

Technical Note – Modelling Energy from Waste Facilities

Background

Energy from Waste (EfW) Facilities are designed to burn waste as an alternative to sending waste to landfill. The heat generated in this process can be recovered and used as a heat source for a community heating scheme. This Technical Note describes how these facilities should be modelled in SAP 2012.

Current approach

Currently, in SAP 2012, there are no specific instructions for modelling heat provided from EfW systems. They are in principle closest in description to ‘Community heating schemes that recover waste heat from power stations’ (described in section C4 of SAP 2012). However, the methodology states that a system that recovers waste heat should be modelled as a CHP where the electrical efficiency is less than 35% and the electrical output is less than 10MW. However, modelling EfW facilities as CHPs can be inaccurate since the primary function of these facilities is the burning of waste at a rate determined by the amount of waste received, whereas the primary function of CHP is to meet the heat needs of the attached buildings by burning a high grade fuel and in the process providing electricity to the grid.

Therefore, for EfW systems the approach described in section C4 of the SAP specification (‘Community heating schemes that recover waste heat from power stations’) should be taken with the conditions regarding 35% efficiency and 10MW output ignored¹. This is deemed appropriate as the waste heat produced by these systems is sent directly to the connected dwellings via the community heating system and any electricity produced is sent to the grid.

To demonstrate this approach gives reasonable values, the following analysis has been carried out using current data derived from the SELCHP² facility and Veolia SELCHP heat network system.

¹ The original basis for the 35% efficiency and 10MW output was that typical power stations that generate electricity have efficiencies of at least 35% and outputs of at least 10MW. However, for systems burning low grade fuels, such as EfW systems, these thresholds may not be reached while other operating conditions and objectives of the system remain the same.

² South East London Combined Heat and Power

Quantity	Value	Equation number
Heat delivered [kWh]	1	(1)
Distribution Loss Factor ³	1	(2)
EfW fraction	0.97	(3)
Back up boiler efficiency	0.85	(4)
Back up boiler fraction	0.03	(5)
EfW heat [kWh]	0.97	(6) = (1)*(2)*(3)
Boiler heat [kWh]	0.0353	(7) = (1)*(2)*(5)/(4)
Heat required [kWh]	1.01	(8) = (6)+(7)
Heat to electricity ratio ⁴	10	(9)
EfW heat contributing to carbon factor ⁵ [kWh]	0.097	(10) = (6)/(9)
SAP electricity displaced from grid factor [kgCO ₂ /kWh]	0.519	(11)
SAP mains gas factor [kgCO ₂ /kWh]	0.216	(12)
EfW carbon factor [kgCO ₂ /kWh]	0.0503	(13) = ((10)*(11))/(1)
Back up boiler carbon factor [kgCO ₂ /kWh]	0.00762	(14) = ((7)*(12))/(1)
Carbon factor for EfW [kgCO₂/kWh]	0.0580	(15) = (13)+(14)

The reason the heat provided is not entirely ‘free’ from a CO₂ point of view, despite being a by-product, is that when heat is extracted less electricity is generated and provided to the national grid. The carbon factor for “waste heat from power stations” in SAP 2012 is 0.058 kgCO₂/kWh. The value calculated above for the Veolia SELCHP heat network system is the same as this therefore by using the “waste heat from power stations” option, the carbon emissions calculated will be the same as using the actual SELCHP carbon factor.

To simplify the process for system operators and assessors, this analysis does not need to be repeated in individual cases and the exception can be used for any EfW system.

Instructions to SAP assessors

Where assessors come across an EfW system, they should select ‘community heating’ for the main heating system with the heat source set to ‘waste heat from power stations’ with an efficiency of 100%. If applicable, the water heating should be selected as ‘from main system’. All other inputs should be selected as normal.

Instructions to Building Control

Where a dwelling is connected to a community heating system served by an EfW facility, the main heating type should be “waste heat from power stations” under the ‘community heating’ system options.

³ Set to 1 to avoid double counting in SAP assessments.

⁴ Ratio of how many units of heat generation are gained by decreasing electricity generation by one unit. This should include pumping energy up to the community heating scheme heat exchanger.

⁵ The heat that is going to the community scheme, instead of the steam turbine for electricity generation.