Port Augusta Solar Thermal Generation Feasibility Study

Milestone 3 Report

Draft Balance of Study

February 2015

A project jointly funded by:

- Alinta Energy
- Australian Renewable Energy Agency, Emerging Renewables Program
- Government of South Australia, Enterprise Zone Fund

For more information:

www.alintaenergy.com.au/Port-Augusta-Solar-Thermal-Generation-Feasibility-Study

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Acronyms

Alinta	Alinta Energy group of companies
ARENA	Australian Renewable Energy Agency
CAPEX	Capital Expenditure
CPI	Consumer Price Index
CSP	Concentrating Solar Power
DNI	Direct Normal Insolation
GHI	Global Horizontal Insolation
IRR	Internal Rate of Return
LCOE	Levelised Cost of Energy
LRET	Large scale Renewable Energy Target
LGC	Large scale Generation Certificates
MLF	Marginal Loss Factor
MW	Megawatt
MWe	Megawatt electric
NEM	National Electricity Market
NPS	Northern Power Station
NPV	Net Present Value
OPEX	Operational expenditure
PPA	Power Purchase Agreement
SAM	System Advisor Model
TMY	Typical Mean Year
WEM	Western Electricity Market

1 Executive Summary

Alinta has completed the next stage of investigations into the feasibility of installing a Concentrating Solar Power (CSP) plant in Port Augusta. The third milestone in Stage One of the study is the Draft Balance of Study which rounds out the information needed to supplement the technology choice (Options Study) and location (Siting Study).

There have been some developments in land availability which eliminate the option of using the preferred location identified in the Siting Study. For the purposes of the remainder of Stage 1 of the feasibility study, the next most ideal site will be used. This ends up being approximately four kilometres further south and further from Alinta's Northern Power Station and has minor implications for cost and operational logistics.

One significant change in the cost assumptions in the Draft Balance of Study report is a reduction in the forecast capital cost estimate. This cost reduction was informed by direct consultation with industry and a more thorough investigation of reference plants recently constructed or currently under construction. The estimated capital cost of most components dropped by some amount, most significantly the heliostat field which is now estimated at ~$140M rather than ~$230M. The final capital cost estimate in the Draft Balance of Study report for a 50MW power tower with 15 hours thermal energy storage in Port Augusta is $577M.

Table ES1 below summarises the reduction in the cost estimate in the Draft Balance of Study compared to the Options Study.

Table ES1: CAPEX cost estimate comparison: Options Study vs Draft Balance of Study

Component	Options Study CAPEX $M	Draft Balance of Study CAPEX $M	Difference $M
Site Improvements	32.3	8.2	-24.1
Heliostat Field	230.4	138.2	-92.1
Tower	26.0	21.5	-4.5
Receiver	90.4	86.0	-4.4
Thermal Energy Storage	79.3	83.4	4.1
Balance of Plant	129.5	118.1	-11.1
Contingency	117.6	67.9	-49.7
EPC & Owner Costs	81.8	53.4	-28.4
TOTAL	**787.2**	**577.0**	**-210.2**

The most revealing information presented in this Milestone 3 Report is the result of the preliminary financial modelling. Even under the best plausible capital cost assumptions, construction and operation of a CSP plant as currently costed and designed would have an un-geared Internal Rate of Return of 7%. Once debt financing and minimum commercial returns are considered, even this optimistic scenario is well outside of the bounds of a commercially attractive investment.

Table ES2 below summarises the outputs of the financial modelling of the base case as well as for +/-30% on the capital cost representing the cost estimate certainty at this stage of the study.

Table ES2: Financial modelling key outputs

Metric	-30%	Base case	+30%
Capital costs ($M)	$403.9	**$577.0**	$750.1
Net Present Value ($M @ 12% IRR)	-$150.4	**-$297.3**	-$448.8
Internal Rate of Return	7%	**4%**	3%
Levelised Cost of Energy	$149/MWh	**$201/MWh**	$253/MWh
Realised revenue	$131/MWh	**$131/MWh**	$131/MWh

In order to investigate all options for project financial viability, Alinta will explore the potential impact of generation dispatch methodologies and spot market movements in more detail prior to the Milestone 4 report, Final Balance of Study, which will be submitted to ARENA on 30 May 2015.

2 Introduction

This report represents the third of six milestones which comprise the Port Augusta Solar Thermal Generation Feasibility Study. Milestone One, Project Definition Report, was submitted to ARENA in January 2014 and Milestone Two, Options Study and Siting Study, was submitted to ARENA in May 2014. Both of these Milestone Reports have been posted on the Alinta Energy website:

www.alintaenergy.com.au/Port-Augusta-Solar-Thermal-Generation-Feasibility-Study

2.1 Review of Assumptions

There were several high level assumptions made by Alinta which were inputs into the early stages of the Port Augusta Solar Thermal Feasibility Study. The assumptions first presented in Milestone 1 the Project Definition Report are shown in Table 1 below along with a current assessment of the previous assumption.

Table 1: Changes to Assumptions from Milestone 1 Report

Milestone 1	Milestone 2	Milestone 3
The location of the Augusta Power Station, and in the vicinity of the facility, is suitable for the siting and development of a solar thermal facility.	**No change**	The site identified as optimal in the Siting Study is now known to be the subject of a Development Application by a third party. The proximity of the CSP plant to the Spencer Gulf raises potential corrosion issues due to salt water spray/deposition.
Alinta Energy understands the current arrangements for land tenure permit the siting and development of a potential solar thermal facility on land within the control of Alinta Energy or adjacent to subject to the Sale / Lease arrangements between Flinders Power Partnership and the Government of South Australia.	**No change**	**No change**
The life of the Leigh Creek Mine, which supplies coal to the Augusta Power Stations, would be extended through further investment by Alinta Energy.	**No change**	**No change**
The Augusta Power Stations would remain in operation, in their current form supplied by the Leigh Creek Coal Mine, until at least 2028 to 2032.	**No change**	**No change**

Milestone 1	Milestone 2	Milestone 3
The useable life of the Augusta Power Stations, including re-use of facility components, extends beyond the current expected life of the Leigh Creek Mine.	**There are significant technical challenges to running NPS on only solar once the coal resource has been exhausted which would require extensive re-engineering of large parts of the plant.**	**No change**
The pre-measure activities and studies relied upon in the development of this study which detail the potential value and strength of the solar resource, the potential for hybrid solutions, and the potential utilisation of components from the Playford B Power Station is the best estimate and advice of the respective experts.	**Use of components from Playford B was determined to be infeasible. Procurement of spares and replacement parts is extremely difficult. The entire facility would require upgrading in order to support the use of usable components.**	**No change**
The range of project benefits, fuel diversity opportunities for South Australia, dispatchable energy potential, compatibility with South Australian energy system, network connection options, technology costs and acceptable technology types do not materially deviate from those understood at the commencement of this study.	**No change**	Recent analysis by the Australian Energy Market Operator suggests that the grid in South Australia is oversupplied which leads to a disincentive for adding generation capacity of any kind.[1]
Progress beyond the study will depend on a number of factors outside the scope of this piece of work which have not been estimated or modelled at this point in time.	**No change**	**No change**

