

ENVIRONMENTAL PERFORMANCE 3

NISSAN ELECTRIC DRIVE DELIVERS PERFORMANCE AND EFFICIENCY ADVANTAGES

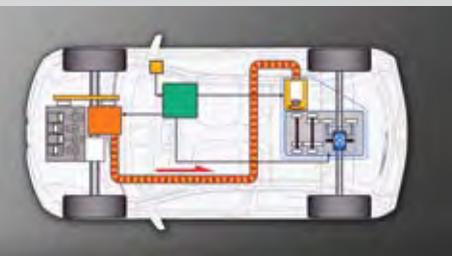


ELECTRIC DRIVE IS A PROPULSION TECHNOLOGY that's coming into its own. Its inherent efficiencies and widespread applications make electric drive much more than the sum of its parts. In fact, its major components such as electric drive motors, sophisticated power electronics, and advanced energy storage devices make electric drive a common denominator in electric, hybrid, plug-in hybrid, and fuel cell vehicles – the very vehicles that most envision are integral to our future.

This future is in motion at Nissan. On today's roads this is evident in both production and developmental vehicles. Electric motors in Nissan vehicles are powered with advanced batteries, electrical power generated by internal combustion engines, and electricity produced by hydrogen fuel cells.

Nissan's latest foray into the world of electric drive, the Mixim concept car shown here, combines battery electric propulsion with features and technologies aimed at a new generation of drivers, in a zero emission and highly efficient package indicative of the road ahead.





The sporty, compact Mixim concept integrates an array of high-tech features that appeal to an electronically-savvy generation of buyers. But the most important feature of this car – electric drive – transcends any individual

market segment. The ability to power a car silently, with zero localized emissions, and at a per-mile energy cost far less than that of gasoline or other alternative fuels makes electric drive a feature of growing interest.

The Mixim's use of two Nissan Super Motor electric motor/generators – one at each axle – provides high levels of efficiency and all-wheel drive performance. The result of an in-house development program at Nissan, the power dense Super Motor offers a unique design with a single motor featuring output through two shafts. This innovation allows a single motor to function as both a motor and generator, dramatically reducing overall

unit, comprised of an electric motor, clutch, and reduction gear, offers packaging efficiencies that allow it to be readily incorporated into 2-wheel drive models with minimal changes. Since a driveshaft is unneeded with this 4WD system, rear seat passengers enjoy a flat floor and additional legroom. The lighter weight of e-4WD also helps fuel efficiency.

Regardless of the application or the primary energy source, advanced batteries play a key role in the power paradigm. They store the electrical energy needed for drive power in a battery electric vehicle like the Mixim. In a fuel cell application like the X-Trail, batteries help extend driving range by capturing energy through regenerative braking during deceleration, and then provide it as electricity on demand.

Advanced batteries are an important focus at Nissan. The compact lithium-ion battery used in Nissan applications represents a technical breakthrough resulting from research that began in 1992. Its laminated cell design improves power output by 50 percent and reduces volume by more than half compared to conventional cylindrical cell designs. This is crucial for energy intensive drive systems like those required in battery

AT NATC, NISSAN'S ENGINEERS WILL PURSUE A RANGE OF GREEN TECHNOLOGIES TO ADDRESS THE CHALLENGES OF CO2 REDUCTION INCLUDING ELECTRIC VEHICLES, HYBRIDS, AND PLUG-IN HYBRIDS.

size and improving efficiency. A Super Motor can also be configured to do the work of two drive motors with independent control of driving force to a vehicle's left and right wheels.

Electric drive provides high levels of efficiencies in Nissan's Altima gasoline-electric hybrid sedan, a model that can be purchased today. Looking forward, one of the highest profile applications of Nissan's electric drive technology is the X-Trail hydrogen fuel cell vehicle. It may be that the X-Trail's energy source is hydrogen, but electricity is what the fuel cell provides to power this vehicle's energy dense Super Motor.

Electric drive is being incorporated in clever ways that enhance safety and performance. For example, Nissan's e-4WD system provides improved traction and hill-climbing capability on icy roads without the weight and bulk of conventional 4-wheel drive. Its rear-wheel drive

electric vehicles and plug-in hybrids.

Leveraging these and other environmentally positive technologies and environmental solutions is the goal of the Nissan Green Program 2010. As part of this, Nissan has made a \$783 million investment to strengthen its research and development facilities, including the Nissan Advanced Technology Center (NATC) in Japan. Here, Nissan's engineers will pursue a range of green technologies to address the challenges of CO2 reduction including electric vehicles, hybrids, and plug-in hybrids to fill the needs of an evolving world.



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