

**Table 3-2: Recommendation Summary**

Facility	Boiler Unit	Recommendation	Estimated Capital Cost	Estimated Yearly Cost Savings	Estimated Efficiency Improvement
<b>Start-up/Shut-down Procedures</b>					
PVT-1	Boiler 5 Boiler 9	Reduce start-up times on all boilers. Utilize natural gas as a start-up fuel to reduce levels of organic toxics.	\$50,000	NA	0
PVT-2	General	Revise SO2 limit in existing air permit to reduce the need for multiple start-ups caused by SO2 limitations.	\$10,000 to \$15,000	NA	0
PVT-5	General	Improve shut down procedures for unneeded boilers	\$0	\$1,500	<1%
PUB-3	General	Reduce start-up times to reduce levels of toxics emitted during start-up procedures.	NA	NA	0
<b>Fuel Management</b>					
PVT-1	General	Fuel dry bark to improve combustion of bark fuel source.	\$100,000 fuel dryer capable of treating bark at a rate of 6 tons per hour .	Up to \$300,000 per year savings in coal use by increasing Btu value of wood fuel.	1 to 2%
PVT-1	General	Cover bark fuel storage area to reduce moisture and improve combustion of bark.	\$50,000 to \$100,000	Up to \$300,000 per year savings in coal use by increasing Btu value of wood fuel.	0.50%
PVT-2	Boiler 9	Reinject ash to reduce the amount of ash (and cost) for disposal. Operators stated that reworking the ash removal system on this unit would greatly reduce maintenance requirements.	\$75,000	\$13,300 to \$26,600	1 to 2%
PVT-2	Boiler 9	Install sootblowers to improved heat transfer and reduce back-end temperatures.	\$100,000	NA	Additional assessment needed by vendor.

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PVT-2	General	Re-use bottom boiler ash to take advantage of Btu value. Bottom boiler ash has been analyzed and contains up to 8000 BTU/lb (better than dry wood).	\$75,000	Fuel cost saving: \$8,200 to \$27,900. Disposal Cost saving: \$48,000	1 to 2%
PVT-2	General	Modify limestone conveying system to improve delivery of correctly sized limestone and minimize quantity of limestone used.	\$100,000	Further assessment by vendor needed.	Further assessment by vendor needed.
PVT-3	General	Tarp rail cars to reduce excess moisture to coal and bark fuel sources to improve combustion process.	10 tarps at \$500 per tarp: \$5,000	\$5,800	0.2% overall improvement for three boiler system
PUB-2	General	Replacing fuel feeders with newer, more modern design to improve opacity and decrease toxic emissions.	\$123,000 per boiler	\$128,000	0.25%
PUB-3	General	Co-fire (or over-fire) up to 20% natural gas to reduce criteria and toxic pollutant emissions.	\$35,000 to \$45,000 to install one gas burner	Dependent on the price of natural gas.	0
<b>Water Treatment</b>					
PVT-2	General	Automated boiler conductivity blowdown and feedwater monitoring instrument systems.	\$50,000 to \$100,000	\$29,000 to \$58,000	1-2%
PVT-2	General	Upgrade water clarifier to minimize the amount of blowdown required and reduce boiler fouling.	\$100,000 to \$200,000	\$29,000	1%
PVT-3	Boiler 1 Boiler 2 Boiler 10	Upgrade water cleaning system to reduce tube fouling.	<\$100,000	\$14,400	0.5% overall improvement for three boiler system
PVT-5	Plant 1	Return condensate to boiler units for reuse.	\$48,000	\$10,480	4%
<b>Combustion air pre-heating</b>					
PVT-1	General	Preheating inlet combustion air to reduce the amount of heat needed for combustion process.	Further assessment by vendor needed.	Further assessment by vendor needed.	0.5 to 2%

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PUB-1	General	Preheat inlet combustion air using heat exhaust and/or air preheaters to reduce the amount of heat needed for the combustion process.	\$12,000 to \$75,000	\$146,700	2%
PUB-4	General	Increase temperature in the condensate (feed water) using boiler exhaust heat and/or to preheat the inlet air with the spent condensate.	Further assessment by vendor needed.	Further assessment by vendor needed.	0.5 to 1%
<b>Controls</b>					
PVT-2	Boiler 6 Boiler 8	Retrofitting two boilers with underthrow feeders and variable frequency drive (VFD) grate drives.	\$150,000	\$45,400 (2 boilers)	1% per boiler
PVT-2	Boiler 7	Convert boiler control to computer based distributed control system to improve overall combustion process.	\$50,000	\$114,700	2%
PVT-2	General	Improved monitoring/metering of the specific paper mill steam and electrical usage to refine power plant operation.	\$30,000	Further assessment by vendor needed.	Further assessment by vendor needed.
PVT-3	Boiler 10	Upgrade O2 controls to maintain outlet temperatures.	\$50,000 to \$100,000	\$33,300 to \$83,200	1% to 2.5%
PVT-4	Boiler 3 Boiler 4 Boiler 9	Improve burner tip workmanship to improve combustion of fuel oil.	\$5,000 to \$10,000 per year	\$36,200 to \$72,500	1% to 2% overall improvement for three boiler system
PVT-5	General	Setting combustion on all boilers	\$5,780	\$3,145	1%
PUB-2	General	Conduct a "NO <sub>x</sub> vs. % overfire air" study to assess potential NO <sub>x</sub> reductions.	\$20,000 for study	Further assessment by vendor needed.	Further assessment by vendor needed.
PUB-3	General	Conduct a "NO <sub>x</sub> vs. % overfire air" study to assess potential NO <sub>x</sub> reductions.	\$20,000 for study	Further assessment by vendor needed.	Further assessment by vendor needed.
<b>Flue gas treatment</b>					
PUB-1	General	Install CO/VOC catalyst unit to reduce toxics.	\$150,000	NA	0
PUB-3	Boiler 1 Boiler 2 Boiler 3	Replace old baghouses for three boiler units. This would reduce the metals portion of the toxic pollutants by, conservatively, 98%.	\$250,000 per boiler	NA	0

