

# LSPI and Fuel Economy – What is the Future Outlook?

SOUTHWEST RESEARCH INSTITUTE®

Thomas E. Briggs, Jr.  
Spark Ignited Engines R&D Department



---

ENGINE, EMISSIONS & VEHICLE RESEARCH

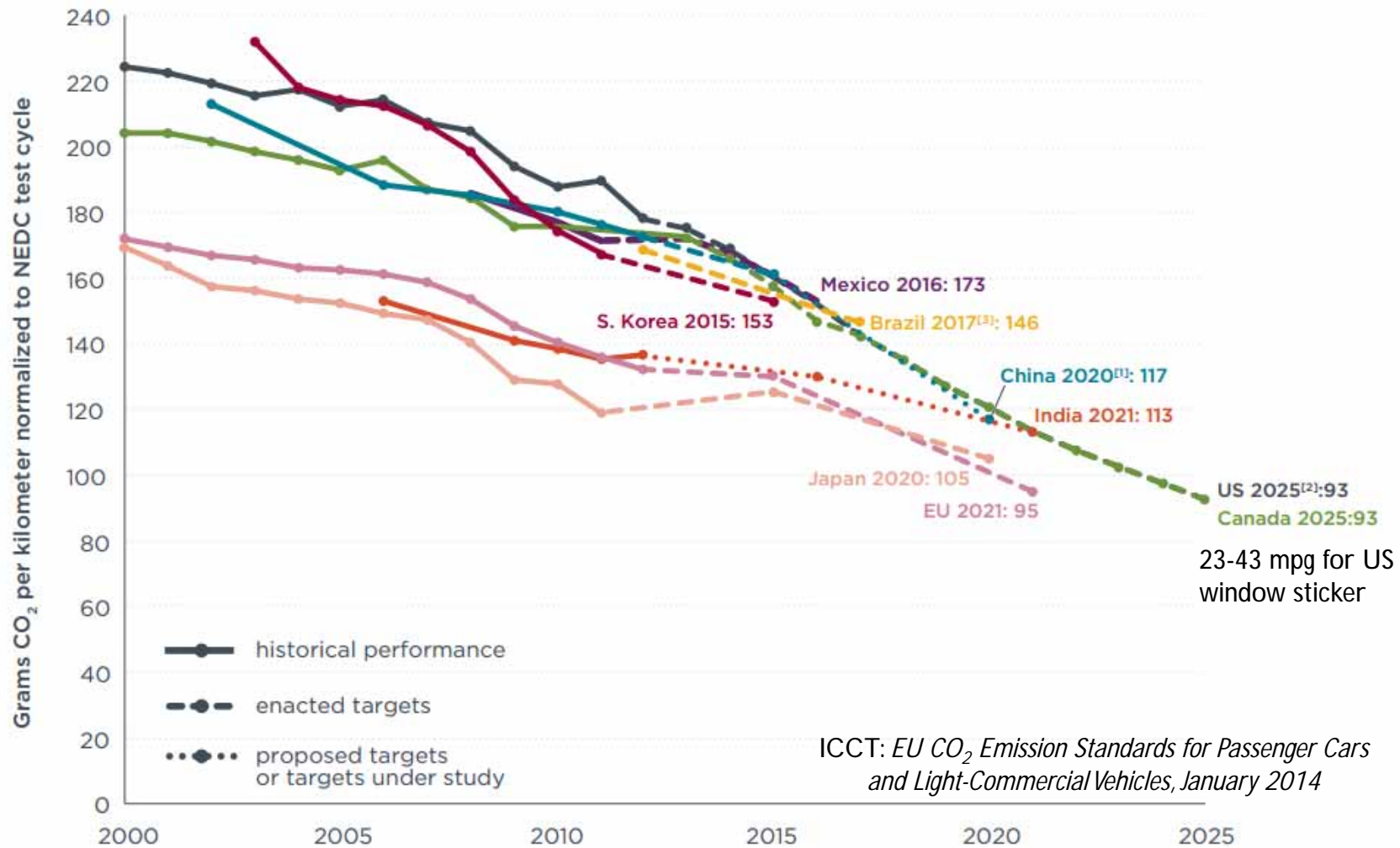
©SOUTHWEST RESEARCH INSTITUTE

swri.org

Will LSPI limit the automotive industry's ability to meet future CO<sub>2</sub> and fuel economy targets?



