Port Augusta Solar Thermal Generation Feasibility Study

Milestone 2 Summary Report

July 2014

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

AEMO	Australian Energy Market Operator
ARENA	Australian Renewable Energy Agency
CAPEX	Capital Expenditure
CSP	Concentrating Solar Power
DNI	Direct Normal Insolation
EIS	Environmental Impact Statement
GIS	Geographic Information System
GHI	Global Horizontal Insolation
LCOE	Levelised Cost of Energy
LRMC	Long Run Marginal Cost
LTO	Land Titles Office
MCA	Multi Criteria Analysis
MLF	Marginal Loss Factor
MW	Megawatt
MWe	Megawatt electric
NEM	National Electricity Market
NPS	Northern Power Station
OEM	Original Equipment Manufacturer
OPEX	Operational expenditure
SAM	System Advisor Model

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. This part of Stage One of the study comprises the Options Study and the Siting Study. Alinta engaged Parsons Brinkerhoff to undertake these studies with the reports identifying and assessing the CSP technologies which could be installed in Port Augusta along with potential locations for the construction of a CSP plant.

During the progress of the Options Study, Alinta uncovered information that changes the nature of some of the assumptions that were made in the original Project Definition Report (Milestone 1). Those changes relate to the potential for a hybrid plant to be installed at Port Augusta. Alinta has now determined that Playford B power station is not a suitable candidate for hybridization and that the use of assets from Northern Power Station will not be feasible for continued use by a CSP plant following the closure of the power station.

The Options Study considered six potential CSP technologies for installation at or near Alinta's Augusta Power Stations:

- Stand-alone parabolic trough
- Stand-alone power tower
- Stand-alone linear Fresnel
- Hybrid parabolic trough
- Hybrid power tower
- Hybrid linear Fresnel

The bulk of the Options Study consists of a compilation and assimilation of existing data and research relevant to the specific location and infrastructure at Port Augusta. Parsons Brinkerhoff assembled solar irradiance data, the most current technology performance data and capital and labour cost estimates scaled for application in Port Augusta. Industry accepted simulation software (Solar Advisor Model (SAM) and Thermoflex) was used to model the predicted output of the various technology configurations.

Using the Levelised Cost of Energy (LCOE) the optimal configuration of solar multiple and storage capacity for each technology option was then determined through a series of sensitivity analyses. The tables below identify the key results for the optimised hybrid and stand-alone CSP plants.

Table 1: Key results for hybrid CSP plants

Parameter	Units	Power tower	Parabolic trough	Linear Fresnel
Net output[2]	MW	50	28[3]	28
Land required	ha	245	54	36
Annual energy	GWh	100	46	47
Capital cost	$'000	275,389	162,816	130,133
Cost per kW	$/kW$_e$	5,513	5,820	4,651
Sent-out power cost (LCOE)	$/MWh	314.60	412.12	323.10

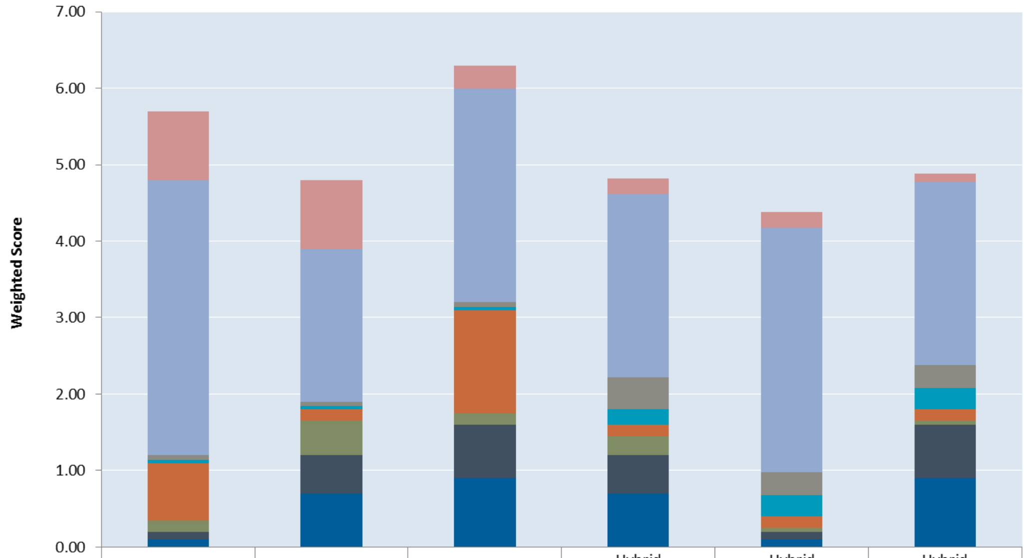
[2] Electricity generated from NPS attributable to steam raised in the solar field.

Table 2: Key results for stand-alone CSP plants

Parameter	Units	Parabolic trough	Power tower	Linear Fresnel
Net output	MWe	50	50	50
Hours of thermal energy storage	hrs	3	15	0
Land required	ha	147	553	68
Annual energy	GWh	123	283	89
Capital cost	$'000	608,478	796,287	348,434
Cost per kW	$/kW$_e$	12,170	15,926	6,969
Sent-out power cost (LCOE)	$/MWh	473.93	258.24	389.96

The six optimized systems were then assessed through a Multi Criteria Analysis (MCA) process where many factors critical to the decision making process were identified and assigned a weighting. Each of the options was scored against each criteria with a weighting applied. The end result is a relative ranking of the options, which can be seen in Figure 1 below. The lowest score represents the best ranking, which in this case is the Hybrid Parabolic Trough option.