[1] Australian Energy Market Operator, 2014 Electricity Statement of Opportunity, August 2014

3 Analysis of Measure Progress

3.1 Data Collection

On 5 July 2014 Measurement Engineering Australia sent two representatives to the Northern Power Station in Port Augusta to install a solar tracker, weather station and data collection equipment. The equipment has been working as intended since installation and is recording the following variables at one minute intervals:

Weather Station

- Global solar radiation
- Air temperature
- Humidity
- Wind speed (min, max, ave)
- Wind direction
- Barometric pressure

Solar Data Station

- Global solar radiation (min, max, ave)
- Global diffuse radiation (min, max, ave)
- Direct normal irradiance (DNI) (min, max, ave)
- Temperature of shaded pyranometer
- Temperature of un-shaded pyranometer
- Temperature of pyrheliometer

3.2 Draft Balance of Study

3.2.1 Scope of Works

The scope of works for the Draft Balance of Study is identified in the Agreement and is summarised below:

- Details of the plant and its operation;
- Capital and operating and maintenance costing at +/-30%;
- Energy yield and generation profile;
- Infrastructure requirements;
- Environmental studies including land use, profile and identification of environmental issues;
- Planning and development requirements for a Development Approval;
- Network connection;
- *Stakeholder consultation plan; and

- *Preliminary financial evaluation.

The last two items marked with "*" were determined to be within the core capability and expertise of Alinta personnel and were completed internally. The remaining scope was completed by Parsons Brinkerhoff (PB).

3.2.2 Methodology

The majority of the high level plant design was completed and reported in the Options Study Report which comprised one of the deliverables for Milestone 2. Therefore only those aspects that have been further refined or have changed or new challenges have arisen will be discussed here.

Capital Cost

Project capital costs were estimated by a combination of scaling the detailed reference plant cost estimate and generating estimates using commercial software and the internal estimating experience of PB personnel. Alinta and PB discussed at length the value of the Labour cost multiplier in the context of the Port Augusta economy and local labour-force skills. The possible variation in this parameter has the potential to have a material impact on both the Capital and Operations cost estimates. While there is a real potential for the labour cost multiplier to be less than that used in the study, it would be well within the +/- 30% accuracy which characterises the pre-feasibility stage.

Capital cost multipliers used in this report are show in Table 2 below.

Table 2: Cost localisation factors

Factor	Value	Comments
Labour cost multiplier	1.14	Ratio of Australian union labour rates to Californian union labour rated (from Thermoflow PEACE) further localised to Port Augusta
Material cost multiplier	1.34	Ratio of Australian to Californian material cost multiplier (from Thermoflow PEACE) further localised to Port Augusta
Currency exchange rate	1.1	AUD to USD

There is a significant reduction in estimated capital cost presented in the Draft Balance of Study Report compared to the cost estimate provided in the Options Study Report. Cost estimates in the Options Study were based entirely on a literature review and desktop investigation. Alinta requested PB to conduct a cost tightening exercise which would draw on direct industry current experience and knowledge as well as consider the relative maturity of the solar thermal industry against well understood technology price curves. The cost estimates provided in the Draft Balance of Study report are informed by conversations with leading industry players and take more into consideration the public knowledge around real costs incurred by reference plants.

The overall capital cost estimate has dropped approximately $200M following this exercise. The most significant reduction comes from the heliostat field. Early estimates using the labour, exchange and material cost multipliers referenced above resulted in a rate of $\$262/m^2$ for the heliostat field. Following discussions with manufactures and installers of heliostats, a revised rate of $\$150/m^2$ was determined to be realistic.

Another significant reduction in the CAPEX cost estimate was realised by taking a weighted average of contingency values applied to individual components rather than applying the same % contingency to the final project cost. Table 3 summarises the difference in CAPEX cost estimates by major component.

Table 3: CAPEX cost estimate comparison: Options Study vs Draft Balance of Study

Component	Options Study CAPEX $M	Draft Balance of Study CAPEX $M	Difference $M
Site Improvements	32.3	8.2	-24.1
Heliostat Field	230.4	138.2	-92.1
Tower	26.0	21.5	-4.5
Receiver	90.4	86.0	-4.4
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EPC & Owner Costs	81.8	53.4	-28.4
TOTAL	**787.2**	**577.0**	**-210.2**

Clearly the assumptions about foreign exchange rates and labour rates could have a material impact on the CAPEX cost estimate. Preliminary analysis indicates that the CAPEX estimate has an exposure of approximately 30-35% to the labour rate and an exposure in the vicinity of 50% to foreign exchange rates. The current exchange rate, for example is approximately 1.28 rather than 1.1 AUD:USD. This has the effect of adding almost 10% or ~$50M on the CAPEX cost estimate. Table 4 below shows the estimated change in the project CAPEX depending on a range of exchange rates.

Table 4: Estimated CAPEX sensitivity to foreign exchange rates

	AUD:USD	USD:AUD	Change to CAPEX $M
Modelled rate	$1.10	$0.909	-
	$1.15	$0.870	+ $13.6
	$1.20	$0.833	+ $27.3
	$1.25	$0.800	+ $40.9
Feb-2015 rate	$1.28	$0.780	+ $49.7
	$1.30	$0.769	+ $54.5

Operational Cost

Operating and maintenance costs were also scaled from the reference plant in a manner similar to the capital cost estimate. A burdened labour rate of 30% was assumed. Where there is a support function that could be considered a corporate service, no labour cost was included. These roles, such as IT, finance, human resources are assumed to be provided by existing Alinta Energy personnel. While the Northern Power Station continues to operate this is an adequate assumption. Should the lifetime of the CSP plant extend past the lifetime of Northern Power Station, additional costs would be incurred. This is considered to be an unlikely scenario and would have a very small relative impact on annual operating costs.

As with CAPEX, the OPEX cost estimate is also sensitive to labour rates, however less so to foreign exchange rates. The ~$8M annual operational costs has an exposure of approximately 60% to the labour rate.

Solar Resource Data

For a more accurate assessment of solar resource and generation profile of the plant, Alinta purchased a typical mean year (TMY) data set synthesised from a 15 year record between 1999-2013. The report provides a retrospective analysis of the past 15 years of solar irradiance, wind and temperature data. The data used is comprised of hourly values, however the long-term average values are only calculated using complete calendar years.

The difference between the dataset used during modelling for the Options Study and this purchased dataset is shown in Table 5 below. The differences in these datasets does not make a material difference on the selection of the plant configuration made during the Options Study. The overall increase in solar resource expressed in the dataset purchased by Alinta for the Balance of Study increases the modelled annual generation by the plant and therefore a nominal increase in modelled revenue.

