



Cleantech Forum
San Francisco

10 years of the Global
Cleantech 100: Let's revisit
two of our (un)conscious
biases and blind-spots!



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| **San Francisco**

10 years of the Global Cleantech 100



YOACHIM HAYNES

Consultant, Cleantech Group



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2009 GlobalCleantech100

61: Energy & Power

21: Solar; 16: Energy Efficiency

16: Resource & Environment

11: Water; 4: Recycling

14: Materials & Chemicals

11: Biochemicals; 3: Adv. Materials

6: Transportation & Logistics

3: Agriculture & Food

0: Industrial & Manufacturing



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2019 Global **Cleantech** 100

40: Energy & Power

10: Smart Grid; 10: Energy Storage

13: Resource & Environment

3: Air; 2: Water; 2: Recycling

9: Materials & Chemicals

3: Biochemicals; 6: Adv. Materials

21: Transportation & Logistics

12: Agriculture & Food

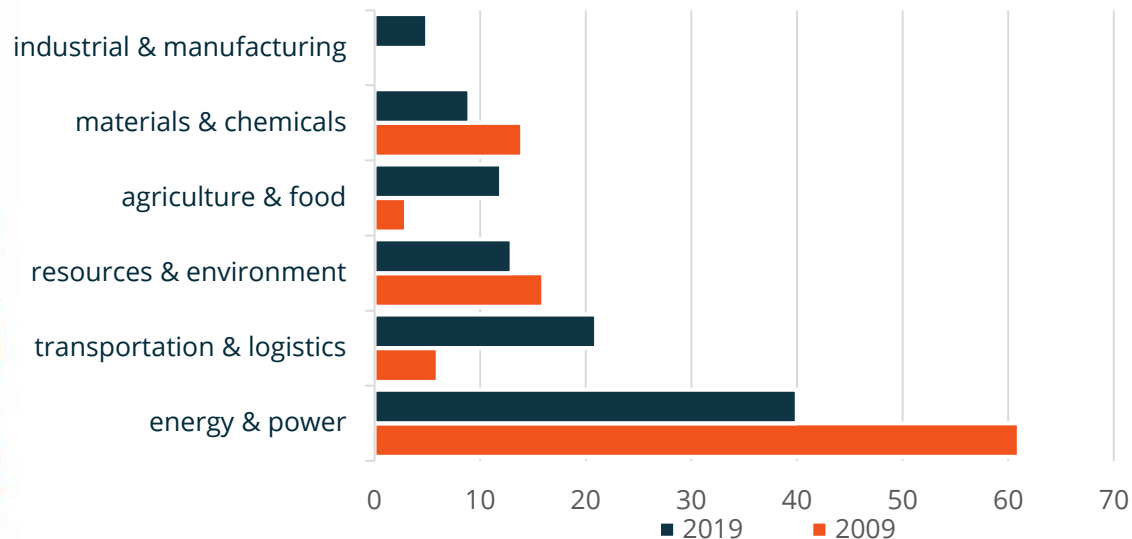
5: Industrial & Manufacturing



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2009 vs 2019 GlobalCleanTech100





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What happen between 2009 and 2019?

- '09 Solar moves to services and off-grid
- '10 Biofuel peaks at 14
- '11 The rise of the corporate in cleantech
- '12 Water fell without new wave
- '13 Energy moved from generation to consumption
- '14 Big data
- '15 As-a-Service
- '17 East meets west
- '18 Ag and food peaks at 12
- '19 Transportation and logistics peaks at 21



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Bias 1

Wave/tidal power has no place in the future energy mix, and that “we’ve been there, done that” in the 2000s



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Bias 2

The future is all-electric and the internal combustion engine is dead



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INNA BRAVERMAN

Co-Founder & International Marketing Director,
Eco Wave Power





Imagine

Turning ocean and sea
waves into electricity!



What makes Wave Energy so great?

