CITY BLACKOUT

Lights-Gas Boilers-Electric Heat Pumps-Computers

Fuel-Water-Food-Phones-Transport ?

OP

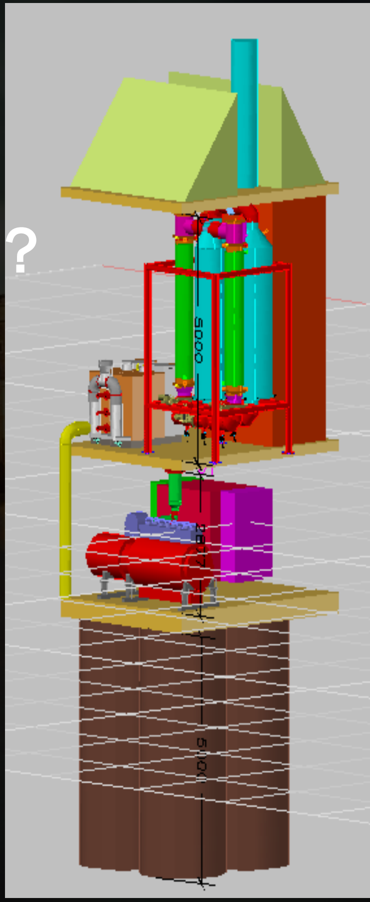
SOLUTION 10 GW DISTRIBUTED DUAL FUEL CHP HUBS AT 11kV RING /415V RADIAL INTERFACE.

CHEAPEST BACK UP FOR COLD DAYS NO WIND & SNOW ?

ZERO CARBON HEAT SOURCE PEAK DAYS

COP INFINITE &

5.4 BASE LOAD COMPETING WITH GGGT



Oil and heat stores secure local heat and power

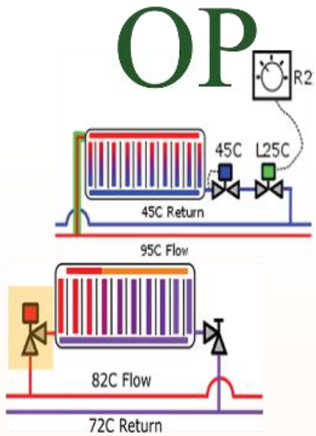
Tanks in dwellings secure domestic hot water supply

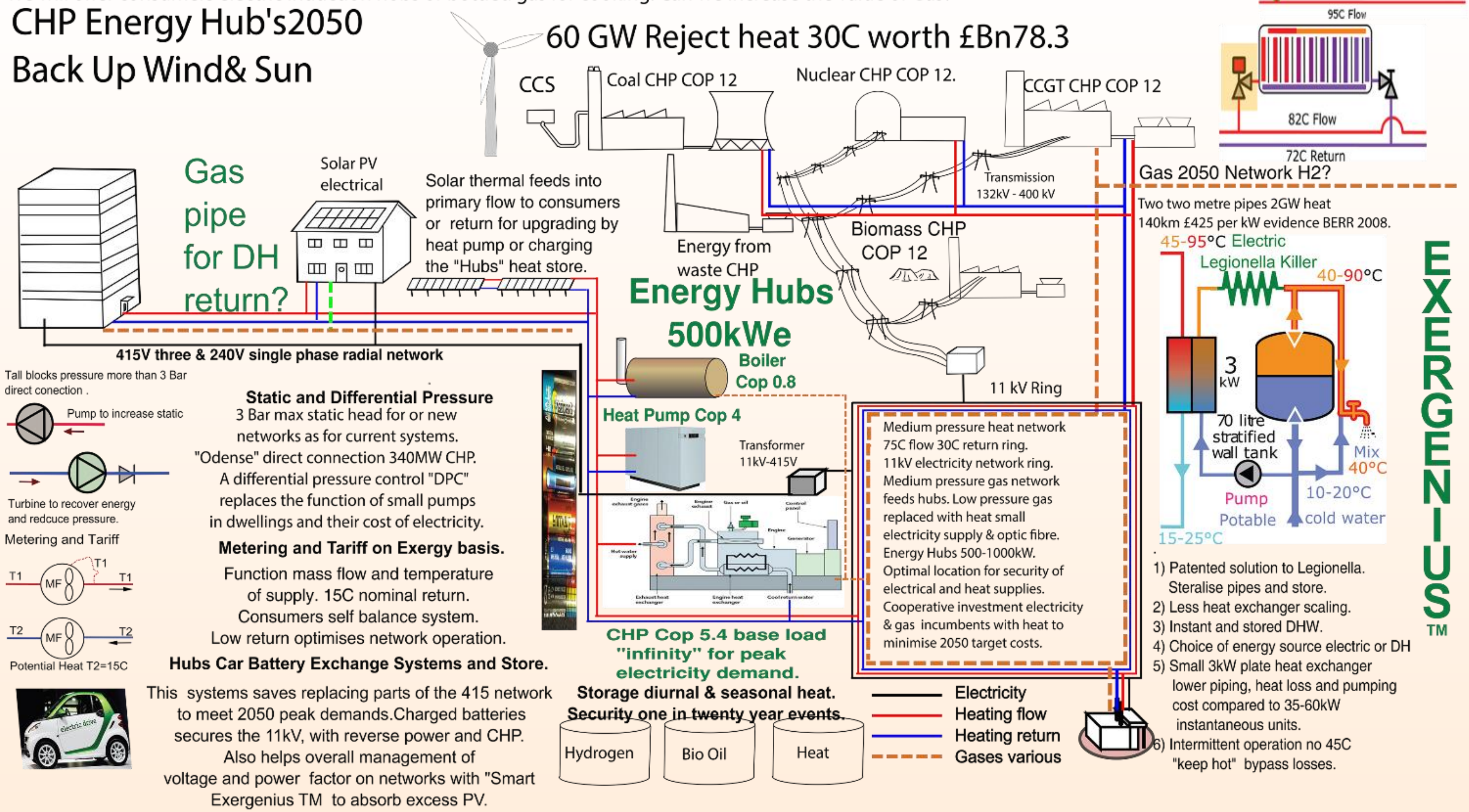
With option for economic electric heating

as well as low carbon heat from heat networks,

Heat Pump, CHP, Solar Biomass. A heat network design to retrofit our domestic sector .

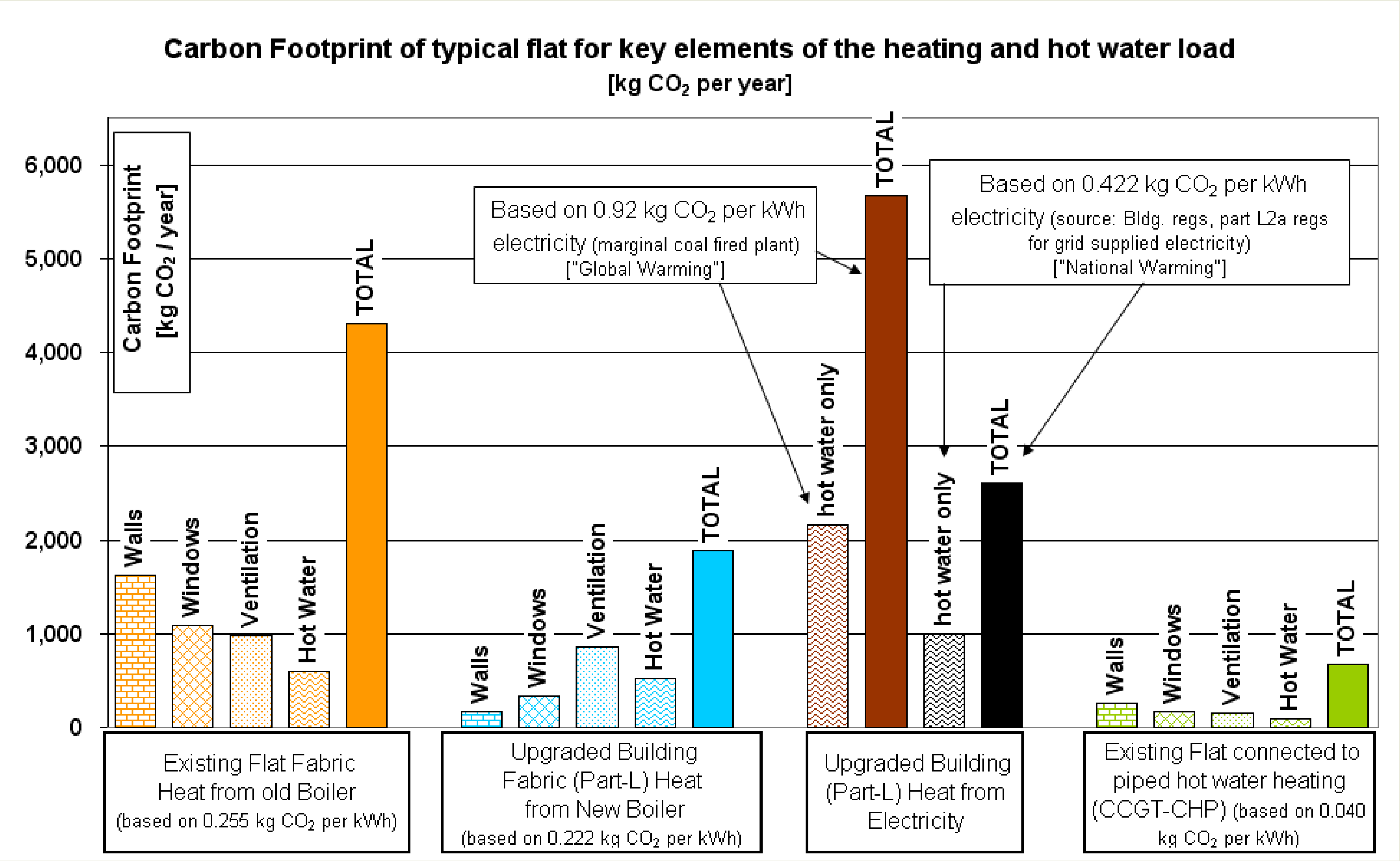
Heat network pipe size heat loss and pumping minimised. 95C flow 45C return. Connected load minimised with smart 3kW domestic hot water stores heated when heat cost is low over 24 hours instead of 35-60kW instant "HIU" for 4 hour morning peak. Exergenius (TM) absorbs high value and intermittent renewable electricity steralising its system. The Heat network is fed by low cost low CO2 solar thermal, heat pumps, renewable boilers, and dual fuel gas CHP. Current radiators are retrofitted with return temperature limiters to minimise return water temperatures. Condensing CHP and boilers and solar thermal improve by 6%. The system is ideal for heat pumps. We expect to use the HDPE yellow gas pipes for our heating return and their wayleaves for a new heat network flow. We will offer consumers electric induction hobs or bottled gas for cooking. Can we increase the value of Gas?





Insulation and low CO2 heat supply.

OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

£78 Bn Heat Network CHP Spend Justified Compared to Air Source Electric Heat Pumps

OP

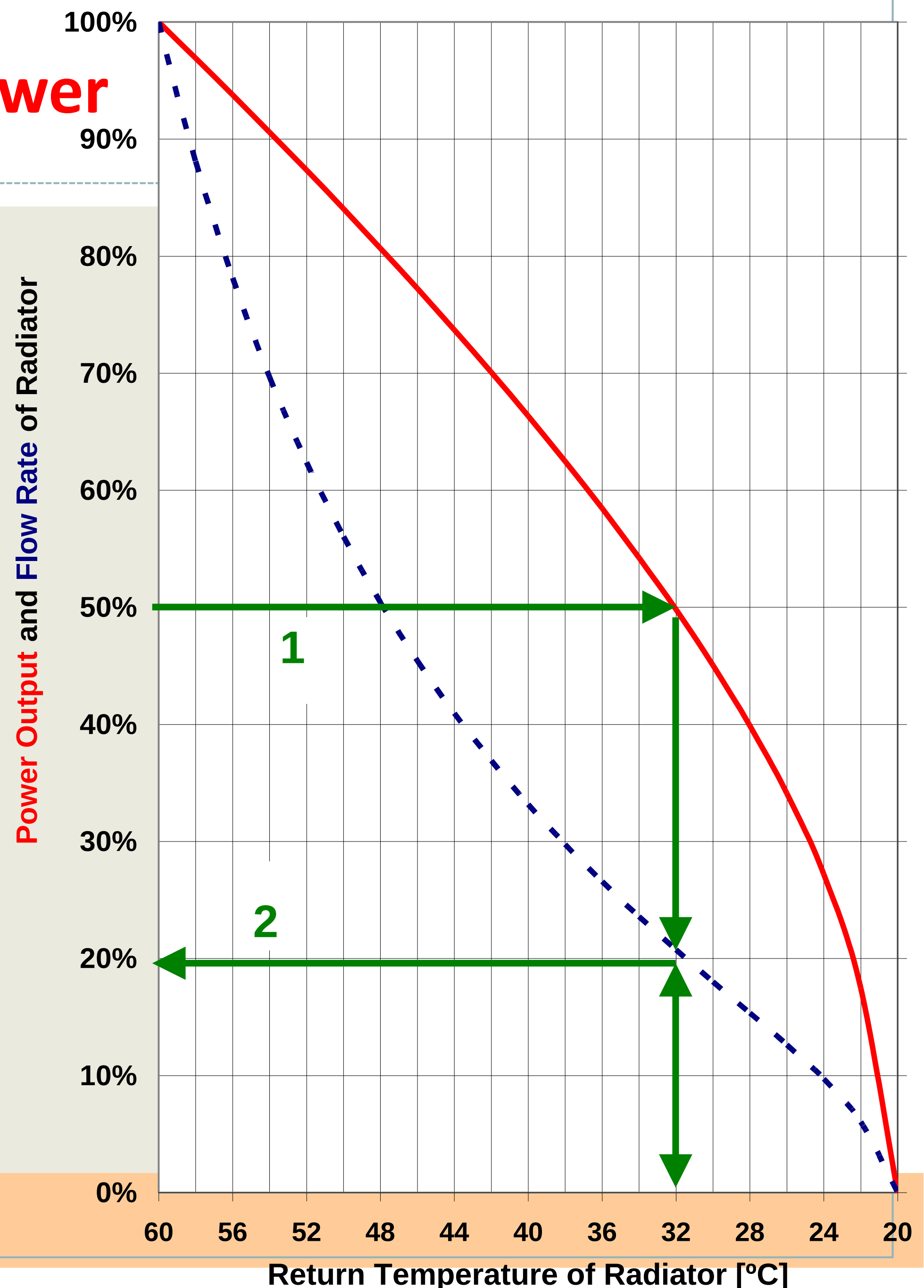
- £78Bn is Carnot value of 30C reject heat in 2035 thermal generation for upgrading by "CHP Virtual Electric Heat Pumps" Lowe, Mackay, Orchard, Comparison Air at lower temperature as heat source for electric heat pumps .
- Use HDPE Gas pipe for return water for new heat network, route for new flow pipe and up to date optic fibre and small emergency supply of electricity to power and control installations.
- Novel piping keeps local heat network hot whilst turning return pipe off.
- Novel Exergenius method to heat domestic hot water ANTI Legionella
- Absorbs excess Electricity from Solar PV improves performance of all heat sources. You are paid to heat your domestic hot water!

Tel 020 8296 8745 email william@orchardpartners.co.uk

Flow Rate at 50% Power

Tests and design for heat networks need to reflect flow and power curves for 80c 60c radiators. They tend to be superior to underfloor heating as require lower pumping overhead smaller pipes they have a faster response and deliver lower return water temperatures.

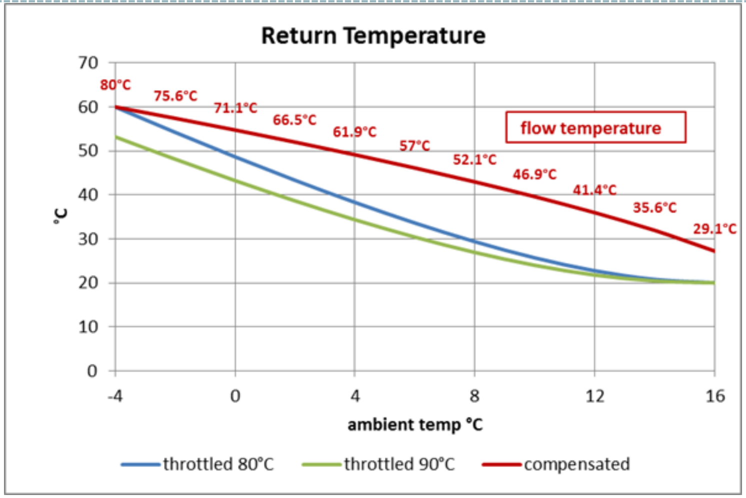
If we are to retrofit the current domestic sector at least cost then direct connection and a peak flow temperature of 90-95C will deliver that result when combined with 75C or lower temperatures to meet most of the heating load where outside air is heated with return water from the radiators and MV. Cheaper than MHVR

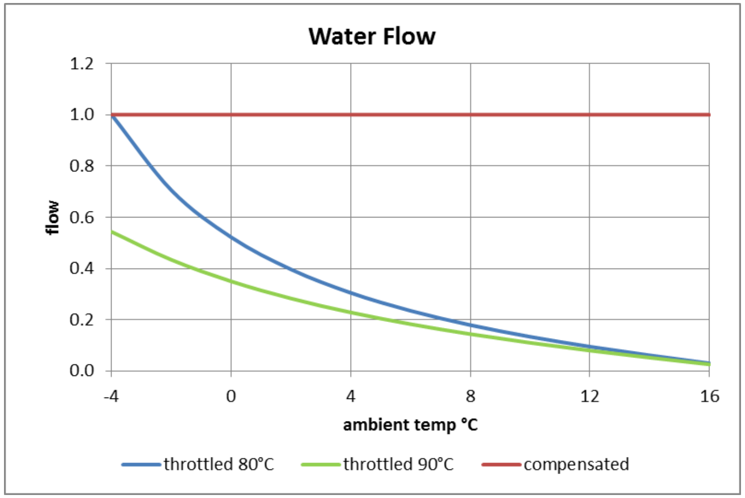


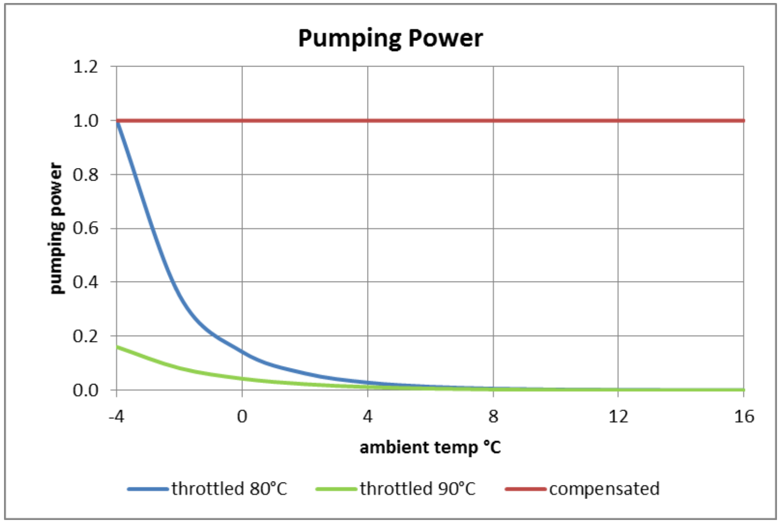
Tel 020 8296 8745 email william@orchardpartners.co.uk

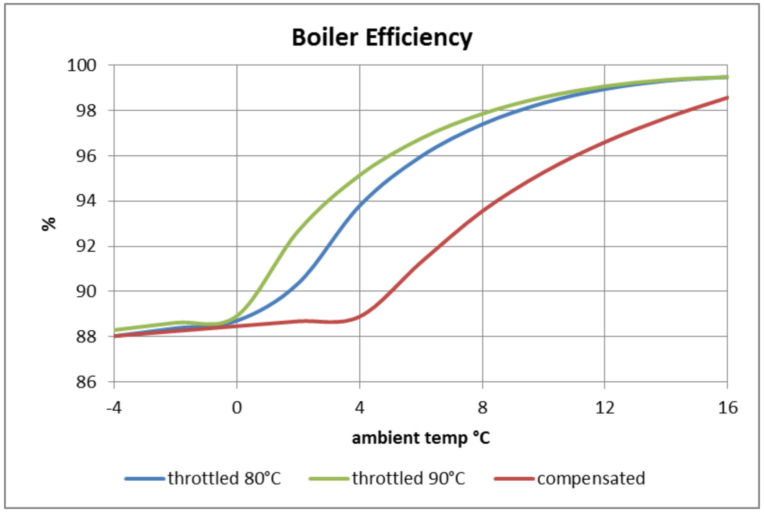
Least Cost Conversion 80C 71C systems Raise flow to 95C Flow bigger Delta T Smaller Pipes lower heat loss and pumping!

OP







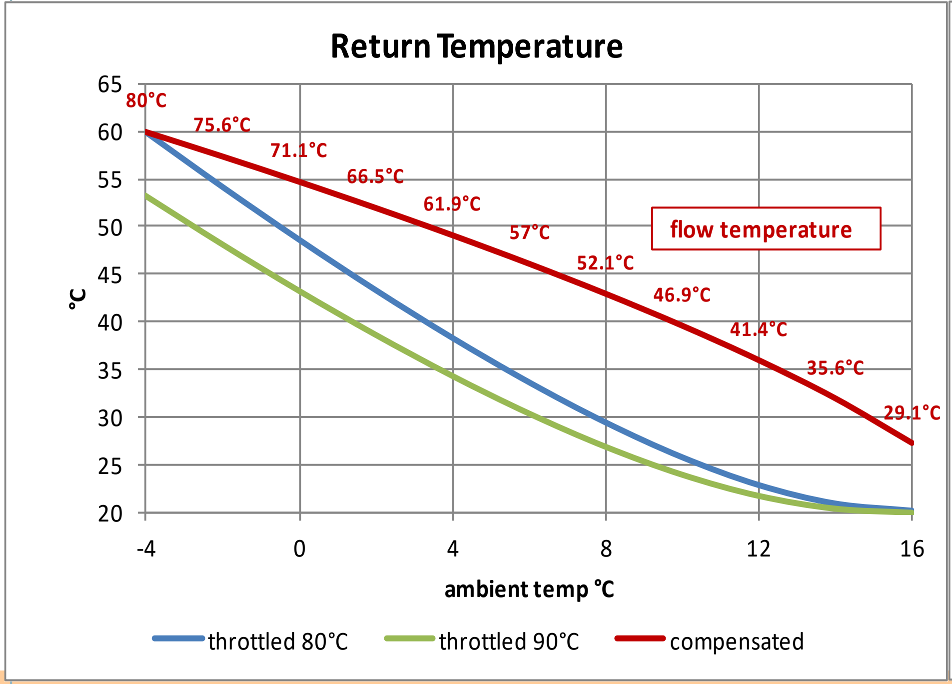


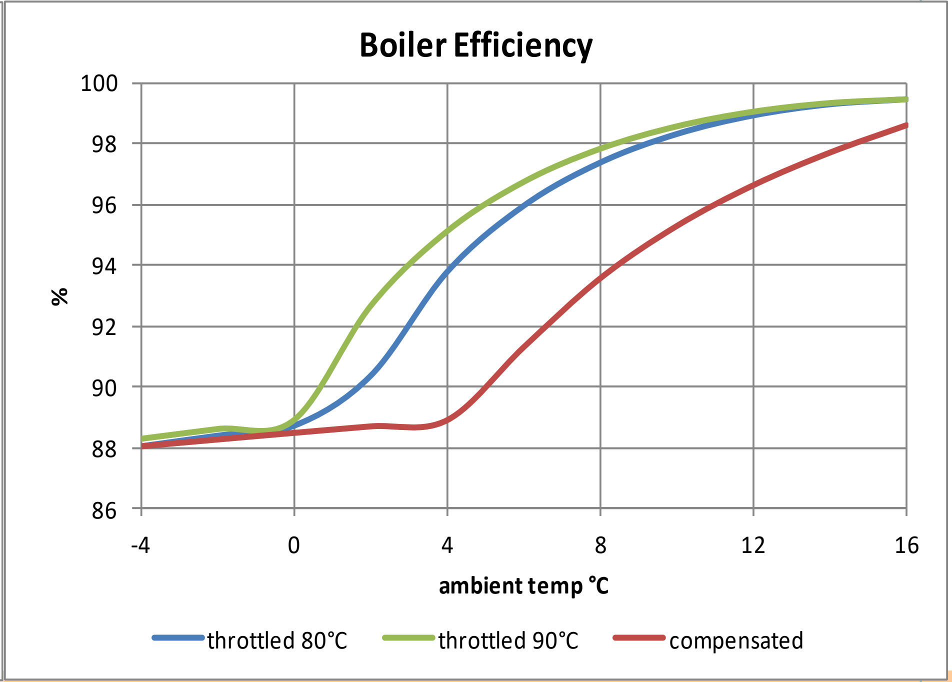
Tel 020 8296 8745 email william@orchardpartners.co.uk

Condensing maximises useful exergy. Latent heat of steam captured from flue gases.

