Zero-Carbon Oxfordshire Heating

Meet the Team

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Project Brief

"Design an overall system for the decarbonisation of heating for an iconic building/estate in Oxfordshire"

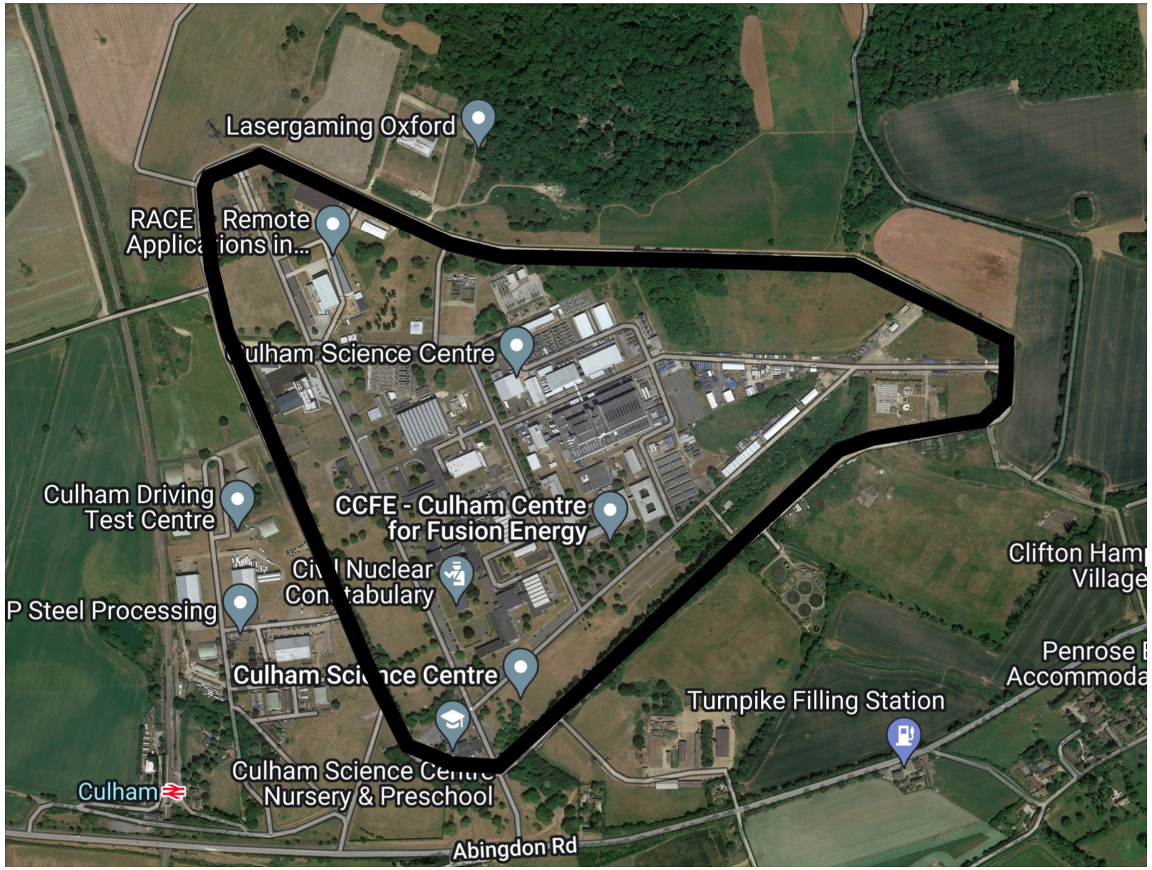
Aims:

- Create an integrated heating and cooling system for our building of choice
- Meet net-zero emissions by 2050
- Demonstrate how our renewable heating system can be integrated into other sites across Oxfordshire

