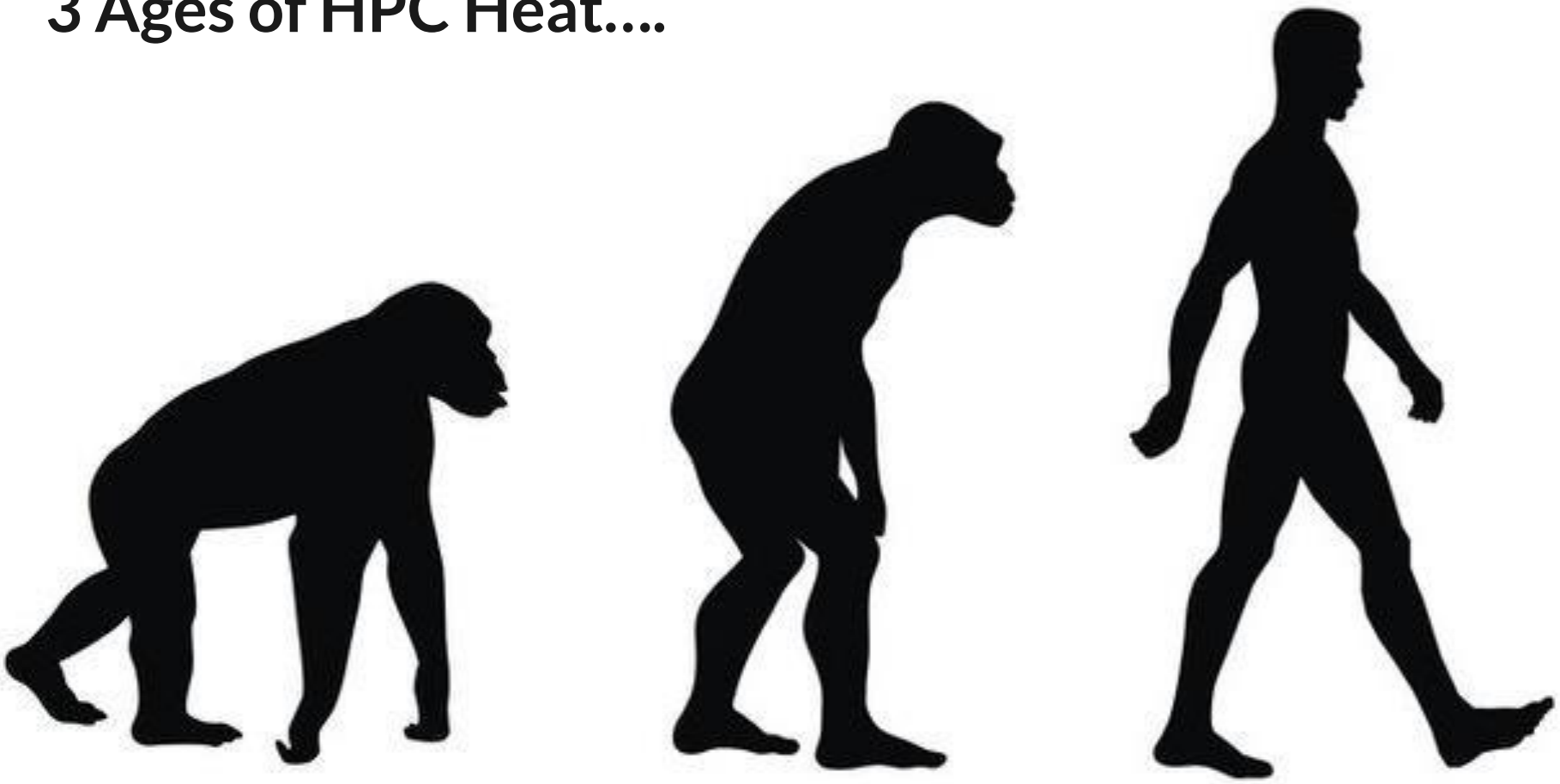
Running HPC and AI workloads whilst saving our planet

