Electrifying Trucks and Other Fleets: Utility Infrastructure Will be Critical

Steven Nadel, ACEEE

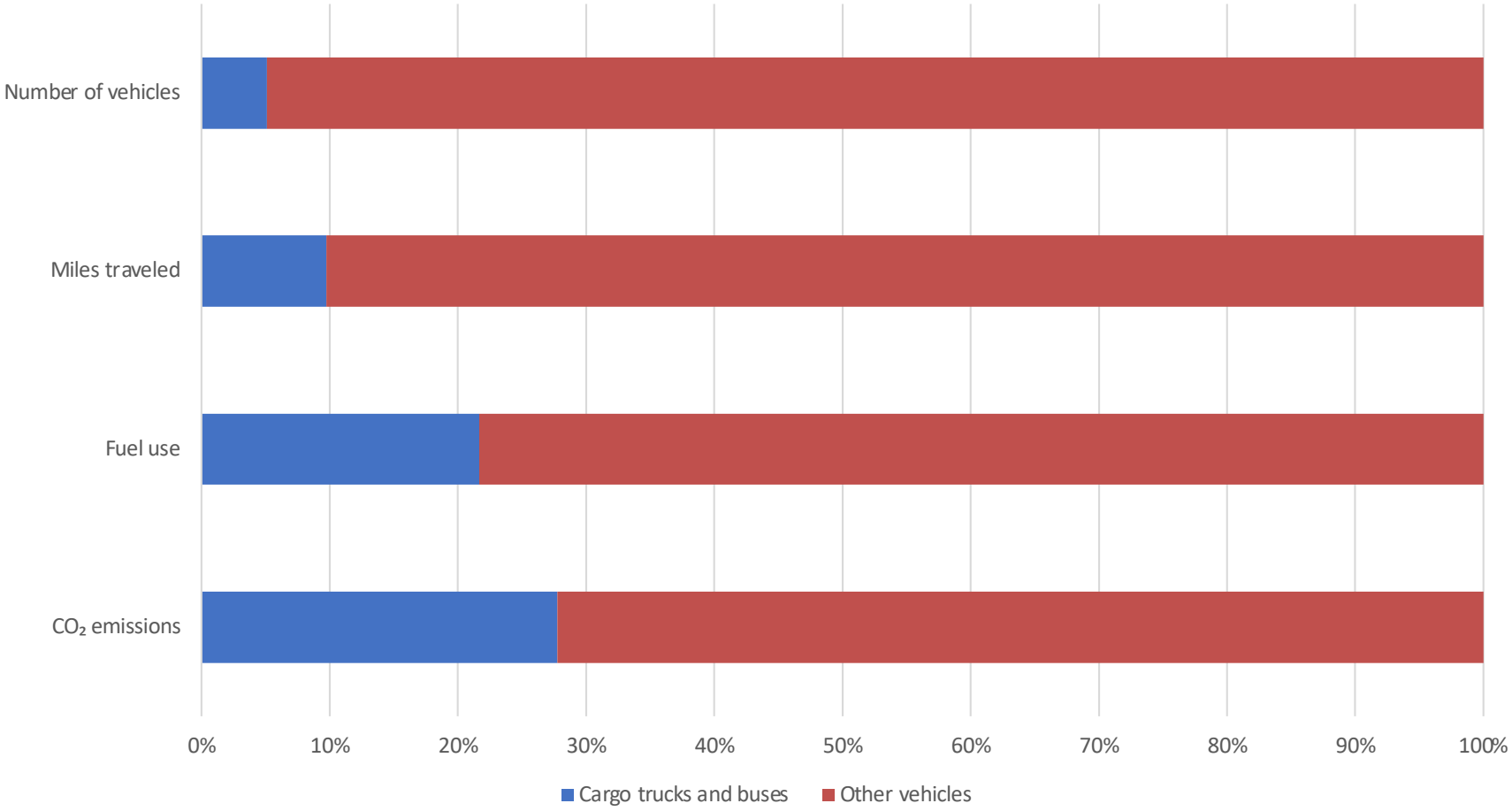
ECEEE Summer Study

