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EV INFRASTRUCTURE 101

An Early Market EV Whitepaper from ABM for Facility Managers

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EXECUTIVE SUMMARY

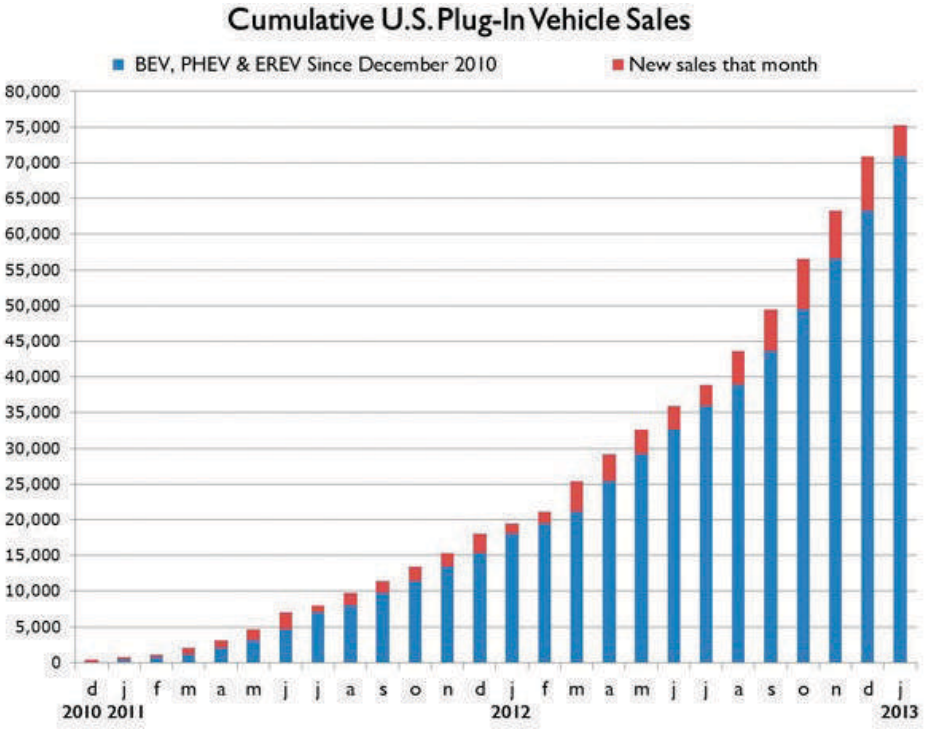
With the exception of traditional fleet management, the Facility Management industry historically had little overlap with what's happening in the Automotive or Transportation sectors. But things are changing – fast. The new generation of Electric Vehicles "EV" is literally bringing the transportation industry to the front doorstep of property owners and managers everywhere. Until recently, the personal fueling habits of visiting drivers were not on the list of property owners' top concerns.

The new era of attractive, mass-market, consumer-friendly EVs is completely changing the way drivers "fuel up" their cars. Rather than going out of their way for a traditional gas station stop, today's EV drivers usually "charge up" at home while they sleep and "top off" while at the places they already spend their time – at work, or while dining, shopping, or enjoying recreation or entertainment. This EV movement brings opportunity and burden to facility owners of all types – government, commercial, retail, industrial and multi-tenant residential. Like it or not, property owners are getting into the business of offering "fuel" for the EV vehicles of their employees, tenants and visitors. This new trend can raise questions, opportunities, risk, rewards and expense.

As EV sales increase, facilities of all types will need to accommodate vehicle charging on their property. This whitepaper provides an introduction to some of the basics of this new and changing industry – and some tips on how to get started on your own EV infrastructure project.

