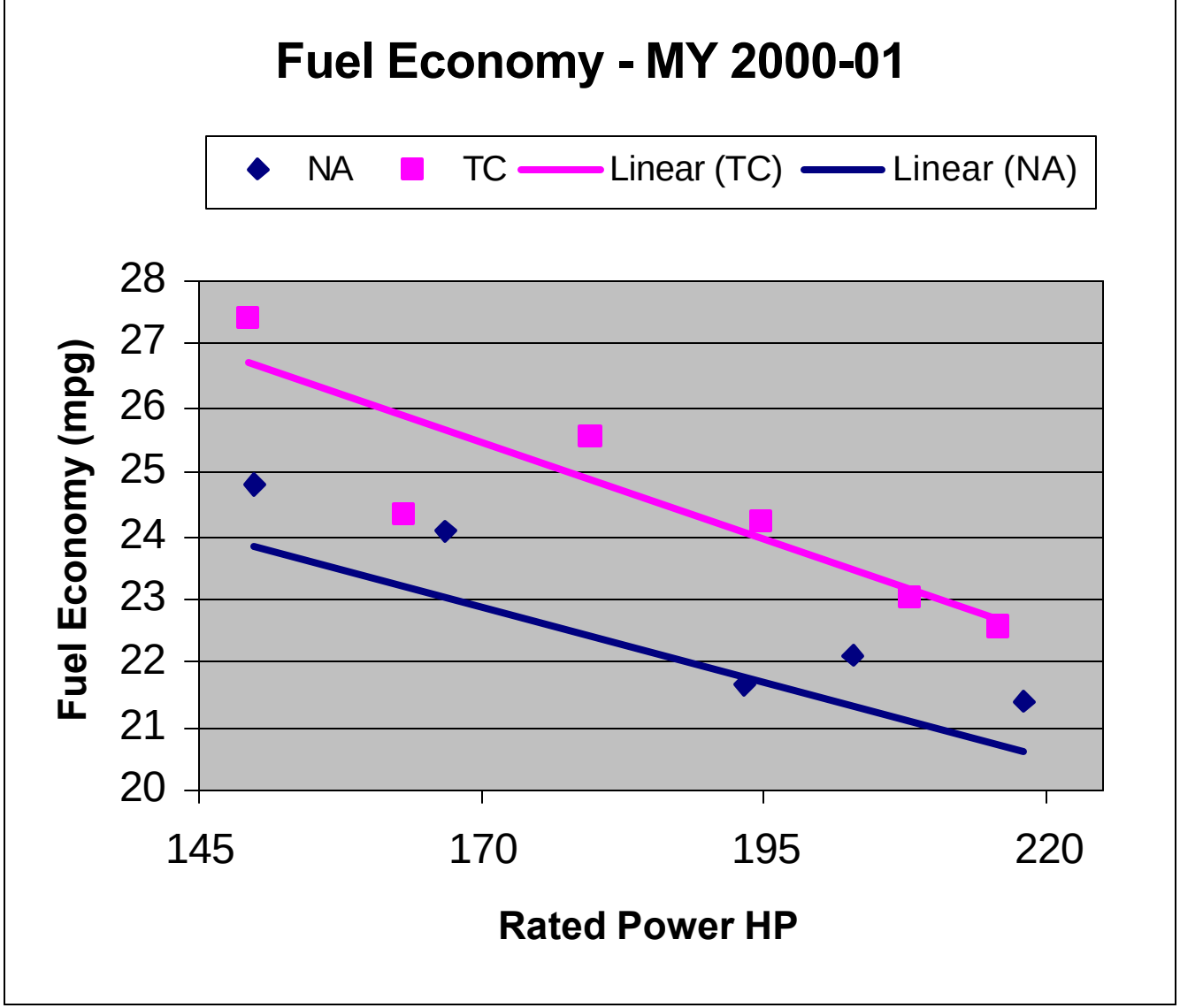
Smart Boosting Systems
e-Turbo™ and e-Charger™
"New" Frontier?

S. M. Shahed
Garrett Engine Boosting Systems
Honeywell International, Inc

US Department of Energy
Diesel Engine Emissions Reduction Workshop
August 6-9, 2001

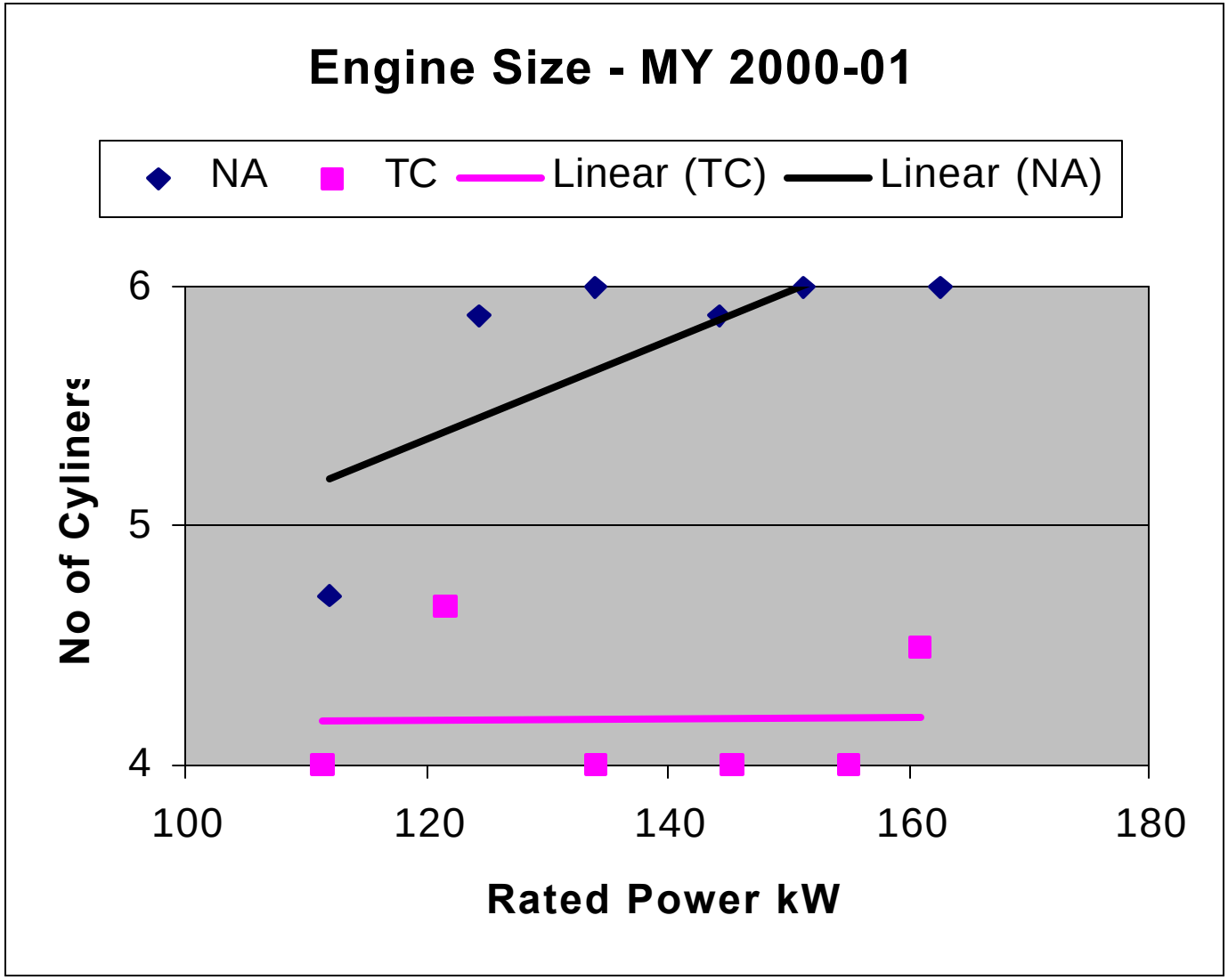
Smart Boosting Systems the New Frontier?

