Written evidence submitted by the Heat Pump Association (CGE0074)

Key Facts

Heat Pumps

- HPs take energy from ambient sources like the air, ground and water and convert to heat at a higher temperature, and is a long established tried and tested technology available right now
- HPs use only a fraction of energy to convert the ambient energy into a useful temperature
- Typically 1 kWh electricity can produce 2.5-4 times as much heat energy (kWh)
- Therefore 1 kWh of renewable electricity would produce 2.5 to 4 kWh of useful heat!
- On average, the carbon emissions are only 22 % of heating oil and 33% of natural gas
- Fuel costs do not replicate carbon emissions, limiting monetary savings

What can the government do?

- Update the carbon emissions factor for mains electricity used in Building Regulations
    - This is currently 7 years out of date and more than 2 x what it should be, which grossly exaggerates the emissions from heat pumps (even though it is roughly 1/3rd for the heat produced- see above) and grossly exaggerates the benefit of solar PV
- Building Regulations: Ensure new homes have to be built "renewable ready", e.g.
    - Low temperature heat emitters installed; space is available for Hot Water Storage
    - Minimum size of pipework which will also save on energy wasted by excessive pumping
- Make a clear, programmed commitment to phase out high carbon fossil fuel heating systems
- Review Planning guidance
    - Bring requirements up to date to reflect changes and improvements in HP manufacture
    - Ensure such guidance is disseminated due to current inconsistencies amongst local authorities
- Support 'independent' sources of technical information (c.f. Scotland) and training schemes
- Encourage 'agile' tariffs, linked to emissions, to encourage the inclusion of thermal storage to facilitate the consumer benefits of lower carbon (& lower cost) electricity and access to future demand side response and management

What can industry do?

- Continue to advise and support both government departments and consumers
- Follow through on joint training initiatives between installers, HPA, GSHPA and MCS
- Work with MCS and Trustmark to provide Quality Standards

HPA Statement on the Electricity Grid Carbon Factor in Current Building Regulations

Executive Summary

The delay (7 years) by the UK Government to update the Building Regulations and in particular the Electricity Grid Carbon factor is resulting in grossly distorted outcomes for Building Regulation compliance calculations and is creating a poorer building stock than necessary which will require further improvements, upgrades and expense for homeowners in the future.

The emissions from anything consuming electricity are wrongly more than doubled which significantly hampers the deployment of devices such as electrically driven heat pumps. On the flip side this also wrongly exaggerates the contribution of solar PV to emissions reductions by the same factor!

Summary

	gCO_2/kWh_e	$kgCO_2/kWh_e$
Current 2012 Building Regulations	519	0.519
Salex lending figure	320	0.320
GLA	233	0.233
Proposed SAP 10 (due April 2020)	233	0.233

Introduction: Reduction in Emissions from Grid Electricity

The last few years have seen a dramatic reduction in the carbon emissions occurring from the central generating electricity grid. This is partly due to the increase in electricity generation by renewable energy (wind & solar) and contributions from nuclear both in UK but also from imports from the French and Dutch Interconnectors. This has led to a significant reduction in the use of carbon intensive coal such that average carbon intensity of grid electricity has dropped from over 0.542 $kgCO_{2e}/kWh_e$. (2006) to well under 0.240 $kgCO_{2e}/kWh_e$.

Building Regulation Discrepancy

After much debate the government issued a proposal for the next version of Standard Assessment Procedure , SAP 10, on the 10th July with a figure of 0.233 $kgCO_{2e}/kWh_e$.
However the current Building Regulations (SAP & SBEM), dating from 2013, currently use a figure of 0.519 $kgCO_{2e}/kWh_e$.

What does this mean in practice?

It means that Heat Pumps are modelled by Building Regulations as being twice as carbon intensive as they actually are on average and hence disadvantaged by a factor of 2.

