This activity received funding from the Australian Government.

Australian Government
Department of Industry and Science
CONTENTS

1 EXECUTIVE SUMMARY ........................................................................................................... 3

2 PROJECT OBJECTIVES ......................................................................................................... 5

  2.1 Project Energy Efficiency Activities .................................................................................... 8

    2.1.1 Geothermal HVAC Technology .................................................................................. 10

  2.2 Project Demonstration and Communications Activities .................................................. 11

3 BUDGET ................................................................................................................................. 16

4 PROJECT OPERATION, MECHANISMS AND PROCESSES ................................................ 17

5 Outcomes and Benefits .......................................................................................................... 21

  5.1 Geothermal HVAC Systems ............................................................................................. 21

  5.2 Additional Benefits ............................................................................................................ 25

6 CONCLUSION ......................................................................................................................... 27

7 DECLARATION ....................................................................................................................... 29

8 Appendix 1 – Project Energy Efficiency Improvement Report ............................................. 30

9 Appendix 2 – Financial Report .............................................................................................. 32
1 EXECUTIVE SUMMARY

The main purpose of this report is to provide an overview of the Bethanie Housing (Bethanie) energy efficiency upgrade project and how the project reduced energy consumption for Bethanie Housing.

By upgrading the facilities with efficient and improved technology the project hoped to reduce maintenance costs, promote the benefits of improving energy efficiency to the broader community and reduce carbon emissions.

The project was to meet its objectives by replacing the existing conventional heating, ventilation and air-conditioning (HVAC) systems in the common use areas with systems that utilise geothermal technology.

The beneficiaries of these upgrades are significantly disadvantaged members of society who as a result are of low socio-economic status. The financial savings that will accrue as a result of the reduction in energy use will materially assist Bethanie Housing in providing and enhancing its services to the elderly, their families and carers.

The project was initially designed to commence in September of 2013 and be completed by mid-June 2014, however a number of delays caused by the complexity of the project resulted in a completion date in early 2015.

To promote the new technology a comprehensive communications plan was carried out which raised awareness of the energy efficiency upgrade to both the local community and users of the facility. The communication plan consisted of educational flyers and posters being produced and distributed along with the Bethanie website and social media pages being updated with project information.

The project achieved its intended outcomes by improving HVAC energy efficiency of the buildings and as a result decreasing the energy consumption across all three sites. The energy consumption currently demonstrated at the sites is significantly less than initially estimated prior to the project commencement, however the system efficiency will continue to improve over the next 12 to 18 months while temperature set point and operational conditions are adjusted to maximise energy efficiency. The project is currently on track to reduce the annual Bethanie Housing electricity consumption by 156,162 kWh. This figure is expected to increase as the system is adjusted and the efficiency maximised. The current savings equate to a reduction of 118,683 kg CO\textsubscript{2}-e per year.
The project was completed within the specified budget. There were a number of delays to the original Milestone table but none of the delays increased costs to the project. Throughout the process Bethanie Housing learned important lessons regarding scheduling and implementation of cutting-edge energy efficiency technologies, including the importance of equipment redundancy and backup.

The project was managed internally by Bethanie Housing staff members. Procurement and installation of the HVAC systems was managed by Subthermal Solutions, while the energy auditing was managed externally by Enigin Western Australia.

The energy efficiency upgrade at the Bethanie Housing sites has met all of its communication objectives and in some cases exceeded them, while additional time and information is required to determine the effectiveness of the energy efficiency outcomes. The promotion of energy efficiency in the community is a commitment of Bethanie Housing and an ongoing goal. This project highlights the benefits of improved technologies which can provide not only cost savings but environmental and social benefits.

*The views expressed herein are not necessarily the views of the Commonwealth of Australia, and the Commonwealth does not accept responsibility for any information or advice contained herein.*
2 PROJECT OBJECTIVES

The project aimed to support Bethanie Housing in increasing its energy efficiency by implementing a selection of new technologies which demonstrated and encouraged the adoption of energy management practices within Bethanie Housing and the broader community.

The project targeted sustained behaviour change by making the benefits of energy efficiency visible and tangible. This included the development of simple and meaningful metrics (namely, the measure of energy efficiency) which provided a compelling illustration of the benefits of the project. Community engagement programs were used to promote energy efficiency to the broader community. The communication plan was implemented and all visitors to the site were exposed to posters and information regarding the project.

The project showcased improved amenity of Bethanie Housing’s facilities and demonstrated to the community that local non-profit organisations are focused on saving energy and costs by managing total energy use and prioritising the investment in energy efficient products and services. This was achieved through the promotion of the project with posters erected within the common use facilities and information posted online which outlined the technologies used and the scope of the project.

The objectives of the Bethanie Housing project were designed to run in parallel with the objectives of the Department of Industry and Science, this was achieved by showcasing the ability for energy-efficiency HVAC to provide excellent space heating and cooling and temperature control to the building as well as increased amenities for the users through the stability of temperature within the common use facilities. The project directly increased energy efficiency of a community use facility which services a large portion of disadvantaged elderly people.

