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How a Problem with Vehicle Emissions Affects the Electricity Industry

Volkswagen, Electric School Buses, and New Energy Storage Resources

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FEBRUARY 2017

ARTICLE SNAPSHOT

What has changed in the industry?
The recent **$14.7 billion court settlement** between Volkswagen (VW) and the federal government to settle allegations of cheating emissions tests and deceiving customers opens up new opportunities for expansion of the electric vehicle (EV) market. The terms of the VW settlement provide funding for the mitigation of pollution and investment in zero-emissions vehicle technology (see **Appendix B** for Settlement details). These funds, provided via a Trust, could act as a catalyst in broadening the electric vehicle market nationwide, including heavy duty EVs.

The influx of $2.7 billion for investment from the VW Settlement's environmental Mitigation Trust offers an opportunity for the nation's electric cooperatives. Trust resources must produce environmental benefits — particularly clean air benefits. Because of their clean energy and clean air characteristics, heavy duty EVs may be a good fit for state plans for these funds. In addition, using VW Settlement funds to advance transportation electrification creates an opportunity for accelerating an emerging win-win for rural and semi-rural utilities; benefitting both co-ops and the communities they serve.

What is the impact on cooperatives?
The VW Settlement trust funds present a beneficial electrification opportunity for cooperatives to extend the electric vehicle market. Utilizing the funds to work with community organizations and convert fleets of heavy duty vehicles to electric would achieve emissions reduction, as well as secure an additional revenue stream for the cooperative. In addition, co-ops could foster a closer relationship with members who have relied on other fuels to support their businesses, bringing a great deal of benefit to both parties, financially and operationally.

Continued

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ARTICLE SNAPSHOT (CONT.)

What do cooperatives need to know about it?
As cooperatives are evaluating their beneficial electrification programs, this Settlement provides an opportunity worth considering. The available funding may offset costs for expansion of EV heavy duty fleets, as well as associated EV charging station infrastructure. Cooperatives are encouraged to contact the local trust administrator for their state to find how to apply for the trust funds and for guidance on any associated requirements.

This article provides the perspective of Vermont Energy Investment Corporations (VEIC), focusing on one potential application of this trust funding, electric school buses.

HOW IT ALL STARTED

In 2014, several U.S. parties charged VW with cheating on tailpipe emissions measurements, and with deceiving customers into thinking they were purchasing "clean diesel" vehicles. After an investigation, VW admitted to intentionally programming their turbocharged direct injection (TDI) engines such that emissions control equipment turned on only during laboratory testing. This meant that, in the laboratory, VW TDI vehicles met the nitrogen oxide (NO_X) standards required by the U.S. Environmental Protection Agency (EPA). Outside the laboratory, however, VW vehicles produced up to 40 times more NO_X. VW programmed approximately 11 million vehicles this way worldwide; 500,000 of them are in the United States.

VW agreed to a $14.7 billion settlement with consumers and states. The settlement involves a $10 billion buy-back on affected cars. The remaining $4.7 billion is divided into two funds. Two billion dollars are set aside for zero emissions vehicle investments distributed nationally, and $2.7 billion is set aside for the environmental VW Mitigation Trust. The Mitigation Trust funds will be allocated to 44 states, plus the District of Columbia (Washington, DC) and Puerto Rico.

The VW Mitigation Trust is a once-in-a generation opportunity to invest in new technologies that will help school districts, local communities, and electric utilities, while reducing greenhouse gas (GHG) emissions and advancing national and state climate commitments. The opportunity, however, is realized only if environmental Mitigation Trust dollars are used to advance new clean energy technologies, rather than invested in older-generation systems such as diesel engines.

HOW A PROBLEM WITH VEHICLE EMISSIONS AFFECTS THE ELECTRICITY INDUSTRY

The VW Mitigation Trust and the $2.7 billion in public resources invested at the state level should be of interest to electricity generators and distribution utilities.

The Trust will allocate a portion of the funds to the 46 individual jurisdictions, primarily according to the number of VW TDI vehicles that operated in each state. Each jurisdiction will create a plan for spending Settlement funds. Funds can be used to replace heavy and medium duty diesel vehicles (and supporting infrastructure), and are tied to 10 eligible measures that reduce NO_X emissions. The VW Settlement gives jurisdictions discretion in how they spend their resources and some flexibility regarding vehicle technologies. States will be developing their plans for distributing these funds in 2017, and can spend up to two-thirds (67 percent) of their allocation in the first two years — that is, by 2019.