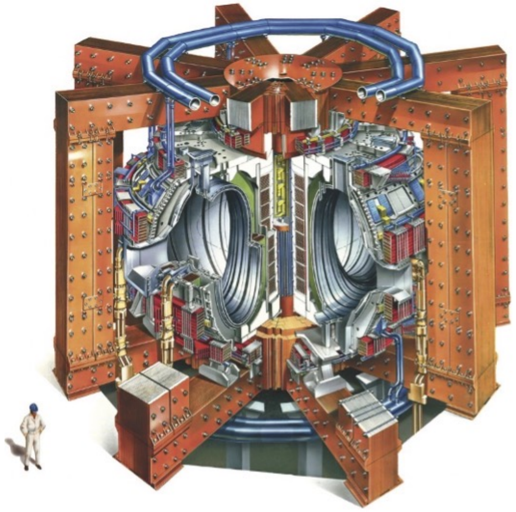
Project Specification

- ✓ Heat/cool an iconic building to sufficient internal temperatures
- ✓ Replace carbon-intensive sources with completely renewable options
- ✓ Utilise methods to reduce energy demand
- ✓ Align heating solution with current council and government plans
- ✓ Ensure project is economically viable and technically feasible

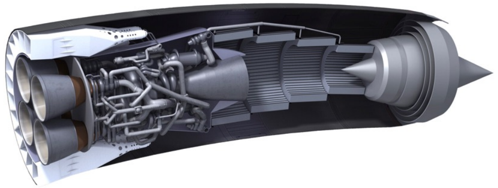
Why Culham?



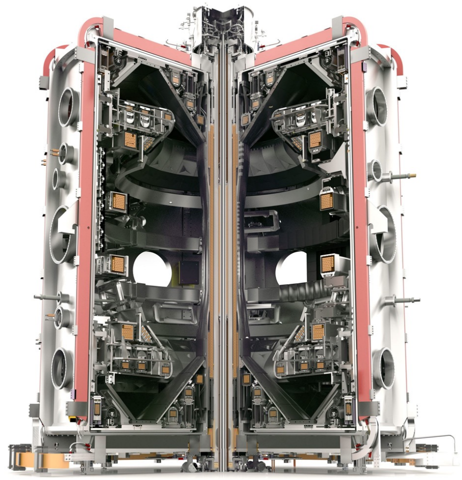
Culham Science Park (Google maps)



Joint European Torus (JET)



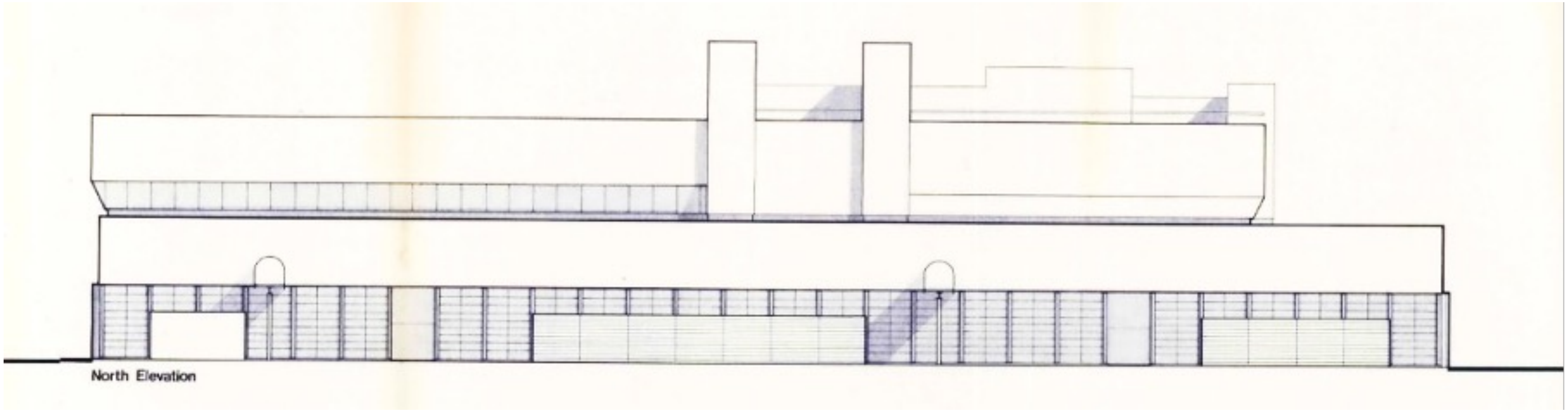
SABRE Rocket Engine



MAST Upgrade

The J1 Building

- Natural gas expense of £190,000 each year
- Releasing over 350 tonnes of CO_2 per year
- Potential to demonstrate a system that can be replicated