Table 5: Solar resource data inputs for generation modelling

Parameter	Units	Data for Options Study	Data for Balance of Study	Difference
Standard Error	%	16%	<9%	-7%
Annual average DNI	W/m^2	235.5	279.2	+19%
Peak DNI	W/m^2	886	981	+11%
Summer average DNI	MJ/day	24.7	28.5	+15%
Winter average DNI	MJ/day	15.9	19.7	+24%
Annual average GHI	W/m^2	215	222.1	+3%

Network Connection

The obvious location to connect into the network is at the Davenport Substation just to the East of Northern Power Station. There is currently a spare bay inside the substation that could potentially accept the assets that would be required to connect the Augusta Solar Thermal plant. There are various options in the definition of asset ownership and boundaries with ElectraNet, which owns and operates the Davenport substation. The decision on what type of arrangement would suit best would be determined by a commercial and contractual discussion that is detail beyond the scope of this report. The connection of 50 MW of solar thermal power at Davenport substation would also not have a material impact on the Marginal Loss Factor (MLF) of the network.

3.2.3 Uncertainties discovered

Plant Siting

Since the Siting Study was completed there has been a material change to the availability of land near Northern Power Station. The land parcel identified as Option 1 has since been the subject of a Development Application for a nearby operation and would no longer be available as a location for the solar thermal plant. The next best location that was part of the siting study is approximately four kilometres further south in the same direction from Northern Power station.

This increases the cost of constructing a transmission line to the switchyard and increases the cost and complexity of sharing any infrastructure or services between the solar thermal plant and the existing activities at Northern Power station.

Another concern that has arisen is the potential for salt corrosion on the plant components. This is a particular concern for the heliostats, however is relevant to all equipment and materials that would be exposed to salt spray and deposition.

Cooling System

The proximity to the Spencer Gulf and the existing cooling water loops used for Northern Power Station make a wet cooled condenser an obvious first option. However the expense of constructing adequate pipework is prohibitive and therefore a cooling tower is proposed. The use of salt water in a cooling tower introduces additional complications and has the potential to increase fouling and corrosion on nearby infrastructure.

The logical conclusion is to move to an air cooled condenser which is also at additional cost.

These issues that have arisen with the plant siting have almost entirely removed the potential benefit that was once thought to exist by co-locating the plant with Northern Power Station. It is Alinta's opinion, therefore, that the initial constraint of choosing a location in proximity to Northern is now not relevant. For the purposes of the Study, Alinta will still consider the location identified by PB as the location of the plant. However should Alinta proceed to Stage 2 of the study, a new location in the region would likely be sought for more detailed investigation and planning.

Time of Day Pricing

Through some initial optimisation assessment it has become apparent that the parameter used to solve for the optimal plant configuration (LCOE) does not necessarily prove to be the most attractive from a project financing point of view. Alinta will explore in greater detail the potential impact of spot market prices and South Australian electricity market demand profile on the configuration and capital cost of the CSP plant over the coming months.

Early indications are that a significant reduction in storage and solar multiple, and therefore capital expenditure, would lead to a reduction in the payback time while at the same time increasing the LCOE of the project.

3.3 Community Issues

Alinta Energy is a significant contributor to employment and the local economy in the town of Port Augusta. Any addition or change to the Alinta infrastructure in the town will have a material impact on the economy of the region.

CSP plants of this type are not common and the potential issues with their construction and operation are still being discovered. There is a certain collection of issues that relate to any development project and which is not unique to a solar thermal plant.

- Loss of open space
- Loss of habitat
- Habitat fragmentation
- Increase or decrease in employment opportunities

- Increased vehicle movements (primarily during construction)

In addition to these potential issues there are others that would be unique to a CSP plant in this location, most significant among them are discussed here.

3.3.1 Visual Amenity

The height of the potential CSP plant in Port Augusta has been modeled at 150m. Other power tower plants of similar scale that have been constructed are located much further from population centers. The location in this feasibility study is only approximately 10-12 km from the center of Port Augusta. Given the proximity of the town to the location of the tower in the study, the visual impact of a plant, once operating would be substantial. The receiver would be taller than any other structure in the vicinity with the exception of the Northern Power Station exhaust stack. The glare off of the receiver at the top of the tower would likely make the structure the most obvious landmark in the viewshed.

When constructed far from towns and cities visual impact is a minor issue. Should such a piece of infrastructure be proposed as close to the town of Port Augusta as the study site, the visual impact of the receiver tower could be a significant issue.

3.3.2 Air Traffic

Port Augusta hosts a small local airport with regular daily services. There is the potential that glare from the receiver and/or heliostat field could pose a safety risk to pilots flying into and out of Port Augusta. There is not a significant body of research and references available for a conclusion yet to be drawn. This issue would require further and detailed investigation during Stage 2 of the Study.

3.3.3 Avian Mortality

The concentration of the sun’s energy onto the receiver of a CSP plant creates a zone around the receiver which can be harmful or fatal to insects, birds and other organisms that pass into it. The scientific documentation around this issue is minimal, however it is a real concern and would require in depth investigation in Stage 2 of the Study.

4 Financial Viability Assessment

4.1 Overview of financial modelling

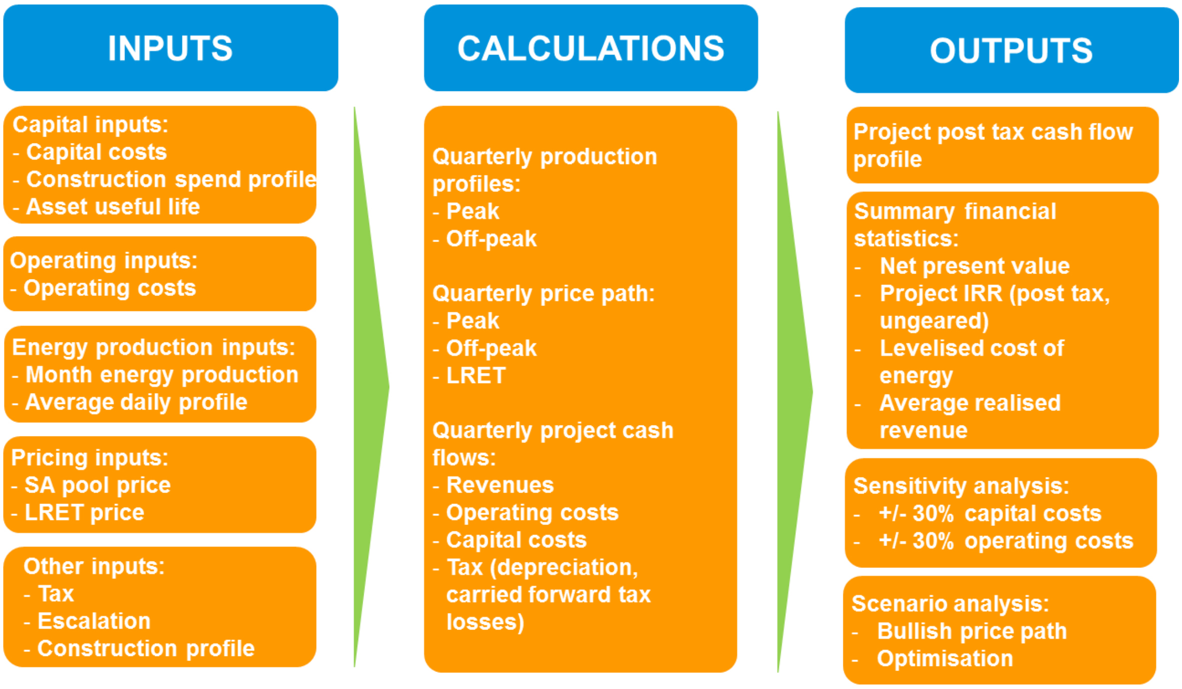
The financial viability of the proposed 50 MW Solar Thermal Power Station in Port Augusta is a key factor in assessing whether to continue to develop the project business case. Alinta has developed a financial model to analyse the overall financial viability of the project. The evidence from the financial analysis is that commercially the project is highly unviable, even under the most optimistic scenarios. Further detailed analysis will be undertaken during the next milestone period in order to determine whether there could be a material impact on the viability of the project by further optimising the major component sizing and/or considering the dispatch regime in the contact of pool price variation in the South Australian electricity market.