TRANSITIONING SCHOOL BUSES FROM DIESEL TO ELECTRIC

Although school transportation is not mandated by the federal government, it is provided by the majority of school districts throughout the United States. Consequently, school transportation is a significant part of the transportation sector. There are an estimated 480,000 school buses in the United States. These buses travel 32 million miles and burn 5 million gallons of diesel fuel every day. Over a 180-day school year, the school bus fleet burns nearly 100 million gallons of diesel fuel, emitting over 9 million metric tons of greenhouse gases.

Electric school bus technology has matured in the past several years with an increasing number of electric buses being deployed in school transportation services.

Electric school bus technology has matured in the past several years with an increasing number of electric buses being deployed in school transportation services. The newest-model electric school buses travel between 60 and 80 miles when the battery is fully charged, a distance long enough for average school bus daily travels for both the morning and afternoon runs.[1] All-electric school buses are currently carrying students in California, Massachusetts, and the Canadian Province of Quebec.

Electric school buses are interesting for electric cooperatives because they represent a new electricity application and can help support grid reliability through off-peak charging.

Funding from the VW Settlement can speed up this trend by covering the purchase cost. The all-in purchase price of an electric school bus is $325,000, nearly three times the price of a conventional diesel bus, which costs between $85,000 and $115,000. The more efficient electric motor offers higher fuel economy, making it less expensive to operate; but operating cost savings do not cover the increased purchase price of the bus. As a result, access to external funding is essential to advance this technology.

Electric school buses are interesting for electric cooperatives because they represent a new electricity application and can help support grid reliability through off-peak charging. With co-ops and school districts working together on effective electric school bus charging plans, both can benefit from off-peak charging and other strategies. Further opportunities involve new ways of thinking about electricity storage and supply. Increasing access to energy storage resources, and reducing the cost of access to storage, can also make it easier for electric co-ops to integrate renewables into their generation mix. The electric school bus market also creates opportunities for more sophisticated — and potentially more profitable — vehicle-building and vehicle-grid interactions.

Another potential winner is local school districts. School transportation is largely funded by local taxes. Local schools could benefit because their annual fuel costs could be cut in half, depending on the extent to which they purchase electric school buses. Nationally, schools spend roughly $2 billion on fuel each year; transitioning to electricity could cut their costs down to $1 billion. Spending less on transportation means more money for operations related to their primary mission; educating children.

In addition to energy market benefits, if school districts replace their fleets with all-electric school buses, the nearly 24 million children in the United States who ride diesel-powered school buses could be the biggest winners. Among the benefits of electric buses is the elimination of tailpipe emissions. This means cleaner air in the area where children congregate and wait to board the bus; it also means better air quality inside the bus cabin.

[1] Weather and terrain can impact the distance electric vehicles can travel on a single battery charge. These factors, as well as the distance of the typical daily busing route, should be considered in the evaluation of the business case for electric bus applications.

Most of the electric school buses deployed to date contain four battery packs for a vehicle range of between 60 and 80 miles when the battery is fully charged.

ELECTRIC BUS BATTERY TECHNOLOGY

A significant determinant of the cost of an electric school bus is the battery. But, this is also where there is value for electric co-ops. The battery's storage capacity (or size) determines how much energy can be stored (or discharged) and how far the vehicle can travel. The battery size also determines how much the bus costs. Consequently, electric school bus manufacturers must balance meeting transportation needs and keeping the vehicle cost competitive. Most of the electric school buses deployed to date contain four battery packs for a vehicle range of between 60 and 80 miles when the battery is fully charged. This equates to a battery storage capacity of approximately 105 kilowatt hours (kWh).

VEHICLE–GRID INTERACTIONS

Vehicle batteries have value beyond their ability to power an electric motor. Batteries store energy that potentially can be exported from the vehicle to other places, like the electric grid or a building. Being able to both import (draw electricity from the grid to store on the battery) and export (send electricity stored in the battery to the grid) has many benefits. This ability to import and export electricity is referred to as *vehicle–grid interaction*.

