

Ford's EcoBoost Technology : A Central Element of a Sustainable CO2 and Fuel Economy Strategy with Affordable Products

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Ford Motor Company

ACEA Automotive Summit
Brussels, Nov. 9-10, 2010



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Contents

- **Introduction**
- **EcoBoost Technology Package**
- **EcoBoost Engine Lineup**
- **Fuel Economy Based on EcoBoost Technology**
- **Future Ecoboost Technology Extensions**
- **Summary**



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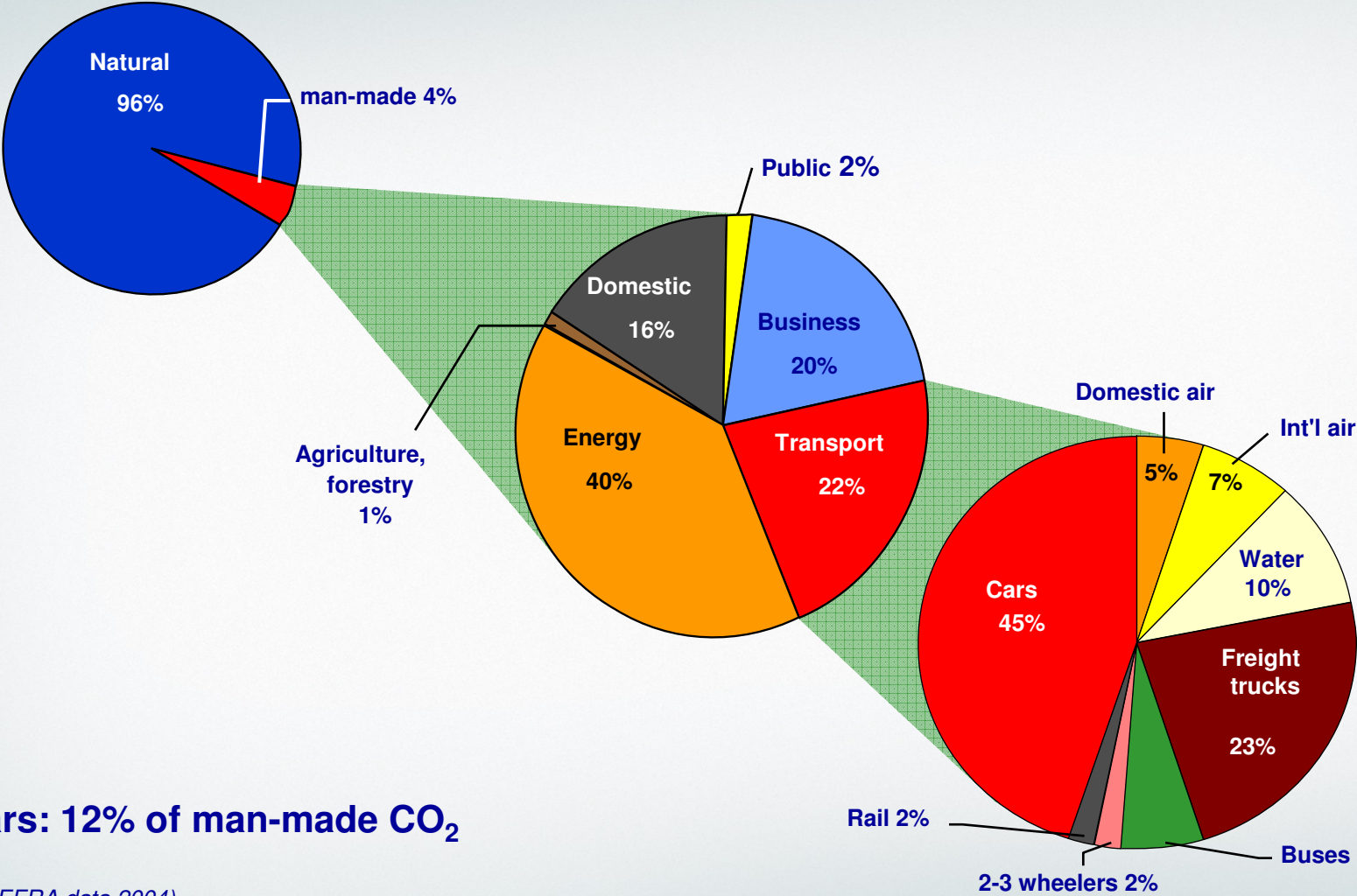
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Global CO2 Emissions by Source



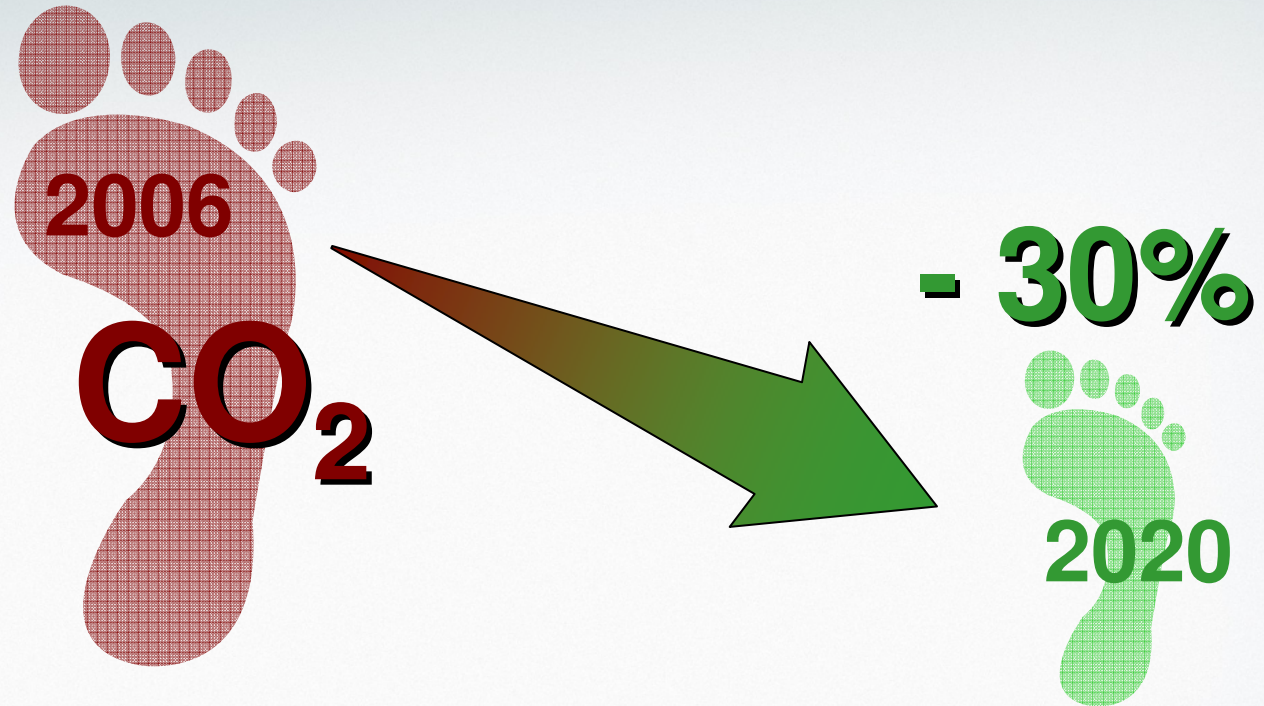
Cars: 12% of man-made CO₂

* (DEFRA data 2004)



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CO2 Emissions Reduction*



*New Ford Models CO₂
Emissions Reduction
(Europe & USA)

*eco*netic

ECOBOOST

 HYBRID

 PLUG-IN
HYBRID

 BATTERY
ELECTRIC



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Technology Migration and EcoBoost Deployment

2007

2012

2020

2030

Near Term

Begin migration to advanced technology

Mid Term

Full implementation of known technology

Long Term

Volume roll-out of hybrid electric technologies and alternative energy sources

Near Term

- Significant number of vehicles with EcoBoost technology
- Dual clutch and 6-speed transmissions replace 4- and 5-speeds
- Increased hybrid applications
- Increased unibody applications
- Introduction of smaller cars and CUVs
- Electric power steering 80% - 90%
- Battery management systems 75%
- Aero improvement up to 5%

Mid Term

- Weight reduction of 250 - 750 lbs
- Engine displacement reduction aligned with weight save
- EcoBoost available in nearly all vehicles
- Increased use of hybrids as a percentage of gas engines
- Additional Aero improvements up to 5%
- EPAS approaching 100% on light-duty vehicles
- Low volume introduction of plug-in hybrids

