Sustainable TRANSPORTATION

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Finding the New Optima for Fuels & Engines

EESI Briefing

December 14th, 2015

The Ames Lab · Argonne National Laboratory · Berkeley Lab · Brookhaven National Laboratory · Fermilab · Idaho National Laboratory · Jefferson Lab · NETL · NREL · Oak Ridge National Laboratory · Pacific Northwest National Laboratory · Lawrence Livermore National Laboratory · Los Alamos National Laboratory · PPPL · Sandia National Laboratories · SLAC · SRNL

Sustainable
TRANSPORTATION

Renewable
ELECTRICITY GENERATION

Energy Saving
HOMES, BUILDINGS, & MANUFACTURING













U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Goal: better fuels and better vehicles

sooner

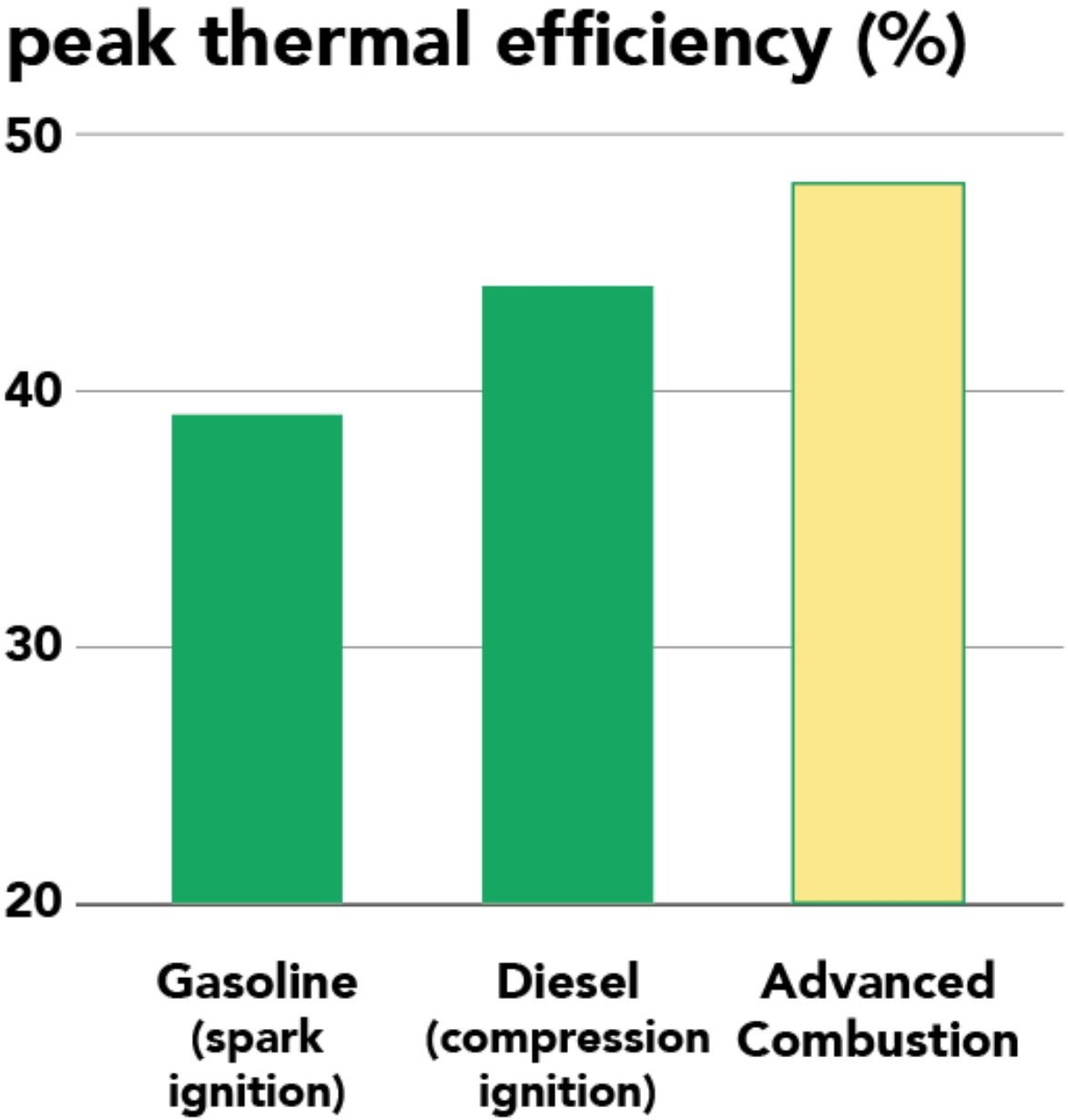
ICEs

will dominate fleet

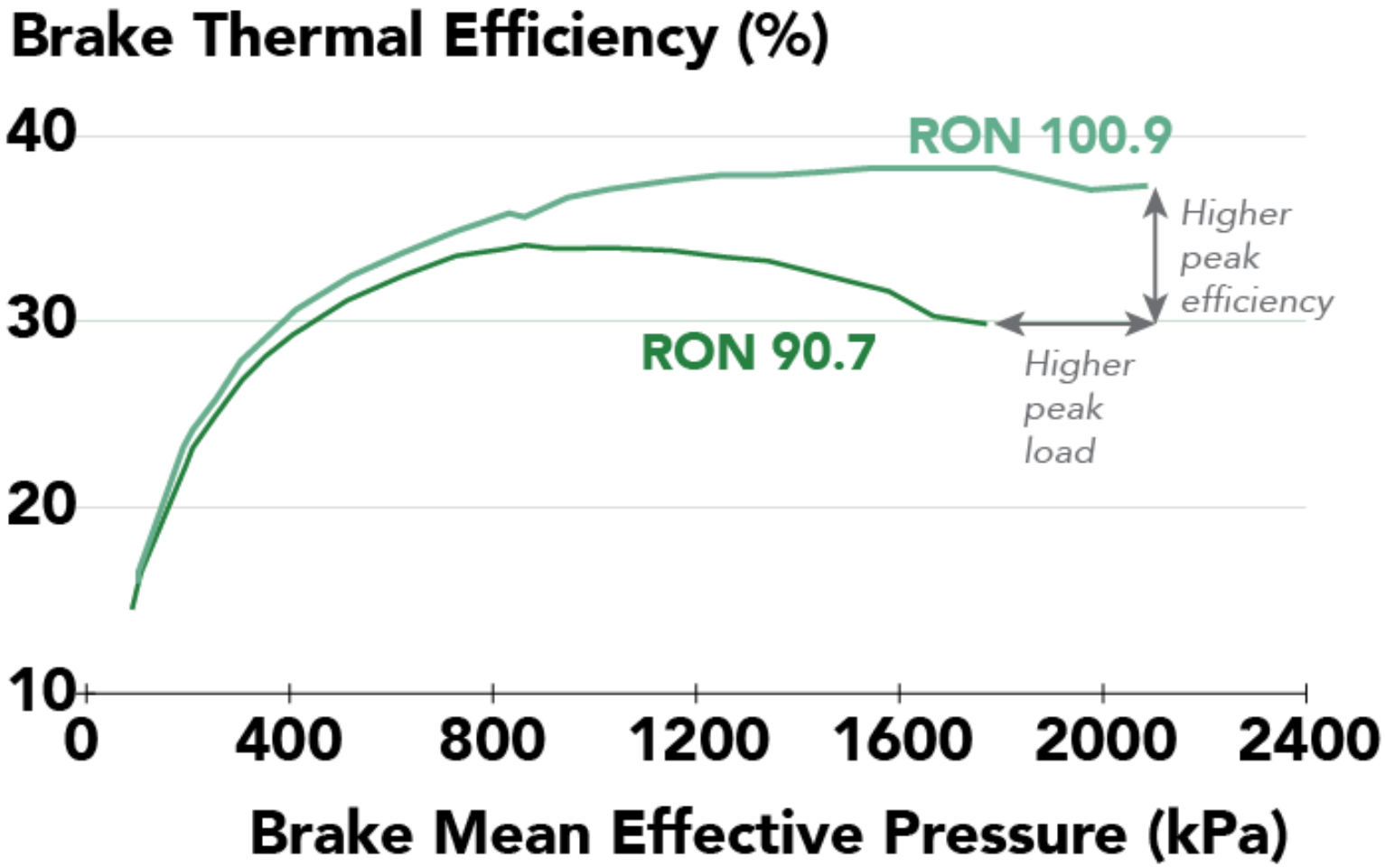
for decades

higher efficiency, low emission engines

are possible



current fuels constrain engine design



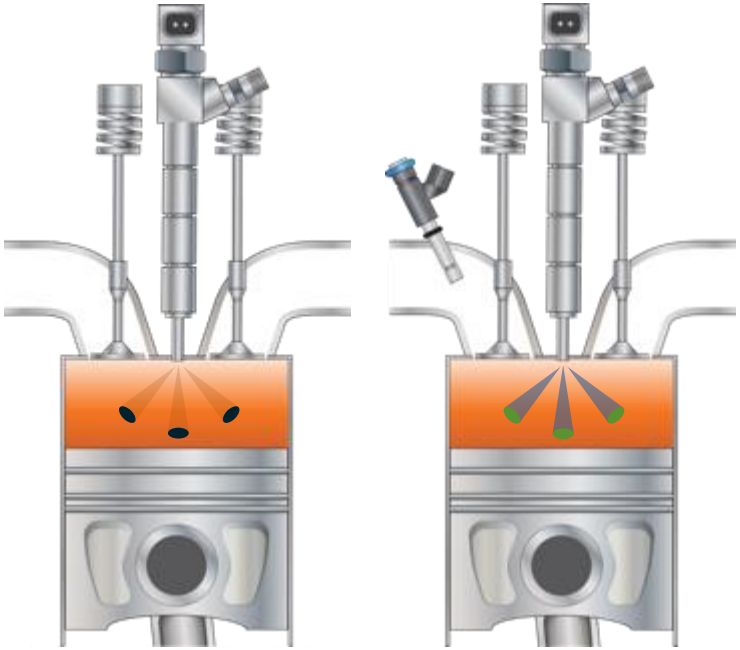
Engine: Ford Ecoboost 1.6L 4-cylinder, turbocharged, direct-injection, 10.1 CR
Source: C.S. Sluder, ORNL

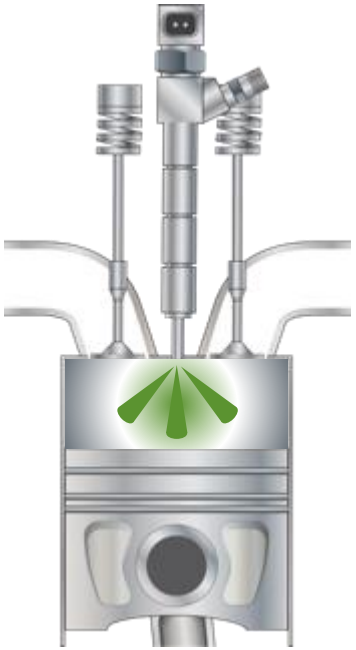
the potential of kinetically-controlled combustion

