PROJECT SUMMARY

23.8 MW PAPER MILL CHP PLANT
TECHNICAL & ECONOMIC FEASIBILITY STUDY

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Bridgestone Associates prepared a detailed technical and economic feasibility study for a 12.5 – 23.8 MW Combined Heat and Power (CHP) plant for the Graphic Packaging International paper mill in Kalamazoo, Michigan, USA. The Mill purchases the majority of its electricity from Consumers Energy, the local electric utility. The Mill also generates a small portion of its own electricity using a steam turbine generator. Mills steam requirements are produced in a number of gas fired boilers.

The detailed feasibility study prepared by Bridgestone included a complete analysis of hourly, daily and seasonal energy uses (electricity, steam, etc.), an analysis of existing costs, evaluation of different CHP plant alternative configurations, modeling of their performance using GT-PRO and GT-MASTER, evaluation of their costs, and a detailed analysis of the financial performance of each alternative.

PROJECT STATISTICS

Client:	Graphic Packaging International / Bryan Power Generation Solutions
Project Type:	Natural gas fired combined heat and power (CHP) plant
Year:	2015
Size:	12.5 – 23.8 MW depending on equipment configuration selected
Estimated Project Cost:	US$22.1 – 45.0 million depending on equipment selected and new or refurbished pre-owned equipment.
Simple Payback:	2.8 – 6.0 years depending on plant configuration and equipment selected
Plant Location:	Kalamazoo, MI, USA
Plant Elevation:	775 feet above sea level
Facility Electric Demand:	18 – 19.5 MW (average), 22 MW (peak)
Facility Energy Purchased:	161,960 MWh/year
Facility Steam Load:	450 psig, 650 ^{o}F 230,000 lb/hr (peak winter) 200,000 lb/hr (peak summer)
Interconnection Voltage:	13.8 kV
Primary Fuel:	Natural gas

Configurations Evaluated: GE LM2500PE Cheng Cycle – New and pre-owned
GE LM2500PE from Graphic Packaging Santa Clara, CA Plant
GE LM2500PH – new and pre-owned
Solar Mars 90 – new and pre-owned – two units
Solar Titan 130 – new and pre-owned
Solar Titan 250 – new and pre-owned

CHP Plant Configuration and Prime Mover	Capacity (MW)	Unfired Steam Production (Avg) (lb/hr)		Duct Firing Steam Production (Avg) (lb/hr)		Total CHP Steam (Avg) (lb/hr)
1 x GE LM2500PE Cheng Cycle New	17,095	76,200	+	114,649	=	190,849
1 x GE LM2500PE Cheng Cycle Used	17,095	76,200	+	114,649	=	190,849
1 x GE LM2500PE Santa Clara New	23,796	56,020	+	101,377	=	157,397
1 x GE LM2500PE Santa Clara Used	23,796	56,020	+	101,377	=	157,397
1 x GE LM2500PH New	20,498	56,020	+	101,377	=	157,397
1 x GE LM2500PH Used	20,498	56,020	+	101,377	=	157,397
1 x Solar Titan 130 New	12,557	53,800	+	68,666	=	122,466
1 x Solar Titan 130 Used	12,557	53,800	+	68,666	=	122,466
1 x Solar Titan 250 New	19,674	63,920	+	93,477	=	157,397
1 x Solar Titan 250 Used	19,674	63,920	+	93,477	=	157,397
2 x Solar Mars 90 New	17,095	76,200	+	114,649	=	190,849
2 x Solar Mars 90 Used	17,095	76,200	+	114,649	=	190,849

The performance of each equipment configuration was modeled using Thermoflow's GT-PRO and GT-MASTER gas turbine and combined cycle modeling software. Heat balances were prepared for the specific site elevation under varying seasonal ambient conditions (e.g. winter extreme, winter, spring/autumn, summer, summer extreme). These results were then used in Bridgestone's proprietary CHP/IPP model to develop a complete technical and economic performance analysis to allow comparison between alternatives.

Based on the results obtained and the evaluations conducted, it was concluded that the development and installation of a CHP plant to include a combustion turbine generator and HRSG was a viable economic, technical and environmental solution.