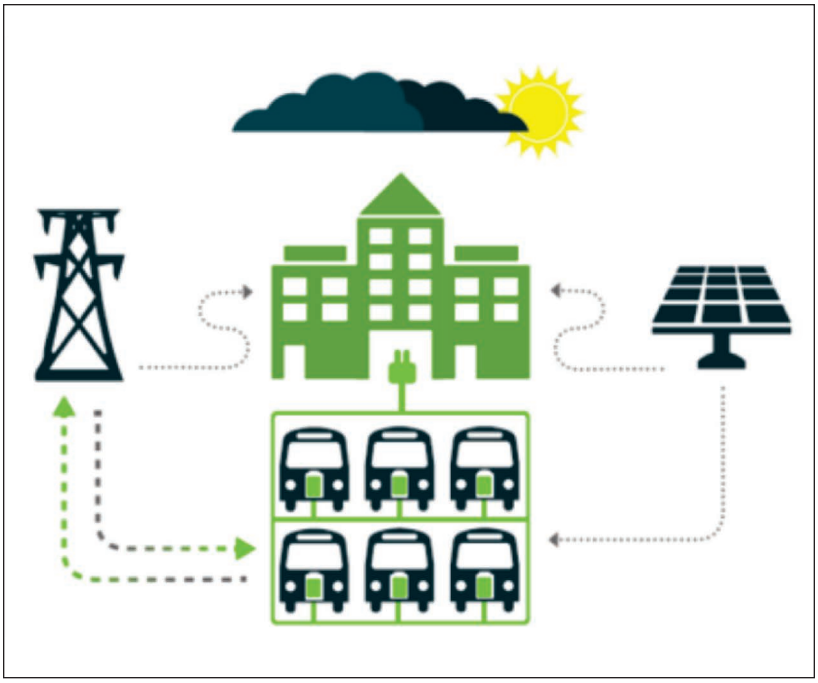


FIGURE 1: Electric School Buses serving as a grid resource, supporting renewable energy generation and V2B through energy storage.

Electric vehicles are an attractive energy storage resource because the vehicle has another purpose (to power an electric motor). It is also flexible. Co-ops with interconnected EVs can call upon the battery when they need it. Electric school buses are especially attractive for vehicle–grid interactions, because buses have larger batteries than passenger vehicles, so they can store more energy. In addition, school bus transportation duty cycles (when and how they are used) are predictable, making it easier to know when the batteries will be available for other uses. Electric school buses, therefore, can create value to electric co-ops. The value comes primarily through:

- **Demand side management.** During times of peak demand, it can be less expensive to reduce the demand for electricity than it is to supply it. Because school buses have flexibility in terms of when their batteries are charged, charging can be timed to occur when demand on the grid and the cost of supplying electricity are low.
- **Vehicle-to-building integration.** School buses can be connected to a building energy management system and be timed to charge only when there is minimal building demand. Conversely, the bus can receive a signal to discharge the battery, supplementing building energy use. So, if a building is going to incur peak demand charges, it can draw power from the school bus to reduce consumption from the grid. This reduces the building's energy cost, benefits the building owner, and benefits distribution utilities by reducing peak energy demand.

- **Vehicle-to-grid (V2G) integration.** V2G systems have demonstrated that electric vehicles can provide many of the same reliability services that generation resources supply to the grid. Vehicle batteries can be connected to the grid and signaled to draw electricity when supply is high, or provide electricity when supply is low. This ability to provide balancing services to the grid is becoming increasingly valuable at both the distribution and transmission levels, as the grid transitions toward more renewable, intermittent resources.

  Vehicle–grid interactions have demonstrated their feasibility and value in projects nationwide. Massachusetts is the site of the first demonstration program to test the integration of electric school buses. Results from the several projects currently in the design phase will be published in 2017 (VEIC, 2016).

Vehicle–grid and vehicle–building interactions are developing as the electric vehicle market overall is maturing. There are some key considerations when exploring the business case for such application, including:

- Impact on battery life and warranty from use beyond that of the electric vehicle operation, and
- Availability and costs associated with infrastructure within buildings and the grid to support such interaction.

CONSIDERATIONS FOR WORKING WITH DISTRICTS THAT HAVE CONTRACTED THE BUS SERVICE OUT TO A THIRD PARTY

Working with contractors (private school transportation providers) adds a level of complexity. Contracts are set up in different ways, but most do not reward contractors for energy efficiency. Indeed, some schools pay for service on an hourly or per mile basis and reimburse operators for fuel expenses. This would need to change, if private operators are to be encouraged to go electric.

LION BUSES EXPERIENCE TO DATE

Currently, several pilot programs have been identified that use Lion Buses. Lion Bus has three buses on the ground in Massachusetts and one more on order, and 21 buses on order to Sacramento California. In 2017, they expect to deliver 100 buses.