The remainder of this section sets out the financial modelling undertaken and presents the detailed outputs from the financial viability assessment.

4.2 Methodology

The financial modelling draws upon a number of information sources in order to calculate the ungeared post tax nominal cash flows associated with the project. The financial modelling is undertaken on a quarterly basis. The modelling methodology is set out in Figure 1.

Figure 1: Financial modelling methodology



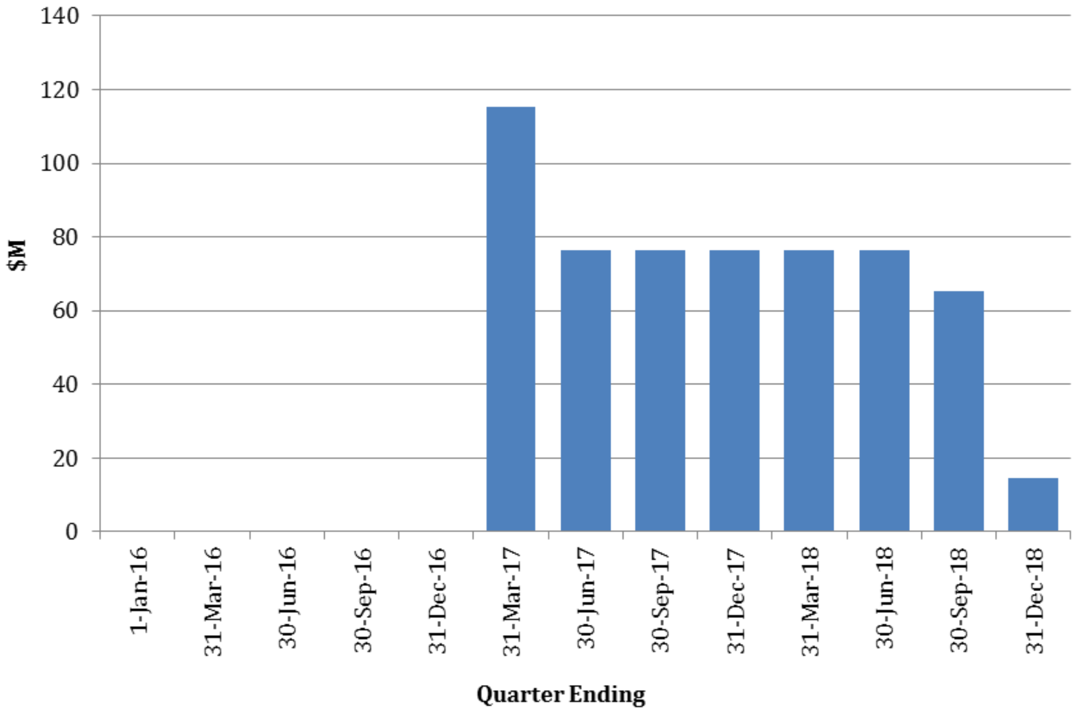
4.3 Input Data

Input data is sourced from independent third party reports wherever possible. A number of the third party reports have been specifically commissioned as part of the Port Augusta Solar Thermal Feasibility Study, whilst others are commissioned by Alinta for use across within its broader business activities and have been leveraged for use in this Study. In some instances, Alinta has made assumptions, drawing upon its internal expertise where required.

4.3.1 Capital Costs

The $577M capital cost of the project used in the financial modelling is based upon the Draft Balance of Study Report prepared by PB. Alinta has supplemented the total capital cost estimate prepared by PB with a construction cost curve, to forecast the potential actual expenditure over an assumed 2 year build period. It is assumed, that construction starts on 1 January 2017. The resulting quarterly construction expenditure curve is shown in Figure 2.

Figure 2: Construction cost curve assumption



4.3.2 Operational Costs

The $7.89M of annual operating costs in the financial modelling are based upon the (Draft) Balance of Study Report prepared by PB . Alinta has supplemented the estimated annual operating costs with the assumption that the operating costs will escalate each July by CPI, and will be incurred equally across the year.

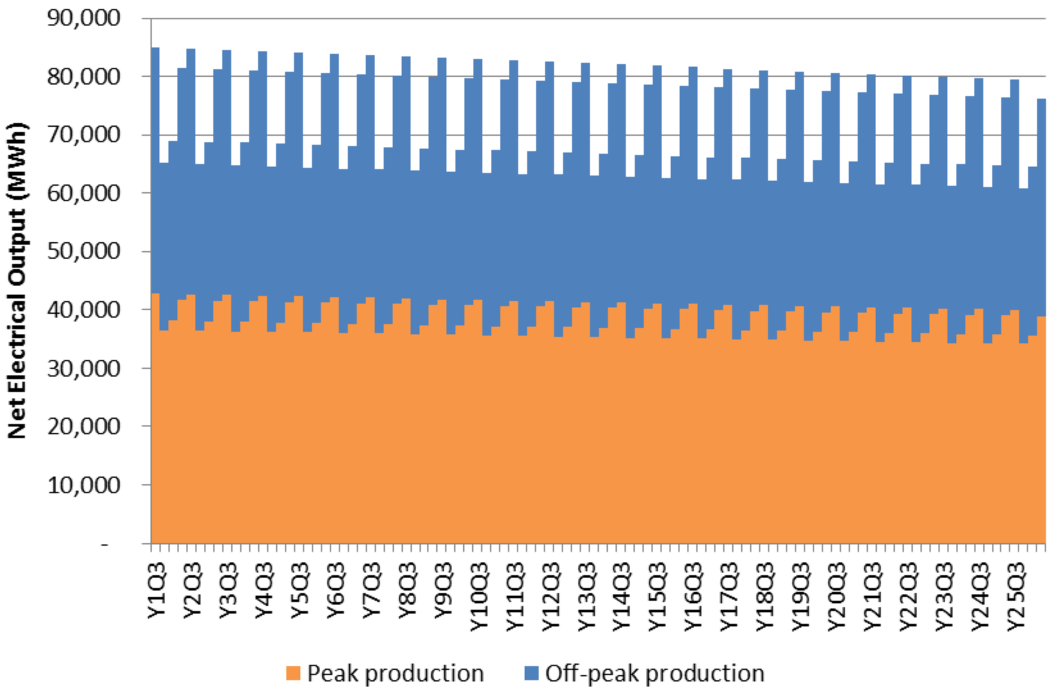
4.3.3 Electricity Generation

PB estimates the energy production capability of the project over its expected lifetime. Importantly, the financial model converts the information in the PB report into peak (7:00 to 22:00 workdays) and off-peak for each calendar quarter. Specifically, the model calculates:

- Average proportion of peak and off-peak energy production for each month (based upon average daily production profiles in each month)
- Average proportion of peak and off-peak energy production for each quarter (based upon total monthly production profiles)
- Energy production during peak and off-peak times for each quarter for each forecast year. This utilises the forecast total annual production for each year of operation from the report (which takes into account degradation) and applies the average quarterly peak and off-peak proportions (calculated in 2) above)

The total forecast peak and off-peak production by quarter is shown in Figure 3 below.