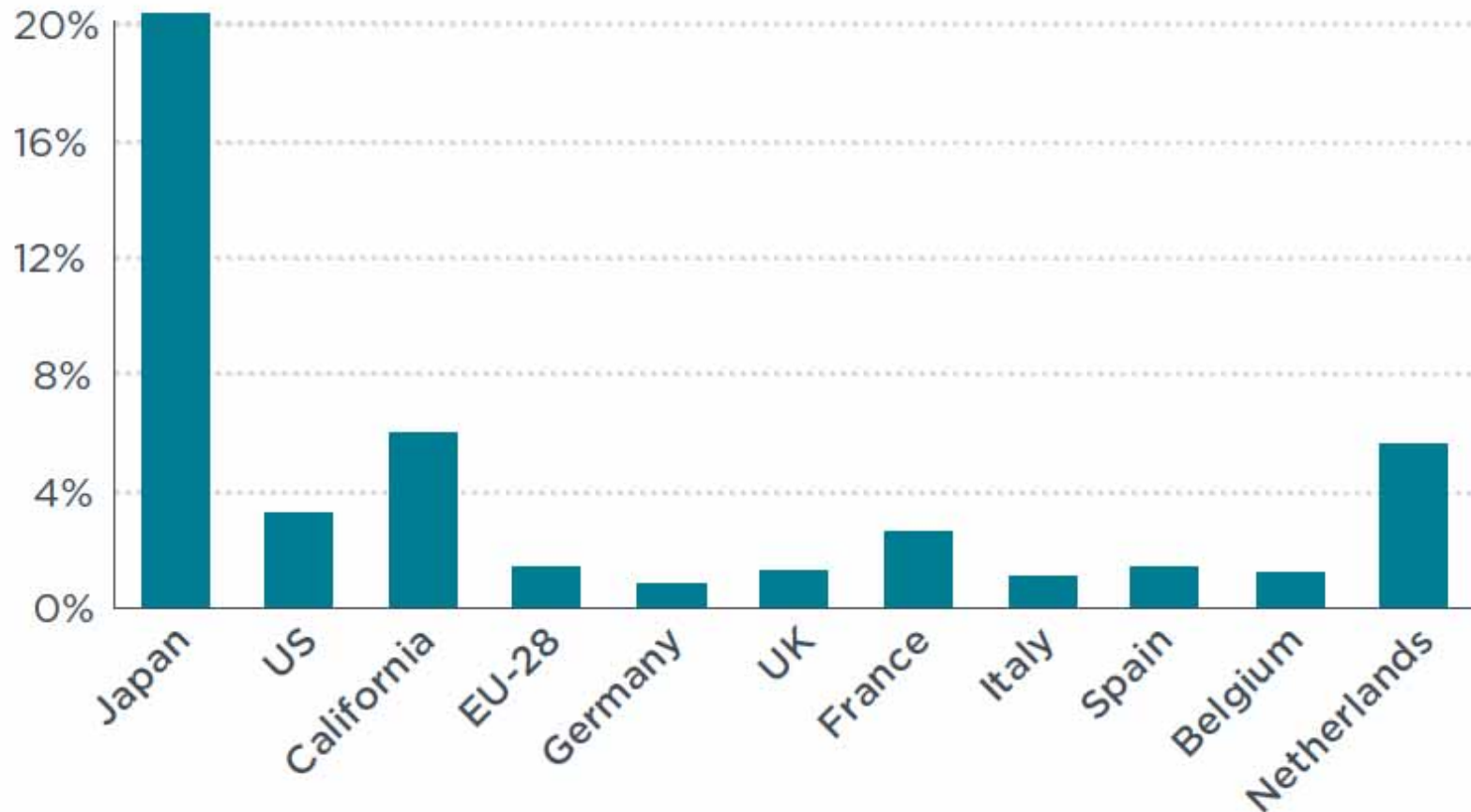
# Our CO<sub>2</sub>/Fuel Economy Target is Aggressive