The communication activities ensured that the benefits of the system encouraged the adoption of improved energy efficiency technology within the broader community.

The Bethanie Housing’s sites are key destination buildings for not only the elderly occupants of the Bethanie Housing facilities but also their visitors, many of whom have a diverse location spread from across WA. The project has adequately demonstrated and encouraged the adoption of improved energy management practices in the broader community (as the sites are used by people from all over the Perth metropolitan area plus Bunbury and Peel regional areas) and the key target audience.
The audience is exposed to the building energy efficiency upgrade first hand which is particularly evident by the greater temperature control and cooling capacity of the new systems. This is a great way of showcasing the multiple benefits of modern energy efficient technology.

The project objectives can be summarised as the following:

1. Showcase and promote the benefits of energy-efficiency upgrades by significantly improving the energy efficiency of Bethanie's three sites and reducing their operating costs.
2. Improve the comfort and amenity of the buildings which have suffered from poor heating, ventilation and air-conditioning.
3. Build the knowledge and capacity of the local energy services and construction industry by sourcing from local vendors and installers and where possible procure locally manufactured equipment.
4. Contribute to the national effort to reduce greenhouse gas emissions.
5. Ensure sustainability of the demonstration of energy efficiency by making the benefits of energy efficiency visible and tangible.

The entire project was completed by local vendors (Subthermal Solutions) and installers and helped contribute to the national effort of reducing greenhouse gas emissions by reducing the electrical consumption at each site.

A key objective of the project was to improve the comfort and amenity of the three sites which have suffered from poor temperature control since their initial inception.

The knock-on effect of improved energy efficient technologies means Bethanie Housing's ongoing operational energy and maintenance costs across all three sites is minimised. It also helped to mitigate the increased cost of electricity supply. With a reduction in energy use comes a reduction in greenhouse gas emissions.

In this document greenhouse gas emissions refer to indirect Scope 2 emission factors from the consumption of purchased electricity from a grid. An emission factor has been used which is consistent with the Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia, Australian Government Department of the Environment (2014). An excerpt of these guidelines is included below for reference:
As all Bethanie sites within the scope of this project are connected to the South West Interconnected System (SWIS) in Western Australia the emission factor used is 0.76 kg CO$_2$-e/kWh.

The project is currently on track to reduce the annual Bethanie Housing electricity consumption by 156,162 kWh. This figure is expected to increase as the system is adjusted and the efficiency maximised. The current savings equate to a reduction of 118,683 kg CO$_2$-e per year.

Any financial savings that are accrued as a result of the reduction in energy use and maintenance costs will allow Bethanie Housing to materially assist in providing and enhancing the services provided to the elderly residents.

In its current state, where maximisation of the efficiency is possible, the benefits to Bethanie Housing are $54,657 per year in reduced electricity consumption costs alone.

It is expected that this figure will continue to increase as the system efficiency increases with the adjustment of HVAC settings.
2.1 Project Energy Efficiency Activities

The three Bethanie Housing sites are located in the following areas:

- Yanchep
- Coodanup
- Dalyellup

The following provides a summary of each site.

The Yanchep facility is a large mixed building combining residential, administration, health services and community area. The project focused on the shared communal areas of the facility and increasing the energy efficiency of the areas. As the largest energy draw of these areas is the HVAC units used to control the climate, this was identified as an ideal area to focus on the reduction of electricity consumption.

Geothermal based HVAC was identified early on in the process as being one of the most energy efficient types of HVAC available and as such is deemed appropriate for the site.

The project provided geothermal heating and cooling in community area as specified under CEEP funding requirements. The system is an open loop geothermal system which requires production and rejection water bores. A permit was acquired from the Department of Water to obtain a zero allocation water licence for this facility.
During the installation of the HVAC units at the Yanchep facility there were issues with the salinity of the water produced by the bores which would create maintenance issues in the future. This was caused by the proximity of the facility to the ocean and unexpected contamination within the water table. This was solved by reversing the direction of the flow between the production and rejection bores.

The Bethanie Coodanup site consists of 66 apartments share a common use auditoria. This auditoria is the installation site for the geothermal HVAC. The building has large aluminium windows and doors that are not double glazed and therefore affect the “R” value of the building. The building is positioned north/south and therefore it is shaded in winter and expose to sunlight during summer.

There is a large commercial kitchen in this area that will contribute to increase the thermal load in summer. The inefficiency of previous evaporative HVAC system meant that the staff had to implement measures to ensure that openings were kept closed during its operation.

This inefficient evaporative HVAC system was not sufficient for the requirements of the site and as such provided poor cooling and heating to the facility. Many complaints were made by the residents about this HVAC system and as such site experienced low levels of use.
Bethanie Dalyellup is very similar in its construction to Coodanup. The apartments use a common area, the auditoria, as an activities room which was previously serviced by an inefficient evaporative HVAC unit. The auditoria is used as a community event area with a high level of occupancy (around 140 to 160 people approx. at its maximum).

