Navigating from Range Anxiety to Charge Anxiety to EV Bliss

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Introduction of new technologies is often met with suspicion, and nascent adoption, with anxiety. With electric vehicles (EVs), the main apprehensions have been Range Anxiety and Charge Anxiety - angst about how far an EV can travel on a single charge and finding a working charging station to replenish EV batteries.

Both types of anxieties impact EV adoption. EV buyers, excited to be in the vanguard of green transportation, can experience buyer's remorse in the face of Range Anxiety and Charge Anxiety - 46% of U.S. EV owners report seriously considering a return to ICE and hybrid vehicles. And both types of anxiety present obstacles to broad mainstream EV adoption.

Fortunately, as new electric vehicles enter the market with more extensive driving ranges, the anxieties that afflict EV drivers are diminishing, mitigated by advances in EV technology, charging point improvements, and investments in EV charging networks.

What is Range Anxiety?

EV drivers with Range Anxiety worry about getting stranded with run-down batteries, unable to reach either their destination or a charging station. Limitations on the range of EVs can include

- **Capacity:** insufficient EV battery capacity (compared to ICE fuel tanks and availability of gasoline)
- **Infrastructure:** gaps in charging infrastructure in regions where EV drivers live and drive
- **Schedule:** time required to charge a vehicle's batteries vs. trip schedules
- **Battery age:** degradation in battery performance as EVs age
- **Driving conditions:** cold weather impact on batteries, power consumption by air conditioning in hot weather, and sustained high-speed driving

Range Anxiety in Decline

Range anxiety, for the most part, no longer haunts EV drivers. EVs on the market today can surpass 350 miles (583 km) per charge, with some models boasting ranges of 500-600 miles (833-1,000 km), even under less-than-ideal conditions.

"We suffer more often in imagination than in reality." - Seneca

What is Charge Anxiety?

EV drivers can still face Charge Anxiety - distress about finding available, operational charging points, on a network they can access. EV drivers have nightmares about

- **Wait-time**: long queues at charging stations
- **Availability**: busy charging points, network downtime and broken-down equipment
- **Compatibility**: charging points incompatible with their vehicles

Overcoming Charge Anxiety

Charge Anxiety will likely persist in the EV marketplace for some time but is increasingly mitigated by several factors: EV charging apps, charging station build-out, charging network management, and advances in technology:

"I don't struggle with anxiety. I'm actually pretty good at it." - Anonymous

Mobile EV Charging Apps and Network Data

Mobile EV charging apps provide real-time data on charging station status, availability, connector type, charging speed and pricing, payment/authentication, and trip planning. Some apps take a different approach, crowd-sourcing charging station feedback and publishing reviews to help users plan routes and charging stops. A huge leap forward is the integration of these apps and capabilities into in-car systems (vs. running solely on mobile phones).

When choosing a mobile charging app, EV drivers should consider user-friendliness, accuracy and real-time data access, interface to multiple charging networks and integration of community-based reviews and feedback.

Advances in Core EV Technologies

The tech that powers electric vehicles does not stand still. Innovation in the various sub-systems that comprise the EV drive-train and charging infrastructure promise to revolutionize EV user experiences, delivering greater range and faster charging within 3-5 years.

The most promising avenues for innovation include

New sources for Lithium (Li) - mining and processing this volatile alkali metal used in EV batteries is both costly and environmentally unfriendly. Recently new Lithium deposits have emerged in the U.S. as well as novel sources, e.g., Li in waste-water from fracking.

Solid-State Batteries and other new technologies promise to halve battery weight, size and cost, and also reduce charging times.

Super Capacitors combine the design of a battery with the physics of a capacitor, offering lower weight, greater electric storage and ultra-fast charging.

Dynamic / Wireless Charging drawing on inductive and magnetic resonance devices embedded in roadways and parking spaces, similar to wireless phone charging.

Standardization driven by government and industry, while not as exciting as other tech innovation, is opening more charging points to a greater variety of vehicles, directly addressing Charge Anxiety.

Achieving EV Bliss

EVs attract consumers with lower operating expense and reduced carbon footprint; increasingly, EVs ownership also reflects social status. However, the EV charging ecosystem still lacks the ubiquitousness of fossil fuel channels and the convenience of legacy ICE refueling and driving. In other words, EV adoption faces anxiety-driven roadblocks.

Fortunately, the EV user experience has advanced remarkably in the last decade, progressing from bleeding edge to leading edge to mainstream. Today's electric vehicles are attractive, well built, comfortable and boast features and performance on a par with or superior to ICE-based competition.

Through partnership and investment by government and industry, EV charging infrastructure is catching up to market demand and consumer expectations. The result – EV Anxiety is on the decline and EV Bliss is just around the corner.