Original Planning sketch

Our Energy System

J1

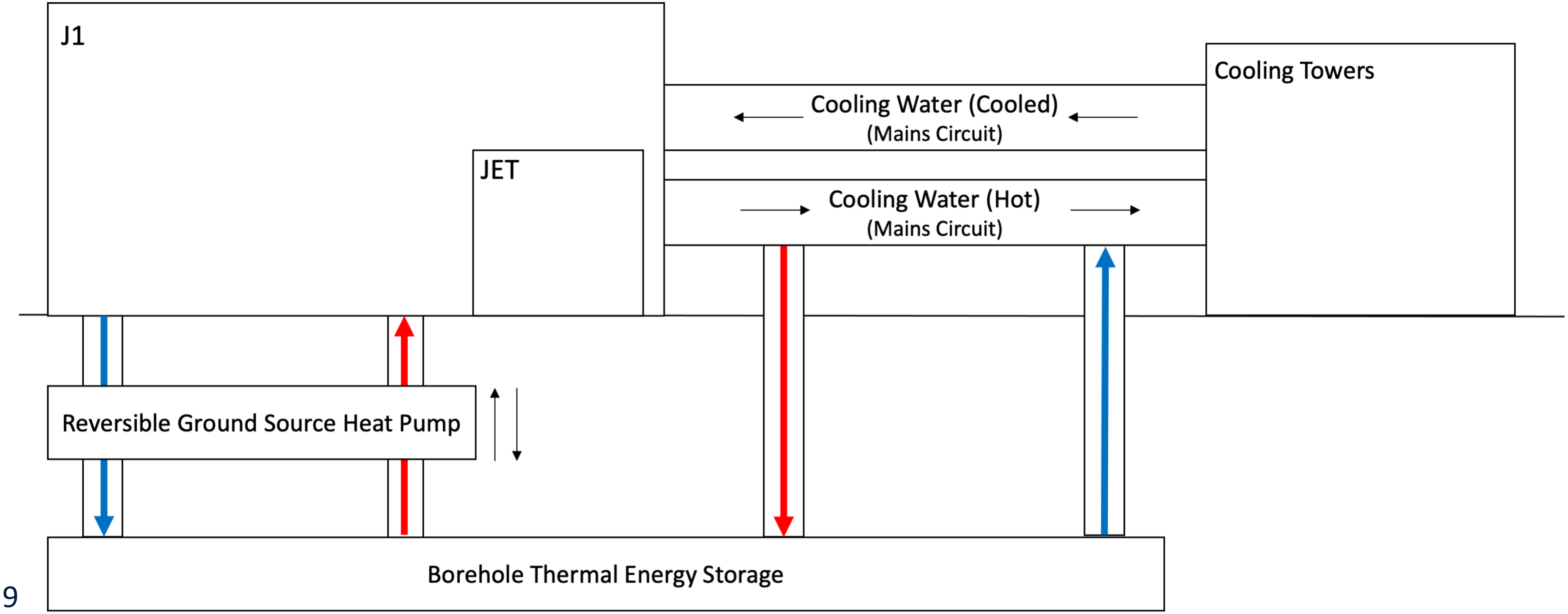
Energy Generation

Energy Storage

