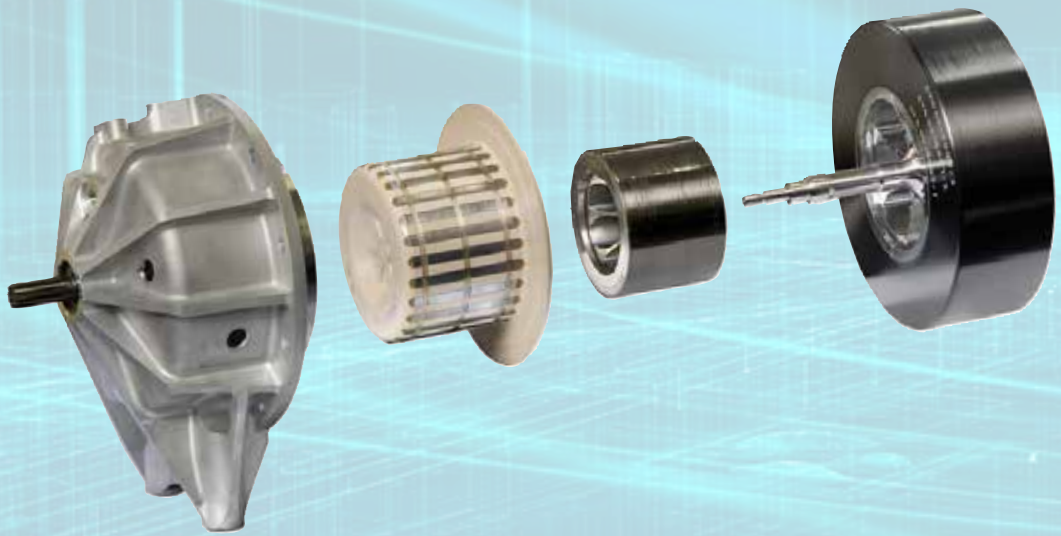
CONSIDER LIFE-CYCLE COSTS

One major consideration with hybrid technology is useful machine life. "The effects of hybrid operating costs are amplified as the useful life of the system is extended," says Anderson. "It is important to identify an application in which the vehicle is retained for long periods of time."



Life-cycle costs are also driven by the initial cost of the technology. As such, Ricardo feels there are applications where flywheel system technology will be an ideal solution. It recently demonstrated such a system on an excavator. "The Ricardo demonstrator featured a hermetically sealed carbon fiber rotor driven through a magnetic gear for high efficiency," Anderson explains. Using the magnetic gear drive allowed Ricardo to:

- **remove the rotating seals**
- **reduce the losses in the flywheel and**
- **eliminate the need for a vacuum management system**

Ricardo expects flywheel systems to be considerably less expensive than electric hybrid systems. "We should be targeting payback in less than two years," says Anderson. "The flywheel avoids the significant battery replacement costs that may be needed in some electric hybrids. Because Ricardo believes the flywheel will deliver the best payback in some off-highway applications, we are continuing the development of production intent hardware."

"As the industry moves forward, hybrid technology will continue to be utilized where customer value can be realized," says Chesterman. "The largest hurdle for hybrid technology adoption is the increased initial acquisition cost."