

# Business Engagement & Technology Transfer



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EUROPEAN UNION



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# An update on Eden Geothermal

Currently still in the preparation phase. Funding has been secured through the European Regional Development Fund, Cornwall Council and an institutional investor.

They have made significant progress over recent months in setting up the contracts needed to drill the first 4.5km well:

- The contract to supply the drilling rig has drawn interest from all over the world. Applications are currently being reviewed.
- The deadline for tenders for the micro-seismic network is approaching
- Soon they will advertise the contract for the design and construction of the site, once the drill rig has been selected.



# The Lost Gardens of Heligan

The Lost Gardens of Heligan is a botanical garden located near Mevagissey in Cornwall, UK.

They include highly productive flower and vegetable gardens, an Italian garden, and a wild area filled with subtropical tree ferns called "The Jungle".



The gardens are also home to Europe's only remaining pineapple pit - a method of growing pineapples in colder climates.

Traditionally heated by horse manure, they currently rely on supplementary heat from 2 electric air heaters to keep the pits at 19°C all year round.



However this is a costly, inefficient and potentially environmentally harmful method of providing heat.



# Pineapple pit ground source heat pump system

## General information:

- ✓ 35m<sup>2</sup> green house used to grow pineapples
- ✓ Currently heated by 2x 2.8kW electric heaters
- ✓ Target temperature of 19°C
- ✓ Current peak heat loss approx. 7kW
- ✓ High current heat loss due to historic nature of the structure



## Heat pump system:

- ✓ Potential for a ground source heat pump system to replace existing electric heaters
- ✓ Underfloor heating pipe to be used as heat emitter
- ✓ Horizontal slinky array to be installed beneath vegetable garden for heat extraction
- ✓ Reducing peak heat loss by upgrading the glazing would result in lower running costs and carbon emissions
- ✓ By reducing the glass U-value to 2.2W/m<sup>2</sup>K, peak heat loss could be reduced to approx. 4kW

Pineapple pit greenhouse and vegetable garden with proposed 50m horizontal array

## Current vs predicted performance:

INDICATOR	UNIT	ANNUAL AVERAGE
Current electric heaters	Efficiency COP	99%
Ground source heat pump (GSHP)		4.0
Electric heaters running cost	£/year	2,935
GSHP running cost (current heat loss)		726
GSHP running cost (improved)		424
Electric heaters carbon emissions	kgCO <sub>2</sub> /year	2,273
GSHP carbon emissions (current)		563
GSHP carbon emissions (improved)		328

\*Unit prices & carbon factors taken from proposed SAP 10.1.



# Charlestown Shipwreck Museum

Located in the World Heritage Site of Charlestown, Cornwall, the museum contains artefacts from over 150 different shipwrecks.



The first floor restaurant is currently heated by an air source heat pump, but the ground floor museum is virtually unheated.

Further development could offer the potential for a ground or water source heat pump system, potentially utilising the harbour located just behind the museum.



# Devon County Council: Corporate & Farm Estates

DCC came to us with a range of properties from their Corporate and Farm Estates that they plan to redevelop, with the potential to install renewable heating systems.

One such example is Lower Farm, High Bickington. Currently only heated by an inefficient oil fired rayburn and an old wood burner. The current renovation plans are to provide a new oil fired condensing boiler, radiators and hot water cylinder, as well as new double glazed windows and doors, loft and other improved insulation.

We proposed something different...