3.2 Billion people near seacoast

Two thirds of the world population is living within 200 kilometers of a seacoast

Renewable Energy

Highest concentration of renewable energy

Stable

Power production is steadier and more predictable

Kinetic Energy

Contains 1000 times the kinetic energy of the wind

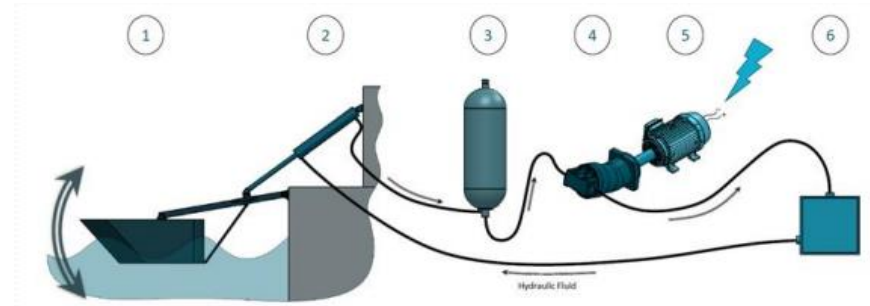


Did you know?

Wave Energy can produce
twice the amount of electricity
that the world produces now



How does the technology work?



1. Floater

Floater moves with motion of waves

2. Piston

Motions moves a piston, compressing hydraulic fluid

3. Accumulator

Accumulator stores compressed fluid

4. Hydraulic Motor

When compressed fluid is released, the energy runs a hydraulic motor

5. Generator

Hydraulic motor turns an electric generator, producing clean electricity

6. Hydraulic Fluid Tank

Hydraulic fluid returns to tank, where it is stored until next wave



Our technology is not only revolutionary



Cost-Efficient



Fully Insurable



**Environmentally
Friendly**



From Small to Medium...to large.



Wave Tank Testing



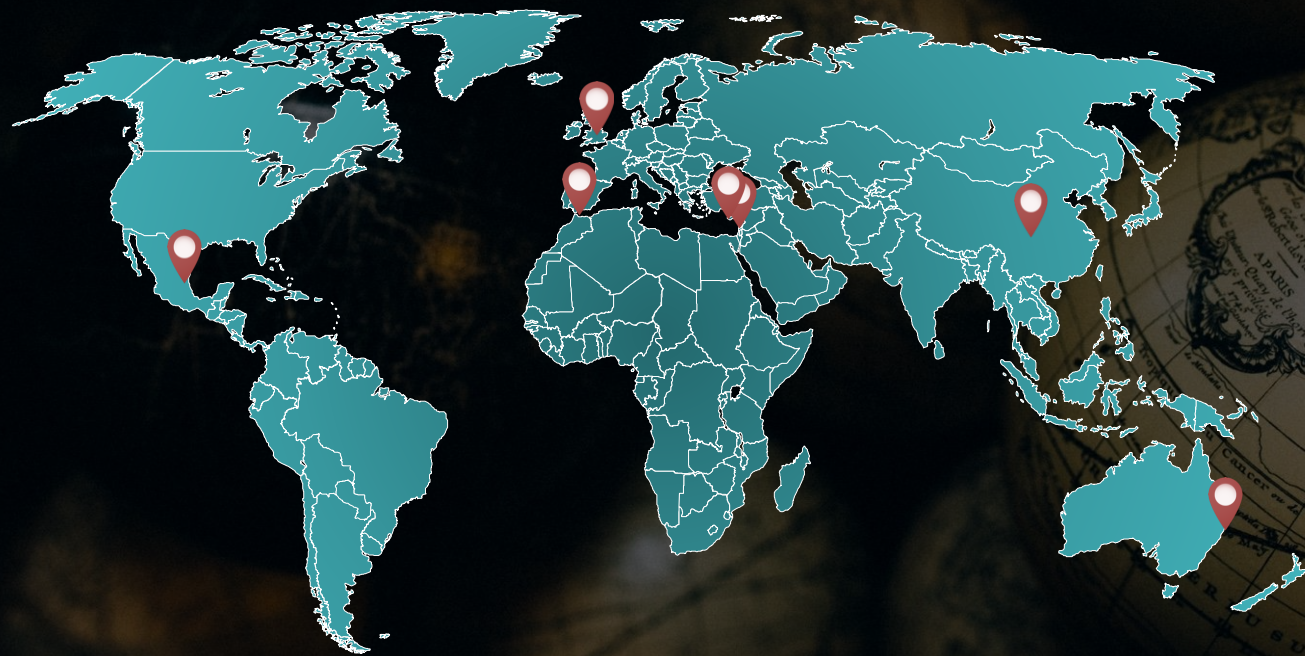
10KW Power Station



100 KW Power Plant



Our current project pipeline



≈ 130MW

Australia - 5MW

China - 50MW

Cyprus - 1.5MW

Gibraltar - 5MW

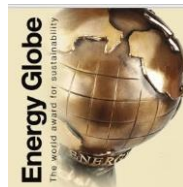
Israel - 10kW

Mexico - 25MW

UK - 44.5



EWP Changing the world **one wave at a time**



中国设计智造大奖
Design
Intelligence
Award



Let's catch waves together!

