February 12, 2018

Texas Commission on Environmental Quality, Air Quality Division
Implementation Grants Section, MC-204
P.O. Box 13087
Austin, TX 78711-3087

ATTN: VW Settlement – Initial Recommendations

To Whom It May Concern,

Environmental Defense Fund (EDF) appreciates the opportunity to provide comments to the Texas Commission on Environmental Quality (TCEQ) on projects to be funded by the Volkswagen (VW) Environmental Mitigation Fund. EDF is a non-profit, non-partisan, non-governmental environmental organization that combines law, policy, science, and economics to find solutions to today's most pressing environmental problems.

As requested by TCEQ, EDF is providing feedback on specific topics outlined in the presentation given on January 17, 2018, at the Texas Capitol. We are also providing additional suggestions that TCEQ should consider in order to ensure optimal use of funding. All of our feedback is outlined (and hyperlinked) below and discussed in greater detail in the following pages.

Overall Goal – Reduce NOx Emissions Where Harms Occurred 2
1. Allocate VW funding "where the Subject Vehicles were, are, or will be operated". 2
2. Use TERP policies for scrappage and utilize simplified applications. 2
3. Use cost effectiveness as a key criterion for funding under VW, with modifications. 2
3.1 Allow projects to request less than the maximum allowable cost reimbursement. 2
3.2 Consider the current best practices (and updated information) for estimating NOx emissions. 2
4. Allow 2-for-1 projects that could provide even greater emission reduction benefits. 3

Eligible Project Categories - Priority 3
5. Work closely with local regional planning organizations to select projects. 3
6. Prioritize projects with the largest benefits – emissions, health, and economic 3
6.1 Ports/Railyard/Freight 3
6.2 Electrification Projects (including Electric Vehicle Supply Equipment) 4

Other Considerations 5
7. TCEQ should update the plan for spending DERA State funding and accept funding from EPA. 5
8. TCEQ should issue a broad call for clean air projects, working to align projects with funding beyond VW. 6

Conclusion 6

Overall Goal – Reduce NOx Emissions Where Harms Occurred

The purpose of the VW Mitigation Trust (EMT), as outlined in court documents[1], is to "reduce emissions of nitrogen oxides ("NOx") where the Subject Vehicles were, are, or will be operated". TCEQ is in the fortunate position of having experience identifying cost-effective projects that reduce NOx from administering the Texas Emissions Reduction Plan (TERP) for the past sixteen years. To best ensure that the goal of reducing NOx emissions where harms occurred is achieved, TCEQ should:

1. ***Allocate VW funding "where the Subject Vehicles were, are, or will be operated".***

   This recommendation follows the stated purpose of the EMT. According to an analysis (provided as **Attachment 1**: *NCTCOG Analysis of VW Registrations*) done by the North Central Texas Council of Governments (NCTCOG) which allocated known county registrations of affected 2.0 and 3.0 liter VW vehicles to regions, approximately seventy-five percent of affected vehicles were registered in the five major metropolitan areas (Houston-Galveston, Dallas-Fort Worth, Austin, San Antonio, and El Paso).

2. ***Use TERP policies for scrappage and utilize simplified applications.***

   TCEQ should ensure that replaced equipment, vehicles, and engines were functional and had been operating in TX prior to requesting funding. Participants should be encouraged to use of simplified application materials developed by the TERP rebate programs (e.g., incorporate default activity information such as hours or annual mileage based on TERP projects funded to date) to be able to clearly quantify NOx emission reductions from projects.

3. ***Use cost effectiveness as a key criterion for funding under VW, with modifications.***

   TCEQ should modify TERP cost-effectiveness calculations to better reflect how the TERP program has historically defined cost effectiveness (grant request in dollars/tons of NOx reduced over TERP contract life). Specific modifications should include:

   3.1 Allow projects to request less than the maximum allowable cost reimbursement.

   This allows projects to leverage other funding sources, making the $209M able to fund more clean air projects. This also allows applications to improve cost-effectiveness of a project to make it more competitive with other projects.

