Pathways to Net Zero

Understanding Electrification Challenges

Washington DC
5th December 2023

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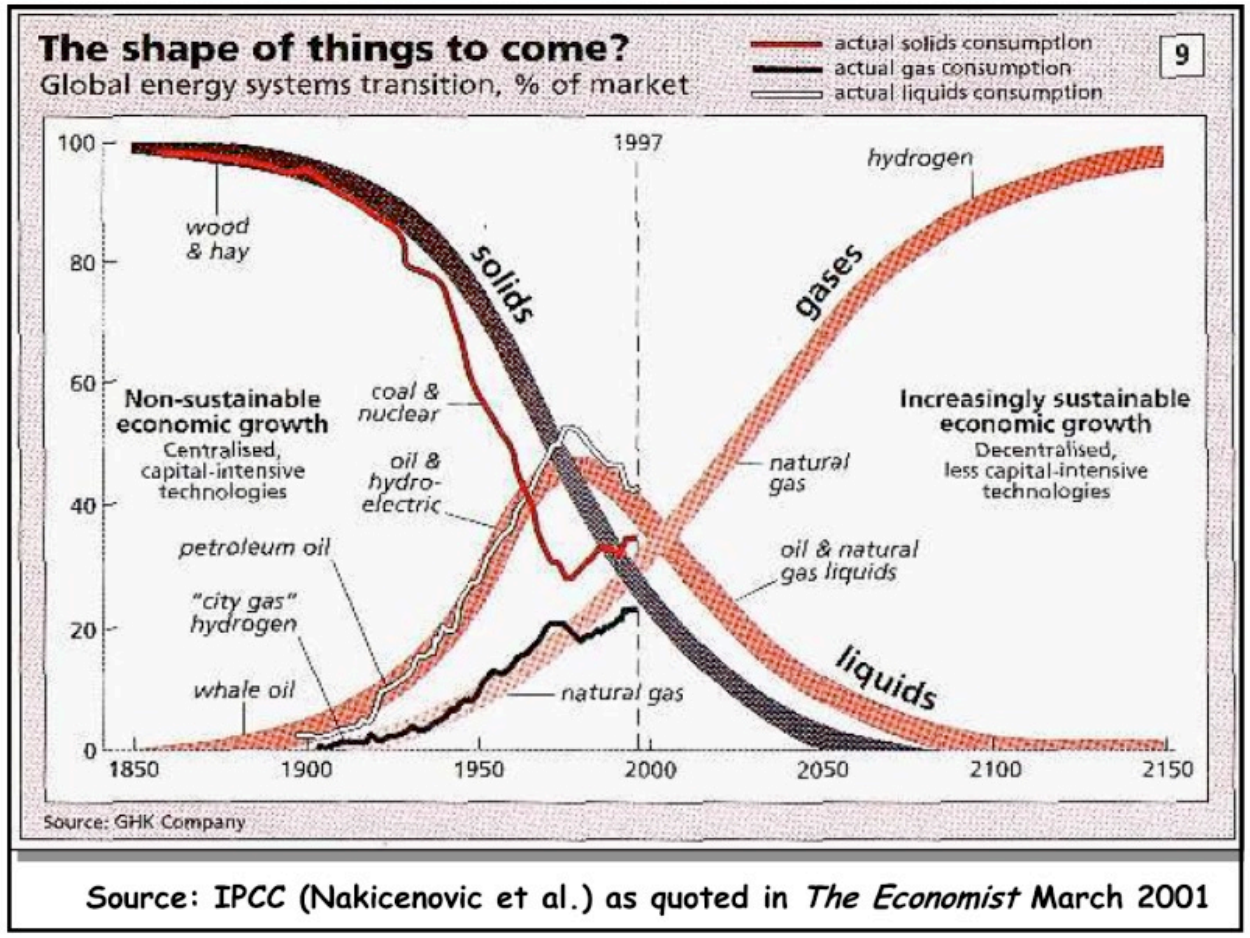
THE AGE OF ENERGY GASES: WHY WE ARE EXCITED ABOUT US ELECTRICITY



Source: IPCC (Nakicenovic et al.) as quoted in *The Economist* March 2001

Gas will not only provide to be the bridge to the sustainable energy fuel mix but also prove to be a systematic component in the provision of energy security"