# The Fuel Economy Challenge Will Not be Solved by Hybrids

Market share of HEV's in major global markets

ICCT: Technical Brief July 2015



ENGINE, EMISSIONS & VEHICLE RESEARCH

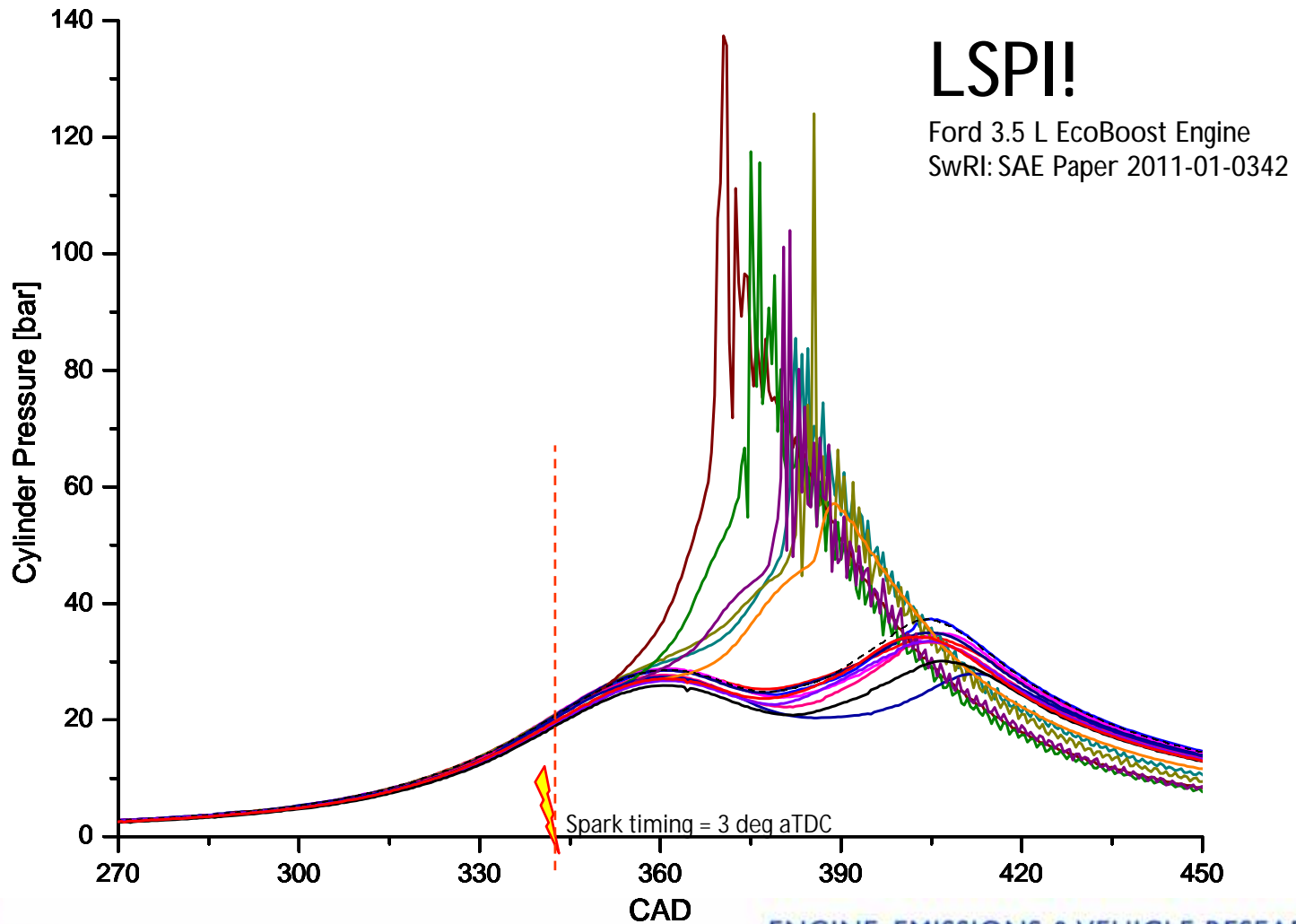
# The Industry Path to Efficiency: Downsizing, Turbocharging, GDI

	2011 328i	2012 328i
