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ELECTRIC VEHICLES IN A MIDWESTERN CLEAN FUELS POLICY

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This case study, prepared by the Great Plains Institute, explores how electric vehicles could perform in a Midwestern clean fuels policy.

What is the Midwestern clean fuels policy?

A Midwestern clean fuels policy is a proposed market-based policy that would reward any fuel that offers a greenhouse gas advantage in the transportation sector, without picking winners or losers. It would reduce the use of higher-carbon fuels and support commercial deployment of lower-carbon fuels, including biofuels, natural gas, and electricity for electric vehicles.

A clean fuels policy, like the California Low Carbon Fuel Standard, sets a standard for reduced carbon intensity of transportation fuels over time, otherwise known as a baseline carbon intensity standard. Carbon intensity is a measure of the lifecycle greenhouse gas emissions of a specific fuel, which includes its production, refining, and use. Fuel producers receive incentives in the form of credits from lowering their carbon intensity through production process efficiency improvement, switching to lower-carbon fuel or feedstocks, and other mechanisms that decarbonize the supply chain. These changes result in reducing overall greenhouse gas emissions in the transportation sector. Fuel producers that do not meet the annual standard must purchase alternative fuel or credits to comply with the program while those that are under the standard generate credits based on the amount of carbon reduced, creating an "opportunity zone" as demonstrated in figure 1.

Figure 1. Clean fuels policy market logic

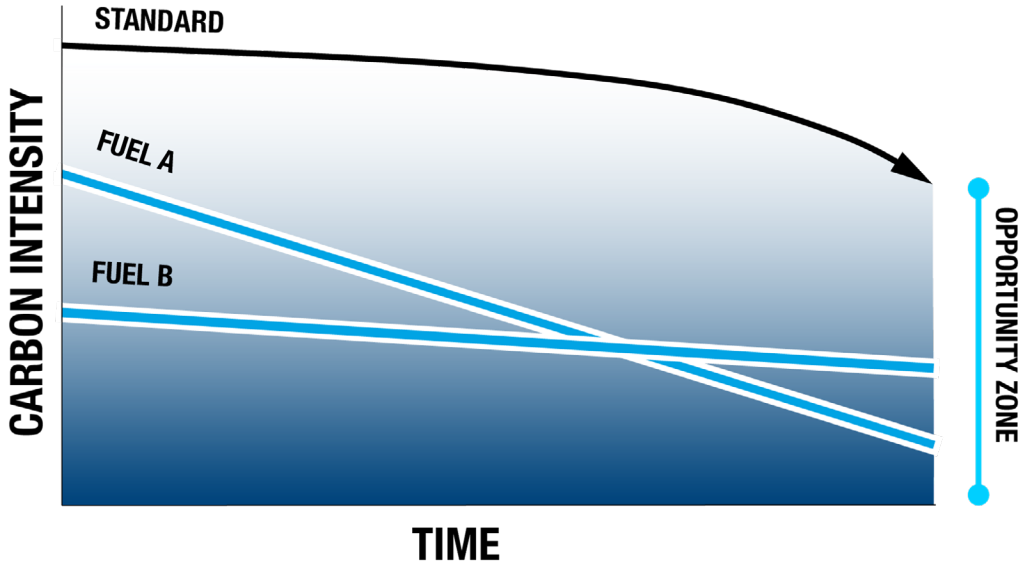


Figure 1 shows the carbon intensity of the standard becoming more stringent over time and two example low carbon fuel pathways, Fuel A and Fuel B. Carbon intensities below the standard create an "opportunity zone," where the lower-carbon fuel pathway generates market credits. As the standard gradually declines, there are additional opportunities to reduce the carbon intensity of lower carbon fuel pathways through improvements in the supply chain. Fuel A shows a decline in carbon intensity over time consistent with the gradual reduction of the standard, ensuring that the opportunity for Fuel A to generate market credit stays constant. Fuel B declines only slightly over time, indicating that the opportunity zone for credit generation becomes slightly smaller.

How do electric vehicles generate credits?

Credits for electric vehicles are generated on a per kilowatt-hour (kWh) basis and vary based on the carbon intensity of the electricity generation mix. Electric grids with lower carbon intensities result in greater credit generation. This case study modeled three electricity generation mix scenarios for five types of electric vehicles: a passenger light-duty electric vehicle, a heavy-duty utility forklift, a school bus, a delivery truck, and a transit bus. The passenger light-duty electric vehicle is the only gasoline-substitute; all other vehicles are diesel substitutes.

MODELING CARBON INTENSITY OF ELECTRICITY

The carbon intensity of electricity depends on the mix of fuels used to generate the electricity. For electric vehicles using the grid to charge, the fuel mix of the electricity production can influence the electric vehicle's carbon intensity. Fuels like natural gas and coal are more carbon-intensive while renewable energy, like wind and solar, is less carbon-intensive. A higher proportion of renewable electricity on the grid equates to less carbon. Carbon intensity scores are reported in grams of carbon dioxide equivalent per megajoule (gCO2e/MJ) to compare fuels on an equivalent energy basis.
The carbon intensity of electricity used for vehicle charging also varies based on the type of fuel that the electricity is substituting (either gasoline or diesel), which is determined by the type of electric vehicle being charged. The figures below reflect different efficiencies between electric vehicles that are alternatives to gasoline and diesel, and the amount of megajoules (MJ) needed to drive one mile.