Mark Bjornsgaard, CEO Deep Green

3 Ages of HPC Heat….

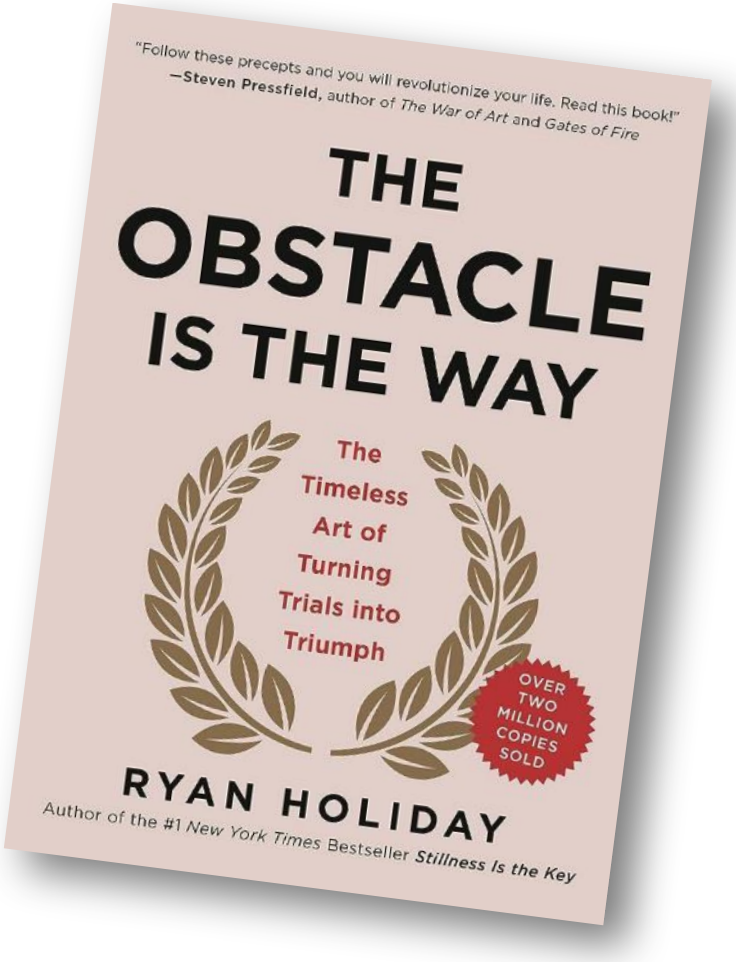


2023 – 2030
Age of HPC Heat “*Adaption*”

The data centre industry consumes a huge proportion of the world's electricity supply

"AI and data centres are a disaster for our planet...."

The challenge is the opportunity



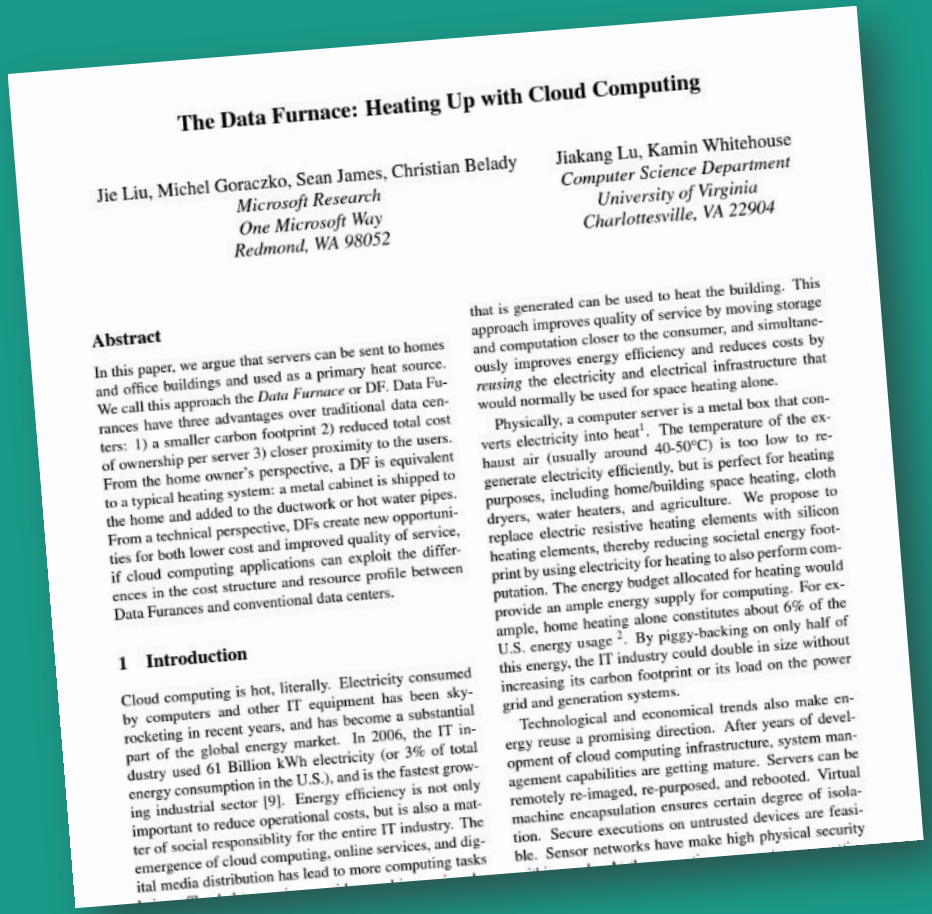
Data centres **are** an environmental disaster…

Hot computers are a critical sustainability asset

Servers are excellent electric heaters.. 97% of the electricity that goes into a computer, comes out as heat…

“Data furnaces”

(Microsoft 2011)



The Data Furnace: Heating Up with Cloud Computing

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Abstract

In this paper, we argue that servers can be sent to homes and office buildings and used as a primary heat source. We call this approach the *Data Furnace* or DF. Data Furnances have three advantages over traditional data centers: 1) a smaller carbon footprint 2) reduced total cost of ownership per server 3) closer proximity to the users. From the home owner's perspective, a DF is equivalent to a typical heating system: a metal cabinet is shipped to the home and added to the ductwork or hot water pipes. From a technical perspective, DFs create new opportunities for both lower cost and improved quality of service, if cloud computing applications can exploit the differences in the cost structure and resource profile between Data Furances and conventional data centers.

1 Introduction

Cloud computing is hot, literally. Electricity consumed by computers and other IT equipment has been skyrocketing in recent years, and has become a substantial part of the global energy market. In 2006, the IT industry used 61 Billion kWh electricity (or 3% of total energy consumption in the U.S.), and is the fastest growing industrial sector [9]. Energy efficiency is not only important to reduce operational costs, but is also a matter of social responsiblity for the entire IT industry. The emergence of cloud computing, online services, and digital media distribution has lead to more computing tasks that is generated can be used to heat the building. This approach improves quality of service by moving storage and computation closer to the consumer, and simultaneously improves energy efficiency and reduces costs by *reusing* the electricity and electrical infrastructure that would normally be used for space heating alone.

