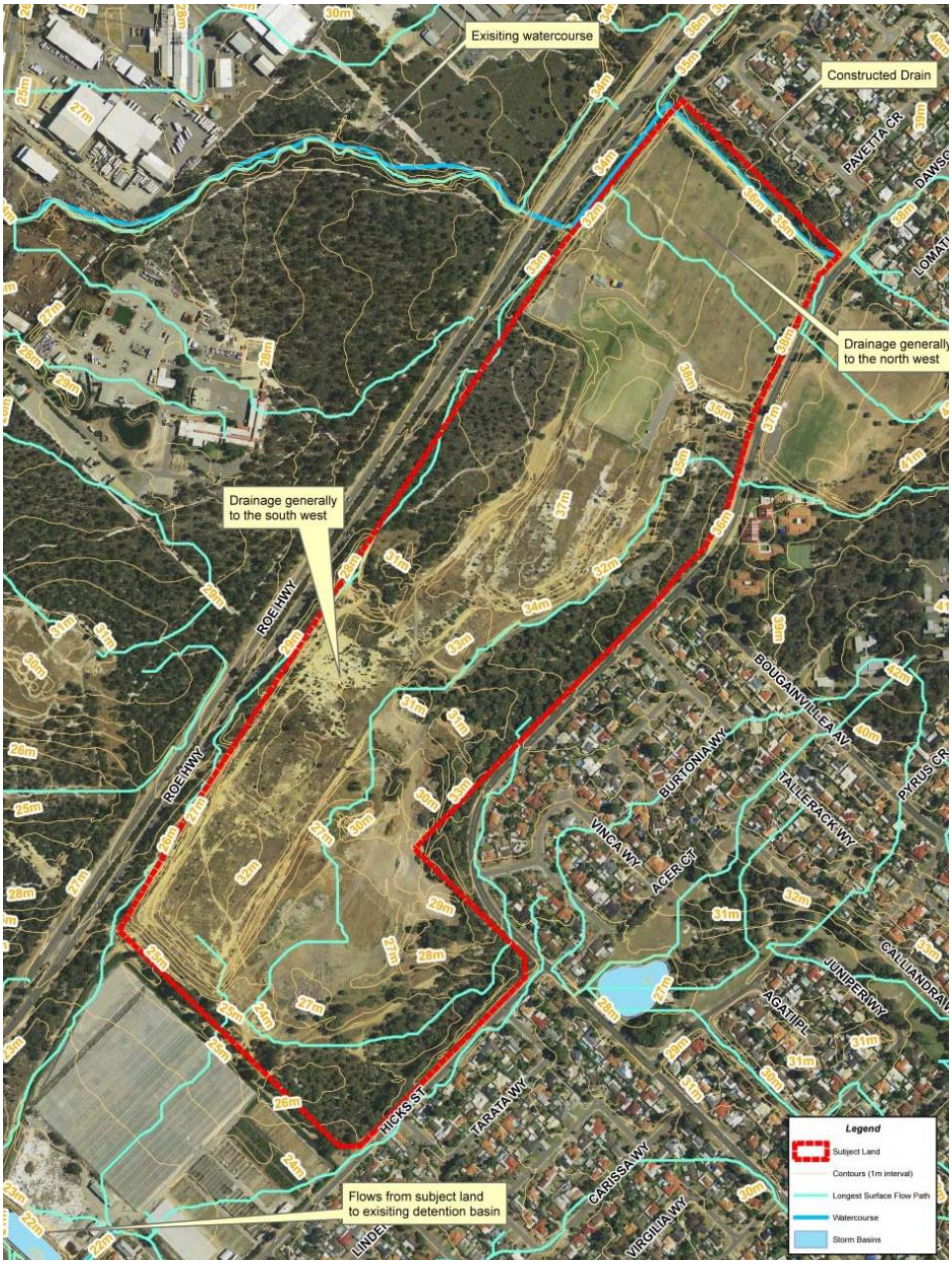


Figure 5-12: Site drainage. Source: 'Trotting Track Fatal Flaw Assessment', 2013, TME

5.6.6 Landfill-specific management considerations

The PFA does not fully address the implications of the site as a former landfill. It is not clear what Council's site-specific obligations are with regards to management in accordance with the Contaminated Sites Act (2003). The PFA does cite the situation with respect to the proposed Fremantle solar farm as follows (Section 3.2):

The City of Fremantle consulted officers of the Contaminated Sites Branch of the Department of Water and Environmental regulation (DWER) in relation to the proposal and were advised:

- The Contaminated Sites Act does not prevent approval on sites with 'contaminated – remediation required' classification.
- Critical factors are how the development would be managed and details of design, cost and ongoing management would need to be considered in any approval.
- Development must not constrain the ability to monitor and remediate the site.
- It may be necessary to cap and cover the footprint of the solar farm.
- People's health and the environment need to be protected.
- The City's environmental consultant and contaminated sites auditor should be involved in developing a management plan associated with any proposal.

Preliminary advice from Fremantle's environmental consultants is that structures which are lightweight and have minimal surface impact could be considered as they would not prevent remediation or management of contaminants. However, substantial structures and below ground services would be problematic.
Community concerns were expressed over health effects of disturbing the contaminated site.
It is noted that the South Fremantle Landfill has not had any gas extraction. The environmental conditions of this landfill may be different to the former Dawson Avenue landfill at Pioneer Park which need to be considered on its own merits.
The developer, Epuron has made an application to the City of Fremantle for development approval, to DWER for environmental approval and to Western Power for connection to the electricity grid.

5.6.6.1 Assessment and implications

The site is not listed on DWER's contaminated sites database[39]. In 2010 it was listed as '*Possibly Contaminated – Investigation Required'*[40]. A subsequent study[41] in 2018 confirmed that part of the site at the south end is not free of landfill material.

The Pioneer Park Master Plan[42] says (at Section 5.1) *"A Contaminated Site and Environmental Management Plan(s) associated with the development of the site would need to be approved by the Department of Environment*."

5.6.6.2 Landfill gas risk and leachate monitoring infrastructure

Gas risk assessment

The pre-feasibility assessment (pp 86) considers the landfill gas (LFG) situation, but only in terms of existing LFG extraction arrangements, and not in terms of gas risk. The gas risk situation was reviewed in 2016 by SERS[43]. Gas sample bores were dug at various points on the east perimeter of the site. The report was mainly concerned with understanding the risk of gas migrating to neighbouring properties, and not with risk of incidental gas produced onsite.

The PFA refers (page 86) to the LFG now being subject to flaring to make the gas emissions safe.

Methane. All samples recorded by SERS measured methane levels as <0.1%v/v.

CO_2. Samples recorded by SERS measured CO_2 levels as high as 13.3%v/v

Based on the CO_2 levels and flow rates, SERS classified the site risk as CS2[44]. This level requires gas protection measures at any future on-site buildings.

[39] https://www.der.wa.gov.au/your-environment/contaminated-sites/58-finding-information-on-contaminated-sites-in-western-australia

[40] GHD, 2010, Pioneer Park Preliminary Site Investigation.

[41] GHD, 2018, 'Dawson Avenue Former Landfill Study (portion of Lot 300)', 6137700

[42] AECOM, July 2015, "Pioneer Park Reserve Master Plan (Final Report)".

[43] Site Environmental and Remediation Services (SERS), "Landfill Gas Risk Assessment, Dawson Avenue, Forrestfield", April 2016

[44] CS = characteristic gas situation based on the method proposed by Wilson and Card (1999). Refer https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/clm/120932groundgasguideline.pdf

5.7 Council and community support

5.7.1 Scope

The PFA considers the question of Council support for the initiative in Section 2.3

The City of Kalamunda has several strategies that support the proposal for the installation of a solar farm including the Strategic Community Plan, Corporate Business Plan, Long Term Financial Plan and Economic Development Strategy. The implications of the solar farm proposals with respects to each of these strategic documents is detailed below.

Strategic Community Plan
The Strategic Community Plan 2017 - 2027 adopted by Council on 26 June 2017 has links that generally support the solar farm project in relation to the effective use of natural resources, management of a contaminated site and developing the City's economy. The specific references relating to the objectives, strategies and success measures in the Strategic Community Plan are outlined below.
Objectives
2.2 To achieve environmental sustainability through ***effective natural resource management***.
2.4 To ensure ***contaminated sites are safe and managed*** to ultimate use.
3.3 To develop and enhance the ***City's economy***.
4.2 To proactively ***engage and partner*** for the benefit of community
Strategies
2.2.1 Facilitate the appropriate use of water and ***energy supplies*** for the City.
2.2.2 Use technology to produce ***innovative solutions to reduce power*** and water usage.
2.4.1 Identify, examine and ***manage risk*** associated with ***contaminated sites***.
3.3.1 Facilitate and support the success and ***growth of industry*** and businesses.
4.2.2 Increase ***advocacy activities*** and develop partnerships to support growth and reputation
Success Measures
- Reduced City water and ***energy consumption***.
- Amount of ***energy saved***.
- ***DoH and DWER approve*** mitigation actions.
- Increasing level of ***investment into economic development related activities through innovation***.

Corporate Business Plan - Priority Action
The Corporate Business Plan adopted by Council on 25 June 2018 provides for a Renewable Power Program to identify and implement a rolling program for annual installation of renewable power supply.
The City has been implementing solar PV installation on three of its major buildings with an enhancement to the system on the Administration Centre planned in 2019. The solar farm is on a small utility scale and surpasses the implementation of roof solar.

Long Term Financial Plan
The most update of the Long Term Financial Plan (LTFP) was adopted at the Special Council meeting held on 25 June 2018. The LTFP outlines the City's revenue, expenditure and funding arrangements over the next ten years.
The LTFP is prepared to ensure the city maintains and enhances its financial position over the life of the plan. The solar farm project is designed to improve the operating position of the council through lower electricity pricing and possibility for revenue generation from exported electricity. The solar farm project is expected to have a life of at least 25 years which exceeds the timeframe of the LTFP, however, the project is expected to continue to have a positive effect on the City's financial position beyond the current LTFP timeframe.
The LTFP includes the following
- To identify the financial opportunities and challenges confronting the City and provide a basis for sound and strategic decision making.
- To clearly outline the City's financial sustainability over the next decade and establish a financial framework against which Council's strategies, policies and financial performance can be measured against industry benchmarked financial indicators.

Economic Development Strategy
The economic development strategy adopted by the City of Kalamunda on 28 November 2017 included a strategic priority for industry expansion and attraction. The section related to Facilitate New Investment and Jobs (1.1) includes the following actions:
- Identify deficiencies and opportunities in employment land.
- Facilitate investment attraction opportunities through:
  - assisting prospective investors with tailored information and site selection
  - liaising with internal stakeholders to manage the relocation/establishment process.

Facilitate the attraction of suitable facilities.

5.7.2 Assessment

Council support. The PFA successfully makes the case that the development and operation of a solar farm is in keeping with Council policy.

Community support. The PFA is silent on the means of cultivating / assessing community support for the project. However, it does note[45], with respect to the proposed South Fremantle solar farm that "*Community concerns were expressed over health effects of disturbing the contaminated site*.". No citation was given to back that up. The question of community support is considered further at Section 8.

