Co-Optima Informational Webinar

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Webinar Agenda

- Overview (10 min)
- Thrust I (25 min)
- Thrust II (25 min)
- Crosscutting Activities (20 min)
- Year Ahead (10 min)
- Q&A (30 min)

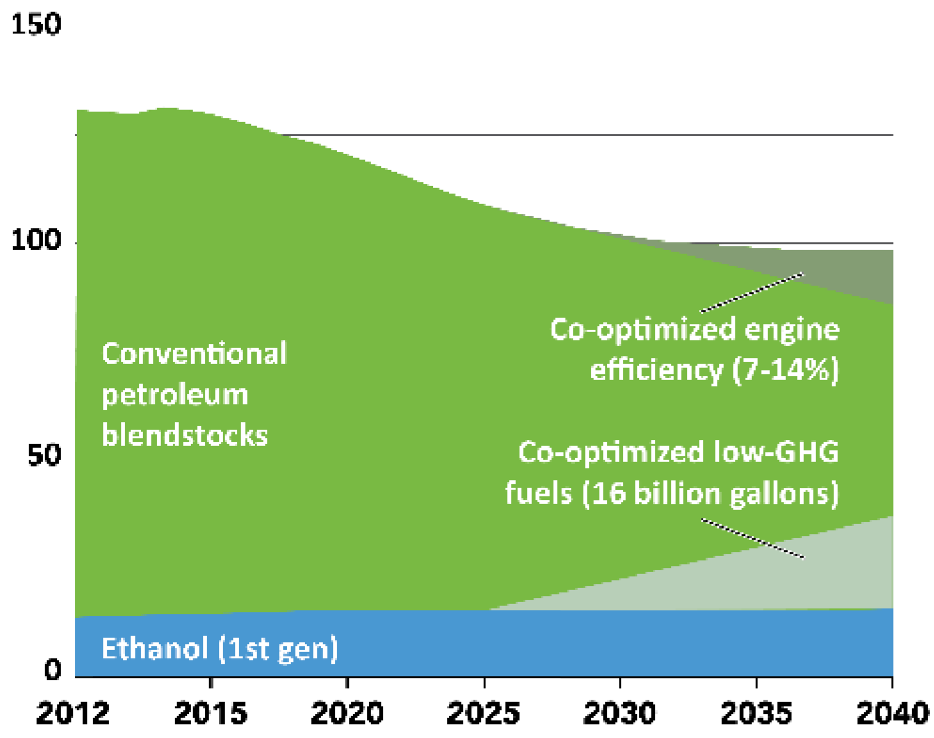
Goal: better fuels and better vehicles **sooner**

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**

Light duty fuel consumption (billion gallons/year)



source: EIA 2014 reference case

Governing Co-Optima hypotheses:

There are engine architectures and strategies that provide higher thermodynamic efficiencies than available from modern internal combustion engines; new fuels are required to maximize efficiency and operability across a wide speed/load range

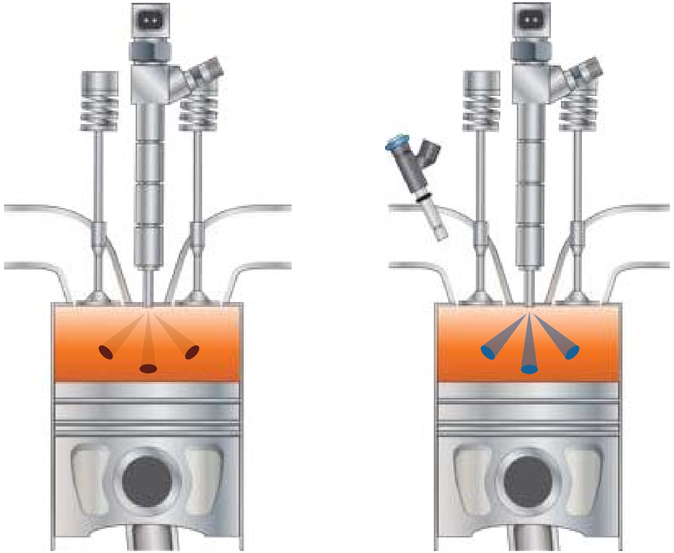
If we identify target values for the critical fuel properties that maximize efficiency and emissions performance for a given engine architecture, then fuels that have properties with those values (regardless of chemical composition) will provide comparable performance

