

# USING NEXT-GENERATION TECHNOLOGY TO REDUCE SHOVEL COST PER TON

## TWO STUDIES SHOW HOW ADVANCED TECHNOLOGY AND ENGINEERING GIVE THE CAT® 6015B AND 6020B A FUEL EFFICIENCY EDGE AGAINST THE COMPETITION.

*Today's volatile fuel prices make controlling cost per ton more of a challenge than ever. In this report, we'll see how the latest Cat® shovels took on the competition in a pair of on-the-job fuel efficiency studies and beat them hands down on cost per ton.*

It's an inescapable fact of mining: The cost of fueling a machine over its working life is almost always substantially more than its purchase price. No matter where the cost per gallon may land in today's volatile economy, fuel remains one of the primary cost drivers in any mining operation.

To help control fuel costs, Caterpillar designed a number of features into their next-generation hydraulic mining shovels that are aimed squarely at increasing tons-per-gallon fuel efficiency. To find out just how efficient the new 6015B and 6020B shovels are, Cat Senior Applications Consultant Kent Clifton recently headed up two major production studies.

Conducted on two customer sites in Ohio, the well-designed studies set up a Cat 6015B on a large quarry site, and put a Cat 6020B to work on a coal overburden operation. Although the two sites were very different, Clifton says they involved similar types of materials, and they provided accurate, real-world conditions for both machines.

The studies compared the Cat 6015B Tier IV shovel with two competitors in the 100-tonne class – the Hitachi EX1200-6 and Komatsu PC1250-8. The 200-tonne Cat 6020B was compared against the Komatsu PC2000-8. All five machines were tested for productivity and fuel efficiency in truck loading applications.

**In every case, the Cat shovels delivered a clear fuel efficiency advantage that resulted in lower cost per ton.**

### CAREFULLY CONTROLLED STUDIES

"The key to running an effective production study is to eliminate as many variables as possible," Clifton explains. "That's how you get usable results that accurately reflect the performance differences between the various machines."

To that end, the Cat and competitive machines worked on the same bench, consisting of well-shot and fragmented material, using identical loading procedures. Experienced operators ran all of the shovels and trucks. To give the most accurate comparison possible, one operator ran all of the shovels. Clifton says, "The operators were world-class, so we could count on consistent, efficient machine operation throughout."



Shovel fuel burn was calculated by two methods: If the machine was equipped with an Engine Control Module (ECM), the data was compared to the standard top-off fueling method, using the day tank with a calibrated scale. If the loading unit was not equipped with an ECM, the top-off method was used by itself, with the same calibrated day tank and scale.

The Cat shovels were equipped with a 17.9 yd<sup>3</sup> (13.7 m<sup>3</sup>) bucket on the 6020B and a standard 10.6 yd<sup>3</sup> (8.1 m<sup>3</sup>) bucket on the 6015B. The competitive machines were outfitted with buckets as close in size as available – around 10.0 yd<sup>3</sup> (7.6 m<sup>3</sup>) on the Hitachi and Komatsu PC1250-8, and 17.8 yd<sup>3</sup> (13.6 m<sup>3</sup>) on the Komatsu PC2000-8.

“We took pains to make sure that the machines did comparable work under identical working conditions,” Clifton says. “We tried to run at least 30 trucks an hour past the 6015B and 15 trucks an hour past the 6020B. That’s what the operators do every day, so we’re confident that the results will translate well to other actual working mine sites.”

### IMPRESSIVE RESULTS

The results, in Clifton’s words, **“returned some big numbers that none of us really expected to see.** The Cat machines produced clear fuel efficiency advantages that were measurable and significant.”

Fuel Efficiency	Cat 6015B	Komatsu PC1250-8	Hitachi EX1200-6	Cat 6020B	Komatsu PC2000-8
Tons/Gal (Tonnes/Liter)	61.6 (14.8)	57.4 (13.8)	47.9 (11.5)	72.2 (19.4)	55.3 (14.8)
% Advantage	129%	120%	100%	131%	100%

The Cat 6015B delivered a 29% tons-per-gallon advantage over the Hitachi and a 9% advantage over the Komatsu. The Cat 6020B recorded a 31% fuel efficiency advantage over its Komatsu competitor.

