

CO2 Footprints for heat and electrical energy supplies.

Both the heat from CHP same and the heat from electric heat pump can be analysed on the same basis as both technologies use some electricity to upgrade heat otherwise in the environment. The electric heat pumps COP and the Z factor for CHP both signal the amount of useful heat per unit of electricity.

CHP and electric heat pumps deliver the most heat for the least electricity when heat is supplied at as low a temperature as possible.

The table signals CO2 emitted when a bio fuel such as wood is burnt. The table allows review of carbon capture and storage signalling the potential to maximise CO2 displacement using biomass when potentially co firing it with coal to give overall negative CO2 emissions.

Note relative average CO2 losses for different energy supply networks. Marginal distribution losses for heat will tend to zero. For electricity they will follow a square law.

© William Orchard, Orchard Partners London Ltd william@orchardpartners.co.uk 2011

CO2 Footprint Table WRH Orchard. Orchard Partners London Ltd 2011.

Heat supply options gross (higher) calorific value (CV) basis and efficiency (eff)	kg/CO2/kWh per unit of Energy	Energy Average loss %	CO2 Average loss kg	kg/CO2/kWh Energy delivered
Hydrogen fuel from electricity(coal) 80%(eff)	1.046			
Biogas burnt in 86% (eff) domestic boiler.				1.008
Electricity from coal 36%	0.837	10	0.084	0.920
Biogas as a fuel 40% (eff) conversion from biomass (Lund University Maria Berglund Pal Borjesson)	0.850	2	0.017	0.867
Biomass wood boiler 78%? (eff).	0.436	5	0.022	0.458
Electricity from gas 48% (eff)	0.397	10	0.040	0.437
Biomass (dry wood) as a fuel	0.340			0.340
Air source heat pump COP 2.9 (Electricity from coal)				0.317
Coal as fuel	0.301			0.301
Old gas boiler 75% (eff)				0.255
New condensing natural gas boiler 86% (eff)				0.222
Heat micro CHP 1kWel 6% (el) (eff) 86% (eff) overall				0.212
Natural gas as a fuel	0.191	2	0.004	0.195
Heat pump ground source winter heat source, COP 3.8 electricity from gas.				0.115
Piped heat from gas fired condensing 500 kWel CHP 34.7 % (el) (eff) 86% (eff) overall	0.103	10	0.010	0.113
Piped heating from very large biomass CHP co fired with coal.	0.075	20	0.015	0.089
Piped urban district heating from coal fired CHP equivalent COP 12.7	0.066	20	0.013	0.079
Piped urban district heating from gas fired CCGT CHP equivalent COP 12	0.033	20	0.007	0.040
Electricity from wind, DTI Future of Nuclear Power page 49	0.020	10	0.002	0.022
Electricity from nuclear 0.006 to 0.026 DTI Future of Nuclear Power page 49	0.010	10	0.001	0.011
Piped district heat from nuclear fired CHP equivalent COP 10	0.001	20	0.000	0.001