spark ignition gasoline

kinetically-controlled combustion

compression ignition diesel





Low Reactivity Fuel

Range of Fuel Properties TBD

High Reactivity Fuel

the

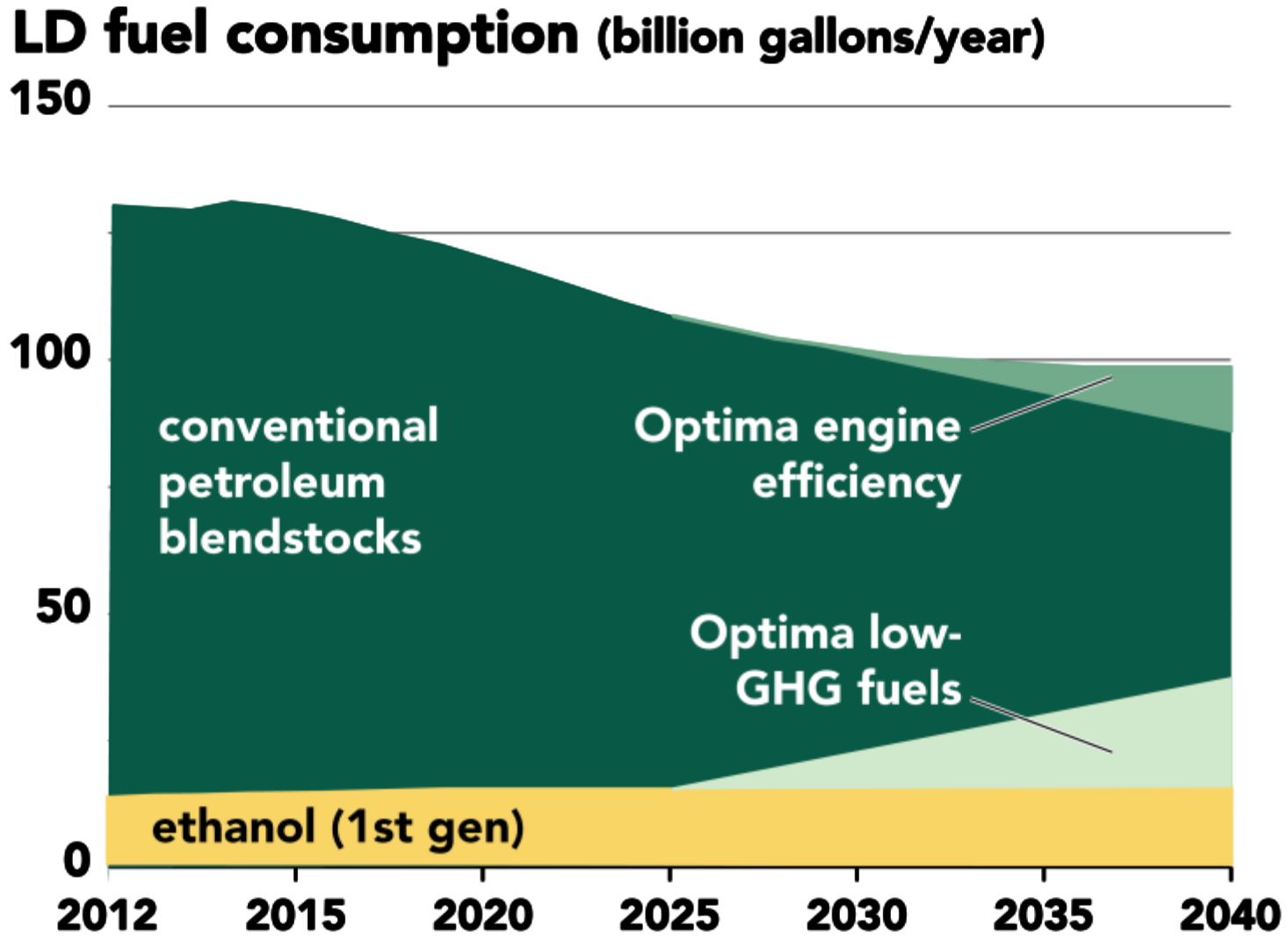