OP

Lowest return temperature and with fully variable flow modulating control superior to "compensated" reducing flow temperature to match air temperature. Higher flow temperature, no exergy penalty for boiler, Increases boiler condensing temperature to radiator. Counterintuitive!



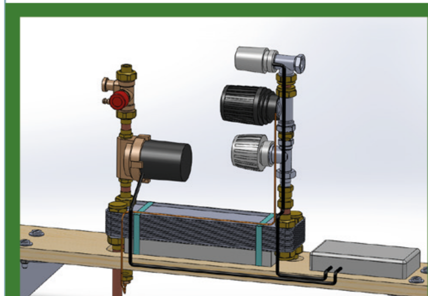


Tel 020 8296 8745 email william@orchardpartners.co.uk

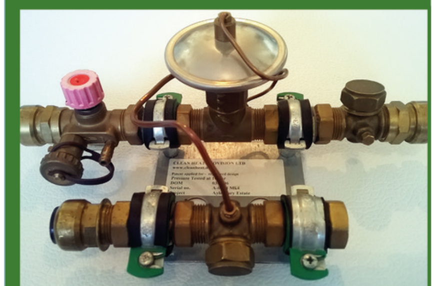
Exergenius & how to simply retrofit UK Domestic Sector to heat networks.

OP

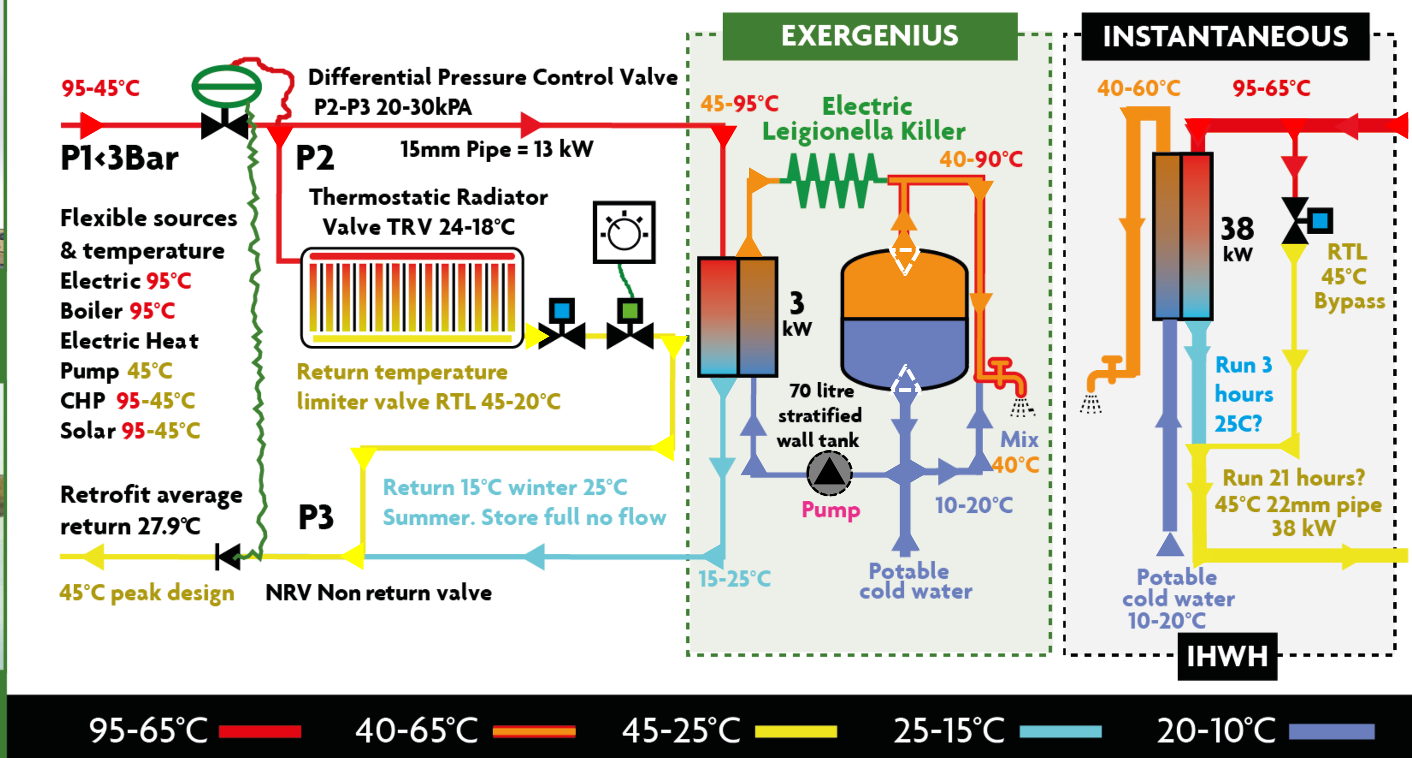
10% energy and exergy saving for heat networks, heat pumps, boilers, solar, combined heat & power



Retrofit for cylinder with Coil for condensing



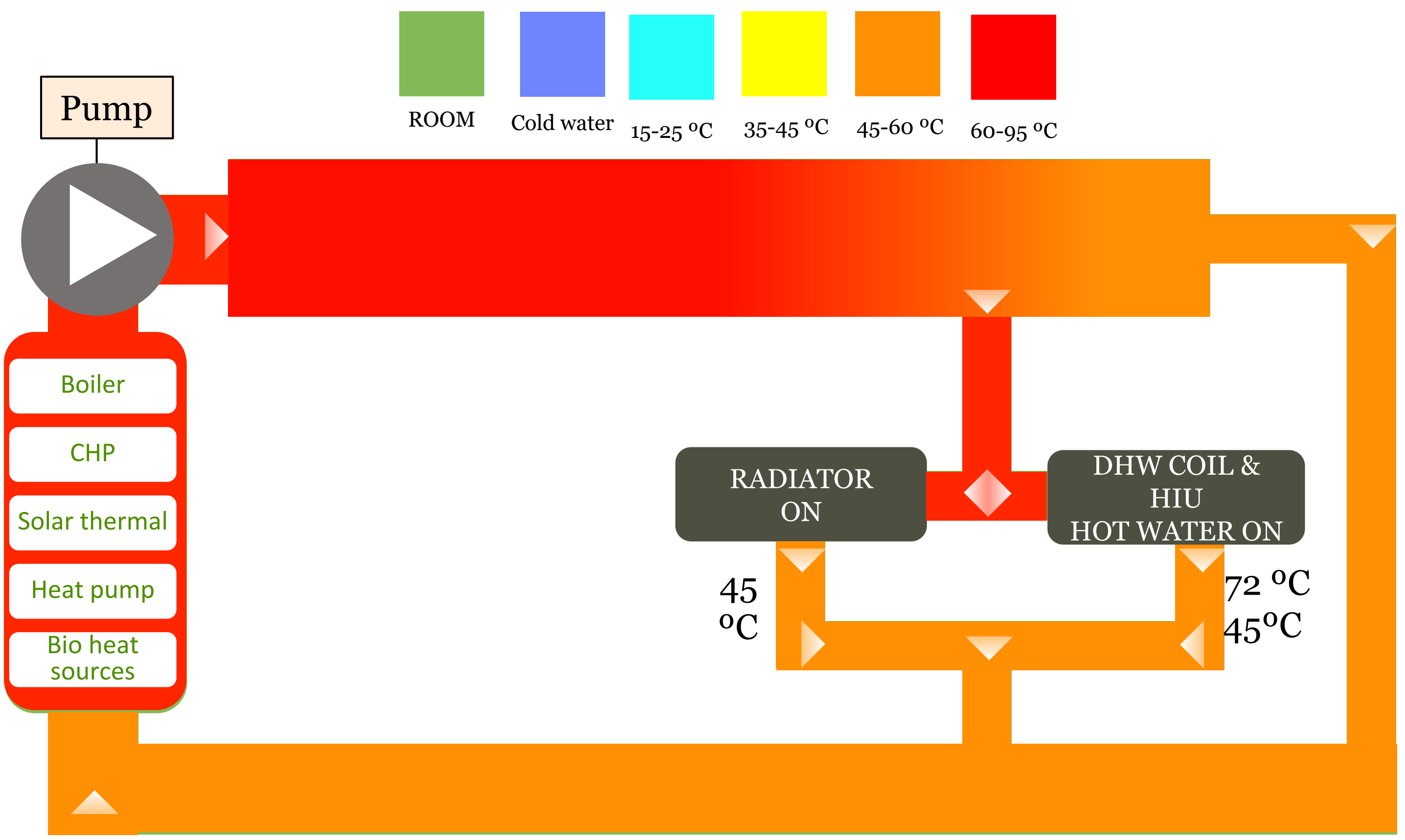
DPC interface product Roupell



Tel 020 8296 8745 email william@orchardpartners.co.uk

Normal Network with Bypass Start and ON

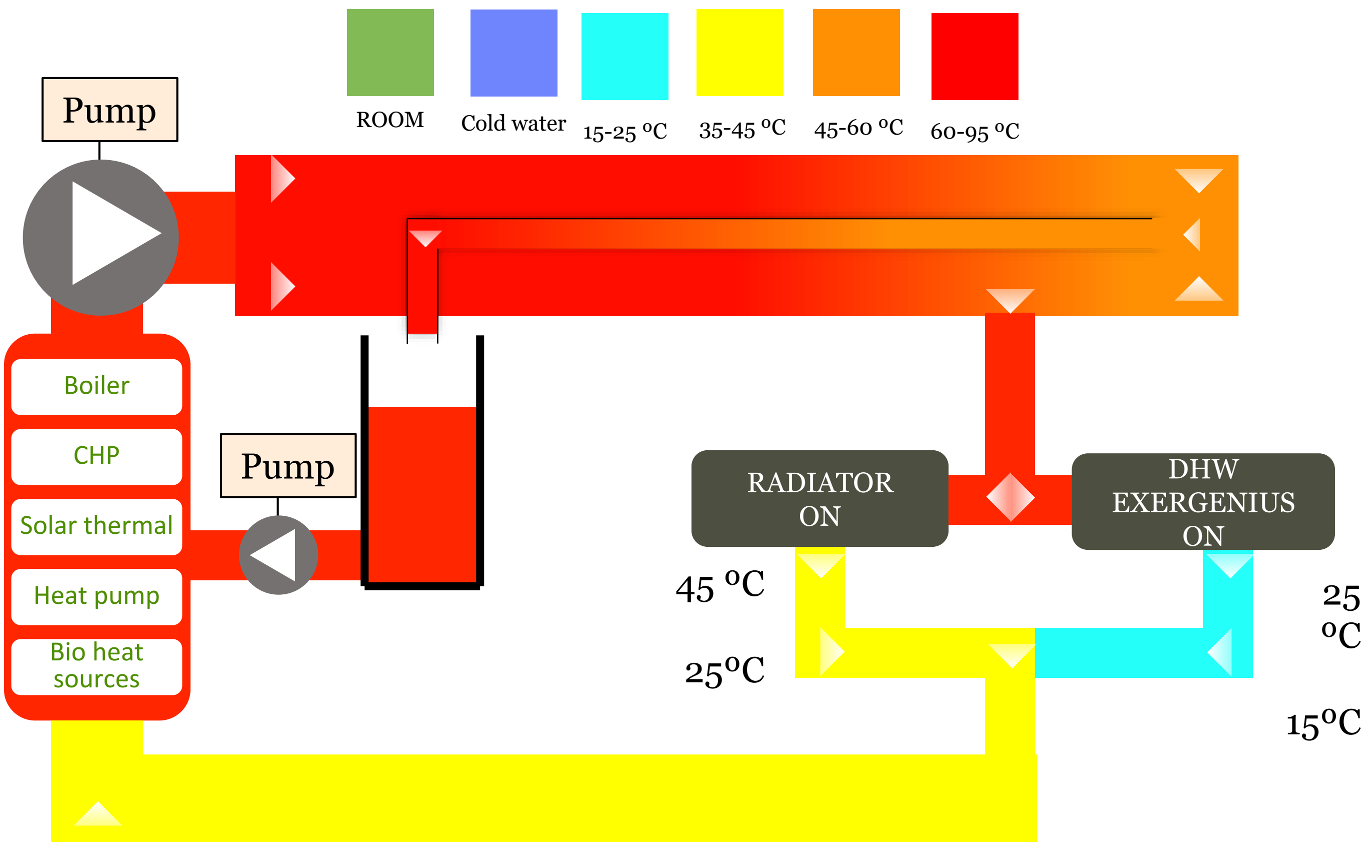
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Novel Heat Network "KEEP HOT PIPE" & EXERGENIUS TM Domestic Hot Water.