Robert A Heffner, 2007

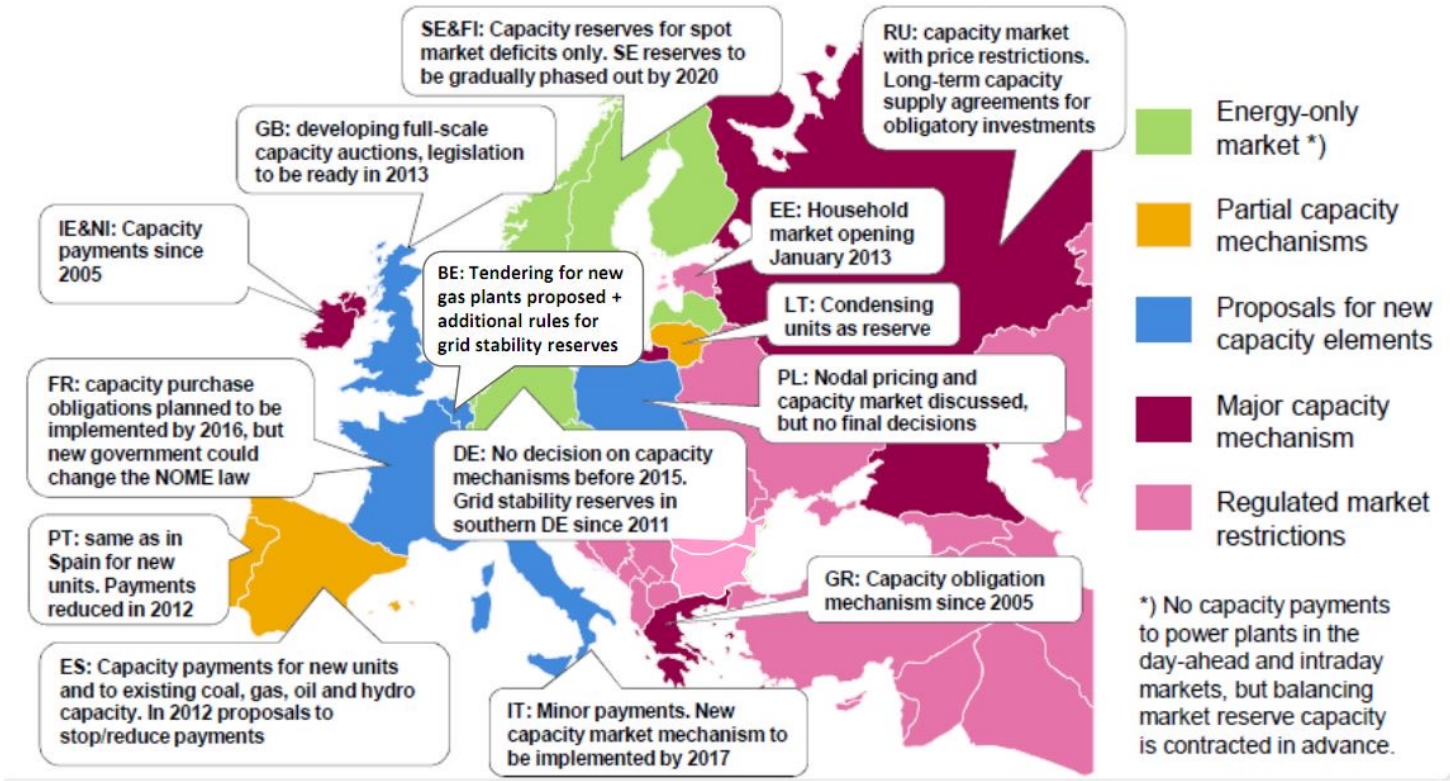
The Age of Energy Gases: Robert A Heffner;