Figure 1: MCA rankings of six optimised CSP systems



	Standalone Parabolic Trough	Standalone Power Tower	Standalone Linear Fresnel	Hybrid Parallel (Power Tower)	Hybrid Solar Boost (Parabolic Trough)	Hybrid Solar Boost (Linear Fresnel)
Total Installed Cost	0.90	0.90	0.30	0.20	0.20	0.10
Levelised Cost of Energy	3.60	2.00	2.80	2.40	3.20	2.40
Integration Risk	0.06	0.06	0.06	0.42	0.30	0.30
Operational Risk	0.04	0.04	0.04	0.20	0.28	0.28
Predictable Generation	0.75	0.15	1.35	0.15	0.15	0.15
Land Usage	0.15	0.45	0.15	0.25	0.05	0.05
Operating Experience	0.10	0.50	0.70	0.50	0.10	0.70
Technological Maturity	0.10	0.70	0.90	0.70	0.10	0.90

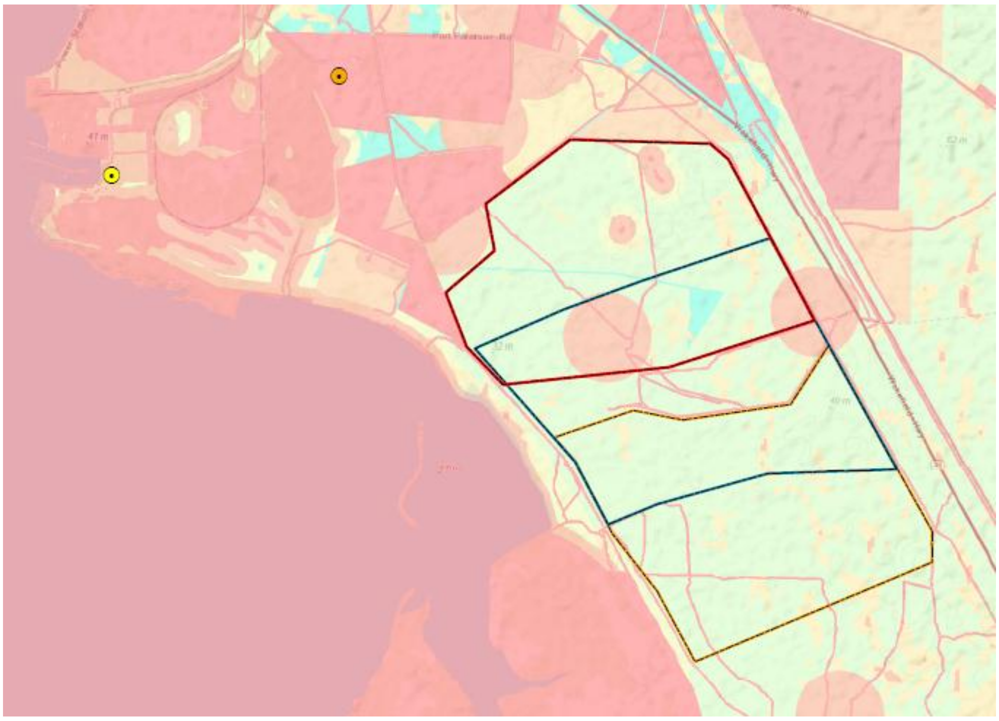
Following the MCA rankings of all systems, Alinta then applied further qualitative analysis of other factors which were felt to be critical in progressing the study, including:

- Potential for commercialization
- Potential for third party investment
- Re-assessment of LCOE vs Capital Cost
- Potential for industry learnings
- Practical obstacles to hybridization

Taking into consideration the MCA rankings and the additional internal analysis of the six technology options in relation to the additional list of items above, Alinta has chosen to pursue the full feasibility study on the basis of a stand-alone power tower plant.

A similar process was followed in order to determine the most suitable location for the plant. Much of the area considered in the study was similar over many variables, including environmental, geological, topographic and heritage constraints. Ultimately the most influential factors in identifying the preferred location were the zoning and ownership of underlying land and the proximity of the site to the connection point. For a stand-alone plant the preferred option is the northern-most (red) of the three polygons outlined in Figure 2 below.

Figure 2: Potential locations for stand-alone CSP plant



Note: The Orange dot represents the Davenport Switchyard and the Yellow dot represents Northern Power Station.

2 Introduction

This report represents the second of five milestones which comprise the Port Augusta Solar Thermal Generation Feasibility Study. The Project Definition Report (Milestone 1) was released by Alinta in March 2014 and is available on the Alinta Energy website:

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

2.1 Review of Assumptions from Milestone 1 Report

There were several high level assumptions made by Alinta which were inputs into the early stages of the Port Augusta Solar Thermal Feasibility study. Through the more detailed analysis of equipment, components and technical implications undertaken during the Options Study and the Siting Study, some of the earlier assumptions have been revised. The current assessment of the assumptions from the Project Definition Report are presented in Table 3 below.