   3.2 Consider the current best practices (and updated information) for estimating NOx emissions.

   TCEQ should modify TERP emissions estimate methodology for both baseline and new emissions estimates to address the following:

   - Account for reduced selective catalytic reduction efficiency for certain on-road vehicle applications (e.g., drayage trucks, refuse haulers, etc.) that operate at low speeds. This on-going issue with newer diesel vehicles could result in a net increase of NOx emissions in some cases.
   - Recognize emission reductions related to improvements in fuel-efficiency (relative to baseline), as well as cleaner tailpipe emissions.

[1] Environmental Mitigation Trust Agreement for State Beneficiaries, filed 10/2/2017; available online at http://www.vwclearinghouse.org/public/Dkt%2051-1%20%20State%20Beneficiary%20Trust%20Agreement.pdf.

- Incorporate more accurate estimates of service lifetimes for vehicles and equipment. For example, in the current TCEQ Technical Supplement 3 for Marine Vessels, activity life is currently estimated to have between 5 and 23 years, depending on engine category. However, better information based upon original equipment manufacturer (OEM) data and even the TCEQ dataset for TERP-funded projects show that these large (>500hp) horsepower engines have service lives that are often 50 years or longer. Other large horsepower applications, such as switcher locomotives, are also rebuilt over and over to the original engine tier and have very long service lives. Recognizing a more accurate life for these engines better reflects the actual emissions benefits from upgrading them.

4. Allow 2-for-1 projects that could provide even greater emission reduction benefits.

For example, a city fleet may scrap two older refuse trucks in return for purchasing a new, all-electric refuse truck with VW funding. Removing as many pieces of legacy older equipment and vehicles (that have been operating in Texas) from service, as well as from the secondary market, helps realize the most significant emission reductions.

Eligible Project Categories - Priority

Ten eligible project types were detailed in Appendix D-2 of the Environmental Mitigation Trust; EDF summarized the projects, as well as potential emission reductions (using standard TERP methods for most of the categories) and cost ranges (**Attachment 2**: *EDF Summary of Projects Eligible for VW Funding*). When determining the approximate percentages to be allocated towards different project categories, TCEQ should do the following:

5. Work closely with local regional planning organizations to select projects.

Local councils of governments, metropolitan transportation organizations, and regional councils have invested significant resources into developing State Implementation Plans, regional transportation plans, and air quality planning. In most cases, these organizations also administer similar funding programs (e.g., Congestion Mitigation and Air Quality funding) that could be leveraged, they lead US Department of Energy Clean Cities Coalitions, and they maintain relationships with public and private fleets. In addition, there are at least two group purchasing initiatives that could be leveraged to provide Texas volume discounts or bid development/allowable purchase coordination (i.e., HGACBuy and NCTCOG's Fleets for the Future participation).

6. Prioritize projects with the largest benefits – emissions, health, and economic.

6.1 Ports/Railyard/Freight

Projects at ports (seaport and inland, as well as airports), railyards, and other intermodal freight facilities can generate substantial NOx emissions reductions, which are frequently located near communities. Prioritizing these projects easily accomplishes the overall goal for VW mitigation, while also improving health impacts for Texans, especially those living close to these facilities. Another priority under the EMT is to fund projects in areas where residents are disproportionately affected by diesel pollution. Considering that ports and terminal facilities congregate diesel equipment and vehicles, funding these projects supports that important requirement. Priority projects for ports, railyard, and freight applications include:

- **Marine engine repowers for tugs** can be very cost-effective because: 1) engines can be decades old (e.g., some tug projects that received funding from TERP demonstrate that these engines can be 50 years or

older, with uncontrolled emissions), 2) tug engines are typically rebuilt to original emissions standards (typically Tier 0 or 1) and do not come out of service unless there has been a catastrophic engine failure.. Cleaner Tier 3 and 4 diesel engines, hybrid/electric, and even fully-electric options are now available for marine engine repowers.

