

Energy Systems Innovation

A presentation to the 11th Oxford Energy Day

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Chief Technology Officer

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About Energy Systems Catapult

Mission: Unleashing innovation and opening new markets to capture the clean growth opportunity



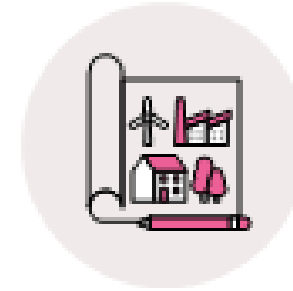
Why do we exist?

To accelerate Net Zero innovation and deliver the future energy system



How do we work?

We do the hard stuff by taking a whole systems approach to net zero



What do we do?

Turboboost innovation across homes, sites, places, whole systems & networks.
Design a future energy system to drive clean growth and benefit people.

- The net zero challenge
- Importance of innovation
- Innovation in practice
- Supporting innovation
- Reflections - how best to drive innovation?

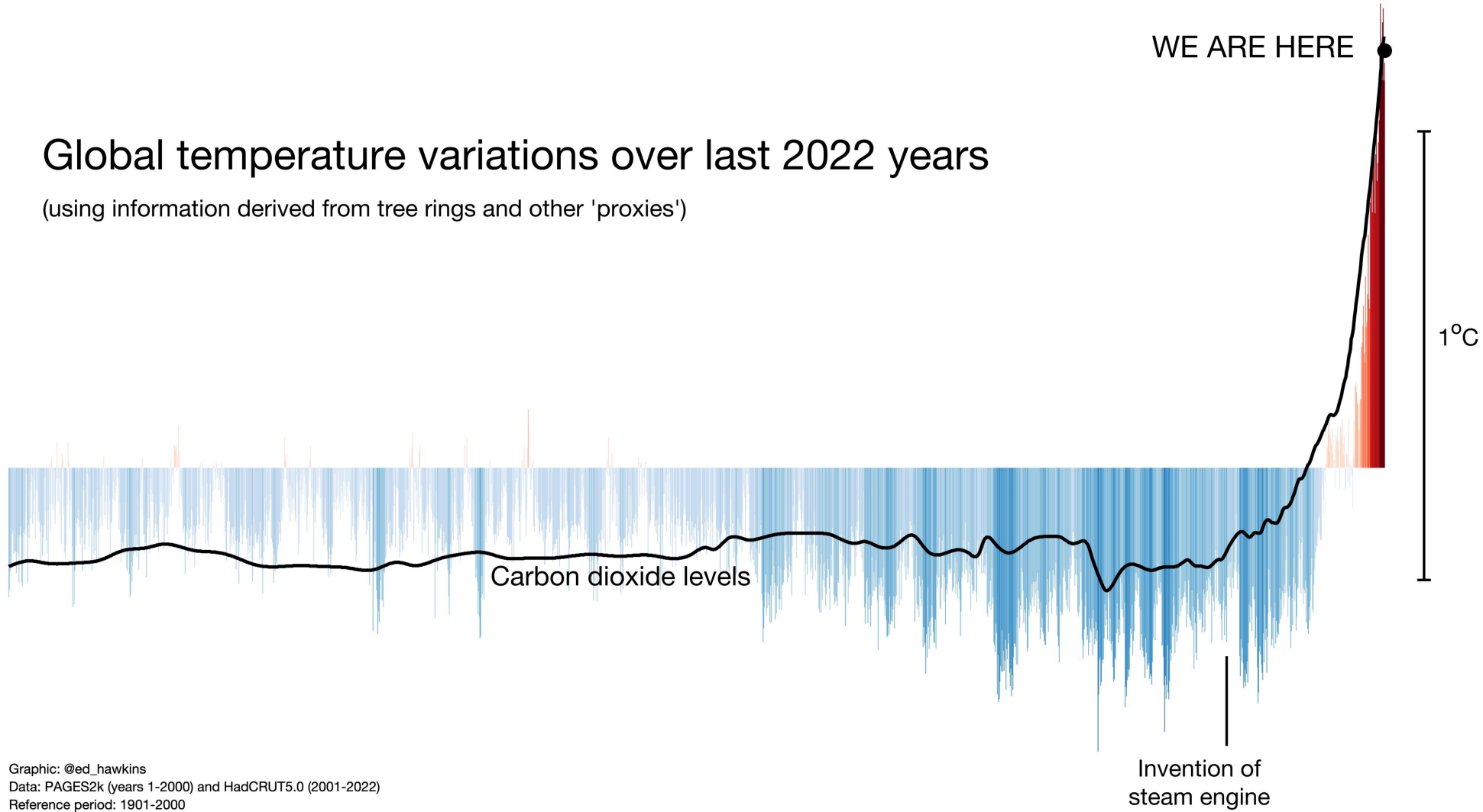
The net zero challenge



Global temperatures and CO₂ levels are highest on record

Global temperature variations over last 2022 years

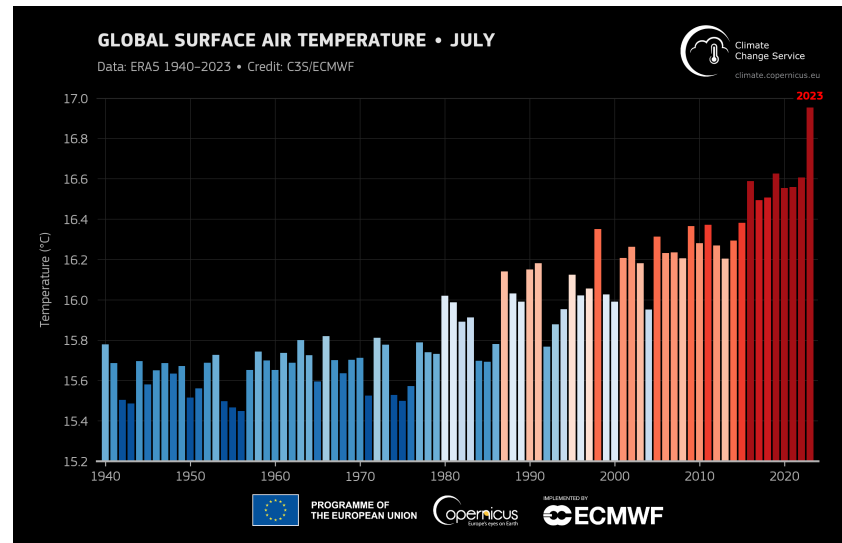
(using information derived from tree rings and other 'proxies')



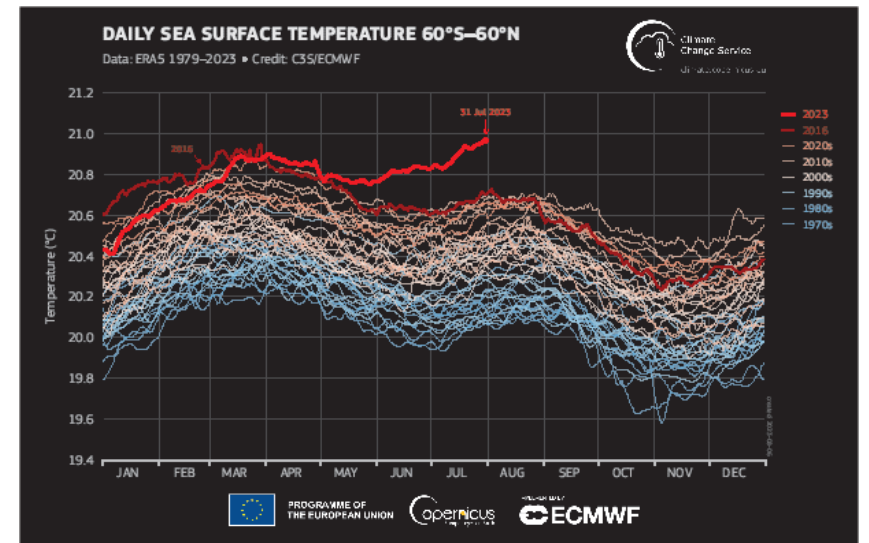
Graphic: @ed_hawkins
Data: PAGES2k (years 1-2000) and HadCRUT5.0 (2001-2022)
Reference period: 1901-2000

Invention of
steam engine

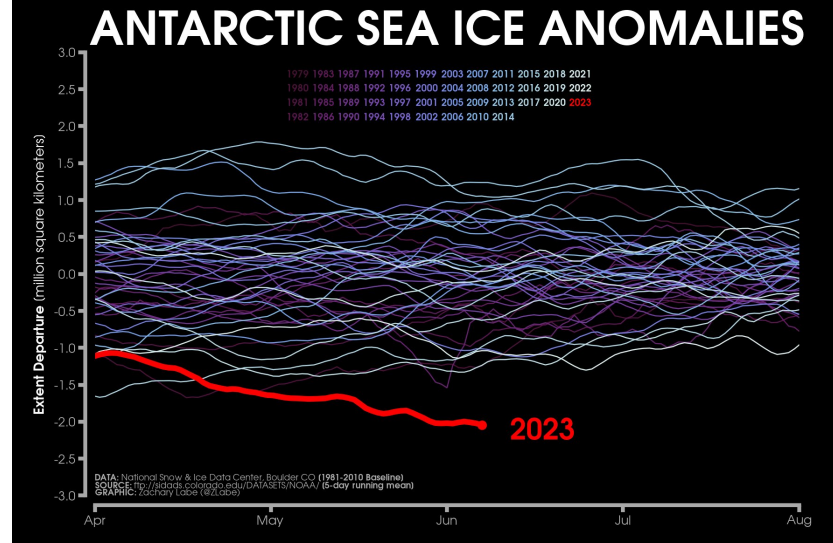
2023 breaking all the wrong records



Globally averaged surface air temperature for all months of July from 1940 to 2023. Shades of blue indicate cooler-than-average years, while shades of red show years that were warmer than average. Data: ERA5. Credit: C3S/ECMWF.