Table 3: Changes to Assumptions from Milestone 1 Report

Initial Assumption	Changes to assumption
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.	**None**
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.	**None**
The life of the Leigh Creek Mine, which supplies coal to the Augusta Power Stations, will be extended through further investment by Alinta Energy.	**None**
The Augusta Power Stations will remain in operation, in their current form supplied by the Leigh Creek Coal Mine, until at least 2028 to 2032.	**None**
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.**
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.**

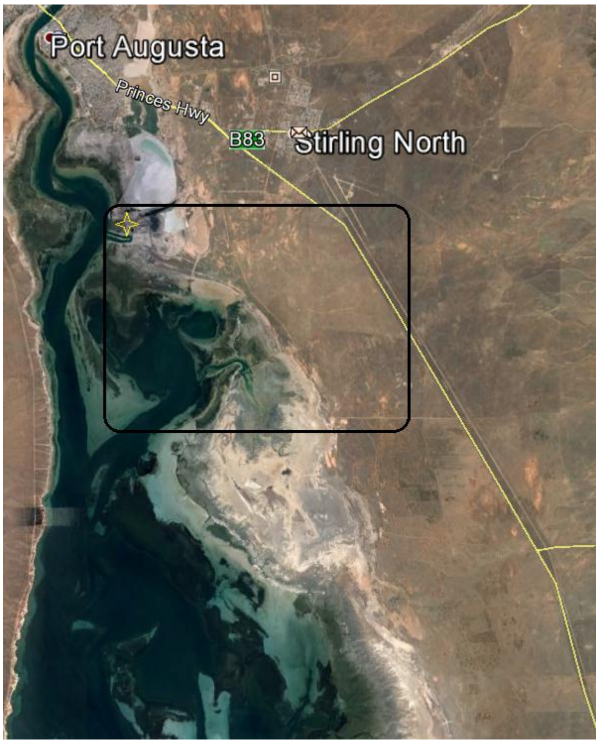
Initial Assumption	Changes to assumption
The range of project benefits, fuel diversity opportunities for South Australia, dispatchable energy potential, compatibility with South Australian energy system, network connection options, technology costs and acceptable technology types do not materially deviate from those understood at the commencement of this study.	**None**
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.	**None**

3 Progress to Date

In the early part of the Milestone 2 period Alinta engaged Parsons Brinkerhoff (PB) to provide specialized consulting services. PB have completed a number of significant investigations in the field of solar thermal generation and have worked with Alinta in the past on the Solar Concept Study which formed part of Alinta's funding application to ARENA.

Following preliminary data collection a site visit to the Port Augusta Power Stations was made by PB and Alinta project personnel. A full day was spent with technical staff touring the facilities, acquiring technical data and understanding the potential locations and logistics of the operation of a stand-alone and a hybrid CSP plant. The area to the south-east of the Northern Power Station was explored in a 4WD vehicle to understand the topography, vegetation and other potential constraints to locating a CSP plant.

Figure 3: Area surveilled during CSP Project site visit



* The yellow star represents Northern Power Station

The Options Study and Siting Study proceeded on the basis of the data and technical information collected prior to and during the site visit along with information gathered during a walk-through of both the Northern and Playford B Power Stations.

3.1 Options Study

The Options Study considered six potential CSP technologies for installation at or near Alinta's Augusta Power Stations:

- Stand-alone parabolic trough
- Stand-alone power tower
- Stand-alone linear Fresnel
- Hybrid parabolic trough
- Hybrid power tower
- Hybrid linear Fresnel

These six options are specified in the Emerging Renewables Program Funding Agreement (the Agreement) between ARENA and Flinders Operating Services (owned by Alinta) and are the most mature and potentially feasible CSP solutions commercially available. A nominal installed capacity of 50 MWe was chosen as the boundary condition for the Options Study. This threshold was selected based on capital cost implications and an understanding of market dynamics in the National Electricity Market (NEM). Demand in the NEM has dropped more than 4.3% since 2009, while supply has increased.

Therefore, the wholesale energy price continues to decline, making investment in additional generation – particularly those with large capital costs – difficult to rationalise. However, Alinta Energy acknowledges that solar thermal technology could have benefits beyond its generation capacity, including industry-learnings and indirect economic benefits for the community associated with construction and tourism. Therefore, at this stage of the feasibility study Alinta considers 50MW to be a realistic benchmark that balances investment challenges with indirect economic benefits.

3.1.1 Scope

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

- Identify and compare technologies (parabolic tough, power tower, Fresnel) with a focus on power tower and Linear Fresnel.
- Estimate energy production from each option based on currently available solar irradiation (building on the concept study).
- Evaluate energy storage options and capacity.
- Estimate capital and operating costs of the options.
- Calculate Long Run Marginal Cost (LRMC).
- Identify any non-measurable factors, in addition to costs and output that should be considered in making a decision.
- Develop a decision matrix.
- Identify a preferred option with respect to the technology to be employed, storage capacity and hybridization.
- Refine the preferred option to the degree required for the study.
- Update costs and performance of Northern Power Station (NPS) integration option.
- Recommend whether stand-alone plant or NPS hybridisation will be taken forward for this study.
- At the completion of this section of the study, a recommendation on preferred technology will be made to Alinta and it is expected that one technology will be taken forward.

3.1.2 Methodology

The first stage of the Options Study was a fatal flaws assessment which ruled out any option that was very likely to be infeasible. During this early stage the heat rate curves and thermal models of both the Northern Power Station and Playford B power station were assessed to determine the potential for hybridization. This information, along with an inspection of the facilities, led to the dismissal of Playford B as a potential site integration of a hybrid CSP plant.