- **Electrification of port/railyard cargo-handling equipment** in high horsepower, high usage applications, as well as for equipment categories where volume of equipment is particularly high (e.g., terminal tractors), could provide not only significant emissions reductions, but also improvements in efficiency (e.g., energy recapture from regeneration), lower operating costs from decreased maintenance requirements, and even safer work conditions (due to noise reductions and improved ambient air quality). Electric technologies are available for a variety of cargo-handling equipment, ranging from cranes (both wharf and rubber tire gantry), to terminal tractors and forklifts.
- **Ocean-going vessel shorepower** for frequent callers, such as cruise ships and regularly scheduled container vessels. The EPA released a comprehensive report in 2016 (National Port Strategy Assessment: Reducing Air Pollution and Greenhouse Gases at U.S. Ports) that highlighted the emissions reduction opportunity for vessels at berth. Importantly, Texas is home to one of the largest cruise ports (Galveston), as well as to one of the most important container ports in the country (Houston); these ship emissions are typically the largest source of mobile emissions (NOx, as well as other pollutants) in a given port because of the very large size of the engines and the duration of time that these vessels are running their engines in port.
- **Switcher locomotive engine repowers** can also be very cost-effective because similar to their marine counterparts, they are often very old. In many cases, the largest line haul locomotives may be pulled out of long-distance service and placed into a switcher application. This not only means that an older, dirtier engine remains in service, but it also means that an over-sized engine is being used (and creating many more emissions since engine is directly proportional to emissions). Electric shuttlewagons, hybrid genets, and Tier 4 engines are available to upgrade switcher locomotive applications.
- **Drayage truck replacements** are an important way to reduce community impacts from port operations because trucks are: 1) often the oldest and dirtiest trucks in the fleet[2], and 2) by their nature, they carry their cargo to and from port facilities, often through neighborhoods surrounding port and terminal facilities. Because of the short-haul nature of these vehicles, electric technologies make a lot of sense, accommodating battery ranges, as well as opportunities for battery regeneration in stop and go traffic. All-electric trucks also minimize tailpipe emissions in communities, where many drayage trucks operate, and reduce operations and maintenance costs, compared to new heavy-duty diesel trucks.

6.2 Electrification Projects (including Electric Vehicle Supply Equipment)

Electrification technologies offer zero or near-zero (in the case of hybrid technologies) emission solutions across all mobile sectors, and many have been commercially available for years (see **Attachment 3**, *Zero-Emission Vehicle & Equipment Manufacturers, Integrators, & Technologies*). Texas is poised to not only be a major consumer market for these new technologies (e.g., Texas was 6th in the nation for electric car sales, 2011-2016[3]), but also an economic engine for design and manufacturing of these technologies. For example,

[2] Heavy-duty trucks often begin their service life in a long-haul application, since when they are new, they are most reliable. As they age, they tend to move into more regional haul with subsequent owners, and then are later sold into short-haul or drayage applications.

[3] https://cleantechnica.com/2017/05/04/us-electric-car-sales-state-whos-1-ohio-california/

Peterbilt (based in Denton, TX) is working with TransPower to demonstrate an all-electric refuse truck[4]. Given the rapid ramp up in technological development for transportation electrification, Texas could strategically leverage VW funding to attract both consumer and business investment in these technologies. Priority electrification projects include:

- **Electric refuse trucks** provide a significant emissions reduction opportunity because they have some of the worst traditional fuel economy in the fleet (2-3 miles per gallon of diesel, by some estimates[5]) due to the idling, power take-off operations required to run compactors, and slow, stop-and-go driving. They often return to a centralized depot at the end of the day and do not typically operate at night, allowing them to recharge batteries. For many municipalities, deploying electric refuse fleets could provide a net positive return on investment because of the virtual elimination of fuel and maintenance costs that recover the initial upfront increase in capital cost.
- **Electric buses (transit, school, and shuttle)** not only provide direct tailpipe emission reductions, but also provide indirect emission reductions by displacing single-occupant vehicles. In addition, electrifying school buses in Texas has the added benefit of reducing the very serious health risks to children from older school buses that were not equipped with closed crankcase ventilation systems[6].
- **Electric local freight truck** projects are poised to provide a much-needed solution to the last-mile problem that has been challenging transportation and air quality planners for years.
- **Electric vehicle supply equipment (EVSE)** will be an integral element of the transportation system for the future. TCEQ should allocate 15% of the $209 M for charging infrastructure to support not only light-duty vehicles, but also medium and heavy-duty vehicles (where co-locating charging makes sense), to smoothly transition Texas into a zero-emission transportation system that is well on its way.

