

CORNING

Sustainable Fleet Technology Conference 2023

***Advancements in Medium/Heavy Duty Vehicles
and Infrastructure***

Dr. Ameya Joshi

Date : August 16th, 2023



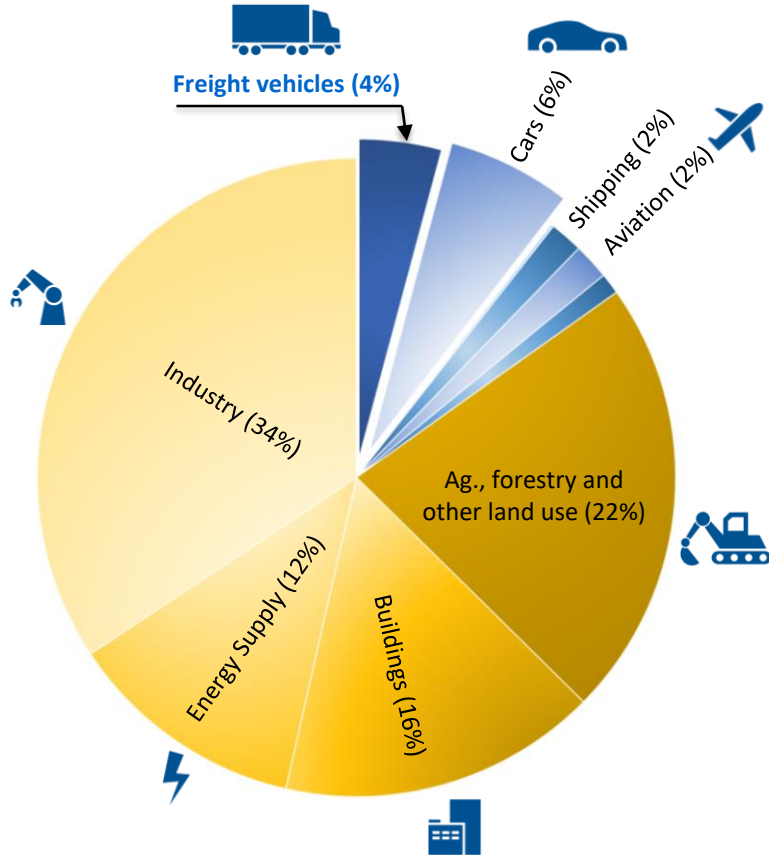
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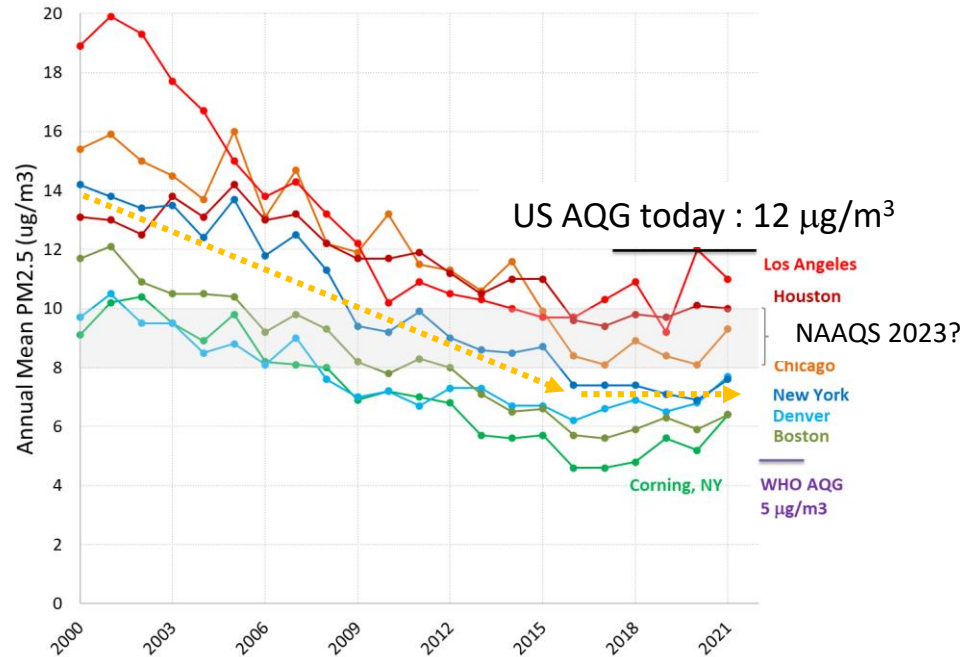
What problems are we are trying to solve in the transportation sector?