The building has large aluminium windows and doors that are not double glazed and therefore affect the “R” value of the building. There is a large commercial kitchen in this area that increases the thermal load in summer. Bethanie Housing had to implement measures to ensure that openings are keep closed during the operation of the evaporative HVAC system. As was similar at the Coodanup facility, there were many complaints about the temperature control of the evaporative HVAC system.

![Location map, Bethanie Dalyellup, 68 Kambany Approach, Dalyellup, Western Australia.](image)

2.1.1 Geothermal HVAC Technology

Many of the elderly residents of the Bethanie Housing facilities are sensitive to high temperatures during summer; something which nearly unavoidable in Perth. Many of the elderly use the common use shared auditoria and common use facilities as part of their daily ritual. When these areas are not adequately temperature moderated they become unusable to the elderly residents. As such, the air-conditioning system is of primary importance in serving the community in an effective manner.
Air-conditioning typically consumes around 60% of the total site electricity. Installing an energy efficient HVAC system at the Bethanie Housing facilities is designed to reduce the operational expenditure of the site, ensuring more money can be spent providing services to the facility users.

A geothermal HVAC system is a central heating and/or cooling system that transfers heat to or from the ground. It uses the earth as a heat source (in the winter) or a heat sink (in the summer). This design takes advantage of the moderate temperatures in the ground to boost efficiency and reduce the operational costs of heating and cooling systems. Geothermal ground source heat pumps harvest heat absorbed at the Earth’s surface from solar energy. The temperature in the ground below 6 metres is roughly equal to the mean annual air temperature at that latitude at the surface.

The project aimed to improve the comfort and amenity of the common use areas of the Yanchep facility, and auditoria’s at both Coodanup and Dalyellup which have previously suffered from poor ventilation, high humidity and air-conditioning which was inadequate in size.

### 2.2 Project Demonstration and Communications Activities

To communicate the energy efficiency activities of the project and their effectiveness, it was decided the Bethanie Housing communication strategy should be premised on regular and sustained engagement with building occupants (facility staff and live-in occupants) and visitors (family of the occupants and general public visitors) who would benefit from or be impacted by the energy efficiency upgrade. Consequently, the project implemented a communications and engagement program which included an awareness campaign delivered by Bethanie Housing during and after the project completion.

The target message was that simple, proven technologies can result in significant financial savings, and contribute to the reduction of Bethanie Housing’s carbon footprint. The facility users, including occupants and managerial staff, nurses, family and visitors, were informed of the project and its energy efficiency benefits via physical media distributed throughout the site and directly to users. The Bethanie Housing social media pages, large posters were erected at each facility, pre-start internal briefings were conducted and flyers were distributed across the Bethanie facilities.
Bethanie Aged Care @Bethanie_Group  ·  10m
We're are proud to announce the introduction of energy efficient geothermal heating/cooling systems to Peel, Dallyelup and Yanchep Villages.

11:25 AM  ·  12 Aug 2014  ·  Details
In addition to the physical media released by Bethanie Housing, electronic energy monitoring devices were installed at the sites to record future trends in consumption by the HVAC units.

In the future these units provide accurate consumption data for seasonal periods across a full 12 month period. These units have been specifically installed to monitor the electricity consumption of the HVAC units at each site, which can later be referenced against the floor plan at each site to determine an efficiency value per square metre. It will then be possible to use this value as a baseline against other facilities conventional HVAC units.

Bethanie Housing now have full access to their real-time monitoring units via an online web portal. This allows them to monitor the electricity consumption of each geothermal HVAC system at each site and the monitoring system will notify them of any consumption which is outside a set parameter. This ensures that any issues with the system are quickly and efficiently dealt with.

**Fig. 1 & 2: Monitoring Systems Installed at the Sites:**
Through approved communications activities, as outlined in the communications plan, the local community, specifically, the Bethanie Housing occupants and staff were kept regularly informed of the project’s progress with an initial staff meeting to announce the arrival of contractors, highlighting the proposed changes and their benefits, and a subsequent staff meeting to highlight the actual
benefits. Posters were hung at all three sites advertising the project, its objectives and the contributions made by the Department of Industry.

On completion of the project, posters and educational flyers were circulated which paid particular attention to promoting the project’s successes and how they were achieved. The printed paraphernalia aimed to identify with the Bethanie Housing unique building façade and promote the energy efficiency activities and savings achieved as a result of the project.

Finally, as HVAC is seasonal, Bethanie Housing have also committed to an annual review of the energy usage to ensure that the efficiency gains are being sustained into the future. This information will again be promoted on the Bethanie Housing website and on flyers around the building to ensure the impact of the project is ongoing.

The installation of the geothermal HVAC units has improved the climatic conditions of the facility, and numerous staff members and facility users (occupants, family, and friends) have commented on the increased and improved comfort levels. Users of the facility have noted that the site is now a more comfortable place to be, and indicated that the improved temperature control enables them to use the facilities more often.
3 BUDGET

Despite the delays in completion this project was completed within the original specified budget.

The budget for the project remained consistent at a value of $1,985,183.50 exclusive of GST. This total figure included the funding provided from both the Department and the Recipient.

