10 Steps to Build Sustainable Electric Fleets

Optimal Charging Networks Ensure Triple Bottom Line Benefits

BLACK & VEATCH

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Introduction

Businesses, governments, and utilities have set ambitious sustainability goals. Their focal point is transportation — the single largest source of greenhouse gas (GHG) emissions in the U.S.[1] — and transitioning to electric fleets is a vital part of their strategy. Black & Veatch developed this eBook, *10 Steps to Build a Sustainable Electric Fleet,* to help fleet and sustainability managers select charging technology and sites, plan for power delivery, and construct optimal electric vehicle (EV) charging facilities.

What you can't see can make all the difference. Behind EV chargers are elaborate energy systems that, when well-designed, provide the cleanest, lowest cost energy, at the right time, and without fail. Black & Veatch makes the invisible invaluable by helping managers scale fleet charging, reach operational goals, and create an enduring sustainability framework.

Vehicle Electrification as a Climate Action

Transportation makes up 27% of all GHG emissions in the U.S. and 14% globally.[2] Burning fossil fuels for internal combustion engines and energy generation produces the most CO_2 in the U.S. and across the world.[3] Broadly, businesses, governments, and utilities select fleet electrification as a top climate action to slash emissions, and many integrate clean energy sources and battery storage concurrently to build resilience.

Communities, governments, and industries are intertwined with and influenced by transportation.

Transportation has enormous impact—either beneficial or adverse.

Fleet Electrification Actions Escalate

645,000
federal fleet vehicles to transition to **electric by 2030**.[4]

330,000
electric vehicles (EV) that **CEVA members** such as Amazon, Best Buy, and Hertz, plan to buy for their fleets **over the next five years.**[5]

537 actions taken to encourage, pilot, or grow EV and **fast-charging networks in 46 states and DC** during Q2 2021.[6]

33% of fleets belonging to **EEI members**, such as Xcel Energy, Duke Energy, and Southern California Edison, will be **electric by 2030.**[7]

$12.5 billion
U.S. dollars allocated for a **national EV charging network** and to **fund low/zero-emission buses**.[8]

500,000
new **EV chargers** installed in the **U.S. by 2030**.

Transportation inextricably connects to communities and to nearly all industries that comprise the U.S. economy. Transportation's impact — either beneficial or adverse — has enormous influence. For this reason, fleet and sustainability managers think about sustainability expansively, pressing beyond their supply chains, jurisdictions, or grids. Tapping sustainability tools, they evaluate electrification projects based on the triple bottom line — **people, planet, profits** — to plan charging infrastructure in locations that best support communities, lead measurable progress in GHG reduction, and provide operational savings. (See the *Sustainability Tools for the Triple Bottom Line* infographic to find out which tools they are using).

Sustainability Tools for the Triple Bottom Line

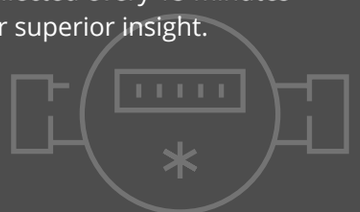
Businesses, governments, and utilities are influential change agents of sustainability. They set ambitious targets, integrate sustainability within their core business models, and pursue projects with measurable outcomes and impact. In addition to electrification, Black & Veatch offers several solutions that reduce emissions, conserve resources, and mitigate infrastructure impacts of climate change.

GHG Inventory:

- Identify emission sources and quantify associated emissions via standardized methods.
- Establish a baseline from which to measure GHG reduction after implementation of projects such as fleet electrification or renewable energy integration.

Advanced Water Metering Infrastructure:

- Identify consumption trends, water leaks, and system anomalies to manage water systems strategically and conserve resources.
- Enhance resource planning, improve asset performance, and reduce system losses. Improve business and billing processes through software platforms that process data collected every 15 minutes for superior insight.



Climate Resiliency Analytics:

- Quantify and mitigate potential costs of climate change.
- Black & Veatch meteorologists use a proprietary, comprehensive analysis to evaluate how climate change events such as flooding, forest fires, and hurricanes will impact critical human infrastructure.

Lifecycle Accounting:

- Account for sustainability and resilience value, economic and community impact, emission impacts, supply chain materials and product impacts, and costs.
- Compare and design ideal projects and locations that align with overarching goals, achieve triple bottom line benefits, and embody sustainable design and engineering.