# Lower Farm ground source heat pump system

## General information:

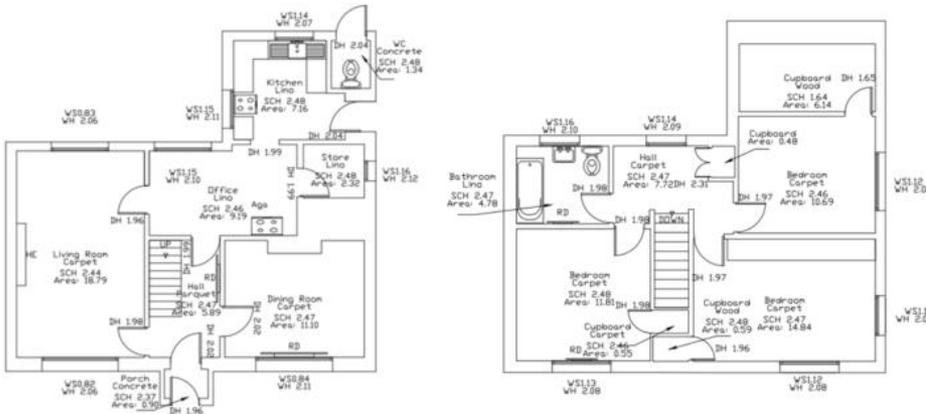
- ✓ Old farmhouse currently heated by oil boiler
- ✓ Potential to improve building fabric and reduce heat demand to:
- ✓ Total heat loss: 7.5 kW
- ✓ Annual heat demand: 15,600 kWh

## Heat pump system:

- ✓ Potential for a ground source heat pump system to replace existing oil boiler
- ✓ 8 kW rating
- ✓ Horizontal ground array would need 3 x 50m trenches with 100m loops
- ✓ Borehole array would need 2 x 65m deep boreholes with 130m loops

## Predicted performance:

INDICATOR	UNIT	ANNUAL AVERAGE
Condensing oil boiler Ground Source Heat Pump	Efficiency COP	98% 4.0
Oil boiler running cost GSHP running cost	£/year	692 685
Oil boiler carbon emissions GSHP carbon emissions	kgCO2/ year	4744 530
GSHP capital cost + Horizontal ground array cost OR Borehole array cost	£	6,000 - 7,000 2,000 - 3,000 8,000 - 10,000
Pay back with RHI – Horizontal system Pay back with RHI – Borehole system	Years	4 6.5



Lower Farm floor plans – total area 115 m<sup>2</sup>

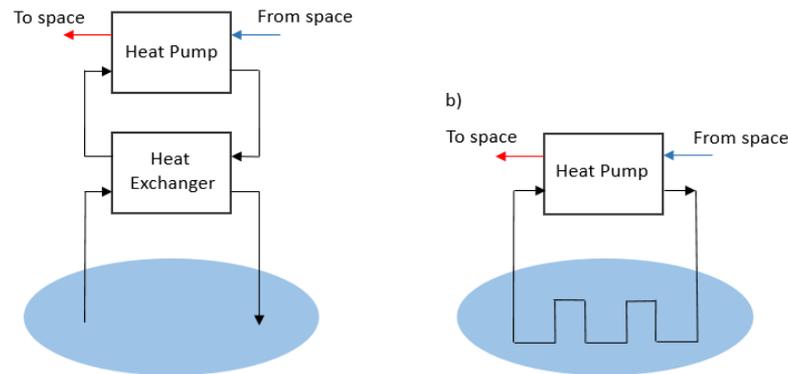
\*Unit prices & carbon factors taken from proposed SAP 10.1.



# Mine water for district heating

Involves extracting heat from flooded mine workings, using a shared ground array to supply individual heat pumps located in each property, or larger heat pumps serving clusters of buildings.