Long Term

- Percentage of internal combustion dependant on renewable fuels
- Volume introduction of hybrids and plug-in hybrids
- Introduction of BEV and fuel cell vehicles
- Clean electricity / hydrogen



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Introduction of EcoBoost Technology

2007

2012

2020

2030

Near Term

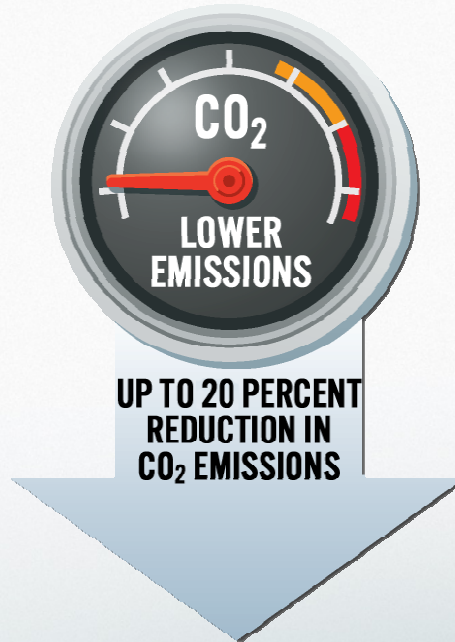


UP TO
20 PERCENT FUEL
IMPROVEMENT



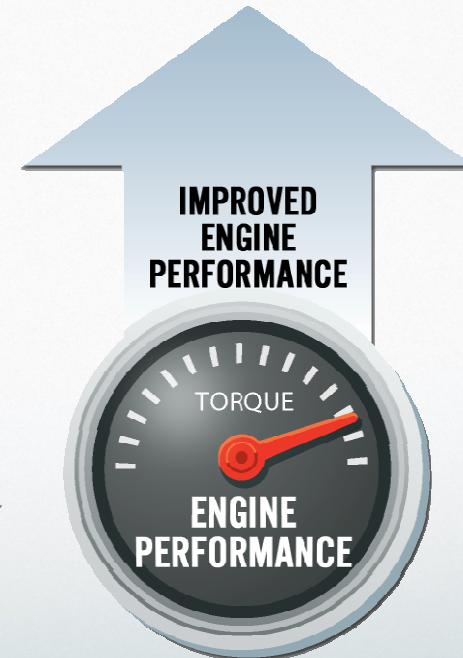
CO₂
LOWER
EMISSIONS

UP TO 20 PERCENT
REDUCTION IN
CO₂ EMISSIONS



IMPROVED
ENGINE
PERFORMANCE

TORQUE
ENGINE
PERFORMANCE



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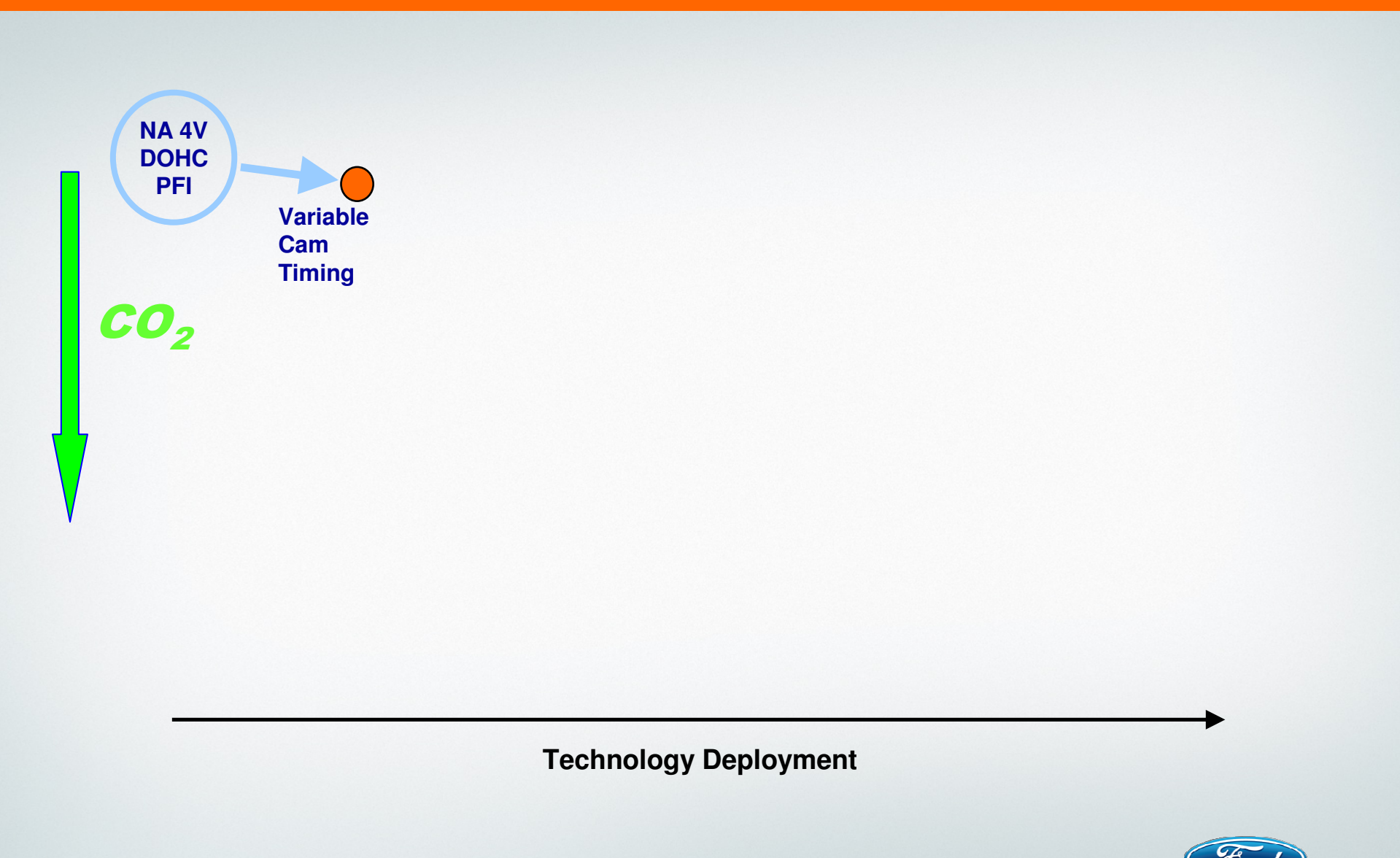
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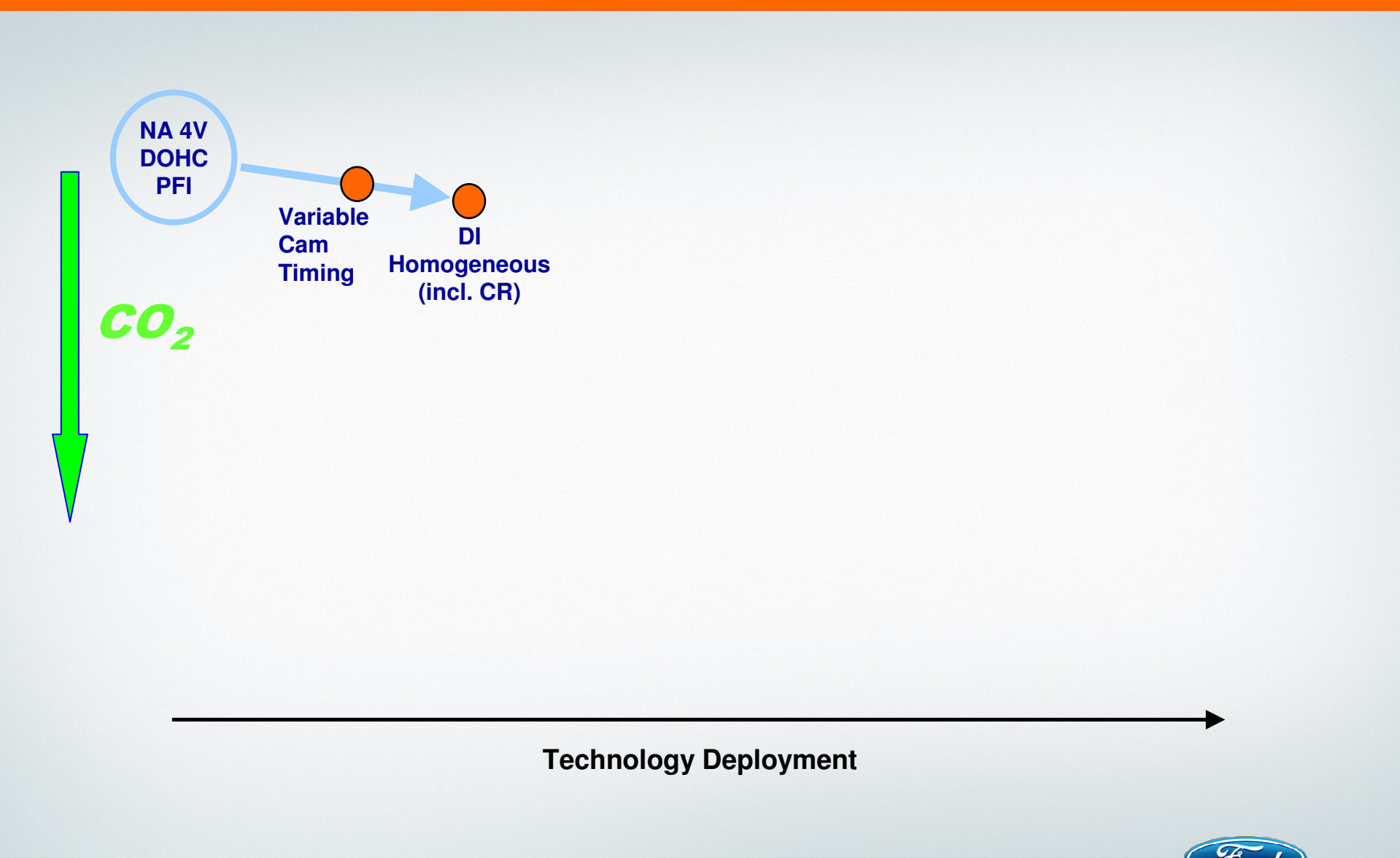
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EcoBoost Technology Package