The Powerful Influence of Fleets

Although U.S. fleet vehicles account for only 3% of all registered vehicles,[9] fleets greatly influence electrification of the entire transportation sector—including the larger personal vehicle market—because of their economies of scale and immense purchasing power. When sizable business, government, and utility fleets electrify, the positive effects ripple across several areas:

Technology

Large fleets foster technological evolution. As components such as power electronics mature, their performance increases, vehicle quantities grow, and vehicle technology and infrastructure costs drop.

Electrification Process Improvements

Through repetition, fleet electrification culls costly inefficiencies from the process. For example, utility interconnection and permitting processes become streamlined and prioritize charging infrastructure.[10]

Public Health

Clean transportation slashes tailpipe emissions and improves air quality, which would help generate over $1.2 trillion in health benefits across the U.S. between 2020 and 2050. These benefits include 110,000 lives saved, over 2.7 million child asthma attacks avoided, and 13.4 million lost works days.[11]

Electrification Equity

Lifecycle accounting helps identify routes and areas that would benefit most from electric fleets, such as those with higher pollutant exposure or designated environmental justice communities. Businesses, governments, and utilities can prioritize electrification of transit buses and delivery vans along routes in sensitive zones to decrease pollutants among the most vulnerable populations.

Climate Change

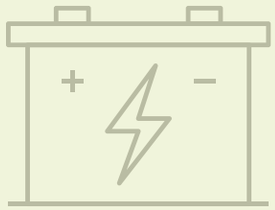
Over $1.7 trillion in global climate benefits could be achieved by reducing over 24 billion metric tons of GHG emissions by 2050.[12]

Four Ways Organizations Can Leverage Sustainability to Create Internal Value[13]

1. Infuse sustainability into corporate culture
2. Address sustainability issues broadly and collaborate with stakeholders
3. Account for sustainability factors when selecting and evaluating suppliers
4. Allow sustainability to influence how they manage facilities and transportation networks

Market Trends that Speed Fleet Electrification

Several factors increase technology confidence and adoption. Fleet and sustainability managers confidently transition to electric fleets, encouraged by several favorable market trends and the positive outcomes of electrifying cars, vans, and buses. (See the *Electric Vehicle Adoption Charges Ahead!* infographic to understand electrification momentum across vehicle classes.)



Battery Innovation Continues: Iron-flow batteries offer 4-24 hours of energy storage compared to 1-4 hours provided by lithium-ion batteries.[20] Several U.S. utilities and large commercial businesses are using them to decarbonize energy and foster sustainability and resilience.

Batteries

Batteries are essential for climate action because they help transportation and energy run on 100% zero-emission sources. Battery costs declined 86% over the last ten years, which helps lower initial purchase prices of all EV classes. The price of battery packs in 2021 was $132/kilowatt-hour (kWh), and costs are expected to drop to $127/kWh in 2023.[14] To reach needed battery cell production capacity and strengthen supply chains, 13 new EV battery factories will be operational in the U.S. by 2030,[15] and the U.S. Department of Energy is funding nearly $3 billion to develop a national battery supply chain for use in EV and energy storage.[16]

Battery performance increases year after year — in fact, warranty claims based on capacity loss are rare. On average, battery health degrades 2.3% per year, 1.6% under ideal climate and charging conditions.[17] Battery warranties range from 8-10 years, at which time 77%-87% of capacity will likely remain; the battery may run longer than guaranteed.[18] The California Air Resources Board proposed a rule — applicable to the 2026 model year and beyond — that would require EV to maintain 80% of their certified test-cycle range for 15 years or 150,000 miles,[19] which helps neutralize concerns over range and performance.

Investment and Incentives

The 2021 U.S. Infrastructure Bill earmarked $12.5 billion for a national EV charging network and low- or zero-emission buses.[21] Additionally, the Federal Highway Administration allocated $615 million nationwide to the National Electric Vehicle Infrastructure Formula Program to build the Alternative Fuel Corridors national network. With expanded commitment to transportation electrification, many states offer tax credits, rebates, and grants to lower the upfront cost of EV charging stations and offset slightly higher vehicle costs.