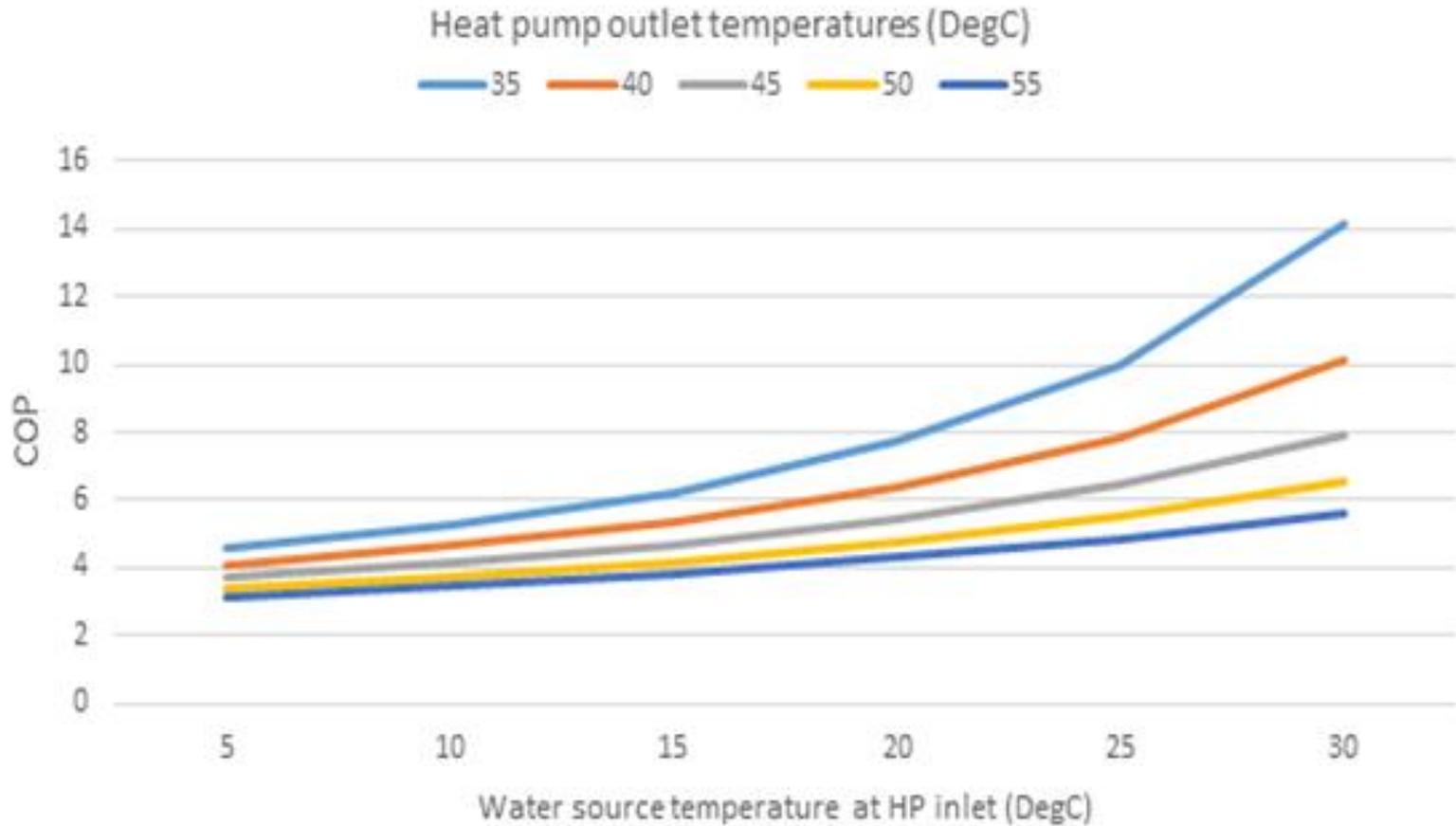
Small scale projects can be operated with a closed loop system. Large scale projects are often better suited to open-loop.



It is estimated that over  $\frac{1}{4}$  of UK homes are situated above former mine workings.



Mine water temps can range from 15-25°C for medium to deep shafts, allowing heat pumps to operate at COPs of over 5.



Sarbu, I. & Sebarchievici, C. (2016) Using Ground-Source Heat Pump Systems for Heating/Cooling of Buildings



# Current UK mine water projects

County Durham district heating project:

- Development set to begin in spring.
- Will consist of 750 affordable homes, 750 private homes, a school and shops.
- Geothermal heat will be supplied from nearby Dawdon mine water treatment scheme (operated by the Coal Authority)

Caerau, South Wales:

- Currently seeking funding
- Will include over 300 residential houses, a primary school and community buildings in its first phase.