- For a Diesel Engine it takes roughly 20,000 Litres of Air for each Litre of Fuel
- For a Gasoline Engine it takes roughly 9,000 Litres of Air for each Litre of Fuel
- Engine "Size" NOT Determined by Displacement but by Breathing Capability
- It is time to Explore the Benefits of Accurate Management of Air, Exhaust Gas Recirculation and Pumping Work

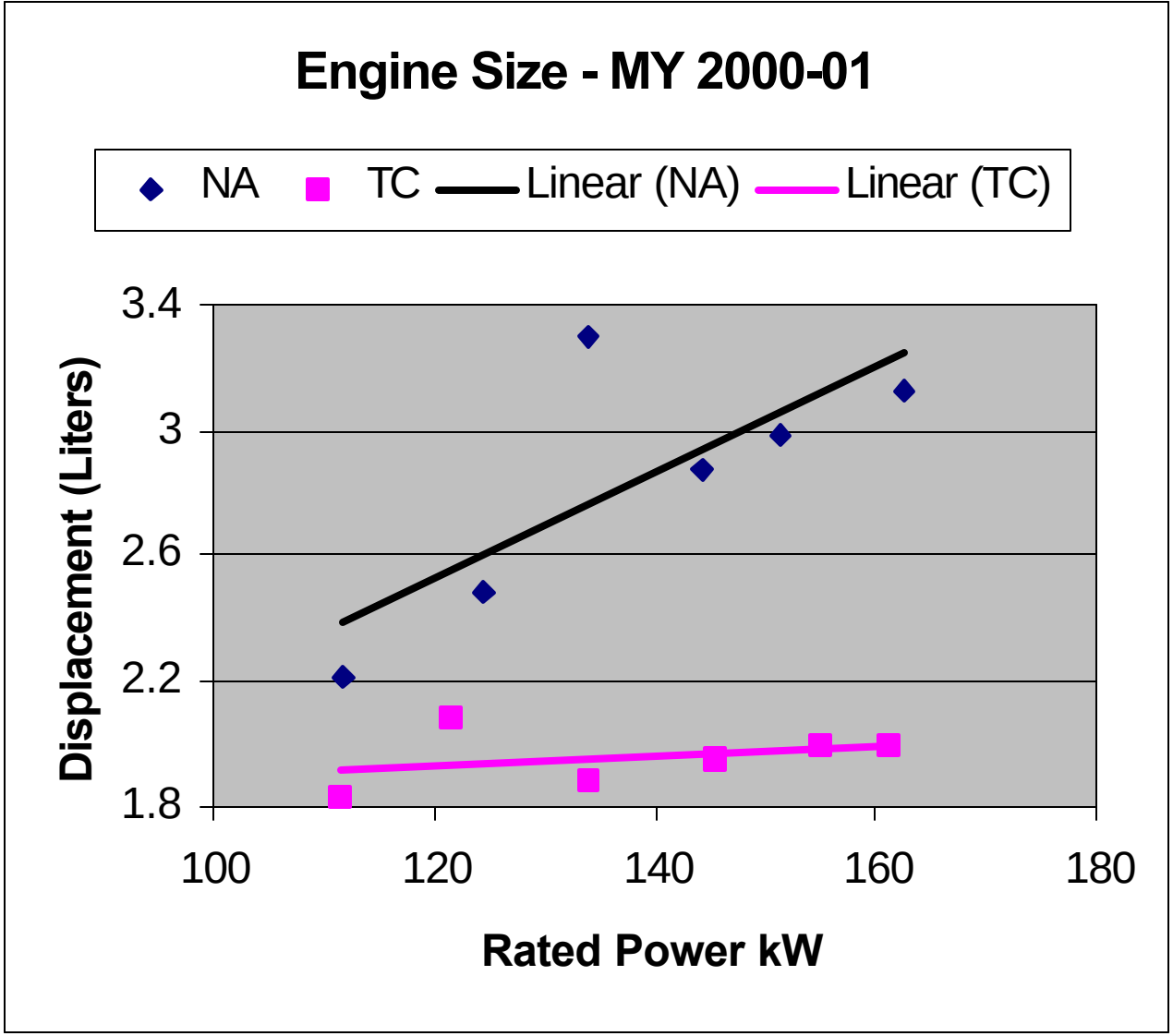


About 200 European Gasoline Engine Powered Vehicles
Downsizing/Turbocharging Gives 10% Better Fuel Economy