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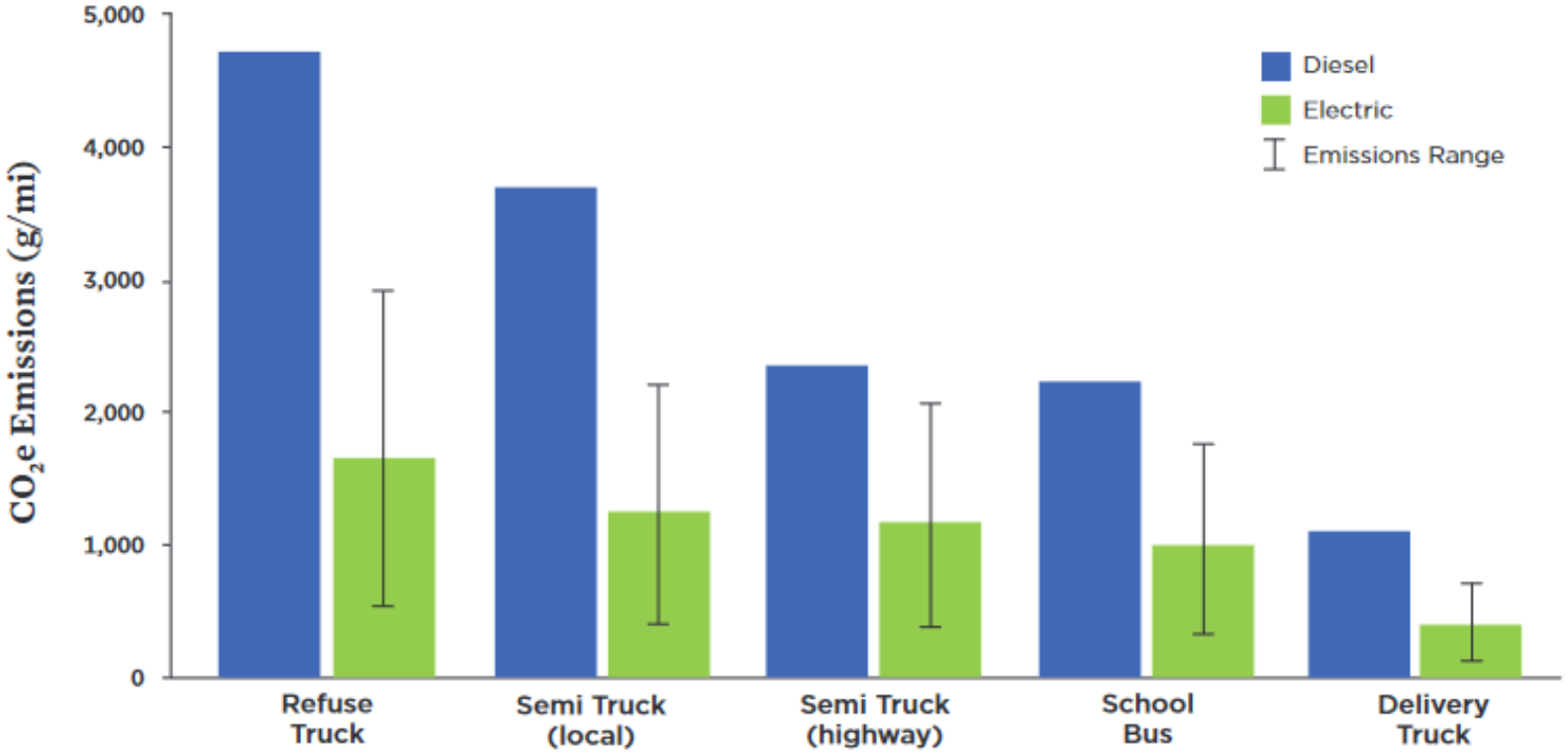
Freight trucks and buses (vehicle Classes 3–8) in the U.S. as a proportion of all vehicles