EU POWER MARKET: A PATCH WORK OF MARKET MODELS AT WORK

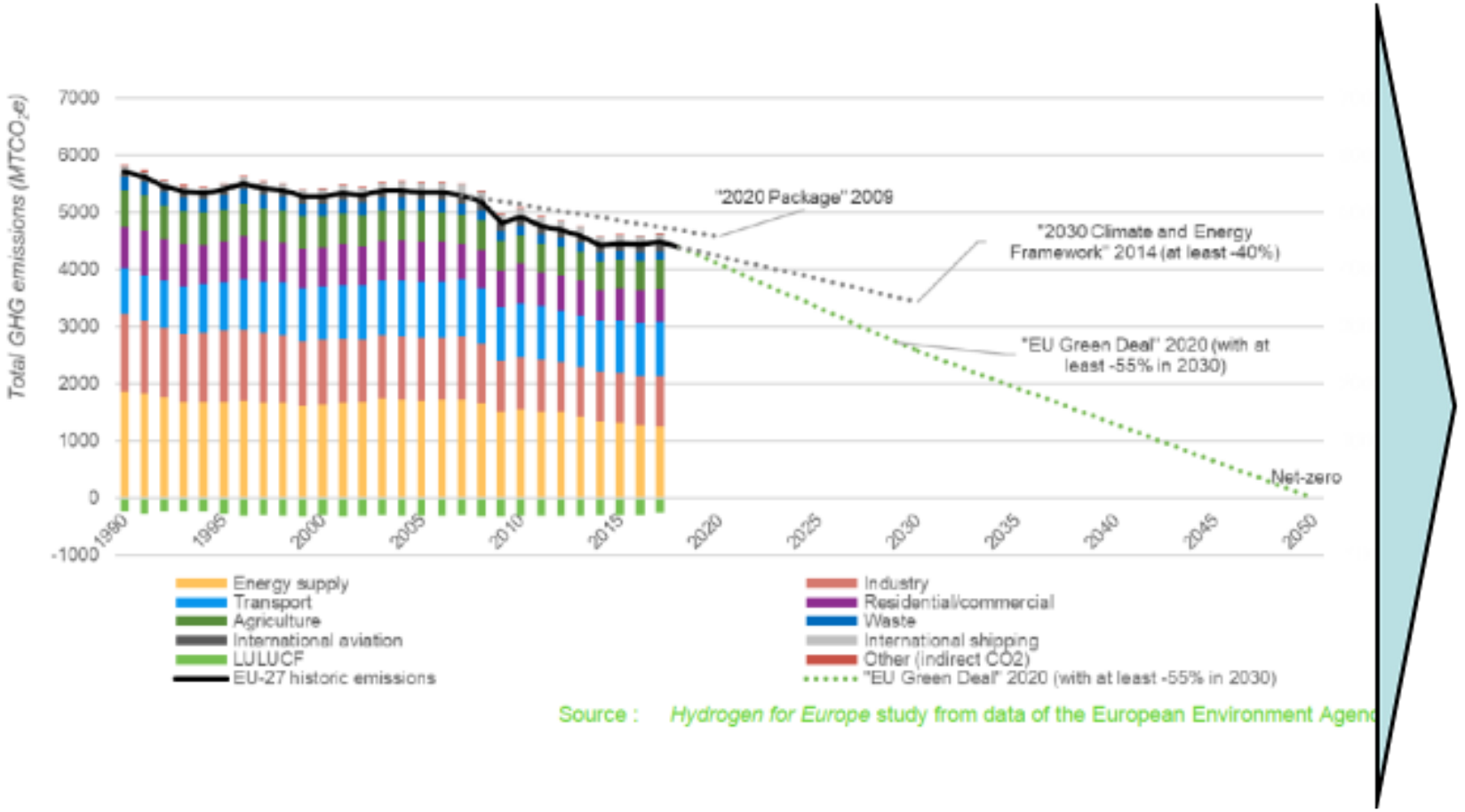
eurelectric
ELECTRICITY FOR EUROPE

Level playing field (1)