Daily global sea surface temperature (°C) averaged over the 60°S–60°N domain plotted as a time series for each year from 1 January 1979 to 31 July 2023. The years 2023 and 2016 are shown with thick lines shaded in bright red and dark red, respectively. Other years are shown with thin lines and shaded according to the decade, from blue (1970s) to brick red (2020s). Data: ERA5. Credit: C3S/ECMWF



Transition to an El Niño year has accelerated climate impacts, with global consequences

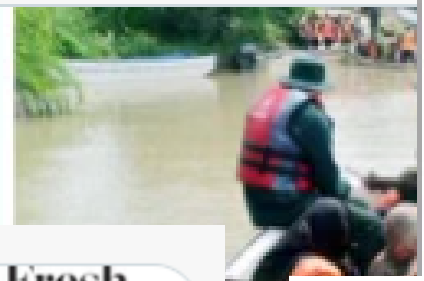


MAIN STORIES
WHY NATO DELAYED UKRAINE
p.14
Volodymyr Zelensky

CONTROVERSY
The court's sharp right turn
Pages 6, 16



TALKING POINTS
Democratic alternatives to Biden
p.17
Gos. Gretchen Whitmer



Europe Is Struggling to Adapt to Extreme Heat

By GAIL FLEINGOLD

FLORENCE, Italy — Tourists clustered under umbrellas as they lined up at Florence's museum, cancelled this week, looking for

Limited Resources and Few Investments in Possible Solutions

swearing temperatures last summer.

This year threatens to repeat the calamity. In some parts of southern Europe, heat waves started as early as May. The most recent heat wave — called “Cerberus” for the mythological dog that guards the gates of the underworld — hit temperatures well above 37 degrees Celsius, or nearly 99 degrees Fahrenheit, in Florence, Rome and parts of Sicily and Sicily this week.

Another round of high temperatures, part of the heat wave caused by an African anticyclone, is expected in the coming days, with peaks of 40 degrees Celsius.

(Continued on Page A1)

Biden walked a fine line in Vilnius

President's cautious tone on Ukraine's NATO bid clashed with some allies

BY MICHAEL BERNARD AND EMILY RAYBOLD

VILNIUS, Lithuania — The negotiations about the NATO bid for Ukraine's membership had come down to the wire, and Biden administration officials believed they had finally found a compromise: a vote to send Ukraine's membership to the NATO summit in June.



Then Ukrainian President Volodymyr Zelensky weighed in with a tweet blasting the draft offer as far too little. It resulted President Biden's careful balance between two capabilities his own conviction that a US strategy in Ukraine could start World War III, and the more demanding Kyiv's desire to join the club. Biden's NATO membership bid.

Zelensky's intervention led way through NATO's high-stakes meeting. Biden made members of the U.S. delegation. Biden's "one official said. And it crystallized a broader tension facing Biden as Ukraine's membership bid came up against entrenched Russian objections. The United States is by far the NATO's biggest military spender. Biden faces an increasing challenge building together the transatlantic alliance, as other countries increasingly push plans for helping Ukraine that don't put Ukraine for the White House to be more involved.

Fresh signs of easing prices

INFLATION CLOSER TO NORMAL LEVELS

Economic picture starkly different from a year ago

BY KATHERINE SHAW AND ANNA BRITTON

A year after inflation soared to the highest level in four decades, price pressures are easing closer to normal levels, with business and consumer prices showing the difference as wages rise faster than prices and policymakers debate how much more to slow the economy.

Government data released Wednesday showed a notable dip in inflation. Prices rose 0.1 percent in June compared with the year before, and a 2.2 percent compared with May. The smallest increase since late March 2021. That marked progress from the fast inflation report, when prices rose 4 percent compared with the previous year.

There is a way to go, especially on major categories such as rent. But encouraging signs were scattered throughout the Bureau of Labor Statistics report. Goods prices, from food to cars, rose 0.1 percent in June, but that was down from 0.3 percent in May. Services prices, which include health care, education and other services, rose 0.2 percent, according to a separate BLS report released Wednesday.

Meanwhile, wages have grown faster than inflation for two straight months, average hourly earnings rose 0.4 percent from May to June, outpacing inflation by 0.2 percent, according to a separate BLS report released Wednesday.