[45] PFA, Section 3.2

6. Financial analysis and modelling

6.1 PFA

The PFA analyses the base-case models over 25 years, showing the 5 MW option giving the best net present value, relative to BAU, of $6.2m. The PFA's financial modelling is summed up here:

A base case financial model has been prepared that shows positive cash flows on an NPV and nominal cash flow basis for each of the options considered. The cash flows are based on savings to Business as Usual (BAU) with the City paying electricity costs on its contestable sites. The results of the base case financial model and some other high-level statistics for each option follows.

	1 MW	*3 MW*	*5 MW*
NPV Saving to BAU	*$0.8 million*	*$4.0 million*	*$6.2 million*
Nominal Cash flow saving to BAU	*$2.6 million*	*$9.5 million*	*$14.4 million*
Project Cost	*$1.8 million*	*$5.1 million*	*$8.7 million*
First year electricity generation (AC)	*1,480 MWh*	*4,440 MWh*	*7,410 MWh*
25-year project electricity generation (AC)	*31,000 MWh*	*105,000 MWh*	*175,000 MWh*
Annual CO_2-e abated (0.7 kg CO_2-e/kWh)	*1,050 tonnes*	*3,110 tonnes*	*5,180 tonnes*
Household equivalents (avg. 18 kWh/day)	*225 houses*	*680 houses*	*1,120 houses*

Important note: The base case financial model is underpinned by a range of assumptions that have been evaluated and assessed for their reasonableness using information currently available. These variables may change as a result of new information and cannot be relied upon for a final business case decision. The feasibility phase will provide more certainty around these variables. The most significant assumption that can affect the outcome relates to the future anticipated increase in electricity charges.

From Section 8 of the PFA, more detail is provided:

Business as usual relates to the cost of the City continuing to buy electricity for its contestable sites without the solar farm operating.

The Net Present Value (NPV) represents the sum of cash flows during the life of the project in current dollar values using an assumed discount rate. In this business case the same discount rate has been used as the cost of capital so that the financing arrangements do not skew the bottom line results. In a pure NPV model the finance arrangements would be excluded and a higher discount rate applicable to allow for interest charges. From a cash flow perspective, it is considered relevant to demonstrate the financing cash flow in this instance.

The NPV model shows that the 5 MW option is the most favourable at $6.2 million, with the 3 MW and 1 MW in descending order at $4.0 million and $0.8 million respectively. These results are contingent on the assumptions which are detailed further in this section. The model is sensitive to changes in the variables that make up the assumptions.

Net Present Value Model	1 MW $m	3 MW $m	5 MW $m
BUSINESS AS USUAL			
City's Energy Charges - Contestable	$8.7	$8.7	$8.7
Business as usual NPV	**($8.7)**	**($8.7)**	**($8.7)**
SOLAR FARM			
Cash Inflow			
Loan Received	$1.8	$5.1	$8.7
Retailer Electricity Export	$0.2	$7.7	$15.0
Large-scale Generation Certificates	$0.2	$0.7	$1.1
Sub Total	$2.2	$13.5	$24.8
Cash Outflow			
Project Cost	$1.8	$5.1	$8.7
Generating Cost (Op.& Maint.)	$0.6	$1.5	$2.3
Network Access - Entry	$0.2	$1.1	$2.2
City's Energy Charges - Contestable	$5.7	$5.3	$5.4
Sub Total	$8.3	$13.0	$18.6
Finance Outflow			
Debt	$0.9	$2.6	$4.3
Interest Repayment	$0.9	$2.6	$4.4
Sub Total	$1.8	$5.1	$8.7
Solar Farm NPV	**($7.9)**	**($4.7)**	**($2.5)**
Difference to BAU	**$0.8**	**$4.0**	**$6.2**

In the PFA analysis, the key assumptions are:

- *Discount rate*: 5.0%
- *Interest rate on debt finance*: 5.0%
- *Network access charges*:
- *Development cost*: $1.50/W
- *Generator availability*: 99% (i.e. 1% offline or curtailed)
- *Distribution loss factor on exported energy*: 1.0121
- *Export price paid*: $120/MWh (peak), $80/MWh (off-peak), $110/MWh (blended)
- *Annual price increase in export price*: 5%
- *Retailer margin*: 5%
- *Generation capacity factor*: 17.9% (expressed at 4.31 MWh/MW/day)
- *Grid connection augmentation cost*: $400k (5 MW scenario)
- *LGC price*: $30 in year 1, and reducing 10%/annum
- *Retail BaU electricity costs*: $0.27/kWh peak, $0.18/kWh off-peak

6.2 Analysis

Overall, we find the PFA financial analysis optimistic in some key areas. Some of the key assumptions are problematic. Where an assumption is not questioned, below, we find it to be reasonable.

6.2.1 Value of generated energy

The assumption of the solar farm attracting a long-term export price of $110/MWh (inclusive of reserve-capacity payments), increasing at 5%/annum is highly optimistic.

For the purposes of the base case model a weighted average (or blended) export price of $110 p/MWh (as at July 2021) for the price of electricity from the solar farm is adopted. This is equivalent to the cost of generation estimated by Ernst and Young in their Long-run Marginal Cost model for 2020/21.

(refer PFA Section 8.4)

Rather than a single value for all generated electricity, the value for the generation from a council owned solar farm comprises two main components:

- Offsetting of electricity costs by netting off on the Council bill for periods where solar farm generation matches council consumption. This is the higher value component and should generally be maximised by limiting the solar farm to a scale where as much of the solar farm generation matches the load curve of the council as possible.
- Export price sold via a retailer during periods when the solar farm generation is greater than council loads. This is typically a lower value than the above offsetting value.

Regarding export prices, the latest AEMC electricity price trends report[46],[47] and the AEMO 2020 Q2 quarterly report[48] indicates a downward trend in energy prices in the NEM (east coast) but an upward trend in WA where the state government still sets retail prices. However, the same forces driving down wholesale energy prices in the NEM will flow into the WEM, namely:

- Reduced daytime operational demand due to increasing rooftop penetration;
- Reduced LGC costs;
- Increasing generator competition, particularly from large new renewable generators.

The latest ERA wholesale electricity market review paper[49] discusses WA market prices (balancing market) as follows:

Average annual balancing prices were 13 per cent lower in 2018/19 than in 2017/18. Most of the price reduction was in the high ranges. Below $45/MWh, the price distribution between 2017/18 and 2018/19 was almost identical (Figure 6). Above this level there were fewer intervals with higher market clearing prices. For example, the market was settled:

• Above $50/MWh in 25 per cent of intervals in 2018/19, compared to 33 per cent of intervals in 2017/18.

• Above $100/MWh in just 5 per cent of intervals in 2018/19, compared to 10 per cent of intervals in 2017/18.

Above a price threshold of $40/MWh, Synergy set the price for 87 per cent of intervals in 2017/18 and 86 per cent of intervals in 2018/19. There has been negligible change in which generator sets the price in the market, and at what levels.

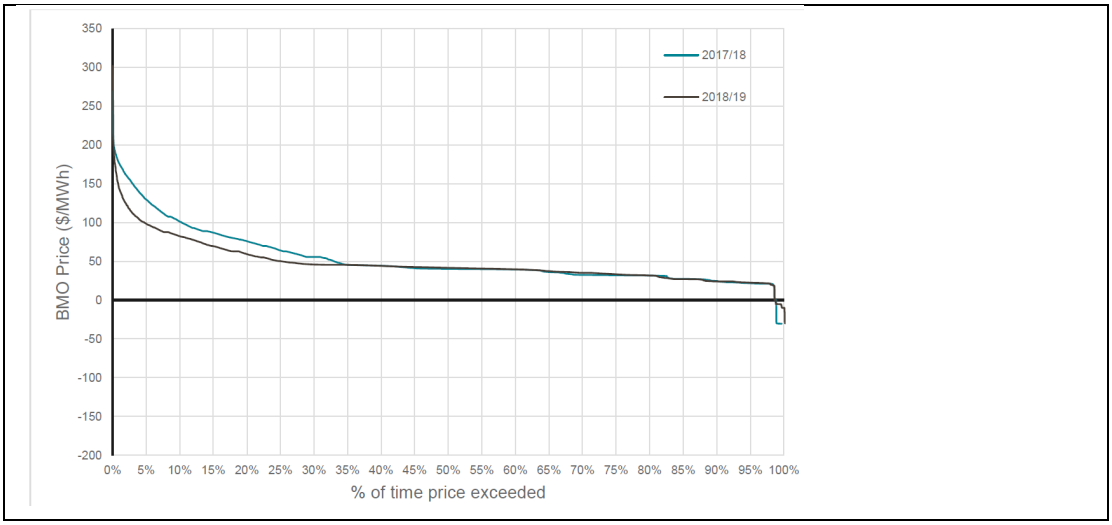
As stated in last year's report, the ERA has undertaken an investigation of Synergy's pricing behaviour and concluded that Synergy has market power and has been bidding wholesale energy into the market at values that are higher than the market rules permit.

[46] https://www.aemc.gov.au/sites/default/files/2019-12/2019%20Residential%20Electricity%20Price%20Trends%20final%20report%20FINAL.pdf

[47] Analysis of AEMC report https://reneweconomy.com.au/electricity-prices-set-to-plummet-as-strong-wind-and-solar-investment-kicks-in-77816/

[48] https://aemo.com.au/energy-systems/major-publications/quarterly-energy-dynamics-qed

[49] Economic Regulation Authority of WA, "Report to the Minister for Energy on the Effectiveness of the Wholesale Electricity Market 2019 Issues Paper", November 2019, https://www.erawa.com.au/cproot/20789/2/Wholesale-Electricity-Market-review-2019---Issues-paper---Final-for-publication.PDF



So, this suggests that the actual median wholesale price in the balancing market is about $45/MWh (not including reserve-capacity payments), and not trending upward. To the extent that the balancing price is a fair proxy indicator for achievable off-take price, this suggests that the PFA-assumed $80MWh (*i.e.* $110, less $30 for reserve capacity payments) is extremely optimistic. This is relevant to any solar power exported in excess of Councils' load *i.e.* requiring offtake between the solar farm and third-party electricity customers.

This price is consistent with Clean Energy Council high-level advice about the fall in solar energy prices[50]:

> *"With solar prices falling dramatically (from $135/MWh in 2015 to between $44.50 and $61.50 per MWh in 2020), large-scale solar is already one of the most attractive options for new generation."*

6.2.2 Reserve-capacity payments

New generators, including non-scheduled generators like solar farms are entitled to register[51],[52] for reserve capacity credits under the WEM market rules. Capacity credits ('Certified Reserve Capacity') are assigned to generators[53] two years ahead, and are publicly disclosed.

Calculation of reserve capacity level is as per WEM market rules Appendix 9 (*Relevant Level Determination*). Based on the Relevant Level Determination, an application for capacity credits need to be made annually.

