November 1, 2023

To: California Air Resources Board
From: John F. Rizzo, Chief Strategy Officer, InductEV
Subject: Comments FY 2023-24 Funding Plan for Clean Transportation Incentives

Submitted via web portal

Introduction
InductEV is a global pioneer in wireless charging solutions for commercial fleets. We appreciate the opportunity to submit comments on CARB's 2023-24 Funding Plan for Clean Transportation Incentives. We recognize our comments address innovative charging infrastructure technology, and that the California Energy Commission oversees incentivizing that aspect of California's drive toward zero-emission transport. That said, we're submitting comments to CARB in an effort to broaden the knowledge base among California's decision makers about the many economic, environmental and technology-advancing benefits of wireless charging to California residents and businesses. We also would like to reinforce what we know is a growing concern – that vehicle purchase incentives and spending must be closely linked with charging infrastructure to ensure the successful growth of fleet electrification.

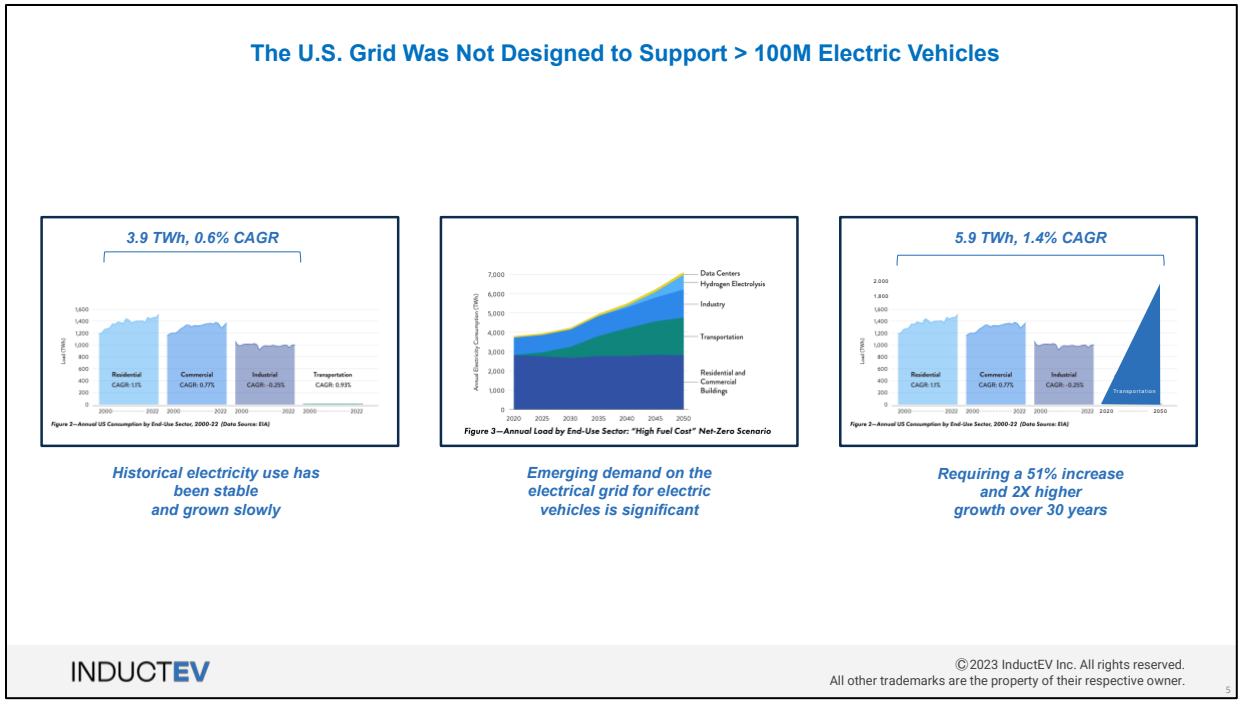
Company Background
InductEV (formerly Momentum Dynamics) is revolutionizing how electric commercial fleet vehicles charge their batteries. With its proprietary wireless technology now deployed in more than 20 locations worldwide, and with nearly 50 patents issued or in process, the Pennsylvania-based company is the global leader in high-power, high-speed wireless EV charging.