Alarms for a planet on edge: Flooding, fires and lethal heat

Warning's link to extreme events is clear. What isn't, experts say, is when we'll act.

BY SHARON KAPLAN

The world is hotter than it's been in thousands of years, and it's as if every alarm bell on Earth were ringing. The warnings are coming through the desiccated mountains of the west, where two months of rain just fell in just two days. India and Japan were deluged by monsoon flooding.

Scientists say there is no question that the complexity was caused by climate change — or that it will continue to get worse as the planet warms. Research shows that the sun's ground-wave goes stationary, particularly from burning fossil fuels, have increased. Delays and costs to quiet nuclear power.

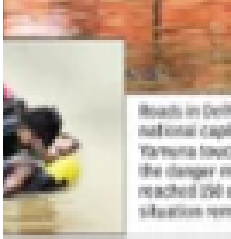
Searing summer heat persists



A Clear Channel Outdoor digital billboard near the Mockingbird Lane exit on northbound Interstate 35E in Dallas displayed the temperature Wednesday. At DFW International Airport, the temperature reached 106, and the heat index hit 95. Triple-digit temperatures are expected to continue in DFW for several days.

of the world, not only in the United States, but everywhere, a combination of unusual weather and ways of life. The report is warning more in the global average, it seems particularly

say Europe's government is significant ways of the climate would mean's eggs, returns a heat wave, the country's 7 on record, hit 70,000 (by some estimates). A heat wave would contribute to Europe's in



Roads in Delhi were submerged and traffic was gridlocked as the national capital saw its worst flood in 45 years Thursday with the Yamuna touching an unprecedented level of 208 feet, 3.2m above the danger mark. The rail in the northern states damaged by rains reached level on Thursday with 24 freight casualties. The flood situation remained grim in Punjab, Haryana and UP.

BY ALEX HARRIS AND LAWRENCE MOKER

Another insurer is leaving Florida, where homeowners are paying more than ever for insurance despite the state's attempt to shore up the wobbling market. Tuesday, Farmers Insurance informed the state it was dropping home, auto and umbrella policies across Florida, potentially affecting tens of thousands of people. It's the fourth company to leave the Florida market in the last year — most citing rising risks from hurricanes. Farmers, a large company with a national presence, also has

reduced new business in California, citing extreme weather and wildfire threats. "This business decision was necessary to effectively manage risk exposure," the company wrote in a statement. Farmers said the decision to withdraw affects about 50% of its assets policies issued in the state, but not ones issued through its subsidiary companies. Those including auto insurer Bristol West and home insurer Foremost — are unaffected. The company decided to speak on the record about how many people would lose coverage. Figures from Florida's Office of Insurance Regulation show Farmers has about 95,000 current home and auto policies, but an industry source suggests that

number is currently closer to 100,000. The day before Farmers made the decision public, Florida Chief Financial Officer Jeremy Patonis tweeted that his office has "zero communication" with the company and would to "explore every avenue possible for holding them accountable" for leaving Florida. Florida's Office of Insurance Regulation said in a statement that the office was

the apply of backup coverage for Floridians how much is at risk, but at a higher price.

BY ALEX HARRIS AND LAWRENCE MOKER

Importance of innovation



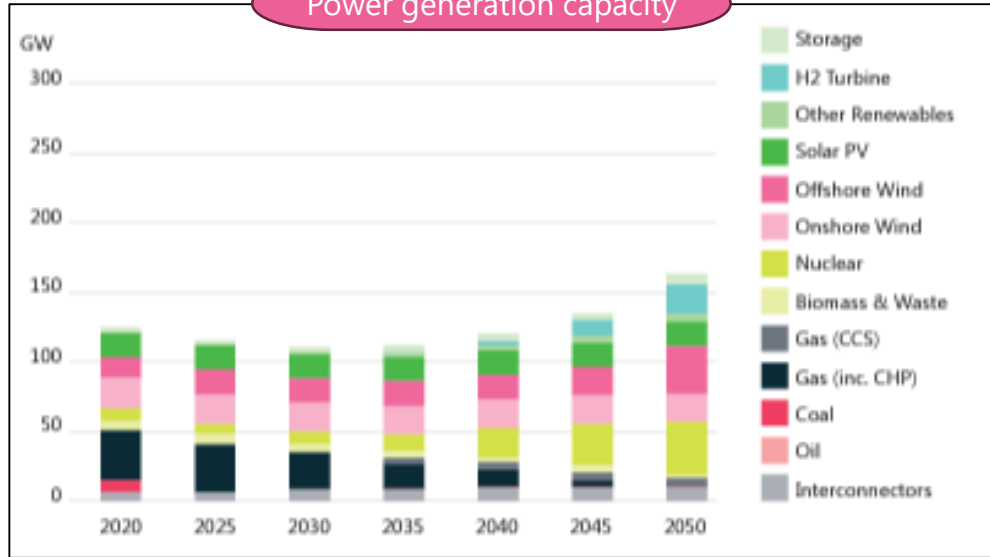
The solution is simple to say...