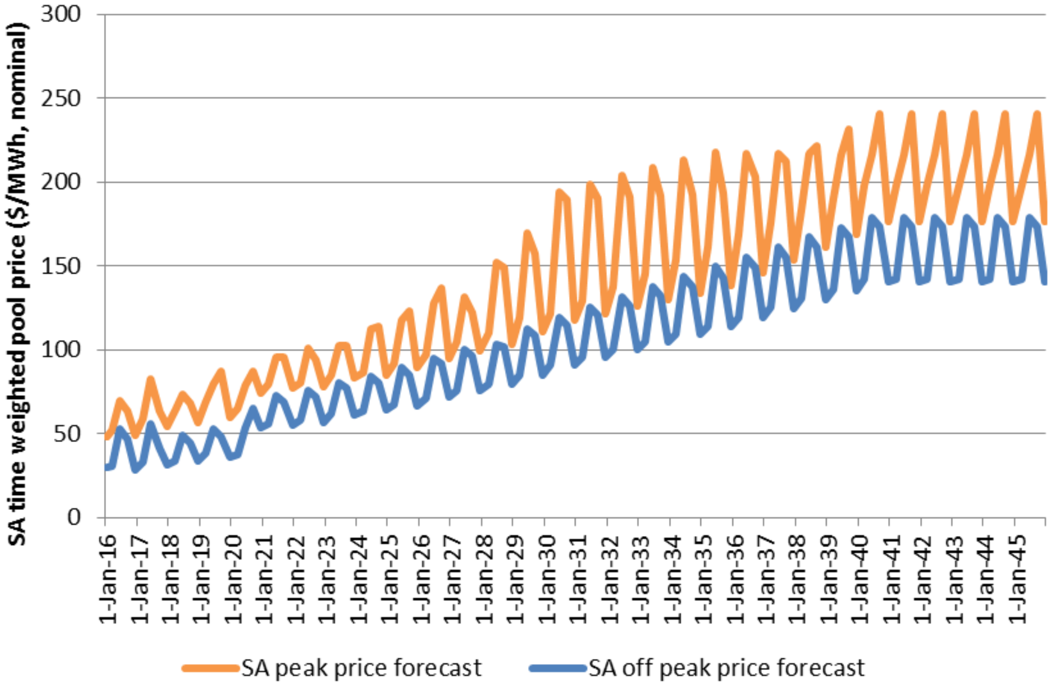
Figure 3: Forecast lifetime electricity production by quarter



4.3.4 Pricing

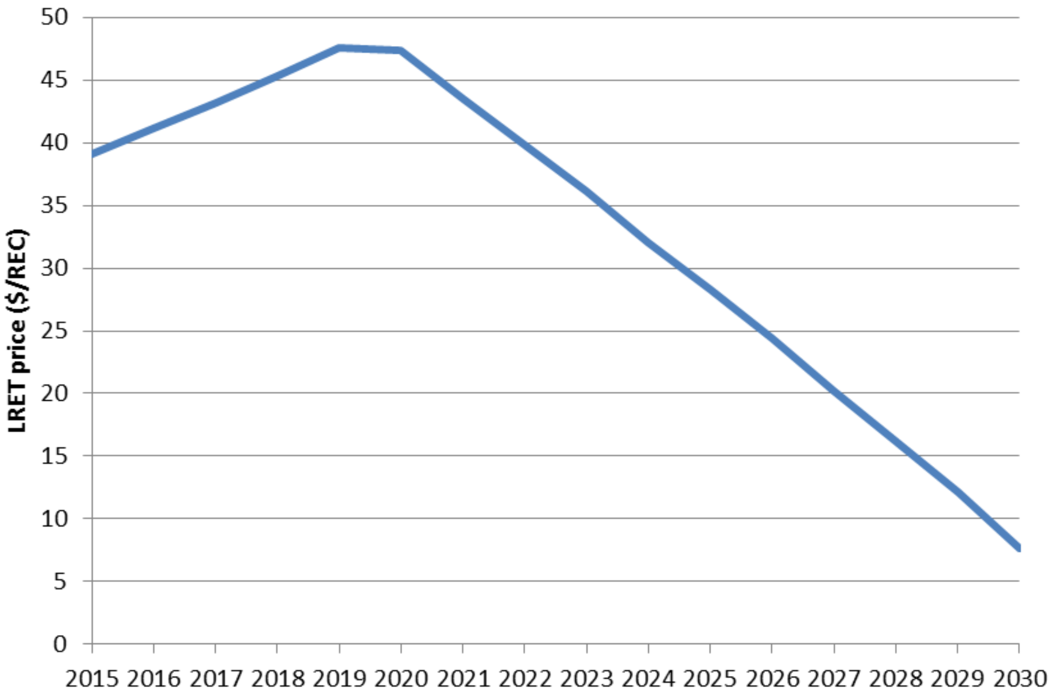
South Australian pool prices are based upon the forecasts contained in Acil Allen Consulting's Australian Energy Market, Analysis of the National Electricity Market (NEM), Western Electricity Market (WEM) and Large scale Renewable Energy Target (LRET) report . The time weighted nominal quarterly forecast peak and off-peak prices to Dec 2030 have been utilised. The price path is then interpolated between 2030 and 2035, and also 2035 to 2040. Beyond 2040, it is assumed that prices remain flat.

Figure 4: Forecast peak and off-peak electricity prices



Forecast large scale generating unit certificate (LGC) prices are also sourced from Acil Allen Consulting's Australian Energy Market, Analysis of the NEM, WEM and LRET report. Acil Allen's reference case is adopted for the base financial viability assessment. LGC prices are only forecast to 2030, when the LRET scheme is currently scheduled to end. The forecast price path is shown in Figure 5 below.

Figure 5: Forecast LGC price path



4.3.5 Other Assumptions

A number of generic assumptions have been adopted in the financial modelling:

- Tax assumptions:
  - To calculate the post-tax cashflows of the project, we have adopted the current company tax rate of 30%
  - Tax depreciation is based upon the diminishing value methodology, with a 200% multiplier and an assumed asset useful life of 25 years from construction completion
- A number of costs and prices are assumed to escalate by CPI. Within the model it is assumed that CPI increases by 2.5% per annum., with adjustments occurring on 1 July in each of the forecast years.
- The Acil Allen report assumes that a carbon price is re-introduced from 1 July 2020

4.4 Financial Modelling Outputs

The forecast annual cashflows of the project are shown in the chart below. Figure 6 shows that once the facility is operational, it would be profitable. However, based upon the metrics in the table below, the level of expected future profitability does not justify the large capital investment required to build the facility.