Cylinder count	6	4
Displacement	2996 cc	1997 cc
Power	170 kW	180 kW
Max BMEP	11 bar	22 bar
EPA Combined FE	22 mpg	27 mpg

Must be ~34 mpg  
in 2025



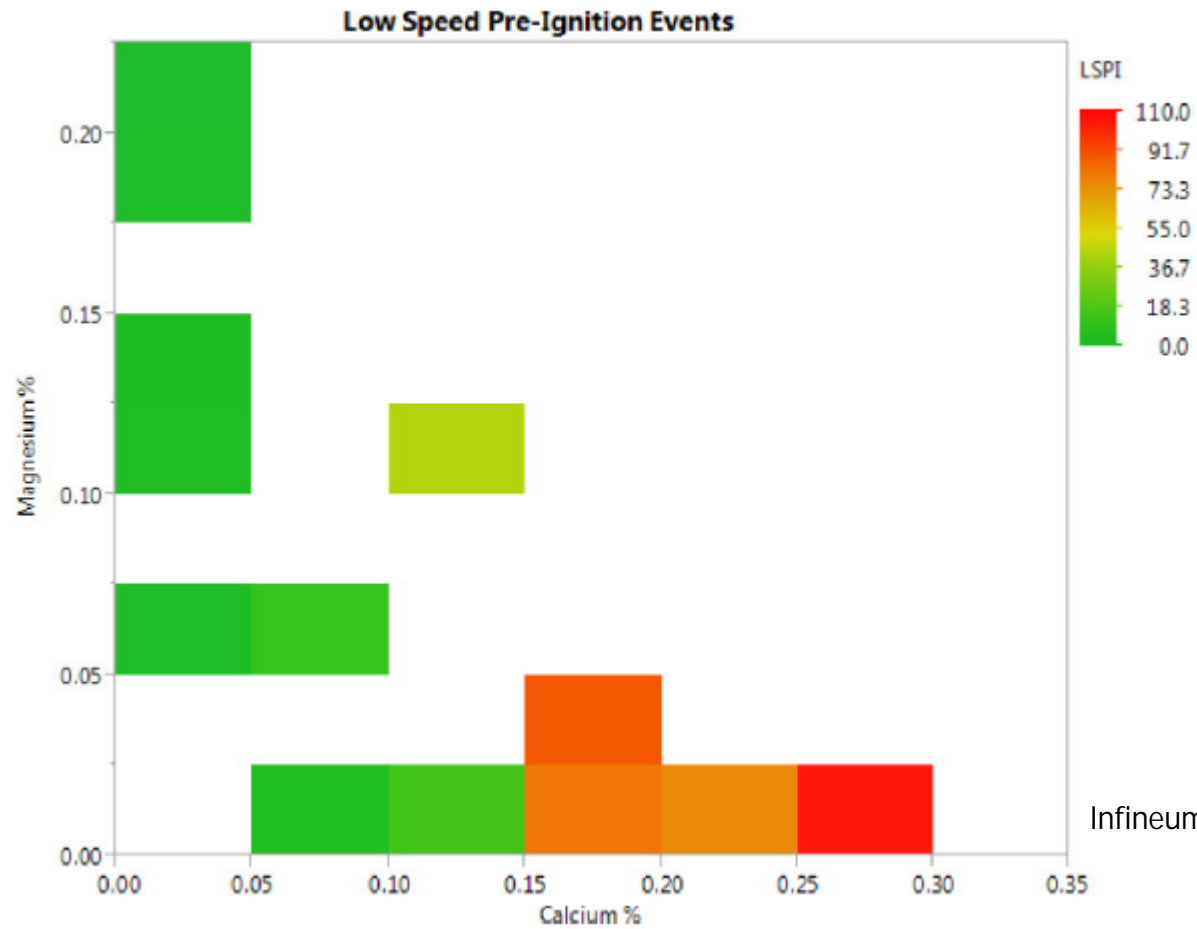
# We Achieved a Massive Efficiency Gain, But at What Cost?



