



### Input

**CHRYSLER GROUP** plans to supply North America and Western Europe with subcompact cars built in China by Chery Automobile, a Chrysler spokesman says, noting an agreement was reached in early December. Production will begin "soon," he tells *Ward's* without giving details about launch timing or volumes. The deal, the first of its kind involving a China-based auto maker, still must be approved by the supervisory board of Chrysler parent DaimlerChrysler AG.

**FORD MOTOR CO.** has filed a lawsuit against Navistar International Corp. over warranty costs and the prices of the diesel engines it supplies the auto maker. In the filing, Ford alleges Warrenville, IL-based Navistar owes it money under an agreement to share engine warranty costs, which it says Navistar has failed to pay. Navistar diesels, which Ford uses in its Super Duty F-Series pickups, have been the subject of various quality issues in the past. Also in the lawsuit, Ford says Navistar began raising prices for the engines "without adequate explanation or support for its actions." Ford seeks reimbursement equal to what it says it overpaid for the engines.

**GENERAL MOTORS Corp.**'s new Saturn Aura sedan and Chevrolet Silverado pickup win both the 2007 North American Car and Truck of the Year awards at the recent North American International Auto Show. GM's sweep marks only the second time in the 14-year history of the competition that one auto maker has taken both awards. Honda Motor Co. Ltd. won last year with its all-new '06 Civic and Ridgeline pickup.

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## Volt charges GM's hybrid future

DETROIT — General Motors Corp. shakes up the global hybrid-electric vehicle contest with the Chevrolet Volt Concept, a plug-in HEV the auto maker says could achieve a startling 150 mpg (1.56 L/100 km).

Revealed at last month's North American International Auto Show here, the Volt signals GM's overarching strategy to move from mechanical to electric-vehicle propulsion systems.

The concept is designed to run solely on charged electric power for a range of 40 miles (64 km). When that power supply starts to wane, a 1.0L, 3-cyl. turbocharged engine, burning gasoline or alternative fuels, kicks in to generate power to run the electric motor.

Unlike traditional HEVs, the Volt is a series

hybrid because the internal combustion engine does not provide propulsion.

The car also is designed to store energy via a lithium-ion battery pack — supplier technology that is still very much in the development stage.

When the entire powertrain is considered, the Volt has a 640-mile (1,029 km) range.

"There are going to be people who don't drive more than 40 or 50 miles (64-80 km) a day," Bob Lutz, GM vice chairman-global product development, recently told *Ward's*.

"They will be perfectly happy with a plug-in hybrid," he says. "They'll be able to drive electrically a lot of the time and their fuel economy is going to be off the chart because they'll almost never use fuel."

Lutz and GM Chairman Rick Wagoner introduced the concept vehicle, but GM engineers say the Volt will not be left to collect dust after the show.

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Chevy Volt concept described as link between conventional vehicles and hydrogen fuel-cell powerplants of the future.

## New ZF 6-speed automatic eager to please

SEDONA, AZ — BorgWarner Automotive struck pay dirt in 2003 when its innovative dual-clutch transmission (DCT) arrived in a few Volkswagen AG models and changed forever the face of the gearbox market.

With DCT, BorgWarner proved there is room for a transmission that functions like an automated manual but can provide quick, clean, sporty shifts and that also can be switched easily to full automatic mode for daily commuting.

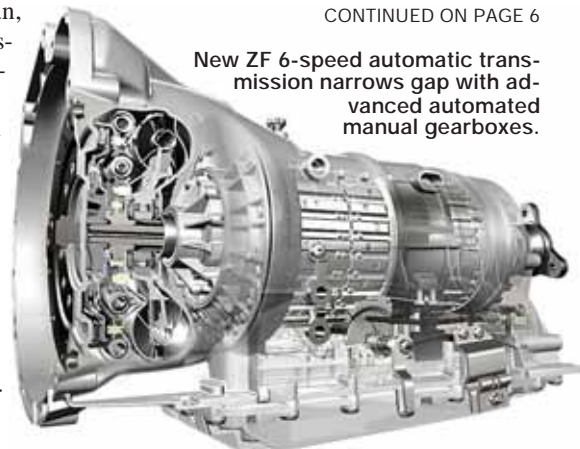
The DCT, which VW markets as its Direct Shift Gearbox (DSG), met instant acclaim in the VW Golf R32 and Audi TT (and now offered throughout the VW and Audi product family), largely because it virtually eliminates the annoying "torque interrupt" between gear shifts.

Today, the market is evolving as continuously variable transmissions ramp up to respectable volumes and as BorgWarner competitors strive to outdo the DCT.

ZF Friedrichshafen AG is among them. It was first to market in 2001 with a 6-speed automatic, and its second-generation unit has arrived in recent months in the BMW 335i coupe and X3 and X5 cross/utility vehicles.

This second-generation 6-speed automatic uses a new torque converter that improves the

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New ZF 6-speed automatic transmission narrows gap with advanced automated manual gearboxes.

# Performance still crucial to GM's success



DETROIT — Paralleling General Motors Corp.'s quest for the "complete electrification of the automobile" will be the increased performance of its enthusiast-based models.

"We have tons (of technologies) on the shelf," GM Powertrain Group Vice President Tom Stephens tells *Ward's* on the sidelines of the recent North American International Auto Show here.

"We can deliver whatever (level of performance) is needed."