Member States have taken the lead



European energy transition challenge: Net Zero is a far cry



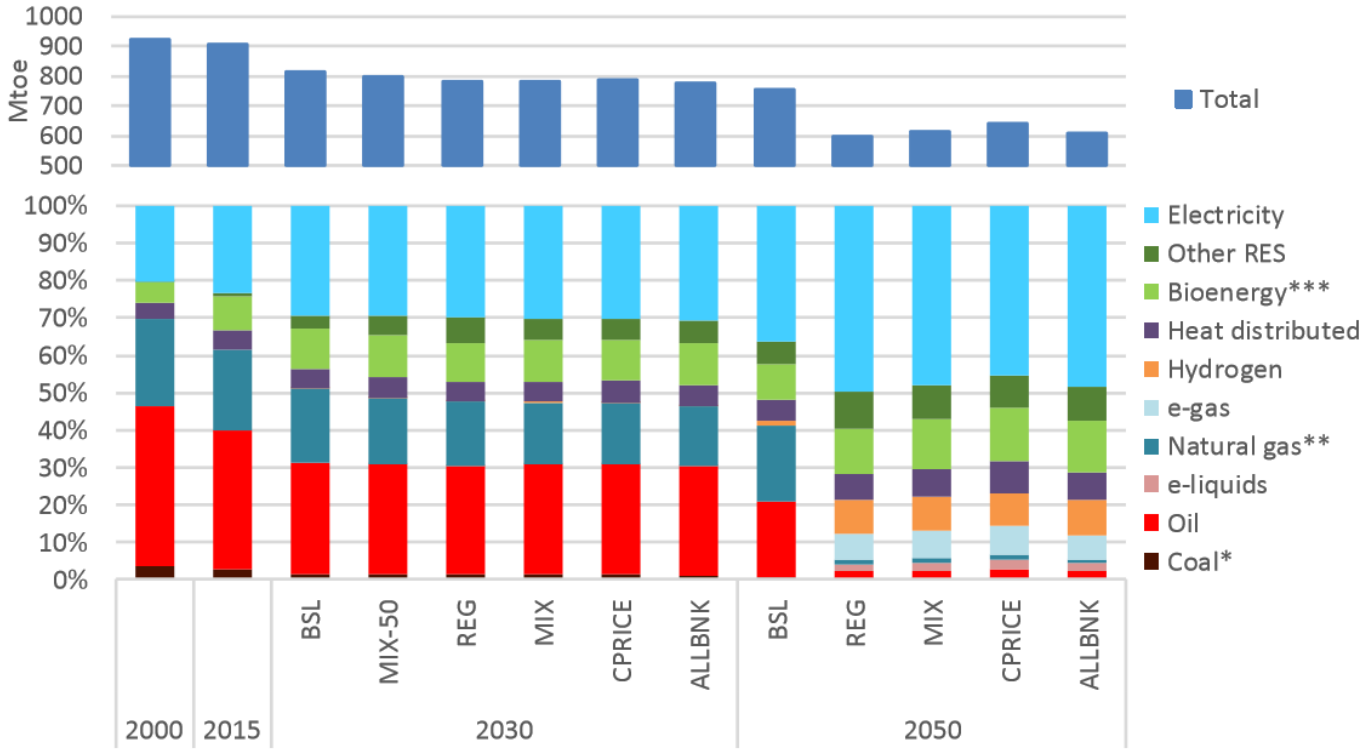
Source : *Hydrogen for Europe* study from data of the European Environment Agenc

The 2050 “Net Zero” target is clearly a very ambitious one; the 55% reduction target for 2030 has been ratified now by the European Parliament

HYDROGEN POTENTIAL IN EUROPEAN 2050 DECARBONISED ENERGY MIX

Final energy demand by energy carrier (for various scenario's)

Source : EU, Impact assessment ***'Stepping up Europe's 2030 climate ambition, 9/2020***



*Note: * includes peat, oil shale, ** includes manufactured gases, *** solid biomass, liquid biofuels, biogas, waste*

Energy system with:

+50% electricity

Hydrogen (and e-fuels) ca. 20 %

+ biomethane / biofuels / biomass

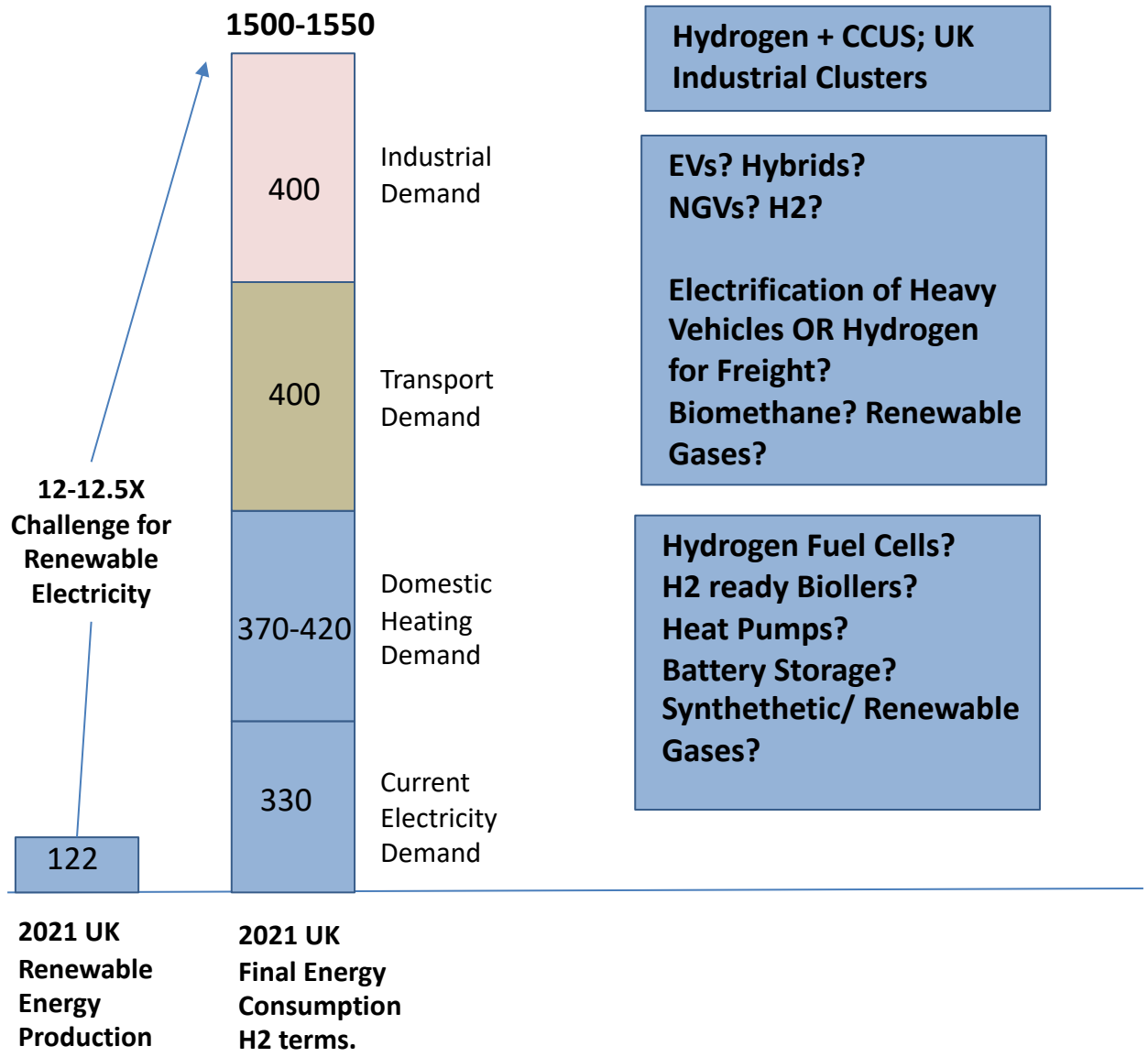
+ heat

Hydrogen- 7-10%

→ **Energy trilemma :**

- → Carbon neutral
- → Ensuring security of supply
- → Affordable

HYDROGEN ROLE IN UK TRANSITION TO "NET ZERO"



1. UK will require to grow its RE production*, not capacity,* ***12.5 X***; in capacity terms the figure could be ***40 X!***