Vehicle Availability

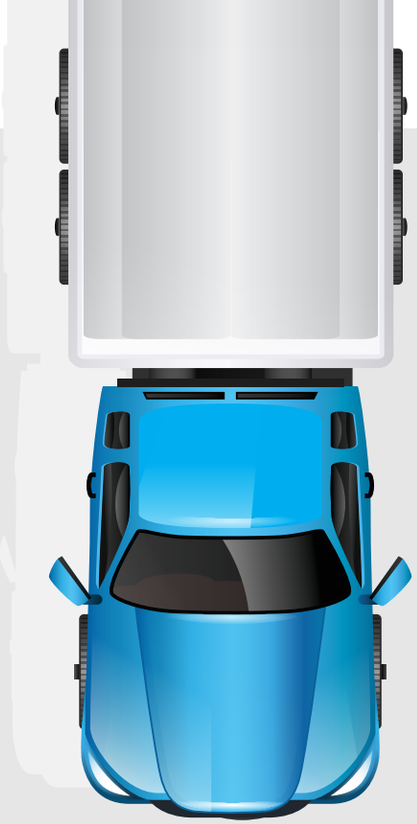
OEMs continue to provide new EV models across classes. Today, there are 122 models for electric sedans/wagons, pickup trucks, and SUVs; 9 electric van and step van models; 19 electric passenger van and shuttle models; 30 electric transit bus models; and 14 electric school bus models.[22]

Sustainability Commitments

Electric fleets help businesses, governments, and utilities meet sustainability commitments and the stringent laws on fuel efficiency and emissions. Now is the time to plan sustainability projects and initiate baseline GHG measurements. If passed, the sustainability reporting regulations proposed by the Securities and Exchange Commission will require publicly listed companies to disclose governance, risk management, and strategy regarding climate-related risks.

Electric Vehicle Adoption Charges Ahead

The transition from diesel and gasoline to electric vehicles (EV) continues to build momentum as favorable market conditions and outcomes increase adopter confidence. Despite the global chip shortage and supply chain issues, EV adoption across all vehicle classes is strong. This momentum could continue alongside massive state and federal investment into charging infrastructure and increasingly stringent emissions regulations and sustainability goals.



Electric Light-Duty Vehicles[30]

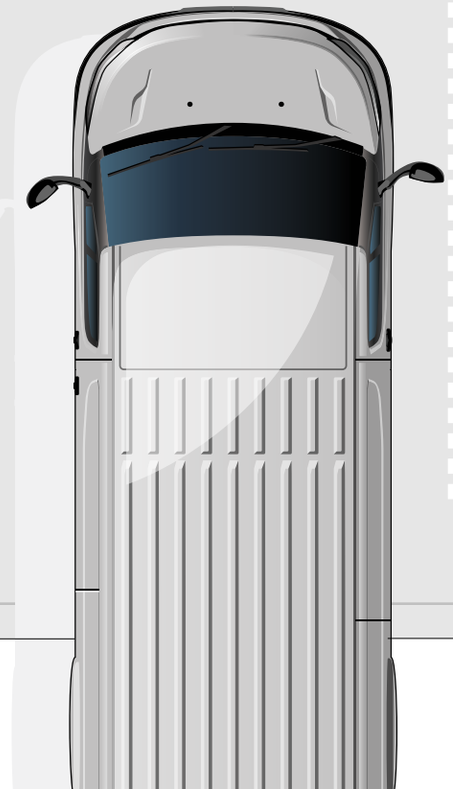
- U.S. **sales doubled** in **2021**
- **700,000** total **EV registrations**
- EV now **4.5% of U.S. car market**

Electric Medium and Heavy-Duty Vehicles[31]

- **1,215 zero-emissions vehicles** Class 2b through Class 8 on road
- **140,000** pending orders
- **By 2035,** electric MHDV will cost the same as or **less than diesel trucks**