Other Considerations

7. TCEQ should update the plan for spending DERA State funding and accept funding from EPA.

Funding from the EPA DERA State program has traditionally been used for the Texas Clean School Bus Program, focusing on emissions control devices that reduce emissions at the tailpipe. Over the years, interest in using these devices has decreased. By updating the state plan for spending State DERA funds, TCEQ could better address sources not being addressed well in existing incentive programs, such as ocean-going vessels, switcher locomotives, and marine engines. Notably, EPA has shared that they are evaluating the potential DERA eligibility for technologies that are alternatives to vessel shorepower, such as the stack bonnet technologies (e.g., Advanced Emissions Control, Advanced Maritime Emissions Control Systems) that have had promising pilots and are now being used in southern California. By re-establishing a Texas program to receive EPA State DERA funds, TCEQ would also be able to take advantage of the VW "DERA Option", which would allow the state to use VW funding for match (and overmatch) and potentially fund projects that are not in the current VW EMT eligible project category list (but are eligible under DERA). More information is available on the EPA VW website[7].

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[4] http://www.transpowerusa.com/press-releases/peterbilt-showcase-first-battery-electric-refuse-truck-using-transpower-electric-drive-technology/
[5] https://www.washingtonpost.com/news/innovations/wp/2015/01/23/the-quest-to-find-a-place-for-electric-trucks-on-u-s-roads/?utm_term=.4a5852cab8e4
[6] https://www.edf.org/sites/default/files/cleanbuses_14_screen.pdf
[7] https://www.epa.gov/cleandiesel/volkswagen-vw-settlement-dera-option

8. TCEQ should issue a broad call for clean air projects, working to align projects with funding beyond VW.

The VW EMT offers an important funding opportunity to address sources of NOx pollution in the eligible project list and has received significant attention in the media. However, a number of worthy emission reduction projects in Texas may not be eligible under VW, or they may be better suited for other funding opportunities. EDF recommends that TCEQ include an option for interested parties to submit their project ideas to TCEQ for evaluation on other funding sources (or for TCEQ to work collaboratively with regional councils on potential project funding sources).

Conclusion

EDF appreciates the opportunity to provide comments to TCEQ on the proposed plan for spending Texas' VW EMT funds. This funding provides a unique opportunity that can be used to meet public health emission reduction goals, while advancing the state of clean technology. If you have any questions, please contact Chris Wolfe at [redacted] or 512-691-3416.

