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Thermal storage

Why Now

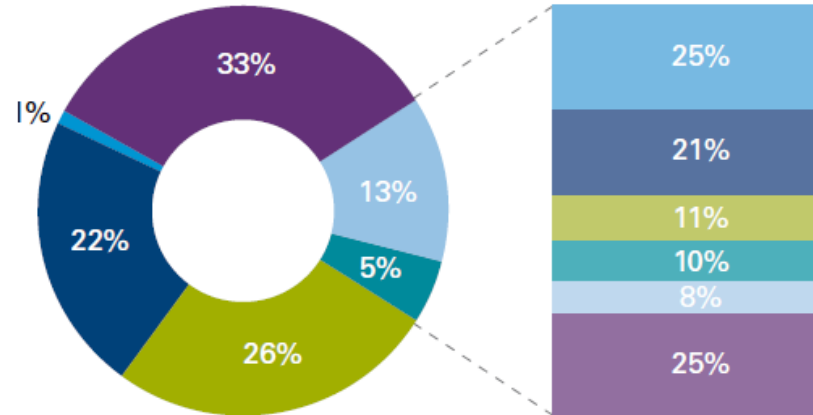


Carbon Emissions from Buildings

Buildings are the single biggest contributor to energy consumption in the UK, accounting for approximately 44% of the country's total CO₂ emissions (this doesn't include building them!)

Non-Domestic buildings are responsible for 18% of CO₂ emissions.

Source: Carbon Trust, Low Carbon Refurbishment of Buildings



Source: BRE 2006

- Transport
- Commercial and Public buildings
- Industrial buildings
- Domestic buildings
- Industrial process
- Agriculture
- Factories
- Retail
- Hospitality
- Warehouses
- Commercial Offices
- Remainder
Govt Estate 3%, Other public offices 1%, Health 3%, Higher education 3%, Schools 4%, Sports/Heritage 4%, Transport 3%, Other 4%

Thermal Energy

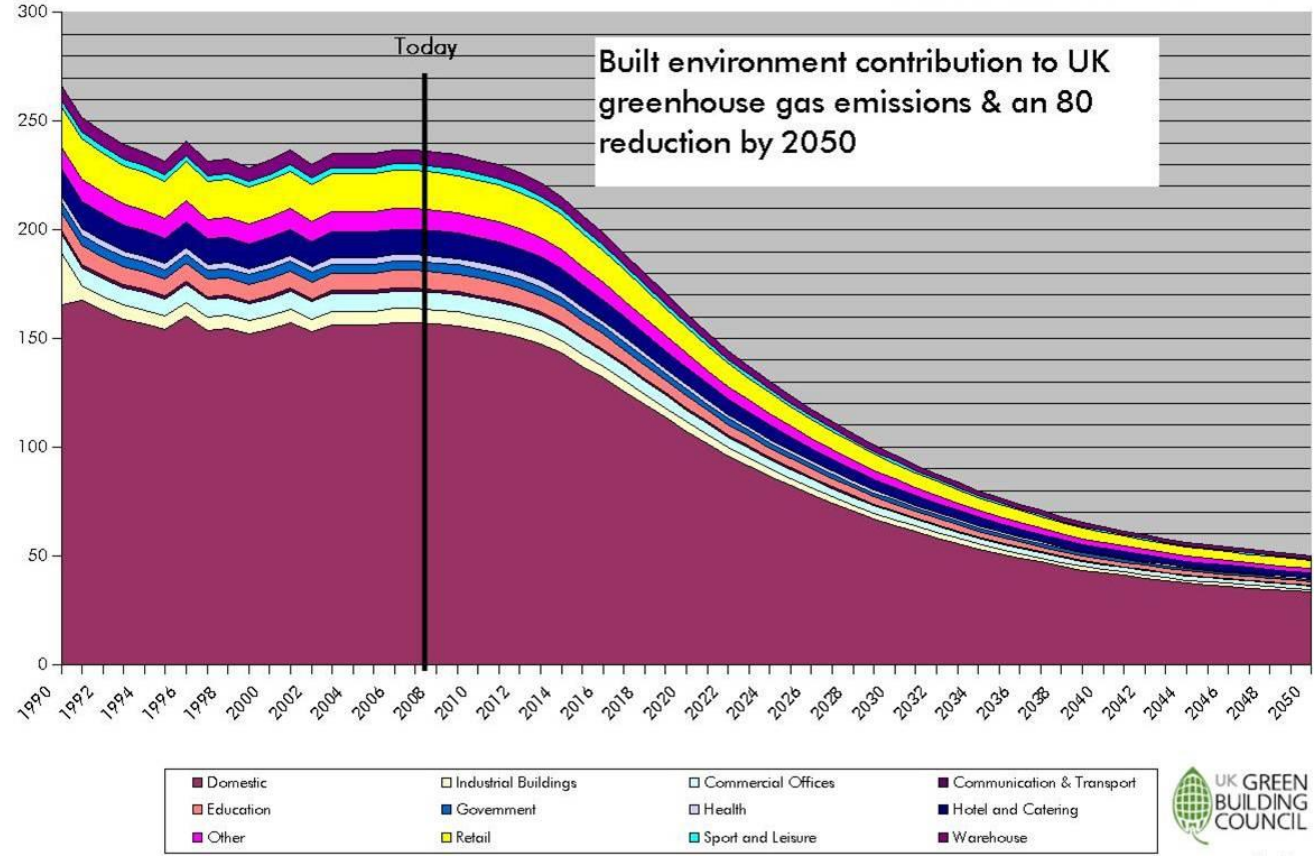
- What is thermal energy?
- Why store - variation sine waves and averages
- What can you use it for
- So much energy is heat
- There is a surplus of free heat at many temperatures
- We can change temperatures with a heat pump
- Better to just collect and store ready for reuse