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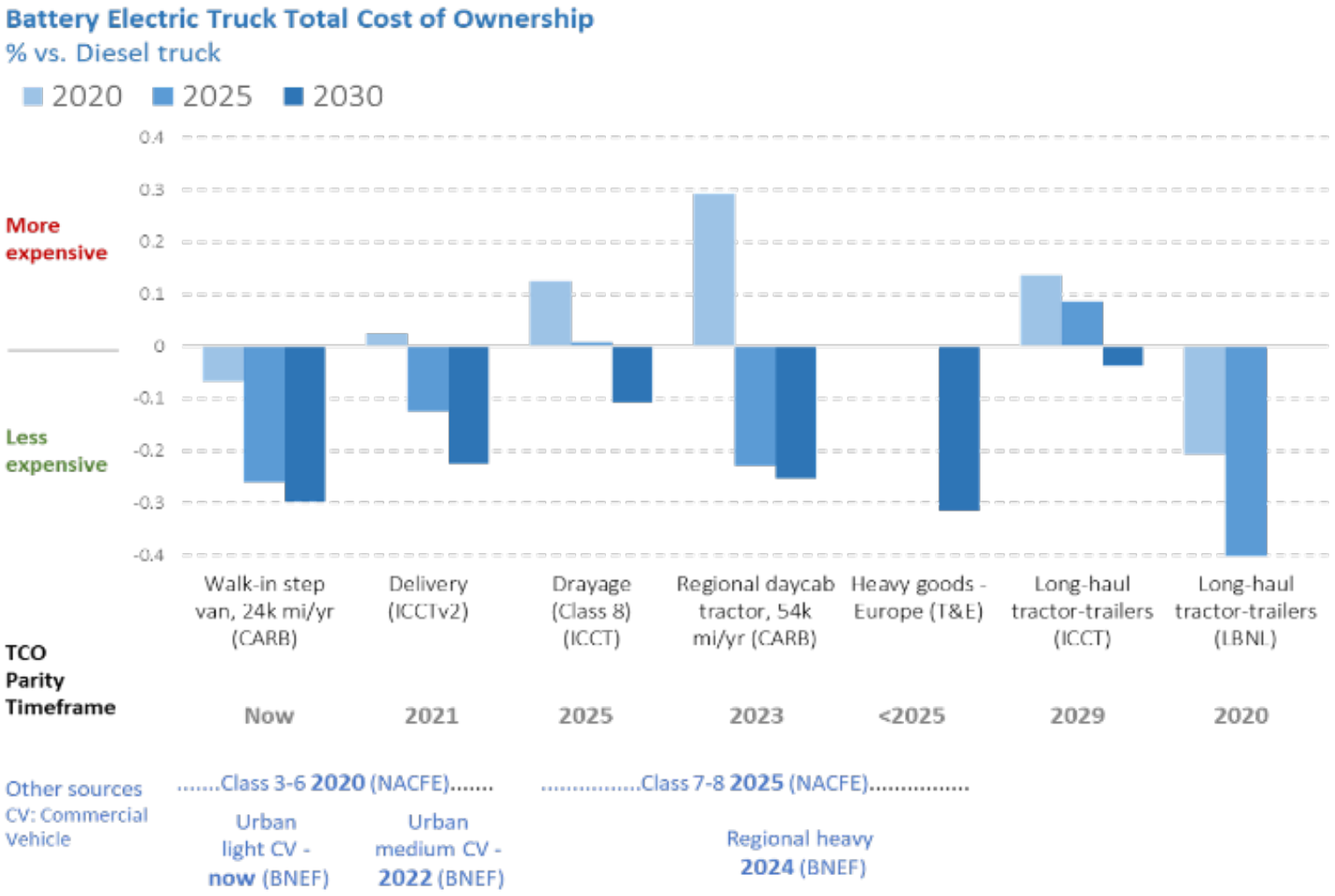
Source: Nadel and Huether, ACEEE, 2021