Physically, a computer server is a metal box that converts electricity into heat[1]. The temperature of the exhaust air (usually around 40-50°C) is too low to regenerate electricity efficiently, but is perfect for heating purposes, including home/building space heating, cloth dryers, water heaters, and agriculture. We propose to replace electric resistive heating elements with silicon heating elements, thereby reducing societal energy footprint by using electricity for heating to also perform computation. The energy budget allocated for heating would provide an ample energy supply for computing. For example, home heating alone constitutes about 6% of the U.S. energy usage [2]. By piggy-backing on only half of this energy, the IT industry could double in size without increasing its carbon footprint or its load on the power grid and generation systems.

Technological and economical trends also make energy reuse a promising direction. After years of development of cloud computing infrastructure, system management capabilities are getting mature. Servers can be remotely re-imaged, re-purposed, and rebooted. Virtual machine encapsulation ensures certain degree of isolation. Secure executions on untrusted devices are feasible. Sensor networks have make high physical security

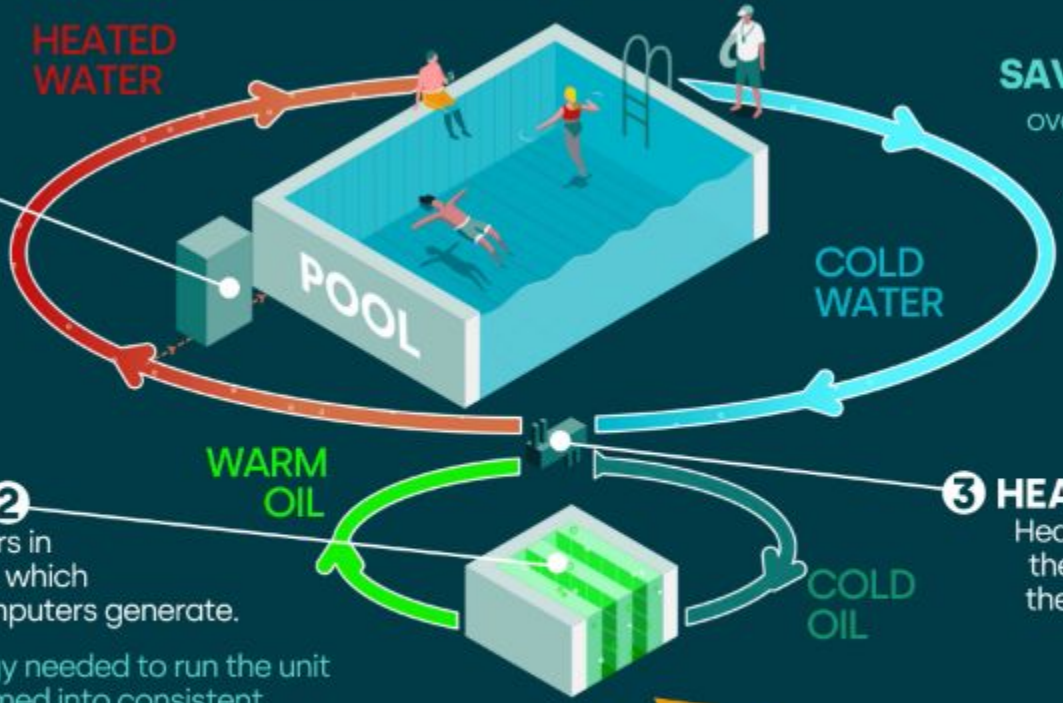
Stop building data centres in the middle of nowhere

Start building them where heat is required

Nelson
Pontllanfraith
Ystrad Mynach
Cwmbran
Newbridge on Usk
Itton
Tutshill
Chepstow
Falfield
Llanfrechfa
Ponthir
Henllys Vale Croes-y-mwyalch
Kemeys Inferior
Bulwark
Crosskeys
Risca
Mathern
Caerleon
Langstone
Llanmartin
Thornbury
Bedwas
Waterloo
Rogerstone
Newport
Llanwern
Caldicot
Portskewett
Rogiet
Magor
Alveston
Old Down
Caerphilly
Bassaleg
Tockington
Bagstone
Nantgarw
Vantage Data Centers | CWL1
Severn Beach
Redwick
Nash
Goldcliff
Almondsbury
Taff's Well
Pontprennau
Marshfield
St Brides
St. Mellons
Patchway
Little Stoke
Winterbourne
Radyr
Rumney
Stoke Gifford
Filton
Emersons Green
Portishead
Pill
Portbury
CITY CENTRE
Walton Bay
CLIFTON
Clifton Suspension Bridge
Bristol
TEMPLE MEADS
Warmley
Llandough
Walton-in-Gordano
Clevedon
Wraxall
Failand
Longwell Green
Wenvoe
Dinas Powys
Nailsea
Long Ashton
Gibbons Down
Keynsham
Sully
Backwell
Saltford
Barry
Chewton Keynsham
Yatton
Cleeve
Winford
Ebdon
Hewish
Congresbury
Pensford
Kewstoke
Chew Magna
Wrington
M4
M48
M5
M32
M49
A48(M)
A470
A48
A4232
A4042
A449
A403
A38
A432
A4174
A4
A37
A370
A3029
A369
A39


WELCOME TO
EXMOUTH
LEISURE
CENTRE
led
Community Leisure

HOW DEEP GREEN HEATS A POOL



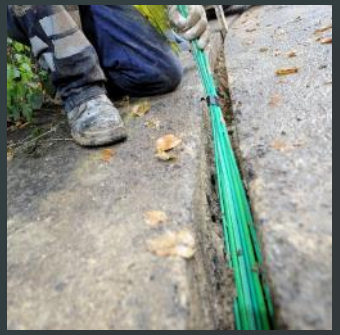
SAVING THE POOL
over **£20,000** a year and reducing their carbon emissions by **25.8 tonnes.**

GAS BOILER 4
Only tops up the water temperature if it is needed.
Reduction of over **62%** of gas required to heat the pool.