Parallel efforts are underway

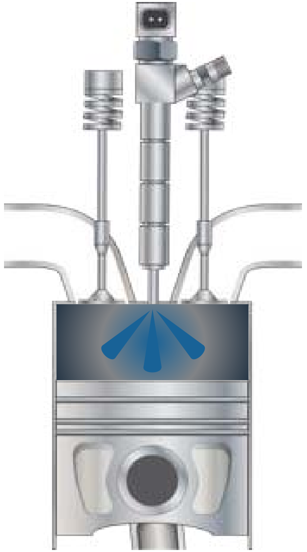
Thrust I: Spark Ignition (SI)

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

Low reactivity fuel

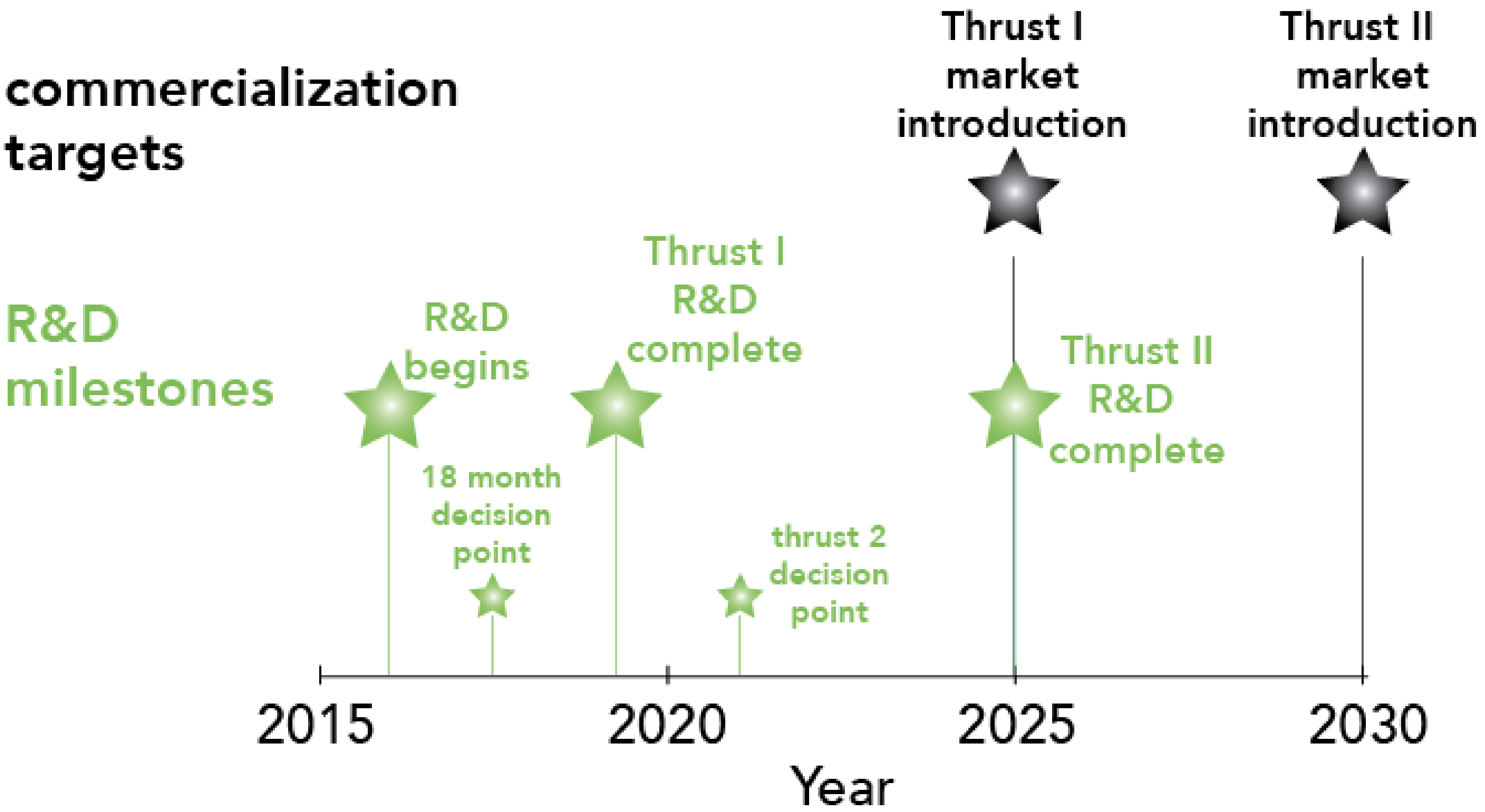


Range of fuel properties TBD

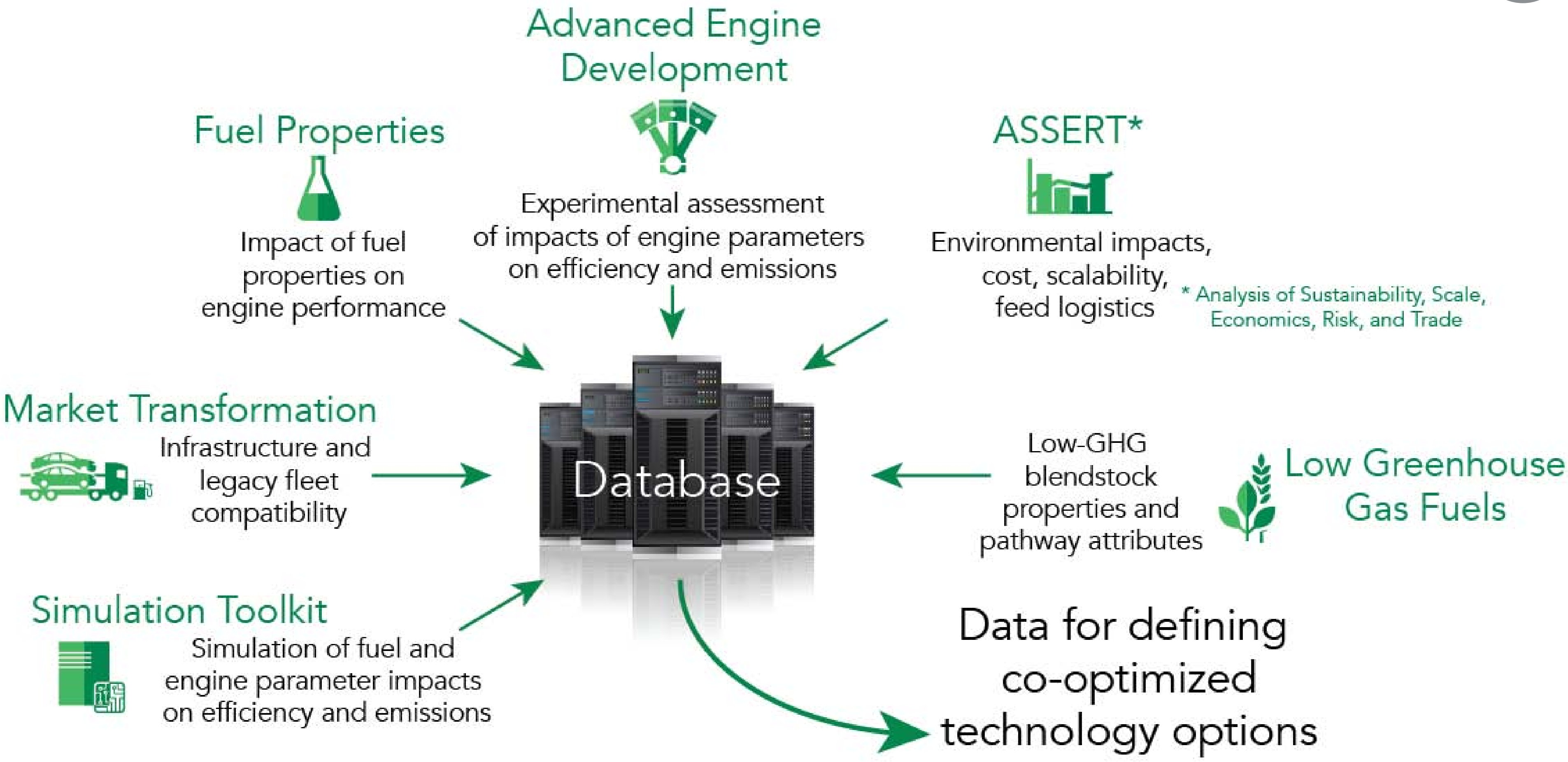


High reactivity fuel

Applicable to
light, medium, and heavy-duty engines
hybridized and non-hybridized powertrains


commercialization targets
R&D milestones
Thrust I market introduction
Thrust II market introduction
R&D begins
Thrust I R&D complete
Thrust II R&D complete
18 month decision point
thrust 2 decision point
2015
2020
2025
2030
Year