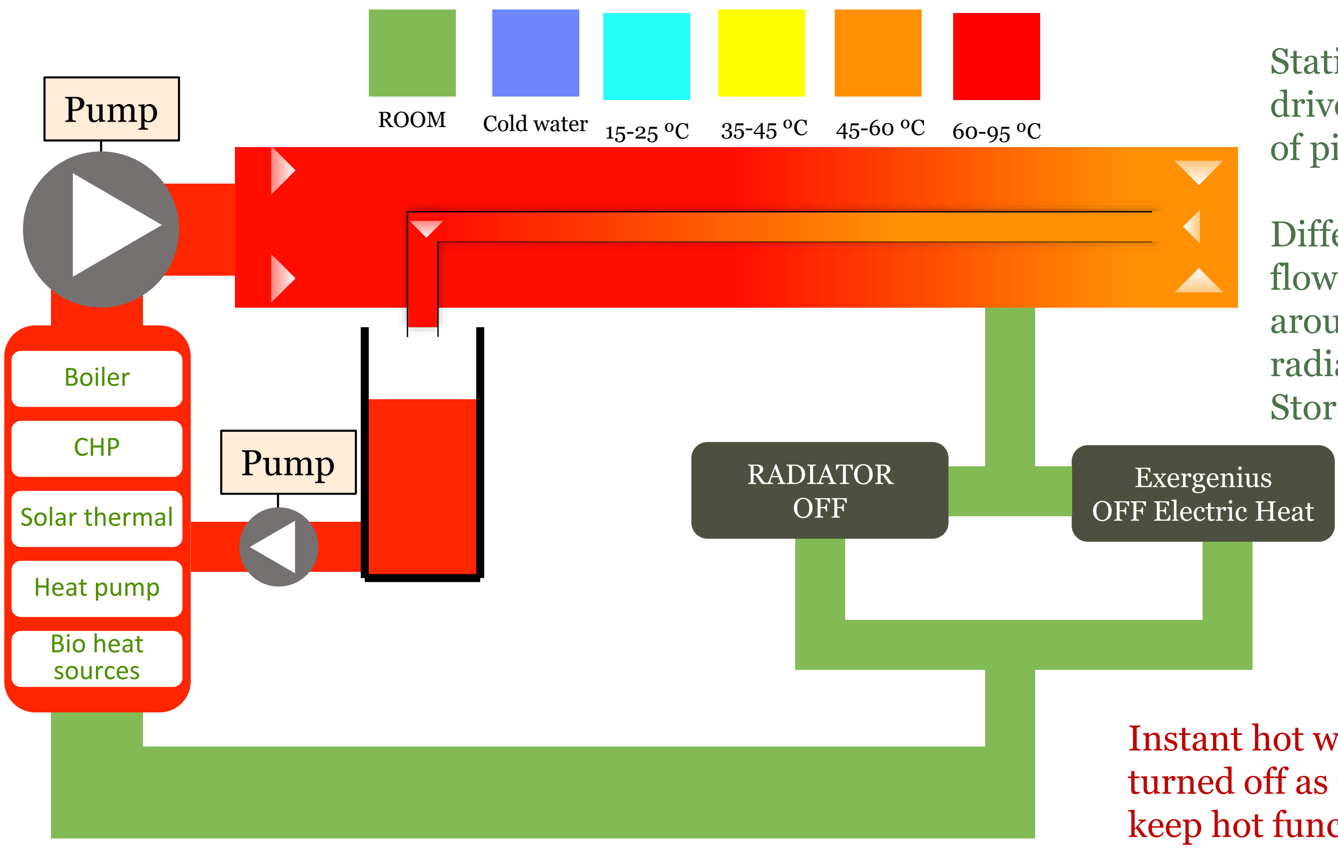
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Keep Hot Pipe. Summer Return Off. Wind PV EL heat water. Return On Solar Thermal EHP.

OP



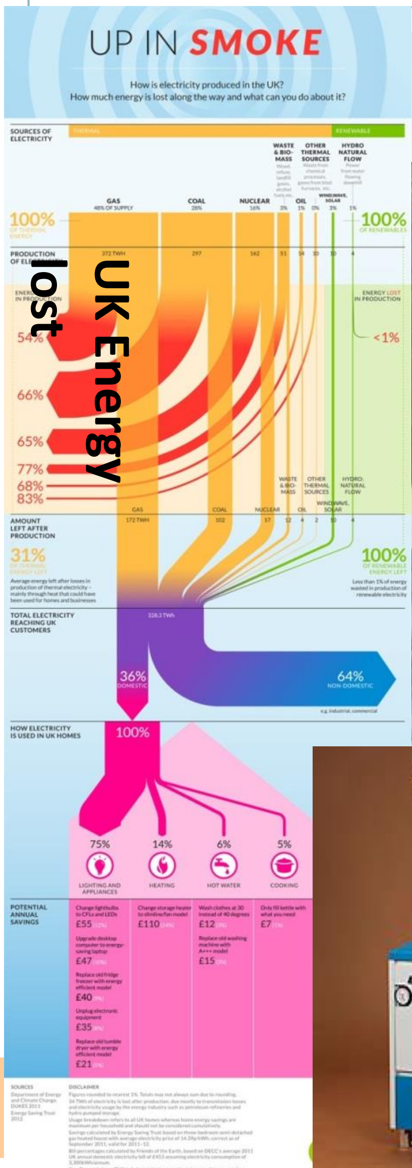
Static pressure (3 Bar) drives water down middle of pipe and out into tank.

Difference in pressure flow return drives water around system through radiators and hot water Stores

Instant hot water can not be turned off as it requires a small keep hot function with a return temperature of around 45C when no demand for DHW.

Do you know that Heat from Coal Fired CHP decarbonises countries heated by gas ?

OP



UK Energy lost

Heat rejected in UK power generation equates to the supply of gas to our domestic sector

DK Energy Gained

CO_2

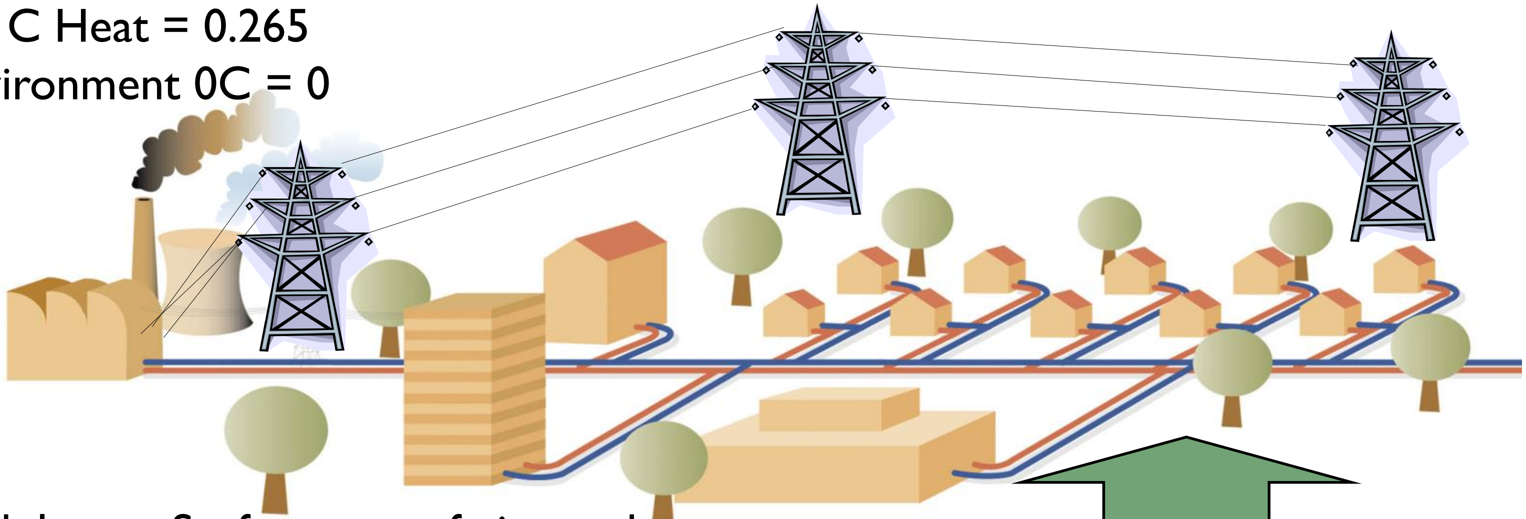
Heat from coal fired CHP	0.079 kg/kWh
Gas boiler 75 % GCV efficiency	0.233 kg/kWh
Electricity coal 36% GCV efficiency	0.837 kg/kWh

Heat & electrical network losses.
Average & Marginal Energy and Exergy

Electricity network losses i x i x r
i = Current r = resistance.
Double power, loss factor increases by four.

Exergy Measures "Value" of Energy
Exergy Electricity = 1.0
Exergy 100 C Heat = 0.265
Heat in Environment 0C = 0

Electrical Distribution CCGT Energy kWh(e)
10 % (average) to > 20 % (marginal)
Exergy loss average 0.1 marginal 0.2



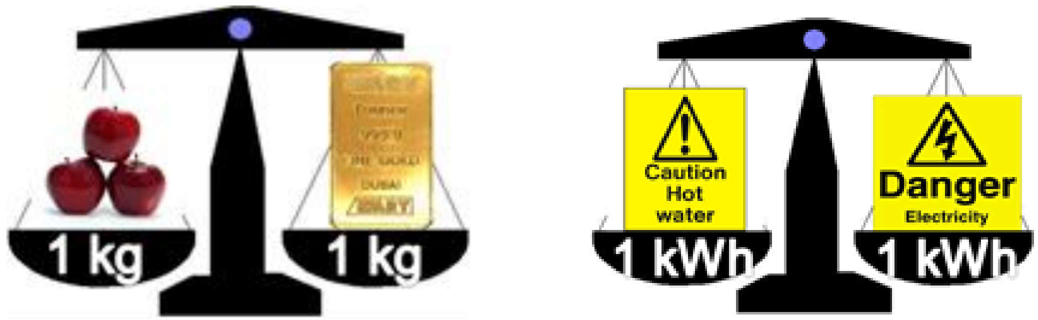
Heat network losses. Surface area of pipe and temperature. Relatively constant. Pipe carrying capacity. Double pipe size four times capacity.

