SBRI Government challenges. Ideas from business. Innovative solutions.

Department for Environment Food & Rural Affairs

SBRI End of Phase Report Form

This report is the company's opportunity to describe the work undertaken during the contract. Describe what work was completed during the project and why this was important. If the work was part of a two phased programme this report will form part of the assessment for Phase 2, it is therefore important that applicants complete the form as completely as possible.

This report must be submitted within 14 days of the completion, or termination, date. The successful contractor should be well motivated to complete this report as completion of this report forms part of the contract.

The report should be submitted to Defra's Climate Ready team at Nobel House, 17 Smith Square, Westminster, SW1P 3JR.

The objectives of reporting:

- to report on the work undertaken, its success in meeting the project's agreed objectives and to provide information on the work so that this can be used in the assessment of further applications (if required and appropriate);
- to explain and prove expenditure; and,
- also provides the company with a comprehensive report to share with stakeholders and those that may help further commercialisation.

The report should be completed by the lead contractor, with input from any sub-contractors or project partners as appropriate. Please answer, wherever possible, on behalf of the business units, divisions, or companies which were involved in the work. If this is not possible (as a result of merger or acquisition, for example), please specify the organisation to which your answers refer.

Please answer the questions in the spaces provided. Try to answer fully, but keep your answers succinct and no longer than necessary to clearly explain them. When describing technical solutions, please regard your audience as being someone familiar with the technology, but not an expert. The report may be done in narrative alone, however diagrams or pictures may be added where these aid clarity within the restriction on the page limit of a total of eight sides of A4.

Because the true impact of an R&D project often takes several years to emerge, Defra or the

Technology Strategy Board may approach you for up to six years after project completion to follow up on the questions in this report. Your co-operation with any such follow up work is greatly valued.

1. Details

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Project Reference: SBRI CA0517_2

Report Type: Final

Total Contract Cost: (£s) £71,500

Start Date: 27th January 2014 End Date: 30th April 2014

2. At the outset of this piece of work what were your aims and objectives?

The overall aim of the project was to create a demonstrator for the DewTherm product, which includes a sustainable urban drainage system (SUDs), linked to rainwater harvesting. The system also includes a ground loop of pipes in the SUDs, which collects heat from solar thermal panels in the warmer months for use with a hybrid (air and ground source heat pump) in the winter months.

The project provides a demonstrator, which will deliver data on the system performance and an opportunity for market testing. The objectives/deliverables of the project were these:

1. An operational, installed and commissioned DewTherm system, including SUDs, rainwater harvesting system, ground loop, hybrid heat pump, integrated renewable energy system (with solar thermal from roof panels), controlled and managed by an integrated smart controller
2. Public data for verification and to demonstrate the benefits of the combined package
3. Case study materials for publishing on websites and the basis for press releases
4. A defined marketing strategy and campaign, including product specification + pricing
5. A framework for installer training and an installer/distributor pack (from initial offer to contract documents)
6. Draft guidance material and package for DewTherm users
7. Launch event and dissemination materials
8. A Final Report to the Authority (including a complete Phase 2 plan)

3. Please provide a summary of the outputs of this project and relate these to the original objectives. How do the outputs address the requirements of this competition?

Objective 1: Operational System

The construction of the demonstrator system has been completed for a farm building, based at Edingley in North Nottinghamshire. The work has been severely impacted by poor weather conditions early in year (heavy and constant rainfall and high winds with a local tornado). A hybrid heat pump was constructed and initial tests suggest a good efficiency (coefficient of performance of 3.0, sustained at over 2.8). This will be further improved during fine-tuning. The below-ground works include the SUDs on two sides of the building with a rainwater harvesting facility on the third side. Ground loops have been installed, which connect to a heat exchanger, taking heat from a blown system, removing heat from below the solar PV system.

Objective 2: Public data

Unfortunately, due to the late installation of the system it has not been possible to gather data from the completed system as intended. Data will be collected and SASIE Ltd intends to work closely with Coventry University to analyse the outcomes and system performance. These data will be made public and will form part of the ongoing publicity and marketing campaigns.

Objective 3: Case study material and draft press release

A case study has been prepared and a draft press release written.

Objective 4: Market research and strategy

Market research has been completed. This included reference to organisations including Severn Trent, the Environment Agency and the National Farmers Union. A product consultation and launch event took place on the 8th May, 2014. An online survey was created and circulated via SUDsnet (800 registered members) and the Water Efficiency network.

