that 90 percent of the energy in the fuel becomes heat and the other 10 percent is lost in the system. In general fossil fuel-fired boilers have high AFUE rating around 90 percent. For example, based on data from Cleaver Brooks for 100 to 800 HP firetube boilers, the fuel-to-steam efficiencies for a 400 HP (heat input 16.3 MMBtu/hr) boiler are 84.7 and 87.5 percent for natural gas and No. 2 fuel oil-firing, respectively.

Higher efficiency means, less fuel will be required to produce the same amount of steam (auxiliary boiler) or heating (gas heater). Recent BACT determinations for GHG emissions from auxiliary boiler and gas heater are based on the proposed efficiency of this equipment.

Step 2 – Identification of Technically Feasible Control Alternatives

Under the second step of the top-down BACT analysis, a potentially applicable control technique listed in Step 1 may be eliminated from further consideration if it is not technically feasible for the specific source under review. EPA considers a technology to be potentially applicable if it has been demonstrated in practice or is available. The boiler efficiency is considered to be the only technically feasible CO_2 control option for the proposed auxiliary boiler and the gas heater.

Step 3 – Rank Remaining Control Technologies

After the list of all available controls is narrowed down to a list of the technically feasible control technologies in Step 2, Step 3 of the top-down BACT process calls for the remaining control technologies to be listed in order of overall control effectiveness for the regulated New Source Review (NSR) pollutant under review. Based on the discussion in Steps 1 and 2, the only technically feasible control option for CO_2 from the proposed auxiliary boiler and the gas heater is energy efficiency.

Step 4 – Economic, Energy, and Environmental Impacts

Under Step 4 of the top-down BACT analysis, economic, energy, and environmental impacts must be evaluated for each option remaining under consideration.

In the top-down BACT analysis, the "top" control option should be established as BACT unless the applicant demonstrates, and the permitting authority agrees, that the energy, environmental, or economic impacts justify a conclusion that the most stringent technology is not "achievable" in that case. If the most stringent technology is eliminated in this fashion, then the next most stringent alternative is considered.

Energy efficiency improvements results in collateral reductions in emissions of all pollutants resulting from combustion processes. Based on emissions factors for distillate oil-firing boilers available in EPA's AP-42, nitrogen oxide (NO_X), sulfur dioxide (SO_2) and particulate matter (PM)/particulate matter less than 10 microns (PM_{10}) emissions are lower for natural gas-firing than oil-firing. Carbon monoxide (CO) and volatile organic compounds (VOC) emissions are expected to be higher for natural gas-firing than oil-firing; however, due to the smaller size of the auxiliary boiler and the gas heater, the higher annual emissions resulting from natural gas-firing will be very small. So combustion of natural gas in the proposed auxiliary boiler and gas heater has no significant trade-offs in emissions.

Natural gas also costs less than distillate oil, which means that firing distillate oil in the auxiliary boiler and gas heater would cost more in fuel cost. Based on U.S. Energy Information Administration's (EIA's) data on natural gas and distillate fuel oil prices, natural gas costs $5.23/1,000 ft^3 (April 2011 price), and distillate oil (ultra low-sulfur No. 2) costs $3.14/gallon (7/19/2011 cost). Using these cost estimates and fuel consumption of a Cleaver Brooks 400 HP (model CBEX Elite) boiler, firing distillate oil will cost $366 per hour compared to approximately $85 per hour if natural gas is fired (fuel oil – 116.6 gal/hr, natural gas – 16,328 ft^3/hr).

Based on Subpart C of 40 CFR Part 98, Mandatory Greenhouse Gas Reporting, GHG emissions for natural gas firing is 116.9 lb CO_2e/MMBtu compared to 163.6 lb CO_2/MMBtu for distillate fuel oil firing. The emission factors include N_2O and CH_4 at the equivalent rates. Therefore, firing natural gas will generate less GHGs than firing oil.

Oil-firing boilers also require more maintenance than natural gas-firing boilers in general.

Step 5 – Select the BACT

In Step 5 of the BACT determination process, the most effective control option not eliminated in Step 4 should be selected as BACT for the pollutant and emissions unit under review and included in the permit.

Energy efficiency, the only remaining and feasible control technology is selected as BACT for the GHG emissions from the proposed auxiliary boiler and gas heater for the Effingham expansion project.

An important measure of the efficiency for a boiler is the units' AFUE. As mentioned in Step 1, natural gas boilers have an AFUE rating around 90 percent in general, which is higher than other fossil fuel-fired boilers. Both the proposed auxiliary boiler and the gas heater will be exclusively fired with natural gas.

The auxiliary boiler and gas heater together accounts for only 0.3-percent of the total GHG emissions potential of the emissions units associated with the expansion project. The operation of the auxiliary boiler will also be limited to 2,500 hours per year (hr/yr). Together, the negligible amount of GHG emissions potential, limitation in operating hours, and use of the natural gas fuel, present the best available option in controlling GHG emissions from the proposed auxiliary boiler and gas heater.

The use of natural gas and the design efficiency are proposed as BACT for GHG emissions from the auxiliary boiler and gas heater. This is consistent with the definition of BACT, which allows "a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology." Due to the negligible amount of GHG emissions potential, a numerical GHG emission limit for the auxiliary boiler and the gas heater is unnecessary.

Table A-2: GHG Emissions Potential for the Effingham Plant Expansion Project

				CO_2 Emissions			N_2O Emissions				CH_4 Emissions				Total
				Emission Factor			Emission Factor				Emission Factor				
Fuel	Power Output (MW)	Heat Input (MMBtu/hr)	Operating (hrs/yr)	(lb/MWh) [a]	(lb/MMBtu) [b]	Emission Rate (TPY)	(lb/MWh) [a]	(lb/MMBtu) [b]	Emission Rate (TPY)	CO_2e [c] Rate (TPY)	(lb/MWh) [a]	(lb/MMBtu) [b]	Emission Rate (TPY)	CO_2e [c] Rate (TPY)	CO_2e [c] Rate (TPY)
Combined-cycle system (2 CTs, 2 DBs)															
NG	660.6	--	7,760	837.9	--	2,147,645.0	0.0016	2.20E-04	4.1	1,271.3	0.0155	2.2E-03	39.7	834.3	
Oil	558.0	--	1,000	1,141.3	--	318,422.7	0.0093	2.20E-04	2.6	804.4	0.0465	2.2E-03	13.0	272.4	
						2,466,067.7				2,075.7				1,106.7	2,469,250
Aux Boiler															
NG	--	17	2,500	--	116.86	2,483.2	--	2.20E-04	0.0047	1.5	--	2.2E-03	0.0465	1.0	2,486
Gas Heater															
NG	--	8.75	8,760	--	116.86	4,478.5	--	2.20E-04	0.0084	2.6	--	2.2E-03	0.0432	0.9	4,482

[a] Based on Table A-1 (Scenarios 2 and 3) of Golder letter to Georgia DNR dated March 22, 2011.
[b] Tables C-1 and C-2, Subpart C, 40 CFR 98. Emission factors in kg/MMBtu were converted to lb/MMBtu by multiplying by 2.204.
[c] N_2O and CH_4 are multiplied by a factor of 310 and 21, respectively, to determine CO_2 equivalence.