The project achieved value for money by implementing a project which will be cash-flow positive over the lifetime of the equipment when compared to the conventional equipment which was initially at the site. The maintenance requirements of a geothermal HVAC unit are significantly less than those of an evaporative HVAC unit, and combined with the reduction in energy consumption provide Bethanie Housing with reduced operational expenditure for the lifetime of the systems.

<table>
<thead>
<tr>
<th>Category:</th>
<th>Expenditure Item:</th>
<th>Budgeted Costs:</th>
<th>Actual Costs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Administration</td>
<td>Project Office and Contract Administration - Initiation</td>
<td>$31,500.00</td>
<td>$31,500.00</td>
</tr>
<tr>
<td></td>
<td>Project Office and Contract Administration - Planning</td>
<td>$21,000.00</td>
<td>$21,000.00</td>
</tr>
<tr>
<td></td>
<td>Project Office and Contract Administration - Implementation</td>
<td>$31,983.00</td>
<td>$31,983.00</td>
</tr>
<tr>
<td></td>
<td>Project Office and Contract Administration - Close</td>
<td>$10,500.00</td>
<td>$10,500.00</td>
</tr>
<tr>
<td></td>
<td>Design and Construct Documentation</td>
<td>$70,000.00</td>
<td>$70,000.00</td>
</tr>
<tr>
<td>Communication</td>
<td>Design &amp; Develop</td>
<td>$12,000.00</td>
<td>$12,000.00</td>
</tr>
<tr>
<td></td>
<td>Delivery</td>
<td>$12,000.00</td>
<td>$12,000.00</td>
</tr>
<tr>
<td>Construction of Geothermal Plant</td>
<td>Construction of Geothermal Bore Field &amp; Civil Works x3</td>
<td>$271,015</td>
<td>$271,015</td>
</tr>
<tr>
<td></td>
<td>Demolition/ Decommission of redundant equipment x3</td>
<td>$36,000</td>
<td>$36,000</td>
</tr>
<tr>
<td></td>
<td>Electrical upgrades and installation x3</td>
<td>$24,000</td>
<td>$24,000</td>
</tr>
<tr>
<td></td>
<td>Modification to plant rooms and installation of GSHP x3</td>
<td>$78,000</td>
<td>$78,000</td>
</tr>
<tr>
<td></td>
<td>Installation of ducting x3</td>
<td>$62,000</td>
<td>$62,000</td>
</tr>
<tr>
<td>Energy Audit</td>
<td>Pre-application x3</td>
<td>$9,000.00</td>
<td>$9,000.00</td>
</tr>
<tr>
<td></td>
<td>Post implementation x3</td>
<td>$9,000.00</td>
<td>$9,000.00</td>
</tr>
<tr>
<td>Financial Audit</td>
<td>End of Project Financial Audit of Eligible Project Expenditure</td>
<td>$13,500.00</td>
<td>$13,500.00</td>
</tr>
<tr>
<td>Integration and Commissioning</td>
<td>Integration into the BMS</td>
<td>$100,000.00</td>
<td>$100,000.00</td>
</tr>
<tr>
<td></td>
<td>Commissioning of equipment and sign off</td>
<td>$18,700.75</td>
<td>$18,700.75</td>
</tr>
<tr>
<td>Total (ex. GST):</td>
<td></td>
<td>$1,985,183.50</td>
<td>$1,985,183.50</td>
</tr>
<tr>
<td>GST:</td>
<td></td>
<td>$198,518.35</td>
<td>$198,518.35</td>
</tr>
<tr>
<td>Total (incl. GST):</td>
<td></td>
<td>$2,183,701.85</td>
<td>$2,183,701.85</td>
</tr>
</tbody>
</table>

Further information can be seen in Appendix 2 - Financial Report.
4 PROJECT OPERATION, MECHANISMS AND PROCESSES

The project was managed internally by Mike Brown, the General Manager at the Bethanie Housing. The project plan, communications and energy auditing was managed externally by Enigin Western Australia. Frequent project workshops were conducted to ensure that communication between the Bethanie Housing and Enigin WA was sufficient.

The actual site works were managed by Subthermal Solutions and Enigin WA. Subthermal Solutions were the physical installers of the geothermal HVAC systems and Enigin WA completed the project administration.

Due to some significant and unforeseeable circumstances at two facilities, delays were incurred during the delivery of the project. The primary subcontractor (Subthermal) had confirmed that there would be a 10 business day delay to complete the bore construction at the Yanchep site (completion initially scheduled for 24/3/14, rescheduled to 7/4/14). This delay was due to the change of design as outlined in the re-submitted project plan. Due to the exclusion of the pool heating from the design, the proposed bore location was changed to a more logical position. This required testing and surveying of the new location of the bore.

This created a delay to the completion of the third milestone.

In addition to this delay a second delay was incurred during the completion of the fourth milestone. This was because of an unanticipated delay associated with the drilling of the geothermal bore field at the Dalyellup site.

The primary contractor (Subthermal) had confirmed that there would be a 4 week delay to complete the bore construction at the Dalyellup site (completion originally scheduled for 20/6/2014). This delay was due to a sub-contractor advising Subthermal that the required drill rig had been delayed on another project.