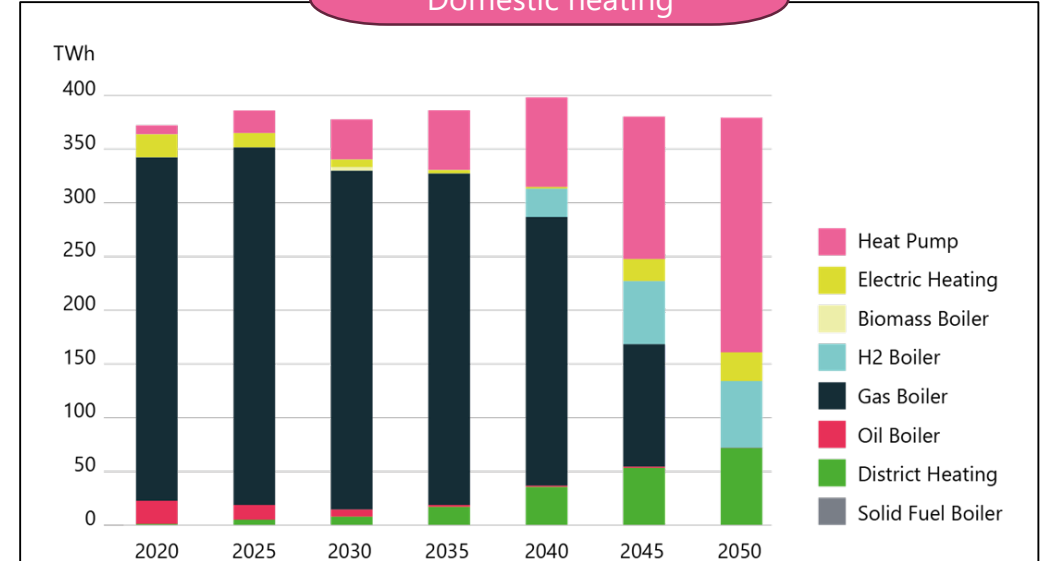
**STOP
BURNING
STUFF**

The solution is simple to say... ..but harder to deliver...

