Heavy Duty Electric Truck Fleets

Charging as a Service ("CaaS")
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Jeff Cox
CaaS Agenda

• Status of Electric Truck Fleets
• Market demand for CaaS
• Why CaaS?
• Owning vs. “as a Service” Model
• CaaS Hardware / Example Site
• Electrical design considerations
• Economic Drivers for CaaS
Current status of HD Electric Trucks

What most clients imagine – future

What reality looks like - Today
Electric Truck Market Growth

- Technology demonstration fleets have been in operation for several years
- Demonstration fleets are now turning the corner toward production models
- Major truck OEM’s ramping up manufacturing for production model electric trucks:
  - Daimler ("DTNA")
    - Freightliner
  - PACCAR
    - Peterbilt
    - Kenworth
  - Volvo
  - BYD
  - Smith
Where do electric commercial vehicles make sense?

Regardless of truck brand or application – the fleet operators’ main consideration in deploying an electric truck fleet becomes the installation of **charging infrastructure**.
Why CaaS?

• Owning charging infrastructure vs. “as-a-service” model
  • Avoids large up-front capital investment
  • Takes advantage of common Power Purchase Agreement (“PPA”) structures
  • O&M responsibility resides with the system lessor – not the end user
  • Payments don’t begin until the system is operational
  • Only have to pay for what you use
  • Technology upgrades to trucks and chargers occur frequently – CaaS model keeps responsibility for upgrades with the lessor – not the end user

If the fleet operators own the charging infrastructure – they also own the problem of constantly keeping the chargers up to date to be compatible with the trucks.
CaaS Hardware – Typical Site

1. Chargers compatible with clients’ chosen truck OEM
2. Charge management software
3. Solar – supports onsite charging and enables maximum tax credits & incentives
4. Microgrid controller – ensures uninterrupted power supply to the chargers. This is critical to ensure fleet availability in all conditions.
5. Battery Energy Storage (and/or additional on-site generation) – in conjunction with the microgrid controller, BES will ensure uninterrupted power supply for chargers.
6. Upgraded main switchgear
7. Utility interconnection
CaaS – Electrical Design Considerations

• Increase in site loads may require utility-side service upgrades
  • New transformers
  • Overcurrent protection hardware and strategy
  • Increased main service capacity
  • Interconnection protocols vary by utility
  • A separate service with a dedicated meter is often required for charging depots

• Truck charging requirements (and chargers) are evolving rapidly
  • Early models relied on high-voltage AC (600 VAC)
  • New trucks and most future models rely on high-voltage DC (600-1500VDC)
  • Faster charger speeds are in high demand – will require higher voltages
  • As charger voltages change, serving conductors need to be large enough to accommodate potential increases. Oversizing them up-front can be helpful.

• Taking DC output from solar and BES inverters and supplying it directly to the chargers via a main DC bus is often desirable. Avoids DC-AC-DC conversion losses.
CaaS – Electrical Design Considerations

• This might seem obvious - but....

How long is that truck?

And

How long is the charger cord? (the one that can’t be changed)
1. **Chargers**
   a. State & Local incentives available
   b. Regulatory agencies offer incentives
   c. VW Emissions Trust Fund

2. **Charging Credits**
   a. LCFS in CA / CFS in OR / more coming soon
   b. Using grid power for charging = low value
   c. Using on-site solar for charging = high value

3. Federal Investment Tax Credit (“FITC”) for solar
   a. Some regional incentives still available

4. **Microgrid Incentives**

5. **Battery Storage Incentives (FITC + State incentives)**

6. & 7. Utility sponsored incentives for FTM side

Combining all the above incentives lowers TCO and expedites conversion from Diesel to Electric truck fleet
Economic Drivers – Charging Credits

• Using the CA Low Carbon Fuel Standard Credit ("LCFS") as our example:
  • 2020 market data yields >$207 / MT
    • Roughly equal to $0.22 / kWh for every kWh used to charge a truck.
    • Equal to about $4.50/gallon Diesel
  • Long-term revenue stream for a fleet operator
  • LCFS payments to operators have to be used for electric fleet costs – this leads to more trucks and more infrastructure.
  • Credit values are designed to escalate from year to year
  • As credits come from every gallon of Diesel purchased – the cost of Diesel will continue to go up along with LCFS Credits. Eventually, maintaining a Diesel fleet will become cost-prohibitive.
Conclusion & Questions

Thanks for your time!

Contact Information:
Jeff.Cox@Siemens.com