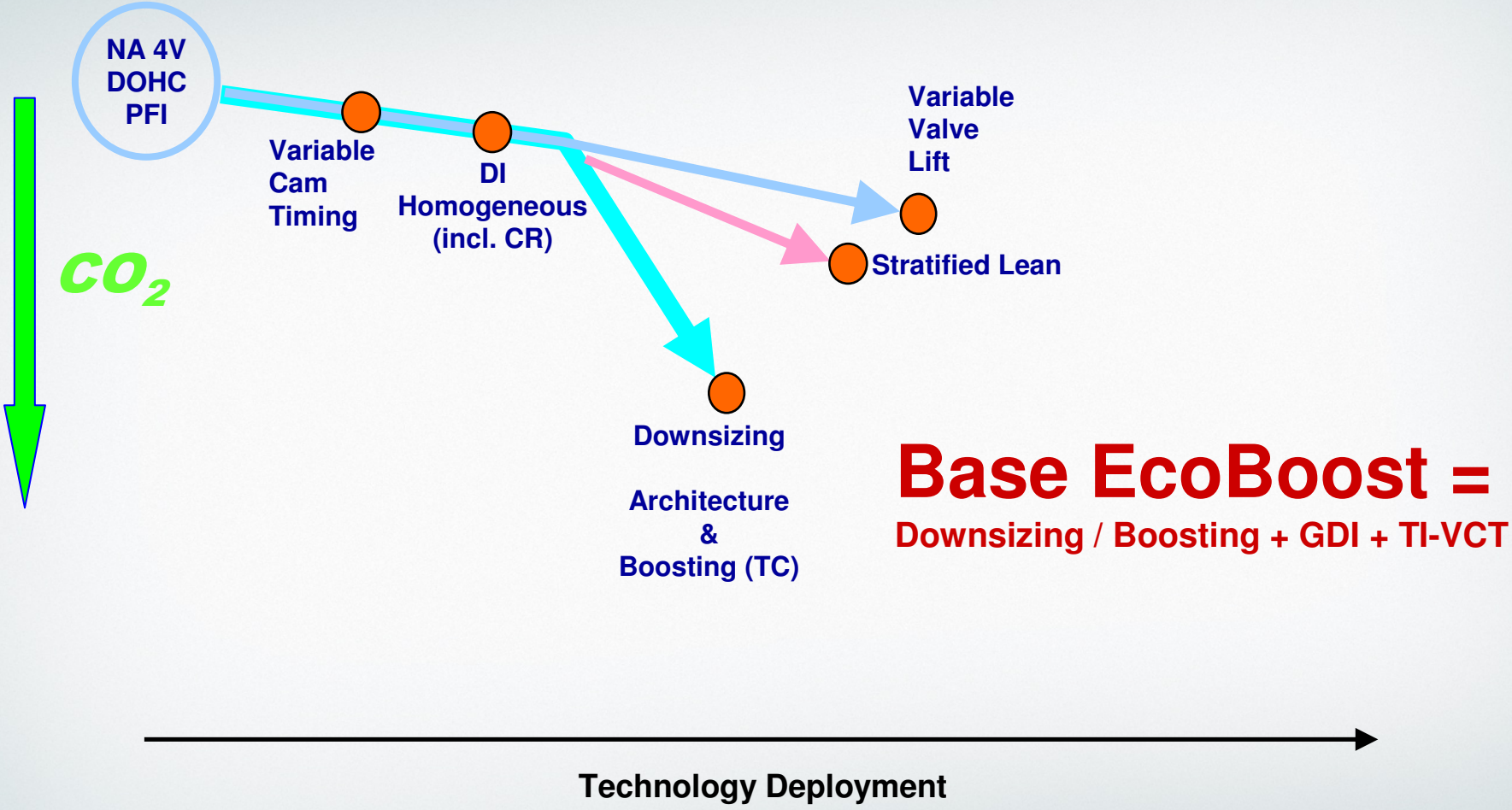
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EcoBoost Technology Package



Feel the difference

EcoBoost Technology Package



Feel the difference

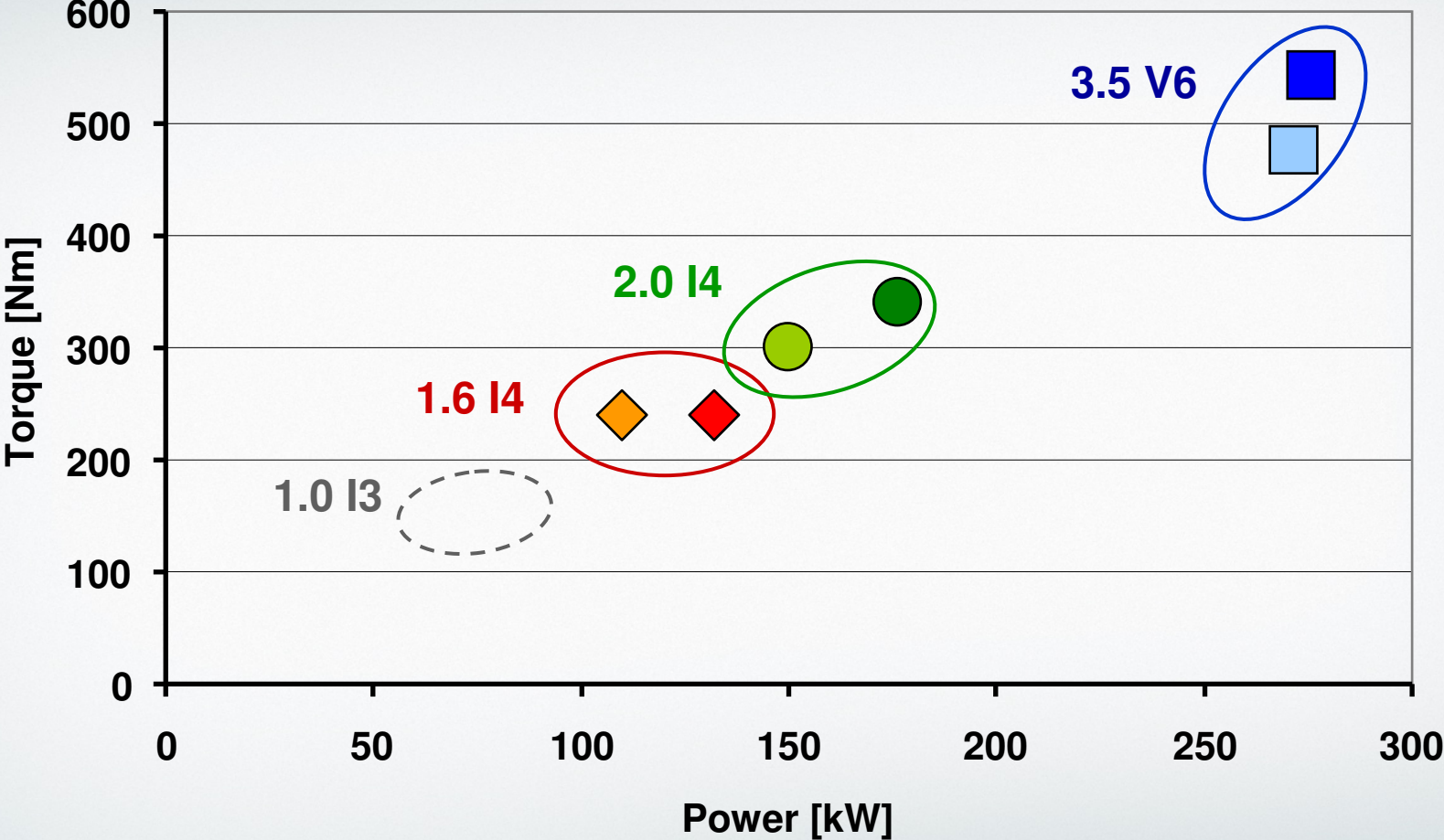
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EcoBoost Engine Lineup