Life-cycle greenhouse gas emissions from different types of vehicles



Source: O'Dea, UCS, 2019

Comparison of diesel and battery-electric trucks on the total cost of ownership



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Source: Hewlett Foundation 2020









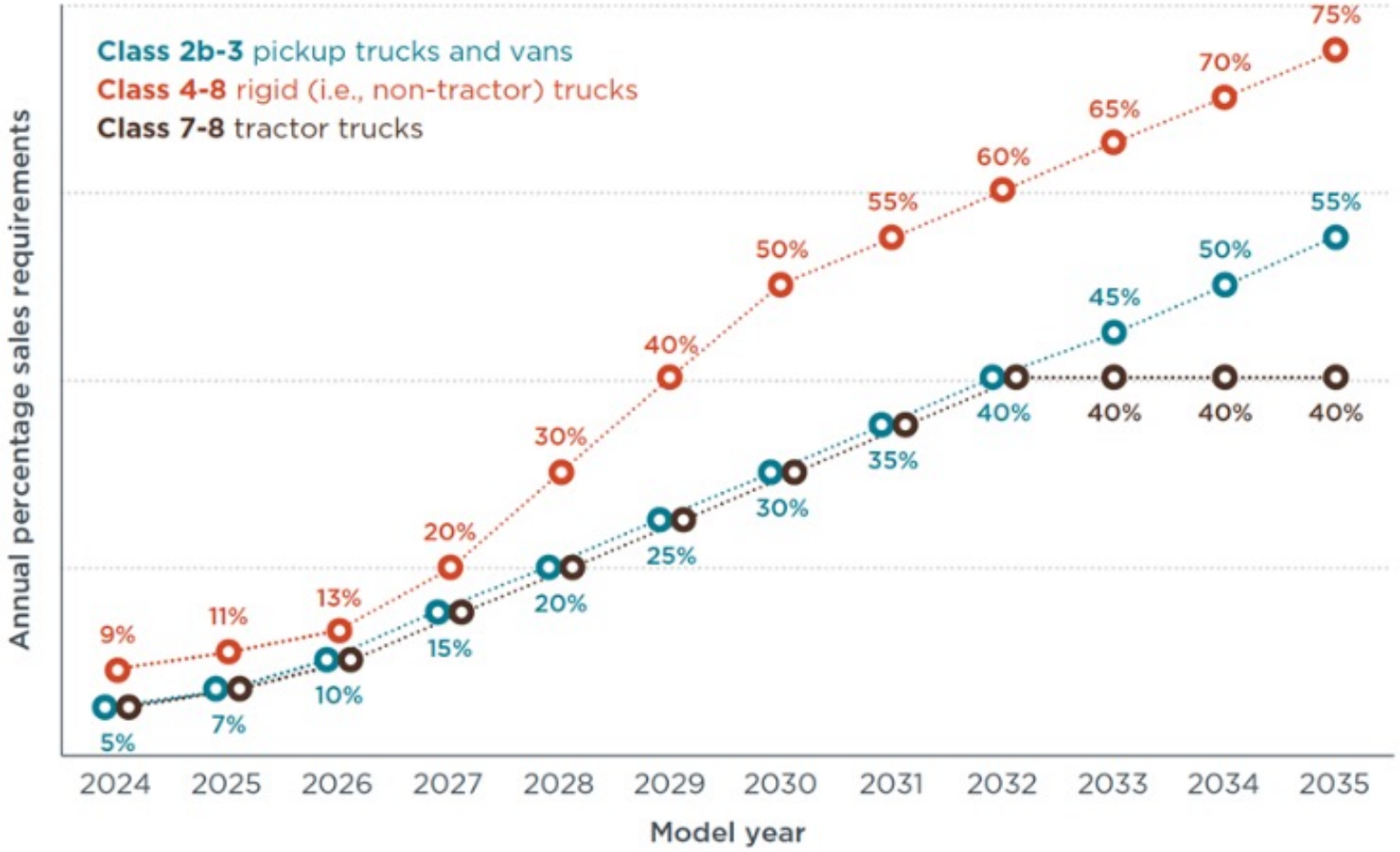







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California zero-emissions sales percentage schedule by vehicle group and model year



