True Balancing LLC
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Value Proposition for Commercial EVs

Overview

Our cell balancing technologies (True Balancing and Positive Balancing) can reduce operating costs of commercial EVs and can increase ROI significantly. They achieve this by doing the following:

- Increase operating time between battery recharges
- Maximize battery capacity
- Extend battery life
- Provide early warning of cells or modules that are going bad

Commercial EV Market Segments

The following segments of the commercial EV market can benefit from our balancing technologies:

- Local delivery and city buses
- Long-haul delivery
- Service vehicles in warehouses, airports, etc.
- Construction
- Agriculture
- Mining
- Light-rail trains
- Marine
- Electrified aircraft (such as eVTOL)

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Cost of Downtime

Commercial vehicles are business assets that generate revenue for the owner of the vehicle. When a commercial vehicle is not operating, it is not generating revenue. Downtime for commercial vehicles can cost several hundred dollars per hour to tens of thousands of dollars per hour[1], depending on the specific vehicle and the industry.

Downtime for forklifts can cost:[2]

- Manufacturing: $20,000 - $22,000 per hour
- Warehousing: $10,000 per hour
- Food processing: $6,000 - $9,000 per hour

Downtime for one dump truck can cost more than $1000/hour.[3]

Downtime in the mining industry can be particularly expensive. If mining operations must cease while equipment is down, the cost can be $40,000 to $200,000 per hour.[4]

True Balancing and Positive Balancing add value to commercial EVs in four ways:

1. Maximize utilization of battery capacity

   - This lets the vehicle operate for as long as possible between battery charges
   - Longer operating time between recharging reduces the amount of downtime
   - Our technologies can increase available battery capacity by 5% to 30%[5]

[1] https://rpmmachinery.com/the-cost-of-heavy-equipment-downtime/

[2] https://www.lillyforklifts.com/blog/how-to-calculate-the-true-cost-of-downtime

[3] https://doranmfg.com/maximizing-uptime-in-the-mining-industry-best-practices-for-truck-maintenance/

[4] https://www.linkedin.com/pulse/types-downtime-mining-industry-scheduled-n8j9c/ and https://www.boltstress.com.au/blog/post/downtime-cost-in-a-mining-industry

[5] Independent tests performed by Center for Energy Research at University of California San Diego demonstrated that True Balancing increased the capacity of Tesla Model S battery modules by an average of 15.9%, with maximum increase in capacity of 36.6%. The modules were between 10 and 12 years old at the time of testing.

2. Fastest possible recharge to true 100% SOC

- Existing balancing technologies, can take hours (and in some cases days) to complete the balancing phase of a charge cycle
- With True Balancing and Positive Balancing, the balancing phase of the charge cycle is typically measured in minutes
- This gets the battery to true 100% SOC and gets the vehicle back to work as soon as possible

3. Maximize battery life

- Battery replacement in commercial EVs imposes a major cost in both CapEx and lost revenue
    - Replacement batteries can cost between $10,000 and $250,000
    - Replacing the battery can take two to seven days, which is significant downtime
- Our technologies can extend battery life by 20% to 40%, which extends the interval between battery replacements

4. Safety – minimize incidences of catastrophic failure or thermal runaway

- Both True Balancing and Positive Balancing can provide real-time measurements of cell impedance. This can give early warning of impending cell failure and/or thermal runaway
- Thermal runaway can lead to a battery fire which will destroy the vehicle and could also ignite surrounding buildings and equipment
- True Balancing can give early warning of common failure conditions and allow preventive maintenance to be performed before critical or catastrophic battery events occur