Sincerely,

Chris Wolfe
Manager, Air Quality, Port and Freight Facilities

ATTACHMENT

Volkswagen and Audi Vehicles Affected by Lawsuit
State of Texas

DRAFT

Texas Regional Councils	Vehicles Affected				Potential Settlement Per Texas Regional Councils
	2.0 L	3.0 L	Total		
Alamo Area Council of Governments (AACOG)	4014	482	4496	11.12%	$ 23,234,000
Ark-Tex Council of Governments (ARK-TEX)	248	22	270	0.67%	$ 1,395,000
Brazos Valley Council of Governments (BVCOG)	606	50	656	1.62%	$ 3,390,000
Capital Area Council of Governments (CAPCOG)	4657	729	5386	13.32%	$ 27,833,000
Central Texas Council of Governments (CTCOG)	1032	42	1074	2.66%	$ 5,550,000
Coastal Bend Council of Governments (CBCOG)	936	61	997	2.47%	$ 5,152,000
Concho Valley Council of Governments (CVCOG)	153	19	172	0.43%	$ 889,000
Deep East Texas Council of Governments (DETCOG)	376	21	397	0.98%	$ 2,052,000
East Texas Council of Governments (ETCOG)	1040	57	1097	2.71%	$ 5,669,000
Golden Crescent Regional Planning Commission (GCRPC)	168	22	190	0.47%	$ 982,000
Heart of Texas Council of Governments (HOTCOG)	402	13	415	1.03%	$ 2,145,000
Houston-Galveston Area Council (H-GAC)	8056	1,599	9655	23.87%	$ 49,894,000
Lower Rio Grande Valley Development Council (LRGVDC)	813	155	968	2.39%	$ 5,002,000
Middle Rio Grande Development Council (MRGDC)	179	14	193	0.48%	$ 997,000
Nortex Regional Planning Commission (NORTEX)	267	24	291	0.72%	$ 1,504,000
North Central Texas Council of Governments (NCTCOG)	8789	1,537	10326	25.53%	$ 53,361,000
Panhandle Regional Planning Commission (PRPC)	436	47	483	1.19%	$ 2,496,000
Permian Basin Regional Planning Commission (PBRPC)	370	73	443	1.10%	$ 2,289,000
Rio Grande Council of Governments (RGCOG)	870	89	959	2.37%	$ 4,956,000
South East Texas Regional Planning Commission (SETRPC)	316	37	353	0.87%	$ 1,824,000
South Plains Association of Governments (SPAG)	348	43	391	0.97%	$ 2,021,000
South Texas Development Council (STDC)	285	41	326	0.81%	$ 1,685,000
Texoma Council of Governments (TEXOMA)	279	15	294	0.73%	$ 1,519,000
West Central Texas Council of Governments (WCTCOG)	559	53	612	1.51%	$ 3,163,000
Total Vehicles Affected in State of Texas					**40,444**
VW Settlement to the State of Texas					**$ 209,000,000**
Potential Settlement Per Vehicle					**$ 5,168**

Source: NREL (Polk Vehicle Registration Database

VW Settlement Recommendations

Prioritize healthy air for communities today & advance clean technology in Texas by:*

1) Prioritize high NOx emission reduction projects (older engines+high horsepower+high activity), and
2) Advance zero-emission (at the tailpipe) technologies.

	Port Cargo-Handling Equipment (CHE) (Forklifts w/>8k lbs lift capacity, scrappage required)	%	Example NOx Reduced (tons per year)	Example Cost of Electric Port CHE ($)	Other Considerations
Private	- Repower (all-electric + charging, + install)	75%	**RTG (650-hp):** 1.0 to 3.5 tons **Yard Hostler (200-hp)**: 0.4 to 1.4 tons **Forklift (72-hp)**: 0.3 to 0.7 tons	**Electric RTG:** $250,000 to $1.5M+ **Electric Yard Hostler**: $150,000 to 250,000+ **Electric Forklift**: $30,000+	+ Zero-emission projects + High horsepower, high annual usage equipment results in large NOx reductions + Significant community benefits
Private	- Replacement (all-electric + charging)	75%			
Public	- Repower (all-electric + charging, + install)	100%			
Public	- Replacement (all-electric + charging)	100%			

	Freight Switchers (Pre-Tier 4 w/ >1000 hours/year, scrappage required)	% Cost Reimbursement	Example NOx Reduced (tons per year)	Example Switcher Repower Cost ($)	Other Considerations
Private	- Repower (diesel, alt-fuel, hybrid, incl. gen-sets, + install)	40%	2 to 12+ tons *(potential for much higher reductions for high usage T0/unregulated engines)*	$1M+	+ Freight switchers can have very old engines (30-40 years) + Limited alternative funding available
Private	- Repower (all-electric + charging, + install)	75%			
Private	- Replacement (diesel, alt-fuel, hybrid, incl. gen-sets)	25%			
Private	- Replacement (all-electric + charging)	75%			
Public	- Repower (diesel, alt-fuel, hybrid, incl. gen-sets, + install)	100%			
Public	- Repower (all-electric + charging, + install)	100%			
Public	- Replacement (diesel, alt-fuel, hybrid, incl. gen-sets)	100%			
Public	- Replacement (all-electric + charging)	100%			