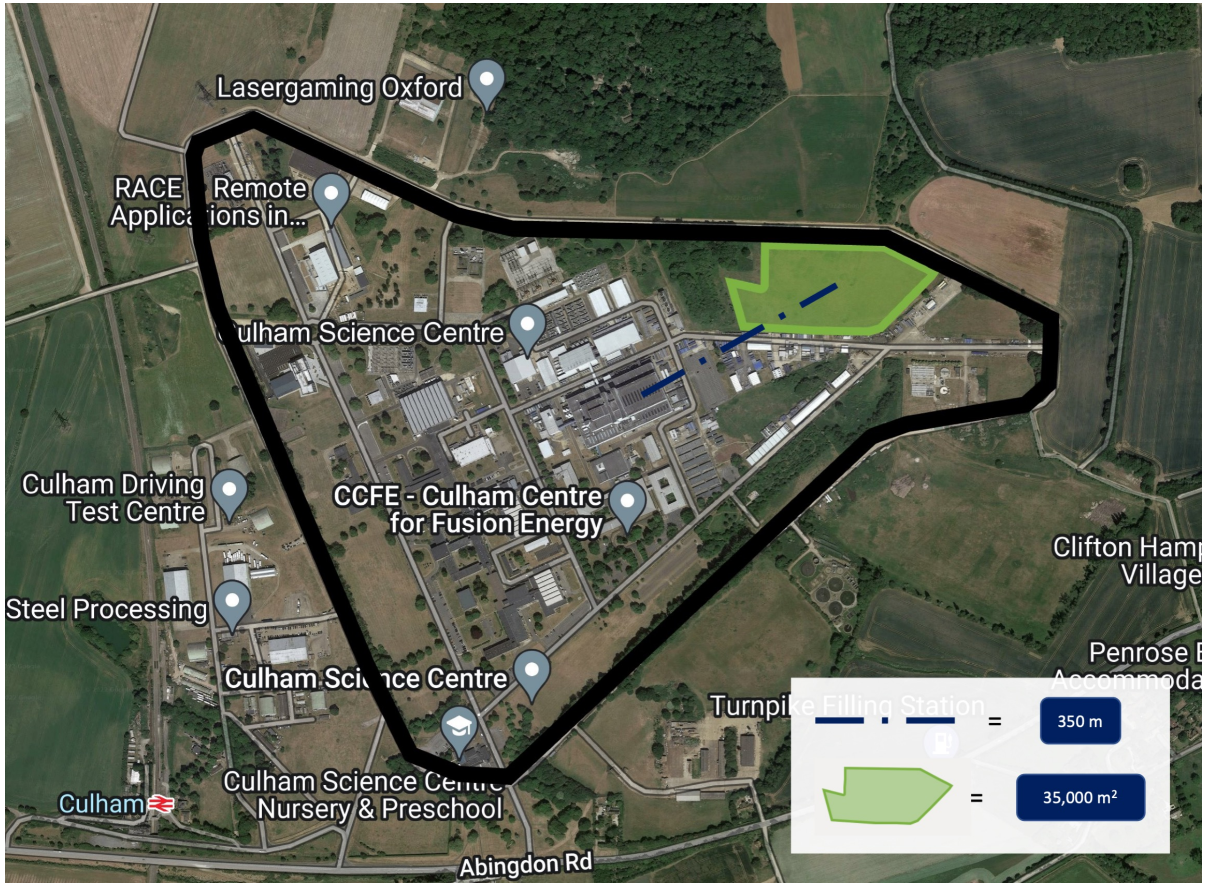
Energy Distribution

Smart Control

Our Heating Solution



Borehole Location



[The Culham Science Park Site]