DEEP GREEN UNIT 2
We immerse our computers in biodegradable mineral oil, which captures the heat the computers generate.
Around **96%** of the energy needed to run the unit will be efficiently transformed into consistent, reliable, low-carbon heat, available for the pool.

3 **HEAT EXCHANGER**
Heat is transferred from the Deep Green oil into the cold pool water via a heat exchanger.

1 **ELECTRICITY**
Only renewable power used.

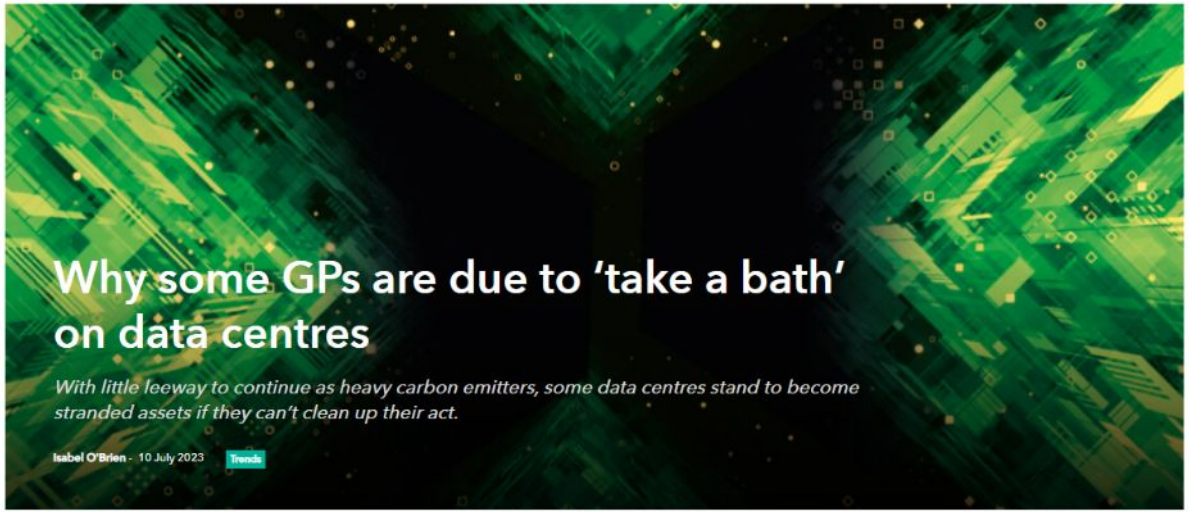


There is already enough power in the ground

Accelerate the adoption of heat pumps

Support critical community assets

Many existing data centres without heat recapture could already be classed as stranded assets



Why some GPs are due to 'take a bath' on data centres

With little leeway to continue as heavy carbon emitters, some data centres stand to become stranded assets if they can't clean up their act.

Isabel O'Brien - 10 July 2023 Trends

"Data is the new oil" is a phrase typically uttered in support of acquiring data centres as assets in an infrastructure portfolio. The expression has been used to justify ultra-high EBITDAs, reaching sometimes up to 20-25x, and overall confident investor sentiment. With the competition fierce to snap up these assets, few saw the irony in the term.

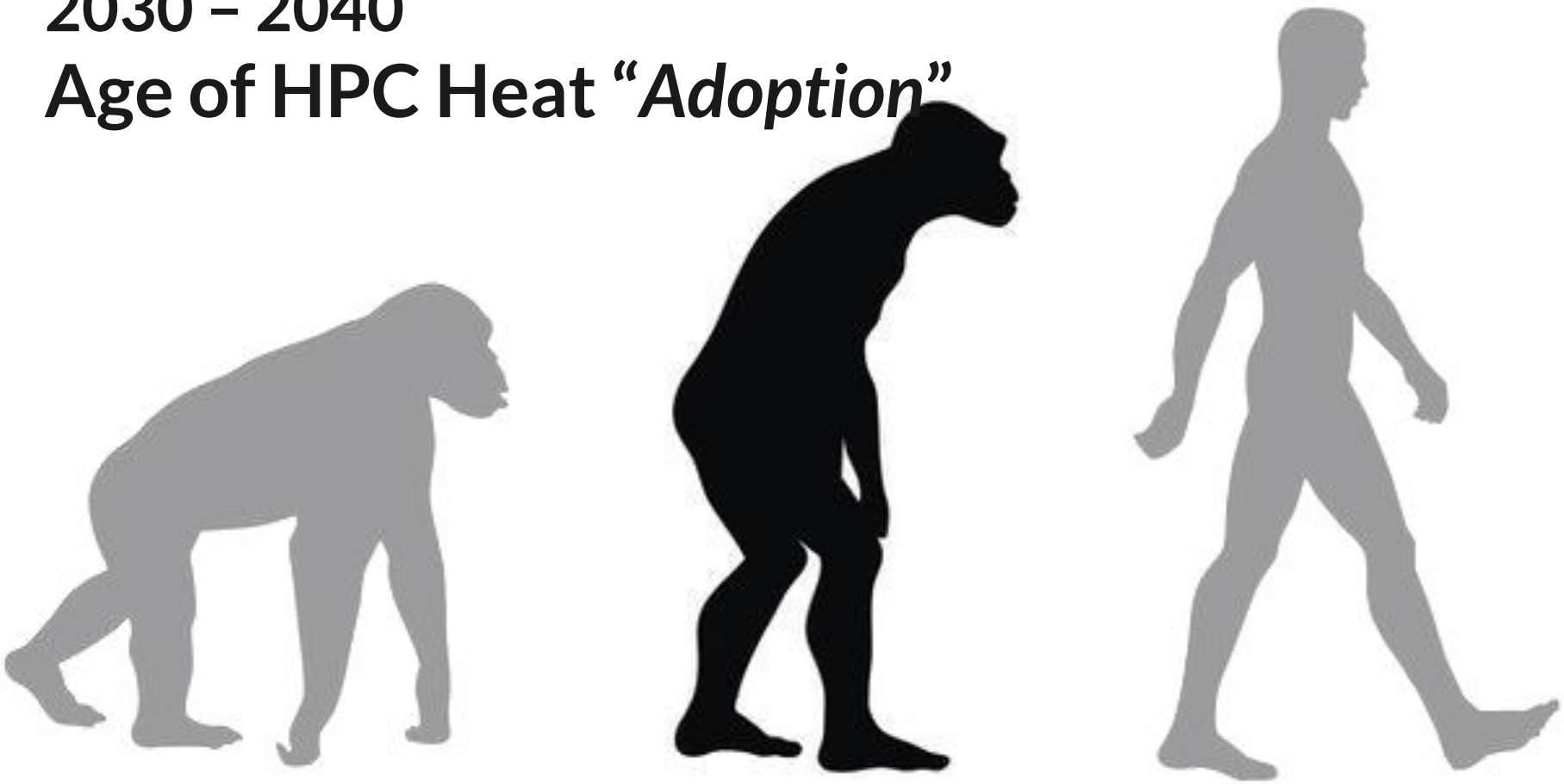
"The whole street talks with respect to fossil fuel assets about exit multiple risk, right?" says one C-suite-level executive at a global infrastructure GP. "But that's ultimately what it translates into whenever you acquire a carbon intensive asset.