When you dig a little deeper into the numbers, Clifton says, **you can see the importance of measuring fuel efficiency rather than simply raw gallons-per-hour fuel consumption.**

Consumption vs. Efficiency	Cat 6015B	Komatsu PC1250-8	Hitachi EX1200-6	Cat 6020B	Komatsu PC2000-8
Fuel Consumption - Gal/Hr. (Liters/Hour)	30.6 (115.8)	26.4 (99.9)	33.6 (127.2)	34.1 (129.1)	36.7 (138.9)
Fuel Efficiency - Ton/Gal (Tonnes/Liter)	61.6 (14.8)	57.4 (13.8)	47.9 (11.5)	72.2 (19.4)	55.3 (14.8)

The Komatsu PC1250-8 actually burned a little over four gallons less fuel per hour, but the Cat 6015B moved so much more material in the same time that it was able to produce a 4.2 tons per gallon (1.0 tonnes per liter) advantage in fuel efficiency. That’s important, because fuel efficiency is what actually lowers your cost per ton and it shows the importance of the correct payload utilization of a given machine.

### FUEL-SAVING TECHNOLOGIES

Clifton points out that there are several efficiency-maximizing technologies and features built into the next-generation Cat shovels. “It starts with integrated engine control technology that keeps the engine running precisely at or very near the rated speed. It prevents large drops in engine rpm and the related over-speeds that often happen in older equipment.”

This proprietary control system estimates fuel requirements based on engine speed and torque, and needed machine torque based on the current hydraulic load. It delivers faster and more consistent engine regulation that prevents lugging and overcorrection, which ultimately reduces fuel consumption.

In addition, a number of on-demand systems also contribute to fuel efficiency. These systems save energy by delivering power only when needed and conserving it when the power demand is low. One example is the oil-cooling system in both the 6015B and 6020B. He notes, "The on-demand oil cooling system is independent from the engine cooling system, so it only draws power when the oil reaches specific temperatures."

In addition to the engine technologies, the larger 6020B incorporates a proprietary dedicated pump flow allocation system. Clifton says, "It's an efficient way to get hydraulic oil to the systems that need it most. Hydraulic pumps are allocated to individual circuits on demand, allowing all of the oil flow to go into the working cylinders rather than into systems that don't need it at the moment."

## THIS SYSTEM SAVES FUEL BY MAKING MORE EFFICIENT USE OF AVAILABLE ENGINE POWER.

This system saves fuel by making more efficient use of available engine power. As an added benefit, Clifton says, "It works without over-revving the engine, which saves wear and tear on the drivetrain."

The other key efficiency strategy used on the latest Cat shovels is regeneration. Clifton explains, "It's a way to capture energy that had previously been wasted and feed it back into the system to help power the work at hand."



The 6015B features two regeneration technologies. The first is a closed-loop swing circuit that captures kinetic energy and turns it into hydraulic force. "The swing motor acts like a pump, driven by the mass of the complete superstructure including attachment and payload. During the braking cycle, that recovered energy is fed back into the system through the pump transfer gears so the engine has to generate less power, allowing it to run more efficiently." A boom float feature on the 6015B works on the same energy-recovery principle, using gravitation instead of hydraulic power.

The efficiency features built into the newest Cat shovels all drive toward the same two goals: **maximum production at the lowest possible cost.** "In an industry that fights for a 1% or 2% gain in unit costs, a 31% or 29% advantage in fuel efficiency is huge," Clifton says. "It speaks volumes about the success of Caterpillar engineering and the effectiveness of our next-generation shovel technologies."

For more information on the full line of Cat Hydraulic Mining Shovels, contact your local Cat dealer or visit [www.cat.com/HMS](http://www.cat.com/HMS).