CHP Heat Distribution Energy Loss per kWh (h)
8 - 20% (average) 0 – 2 % (marginal)
Exergy loss average 0.02 marginal 0.002

Tel 020 8296 8745 email william@orchardpartners.co.uk

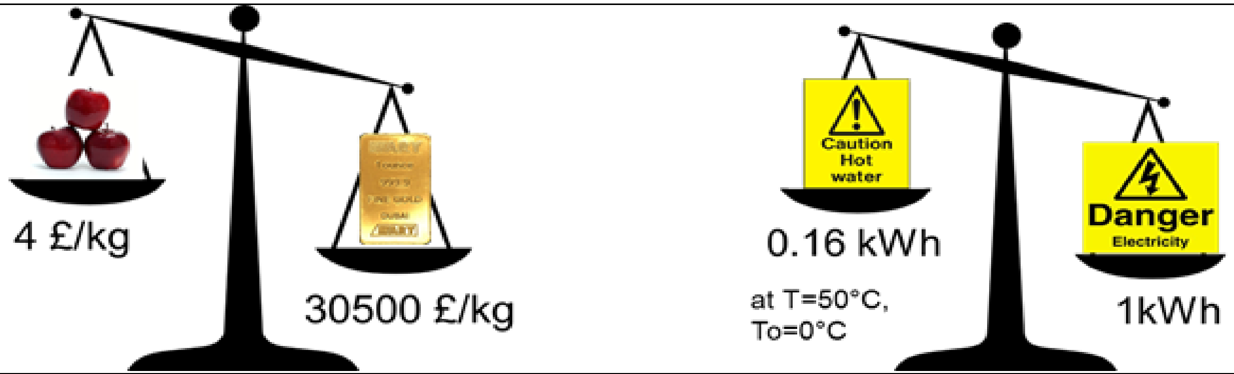
CHP task for Energy or Exergy Economists ? OP

Figure 1: First Law Energy Analysis



Source: Dr Audrius Bagdanavicius, Institute of Energy of the Cardiff School of Engineering

Figure 1: Second Law Exergy analysis for water at 50C with reference Carnot temperature zero C



Source: Dr Audrius Bagdanavicius, Institute of Energy of the Cardiff School of Engineering

Tel 020 8296 8745 email william@orchardpartners.co.uk

Information from Excel Spreadsheet Comparing Instant Hot water and Storage Options.

OP

The model compares the effect of retrofitting UK dwellings with 82C heat networks by raising the flow temperature to 95C compatible with optimal seasonal thermal storage . The effect is to reduce return water temperatures and reduce the pipe size and thus pumping and heat losses from the heat network. A further feature analysed in the spreadsheet is the effect of heating outside air for ventilation with the return water from the radiators thus further reducing pipe size and heat loss. The inputs to the spreadsheet are as shown on the next slide. The analysis is against recorded outside hourly outside air temperatures for a year measured at Heathrow.

For the UK retrofitting at 90-95C flow on peak days is likely to be optimal.

Tanks where boilers are replaced can give consumers better service in terms of rate of fill of appliances and security of supply. Tanks offer of an electrical heat the advantage absorbing excess renewable electricity which at times has a negative Price. The following are screen shots from the spreadsheet.

Tel 020 8296 8745 email william@orchardpartners.co.uk

Input Structure with Dropdown Choices

OP

Input to Spreadsheet

Ventilation Heat Recovery		
Engineering Toolbox factor n		1.33
heat loss		
radiator design oversize	%	
occupied space	m²	100
dwelling type		detached
floors		2
room height	m	2.7
ventilation rate	a-c/h	1
U value floor	W/m²K	0.6
U value walls	W/m²K	1.4
U value roof	W/m²K	0.4
shape factor		1.25
calculated heat loss	kW	7.44
heat loss over-ride		none
detached	kW	10
semi-detached	kW	6
terrace	kW	4
user defined	kW	25
vent heat loss-over ride	%	
temperatures		
design ambient temperature	°C	-4
system design ambient temp	°C	-6
internal temperature	°C	21
internal gain	K	4
system design		
maximum air supply temp	°C	50
min air supply temp	°C	21
system flow temp max	°C	95
system flow temp design	°C	75
radiator design flow temp	°C	82
radiator design return temp	°C	71
air heater		
water side exponent		0.65
air side exponent		0.65
design approach	K	10
air side resistance proportion		0.65
DHW heating		

DHW heating		
air temperature	°C	25
mains water temperature	°C	20
DHW temperature	°C	60
base mains water temperature	°C	10
number of persons		2
demand at ΔT of 50K	l/per/d	70
instantaneous demand	kW/person	15
DHW output at 45°C	litres/min	12.3
DHW heating duration - cont	hours	24
DHW heating duration- int	hours	12
approach - instantaneous	K	5
approach - continuous	K	5
approach - intermittent	K	5
maintained temperature	°C	45
surrounding temperature	°C	30
HIU loss - instantaneous	W/K	5
HIU loss - continuous	W/K	
HIU loss - intermittent	W/K	
storage heat loss factor		1
pumping		
design for pressure or velocity		pressure
DP control location		dwelling
design velocity	m/s	1.5
DH system design DP	kPa	1000
maintained customer DP	kPa	20
pressure margin at road	%	10
pump efficiency		0.6
roughness	mm	0.002
density	kg/cu.m	1000
µ	Pas	0.001
supply pipe length	m	15

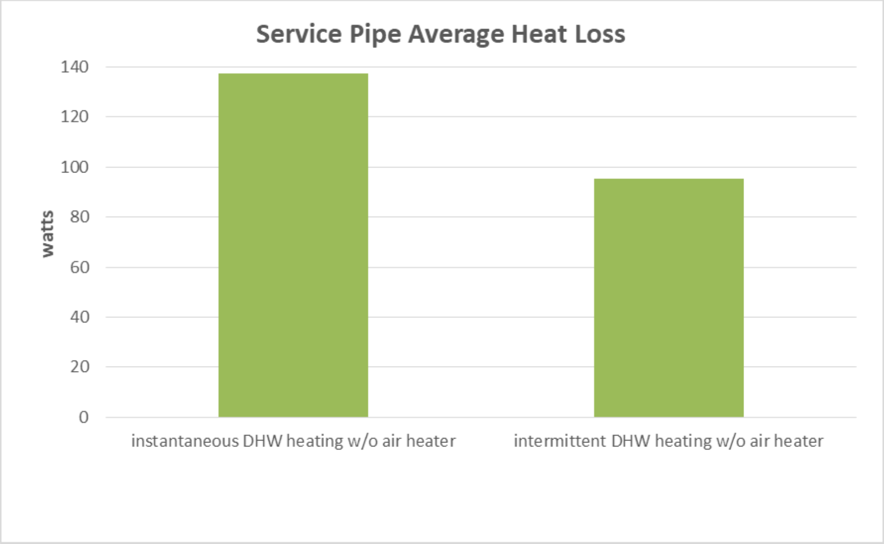
		flow	return
path length			
insulation	mm	32	32
sheath	mm	2.5	2.5
soil	mm	500	500
conductivity			
pipe wall	W/mK	76	76
insulation	W/mK	0.027	0.027
sheath	W/mK	0.43	0.43
soil	W/mK	1.5	1.5
copper pipe			
cost	£/kg	8	
primary energy factors			
electrical generation effy		0.484	
extraction coefficients		0.0034	-0.0789
radiator temperature			
flow		95	70
return		45	40

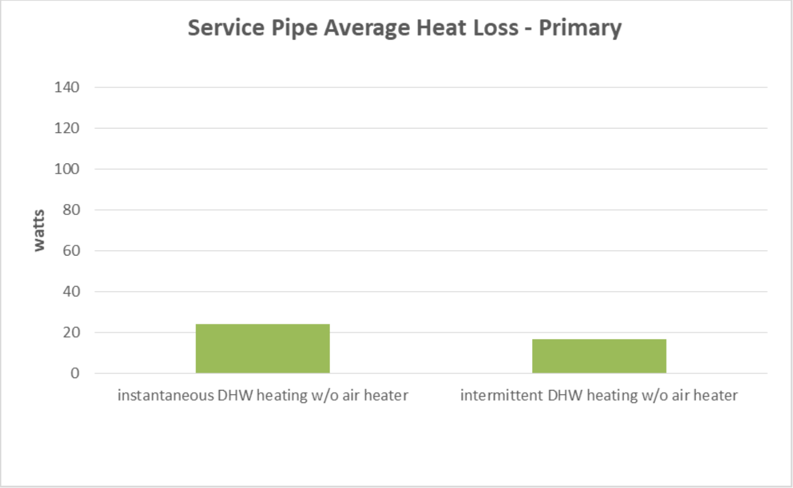
Tel 020 8296 8745 email william@orchardpartners.co.uk

Outputs from Assumptions

OP

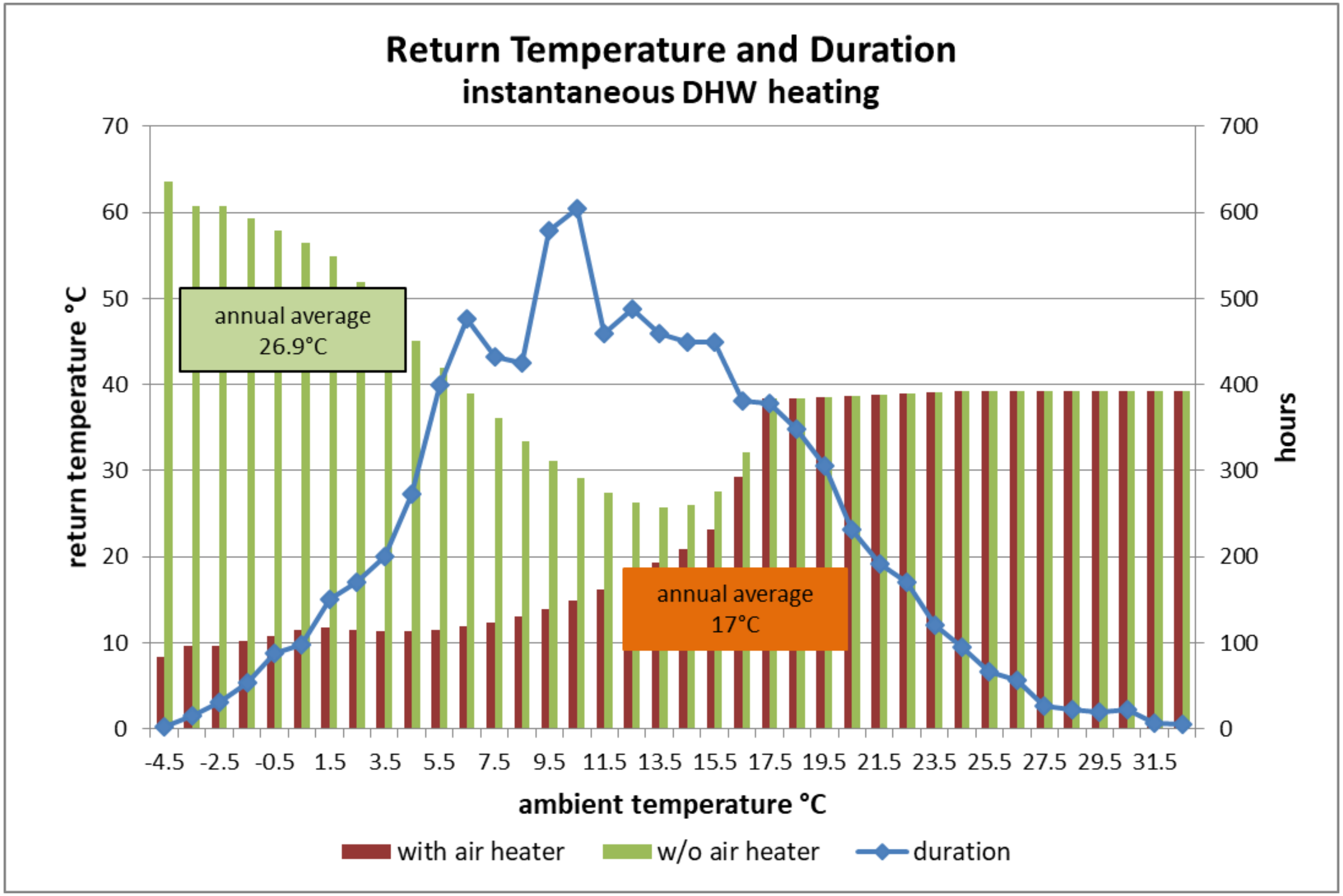
service pipe details		ID	OD	weight	weight	cost
		mm	mm	kg/m	kg	£
instantaneous DHW heating	Radiator + air heat	16.4	18	0.386	11.59	92.75
	Radiator "R"	16.4	18	0.386	11.59	92.75
continuous DHW heating	Radiator + air heat	6.8	8	0.125	3.74	29.93
	Radiator "R"	10.8	12	0.192	5.76	46.11
intermittent DHW heating	Radiator + air heat	6.8	8	0.125	3.74	29.93
	Radiator "R"	10.8	12	0.192	5.76	46.11





Return water temperature effect of heating ventilation load with return water from radiators.