## Heat demand areas with potential for water source heat pumps

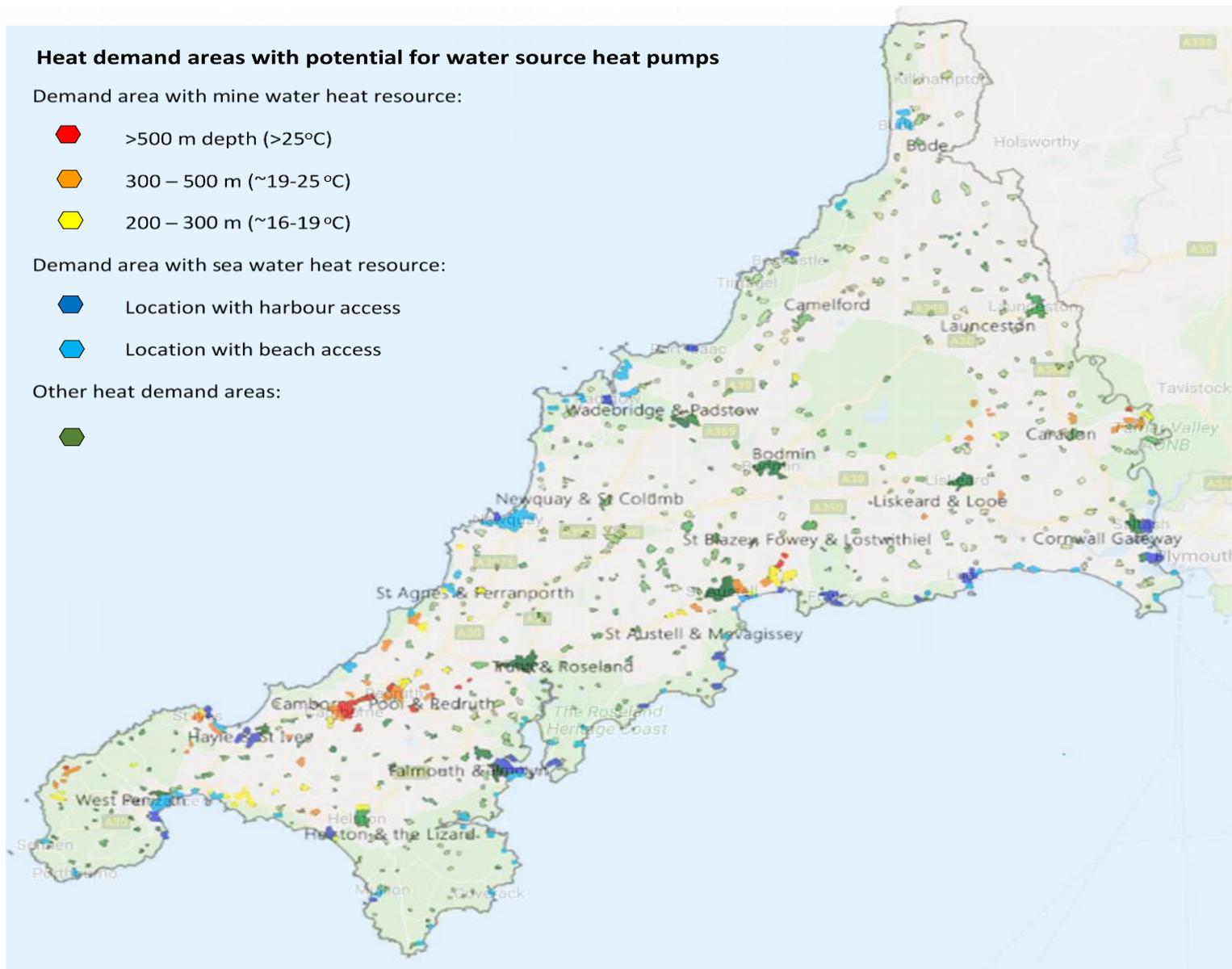
Demand area with mine water heat resource:

-  >500 m depth (>25°C)
-  300 – 500 m (~19-25°C)
-  200 – 300 m (~16-19°C)

Demand area with sea water heat resource:

-  Location with harbour access
-  Location with beach access

Other heat demand areas:



# National Trust

The National Trust owns and operates a large number of estates and properties in Cornwall, both public and private. We are working with them to highlight opportunities for both mine water and sea water source heat pumps.