Figure 2. Carbon intensity by electricity source for heavy-duty vehicles for 2025

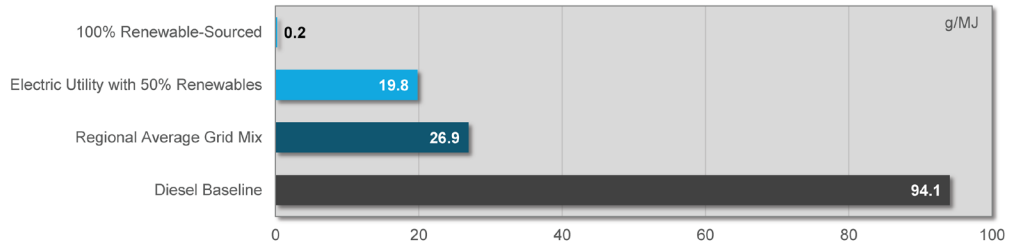
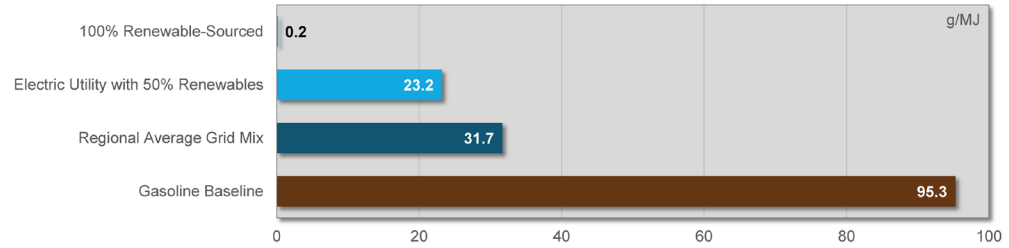


Figure 3. Carbon intensity by electricity source for light-duty vehicles for 2025



Figures 1 and 2 show that the carbon intensity of most electricity sources is projected to be less than a third of that for gasoline and diesel by the mid-2020s, presenting the opportunity for electric vehicles to generate credits under a clean fuels policy. This also highlights the impact that electricity generation mixes have on the resulting carbon intensity of electric vehicles. Vehicle types have varying levels of energy efficiency, and electric vehicles are generally 3-5 times more energy efficient than internal combustion engines. To account for the efficiencies of different vehicles, a specific energy economic ratio is used for each vehicle type. Great Plains Institute calculated carbon intensity scores using Argonne National Laboratory's GREET model. Regional Average Grid Mix references the electric grid associated with the Midwest Reliability Organization (MRO) footprint, which spans the Midwest.

GENERATING CREDITS AND VALUES

Credits are generated by fuels with carbon intensities lower than the standard, which declines over time based on the policy determination. The difference between a fuel's carbon intensity and the carbon intensity set by the standard in any given year determines the number of credits it can generate. The dollar value of credits varies according to market forces but would be expected to be between $100 and $200 per ton in a Midwestern clean fuels policy based on historic credit prices from existing clean fuel policy markets. Table 1 shows theoretical total credit values generated by the modeled types of vehicles under a policy that would aim to achieve a 15% carbon intensity reduction from the baseline by the end of the policy. The policy and market forces would determine the actual allocation and distribution of credits to appropriate entities, including the vehicle operator, electric utility, charging station operator, and others.

Table 1. Range of ten-year credit values generated for electric vehicles under various electricity generation mixes (15% reduction policy)

VEHICLE TYPE	ELECTRICITY GENERATION MIX	CUMULATIVE CREDIT VALUE OVER 10 YEARS for credit values: $100 - $200 / ton
Passenger Light-Duty Electric Vehicle	*Regional Average* *Electric Utility with 50% Renewables* *100% Renewable*	$2.0 - $4.1 thousand $2.3 - $4.6 thousand $3.1 - $6.3 thousand
Heavy-Duty Utility Forklift	*Regional Average* *Electric Utility with 50% Renewables* *100% Renewable*	$8.0 - $16.0 thousand $9.0 - $18.1 thousand $12.0 - $23.9 thousand
Electric School Bus	*Regional Average* *Electric Utility with 50% Renewables* *100% Renewable*	$26.8 - $53.6 thousand $29.1 - $58.4 thousand $35.8 - $71.5 thousand
Electric Delivery Truck	*Regional Average* *Electric Utility with 50% Renewables* *100% Renewable*	$36.6 - $73.2 thousand $39.9 - $79.8 thousand $48.9 - $97.7 thousand
Electric Transit Bus	*Regional Average* *Electric Utility with 50% Renewables* *100% Renewable*	$76 - $152 thousand $82.9 - $166 thousand $98.9 - $203 thousand

Note: Regional average assumes carbon intensity of electricity produced in the Midwest Reliability Organization region, which covers much of the Midwest. Great Plains Institute calculated the credit values.

ACHIEVING ECONOMIC AND ENVIRONMENTAL GOALS THROUGH A MIDWESTERN CLEAN FUELS POLICY

The Midwest stands to gain economic and environmental benefits from a clean fuels policy—even more so than California has from its long-running low-carbon fuel standard. California's standard has provided growth opportunities for lower-carbon fuels, including significant value for Midwestern low-carbon fuels exported to California. A Midwestern clean fuels policy, through a technology-neutral and performance-based approach, has the potential to use similar market-based mechanisms to develop demand growth in the region without the need to import fuel. Establishing a clean fuels policy in the Midwest would support development of clean fuel projects and deliver environmental benefits like greenhouse gas emission reductions, nitrogen loss reductions, improved water and air quality, and others for the region. It would also reduce reliance on federal policy and policy makers in other states and retain autonomy for Midwestern states.

For more information and to stay updated on efforts to advance a Midwestern clean fuels policy, contact Brendan Jordan at bjordan@gpisd.net or visit www.betterenergy.org.

The Midwestern Clean Fuels Policy Initiative brings together a diverse group of stakeholders to help create economic benefits for the region through policy, research, and education on the production and use of cleaner fuels. The Initiative is facilitated by the Great Plains Institute, a nonpartisan, nonprofit organization that is transforming the energy system to benefit the economy and environment.