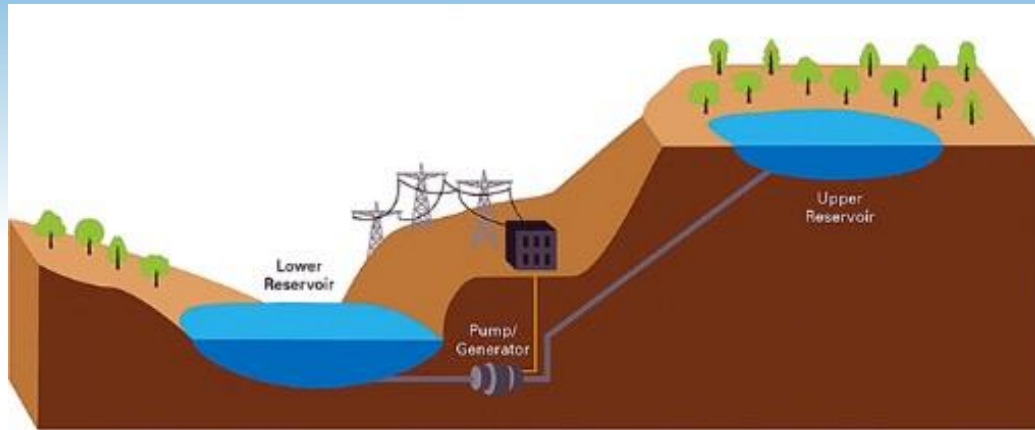


Thermal Storage, Flexible Decarbonised Heat

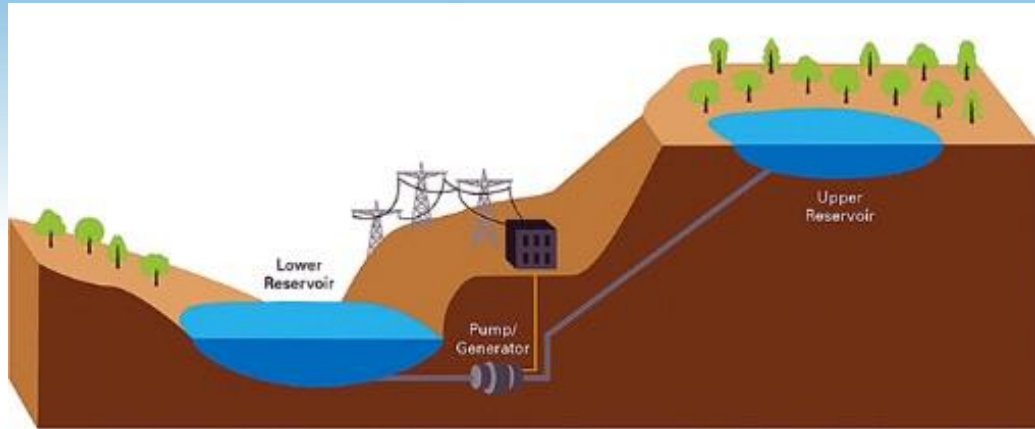
The Ground Source Heat Pump Association
Wednesday 5th June 2019