The sub-contractor confirmed that they would complete drilling at Dalyellup by the 18th of July 2014.

The Dalyellup and Coodanup borefields were completed in accordance with the revised schedule outlined in the aforementioned extension requests.

The Yanchep site experienced an additional delay.
Upon preparation of the Groundwater Licence Operating Strategy (GLOS) for Yanchep, routine water samples determined that the production bore to be utilised for the geothermal project turned brackish, which now presents a problem for reinjection to the newly drilled injection bore.

A tenable solution was provided to Bethanie Housing by Subthermal Solutions, and Subthermal were directed by the client to extend the scope in order to deliver the solution required. The operational duties of the bore design was changed to facilitate better irrigation water quality for the client, and meet injection requirements of the Department of Water in order to obtain the appropriate license.

Deployment of this solution met the Department of Water’s requirements, and due diligence was carried out on the impact and suitability of the solution, including injection testing, further water sampling and all other tests deemed necessary to facilitate a reasonable approval turn-around from the licensing process.

A significant scope of works was required to occur before the GLOS could be resubmitted for approval, and prior to system testing and commissioning. The knock on effect of this delay to commissioning caused further delays to the decommissioning of u/s systems (those being upgraded), and to the integration of the new equipment into the existing HVAC system.

Other delays were incurred due to Departmental closure over Christmas / New Year, along with the availability of contractors during this period.

Due to the delay in receiving the Department of Water’s approval for this revised system design the system was not able to be operated until late March 2015. The system was commissioned and fine-tuned throughout April 2015, officially completed late April 2015.

Bethanie Housing would not hesitate to run future projects in a similar manner, however expectations of completion schedules would be adjusted to match the more realistic timetable demonstrated during this project. Outsourcing a significant amount of the project freed up the overstretched internal resources. Enigin WA were able to provide assistance with the reporting and project management requirements of the project, where internal capacity at Bethanie Housing was lacking.

As the Enigin project manager oversaw the contractors on site and the contracts that were outsourced, there were enough internal resources to successfully implement the project. Bethanie Housing believes the experience gained by undertaking this Department of Industry and Science
project means it is better equipped to undertake future similar projects of this size and scale. Specifically, Bethanie Housing have learnt an important lesson about adjusting expectations with regards to projects of this magnitude.

In addition to this they would add additional contingency for future projects to combat the dependency on specific contractors and their associated equipment.

If, in future, contractors or their equipment experienced delays at other jobs, Bethanie Housing will aim to have backup contractors and equipment available to complete the work in the specified time. It is hoped that this additional contingency would prevent significant delays in the future for similar projects.

Mike and other internal managerial staff have witnessed first-hand a site-wide implementation of a new technology, and are now aware of the requirements and processes for the planning, implementation and reporting of such a project.

There were no difficulties in managing the project, however difficulties with implementation mentioned previously in this report restricted the speed at which the project would be deployed. Time management was co-ordinated using PRINCE2 methodology to ensure the schedule specified was adhered to where possible and appropriate change control was used when delays were specified by the primary contractor.

The greatest challenge to overcome throughout this project was managing the delays created when the primary contractor’s periods significant issues with the installation process. Ample time was taken engineering alternatives to ensure the geothermal systems met the strict guidelines imposed upon them by the Department of Water.

While these delays did affect the project delivery date, Bethanie Housing explored every available option at its disposal in an attempt to mitigate against delays, including requesting new subcontractors to be used.

Unfortunately, due to the fact that the geothermal HVAC technology is relatively uncommon in Western Australia, there are very few contractors who can complete the work required. Bethanie Housing believes this problem is inherent to early adopters of new technology and in this particular instance there were no possible alternatives which would have resulted in the project being completed on time.
Important lessons were learned regarding the necessity of ensuring all risks with a project are identified prior to commencing any work, and the inclusion of contingency where possible. Some risks were only identified once the project had begun, and at this stage the risks identified were considered likely.

Bethanie Housing now has a greater understanding of the renewable energy sector, and in particular understands the procurement and delivery aspects of an energy efficiency project. Specifically, the adaptation of a new technology will often require the procurer to apply a level of trust to a contractor that is uncommon in other sectors. This is due to the nature of being an early-adopter of the new technology, and having minimal case studies to rely on in order to evaluate the experience of a tenderer.

In addition to this, Bethanie Housing has learned that the adoption of new technologies can aid in increasing the habitability of the site while decreasing the operational costs. Since the installation of the geothermal HVAC units, the climatic conditions of the site have improved and both the staff and occupants have benefited from this. This focus on efficiency, and not simply reduction, is what will drive Bethanie Housing’s future projects.


5 OUTCOMES AND BENEFITS

5.1 Geothermal HVAC Systems

In August of 2013, Bethanie Housing engaged a contractor to complete all works associated with the design, commissioning and installation of three geothermal air conditioning systems. This included geothermal equipment being installed at all three sites to exchange energy with the open ground loop.