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3.5L V6

- I-VCT and TI-VCT Versions
- 272 and 276 kW
- 475 Nm @ 1500 rpm and 542 Nm @ 2000 rpm (19.5 bar BMEP)
- B/S = 1,07
- 10:1 Compression Ratio (95 RON)
- Side Mounted MH Injectors
- 150 bar fuel pressure
- Twin TC with dual wall manifolds
- 950 °C Turbine Inlet Temp.
- 0-20s feedgas emissions supporting PZEV emissionability

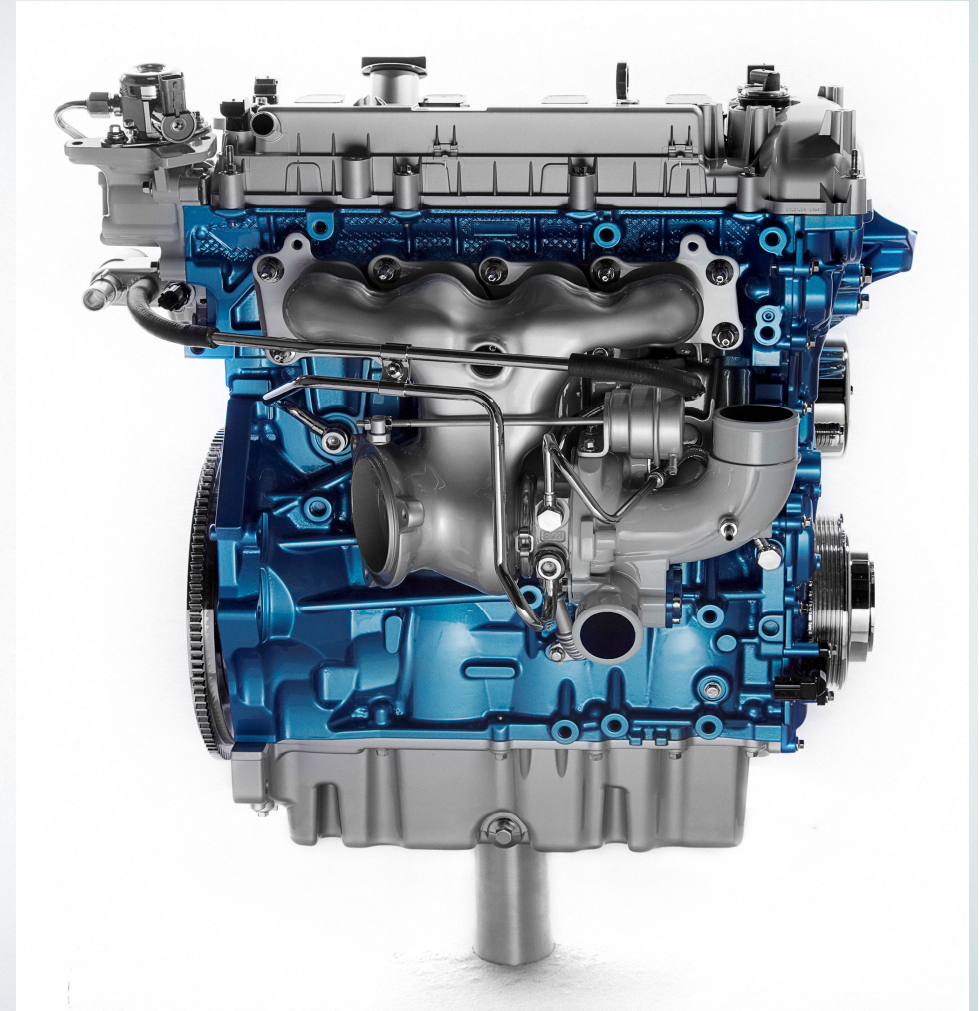


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2.0L I4



- TI-VCT
- 149 and 176 kW
- 300 Nm @ 1750 rpm and 340 Nm @ 1750 rpm (21.4 bar BMEP)
- B/S = 1,05
- 9.5:1 Compression Ratio (95 RON)
- Side Mounted MH Injectors
- 150 bar fuel pressure
- Sheet Metal dual wall exhaust manifold and integrated TC housing
- 970 °C Turbine Inlet Temp.
- 0-20s feedgas emissions supporting PZEV emissionability



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1.6L I4



- TI-VCT
- 110 and 132 kW
- 240 Nm @ 1500 rpm (18.9 bar BMEP) , 260 Nm Overboost
- B/S = 0,97
- 10:1 Compression Ratio (95 RON)
- Central mounted MH Injectors
- 150 bar fuel pressure
- Steel cast exhaust manifold and TC housing
- 1050 °C Turbine Inlet Temp.
- 0-20s feedgas emissions supporting PZEV emissionability



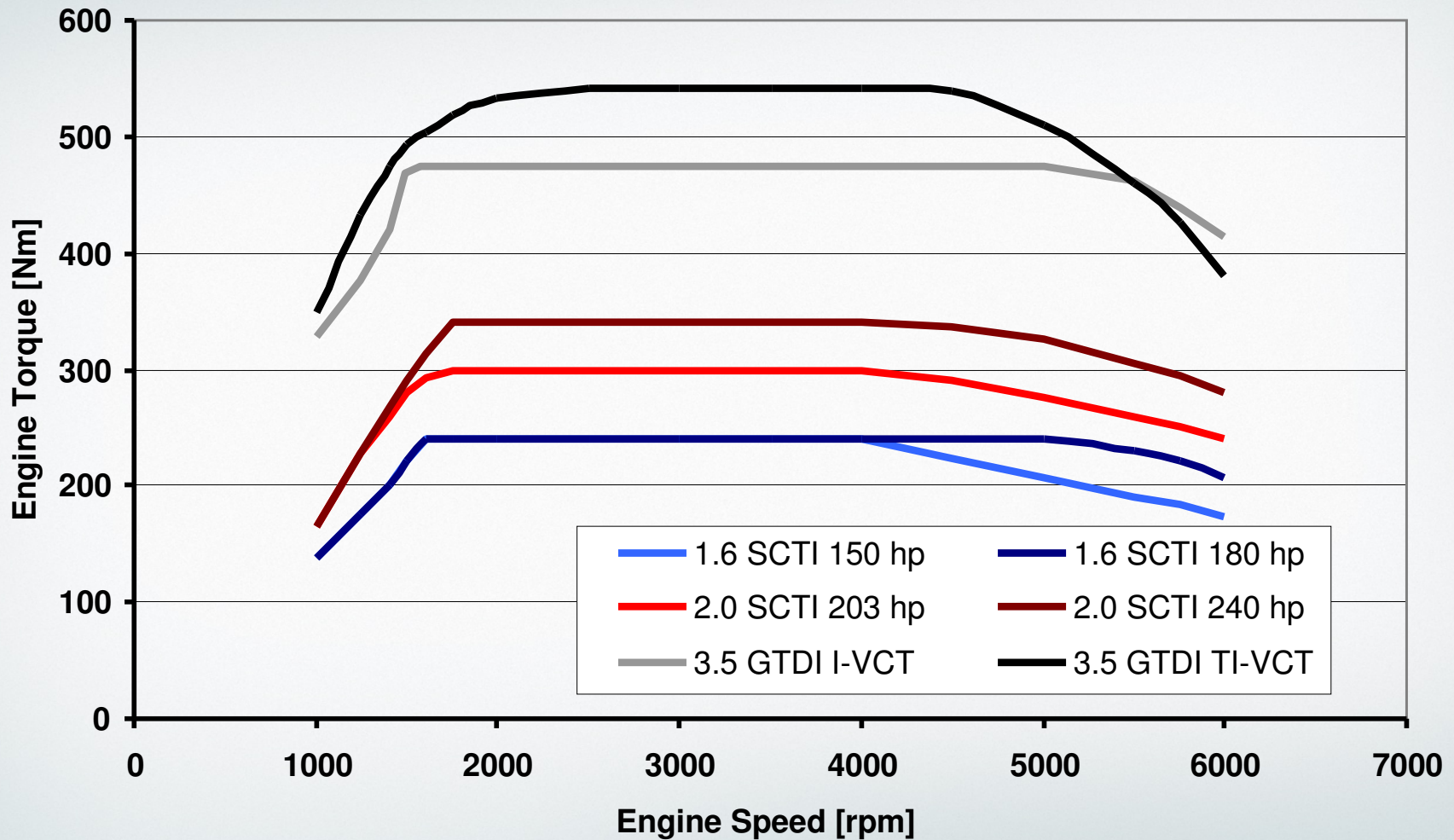
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1.0L I3 ECOBOOST