Advanced electric-based vehicles and concepts such as the Chevrolet Volt plug-in concept, dominated NAIAS this year and foretell GM's future product direction. But Stephens describes a diametric structure for future vehicles, where the auto maker's mainstream models are flanked by niches of

advanced, environmentally friendly vehicles and performance-oriented sports cars and sedans.

"Performance is alive and well (at GM)," he says.

The dichotomy is part of GM's core plan for powertrain diversity, Stephens says, noting the auto maker will continue to develop conventional, alternative-fuel and electric-based engines and drivetrains.

Symbolizing this structure is GM's commitment to performance brands within its mainstream vehicle lineups, such as the Chevrolet SS; Pontiac GXP; Saturn Red Line and Cadillac V-Series; all of which will



Camaro convertible concept signifies GM's performance intentions.

grow stronger in the future, Stephens says.

Also of note is the next-generation rear-wheel-drive architecture being developed by GM Holden Ltd. in Australia. The platform will underpin several fun-to-drive models, Stephens says, including the new Chevrolet Camaro and Impala, both of which will hit the U.S. market later in the decade.

In addition, Bob Lutz, vice chairman-global product development, confirms Australian media reports that GM will export RWD, V-8-powered Holden Commodore SS models to the U.S. to be rebadged as Pontiac G8 sedans.

The Commodore has a long performance legacy Down Under and, in G8 guise, is expected to revive Pontiac's ailing reputation for performance and excitement.

Media reports also indicate GM will unveil a more powerful version of the Corvette Z06 within a year to better compete against the new 600-hp '08 Dodge Viper, a possibility Stephens does not dismiss.

When prodded on the future of the small-block V-8 in GM's lineup, he says fuel economy and refinement will continue to improve, as will performance.

"Supercharging is not a problem," Stephens says of the Z06's 500-hp LS7 V-8, adding direct gasoline injection is a challenge for the small-block, but development work already has been built into its architecture.

As for the horsepower limits of GM's mainstream, high-end vehicles, such as a "super" Z06, Stephens says: "Integration is key. There are few limits if the balance is there with the chassis and the electronic stability controls."

Stephens also promises the aging Northstar DOHC V-8, which has powered various Cadillac vehicles for more than a decade, will not go away.

"We plan to be more than competitive (with the Northstar) in horsepower, torque, fuel economy and emissions," he says, declining to tip his hand on the specific future of the engine's development. □

— Mike Sutton

## Audi may drop manuals for U.S. models

DETROIT — Audi AG has an ambitious \$15 billion investment slated for the next five years, with 70% earmarked for new product.

One item the auto maker may be cutting from its investment plan, however, is manual transmissions for the U.S.

Audi officials, at a roundtable discussion at last month's auto show here, admit they're considering doing away with the stick shift for mainstream U.S. models.

"It's conceivable in the U.S. we may dispense with manuals," Johan de Nysschen, executive vice president of Audi of America Inc., says.

Manual-transmission installation rates in the U.S. continue to fall. And despite ongoing efforts to reinforce the brand's sporty characteristics, Audi cannot ignore the reality that most U.S. customers — as opposed to Europeans — simply do not want to deal with a clutch pedal, de Nysschen says.

"For us, the S-Tronic represents the best of both worlds," he says, referring to Audi's version of parent Volkswagen Group's successful automated manual transmission, named Direct Shift Gearbox.

The S-Tronic is a dual-clutch manual transmission fitted with an electrohydraulic module that automatically actuates the clutch. The high-tech transmission can shift gears on its own, just like an automatic transmission, or allows the driver to shift gears sequentially, without a clutch pedal.

De Nysschen stresses that Audi's high-performance S and RS variants of its mainstream models would continue with manual transmissions, because those buyers typically seek the full control of a manual transmission and clutch pedal. Audi currently has S or RS vari-

ants of almost all its standard model lines except the Q7 cross/utility vehicle.

"I would not imagine an automatic-transmission RS4 (for example)," de Nysschen says, adding, "The mainstream cars (in the U.S.) may well go automatic only."

He says Audi expects to further expand use of the dual-clutch S-Tronic gearbox to replace both manual and conventional torque-converter automatic transmissions.

Audi interim CEO and CFO Rupert Stadler says the auto maker plans to increase its product range from 22 models today to 40 models during the next five years as part of its ambitious investment plan. Much of it is focused on the U.S. market, where Audi had a record sales year in 2006, up 8.5% to 90,116 deliveries.

While the U.S. is Audi's leading export market, trailing only Germany in sales, China rapidly is approaching U.S. volumes and soon may surpass the U.S. to become the auto maker's largest export market, Ralph Weyler, board member for sales and marketing, says.

Despite a growth plan that earmarks a leap from 2006's 905,100 worldwide sales to 1.4 million by 2015, Stadler says there are no plans to add manufacturing capacity until sales surpass 1 million units.

Then, he says, Audi likely first will look for capacity within the VW Group. Despite frequent auto industry discussion about the effects of currency exchange rates, all three Audi executives say the company currently is not considering the U.S. for a new assembly plant.

A factory in the U.S. "would not solve problems with the exchange rate," Stadler says. "The time is not right." □ — Bill Visnic

# Volt charges GM's plug-in hybrid future



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The Volt's E-Flex platform is an adapted version of the future Global Compact Vehicle Architecture (Delta) that will underpin the next-generation Chevy Cobalt and HHR.

GM managers say they want to leverage the auto maker's global manufacturing capability to manufacture the Volt in several different regions, rather than produce a low-volume niche model solely for the U.S.

