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Trucks Are Cleaner Today Than Ever Before; But They Can Still Improve
Cleaner Engine Options Available Today

Ultra Low NOx Natural Gas; 90% cleaner than current diesel
Cleaner Fuel Options Available Today

1. Renewable Natural Gas: 90% NOx reduction in ULN engine
2. Renewable Diesel Fuel: 30% PM reduction, 10% NOx reduction
3. Biodiesel: 50% PM reduction, 10% NOx increase

Source: CARB, U.S. DOE

Renewable diesel—Also called "green" diesel, renewable diesel is a biomass-derived transportation fuel suitable for use in diesel engines. It meets the ASTM D975 specification in the United States and EN 590 in Europe.

Renewable diesel is distinct from biodiesel. While renewable diesel is chemically similar to petroleum diesel, biodiesel is a mono-alkyl ester, which has different physical properties and hence different fuel specifications (ASTM D6751 and EN 14214). The two fuels are also produced through very different processes. While biodiesel is produced via transesterification, renewable diesel is produced through various processes such as hydrotreating (isomerization), gasification, pyrolysis, and other thermochemical and biochemical means. Moreover, biodiesel is produced exclusively from lipids (such as vegetable oils, animal fats, grease, and algae), whereas renewable diesel is produced from lipids and cellulosic biomass (such as crop residues, woody biomass, and dedicated energy crops).

Source: U.S. Department of Energy
In 2019, Electric Is Coming; But Not Widely Available…Yet

Yard Trucks; Demo Stage

Pick Up and Delivery; Demo Stage

Class 8 Over the Road; Prototype Stage
ZE Commercial Vehicle introduction timing and pace of deployment will happen in phases or waves.

**Wave 1**
Transit
- Chanje Class 5 Delivery Van Available now
- Fusco ECanter Available now
- ZE transit buses Available now
- ZE industrial lifts Available now

**Wave 2**
Delivery
- Orange EV yard tractor Available now

**Wave 3**
Medium Freight
- E-Fuso Vision One Announced 2021
- Freightliner eM2 Demo now Announced 2021
- Expanded supply chain capabilities and price reductions enable additional applications

**Wave 4**
Heavy Regional Freight
- Freightliner e-Cascadia Demo Now; Announced 2021
- Volvo VNR Demo now; 2019 Europe; 2021 NA?
- Mack e-Refuse Demo 2020; Coming 2022?
- Steadily increasing volumes and infrastructure strengthen business case and performance confidence

**Corridor Longhaul**
- Nikola FC tractor Coming 2022?

2019 2020 2021 2022 2023
All New Technology Needs Infrastructure

20 + Natural Gas stations in the Valley, but more are needed

EV charging for cars expanding, but public use truck charging is needed
Example of Challenges

Fresno Main Post Office deploying 10 all-electric parcel delivery vans. Project funded by CARB in partnership with San Joaquin Valley Air Pollution Control District.
Electric Requires Planning

- Large scale electric will require move to planning holistic integrated community scale deployments of renewable energy, advanced energy storage, and supporting infrastructure.
- These developments should incorporate renovation and efficiency upgrades of existing buildings with new construction while blending onsite energy production with energy-efficient equipment and energy storage.
- Time line for deployment will require up to 4+ years for large scale projects.
Electric Requires Planning

Distribution Grid Upgrade Schedule Impacts

Source: Black and Veatch
What Will These Communities Look Like? It Could Be Something Like This…
Questions?

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