Cooling Towers

4x JET Cooling Towers

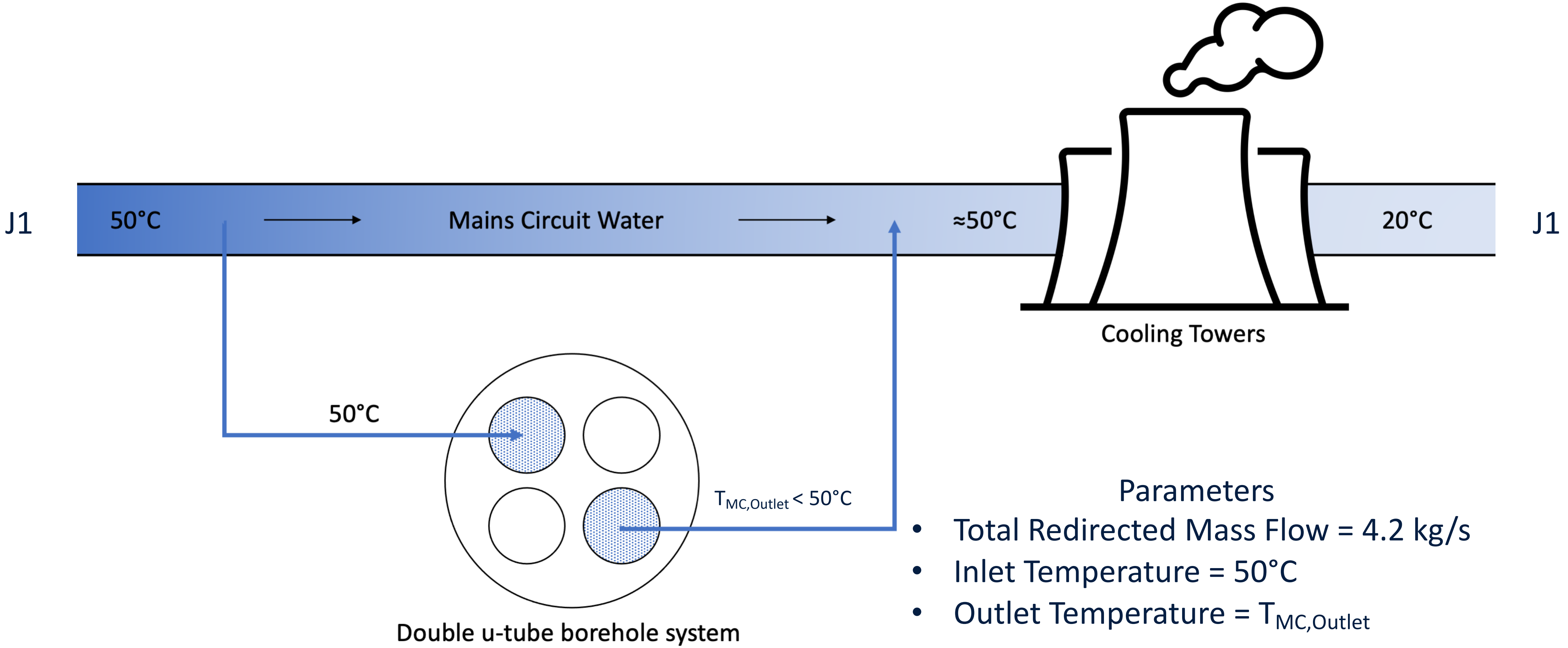
Water Inlet Temperature = 50°C

Water Outlet Temperate = 20°C

4x CTs each with mass flow rate of ~280 kg/s

Rate of heat loss = 140 MW (a maximum)

Heat Recovery



Parameters

- Total Redirected Mass Flow = 4.2 kg/s
- Inlet Temperature = 50°C
- Outlet Temperature = $T_{MC,Outlet}$