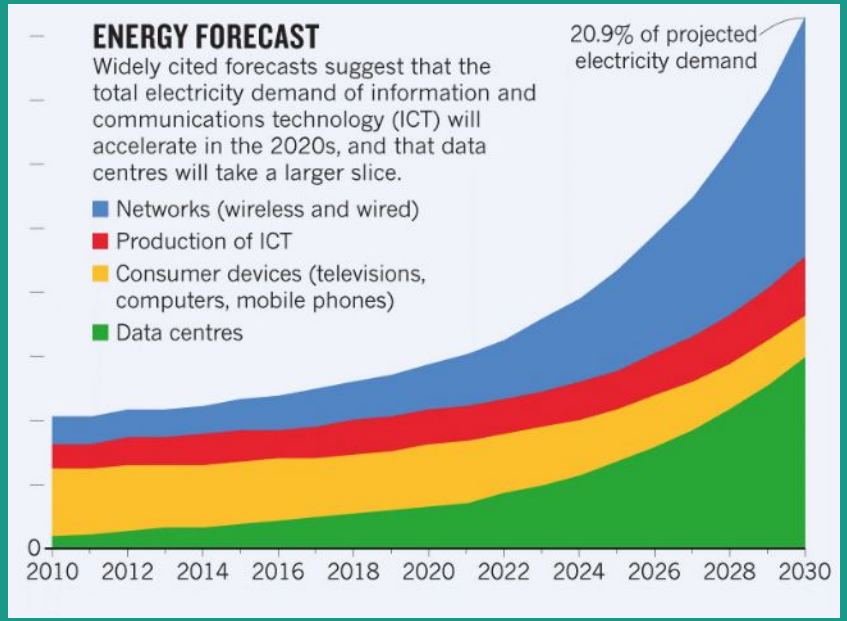
"I think there is a chance that we will go into a world where investors budget for their carbon emission capacity that they have in their portfolio,

MOST RECENT

The north is king of European infrastructure

2030 – 2040
Age of HPC Heat “*Adoption*”





Demand set to grow by 10x by 2033…

Aren’t enough electrons to go around…..

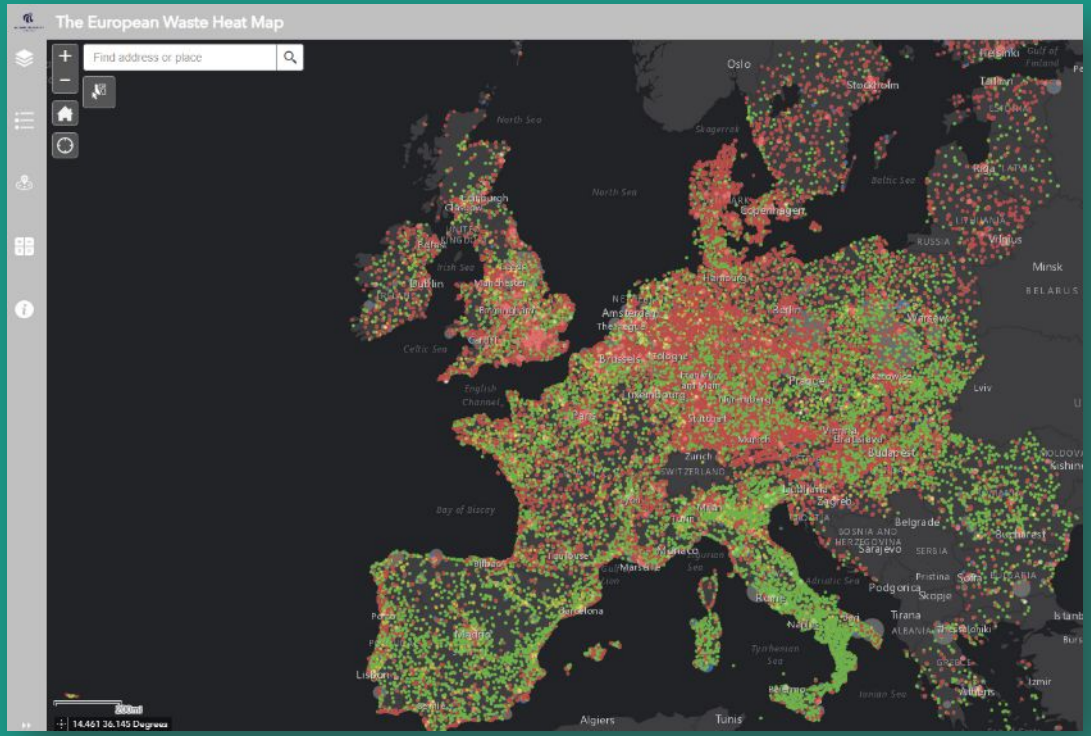
Are enough electrons, if we use them twice (enabling everyone else to electrify their heating)..