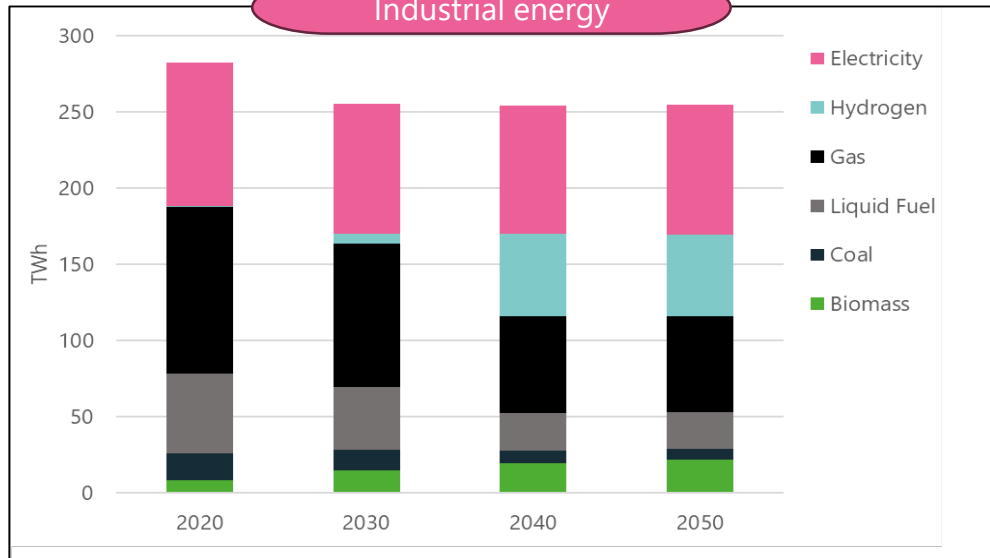
Power generation capacity



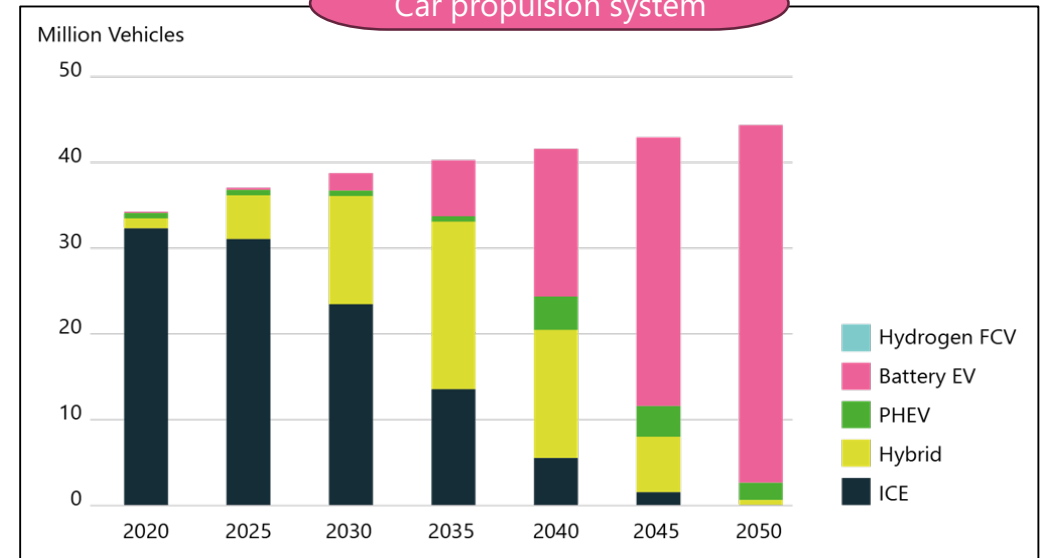
Domestic heating



Industrial energy



Car propulsion system



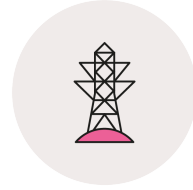
The solution is simple to say... ..but harder to deliver... ...and requires a whole system approach

Joining up the system from sources of energy to the consumer



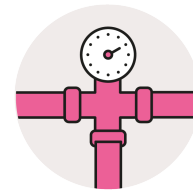
Generation

+



Transmission

+



Distribution

+



Buildings

+



Consumer

Breaking down silos between different parts of the energy system



Electricity

+



Heat

+



Transport

Joining up physical requirements of the system, with policy, market and digital arrangements



Physical System

+



Digital System

+

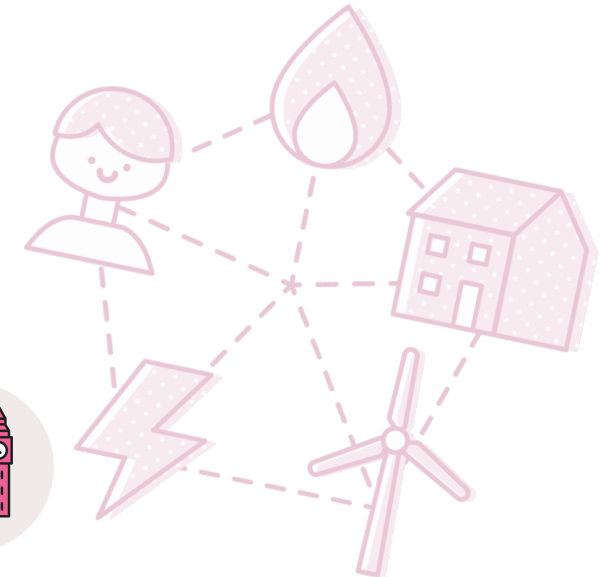


Market System

+



Policy



We cannot reach 2050 with the technologies we have today



“While most of the CO2 emission reductions envisioned in the Net Zero by 2050 Scenario can be achieved by 2030 with existing technologies, the path beyond that will require the deployment of technologies which are still in development or are not yet commercially competitive.”

Innovation is the way to drive down costs, increase performance and create user-focused solutions to net zero

Innovating To Net Zero (2020) provides a window on the innovation required



“Meeting the UK’s Net Zero target will require unprecedented innovation across the economy. Innovation not just in new technologies, but in new ways of deploying existing technologies, new business models, new consumer offerings, and, crucially, new policy, regulation and market design.”

The report lays out a set of credible pathways for the UK to get to Net Zero that reflect a diversity of implementation approaches and the consequences of differing levels of technology innovation and societal behaviour changes.