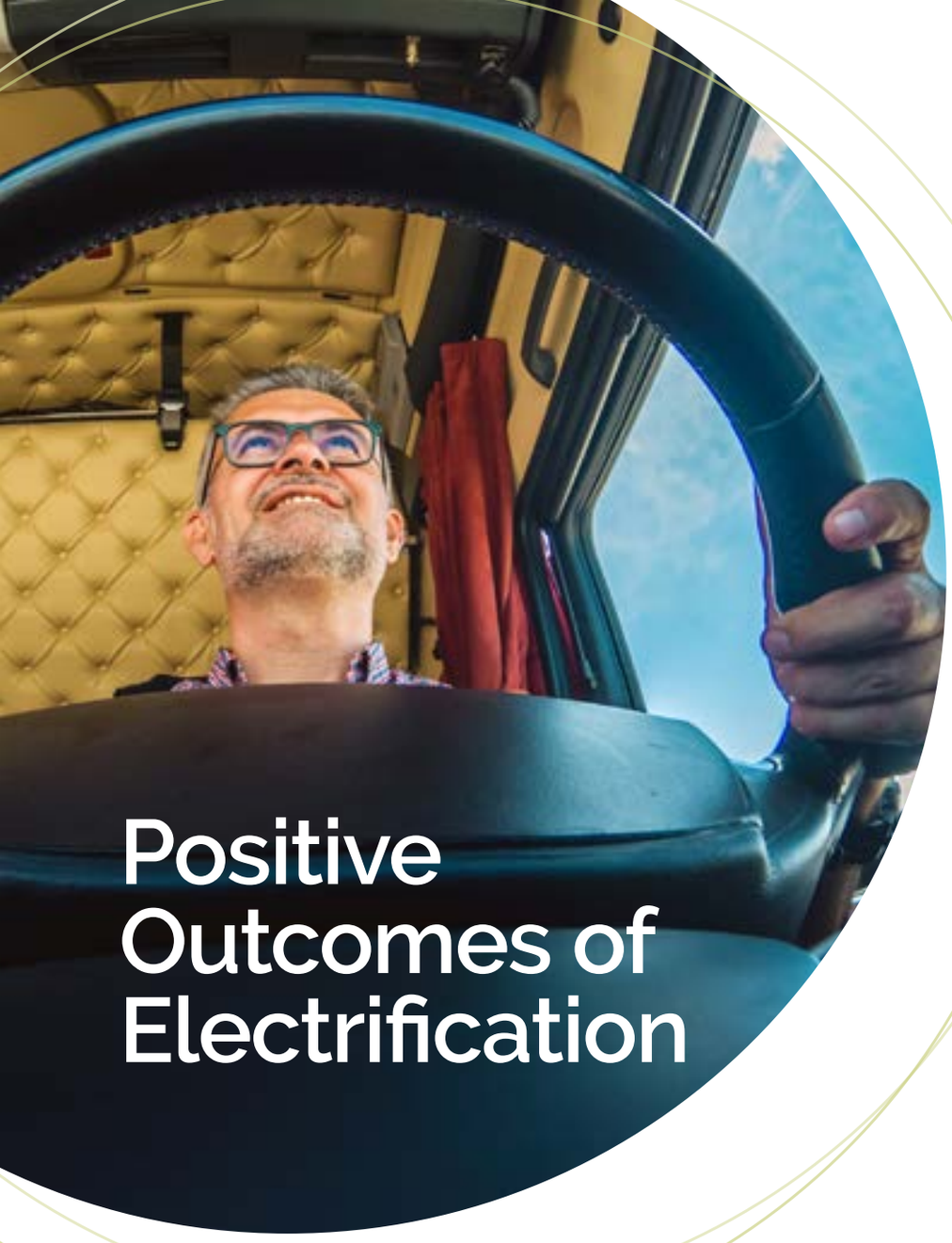
Electric Transit Buses[32]

- **Sales grew 112%** from 2018—2021
- **3,533 buses** on the road or on order in **46 states**
- At **cost-parity** with, or less than, **diesel**



Electric Delivery Vans and Step Vans[33]

- **e-Commerce boom** is driving growth
- **Multiple OEM** models
- **FedEx, UPS, Amazon,** and **Walmart** placing orders
- **2,200 on road** in U.S. & Canada by **2025**



Positive Outcomes of Electrification

Lowered Total Cost of Operation (TCO)

Commercial electric trucks and vans could lower maintenance costs by 25-40% and electric light-duty vehicles (LDV) by 40%.[23] Even with regional surges in electricity prices, fleet and sustainability managers will pay less to charge their EV than to fill a gas tank. After eight years, an electric LDV could save $6,576 in fuel costs.[24] Electric transit buses are already at cost-parity with, or less than, diesel. Compared to their gasoline counterparts, a fleet of electric vans or step vans would save $8,107 in annual fuel costs per vehicle, per year.[25]

Improved Working Conditions and Safety

Electric motors are quiet, fumeless, and do not vibrate, which reduces driver fatigue and may increase driver retention. Without a loud, rumbling engine, drivers hear critical radio communication, increasing safety. On-board telematics collect speed data, enabling managers to monitor and encourage safe driving habits.