Type C eLion buses cost $325,000 (in 2016) and are equipped with 4 battery packs of 26 kWh each for a total of 104 kWh. Lion bus claims the buses have an efficiency of .71 miles per kWh, so the range is 74 miles. VEIC will be testing this in the field and will be providing results in winter 2017.

The usable capacity of the battery for storage is 93 kWh. It takes 4 hours 20 minutes to charge the battery from zero percent State of Charge to 100 percent. It takes 3 hours and 15 minutes to go from 20 percent SOC to 100 percent. Lion Bus provided a battery warranty for 8 years or 160,000 kWh. They also promised 80 percent of the battery capacity would remain at the end of 5 years. The battery warranty allows for about 20,000 kWh per year, or about 190 charges/discharges each year (assuming we charge 104 kWh each time). V2G/V2B could impact the warranty, and that needs to be considered. In other words, if you charge and discharge a lot, the value you get ($) needs to outweigh the cost/impact on the warranty.

The New Electricity Sector includes Transportation.

CONCLUSION

School transportation is significant in the United States. Nationwide, school buses travel nearly 32 million miles each day, consuming over 5 million gallons of diesel fuel and emitting over 51,500 metric tons of carbon. Alternative vehicle technologies have proven their success in transportation operations and in offering environmental and public health benefits. The biggest challenge to bringing more alternative vehicles into the market is capital costs. The $2.7 billion in the VW Mitigation Trust could well transform the school transportation sector, if there is sufficient interest to do so.

Utilities can play an important role in advancing the transition to clean energy transportation. As the energy sector increases its recognition of the value and importance of energy storage, it will also likely recognize how storage supports the transition from carbon-intensive production to cleaner forms of energy supply. Clean, renewable resources require storage for optimal integration and deployment.

The VW Settlement provides a unique opportunity for co-ops and other utilities to encourage and support beneficial electrification of the transportation sector. Assuming investments from the Trust will be directed toward low-carbon/low fossil fuel transportation solutions (such as electric school buses), utilities can benefit by obtaining access to storage resources at little or no cost. This could well result in reductions in utility capacity and transmission costs and help electric co-ops acquire valuable (and even necessary) energy storage resources.

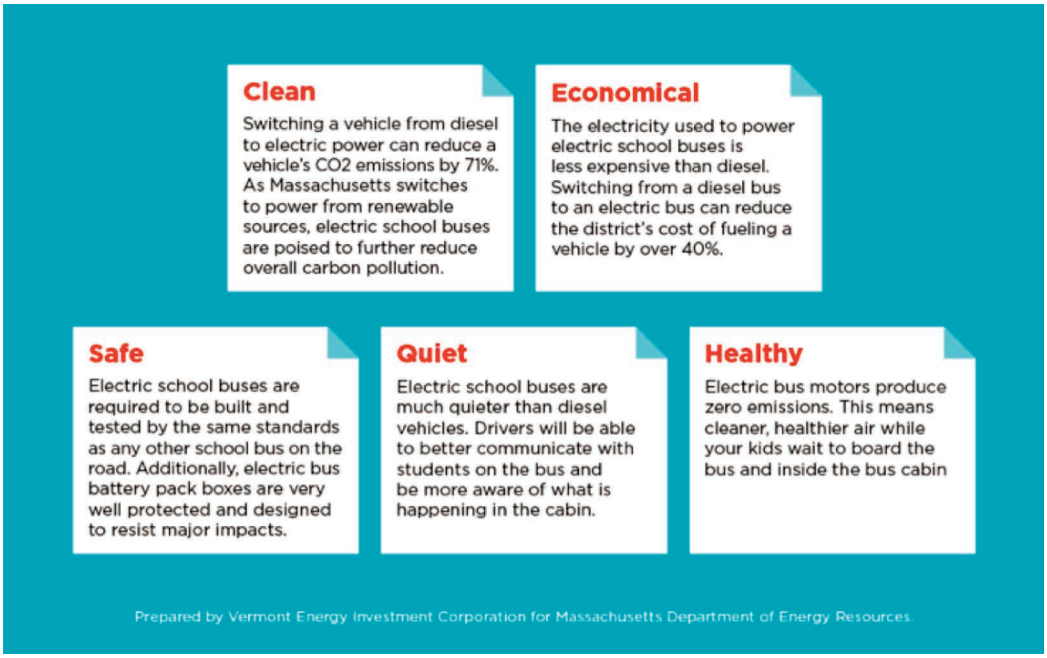
NEXT STEPS FOR CO-OPS

1. **Get involved in how your state is disbursing funds from the VW Mitigation Trust and advocate for electric vehicles.** Electric co-ops can be advocates for using these resources to advance electric vehicle technology. More electric vehicles benefit co-ops by increasing revenues, supporting climate change commitments, and creating new opportunities for low cost energy storage resources. The Trust fund application and selection process will be determined on a state-by-state basis. The key will be to locate the agency in your state that is developing the plan, the process they will be using to solicit comments on the plan, and later in awarding funds. Direct communication with these people will be helpful in sharing your interest in participating in these awards and the value this would bring to reducing NO_X, and improving economic opportunities.