A detailed marketing strategy review and draft forward plan have been completed.

Objective 5: installer training and guidance

A framework for the installer training has been designed. A draft pack for installers/distributors has been written.

Objectives 6: Guidance material for users

Draft guidance material for end-users has been written

The documents for the installers/distributors and end-users require further development, incorporating more details on the system performance and including operational data once the system has been operated for a longer period of time.

Objective 7: Launch event

A launch event was held on the 8th May, slightly later than planned. The event was used for consultation and dissemination. It is intended to establish a steering group from those attending for future development of the product.

Objective 8: Final report + Phase 2 Plan

This document provides the required final report and the plan for Phase 2

4. Describe any changes to the original project. What was the reason for these changes? Please include any circumstances that aided or impeded the progress of the project and the actions taken to overcome them.

The content of the original project remains largely unchanged. The only significant variation has been the difficulty in collecting data on performance within the project period. It was always intended to collect longer-term data, especially over the heating season in order to prove the overall system performance.

Progress on the project was virtually impossible during January and February due to weather conditions. Unusually heavy rainfall occurred in January and early February. Gales also made installation of the solar thermal element of the system impossible – a freak tornado in the area on the 25th January also caused damage on site. The tight timescales have generally been a serious issue for the project and not ideal for delivery of a good outcome.

Responsibility for the development of the control system passed to SASIE Ltd in place of Gannet Solutions as originally planned. The controller is based on a previously developed system, the TA Controller, supplied from a partner in Germany, which has proved successful in six previous installations by SASIE through the TSB SmartNet programme.

5. Please provide a short factual summary of the most significant outcomes of your work.

The most significant outcomes of the work to date include:

1. Completion of the Project Plan, the R+D plan and the Technical Specification for the DewTherm system. This provided a solid start to the project.

2. Project meeting with the project partners.
It has emerged that several of the project partners (Mo Kelly of SASIE, Charlie Fry of Down to Zero and Dr Sue Charlesworth) were all involved in the original installation of the Hanson FormPave/AquaPave system at the BRE Innovation Park in 2008/9. Coventry University was expecting to analyse data from this installation but information has not been readily available. The system showed several failures due to loss of rainwater around the thermal ground loop and difficulties in obtaining suitable data. It is hoped that data from the DewTherm project can be shown to remedy some of these problems.

3. Completion of the hybrid heat pump system
The 15kW heat pump has been designed and built from scratch to accept a heat supply from air or the ground water. Initial testing has shown the heat pump has good potential with an estimated measure of performance of 3 (3 heat units per supplied unit of electricity). Further fine-tuning should improve this further and verify the performance more accurately. An attractive design for the heat pump casing has been completed by Nottingham Trent University.

4. Market survey and development
The reaction to DewTherm by potential stakeholders, such as the Environment Agency, the NFU, Severn Trent and NGOs, such as the Warwickshire Wildlife Trust, has been encouraging. Identifying specific sectors such as poultry farming and pig weaning that particularly require low temperature hot water supplies has been especially useful for targeting future marketing campaigns. An online survey was published and the opinions gathered were also encouraging. 62% said they were extremely interested in the product. Respondents liked the integration of systems but were concerned about costs. All felt it was suitable for new housing and commercial buildings (75%) with two thirds confirming the farming sector.

5. System installation and commissioning
A system for extraction of heat below the solar PV panels on the south-facing part of the roof has been installed and heat is being passed through a heat exchanger for storage in the ground loops.
Excavations have provided below-ground water storage for SUDs systems along two sides of the building. Rainwater harvesting is collecting water on the third side. The ground loop for heat storage has been installed and an underfloor heating system inside the building. Sensors have been installed to monitor the system and a single point controller is managing the heat pump operation, the rainwater harvesting pump and gathering data from the sensors, which will be monitored every minute.

6. Product dissemination
The DewTherm product was presented for further consultation on completion of the project. Guidance material and a forward marketing plan have been completed.

6. Describe the innovative aspects of the work including any new findings or techniques.

The innovation of the DewTherm project is the combination of energy storage within a SUDs/rainwater harvesting system. Previous experimental systems (the original FormPave system at the BRE Innovation Park) had not proved successful as heat was being extracted from the SUDs system. The DewTherm product will use the storm water sump for heat storage, based on surplus energy from the solar thermal system during the summer months. This temporary heat storage allows the heat pump to operate more efficiently. In the online survey, the vast majority of respondents were unaware of similar systems, which combined all three aspects (surface water management, rainwater collection and heat storage). Others mentioned the FormPave system and individual products that linked SUDs with rainwater harvesting. Respondents also mentioned the novel aspect of integrating renewable energy within the system and felt that this provided a greater incentive to developers and installers to accept SUDs and rainwater systems to which the current market has been resistant.