Global Greenhouse Gas emissions




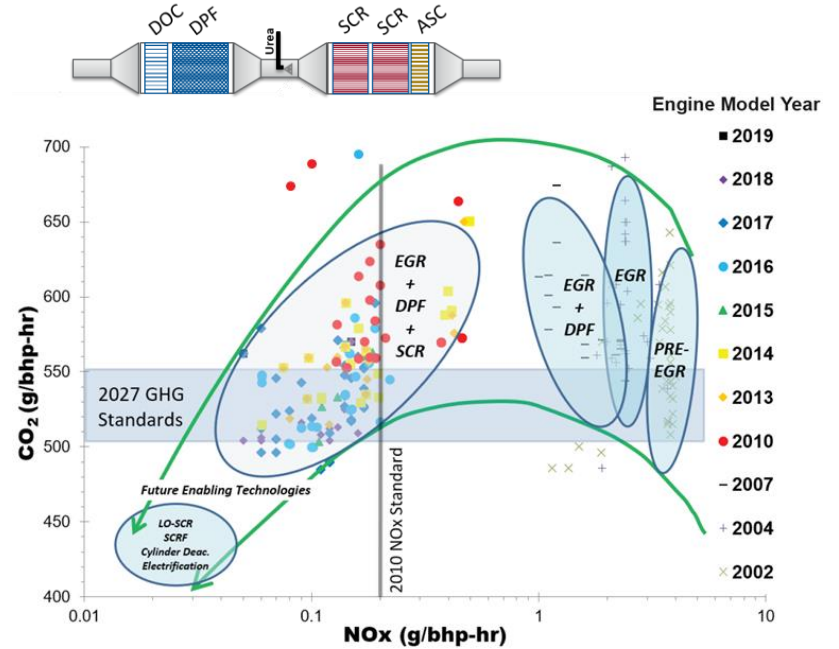
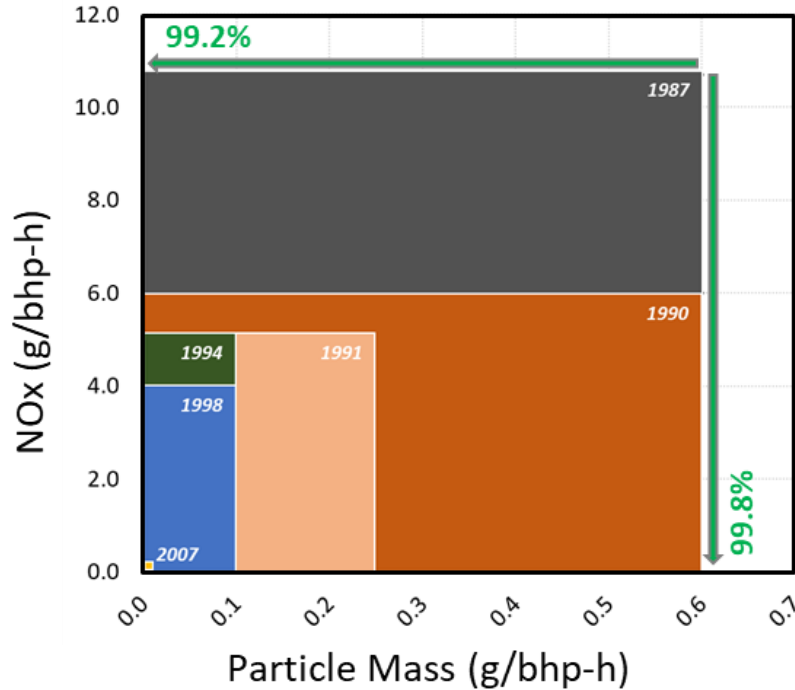
Local Criteria Pollutants

We are nearing zero-impact emissions with upcoming regulatory steps (~ Euro 7/VII/EPA Tier 4/Low NOx/CN 7 ...)