# Training & Entrepreneurship

In collaboration with another research project at Exeter University (IHLS) and the GSHP association we are in the process of establishing a new training course for the heat pump industry in Cornwall.

Innovation in Higher Level Skills seeks to:

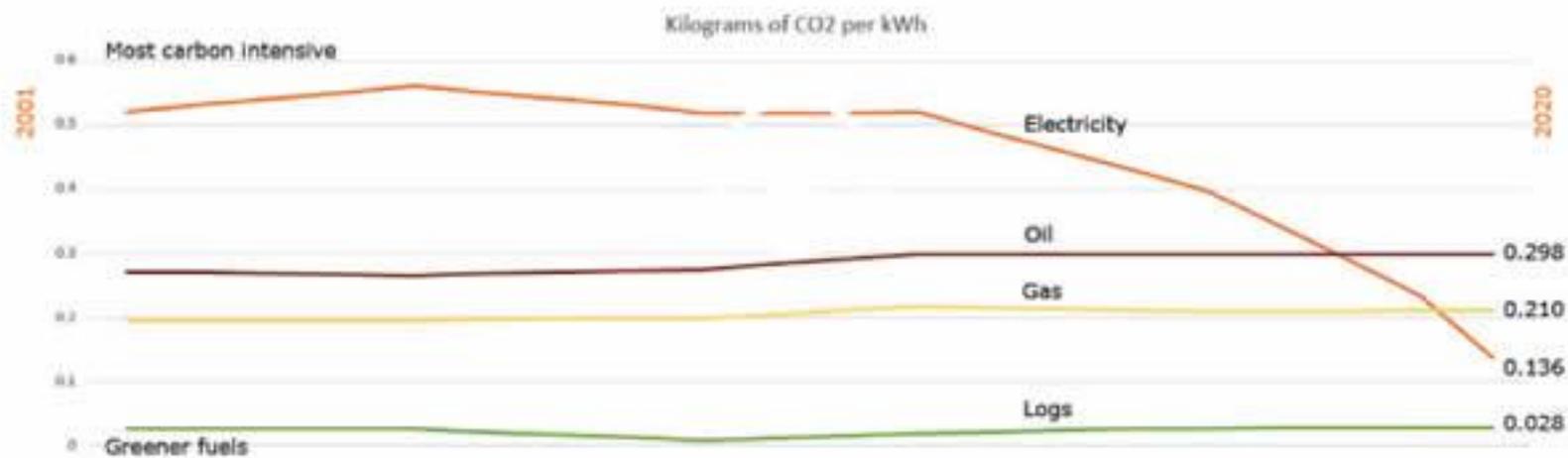
- Identify skills and knowledge gaps within SME and micro-businesses in Cornwall and the Isles of Scilly.
- Work with businesses to design training and short courses aimed at filling these gaps.
- Particularly in the renewable energy sector.



With the government's mandate that from 2025 all new houses will be equipped with non fossil-fuel heating systems, and with decarbonisation of the gas network still many years from fruition, electric based heating (i.e. heat pumps) will have to be the replacement for most new properties.

*energist*

## Emission factors of fuel types since 2001



However the heat pump industry is not currently equipped to cope with this sudden surge of demand. There is a lack of skilled people throughout the supply chain.

From design & specification (starting with architects and building design) right through to installation and maintenance. Especially on the ground source side of the industry, which also requires borehole spec and installation.

- Air vs ground source decision making
- Heat loss calculations
- Heat pump sizing
- Ground array sizing (borehole & horizontal)
- Ground array design
- Heat emitters - Radiators vs UFH
- Heat pump install - Gas & heating engineers
- Operation and controls
- Maintenance and servicing



# Thanks for listening

## Any questions?