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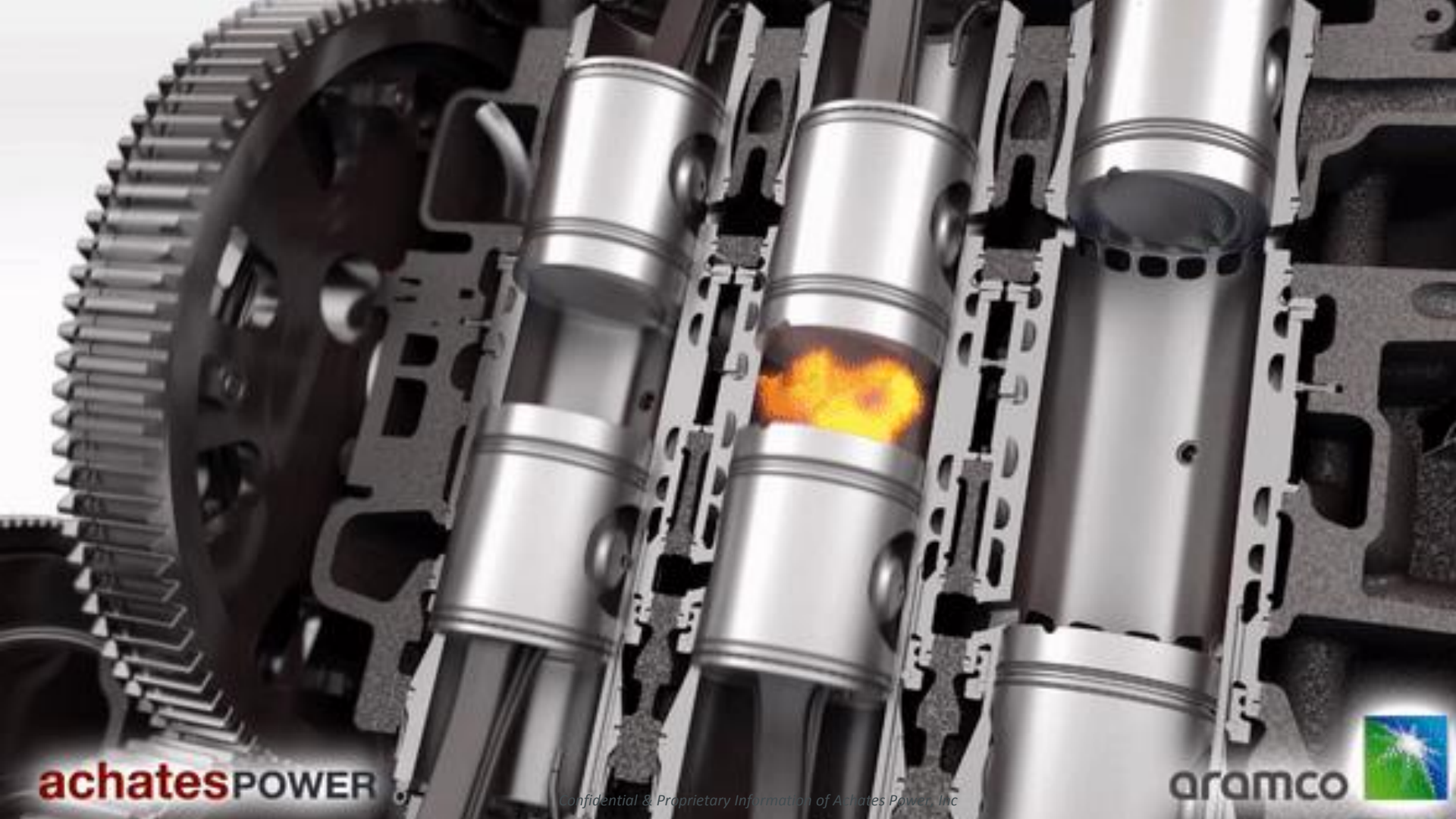
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LARRY FROMM

EVP, Chief Commercial Officer, Achates Power



achatesPOWER

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achatesPOWER™ Fundamentally Better Engines®