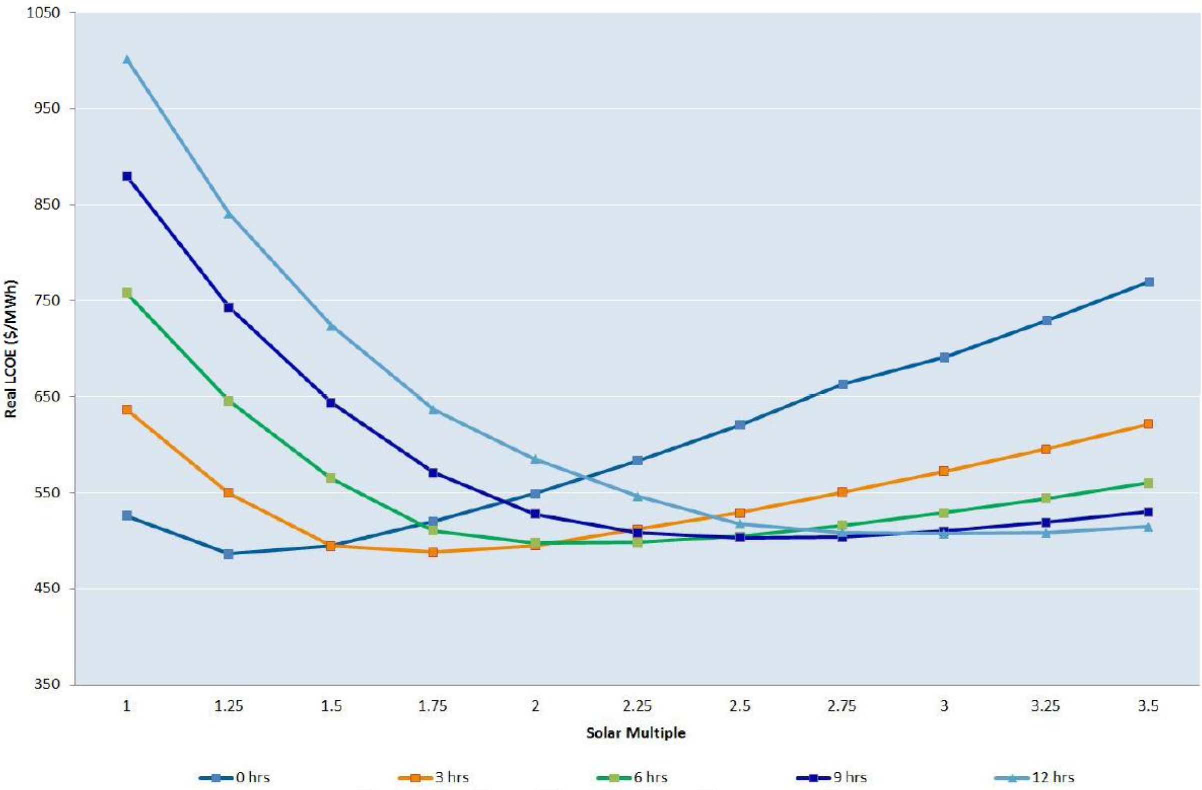
The bulk of the Options Study consisted of a compilation and assimilation of existing data and research relevant to the specific location and infrastructure at Port Augusta. PB assembled solar irradiance data, the most current technology performance data and capital and labour cost estimates scaled for application to Port Augusta. Industry accepted simulation software (Solar Advisor Model (SAM) and Thermoflex) was used to model the predicted output of the various technology configurations.

Plant Optimisation

SAM has been under development and improvement at the US National Renewable Energy Laboratory (NREL) for over ten years and is recognized as the industry best practice tool for modeling solar thermal energy systems.

For each of the six system types SAM was used to optimise the combination of design elements which delivered the minimum Levelised Cost of Energy (LCOE). The LCOE for each system type was modeled as a function of solar multiple and hours of storage. Figure 4 below is an example of the results of this assessment of LCOE for a stand-alone parabolic trough. A full assessment of all six technologies can be found in the Options Study Report (Appendix A).

Figure 4: LCOE sensitivity to Solar Multiple & hrs of storage for stand-alone parabolic trough



The system design with the lowest LCOE for each system type was then analysed in detail to determine the value of all relevant parameters which would be used to compare the different system types. The most heavily considered metrics in the comparative analysis are financial metrics, however other important factors include technological maturity, land area required and potential issues with integration into the existing power station and transmission infrastructure.

The key results for each of the six lowest LCOE system types are show in Table 4 and Table 5 below.

Table 4: Key results for hybrid CSP plants

Parameter	Units	Power tower	Parabolic trough	Linear Fresnel
Net output[2]	MW	50	28[3]	28
Land required	ha	245	54	36
Annual energy	GWh	100	46	47
Capital cost	$'000	275,389	162,816	130,133
Cost per kW	$/kW$_e$	5,513	5,820	4,651
Sent-out power cost (LCOE)	$/MWh	314.60	412.12	323.10

[2] Electricity generated from NPS attributable to steam raised in the solar field.

Table 5: Key results for stand-alone CSP plants

Parameter	Units	Parabolic trough	Power tower	Linear Fresnel
Net output	MWe	50	50	50
Hours of thermal energy storage	hrs	3	15	0
Land required	ha	147	553	68
Annual energy	GWh	123	283	89
Capital cost	$'000	608,478	796,287	348,434
Cost per kW	$/kW$_e$	12,170	15,926	6,969
Sent-out power cost (LCOE)	$/MWh	473.93	258.24	389.96

On the basis of PB's expertise, Alinta requested PB to propose a decision matrix as required by the Agreement. The decision matrix selected was a Multi Criteria Analysis scoring table.

