Rightsizing with Saab BioPower and Next-Generation GM Hybrid System

The Saab 9-X BioHybrid demonstrates the potential of partnering bioethanol fuel with the next-generation GM Hybrid system to deliver exceptional levels of efficiency and performance.

Optimized for E85 fuel, the small, 1.4-liter BioPower turbo engine generates a substantial 200 hp/147 kW on E85 and an even more impressive 280 Nm (207 lb.ft) of torque, as well as reduced CO2 emissions compared to gasoline. With a full flex-fuel capability, it is a rightsizing formula backed by hybrid technology, giving projected fuel consumption when running on gasoline over the combined cycle of just 4.9 l/100 km and 117 g CO_2/km. When running on E85, CO2 emissions are projected to be even lower, at just 105 g/km, with estimated fuel consumption of 6.4 l/100 km.

Mated to a six-speed manual gearbox with an automatic clutch and steering wheel controls, it is a sophisticated powertrain tailored to meet the environmental and energy-saving priorities of modern day motoring.

BioPower Optimized

Saab already leads the automotive industry in applying its turbocharging expertise to enhance the performance and environmental benefits of E85 fuel (85% bioethano/15% gasoline). Saab BioPower models are the top-selling flex-fuel vehicles in Europe and produce more power with E85, as well as less CO2 emissions compared to gasoline.

The Saab 9-X BioHybrid now takes this proven BioPower flex-fuel technology further by using an engine that fully exploits the high octane benefits of E85 fuel. It uses a

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higher compression ratio (10.2: 1) and turbo boost pressure (up to 1.6 bar) than would be possible with a gasoline-only engine. This is because E85 has a higher octane rating (104 RON) than pump gasoline (95 RON), which makes it more resistant to harmful pre-detonation, or 'knocking', as the fuel/air mixture is compressed in the cylinder.

Whilst optimized for E85, the engine retains a flex-fuel capability and will still run on gasoline, although it will not produce as much power. The engine management system is able to adjust the ignition timing and boost pressure to ensure there is no pre-detonation due to the higher compression ratio.

Running on E85 fuel, this lightweight yet sophisticated BioPower engine delivers the power characteristics of a much larger powerplant. That impressive torque of 280 Nm (207 lb.ft), for example, is available all the way from just 1,750 to 5,000 rpm. It's another demonstration of Saab's rightsizing engine strategy – offering exceptional power without the greater weight, size, fuel consumption or emissions of a larger, naturally-aspirated engine.

The advanced specification of this engine also includes direct injection (DI), with centrally-located fuel injectors, and continuously variable valve timing (VVT) on both the inlet and exhaust sides.

DI delivers fuel directly into the combustion chamber of each cylinder, instead of the intake port. . VVT then manages airflow by opening and closing the intake and exhaust valves to improve combustion, and allow the use of a higher boost pressure. The result is greater low-end torque and improved fuel consumption. The central location of the fuel injector, at the top of the combustion chamber, allows further optimization of the intake ports for improved engine breathing.

Next-Generation GM Hybrid System

Fuel consumption and CO2 emissions are reduced still further by the addition of the next-generation GM Hybrid system, which features a lithium-ion battery and a

significantly higher power capability to capture more energy and more electric boost than the current GM Hybrid system. An electric motor/generator, belt-driven from the engine's crankshaft, replaces the conventional alternator. Electrical power is delivered and stored by the compact lithium ion battery pack, located under the rear cargo floor.

The electric motor reacts spontaneously and complements the torque of the boosted engine. With this combination of turbocharger technology and a hybrid propulsion system, the dynamic behaviour of the downsized powertrain is improved still further.

At take-off from rest and during overtaking manoeuvres, the electric motor adds accelerative power. It is also used to re-start the engine, supporting the automatic fuel-saving function whenever the car is stationary. To further improve efficiency, the hybrid system enables a longer fuel cut-off during deceleration and braking.

The electric motor also acts as a generator. It can be powered by the engine to charge the battery pack and support vehicle electrical loads. Or it can be used to capture the vehicle's kinetic energy when decelerating, storing that energy in the battery pack. This second type of charging is commonly known as 'regenerative braking'. Sophisticated electronics manage AC/DC and all voltage interfaces, including the 12-volt in-car supply.

The combination of GM Hybrid and Saab BioPower technologies has significant synergies. The hybrid system adds accelerative power and, in effect, improves throttle response. This allows further rightsizing of the engine with additional fuel consumption benefits. Engine rightsizing and hybridization complement each other, the combined benefit being greater than that of the individual technologies.

Responsible Performance

The 9-X BioHybrid also harnesses power from the sun. The large solar cell in the glass roof takes advantage of this free energy by adding charge to the hybrid battery pack while the vehicle is parked and also when it is being driven.

Apart from saving fuel and energy, responsible performance means ensuring high standards of safety. In addition to a full arsenal of electronic stability and braking systems, the front seats of the 9-X BioHybrid are fitted with 4-point seatbelts to help hold occupants firmly in place. The seat-mounted belts are extended electrically from the sides of the seatback over each shoulder and are connected together by a central buckle.

Active safety measures are taken a step further with the Lane Departure Warning (LDW) function. A front-mounted camera scans the road ahead and warning messages are flashed on the driver information display if the car veers across lane markings. The same camera is also used to monitor light sources at night. Small shutters automatically 'hood' the high headlamp beam when on-coming traffic is approaching.

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