Strengthened Resilience

Emissions reduction requires a fundamental shift in fleet operations. This shift is an opportunity to include generation sources and onsite storage to monetize energy sources and control fleet expenditures. As part of EV charging planning, managers can choose a flexible, modular design that supports energy storage and a mix of energy sources such as renewables, electricity, biogas, hydrogen, and liquified natural gas. The system evolves to support new apps and technologies as they mature.

Enriched Customer Loyalty

IBM found that 57% of consumers would change their buying habits to help cut negative environmental impact; this number jumps to 77% among those who say sustainability is important to them.[26] Corporate fleets gain a competitive edge by setting sustainability goals that emphasize triple bottom line benefits.

Sustainable municipalities capture similar advantages. The World Economic Forum found that businesses prefer to invest in sustainable cities to increase the wellbeing of employees, strengthen corporate reputation, and demonstrate corporate responsibility.[27]

Expanded Charging Networks for the Greater Grid

Right now, third party companies own most charging stations, but utilities are well-positioned to create profitable charging and grid services, bolstered by expanding regulatory approval from state utility commissions. The National Electric Highway Coalition (a group of more than 50 power companies) provides EV fast-charging posts to fill the charging gaps along highways. As specialized stakeholders, utilities extend high-voltage connections to existing or new charging locations or purchase charging locations as the host.

Once networked, charging stations support vehicle-to-grid and managed charging to turn EV charging stations into a grid-regulating tool that balances performance like voltage, frequency, and ramp rate reduction. Managed charging is highly valuable in energy systems with variable renewables, which creates an agile system that matches supply and demand[28], minimizes peak demand, and levels electrical costs to save fleets money. In Denver, an electric city bus fleet that uses managed charging saves 83% over gas or diesel; an electric LDV fleet saves 63%; and a medium-duty van fleet saves 71%.[29]

The Town of Vail, CO, is among the first U.S. cities to begin full electrification of its diesel bus fleet. Vail chose Black & Veatch to help them make this important transition to sustainable transit.

10 Steps to Build Sustainable Fleets

As electricity becomes their new fuel, fleet and sustainability managers navigate a maze of technologies, infrastructure choices, and supply chains. The transition to electric fleets is different for each organization. Some managers electrify major portions of their fleets, while others begin with a smaller trial project to help with proof-of-concept. Regardless of the undertaking, EV fleets present a substantial opportunity for organizations to reduce their operating costs and drive the adoption of emissions-free transportation.

Electrification must be systematically tackled to avoid increased costs.[34] Black & Veatch developed these steps to guide the process, inform scheduling, and cost-effectively plan optimal charging facilities.

Step 1:

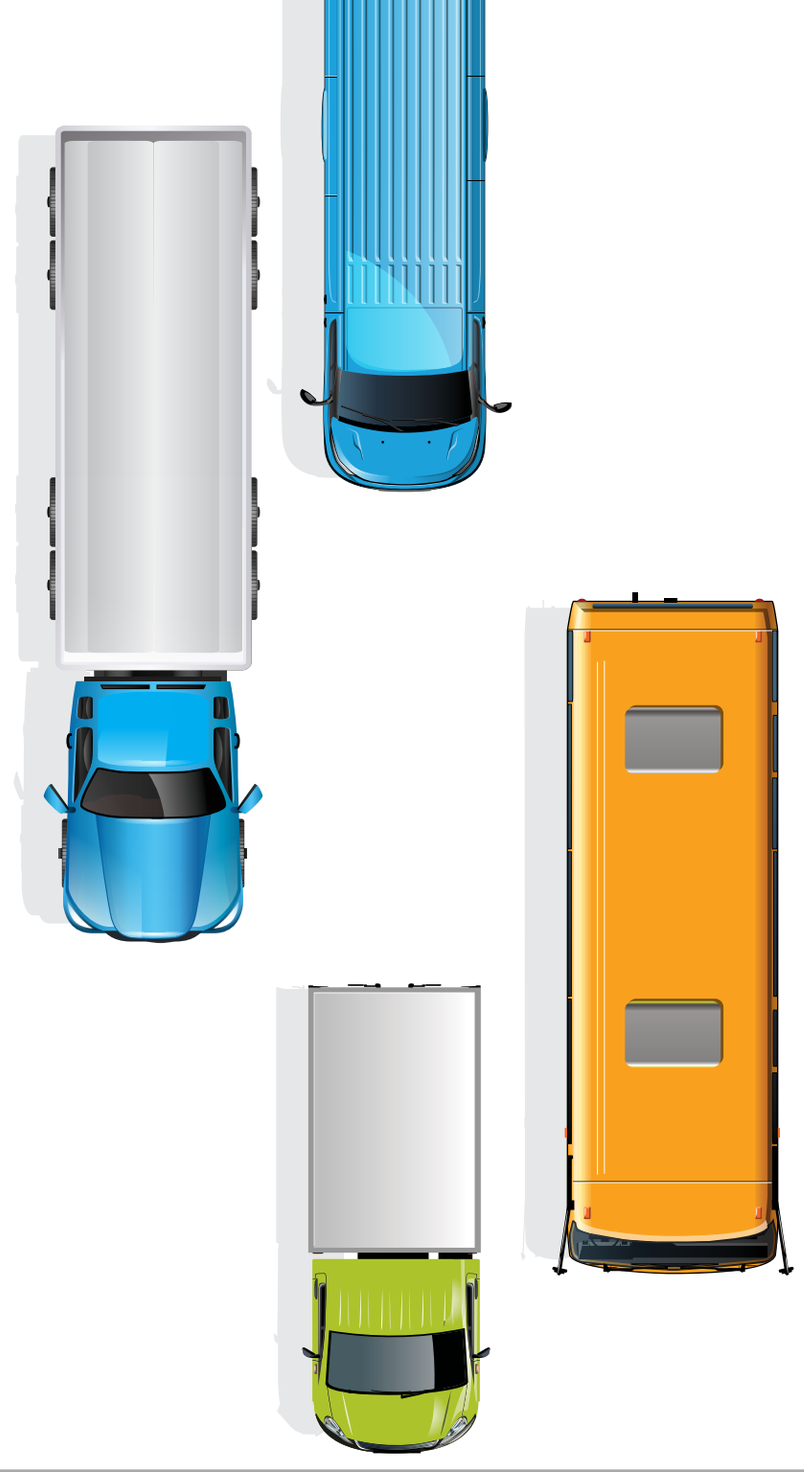
Define Fleet Profile and Use

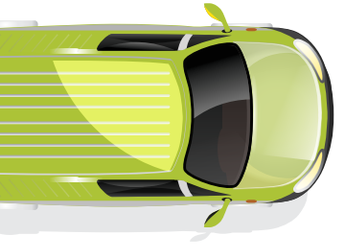
Define duty/drive cycles, fleet route length and conditions, lifetime cycles, payload, dwell time, and maintenance & operational considerations. Identify available grants and incentives. This information helps determine the TCO, optimize technologies, and translate route data into cost savings. Options include depot charging, on-route, shared, and destination/endpoint charging, either alone or in combination, to meet capacity and resilience requirements.

Step 2:

Manage Organizational Changes

Electrification requires staff to adopt a new way of working. Apply change management methods to set an organizational strategy to guide the transition to an electric operation. This strategy helps determine and manage operational impacts, keep morale high during the transition, ensure staff skills evolve to support electric fleet operations, and align outcomes with goals.





Step 3:

Review & Select Technology Options

Consider types of vehicles, charging technologies, communications networks, and software platforms for EV charging coordination and management. These selections help managers integrate on-site facilities and distributed energy resources, and optimize these systems around management of fleets, green energy, and charging. A networked system is especially valuable to managers and utilities as the size of fleets and capacities grow exponentially. Supply chain bottlenecks create long lead times for equipment such as switchboards and batteries. Order equipment early.