Fuel Economy Benefits Attributable to a Combination of Effects



European Gasoline Engine Powered Vehicles
150-200 Vehicle Data Base



European Gasoline Engine Powered Vehicles
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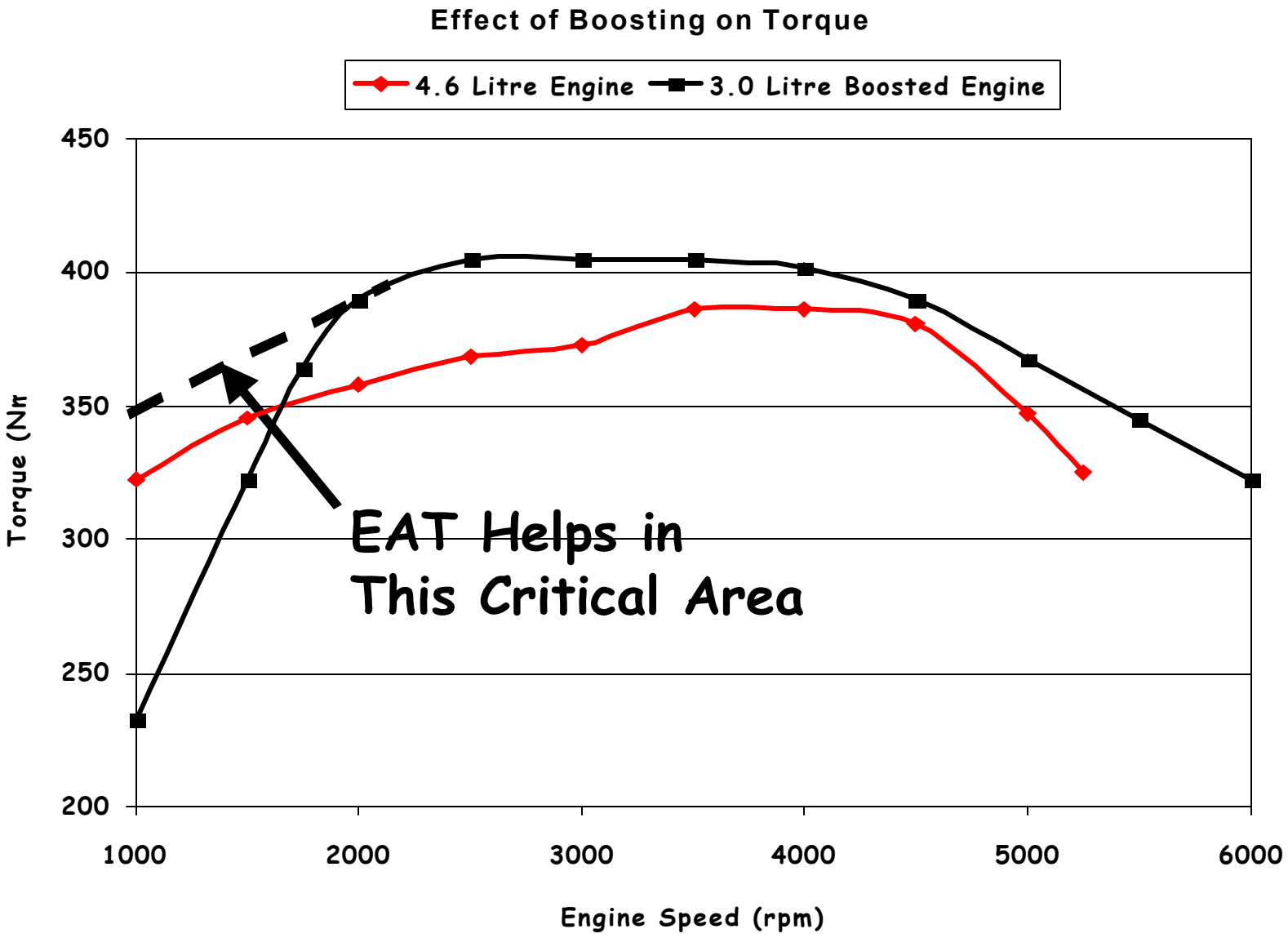
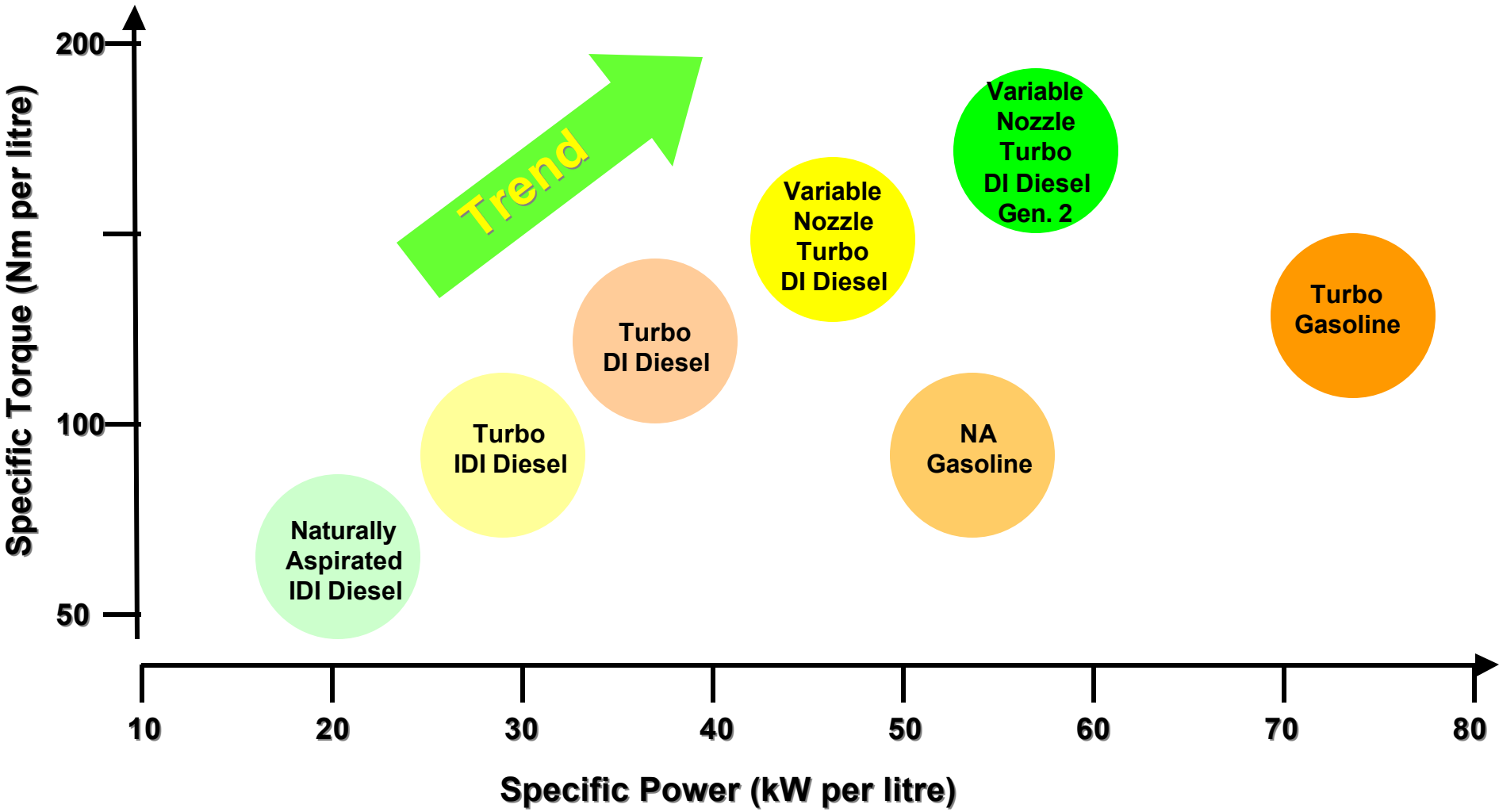
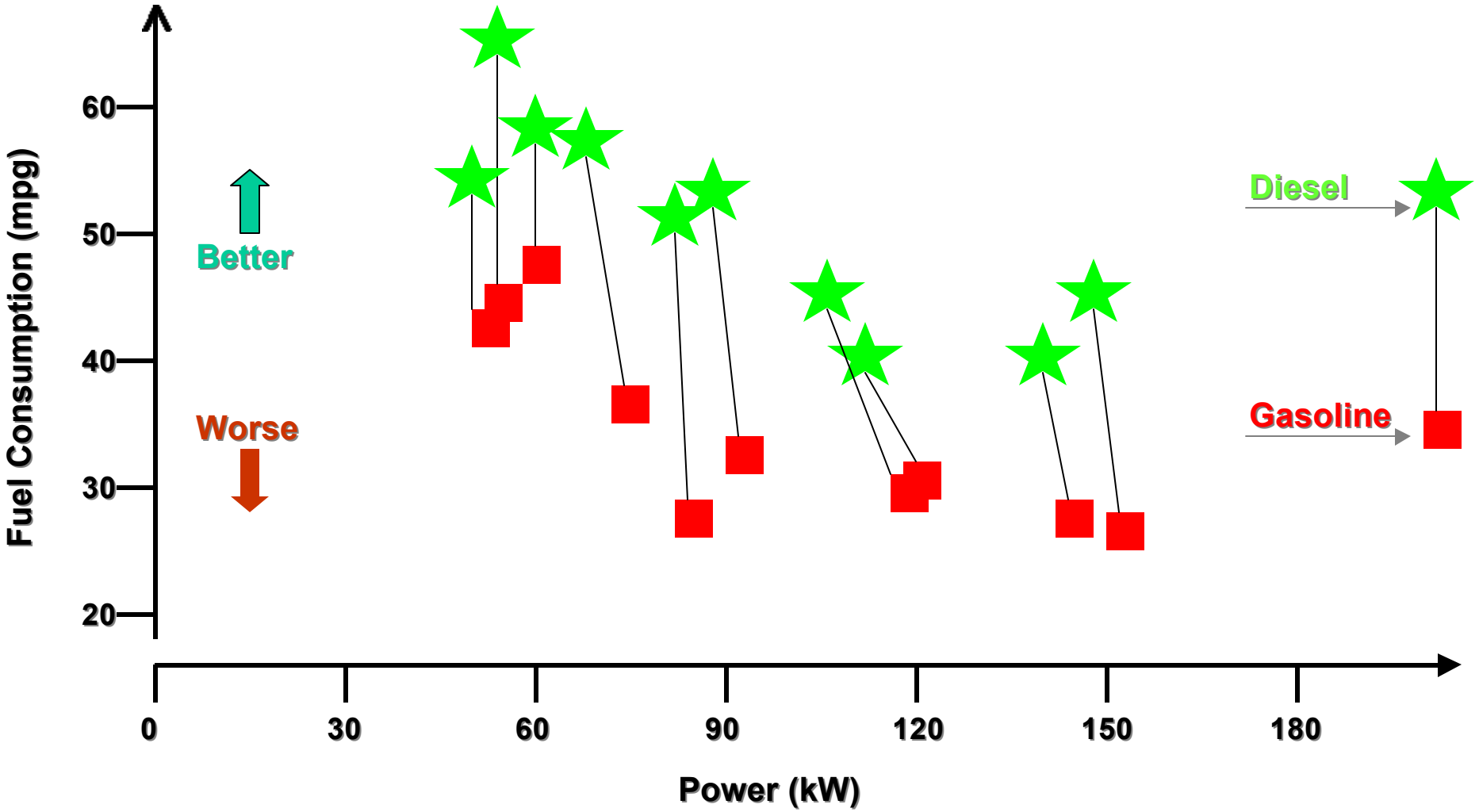