Multi Criteria Analysis

Multi Criteria Analysis combines a quantitative and qualitative assessment of the critical decision-making factors in a complex selection process. Alinta and PB developed a list of critical factors which will have a significant impact on the detailed design and construction of any CSP plant which is carried forward in this study. The factors selected include:

- Technological Maturity
- Operating experience
- Land usage
- Predictable generation
- Operational risk
- Integration risk
- Levelised cost of energy (LCOE - $/kWh)
- Total installed cost per kW ($/kWe)

The weighting of each of these factors was discussed and agreed between PB and Alinta. The most heavily weighted factor was chosen to be the LCOE, also known as LRMC. This metric provides an appreciation of the revenue required to operate a 'break-even' operation, and can be assumed to be equivalent to the wholesale price of electricity in the NEM). It is also the LCOE which would inform the necessary sell price for energy when entering into an off-take agreement with a customer.

Table 6: Options Study Multi Criteria Analysis parameters and weighting

Parameter	Weighting
Technological Maturity	10%
Operating experience	10%
Land usage	5%
Predictable generation	15%
Operational risk	6%
Integration risk	4%
Levelised cost of energy (LCOE - $/kWh)	40%
Total installed cost ($/kWe)	10%

There are two primary reasons that this parameter was given a weighting far above that of any other parameter:

1. Renewable energy technologies typically have large capital costs while having far lower operational costs than traditional energy technologies. Use of LCOE as the most important parameter recognizes the importance of life-cycle costing in assessing renewable energy technology projects.
2. Alinta is a commercial entity. As such, the potential return on investment is the most significant driver in prioritizing investment. The heavy weighting of LCOE over capital expenditure recognizes Alinta's desire to invest in projects that are sustainable in the long term and not just to minimize the capital cost of projects.

The output of the Multi Criteria Analysis is a relative ranking of the options according to the chosen parameters.

3.1.3 Findings

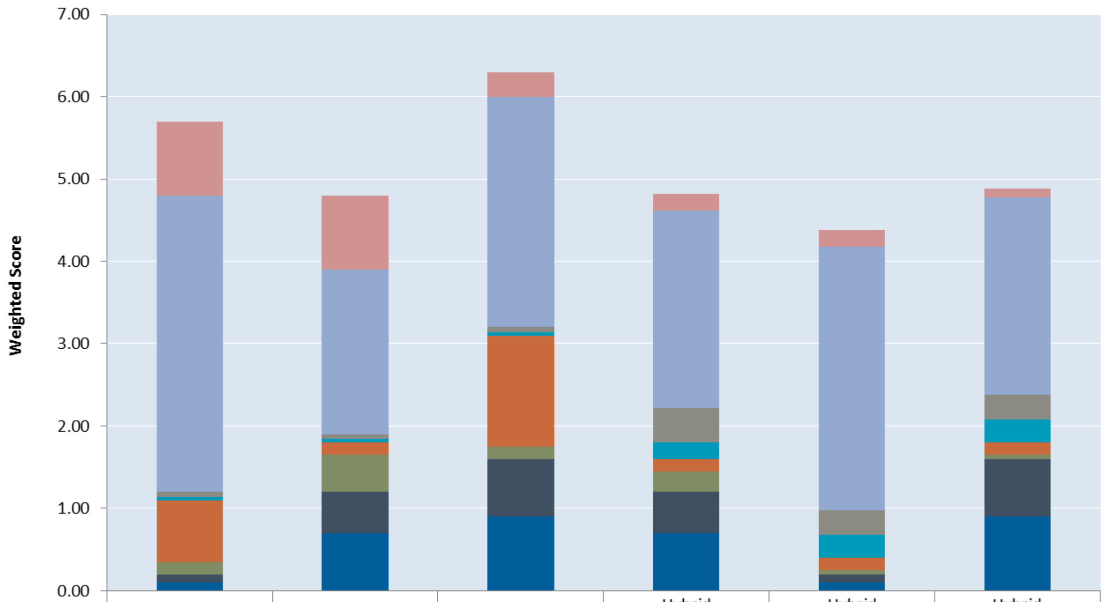
The MCA scores are shown in Table 7 below. A lower score indicates a better result.

Table 7: MCA ranking scores

System type	MCA score
Stand-alone power tower	4.8
Stand-alone parabolic trough	5.7
Stand-alone linear Fresnel	6.3
Hybrid power tower	4.8
Hybrid parabolic trough	4.4
Hybrid linear Fresnel	4.9

The output of the MCA and the relative contribution of each parameter to the score of each system type is presented graphically in Figure 5.

Figure 5: MCA Rankings



	Standalone Parabolic Trough	Standalone Power Tower	Standalone Linear Fresnel	Hybrid Parallel (Power Tower)	Hybrid Solar Boost (Parabolic Trough)	Hybrid Solar Boost (Linear Fresnel)
Total Installed Cost	0.90	0.90	0.30	0.20	0.20	0.10
Levelised Cost of Energy	3.60	2.00	2.80	2.40	3.20	2.40
Integration Risk	0.06	0.06	0.06	0.42	0.30	0.30
Operational Risk	0.04	0.04	0.04	0.20	0.28	0.28
Predictable Generation	0.75	0.15	1.35	0.15	0.15	0.15
Land Usage	0.15	0.45	0.15	0.25	0.05	0.05
Operating Experience	0.10	0.50	0.70	0.50	0.10	0.70
Technological Maturity	0.10	0.70	0.90	0.70	0.10	0.90

3.2 Siting Study

The aim of the Siting Study was to identify potential locations which would suit the installation of the chosen solar thermal technology. For hybrid options there is a limit to the feasible distance between the CSP plant and the point of connection to the existing plant. For stand-alone systems the limiting factor is the distance to the nearest substation.

