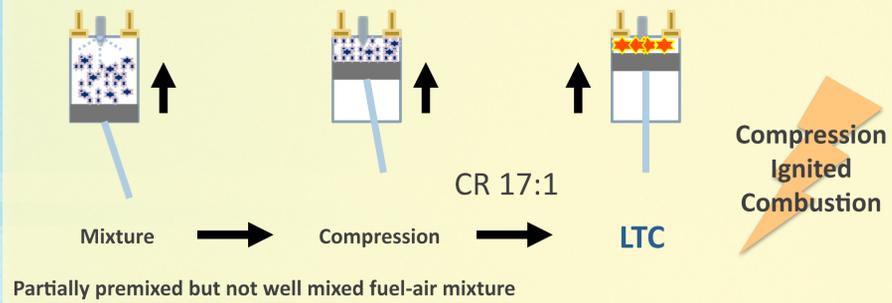


Argonne's Innovative Approach to Engine Efficiency and Emissions

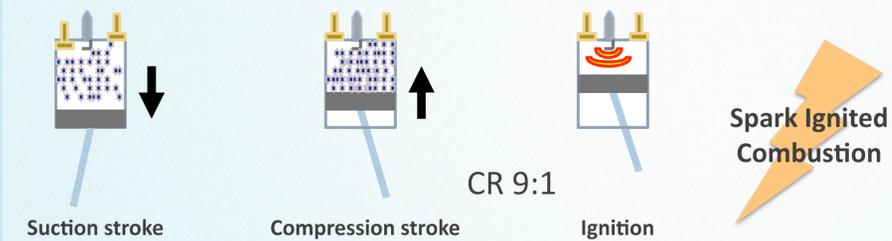
Improving Low Temperature Combustion through Fundamental Science and Applied Engineering

Different Combustion Processes

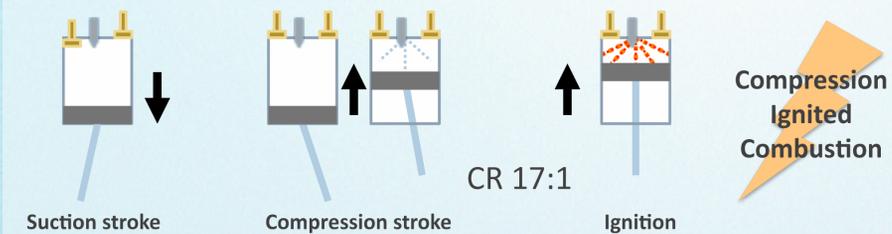
Low Temperature Combustion (LTC)



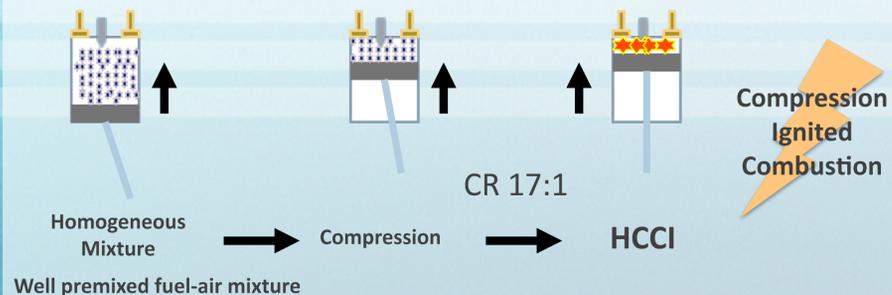
Spark Ignition (homogenous mixture; no soot; HC, CO and (NO) emissions; throttling issues)



Compression Ignition (diffusion combustion, fuel efficient, high smoke and NO_x emissions)

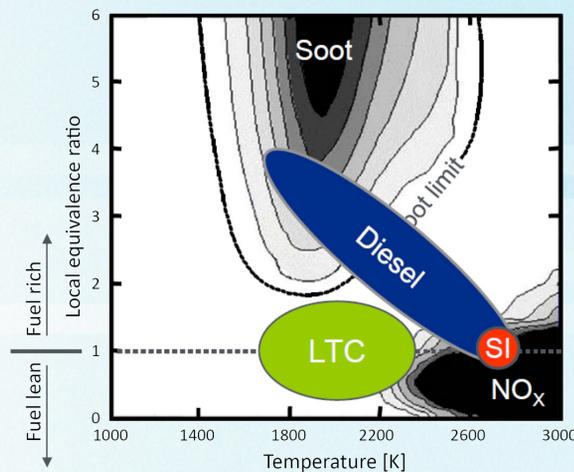


Homogeneous Charge Compression Ignition (HCCI)



LTC: A Promising Approach

Why is LTC an Attractive Solution to Efficiency and Emissions Challenges?



