

Performance Modifications

You're happy with your 4x4, but you feel that it would be even better if it went a little bit harder. There are ways...

There are two approaches to improving 4x4 engine performance: 'hotting up' the existing engine or repowering the vehicle. Both methods have their advantages and disadvantages.



The traditional way of getting more power out of an engine is to improve its breathing and make it rev faster: that results in more 'bangs' per minute and hence more power.

There may be a torque sacrifice, because the engine mods may move the maximum torque point higher up the rev scale and torque may actually be less at lower revs than the standard engine's. That's not a good result if you're trying to improve towing performance.

An alternative to making an engine rev faster to produce more power is to cram more air into it, allowing it to burn more fuel during each combustion stroke: bigger bangs per minute rather than more bangs per minute.

Forced induction – turbo-charging or supercharging – is a popular means of getting more air into a given engine and increasing its fuel-burning capability. That route results in bigger bangs without any increase in engine speed.

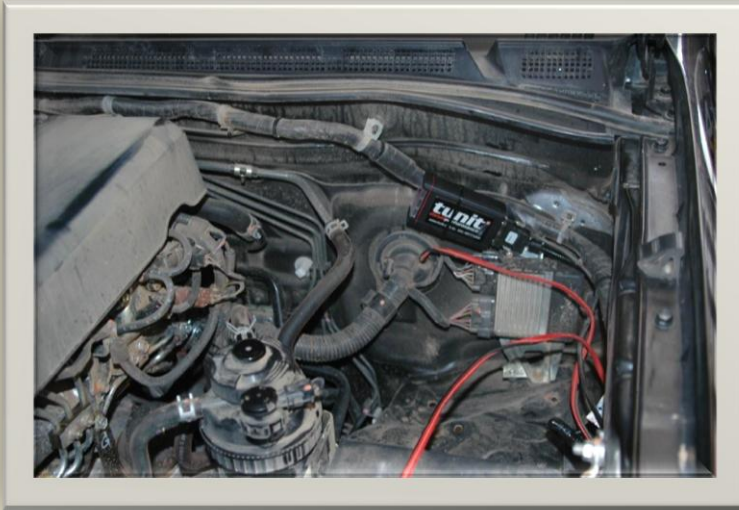
Naturally aspirated petrol and diesel engines can be made to improve maximum output and torque by up to 50 percent using supercharging or turbo-charging.

Turbo-charging is the most popular way of improving diesel engine performance, while either turbo-charging or supercharging works well on petrol engines.

Good quality turbo and supercharger kits cost between \$2500 and \$5000.



'Intercooling' is now common on factory-built turbocharged and supercharged engines and can be fitted to existing engines. An intercooler is an air-to-air radiator between the supercharger or turbocharger and the inlet manifold, to drop the temperature of the compressed air and increase its density and oxygen content.



As a rule of thumb, turbo-charging or super-charging a high-mileage engine isn't a wise move, unless the engine is completely rebuilt as part of the process. Most original equipment, forced-induction engines have oil-spray cooling to the undersides of the pistons, so you may need to incorporate that feature in a rebuilt engine.

It's almost certain that the standard cooling system will need to be upgraded by fitting a high-flow thermostat, a larger radiator or a supplementary electric fan...or all three, in some cases.

Chip Engineering

If you're looking to improve the performance of an engine that's already fitted with electronic injection control the easiest way is to 're-chip' it.

When electronic engine controls first appeared it looked like the after-market engine tuner's days were numbered, because it seemed impossible to come up with a better mousetrap than the factory original – the product of many years and millions of dollars worth of testing. We should have known better. After-market specialist tuners around the world soon worked out ways to modify the factory settings and come up with higher performance versions of the factory electronics. However, many of these require considerable fitting skill and are difficult to remove at trade-in time. The best types are plug-in jobs. The price range is \$1000-\$1500, depending on engine type.

However, there's no such thing as a free lunch and performance improvement may come at the cost of higher fuel consumption and reduced engine life. It's best to strive for a modest performance increase, rather than go for broke.

Engine Swaps

Engine swaps are for those who subscribe to the theory that 'there's no substitute for cubic inches'. A bigger engine has the potential to improve vehicle performance on-road and promises better off-road torque at lower revs, if the job is done properly.

Another facet of engine-swapping is the likelihood that the job won't cost much more than rebuilding a worn Japanese engine. Doing a major rebuild on a Toyota or Nissan six-cylinder diesel is at least a \$4000 job these days and may well cost \$8000. You can do a quality engine swap for that sort of money.

Pricing engine swaps is difficult, because there's a huge choice of engines and recipient vehicles, and there's sometimes the need to change transmissions and final drives as part of the conversion. We've heard of capable people doing a



swap for as little as \$2000 and others spending \$20,000.

The average job, done by a qualified operator to vehicle registration authorities' specifications, using a quality gearbox adaptor will cost \$4-8000.

Mark's 4WD Adaptors and other engine-swap kit makers have certainly done their bit, producing components that allow a range of engine swaps to be done, but many 4x4 work-overs involve too much compromise, such as great on-road, but poor off-road, performance and horrendous fuel bills.