On the flip side solar Photovoltaic (PV) appears to offset twice as much carbon as it actually does.
The result is that buildings are being sanctioned under legislative framework with a completely distorted view of their environmental impact. This means for instance that heat pumps appear only marginally better than oil heating and far worse than natural gas when in fact they are considerably better!

It means install a bit of relatively inexpensive PV on the roof and the benefit is distorted but appears in compliance with regulations. However, propose a heat pump and it wrongly shows very little if any benefit of an investment in the future for low carbon heat.

Referring to Table 1 it can be seen that natural gas systems generate about 3 x the emissions of an average performing heat pump and LPG & oil is even worse at between 3 -4.7 x more carbon emissions!

Table 1 True Comparison of Emissions of different heating fuel sources:
as proposed by Future Building Regulations i.e. SAP10

	CO_2e emissions per kWh supply energy (gCO_2e/kWh) (see note 2)	Typical heat conversion factor/ Coefficient of Performance	CO_2e emissions per kWh delivered energy (gCO_2e/kWh)	CO_2e Emissions compared to GSHP %	CO_2e Emissions compared to ASHP %
GSHP	233(2)	3.2	90	100%	84%

(Electricity)					
ASHP (Electricity)	233(2)	2.7	107	119%	100%
Gas	210(2)	0.87	241	332%	280%
Oil	298	0.87	343	470%	397%
LPG	241	0.87	277	380%	321%

References
1: Updated Energy & Emissions Predictions 2017: BEIS, January 2018.
2. BEIS/MHCLG proposal for Grid Carbon Factor in Building Regulations (SAP version 10.0) due 2020, published July 2018
www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-20184

Table 2 shows the current position of the Building Regulations (2012/2016) as regards emissions and default efficiency values and demonstrates that it is currently much more difficult for heat pumps to provide a pass. If a specific heat pump is not selected and the default value is used (which is very low to represent the worst possible case) it makes it virtually impossible for a heat pump to pass. In early SAP assessments it is often not decided which model will be installed and hence the default value is often used putting off potential applicants.

Table 2: Comparison as current Building Regulations using default efficiency values (i.e. equipment not specified)

	CO_2e emissions per kWh supply energy (gCO_2e/kWh)	Typical heat conversion factor/ Coefficient of Performance	CO_2e emissions per kWh delivered energy (gCO_2e/kWh)	CO_2e Emissions compared to GSHP %	CO_2e Emissions compared to ASHP %
GSHP (Electricity)	519	2.3	226	100%	74%
ASHP (Electricity)	519	1.7	305	135%	100%
Gas	216	0.84	250	111%	82%
Oil	298	0.84	355	157%	116%
LPG	241	0.84	287	127%	94%

Table 2 shows how easily the output of the current SAP 2012 can give a completely distorted view and partially answers why it is so easy to still install oil boilers in new build off gas grid with a paltry amount of PV on the roof which benefits from the excessive carbon value which effectively offsets the high carbon fuel- incorrectly.

The result

These buildings will be generating far greater emissions than modelled, which means at some point in the future this will have to be dealt with again, most likely as an expensive refit. Of course such upgrades will not only be expensive but much more difficult to achieve the efficiency of an holistic approach at new build stage. In short we are creating an environmentally poor legacy for the future, requiring further expenditure in the future.

A legacy burden for the future

The current Building Regulations and the associated carbon factors will not be updated until at least spring 2020 due to the process required which is a combination of the need to go to public consultation and the need to pass law within Parliament, which is currently awash with Brexit legislation with no time for mundane domestic matters such as accurate building regulations. Hence this environmentally poor legacy is set to rumble on.

The legacy burden gets worse: further delays

So buildings are being built with potentially much higher emissions than modelled and will need expensive refurbishments on the future, but that is not the end of the issue, especially with the delay in updating Building Regulation carbon factors.