In the past 35 years, tailpipe criteria pollutants have reduced by >99% ... while also reducing fuel consumption

 US EPA heavy-duty diesel tailpipe standards



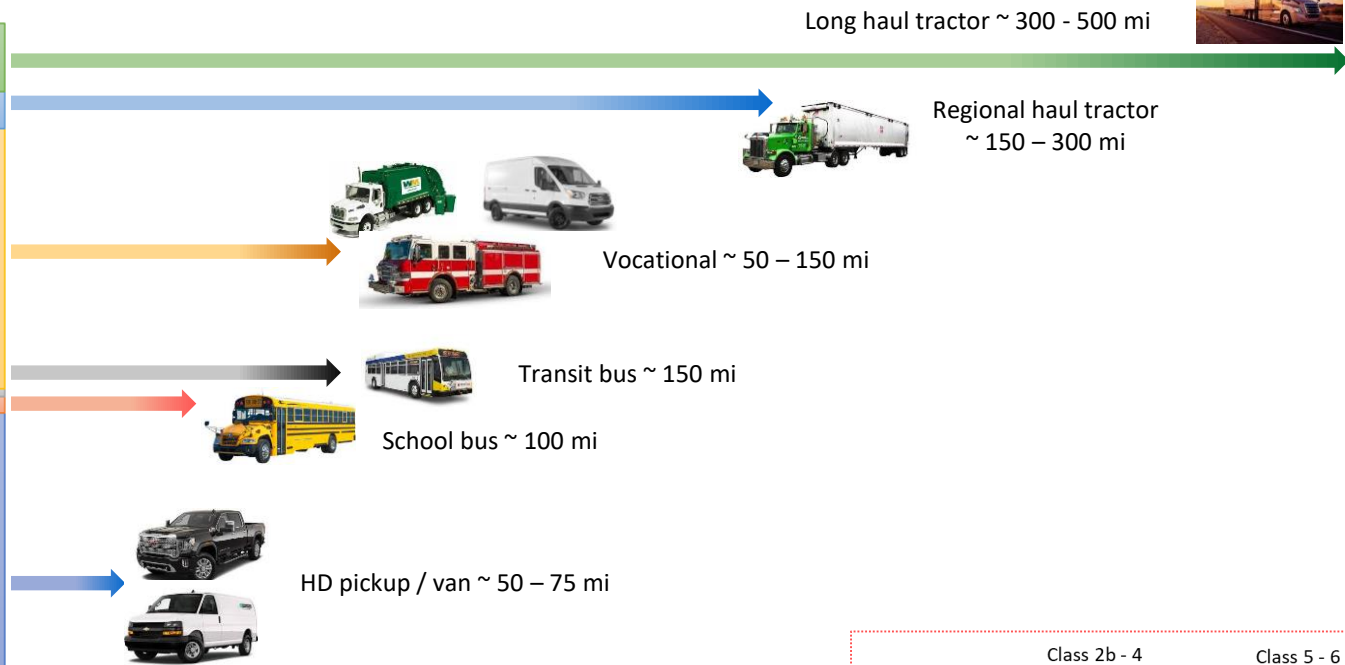
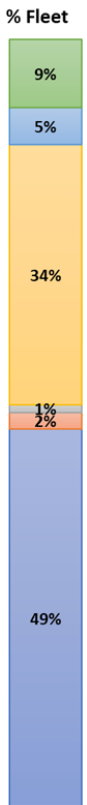
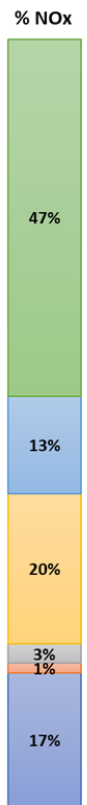
DOC = Diesel Oxidation Catalyst, DPF = Diesel Particulate Filter
 SCR = Selective Catalytic Reduction (of NOx), ASC = Ammonia slip catalyst
 EGR = Exhaust gas recirculation

