Example Boiler Emission Credits

- A hypothetical facility manufactures wigits, operates 1 large heavy liquid fuel boiler rated at 300 MMBtu/hr and 85% efficient (Boiler # 1), and 1 medium size 60 MMBtu/hr boiler burning other gases and generating 50,000 lb/hr steam and 75% efficient (Boiler # 2)
- Boilers are used to provide steam and hot water for manufacturing process
- A major HAP source, the plant operates 24 hr/day, 365 days/yr (8,760 Hrs/Yr)

Baseline Energy Input (**EI**) for Boiler 1 = (300 MMBtu/hr) (8,760hr/yr) (.85)
= 2.23 E+6 MMBtu/yr
(Based on yearly operation of 8,760 hours & running at 85% of rated design capacity)

Baseline Energy Input (**EI**) for Boiler 2 = (60 MMBtu/hr) (8760hr/yr) (.75)
= 3.94 E+5 MMBtu/yr
(Based on yearly operation of 8,760 hours & running at 75% of rated design capacity)

A hypothetical **energy assessment** identifies several cost-effective energy conservation measures and facility implements the following measures:

- Boiler #1: Add insulation to steam system piping (Section 3.3 of DoE Guidance)
- Boiler #1: Replace burners with a flame retention burner (15% savings estimated)
- Boiler #2: Reduce boiler blowdown (Section 3.1 of DoE Guidance)

Energy Input Savings (**EIS**) for each measure implemented:

1. (Insulation) **EIS** = (.02klb/hr) (100ft/20ft) (8760hr/yr) (1003.342Btu/klb)
   = **879 MMBtu/yr**
   Based on replacing 100 ft. of 3-inch diameter pipe, carrying steam at 165 psi, with fiberglass insulation of 1.5 inch thickness. See estimates in ConED Steam Use Efficiency and Demand Reduction (at http://www.coned.com/steam/kc_sdrt.asp)

2. (Burners) **EIS** = (EI)(.15) = **335,070 MMBtu/yr**
   Based on 15% savings in actual energy purchases for installation of a flame retention burner. See estimates in:
   http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12540

3. (Blowdown) **EIS** = **3,931** MMBtu/yr
   Based on blowdown reduction from 6-8% assuming continuous operation at 150 psig, 60ºF make-up water temperature, and 80% boiler efficiency.

   Initial feedwater: 50,000 lb/hr / (1 - 0.08) = 54,348 lb/hr
   Final feedwater: 50,000 lb/hr / (1 - 0.06) = 53,191 lb/hr
   Makeup water savings = 54,348 – 53,191 = 1,156 lb/hr

   Enthalpy of boiler water at 150 psig (165 psia) = 338.5 Btu/lb
   Enthalpy of makeup water at 60ºF = 28 Btu /lb
   (calculations of thermodynamic properties of saturated steam can be found at http://www.peacesoftware.de/einigewerte/wasser_dampf_e.html and using enthalpy conversion factor of kj/kg = 0.4299 Btu/lb)

   Thermal energy savings = 338.5 – 28 = 310.5 Btu/lb

   Annual energy savings = (1,156 lb/hr x 8,760 hr/yr x 310.5 Btu/lb) / (0.80 x 10^6 Btu/MMBtu) = **3,931 MMBtu/yr**

Credit for Boiler 1 = [(#1 EIS) + (#2 EIS)] / {EI for Boiler 1}
= [(879 MMBtu/yr) + (335,070 MMBtu/yr)]/ 2.23 E+6 MMBtu/yr = 0.15

Credit for Boiler 2 = 3,931 MMBtu/yr / 3.94 E+5 MMBtu/yr = 0.01

Adjusted emission levels = (stack test measurement) x (1 – credit) = see table below

Compliance is met if **adjusted emissions** (lb/MMBtu of steam output) are less than **emission limits** from ***Table 2*** of the final rule (lb/MMBtu of steam output), per table below.

Pollutant	Boiler 1 Emission Limits	Boiler 1 Measured Emissions	Boiler 1 Adjusted Emissions	Boiler 2 Emission Limit	Boiler 2 Measured Emissions	Boiler 2 Adjusted Emissions
PM	**0.075**	0.0080*	**0.0068**	**0.012**	0.020*	**0.020**
HCl	**0.0015**	0.00025*	**0.00021**	**0.0029**	0.0010*	**0.00099**
Hg	**3.3e-5**	9.0e-7*	**7.7e-7**	**1.4e-5**	7.8e-6*	**7.7e-6**

*Measured (hypothetical) emissions from compliance test