The Building Regulations approval process lasts for 3 years from approval and is frozen to that approval once building work starts. Hence we will still have distorted approvals until at least spring 2020 and if Building Regulations are sought just before this the constructor has until spring 2023 to START construction. So lay the foundations and slab and hey presto this building can be finally constructed based on a false premise of carbon emissions and this emissions poor building can be constructed at some later date.

The potential extent of this poor building legacy

Take the domestic sector. The government announced in the 2017 Budget 19th November an intention to build 300,000 houses a year. Most construction professionals have stated this will not be achievable and the figure will be nearer 250,000 per year. Thus from the announcement of the new figures (July 2018) to when the regulations may actually be realised in construction (say 2024) approximately 1.5 million homes will have been added to the legacy of false assumption on emissions and require upgrades by 2050!

Dangers

Two main dangers become apparent.

1. Direct Electric Resistive heat in New Build: developers could turn to low capital cost, but high carbon emission and high running cost solution of direct electric resistive heating. This is very attractive to them as they will not be paying the bills going forward but it would be a major blow for emissions targets and a real threat to reducing fuel poverty, possibly pushing more households in this direction

2. Because the clean growth strategy does not yet include LPG we could see the current migration away from heating oil increasing to a fuel that is only marginally better and again creating a legacy to reverse in the future. That is in addition to the legacy of the emissions already emitted and the resulting rise in average global temperature

Summary

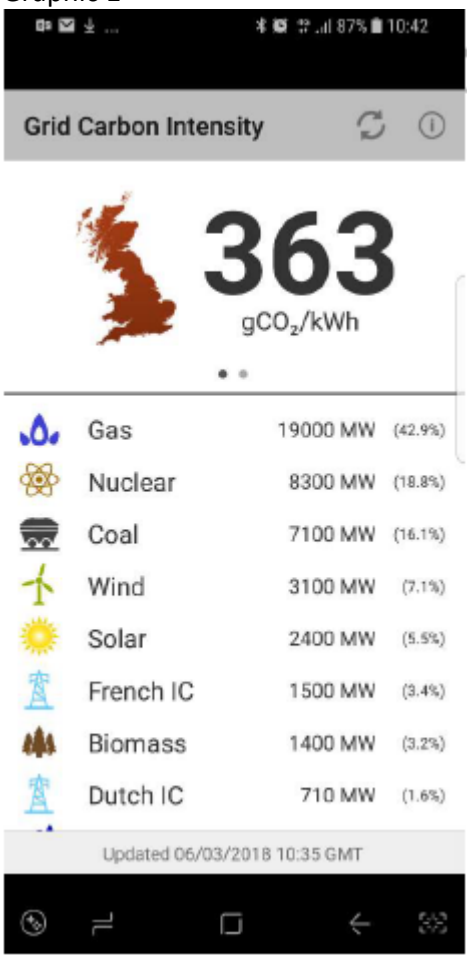
The vastly out of date carbon factor contained in the current Building regulations and not likely to be changed until Spring 2020, 8 years after the last change) is seriously inhibiting the wider deployment of low carbon heating systems like Heat Pumps and is therefore creating an expensive legacy to be addressed again in the future rather than now.

Sample Electricity Grid Carbon Factors

The following are some sample electricity grid carbon factors. This is NOT scientific sample and does not attempt to be but shows the range possible. It clearly shows that natural gas is still the main source of energy and that renewables can provide a significant proportion of energy as well as nuclear (which is low carbon however it's overall environmental impact is subject to much debate!). However the effect of burning coal at peak times is very clear.

However we know the figure of 519 gCO_2/kWh_e used in current Building Regulations 2012 is vastly out of date.

