Herstmonceux Castle
Moat Source Heat Pump

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1. About Baystar
Who are Baystar?

Our company was originally formed of three individuals who have over twenty years of combined experience in heating systems engineering, and construction.

– **Jonny Starmer** - A quantity surveyor specialising in commercial construction and a full member of the Chartered Institute of Building
– **Tessa Guy** – Mechanical engineer who has worked closely with developers and housebuilders on project finance.
– **Jason Bayliss** - Experienced heating engineer who specialises in Renewable and energy systems and controls
– **Robin Curtis** – Mechanical engineer and geothermal expert. Designed heat pump systems for past 30 yrs incl some of the 1st UK systems
– 7 office staff and a specialist system designer, 15 full time installers and a regular local sub-contracting team of ground workers & electricians
Our technical expertise is rooted in low energy technologies.

We offer 3 core services:

**M&E BUILDING SERVICES**
Baystar provides single-source, one-stop-shop, solution for the design, installation and commissioning of plant replacement and upgrade M&E Projects.
- Consult
- Price
- Design
- Install
- Maintain

**FACILITIES MANAGEMENT**
Baystar provide leading FM advice and expertise to a broad portfolio of commercial and industrial clients, whatever the nature of your business, we can support all your HVAC requirements in any environment.
- Planned Preventative Maintenance
- Reactive Maintenance as required.

**SUSTAINABLE SOLUTIONS**
Through a diverse range of expertise and experience across various disciplines, Baystar provide a comprehensive suite of sustainability solutions from preliminary advice through to project completion.
- Heat Pumps
- Biomass
- CHP
- Solar
2. Herstmonceux Castle Installation
Client: Queen’s University, Bader International Study Centre, East Sussex

SERVICES: Sustainable Energy Solutions, Mechanical & Electrical Engineering
INDUSTRY: Culture & Heritage, Education
VALUE: c£160,000
PROGRAMME: 3 months
Overview

A 15th century moated castle with Elizabethan gardens, and home to the Bader International Study Centre.

The requirement was to reduce the annual oil bill of £60,000 by utilising a sustainable energy solution.

Baystar carried out a detailed feasibility study, which established that given the high summer heat load, and the good thermal mass in the solid brick walls of the castle, utilising the moat as the heat source would provide an excellent return on investment.

Baystar installed a 130kW water source heat pump system to provide heat to the castle and associated university facilities.
Design Summary

- Moat collector of 24 coils with each coil being fixed to a low profile stainless steel frame.
- Each collector will include 150m of coiled pipe and will be 1m wide by approximately 3m long and will support a 130kW heat pump.
- Central bespoke manifold, tailor made by our team of engineers to Herstmonceux.
- Kept both existing oil boilers as system top up and back up
- 1,000 litre buffer tank
- Two 500 litre calorifiers with heat pump compatible alternatives that incorporate a large surface area coil to provide domestic hot water heating for the castle.
- Specialist contractor with experience working with listed buildings.
- No damage to existing features during install
- No evidence of works carried out (except new plant)
Detailed site visits and assessment of energy data showed that we could achieve a highly efficient system with considerable savings whilst providing an attractive income from the RHI from a virtually maintenance free, fit and forget technology.

The heating system flow temperatures are below 60 degrees and the hot water requirements are met by an alternative method.
Heat Load

- Calculations based on Herstmonceux’s average oil usage (mild winter of 2013).
- Est requirement of around 900,000 kWh useful heat to the castle.
- Peak load to be around 270kW,
- 130kW heat pump = around 80% of annual heat load requirement.
- Existing oil boilers = 20% of the demand (at peak during winter)
- This is offers a more economical option to using an immersion or in line electric heating as a supplement, which can be high in kW output and very costly to run.
Seasonal Operation

The system will operate in three ways:

**Summer:**
- There is modest requirement for heat and some requirement for hot water.
- The heat pump will provide all required space heating and hot water.