The E-Flex architecture "strikes at the heart of some of the paradigms that govern this industry," Jon Lauckner, GM vice president-global program management, says.

The Volt's 12-gallon (45 L) tank can run on gasoline or plant-based alternative fuels, such as E85, a gasoline/ethanol blend.

"If it's in Europe, it could be biodiesel; if it's in Brazil, it could be E100 (100% ethanol)," Lauckner says. "GM is committed to making this a volume play globally."

Engineers say annual home recharging of the Volt will consume about as much electricity as running three or four refrigerators a year.

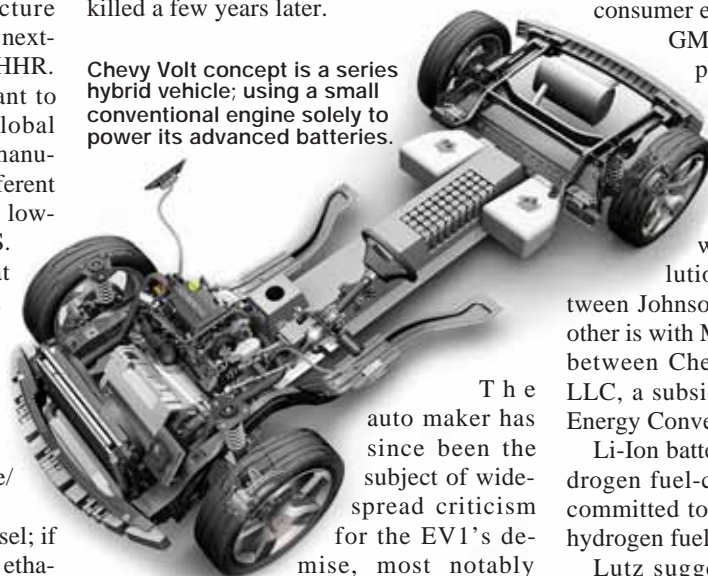
Viewed another way, the price of electricity is the gasoline equivalent of \$0.60 per gallon, assuming a \$2 per gallon price and when driving the Volt 40 miles on electric power.

The per-mile cost for electrical power is roughly one third of the price of gasoline, GM estimates.

Nick Zielinski, chief engineer, says his team has conducted several months of simulations but has yet to road test the concept car.

A number of Volt engineers also worked on GM's ill-fated EV1, a pure electric vehicle GM introduced in 1996 as a Saturn, but killed a few years later.

Chevy Volt concept is a series hybrid vehicle; using a small conventional engine solely to power its advanced batteries.



The auto maker has since been the subject of widespread criticism for the EV1's demise, most notably with last summer's documentary "Who Killed the Electric Car?"

Unlike the Volt, the EV1 did not contain an internal combustion engine.

Recharging the Volt's battery from zero to full power is estimated to take up to 6.5 hours, compared with eight hours for the EV1, which had a range of just 90 miles (144 km).

The Volt's electric-drive motor is capable of running on 161 hp (120 kW) of peak power from a still-to-be selected Li-Ion battery pack. The engine can churn out 236 lb.-ft. (320 Nm) of torque, while the onboard generator kicks out 71 hp (53 kW) of power, according to engineering plans.

The big uncertainty for the Volt remains the Li-Ion battery pack, and the limitations of the technology, which mainly powers consumer electronics.

GM recently announced two supplier contracts to develop Li-Ion batteries for the Saturn Vue Green Line PHEV, which GM has committed to building, possibly by 2010.

One battery contract is with Saft Advanced Power Solutions LLC, a joint venture between Johnson Controls Inc. and Saft; the other is with Michigan-based Cobasys, a JV between Chevron Technology Ventures LLC, a subsidiary of Chevron Corp., and Energy Conversion Devices Inc.

Li-Ion batteries are critical for future hydrogen fuel-cell vehicles, as well. GM is committed to building a production-ready hydrogen fuel-cell car by 2011.

Lutz suggests the Volt represents the missing vehicle link between gasoline engines of today and GM's future hydrogen fuel-cell vehicles. "They're enabled by basically the same vehicle architecture," he says. "The question is what do you use to generate electricity?"

It's unclear if the production-ready Volt will retain its aggressive styling, which is somewhat reminiscent of the Chevy Camaro concept that was the star of the 2006 Detroit auto show. But program managers say the Volt is designed to make a statement.

"We wrapped — we hope — a very attractive package around it," Tony Posawatz, vehicle line director, says. □ — *Scott Anderson*

## Hemi powering up Dodge Durango Hybrid

DETROIT — Chrysler Group began pilot production last month of the Durango Hybrid, its first gasoline-electric vehicle, Frank Klegon, executive vice president-product development, says.

Klegon also confirms the powertrain's electric motors will be mated to Chrysler's trademark 5.7L Hemi V-8. Factoring in the Hemi's Multi-Displacement System that shuts down cylinders when not needed, the hybrid powertrain will offer a fuel economy improvement of up to 30%.

This portends combined city/highway performance of 20.6 mpg (11.4L/100 km) for the rear-wheel-drive Durango and 19.4 mpg (11.9L/100 km) for the 4-wheel-drive variant.

"Things are moving right along," Klegon says of the hybrid's development, adding its complexity requires a phase-in that is "a little bit longer" than a conventionally powered vehicle.

Series production is expected to begin in the fourth quarter at Chrysler's assembly

plant in Newark, DE.