Heat Recovery

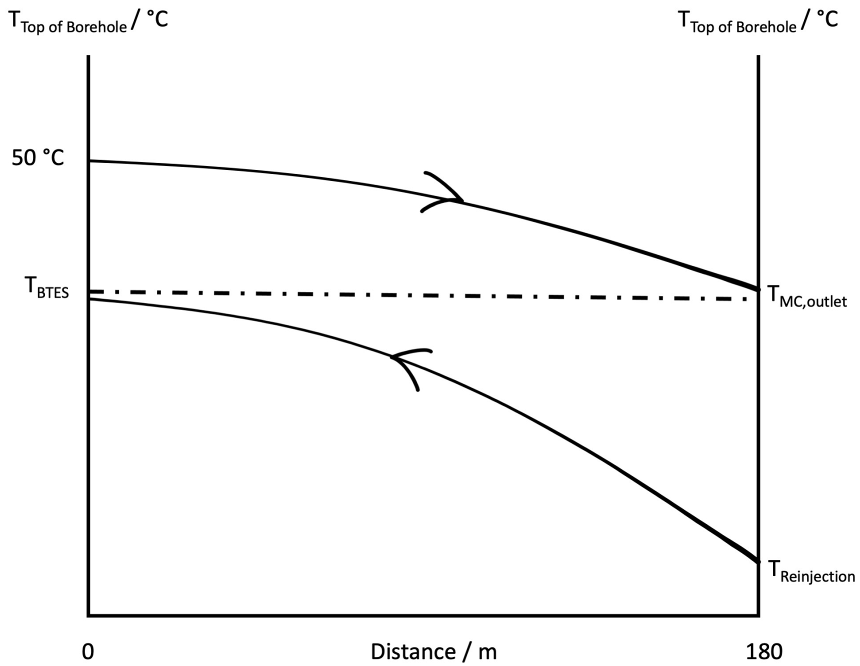
EUROfusion

Annex 1 to Letter Ref. PMU/1386-TD-L/SJ

JET 2019 Workprogramme Timeline

JET

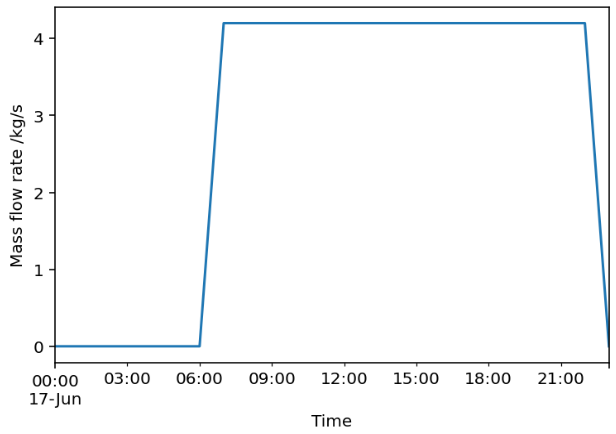
Exp-ID	Experiment title	Date
	Campaign C38 - Deuterium	
	Week 25 (Campaign week: 1) 17 - 21 Jun	
M18-14	Isotope effects on L-H transition power threshold (1/2)	17/06/19
M18-19	Isotope effects on confinement and transport (1/6)	
M18-02	Hybrid scenario development for DT (1/28)	18/06/19
M18-02	Hybrid scenario development for DT (2/28)	
M18-05	ICRH scenario support in D and T plasmas (1/6)	19/06/19
M18-09	Prepare integrated RTC schemes for scenarios (1/4)	
M18-01	Baseline scenario development for DT (1/28)	20/06/19
M18-01	Baseline scenario development for DT (2/28)	
M18-08	Impact of fuelling and pacing pellets on SOL and pedestal (1/4)	21/06/19
M18-04	Plasma terminations and disruption avoidance for scenarios (1/4)	



Heat Recovery in Python

$$Q_{recovered} = mc_p(T_{MC,\ inlet} - T_{MC,\ outlet})\Delta t$$
$$= (4.2)(4182)(50 - T_{MC,\ outlet})(54{,}000)$$