3.2.1 Scope

The The scope of works for the Siting Study is identified in the Agreement and is as below:

- The initial survey and site selection will be based on Geographic Information System (GIS) and satellite data (with appropriate constraints) identifying a short listing of potential sites.
- Consideration of environmental, infrastructure, community constraints issues with respect to plant layout and future development approval process will follow.
- Analysed site specific conditions including meteorological factors, proximity to local communities and land acquisition costs.
- Site topography, geology and geotechnical conditions.
- Development of a siting matrix to identify the preferred site.

3.2.2 Methodology

The methodology for the Siting Study was similar in approach to that taken in the Options Study. Initially a reasonably large boundary limit distance of 20km was set within which other constraints were assessed. Both GIS assessment and a site visit informed the Study. The factors which were determined to be relevant influencers of the selection of a site are:

- Proximity to connection point (power station or substation)
- Slope of the site
- Potential environmental impacts
- Potential heritage impacts
- Existing land use and potential to acquire land
- Adjoining land uses and potential sensitive receptors
- Potential for inundation or flooding

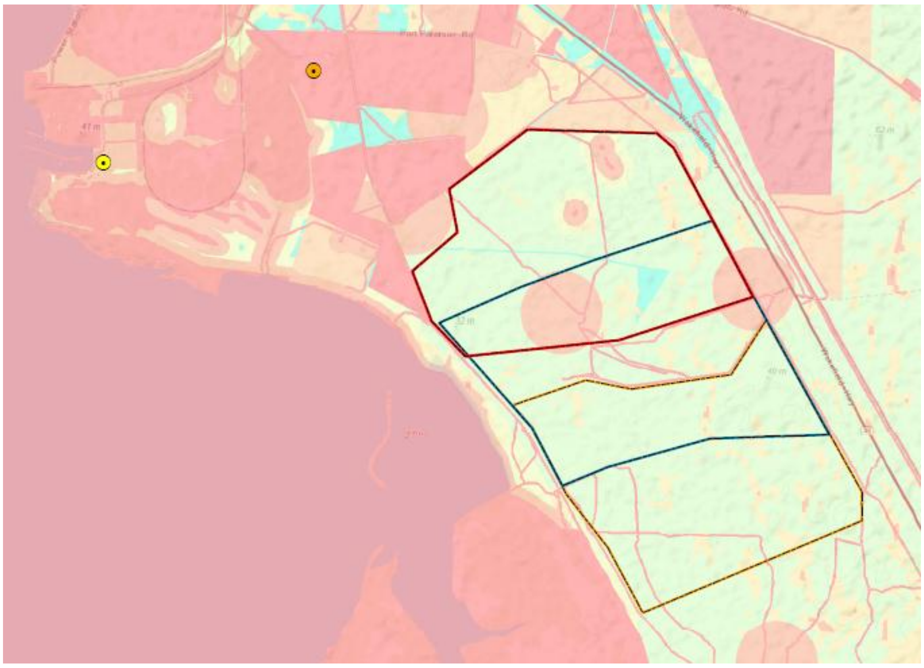
Constraints Analysis

A constraints map was produced for each of the factors which were assessed to be critical to site selection. For some factors, such as many of the potential environmental impacts, no constraints map was produced because there was determined to be no material variation in potential impact at any point across the assessment area.

The Siting Study identified three potential locations which would meet the minimum criteria for a hybrid CSP plant and three that would meet the minimum requirements for a stand-alone CSP plant.

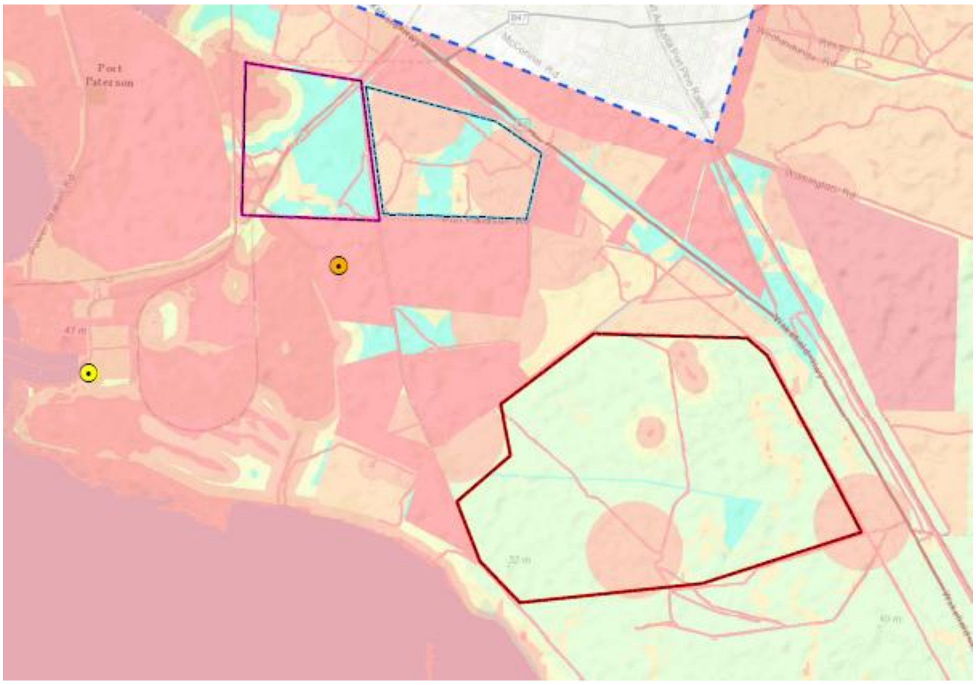
The grey-scale in Figure 6 and Figure 7 below show the combination of constraints found in assessing each of the critical factors. The coloured polygons are the indicative sites that meet all the requirements for the installation of a stand-alone and hybrid CSP plant near the Northern Power Station.