# Engine Failure from LSPI is Unpredictable and Expensive



# Can We “Solve” LSPI?



Better living through lubricant chemistry\*

\* Assuming the engine power density doesn't increase



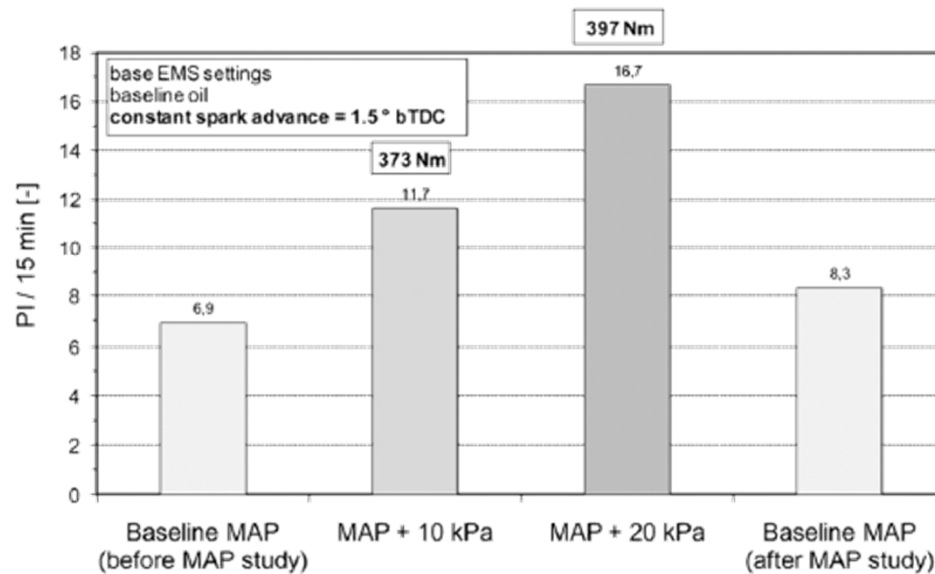


# Without a Solution, LSPI Limits Downsizing

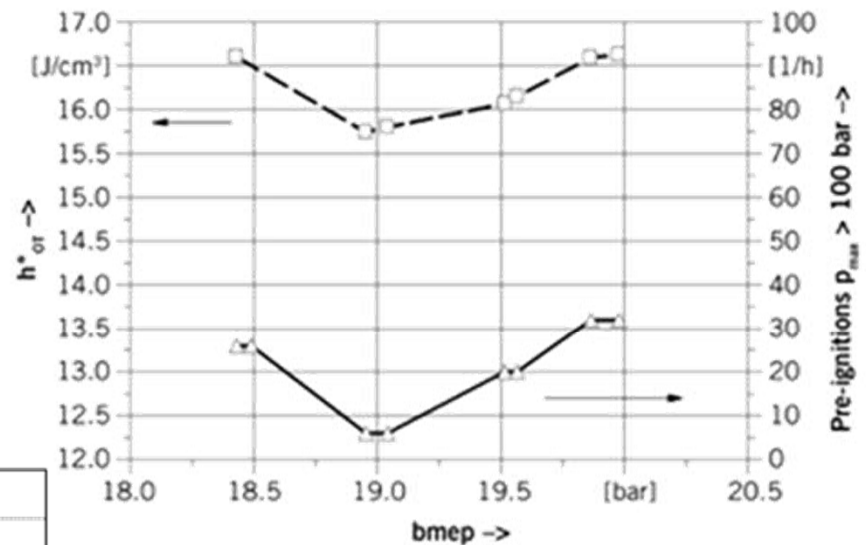
More downsizing → higher BMEP

Higher BMEP → more LSPI

More LSPI → A bad day



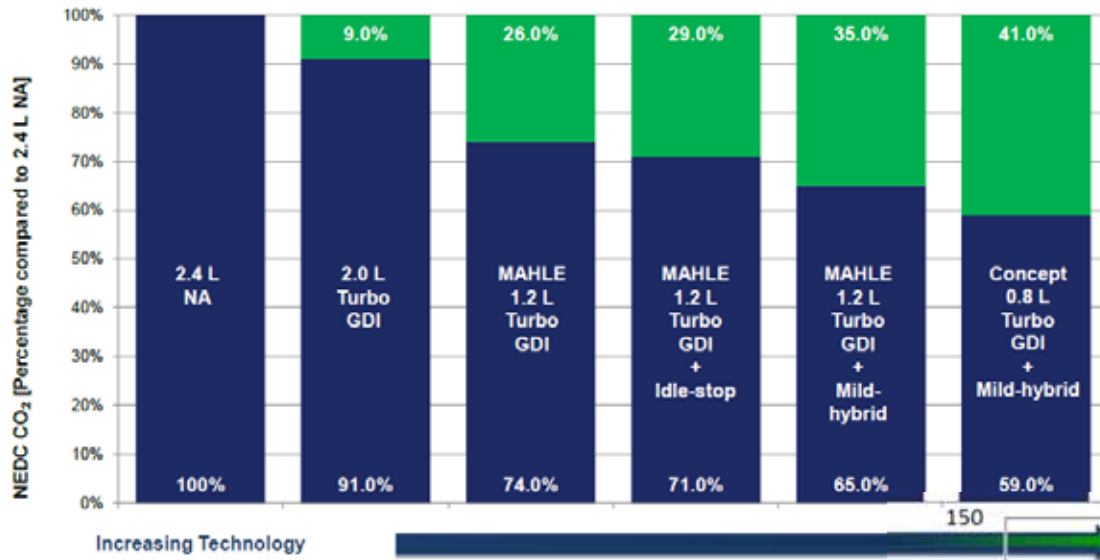
GM: SAE Paper 2011-01-0340



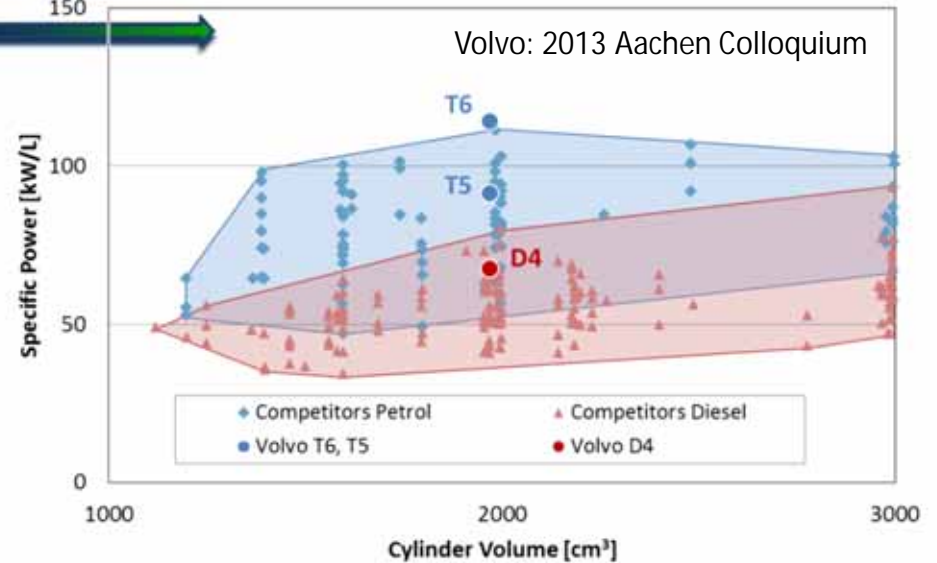
Limits on Downsizing in Spark-Ignition Engines Due to Pre-Ignition  
MTZ May 2009