Examples of capacity credits for WA solar farms[54] shown in table below (for the Capacity Year from 1 October 2021 to 1 October 2022):

[50] https://www.cleanenergycouncil.org.au/resources/technologies/large-scale-solar

[51] https://aemo.com.au/-/media/files/electricity/wem/participant_information/guides-and-useful-information/factsheet-new-generators-participating-in-the-wem.pdf

[52] AEMO, 2020, "New Generator Fact Sheet to Participate in the WA Reserve Capacity Mechanism"

[53] https://aemo.com.au/en/energy-systems/electricity/wholesale-electricity-market-wem/wa-reserve-capacity-mechanism/assignment-of-capacity-credits

[54] https://aemo.com.au/-/media/files/electricity/wem/reserve_capacity_mechanism/assignment/2019/capacity-credits-assigned-for-the-2021-22-capacity-year.pdf

Table 6-1: Reserve-capacity credits - solar-farm examples

Generator	Capacity credits [MW]	Nominal capacity [MW]	Tracking mounts?	Ratio[55]
Merredin Solar Farm[56]	16.320	132	Yes	12.3%
Ambri Solar[57]	0.198	1.0	Yes	19.8%
Northam Solar[58]	1.798	10	Yes	18.0%
Greenough River[59]	7.377	40	Yes, on 30MW	18.4%

BRCP. Reserve capacity payments are the product of the benchmark reserve capacity price (BRCP) and the generator's assigned capacity credits. Historical BRCP shown in the chart below[60]. The current proposed BRCP (2020 cycle, for the 2022-23 capacity year) is $141,900/MW/annum.

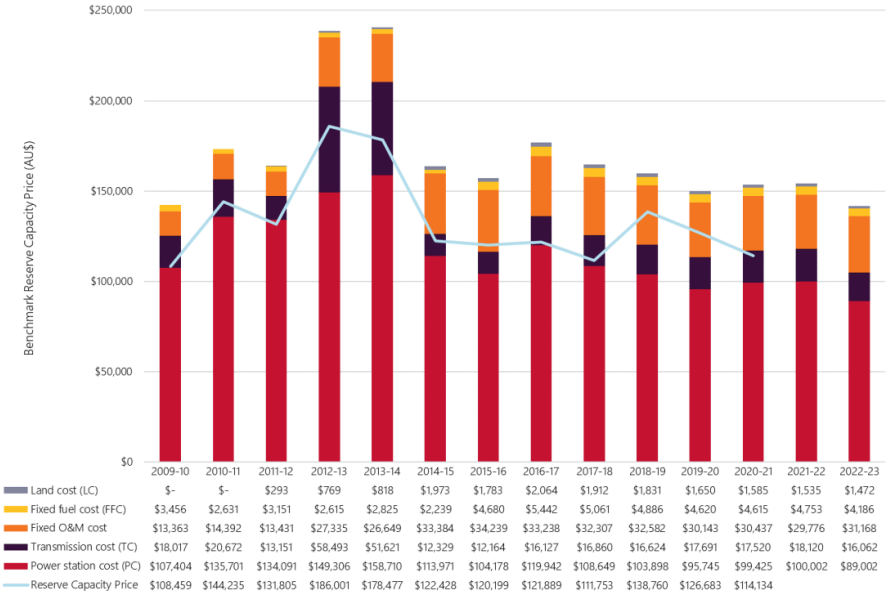


Figure 13: Benchmark Reserve Capacity Price (AEMO)

[55] Ratio of capacity credits to nominal capacity.

[56] https://www.merredinsolar.com.au/solar-farm/

[57] https://www.youtube.com/watch?v=rhYRtl9UD18

[58] http://www.northamsolar.com/

[59] https://www.brightenergyinvestments.com.au/greenough-river-solar-farm

[60] https://aemo.com.au/en/energy-systems/electricity/wholesale-electricity-market-wem/wa-reserve-capacity-mechanism/benchmark-reserve-capacity-price

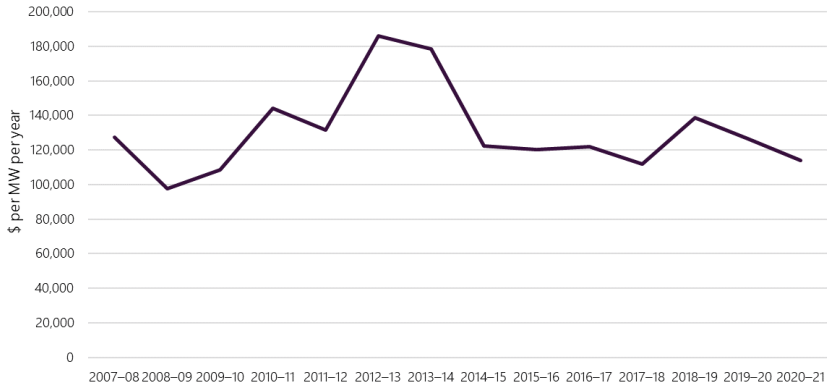


Figure 14: Actual Reserve Capacity Price (AEMO)[61]

Achieved reserve capacity prices vary slightly from the benchmark prices, above. Notwithstanding, a reasonable estimate of reserve capacity annual income to a generator is the arithmetic product of the BRCP and the facility's capacity credits.

Estimating capacity credits. The calculation formula for capacity credits is obscure. Notwithstanding, based on what other solar farms achieve, a fair estimate of capacity credits would appear to be about 0.17MW per MW of solar capacity.

Estimating capacity payments. We estimate a 0.8MW solar farm would earn $16,700/annum in capacity payments. To earn this there are annual overheads associated with generator registration and capacity-credit administration.

Table 6-2: Reserve capacity analysis summary for a 0.8MW solar farm

Item	Value
Modelled generator size [MW]	0.80
Estimated reserve capacity credits [MW]	0.137
average for last five years [$/MW per annum]	$121,967
Estimated payments for this scenario [$/annum]	$16,709
Effective earnings per unit of energy [$/MWh]	$12.64

6.2.3 LGC price

The baseline model assumes LGCs at $30 in year 1, and reducing 10%/annum. The financial markets (as reflected in the Mercari futures[62] price to 2024) are expecting a much steeper drop in LGC price, reflecting that the renewable energy target has been reached, and there will be an excess of capacity competing for the same pool of LGCs. Post 2024, Enhar assume that the price will tend linearly towards zero by 2030 for purpose of this analysis, but it could conceivably go very low, sooner.

The 'new model' line in the chart uses today's starting value and reduces at 30%/annum. This gives a good approximation to the Mercari Futures/Enhar trend.

[61] https://aemo.com.au/-/media/files/electricity/wem/reserve_capacity_mechanism/reserve-capacity-price/historical-reserve-capacity-prices.xlsx?la=en

[62] http://lgc.mercari.com.au/

The RET scheme concludes in 2030 and there will be zero contribution from LGC after that time, unless Federal bipartisan policy emerges which supports a higher renewable energy target for Australia. Bipartisan renewable energy policy appears unlikely to emerge in the medium term however.

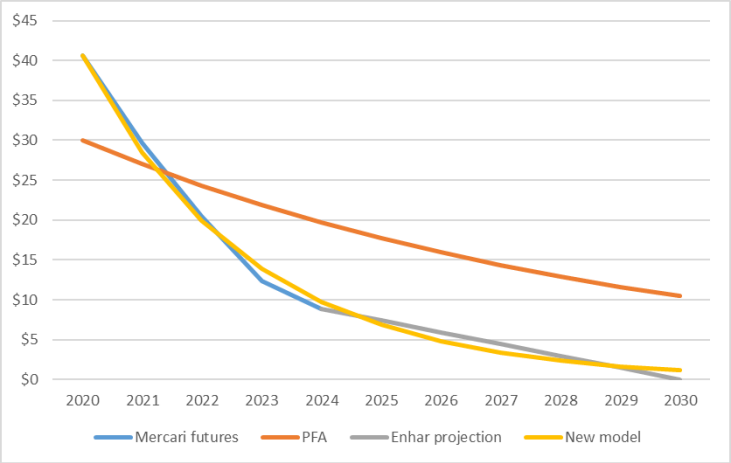


Figure 6-15: LGCs - PFA price assumption vs Futures market

6.2.4 Discount rate, interest rate on finance

The discount rate and finance interest rate are both set at 5%. Both these rates seem too high, but because they are the same, they effectively cancel each other out. A value of 2% for both would seem to be more realistic.

6.2.5 Updated analysis - PFA

The PFA's baseline finance model was updated by Enhar only to reflect our assumptions about market price and LGC value. The new assumptions are:

- Average market price paid: $74/MWh (energy) plus $13/MWh (reserve-capacity payments), falling by 1%/annum;
- LGCs: $28/MWh, falling by 30%/annum with eight years to run (refer Figure 6-15);
- Indexation of expenses: 1.5%;
- Loan rate: 2%
- Discount rate: 2%

Using Kalamunda's provided spreadsheet model, the impact of changing these assumptions is shown in the table below.

Table 6-3: Financial comparison: PFA baseline assumptions vs updated baseline assumptions

Scenario assumptions	NPV vs BAU: 1MW	NPV vs BAU: 3MW	NPV vs BAU: 5MW
PFA original baseline	$0.8m	$4.0	$6.2
Updated baseline	-$3.5m	-$5.3m	-$8.1m

Table 6-4: Summary of PFA model with updated assumptions

Net Present Value Model	1 MW $m	3 MW $m	5 MW $m
BUSINESS AS USUAL			
City's Energy Charges - Contestable	$6.2	$6.2	$6.2
Business as usual NPV	**($6.2)**	**($6.2)**	**($6.2)**
SOLAR FARM			
Cash Inflow			
Loan Received	$1.8	$5.1	$8.7
Retailer Electricity Export	$0.1	$3.1	$5.9
Large-scale Generation Certificates	$0.1	$0.4	$0.6
Sub Total	$2.0	$8.5	$15.3
Cash Outflow			
Project Cost	$1.8	$5.1	$8.7
Generating Cost (Op.& Maint.)	$0.8	$1.8	$2.8
Network Access - Entry	$0.2	$1.4	$2.6
City's Energy Charges - Contestable	$7.1	$6.7	$6.7
Sub Total	$9.9	$14.9	$20.8
Finance Outflow			
Debt	$1.4	$3.9	$6.7
Interest Repayment	$0.4	$1.2	$2.0
Sub Total	$1.8	$5.1	$8.7
Solar Farm NPV	**($9.7)**	**($11.5)**	**($14.3)**
Difference to BAU	**($3.5)**	**($5.3)**	**($8.1)**

Refer to Appendix A for updated cash flow tables, equivalent to those in Appendix F of the PFA.

It is clear that changing the assumptions about achievable market price, and LGC, and price decline/escalation rate, turn the solar farm, as modelled, into a loss-making project. Based on Enhar's prior experience, this model would now appear to suggest a worse outcome than may be achievable. Enhar's models for other councils have achieved positive NPVs and paybacks in the order of 15 years. Accordingly, further work is required to review the financial model assumptions and potentially prepare a model which reflects the better economics of a project which load-matches to the Council's load curve. This is beyond the scope of the current review but is a recommended step.

6.2.6 Updated analysis required

Further independent financial modelling is necessary to verify the likely financial case of a solar farm. Notwithstanding, we consider there's a chance that a ~1MW Council-load-matching solar farm might be have a viable payback period if its operation is linked to the energy purchase at the contestable sites (refer 4.3.2.2).

Enhar have an existing financial model framework for solar arm business-case analysis which we could apply and adapt to the Pioneer Park project if need be.

6.3 Options to improve project economics

Novel features that may potentially improve project economics are described here. Some have already been considered elsewhere in this report.