Figure 6: Potential locations for stand-alone CSP plant



Note: The Orange dot represents the Davenport Switchyard and the Yellow dot represents Northern Power Station.

Figure 7: Potential locations for hybrid CSP plant



Multi Criteria Analysis

As with the Options Study, Alinta and PB developed a list of critical factors which will have a significant impact on the suitability and selection of the site which is carried forward in this study. The factors selected include:

- Capital cost
- Slope
- Flooding and tidal inundation
- Geotechnical
- Tenure and Land Access
- Sensitive receptors
- Build environment
- Planning and approvals
- Heritage
- Terrestrial and marine ecology
- Waterway and coastal buffers

The weighting of each of these factors was discussed and agreed between PB and Alinta. The most heavily weighted factor was chosen to be the Capital cost which is a direct correlation to the proximity of the CSP plant to the connection point. Capital cost in reference to location is primarily to costs associated with connection to either the switchyard (for stand-alone plants) or Northern Power Station (for hybrid plants).

Table 8: Siting Study Multi Criteria Analysis parameters and weighting

Parameter	Weighting
Capital cost	30%
Slope	5%
Flooding and tidal inundation	5%
Geotechnical	5%
Tenure and Land Access	15%
Sensitive receptors	10%
Build environment	5%
Planning and approvals	10%
Heritage	5%
Terrestrial and marine ecology	5%
Waterway and coastal buffers	5%

3.2.3 Findings

The MCA scores for the Siting Study are most easily understood by looking at the maps and figures that can be seen in full in the attached Siting Study Report.

3.3 Alinta Energy Internal Analysis

Following the receipt of the Options Study and Siting Study, these reports were circulated within Alinta and discussed at a workshop attended by a range of Alinta personnel. The reports were also confidentially reviewed by qualified third parties.

While the MCA results are a significant input into the decision making process, the results must be interpreted and other factors, both qualitative and quantitative, have influenced the final selection of technology and site.

3.3.1 Technology Selection

The relative ranking of technology options which was generated by the MCA in the Options Study clearly eliminated two of the three stand-alone options from consideration, Parabolic Trough (5.7) and Linear Fresnel (6.3). The remaining four options all ranked very closely with the Hybrid Parabolic Trough receiving the lowest score (4.4).

Potential for Commercialisation

While the capital and lifetime costs of the chosen system are the primary financial indicators for the potential construction of any CSP plant, the possibility for future expansion and commercialisation by Alinta of the selected technology is also an important factor. In the current environment, none of the CSP technologies was determined to be commercially viable in the market where Alinta operates in the absence of partnerships and/or subsidies. Therefore, in order for any CSP technology to be a viable commercial proposition for Alinta one of two things would be required:

1. The cost of the CSP technology relative to traditional energy generation technologies, drops significantly. This may be through economies of scale as CSP technologies become more advanced, more common and progress along the standard cost vs. maturity curve. This factor may also be affected by an increase in the cost of traditional energy technologies through the rise in fuel prices, imposition of fines or taxes on emissions or other regulation.

2. The CSP technology opens up a new market to Alinta by offering an affordable energy solution where traditional energy technologies are not commercially feasible.

Linear Fresnel and Power Tower options are relatively new technologies on a commercial scale. Parabolic trough plants have been in operation for much longer and would be expected to be further along the cost vs. maturity curve. The assumption, therefore, is that the cost of linear Fresnel and power tower plants will reduce at a quicker rate and by a larger quantum and more quickly than parabolic trough plant.

Potential for Third Party Investment

The ability of Alinta to secure third party investment will be an important factor in realizing the construction of a CSP plant in Port Augusta. Alinta would explore both private industry and government for potential investors and there is likely to be more interest in supporting a technology that has a greater potential of becoming commercially viable, which we determine to be Linear Fresnel and power tower options.

There is always the possibility that internal or external circumstances delay the pursuit of constructing a CSP plant at Port Augusta. Due to the finite lifetime of Northern Power Station, which is currently forecast to operate until approximately 2030, any delay in establishing a CSP plant would mean that the payback time on the plant would reduce. This in turn would make investment in a hybrid solution less attractive to industry partners and other potential sources of investment.

Therefore Alinta believes that a stand-alone solution would have more chance of attracting sufficient investment to make the project commercially feasible.

Capital Cost vs. LCOE

Following the receipt of the draft Options Study, Alinta held internal discussions on the relative importance to potential project funding of the LCOE and CAPEX. As expected with renewable energy projects, the option with the highest capital cost is also the option with the lowest LCOE, being a stand-alone power tower.