Heavy duty engines serve diverse vehicle applications

- Decarbonization will require a range of technology solutions



Total in-use ~ 23 million



Vehicle Class

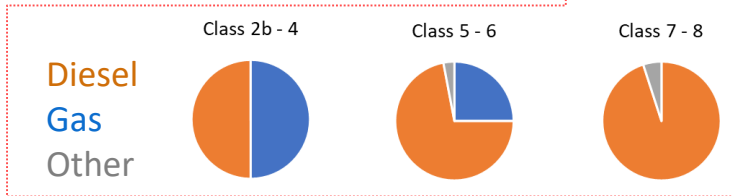
Class 7 - 8

Class 3 - 7

Class 7 - 8

Class 2b - 3

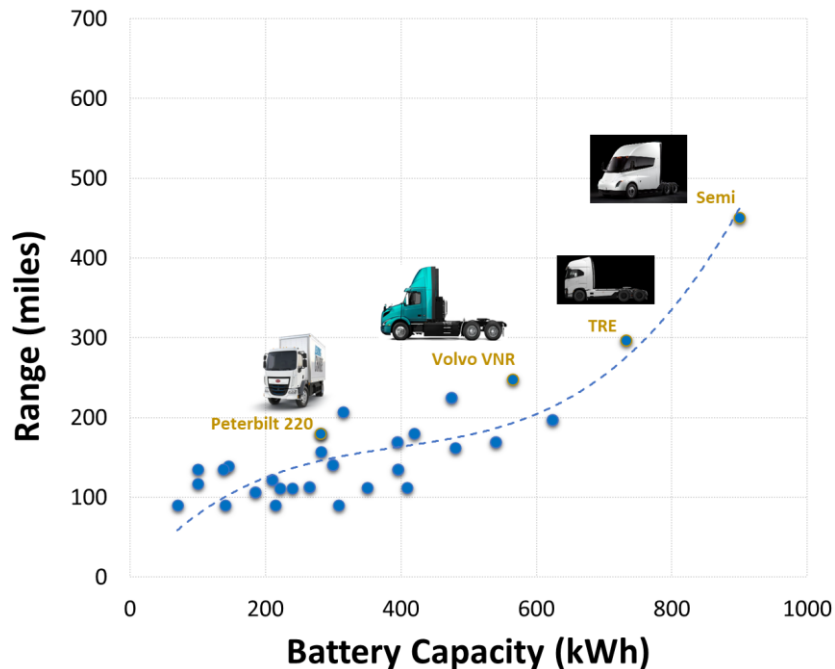
Fuel type



Long-haul trucking : Need to advance megawatt charging & H₂ delivery

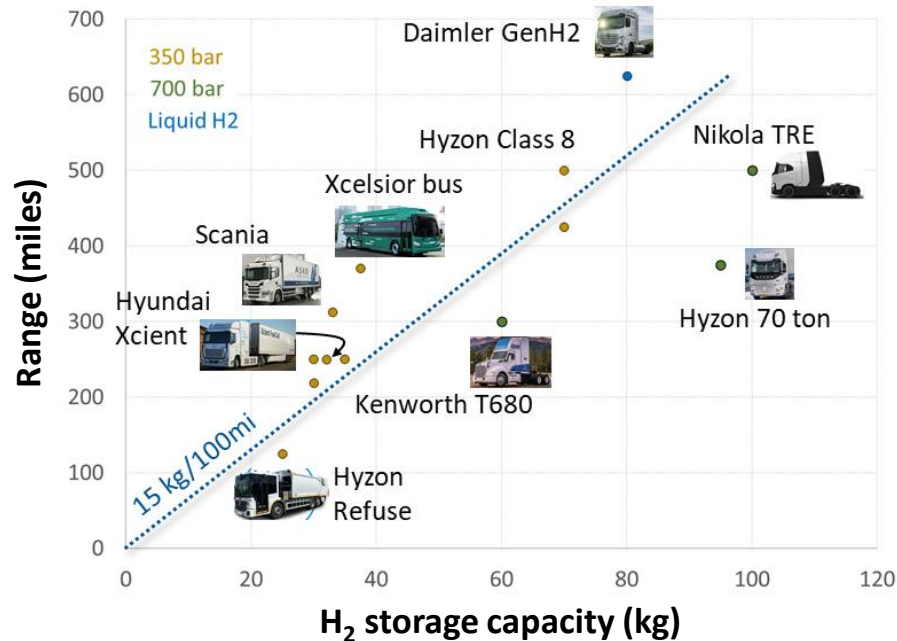
Battery Electric Trucks

~ 1MWh battery pack needed for 500+ mile range



H₂ fuel cell trucks

Need to significantly increase green H₂ production



For ~ 0.5M long-haul trucks running 350 mi per day, H₂ annual requirement = ~ 9.6M tons
US total H₂ demand today is 10M tons per year, almost all made from fossil fuels

Several technology choices to reduce well-to-wheel CO₂ emissions

- Each with their pros and cons

	IC Engine (Ref.)	Low C Fuels	BEV	H ₂ Fuel Cell	H ₂ ICE
<i>GHG Reduction</i>	Ref.	++	++	++	++
<i>Fueling Infrastructure</i>	Ref.	o (Ready)	--	---	---
<i>Refueling Time</i>	Ref.	o	--	o	o
<i>Range</i>	Ref.	o	--	o	o
<i>NOx/PM emissions</i>	Ref.	o	+++	+++	+
<i>TCO</i>	Ref.	---	++/-- (*)	++/-- (*)	--
<i>Critical materials</i>	Cat. only	-	-	-	o
<i>Existing fleet</i>	Ref.	Yes	No	No	No

We need to pursue all pathways for transport decarbonization

Detroit DD15, inline 6-cyl
2024 GHG compliant



Efficiency improvements
55% BTE, Opposed piston



AchatesPower Opposed
Piston engine

ClearFlame Engine
Runs on ethanol



