INTERMOUNTAIN U.S. DOE CLEAN ENERGY APPLICATION CENTER

PROJECT PROFILE

# Kennecott Utah Copper Smelter

## 32-MW Waste Heat Recovery System

### Quick Facts

**LOCATION:** Salt Lake County, Utah
**MARKET SECTOR:** Primary metals
**SMELTER SIZE:** 300,000 tons of copper anodes produced annually
**EQUIPMENT:** Waste heat boilers, heat recovery system, steam turbine generator
**ELECTRIC CAPACITY:** 32 MW nameplate, 20–25 MW average
**PERCENT OF FACILITY LOAD:** ~60%
**WASTE HEAT SOURCE:** Smelter exhaust, acid plant
**IN OPERATION SINCE:** 1995
**ENVIRONMENTAL BENEFITS:** Pollution-free electricity from waste heat, improved energy efficiency

PHOTO COURTESY OF KENNECOTT UTAH COPPER

## Site Description

Kennecott Utah Copper, a subsidiary of Rio Tinto, produces copper, silver, gold, molybdenum and sulfuric acid. It is the second-largest copper producer in the U.S., providing about 25 percent of the country's copper needs.

The copper smelter is the key facility that processes copper concentrate through heat and oxidation in furnaces, into 99.5% copper metal called anodes (which are then transported to the nearby refinery to be processed into copper cathodes and sold to customers). The smelter produces about 300,000 tons of copper anodes per year.

## Reasons for Waste Heat Recovery

The smelter was re-designed and modernized in 1995 to be among the lowest-emission smelters in the world, and a pollution-free, waste-heat-to-power generation system was a key component of the modernization. The Kennecott Utah Copper smelter has the highest level of energy recovery of any smelter in the world.

Since the copper production process is energy intensive and energy is a key component of Kennecott's costs, the company strives for continual improvement in how it manages, generates, and uses energy. Based on forecasts of rising energy costs, the company determined that it would be a wise long-term investment to generate power from thermal energy that would otherwise be wasted. The company's on-site engineers continue to improve the system design to optimize the energy output and reliability.

**The custom-designed waste heat recovery system takes heat from several different sources in the smelting process and converts it to steam, which produces electricity with a steam turbine.**

PHOTO COURTESY OF KENNECOTT UTAH COPPER

## Waste Heat Recovery Process

The smelter is the most complex system in the copper production process, and the waste heat recovery is designed as an integral part of the smelter.

Exhaust gases (at about 530°F) from the flash smelting and flash converting furnaces pass through waste heat boilers that remove heat from the gasses and produce steam. The steam is then superheated to about 755°F and added to supplemental steam from two other gas-fired boilers as necessary to drive the acid plant compressors. The compressors pull the emissions through the pollution control equipment upstream of the compressors and then push the gases through the downstream acid plant. Heat is captured from the exothermic (heat producing) conversion of sulfur dioxide to sulfuric acid to produce yet more steam.

The steam generated in the acid plant is then superheated and combined with the low-pressure steam discharged from the acid plant compressors. The resulting steam drives a low-pressure steam turbine generator set to produce approximately 20-25 MW of electricity—about two-thirds of the smelter's electrical needs and about 10 percent of Kennecott Utah Copper's total electrical needs (based on electrical demand in 2011).

The system was sized based on the amount of thermal energy (steam) available. Therefore, the amount of electricity produced depends on the amount of steam at hand, which depends on how much copper anode is being processed, which goes back to mine and concentrator production. Since the smelter plant runs 24/7, the waste heat recovery system also runs 24/7 at a relatively constant rate.

## Lessons to Share

Based on more than 15 years of experience with waste heat recovery, Kennecott sums up its two main lessons for other industrial companies as:

- If you have waste heat you can use to generate electricity, then go forward with the proper analysis. It can potentially be a great energy efficiency project with positive economic returns and environmental benefits.
- When designing the system, focus upfront on getting the high level of reliability required by your plant.

## For More Information

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