IMPORTANCE OF THE EXISTING STOCK



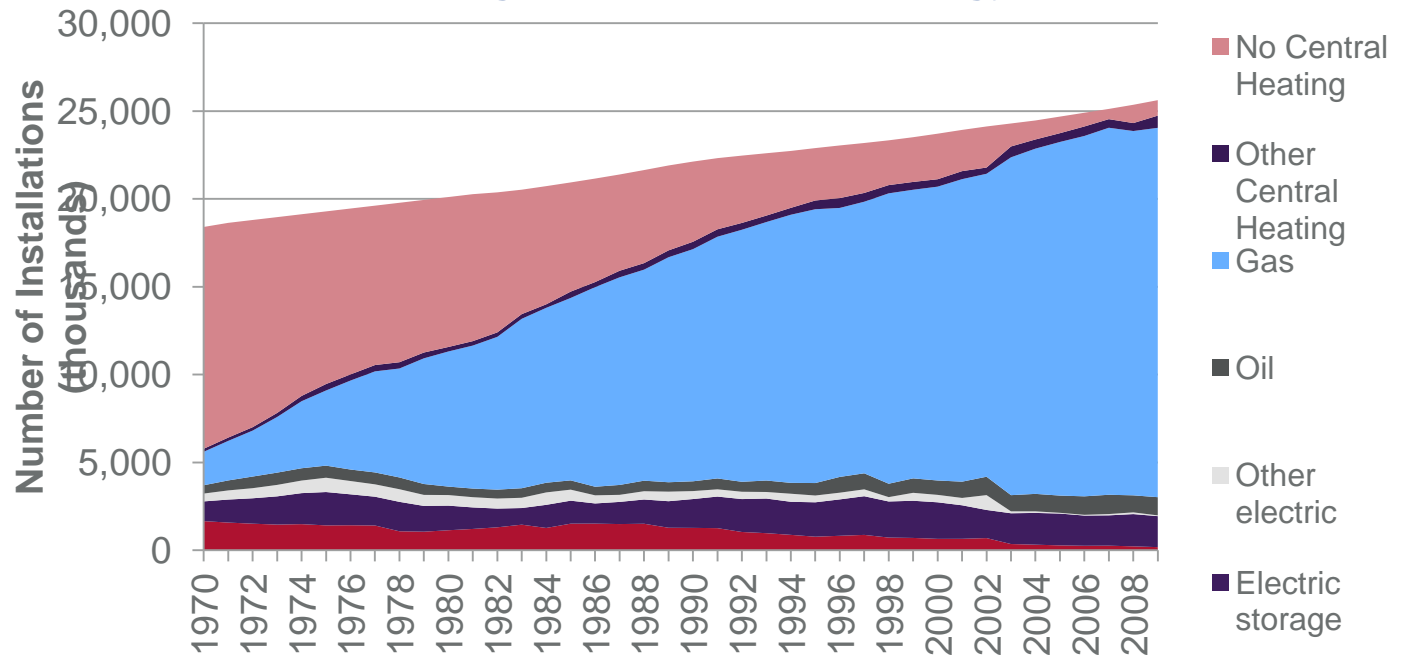
HEAT IN RESIDENTIAL BUILDINGS IS CRITICAL