£3.4 trillion

retrofit

opportunity

across Europe



The coming explosion in HPC and AI can't come fast enough...

...with it we can heat all the homes and offices in Europe for free

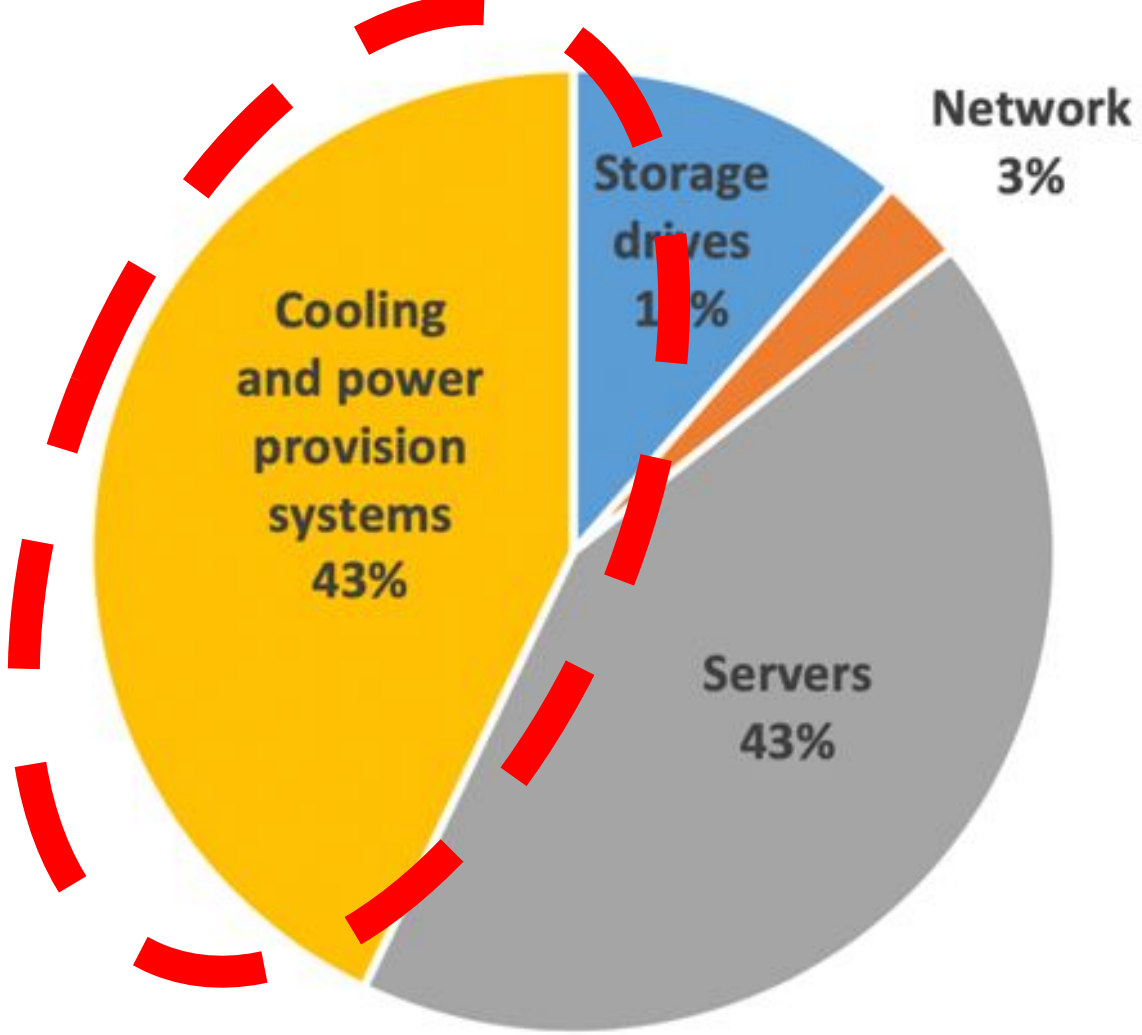
“Excess heat in the EU alone amounts to 2,860 TWh/y, corresponding almost to the EU’s total energy demand for heat and hot water in residential and service sector buildings”.

