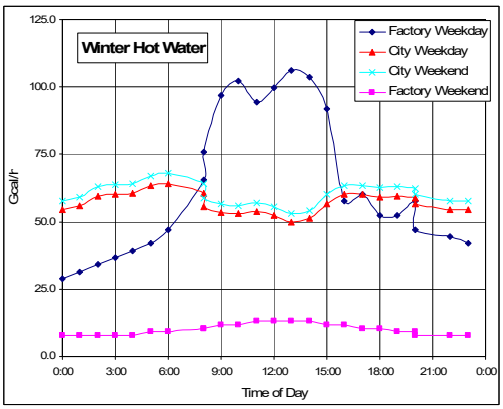
PROJECT SUMMARY

180 MWe YUZHMASHENERGO BIOMASS AND NATURAL GAS CHP PROJECT COMPREHENSIVE FEASIBILITY STUDY

PROJECT SUMMARY

Bridgestone Associates was the technical partner on this USTDA funded study. Bridgestone performed a detailed technical and economic evaluation of the rehabilitation of an existing 100 MW combined heat and power (CHP) plant and district heating system serving a large industrial complex, a hospital, a sports complex and approximately 200,000 local city inhabitants with steam, hot water and electricity. Once rehabilitation of the existing plant was determined to be impractical, Bridgestone prepared a detailed feasibility study on a new biomass and natural gas fired CHP plant to serve the same users and sell excess power to the Ukraine grid.



PROJECT STATISTICS

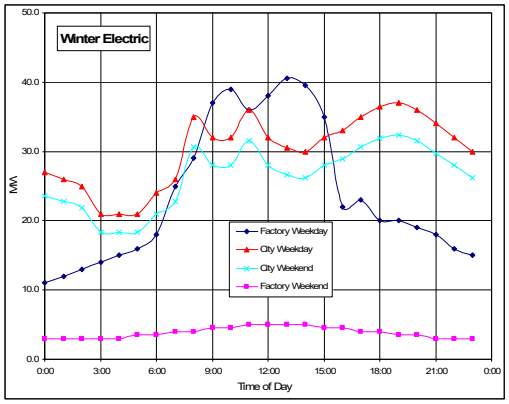
Client:	Broad Street Capital Group (financial partner on study) and YushmashEnergo, a Division of the State Enterprise A.M Makarov Production Association Yuzhny Machine Building Plant
Project Funding:	United States Trade Development Agency
Project Type:	Biomass (bio-energy crop) and natural gas CHP plant comprehensive feasibility study
Thermal Sales:	YuzhmashEnergo Factory (steam and hot water), Hospital (steam and hot water), Sports Complex (hot water), Dnipropetrovsk City (hot water)
Electrical Sales:	YuzhmashEnergo Factory, Dnipropetrovsk City, Ukraine grid
Plant Electrical Output:	130 or 180 MWe (60 MWe biomass and 70 MWe or 120 MWe natural gas)
Unit Sizes:	2 x 250,000 lb/hr biomass boilers + 1 x 60 MWe extraction condensing steam turbine 1 x 1 combined cycle: 70 MWe or 2 x 1 combined cycle: 120 MWe Natural gas steam boiler: 100 tonne/hour @ 40 bar and 440 °C (220,000 lb/hour @ 580 psig and 825 °F) Natural gas hot water boiler: 100 Gcal/hour @ 130 °C (400 MMBtu/hour @ 266 °F)

CHP Design Conditions:	Hot Water Requirement: 350 Gcal/hour @ 130 °C (1,390 MMBtu/hour @ 266 °F) Steam Requirement: 50 tonne/hour @ 3.5 bar with 5 °C min superheat (110,000 lb/hour @ 50 psig with 43 °F minimum superheat) Electrical: Maximum 75 MWe to City and Factory
Plant Design Conditions:	Maximum thermal output at -23 °C (-9 °F), 60% RH Maximum electrical output at 32 °C (90 °F), 42% RH
Plant Steam Conditions:	1,250 °F, 950 psig (turbine inlet)
Plant Location:	Dnipropetrovsk, Ukraine
Plant Elevation:	509 feet above sea level
Interconnection Voltage:	150 kV grid, 11 kV Factory and City
Primary Fuels:	Bio-energy crops (Sida Hermaphrodita Rusby and/or Rumex Patientia) and natural gas
Biomass Fuel Characteristics:	6,300 Btu/lb (3,500 kcal/kg) as delivered with 3.5% ash content
Fuel Use:	6,708,000 MMBtu/yr (438,000 metric tons/year) biomass and 599,000 MMBtu/year natural gas
Estimated Project Cost:	Biomass boiler and STG (60 MW): US$194 million (equipment turnkey) 1 x 1 combined cycle with biomass boilers (130 MW): US$294 million 2 x 1 combined cycle with biomass boilers (180 MW): US$339 million
Boiler Plant:	To be determined
Combustion Turbines:	Siemens SGT-800
Steam Turbine Generator:	Siemens
Cooling:	Evaporative cooling towers
On-Site Fuel Storage:	5 – 6 days in covered storage shed
Fuel Delivery:	Baled biomass via rail and truck

PROJECT DESCRIPTION

In a project partially funded by the United States Trade Development Agency (USTDA), Bridgestone Associates performed a detailed technical and economic evaluation of the rehabilitation of an existing 100 MW combined heat and power plant and district heating system serving a large industrial complex, a hospital, a sports complex and approximately 200,000 local city inhabitants with steam, hot water and electricity. The plant was originally built at this former intercontinental ballistic missile factory by the Russians in the late 1940's. It included boilers and steam turbines obtained from German and British World War II warships as well as some later (1950's and 1960's) Russian boilers and turbines.