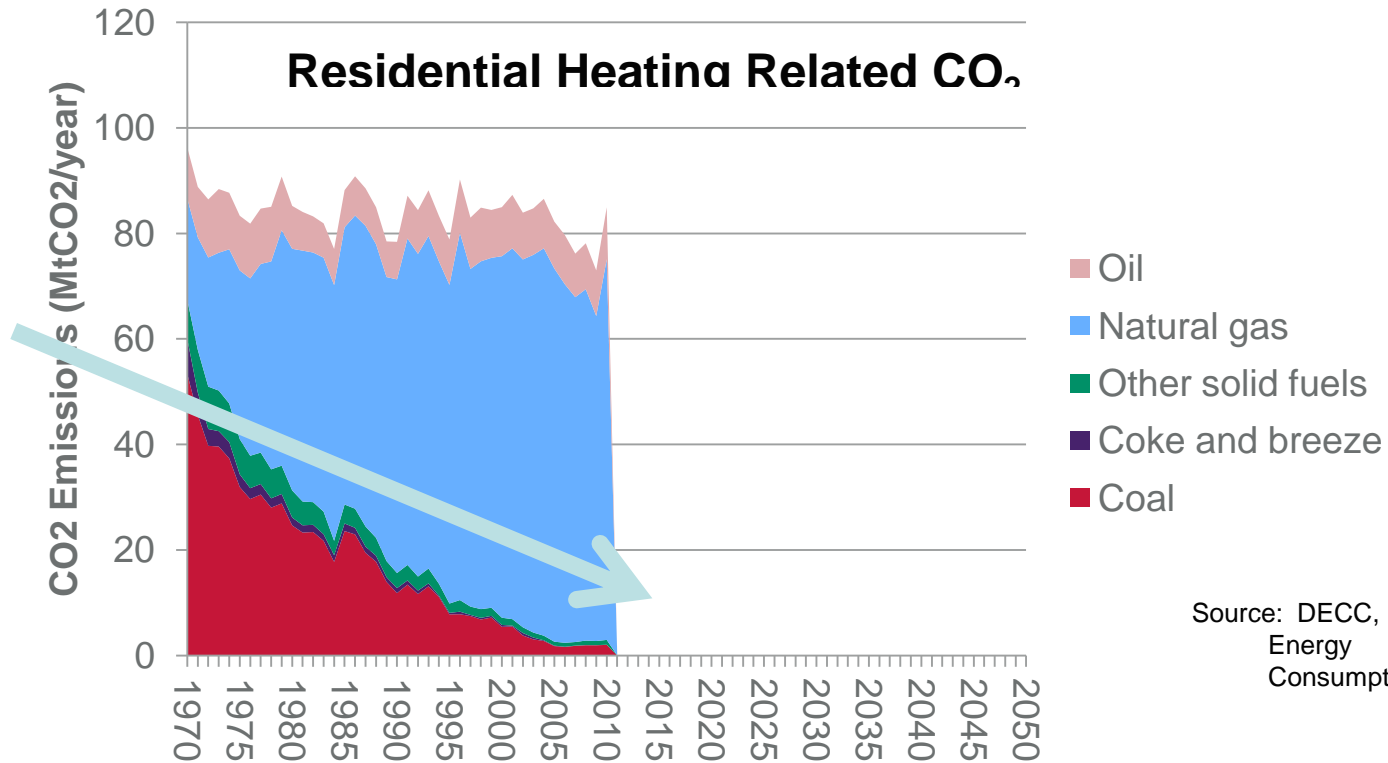
Can it be done? The gas precedent

- Post WWII UK saw the start of the demise of solid fuelled heating and the rise of gas. By the 1980s gas central heating was considered to be a standard feature.

- **40 Years of UK Residential Heating (Source: DECC, Energy Consumption in the UK, 2010)**



The challenge



COMFORT



Halve the demand

Behaviour Change - Central heating changed the way we live

- **BBC Article Interviews in “What central heating has done for us”, October 2009**
- “People don't wear clothing to keep warm any more. One of the social norms is that people can go around in shirt sleeves at home.”
- “Everyone wants open-plan now, but you can only have open-plan with central heating.... People used to huddle in small rooms around a fireplace”
- “People used to have to go to bed when it got too cold, even as late as the 1950s. Now people can sit up in a T-shirt and go to bed when they want to.”
- “Central heating also meant the rise of the bedroom as a living space... So the teenager's domain, a symbol today for youth consumption and freedom from parents, was born.”

Halve the demand - Behaviour Change

- “To one side of the fireplace sits Dad, reading the evening paper. To the other side sits Mum, doing her knitting. On the hearthrug sit the children, playing snakes and ladders. Up against the fender, roasting himself, lies the dog. It is a comely pattern, a good background to one’s memories, and the survival of the family as an institution may be more dependent on it than we realise.”