**Achates Power Opposed-Piston Diesel Engine Heavy Duty Truck
Project Partnership Awarded \$9 Million from California**

Annual Energy Outlook 2017

with projections to 2050



eia
Independent Member of Congress
U.S. Energy Information
Administration

#AEO2017

January 5, 2017
www.eia.gov/aeo

U.S. EIA - BEV: 6% of sales by 2040

icct THE INTERNATIONAL COUNCIL ON
Clean Transportation

The future is electric, but why's it
taking so long?

achatesPOWER™

BCG

Powertrain 2030: The Electric Car Tipping Point

November 2017

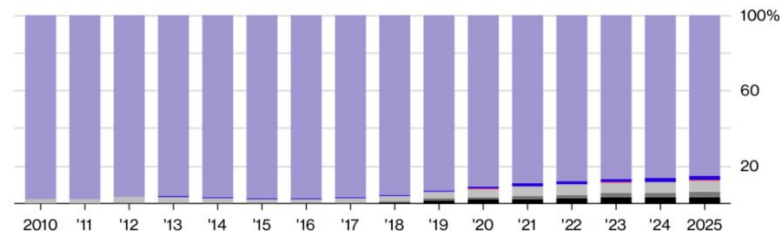
THE BOSTON CONSULTING GROUP

BEV: 14% of sales in 2030

Gasoline's Staying Power

Internal combustion engines will still power 85 percent of new U.S. cars in 2025

■ Mild hybrid (with 48V) ■ Plug-in hybrid ■ Full hybrid ■ Fuel cell ■ Battery electric vehicle
■ Extended-range EV ■ Internal combustion engine



Source: LMC Automotive forecast

Bloomberg

BEV: 15% of sales in 2025

BEV ≠ ZEV

“It is time to stop our green worship of the electric car. It costs us a fortune, cuts little CO2 and surprisingly kills almost twice the number of people compared with regular gasoline cars.” Bjorn Lomborg, USA Today, 2/18/2015

**Electric car benefits?
Just myths**



“While the BEV driver reduces their local contribution to GHG emissions, they create a more diffuse set of environmental impact spread across the globe, the consequences of which are largely borne by rural and often disadvantaged communities near the mines...” Arthur D. Little 2/19/2016

**Battery Electric Vehicles
vs. Internal Combustion
Engine Vehicles**

Arthur D Little

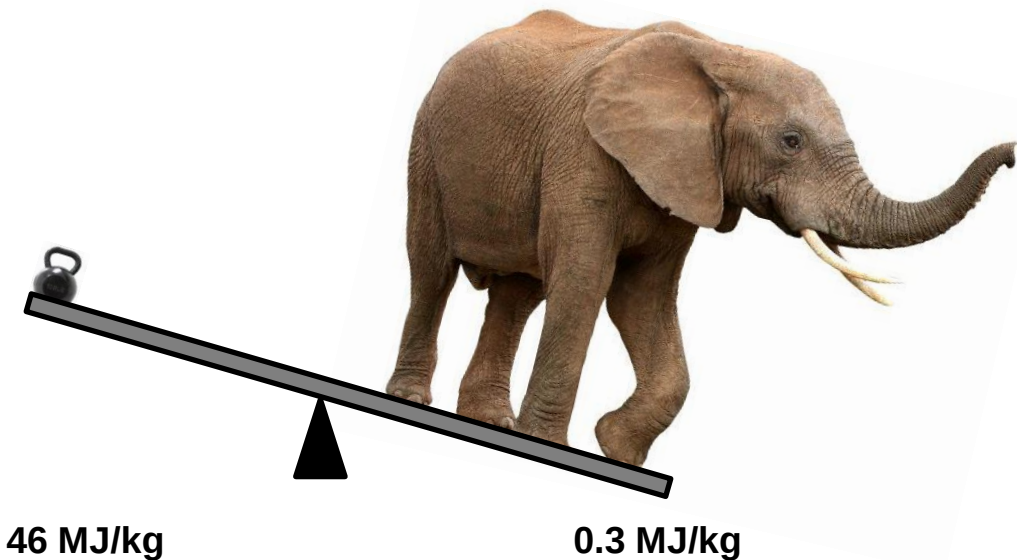
“EVs powered by grid-average electricity ... have greater negative impacts than do vehicles powered by gasoline.” The National Academy of Sciences, 12/30/2014