Graphic 1



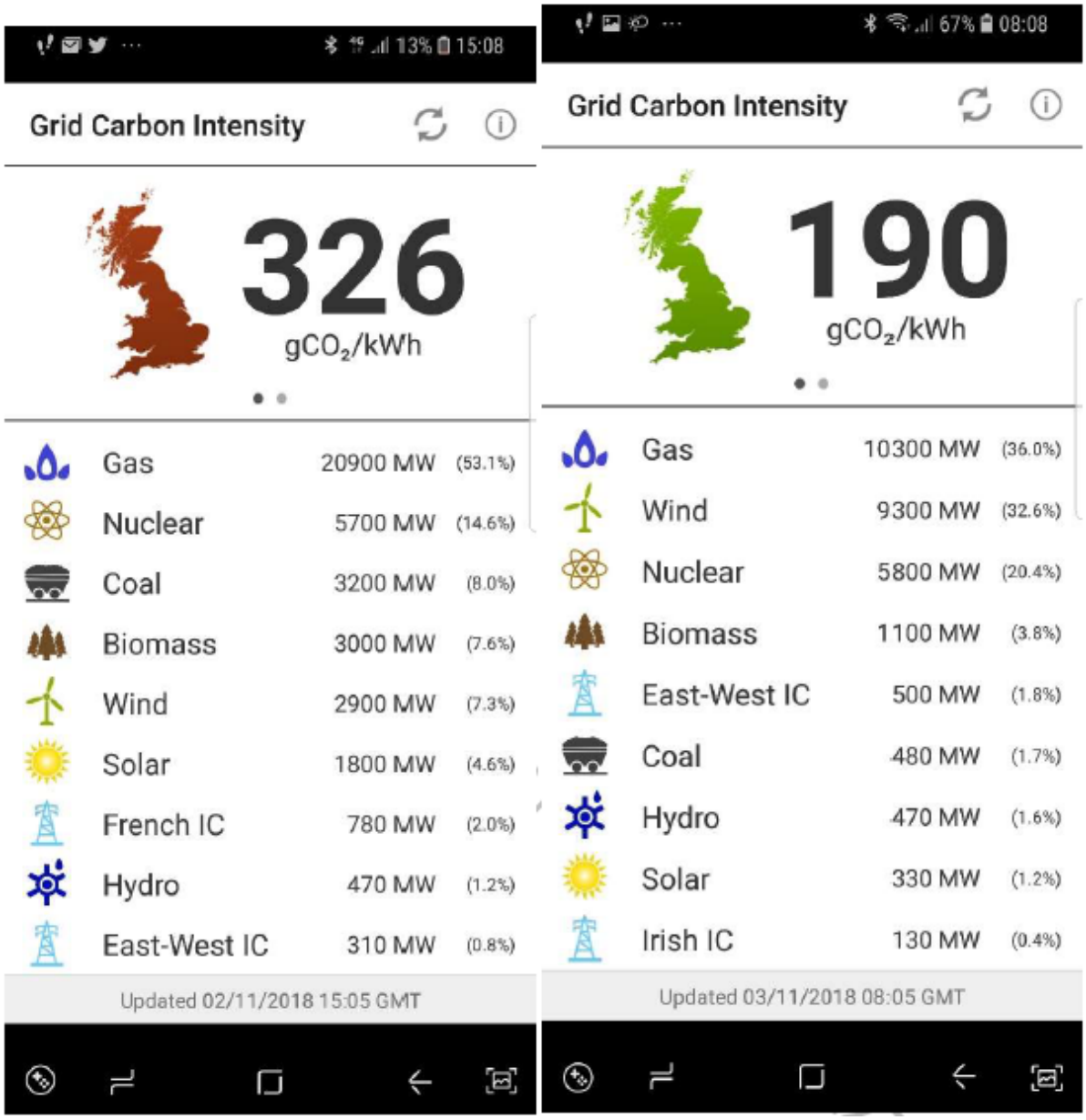
The figure 363 gCO_2/kWh_e on 6th March 2018 is of interest because this was one of the coldest days of 2018 with snow on the ground throughout the UK. Even at this carbon intensity a very average heat pump system (i.e. there are better performing) will emit less than 1/3rd (31%) the emissions of gas & circa 1/5th (22%) that of oil !!!. This is the worst day not the average!