Alternate fuels

CNG, LPG
Ethanol

Fuel agnostic engines



Volvo 7900 hybrid

Hybridization
Mild, full hybrid

Cummins
fuel agnostic
engines



X15
Clean Diesel
Natural Gas
Hydrogen



L9
Clean Diesel
Natural Gas
Hydrogen



B6.7
Clean Diesel
Natural Gas
Gasoline
Propane
Hydrogen

Low carbon fuels
Renewable fuels

Fuels

ICE

Hybrid + green fuel
H₂ ICE
Plug-in + Syn fuel



Cummins
15L H₂ ICE

Electrification

Synthetic fuels
e-diesel



ZEVs

Battery electrics
Fuel cell vehicles



Phillips 66 Makes Final Investment Decision to Convert San Francisco Refinery to a Renewable Fuels Facility

MOBILE EMISSIONS REDUCTIONS

↓ 8 million
metric tons per year
of lifecycle carbon
emissions reductions,
the equivalent of taking
1.4 million cars
off the road

May 11, 2022

It will be one of the world's largest facilities of its kind; expected to begin commercial operation

Thank you !

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Advancements in Medium/Heavy Duty Fleets

Wednesday, August 16th

Stuart Weidie

Alliance AutoGas





Class 3-7 Autogas & Renewable Propane



Ford Transit



Ram 5500 6.4L



Ford F650/F750



Isuzu NQR 6.6L



Renewable Liquid Fuels – Available Now & Supply is Growing





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Intelligent Electric Mobility

More Plugs For Trucks



Marcus Suvanto, Director
Operations & Business
Development
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Quiz Time!