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EcoBoost Lineup : Torque Characteristics



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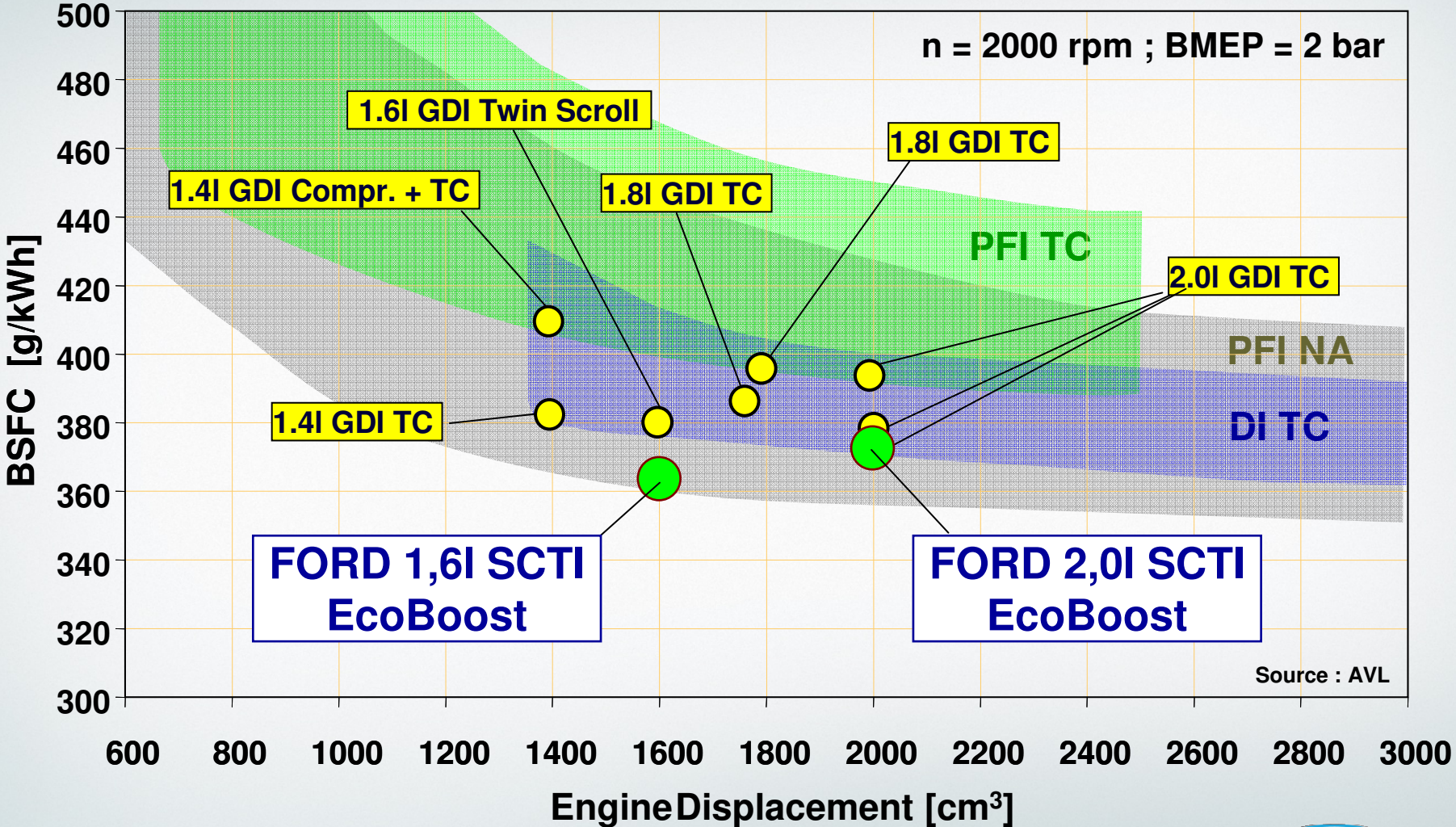
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Part Load Fuel Economy vs. Benchmark

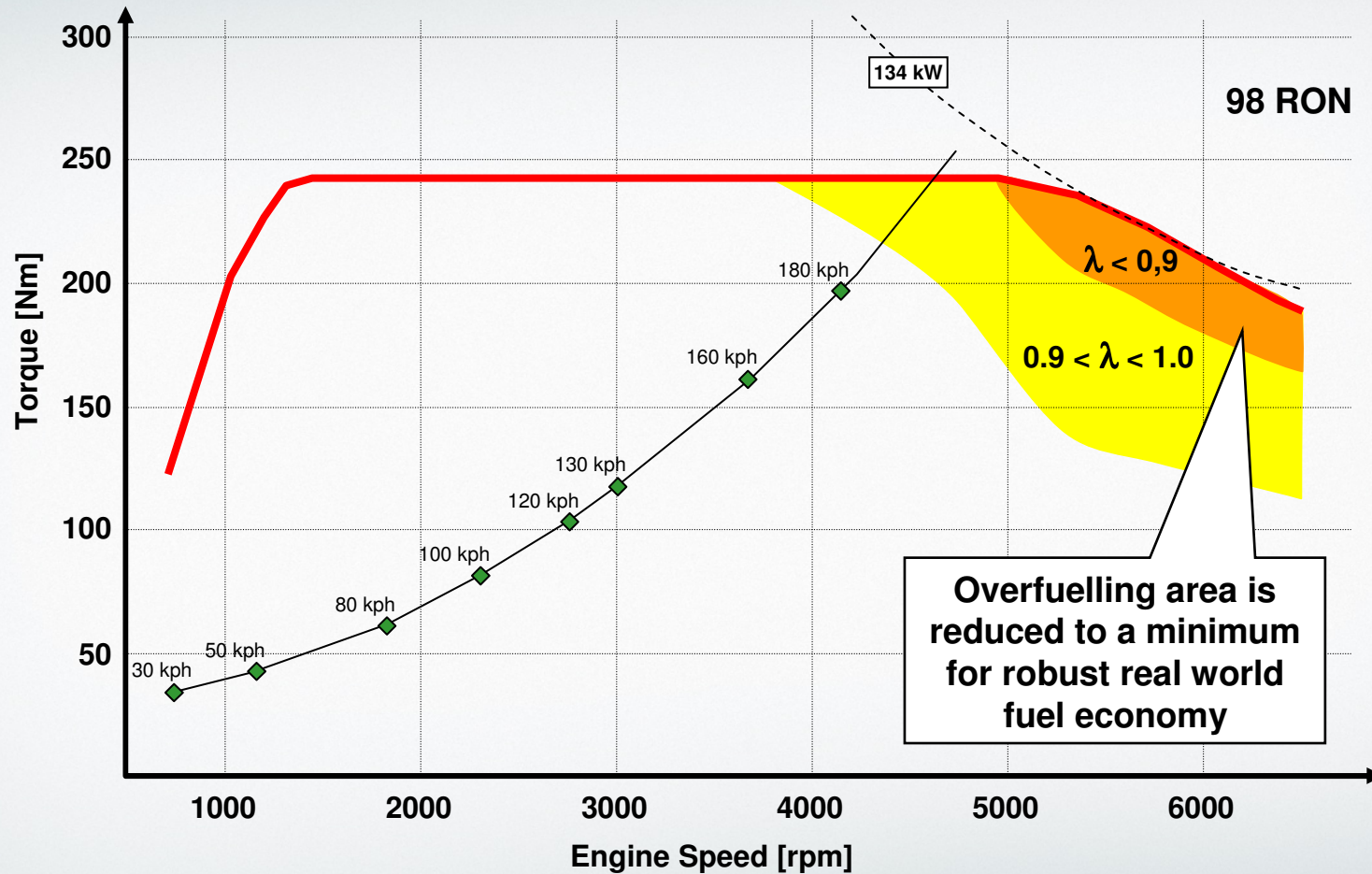


Source : AVL



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Engine Torque and A/F Ratio Strategy