Hence even if emissions rose because of increased demand and generating requirement, Heat Pumps will still provide carbon emission savings

Emissions of Heat Pump @ 363 gCO_2/kWh_e compared fossil fuels

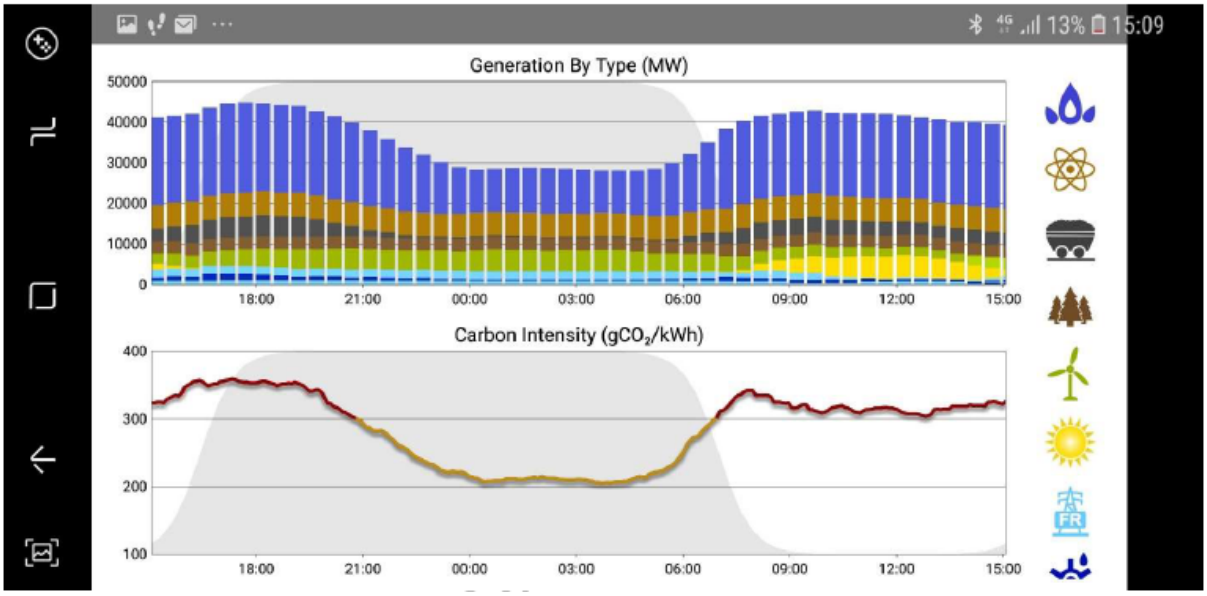
	Heat Pump
Natural Gas	50%
Heating Oil	30%
Direct Electricity	33%