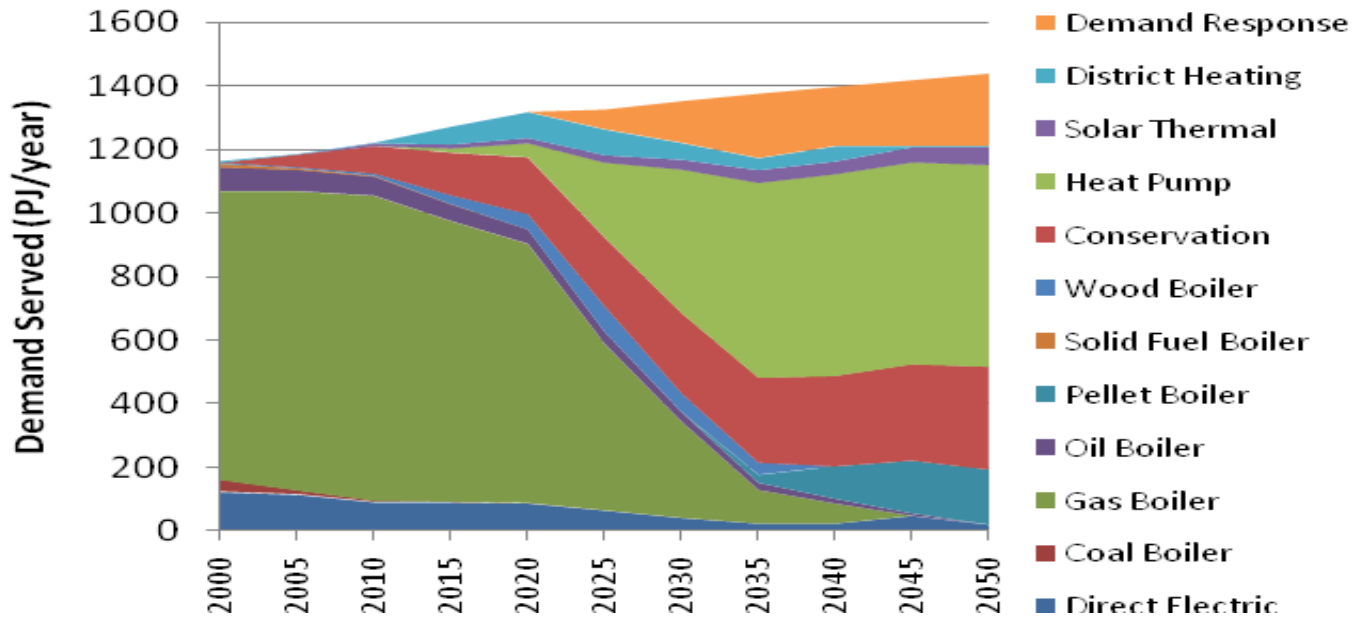
- G. Orwell, Evening Standard, 1945



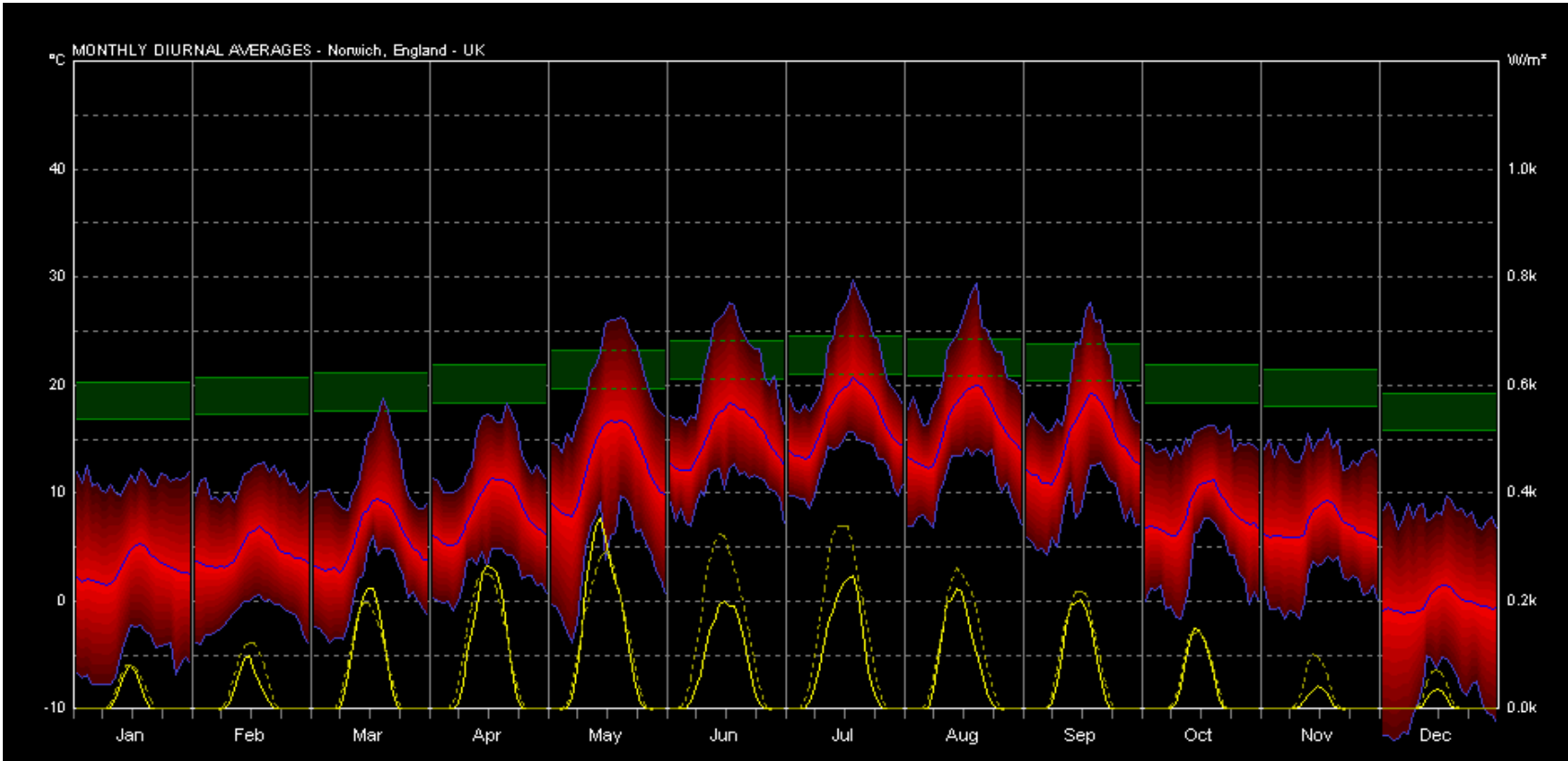
Can it be done? Technically possible

A technically feasible (and cost optimal) pathway – UK MARKAL 2011

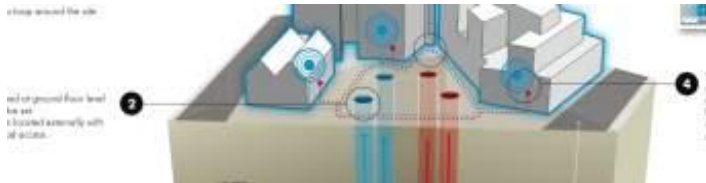
UK Residential Sector Technology Mix Scenario