6.3.1 Focus on meeting Council load

If the majority of generation is used to offset Council contestable load then the exposure to market-price risk is greatly reduced. This is discussed in this report as load-matched generation. Refer 4.3.2.2. This simplifies potential retail agreements and increases the likelihood of getting a long-term off-take agreement;

6.3.2 Reducing connection costs

As discussed at 5.4.2.3, a good outcome would be to use the redundant generator grid connection associated with the landfill-gas system. It could be an elegant means of reducing cost, risk and development time. It remains to be seen if this is feasible, but it's worth exploring. A similar option is to use the existing kiosk transformer already onsite. However, there is no generator connection approval associated with that transformer.

6.3.3 Improving specific yield and generation profile

The assumptions in the PFA are for a solar farm configured with fixed-tilt north-facing single-sided solar panels which achieve a net generator capacity factor[63] of 18%. An option for the project is to use a single-axis-tracker mounting system (refer 5.3.5) along with bi-facial solar PV modules. The combination of these two methods have the potential to increase the output per MW of capacity.

Configuration study. Enhar has done initial study of the impact of single-axis tracking and bi-facial panels. The results are shown below. In this example, a 9% bi-facial gain is assumed for the tracking mount. It also assumes 800kW DC capacity and 625kW inverter size.

Table 6-5: Comparing solar-farm configurations

Modelled configuration	Specific yield [MWh/MWp/yr]	Capacity factor (DC)	Specific yield improvement
Fixed-tilt, mono-facial PV	1671	19.1%[64]	-
Single-axis tracking, mono-facial PV	1744	19.9%	4.4%
Single-axis tracking, bi-facial PV	1867	21.3%	11.8%

Reduced capacity requirement. Another way of looking at that improvement is that, for a given target yield, the advanced solar farm configurations need less installed capacity. So, whereas a 748kWp fixed-tilt mono-facial solar farm would be needed to achieve the 1250MWh/annum target, the same generation could be achieved with only 669kWp of capacity configured with single-axis tracking and bi-facial solar PV modules.

Improved generation profile. Another benefit of the single-axis tracking system is to flatten-out the generation profile, which has the benefits of:

- Increasing generation (relative to fixed-tilt) early and late in the day; and
- Reducing peak output in the middle of the day, which helps because:
  - Lower peak output means less inverter capacity required, *i.e.* reduced hardware cost; and
  - Less dependence upon earning solar income when market price is likely to be lowest.

[63] Capacity factor: refer Glossary.

[64] This capacity factor (19.1%) is higher than the 18% referred to in the preceding text (from PFA). The PFA estimated performance looks to be conservative.

Cost of tracking system. In a comparable proposal seen by Enhar, a configuration using Alion single-axis tracker with new high-capacity bi-facial PV modules achieved a reduction in specific cost of generation [$/MWh] of about 10%, all other things being equal.

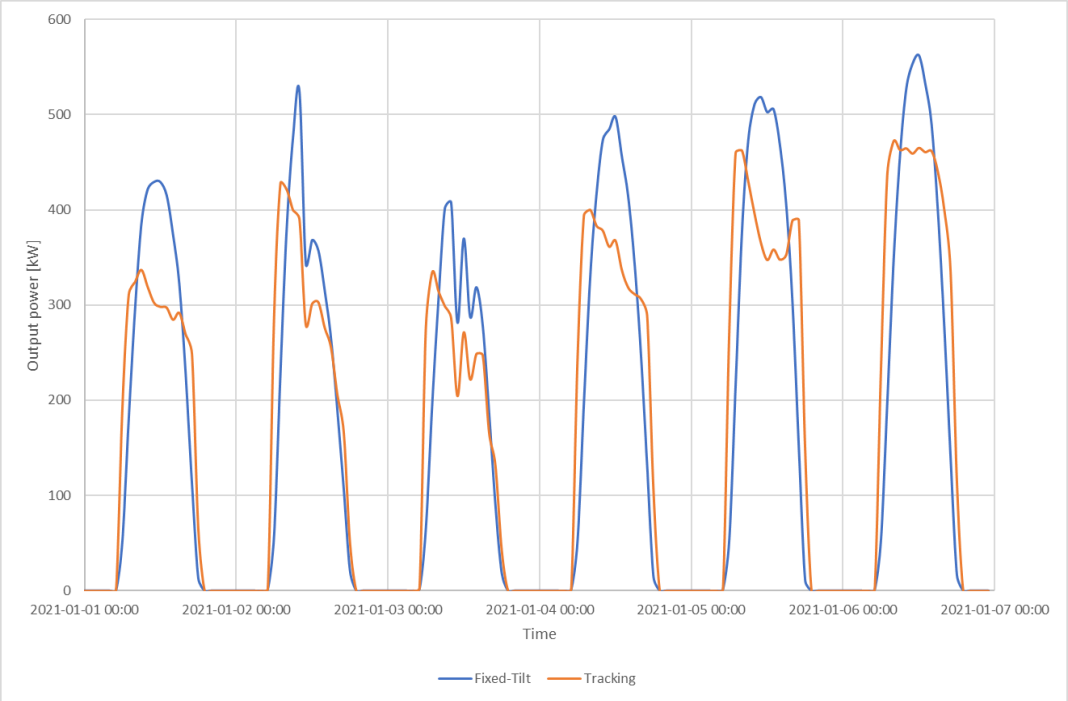


Figure 6-16: Output power comparison: fixed-tilt vs single-axis-tracking for same annual yield

6.3.4 Addition of a battery

Based on attractive returns achieved from batteries in the NEM in 2020, battery revenues could be worth investigating. If battery revenues from frequency control markets are sufficient to improve the overall economics of the project, this may be a method to improve the overall business case.

7. Alternative sites consideration

7.1 Scope

The PFA does not consider the question of alternative sites for a solar farm. Kalamunda have requested[65] that there be some consideration of whether an alternative site should be sought.

7.2 Assessment

In correspondence with Enhar, Kalamunda stated[66]:

> *"We cannot see any other large lots in the City that (a) we own freehold or (b) are in private ownership but have little land value such that purchasing could be accommodated in a financial viability".*

There being no candidate alternative sites for specific review, Enhar's view is that Pioneer Park is highly suited, and available. Accordingly, further consideration of alternative sites is not necessary.

[65] Kalamunda's scope of services document, scope item f).

[66] Email, 2020-03-05. Brett Jackson (Kalamunda) to Demian Natakhan (Enhar).

8. Community engagement package

8.1 Scope

Council's RFQ said "*It is expected that the Consultant will review the draft engagement package developed by the City and allow to include the outcomes of the community engagement report within the feasibility report*.". This section will review the draft community engagement package as part of the final report.

8.2 Assessment

Consideration of Council's 'community engagement package' for the solar farm would allow the following questions to be addressed:

- How likely the project is to receive wide community support;
- Clear and practical role for community to play in the project;
- Project delivers community benefit.

At the time of writing there is no community engagement package to review for this report. By agreement[67] with Council, Enhar will provide a separate review of the community engagement package when it later becomes available, and separate to this report.

Community acceptance: interim observations. In the absence of the community engagement package, a few tentative observations can be made:

- *Energy consumer sentiment*. It has been noted that[68] "*WA is the only state without funded consumer research and representation in its energy market*.", so there is poor data on general community sentiment about renewable energy in WA;
- *Renewables penetration.* WA's net proportion of energy arising from renewables is relatively low (8.2% in 2018[69]). However, the proportion of WA households with PV is relatively high (28.8% in October 2019[69]). Kalamunda's PV penetration is even higher at 33%[70]. This suggests that the community in Kalamunda is perhaps more supportive of renewable energy than average;
- *Precedents – the national experience.* There are good precedents elsewhere in Australia for installations which have proceeded without giving rise to problems with respect to community opposition. Many of the examples are in the PFA at Section 3;
- *Solar isn't wind.* The emergence of wind energy saw many examples of organised community opposition and obstruction. However, utility-scale solar energy installations seem largely free from these hold ups.

The main characteristics that appear to contribute to a public acceptance would seem to be:

- Broad public familiarity with PV and electrical technology;
- Solar farms are generally not *in your face*, *i.e*. from ground level, generally less visually obtrusive when compared to wind turbines;
- Solar farms can 'tread lightly', *i.e*. they don't involve large-scale penetration/modification of the land and they can often co-exist with other land uses;
- Sufficient understanding of the need for / benefits of low-emissions energy.

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[67] Email, Richard Keech (Enhar) with Brett Jackson (Kalamunda), 2020-07-13

[68] Economics and Industry Standing Committee, February 2020, "TAKING CHARGE: WESTERN AUSTRALIA'S TRANSITION TO A DISTRIBUTED ENERGY FUTURE". https://www.parliament.wa.gov.au/Parliament/commit.nsf/(Report+Lookup+by+Com+ID)/444FE5266D8EDEA14825851300106DCD/$file/EISC%20Report%208%20for%20web%20FINAL%20REPORT.pdf

[69] https://www.climatecouncil.org.au/wp-content/uploads/2019/12/CC_State-Renewable-Energy-Nov-2019_V5.pdf

[70] Kalamunda, 'Energy Mega Trends' presentation 2019, page 5

9. Recommendations and next steps

9.1 Sizing

Siting a solar farm at Pioneer Park is viable. However, choosing the optimal system size is challenging. The PFA looks at three possible system sizes (1, 3 and 5 MW) and requested Enhar review system size considerations.

In preparing this review, and in particular reviewing the risks, it is apparent that many of the identified risks are reduced in line with reducing the system generating capacity. Further, we note that:

- There are two possible (unconfirmed) grid-connection options (see 5.4.2.3) suitable for a small (sub-1MW) solar farm which may avoid, or greatly reduce the uncertainty and costs associated with a new grid connection;
- The lowest-risk and simplest commercial arrangement for selling the energy is likely to be one that involves restricting generation to about that required to offset Council's contestable energy load of about 1250MWh/annum. This is discussed at 4.3.2.2.

These factors, combined, tend to suggest that Council should opt for a ~1MW solar farm to reduce cost and risks.

Reducing risks. As mentioned above, a number of the identified project risks would seem to be, at least in part, mitigated by keeping the size of the generator small, as follows:

- *Grid-connection*. Keeping the generation capacity to within the size of, and/or using the previously permitted (~1MW) generator connection, opens the possibility of entirely by-passing the risk, cost and hassle of obtaining a new-generator grid connection (refer to risks discussed at 3.2.12 and 3.2.14);
- *Off-take agreement.* For a solar farm sized above Council's own load, the risk of not obtaining a satisfactory off-take agreement (PPA) to third parties is rated (refer 3.2.1) as *Extreme.* Achieving a low-risk and satisfactory commercial agreement is likely to be most straightforward if solar generation and Council's contestable load are dealt with together as part of the same long-term deal (a strategy of load-matched generation – refer 4.3.2.2) ;
- *Business model*. Private developer with Power Purchase agreement is a potentially low-risk model. Private developer would lease land, and build and operate the solar farm, de-risking the commercial operation of the solar project for Council. This model would ensure Council achieves many of the desired benefits without the complexity and cost of developing the project itself.
- *Tariff.* A load-matched generation strategy would also eliminate the tariff risk (refer 3.2.2) because most of the generation would be accounted for by Council load under an agreed purchase price;
- *Retail license.* The question and risk (refer 3.2.3) of needing a separate retail license goes away in the type of arrangement imagined above;
- *Community objections.* A smaller solar farm is less likely to give rise to community objection. One reason is that a small farm will not completely displace those that currently use the landfill cap area casually for dog walking (see Figure below). Another reason is that the visual impact is more contained;
- *Glint and glare.* A smaller solar facility is likely to be slightly less problematic, all other things being equal, in regards to aviation stakeholder concerns about possible glint and glare;

- *Funding.* The risk associated with funding is lessened with a smaller, cheaper, facility (3.2.15);
- *Planning approval.* Choosing a smaller solar farm allows greater latitude in layout and placement which is likely to give some 'elbow room' in terms of achieving the installation that is least-impactful on the local environs, and therefore easier in terms of achieving planning approval, all other things being equal.