THE NEW WORLD OF ELECTRIC VEHICLES

The new age of mass-market Plug-in Electric Vehicles (PEVs, or simply, "EV") is here as the Nissan Leaf and Chevrolet Volt kick-started the industry in 2010 and are on their third model years with faster charging options and enhanced features. As anticipated, new models from Ford, BMW, Toyota, Tesla and more have arrived in showrooms and on the highways. Plug-In Vehicle sales for the USA in March 2013 set an all-time high by surpassing 4,500 vehicles sold, according to the Electric Drive Transportation Association. EV sales growth is highlighted in the chart below. According to Plug In America® (the leading voice for consumer adoption of plug-in vehicles) the historic milestone of more than 100,000 new generation, highway capable plug-in electric vehicles was reached in May 2013.



Source: http://www.electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952

Nissan Leaf

Chevrolet Volt

EVs on display: Ford, BMW, Nissan, Toyota

Three Types of Plug-In Electric Vehicles

Plug-In Hybrid Vehicle (PHEV)	Extended Range Electric Vehicle (EREV)	Battery Electric Vehicle (BEV)
Wheels powered by ICE and/or electric motor	Wheels powered only by electric motor	Wheels powered only by electric motor
Electric only range of about 15 miles	All-electric range of approx. 35 miles	Range of 80-250 miles
Blended with gasoline engine to achieve higher speeds and torque	Gasoline generator powers the vehicle for extended driving	Depending on driving conditions, battery size

Battery Electric Vehicle (BEV)
100% Electric • Zero Emissions

BMW Active E

Extended Range Electric Vehicle (EREV)
No "Range Anxiety"

Chevrolet Volt

Nissan Leaf Battery Pack

EV INDUSTRY SUPPORT

ABM in Los Angeles

The push for Electric Vehicles is being accelerated through governments as well as the private sector. Public agencies are phasing low or zero-emission vehicles into their fleets to reduce toxic emissions and improve air quality. Federal and regional investments for public charging infrastructure are becoming more commonplace.

For example, California Governor Brown signed an executive order laying the foundation for 1.5 million zero-emission vehicles (ZEV) on California's roadways by 2025. The Governor also announced a $120 million dollar settlement to fund the construction of a network of 10,000 EV charging stations across 1,000 locations throughout the state. In New York, Governor Cuomo announced Charge NY, an initiative to create a statewide network of up to 3,000 public and workplace charging stations over the next five years and to put up to 40,000 plug-in vehicles on the road during that same period.

Power utilities across the country are offering incentives and special pricing packages that encourage the purchase of low and no-emission vehicles. Most utility programs offer cheaper electric rates at night to encourage off-peak charging when the power grid is not stressed.

ABM at California State Capitol, Sacramento

The government initiatives are designed to strengthen growth in clean tech job creation, improvements in air quality, and to reduce our country's dependence on foreign oil. Every year, billions of US dollars are sent out of state and out of country for petroleum products. EVs can help reduce the amount of expense and dependence on potentially hostile countries while also cutting back on emissions that cause health problems for our citizens.


ABM at U.S. Navy Exchange, San Diego


ABM at AT&T Park, San Francisco


ABM at City of Laguna Beach

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ELECTRIC VEHICLE INFRASTRUCTURE

The EV charging station industry is growing fast and changing rapidly. The industry refers to EV charging stations as Electric Vehicle Supply Equipment, or simply "EVSE".

Types of EV Charging Stations

Level-1 uses a standard 110/120-volt receptacle. A simple cord with an adapter uses a standard wall plug on one end and the EV's standard charging port on the other. This offers a slow charge that takes most of the night or more to fill a BEV from empty to full.

Level-2 uses the SAE J1772 for faster charging. 208/240-volt. Level-2 is about twice the speed of a Level-1 (4-6 hours to fully charge a Nissan Leaf) and the global industry standard. With their relatively low cost and moderate electrical infrastructure demands, Level-2 stations have become the practical standard for the majority of sites. Keen eyes will notice a growing number of charging stations popping up in key metro areas at retailers, public parking sites, workplace hosts, parking structures and at residences. Early adopter host sites are still making headlines and are proud of their investments to encourage eco-friendly and emission-free vehicles.

Level-3 DC Fast Charge: 480 volt, very fast charging for automobiles equipped with the Fast Charge option. DC Fast Charging can charge a Nissan Leaf to 80% of its capacity in less than 30 minutes. At the time of this writing, a small number of US vehicle models offer the fast charge port option but that should change by year end.