The system performance will need to be testing over a longer period of time before conclusions can be drawn and the concept confirmed, especially cross-seasonal performance, summer heat storage and winter efficiencies.

The heat pump performance so far has been encouraging although fine tuning and longer term testing is now required.

7. Please give a description of how funds were spent with reference to the original budget and explain any significant variations.

The first milestone was achieved on time and the first claim for £21,835 was submitted as planned.

Milestones 2 (below ground works),3 (above ground works) and 5 (marketing) were achieved and claims submitted by the end of March (£36,605).

The remaining milestones, 4 (system operational), 6 (product launch) and 7 (final report and planning) were completed one month later, by agreement (final claim submitted for £13,060)

Initially the detailed costing appeared more than the budget (£61K for the system alone) allowed but with careful sourcing of materials, the project has been largely delivered in line with the original budget.

The cost of aggregate and materials for the Sustainable Urban Drainage scheme have proved more expensive than allowed for due to the large system being installed. However, other pieces of equipment have proved less expensive (for example, the heat pump components). As such the overall costs for equipment and consumables remain as the original budget.

8. Describe any potential long-term collaborations/partnerships entered into. Please list the company and the role they played in the project.

We are developing a better understanding of the components and materials for SUDs. As a result of the project, we have made closer links with the SUDs Research Team at Coventry University. We were invited to an initial meeting on the 12th February, 2014, of the CLUSTERED group in Coventry, who are seeking to define and raise funds for a significant SUDs project in the city. This has the support of the two Coventry based universities, the City Council, the Environment Agency and Severn Trent. There was considerable interest in the DewTherm product and the concept of linking SUDs with heat storage.

As a consequence of this initial meeting, an ongoing project team has been established and SASIE/Down to Zero have been invited to join.

We have been made aware of a need and opportunity to develop installer training for permeable paving and surfaces, alongside Coventry University. This would fit well with SASIE's hands-on approach to training (at Levels 2/3) and funding opportunities to develop a training course will be explored.

As a result of the project, we have been in contact with the NFU and are hopeful of being able to gather interest in the system with the farming sector. We already have one potential project lined up, which will prove useful as a second case study after the demonstrator is complete.

SASIE was already forming a tentative relationship with a Nottingham-based start-up company, SymWall Ltd. This company is developing a new product from recycled gypsum for internal walls. SASIE intends to build a demonstrator house using offsite constructed wall modules, using an adaptation of SymWall's product. The walls will be highly insulated using a hemp-based infill, with gypsum outer walls. The resulting product (H-SIP) will be certified and IP-protected. The DewTherm project has provided an opportunity to install internal walls within the farm building, in parallel with the activities for DewTherm, using early prototypes of the H-SIP product. Although not directly linked to DewTherm, the project has helped to provide an overall exemplar farm building and strengthen the relationship with SymWall.

The hybrid heat pump unit has been designed and built as the first SASIE manufactured unit. Relationships have been formed with several suppliers, such as SWEP, Dawmec, Climate Centre and Dean Woods. Alongside the DewTherm project, SASIE has worked with Nottingham Trent University to provide an attractive outline casing design to suit the heat pump, suitable for vacuum forming.

At the launch event, representatives of Nottingham City Homes and East Midlands Councils attended. We have had an offer of support from East Midlands Councils who have good ties with the farming sector. NCH is also keen to explore the potential for DewTherm and are especislly keen to see an integrated renewable energy system installed on an exemplar high-rise building for social housing. A representative of the University of Nottingham has also nominated sustainability experts in the Unversitiy' Sustainable Architecture team to support the Steering Group for next phases.

9. Please describe how your company has gained from this project. What new business opportunities have been created? Do you expect your company to grow as a result of this project?

SASIE has been able to create a demonstrator system for DewTherm which will allow collection of real data and a proof of concept. The demonstrator will provide evidence of performance, which can be used to promote the system as a product. The project has also provided the opportunity to form closer links to the SUDs Research Unit at Coventry and the newly formed CLUSTERED group, which will be important for SASIE in the longer term.