Greater engine power and weight can also have a negative effect on handling, braking and driveline durability.

One of the secrets of success is getting a replacement engine that matches the maximum power and torque revolution points of the stock engine, because that means the gearbox ratios and the final drive ratios won't need to be changed. The alternative is to fit larger than standard wheels and tyres to the finished vehicle, to drop engine revs at cruising speeds.



'Torque Topping'

Introducing Liquid Petroleum Gas (LPG) into the intake air of a diesel engine isn't a new idea, but electronically-controlled systems for doing this 'fumigation' job are relatively new in Australia.



In these systems the components are controlled by an under-dash electronic control unit (ECU) that acts on sensor inputs of throttle position, brake-pedal position, manifold pressure and engine speed. The engine fires up and idles on diesel. Gas enters the air intake in increasing volume as the accelerator pedal is depressed, up to a pre-determined level that is normally set between 20 percent and 30 percent of diesel flow rate.

The LPG tank is sized to be in proportion with the 4x4's fuel tank and is typically 40 litres' capacity. The tank can be mounted underneath the bodywork or inside the vehicle.

For around \$3500 installed the LPG fumigation kit gives considerable performance improvement, but as with re-chipping an engine, it's best to err on the side of caution with the gas injection amount.

No Magic Wand to Improve Fuel Economy

High fuel prices cause many people turn to products or fuel additives that claim large gains in fuel economy.

The USA's Environment Protection Agency (EPA) has concluded a series of scientific tests on a wide variety of devices and additives that are claimed to improve fuel economy. Of the hundreds tested, very few actually reduced fuel consumption.

Of the six that worked without illegally increasing air pollutants, one was a spoiler system that made a vehicle more aerodynamic, three shut off power to accessories such as the air conditioner and the other two provided ways to decrease idling time.

Most of the products marketed fall into five basic categories: vortex generators that create swirling air flow in the air intake, magnets that strap around or connect into the fuel lines, air-bleed devices, fuel additives and oil additives.

None of the magic pills and potions, fuel line magnets or vortex generators works, according to test results from the EPA.

Magnets make your speakers function and provide detailed images of the human body, but they aren't likely to save a cost conscious motorist any money at the gas pump, said EPA spokesman John Millett.

Car owners would be better to change a few of their driving habits and make sure their vehicles are properly tuned and maintained, he said.

Claudia Bourne Farrell, a spokeswoman for the US Federal Trade Commission, said that the Commission has evaluated many products that claim to enhance performance and has not seen any that lived up to their claims.

So why do these products keep selling? Why do so many people swear by them while others are completely convinced they are scams?

'Results May Vary'

All fuel economy 'improver' packages and labels have disclaimers that say results may vary, because of driving habits, vehicle type, vehicle condition and road conditions.

In that simple caveat lie the reasons why people can install a device or use an additive that does nothing to change fuel economy but can see an improvement in fuel economy after adding it.

Many people install vortex generators or magnets at the same time as they give their vehicles a tune-up, so the devices get the credit for the improvement in fuel economy that really resulted from the tune-up.

Testing a product to determine if it has increased fuel economy requires an automotive laboratory with sophisticated equipment. The equipment is necessary to rule out the effects of different air temperature, humidity and road conditions that can cause fuel consumption to vary 10 or 20 percent.

Many fuel consumption 'improvement' device makers claim that their fuel-saving function is due to improved combustion quality, but in a modern 4x4 engine that's correctly tuned, less than one percent of the fuel that enters the combustion chamber isn't burned. Maximizing the burn further might lower emissions minutely, but would do virtually nothing for fuel economy.

Real Economy Improvers

Regular servicing, maintaining correct tyre pressures and keeping your 4x4 as streamlined as possible are the starting points for improved fuel economy.

A well-serviced 4x4 rolls freely on lubricated and adjusted wheel bearings, doesn't have dragging brakes and its engine is operating at its optimum, with clean oil, fresh plugs and/or clean injectors.

Tyres inflated to the 4x4 maker's recommendation roll with less resistance than under-inflated ones.

Don't run heavily-blocked mud tyres unless you really need them. 'Lug' tyres have a huge influence on rolling resistance – we regularly measure at least a five percent fuel consumption difference between mud tyres and road types.

A roof rack increases drag and drag eats fuel. If you need your roof rack only once or twice a year, take it off and stow it.

Once you've taken these fuel economy steps, take a critical look at your driving style. If you don't get high kilometres out of your 4x4 tyres and brake pads you're wasting fuel. Driving for economy means no hard-braking or hard-cornering.

Use anticipation when you're driving, so you don't have to brake hard to wash off speed and then have to build it up again.

Try cruising at lower speeds. It's easy to measure the difference in fuel consumption if you cruise on the bitumen at 95km/h instead of 110km/h.

On dirt, knock your speed back to a more economical and safer 80km/h. In the case of the average diesel 4x4 you'll get at least a 10 percent fuel saving by slowing down.