# The Past Future of Fuel Economy

NEDC



Mahle: DEER 2011 Presentation

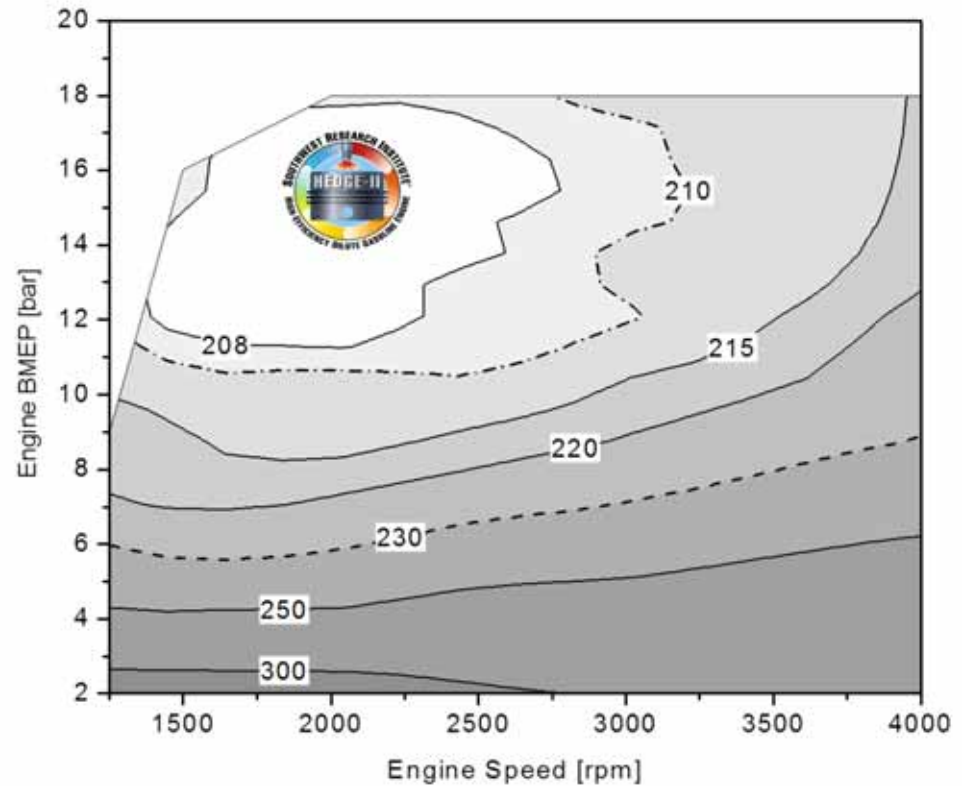
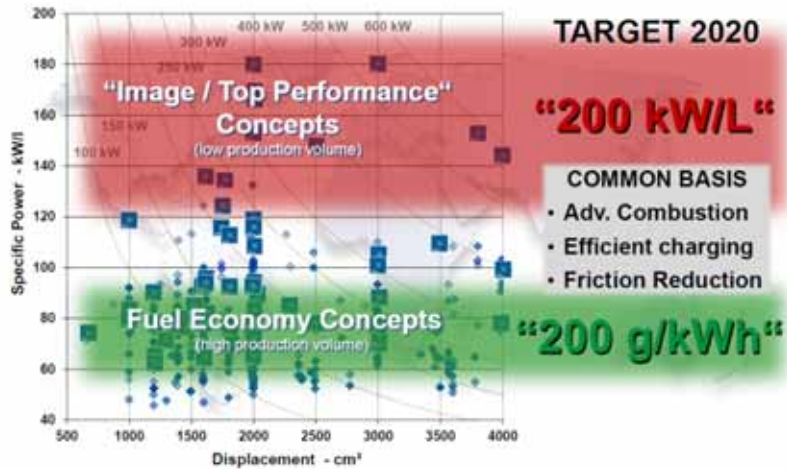