OPPORTUNITY

co-optimize

fuels and engines

accelerate, coordinate, and focus

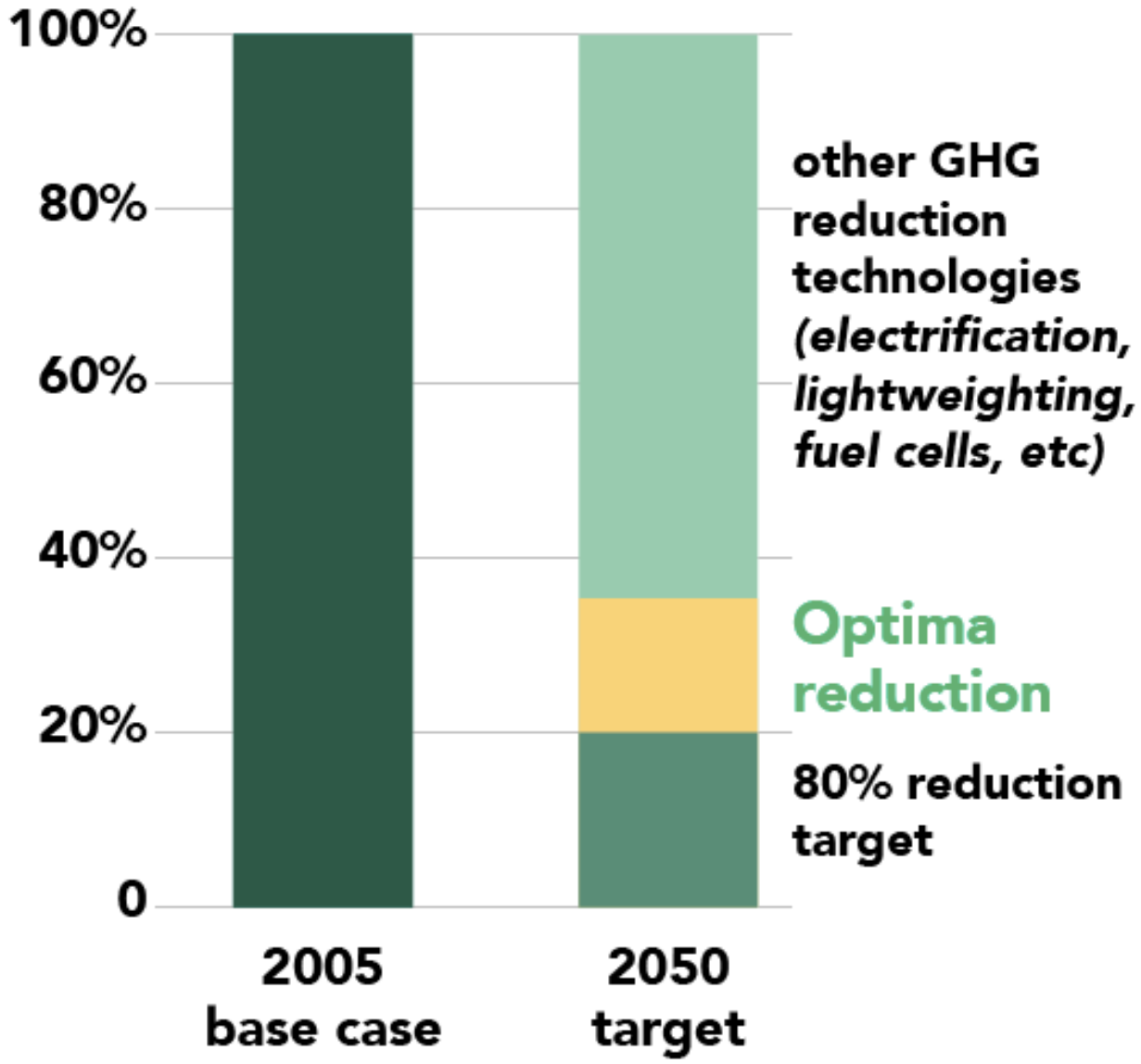
30% per vehicle petroleum reduction via efficiency and displacement