Ref. SAE 2003-01-1789, Takaaki Kitamura et.al.

This chart illustrates how LTC avoids both soot and NO_x by controlling fuel/air mixing (equivalence ratio) and by slowing down the rates of reaction (peak combustion temperature).

Key Factors for LTC



Pressure and temperature (air preheating, turbo charging, EGR and compression ratio)



Octane rating, cetane rating (fuels and additives)

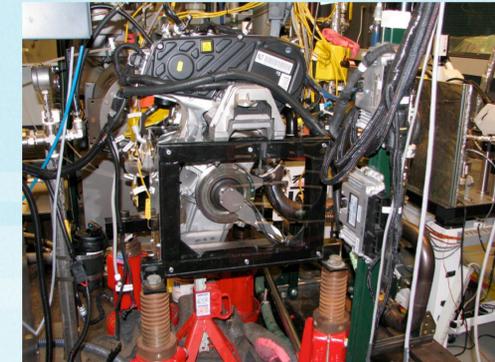


Injection timing, pressure and number of injections

Argonne researchers are working across scientific disciplines and leveraging the lab's state-of-the-art facilities as they pursue optimal LTC operating conditions.

Project Details

Engine Specifications and Fuel Properties



Argonne's experimental setup includes a GM 1.9 L, 110 kW @ 4500 rpm (designed to run on #2 diesel), and a Bosch II generation common rail injection system.

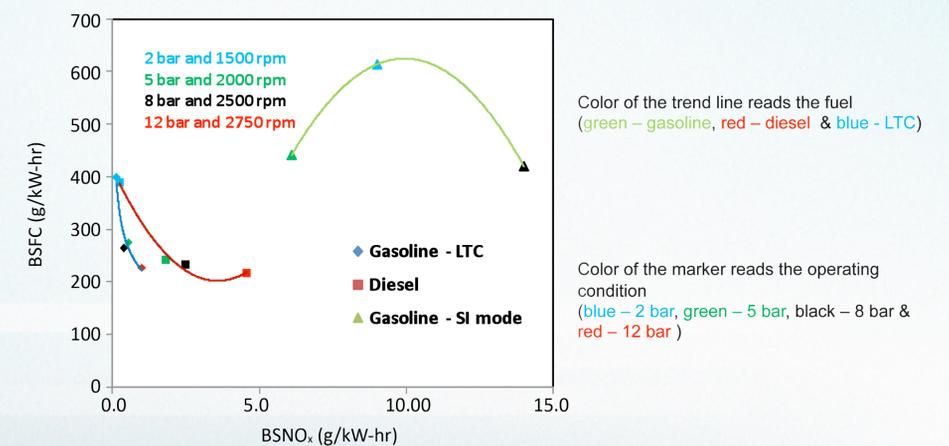
Engine Specifications

| | |
|----------------------------|---------------------------|
| Compression ratio | 17.8:1 |
| Bore (mm) | 82 |
| Stroke (mm) | 90.4 |
| Connecting rod length (mm) | 145.4 |
| Number of valves | 4 |
| Injector | 7 holes, 0.15-mm diameter |

Properties of the Two Tested Fuels

| Property | #2 diesel | Low-octane gasoline |
|----------------------------|-----------|---------------------|
| Specific gravity | 0.8452 | 0.7512 |
| Low heating value (MJ/kg) | 42.9 | 42.5 |
| Initial boiling point (°C) | 180 | 86.8 |
| T10 (°C) | 204 | 137.8 |
| T50 (°C) | 255 | 197.8 |
| T90 (°C) | 316 | 225.1 |
| Cetane Index | 46.2 | 25.0 |

Effect on BSFC and BSNO_x Emissions



This graph shows the effect of different combustion processes on BSFC and BSNO_x.