Six integrated teams



Thank You

Identifying the best options, subject to many constraints

Approach

Database: fuel properties, sustainability, affordability, scalability, infrastructure, and retail attributes

$\Delta GHG = a$
H_2O consumption $= b$
Viable routes $> c$
Feedstock cost $< d$
Pipeline compatibility $= e$
Tech Readiness Level $> f$
Energy density $> g$
Biodegradability $> h$
$\vdots \quad \vdots \quad \vdots$

Scenario constraints

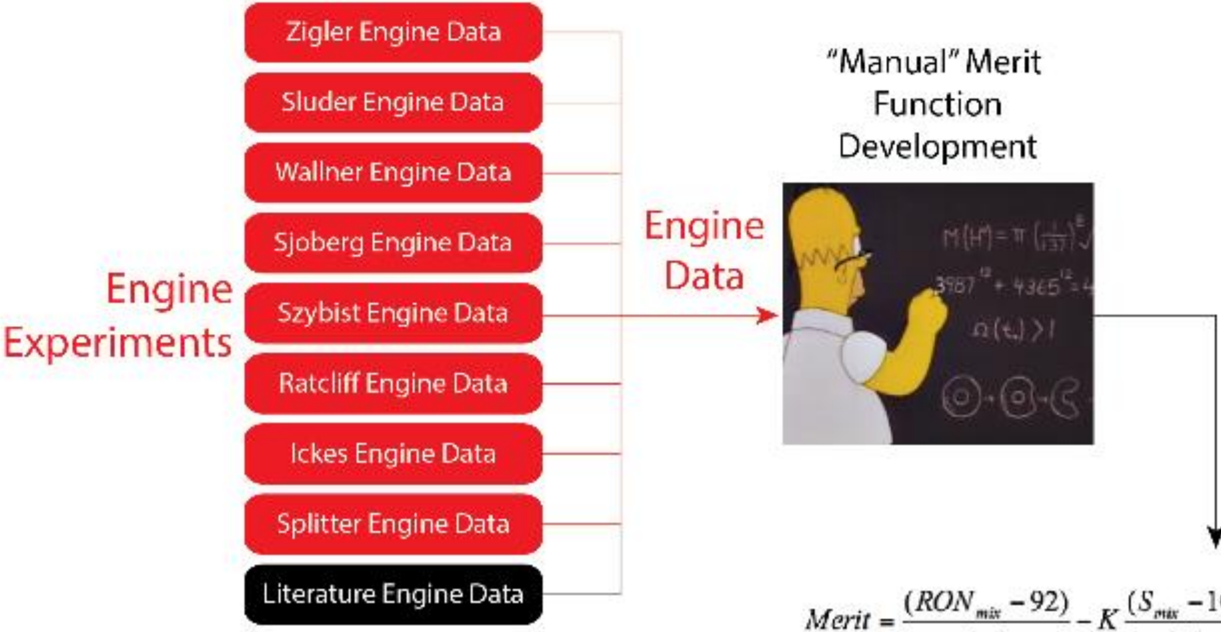
"Optimizer"

Engine/vehicle merit function

Optimal fuel blend formulations

Need to explicitly account for uncertainty

Current merit function development approach



$$
\begin{aligned}
Merit = {} & \frac{(RON_{mix} - 92)}{1.6} - K\frac{(S_{mix} - 10)}{1.6} + \frac{0.01[ON/kJ/kg](HoV_{mix} - 415[kJ/kg])}{1.6} \\
& + \frac{(HoV_{mix} - 415[kJ/kg])}{130} + \frac{(S_{L,mix} - 46[cm/s])}{3} \\
& - LFV_{150} - H(PMI - 2.0)[0.67 + 0.5(PMI - 2.0)]
\end{aligned}
$$

Numerically optimized merit function