source: EIA 2014 reference case

9-14%
GHG reduction beyond BAU

15% - 20%
Fuel Economy improvement beyond current R&D by 2025-2030



17 year
fleet turnover
2050
impact requires
2030
vehicle introduction

2030
vehicle introduction
requires
2020s
solutions

2020s
solutions requires
R&D
today

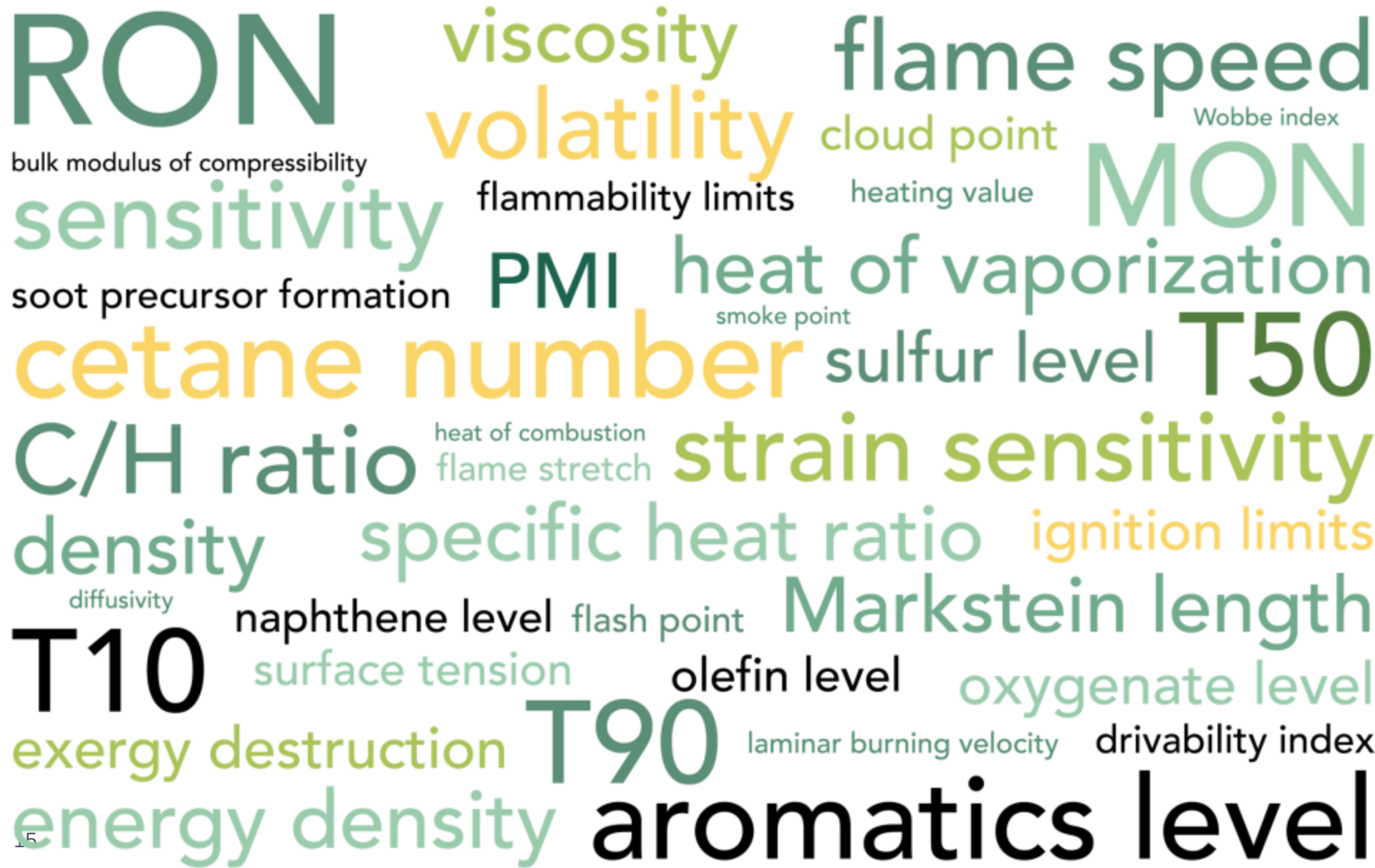
the

APPROACH & SCOPE

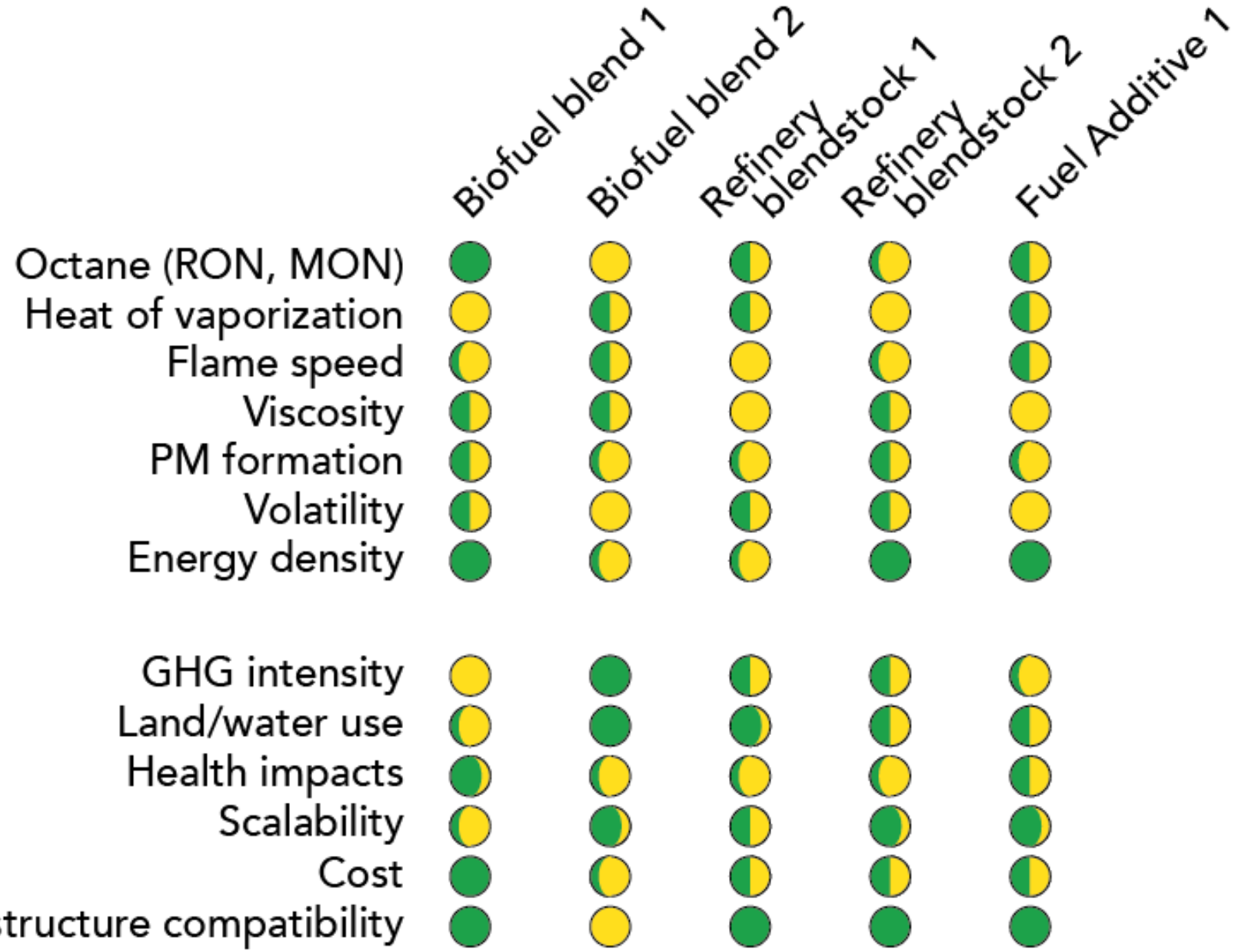
fuel evaluation

approach

what fuel properties are important?