**Life cycle air quality impacts of conventional
and alternative light-duty transportation in
the United States**

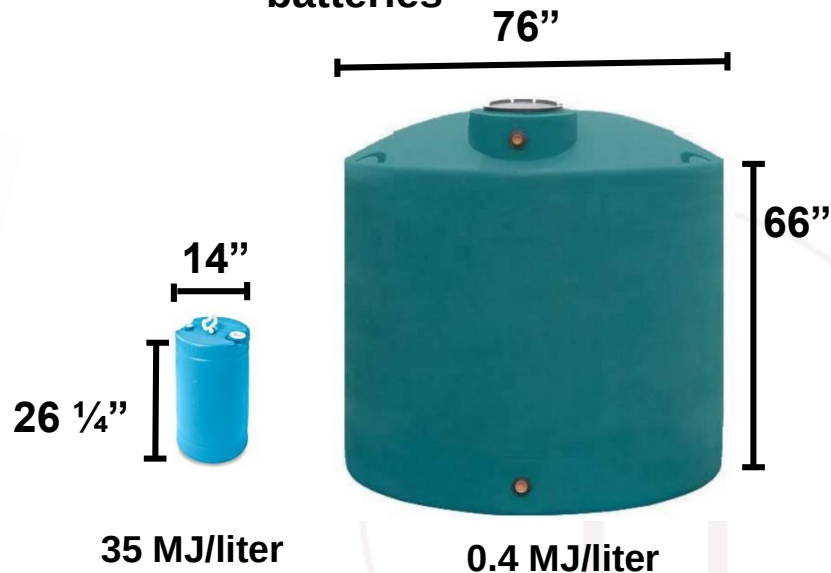
**Proceedings of the
National Academy of Sciences
of the United States of America**