	Ferries/Tugs (Unregulated/Tier 1/2 marine, scrappage required)	% Cost Reimbursement	Example NOx Reduced (tons per year)	Example Vessel Repower Cost ($)	Other Considerations
Private	- Repower (diesel to Tier 4 or upgrade to CMS/VEU, alt-fuel, hybrid, + install)	40%	**Tug (4000-hp)**: 18 to 30 tons	**Tug (4000-hp):** $2M+	+ Vessels typically have 2 propulsion engines and 1-2 auxiliary engines + Limited alternative funding available
Private	- Repower (all-electric + charging, + install)	75%			
Public	- Repower (diesel to Tier 4 or upgrade to CMS/VEU, alt-fuel, hybrid, + install)	100%			
Public	- Repower (all-electric + charging, + install)	100%			

	Ocean-Going Vessel (OGV) Shorepower (Equipment: cables, cable management systems, coupler systems, control systems, power distribution)	% Cost Reimbursement	Example NOx Reduced (tons per year)	Estimated ($)	Other Considerations
Private	- Shoreside costs	25%	123 tons	$5M+	+ Good option for frequent callers, such as cruise ships + Limited alternative funding available *Note: may also be a cost-effective option for tugs*
Public	- Shoreside costs	100%			

	DERA Option	Example NOx Reduced (tons per year)	Example Cost of OGV Bonnet Technology ($)	Other Considerations
	- Beneficiaries may use funds for non-federal voluntary match; only applies for State DERA programs (EPA would need to approve technology) **If beneficiaries were to choose to modify the existing state DERA program, and if Congress appropriates funding to the DERA program, funding could be used for other very cost-effective projects, such as stack bonnet technologies that reduce ocean-going vessel emissions**	**OGV Stack Bonnet Technology (AMECS):** 100+ tons *(depends on vessels; technology not yet approved)*	$4M to 6M	+ OGV hoteling emissions have not been previously addressed and represent a large opportunity + Houston Ship Channel potential could be significant (>140 terminals)

	Class 8 Local Freight/Waste/Dump Trucks & Port Drayage Trucks (1992-2009, scrappage required)	% Cost (Freight)	% Cost (Drayage)	Example NOx Reduced (tons per year)	Example Cost of Class 8b Truck ($)	Other Considerations
Private	- Repower (diesel, alt-fuel, hybrid, + install)	40%	40%	0.2 to 1.0 ton	$100,000 to $125,000+	+ Community benefits for projects where trucks travel in neighborhoods (e.g., drayage and waste haulers) - Alternative funding available
Private	- Repower (all-electric + charging, + install)	75%	75%			
Private	- Replacement (diesel, alt-fuel, hybrid)	25%	50%			
Private	- Replacement (all-electric + charging)	75%	75%			
Public	- Repower (diesel, alt-fuel, hybrid, + install)	100%	100%			
Public	- Repower (all-electric + charging, + install)	100%	100%			
Public	- Replacement (diesel, alt-fuel, hybrid)	100%	100%			
Public	- Replacement (all-electric + charging)	100%	100%			

For Information Only - Please contact C. Wolfe at EDF for questions (cwolfe@edf.org or 512-691-3416).

