



HYBRID COMES OF AGE

The second generation Hino Hybrid is slowly gaining acceptance as an efficient metropolitan truck. Peter Shields put one to work and found it is more than just a 'greenie' gimmick.

The current Hino Hybrid model replaced the first version that was introduced to Australia in 2007. At the time, Hino emphasised the hybrid's comparatively low emissions, and the model was mostly taken up by fleets that wanted to stress their environmental commitment.

This second generation released in late 2011 and based on Hino's new 300 series range, is a combination of innovative, yet mature engineering that provides an urban delivery truck that is essentially no different to drive than any other light truck and can therefore stand alone on its performance and efficiency with the environmental aspects being a bonus.

The Hino Hybrid driveline has undergone a number of fundamental changes, the most significant being the relocation of the automated clutch to a spot between the diesel engine and the electric motor, allowing each to be uncoupled to promote fuel and emission efficiency, and re-coupled to maximise power delivery and or maximum engine braking in what is termed a parallel hybrid system.

The electric motor/generator is a supplementary power source that generates electricity by gathering kinetic energy when the truck decelerates. The diesel engine is not involved in electricity generation and returns to idle whenever it is not required to drive the truck, thereby saving more fuel. The four-litre turbocharged diesel engine produces 110kW of power at 2,500 rpm and 420Nm of torque at a low 1,400 rpm. The 300V air-cooled electric motor produces 36kW and 333Nm across its operating range, and combined, the power units have 10 per cent more power and 19 per cent more torque, both at lower revolutions, than the previous model.

The engine also has cooled Exhaust Gas Recirculation, an oxidation catalyst and diesel particulates filter. A bar graph on the dash indicates the condition of the diesel particulate filter and triggers a "burn" once it reaches level three. At no time during several days of driving the Hybrid did we need to manually instigate a cleaning burn, though that facility is there if required.

The electrical components – including the motor, inverter and nickel-metal hydride battery – have been completely redesigned in order to reduce each item's weight and size and to increase their efficiency.

The 40-module (240 cells) 288 volt Nickel-Metal hybrid battery is the same as used in the Lexus RX450h luxury SUV and has a five-year warranty. Battery replacement cost is around \$3,000, which is less than half the figure often perceived by the Australian market. The battery weighs 42 kg and is mounted out of the way on the kerb side of the chassis.

The Hino Hybrid does not have a conventional starter motor or alternator as it uses the electric drive motor as the starter for the diesel engine and has a converter to create 24 Volt power for the lights, electronics and cabin functions. Eliminating the starter and alternator reduces weight as well as eliminating several components that over time wear out and would require replacement. Using the powerful electric motor to start the diesel makes for almost instant ignition, a factor crucial to the vehicle's Auto Stop Start feature.

When cruising at a constant speed, the engine is operating in its most efficient range and provides all of the power to propel the vehicle while the electric motor remains inoperative.

Activated by a switch on the dash, the Auto Stop Start function can automatically shut down the diesel engine when the vehicle comes to a stop, effectively eliminating the consumption of fuel that would otherwise be wasted when idling at intersections or in stop-start traffic. The engine automatically restarts when the driver removes their foot from the brake pedal.

The system works in conjunction with the Easy Start hill start assist feature, which automatically keeps the brakes applied

until the clutch reaches its friction point. The process quickly becomes second nature for the driver and an adjusting switch for the speed of the brake release ensures smooth take off regardless of the incline or the vehicle's load.

The Hybrid's transmission is Hino's own ProShift 5 sequential-shift five-speed automated manual (AMT), a classic two-pedal system. The developments in the electronic controls of the integrated driveline mean that the AMT is the only transmission offered (rather than a conventional automatic) and it provides smooth take offs and shifts as well as working with the control modules to ensure that the correct gear is always selected appropriate to the current conditions to obtain maximum efficiency. The nifty selector lever allows for manual over-ride if the driver wants it, but we found that leaving the selector in "D" produced the better result in both performance and economy.

The combined torque of the hybrid driveline permits the transmission to shift at very much lower rpm that a driver would probably expect from a diesel only truck.

The Hino Hybrid has a number of fundamental driving phases during which the various components interact in different ways. To the driver, all of these changes are seamless but many can be observed via the changing electronic icons on the dash.

On initial acceleration, the driving force is usually generated by a combination of the diesel engine and electric drive motor. However, depending on the state of charge of the hybrid battery and other conditions



such as load and incline, an electric motor-only standing start is possible with the diesel remaining disconnected from the driveline and maintaining idle speed in order to provide power for accessory drives such as the power steering and air conditioner.

During acceleration, the clutch will engage to couple the engine and motor in parallel configuration which allows the electric drive motor to supplement the diesel engine with assisted torque, effectively maximising power output while still obtaining good fuel economy.

When cruising at a constant speed the diesel engine is operating in its most

efficient range and provides all of the power to propel the vehicle while the electric motor remains inoperative.