Step 4:

Optimize On-Site Energy

Evaluate options for on-site renewable energy and storage to minimize peak demand charges, balance loads, and lower the cost of clean energy. A flexible, low-cost energy system monetizes energy sources to control fleet expenditures, speeds return-on-investment, and reduces the TCO.

Step 5:

Understand Demand for On-Site Electric Power

EV sites need power. For example, a fleet of 56 buses would require around 11 MWh, and a fleet of 542 could demand around 109 MWh.[35] Equipment upgrades to grid elements and facilities may be required to support on-site charging. Building retrofits require electrical and utility interface planning, cooling design, and space for equipment.

Step 6:

Site Selection and Planning

Careful consideration of zoning, permitting, physical space, communications, and power supply is critical. Thoughtful and informed site selection minimizes project cost and time. Sites need to accommodate a functional facility layout ideally located and built within the community. Several factors can dramatically affect schedule and cost, like distance from the site to a substation and whether upgrades are needed along the distribution circuit due to competing site developments and charging load.

Step 7:

Conduct Utility Coordination, Engineering & Design

Start local and regional utility engagement early to develop a power delivery roadmap that leverages utility programs and charging rates. The planning process incorporates calculated savings based on future charging or production loads. To future-proof design, consider growth over five to ten years (and longer) to anticipate power capacity for a facility. Charging and energy production and storage technology will continue to advance, but it may be most cost-effective to install existing and anticipated on-site infrastructure at the same time.[36]

Step 8:

Apply for Permit & Approvals

With larger-scale developments and increased power levels, zoning, land use, permitting, and right-of-way requirements are complex. This complexity comes from space requirements and the many real property agreements needed by the utility to cross parcels for power delivery. Required entitlements may include state environmental impact filings and interagency agreements and approvals. Other related paperwork that may be required includes applicable terms and conditions of equipment, vehicles, and infrastructure, leaseholder or property owner agreements, and deployment services.

Real estate is quickly becoming a competitive hot spot in electrification. Guided by sustainability goals, many facilities managers actively purchase suitable sites and rent out sites until they are ready to develop. Obtaining the right sites now will save money in the long run. Black & Veatch services help simplify this process:

- Pre-Acquisition & Acquisition
- Title Services
- Land Use
- Environmental, Regulatory & Permitting
- Siting & Routing Services
- Right-of-Way Services
- Fielding Services

Step 9:

Distribution Grid Upgrades

New charging loads may require upgraded or new utility feeders, substation modernization, and even new substations. Engineering, design, and construction scopes become more intricate with increasingly complex upgrades, affecting deployment cost and schedule. A power delivery schedule without grid upgrades is about eight months. As the *Grid Connection Lead Times* Infographic shows, grid upgrades can run 48 months or longer depending on the complexity.

Grid Connection Lead Times

Charging Site Capacity	Grid Upgrade	Example Timeline
Up to 1 MW	**No distribution circuit upgrades.** Site is supported with a new service transformer connected to the local distribution grid.	2-4 months
1 MW	**No grid upgrades.** The supply conductor may require replacement as service transformer size increases.	6-10 months
	Grid upgrade, re-conductor or new line equipment. If the distribution circuit overloads, then the overhead or underground wire may require upsizing to increase the load capacity and improve voltage regulation on the feeder.	10-14 months
2 MW	**No grid upgrades.** The site may require primary service at medium voltage if the site load exceeds standard service transformer and low voltage switchboard ratings (typically around 3000 A). Medium voltage accommodates multiple service transformers (behind the meter, customer owned).	3-6 months
5 MW	**Grid upgrade, new feeder.** A new circuit from the substation to project site is required if site capacity exceeds the line capacity and line upgrades cannot address overloads.	12-26 months
10 MW	**Substation upgrade, new transformer bank.** An overloaded transformer bank is either replaced by a larger bank in the substation or another bank is added.	24 months or more
20 MW	**New substation.** A new utility substation or dedicated high voltage substation may be required for very large installations.	24-48 months or more

Step 10:

Integrate Equipment, Construct, & Commission

Construction starts when the fleet manager receives all permits and approvals including a signed/sealed drawing package and a utility design package. If new or upgraded electric service is required, the utility will complete their infrastructure construction before energizing the site.