InductEV's technology lowers the total carbon footprint, capital outlay and ongoing operational costs for commercial fleet operators by minimizing dependencies on real estate and manual operations while maximizing vehicle uptime with on-route charging during daytime hours. This reduces electricity usage during peak-load times, while eliminating the need for large batteries, battery replacement, and recycling. To that end, InductEV recently opened the nation's first R&D center for wireless EV charging.

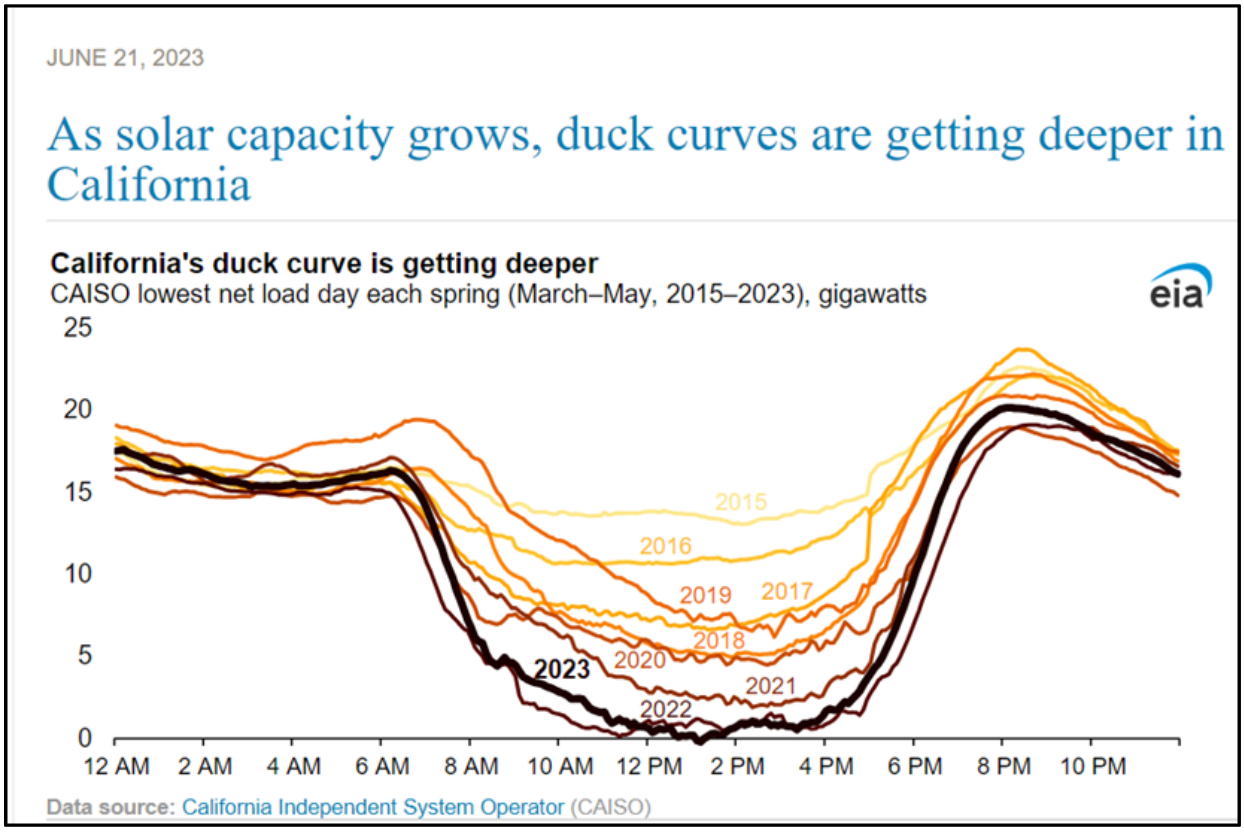
Helping the Grid
New technology developments in wireless electric vehicle charging could have profound effects on grid usage, carbon emissions, and electric vehicle costs. We strongly suggest CARB and other state agencies consider including wireless charging as a key technology ingredient to meeting California's carbon and criteria emission-reduction goals as you finalize your funding plan for Clean Transportation Initiatives.