The evaluation included development of a detailed understanding of the minimum seasonal thermal and electrical output requirements of the plant (many of which had not been served due to poor plant maintenance), modeling of historic thermal and electrical output data, assessment of thermal and electrical requirements (assuming all systems are operating), and modeling of requirements on a seasonal, time-of-day and day-of-week basis. A detailed model was developed for both thermal and electrical energy use on an hour-by-hour basis for a

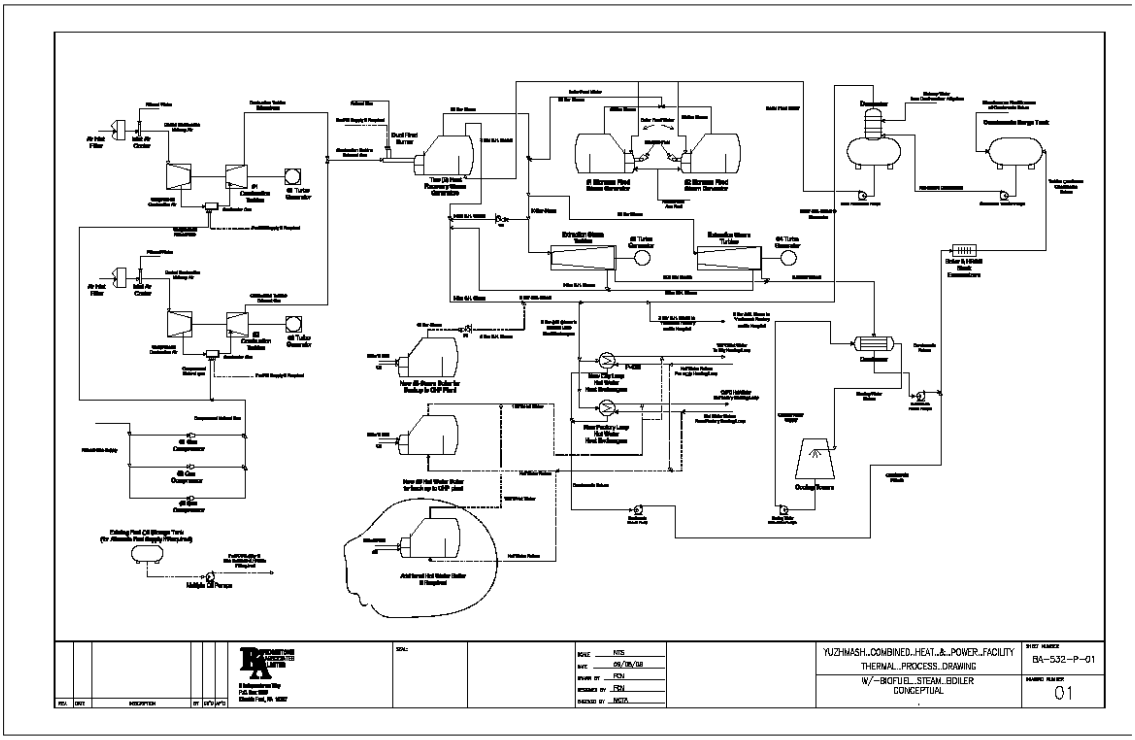


typical year in order to develop thermal and electrical output requirement profiles for the CHP plant.

The evaluation included assessment of the existing equipment and determination of rehabilitation and replacement options. Due to poor maintenance practices, mainly as a result of lack of maintenance funds and capital investment, the existing equipment was deemed to be almost completely worthless.

Numerous replacement alternatives were examined. These included boiler and steam turbine systems using natural gas, coal and/or biomass, and gas-fired combined cycle. An assessment of biomass potential was conducted and it was determined that a purpose grown bio-energy crop (12 – 15 ft patented perennial grasses) could be grown on land owned by the factory and used to provide approximately 45 – 60 MW of base load production. Bridgestone Associates worked with a Latvian based company specializing in the growth of such bio-energy crops to develop a supply plan and cost structure for the bio-energy feedstock.

While Ukraine has indigenous coal supplies, the Factory Management expressed a concern with the use of coal due to environmental issues. Coal use and its costs were examined but the preferred additional fuel was natural gas. The remainder of the plant's output would be provided therefore by natural gas using a gas-fired combined cycle that could be cycled on and off to meet grid power peak prices.



Full heat balances and performance estimates were developed for all scenarios for each season of the year for full and partial loads. A detailed capital cost estimate was prepared using budget costs obtained from major equipment vendors. A detailed operations and maintenance cost was prepared and used in the comprehensive economic analysis model prepared by Bridgestone Associates. This model was used to compare equipment design and fuel alternatives as well as variations in assumptions.

A formal written report was prepared. This was combined with reports prepared by a local environmental consultant and Broad Street Capital, the New York based financial adviser and project partner. After translation into Russian, the report was submitted by Broad Street Capital to the USTDA, the factory management and the Ukrainian Government. This report is being used as the basis to develop a funding plan for the project.