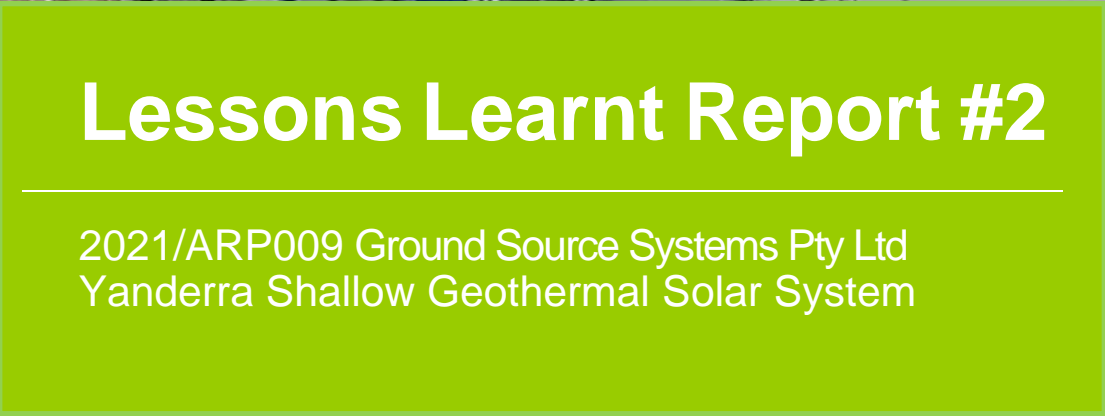


Lessons Learnt Report #2

2021/ARP009 Ground Source Systems Pty Ltd
Yanderra Shallow Geothermal Solar System



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1. Project Details

Project Title	Ground Source Systems Yanderra Shallow Geothermal-Solar Systems Demonstration
Recipient Name	Ground Source Systems Pty Ltd (ABN 82 164 680 424)
Project Participants	The University of Melbourne (ABN 84 002 705 224) Fourth Element Energy Pty Ltd (ABN 41 644 610 926)
Primary Contact Name	Brad Donovan
Contact Email	brad@groundsourcesystems.com.au
Reporting Period	July 2022 - January 2023
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The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

2. Executive Summary

Ground Source Systems Pty Ltd is developing a hybrid geothermal system for heating and cooling a commercial poultry breeding facility in Yanderra, NSW to demonstrate its effectiveness and its financial & environmental benefits to the rural industries. The hybrid geothermal system comprises a ground-source heat pump (GSHP) system in part fed by a solar PV, and with gas back-up. A GSHP system is being installed to replace in full or in part LPG (Liquefied Petroleum Gas) as a fuel for heating and evaporative cooling for a single poultry shed. The typical mid-sized poultry operation at the Yanderra demonstration site is expected to provide an important case study to drive uptake across the sector.

Contracts were signed between November 2021 and February 2022, with the geothermal-solar system becoming operational by September 2022, ahead of the planned November 2022 start to be able to capture some of the winter batches that require most heating. The system construction was largely completed during this reporting period. This lessons learnt report focuses on the lessons gained through the re-design of distribution system, contracting and construction phases of this project. Specific technical lessons learnt on this project are shared in this report.

The lessons learnt explored in this report focus on four key learnings:

- There is still a lack of market maturity for shallow geothermal projects in the agriculture sector, however this is changing with a number of media outlets arising from this project and word of mouth. Particularly, there is limited depth of ground source heat pump designers and providers in Australia able to demonstrate a comprehensive understanding of the specific needs of the poultry industry.
- There is a variety of ways farmers operate the broiler facilities and a variety in the heating demands among sheds within a same farm, impacting on thermal load demand to satisfy, and requiring energy audits early on in the design phase for cost-effective systems (not over- or under- designed).
- Dust in sheds was a major issue for the fan coil unit distribution systems used in the project. The severity of the issue was not foreseen, so additional efforts and investment led by the Recipient derived in a technical solution for largely automated cleaning of filters.
- In this “retrofit” project, commercial operation of the poultry sheds continues, and installation of the new systems particularly inside the sheds must be planned around this schedule. Therefore, careful planning and coordination among stakeholders are required. Installation of fan coil units inside the shed had to be undertaken in stages rather than at once.

3. Project Overview and Progress

The overall purpose of the project is to demonstrate a hybrid geothermal system for heating and cooling a commercial poultry breeding facility in Yanderra, NSW. The hybrid geothermal system comprises a ground-source heat pump (GSHP) system in part fed by a solar PV, and with gas back-up. A GSHP system has been installed to replace in full or in part LPG (Liquefied Petroleum Gas) as a fuel for heating and evaporative cooling for a single poultry shed. The typical mid-sized poultry operation at the Yanderra demonstration site is providing an important case study to drive uptake across the sector.

