Co-Optimization of Fuels and Engines

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Goal: better fuels and better vehicles sooner

Fuel and Engine Co-Optimization

- What fuel properties maximize engine performance?
- How do engine parameters affect efficiency?
- What fuel and engine combinations are sustainable, affordable, and scalable?
30% per vehicle petroleum reduction via efficiency and displacement

source: EIA 2014 reference case
National goal: 80% reduction in transportation GHG by 2050

Co-Optimization: 9-14% GHG reduction (beyond “business as usual”)
Why is this effort needed?
Engines will dominate fleet for decades.
higher efficiency, low emission engines are possible
Current fuels constrain engine design

Brake Thermal Efficiency (%)

- RON 100.9
- RON 90.7

Brake Mean Effective Pressure (kPa)

- Higher peak efficiency
- Higher peak load

Engine: Ford Ecoboost 1.6L 4-cylinder, turbocharged, direct-injection, 10.1 CR
Source: C.S. Sluder, ORNL
Fuel is more than just octane
Parallel thrust efforts are underway

Thrust 1: Spark Ignition (SI)

Thrust 2: Advanced Compression Ignition (ACI)
kinetically-controlled and compression-ignition combustion

Low reactivity fuel

Range of fuel properties TBD

High reactivity fuel
Fundamentally different combustion dynamics require different fuel properties.

- Spark ignition (gasoline)
- Kinetically controlled combustion
- Compression ignition (diesel)
New fuels open up engine design options
Applicable to light, medium, and heavy-duty engines
Co-Optima: Leveraging expertise and facilities from 10 national labs
Broad Diversity of Skills Critical for Success
Mobilize world-class research facilities
Integrated multi-lab teams with significant external stakeholder engagement

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>Light and heavy duty vehicle manufacturers</td>
<td>13</td>
</tr>
<tr>
<td>Oil companies/refiners</td>
<td>10</td>
</tr>
<tr>
<td>Biofuel companies</td>
<td>8</td>
</tr>
<tr>
<td>Regulatory agencies</td>
<td>4</td>
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<tr>
<td>End consumer organizations</td>
<td>2</td>
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</tbody>
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Identify and mitigate barriers to wide-scale deployment
Reality check time
Why another new fuel?
Why not just use ethanol blends?
Will the new fuels be compatible with current station hardware?
What about mis-fueling?
Summary

- Ambitious new Department of Energy initiative
- Accelerating introduction of affordable, scalable, and sustainable fuels and high-efficiency, low-emission engines
- Engagement with industry stakeholders critical to success

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Thank You!