The Effect of Electrically Assisted Boosting on Low Speed Torque of Downsized Engine

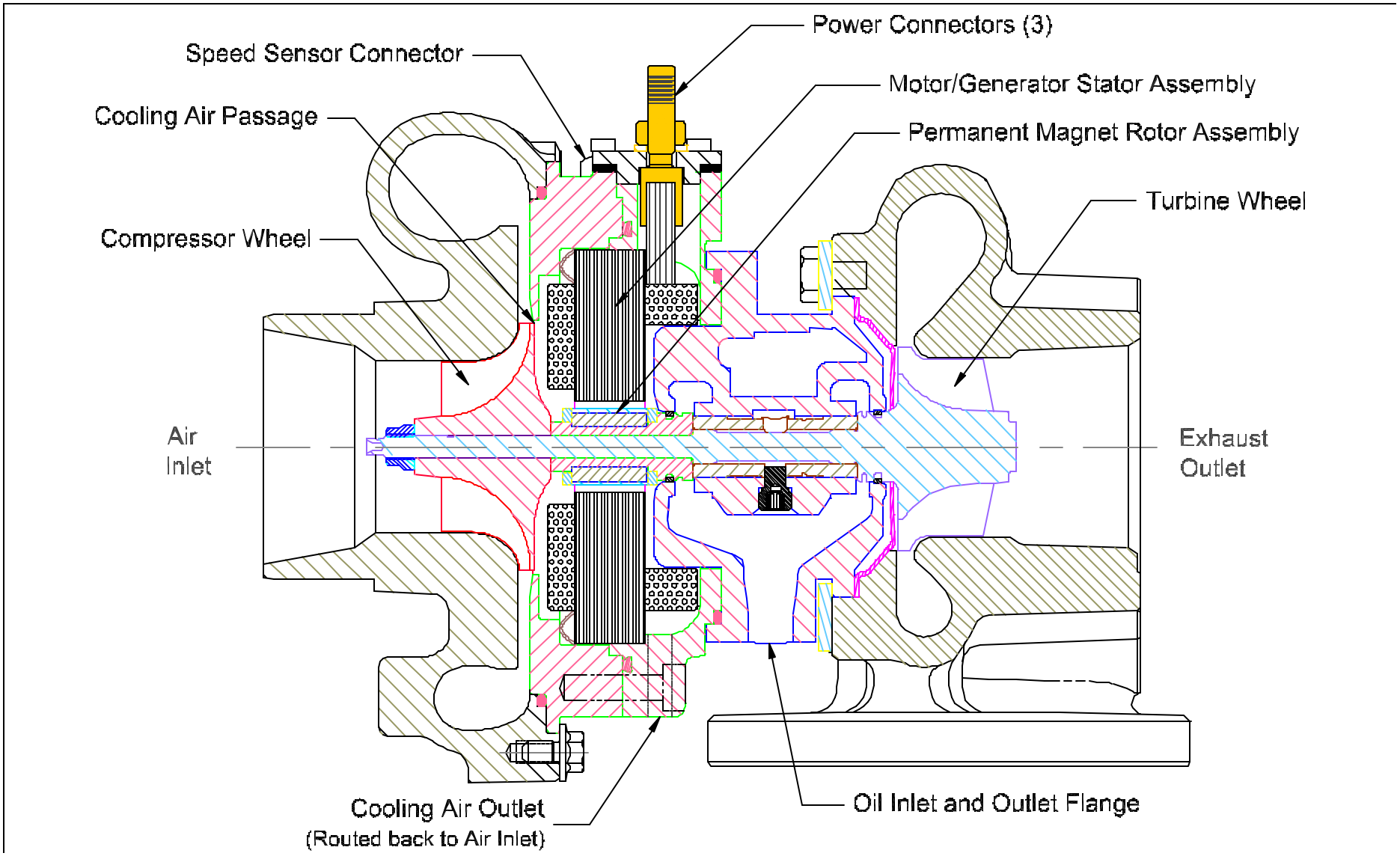
Power and Torque Trend for Diesel and Gasoline



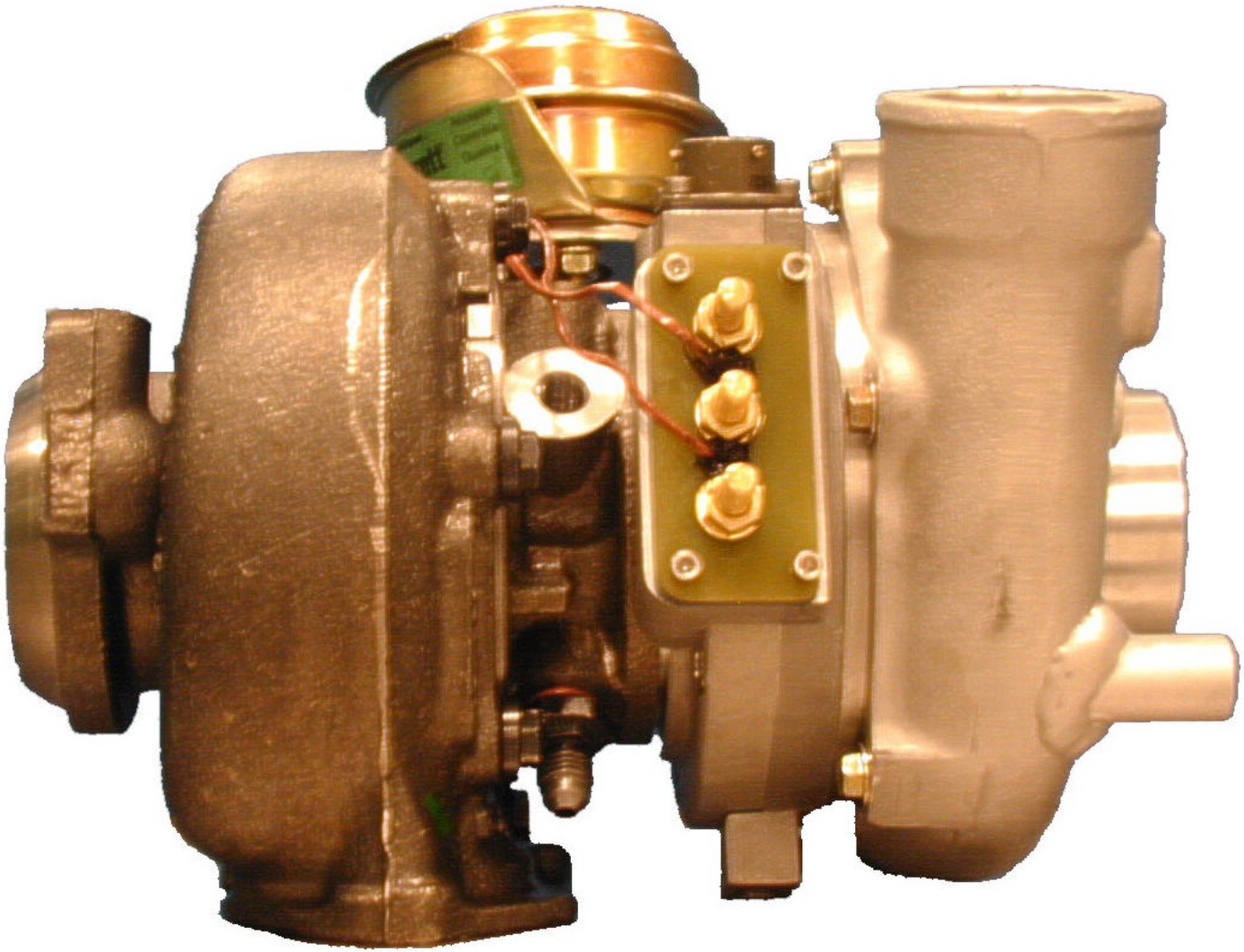
Fuel Consumption Comparison of 10 Production Cars using Diesel and Gasoline Engines of similar Power