Meanwhile, the jury still is out on plans to build a hybrid version of Durango's platform-mate, the newly launched Chrysler Aspen.

"It's a decision we haven't made yet," Klegon tells *Ward's*. "But it's something we can do easily. It depends on market conditions, not engineering."

Chrysler's hybrid system was developed in conjunction with a \$310 million partnership involving General Motors Corp. and BMW AG. GM launches its first product, also a fullsize SUV, later this year, while BMW has not yet announced its intentions.

Chrysler can expect to generate some buzz for using its high profile, performance-oriented Hemi as the foundation for its hybrid powertrain.

"Hemi is a great brand," notes Global Insight analyst John Wolkonowicz. And it could pay dividends for Chrysler as a hybrid

by offering — at least on the surface — the best of both worlds, performance and fuel economy.

Hybrids have become fashionable, Wolkonowicz says, adding: "Fashion is what the industry's all about." □ — *Eric Mayne*



Hemi V-8 to be part of Chrysler's first hybrid powertrain.

# Audi to offer torque vectoring on next quattro

Powertrains

DETROIT — Aware that it needs to maintain the top-flight reputation of its famous quattro all-wheel-drive systems, one of Audi AG's chief vehicle engineers says it will introduce a highly advanced form of quattro later this year.

Michael Dick, Audi's head of Total Vehicle and Chassis Development, tells *Ward's* at the recent auto show here the auto maker will incorporate so-called torque-vectoring technology into the next-generation quattro system slated to launch later this year in Europe for the all-new A5 coupe, to be quickly followed by the eighth-generation A4 sedan, which comes to the U.S. in early 2008.

Both vehicles are built on the same all-new architecture.

Torque vectoring takes all-wheel drive to another level by varying drive torque not just between front and rear axles but also between wheels on the same axle.

By adjusting torque side-to-side, a higher degree of handling performance can be achieved by delivering more torque to the outside wheel in a turn, turning the vehicle more sharply and precisely into the corner.

Torque vectoring also is a way to enhance safety, in effect an "active" form of the conventional brake system-based vehicle stability control systems.

Dick says the next-generation quattro with torque vectoring will retain Audi's longstanding Torsen (torque-sensing) center differential to apportion torque between the front and rear axles, but adds a differential on the rear axle, incorporating electronically controlled clutches, to selectively apportion torque between the rear wheels.

Dick says Audi began testing its torque-vectoring quattro system early last year, and engineers will be ready to launch the system with the new A5 and then in performance-oriented S and RS variants of the all-new A4 sport sedan.

Dick says the torque-vectoring quattro



Next generation Audi A4 slated for new quattro all-wheel-drive in '08.

system, combined with Audi's introduction of an active-steering system, will deliver "driving dynamics as no Audi (has) before."

Torque vectoring, Dick says, "will be a way to eliminate understeer, particularly on high-grip roads. It imparts a very neutral driving dynamic."

Despite the traction-enhancing benefits of quattro, Audi vehicles long have been criticized for their tendency to understeer — a cornering situation where the front of the vehicle tends to "push" away from direction of the corner.

In 2006, Audi launched its third-generation quattro system with a Torsen center differential designed to bias drive torque between the front and rear axles at a ratio of 40% front and 60% rear, which imparts a handling character that more closely replicates that of a rear-drive layout.

The new 40/60-quattro bias is used for the RS4 and other performance-tuned models, while mainstream Audi vehicles retain the standard quattro 50/50 bias. Dick says the next-generation quattro with torque vectoring also will use the performance-oriented 40/60 arrangement.

The new-generation quattro AWD and the new active steering system, which is designed to help the driver steer in crucial situations, were developed internally as a project named "charisma."

Dick does not say which other vehicles in the future Audi lineup will be fitted with the torque-vectoring AWD, but says it likely will be used, at least initially, for "high-end" vehicles such as the performance S and RS variants of its A3, A4, A6, and A8 sedans, as well as the TT coupe.

However, he does not rule out use for the new Q7 cross/utility vehicle, although he says torque-vectoring technology is best suited for powerful, high-performance cars.

To date, the only auto maker to launch production vehicles with torque-vectoring AWD is Honda Motor Co. Ltd.'s Acura mid-luxury division.

Other auto makers and driveline suppliers are known to be developing torque-vectoring systems that likely will see production in the near future. □

— Bill Visnic

## Saab touts Two-Mode, BioPower Hybrid

DETROIT — Saab Automobile brings its latest green machine to the recent North American International Auto Show here as it introduces the BioPower Hybrid Concept vehicle.

The flex-fuel vehicle, which premiered in Europe and was featured at last summer's Sydney auto show, is equipped with General Motor Corp.'s new Two-Mode hybrid system and is capable of running on 100% ethanol or any combination of ethanol and gasoline.

The concept, which the Swedish auto maker displays as a 9-3 Convertible, proves the Two-Mode hybrid system, which includes three electric motors and four fixed gears within a single transmission housing, can be scaled down for small vehicles.

GM co-developed the Two-Mode system with DaimlerChrysler AG and BMW AG and will launch the technology later in 2007 in its '08 fullsize SUVs.

The BioPower concept "shows how we can continue to express the sporty performance associated with Saab while using renewable resources and saving energy overall," Managing Director Jan Ake Jonsson says.

The show car primarily is powered by a 2.0L engine that kicks out 260 hp. The three electric motors contribute a combined 48 kW (199 hp) to the engine's 277 lb.-ft. (375 Nm) of torque.

