

## **Air- & Ground-source Heat Pumps**

The role of electrification in decarbonising homes, all you ever wanted to know about heat pumps & the implications of current government policy



September 2022

#### Why decarbonise at all?



One hundred years of impact in 35 seconds using data from NASA observations



#### Why is electrification carbon-efficient?





https://www.hpf.org.uk/carbonwatch

## Carbon Dioxide Emissions Comparison -Electricity vs. Oil vs. LPG vs. Gas

Total Heating (+ DHW) Demand	10,800	kWh/annum	Note :						
SPF	3.20								
Electricity Consumed By Heat Pump	3,375	kWh/annum	Note :						
						Carbon	Heat Pump	% CO2	Average
			Carbon			Dioxide	CO2 Saving	Saving	no. of
		Boiler	Dioxide		Demand	Emissions	Against	With Heat	family cars
Fuel/Carbon Emissions		Efficiency %	Factor		kWh/annum	kg	Fuel	Pump	displaced
Electricity (National Grid)		100	0.193	kgCO2/kWh	10,800	2,084	1,433	<b>69%</b>	0.8
Oil		89	0.268	kgCO2/kWh	12,135	3,252	2,601	80%	1.5
LPG Gas		90	0.215	kgCO2/kWh	12,000	2,580	1,929	75%	1.1
Mains Gas		92	0.184	kgCO2/kWh	11,739	2,160	1,509	<b>70%</b>	0.9
Coal		80	0.333	kgCO2/kWh	13,500	4,496	3,844	86%	2.2
Biomass (High Quality Pellets)		85	0.040	kgCO2/kWh	12,706	508	-143	-28%	-0.1
Electricity - Heat Pump		320	0.193	kgCO2/kWh	3,375	651			
Assumes that electricity is purchased from a s	standard su	oply. Purchasi	ing from a	green energ	y tariff will s	ignificantly	increase CC	02 emission	s savings.
			Carbon fac	ors taken from Defra figures for 2022.					
	Average family car :		Ford B-MAX 2017 1.4 Pe		etrol				
	Emissions (DVLA Vehicle Certificat			n Agency) :		0.139	kg/km		
	Average ann	nual mileage (R	AC Founda	tion) :		12,560	km		
	Average annual emissions :					1,746	kgCO2e		







## Heat pumps 101 – what do they look like?













## Heat pumps 101 – all house & development types



#### **Incumbent fear & doubt**



Massive radiators, probably not!



Garden a disaster, yes, but worth it, or drill!



Re-plumb the whole house and UFH, just not necessary!



Installing central heating was a disruption, but stay with coal, really?



## Heat outputs & the value of "design"

- Heat outputs; can a heat pump system provide enough heat or are supplementary systems required? What are the benefits and limitations of heat pump systems?
  - Heat loss calculations & proper design the lost art
  - Flow temperatures and losses where does the heat come from, and does the building know?
  - Supplemented or hybrid systems what is the Plan B?
  - Benefits improved comfort, internet control (landlords), carbon, air quality (both internal and external)
  - Procurement advice –

https://www.hpf.org.uk/advice/homeowners



## **Location & planning**

- Locating heat pump equipment and potential planning constraints, noise concerns from neighbours and adjacent properties
  - Current generation machines are very quiet
  - MCS 020 applies to Permitted Development Rights (which vary across the four countries of the Union) and which need updating (GLA, Welsh and NI activities)
  - Conservation areas or Listed buildings may need additional consents
  - New form factors and "finishes"
  - Significant differences between air-source and ground-source in these respects
  - Overnight operation for flexibility value



## The Visuals











#### **Case Study : Large domestic air-source**



- Barn conversion, heating & hot water
- 60,000kWh/annum
- CO2 emissions reduction against natural gas 67% (2021)
- Over 8t CO2 saved per annum
- Equivalent to 4.6 average cars displaced