Natural Variations



Renewables – largely Intermittent



- SOLAR THERMAL --- intermittent

-
- GROUND SOURCE COOLING/ HEATING

In balance it's a good idea ---- RHI no cooling Stored Heat

- WIND TURBINES

Not enough wind, go large!! ----- Intermittent

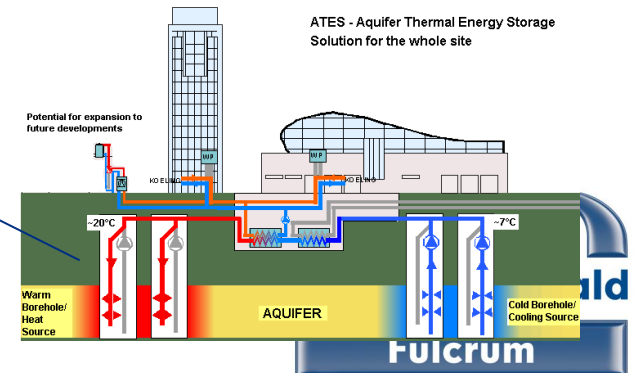
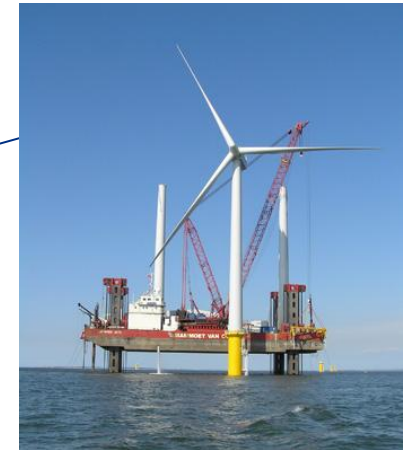
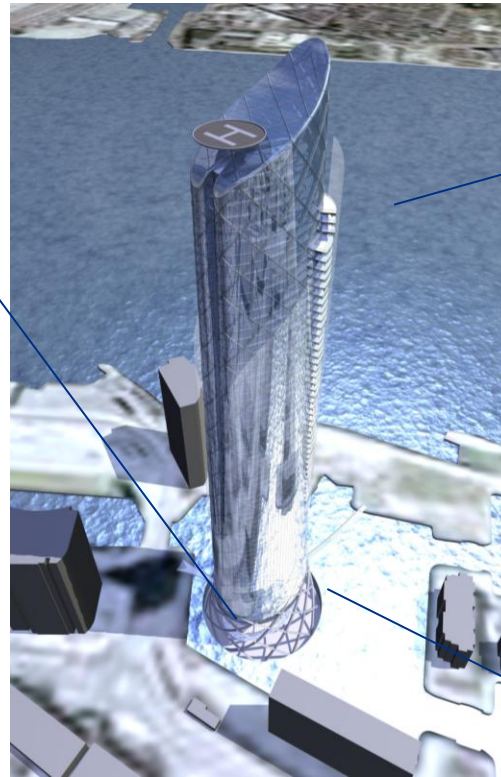
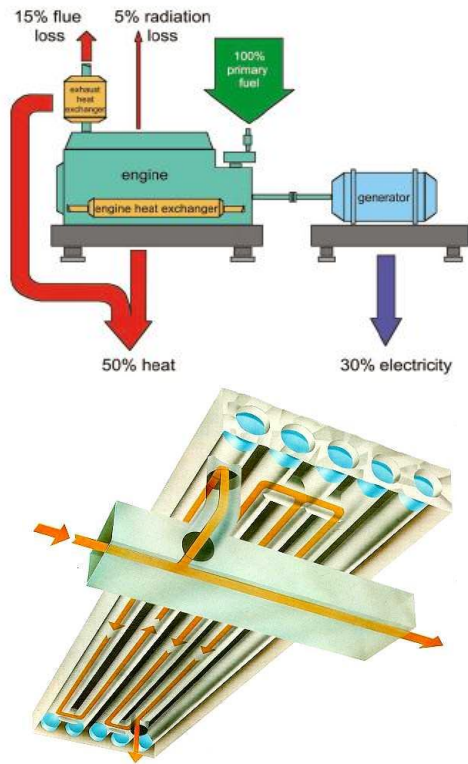
- PHOTOVOLTAIC CELLS

Not enough roof or money ---- FIT- Intermittent!

- BIOMASS/WASTE

Central rather than small plant for better
audit/control of emissions ----- Stored Heat