	Class 4-8 School Bus, Shuttle Bus, or Transit Bus (<=2009, scrappage required)	% Cost Reimbursement	Example NOx Reduced (tons per year)	Example Cost of School & Transit Bus ($)	Other Considerations
Private	- Repower (diesel, alt-fuel, hybrid, + install)	40%	**School bus**: 0.1 to 0.2 ton **Urban bus**: 0.3 to 0.7 ton	**School bus**: $125,000+ **Transit bus**: $400,000+	+ School bus projects have important health co-benefits for children + May reduce idling in neighborhoods & at schools + Public transit supports reduced congestion - Alternative funding available
Private	- Repower (all-electric + charging, + install)	75%			
Private	- Replacement (diesel, alt-fuel, hybrid)	25%			
Private	- Replacement (all-electric + charging)	75%			
Public	- Repower (diesel, alt-fuel, hybrid, + install)	100%			
Public	- Repower (all-electric + charging, + install)	100%			
Public	- Replacement (diesel, alt-fuel, hybrid)	100%			
Public	- Replacement (all-electric + charging)	100%			
	Airport Ground Support Equipment (GSE) (< Tier 4 CI, Uncert/>3.0 g/bhp-hr SI, scrappage required)	**%**	**Example NOx Reduced (tons per year)**	**Estimated ($)**	**Other Considerations**
Private	- Repower (all-electric + charging, + install)	75%	**Baggage Tug (100-hp):** 0.1 to 0.4 ton **Aircraft Tug (500-hp):** 0.6 to 2 tons	**Electric Baggage Tug (100-hp):** $30,000+ **Electric Aircraft Tug (500-hp):** $90,000+	+ Zero-emission projects + Projects could support both passenger and air freight operations - Alternative funding available
Private	- Replacement (all-electric + charging)	75%			
Public	- Repower (all-electric + charging, + install)	100%			
Public	- Replacement (all-electric + charging)	100%			
	Class 4-7 Local Freight ("Medium") Trucks (1992-2009, scrappage required)	**% Cost Reimbursement**	**Example NOx Reduced (tons per year)**	**Example Cost of Medium Truck ($)**	**Other Considerations**
Private	- Repower (diesel, alt-fuel, hybrid, + install)	40%	**Class 4 (flat bed and stake trucks)**: 0.1 to 0.2 tons **Class 7 (beverage)**: 0.1 to 0.2 tons	**Class 4 (flat bed and stake trucks)**: $60,000+ **Class 7 (beverage)**: $70,000+	- Typically lower mileage vehicles (~20k/year), with some exceptions - Alternative funding available
Private	- Repower (all-electric + charging, + install)	75%			
Private	- Replacement (diesel, alt-fuel, hybrid)	25%			
Private	- Replacement (all-electric + charging)	75%			
Public	- Repower (diesel, alt-fuel, hybrid, + install)	100%			
Public	- Repower (all-electric + charging, + install)	100%			
Public	- Replacement (diesel, alt-fuel, hybrid)	100%			
Public	- Replacement (all-electric + charging)	100%			
	LD ZEV Supply Equipment (Max use of up to 15% of funds, L1/2/fast charging equipment, H2 FC equipment w/ 70 MPa pressure)	**%**	Note: $2.0 B is also being allocated through the ZEV Investment Commitment (detailed in Appendix C of the Partial Consent Decree for 2.0 L, 9/30/2016)		
Public	- Electrical vehicle supply equipment available to public (purchase/install/maint)	75%			
Public	- Electrical vehicle supply equipment available to public (purchase/install/maint)	100%			
Other	- Electrical vehicle supply equipment available to workplace/multi-unit dwelling (purchase/install/maint)	60%			
Other	- H2 FC vehicle supply equip. w/250 kg/day dispensing capability available to public (purchase/install/maint)	33%			
Other	- H2 FC vehicle supply equip. w/100 kg/day dispensing capability available to public (purchase/install/maint)	25%			

*** Projects prioritized (with green star) by high NOx emission reduction potential, as well as potential to help transform transportation sector to low-/zero emissions in Texas.**

Resources/Appendix

Partial Consent Decree (9/30/2016) - 2.0L vehicles
- Appendix C - ZEV Investment Commitment ($2.0 B), 10 years
- Appendix D - Environmental Mitigation Trust Fund ($2.7 B)

Partial Consent Decree (12/20/16) - 3.0L vehicles
- Mitgation Appendix ($225 M)

Eligible Project Types (assumptions & resources; many estimates from NOx-focused Texas Emissions Reduction Plan)