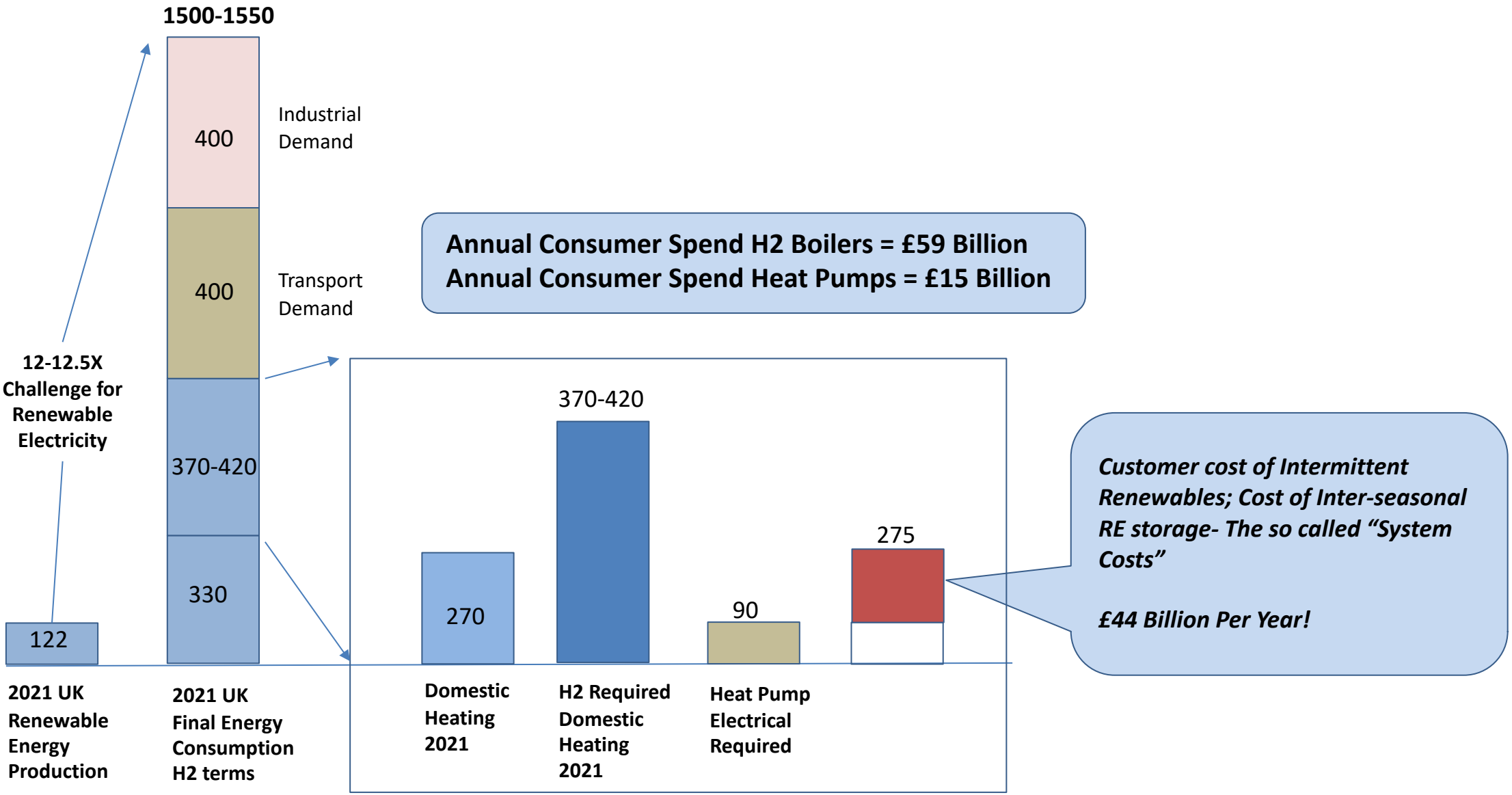
2. To pull off Industrial decarbonisation, both CCUS and Hydrogen will have to grow with aligned policies and business models, ***politically possible?***

3. ***No proven solutions***, deployable at scale are as yet on the horizon in industrial decarbonisation, where solutions exist they ***are at FOAK stage***.

4. Hydrogen solutions compete in individual application markets, some will succeed while others fail. ***Mixed results don't enthuse investors***.

Source: BEIS & DUKES 2021 Data; EnerStrat Analysis

AN EXAMPLE OF APPLICATION MARKETS COMPETITION- UK DOMESTIC HEAT MARKET VERSUS H2 BOILERS



Source: BEIS & DUKES 2021 Data; EnerStrat Analysis

SOME THOUGHTS ON THE US POWER MARKETS

Keep it Simple-

Grid Emission Factor based electricity market development
Emission Performance Standards
Clear dispatch algorithms consistent across states within the same region (at the minimum)
There is no alternative to having new capacity investment triggers in market design
States within one RTO area

Wholesale Market Reform preceding Grid Decarbonisation

German Power Market Example
UK Supply competition has helped in keeping overall decarbonisation costs low- until recently!

System Balancing Costs and Incentive Mechanisms (UK UMIS Scheme 1997-1999)! Incentives work)

There are a number of good policy ideas in the ongoing 25 year experiment in EU Electricty Markets: EPRINC believes a number of policy ideas in Europe could be successfully implemented in the US; esp around Grid Resilency, Resource Adequacy and Network Code

THANK YOU

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For further questions please contact:

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