The rear-drive electric motor, generating 38 kW (51 hp), alone, is located between the rear wheels and powers the transmission differential and drive shafts, supplying up to 490 lb.-ft. (665 Nm) of additional torque when the vehicle is accelerating at low speeds.

A high-capacity, 300-volt lithium-ion battery provides storage for the three motors. The hybrid system also features engine stop/start; electric power assist; regenerative braking; and electric-only "Zero Mode" capability mainly for city driving.

The auto maker introduced a Saab 9-5 BioPower last year in Sweden sporting a 2.0L 16-valve turbocharged engine, followed this year by a Saab 9-5 2.3t BioPower performance sedan and wagon for Scandinavia, the U.K. and Ireland, with other European countries to follow.

The auto maker's BioPower vehicles are a sales success in Sweden, where the 2.0L 9-5 is Sweden's best-selling environmentally friendly vehicle.

Bob Lutz, GM's vice chairman for global product development, has said GM intends to bring the Saab BioPower vehicles to the U.S. but does not indicate when that will take place.

The 9-3, Saab's best-selling model in the U.S., is expected to be the first in Saab's U.S. lineup to be equipped as a flex-fuel-powered model. □

— Scott Anderson

# Mitsubishi plans diesel, unveils Prototype X

DETROIT — Mitsubishi Motors North America says it will offer its new Lancer compact car with a next-generation common-rail turbodiesel engine, beginning in 2010.

The new-generation '08 Lancer goes on sale in March at U.S. Mitsubishi dealerships, meaning the diesel mill will debut mid-cycle.

Mitsubishi Motors Corp. currently is developing a turbodiesel engine with Mitsubishi Heavy Industries for European export models.

The engine in the U.S.-spec Lancer will be based on this powerplant, which will use a diesel particulate filter and oxides of nitrogen trap to meet U.S. Tier 2 Bin 5 emissions regulations.

Mitsubishi joins fellow Japanese auto makers Honda Motor Co. Ltd. and Nissan

Motor Co. Ltd. in planning to bring to the U.S. market a diesel capable of being sold in all 50 states.

It will be the first time since 1985, when it sold a diesel pickup truck, that Mitsubishi has offered a diesel engine option in the U.S.

Other features include an aluminum block; common-rail fuel-injection system with piezohydraulic injectors; and a new variable-geometry/variable diffuser turbocharger for quick and powerful response, Mitsubishi says.

Turbo lag is minimized thanks to varying degrees of exhaust turbine flow because of the turbocharger's design, the auto maker says, adding the diffuser will vary flow from compression to intake, providing even better power and fuel efficiency.

Horsepower and torque figures for the new diesel have not been finalized.

Meanwhile, the Prototype X model recently unveiled at the 2007 North American International Auto Show hints at the upcoming Lancer Evolution, going on sale in first-quarter 2008.

The Prototype X has an all-new 2L DOHC turbocharged I-4 as well as

Prototype X foretells Mitsubishi's '08 Lancer Evolution performance car.

Mitsubishi's new Super-All Wheel Control (S-AWC) all-wheel-drive system, both of which will be offered in the production Lancer Evolution.

The new 2L turbo's aluminum engine block is 53.4 lbs. (20 kg) lighter than the outgoing iron-block in the 4G63 series engine of the current Evolution, the auto maker says, adding a bulkhead-side exhaust placement lowers the center of gravity.

Large water jackets and metal areas surrounding the block's siamesed cylinder bores provide high inherent strength, Mitsubishi says.

An automated manual transmission with magnesium paddle shifters are featured in the Prototype X and next-generation Lancer Evolution. Mitsubishi says it is a true automated manual similar to those found in high-end sports cars and not a conventional torque-converter automatic.

The Lancer Evolution also will offer a 5-speed manual, the auto maker says.

S-AWC combines stability control with full-time 4-wheel drive, an active center differential with a yaw control rear differential and active skid control.

"The next Evolution will offer major gains in handling dynamics and technology while maintaining the kind of thrilling turbo engine performance that has made the model a street legend around the world," Mitsubishi says. □

— Christie Schweinsberg



## Porsche cranks up Cayenne with direct injection

DETROIT — After skipping a model year, Porsche AG's Cayenne cross/utility vehicle roars back for '08 with freshly revised powerplants sporting the hottest new technology for gasoline engines: direct injection.

Direct-injection gasoline (DIG) fueling and increased displacement for the luxury CUV's DOHC V-6 and V-8 engines means Porsche is able to inject the '08 Cayenne with meaningful boosts of power while simultaneously reducing fuel consumption, Wolfgang Durheimer, Porsche's executive vice president-research and development, says.

Durheimer tells *Ward's* that despite power improvements of as much as 17%, the more powerful Cayenne engines deliver an average of 8% better fuel economy, based on new European Union driving cycles.

Porsche's testing, on its own driving cycle that includes high-speed Autobahn cruising, has demonstrated gains nearing 15%.

A Porsche spokesman says the new Cayenne Turbo — with a 4.8L DOHC V-8 flaunting no less than 500 hp and 516 lb.-ft. (700 Nm) of torque, vs. the 450 hp and 460 lb.-ft. (624 Nm) from the superceded 4.5L V-8 — will get 13 mpg (18 L/100 km) in city driving and 20 mpg (11.8 L/100 km) on the highway.