Figure 9-17: A small solar farm won't completely displace current users [Source: Rob McMillan via Google]

9.1.1 Sweet spot size: Matching load

The indicated contestable Council load is 1250MWh/annum. That amount of energy could be generated by a fixed-tilt, un-shaded solar farm of about 700-800kW capacity (depending on configuration and technology choice). This size may well be the sweet-spot size for a council-led solar farm at Pioneer Park, potentially connected using the existing generator grid connection (subject to confirmation that it is available).

This smaller-sized solar-farm option makes most sense because of the degree that it avoids or substantially mitigates grid-connection risk and cost. If that alternative grid-connection pathway does not bear further scrutiny, then a larger (~5 MW) solar farm may be indicated so that the substantial grid-connection cost is spread across more generation capacity.

9.2 Next steps

Suggested next steps are to:

1. *Modelling* Undertake more financial modelling to identify project sizing scenario which would deliver a viable return on investment*;*
2. *Community engagement.* Enhar will assess the community engagement package, when that is ready for review;
3. *Retail model.* Firm up possible retail model for energy sales as discussed at 4.3.2.2. This needs to be considered very early because the extent to which Council loads needs to be part of any contractual arrangement with a retailer has a large bearing on the selection of the appropriate solar generation capacity;
4. *Grid connection: existing generator connection.* If the discussions on retail model bear out the idea that a smaller-capacity solar farm may suit, then open a dialog with EDL Energy[71], current lease holders of the landfill-gas generator concession, to

[71] Energy Developments (EDL), https://edlenergy.com/

ascertain their appetite for possible productive use of the un-used existing grid connection (refer 5.4.2.3);

5. *Grid connect: new connection*. If, after discussions related to steps #2 and #3 above, a new grid connection is appropriate, then proceed with the quoted-for detailed connection enquiry process with Western Power (refer 5.4.2.1);
6. *Contaminated-site status.* The long-standing status of the site as '*Possibly Contaminated – Investigation Required*' needs to be resolved because a project approval will probably be delayed so long as that question mark remains (refer 3.3.2);
7. *Geotech study.* Because of the AECOM report's advice regarding the possible need for very costly site remediation work (refer 3.3.1), there will need to be a follow up geotechnical study to verify the extent to which any site remediation is actually required. This applies to the northern landfill cap section only.

The above steps could be incorporated into a full Feasibility Study stage of the project.

Based on the outcome of those seven steps, a clear sense of the options open, and appropriate further steps will become apparent.

9.2.1 Next steps - proposal

Based on the recommended downsized model, the following indicative scope and price guidance is provided for Enhar to perform many of the steps, above, to help firm up the feasibility of this proposed solar farm:

Step	Outline	Indicative cost (ex GST)
Perform financial modelling	Prepare a detailed financial model of the recommended downsized scenario.	$4,000
Further analyse retail energy arrangement	Engage with candidate energy retailers to further explore the feasibility of using the solar farm to offset Council contestable loads.	$2,900
Further analyse grid connection	Engage with EDL to flesh out the technical and commercial potential to re-use the existing generator connection.	$4,000
Review community engagement	Enhar will assess the community engagement package when this prepared by Council, as already agreed within the scope of this current review.	$0
Review site status	Enhar to assess any documents arising from future review/amendment of contaminated site status.	$800
Review Geotech study	Enhar to assess any documents arising from future review of Geotech situation.	$800
Reporting	Prepare supplementary report on the conclusions of the steps above.	$4,800
Total		$17,300

The above pricing does not include any site visits by Enhar.

This is based on the expectation that Council will separately arrange and fund:

- Community engagement;
- Review/amend contaminated sites status;
- Limited geotechnical review, limited to resolving what, if any, site remediation works are required in the area proposed for the solar farm.

New grid connection. This proposal does not consider alternative scenario where an entirely new grid connection is required. As discussed at 5.4.2.1, Western Power have quoted $33,860 to conduct a detailed study into the needs of a new grid connection. There's no way to accurately estimate the cost of a new grid connection until that study is performed, hence we recommend that budget is secured to undertake this item after the above work is completed, to enable the larger solar farm to remain among the options.

The cost to deliver a full feasibility study would therefore be a total of $17,300 ex GST plus $33,860 ex GST for Western Power if needed.

Appendix A – Amended Cash Flow Models

The PFA, at Appendix F, includes tabulated cash-flow models for the three modelled scenarios based on many assumptions. It was beyond the scope of this review to create a new financial model. However, Enhar has adjusted some of the key assumptions as reflected in the table below. The summary results are as shown in Table 6-3. This appendix provides the updated cash-flow tables, equivalent to those at Appendix F of the PFA.

Enhar is not suggesting, that the PFA model with the new assumptions is necessarily a reasonable new model. The point is simply to explore the impact, in the PFA financial model, of the updated, more reasonable, assumptions.

Item	Baseline assumption in PFA	New assumption
Initial export price – Peak [$/MWh]	122	63
Initial export price – Off-peak [$/MWh]	80	48
Blended initial export price [$/MWh]	110	58
Initial LGC price	30	28
LGC annual rate of change	-10%	-30%
Electricity annual export price change	5%	-1%
Expenses annual change	3%	1.5%
Loan interest rate	5%	2%
Discount rate	5%	2%