Modern Turbo-diesel Cars Typically Provide 50% Better Fuel Efficiency



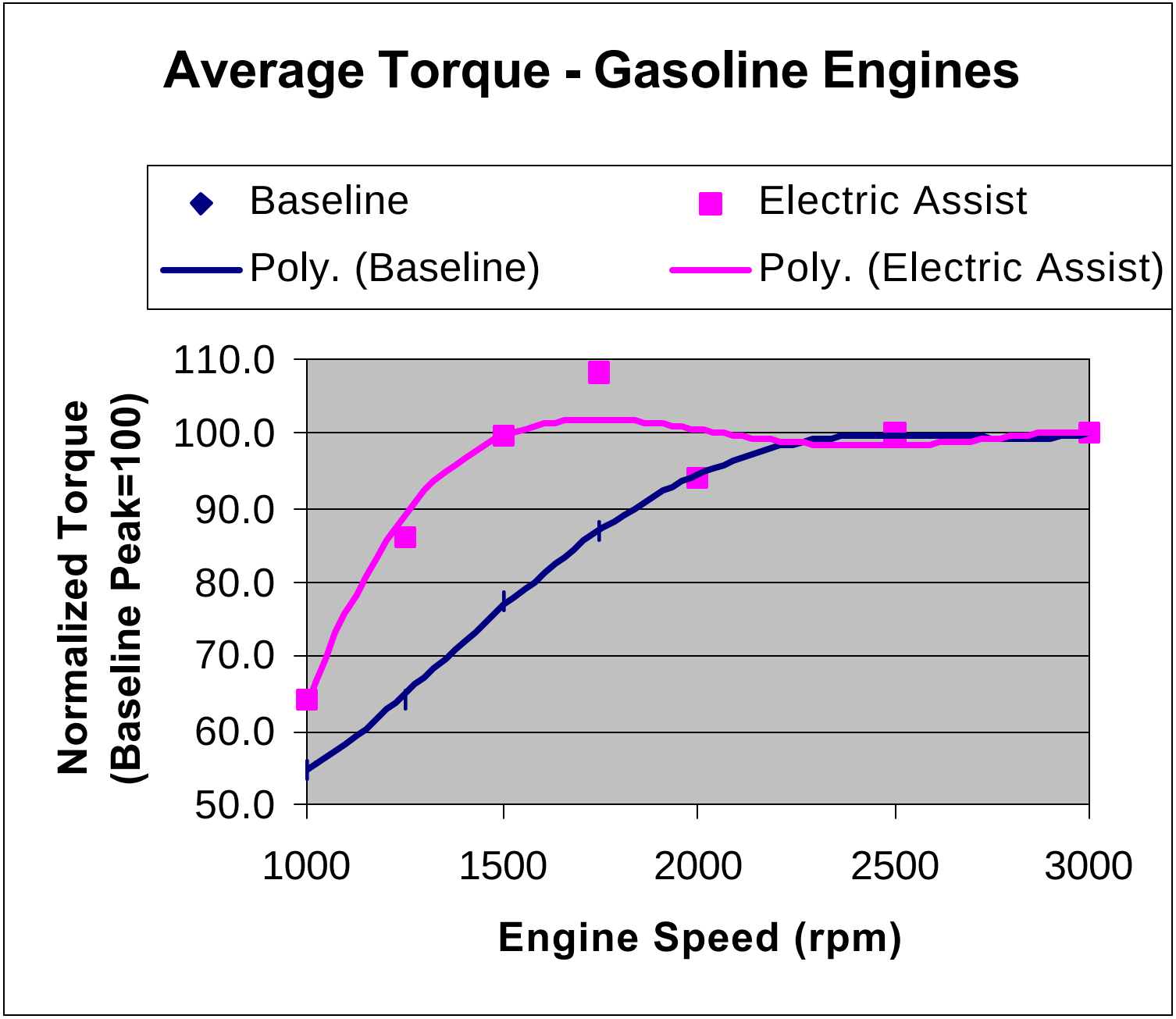
Electrically Assisted Turbocharger - Description of Design



Prototype EAT - GT25V

New Electrical Technology

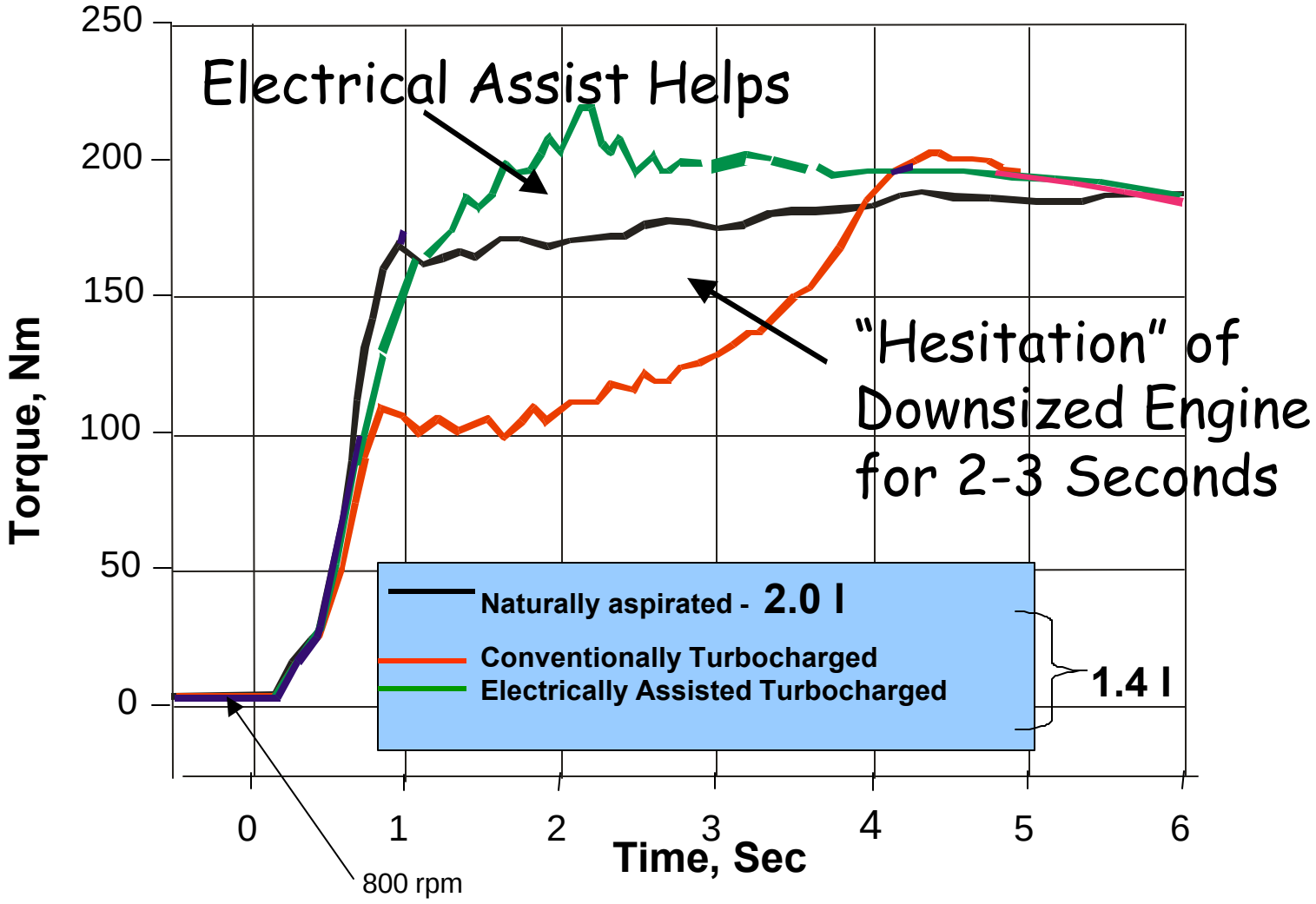
- Induction vs Permanent Magnet
  - Cost
  - Temperature
  - Demagnetization
- Current Level
  - 6 Ø Induction
- Cost of Power Electronics at high Current Levels
- e-Turbo™
- e-Charger™