Build out the capacity in months not years…

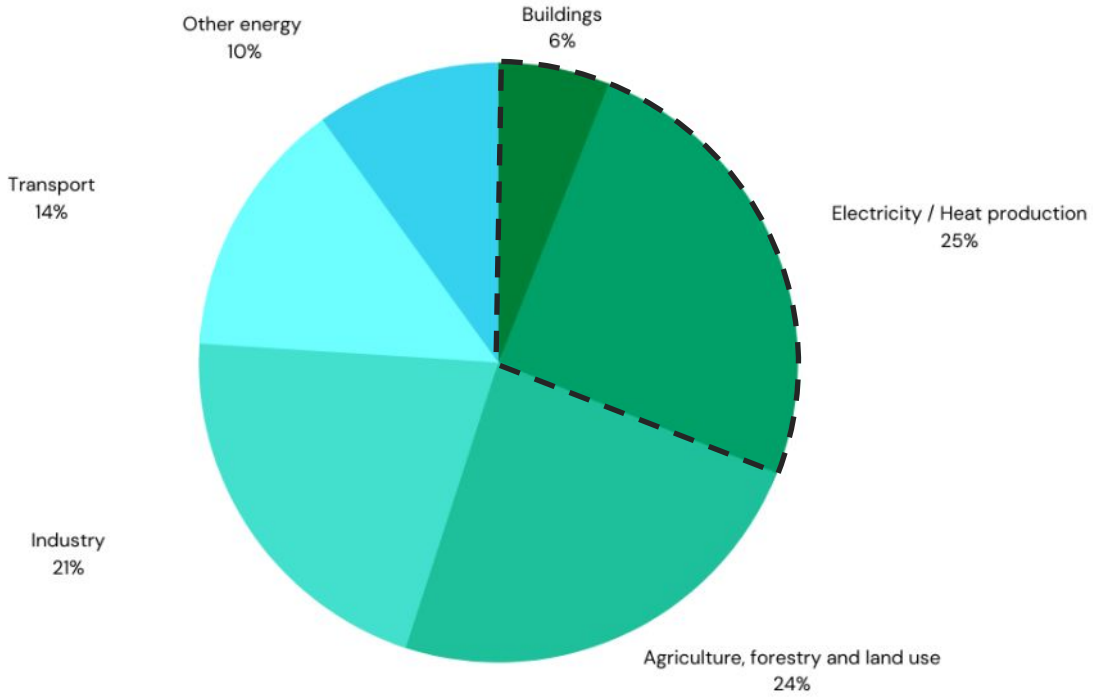
Solar available for land : Total power requirement