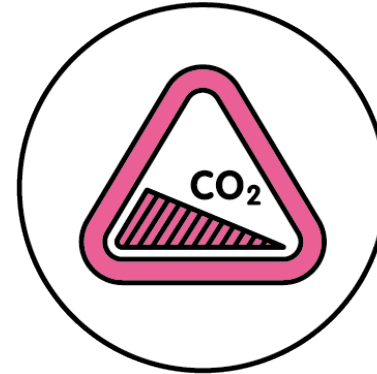
Innovation in practice



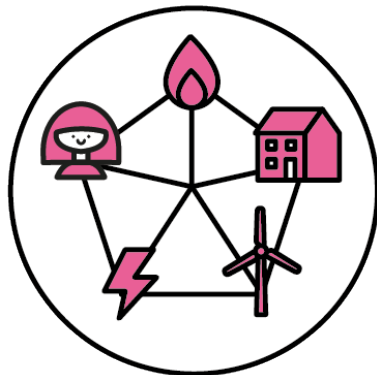
Some of the innovation priorities across the energy system **CATAPULT** Energy Systems



Homes



Business and the
public sector



Whole energy
system



Markets, policy
and regulation

Making it easier to decarbonise homes

Innovation in financial products – Green Mortgages mortgage brokers

Innovation in business models – Octopus Energy

Innovation in technology – Airex Technologies

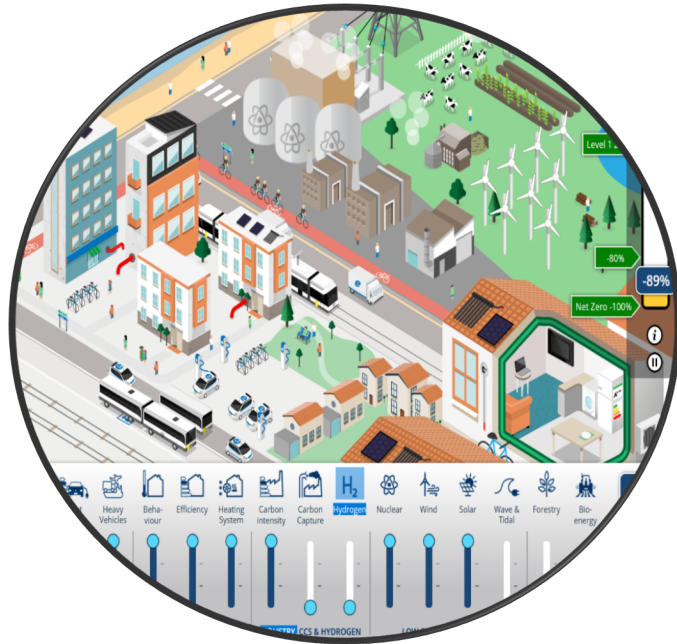


Helping businesses and the public sector decarbonise

Structured planning processes – Local Area Energy Planning

Tools to explore alternative pathways – 2050 Calculator

Novel approaches to support, guidance and access to data – Net Zero Go

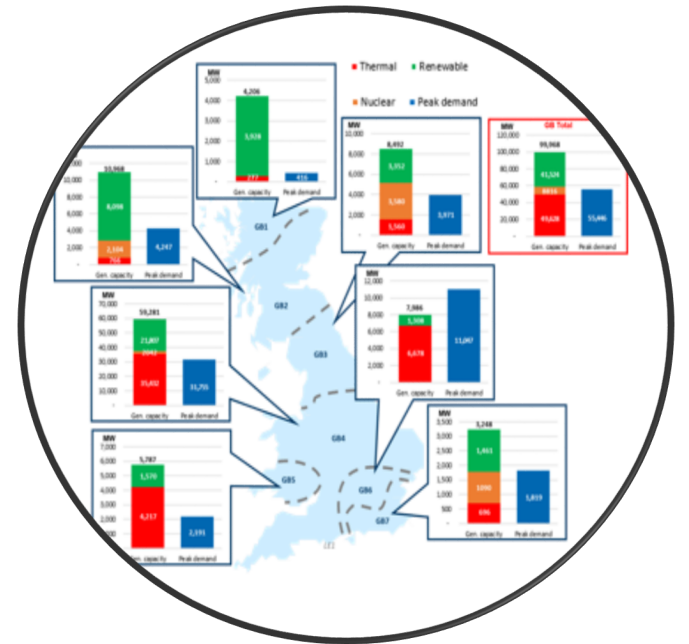


Balancing supply and demand

Innovative peer to peer trading for flexibility – Pico

First of a kind demonstrators – Keadby hydrogen power station SSE and Equinor

Innovative market arrangements – Locational Marginal Pricing



Speeding up policy and regulatory development

Innovative in overall approach – Electricity Networks Commissioner Report
Regulatory sandboxes – Ofgem energy regulation sandbox
Environments for large scale policy trials – Energy Systems Catapult Living Lab



Supporting innovation



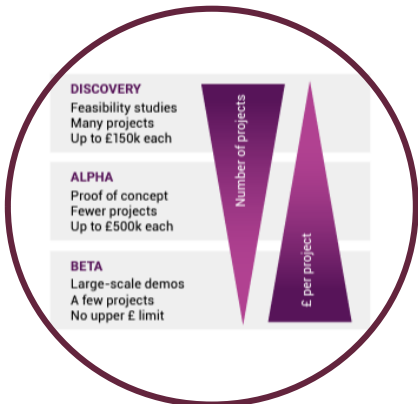
UK supports energy innovation through 3 main routes...