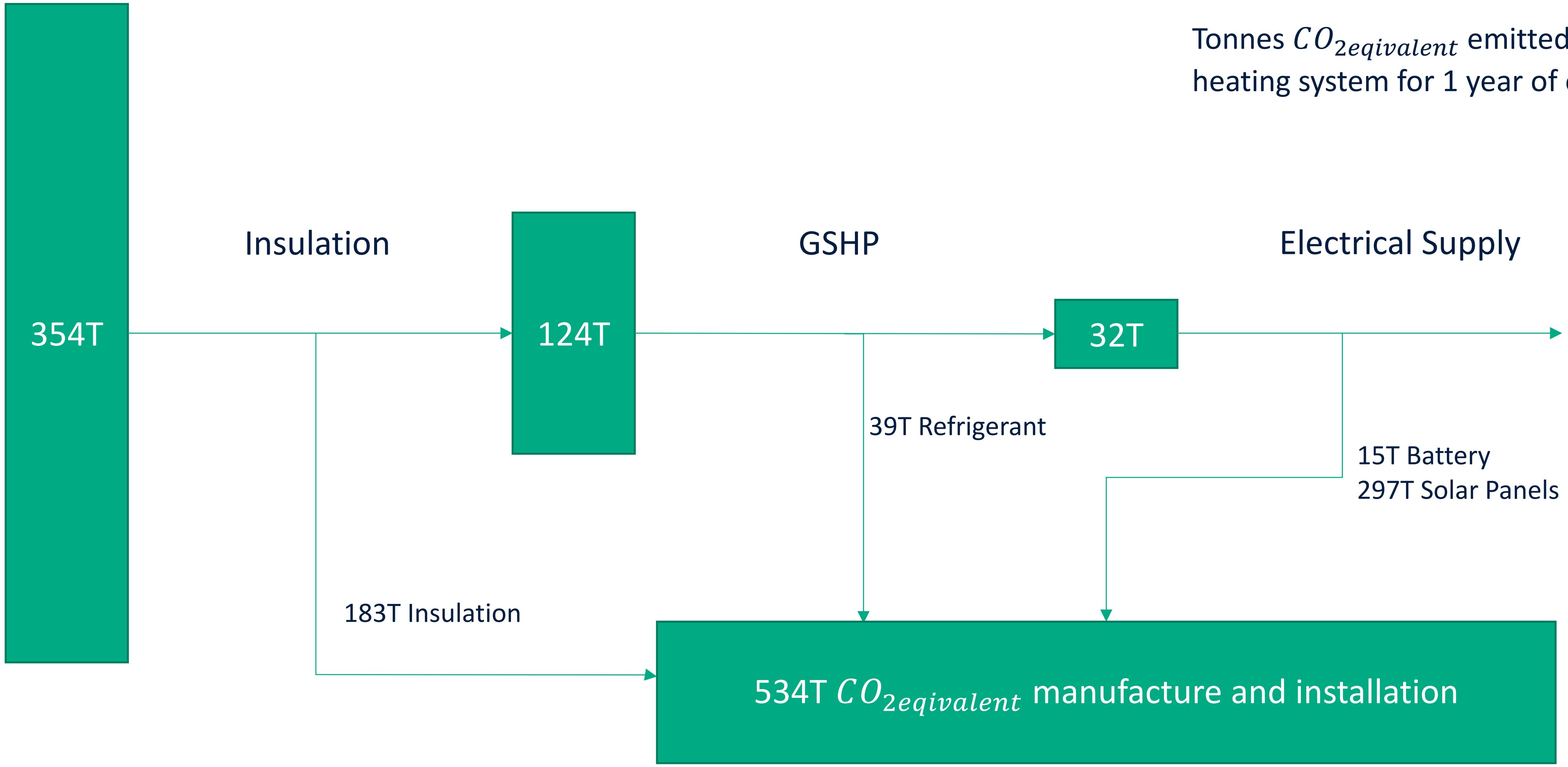
Mass Flow Rate of Redirected Mains Circuit Water Through BTES When JET is Operational



Variation in BTES Temperature Before Heat Injection Computed by Xiaoqi

Carbon Saving

Tonnes $CO_{2eqivalent}$ emitted by the heating system for 1 year of operation



Impact in Oxfordshire

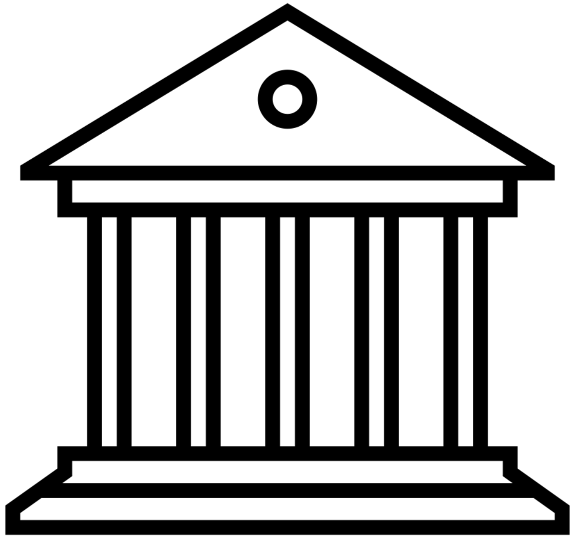
Harwell

UYS Oxford

John Radcliffe Hospital

BMW Mini Plant

How will we Finance?



Non-domestic Renewable Heat Incentive (NDRHI)

Public Sector Decarbonisation Scheme

UKAEA

Summary

Can be integrated into wider net-zero energy planning for the county of Oxfordshire

Economically viable

Maximises available assets

Scalable & Flexible