

INNOVATING + INTEGRATING

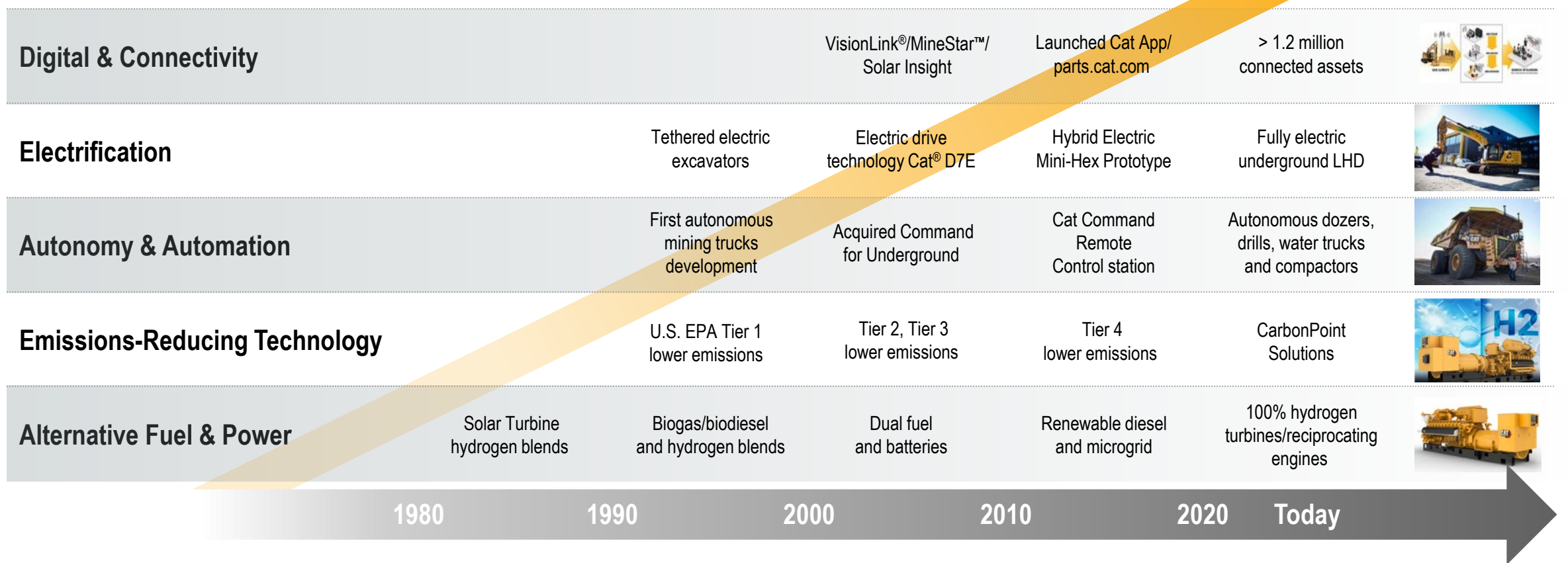
PRODUCTS · SYSTEMS · SOLUTIONS



Our customers are seeking alternatives to established fuels and energy sources to power their work while growing their businesses.

We are ready.

Decades of Industry-Leading Innovative R&D and Technology-Related Investments



Investing in Advanced Power Technology



ESTABLISHED POWER SOURCES

More efficient and fuel-flexible



Lower-Carbon Intensity Fuels*

Enable use of reduced-carbon options and hydrogen blends

** Tailpipe greenhouse gas emissions from lower-carbon intensity fuels are often the same as traditional fuels.*

HYBRID & ELECTRIC DRIVE

Established power sources coupled with new technologies



Electric and Hybrid Powertrains

Employ an electric drive transmission with power components



Microgrids

Integrate renewable energy sources into electric power systems

EMERGING POWER SOURCES

Replacing established power sources



Batteries

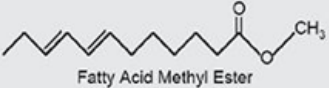
Power the work with stored electrical energy