Experimental Data Normalized and Averaged

Electrically Assisted S.I. Performance Simulation

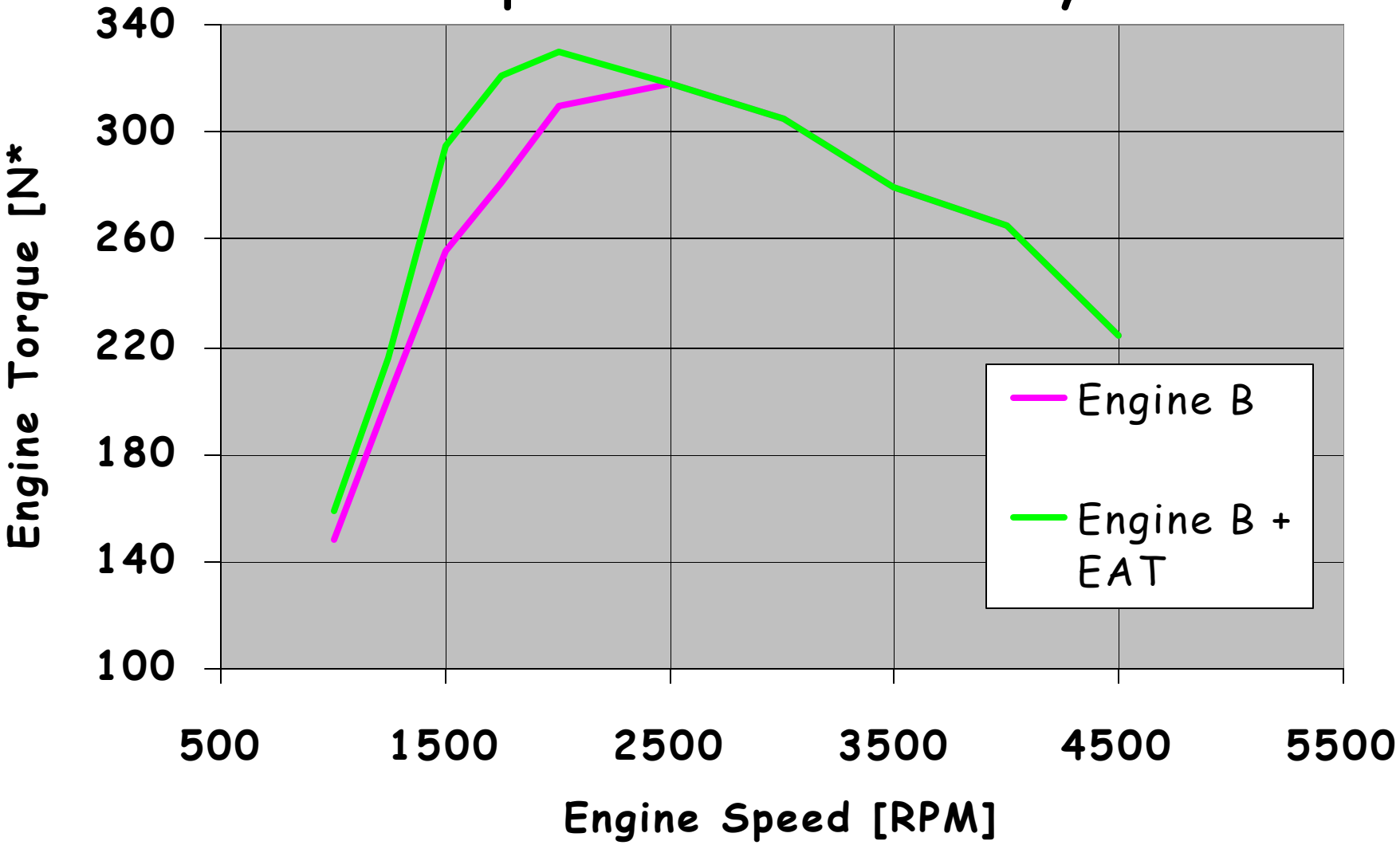
(2nd Gear Acceleration)