The battery challenge

Gasoline has 150x the gravimetric energy density of lithium ion batteries



Gasoline has 80x the volumetric energy density of lithium ion batteries

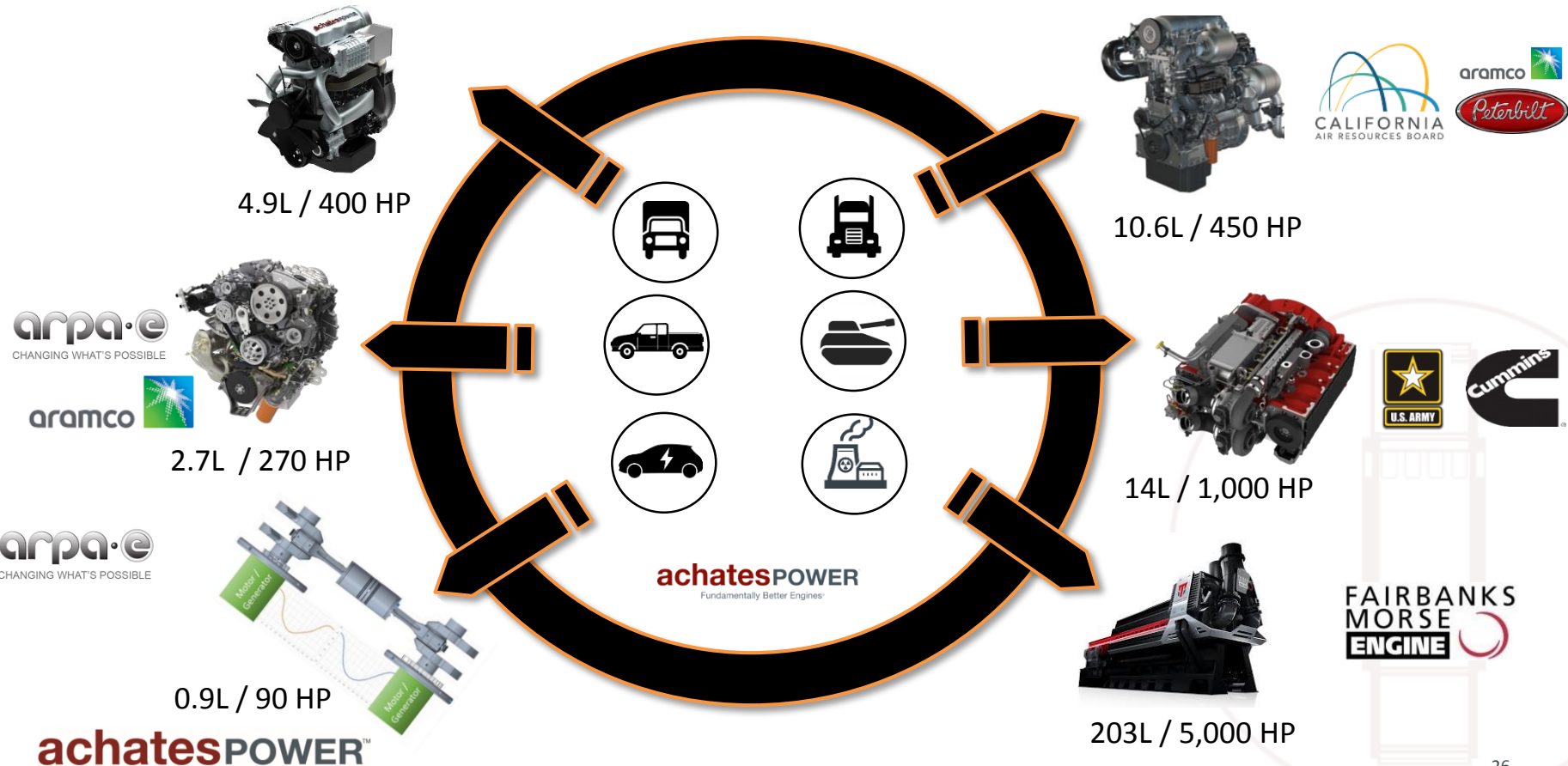


Toyota: News of the death of the ICE have been greatly exaggerated.
February 2018

Small electric cars may be unaffordable for some: VW chairman to newspaper.
January 2019

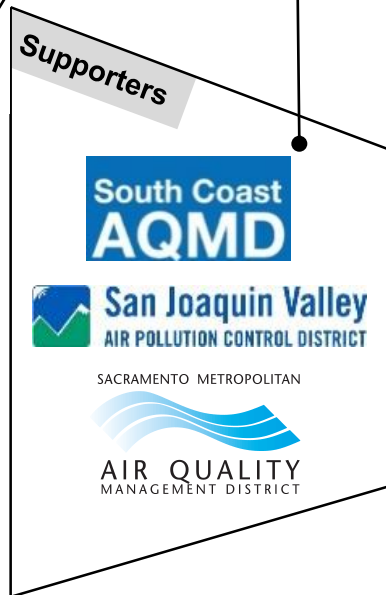
“I worry we are overstimulated in our belief that EVs are going to take over the world quickly.” CEO, Toyota North America
January 2019

Present Range of Applications





CARB Ultra-Low NOx Heavy Duty Demonstration



PROGRAM GOALS

NO _x	0.02 g/bhp-hr
CO ₂	391 g /bhp-hr

90% NO_x reduction
15% CO₂ reduction



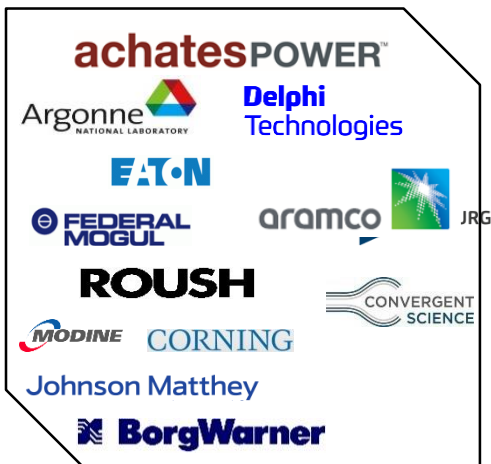
“OP engines have significant benefits & potential”
- Jack Kitowski
Chief
Mobile Source Control Division
California Air Resources Board

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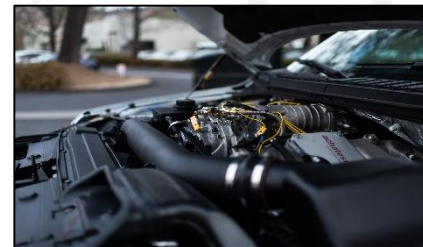
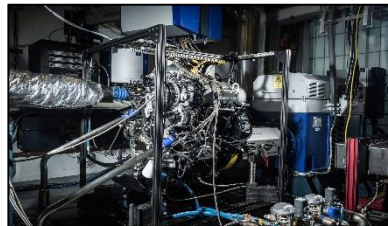
Opposed-Piston Gasoline Compression Ignition



- 37 mpg gasoline (combined highway & city, unadjusted)
- 42 mpg diesel
- Driving demonstrations available today



Parallel development of
Diesel fueled variant



Larry Fromm
fromm@achatespower.com