As shown in the figure below, the United States electrical grid has historically delivered about 4 Terawatts of power to support the needs of commercial, industrial, and residential uses. Over the past 20 years, virtually no meaningful amount of electricity was used to power electric vehicles.

Forecasts for the electricity consumption of the electrification of vehicles in the United States are estimated to add another 2 Terawatts of demand for EV charging. This means U.S. grid capacity must grow at nearly three times the rate for the next 30 years as it has for the past 20. This is an unrealistic expectation at worst and a very expensive one at best. While we cite national grid data, it fits California's grid picture as the charts below show (source: https://liftoff.energy.gov/wp-content/uploads/2023/09/20230911-Pathways-to-Commercial-Liftoff-Virtual-Power-Plants_update.pdf)

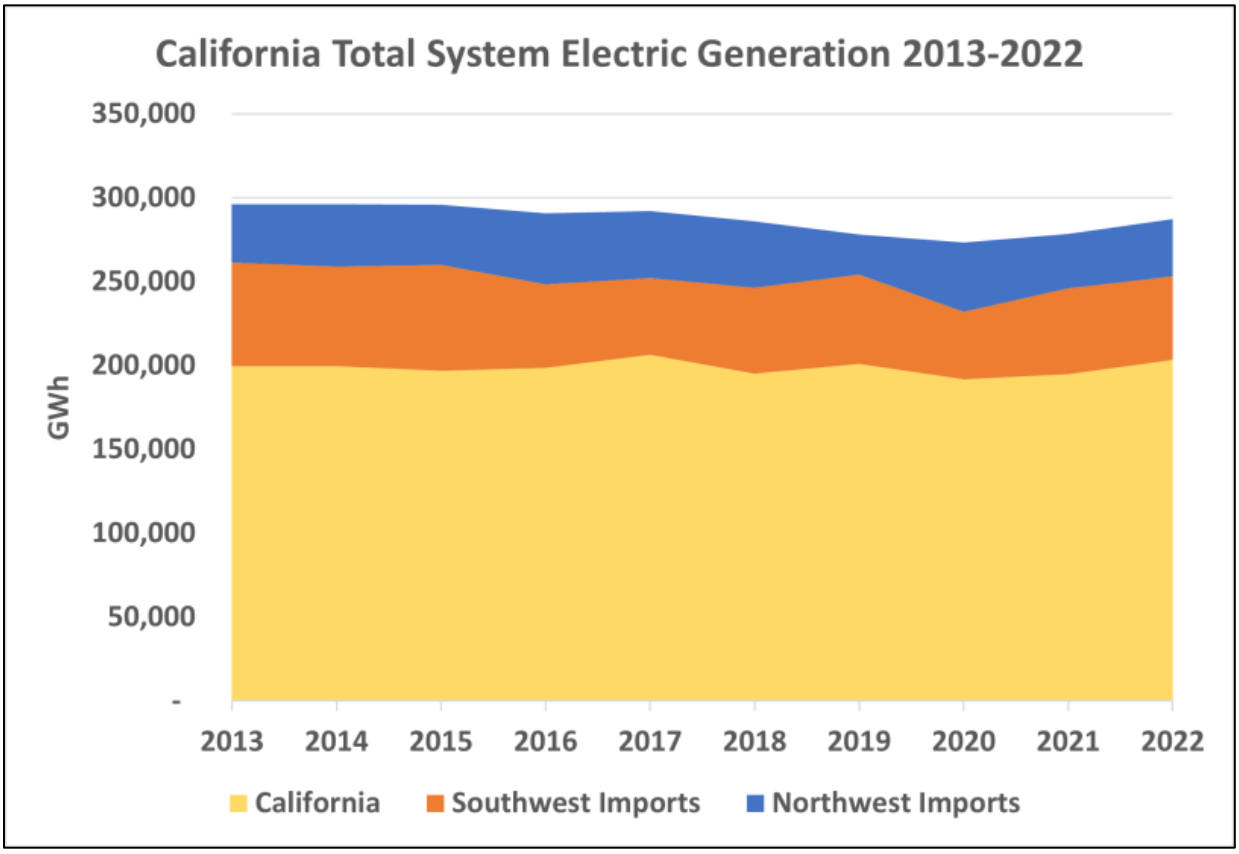