Unlike Level-2 where there is one global standard, Level-3 chargers have at least two "competing standards". These "standards" have regional roots yet both are battling for global dominance. It will take some time to see if the industry moves to a single option or if we live with two for the foreseeable future.

- **CHAdeMO "Cha-de-mo"** – The Nissan Leaf and the Mitsubishi i-Miev offer a CHAdeMO Fast Charging port as an option in the US.
- **SAE Combo** – Leverages the original J-1772 plug format and claims to help save auto makers money by having a single combo port. New car models from USA and Europe are said to be adopting this option

Two short years ago, Level 3 charging seemed to be a long way off from practical deployment. However, recent developments are bringing DC Fast Charging to selected markets in the US and abroad. The good news is that prices are dropping and more options are coming to market. As in most industries, there are a variety of options and features to consider that affect price and payback.

Need to Future-Proof? We're Plugged In

Newer vehicles, and their owners, demand faster, better charging, and even Level 2 charging is falling behind the curve. Level 3 DC Fast Chargers rise to the challenge, but they also need higher voltage support, and that requires capable technicians trained to safely work with higher voltages.

ABM teams know how to design efficient, safe, and dependable installations. We have the experience to help you plan ahead and future-proof your installation. Our teams include emergency preparedness to make sure fleets can be fueled and ready for critical tasks. ABM provides the entire package, from design and implementation, to proper service and maintenance, so you can right-size your EV charging assets and maximize their useful service life.

Electric vehicles continue to evolve, and ABM is helping our clients lead the way, with projects like infrastructure for electric shuttle and bus fleets. For event venues, car dealerships, parking centers, and businesses across the nation, our teams can help you take charge of your EV strategy.

THE NEED FOR EV CHARGING STATIONS

In September 2012, ABM helped AT&T Park in San Francisco become the first ballpark in California where fans can fully charge their EV during the course of a game, enabling them to meet yet another sustainability milestone.

Retailers are rewarded for their EVSE investments through shoppers that pick their EV-friendly locations over the competition. Workplaces see the rewards of happy employees who can top off their EV while at work. Local governments draw drivers (and shopping dollars) to their cities though convenient EV charging infrastructure. Condos, apartments and parking structures offer EVSE as a competitive amenity to attract the EV driver population.

EV charging stations are required across a variety of venues and can also help facilities meet their green initiatives:

- **Parking structures** – Commercial complexes, airports, shopping centers
- **Government** – City, county, state, federal - Public access to charging at downtown parking and shopping, and as an employer and for EV fleets
- **Commercial and industrial** – Employer workplace locations and EV fleets
- **Large entertainment venues** – Stadiums, Theme Parks, and Concert Venues
- **Mixed-use facilities** – Multi-tenant building owners will need to accommodate EV drivers
- **Public and private fleets** – Electric buses and shuttles need access to efficient charging

Reasons for Installing EV Charging Stations

As Electric Vehicle adoption continues to grow, consumers will gravitate to places where they can charge up while doing other things like working, shopping or dining. Stadiums with EVSE can let customers charge up while taking in a game or a concert. Consider:

1. **A facility might reward employees who made early stage investments in non-petroleum transportation by offering free or subsidized charging**
2. **Companies, universities and local governments want to show they are doing their part in helping America achieve energy independence while fostering environmental stewardship**
3. **A large entertainment venue (stadium, theater, etc.) might offer close-up or covered EV charging and parking near the VIP section**
4. **If the pursuit is a commercial endeavor, a facility can add a surcharge on top of a standard parking fee. Payment options include:**
   a. Fees can be collected as they are today by parking staff
   b. Valet services can optimize charging station utilization by promptly moving EVs when their allotted charge is done
   c. Premium charging stations have the capability to accept credit cards, selected membership cards, and payment-by-phone
   d. Premium EV charging stations handle variable billing rates so a facility can optimize time-of-day pricing to balance access and station sharing
   e. A commercial EV charging station can work like an "electronic vending machine" that needs no refills and no middle man