The Geothermal HVAC systems were installed at three sites over a period of 14 months. The construction of the Coodanup and Dalyellup systems were completed in November 2014 with the systems turned on and commissioned in late February 2015. The Yanchep system construction was completed and commissioned in January 2015, with additional fine tuning occurring until March 2015.

An energy audit was completed prior to the commencement of the project. This used information available on period of mid-July 2012 to June 2013.

The geothermal HVAC systems have improved the climatic conditions within each service area of each site. Residents, visitors and staff are already reporting favourable changes the humidity and temperature within each building. This is expected to become further evident during extreme temperature seasons. The residents of the facility in particular are significantly benefited by being able to use the facilities more frequently and more comfortably than before the project was implemented.

Due to the reduction in humidity at each site and improvement of temperature control the comfort and amenity of the buildings have been significantly improved. As the posters outlining the details of the project are displayed at each site, the energy efficient technology which is responsible for this improvement in climatic conditions within the building is visible to all who use the site. This demonstrates the benefits of energy efficient technology to the residents, visitors and staff.

In addition to this, Bethanie Housing have agreed to allow the local contractor (Subthermal) to display signage at the site promoting their company and thus building the knowledge of the local energy services and construction industry. This has been achieved because Bethanie Housing insisted on using local vendors and installers and procured locally manufactured equipment where possible.
In addition to these benefits, the Bethanie Housing project has also showcased and promoted the benefits of energy efficiency upgrades by improving the energy efficiency of all three of the Bethanie Housing sites; in turn reducing their operational costs.

At the Yanchep site the electricity consumption is expected to reduce further over the next 6 to 9 month period, and currently a 4.28% reduction in electricity consumption at the site has been achieved. This equates to a 48,472kWh of annual electricity consumption reduction and a financial savings of $16,966 annually.

This current electricity reduction level equates to an annual emission reduction of 36,838 kg CO$_2$-e.

At the Coodanup site a steady increase in electricity consumption brought about by a change in the operational parameters of the site has been stopped by the installation of the geothermal HVAC units.

When compared to expected values for the energy consumption at the site, the geothermal HVAC units are demonstrating a significant increase in energy efficiency over the previous units. Instead of the expected 5.83% increase in electricity consumption at the site for the months of March and April, the site experienced a 1.3% reduction in electricity consumption when compared to the same month in the previous year due to the geothermal HVAC units.

This results in a reduction of approximately 7.1%, consistent over the two month period.

It is expected that these reductions will continue and will increase through the fine tuning of the geothermal HVAC units over the next 6 to 12 months.

The projected electricity consumption at the site equates to a reduction of 63,821 kWh at the site annually when compared to the baseline. As the majority of this consumption occurs during on peak times, this reduction will be responsible for a savings of $22,337 annually.

This current electricity reduction level equates to an annual emission reduction of 48,504 kg CO$_2$-e.

The Dalyellup site has been experiencing dramatic increases in electricity consumption since October 2014 due to changes in the operational parameters of the site and increases in the usage of the facility. Unfortunately this has a significant effect on the electricity consumption of the site and as such it is very difficult to draw any conclusions from the electricity consumption of the site as a whole.
Since October 2014 the site has experienced an average of 23.1% increase in electricity consumption when compared to the same month in the previous year.

The trend of increasing electricity consumption at the site has been stopped by installation of the geothermal HVAC unit. It is evident when comparing the March and April consumption figures in 2015 with those of 2014. These two months demonstrated a change in trend of the increase in electricity consumption when compared to similar months in the previous years. While the previous five months experienced an average of 23.1% increase over the same months in 2013, the increases in March and April 2015 once the geothermal HVAC unit was installed and commissioned were only, on average, 14.3%.

Due to the significant increase in electricity in the 2014 period, it is only possible to extrapolate an estimate for the reduction in electricity consumption at the site.

Based on the increases seen through the months of November and December, it would be prudent to expect similar increases due to the increased functionality at the site and greater operational hours.

As such, an increase of only 14.3% instead of the expected 23.1% can be seen as a reduction of 8.8% in expected electricity consumption. As this figure is extrapolated, it should be verified by continuing to monitor the electricity consumption of the site for the next 12 to 24 months.

It is expected that these reductions will continue and will increase through the fine tuning of the geothermal HVAC units over the next 6 to 12 months.

The projected electricity consumption at the site for the next 12 months is 98,879 kWh. When compared to the baseline consumption figure of 142,748 kWh, this represents a savings of 43,869 kWh annually. This equates to a savings of $15,354 annually.

This current electricity reduction level equates to an annual emission reduction of 33,340 kg CO2-e.

It is expected that the energy reduction levels will significantly increase throughout the summer months as the geothermal HVAC units are operated more frequently. The set points and operational hours of the units continue to be tuned to the facility’s unique requirements and this will also improve the energy efficiency of the units over the next 12 months.
The project is currently on track to reduce the annual Bethanie Housing electricity consumption by 156,162 kWh. This figure is expected to increase as the system is adjusted and the efficiency maximised.

The current savings equate to a reduction of 118,683 kg CO₂-e per year.