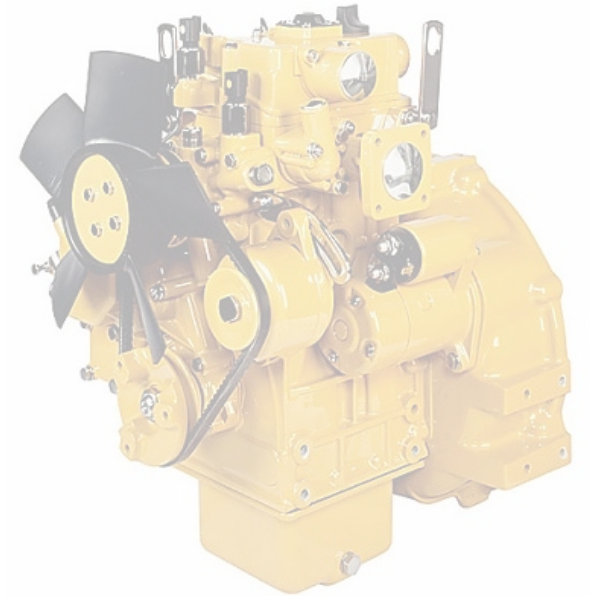


Fuel Cells

Use renewable hydrogen fuel as a scalable source of electric power

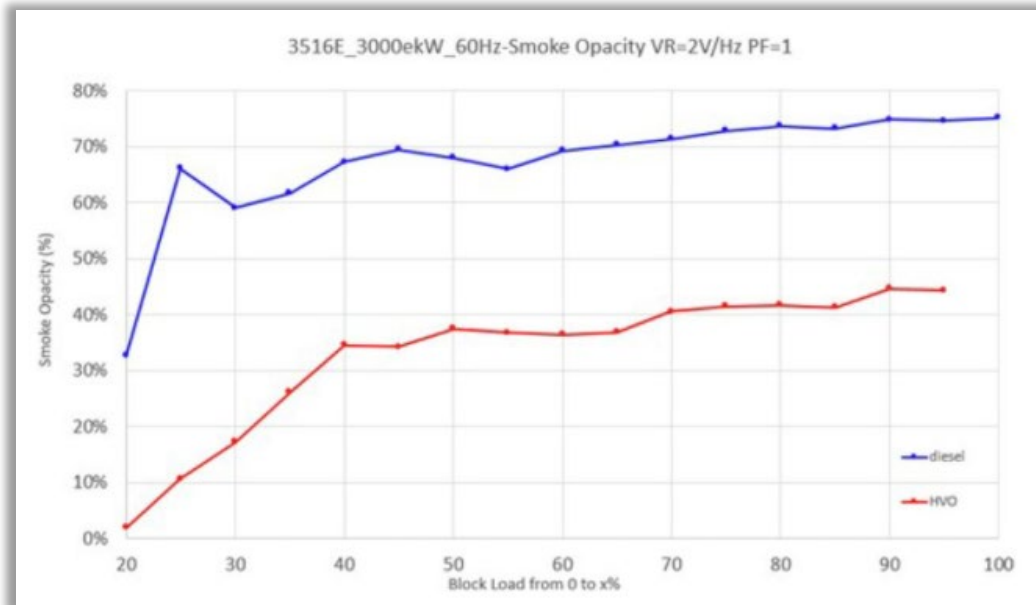
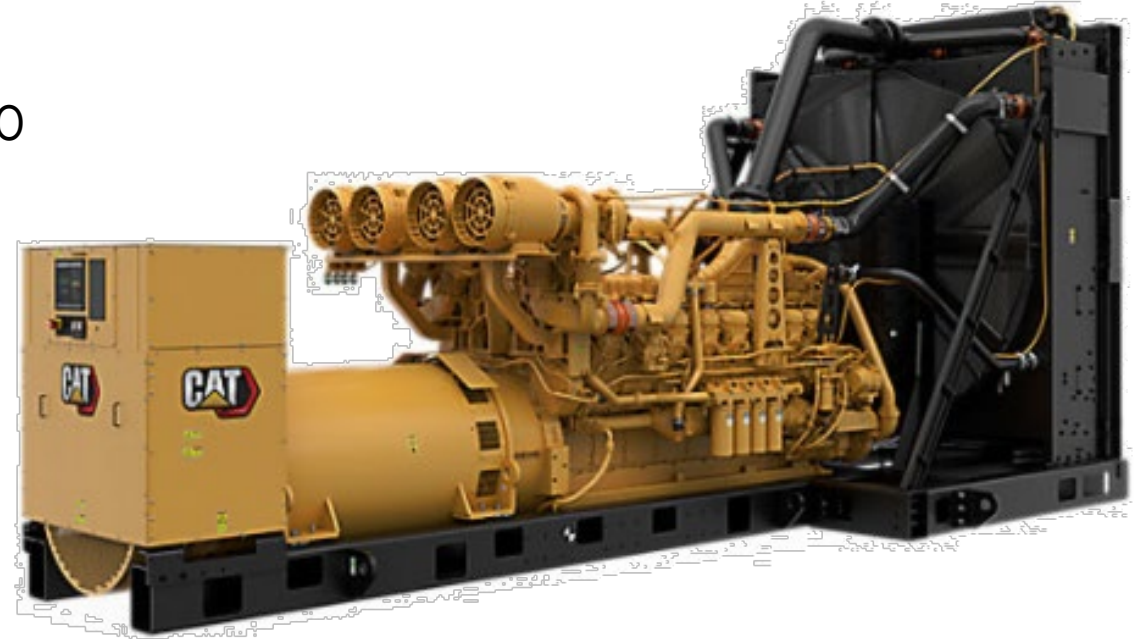
Alternative Fuels: Biodiesel / Renewable Diesel