property-based selection criteria



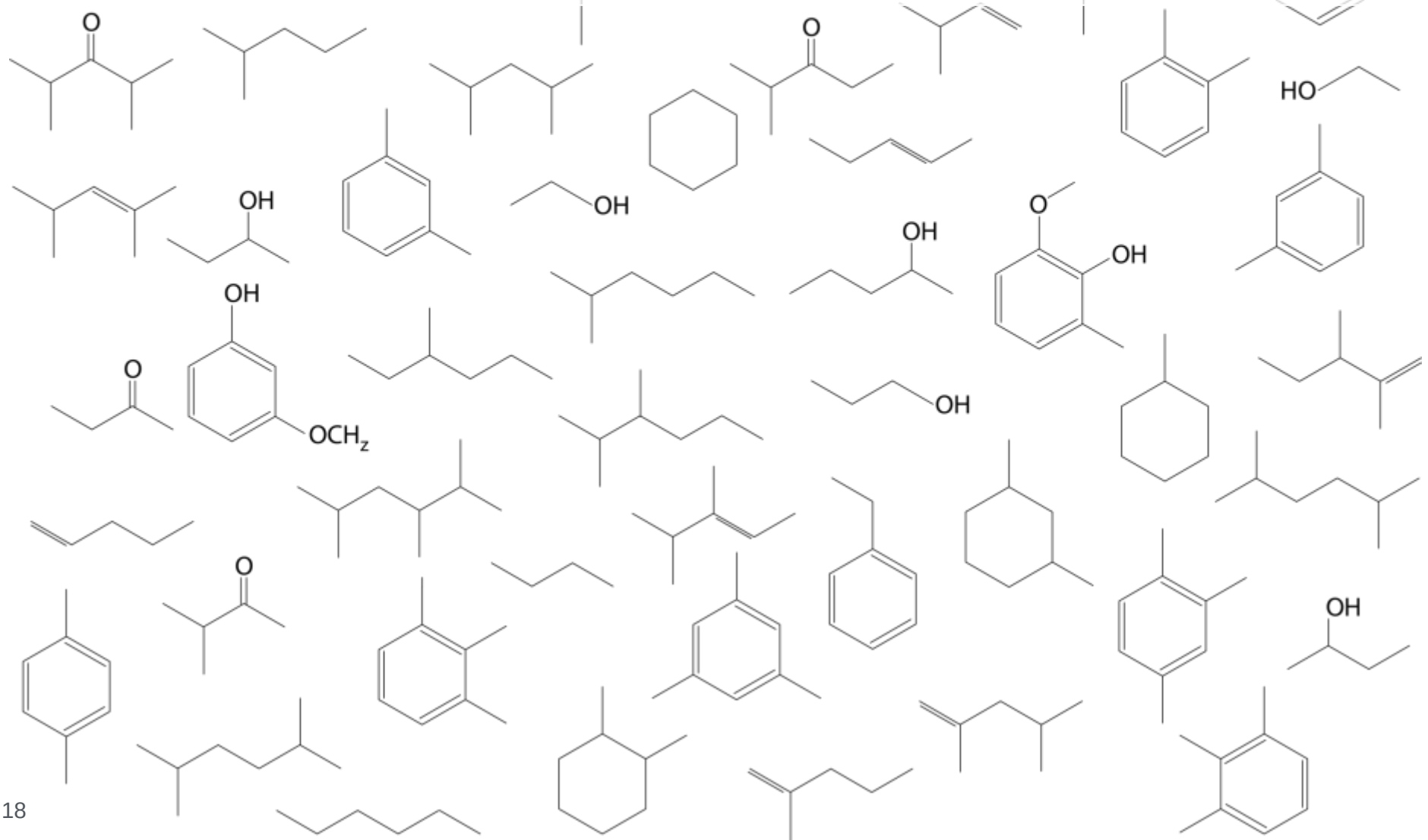
lower GHG fuels are essential

biofuels (biochemical and thermochemical)

low-carbon petroleum-derived fuels

what molecules

provide desired properties?