But Porsche customers likely don't choose the brand for fuel economy, so the primary goal in adding engine displacement and DIG fueling is to improve performance.

In addition to the Cayenne Turbo's horsepower and torque gains, the Cayenne S' normally aspirated 4.8L DOHC V-8 jumps from 340 hp and 310 lb.-ft. (420 Nm) of torque to 385 hp and 369 lb.-ft. (500 Nm).

The largest gain, however, is for the Cayenne V-6, which goes from 247 hp and 229 lb.-ft. (310 Nm) for the outgoing 3.2L unit to 290 hp and 273 lb.-ft. (370 Nm) for the new 3.6L V-6.

Durheimer says the improved engine performance is attributable to increased displacement and DIG fueling, which enables higher compression ratios.

The V-6 moves from an already impressive 11.5:1 compression ratio to 12.3:1.

The V-8 is boosted from 11.5:1 to 12.5:1, and the turbocharged V-8 has a compression ratio of 10.5:1, up from 9.5:1.

Durheimer says the V-6, in

Direct-injection gasoline technology allows '08 Cayenne Turbo to produce 500 hp.

particular, has been heavily revised. The unique "narrow-angle" design, pioneered by the Volkswagen Group, goes even further, reducing the vee angle from 15 degrees to just 10.6 degrees.

Durheimer will not confirm whether Porsche is planning to adapt its DIG fueling for its signature "boxer" horizontally opposed 6-cyl. engines that power its 911 and Boxster/Cayman sports cars — but he does say "the technology is going to be applied to other Porsche engines in the future." □

— Bill Visnic



# New ZF 6-speed automatic eager to please



CONTINUED FROM PAGE ONE

connection between the driveline and the engine.

In combination with optimized software control and hydraulics, the new gearbox cuts shift times by 50% and is expected to improve fuel economy by 3% with gasoline engines and 6% with diesels, ZF says.

The new 6-speed has five clutch packs. In varying order, each clutch is engaged by applying hydraulic pressure to squeeze together two parallel friction plates to engage the next gear. Sophisticated control algorithms vary the speed at which those friction plates are squeezed for varying degrees of performance.

Reaction times for the new transmission are impressive. ZF says manual down-

shifts occur in about 200 milliseconds, while its first-generation 6-speed auto required at least twice as much time.

At 42 mph (68 km/h), the new transmission can shift from sixth to second gear in that same 200 milliseconds, ZF says.

There are three ways to drive ZF's new 6-speed auto in the BMWs. In normal drive mode, it functions like a normal automatic with little to distinguish it from others in the marketplace.

Move the gear shifter to the left, and the transmission is in "drive sport" mode. That is all the driver must do to fully enjoy the capabilities of this extremely intelligent new gearbox, as the gear changes now will come a bit later in the rev range. Generally, there is a 500-rpm difference between normal automatic and drive sport mode.

The control algorithms take over and

will manually shift gears on your behalf to optimize engine performance. The harder the car is driven, the longer the gears are held before upshifting. Still, there is no harshness in the gear changes.

The third option for shifting this new transmission is to do so manually by bipping the gearshift lever forward or back, without having to fuss with a clutch pedal.

The 3-Series coupe also offers paddle shifters on the steering wheel, which work quite nicely. This system allows the driver to smack the redline with every single gearshift, if so desired.

On winding roads through the Arizona desert south of here, the ZF gearbox shows its stuff. With every throttle input, the driver is an active and willing participant in each gearshift event as the engine and transmission work in tandem, eager to please.

Even the porky BMW X5 4.8i benefits greatly and feels more nimble due to the crisp shifting afforded by the new ZF 6-speed.

For fuel economy purposes, the manual shift mode may be less than optimal. But even after a day of hard driving in all three modes, the trip computer on the BMW 335i reported 22.6 mpg (10.4 L/100 km) — not too shabby for a 300-hp twin-turbo 3L I-6.

The V-8-powered X5 was less impressive on the fuel-economy front, delivering 14.5 mpg (16.2 L/100 km), according to the vehicle computer.

ZF has plenty to be proud of with its new second-generation 6-speed automatic.

The company worked hard to devise a transmission that satisfied American infatuation with 0-60 mph (97 km/h) times while appealing to Europeans who love high-speed cruising, Paul Olexa, vice president-driveline sales and marketing for ZF in North America, says.

Olexa isn't giving hints about the next application for the new 6-speed automatic, except to say "others will follow." He says the new transmission is easily tunable to match the desired "feel" of a particular brand.

Although BorgWarner is a competitor, Olexa thinks highly of the DCT.

"The DCT has raised the level of expectations for shift dynamics, and we've brought that level now to conventional automatics," he says.

But ZF also is developing its own DCT, with an emphasis on rear-wheel-drive vehicle architectures with north-south engine orientations. Look for it in the 2009 timeframe, Olexa says. □ — Tom Murphy

## Slim Seat increases legroom for low cost

DETROIT — What price might an auto maker pay for a slim, comfortable front-row bucket seat that affords back-seat passengers an extra 2 ins. (5 cm) of legroom?

Johnson Controls Inc. recently displayed its new Slim Seat design concept here at the North American International Auto Show, and a company executive says the new seat carries a cost premium of between \$8 and \$10, yet weighs no more than a conventional automotive seat.

To keep costs down, the Slim Seat consists of a standard lower cushion and steel frame, riding on a conventional steel track, David Kingston, executive director-complete seat product and business development for JCI, says.