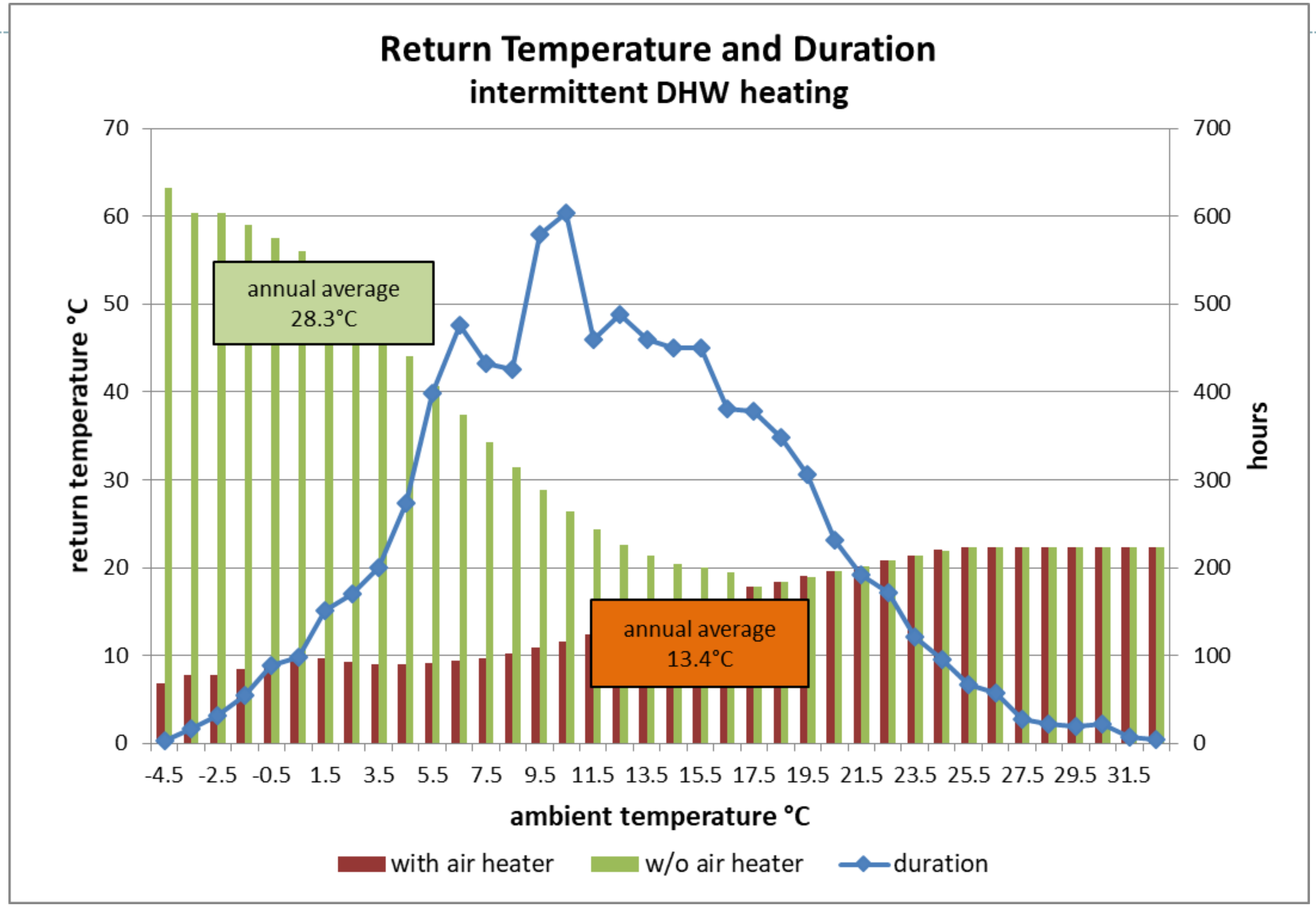
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Return water temperature effect of heating ventilation load with return water from radiators.

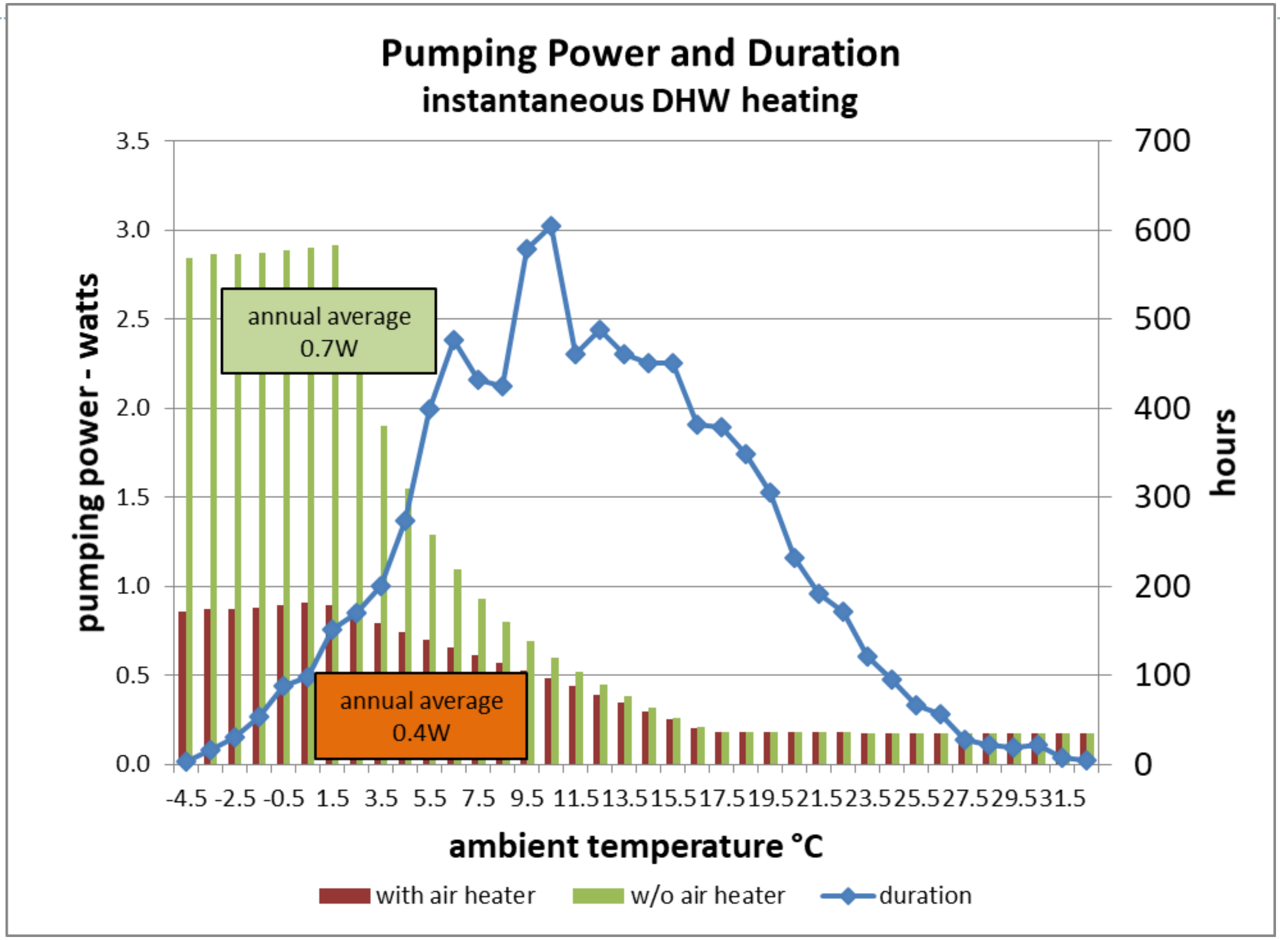
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Pumping Power and Duration.

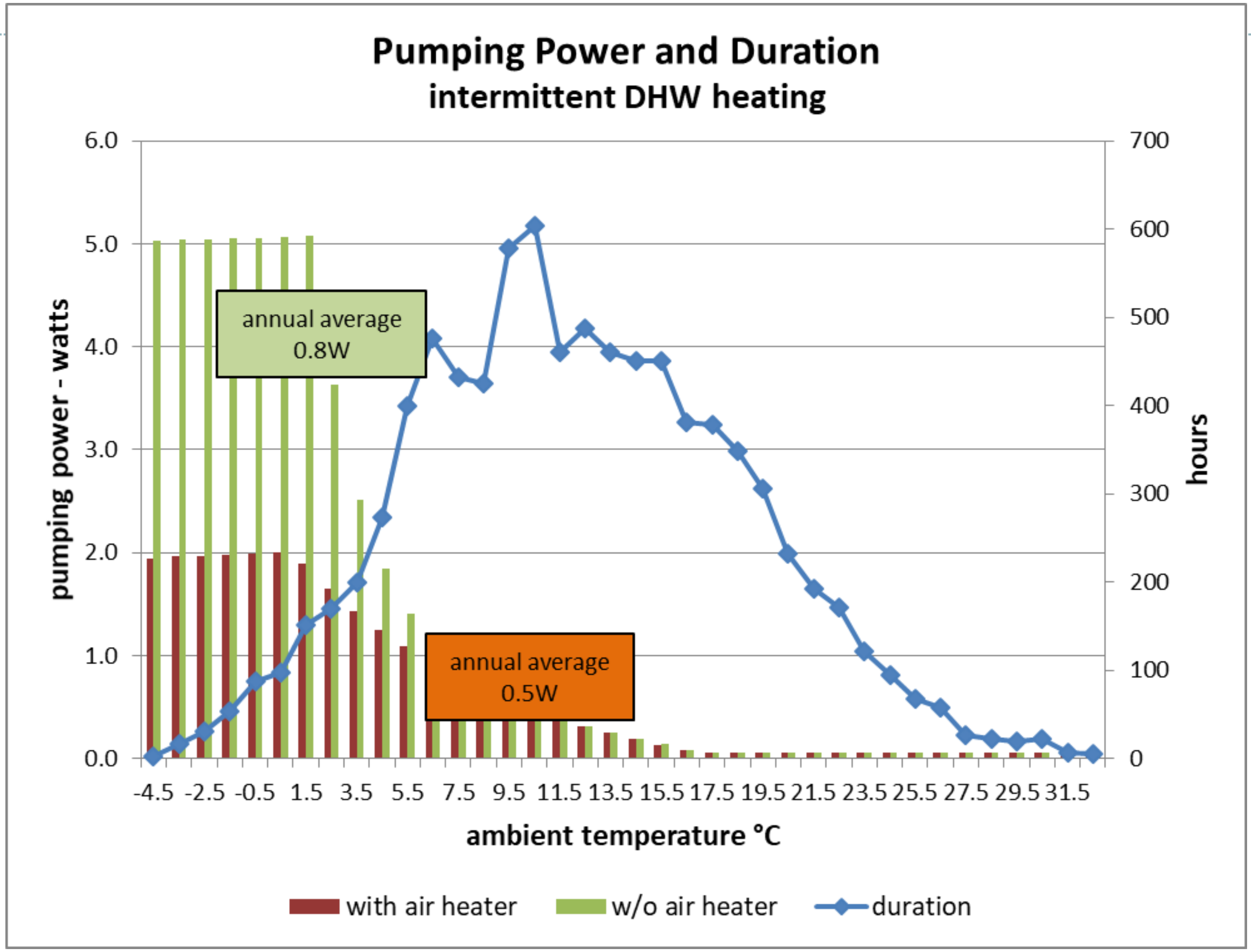
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Pumping Power and Duration.