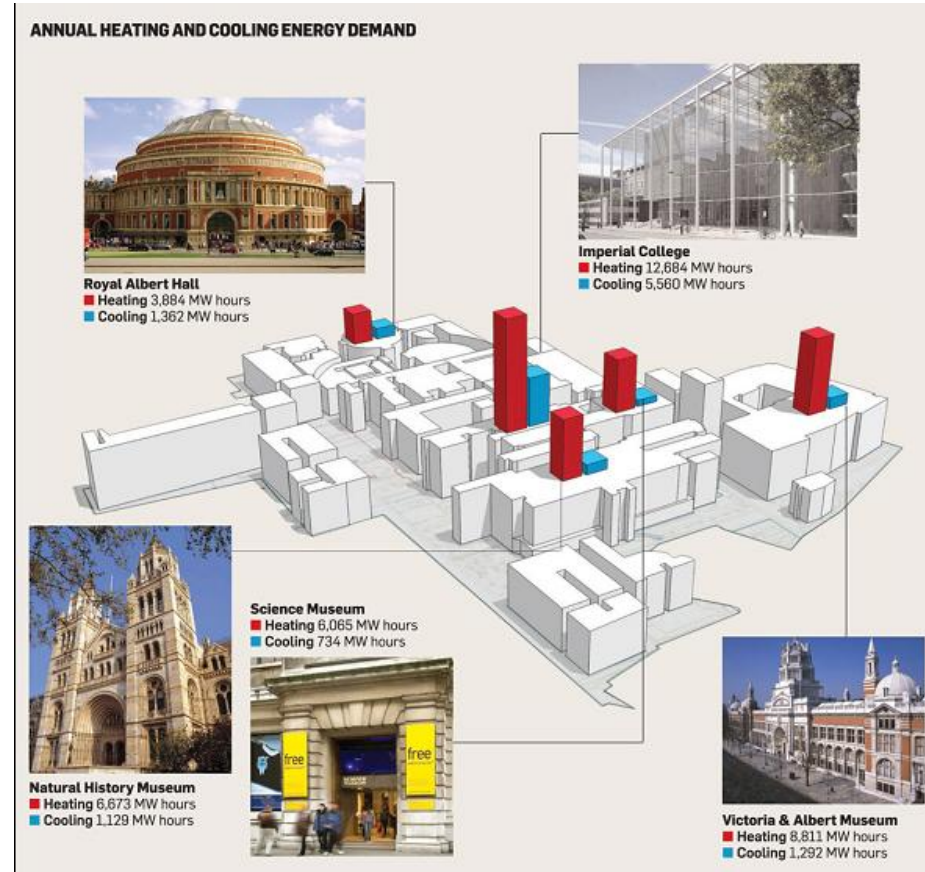
Integrating technologies with storage



The Existing stock -1851 Commission

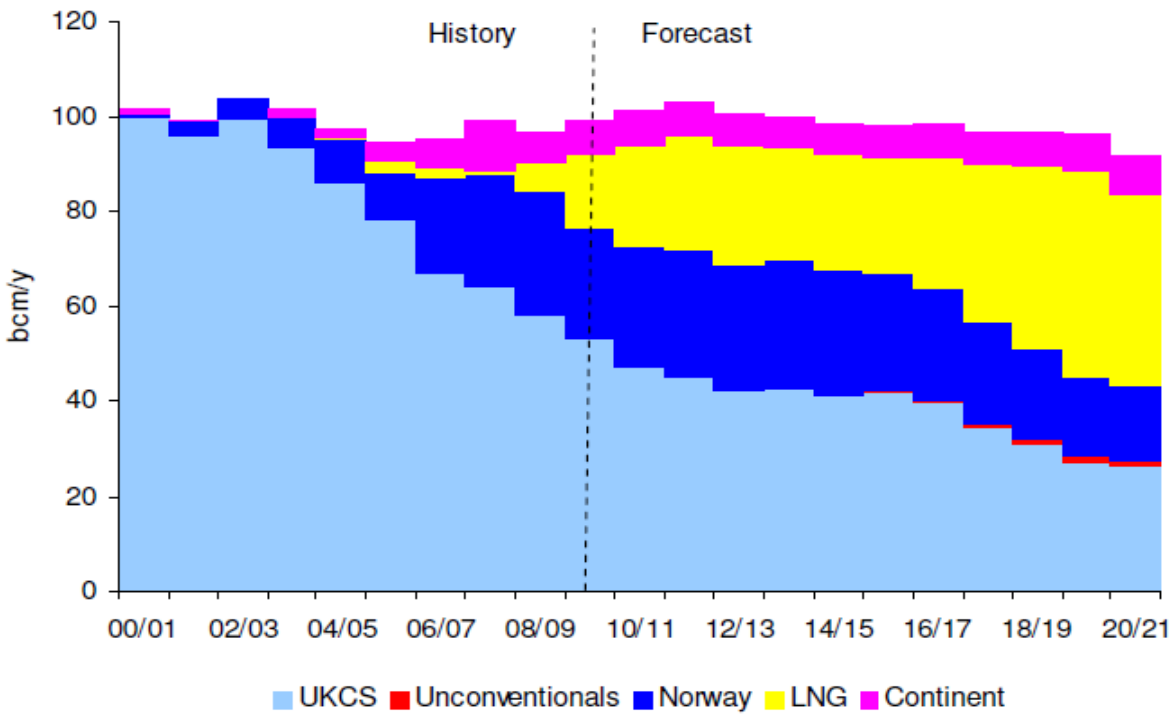
Combining Technologies to optimise solutions

- A number of heat networks remain in place and the institutions are now coming together again in the development of a Carbon Masterplan
- Research and feasibility investigations for combining CHP and ATEs technology as part of an low-carbon urban heat network for the area
- **BALANCED THERMAL DEMANDS NEED STORAGE**



Energy Pressures

Supply view to 2020



Interconnectors: little change



Confusion in High Places

heat

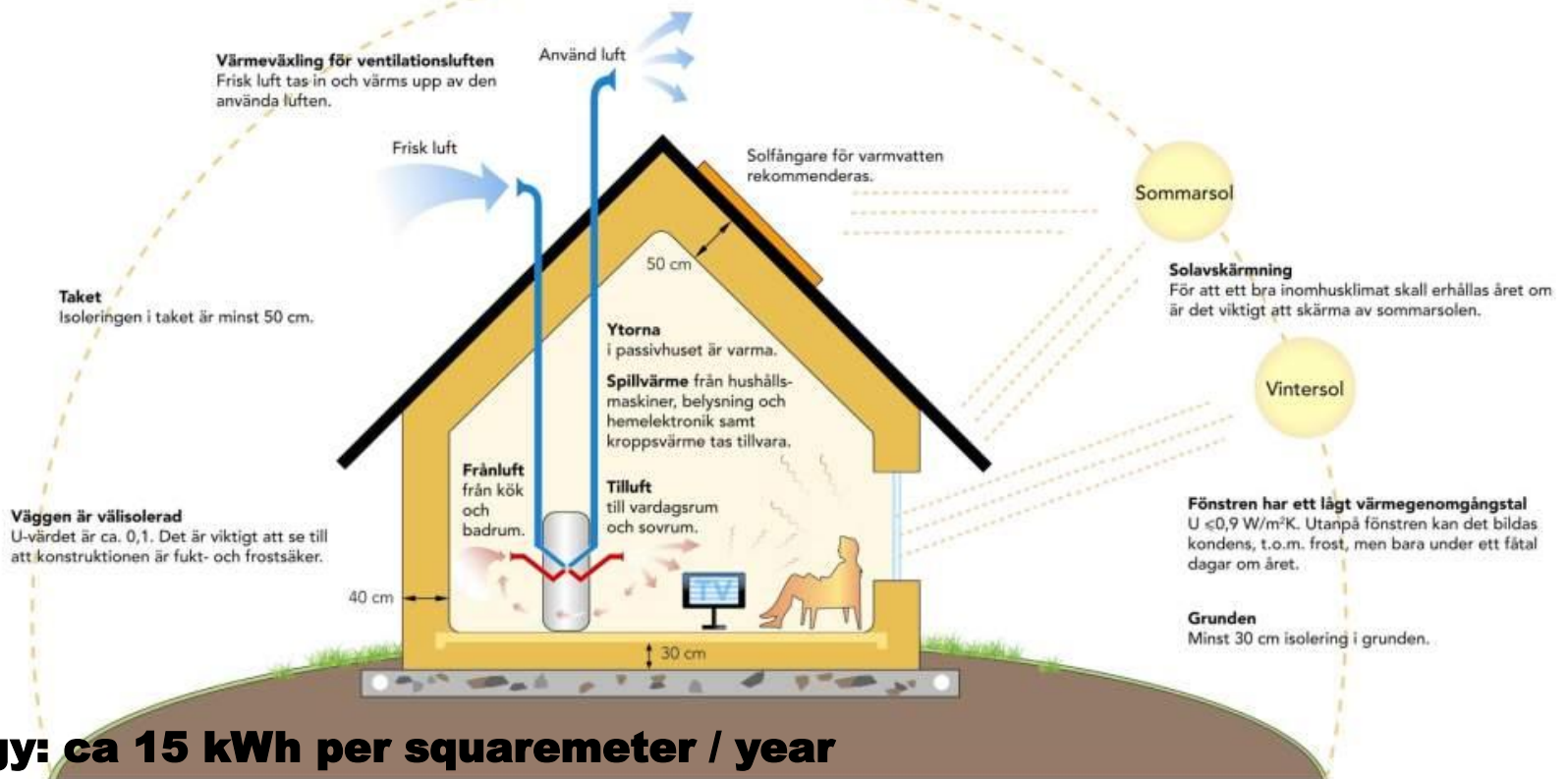
- We use heat to keep our homes and offices warm, and we use energy to cool them in hot weather. We also use heat to provide us with hot water, cook our food, and manufacture the goods such as steel, iron, cement and chemicals, upon which our economy depends.