But the seat back represents a completely new concept. The Slim Seat has only a tubular frame and uses lightweight composites and non-molded foam in place of springs and other steel hardware, Kingston says.

The cushion also is much smaller and thinner than that of a conventional seat, placed only where the torso and shoulders actually touch the seat.

Despite its thin profile, there is room in the lateral bolsters for seat-mounted side-impact airbags, Kingston says, noting the seat also can accommodate pivoting active head restraints.

The lumbar support consists only of a thin polypropylene sheet behind the cushion that flexes as the occupant moves. It is surprisingly comfortable with-

out conventional springs.

JCI says it hopes to begin producing the new Slim Seat in 2009, although the supplier confirms it does not yet have a committed automotive customer.

"We have development programs," Beda Bolzenius, JCI vice president and president-Interior Experience, says.

"We are installing the seat in two different cars just to make it accessible and to convince the customer," he says. "It is a big step because a seat is not just a design feature. It's a security question, and we have to go through the whole process to make it a real, salable product." □

— Tom Murphy

With thin polypropylene lumbar support, Slim Seat yields extra 2 ins. (5 cm) of rear legroom.



# Batteries are key to Chevrolet Volt program



DETROIT — Declaring it “isn’t a science project” but a harbinger of General Motors Corp.’s future technology and manufacturing strategy, CEO Rick Wagoner says early production work has begun on its Chevrolet Volt Concept, unveiled at last month’s auto show here.

Wagoner says the plug-in electric vehicle is concrete evidence GM is seeking to redefine how it engineers powertrains and the fuels that run them.

“We’ve got to stop thinking about either/or,” Wagoner says. “It’s either a petroleum, a gasoline, diesel or electric (vehicle). Our point is that you’ve really got to embrace the concept of a diversity of sources of energy.”

The Volt is designed to run solely on charged electric power for a range of 40 miles (64 km) from a standard 110-volt outlet. Additional power is supplied via a 3-cyl., 1.0L turbo engine that can run on gasoline, diesel or agricultural-based fuels such as biodiesel and ethanol/gasoline blends such as E85.

A suitable lithium-ion battery pack remains the main obstacle to building the vehicle. Engineers say the battery must have at least a 10-year life for GM to bring the car to market.

“There’s a lot of work that needs to be done by battery suppliers,” Wagoner concedes.

“It’s going to be a great race to see who can move faster,” he says.

Wagoner says the auto maker learned a lot about hybrid-electric technology from its failed EV1 vehicle, the all-electric model it introduced in 1996 and killed in 2003. The EV1 had a range of just 90 miles (144 km).

“It was a bit ahead of its time,” he says. “The thing we learned (was) customers’ unwillingness to sacrifice things like range. We also learned they want kind of a normal vehicle, and that’s what (the Volt) tries to represent.”

Production and engineering work on the Volt concept is taking place at GM’s Warren (MI) Technical Center, but Wagoner says it’s too soon to say when or where GM will build the production version. However, he does say the Volt could be manufactured in several different countries.

“Our goal is to have this in the showroom like any other car,” Bob Lutz, GM vice chairman-global product development, says. “The (E-Flex) architecture is so flexible, we could do station wagons, crossovers, sport coupes.”

Lutz notes U.S. auto makers have applied for battery development grants from the Department of Energy and says the federal government could do more to help

advance the technology.

“Let’s face it, the Japanese government is pouring hundreds of millions (of dollars) into advanced battery research,” he says. “We really don’t want to get to a point where we have to rely on Japanese batteries and Japanese producers saying, ‘Don’t sell any-

thing to the Americans.’”

Asked if the Volt has leapfrogged Toyota Motor Corp. in terms of fuel economy, Lutz says, “I don’t know what (Toyota’s) got up their sleeve, but I think (the Volt) — at the very least — closes the gap substantially.” □

— Scott Anderson

## Ford, Microsoft in Sync on communication

DETROIT — Ford Motor Co. President-The Americas Mark Fields and Microsoft Corp. Chairman Bill Gates reveal details of Sync, a new in-vehicle technology that will debut in the new ’08 Ford Focus, at last month’s North American International Auto Show here.

Eventually Sync will be offered in 11 Ford, Mercury and Lincoln vehicles.

The factory-installed system will enable hands-free calling via a Bluetooth connection as well as connectivity to MP3 players, such as Apple’s iPod or Microsoft’s Zune.

Sync also boasts voice recognition and can convert cell-phone text messages into audio and broadcast them through the vehicle’s speaker system.

Ford declines to reveal how much Sync will cost but says it will be affordable, which is why it is debuting on the entry-level Focus.

“In the past, (a technology like) Sync

’08 Ford Focus will feature Sync in-vehicle communication technology.

would have been offered in luxury vehicles, but we’re going to roll it out quickly and affordably,” Fields says.

Ford is aiming Sync at Generation Y, which it defines as the 57 million people born between 1981 and 1995, because they grew up with computers and the Internet, making them more technology savvy than previous generations.

Ford also says the first-time car-buyer market is one of the most rapidly growing segments, and Sync will give the Focus an advantage. □

— Byron Pope



## BMW diesels coming to U.S. in 2008

DETROIT — After being non-committal last year about whether it would offer a diesel powertrain in the U.S., BMW AG announces at the recent North American International Show here it intends to offer diesel-powered vehicles in the U.S. market in 2008.

The engine will feature state-of-the-art catalytic-converter technology and be able to meet emissions requirements in all 50 states, says a BMW executive.