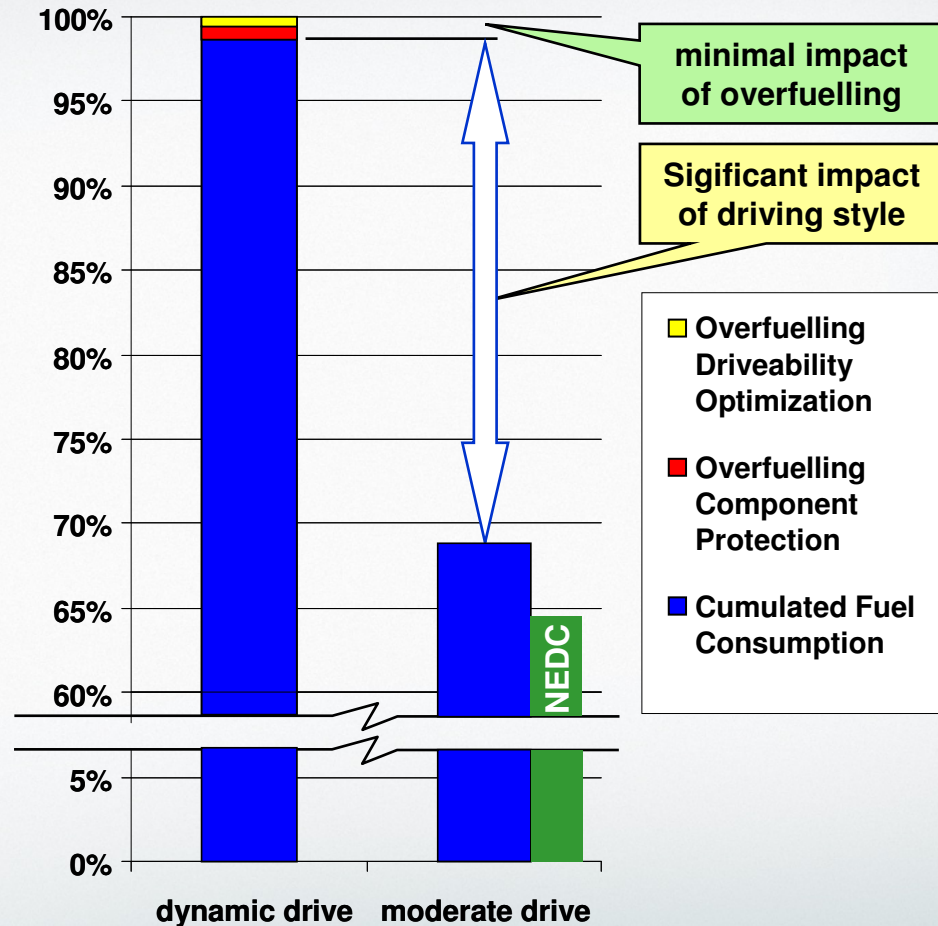


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EcoBoost Real World Drive Fuel Consumption



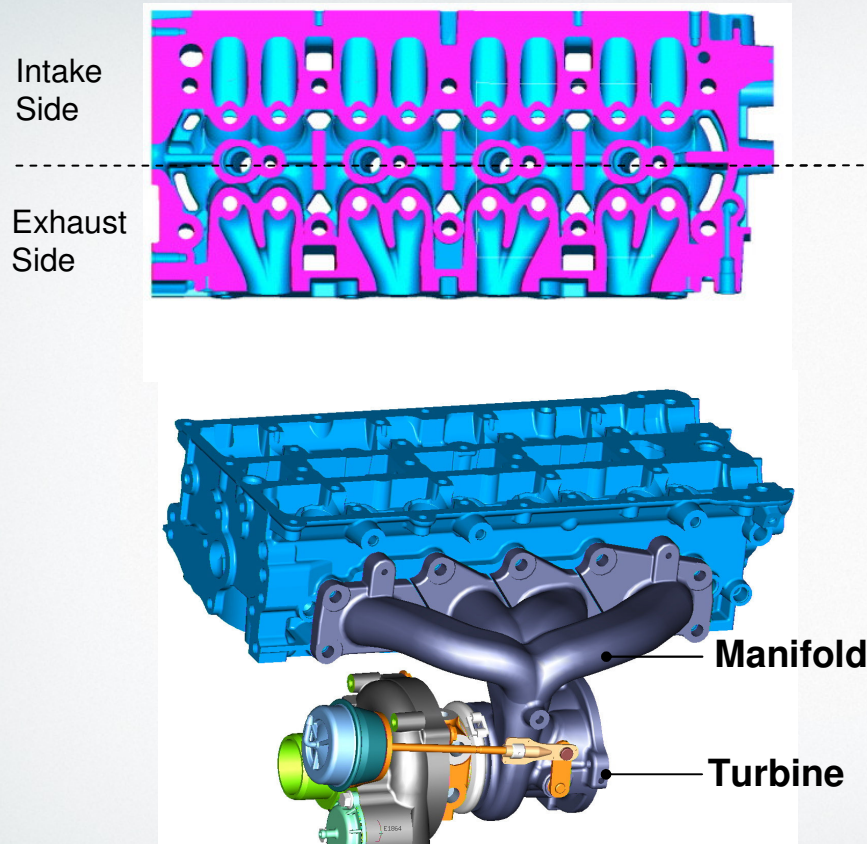
Dynamic and moderate driving of new C-MAX 1.6 EcoBoost vehicle performed in the french sea alps



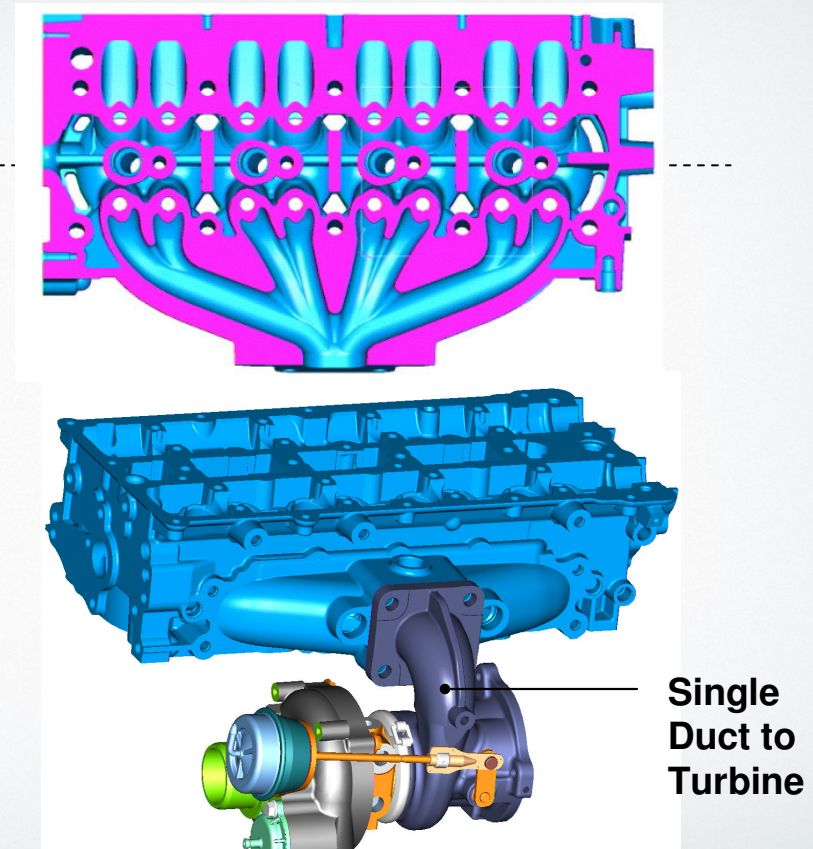
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Next Step for RWFE : Integrated Exhaust Manifold