Figure 6: Project lifetime cashflows

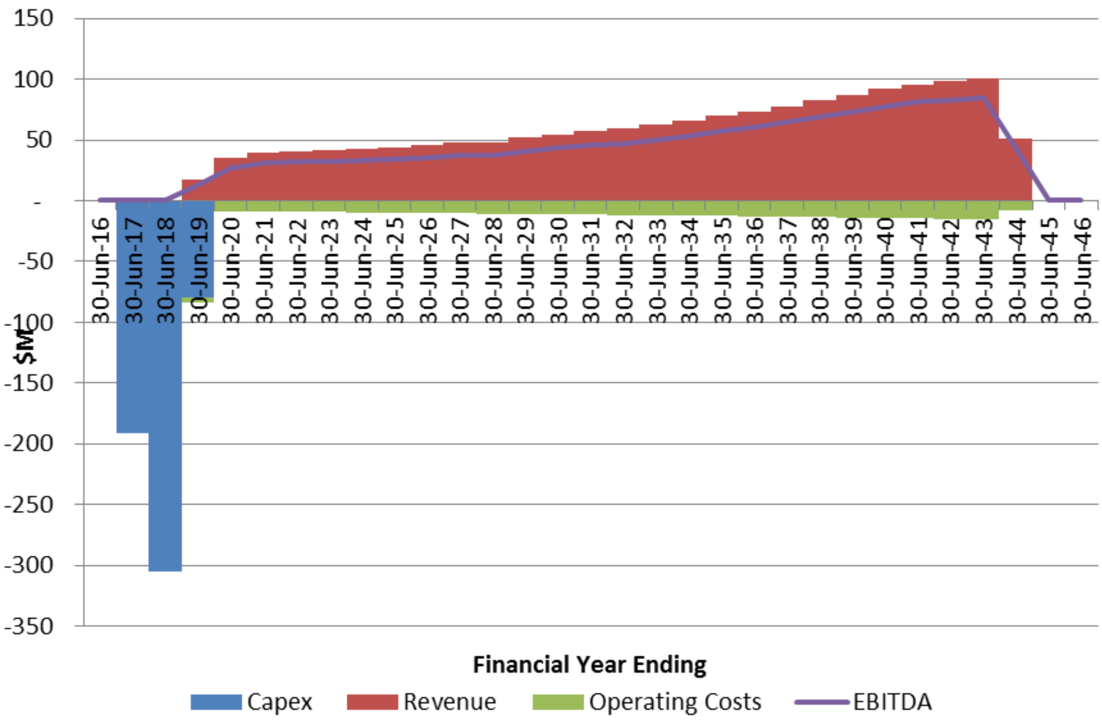


Table 6: Base case financial modelling key outputs

Metric	Value	Comments
Net Present Value	-$297.3M	Based on an assumed 12% post tax discount rate
Internal Rate of Return	4%	Unlikely to achieve private sector investment return requirements.
Levelised Cost of Energy[2]	$201/MWh	Represents the revenue that would be required per MWh for the project to achieve the required return metrics.
Realised revenue[3]	$131/MWh	Represents the revenue that is forecast to be realised per MWh produced.

4.5 Sensitivity Analysis

The scope of this (Milestone 3 report) was to identify the cost of the project to within a tolerance of +/- 30%. The financial evaluation has been based upon the expected costs estimated by PB to within this level of accuracy. Given the level of accuracy with in the costs, it is prudent to undertake a sensitivity analysis to confirm whether, across the plausible range of cost estimates (i.e. +/- 30%), the project could be considered to be commercially viable. As the metrics in the table below indicate, even if the capital costs have been over-estimated by 30%, the project would still be unviable, with a Net Present Value (NPV) of -$150.4M, and an Internal Rate of Return (IRR) of 7%. It is on this basis that it is considered that the project is unlikely to be commercially under any plausible cost estimate.

Table 7: +/- 30% financial modelling key outputs

Metric	-30%	+30%
Capital costs	$403.9	$750.1M
Net Present Value (@ 12% IRR)	-$150.4M	-$448.8M
Internal Rate of Return	7%	3%
Levelised Cost of Energy	$149/MWh	$253/MWh
Realised revenue	$131/MWh	$131/MWh

[2] Levelised Cost of Energy is calculated as [NPV of Capital Costs and Operating Costs] divided by the [NPV of Demand escalated CPI]

[3] Realised Revenue is calculated as [NPV of Total Revenue] divided by the [NPV of Demand escalated CPI]

4.6 Conclusions on Financial Feasibility

Based upon Alinta's financial modelling this project does not meet the minimum internal metrics to be considered a commercially viable investment. Under even the most optimistic scenario, a capital cost of 30% less than modelled, there is a $150M capital funding gap.

4.7 Wholesale Price Points

Alinta's Northern Power Station is connected to the NEM, which is a wholesale market. As the potential CSP plant would be closely linked to Alinta's existing assets both geographically and commercially, it has been assumed that any output from a CSP plant would be sold only into the wholesale market. Within the NEM market structure retail prices are higher on averaged than wholesale prices. The higher average retail price represents the retailer's margin.

The financial modeling completed by Alinta has determined that the levelised cost of energy for this project, in the base case is approximately $200/MWh sent out. This can be interpreted as the required level of revenue per MWh of electricity sent out by the CSP plant to be commercially viable. The source of that revenue is not important and in fact would likely be split among multiple sources. The required wholesale price would effectively be $200 minus the value of any other potential revenue streams such as the sale of LGCs (see Figure 5). To the extent the levelised cost of energy is lower, due to the impact of impact of CAPEX reduction resulting from third party capital funding for example, then the minimum required wholesale energy price would also be lower.

A simple assessment reflecting today's policy environment (carbon price = $0/ton and LGC = $40) and assuming no capital grant funding returns a minimum wholesale price required of ~$160/MWh. This is close to 4x the average wholesale price reflected in the NEM pool price for South Australia in the current financial year (~$42).

One complication in assessing the required wholesale price for the life of the project is the forecast price for LGCs peaks at ~$47 in 2020 and drops to $0 in 2030, when the RET scheme is currently scheduled to end, while the project lifetime of the CSP plant extends for another 10+ years.

4.8 Project Payback Time

Any investment will have a large number of variables which inform the expected payback time. In the context of a potential CSP plant which could be constructed at Port Augusta the primary inputs are:

- Capital cost
    - Loan structure
    - Interest rate
- Plant lifetime
- Operating cost
- Expected Project IRR
- Annual revenue
    - Carbon price
    - RET
    - Pool price/PPA
    - Forecast Demand

Preliminary analysis indicates that the simple payback time for investment in the modelled CSP plant including a modest investment return of 12% would be more than 30 years, which is longer than the assumed project lifetime of 25 years. Alinta has commissioned some further analysis on optimising plant configuration with minimum payback time as the boundary condition. Assuming 100% of CSP generated electricity could be sold at the pool price, there is the possibility that the simple payback time may be reduced to ~28 years. This possibility will be explored in further detail and findings incorporated into the Final Balance of Study report.