All three facilities will experience reduced maintenance costs throughout the lifetime of the geothermal HVAC system when compared to a conventional system. In addition to being more energy efficient, the system will never require re-gassing. It is expected that the reduction in maintenance costs across all three facilities will average out to be approximately $12,000 per year when compared to a conventional or evaporative HVAC system over the lifetime of the geothermal HVAC unit.

Including the projected maintenance savings and a CPI increase on electricity prices of 3.5% per annum, the return on investment of the project as a whole is 22.0 years.

In addition to this, the successful implementation of an energy efficiency project has paved the way for the approval of new projects. Bethanie Housing are now looking to implement additional energy efficient technologies throughout the facilities including the implementation of LED lights.

5.2 Communication Benefits

Through approved communications activities, as outlined in the communications plan, the local community, specifically, the Bethanie Housing occupants and staff were kept regularly informed of the project’s progress with an initial staff meeting to announce the arrival of contractors, highlighting the proposed changes and their benefits, and a subsequent staff meeting to highlight the actual benefits. Posters were hung at all three sites advertising the project, its objectives and the contributions made by the Department of Industry.

On completion of the project, posters and educational flyers were circulated which paid particular attention to promoting the project’s successes and how they were achieved. The printed paraphernalia aimed to identify with the Bethanie Housing unique building façade and promote the energy efficiency activities and savings achieved as a result of the project.
The communication activities reached the majority of the facility users and all of Bethanie Housing’s social media followers. Verbal feedback received from the facility users was positive.

Finally, as HVAC is seasonal, Bethanie Housing have also committed to an annual review of the energy usage to ensure that the efficiency gains are being sustained into the future. This information will again be promoted on the Bethanie Housing website and on flyers around the building to ensure the impact of the project is ongoing.

The installation of the geothermal HVAC units has improved the climatic conditions of the facility, and numerous staff members and facility users (occupants, family, and friends) have commented on the improved comfort levels. Users of the facility have noted that the site is now a more comfortable place to be, and indicated that the improved temperature control enables them to use the facilities more often.

As Bethanie Housing will now be looking for additional energy efficiency projects to complete, the benefits the local industry is significant. Bethanie Housing represent one of the largest elderly housing facilitators in WA and will be looking to roll out projects such as LED lighting retrofit’s and Additional geothermal HVAC units at all of their facilities across WA.

**5.3 Additional Benefits**

Due to the advanced nature of the new technology utilised at the Bethanie Housing sites, the selected contractor (Subthermal) have further benefited from this project by increasing their knowledge of local environmental factors can affect the systems. It also allowed them to make use of a new geothermal HVAC system design which is in the process of being patented. This increase in knowledge will in turn benefit to the local energy services industry by removing the requirement to source a geothermal HVAC contractor from non-Western Australian companies.

Subthermal Solutions have a “Patent Applied For” with respect to the design and operation of the systems at all three sites which is Australian Provisional Patent Pending #2015900848, Improvements in Geothermal Systems. Subthermal are currently negotiating the final development of the patent as joint venture project with Murdoch University.

This allows Subthermal to continue to develop and protect the Intellectual Property. As proof of the ongoing benefits to the local energy sector, Subthermal have been awarded another project based on the design and knowledge obtained during the design and construction of this system.
Subthermal have also learned valuable lessons with regards to the project management of future similar projects. The delays in the commencement of the project highlights the additional internal cost of delivering the project that was not initially considered, Subthermal now engages external project management (also from a local contractor) at a fixed cost rather than in house variable cost methods.

The issues with the hydrogeology at the site which caused delays also highlighted that pilot drilling and testing should be commenced at the earliest possible time during the construction phase of the project.

As Subthermal have now successfully applied for and been awarded a Department of Water permit for their newly patented design they are well equipped to complete similar projects in the future.
6 CONCLUSION

In conclusion, Bethanie Housing believe that the jointly funded Department of Industry and Science energy efficiency upgrade project was a success from a delivery, quality and financial perspective.

The project scope remained consistent throughout the project, and Bethanie Housing understands that being an early adopter to new technology can often result in unexpected issues or problems. In this instance the final outcome of the project was achieved, however significant delays were experienced during the project due to the highly specific equipment which is required to deliver a project of this magnitude.

Bethanie Housing would like to roll out geothermal HVAC to additional sites and will fully investigate the proposed timelines based on experience gained through the completion of this project.

The benefits of this project, as detailed in the outcomes and benefits section of this report, include a reduction in energy consumption and improved climatic conditions within the community use areas of the facilities.

The projects benefits and outcomes are important to the staff and users of the facility as it highlights the importance of collaborative thinking in relation to energy efficiency and is a stand-alone example of how simple changes in the built environment can provide not only a reduction in ongoing costs but also reduce the communities impact on the environment. Bethanie Housing wish to thank the Federal government for their support of such a valuable initiative.