After inspection and commissioning, conduct regular and preventative maintenance of charging equipment to ensure the physical infrastructure and user interface function properly, accurate power supply, and safe operation of the charger. Monitor utilization data, drive cycles, and vehicle charging rates to understand fleet profile and use, and adjust operations for optimized charging.

End Notes

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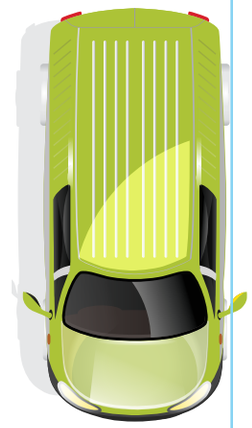
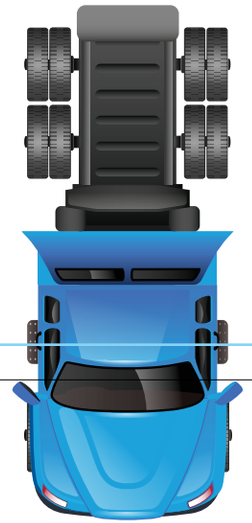
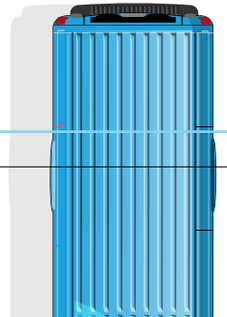
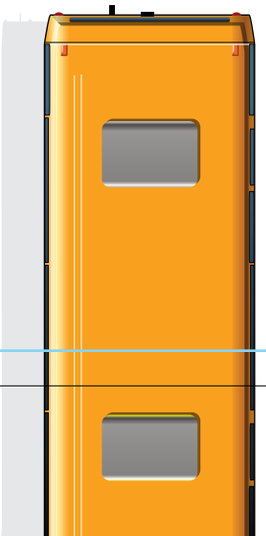




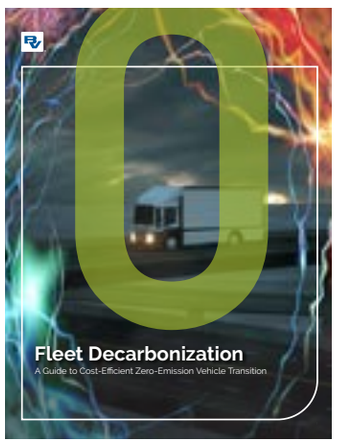


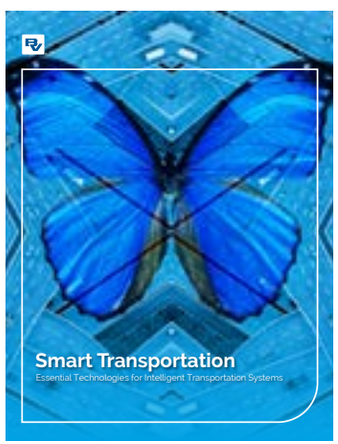


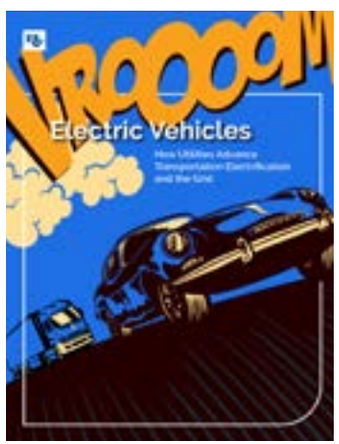
Conclusion

Massive charging infrastructure investment and favorable market conditions are generating technology confidence and motivating fleet and sustainability managers to transition to an electric fleet. As long-term investments, charging facilities are enduring networks that support managers and their unique transportation mission. Insightful planning is critical because present-day design decisions impact longevity, scalability for future growth, and bottom line TCO.

As an infrastructure leader in transportation, power, sustainability, and telecommunications, Black & Veatch provides valuable planning, analysis, site acquisition, and design services for optimal charging facilities. We go beyond the project to enable growth, sustainability, resilience, and more.







At Black & Veatch, we've made it our mission to help companies and organizations identify, evaluate, and deploy the most advanced clean transportation technologies available.

Read our eBooks to stay ahead of the curve.

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