

## **Enhanced mixing and combustion through ducted fuel injection**

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### **Abstract**

This presentation introduces ducted fuel injection (DFI), a simple and effective mechanical approach for improving fuel/charge-gas mixture preparation within diesel-engine combustion chambers, with the ultimate goal of reducing emissions while increasing efficiency. In DFI, each fuel spray is injected along the axis of a small cylindrical duct, promoting more complete local premixing at or near the duct exit, where autoignition occurs. The presentation summarizes the development of DFI technology at Sandia, beginning with proof-of-concept experiments in a constant-volume combustion vessel, continuing through testing in a single-cylinder optical engine, to a recent study employing a retrofitted heavy-duty multicylinder engine. The underlying physical mechanisms that enable DFI to work are discussed, as well as potential performance-limiting factors. The presentation concludes with a summary of promising initial progress toward achieving low-emissions, high-efficiency, “lean mixing-controlled combustion” with DFI. Such advancements diversify humanity’s portfolio of technology options available for efficient, clean power, and they can enable pragmatic solutions where electrification or switching to carbon-free fuels is too costly.

### **Speaker bio**

Charles J. “Chuck” Mueller is a Distinguished Member of the Technical Staff in the Applied Combustion Research Department at Sandia National Laboratories’ Combustion Research Facility in Livermore, California. He has been working at Sandia since receiving his Ph.D. degree in Aerospace Engineering from the University of Michigan in 1996. His research group uses experimental and computational techniques to better understand the processes occurring within modern diesel engines, to facilitate the identification and deployment of cleaner, more-efficient combustion processes that are synergistic with sustainable fuels.