



UTILITY SERVICES

HOW COGENERATION WORKS

What is cogeneration?

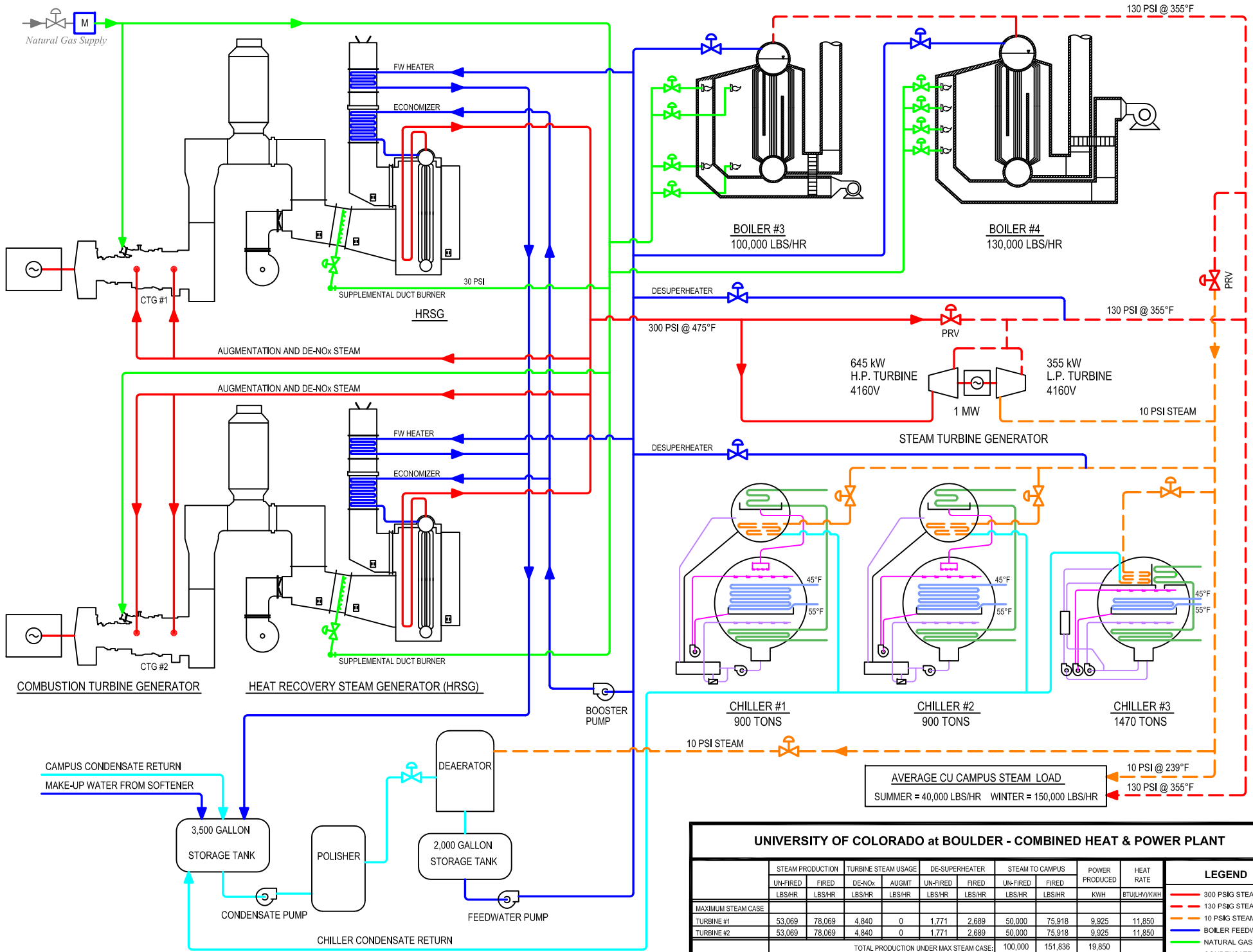
Cogeneration is the generation of power while taking advantage of the exhaust heat from gas turbine to meet on-site heat needs. Electricity and steam are both produced and cogenerated through the combustion of natural gas in two industrial gas turbines. The plant's rejected heat is used for space heating and cooling. CHP is one of the most cost efficient methods of reducing carbon emissions of heating in cold climates.

Cogen at CU (See Diagram Below)

Natural Gas is burned in a Combustion Turbine, which produces electricity and hot gases, then travels to the Heat Recovery Steam Generator. (HRSG)

Our CHP system utilizes two conventional boilers, 130,000 lb/hr and 100,000 lbs/hr, as well as two 16 MW gas combustion turbines coupled to two 80,000 lb/hr heat recovery steam generators. A 1 MW steam turbine is used to provide 10 PSIG steam. Also, two additional steam absorption chillers were added bringing the total plant cooling capacity to 3,300 tons. Currently, the University is served by three 13.2 kV distribution system branch feeders from Xcel energy.

The steam turbine generator consists of dual topping turbines driving a common generator. The turbine reduces or "tops" the incoming steam pressure by expanding it through the turbines, which in turn drives the generator. The exhaust steam is then exported to either the 130 psig or the 10 psig steam header. The purpose of the high-pressure steam system is to deliver 300 psig steam to the gas turbines for Nox control and steam injection for power augmentation.



AVERAGE CU CAMPUS STEAM LOAD
 SUMMER = 40,000 LBS/HR WINTER = 150,000 LBS/HR

UNIVERSITY OF COLORADO at BOULDER - COMBINED HEAT & POWER PLANT												
	STEAM PRODUCTION		TURBINE STEAM USAGE				DE-SUPERHEATER		STEAM TO CAMPUS		POWER PRODUCED KWH	HEAT RATE BTU/LH/KWH
	UN-FIRED LBS/HR	FIRED LBS/HR	DE-NOx LBS/HR	AUGMIT LBS/HR	UN-FIRED LBS/HR	FIRED LBS/HR	UN-FIRED LBS/HR	FIRED LBS/HR				
MAXIMUM STEAM CASE												
TURBINE #1	53,069	78,069	4,840	0	1,771	2,689	50,000	75,918	9,925	11,850		
TURBINE #2	53,069	78,069	4,840	0	1,771	2,689	50,000	75,918	9,925	11,850		
TOTAL PRODUCTION UNDER MAX STEAM CASE:							100,000	151,836	19,850			
MAXIMUM POWER CASE												
TURBINE #1	69,302	94,302	4,500	35,500	1,076	1,994	30,378	56,296	15,050	10,350		
TURBINE #2	69,302	94,302	4,500	35,500	1,076	1,994	30,378	56,296	15,050	10,350		
TOTAL PRODUCTION UNDER MAX POWER CASE:							60,756	112,592	30,100			

- LEGEND**
- 300 PSIG STEAM
 - 130 PSIG STEAM
 - 10 PSIG STEAM
 - BOILER FEEDWATER
 - NATURAL GAS
 - CONDENSATE
 - REFRIGERANT
 - ABSORBER SOLUTION
 - CHILLED WATER
 - CONDENSER WATER