4.9 Estimates of LCOE

The financial modelling shows that the levelised cost of energy over the 25 year lifetime modelled for this CSP plant is approximately $200/kWh sent out including an assumed basic commercial return of 12%. When considering the +/- 30% accuracy at this level of the pre-feasibility assessment the window of LCOE ranges from $150-$250/kWh sent out.

Preliminary analysis on plant optimisation based on simple payback time rather than LCOE indicates that a system with less storage would have a higher LCOE (expected due to a lower capacity factor) but may have a shorter payback time. This is due to the ability to obtain a much higher average sale price for electricity sent out.

Therefore, in a scenario optimised for base load operation, LCOE is modelled to be approximately $200/kWh sent out. In a scenario where a CSP plant operates according to a dispatch regime other than base-load, LCOE is likely to be higher.

4.10 Cost Structure Variation

The financial modeling undertaken by Alinta was based on an un-geared, post-tax investment. This represents the most optimistic base-case for any financial modeling. If a project looks to be potentially viable in a model with this assumption, a more sophisticated model is then built which contemplates debt funding and sources.

4.11 Project Payback & Dispatch Regime

Alinta engaged IT Power to undertake some preliminary analysis on the simple payback time for CSP plants of varying configurations. One early learning from this work is that capital expenditure (CAPEX), plant configuration and dispatch regime are all intricately tied and cannot be considered in isolation.

- The lowest LCOE system with 15 hours of storage effectively performs as a baseload plant during much of the time. This leads to electricity generation at times of lowest prices as well as highest prices.
- Systems with between 1-7 hours of storage offer a small but significant improvement in economic performance measured in simple payback time. This is due to the ability of these systems to regularly generate during the higher priced, late-afternoon/early-evening peak periods while avoiding generation during the late-night/early-morning trough.
- Reduction in hours of storage translates into a significant reduction in CAPEX. A plant with 4 hours storage reduces CAPEX to ~65% of the cost of the reference plant with 15 hours storage.

Ultimately, the design and dispatch regime of any potential CSP plant would need to be supported by a suitable Power Purchase Agreement (PPA), as any contractual constraints or requirements would also have an impact on the dispatch regime of the plant.

4.12 Potential Optimisation

Alinta has taken some preliminary steps toward investigating the impact of different CSP plant configurations on the financial viability of the project. In the Options Study which was part of Milestone 2, PB used minimum LCOE to determine the optimal system configuration, the logic being that the lowest cost to generate would result in the best return on investment. It is possible, however that, due to variation in spot market prices over the course of the day and seasonally, the CSP plant with lowest LCOE is not the plant with the best economic payback.

Further work to be presented in the Final Balance of Study report will explore whether and to what degree there might be a positive correlation between the generation profile of a potential CSP plant and the spot market price in South Australia.

4.13 Final Balance of Study

This Draft Balance of Study report will be augmented and strengthened over the coming months before being re-released as the Final Balance of Study report. The Final Balance of Study report will represent the end of Stage 1, or Pre-feasibility level, of the Port Augusta Solar Thermal Generation Measure and it will be following the completion of Stage 1 that a decision is made whether to continue the Study into the Full Feasibility stage.

Additional information that is expected to be presented in the Final Balance of Study report includes:

- Updated pricing data from component suppliers and manufacturers for input into the overall cost estimate;
- Results from additional consultation with industry;
- More in depth assessment of the interdependence of plant configuration, dispatch regime, time of day pricing and project payback time;
- High level assessment of multiple plant configurations;
- Exploration and preliminary assessment of CSP technologies expected to be commercialised within the next 3 years;
- Analysis of the degree of correlation between DNI and pool price fluctuations;

4.14 Ongoing Data Collection and Monitoring

Alinta has installed and maintained a solar tracker, weather station and data collection system at the Northern Power Station site since June 2014. Monitoring results are broadly consistent with the data supplied by 3 Tier as an input into the system modelling. A slight misalignment of the solar tracker was discovered in November with a readjustment carried out in December.

The 3Tier data and the data recorded by Alinta are displayed in Table 8 and Figure 7 to Figure 9 below.

Table 8: Comparison of synthesised vs. recorded DNI data at Port Augusta

Data source	Daily average w/m^2		
	September	October	November
3Tier	282	300	310
Recorded	279	321	325