	Discounted Cash Flow	Total Nominal Cash Flow	Year 0 Jun-2021	Year 1 Jun-2022	Year 2 Jun-2023	Year 3 Jun-2024	Year 4 Jun-2025	Year 5 Jun-2026	Year 6 Jun-2027	Year 7 Jun-2028	Year 8 Jun-2029	Year 9 Jun-2030	Year 10 Jun-2031	Year 11 Jun-2032	Year 12 Jun-2033	Year 13 Jun-2034	Year 14 Jun-2035	Year 15 Jun-2036	Year 16 Jun-2037	Year 17 Jun-2038	Year 18 Jun-2039	Year 19 Jun-2040	Year 20 Jun-2041	Year 21 Jun-2042	Year 22 Jun-2043	Year 23 Jun-2044	Year 24 Jun-2045	Year 25 Jun-2046
OPTION 1 - SOLAR FARM - 1 MW																												
Business as Usual																												
Energy Charges - Contestable	$6,152,380	$7,708,094	$335,197	$331,845	$328,527	$325,242	$321,989	$318,769	$315,582	$312,426	$309,302	$306,209	$303,147	$300,115	$297,114	$294,143	$291,201	$288,289	$285,406	$282,552	$279,727	$276,930	$274,160	$271,419	$268,704	$266,017	$263,357	$260,724
BAU Cash Flow	**($6,152,380)**	**($7,708,094)**	**($335,197)**	**($331,845)**	**($328,527)**	**($325,242)**	**($321,989)**	**($318,769)**	**($315,582)**	**($312,426)**	**($309,302)**	**($306,209)**	**($303,147)**	**($300,115)**	**($297,114)**	**($294,143)**	**($291,201)**	**($288,289)**	**($285,406)**	**($282,552)**	**($279,727)**	**($276,930)**	**($274,160)**	**($271,419)**	**($268,704)**	**($266,017)**	**($263,357)**	**($260,724)**
Solar Farm																												
Large-scale Generation Certificates per MWh				$28	$20	$14	$10	$7	$5	$3	$2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MWh		31,097		1,482	1,459	1,438	1,416	1,395	1,374	1,354	1,333	1,313	1,294	1,274	1,255	1,237	1,218	1,200	1,182	1,164	1,147	1,130	1,113	1,096	1,080	1,064	1,048	1,032
MWh - City Use				1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,237	1,218	1,200	1,182	1,164	1,147	1,130	1,113	1,096	1,080	1,064	1,048	1,032
MWh - Retailer Export				306	210	188	167	145	125	104	84	64	44	25	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Price per MWh Peak				$62.64	$62.01	$61.39	$60.78	$60.17	$59.57	$58.97	$58.38	$57.80	$57.22	$56.65	$56.08	$55.52	$54.97	$54.42	$53.87	$53.34	$52.80	$52.27	$51.75	$51.23	$50.72	$50.21	$49.71	$49.21
Price per MWh Off-peak				$47.64	$47.16	$46.69	$46.23	$45.76	$45.31	$44.85	$44.40	$43.96	$43.52	$43.08	$42.65	$42.23	$41.81	$41.39	$40.97	$40.56	$40.16	$39.76	$39.36	$38.97	$38.58	$38.19	$37.81	$37.43
Blended Price per MWh				$57.64	$57.06	$56.49	$55.93	$55.37	$54.82	$54.27	$53.72	$53.19	$52.66	$52.13	$51.61	$51.09	$50.58	$50.07	$49.57	$49.08	$48.59	$48.10	$47.62	$47.14	$46.67	$46.21	$45.74	$45.29
Inflow																												
Loan Received	$1,840,000	$1,840,000	$1,840,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Retailer Electricity Export	$76,534	$82,955	$0	$17,851	$12,130	$10,761	$9,436	$8,155	$6,916	$5,719	$4,561	$3,442	$2,361	$1,316	$308	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Large-scale Generation Certificates	$121,945	$128,784	$0	$42,136	$29,054	$20,034	$13,814	$9,525	$6,568	$4,529	$3,123	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub Total	$2,038,479	$2,051,740	$1,840,000	$59,987	$41,184	$30,795	$23,251	$17,681	$13,484	$10,247	$7,684	$3,442	$2,361	$1,316	$308	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Outflow																												
Project Cost	$1,840,000	$1,840,000	$1,840,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Generating Cost (Op.& Maint.)	$751,426	$977,048	$0	$32,500	$32,988	$33,482	$33,985	$34,494	$35,012	$35,537	$36,070	$36,611	$37,160	$37,718	$38,283	$38,858	$39,440	$40,032	$40,633	$41,242	$41,861	$42,489	$43,126	$43,773	$44,429	$45,096	$45,772	$46,459
Network Access - Entry	$206,388	$268,358		$8,927	$9,060	$9,196	$9,334	$9,474	$9,616	$9,761	$9,907	$10,056	$10,206	$10,360	$10,515	$10,673	$10,833	$10,995	$11,160	$11,328	$11,498	$11,670	$11,845	$12,023	$12,203	$12,386	$12,572	$12,760
Network Access - Exit Contestable	$4,067,950	$5,243,613		$185,958	$188,777	$191,392	$194,047	$196,742	$199,478	$202,256	$205,075	$207,938	$210,844	$213,794	$216,788	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733	$217,733
Energy Charges - Contestable	$3,030,348	$3,855,684	$335,197	$82,812	$96,387	$106,657	$114,631	$121,016	$126,305	$130,848	$134,886	$140,741	$143,587	$146,498	$149,475	$150,948	$151,728	$152,520	$153,323	$154,139	$154,967	$155,808	$156,661	$157,526	$158,405	$159,297	$160,202	$161,121
Sub Total	$9,896,113	$12,184,704	$2,175,197	$310,196	$327,212	$340,728	$351,997	$361,726	$370,412	$378,401	$385,938	$395,345	$401,797	$408,368	$415,061	$418,211	$419,734	$421,280	$422,849	$424,442	$426,058	$427,699	$429,364	$431,055	$432,770	$434,512	$436,279	$438,073
Project Cash Flow	**($7,857,634)**	**($10,132,964)**	**($335,197)**	**($250,209)**	**($286,027)**	**($309,933)**	**($328,746)**	**($344,046)**	**($356,927)**	**($368,153)**	**($378,254)**	**($391,904)**	**($399,436)**	**($407,052)**	**($414,753)**	**($418,211)**	**($419,734)**	**($421,280)**	**($422,849)**	**($424,442)**	**($426,058)**	**($427,699)**	**($429,364)**	**($431,055)**	**($432,770)**	**($434,512)**	**($436,279)**	**($438,073)**
Finance																												
Debt	$1,407,588	$1,839,487		$57,430	$58,578	$59,750	$60,945	$62,164	$63,407	$64,675	$65,969	$67,288	$68,634	$70,006	$71,406	$72,835	$74,291	$75,777	$77,293	$78,839	$80,415	$82,024	$83,664	$85,337	$87,044	$88,785	$90,561	$92,372
Interest Repayment	$432,099	$516,253	$0	$36,800	$35,651	$34,480	$33,285	$32,066	$30,823	$29,555	$28,261	$26,942	$25,596	$24,223	$22,823	$21,395	$19,938	$18,452	$16,937	$15,391	$13,814	$12,206	$10,566	$8,892	$7,185	$5,445	$3,669	$1,858
Sub Total	$1,839,687	$2,355,740	$0	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230	$94,230
Debt Owing			$1,840,000	$1,782,570	$1,723,992	$1,664,242	$1,603,298	$1,541,134	$1,477,727	$1,413,052	$1,347,084	$1,279,796	$1,211,162	$1,141,156	$1,069,749	$996,915	$922,623	$846,846	$769,554	$690,715	$610,300	$528,276	$444,612	$359,275	$272,231	$183,446	$92,885	$513
Net Cash Flow After Finance	**($9,697,321)**	**($12,488,704)**	**($335,197)**	**($344,438)**	**($380,257)**	**($404,163)**	**($422,976)**	**($438,275)**	**($451,157)**	**($462,383)**	**($472,484)**	**($486,133)**	**($493,666)**	**($501,281)**	**($508,983)**	**($512,440)**	**($513,964)**	**($515,509)**	**($517,078)**	**($518,671)**	**($520,288)**	**($521,928)**	**($523,594)**	**($525,284)**	**($527,000)**	**($528,741)**	**($530,509)**	**($532,303)**
Cumulative Cash Flow			($335,197)	($679,636)	($1,059,893)	($1,464,055)	($1,887,031)	($2,325,307)	($2,776,463)	($3,238,846)	($3,711,330)	($4,197,463)	($4,691,129)	($5,192,411)	($5,701,394)	($6,213,834)	($6,727,798)	($7,243,307)	($7,760,386)	($8,279,057)	($8,799,344)	($9,321,273)	($9,844,867)	($10,370,151)	($10,897,151)	($11,425,892)	($11,956,401)	($12,488,704)
Difference to BAU	**($3,544,941)**	**($4,780,610)**	**$0**	**($12,593)**	**($51,730)**	**($78,921)**	**($100,987)**	**($119,506)**	**($135,575)**	**($149,957)**	**($163,182)**	**($179,925)**	**($190,519)**	**($201,166)**	**($211,869)**	**($218,298)**	**($222,762)**	**($227,220)**	**($231,672)**	**($236,119)**	**($240,561)**	**($244,999)**	**($249,433)**	**($253,865)**	**($258,295)**	**($262,724)**	**($267,152)**	**($271,579)**
Cumulative Cash Flow			$0	($12,593)	($64,323)	($143,244)	($244,230)	($363,736)	($499,311)	($649,268)	($812,451)	($992,375)	($1,182,895)	($1,384,061)	($1,595,930)	($1,814,228)	($2,036,990)	($2,264,210)	($2,495,882)	($2,732,001)	($2,972,562)	($3,217,561)	($3,466,994)	($3,720,859)	($3,979,155)	($4,241,879)	($4,509,030)	($4,780,610)
Analysis																												
Generating Cost MWh				$21.94	$22.60	$23.29	$24.00	$24.73	$25.48	$26.25	$27.05	$27.88	$28.72	$29.60	$30.50	$31.42	$32.38	$33.36	$34.38	$35.42	$36.50	$37.61	$38.75	$39.93	$41.15	$42.40	$43.69	$45.01
Network Cost MWh				$6.02	$6.21	$6.40	$6.59	$6.79	$7.00	$7.21	$7.43	$7.66	$7.89	$8.13	$8.38	$8.63	$8.89	$9.16	$9.44	$9.73	$10.03	$10.33	$10.64	$10.97	$11.30	$11.64	$12.00	$12.36
Finance Cost MWh				$63.60	$64.57	$65.55	$66.54	$67.55	$68.58	$69.62	$70.67	$71.75	$72.83	$73.94	$75.06	$76.20	$77.36	$78.53	$79.72	$80.93	$82.16	$83.41	$84.67	$85.96	$87.26	$88.59	$89.93	$91.30
Total Generation Cost MWh				$91.56	$93.38	$95.23	$97.13	$99.07	$101.05	$103.08	$105.16	$107.28	$109.45	$111.66	$113.93	$116.25	$118.63	$121.06	$123.54	$126.09	$128.69	$131.35	$134.07	$136.86	$139.71	$142.63	$145.62	$148.68
Net (after LGCs) Generation Cost MWh				$63.12	$73.47	$81.30	$87.38	$92.24	$96.27	$99.74	$102.81	$107.28	$109.45	$111.66	$113.93	$116.25	$118.63	$121.06	$123.54	$126.09	$128.69	$131.35	$134.07	$136.86	$139.71	$142.63	$145.62	$148.68
City use cost MWh				$268.27	$215.11	$228.23	$238.54	$247.05	$254.31	$260.74	$266.60	$272.08	$279.06	$283.66	$288.36	$293.13	$298.14	$303.31	$308.57	$313.93	$319.40	$324.97	$330.64	$336.43	$342.32	$348.33	$354.46	$360.70	$367.07
LCOE NPV Rate	10%																											
Production MWh	31,097																											
NPV Opex	$422,104				$41,427	$42,048	$42,679	$43,319	$43,969	$44,628	$45,298	$45,977	$46,667	$47,367	$48,077	$48,798	$49,530	$50,273	$51,027	$51,793	$52,570	$53,358	$54,159	$54,971	$55,795	$56,632	$57,482	$58,344	$59,219
NPV Capex	$1,840,000																											
Levelised Cost of Energy (LCOE)	$72.74																											