Further, there are significant shifts that are accelerating with respect to the national grid load. Historically, electricity consumption increased in the afternoon and evening but was still robust in the daytime. Over the past five years, significant shifts in load have driven most of the consumption in the afternoon and evening with dropping consumption during the daytime.

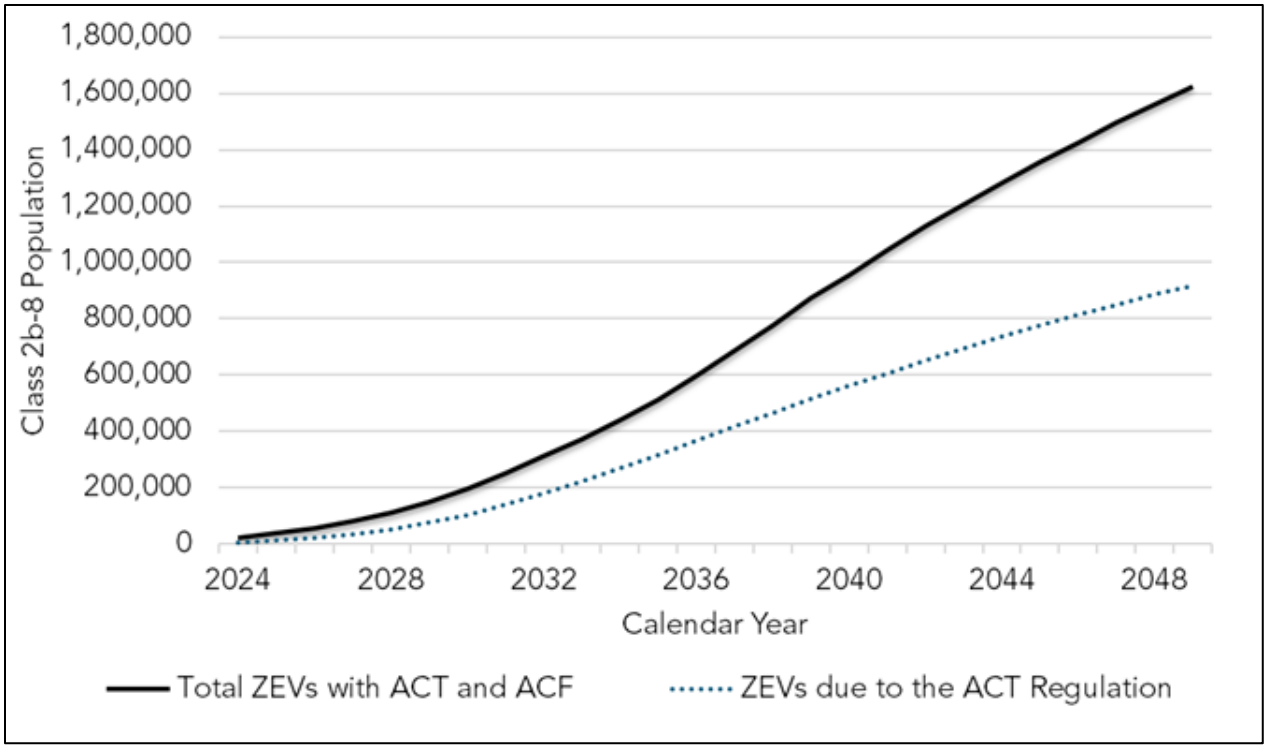


California's "duck curve" continues to show low loads during the day when renewable energy generation is highest. This shift implies that peak demand is increasing at a tremendous rate, which makes electricity more expensive during afternoons and evenings when most EVs are charged at home or in commercial fleet depots. In fact, compared to the diesel fuel equivalent, electricity can cost 4 times more per mile traveled than diesel when electricity demand spikes at peak times when fossil fuels are used to produce electricity, increasing emissions.