Graphic 2

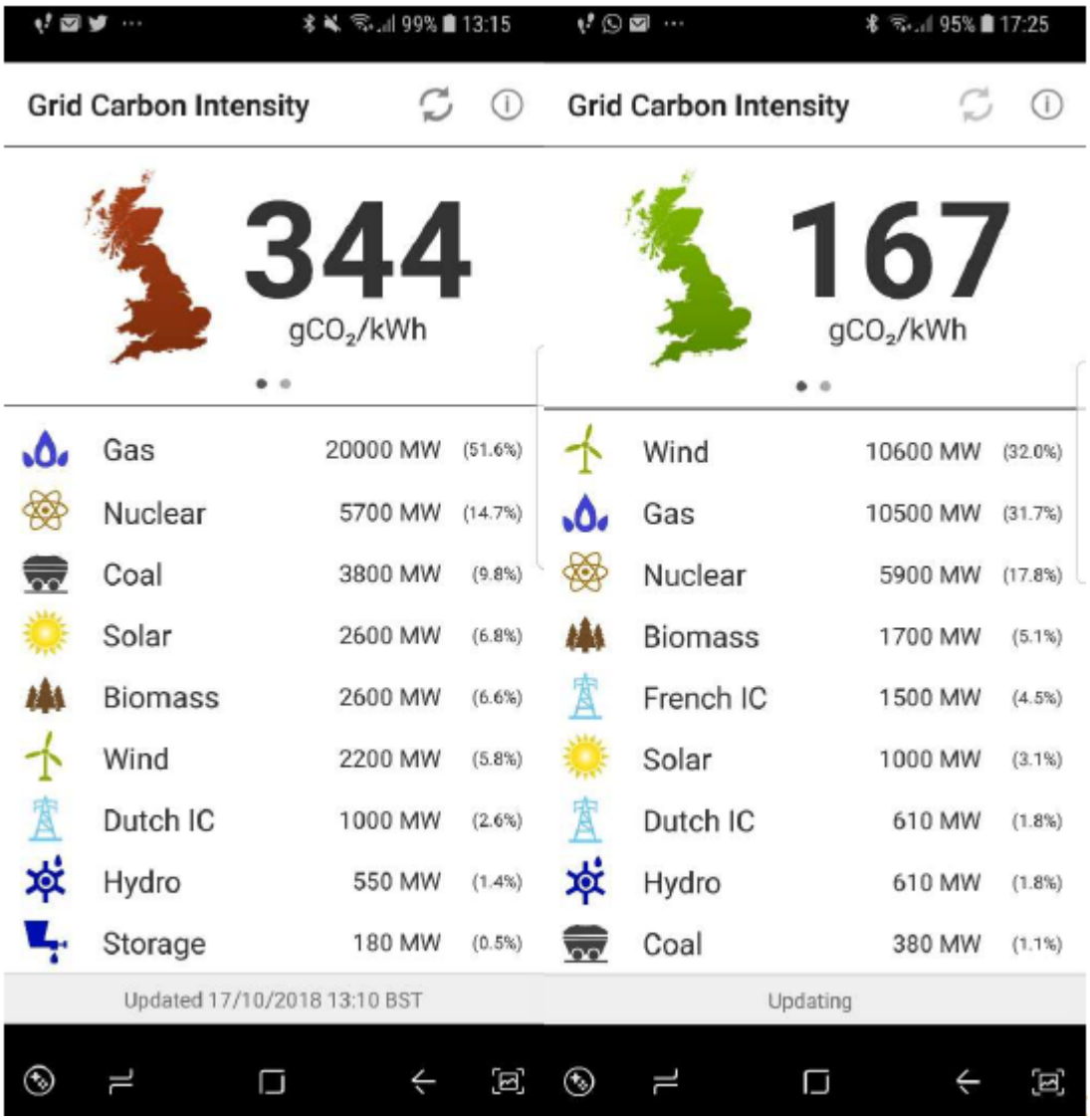


These two images (Graphic 2), 326 & 190 gCO_2/kW_e are of interest because they are only a day apart. It shows the variance of emissions, unscientifically validates the average, but also the previous graphic (1) clearly showed that even relatively high emission periods do not cause emissions to rise above those of fossil fuels.

Graphic 3



This graphic (3) relates to the higher of the two previous (Graphic 2) spanning from 15:00 on 1st Nov to 15:00 2nd Nov 2018. It shows that even on a relatively high daytime emission rate (still providing emission savings though) the night time rate drops considerably and Heat pumps can generate sanitary hot water overnight and use thermal stores etc. to increase efficiency further



These two emissions are interesting as they are just 3 days apart again demonstrating that the average emission evens out to the typical 233 gCO_2/kWh_e. However even at 344 gCO_2/kWh_e the source energy for a heat pump is just a fraction of fossil fuels used directly.

Graphics obtained from the grid carbon app available from www.gridcarbon.uk using data from Elexon to both of whom the HPA express their appreciation

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