Classic cylinder head 14 Turbo for separate exhaust manifold



Cylinder head with integrated exhaust manifold (ports and plenum)

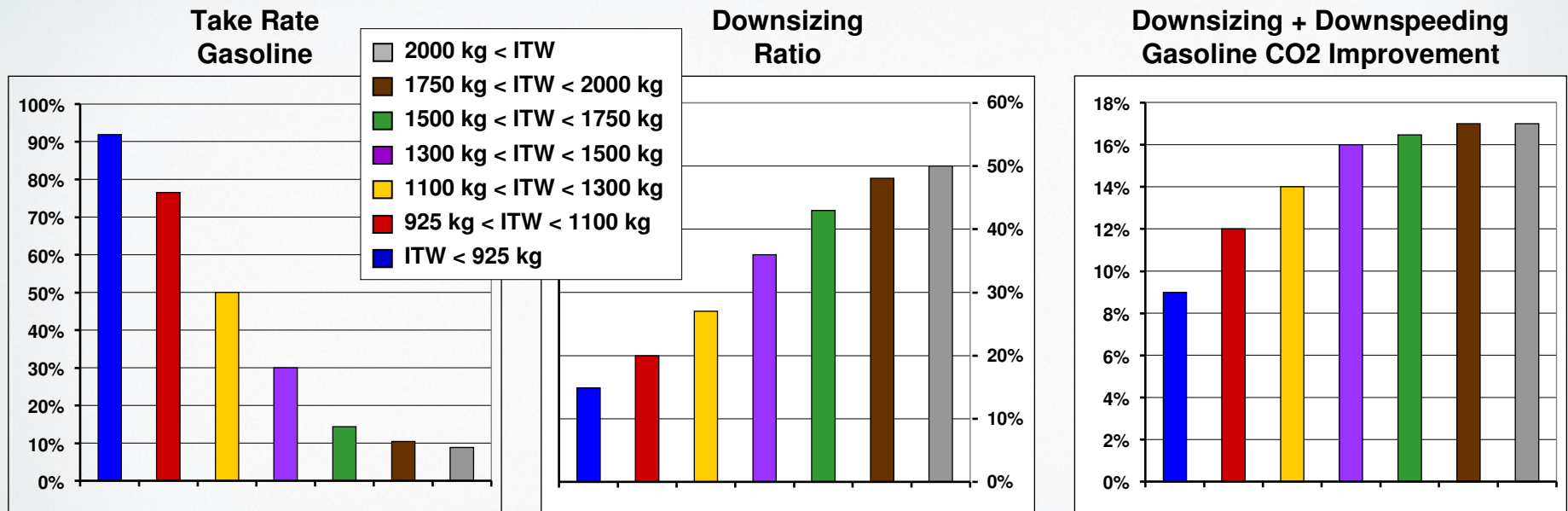


➔ **Enabler for stoichiometric operation in entire engine map**



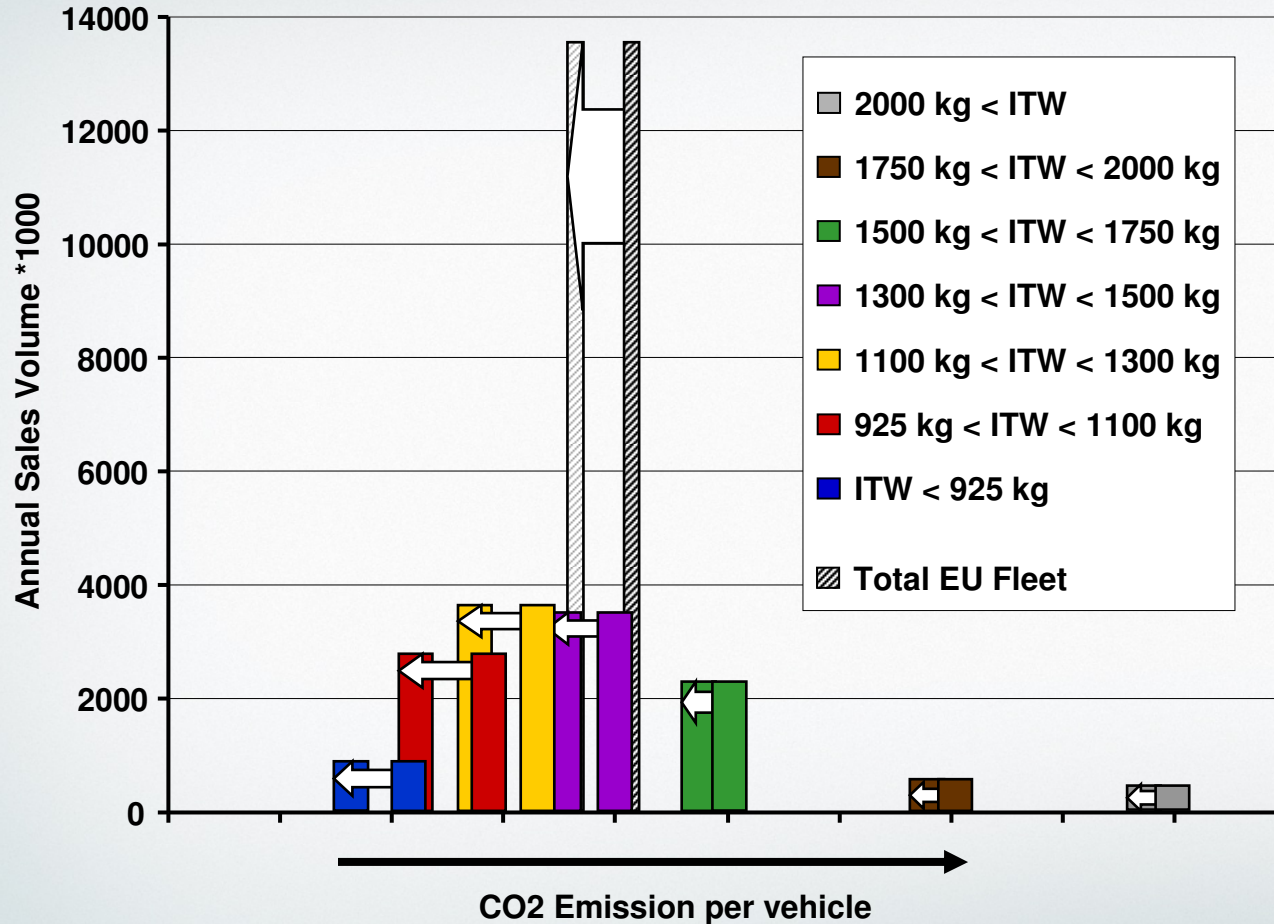
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CO₂ Fleet Impact Study Assumptions (EU Market)

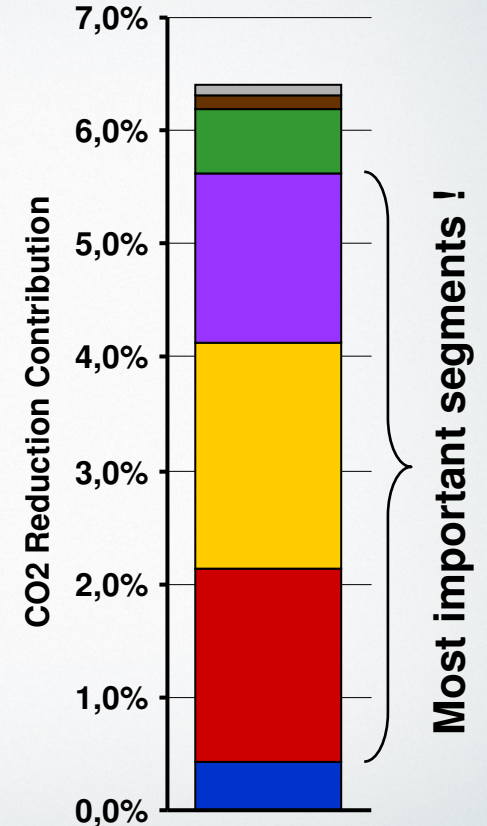


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Impact of Gasoline Downsizing on Fleet CO₂