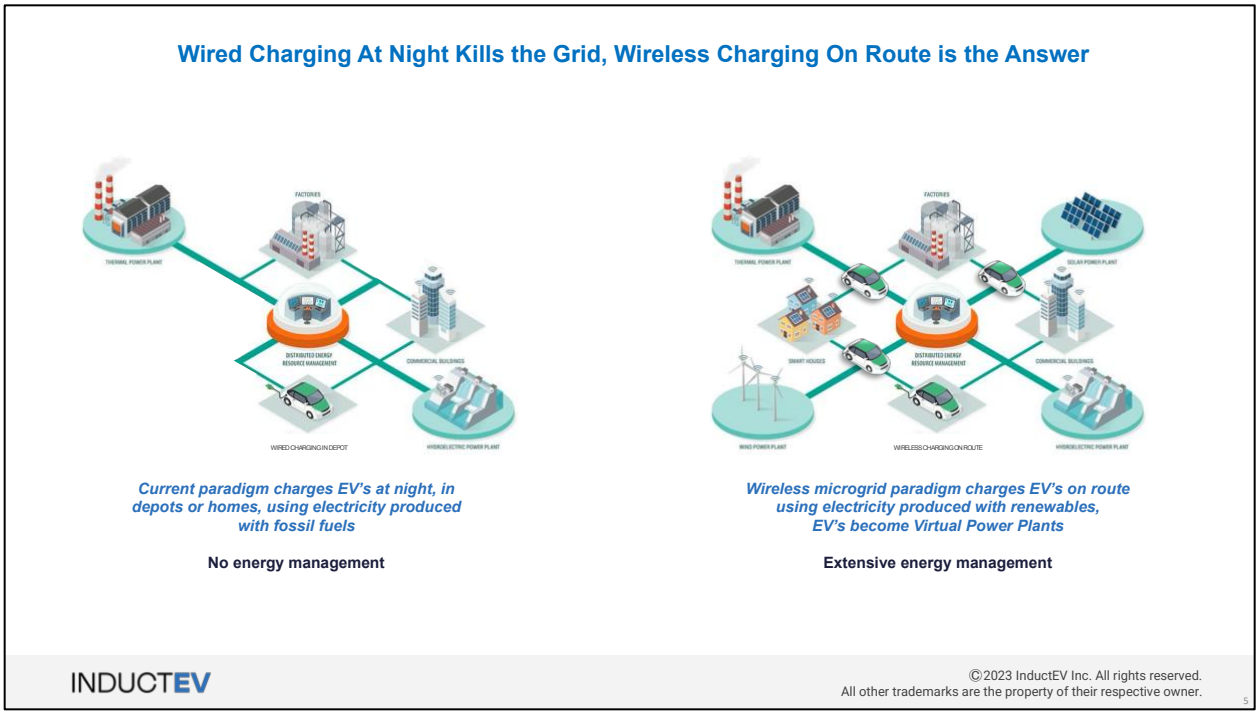
This significant price shift is largely due to renewable sources of electricity being largely online during the daytime (solar and wind) and offline at night. The surplus energy in California from renewables can be better consumed by charging electric vehicles on route during the daytime, rather than at night at homes or in depots. In certain markets where hydro and nuclear power are prevalent, the use of these renewable sources continues at night, but those fuel sources are generally a small fraction of overall grid electricity production.



Flat electricity production (above chart from CEC) is forecast while projected EV charging demand increases are expected to skyrocket (projections below from CARB's ACF Rule).