2. **Explore new business models for how your co-op may be actively engaged in supporting electric vehicles.** Co-ops can translate the value of electric vehicles and the associated energy storage opportunity into new business models and strategies to support investment in electric vehicles. There are several business models that have been considered, but not fully developed, such as the value of owning a vehicle battery to a co-op.

3. **Engage partners — school districts or school transportation providers — in your service area and talk about electric school buses and VW funding. School districts might not know about all-electric school buses or the VW Settlement funds.** Co-ops can facilitate these conversations to help local school districts develop demonstration projects. One way to work with schools/communities to forward electric bus initiatives would be to follow a model used in Massachusetts; where VEIC issued a Program Opportunity Notice (PON) and let the schools apply. In this case, VEIC circulated the PON through the Green Communities network and other green school networks. Sample marketing material is attached as Appendix A. ■

APPENDIX A: SAMPLE MARKETING MATERIALS



APPENDIX B: VW SETTLEMENTS INFORMATION

Note: Two settlements associated with VW include one with EPA and FTC. The mitigation plans discussed within this article are from the EPA settlement.

- EPA Settlement Information: **https://www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement**
- Related Settlement with the United States and the State of California: **https://www.ftc.gov/system/files/documents/cases/proposed_partial_stipulated_order_filed_copy_0.pdf**
- Settlement Requirements for Volkswagen to Mitigate Pollution and Make Investments in Support of Zero-Emission Vehicle Technology **https://www.ftc.gov/news-events/press-releases/2016/06/volkswagen-spend-147-billion-settle-allegations-cheating**

  Excerpt from Federal Trade Commission Website:

"**Emissions Reduction Program**: The settlement of the company's Clean Air Act violations also requires Volkswagen to pay $2.7 billion to fund projects across the country that will reduce emissions of NO_X where the 2.0 liter vehicles were, are or will be operated. Volkswagen will place the funds into a mitigation trust over three years, which will be administered by an independent trustee. Beneficiaries, which may include states, Puerto Rico, the District of Columbia, and Indian tribes, may obtain funds for designated NO_X reduction projects upon application to the Trustee. Funding for the designated projects is expected to fully mitigate the NO_X these 2.0 liter vehicles have and will emit in excess of EPA and California standards.

The emissions reduction program will help reduce NO_X pollution that contributes to the formation of harmful smog and soot, exposure to which is linked to a number of respiratory- and cardiovascular-related health effects as well as premature death. Children, older adults, people who are active outdoors (including outdoor workers), and people with heart or lung disease are particularly at risk for health effects related to smog or soot exposure. NO_2 formed by NO_X emissions can aggravate respiratory diseases, particularly asthma, and may also contribute to asthma development in children.

Zero Emissions Technology Investments: The Clean Air Act settlement also requires VW to invest $2 billion toward improving infrastructure, access and education to support and advance zero emission vehicles. The investments will be made over 10 years, with $1.2 billion directed toward a national EPA-approved investment plan and $800 million directed toward a California-specific investment plan that will be approved by CARB. As part of developing the national plan, Volkswagen will solicit and consider input from interested states, cities, Indian tribes and federal agencies. This investment is intended to address the adverse environmental impacts from consumers' purchases of the 2.0 liter vehicles, which the governments contend were purchased under the mistaken belief that they were lower emitting vehicles."

About VEIC

The Vermont Energy Investment Corporation (VEIC) is a 31-year-old "think and do" non-profit organization whose mission is to act with urgency to enhance the economic, environmental, and societal benefits of clean and efficient energy use for all people. It has an international recognition as the organization that has continuously operated the longest-running statewide energy efficiency utility, Efficiency Vermont. It now also operates two other efficiency utilities, the District of Columbia Sustainable Energy Utility (DCSEU) and Efficiency Smart (for American Municipal Power). VEIC complements its efficiency utility business with a consulting practice.

About the Authors

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Questions or Comments

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- Business and Technology Strategies **feedback line**.
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