Bethanie Housing are very proud of their leadership in energy efficiency at not-for-profit organisations through their adaptation of new HVAC technologies and hope that through their project other not-for-profit organisations and the community at large will step up and become more energy efficient and energy aware. The General Manager at Bethanie Housing, Mike Brown, actively ensures that the project is promoted to other not-for-profit organisations by frequently discussing the results of the project with fellow employees of these organisations.

The need for a detailed analysis of the required timeline has been a key lesson learnt from the outcomes of this project. While Bethanie Housing performed due diligence and conducted extensive background research into the technology, there were a number of complexities with regards to obtaining the required permits and securing the availability of the appropriate equipment which were unforeseeable. Any future Bethanie Housing projects of this nature would undergo rigorous risk
analysis, planning and management to sufficiently ensure the appropriate timeframes were allowed before commencement.

Bethanie Housing now has a greater understanding of the renewable energy sector, and in particular understands the procurement and delivery aspects of an energy efficiency project. Bethanie Housing has had moderate results by being an early-adopter of new energy efficient technology, and will continue to investigate options that will see improvements to energy efficiency for all sites in the future.

In addition to this, Bethanie Housing has learned that the adoption of new technologies can aid in increasing the habitability of the site while decreasing the operational costs. This focus on efficiency, and not simply reduction, is what will drive Bethanie Housing’s future projects.
7 DECLARATION

The Authorised Officer of the organisation makes the following declarations:

☑️ I declare that I am authorised to submit this Final Report (including any attachments) on behalf of

................................................................. (Name of organisation)

☑️ I declare that the information provided in this Final Report is true and accurate.

☑️ I understand, and acknowledge that giving false or misleading information in this Final Report is an offence under the Criminal Code Act 1995.

☑️ I understand that final payment will only be made in accordance with the Funding Agreement including on satisfactory completion of Milestones.

Authorised Officer Signature: .......................................................... Date: 22/05/2015

Name: .............. Mike Brown .................................................

Position: ...... General Manager .......... Organisation: Betty Housing .........................

Witness Signature: ................................................................. Date: 22/05/2015

Name: ............ Paul Brockbank .............................................

Position: ......Project Manager .......... Organisation: ....Enigin WA.................................

The use and disclosure of information provided in this Final Report is regulated by the relevant provisions and penalties of the Public Service Act 1999, the Privacy Act 1988, the Freedom of Information Act 1982, the Crimes Act 1914 and the general laws of the Commonwealth of Australia.

Information contained in the Final Report may be disclosed by the Department for purposes such as promoting the program and reporting on its operation and policy development. This information may also be used in answering questions in Parliament and its committees. In addition, the selected project information will be made publicly available. Public announcements may include the name of the grant recipient and of any project partners; title and description of the project and its outcomes; and amount of funding awarded.
8 APPENDIX 1 – Project Energy Efficiency Improvement Report

See attachment “Bethanie - Energy Audits.pdf”

<table>
<thead>
<tr>
<th>Site 1: Yanchep (Beachside)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Site:</td>
</tr>
<tr>
<td>Location:</td>
</tr>
<tr>
<td>Type of Building:</td>
</tr>
<tr>
<td>Activity Type and Measure:</td>
</tr>
<tr>
<td>Baseline Electricity Usage:</td>
</tr>
<tr>
<td>Baseline Electricity Efficiency:</td>
</tr>
<tr>
<td>Electricity Efficiency Improvement:</td>
</tr>
<tr>
<td>Cost of Activity:</td>
</tr>
<tr>
<td>Estimated Cost Savings:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site 2: Dalyellup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Site:</td>
</tr>
<tr>
<td>Location:</td>
</tr>
<tr>
<td>Type of Building:</td>
</tr>
<tr>
<td>Activity Type and Measure:</td>
</tr>
<tr>
<td>Baseline Electricity Usage:</td>
</tr>
<tr>
<td>Baseline Electricity Efficiency:</td>
</tr>
<tr>
<td>Electricity Efficiency Improvement:</td>
</tr>
<tr>
<td>Cost of Activity:</td>
</tr>
<tr>
<td>Estimated Cost Savings:</td>
</tr>
</tbody>
</table>
### Site 3: Coodanup (Peel)

<table>
<thead>
<tr>
<th>Name of Site:</th>
<th>Bethanie Waters – Coodanup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Olivenza Crescent, Port Kennedy WA, 6172</td>
</tr>
<tr>
<td>Type of Building:</td>
<td>Aged care facility</td>
</tr>
<tr>
<td>Activity Type and Measure:</td>
<td>Upgrade of HVAC System</td>
</tr>
<tr>
<td>Baseline Electricity Usage:</td>
<td>137,445 kWh (494,803 MJ)</td>
</tr>
<tr>
<td>Baseline Electricity Efficiency:</td>
<td>1,382 MJ/m²</td>
</tr>
<tr>
<td>Electricity Efficiency Improvement:</td>
<td>641 MJ/m²</td>
</tr>
<tr>
<td>Cost of Activity:</td>
<td>$266,175</td>
</tr>
<tr>
<td>Estimated Cost Savings:</td>
<td>$22,337 annually.</td>
</tr>
</tbody>
</table>
9 APPENDIX 2 – Financial Report