Figure 7: 3Tier TMY data vs. recorded data – DNI September 2014

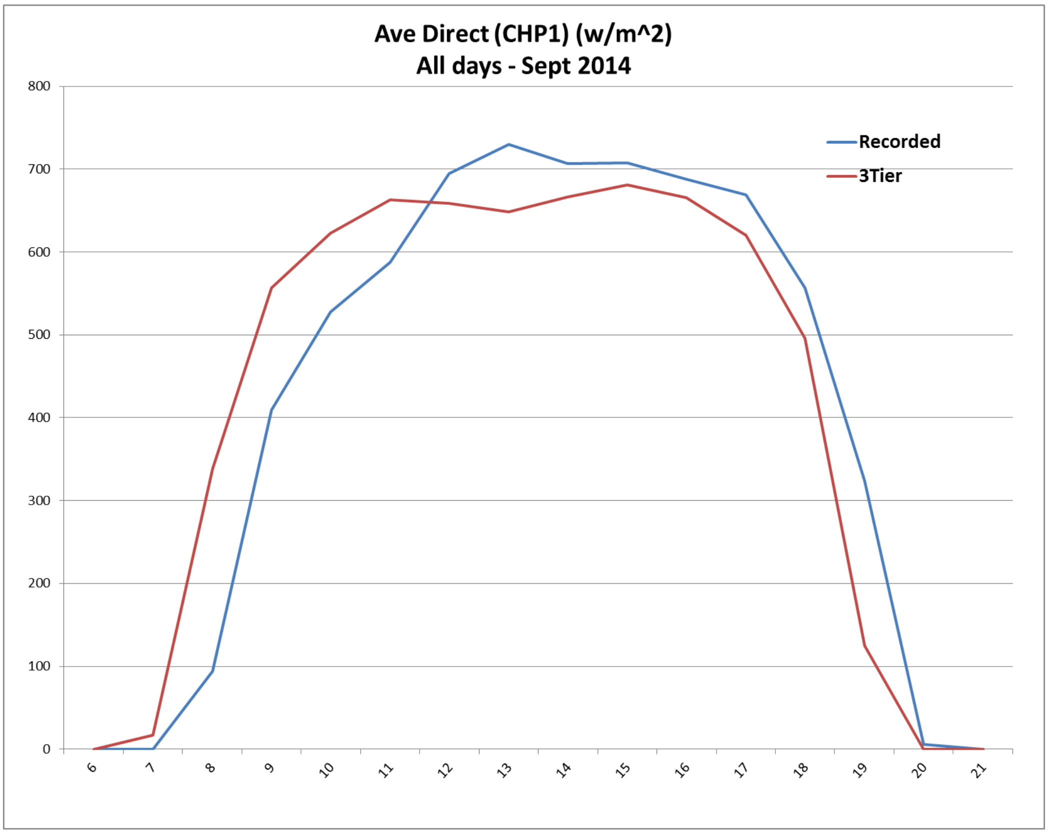


Figure 8: 3Tier TMY data vs. recorded data – DNI October 2014

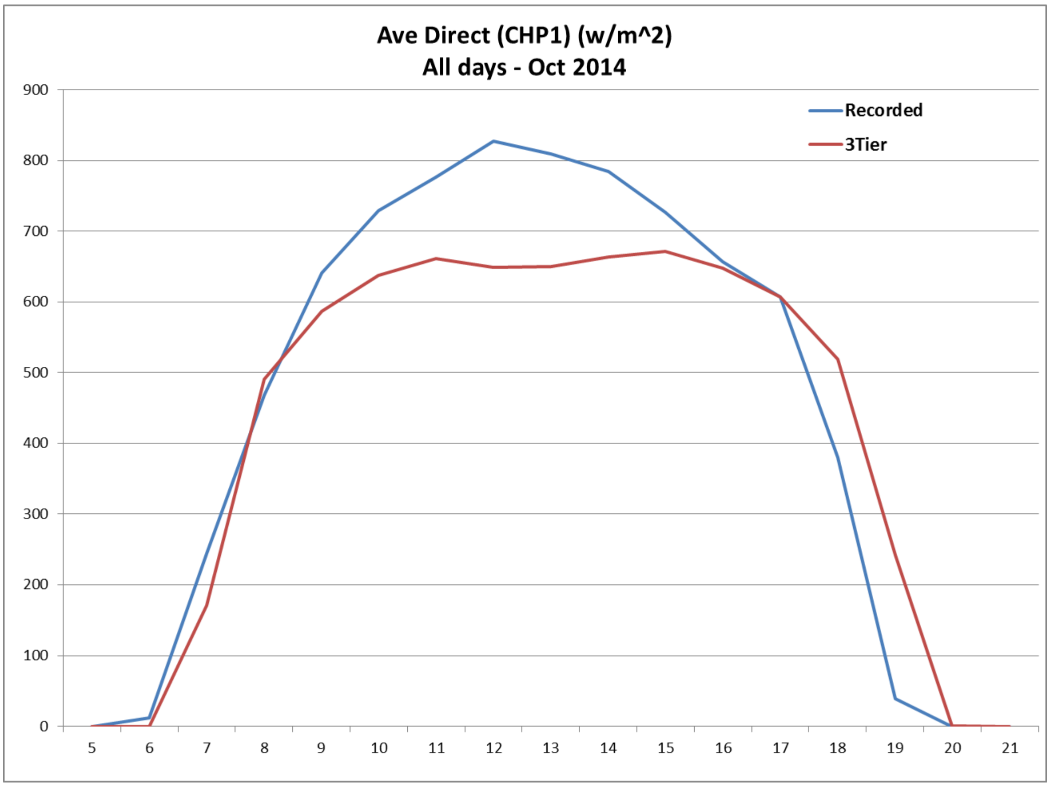
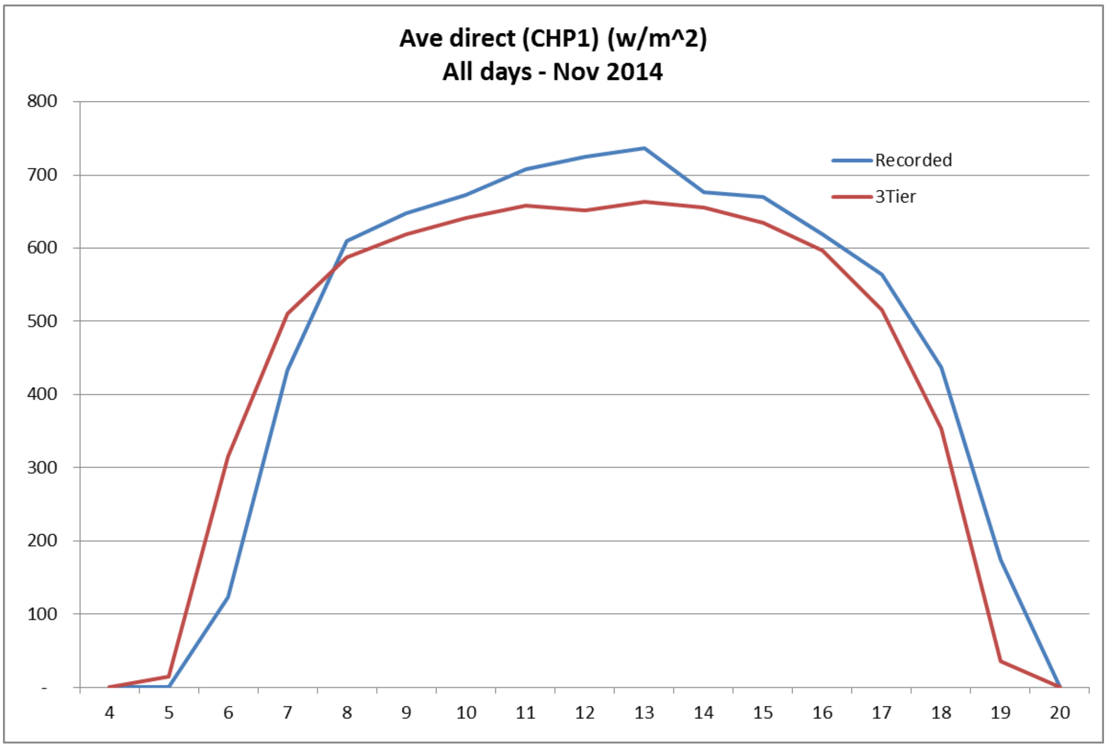


Figure 9: 3Tier TMY data vs. recorded data – DNI November 2014



5 Further Information

A dedicated public webpage has been established on Alinta Energy's website:

http://alintaenergy.com.au/about-us/power-generation/port-augusta-solar-thermal.

All milestone reports and media releases have been publicly-available on this website through the course of the study. This includes the Project Definition Report, which was published following review by ARENA. Any additional resources of public interest (photos, media articles) can also be stored on the webpage for public access.

Alinta has also created a public comment form with the intention of collecting input from interested individuals:

https://alintaenergy.com.au/about-us/power-generation/port-augusta-solar-thermal/feasibility-study

Since this open forum was launched in November 2014 there has been only one comment sent through to the Alinta project team. Alinta intends to continue to receive comments via this channel for the duration of the feasibility study.

Also free to the public will be the data that Alinta has collected since the installation of the solar tracker and weather station in early June, 2014. Monthly files containing all solar data and weather station data in .csv format will be uploaded onto the Alinta Solar Thermal web page and will be freely available to the public. This site is currently in production and will be made available in the coming months.

Appendix A

Balance of Study Report