	Discounted Cash Flow	Total Nominal Cash Flow	Year 0 Jun-2021	Year 1 Jun-2022	Year 2 Jun-2023	Year 3 Jun-2024	Year 4 Jun-2025	Year 5 Jun-2026	Year 6 Jun-2027	Year 7 Jun-2028	Year 8 Jun-2029	Year 9 Jun-2030	Year 10 Jun-2031	Year 11 Jun-2032	Year 12 Jun-2033	Year 13 Jun-2034	Year 14 Jun-2035	Year 15 Jun-2036	Year 16 Jun-2037	Year 17 Jun-2038	Year 18 Jun-2039	Year 19 Jun-2040	Year 20 Jun-2041	Year 21 Jun-2042	Year 22 Jun-2043	Year 23 Jun-2044	Year 24 Jun-2045	Year 25 Jun-2046
OPTION 2 - SOLAR FARM - 3 MW																												
Business as Usual																												
Energy Charges - Contestable	$6,152,380	$7,708,094	$335,197	$331,845	$328,527	$325,242	$321,989	$318,769	$315,582	$312,426	$309,302	$306,209	$303,147	$300,115	$297,114	$294,143	$291,201	$288,289	$285,406	$282,552	$279,727	$276,930	$274,160	$271,419	$268,704	$266,017	$263,357	$260,724
BAU Cash Flow	**($6,152,380)**	**($7,708,094)**	**($335,197)**	**($331,845)**	**($328,527)**	**($325,242)**	**($321,989)**	**($318,769)**	**($315,582)**	**($312,426)**	**($309,302)**	**($306,209)**	**($303,147)**	**($300,115)**	**($297,114)**	**($294,143)**	**($291,201)**	**($288,289)**	**($285,406)**	**($282,552)**	**($279,727)**	**($276,930)**	**($274,160)**	**($271,419)**	**($268,704)**	**($266,017)**	**($263,357)**	**($260,724)**
Solar Farm																												
Large-scale Generation Certificates per MWh				$28	$20	$14	$10	$7	$5	$3	$2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MWh		104,701		4,445	4,423	4,400	4,378	4,357	4,335	4,313	4,292	4,270	4,249	4,227	4,206	4,185	4,164	4,144	4,123	4,102	4,082	4,061	4,041	4,021	4,001	3,981	3,961	3,941
MWh - City Use				1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249
MWh - Retailer Export				3,417	3,173	3,151	3,129	3,107	3,085	3,064	3,042	3,021	2,999	2,978	2,957	2,936	2,915	2,894	2,873	2,853	2,832	2,812	2,792	2,771	2,751	2,731	2,711	2,691
Price per MWh Peak				$62.64	$62.01	$61.39	$60.78	$60.17	$59.57	$58.97	$58.38	$57.80	$57.22	$56.65	$56.08	$55.52	$54.97	$54.42	$53.87	$53.34	$52.80	$52.27	$51.75	$51.23	$50.72	$50.21	$49.71	$49.21
Price per MWh Off-peak				$47.64	$47.16	$46.69	$46.23	$45.76	$45.31	$44.85	$44.40	$43.96	$43.52	$43.08	$42.65	$42.23	$41.81	$41.39	$40.97	$40.56	$40.16	$39.76	$39.36	$38.97	$38.58	$38.19	$37.81	$37.43
Blended Price per MWh				$57.64	$57.06	$56.49	$55.93	$55.37	$54.82	$54.27	$53.72	$53.19	$52.66	$52.13	$51.61	$51.09	$50.58	$50.07	$49.57	$49.08	$48.59	$48.10	$47.62	$47.14	$46.67	$46.21	$45.74	$45.29
Inflow																												
Loan Received	$5,120,000	$5,120,000	$5,120,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Retailer Electricity Export	$3,051,695	$3,836,986	$0	$199,376	$183,310	$180,213	$177,165	$174,166	$171,215	$168,313	$165,457	$162,647	$159,882	$157,162	$154,486	$151,853	$149,263	$146,715	$144,208	$141,742	$139,315	$136,928	$134,580	$132,270	$129,997	$127,762	$125,562	$123,399
Large-scale Generation Certificates	$372,284	$393,437	$0	$126,409	$88,044	$61,323	$42,711	$29,748	$20,720	$14,431	$10,051	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub Total	$8,543,979	$9,350,423	$5,120,000	$325,785	$271,354	$241,535	$219,876	$203,914	$191,935	$182,744	$175,508	$162,647	$159,882	$157,162	$154,486	$151,853	$149,263	$146,715	$144,208	$141,742	$139,315	$136,928	$134,580	$132,270	$129,997	$127,762	$125,562	$123,399
Outflow																												
Project Cost	$5,120,000	$5,120,000	$5,120,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Generating Cost (Op.& Maint.)	$1,768,741	$2,299,821	$0	$76,500	$77,648	$78,812	$79,994	$81,194	$82,412	$83,648	$84,903	$86,177	$87,469	$88,781	$90,113	$91,465	$92,837	$94,229	$95,643	$97,077	$98,534	$100,012	$101,512	$103,034	$104,580	$106,149	$107,741	$109,357
Network Access - Entry	$1,357,595	$1,765,225		$58,717	$59,598	$60,492	$61,400	$62,321	$63,255	$64,204	$65,167	$66,145	$67,137	$68,144	$69,166	$70,204	$71,257	$72,326	$73,410	$74,512	$75,629	$76,764	$77,915	$79,084	$80,270	$81,474	$82,696	$83,937
Network Access - Exit Contestable	$3,874,767	$4,985,891		$185,958	$189,613	$190,483	$191,357	$192,236	$193,119	$194,007	$194,899	$195,796	$196,697	$197,603	$198,513	$199,428	$200,347	$201,271	$202,200	$203,133	$204,071	$205,014	$205,961	$206,913	$207,870	$208,832	$209,799	$210,770
Energy Charges - Contestable	$2,801,193	$3,554,157	$335,197	$79,994	$92,378	$101,423	$108,136	$113,221	$117,174	$120,341	$122,962	$127,360	$128,706	$130,072	$131,460	$132,869	$134,301	$135,755	$137,232	$138,733	$140,257	$141,806	$143,380	$144,978	$146,603	$148,253	$149,930	$151,635
Sub Total	$14,922,296	$17,725,095	$5,455,197	$401,169	$419,237	$431,210	$440,887	$448,972	$455,961	$462,200	$467,932	$475,477	$480,009	$484,600	$489,252	$493,965	$498,742	$503,581	$508,485	$513,455	$518,491	$523,595	$528,768	$534,010	$539,323	$544,708	$550,167	$555,699
Project Cash Flow	**($6,378,317)**	**($8,374,672)**	**($335,197)**	**($75,384)**	**($147,883)**	**($189,675)**	**($221,011)**	**($245,058)**	**($264,026)**	**($279,456)**	**($292,424)**	**($312,831)**	**($320,127)**	**($327,438)**	**($334,766)**	**($342,112)**	**($349,478)**	**($356,866)**	**($364,277)**	**($371,713)**	**($379,176)**	**($386,667)**	**($394,188)**	**($401,740)**	**($409,326)**	**($416,947)**	**($424,604)**	**($432,300)**
Finance Outflow																												
Debt	$3,916,766	$5,118,572		$159,804	$163,000	$166,260	$169,585	$172,977	$176,437	$179,965	$183,565	$187,236	$190,981	$194,800	$198,696	$202,670	$206,724	$210,858	$215,075	$219,377	$223,764	$228,240	$232,804	$237,460	$242,210	$247,054	$251,995	$257,035
Interest Repayment	$1,202,363	$1,436,530	$0	$102,400	$99,204	$95,944	$92,619	$89,227	$85,767	$82,239	$78,639	$74,968	$71,223	$67,404	$63,508	$59,534	$55,480	$51,346	$47,129	$42,827	$38,440	$33,965	$29,400	$24,744	$19,994	$15,150	$10,209	$5,169
Sub Total	$5,119,130	$6,555,102	$0	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204	$262,204
Debt Owing			$5,120,000	$4,960,196	$4,797,196	$4,630,936	$4,461,350	$4,288,373	$4,111,937	$3,931,971	$3,748,407	$3,561,171	$3,370,190	$3,175,390	$2,976,694	$2,774,023	$2,567,300	$2,356,442	$2,141,366	$1,921,990	$1,698,225	$1,469,986	$1,237,181	$999,721	$757,511	$510,458	$258,463	$1,428
Net Cash Flow	**($11,497,447)**	**($14,929,774)**	**($335,197)**	**($337,588)**	**($410,087)**	**($451,879)**	**($483,215)**	**($507,262)**	**($526,230)**	**($541,661)**	**($554,628)**	**($575,035)**	**($582,331)**	**($589,642)**	**($596,970)**	**($604,316)**	**($611,682)**	**($619,070)**	**($626,481)**	**($633,917)**	**($641,380)**	**($648,871)**	**($656,392)**	**($663,944)**	**($671,530)**	**($679,151)**	**($686,808)**	**($694,504)**
Cumulative Cash Flow			($335,197)	($672,786)	($1,082,873)	($1,534,752)	($2,017,967)	($2,525,229)	($3,051,459)	($3,593,120)	($4,147,748)	($4,722,783)	($5,305,114)	($5,894,756)	($6,491,726)	($7,096,042)	($7,707,725)	($8,326,795)	($8,953,276)	($9,587,194)	($10,228,574)	($10,877,445)	($11,533,836)	($12,197,780)	($12,869,310)	($13,548,461)	($14,235,269)	($14,929,774)
Difference to BAU	**($5,345,067)**	**($7,221,680)**	**$0**	**($5,743)**	**($81,560)**	**($126,638)**	**($161,226)**	**($188,493)**	**($210,649)**	**($229,235)**	**($245,327)**	**($268,826)**	**($279,184)**	**($289,527)**	**($299,856)**	**($310,173)**	**($320,481)**	**($330,781)**	**($341,075)**	**($351,365)**	**($361,653)**	**($371,941)**	**($382,231)**	**($392,525)**	**($402,825)**	**($413,133)**	**($423,451)**	**($433,781)**
Cumulative Cash Flow			$0	($5,743)	($87,303)	($213,940)	($375,166)	($563,659)	($774,307)	($1,003,542)	($1,248,868)	($1,517,695)	($1,796,879)	($2,086,406)	($2,386,262)	($2,696,436)	($3,016,917)	($3,347,698)	($3,688,773)	($4,040,138)	($4,401,791)	($4,773,732)	($5,155,964)	($5,548,489)	($5,951,315)	($6,364,448)	($6,787,899)	($7,221,680)
Analysis																												
Generating Cost MWh				$17.21	$17.56	$17.91	$18.27	$18.64	$19.01	$19.39	$19.78	$20.18	$20.59	$21.00	$21.42	$21.85	$22.29	$22.74	$23.20	$23.66	$24.14	$24.63	$25.12	$25.63	$26.14	$26.67	$27.20	$27.75
Network Cost MWh				$13.21	$13.48	$13.75	$14.02	$14.31	$14.59	$14.89	$15.19	$15.49	$15.80	$16.12	$16.44	$16.77	$17.11	$17.46	$17.81	$18.16	$18.53	$18.90	$19.28	$19.67	$20.06	$20.47	$20.88	$21.30
Finance Cost MWh				$58.99	$59.29	$59.59	$59.89	$60.19	$60.49	$60.79	$61.10	$61.41	$61.71	$62.02	$62.34	$62.65	$62.96	$63.28	$63.60	$63.92	$64.24	$64.56	$64.89	$65.21	$65.54	$65.87	$66.20	$66.53
Total Generation Cost MWh				$89.41	$90.32	$91.24	$92.18	$93.13	$94.09	$95.07	$96.07	$97.08	$98.10	$99.14	$100.20	$101.28	$102.37	$103.48	$104.60	$105.75	$106.91	$108.09	$109.29	$110.51	$111.74	$113.00	$114.28	$115.58
Net (after LGCs) Generation Cost MWh				$60.97	$70.41	$77.31	$82.42	$86.30	$89.31	$91.73	$93.73	$97.08	$98.10	$99.14	$100.20	$101.28	$102.37	$103.48	$104.60	$105.75	$106.91	$108.09	$109.29	$110.51	$111.74	$113.00	$114.28	$115.58
City use cost MWh				$268.27	$212.85	$225.69	$233.62	$239.70	$244.47	$248.34	$251.59	$254.40	$258.63	$260.43	$262.25	$264.09	$265.95	$267.83	$269.74	$271.66	$273.61	$275.58	$277.57	$279.59	$281.63	$283.70	$285.79	$287.91	$290.05
LCOE NPV Rate	10%																											
Production MWh	104,701																											
NPV Opex	$1,377,760			$135,217	$137,246	$139,304	$141,394	$143,515	$145,668	$147,853	$150,070	$152,321	$154,606	$156,925	$159,279	$161,668	$164,094	$166,555	$169,053	$171,589	$174,163	$176,775	$179,427	$182,118	$184,850	$187,623	$190,437	$193,294
NPV Capex	$5,120,000																											
Levelised Cost of Energy (LCOE)	$62.06																											