During this reporting period, the construction of the hybrid ground source heat pump system was practically completed, and the system (ground loops, plant, fan coil units, solar PV) was operational and commissioned, with a pre-commissioning run in September 2022, and a commissioning run in November 2022. The plant, which contains mainly heat pumps, valving, circulation pumps and control systems, is located just outside the shed. A shipping container was used to house them (see Figure 1). Other works took place inside the chicken sheds (fan coil units) and in connecting plant and shed's fan coil units to commission the system.

The control and switchboard installation took place to make the system operational before the winter season was over, this took priority over electronic data taking, however, most instruments were also installed (some ahead of schedule during the previous reporting period, particularly gas meters) and wiring and programming to switchboard completed toward the end of the year. Some of the automatic datalogging needs further refinement and rectification, to be done in the next reporting period.

The operation of the pre-commissioned system in the September batch of birds allowed capturing some key data about the important winter season to avoid needing to wait one whole year for these data and made highlighted the importance of keeping fan coil units and filters clean for optimal operation. Gas savings of up to 83% were achieved with respect to control sheds. Further optimisation still possible.

Joint press releases took place on Friday 5th of August 2022 with significant media and rural & poultry industry interest, deriving in more than a dozen articles (and growing), both nationally (e.g., this [link](#)) and internationally plus a number of twitter and LinkedIn stories and re-posts, and live presentations to industry.



Figure 1. Plant comprising of circulation pumps, ground source heat pumps (GSHPs), buffer tanks, control (and monitoring) systems. Insulated pipes connected to fan coil units (FCs) inside the demonstration shed (right) completes the system.

4. Key Learnings

4.1 Lesson learnt No. 1: Lack of market maturity for shallow geothermal projects in the agriculture sector

Category: Commercial

Objective: Improving understanding of agriculture market needs and supply chains

Detail:

There is still a lack of market maturity for shallow geothermal projects in the agriculture sector. In particular, there is limited depth of ground source heat pump designers and providers in Australia able to demonstrate a comprehensive understanding of the specific needs of the poultry industry.

In addition to design, earthworks as a service may need better integration in the rural settings and access to supply of earthworks is still constrained by large infrastructure and construction booming in nearby.

Implications for future projects:

Ground Source Systems expects this situation will change over time as new, and more mature, GSHP suppliers in the chain enter the Australian market and expertise develops for suppliers. The press releases and media outlets have already generated movement. Future projects will be able to leverage the learnings and market developments that this project has enabled.

4.2 Lesson learnt No. 2: Variety in determining thermal load demand to satisfy and needs for energy audits

Category: Technical

Objective: Improving sizing of systems even with same farms

Detail:

Ground Source System's experience with other poultry farms and the various shed here at Yanderra NSW has shown that there is not one-size-fit-all. This is not only because there is a variety of ways farmers operate the broiler facilities, but also there are variations among sheds, exposure to sun/wind, state of sheds envelopes that impact on thermal load demand to satisfy for each shed in a given farm.

Implications for future projects:

While there is no one-size-fit-all solution to the sizing required for space heating and cooling of the broiler facilities, it may be possible to identify demand by monitoring current energy consumption of various sheds in a farm. For newbuild sheds, energy modelling may be required based on planned shed envelop and the most common operational practice across farms and regions.

4.3 Lesson learnt No. 3: Dust in sheds reduces fan coil unit efficiency over time, automated cleaning systems required to maintain performance

Category: Technical and Commercial

Objective: Improving customer experience and minimizing maintenance labour

Detail:

The operation of the pre-commissioned system in the September batch of birds showed the importance of keeping fan coil units and filters clean for optimal operation. Much effort, outside the original scope of works of this ARENA project, was put in place to find a technical solution, trialling four different cleaning technologies on the fan coil units (beside manual cleaning), one of which proved most efficient.

Implications for future projects:

Fan coil units will be equipped with such automated cleaning system and installation costing will be built-in. This will avoid or largely minimize maintenance of the units and operational costs overrun since performance is maintained over time.

4.4 Lesson learnt No. 4: Retrofit projects needs good planning of installation works around continuing commercial operations of poultry sheds

Category: Commercial

Objective: Improving of planning and costing of work inside sheds

Detail:

Already notice during the 1st report, during retrofitting of the poultry sheds it is hard for farmers to stop or delay their commercial operations, in the case of Yanderra and most other similar farms, often farmers do not have control on when the batches of birds go in and out of the sheds, and in this period, shorter turn around between birds batches took place. As a result, commercial operation of the poultry sheds continues, and installation of the new systems must be adjusted accordingly. This may have implications on the program and delay commissioning.

Implications for future projects:

Installation of the geothermal-solar systems must be planned around the commercial operation of the sheds for all gear to be installed inside them. Biosecurity measures are strict and activities inside shed needs to be scheduled for during the short cleaning period between batches of birds. Clear and fluid communications with farm managers are required to avoid lengthy and costly program delays due to this constrain.