Sample of Advanced Features to Be Considered

The use of technology in charging stations brings features that provide additional value from a management and usability perspective. Manufacturers offer product options ranging from simple no-frills devices to technologically advanced networked systems with cloud-based software to track activity and create usage reports. For example,

- Facility Managers can limit access to their chargers through a number of security options such as RFID and proximity card readers, key fobs, and PIN numbers.
- Smart charging stations feature a central control center that allows the connected units to be remotely monitored, accessed and serviced, 24/7.
- Today, some facilities are adding advanced photo voltaic arrays that augment their power source with solar energy.
- New payment models are evolving – such as subscriptions similar to today's cellular service –providing more cost-efficient and flexible solutions.

Considerations Prior to Installing EV Charging Stations

We believe facilities should consider EV infrastructure as part of a larger sustainability or energy- efficiency strategy, not just an independent green project. Realize in advance how the new EVSE load can alter the energy profile and pricing impact of a building or a campus. Fortunately, a balanced approach can help facilities offset the new load through other energy-reduction programs. Other considerations:

1. **Government, commercial, retail, and public parking sites:**
    a. Requires engineering, electrical permits, and city planning approvals
    b. Additional electrical load requirements. Additional circuits, panels, meters, transformers might be needed, so it is wise to get an expert
    c. Wireless networking, software and billing system processes may be required
    d. Must select the best hardware/software manufacturer for the desired application
    e. Underground work to bring power from buildings to parking area
    f. Protect/preserve landscaping
    g. Training of building personnel to ensure proper operations and safety
    h. ADA compliance
    i. Bollards, signage, rules and parking enforcement need to be considered
    j. Commercial and public use – Forward-looking discussions on the use of the chargers, equipment upgrade-ability, after-hour access, security, and flexibility in billing.

2. **The right decisions will set up a bright future and ensure the EVSE is a great investment**
    a. The electrical load created by the EVSE could significantly raise the cost of electricity. Higher electrical price tiers, especially during peak daytime hours, can negatively impact operating costs.
    b. ABM Energy offers a holistic approach with customers to ensure in-building sustainability systems and processes are discussed and in place set to help offset the additional load of EV charging equipment.

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Trusted Provider

ABM exceeds the standards listed on the previous page and would like to become your provider of choice in this exciting yet complex new green market. As a solution provider, we can offer clients:

- Single source provider for consultation, selection, configuration and pricing, installation, permitting, testing and maintenance
- Close partnership with the various EV charging station manufacturers to ensure you get the best information, the right fit, and the right solution for your site
- Lower electricity rates through our supply-side power offerings
- Building and facility services to improve energy efficiency through HVAC/Mechanical, Electrical and LED lighting and intelligent lighting controls
- Guaranteed energy contracts and funding programs for bundled energy efficiency projects

EXPERIENCE MATTERS

We've found that a successful installation requires more than a trained technician. It takes experience working alongside cities and utilities, engineering excellence, and the exceptional customer service skills of a qualified EV charging partner. ABM has installed over 12,000 EV charging ports in multiple states, including Level-2 and DC Fast Charging stations.

As the electric vehicle industry continues to accelerate, it's important to understand what drivers will want, today and tomorrow. ABM has the experience to help you future-proof your facility with a robust and efficient EV charging strategy.

ABOUT ABM

ABM (NYSE: ABM) is a leading provider of facility services in the United States and various international locations. ABM's comprehensive capabilities include janitorial, electrical & lighting, energy solutions, facilities engineering, HVAC and mechanical, landscape and turf, mission critical solutions and parking, provided through stand-alone or integrated solutions. ABM provides custom facility solutions in urban, suburban and rural areas to properties of all sizes — from schools and commercial buildings to hospitals, data centers, manufacturing plants and airports. ABM Industries Incorporated, which operates through its subsidiaries, was founded in 1909. For more information, visit ABM.com.

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