

# Advantages and Disadvantages of Downsizing and Turbocharging as Related to Fuel Economy and Emissions

For a given power requirement at constant speed, a downsized engine operates at increased BMEP (i.e. brake mean effective pressure) which results in greater overall efficiency (or lower bsfc). Also, downsizing has become attractive as well. Maintaining a given vehicle power requirement at reduced speed also requires that engine operate at higher BMEP ( or specific load) which again results in greater overall efficiency and reduced bsfc. Hence, combining downsizing with downsizing is particularly effective for reducing fuel consumption and CO<sub>2</sub>

emissions. However, sufficient engine torque is required at lower speeds to maintain vehicle gradeability and takeoff performance. For this, turbocharging / intercooling are used to increase specific torque and specific power. But engine knock is the limiting factor at high load with turbocharging. At low rpm, with increased cycle time, increased reaction rates (due to high temperature at increased load) can lead to knock. Consequently, the GDI engine is the best configuration to take advantage of this downsizing/downspeeding strategy. Also, the turbo lag is another concern that is to be addressed and generally is not a difficult issue.

From the emission perspective, a smaller engine which provides higher efficiency, means reduced fuel consumption relative to the larger engine. This contributes to all regulated emissions and in particular to the CO<sub>2</sub>.

