

## Issues with ACT Regulation TCO Modeling Approach

On December 19<sup>th</sup>, 2019, Staff presented the draft ACT regulation to the Board and included the associated total cost of ownership (TCO) model used to estimate the regulation's costs. Several Board members expressed concerns over the accuracy of the TCO model and the implications to the success of the rule. Dr. Sperling, in particular, noted that Staff's TCO models are notoriously optimistic and identified concerns with the assumptions related to battery life, range, and electricity costs.

Staff have since revised the model and addressed some areas of concern, including:

- Average daily mileage was too high for the Class 8 tractor category. Staff reduced it from 180 miles to 140 miles.
- Sales tax was too low. Staff increased it from 7.75% to 8.5%.
- Diesel fuel economy was too low. Staff increased the 2024 and 2027 fuel economy figures substantially (now 8.8 and 9.2 mpg respectively).

While these adjustments improve the TCO model for Class 8 tractors, there are many important costs missing from the analysis including:

- Charger network service costs are not included. Staff includes a \$500/year per charger cost for maintenance. Current experience by Class 8 fleets is that network service costs (from Chargepoint, Greenlots, EVgo, etc) are more likely to be \$2,500/charger per year and could exceed \$10,000/charger per year if the contract specifies stringent service level agreement requirements.
- Insurance costs are not included for any vehicle type. Because EVs and FCVs are more expensive, insurance costs are greater for these vehicles than diesels. Assuming a 3% per year insurance premium on the replacement cost of the vehicle, insurance could represent a net \$8-12k/year per vehicle incremental cost for EVs over diesels
- EVSE redundancy is not considered. When a CNG or hydrogen station is constructed, redundancy is provided by including spare compressor capacity. Staff's model includes the minimum number of chargers required to support the fleet. In practice, some spare number of chargers should be provided. The spare ratio might be 1.1 to 1.2, possibly greater, but this cost element has not been considered in Staff's model at all.
- Resiliency remains a significant and completely unaddressed issue. Staff's baseline scenario for Class 8 trucks is a 20-truck fleet that would require approximately 700 kW of power for 8+ hours. If one day of resiliency were provided for that load through battery storage, a fleet would require a 6 MWh battery system costing approximately \$3M. This would add \$150k to the TCO of each truck, or about 30% of the 2024 TCO estimate. If the vehicles are backed up with a 700 kW diesel or NG genset, the cost would be lower than battery storage, maybe \$500k-\$1M; still a significant expense not captured in the TCO model.

All of these missing costs significantly impact the accuracy of the TCO model, resulting in an underestimate of costs. Further, consistent with concerns raised by Dr. Sperling, the Staff analysis substantially underestimates the required battery capacity for the EV based on range.

- Staff estimate the required battery capacity for a truck's based on the daily average range, increased by 35% for "operational variability," and then multiplied by the energy efficiency (in kWh/mile). A truck that's expected to drive 140 miles per day on average, would be specified to have only 190 miles of range. This is equivalent to a consumer buying an EV with 70 miles of range because their average daily commute is 50 miles. Consumers do not behave this way, nor

is it reasonable to expect fleets to behave this way. Data from the 2018 California VIUS survey and several other studies of drayage trucks and goods movement trucks in Southern California suggests that if a Class 8 tractor's average daily mileage is 140 miles, the maximum daily mileage is approximately 1.65x the average, or 230 miles.

- Staff also use the average VMT over the entire life of the truck to estimate the battery capacity. Commercial trucks routinely accrue substantially more annual mileage when they are new and travel fewer miles per year as they age. Data from California VIUS and EMFAC 2017 suggest that a new truck's annual VMT is approximately 25% more in the first couple of years than its average VMT over its life. Because trucks are specified by buyer to meet the higher daily activity of a new truck, Staff should be using a higher average VMT when sizing the battery (but not when calculating activity).
- The net result is that a truck expected to run 140 miles per day on average, over its lifetime, should be specified with about 300 miles of range when brand new ( $140 \text{ miles} * 1.25 * 1.65$ ). Because Staff are missing these two factors, the size of the battery is underestimated by about 50%. The battery capacity has such a significant impact on the TCO model that ignoring these mileage factors dramatically overestimates the utilization of the battery and underestimates the TCO of the EV. If these revisions are made to the TCO model, Staff are likely underestimating the TCO of a Class 8 electric truck by 30-40%.

Finally, it needs to be recognized that Staff base the TCO model on a nearly idealized assumption about the operation of the fleet, specifically that the trucks can charge overnight at their home base. However, a survey of drayage operators conducted for the Ports of Los Angeles and Long Beach indicated that approximately half the fleet operated one shift per day and half the fleet operated two shifts. This is particularly relevant because Staff note that they assume EV adoption will happen first in drayage and other short-range applications. The model would have to be extensively revised to capture the impacts on a two-shift fleet, in particular, reassessing the infrastructure and electricity costs.

Staff repeatedly note that their economic assumptions are based on lower mileage fleets with operations more conducive to electrification, implying that the TCO model does not need to consider these higher mileage/two shift operations. However, given the significant fraction of fleets that operate two shifts and the proposed increase in sales requirements, it is extremely likely that the ACT regulation will impact fleets operating trucks more than one shift per day.

## Takeaway

Absent costs associated with addressing grid resiliency issues, the TCO model is likely underestimating the actual TCO for electric Class 7-8 tractors by 50 percent. This underestimate applies only to the nearly idealized use profile for single shift fleets. Costs will be higher for two-shift fleets that have not been considered by Staff. If resiliency measures are included, the TCO model could be underestimating costs by 80-90 percent.