Decentralisation keeps network traffic (another 3.5% electricity) local

Providing a heat sink for data centres makes them *more* profitable

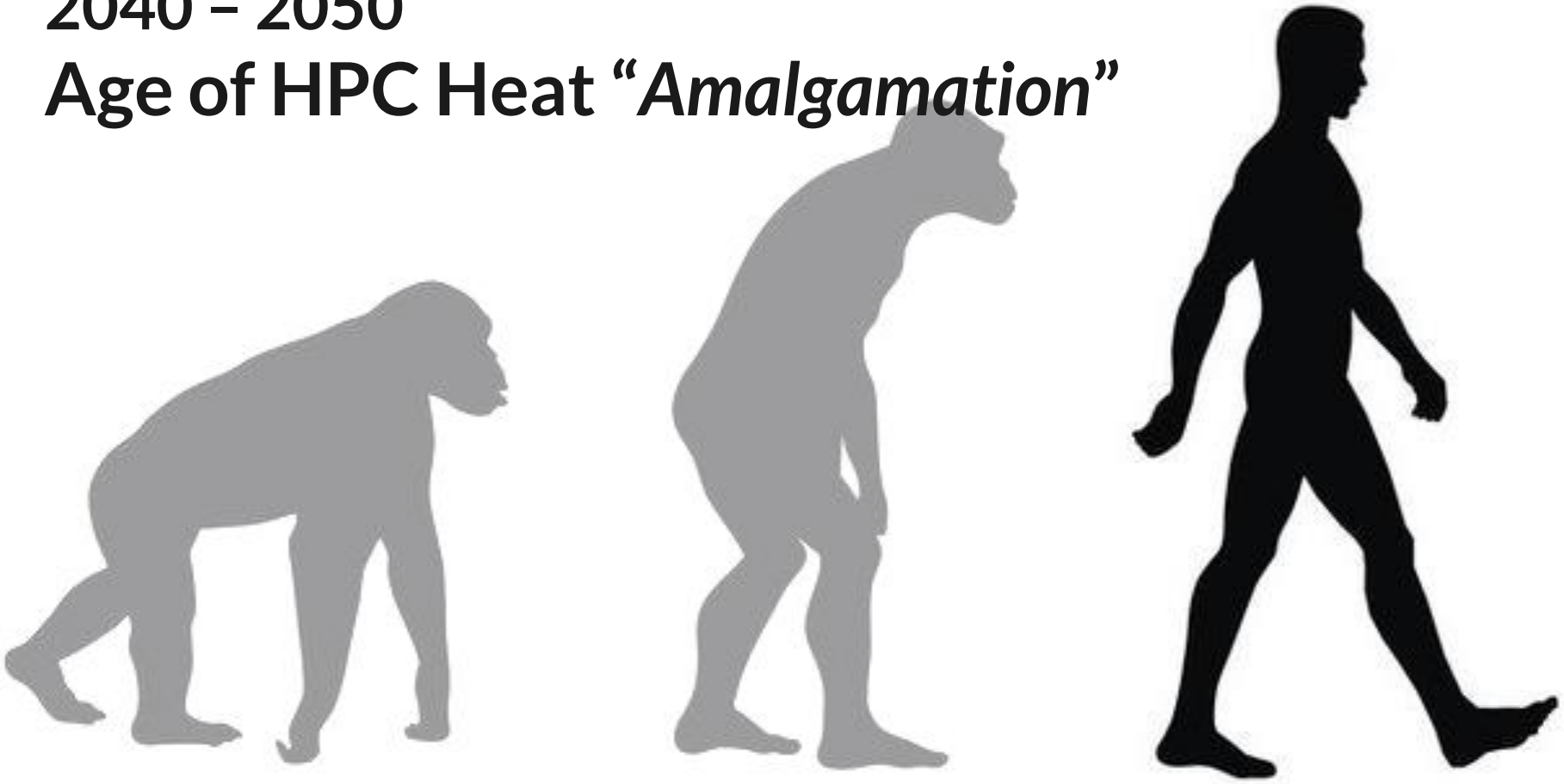


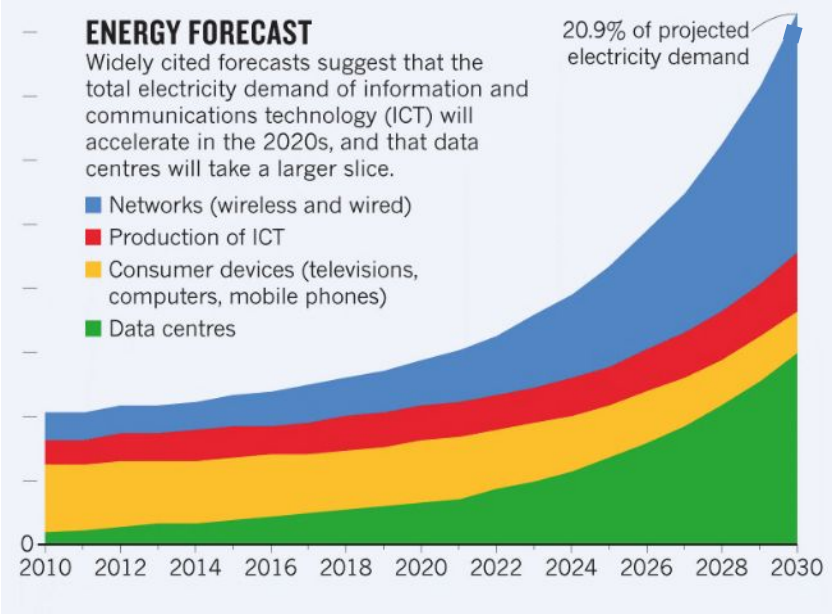
Co2 Emissions by sector…



By 2040 HPC Heat could be responsible for supporting the decarbonisation of >30% of the economy..

2040 – 2050
Age of HPC Heat “*Amalgamation*”





Demand won't stop at 10x… in 20 year's time it will be 30x…

Laundries

District Heating

Distilleries

30% of all industrial processes

Food production

Swimming pools

Industrial drying and curing

Perhaps most importantly of all… expansion in urban farming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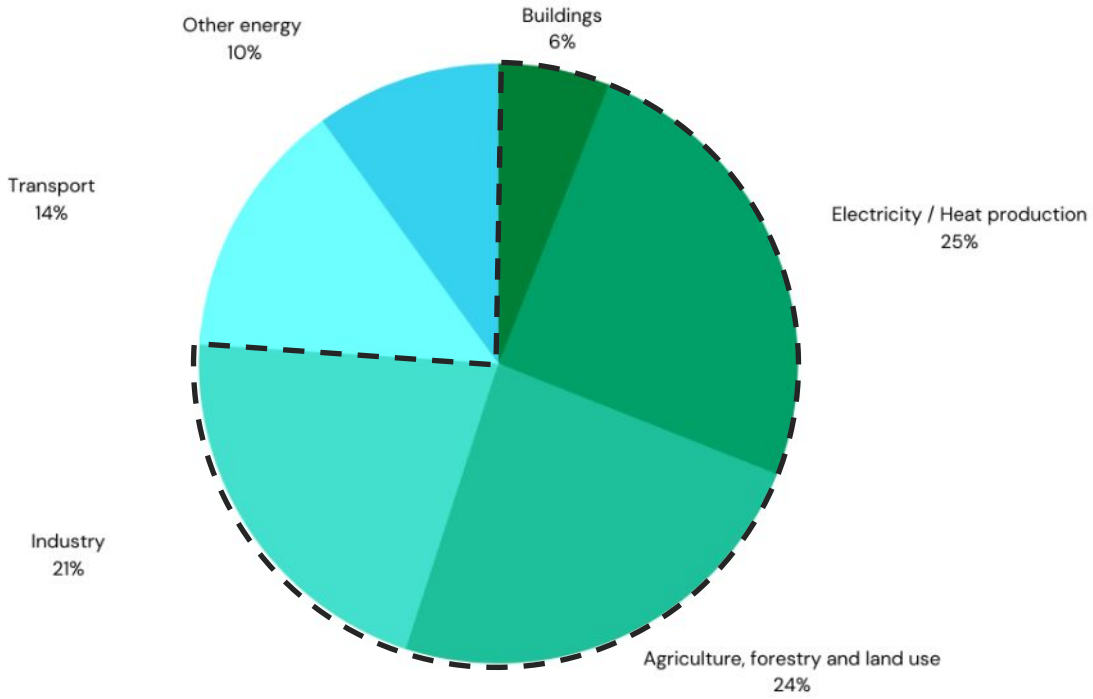
Imagine town centre as warm, green inviting places…

…The Hanging Gardens of Babylon meets the Eden Project meets a Roman Spa….

Co2 Emissions by sector…



By 2050 HPC Heat could be responsible for supporting the decarbonisation of >50% of the economy..


GET IN TOUCH
www.deepgreen.energy

Just while we're at it… lets bust all the myths around heat recapture…

1. It is not more expensive to capture heat
2. 20 degree heat is incredibly useful
3. Decentralisation is <u>better</u> not worse