The current charging paradigm of electric vehicles and a future state is shown in the following diagram:

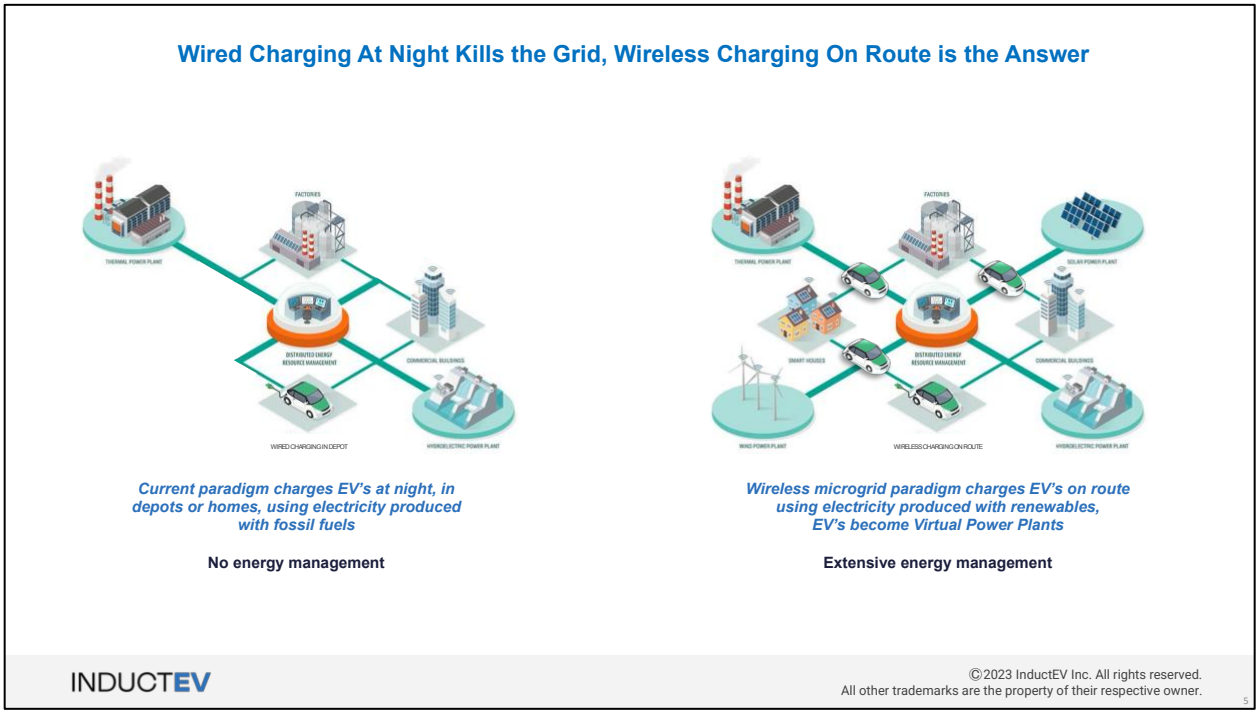


On the left side of the diagram is the current paradigm of wired charging, which has the following key attributes:

- Vehicle batteries are sized so that the vehicle can travel the normal daytime route and have enough energy to return 'home' to recharge overnight. Home may be literally a garage or an apartment building for passenger vehicles or a centralized depot for commercial and mass transit vehicles.
- Vehicles are more expensive and weigh more because they must carry large battery systems to have sufficient range.
- Compared to the diesel fuel equivalent, electricity can cost more per mile traveled than diesel when electricity demand spikes at peak times when fossil fuels are used to produce electricity, increasing emissions.
- Electricity produced at nights is produced generally by burning fossil fuels, which produce carbon, effectively powering clean cars with dirty energy.
- Batteries go through a deep recharge and deep discharge cycle, which increases costs because they need to be replaced or recycled.
- With the advent of high-power wireless charging systems, using the same inductive magnetic resonance charging used for smart phones, a new charging paradigm is now possible. This uses the same technology that has been used for decades in MRI medical imaging systems and inductive cooktops and is now being successfully applied to EV charging.

Improving the Economics and Adoption of Electric Vehicles

Referring now to this new wireless charging paradigm, shown on the right side of the diagram below, a new mechanism to charge vehicles is emerging. This approach involves charging vehicles while they are on their natural routes and charging them at high power when they stop and dwell normally, for example, when a transit bus makes a stop to collect and disembark passengers. Or a loading dock where trucks are stationary when they are loaded and unloaded. Wireless inductive charging systems begin high-powered charging in seconds compared to the minutes required for wired systems, so they enable this on route charging approach to be practically implemented.