1st Half of 2023

Strong year



139.8

Million USD
Revenue

25.2

Million USD
Order intake



287%

Revenue growth
year-on-year, %

51%


Operative EBIT
margin, %

The availability of electronic components **has improved from the previous year.**


Revenue outside Nordics **more than 60%** of total revenue.

+ Modular, Scalable, Dynamic & User-Friendly Charging Solutions

Modular power source



1-
12x



25kW increments

Scalable charging, Kempower Power Unit

Kempower ChargeEye



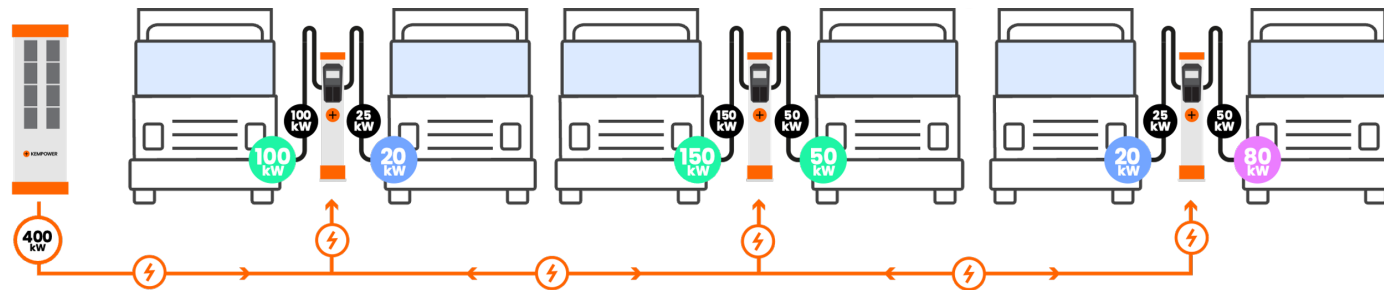
User-friendly Kempower Satellites



+ KEMPOWER'S FAST CHARGING SOLUTION

More Plugs for Your Trucks

Kempower's fast charging solution



→ 400 kW power module delivers 390 kW of charging power, 10 kW of unused power

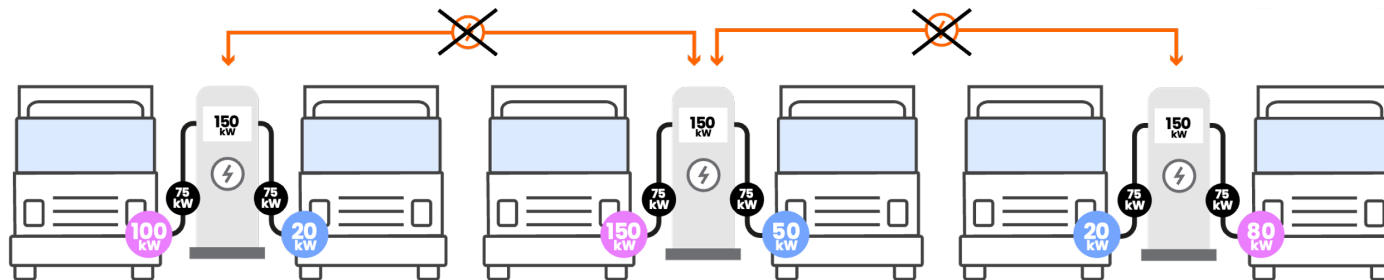
Chargers distribute power dynamically, allowing multiple vehicles to be charged at optimum power, **maximizing power utilization**

● EV is able to achieve the max capacity of kW

● EV is able to achieve less kW than max capacity

● EV's reserve more power than they are able to use

Traditional fast charging solution



→ 315 kW of charging power delivered from three 150 kW power modules (450 kW total), 135 kW of unused power

Charging capacity is low. Trucks do not get the power they want and there is **low utilization** of grid power.





Thank You.

www.kempower.com