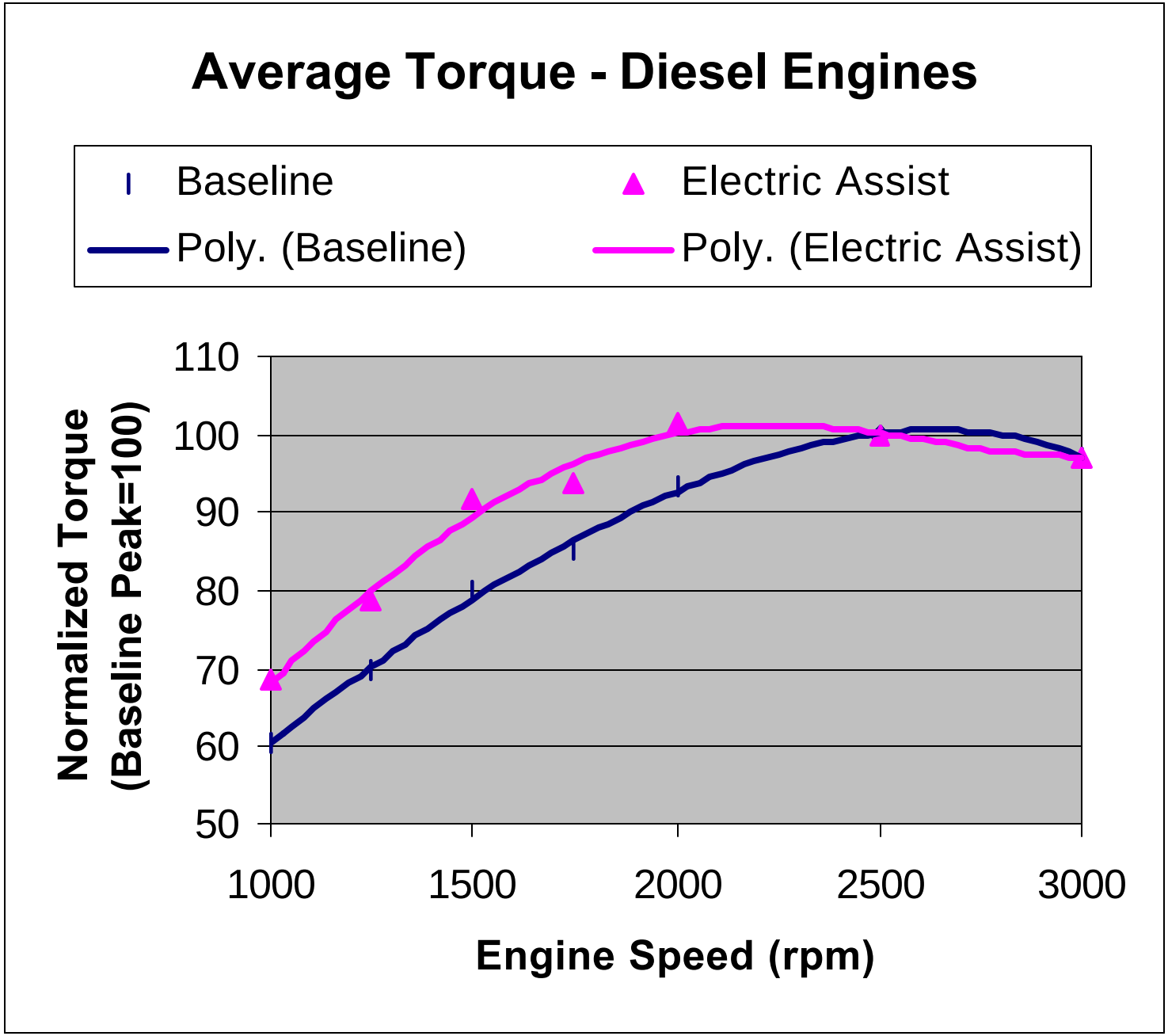
Simulated Transient Performance

Data Courtesy *FEV*

Steady State Torque Improvement with DynaCharger
1.8 kW Power
Fuel Rate per Baseline Control System