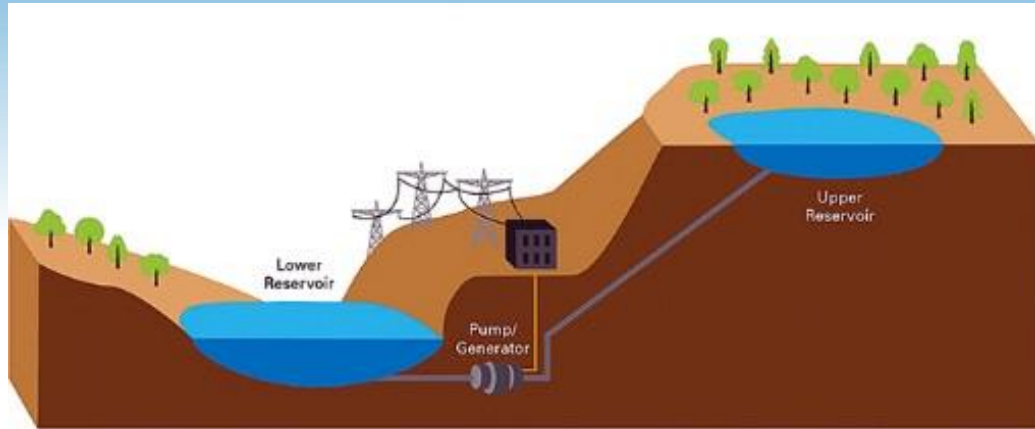
Pumped hydro



Pumped hydro & electric vehicles



Pumped hydro, electric vehicles and large scale batteries



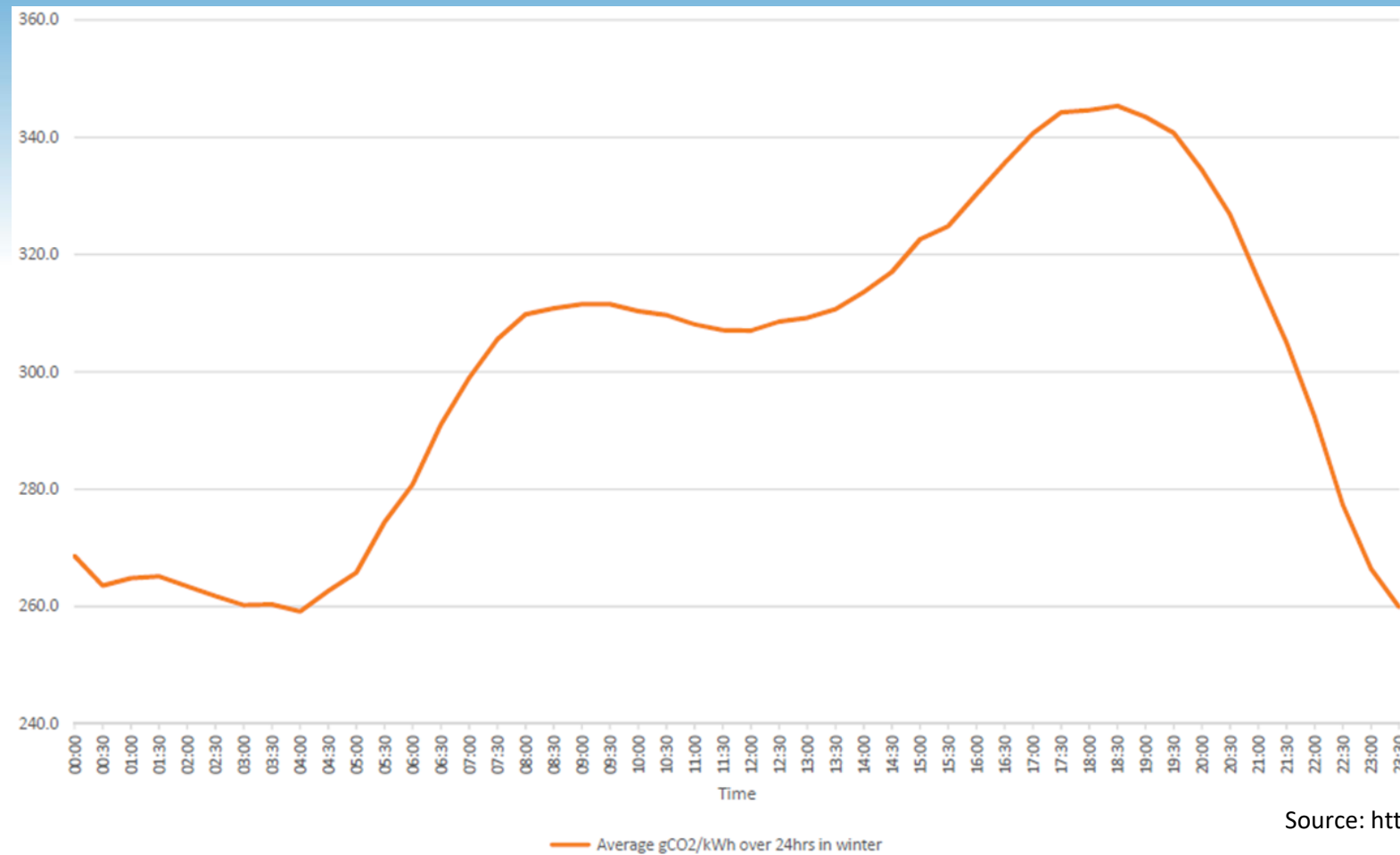
Planetary scale thermal storage



Massive renewable thermal battery storage capacity