| | Biodiesel (FAME) | Hydrogenated Vegetable Oil (HVO) (Renewable Diesel) |
|--------------------------------|--|--|
| Source | Vegetable oils and fats | Vegetable oils and fats |
| Process | Transesterification | Hydrotreating |
| Chemistry | | |
| Product | Oxygenated, ester  Fatty Acid Methyl Ester | Non-oxygenated, paraffin n-Paraffin $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$ <i>n-Decane C₁₀H₂₂</i> |
| Replacement for diesel? | Yes, with some cautions | Yes |
| Specifications | ASTM D6751, EN 14214, Cat Spec | EN 15940 |
| | LOCAL CAT DEALERS CAN PROVIDE GUIDANCE AND RECOMMENDATIONS FOR THE USE OF BIODIESEL | CAT® ENGINES HAVE ACCOMMODATED THE USE OF BIODIESEL AND HVO FOR OVER A DECADE. |



Renewable Diesel Experience





- Back-to-back test performed on 3 MW genset with Diesel and HVO
 - HVO had half the smoke opacity on transients
 - HVO had nearly same NO_x, slight reduction at lower loads



Caterpillar Collaborates with Microsoft to Provide Standby Power to its Swedish Data Centers

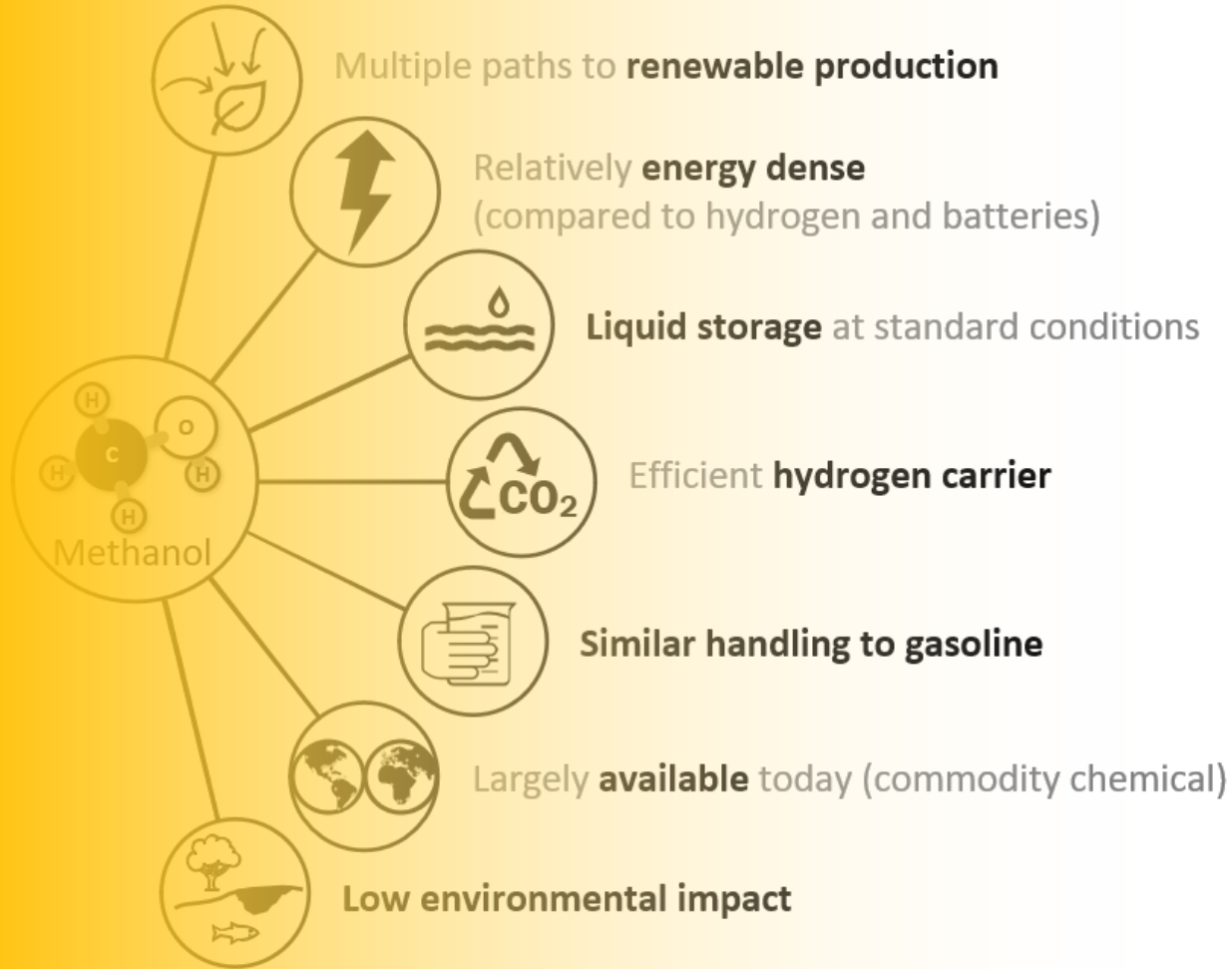
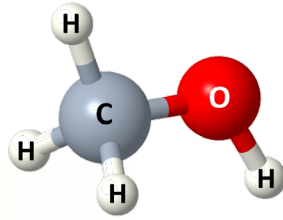
Caterpillar to support Microsoft's carbon-negative goals with standby power running on renewable liquid fuel