## **Building Regulations & EPCs**

- Building Regulations
  - The Interim Uplift includes a mandated 55 ℃ flow temperature to improve condensing boiler performance (8% on average)
  - In 2024/25, a further update should include the full Future Homes Standard
- EPCs; do heat pumps improve the EPC?
  - EPCs report on cost, rather than carbon, so whilst electricity is penalised, no EPC will ever recommend a heat pump
  - Has the Interim Uplift to Building Regulations changed this? No, more work on SAP and RdSAP is required
  - There is no current recognition of the value of thermal storage and time-of-use tariffs (the entry to domestic flexibility)



#### Two aspects to affordability – operational costs





## Two aspects to affordability – capital costs

- Feed-in-tariff, FiTs
  - opening tariffs >40p/kWh stripped funding from heat
  - but grid electricity is increasingly low carbon anyway, so VfM?
- Domestic Renewable Heat Incentive
  - flawed opening tariffs, cut heat pump market by 50%
  - didn't help with capital
  - closure cliff edge doesn't encourage long term investment
- Boiler Upgrade Scheme (BUS), commenced 1<sup>st</sup> April 2022
  - fine for small air-source, very poor for ground-source
  - still doesn't really help with capital, except for small air-source
  - budget & voucher limits may throttle the market
  - repeats closure cliff edge
- 0% VAT



## Will "able to pay" consumers fund decarbonisation?

- Long term loans
  - everyone loves a hand out but....
  - little consumer resistance, once the parameters are explained
  - no cliff edges (enabling installer investment in skills and capacity to increase competitiveness and reduce costs)
- Private investment for, in part, the public good
  - societal benefit justifies government backed ultra-low interest rate loan scheme (compare with student loans)
  - consumer choice on borrowing level vs efficiency, aesthetics, noise, etc.
- "Willing to contribute"



#### What is needed to deliver 600,000 heat pumps by 2028?

- Consumer confidence, which comes from
  - consistency of government messages
  - robust consumer protection (MCS)
  - affordability package (100% capital and operational)
- Legislation on new build Future Homes Standard
  - new home buyers are given no information on the capital costs associated with upgrading to meet net zero
- Legislation for off-gas fossil fuels
  - consultations closed but 2024/26 legislation inception looming
  - proportional grant contribution to support early adopters
- Scottish experience
  - zero-rate, but comparable, deployment up by nearly 50%



## **Tenants & homeowners are key – what factors matter?**

- Fossil fuels work, or do they?
- Resistance to, or fear of, change
- Very low valuation of energy (resistance to insulation)
- Capital cost of change
- Operational costs (spark gap)
- Knowledge & understanding
- Environmental attitudes (Sir David Attenborough, Greta) and increasing intergenerational pressure
- Regulations (MEES, Building Regulations), off-gas consultations
- Government subsidy
- A better offer (controllability), transitional approaches (hybrids)



#### **Government policy requirements**

- Government to lead by example Public Sector Decarbonisation Scheme & Social Housing Decarbonisation Fund
- Local plans to proactively seek out waste heat opportunities, ease the planning pathway for heat networks, zoning proposals
- Government to start tackling the spark gap (environmental & social levies soon?)
- DLUHC to go further on Part L in SAP25
- Adoption of Low Temperature Heating qualification
- Consider voucher funding for PAS 2035 home assessments
- Specific funding for rural communities to support removal of oil
- Significant changes to SAP & RdSAP to better recognise carbon and time-of-use tariffs & thermal storage (DSM/DSR/Flexibility)
- Provision of affordable capital



#### Potential: unlocking the value of flexibility





Carbon Trust/Imperial College report on this has projected a value from flexibility of £16.7bn per annum by 2050 : https://www.carbontrust.co m/news-andevents/news/groundbreakin g-analysis-reveals-a-fullyflexible-energy-systemcould-cut-the

#### The ultimate renewable energy resource



"The stone age did not end because the world ran out of stones, and the oil age will not end because we run out of oil" Don Huberts (Shell) 1999



# Thank you

<u>www.hpf.org.uk</u> <u>https://www.hpf.org.uk/advice/homeowners</u>

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