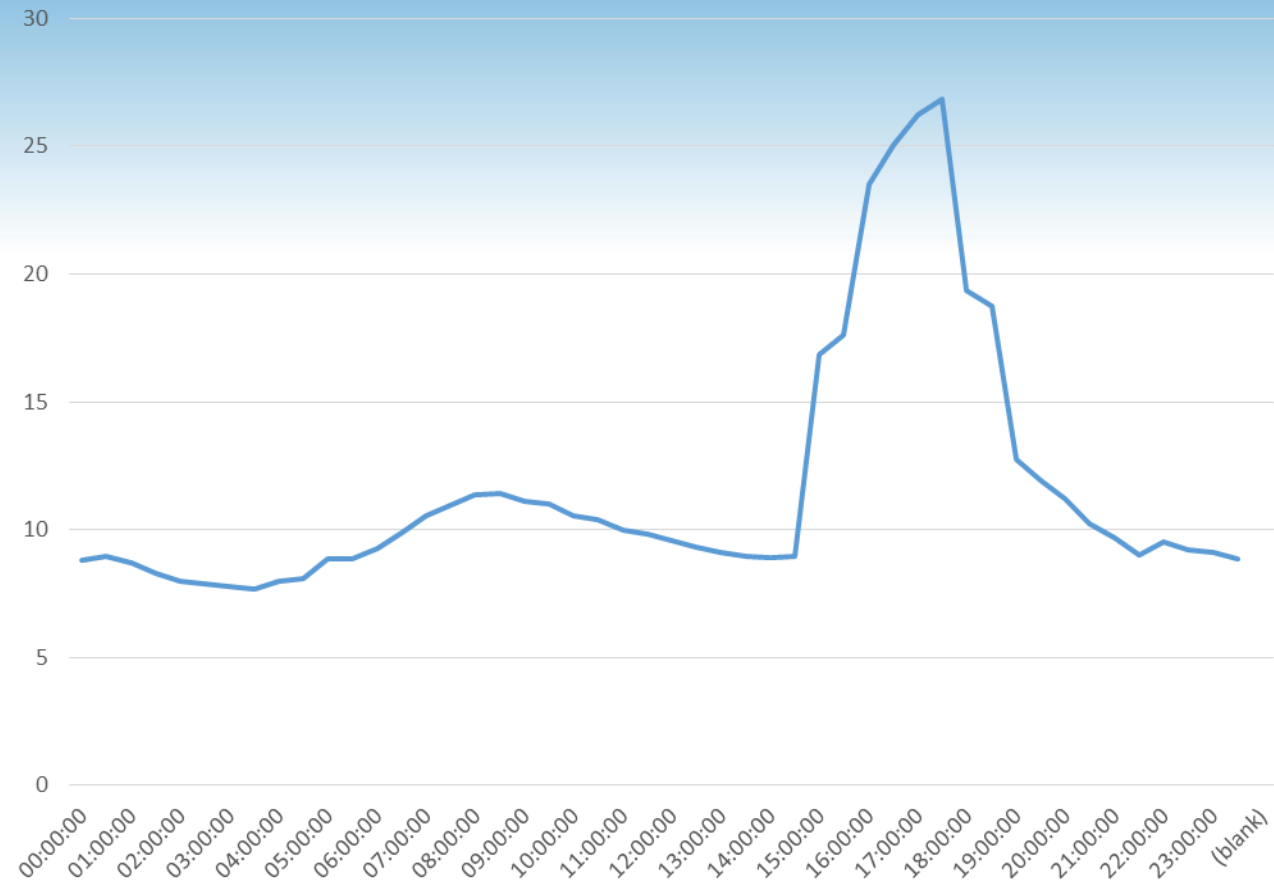


Average UK grid carbon intensity by half hour



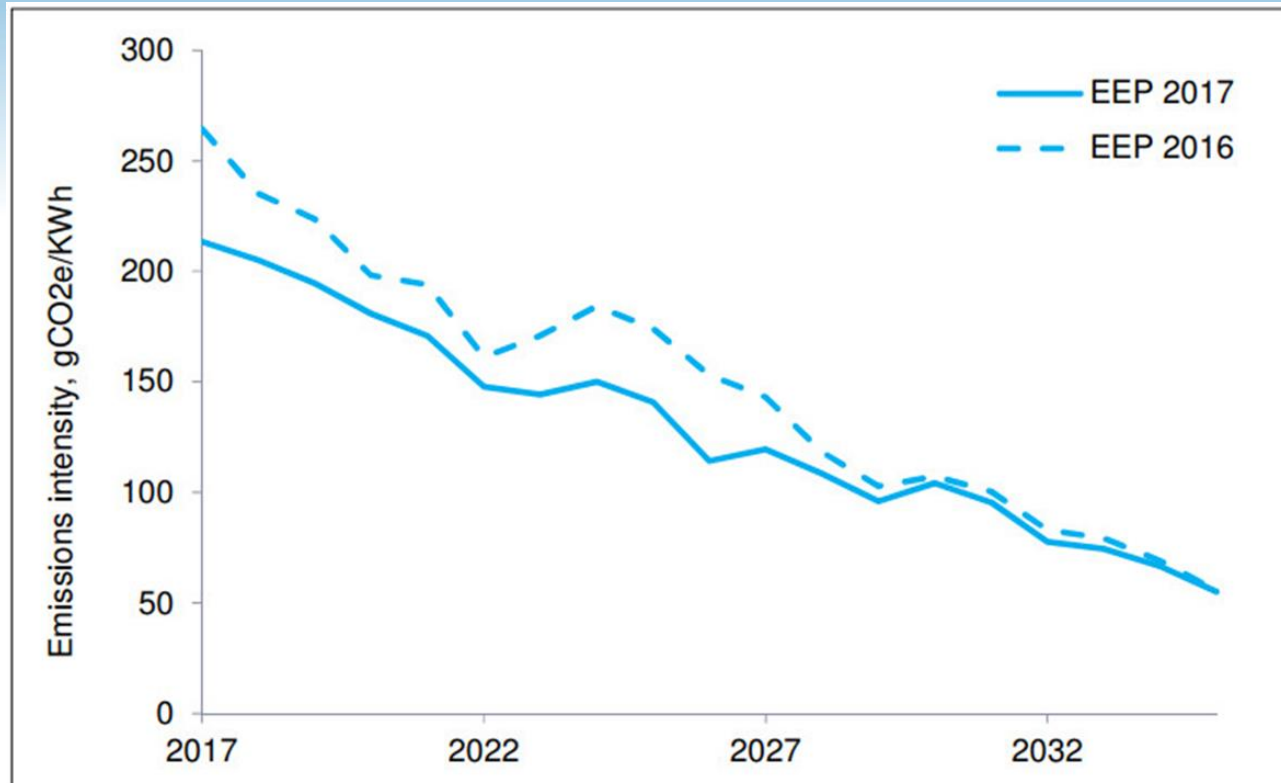
Average UK retail electricity price by half hour

Average price by half-hour segment in London
(23/5/2017 - 23/5/2018)



Source: Octopus Energy

What is happening to grid carbon intensity?



Source: DBEIS

CO2 from Heating systems

UK grid at : 2018-10-12 08:30

is emitting : 194 grams CO2 /kWh

Ground Source Heat Pump (400%):	48
Ground Source Heat Pump (320%):	61
Direct Electric heating (100%):	194
Gas boiler (85%):	215
Oil boiler (85%):	320
Coal (50%):	630