**Autumn and Spring:**
- Temperatures generally do not fall below 5 to 10 degrees C.
- Again the heat pump will have the capacity to meet all the heating and hot water demand.

**Winter**
- On unseasonably cold days when temperatures drop below 0 to 5 degrees and the demand exceeds 130kW, the heat pumps and existing boiler system will operate on an alternate system—this means that the heat pump will carry the load up to its maximum capacity of 60 degrees.
- The boiler will then need to take over if the comfort factor within the building is not met to raise flow temperatures above 60 degrees.
- We anticipate this to be around 20% of the total year.
Financially logical: Cost benefit graph

- A project of this size will earn £25-£30k per annum in Renewable Heat Incentive payments.
- Payback = 3 Years
- IRR = 40%

Solid Financial Logic behind investment decision:

130kW Heat Pump
New fuel bill c£9,900 p.a
1000000
1500000
Cost benefit of GSHP including inflation

Old Oil Boilers
Oil c£57,000 p.a
RHI : c£28,000
Cash back £0
The Tech

The liquid transfers energy to the refrigerant, which evaporates

Compressor

Condenser

+60°C

+65°C

Expansion valve

The refrigerant is then compressed causing the temperature to rise considerably

Evaporator

+2°C

-3°C

Stored solar energy in the ground or rock

Heat transfer medium (glycol/water) circulates in a plastic hose, collecting energy from the ground

The heat is transferred to the heating and hot water system of the house
The Tech

- **Why heat pumps?** - Maintenance free technology
- **Fit and forget**
- **No fuel deliveries required**
- **Space saving and discrete**
- **High efficiency**
- **Low running costs**
- **No emissions or smell**
- **Collectors out last the RHI 20 year term**

A Heat Pump takes low-grade heat from the ground or water and turns it into useful heat for space heating and hot water. This is achieved through a cycle of using the water temperature to evaporate a refrigerant gas that is then compressed to generate useful heat from the low-grade heat in the water.
Impressive & Successful HP Retrofit

• Scale challenges and complexity of retrofitting heat pumps
• The project has been a 100% success in terms of delivery and results
• Ground breaking retrofit project that involved minimum disruption
• Significant reduction of energy costs and carbon
• Created a better awareness of energy and the potential reductions
• Delivered the expected results in terms of savings and performance
Post Installation

Controls

Heating the Building

Minimal Servicing

Minimal Breakdowns

Client Costs

Waste Energy
3. Case Studies
Tattleton Estate  
- December 2012  
- Lake collector for country estate providing all heating and hot water

I was responsible for the project feasibility, system design and management of the installation. A 90kW cascade system of heat pumps using 18-loop lake collector was installed at this working shooting & equestrian estate. The four separate buildings were linked using a quasi district heating scheme distributing low temperature water from the central lake collector to heat pumps positioned in the separate buildings. Great consideration was given to the hot water production in the main house due to fluctuating demand (sometimes 3 occupants, sometimes 20). 1200 litres of hot water storage was including an LPG back up for fast cylinder recharge and control set up when needed.
Glyndebourne Opera House
- December 2014
- Biomass installation

I managed the project from tender stage, design and installation including the mechanical installation and groundwork’s. Grade II listed building required complete heating upgrade and a woodchip biomass system was chosen by the consultant to bring the estates woodland back into management. The new biomass system was incorporated within an existing old disused fire shed within the main thoroughfare for the Opera guests resulting in difficult working conditions. The old heating system was situated in the cellar again resulting in the challenges associated with a very old oil heating system to be decommissioned.
I managed the project from design and installation of the heating system and decommissioning of the old system. The large Grade II listed building required complete heating upgrade and fully automated pellet biomass system was chosen by the client to displace the heating load of c. 900,000kWh. The new biomass system was incorporated within a new purpose built building. Being a care home the switch over and back up considerations were paramount to the project. The old oil heating system was situated in the cellar resulting in the challenges associated with a very old oil heating system to be decommissioned.