International Newsroom

Navistar Reaches Development Agreement with Ecomotors International on Groundbreaking Engine Design

EcoMotors International's Opposed-Piston, Opposed-Cylinder Engine Promises to Revolutionize Commercial Vehicle Design with Powerful, Lightweight, Fuel Efficient, Low Emissions Engines

Navistar Continues to Deliver Customer-Focused Solutions by Working with EcoMotors to Commercialize this Innovative, Cutting-Edge Powertrain

WARRENVILLE, Ill. – (Feb. 22, 2011) – Navistar International Corporation (NYSE: NAV) today announced it has reached a development agreement with EcoMotors International™ in support of the company's opoc® (Opposed Piston-Opposed Cylinder) engine architecture.
EcoMotors International's first product targeted for commercial application is a turbo-diesel version of the innovative opposed-piston, opposed-cylinder engine.

"We continue to be on the cutting edge of technology and our development agreement with EcoMotors once again demonstrates our commitment to develop new, innovative approaches to the commercial vehicle industry," said Dan Ustian, Navistar chairman, president and chief executive officer. "Our company has a long history of pushing the envelope to deliver state-of-the-art, customer-focused solutions and we see great promise in EcoMotors' breakthrough engine design."

Khosla Ventures' Vinod Khosla, EcoMotors primary investor along with Bill Gates, sees the Navistar-EcoMotors alliance as a reflection of the disruptive nature of the opoc® technology.

"We are delighted that Navistar, a global leader in the commercial vehicle

industry, has recognized the game-changing promise of opoc®," said Khosla. "The only truly disruptive technologies are those that can provide not only rapid payback but also economic and carbon benefits to large segments of the world's population without the need for subsidies or massive infrastructure investments. Among next-generation propulsion systems, the opoc® engine is broadly applicable and can provide lower carbon emissions than almost any other technology."

Opposed-Piston Opposed-Cylinder Engine with Modular Displacement Capability

EcoMotors' patented engine design creates a ground-breaking internal combustion engine family architecture that will operate on a number of different fuels, including gasoline, diesel, natural gas and ethanol. The opoc's new opposed piston-opposed cylinder direct gas exchange operation provides the well known emissions benefits of 4-cycle engines, the simplicity benefits of 2-cycle engines, the power density of the less well known opposed piston engine, and the extraordinary developments in electronics and combustion technology all tied together in a new and proprietary engine architecture.

"EcoMotors is proud to partner with Navistar to commercialize the revolutionary opoc® engine," said Don Runkle, CEO, EcoMotors International. "For customers such as Navistar, this remarkable engine technology represents a competitive advantage that enables not only enhanced environmental sustainability, but also greater profitability. Our engineers are working to effectively rejuvenate the internal combustion engine for the 21st century."

The opoc® engine comprises two opposing cylinders per module, with a crankshaft between them—each cylinder has two pistons moving in opposite directions. This innovative design configuration eliminates the cylinder-head and valve-train components of conventional engines, offering an efficient,

compact and simple core engine structure. The result is an engine family that is lighter, more efficient and economical, with lower exhaust emissions.

EcoMotors' opoc® engine has a number of distinct advantages over traditional internal combustion engines. The opoc® engine has very high power density of nearly one horsepower per pound resulting in an unprecedented lightweight and compact engine. The opoc® engine is perfectly balanced enabling stackable power modules. This unique modular displacement capability is one of the long standing, but elusive goals of engine engineers' quest for high efficiency. In addition, it also results in much less NVH than a conventional engine of comparable power. It's elegantly simple design allows for low cost, efficient manufacturing and increased operating durability:

- 50 percent fewer parts than a conventional engine
- Straightforward assembly
- No cylinder heads or valve-train
- Uses conventional components, materials and processes

"Consistent with our leadership strategy, Navistar continues to seek innovative products which differentiate us from the marketplace, while others embrace the status quo," said Eric Tech, president, Navistar Engine Group.

Power Density

The internal combustion piston engine has been the primary means of automotive propulsion for more than a century. Today, thousands of engineers around the world are hard at work trying to improve this 19th century invention. Some are striving to make incremental gains; some are hoping for a breakthrough. For all of them, one measuring stick is the "acid test" for any engine—power density. As greater power density is achieved, a range of critically important attributes will result, including:

- Lower weight
- Smaller size

- Lower material costs
- Lower friction
- Greater fuel efficiency
- Lower emissions
- Lower heat rejection

Electrically Controlled Turbocharger

EcoMotors' intellectual property also includes an electrically controlled turbocharger technology which incorporates an electric motor in the turbo assembly to regulate boost pressure resulting in a long list of unique advantages:

- Improved combustion efficiency to meet emissions
- Electrically controlled variable compression ratio
- Improved vehicle fuel economy
- Enhanced vehicle drivability due to improved low-end torque
- Eliminates Turbo lag
- Waste heat recovery by generating electricity

Electrically Controlled Clutch

The development in clutch technology enables customers to take advantage of the engine's modular displacement capability. The clutch assembly is housed between two engine modules, and is engaged when vehicle power demands require both modules to deliver power. When the power of the second module is not needed, the clutch is disengaged, allowing the second engine to stop completely. This not only improves fuel economy dramatically by reducing parasitic losses, but also improves the efficiency of the primary module.

About EcoMotors International

Established in early 2008, EcoMotors is changing the landscape of internal combustion power. Based in Allen Park, Mich., EcoMotors is commercializing the unique opoc® engine for use in cars, light trucks, commercial vehicles,

aerospace, marine, agriculture, auxiliary power units, generators, etc. Anywhere conventional gas or diesel power is currently utilized, opoc® represents a better propulsion solution. The two primary investors in EcoMotors are Khosla Ventures and Bill Gates. Khosla Ventures offers venture assistance, strategic advice and capital to entrepreneurs. The firm helps entrepreneurs extend the potential of their ideas in breakthrough scientific work in clean technology areas such as solar, battery, high efficiency engines, lighting, greener materials like cement, glass and bio-refineries for energy and bio-plastics, and other environmentally friendly technologies as well as traditional venture areas like the Internet, computing, mobile and silicon technology arenas. Vinod Khosla founded the firm in 2004 and was formerly a General Partner at Kleiner Perkins and founder of Sun Microsystems. Khosla Ventures is based in Menlo Park, California.