Future Housing

Passive houses:

The fresh support air may be heated. You can withdraw radiators or floor heating

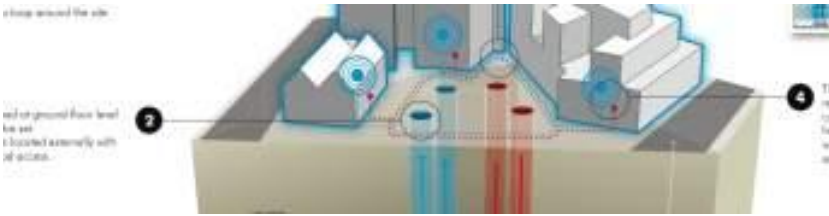
10 W per squaremeter for heating / cooling power



Energy: ca 15 kWh per squaremeter / year



NOT MANY URBAN MICROGENERATION OPTIONS



- **SOLAR THERMAL**

Pricey in terms of £/Kg CO2 saved but probably worth it

- **GROUND SOURCE COOLING/ HEATING**

On balance it's a good idea

- **WIND TURBINES**

Not enough wind, go large!!

- **PHOTOVOLTAIC CELLS**

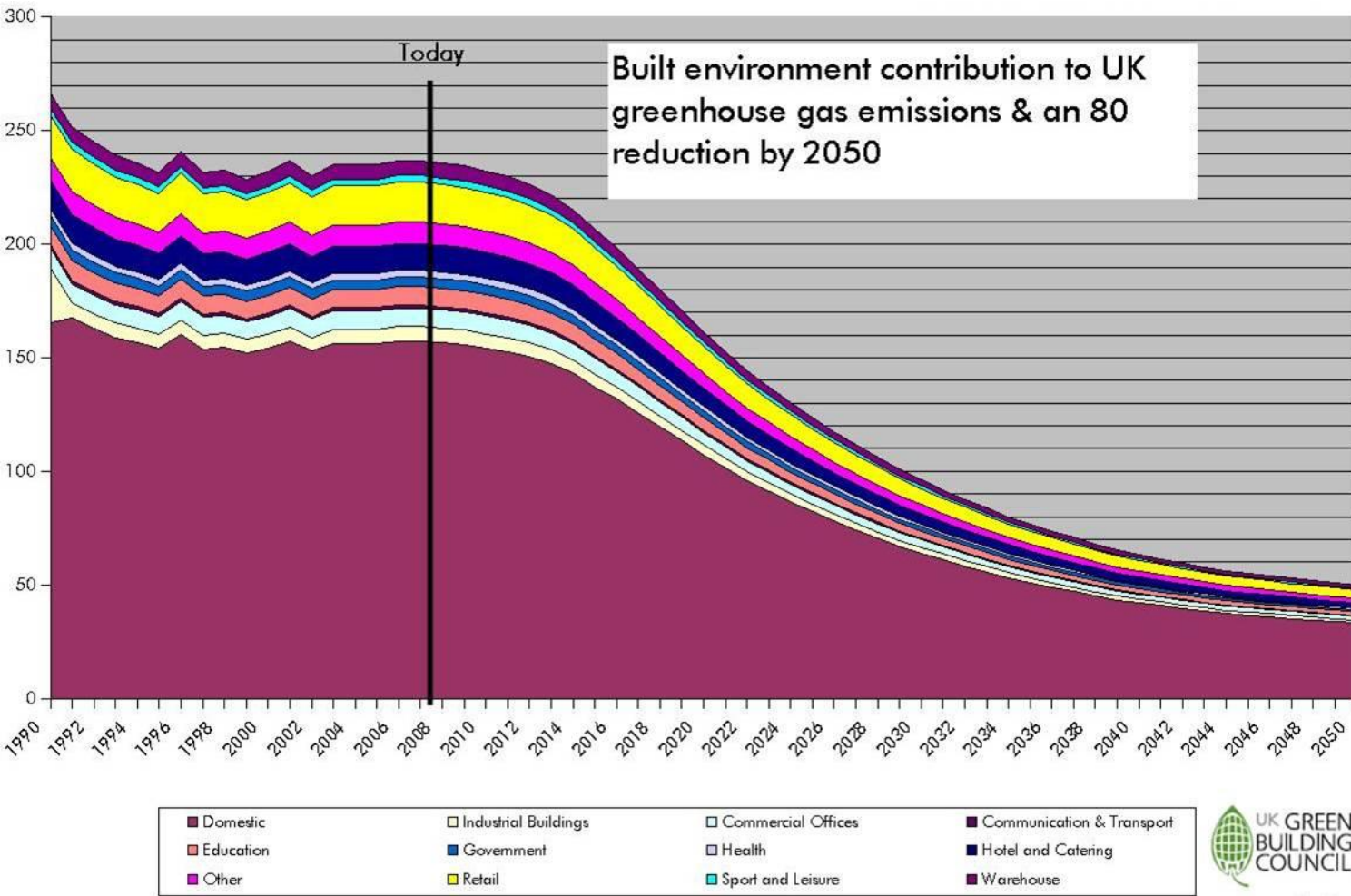
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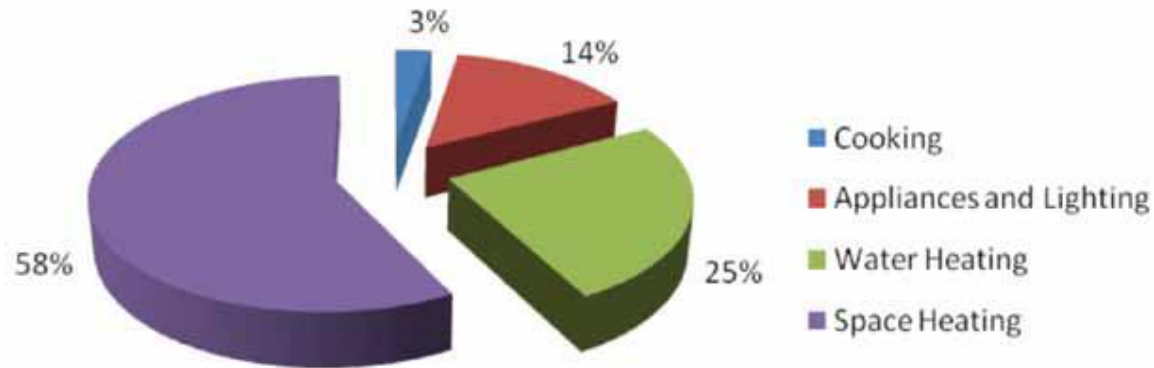
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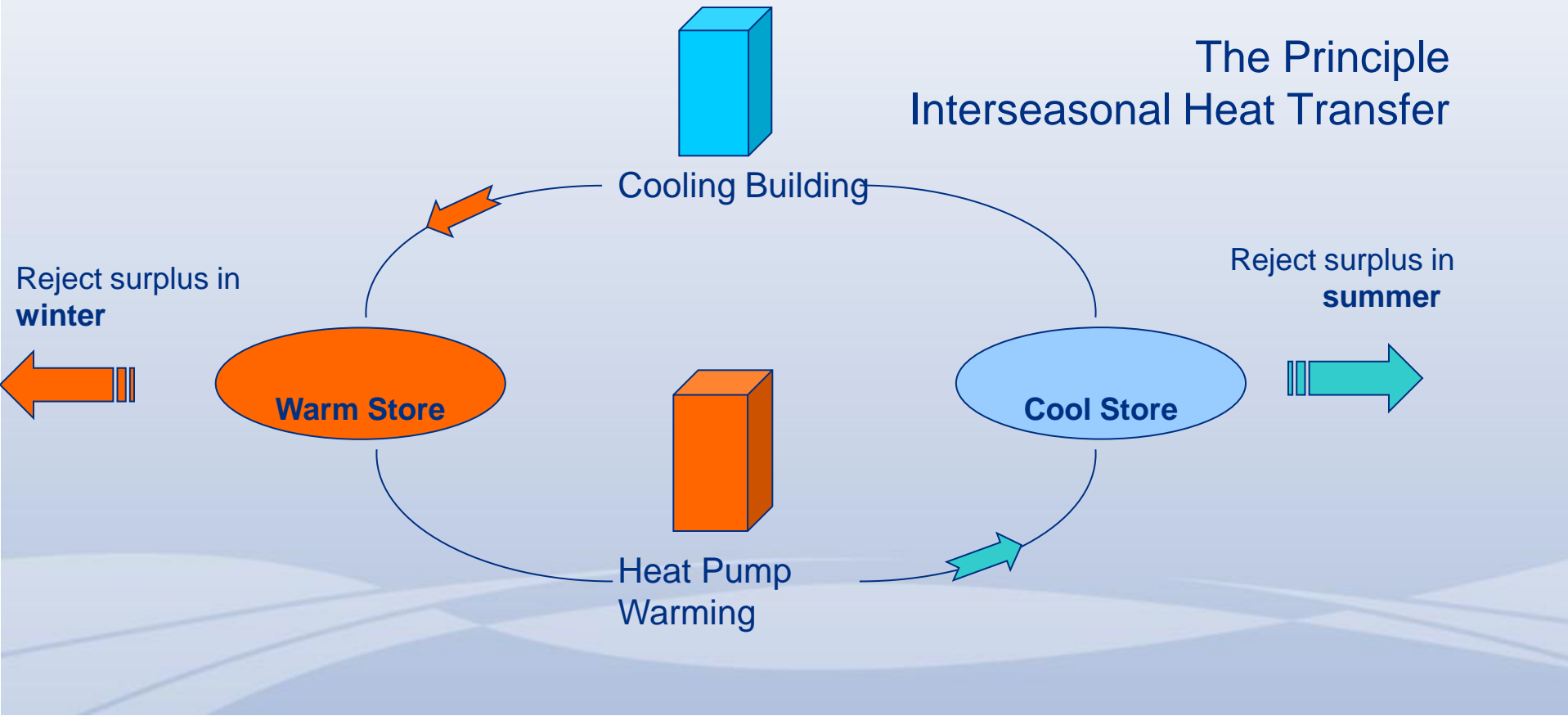
IMPORTANCE OF THE EXISTING STOCK



Domestic Energy is mostly heat
Climate change leads to heatwaves
Cooling is next



The Principle Interseasonal Heat Transfer





Mott MacDonal

Fulcrum