identify
market-driven
solutions

identify and mitigate
barriers to
wide-scale
deployment

Optima evaluation criteria

1. GHG reduction
2. Engine/powertrain/vehicle performance
3. Incremental fuel cost
4. Incremental vehicle cost
5. Land/water use
6. Infrastructure compatibility
7. Emissions/aftertreatment
8. Health effects
9. Legacy fleet compatibility
10. Consumer acceptance
11. Scalability
12. Global product harmonization

the

STAKEHOLDERS

what is Optima?

multi office

multi lab

multi year

new initiative

BIOENERGY TECHNOLOGIES OFFICE

VEHICLE TECHNOLOGIES OFFICE

cross-cutting potential

EERE
Science
Fossil
ARPA-E

USDA

role of others

industry:

close coordination essential to identify/mitigate barriers and hand-off effectively

R&D community:

leverage work at universities and contract labs as appropriate

others:

technical and implementation guidance from government agencies

Optima Plan

- **FY16 Budget Request - $27M**
- **Oct 1st – Kick-off (builds on FY15 efforts)**

Thrust 1

spark ignition (SI)

2025 commercial entry

Low Reactivity Fuel
(gasoline)
high RON

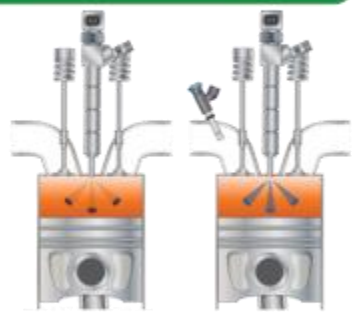
- Octane & beyond
- Downsized, boosted engines, higher CR
- FY16 Q1 -Select 20 fuels
- **FY17 Q2- Go/No Go vs. existing high octane alternatives**

Thrust 2

Advanced compression ignition (ACI)
including low temperature, kinetic regimes

2030 commercial entry

High Reactivity Fuel
(diesel)
high cetane



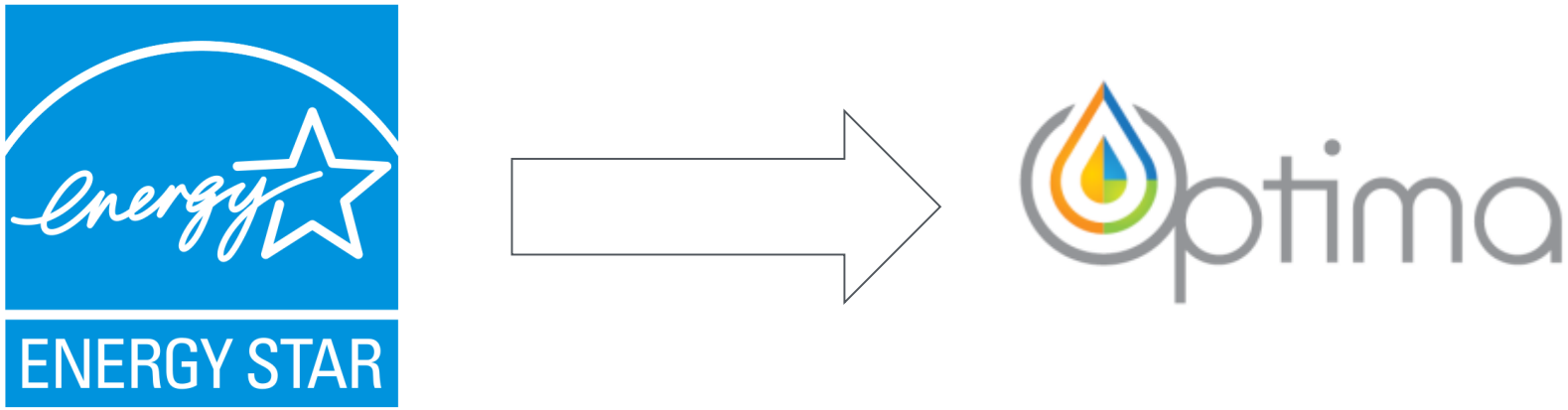
Range of Fuel Properties TBD
(new fuel)
undetermined fuel needs

- Kinetically controlled
- Low temperature combustion
- Maximize fuel efficiency with very low emissions
- Less known needs
- **Parallel to Thrust 1**

Backward / Forward Compatibility Legacy fleets, Thrust 1, Thrust 2

Optima a potential model

1. Performance based vs. formulation spec
2. Emissions (wells-to-wheel, criteria, other)
3. Compatibility (known design limits)



R&D to broaden suite of available technologies


better fuels
and
better vehicles
sooner