For a project of this scale to be realized Alinta would need to secure long term off-take agreements with one or more customers to purchase the electricity generated from the CSP. Any off-take agreement would have it's starting point at the LCOE, which is why Alinta believe that LCOE is, in most circumstances, a more important metric than CAPEX in considering the potential construction of a commercially viable CSP plant.

Potential Industry Learning

The industry learnings that could be realized out of the construction of a CSP plant is closely related to, and would be expected to influence, commercialization potential and attractiveness to grant funding/investment opportunities and this is directly related to the maturity of the technology. The construction and operation of linear Fresnel and power tower plants would be expected to offer the most learnings for the CSP industry.

Having in-house expertise in one of these two technologies, which are expected to dominate the CSP market in the near future, could be valuable to Alinta while the construction and operation of one of these two plant types could be a solid foundation for the industry in Australia more broadly.

Practical Obstacles to Hybridisation

Hybrid CSP plant options are more constrained and influenced by geography, land tenure and existing infrastructure than a stand-alone plant would be. The geography of Port Augusta and the Northern

Power Station presents some particular challenges due to the location on the Spencer Gulf, local development, the coal delivery rail loop and the large number of transmission lines and associated easements which are not under the control of Alinta.

As mentioned under the section on third-party investment, Northern Power station is currently projected to operate until ~2030. Geotechnical work and testing at Northern Power Station continues as Alinta assesses the achievability of commercializing and additional coal deposit at the Leigh Creek Mine. This would extend the life of both operations to around ~2030, depending on market conditions and optimal operating regime. The displacement of coal by the energy input of a hybrid CSP plant would likely extend the life of Northern Power Station. Internal analysis estimates that the impact would be minimal, however, extending the lifetime of the coal deposits by between one and two years.

Alinta and Parsons Brinkerhoff explored the possibility of installing a hybrid plant which could be modified later in life to be a stand-alone plant once the Northern Power Station is closed and continue using the power block and other infrastructure items. This would not be possible for the parabolic trough or linear Fresnel due to the heat flows required at the power block. Neither would it be possible with a 50MW Power Tower due to the minimum operating load possible on one of the two Northern Power Station turbines.

It may be possible to operate one of the turbines at minimum load with the input of a 100MW power tower. This possibility was not explored as part of the Options Study.

Another difficulty faced by attempting to integrate a hybrid CSP into Northern Power Station is the arrangement of existing infrastructure. Because the power station is located on the water's edge and immediately south of urban development, there is a concentration of infrastructure to the east and south of Northern Power Station. The primary infrastructure items are the Leigh Creek to Augusta rail loop used to deliver coal to the power station and multiple high voltage transmission lines. All existing infrastructure poses the double challenge of acquiring the right to access the land and engineering a safe and effective interface between intersecting infrastructure.

As with any refurbishment or modification of an existing asset, there are many more technical unknowns associated with integrating a hybrid CSP plant into the existing Northern Power Station than there are for constructing a stand-alone plant.

These arguments support the selection of a stand-alone CSP plant over a hybrid CSP plant.

Final Technology Choice

Based on the substantial input from the Options Study report and the other considerations discussed above, Alinta intends to continue the pre-feasibility study on the basis of the stand-alone power tower.

3.3.2 Site Selection

Cost to acquire land

The land acquisition costs analysis was conducted on the basis of 2013 data from the South Australian Land Titles Office (LTO). Land valuations for each parcel intersected by the five site locations were summed in order to return an indicative cost for the land that would be acquired for each possible location. These numbers should be treated as very rough estimates and are not intended to represent what either Alinta or the current property owners would consider is a fair price for any transaction.

Where only part of a land parcel is within the site proposed in the Siting Study, the LTO valuation for the whole land parcel is included in the indicative value. In pursuing the acquisition of any of the land areas identified in the Siting Study there would necessarily be additional costs and resources required to undertake negotiations with current owners and to structure any agreement around the transaction. In this aspect it would be much simpler to engage with fewer stakeholders regarding the lowest possible number of land parcels.

Table 9 below summarises the number of land parcels, owners and the approximate land value as a starting point for any assessment by Alinta regarding the possible acquisition of land for construction of a CSP plant. These values are indicative only and are based on values available on the website Property Assist which come from the Valuer General's Department in the South Australian Land Titles Office.

Table 9: Indicative land values

Site		No. of Parcels	No. of Owners	Indicative $
Stand-alone 1st	**RED***	6	1	~$450,000
Stand-alone 2nd	**BLUE**	7	2	~$800,000
Stand-alone 3rd	**ORANGE**	7	3	~$1,000,000
Hybrid 1st	**PINK**	Owned by Alinta		
Hybrid 2nd	**RED**	6	1	~$450,000
Hybrid 3rd	**BLUE**	18	16	~$3,800,000

* the colour of the polygon in the Siting Study Report (Figure 6 & Figure 7)

For the three sites considered as potential locations suitable for a stand-alone power tower the maximum land value is approximately $1M. As this is a fraction of one per cent of the capital cost of construction, the land value is not a significant factor in selecting a site.

Final site selection

Alinta believes the technology selection is significantly more involved and critical than the selection of site. At this stage Alinta has not discovered a strong argument for investigating the use of the site which was ranked highest for a stand-alone system in the MCA scoring.

Alinta will pursue the pre-feasibility study on the basis of the northern-most site (RED) identified for a stand-alone plant in the Siting Study.

Appendix A

Options Study Report

Appendix B

Siting Study Report