Source: Buysse and Sharpe, ICCT, 2020

Sample Fleet Power Needs

- Amsterdam airport, 100 bus fleet, 13 MW (might grow to 250 buses)
- 200 Amazon delivery vans, 4 MW
- Interstate truck stop every 100 miles along I-5, 23.5 MW







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Distribution upgrades



Amount of new load (MW)	Upgrade typically needed
20	New substation
10	New transformer bank
5	New circuit
2	Customer needs to take higher voltage service
1	Upsizing wire or cable or reconductoring

Source: Black & Veatch 2019

CalETC (2020): For loads over 5 MW, distribution system and substation upgrades will be needed most of the time.

Typical utility costs are:

$1,000,000–9,000,000 for substation upgrades,

$150,000-6,000,000 for primary distribution upgrades,

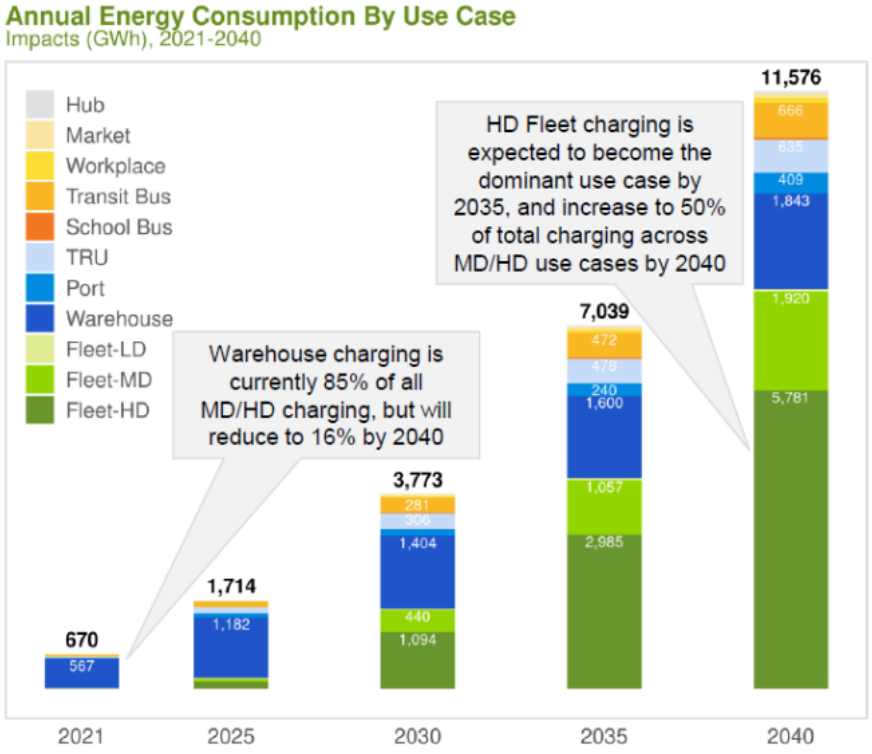
$5,000-100,000 for secondary distribution upgrades.