1	Port CHE: *TERP methodology for rubber-tire gantry (RTG) crane (650 hp, 1251 hrs), yard hostlers (200 hp, 1261 hrs), & forklift w/8k lift capacity (72 hp, 1706 hrs) for T0/T1/T2/T3*
2	Freight Switchers: *TERP methodology for locomotive projects using T0 (@17.5k gal) and T2 (@50k gal) for baseline; (min fuel use approx 1000 hours @ 140 gal/day)*
3	Ferries/Tugs: *TERP methodology for marine projects (Cat 2, 4000 hp) to repower from T0/T2 to T4, at 2500-3000 annual hours*
4	OGV Shorepower: *EPA National Port Strategy Assessment (2016); page 84.*
5	DERA Option: *Port of Long Beach emission inventory method to evaluate potential emissions reductions for tanker hoteling at terminal in the HGB region*
6	Class 8 Local Freight/Drayage Trucks: *TERP methodology for onroad Class 8b project using range of model years & annual mileage of 30,000 - 60,000*
7	Class 4-8 Bus: *TERP methodology for school/transit bus project using range of model years & annual mileage of 10,000 (school) - 35,000 (transit)*
8	Airport GSE: *TERP methodology for GSE equipment using horsepower range of 100 hp (e.g., baggage tug, lift) to 500 hp (e.g., widebody aircraft tug) and 681 annual hours*
9	Class 4-7 Local Freight Trucks: *TERP methodology for onroad Class 4 & 7 projects using range of model years & annual mileage of 10,000 - 20,000*

Zero-Emission Vehicle & Equipment Manufacturers, Integrators, & Technologies

Onroad Vehicles	Nonroad Equipment	Marine Engines	Locomotive Engines
BYD (bus, freight truck, refuse truck)	**BYD** (forklift, terminal tractor)	**ABB** (ferry)	**Alstom** (freight locomotive)
Charge (freight truck)	**Cat Lift Trucks** (forklift)	**Corvus Energy** (ferry)	**Bombardier** (freight locomotive)
Daimler (freight truck)	**Charlatte** (pushback, belt loader, luggage tug, lavatory truck, water truck)	**Elco** (tug, workboat)	**Hydrogenics** (freight locomotive)
EFA-S (freight truck)	**Crown** (folklift)	**Siemens** (ferry)	**Nordco** (railcar mover)
E-Force (freight truck)	**Eagle** (luggage tug, pushback)	**Visedo** (ferry)	**Railquip** (railcar mover)
EMOSS (freight truck)	**Hercules** (belt loader)	**Warsila** (ferry)	**TransPower** (railcar mover)
ESORO (freight truck)	**Hydrogenics** (crane)		**Whiting** (railcar mover)
EVI (freight truck, utility vehicle)	**Hyster** (forklift, container handler)	*Hybrid tug/ferry applications by Rotortug, Corvus Energy, Caterpillar Marine, Foss Maritime/AKA, and others.	*Hybrid locomotive applications by GE, Railpower, Vehicle Projects LLC, and others.
Ford (freight truck)	**JBT** (container loader)		
Ginaf (freight truck)	**Jetporter** (pushback)		
Iveco (freight truck)	**Jungheinrich** (forklift)		
Kenworth (freight truck)	**Konecranes** (RTG crane, reachstacker, automated guided vehicle [AGV])		
Motiv Power Systems (bus, work truck, freight truck)	**Landoll** (forklift)		
Nikola (freight truck)	**Lektro** (pushback)		
Orten (freight truck)	**Linde** (forklift)		
Paneltex (freight truck)	**Mitsubishi** (forklift)		
Peterbilt (refuse truck)	**OrangeEV** (terminal tractor)		
PVI (refuse truck)	**Plug Power** (forklift)		
Renault (freight truck)	**Raymond** (forklift)		
Scania (bus, freight truck)	**Terberg** (terminal tractor)		
Spijkstaal (bus)	**TLD** (pushback, container loader)		
Symbio (refuse truck)	**Toyota** (forklift)		
Tesla (freight truck)	**TransPower** (terminal tractor, reach stacker, airport tow tractor)		
Toyota (freight truck)	**TUG Technologies** (pushback, luggage tug)		
Thor Trucks (freight truck)	**UniCarriers** (forklift)		
TransPower (bus, drayage truck)	**US Hybrid** (terminal tractor)		
US Hybrid (freight truck)	**Yale** (forklift)		
Volvo (freight truck)			