

Caterpillar Paving Products



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“Working with Caterpillar to improve their energy efficiency provided the perfect opportunity to expand my technical knowledge and analytical skills. This experience taught me how to work and communicate effectively with the variety of stakeholders involved in a large-scale manufacturing operation. The connections I’ve made will be invaluable as I transition to a career in environmental management.” ~WB

Project Background

The majority of compressed air is generated by three fixed-speed, 75 hp oil-injected, rotary screw compressors. These compressors are staged across a large pressure band, cycling between a loaded and unloaded state to meet fluctuations on demand. Air is dried and filtered, then fed to a 1,550 gallon receiver prior to being distributed throughout the plant. Use of compressed air begins in the first steps of the fabrication process for each product. The CNC machines that cut and process parts use compressed air for tool changes. Residual slag and oxide build-up is removed manually using hand-held pneumatic tools. Parts are fastened to fixtures to be welded into frames using pneumatic impact wrenches. Prior to assembly, frames are painted. Several pneumatic pumps and mixers are used in the plant’s paint kitchens. Pressure is released through spray guns to deliver paint, while specially treated compressed air supplies clean breathing air to the painters. Numerous pneumatic torque tools are used throughout the assembly processes that follow. In some cases, frames are moved through each step of assembly on an air pallet that releases compressed air

Company Background

Caterpillar Paving Products Inc. (Cat® Paving), a subsidiary of Caterpillar Inc., specializes in the production of road paving machinery. Its main facility in Brooklyn Park is the global headquarters for marketing and engineering efforts that design, build and support the machinery produced by this segment of the company. Machines fabricated and assembled at the facility include 70 different models of asphalt pavers, screeds, compactors and road reclaimers and Cat® Paving is adding an additional line of large asphalt compactors.

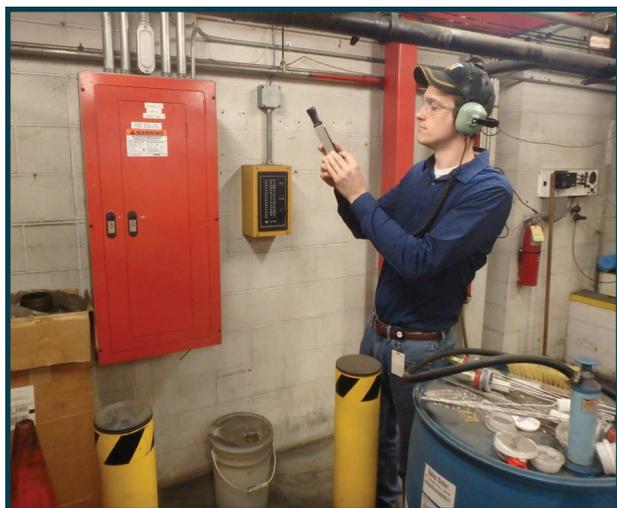


to create a near-frictionless surface between the floor and the fixtures.

Incentives To Change

Intensified efforts by Cat® Paving to curb the energy consumption of its expanding manufacturing operations are necessary in order to keep pace with the aggressive sustainability goals established by its parent company. By 2020, the company aims to reduce the energy intensity and GHG emission intensity of its operations by 50% of an established 2006 baseline year. Cat® Paving is currently participating in the Process Efficiency Program offered by Xcel Energy and CenterPoint Energy, which helps companies identify and quantify conservation opportunities and provides rebate incentives on capital investments to improve energy efficiency.

Compressed air is used heavily throughout each production line at the facility and currently accounts for 11% of annual electricity use. Implementation of energy saving opportunities throughout the generation, distribution and use of compressed air will result in significant cost saving and bring the company closer to achieving its energy and GHG emission intensity targets.



Repair All Identified Compressed Air Leaks and Isolate CNC Machines and Robots During Non-Production Hours

As much as 30% of the compressed air generated is currently lost to leaks. Most of this waste can be attributed to the 111 compressed air leaks that were identified and tagged for repair, while some leak flow results from internal losses within CNC machines, robots, and other equipment. By repairing all identified leaks and isolating machines that aren't in use, a minimum annual energy savings of 94,200 kWh is predicted. This equates to an annual cost savings of \$8,800 and a 44.5 MT CO₂-eq emission reduction.

Engineer Alternatives to Air Pallets or Regulate Inlet Pressure to Minimize Artificial Demand During Use

The use of air pallet jacks (particularly on the RM and paver line) consume excessive amounts of compressed air. The back-up compressor is often needed to maintain plant pressure during their use. While it would be ideal to engineer alternatives to air pallets, much of their air use can be eliminated by down-regulating inlet pressure. Further analysis is needed to quantify energy savings accurately.

Solutions

Integrate a Variable-Speed Drive Compressor into the Primary System and Upgrade Controls

Energy is wasted by the primary compressed air system due to unnecessary start-ups of trim and back-up compressors and excessive time spent unloading. Together, these compressors operate with an average specific power of 36.3 kW/100 CFM and consume approximately 648,300 kWh per year. Replacing one of these fixed-speed compressors with a VSD and upgrading controls to sequence the system is estimated to reduce annual energy use to 444,100 kWh per year. This 204,100 kWh reduction will save the company approximately \$19,100 per year and reduce annual indirect GHG emissions by 96.5 MT CO₂-eq. This project has been pre-approved for a large rebate to partially offset the implementation cost.



Recommendation	Annual Reduction (kWh)	Annual Savings	Status
Add VSD and Control Upgrades	204,100	\$19,100	Implementation in progress
Repair Identified Air Leaks and Isolate Equipment During Non-Production Hours	>94,200	\$8,800	Partially implemented
Engineer Alternatives to RM and Paver Air Pallets or Down-Regulate Pressure to Minimize Artificial Demand	Unknown	Unknown	Needs further analysis