EU Market 2007



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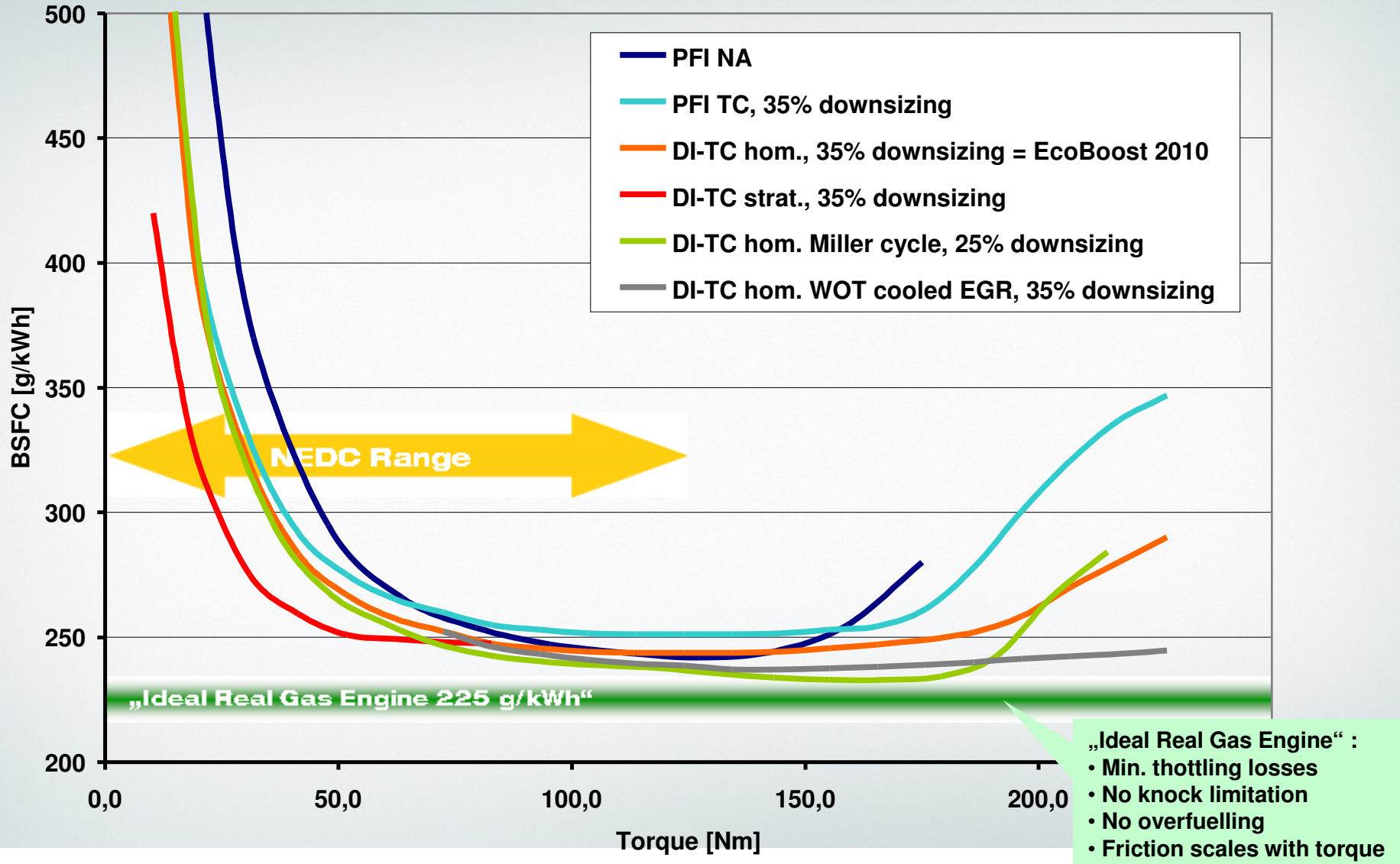
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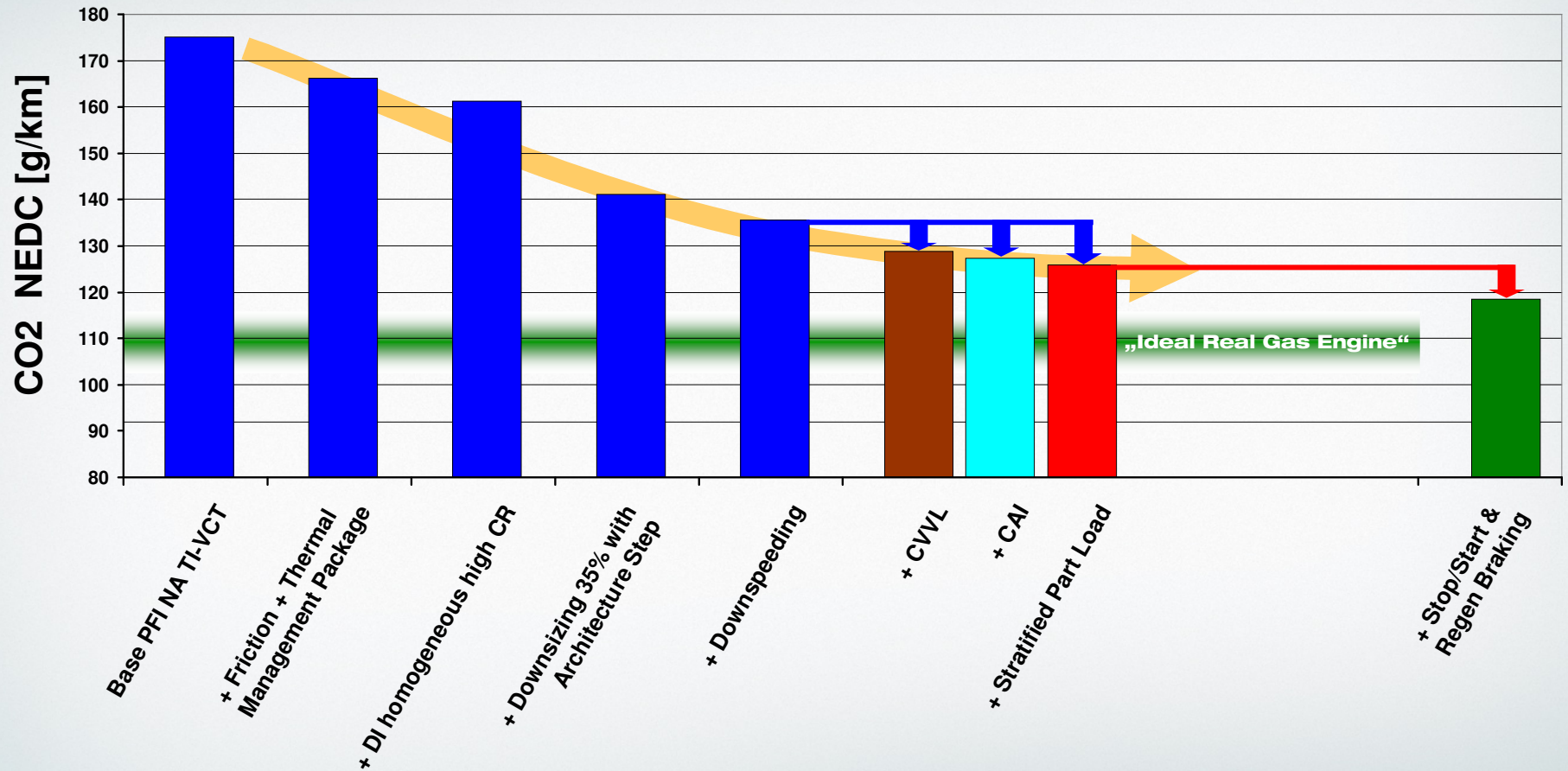
Thermodynamics : Approaching the Ideal Real Engine



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CO₂ Strategy NEDC

Equivalent Test Weight = 1450 kg



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Summary

- **CO₂ reduction is a challenge for human society and vehicle based CO₂ emissions need to be addressed together with all other sources**
- **Ford's EcoBoost technology package based on gasoline engine downsizing is an effective way to reduce vehicle based CO₂ emissions**
- **EcoBoost will be combined with advanced combustion systems and vehicle systems to maximize CO₂ reduction**
- **Ecoboost is embedded in a large scope sustainable technology deployment plan including electrification and all reasonable upgrades of the internal combustion engine for all future fuels**



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Thank you for your attention



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