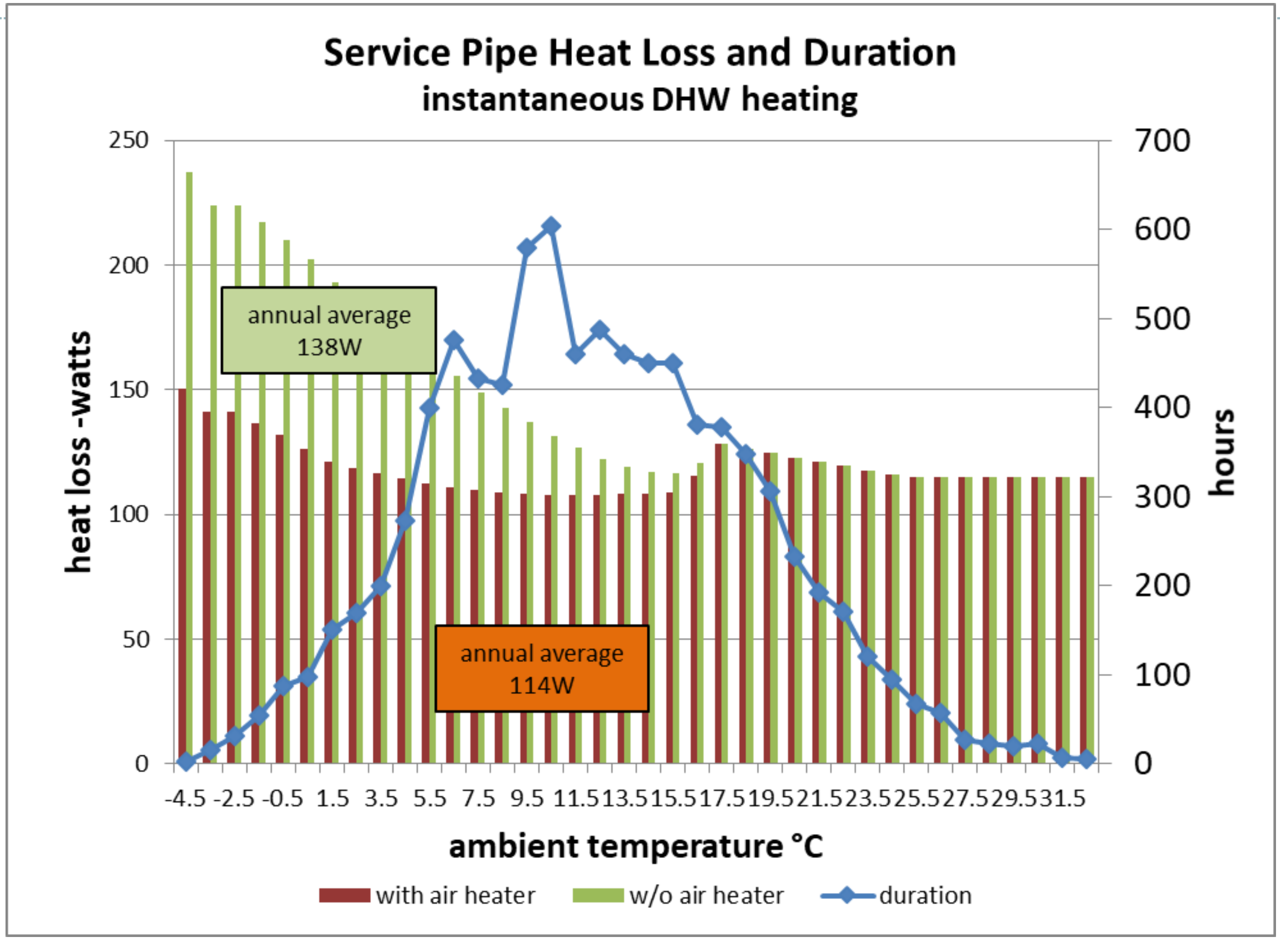
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Pipe from road to dwelling heat loss.

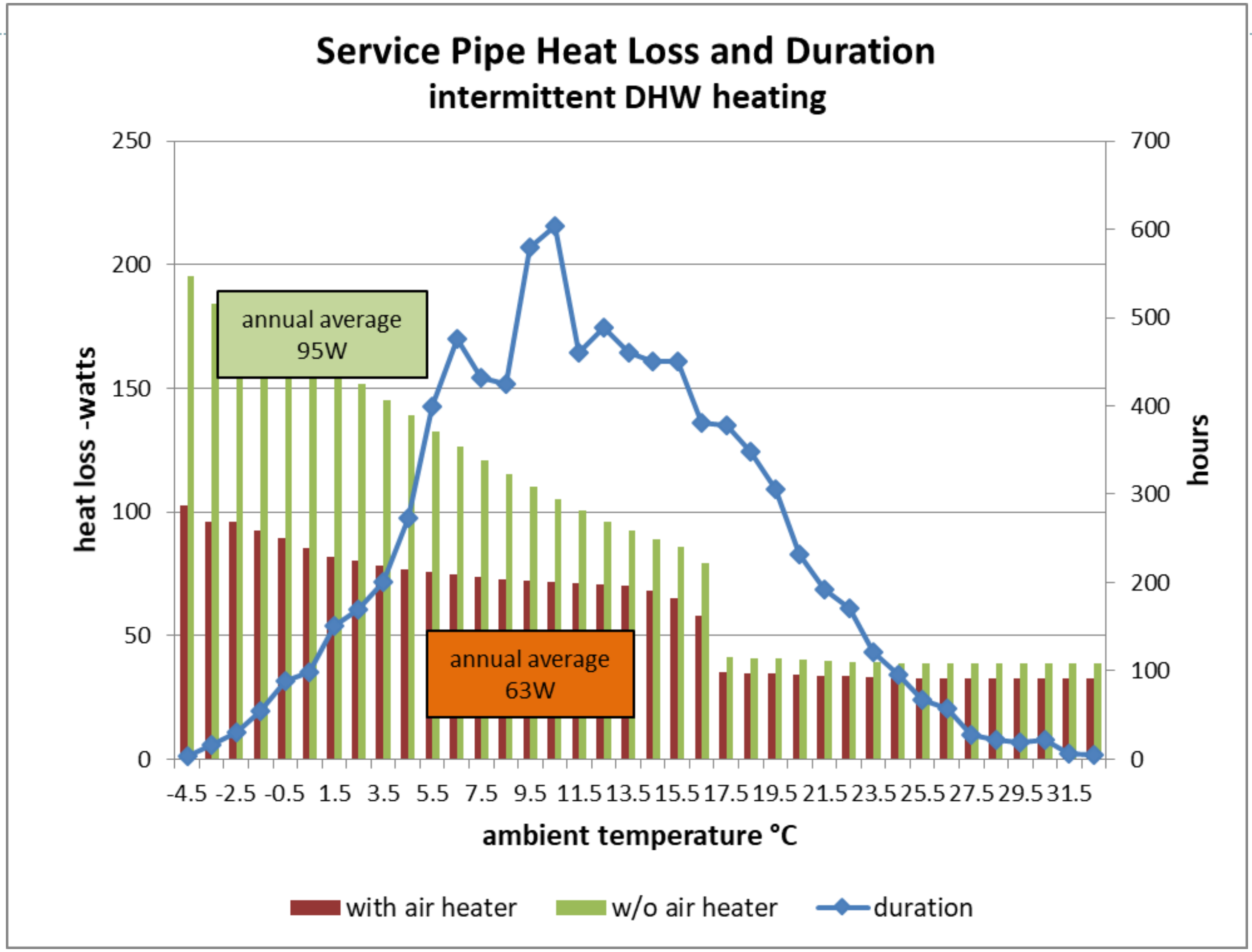
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Pipe from road to dwelling heat loss.

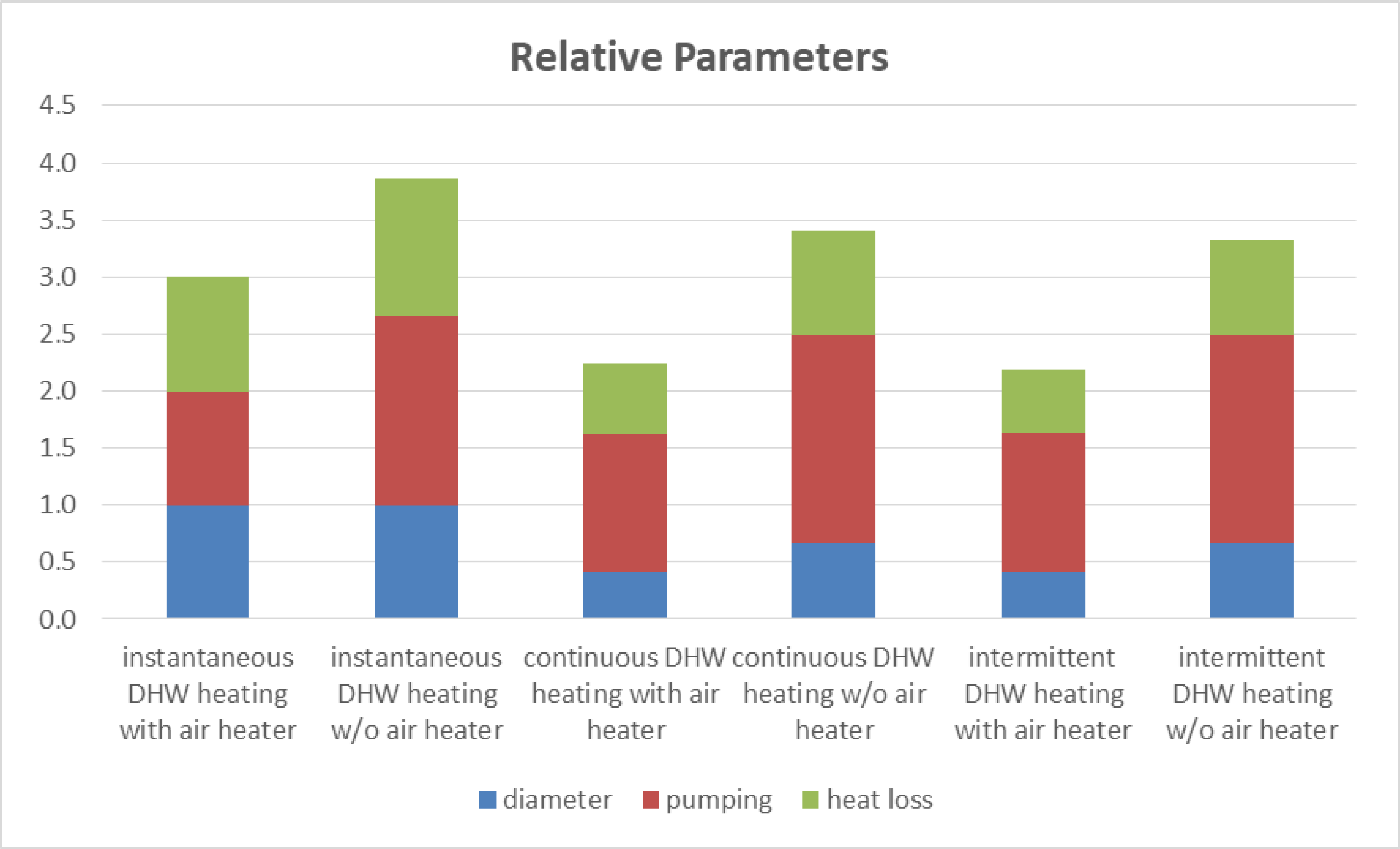
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Comparison tank storage and Instant Hot Water