BMW has a family of renowned turbodiesels, and about 40% of its vehicles worldwide are powered by diesels.

Nevertheless, BMW has been downplaying its interest in offering a diesel option in the U.S. It also has been unwilling to join forces with fellow German auto makers Volkswagen AG, Audi AG and DaimlerChrysler AG in jointly developing and marketing a new generation of “clean” diesels using urea-injection technology to make the engines compliant with emissions nationwide.

The auto makers are marketing the technology under the Bluetec name.

Mounting competitive pressures may have changed BMW’s thinking. Klaus Borgmann, senior vice president-powertrain development, told *Ward’s* last spring BMW feared offering diesel alternatives to its performance-oriented gasoline engines in the U.S. because it would make for few conquest sales.

He said it might be difficult to fully recover the cost of diesel engines and their complex exhaust aftertreatment systems.

However, he says BMW now is commencing work on a 3-tier strategy under the heading of EfficientDynamics.

The long-term focus, the executive says, is using zero-emission hydrogen as a fuel for combustion engines, with hybrid-electric powertrain development comprising the mid-term strategy.

The third tier of the plan is improving the efficiency and performance of its conventional gasoline and diesel engines. □

— Drew Winter



# Output

## Holden sedan to be new Pontiac G8

GM Holden Ltd. will export up to 50,000 Australian-built Commodores annually to the U.S. as rebadged Pontiacs.

Australian newspapers report Bob Lutz, General Motors Corp. vice chairman-global product development, confirmed the plan at last month's North American International Auto Show in Detroit.

Lutz says the Commodore SS V-8 will be rebadged as the Pontiac G8 to fill a void in

Pontiac's lineup. The car is to be unveiled this month at the Chicago show.

"We're seriously planning to import a lot of Commodore SSs in the guise of Pontiac G8s," Lutz is quoted as saying. "It's such a logical thing to do."

Lutz did not specify when shipments would start, but the Australian reports suggest late this year or early 2008. □

**Holden Commodore SS to be basis for new Pontiac G8.**



## Plant investments ready new GM V-8

General Motors Corp. will invest \$300 million for tooling and renovation of its Tonawanda (NY) Powertrain Plant to produce an all-new V-8 engine in 2009.

The auto maker also is directing \$16 million into the Flint (MI) South plant to assume production of Tonawanda's 3.7L inline 5-cyl. this summer.

A spokeswoman says the Tonawanda-produced gasoline V-8 will power future luxury vehicles, but she declines to name specific brands or applications.

The new powerplant may be the next-generation Northstar DOHC V-8, as the 2009 release for the new engine coincides with the expected debut of an all-new Cadillac STS sedan. The vehicle's current 320-hp V-8 has been surpassed by more advanced mills (producing nearly 400 hp) from German and Japanese luxury marques.

A bump in displacement, along with the adoption of direct injection, cylinder deactivation and other advanced technolo-

gies, could allow a new Northstar to better compete against rival V-8s. □

## Mitsubishi, PSA ready to share diesels

Mitsubishi Motors Corp. will buy diesel engines with particulate filters from PSA Peugeot Citroen for its version of the Mitsubishi Outlander cross/utility vehicle the two auto makers are sharing.

The 2.2L 4-cyl. turbodiesel, developed jointly by PSA and Ford Motor Co., will be sold alongside a 2.0L diesel Mitsubishi has sourced from Volkswagen AG to sell in Europe starting earlier this year.

The new engine is tuned for 156 hp and 280 lb.-ft. (380 Nm) of torque and will be mated to a 6-speed manual transmission. The mills also meet Euro 5 emission regulations and can run on B30, a blended diesel fuel made of 30% plant material.

PSA will begin shipping engines from its plant in Tremery, France, to Mitsubishi in Japan in the middle of this year, about the same time PSA's versions arrive on the market. □

## Ford TwinForce will be produced

DETROIT — Ford Motor Co.'s new TwinForce V-6, showcased in the Lincoln MKR concept unveiled at the recent auto show here, will debut in a production vehicle in the near future, a top executive says.

The TwinForce V-6 is able to produce V-8 power due, in part, to its twin turbochargers. However, production versions generally will boast one turbo, Derrick Kuzak, group vice president-global product development, says.

The 415-hp all-aluminum engine, based on Ford's new Duratec 35 V-6, is capable of running on E85 or premium gasoline and is able to deliver a 15% gain in fuel economy compared with a similar V-8, Ford says.

"TwinForce is indicative of where we're heading with 'greener miles' technology," Kuzak says. "It produces V-8 power with a V-6 through three steps: direct (fuel) injection, turbo and downsizing displacement." □

## Ferrari to celebrate 60th anniversary

DETROIT — Italy's Ferrari SpA announces plans to celebrate its 60th year in operation in grand style — with a rally race around the world.

Outlined at the recent auto show here, the Ferrari 60 Relay event will bring together Ferrari clients and their cars representing every model and era, Vice General Manager Amedeo Felisa says.

The symbolic race began Jan. 28 in Abu Dhabi and will cover ground in about 50 countries before concluding at a special event June 21-24 at the auto maker's home base in Maranello, Italy.

Throughout the event, rally participants will carry and pass a baton specially created for the occasion, with embossed symbols of the 60 greatest moments in Ferrari's history, from its first victory at the Rome Grand Prix in 1947 to the present-day FXX supercar development program. □

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