PureCell Heat 101

(an overview)

Key facts to know

- Heat produced by the fuel cell is essentially proportional to kWh produced. For example, if the 460kW FC generates 230 kWh of electricity, the heat is also half the max output

- The efficiency of a conventional boiler is roughly 80%. For example, if the customer needs 1.0 MMBtu/h of heat, (1.2* 1.0) or 1.2 MMBtu/h of gas must be purchased

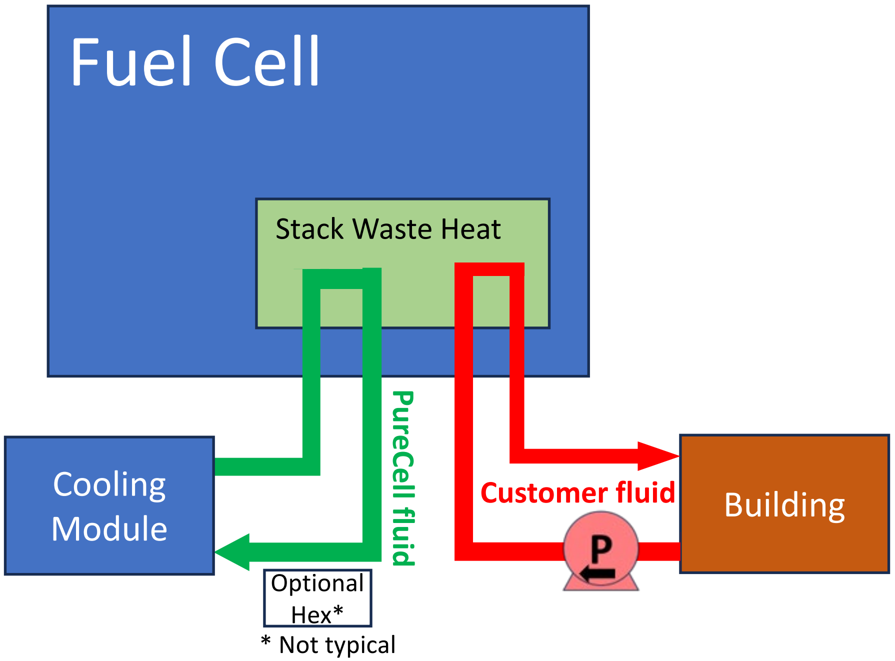
- The cost of gas needed to fire a boiler is purchased at full price. There is no DG Rider discount for gas used in a boiler. When calculating heat savings provided by the fuel cell, the cost of boiler heat should be based on full price gas and not the DG rider price

- The fuel cell power degrades annually. This decline produces additional waste heat. Even though more heat is generated in subsequent years, it is recommended to assume the heat output stays flat in all years

The Basics

The FC has internal equipment to heat the customer's fluid. In other words, the customer does not directly use hot water from the fuel cell. The hot water inside the fuel cell heats the customer fluid

Waste heat needs to be removed from the fuel cell to prevent overheating. Any heat not taken by the customer's fluid is removed by the fuel cell cooling module



The FC has two types of heat. High Grade is high temperature and is the main heat output. Low Grade is low temperature and is obtained by extracting heat outside the FC at the cooling module loop

Calculating the savings

Excerpt from the June 2023 PureCell Data Sheet

RATED POWER OUTPUT: 460KW, 480VAC, 60HZ

Characteristic	Units	Operating Mode	
		Power 460kW	Eco 440kW
Electric Power Output[1]	kW/kVA	460/532	440/517
Electrical Efficiency[1]	%, LHV	43.5%	44.4%
Peak Overall Efficiency	%, LHV	90%	90%
Gas Consumption[1]	MMBtu/h, HHV (kW)	4.04 (1,185)	3.78 (1,108)
Gas Consumption[1,2]	SCFH (Nm³/h)	3,941 (106)	3,688 (98.7)
High Grade Heat Output @ up to 250ºF[1]	MMBtu/h (kW)	1.30 (382)	1.16 (341)
Low Grade Heat Output @ up to 140ºF[1,6]	MMBtu/h (kW)	1.68 (492)	1.54 (452)

More Typical

1) 1.30 MMBtuh of HG heat is produced when the FC generates 460kWh of electricity
2) This means 0.00283 MMBtu of heat is produced for each kW of electricity generated (1.30MMBtu/460kW)
3) One 460kW FC having a 95% uptime per year will produce 0.95*460kW*8760hrs/yr=3.83 MM kWh/yr
4) The heat from 3.83MM kWh of electricity production offsets 10,840 MMBtu of site heat (3.83*0.00283)
5) To make 10,840 MMBtu of heat with a boiler, (1.2*10,840) or 13,008 MMBtu of gas is needed
6) If gas price without DG rider is $9 per MMBtu, total gas cost saved is ($9 * 13,008 MMBtu) or $117K

Less Typical

1) 1.68 MMBtu/h of LG heat is produced when the FC generates 460kWh of electricity
2) The means 0.00365 MMBtu of heat is produced for each kW of electricity generated (1.68MMBtu/460kW)
3) One 460kW FC having a 95% uptime per year will create 0.95*460kWh*8760hrs/yr=3.83 MM kWh/yr
4) The heat from 3.83MM kWh of electricity production offsets 13,980 MMBtuh of site heat (3.83*0.00365)
5) To make 13,980 MMBtu of heat with a boiler, (1.2*13,980) or 16,776 MMBtu of gas is needed
6) If gas price without DG rider is $9 MMBtu, total gas cost saved is ($9 * 16,776 MMBtu) or $151K

- It is possible for the customer to use both High Grade and Low Grade heat. The Savings calculation will need to be prorated accordingly. It is recommended to use the HG case to simplify the heat calculations
- Note HG heat connects directly to the fuel cell where LG heat takes heat from the fuel cell fluid flowing to the cooling module. A heat exchanger needs to be added to capture the LG heat (added cost & complexity)