	Discounted Cash Flow	Total Nominal Cash Flow	Year 0 Jun-2021	Year 1 Jun-2022	Year 2 Jun-2023	Year 3 Jun-2024	Year 4 Jun-2025	Year 5 Jun-2026	Year 6 Jun-2027	Year 7 Jun-2028	Year 8 Jun-2029	Year 9 Jun-2030	Year 10 Jun-2031	Year 11 Jun-2032	Year 12 Jun-2033	Year 13 Jun-2034	Year 14 Jun-2035	Year 15 Jun-2036	Year 16 Jun-2037	Year 17 Jun-2038	Year 18 Jun-2039	Year 19 Jun-2040	Year 20 Jun-2041	Year 21 Jun-2042	Year 22 Jun-2043	Year 23 Jun-2044	Year 24 Jun-2045	Year 25 Jun-2046
OPTION 3 - SOLAR FARM - 5 MW																												
Business as Usual																												
Energy Charges - Contestable	$6,152,380	$7,708,094	$335,197	$331,845	$328,527	$325,242	$321,989	$318,769	$315,582	$312,426	$309,302	$306,209	$303,147	$300,115	$297,114	$294,143	$291,201	$288,289	$285,406	$282,552	$279,727	$276,930	$274,160	$271,419	$268,704	$266,017	$263,357	$260,724
BAU Cash Flow	**($6,152,380)**	**($7,708,094)**	**($335,197)**	**($331,845)**	**($328,527)**	**($325,242)**	**($321,989)**	**($318,769)**	**($315,582)**	**($312,426)**	**($309,302)**	**($306,209)**	**($303,147)**	**($300,115)**	**($297,114)**	**($294,143)**	**($291,201)**	**($288,289)**	**($285,406)**	**($282,552)**	**($279,727)**	**($276,930)**	**($274,160)**	**($271,419)**	**($268,704)**	**($266,017)**	**($263,357)**	**($260,724)**
Solar Farm																												
Large-scale Generation Certificates per MWh				$28	$20	$14	$10	$7	$5	$3	$2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
MWh		174,501		7,408	7,371	7,334	7,297	7,261	7,225	7,188	7,153	7,117	7,081	7,046	7,011	6,975	6,941	6,906	6,871	6,837	6,803	6,769	6,735	6,701	6,668	6,634	6,601	6,568
MWh - City Use				1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249	1,249
MWh - Retailer Export				6,527	6,121	6,085	6,048	6,011	5,975	5,939	5,903	5,867	5,832	5,796	5,761	5,726	5,691	5,656	5,622	5,588	5,553	5,519	5,486	5,452	5,418	5,385	5,352	5,319
Price per MWh Peak				$62.64	$62.01	$61.39	$60.78	$60.17	$59.57	$58.97	$58.38	$57.80	$57.22	$56.65	$56.08	$55.52	$54.97	$54.42	$53.87	$53.34	$52.80	$52.27	$51.75	$51.23	$50.72	$50.21	$49.71	$49.21
Price per MWh Off-peak				$47.64	$47.16	$46.69	$46.23	$45.76	$45.31	$44.85	$44.40	$43.96	$43.52	$43.08	$42.65	$42.23	$41.81	$41.39	$40.97	$40.56	$40.16	$39.76	$39.36	$38.97	$38.58	$38.19	$37.81	$37.43
Blended Price per MWh				$57.64	$57.06	$56.49	$55.93	$55.37	$54.82	$54.27	$53.72	$53.19	$52.66	$52.13	$51.61	$51.09	$50.58	$50.07	$49.57	$49.08	$48.59	$48.10	$47.62	$47.14	$46.67	$46.21	$45.74	$45.29
Inflow																												
Loan Received	$8,700,000	$8,700,000	$8,700,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Retailer Electricity Export	$5,938,245	$7,474,941	$0	$380,901	$353,639	$347,995	$342,439	$336,969	$331,585	$326,284	$321,067	$315,930	$310,874	$305,897	$300,997	$296,174	$291,426	$286,753	$282,152	$277,624	$273,166	$268,778	$264,459	$260,207	$256,021	$251,902	$247,846	$243,855
Large-scale Generation Certificates	$620,473	$655,729	$0	$210,682	$146,740	$102,204	$71,185	$49,581	$34,533	$24,052	$16,752	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sub Total	$15,258,719	$16,830,669	$8,700,000	$591,582	$500,379	$450,199	$413,624	$386,550	$366,118	$350,336	$337,819	$315,930	$310,874	$305,897	$300,997	$296,174	$291,426	$286,753	$282,152	$277,624	$273,166	$268,778	$264,459	$260,207	$256,021	$251,902	$247,846	$243,855
Outflow																												
Project Cost	$8,700,000	$8,700,000	$8,700,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Generating Cost (Op.& Maint.)	$2,786,057	$3,622,594	$0	$120,500	$122,308	$124,142	$126,004	$127,894	$129,813	$131,760	$133,736	$135,742	$137,778	$139,845	$141,943	$144,072	$146,233	$148,427	$150,653	$152,913	$155,206	$157,535	$159,898	$162,296	$164,730	$167,201	$169,709	$172,255
Network Access - Entry	$2,609,933	$3,393,587		$112,882	$114,576	$116,294	$118,039	$119,809	$121,606	$123,431	$125,282	$127,161	$129,069	$131,005	$132,970	$134,964	$136,989	$139,044	$141,129	$143,246	$145,395	$147,576	$149,789	$152,036	$154,317	$156,632	$158,981	$161,366
Network Access - Exit Contestable	$3,874,767	$4,985,891		$185,958	$189,613	$190,483	$191,357	$192,236	$193,119	$194,007	$194,899	$195,796	$196,697	$197,603	$198,513	$199,428	$200,347	$201,271	$202,200	$203,133	$204,071	$205,014	$205,961	$206,913	$207,870	$208,832	$209,799	$210,770
Energy Charges - Contestable	$2,867,247	$3,639,868	$335,197	$82,926	$95,346	$104,428	$111,178	$116,302	$120,293	$123,499	$126,160	$130,599	$131,986	$133,394	$134,825	$136,278	$137,754	$139,253	$140,776	$142,324	$143,896	$145,493	$147,115	$148,764	$150,439	$152,142	$153,872	$155,630
Sub Total	$20,838,003	$24,341,942	$9,035,197	$502,266	$521,842	$535,347	$546,578	$556,241	$564,832	$572,696	$580,078	$589,298	$595,530	$601,847	$608,250	$614,742	$621,323	$627,995	$634,758	$641,616	$648,568	$655,617	$662,764	$670,010	$677,357	$684,807	$692,361	$700,021
Project Cash Flow	**($5,579,284)**	**($7,511,272)**	**($335,197)**	**$89,316**	**($21,463)**	**($85,148)**	**($132,954)**	**($169,692)**	**($198,714)**	**($222,360)**	**($242,259)**	**($273,368)**	**($284,656)**	**($295,950)**	**($307,253)**	**($318,568)**	**($329,897)**	**($341,242)**	**($352,606)**	**($363,992)**	**($375,402)**	**($386,839)**	**($398,305)**	**($409,803)**	**($421,336)**	**($432,905)**	**($444,514)**	**($456,166)**
Finance																												
Debt	$6,655,443	$8,697,574	$0	$271,542	$276,973	$282,512	$288,163	$293,926	$299,804	$305,800	$311,916	$318,155	$324,518	$331,008	$337,628	$344,381	$351,269	$358,294	$365,460	$372,769	$380,224	$387,829	$395,586	$403,497	$411,567	$419,799	$428,194	$436,758
Interest Repayment	$2,043,078	$2,440,978	$0	$174,000	$168,569	$163,030	$157,379	$151,616	$145,738	$139,742	$133,626	$127,387	$121,024	$114,534	$107,914	$101,161	$94,273	$87,248	$80,082	$72,773	$65,318	$57,713	$49,957	$42,045	$33,975	$25,744	$17,348	$8,784
Sub Total	$8,698,521	$11,138,552	$0	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542	$445,542
Debt Owing			$8,700,000	$8,428,458	$8,151,485	$7,868,973	$7,580,810	$7,286,884	$6,987,080	$6,681,279	$6,369,363	$6,051,208	$5,726,690	$5,395,682	$5,058,053	$4,713,672	$4,362,404	$4,004,110	$3,638,650	$3,265,881	$2,885,656	$2,497,827	$2,102,242	$1,698,745	$1,287,178	$867,379	$439,185	$2,426
Net Cash Flow	**($14,277,805)**	**($18,649,824)**	**($335,197)**	**($356,226)**	**($467,005)**	**($530,690)**	**($578,496)**	**($615,234)**	**($644,256)**	**($667,902)**	**($687,801)**	**($718,910)**	**($730,198)**	**($741,492)**	**($752,795)**	**($764,110)**	**($775,439)**	**($786,784)**	**($798,148)**	**($809,534)**	**($820,944)**	**($832,381)**	**($843,847)**	**($855,345)**	**($866,878)**	**($878,447)**	**($890,057)**	**($901,708)**
Cumulative Cash Flow			($335,197)	($691,423)	($1,158,429)	($1,689,119)	($2,267,615)	($2,882,848)	($3,527,105)	($4,195,006)	($4,882,808)	($5,601,718)	($6,331,916)	($7,073,408)	($7,826,203)	($8,590,313)	($9,365,752)	($10,152,536)	($10,950,684)	($11,760,218)	($12,581,162)	($13,413,542)	($14,257,389)	($15,112,734)	($15,979,612)	($16,858,059)	($17,748,116)	($18,649,824)
Difference to BAU	**($8,125,425)**	**($10,941,730)**	**$0**	**($24,380)**	**($138,479)**	**($205,448)**	**($256,507)**	**($296,464)**	**($328,675)**	**($355,476)**	**($378,500)**	**($412,702)**	**($427,051)**	**($441,377)**	**($455,681)**	**($469,967)**	**($484,237)**	**($498,494)**	**($512,742)**	**($526,982)**	**($541,217)**	**($555,451)**	**($569,687)**	**($583,926)**	**($598,173)**	**($612,430)**	**($626,699)**	**($640,984)**
Cumulative Cash Flow			$0	($24,380)	($162,859)	($368,307)	($624,814)	($921,278)	($1,249,953)	($1,605,429)	($1,983,928)	($2,396,630)	($2,823,681)	($3,265,058)	($3,720,740)	($4,190,707)	($4,674,944)	($5,173,439)	($5,686,180)	($6,213,162)	($6,754,379)	($7,309,830)	($7,879,517)	($8,463,443)	($9,061,616)	($9,674,046)	($10,300,745)	($10,941,730)
Analysis																												
Generating Cost MWh				$16.27	$16.59	$16.93	$17.27	$17.61	$17.97	$18.33	$18.70	$19.07	$19.46	$19.85	$20.25	$20.65	$21.07	$21.49	$21.92	$22.37	$22.81	$23.27	$23.74	$24.22	$24.71	$25.20	$25.71	$26.23
Network Cost MWh				$15.24	$15.54	$15.86	$16.18	$16.50	$16.83	$17.17	$17.52	$17.87	$18.23	$18.59	$18.97	$19.35	$19.74	$20.13	$20.54	$20.95	$21.37	$21.80	$22.24	$22.69	$23.14	$23.61	$24.08	$24.57
Finance Cost MWh				$60.14	$60.45	$60.75	$61.06	$61.36	$61.67	$61.98	$62.29	$62.60	$62.92	$63.24	$63.55	$63.87	$64.19	$64.52	$64.84	$65.17	$65.49	$65.82	$66.15	$66.49	$66.82	$67.16	$67.49	$67.83
Total Generation Cost MWh				$91.65	$92.58	$93.53	$94.50	$95.48	$96.47	$97.48	$98.51	$99.55	$100.60	$101.68	$102.77	$103.88	$105.00	$106.14	$107.30	$108.48	$109.68	$110.90	$112.14	$113.39	$114.67	$115.97	$117.29	$118.63
Net (after LGCs) Generation Cost MWh				$63.21	$72.68	$79.60	$84.74	$88.65	$91.69	$94.13	$96.16	$99.55	$100.60	$101.68	$102.77	$103.88	$105.00	$106.14	$107.30	$108.48	$109.68	$110.90	$112.14	$113.39	$114.67	$115.97	$117.29	$118.63
City use cost MWh				$268.27	$215.20	$228.06	$236.03	$242.13	$246.94	$250.84	$254.11	$256.96	$261.23	$263.06	$264.91	$266.78	$268.68	$270.60	$272.54	$274.50	$276.48	$278.49	$280.52	$282.58	$284.66	$286.77	$288.90	$291.06	$293.24
LCOE NPV Rate	10%																											
Production MWh	174,501																											
NPV Opex	$2,377,985			$233,382	$236,883	$240,436	$244,043	$247,704	$251,419	$255,190	$259,018	$262,904	$266,847	$270,850	$274,913	$279,036	$283,222	$287,470	$291,782	$296,159	$300,601	$305,110	$309,687	$314,332	$319,047	$323,833	$328,690	$333,621
NPV Capex	$8,700,000																											
Levelised Cost of Energy (LCOE)	$63.48																											