Hydrogen Experience

| Product | Power Range (electric) | Available NOW | Production Planned | Demonstration | |
|---|------------------------|---------------|--------------------------|--------------------------|--------------------|
|  | CG132B | 0.4 – 1.0 MW | Up to 10% H ₂ | Up to 25% H ₂ | 80% H ₂ |
|  | CG170B | 1.38 – 2.3 MW | Up to 10% H ₂ | Up to 25% H ₂ | 10% H ₂ |
|  | G3500H / FR | 1.0 – 2.5 MW | Up to 5% H ₂ | Up to 25% H ₂ | 40% H ₂ |
|  | CG260 | 3.0 – 4.0 MW | Up to 10% H ₂ | Up to 25% H ₂ | 60% H ₂ |



Methanol Experience



CATERPILLAR MARINE INVESTS IN METHANOL ENGINES TO PROMOTE SUSTAINABLE FUTURE

Caterpillar Sees Methanol as Key Fuel in the Decarbonization of the Marine Industry

March 2022

Houston, Texas - Caterpillar is announcing additional development of alternative fuels with an investment in methanol engine technologies. This commitment supports the development of decarbonization efforts in the marine industry by offering cost effective methanol-powered solutions without sacrificing the value customers expect from Caterpillar.

"In order to continue supporting our customers with their climate-related goals Caterpillar Marine will continue exploring combustion technologies such as methanol. Today's products are being designed to be upgradable for future methanol utilization, thus further enabling the energy transition," comments Derrick York, Caterpillar Marine Managing Director.

For more information about future technologies and Caterpillar products, contact your local Caterpillar dealer.

CATERPILLAR[®]

Battery Electric Equipment

Integrating electrified systems and components into our current products



**R1700 XE
UNDERGROUND LOADER
+ MEC500 CHARGER**



**SWITCHER
LOCOMOTIVE**



**ENERGY
STORAGE**

PRODUCTS INTRODUCED IN HIGH POWER APPLICATIONS

Electrification Opportunities Across the Product Portfolio

Leveraging our experience, expertise and learning to develop fully electric products



LOCOMOTIVES

← CAT MACHINES →

STATIONARY
POWER

BATTERY
CHARGERS

**TAILORED TO
THE APPLICATION**

.....
**DESIGNED FOR
SECOND LIFE USE**

Successful Demonstration of First Battery-Electric Large Mining Truck

- Caterpillar unveiled first battery-electric 793 large mining truck prototype
- Truck completed a live demonstration of capabilities, including:
 - 7 km course run while fully loaded to rated capacity
 - 60 km/h top speed
 - One kilometer up 10% graded haul road at 12 km/h
 - One kilometer down 10% graded haul road, capturing regenerated energy
 - Maintained enough battery energy to perform additional work



- Truck was fitted with more than 1,100 data channels gathering 110,000 data points per second to validate performance

WHATEVER THE CHALLENGE

A yellow Caterpillar D6 bulldozer is shown in profile, pushing a large pile of dark brown earth. The bulldozer has "D6" and "CAT" markings on its side. The background is a clear blue sky with some greenery visible in the distance.

Advanced Power. Fuel Flexibility.
Operational Efficiency. Sustainability.

THERE'S CATERPILLAR.