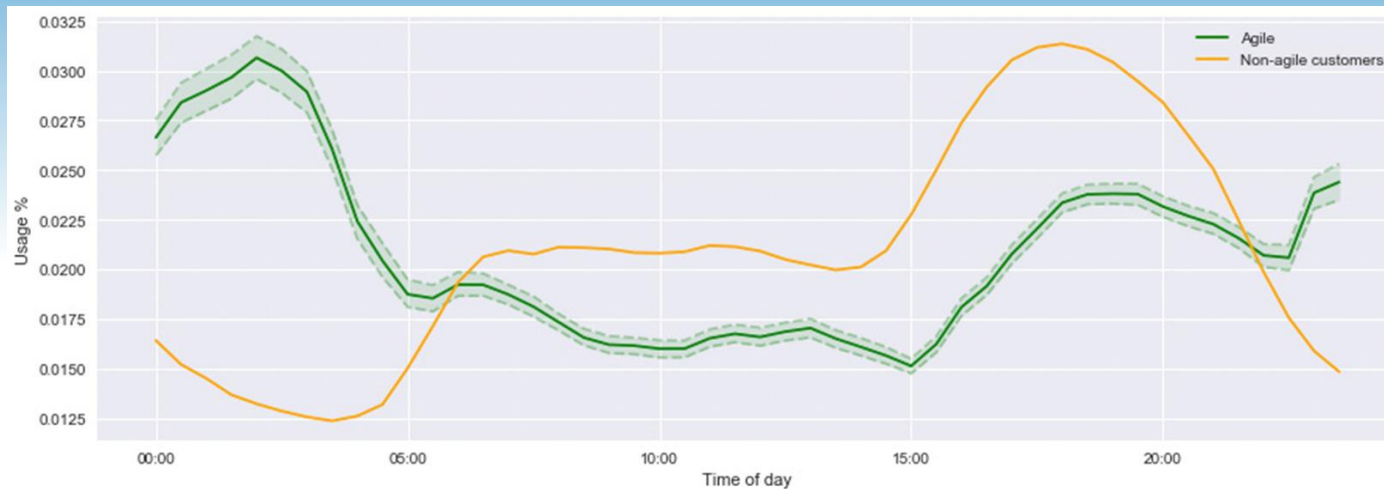
grams CO2 per kWh delivered heat

GSHP
association

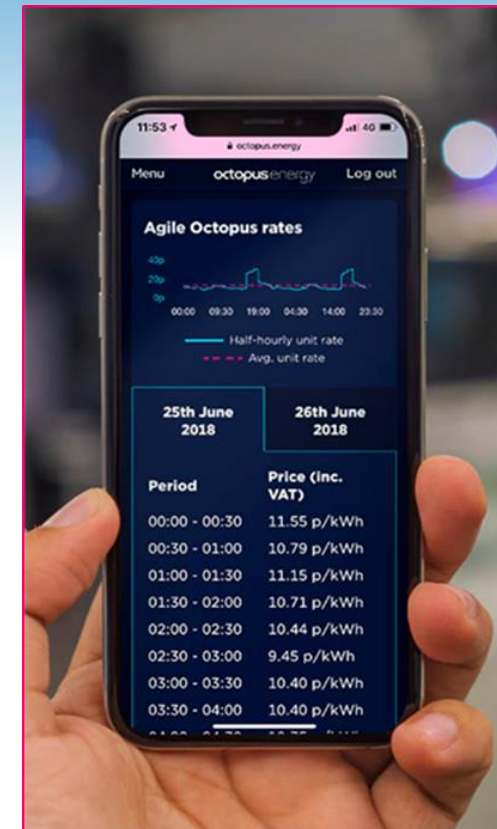
www.gshp.org.uk

Source: GSHPA

EV evidence for load shifting



Octopus Energy Agile Tariff consumers demonstrate significantly different consumption profiles compared to average non-agile consumers. Low cost electricity is a proxy for low carbon intensity. Initial benefits for EV charging but progressing to heat pump deployment with thermal storage.