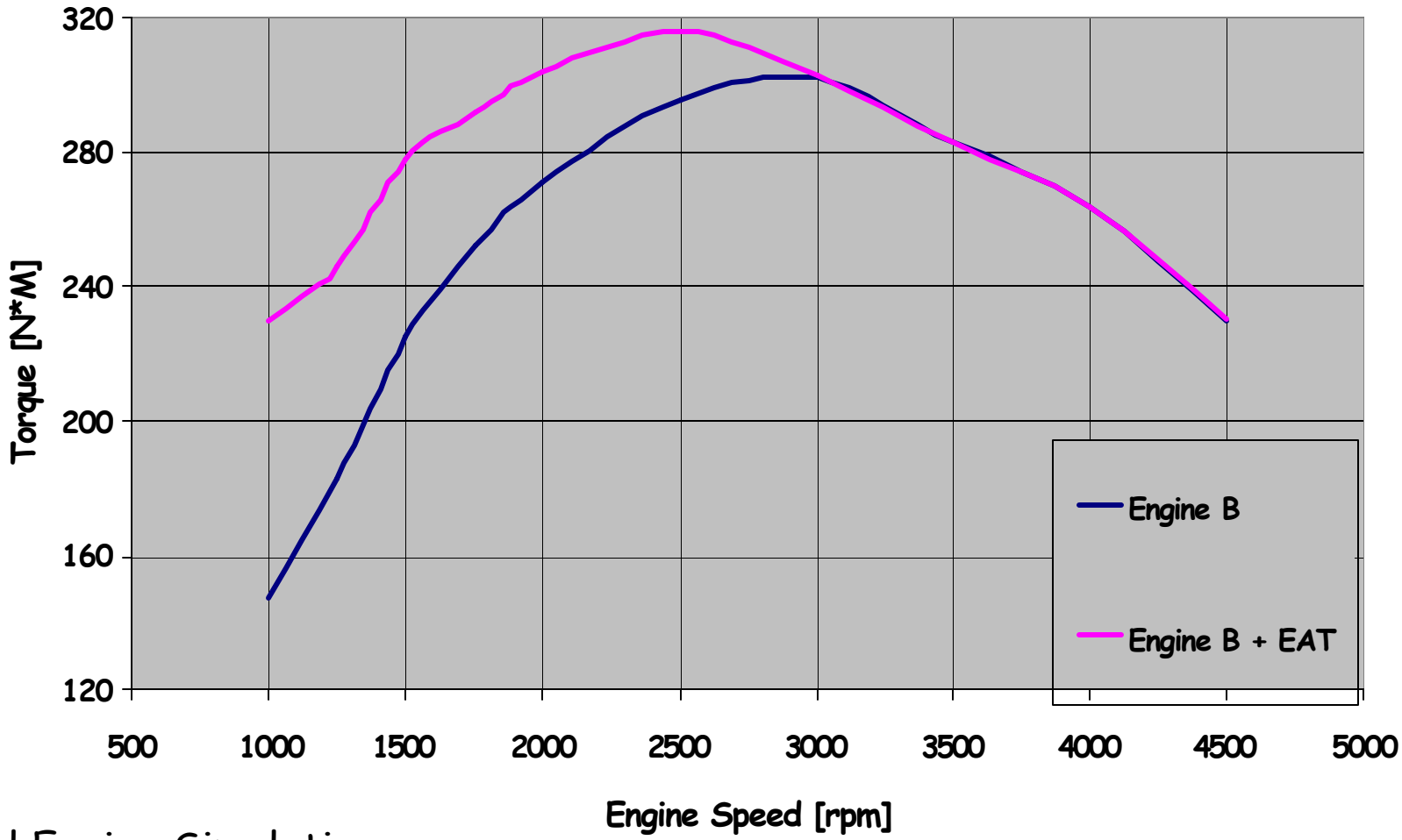


From DEER 2000



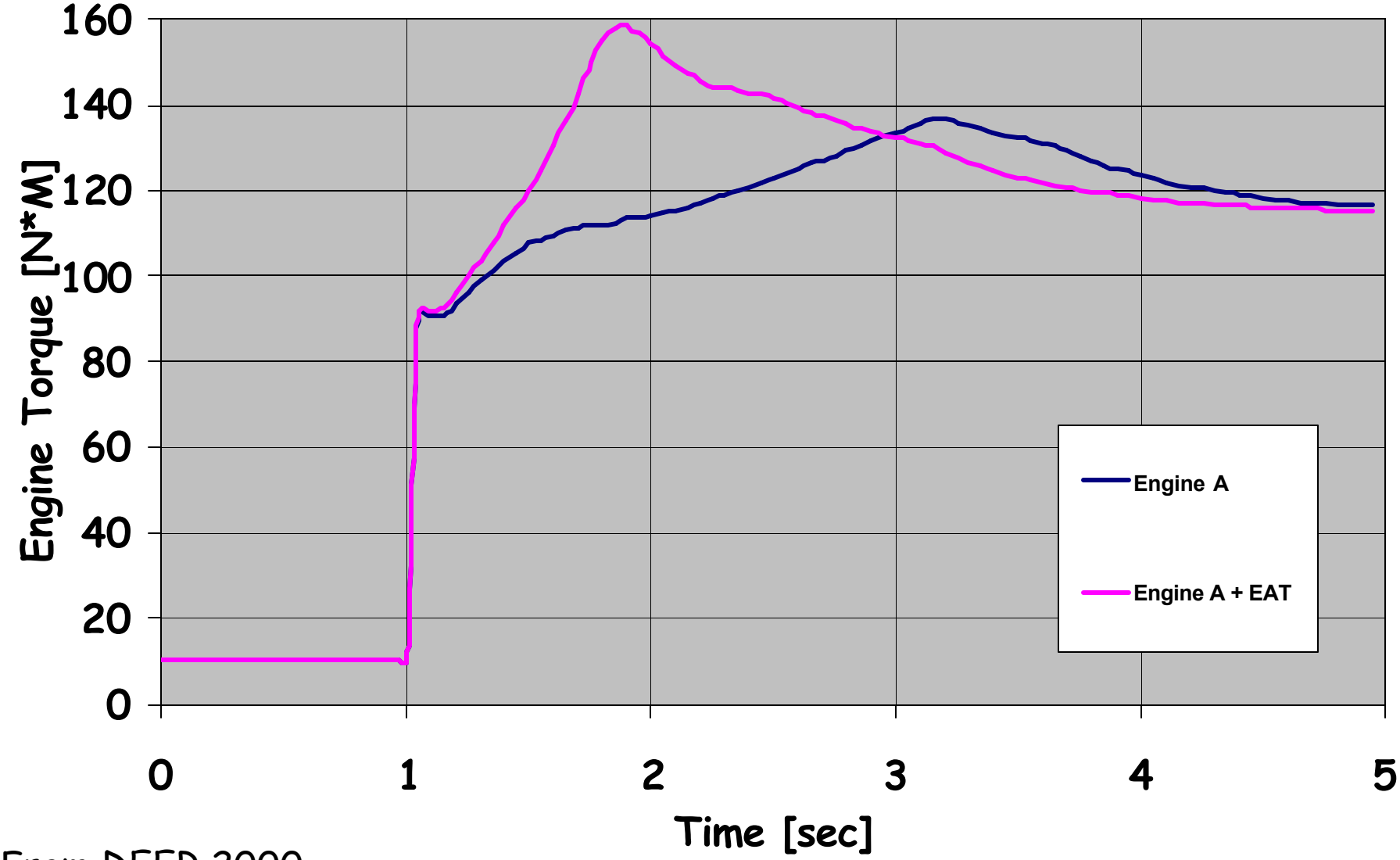
Experimental Data Normalized and Averaged

Steady State Torque Improvement
Electrically Assisted Turbocharging
1.8 kW Power
Baseline Air Fuel Ratio

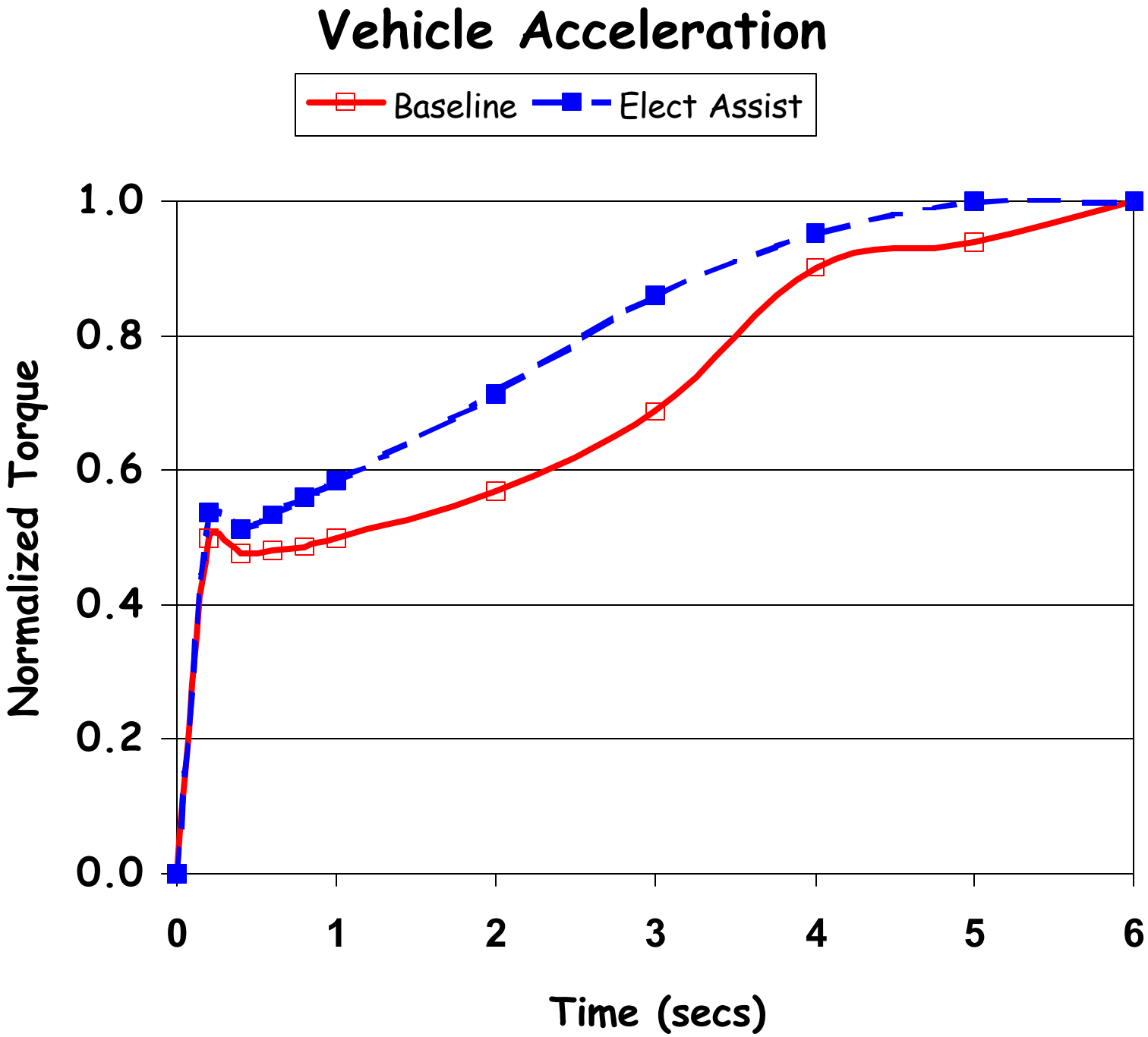


Diesel Engine Simulation
From DEER 2000

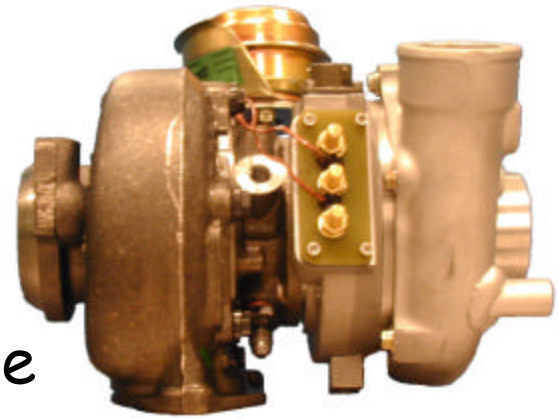
Transient Response
Power 1.8 kW
Fuel Rate per Baseline Control System



From DEER 2000


Vehicle Acceleration
Baseline
Elect Assist
1.0
0.8
0.6
0.4
0.2
0.0
Normalized Torque
0
1
2
3
4
5
6
Time (secs)

Electrically Assisted Turbocharging to ...



- Downsize the Engine
- Shape the Torque Curve
- Improve Acceleration Performance
- Generate Electrical Power
- Manage Exhaust Temperature for Aftertreatment
- Manage EGR Rate
- Improve Vehicle Braking (Heavy Duty Diesel)

Smart Boosting Systems New Frontier?

- Turbocharging … Old Hat
- VNT - in Production
- e-Turbo™ or e-Charger™
  - Low Speed Torque
  - Particulate Control
- e-Turbo™
  - EGR Control
  - Electrical Turbocompounding
  - Auxiliary Power Generation