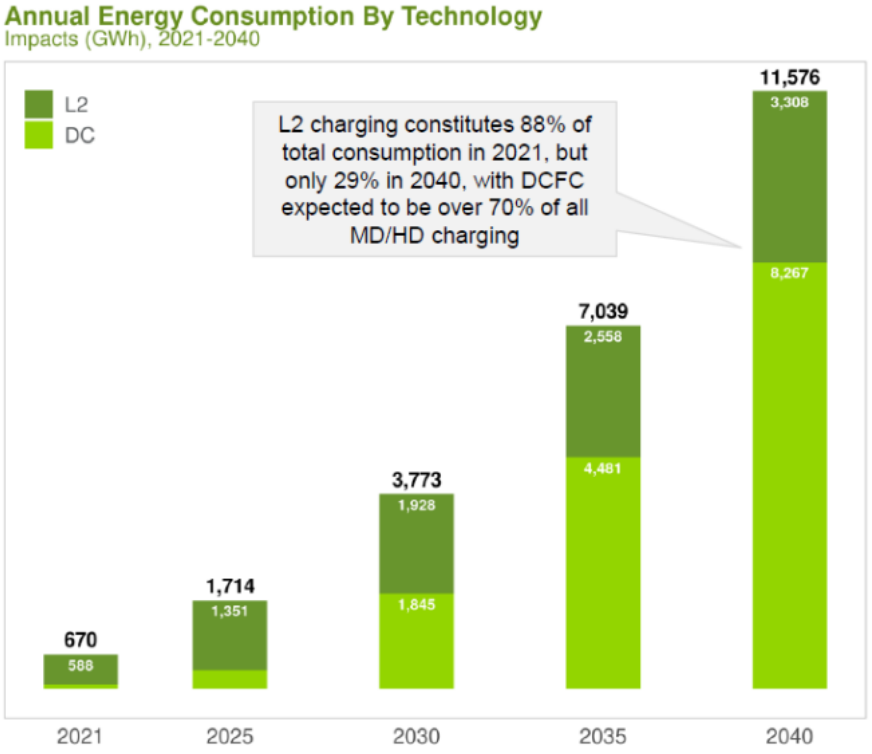
Installing chargers



1. Engage utility
2. Choose vehicles
3. Determine charging needs
4. Assess incentives and financing
5. Design site plan
6. Apply for permits, modifying plans if needed
7. Procure charging components
8. Deploy charging infrastructure.