The demonstrator has provided an idea of cost and the reality of creating the integrated systems. This offers practical details that can be used to design and development further systems and ultimately market the DewTherm product. The project has enabled market research with key stakeholders and the chance to consult with experts in the sector, which has provided encouragement and motivation to take the product to the next stage. The project has also allowed the chance to develop a marketing plan for the product in Phase 2.

It has enabled SASIE to create a new design of hybrid heat pump, which will be developed further in another project and certified. This first unit has provided vital understanding of the components needed and sizing as well as a useful design and the liaison with NTU has provided an attractive external design.

SASIE will continue to develop the DewTherm product, the hybrid heat pump and the integrated renewable energy system with controller, which will further grow the business and provide more employment opportunities. The aim is to sell up to 1,000 systems per year over the next 5-10 years.

10. Describe the potential for exploiting the work. Please identify any new IP which has been filed or for which filing is anticipated.

Once the demonstrator system for DewTherm has been fully tested over the heating season in 2014/15, depending on a successful outcome, the product will be prepared further for market readiness.

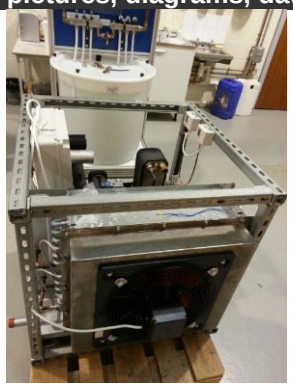
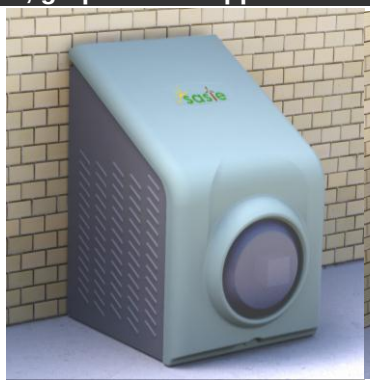
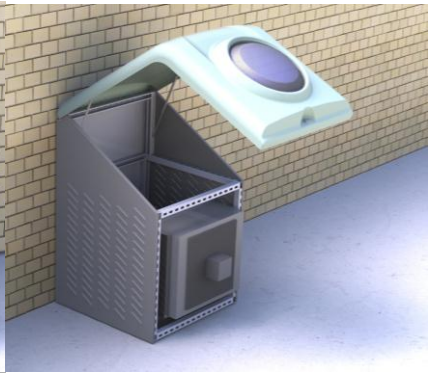
Alongside the integrated DewTherm system, the hybrid heat pump has been designed and built. This product will be further developed and prepared by building a second unit and tested for approvals.

SASIE intends to protect the product name ‘DewTherm’ through with a copyright application. It also intends to file for a patent for the integrated system to protect the IP and also for the H-SIP walling system that has been developed alongside the DewTherm project (for internal walling).

An integrated renewable energy system, incorporating solar PV, thermal and ground source heat pumps is in the process of being patented within the UK market. SASIE, expects to install this system on a high-rise building in 2015.

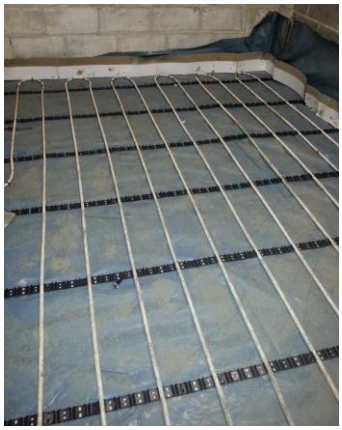
SASIE will explore the potential to broaden the IP protection for the new products and any spin offs concepts that arise.

11. Please insert additional information that may be pertinent. This may be in the form of text, pictures, diagrams, data, graphs that support the work.

The SASIE hybrid heat pump (left: system as built, right: images of casing) will use heat stored in the SUDs system to boost the coefficient of performance.

Trenches were excavated on three side of the farm building. Early problems with heavy rainfall caused problems with the trenches rapidly filling with water. The level of water in the trenches did dissipate over a period 10 days, suggesting that the system will work well as a SUDs reserve.



An underfloor heating system has been installed within the farm building with six diferent temperature zones. The building will eventually (depending on successful planning application) be used for demonstration and training purposes.

The DewTherm launch event on the 8th May attracted a wide range of attendees.
Both the online market research survey and the interest shown at the event suggest a high level of interest.

Further details of the DewTherm project have been published on the SASIE webpages.