The benefits of this approach include:

- Vehicles are charged during the day when electricity is produced with clean, inexpensive renewable sources.
- Fossil fuel produced energy at night is reduced as grid demand shaping occurs.
- The electricity for charging is spread over a wide geographic area instead of being concentrated in a depot. This means that permitting and new grid resources aren't as difficult to provision – it's easier to find 30 locations for 30 300 kW charges (total of 10 mW) than 30 300 kW chargers in one location.
- This speeds EV adoption due to the greater availability of grid resources.
- As vehicles now have more frequent charging locations on route and can count on charging resources they can be equipped with smaller batteries, reducing both vehicle cost and weight.
- Because battery life is extended by 8-fold by charging batteries in a narrow charge range (rather than deep discharge and recharge) batteries don't need to be replaced or recycled as often, saving cost.
- For emerging applications where vehicles are moving goods on private property and want to use drone like control, they can only be charged wirelessly.
- With respect to labor safety, there are no cables, no moving parts and as a result offer superior human factors and risk.
- Some labor unions are prohibiting vehicle drivers from using wired chargers, which thwarts adoption and growth of the vehicles.
- Overall, total cost of ownership and ongoing annual operating expenses are reduced compared to wired chargers, adding another benefit beyond decarbonization to the EV value.

Wireless High Power Inductive Charging is Market and Deployment Proven

Over the past 13 years over $140M has been invested in InductEV's technology development initiatives. This is complemented by over $300M invested by WAVE, WiTricity, and others. These development investments amplified the over $1B invested by Qualcomm, a San Diego company, in the 2000s to commercialize the technology.

Independent research studies confirm the efficiency of wireless charging systems from Grid to Battery at 90%, similar in performance to wired chargers at the same power level (Idaho National Laboratory, 2022, Intertek, 2017, reports available upon request.)

This technology has been adopted and integrated by manufacturers of Transit Battery Electric Vehicles being built in the state of California, including GILLIG in Livermore, GreenPower in Porterville, and RIDE (previously BYD) in Lancaster. Globally, the technology has been integrated onto models by Volvo Cars, Jaguar Land Rover, Vauxhall, and additional integrations are underway for the first yard tractors by OrangeEV and MAFI. The company expects to have the top 6 terminal tractors in the world integrated by end of the 1H of 2024.

The technology has been deployed by InductEV at 75 kW, 150 kW, and 300 kW across transit uses in Chattanooga, Tennessee; Indianapolis, Indiana; Wenatchee, Washington; Martha's Vineyard, Massachusetts; Gothenburg, Sweden; and is supported with grants approved by the CEC for transit deployments in Solano County, California. There are deployments rapidly getting underway in the Port of Long Beach and elsewhere across the state.

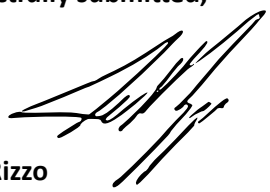
Wireless chargers deployed by InductEV have supplied more than 2 GW of power to vehicles during trials over the past 6 years and InductEV's order growth in expanding year over year by 10-fold from 2022.

Recommendations for your 2023/2024 Clean Transportation Funding Plan

Given the above considerations for this new technology we would respectfully ask the California Air Resources Board to consider the following:

- Allocate specific incentive funding for end users and OEMs to equip and enable the purchase of commercial vehicles with wireless charging technology built in.
- Allocate specific funding to equip and enable end users to purchase wireless chargers to be installed in commercial sites and municipal transit routes.
- Promote grid-friendly charging technologies, such as daytime charging and on-route charging.
- Suggest a percentage of commercial vehicles power for charging that comes from renewable energy sources.
- Allocate a percentage of funds for vehicles and charging that utilize wireless technology.
- Create grant funding opportunities for AI-software powered energy management systems to utilize grid shaping techniques to lower peak load challenges.

Respectfully submitted,



John Rizzo
Chief Strategy Officer, InductEV
John.Rizzo@InductEV.com