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<b>Associated equipment</b>					
PVT-2	Boiler 6	Install new forced draft fan and improve overfire air flow measurement.	<\$100,000	\$49,000	2%
PVT-2	Boiler 6 Boiler 7 Boiler 8	Chemically clean three boilers to remove scale and improve heat exchange.	\$30,000	\$170,600 for three boiler system	5%
<b>Steam systems</b>					
PVT-2	General	Conduct regular maintenance of 300 to 400 steam traps.	\$50,000 to \$60,000 per year	\$1,200,000	<a href="#">10% to 20% (1)</a>
PVT-5	General	Conduct steam pressure profiling on 2 boilers	\$11,900	Further assessment by vendor needed.	Further assessment by vendor needed.
PVT-5	General	Insulate steam and condensate lines.	\$42,300	\$21,100	8%
PVT-5	Plant 1	Conduct flash steam loss study to reduce utilizable steam lost to the atmosphere	\$2,900	Further assessment by vendor needed.	Further assessment by vendor needed.
PVT-5	Plant 2	Reduce utilizable flash steam currently vented to the atmosphere	\$13,000	\$29,400	11%
PVT-5	Plant 1	Reduce operational steam pressure	\$3,000	\$5,200	2%
<b>Heat Recovery</b>					
PVT-3	Boiler 10	Relatively high outlet temperature (489°F to the precipitator) indicate that some excess heat still available. No immediate potential process uses were apparent.	Further assessment by vendor needed.	Further assessment by vendor needed.	Further assessment by vendor needed.
PUB-1	Boiler 1 Boiler 2 Boiler 3	Relatively high outlet temperatures for three boilers (530°F) indicate some excess heat is available. No immediate process uses for the excess heat were identified; however, a study should be completed to assess potential.	Further assessment by vendor needed.	Further assessment by vendor needed.	Further assessment by vendor needed.

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PUB-2	Boiler 1 Boiler 2 Boiler 3	Relatively high outlet temperatures for three boilers (450°F) indicate some excess heat is available. No immediate process uses for the excess heat were identified; however, a study should be completed to assess potential since ductwork combines the exit gases into one plant stack.	Further assessment by vendor needed.	Further assessment by vendor needed.	Further assessment by vendor needed.
PUB-3	Boiler 1 Boiler 2 Boiler 3	The boilers are all designed to produce 425 psi steam. In reality they generate steam at only 175 psi. No immediate uses were identified. Consideration should be given to purchasing a larger steam turbine that can accept the higher pressure steam and, in turn, generate (20% to 30%) more megawatts using the same amount of fuel.	Further assessment by vendor needed.	Further assessment by vendor needed.	Further assessment by vendor needed.
<b>Facility specific Recommendations</b>					
PVT-1	General	Install activated carbon filters to collect vapors from the paper rolling/process rooms. Organic vapors are generated from the steam injection process.	Further assessment by vendor needed.	Further assessment by vendor needed.	Further assessment by vendor needed.
PVT-2	General	Redesign the turbines for efficiency improvements. Turbines with less extracting ability and more condensing ability would result in more efficient units, but not without significant cost.	Further assessment by vendor needed.	Further assessment by vendor needed.	Further assessment by vendor needed.
PVT-2	General	Consider installing a new boiler and removing two old boilers from service. This would prolong the life of the existing baghouse and eliminate the need for costly installation of additional additional modules while upgrade to new, higher efficiency boiler units.	Further assessment by vendor needed.	Further assessment by vendor needed.	Further assessment by vendor needed.
PVT-5	General	Connect boilers in Plants 1 and 2. Two boilers would be sufficient to meet the steam needs of the facility. Connecting the systems would remove redundancy and excess energy use.	\$64,700	\$23,600	9%

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[\(1\) SIP Energy Efficiency Renewables Catalog 9Draft\), January 5, 1999, Table C-1.](#)