# The New Future of Fuel Economy



**GASOLINE ENGINE 2020**  
200 g/kWh or 200 kW/l ?

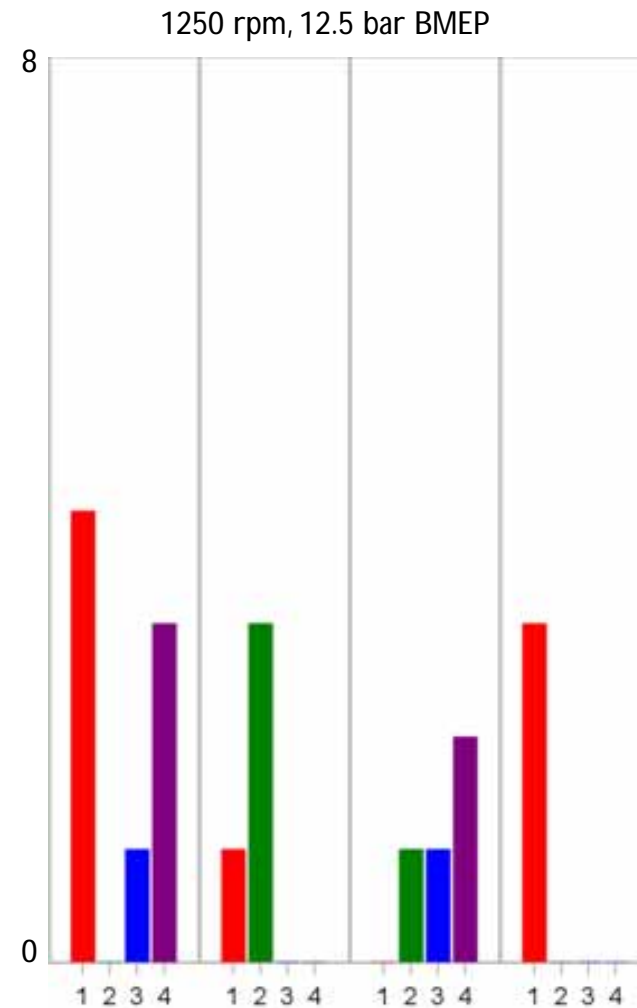
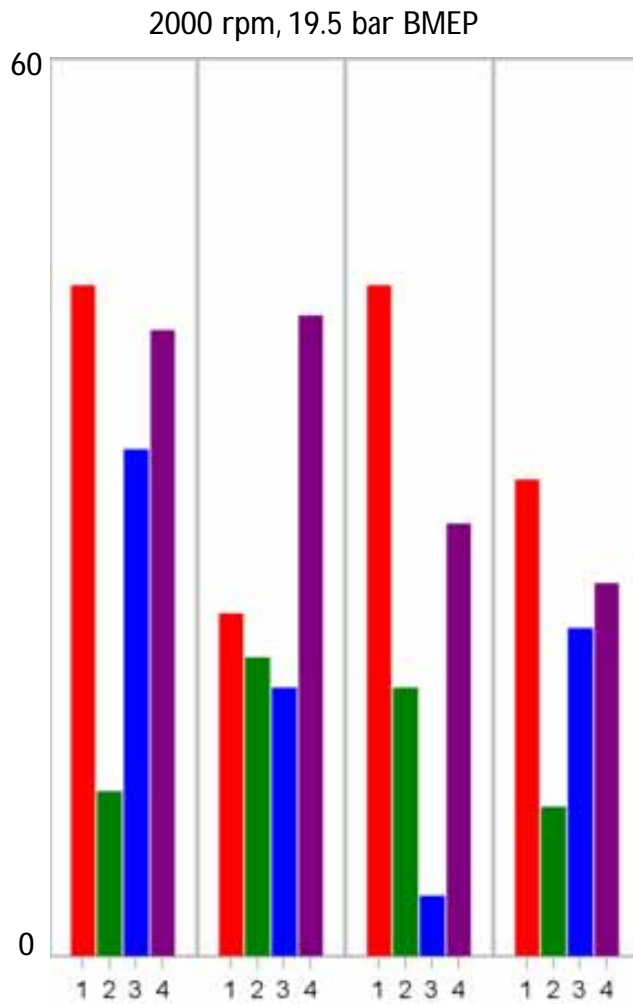
Guenter Fraidl  
AVL List GmbH



AVL: 2015 SAE High Efficiency Engine Symposium



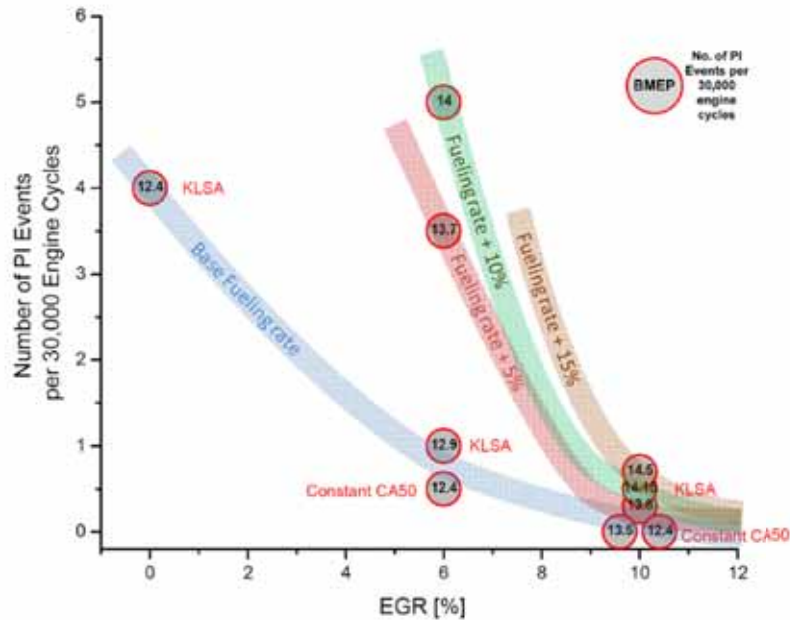
# Lowering BMEP Makes LSPI a Solvable Problem



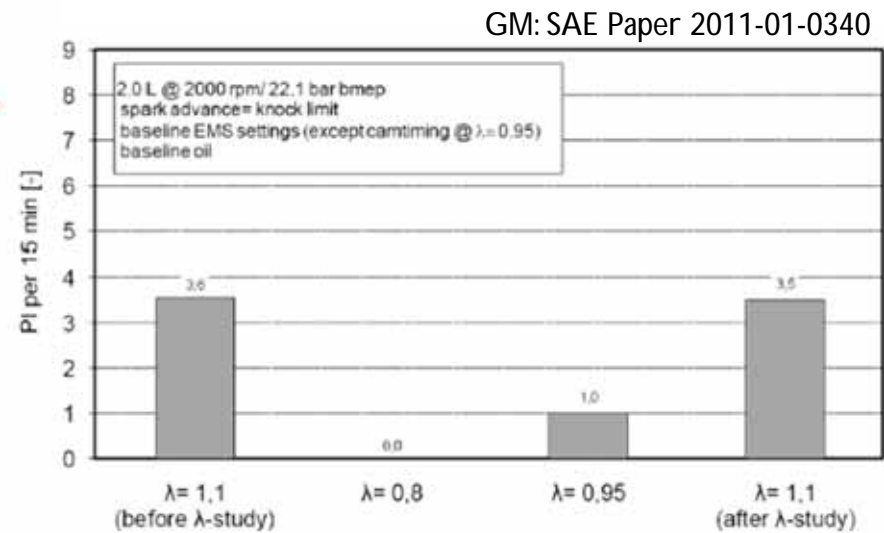
P3-Protocol LSPI Test Results – High LSPI Simulated Market Fuel