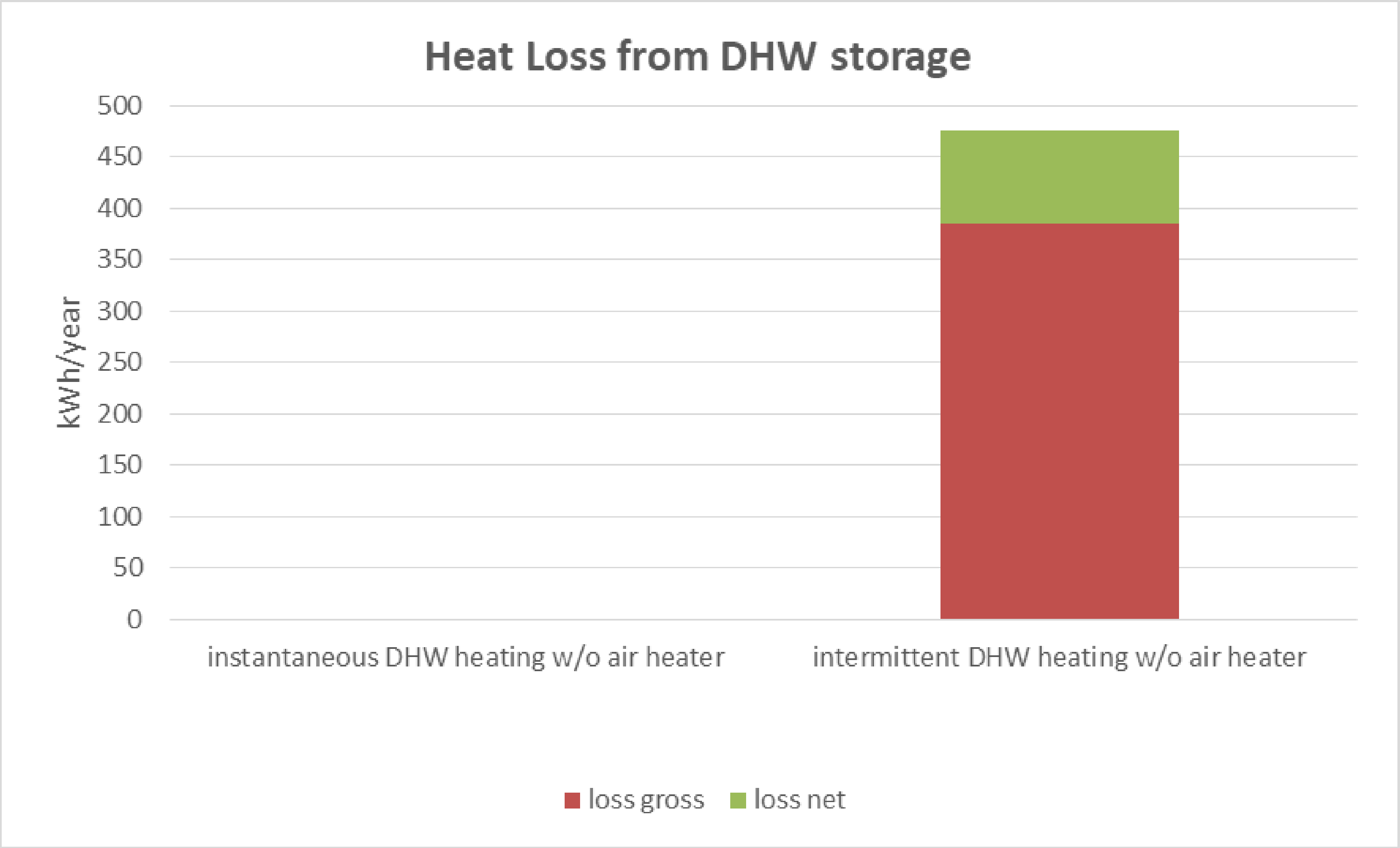
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Heat loss from tank contribution to heat load

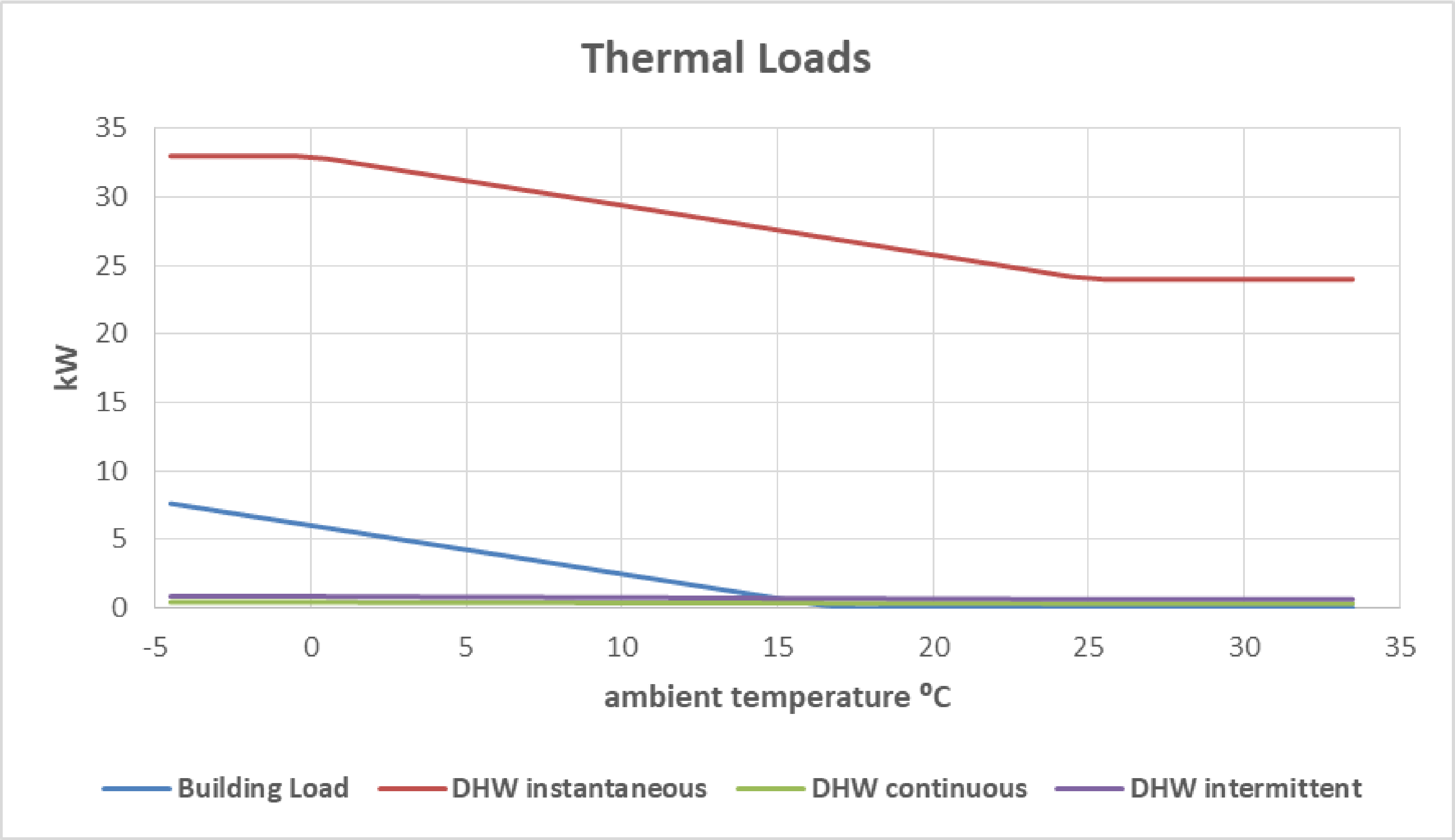
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Comparison of thermal design load tank store and instant hot water.

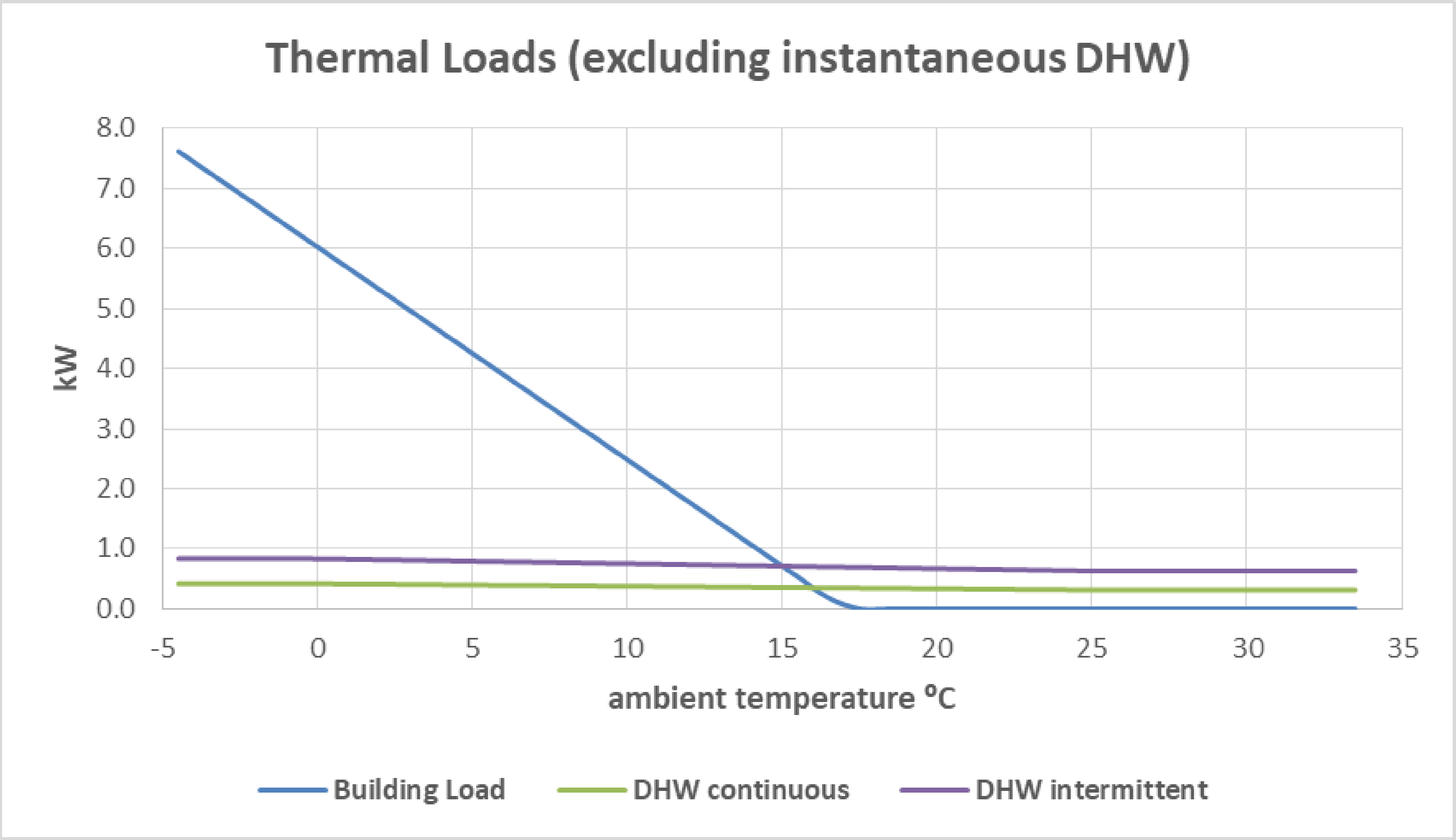
OP



Tel 020 8296 8745 email william@orchardpartners.co.uk

Chart showing when how heat loss from store is useful to heat dwelling.

OP



Tel 020 8296 8745 email william@orchardpartners.co.uk