Net Zero Innovation Portfolio



UKRI Energy programme



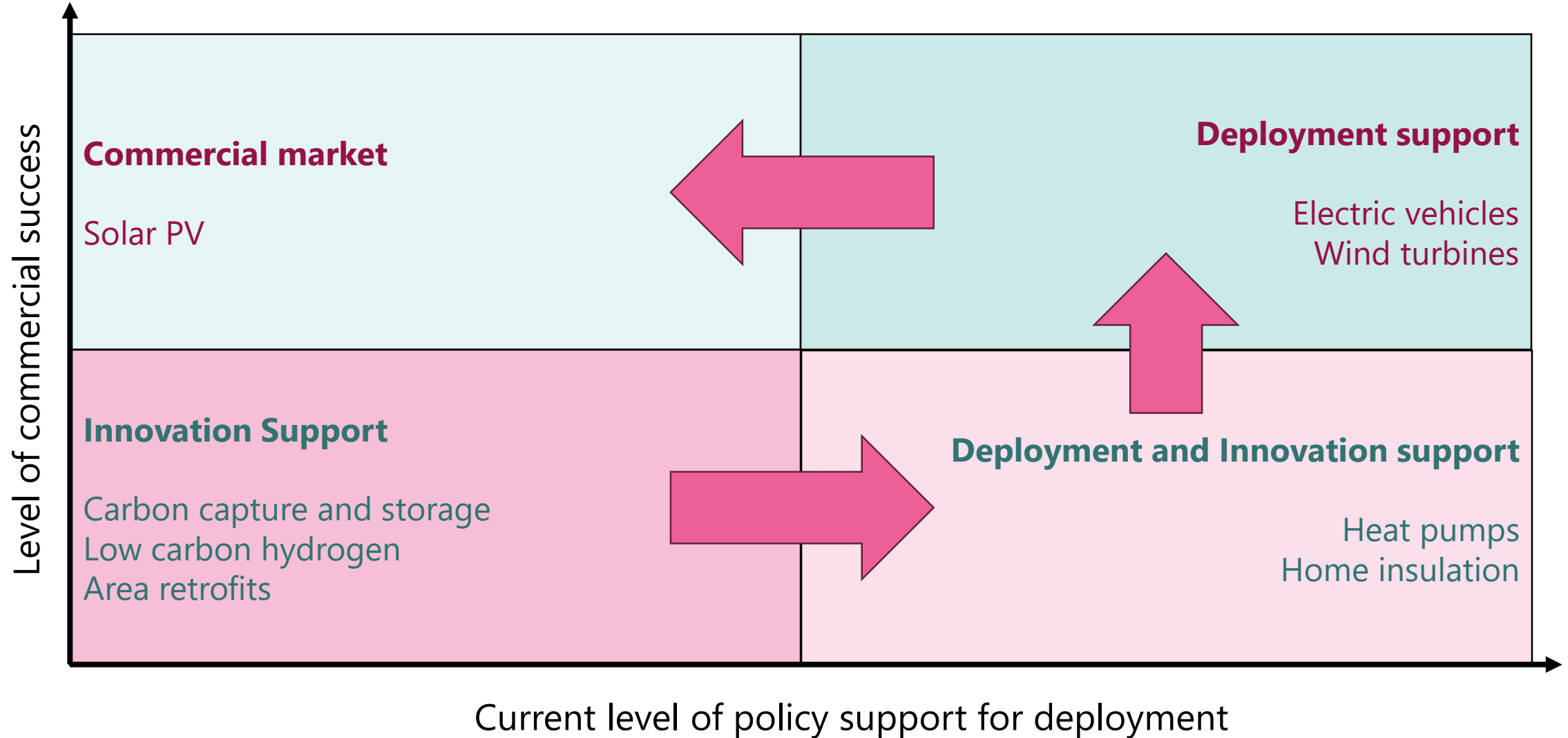
Ofgem Strategic Innovation Fund

UK supports energy innovation through 3 main routes... ...but enduring investment comes from business

Policy support for deployment develops the market allowing business to invest

- Boiler upgrade scheme – Direct subsidy
- Contracts for difference – Regulatory business model
- Energy Company Obligation – Regulatory requirement
- EV charge point grant – Indirect subsidy
- Simple Energy Advice website – Information provision
- Product regulations – Business intervention

Support for innovation and deployment must work together



Reflections and conclusions



- Innovation policy and deployment policy go hand in hand
- The energy system is large, complex and heterogeneous
- Innovation is much more than technology
- Most successful innovation involves integrating existing ideas
- Conveying the innovation to others is as important as creating it
- **Innovation works best when you take a whole system approach**

Questions Thank you

Jon Saltmarsh

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