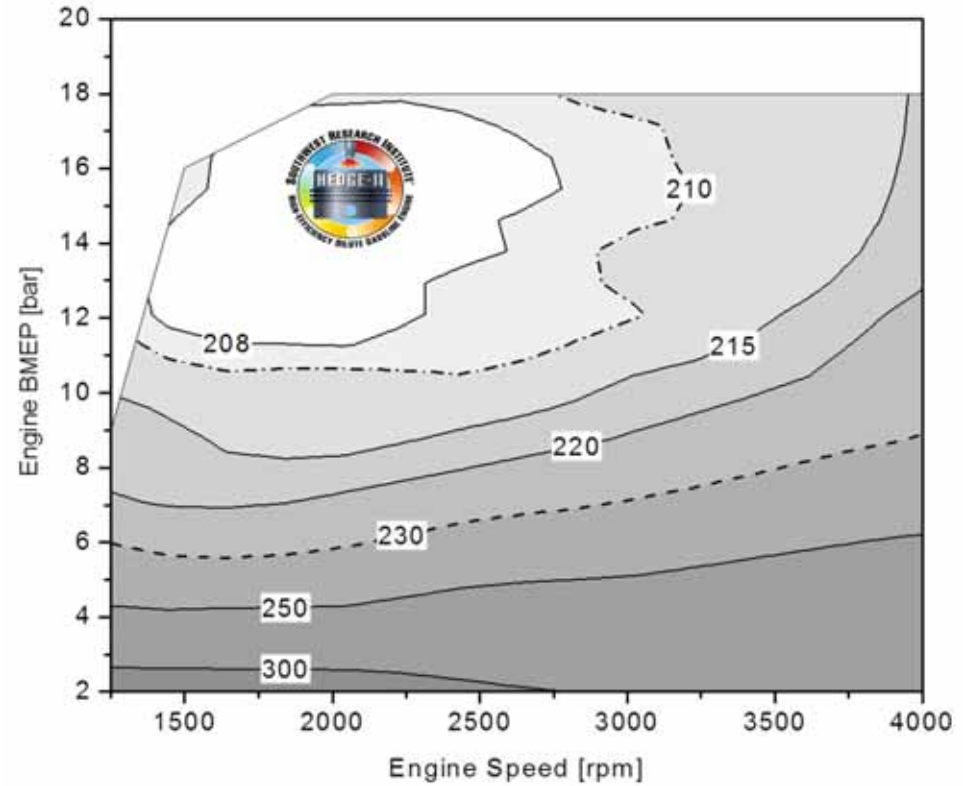
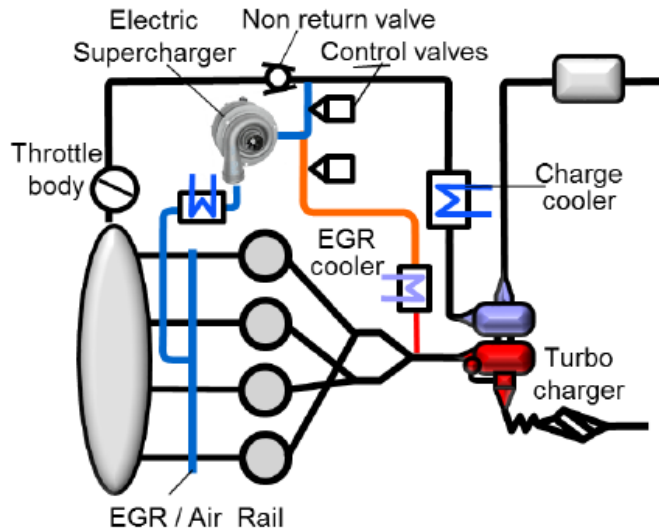
# Other Efficiency Technologies Support LSPI Reduction



SwRI: SAE Paper 2011-01-0342



# An LSPI-Free Engine of the Future



## GF-6

We can achieve compliance with future CO<sub>2</sub> regulations while minimizing the risk of LSPI and while maintaining vehicle performance for customer satisfaction.



# Thank you

Dr. Thomas (Tom) Briggs  
Program Manager  
Spark Ignited Engines R&D Department  
tbriggs@swri.org

