RUNNING ON LIQUID ENERGY

Darwin College's plans for river source heat pump

CHALLENGES AND OPPORTUNITIES

The River Cam flows through the grounds of Darwin College, just upstream of the Cambridge 'Backs', providing around 350m of river frontage at the heart of the estate. The 14 buildings on the main College site are located in a tight triangle, with busy roads on two sides and the river as the border on the third side. These buildings provide accommodation for around 120 postgraduate students as well as housing administrative offices, the Library, Dining Hall and kitchens, student bar and common rooms.

In 2021, Darwin College commissioned an estate-wide review of the buildings and their heating systems. A working group of College members was subsequently tasked with developing an ambitious but achievable plan to decarbonise the entire built estate over the next decade. It examined the scope for fabric improvements to reduce energy demand and the various options for renewable heat: air source heat pumps, ground source heat pumps, direct electric heating powered by on-site PV generation, and a closed heat network fed from a water source heat pump using the river Cam as a heat source.

DARWIN COLLEGE
CAMBRIDGE

THE POTENTIAL OF RIVER SOURCE HEAT

In 2013 the Department of Energy and Climate Change assessed around 40 urban rivers to show the potential for water source heat pumps to be used for heating and cooling purposes. This work was incorporated into a Government report produced in 2015 and estimated that the total heat capacity of English rivers is approximately 6GW. It noted that the total heat capacity of rivers is strongly proportional to flow, and suggested that smaller urban areas on rivers of sufficient size could meet their entire heat demand through the river alone

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Cambridge was ranked 23rd in a table of locations in England with the "highest potential for water source heat pump deployment in areas of high heat demand". But this was caveated in the 2015 report: the work was done at a high level and did not provide a quantitative estimate of heat capacity for each location. In 2022, in a collaboration with six other riverside Colleges, Mott MacDonald were commissioned to monitor water flow, depth and temperature at four locations on the river and to produce a detailed hydrology study. The report, delivered in 2023, confirms the considerable potential of the river to supply heat for space and hot water heating for the adjacent Colleges.

The report's findings show that, in winter:

- the energy output under historically 'normal' conditions is equal to 227 MWh/day
- with a constant flow abstraction rate of 0.75 m3/sec
- falling to between 106 MWh/day and 181 MWh/day corresponding to 0.35 m3/sec to 060 m3/sec in dry winters

ECOLOGY

Any on-site development will take into account the protection of Darwin's precious and varied biodiversity. No detrimental effect to the site's ecology is anticipated, and we will undertake further work to confirm this.

FUNDING THE FUTURE

Darwin is now working up a decarbonisation plan for its main site. Following a grant award of over £200,000 from the Salix Low Carbon Skills Fund in June 2023, work is underway to design, to a RIBA Stage 3 level, an on-site heat network feeding all 14 buildings on site from water-source heat pumps at the edge of the estate, and to include associated building fabric upgrades. The final report, due in March 2024, will form the basis of a proposal that will work through 2024, with the aim of the works being undertaken in 2025/6.

A LOCAL SOLUTION

Having rapidly progressesd from hypothetical investigation to concrete plan, the project could now set the template for the optimal approach in riverside contexts without space or planning permission for air or ground source installations.

The scheme now forms an integral component of Darwin's strategic ambition to reach carbon neutrality by 2032, and the information and lessons learnt are being shared with other Colleges. We look forward to the river, already the physical and emotional heart of the College, becoming the means by which it proceeds to a more sustainable future.