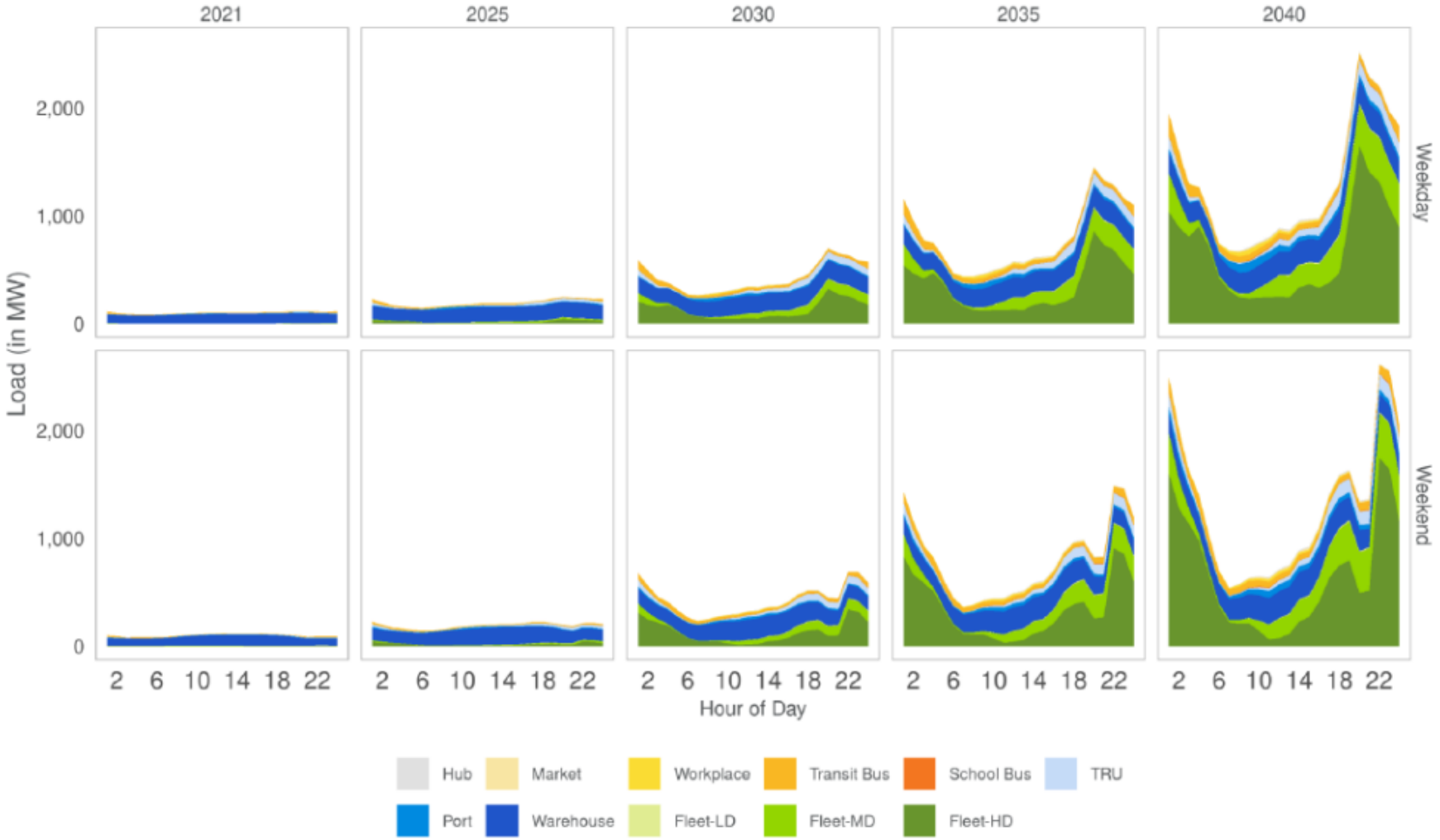
California forecast of energy needed for medium- and heavy-duty vehicles





Source: Guidehouse 2021

California forecast of power needs for medium- and heavy-duty vehicles



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Source: Guidehouse 2021

Southern California Edison



- Operate “Charge Ready Transport” program for medium/heavy-duty fleets
- Provides TA, covers service upgrade costs and cost-shares charger costs.
- Sites procuring at least two EVs are eligible, but more vehicles are often needed for the utility economics to work.
- So far most fleets choosing to electrify only ~10% of their fleet.
- Utility encourages phased plans; key components sized for planned growth.
- Customers often think they will need high-power draw chargers but analysis often finds that chargers using <50 kW will serve the need. Load management techniques can often reduce capacity needs.
- Have 64 commitments (signed contracts). “Make ready” upgrades have been completed for 27 sites. An additional 73 applications are now being evaluated.
- During program, they ask customers about their electric vehicle plans for the next ten years and incorporate this information in a database to that is consider in distribution system planning.
    - So far finding that grid capacity is generally adequate in the short term to serve charging needs.
    - But around the Ports of Los Angeles and Long Beach, where many fleets are located, electric trucks and buses are already being factored into grid upgrade plans.
    - Anticipate phased grid upgrades in many areas as approach 2030.