Source: Octopus Energy

Tariff gains from load shifting

Sunday
18th March 2018

For electricity meter 17P3001648

Total cost

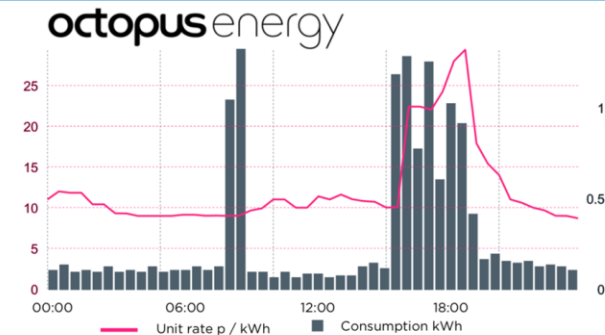
£ 2.26

Total consumption

13.82 kWh

Weighted average unit rate

16.36 p / kWh



Period	Rate p / kWh	Consumption kWh	Cost p
00:00 - 00:30	11.00	0.10	1.100
00:30 - 01:00	11.98	0.13	1.557
01:00 - 01:30	11.82	0.09	1.064
01:30 - 02:00	11.82	0.10	1.182
02:00 - 02:30	10.40	0.09	0.936
02:30 - 03:00	10.40	0.12	1.248
03:00 - 03:30	9.30	0.09	0.837
03:30 - 04:00	9.28	0.10	0.928
04:00 - 04:30	8.98	0.09	0.808
04:30 - 05:00	8.98	0.12	1.078
05:00 - 05:30	8.98	0.09	0.808
05:30 - 06:00	8.98	0.10	0.898
06:00 - 06:30	9.12	0.10	0.912
06:30 - 07:00	9.12	0.12	1.094
07:00 - 07:30	9.00	0.10	0.900
07:30 - 08:00	9.02	0.12	1.082
08:00 - 08:30	8.98	1.04	9.339
08:30 - 09:00	9.02	1.32	11.906
09:00 - 09:30	9.64	0.09	0.868
09:30 - 10:00	9.91	0.09	0.892
10:00 - 10:30	11.00	0.06	0.660
10:30 - 11:00	11.00	0.09	0.990

Thursday
22nd March 2018

For electricity meter 17P3001648

Total cost

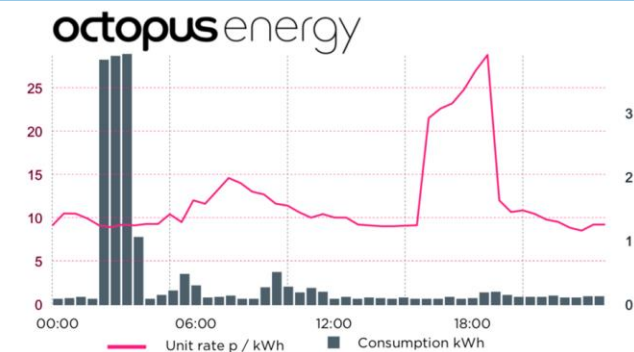
£ 1.85

Total consumption

18.48 kWh

Weighted average unit rate

10.01 p / kWh



Period	Rate p / kWh	Consumption kWh	Cost p
00:00 - 00:30	9.07	0.07	0.635
00:30 - 01:00	10.49	0.08	0.839
01:00 - 01:30	10.46	0.10	1.046
01:30 - 02:00	9.90	0.07	0.693
02:00 - 02:30	9.10	3.82	34.762
02:30 - 03:00	8.90	3.88	34.532
03:00 - 03:30	9.20	3.91	35.972
03:30 - 04:00	9.10	1.04	9.464
04:00 - 04:30	9.27	0.07	0.649
04:30 - 05:00	9.27	0.13	1.205
05:00 - 05:30	10.40	0.20	2.080
05:30 - 06:00	9.48	0.46	4.361
06:00 - 06:30	12.00	0.28	3.360
06:30 - 07:00	11.60	0.09	1.044
07:00 - 07:30	13.09	0.10	1.309
07:30 - 08:00	14.58	0.12	1.750
08:00 - 08:30	14.00	0.07	0.980
08:30 - 09:00	13.00	0.07	0.910
09:00 - 09:30	12.68	0.25	3.170
09:30 - 10:00	11.61	0.49	5.689

Source: Octopus Energy

The resulting numbers

Heat demand 20,000kWh/ annum	Carbon emissions/ Annum Kg	Operational cost : Gas at 4.5p/kWh	Operational cost : Ground source electricity at 16p/kWh	Operational cost : Ground source electricity at 10p/kWh
Gas at 85% efficient	4,300	£900		
Ground source at SPF 3.5:1	1,120 Reduction of 74%		£914	£572 Reduction of 36%

The resulting benefits

- Lower operational cost for heating and cooling
- Lower carbon intensity for heating and cooling
- The value of demand side management, demand side response and load shifting
- Smart integration between local electrical generation, local electrical demand, EV battery charging (and discharge to grid) and heat (or coolth) demand
- Reduced grid reinforcement investment required
- Reduced investment in generation capacity
- Can be combined with innovative retail models for heat as a service
- Potential for lower lifetime costs due to the long term value of in-ground ground source infrastructure
- Potential reduced decommissioning / recycling costs for thermal storage vs electrical battery storage

Developments in thermal storage



Thank you

www.gshp.org.uk

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