When the truck slows and there is no pressure on the accelerator pedal, the clutch disconnects the diesel engine from the motor, so the motor can act as a generator to charge the Hybrid's battery. The electrical resistance created in this mode assists in slowing the vehicle as well. However, the clutch remains connected if the exhaust brake is activated so that the extra engine braking from engine compression and exhaust compression can be applied if travelling down a steep decline.

There are three driving modes that

can be selected from a dash-mounted switch. The ECO mode is configured to prioritise economy while the PWR setting, as expected, is designed to prioritise acceleration. The transmission uses revised shift points in PWR mode. The third mode is Normal, which provides economy and performance midway between ECO and PWR modes and switches between each depending upon the position of the accelerator pedal.

An ECO indicator lamp in the instrument panel also helps the driver achieve optimum fuel savings as it lights up when efficient driving is being performed. It can be beneficial to have some electronic acknowledgement that your driving is at its best and we very quickly learned that gentle pressure on the accelerator and lifting right off when feasible produced the optimum fuel economy.

The test vehicle was a wide cab model fitted with a polycarbonate pan body and a tailgate lifter. The cabin door openings are quite large for a light duty truck and provide good access for even the biggest of occupants. The cab has particularly thin A pillars that minimise blind spots and the electric controlled and heated main and spotter mirrors provide good rear vision. The front sides of the mirrors have a convex shape that all but eliminates wind noise even at 100 kilometres per hour.

The test truck had the benefit of an optional reversing camera being integrated into the dash mounted multimedia system. This set up had the added advantage of being equipped with a microphone at the rear of the truck which provides additional safety and practicality as the driver can hear quite clearly via the speakers in the cab any reversing directions from a person that would normally be in a blind spot and certainly makes backing up to unfamiliar docks much easier.

The Hybrid's Australian -designed multimedia system has so many features that it is probably worthy of an entire article on its own, so for the purpose of this story we'll just look at the stand outs other than the camera display. The audio functions are first rate, including crystal clear digital radio. The phone functions permit the uploading of a phone's contact



list wirelessly so that details are displayed on the large screen and can be scrolled using the steering wheel buttons. The multimedia unit can be optioned up to include a GPS system incorporating NAVTEQ maps and even truck-specific routing.

The fore and aft slides on the driver's seat are angled down toward the front so that as the seat moves forward it gets lower, making pedal reach much better for shorter drivers. The driver's seat has a torsion bar suspension and adjustable magnetic dampening and the steering wheel has an adjustable tilt angle and a telescopic height adjustment to accommodate almost every size of driver.

An effective feature in the cab is the central LED cab light, which not only provides great illumination, but draws so little current that if it is accidentally left switched on overnight, it won't flatten the starting batteries.

The test vehicle was a wide cab equipped with leaf spring front suspension (narrow cab models have coil front springs). Hino's Vehicle Stability Control (VSC) is standard equipment and works in conjunction with the ABS and traction control systems in situations where the truck may be about to commence a slide or not react to the driver's inputs especially in wet and slippery conditions. The fuel consumption figures displayed on the Hybrid's on board readout are

expressed in kilometres per litre of fuel used, rather than the equation of how many litres per 100 kilometres that is used when discussing passenger vehicles. At a steady 45 km/h, the diesel was happy at around 1,150 rpm in fourth gear and the dash readout indicated that fuel burn was at six kilometres per litre. When the transmission shifted to fifth gear, the economy increased to eight kilometres per litre as a dramatic demonstration of the benefits of having the transmission up shift at low revs when the combined power plants are producing sufficient torque to maintain momentum.

Our road and work test covered 575 kilometres, varying from city crawl to freeway cruising with various weight loads and we achieved an average of 8.7 kilometres per litre. We deliberately had the PWR mode selected for almost 100 kilometres of the assessment, so even better economy results could have been achieved if we had left ECO mode activated.

Overall, the Hybrid was not much different to drive than an equivalent conventional diesel truck, and a regular driver would quickly become accustomed to the very subtle adjustments in driving style required to maximise fuel efficiency. But even if they just drive it like any other light-duty truck, there would still be an improvement in economy.

There is an acknowledged premium associated with the initial purchase of a Hybrid, though as with most modern technology, this is significantly less than a few years ago. The estimations suggested by Hino indicate that the average metropolitan operator can reduce fuel costs by up to 26 per cent, and those savings would recoup that extra initial investment in around 30 months. Home delivery giant Coles Online and the Green Truck Partnership conducted their own independent fuel comparison on local delivery runs in the Sydney metropolitan area using a Hino Hybrid AMT and an equivalent Hino 300 series automatic truck. Based on those trial results, a 21 per cent reduction in fuel use and carbon dioxide emissions was achieved and when extrapolated out to a fleet of 50 trucks each covering 650 kilometres every week, at current fuel prices could save almost \$160,000 per year in fuel expenses and reduce greenhouse emissions by 30 tonnes. Then take into account the longer term savings on clutches, starter motors and alternators, then in the right application the Hino Hybrid makes an even stronger economic case.

It's safe to say Hino has drawn upon its parent company Toyota's world leading expertise and experience in hybrid road vehicle technology to produce a truck that makes economic and environmental sense.