National Grid



- Investor-owned utility serving parts of Massachusetts, New York and Rhode Island. Owned by the UK company of the same name.
- Have “Electric Vehicle Fleet” offerings in all three states including a no-cost service to advise on vehicles and infrastructure, funding for make-ready infrastructure and charging stations, and fleet ambassadors to connect customers to other programs.
- Offer free fleet studies in all 3 states to help accelerate decision-making process, but so far purchases of electric vehicles have been less than they hoped. High initial costs have been an issue, despite lifecycle cost savings. Studies are easy to update; hope leads to EV purchases in the future.
- Company has begun work to integrate fleets into their grid planning. Conducted a joint study with Hitachi ABB to look at the grid impacts of electric fleets on 19 distribution feeders that all served a substantial number of fleets.
    - Found that of the 19 feeders, 13 would eventually need to be upgraded when nearby fleets fully electrify. Also found that on some feeders, upgrades will be needed before full electrification, especially when electrification of light-duty vehicles and space heating loads are also considered.
- Find that charging strategies can reduce the magnitude and duration of peak loads, and thus charging management needs to be an important part of future efforts.
    - They believe that distribution upgrade costs can be significantly reduced if grid upgrades for an entire corridor are planned as a system, and not piece meal.

Illinois



- Fall 2021 legislation requires Illinois utilities to develop plans for electric vehicle fleets as part of a “Beneficial Electrification” plan to be filed with the Illinois Commerce Commission (ICC) in July 2022. The plans will be reviewed by the ICC, with final decisions planned for the end of 2022, potentially leading to new programs starting in 2023.
- At ICC workshops presentations emphasized how each fleet has unique needs and requirements and that a substantial portion of fleets are located in or near low- and moderate-income communities.
  - Thus, fleet electrification can be an important step to reducing diesel emissions in these communities and thereby improving community health. While some fleets are large, many are small.
- Presentations at the workshops discussed:
  - The need to educate fleet decision-makers about electric vehicles
  - Good initial markets for electric fleet vehicles (drayage [hauling freight around ports, rail yards and trucking terminals], delivery vehicles, and medium-duty trucks)
  - Recommendations for utility efforts (fleet planning services, total cost of ownership analyses, preliminary site assessments, early engagement on grid capacity issues and planning, incentives, and considering rate design issues).

Discussion



- Case studies show that when utilities and states are proactive in educating and assisting fleet owners to consider electric vehicles, substantial uptake can happen.
- Attention needs to be paid to serving more than one vehicle per charger and to considering what power level is needed. Customers should be encouraged to share their EV plans for future years and this data should be logged to assist with distribution planning.
- Fleets are often grouped together, and these local areas will often need distribution system upgrades by the time fleets fully electrify.
  - Often these fleet-intensive areas are in low- and moderate-income communities; these communities will benefit from reduced diesel emissions as vehicles are electrified.
  - Other growing electric loads, such as for light-duty vehicles and heat pumps, will contribute to need for distribution upgrades.

Discussion (continued)



- Utilities should work with fleet owners to understand their vehicle electrification plans so that they can plan to have adequate power available when needed. Since many fleet owners do not yet know their plans, utilities will need to plan for uncertainty but can reduce this uncertainty by regularly talking with their fleet owners to keep abreast of the latest information and to spot nascent trends.
  - Given these uncertain but evolving trends, distribution planning analyses may need to occur more frequently for circuits with many fleets. These efforts should consider major trucking corridors together, as there are interrelationships along these corridors and potential economies from systematic planning that avoids many piecemeal upgrades.
- Regulators should encourage utilities to expand distribution planning to consider fleet needs. Regular and open discussions between regulators and utilities about these issues would be useful, so that grid upgrades can proceed in an orderly way to help meet fleet needs and state decarbonization and environmental justice goals, while minimizing long-term costs to consumers.

Conclusions



- Based on these cases, it appears that fleet electrification is gaining momentum and can have a substantial impact on electric grids.
- Grid impacts are small at present, they will likely grow over time.
- Fleet owners, electric utilities, and utility regulators need to start planning for these impacts now, so that grid improvements can be made steadily as electric fleets grow.
- Fleet and grid planning should happen in parallel, so that grid upgrades do not happen sooner or later than needed but are in place when needed.
- Grid impacts can be managed and planned for, but the time to begin this planning is now.

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