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DRAFT FINAL WORKPLAN: EVALUATING OZONE PRECURSOR EMISSIONS REDUCTIONS IN THE GREAT LAKES REGION

**Draft Final Workplan: Evaluating Ozone Precursor
Emissions Reductions in the Great Lakes Region**

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1.0 INTRODUCTION

This workplan addresses the identification and evaluation of nitrogen oxides (NO_x) and volatile organic compound (VOC) emissions reductions from anthropogenic sources in the Lake Michigan Air Directors Consortium (LADCO) region. The primary objective of this study is to identify strategies that will lower ground-level ozone concentrations in counties designated as nonattainment for the 2015 ozone National Ambient Air Quality Standard (NAAQS).

For each technical task (Tasks 1, 2, and 3), this workplan describes analysis scope, information sources to be consulted, steps to be taken, and deliverables. For Task 4 (Project Administration and Final Report), this workplan describes documentation to be developed (i.e., draft and final workplan and draft and final report), task schedule (including review periods and suggested webinar dates), and progress updates (i.e., weekly, monthly, and as needed).

This effort will encompass all six LADCO states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. In general, control strategies for nonpoint sources would be focused on areas designated as 2015 ozone nonattainment and maintenance areas. Control strategies for stationary, onroad vehicles, and nonroad mobile sources would be evaluated across the entire LADCO region.

The project team will develop the technical analysis under the following tasks:

- Task 1: Summarize Existing NO_x and VOC Control Programs in the LADCO Region
- Task 2: Identify NO_x and VOC Emissions Control Options for NEI Sources in the LADCO region
- Task 3: Identify NO_x and VOC Emissions Control Options for non-NEI Sources in the LADCO Region

Under Task 4 (Project Administration and Final Report), Ramboll will perform project administration functions and develop the comprehensive report documenting work completed under Tasks 1, 2, and 3.

Work to be conducted under each task is described below.

2.0 TASK 1: SUMMARIZE EXISTING NOX AND VOC CONTROL PROGRAMS IN THE LADCO REGION

In Task 1, Ramboll will develop a listing of on-the-books (OTB) and on-the-way (OTW) emissions control programs for the LADCO region. This task will include the following steps:

- Develop a table listing regulations applicable to emission source categories in the LADCO region;
- Develop a table describing regulations in the LADCO region; and
- Develop final report chapter and summarize findings in webinar presentation.

Ramboll will first develop a listing of regulations applicable to emission source categories in the LADCO region. The table will simply list by emission source category, applicable regulations and reference regulatory source documentation or website by regulatory authority (Federal, State, and Local). In the table, Ramboll will identify the regulations which it intends to summarize, note any regulations for which additional information from LADCO is needed for the regulation summary, and ask that LADCO provide input on gaps in the regulations table.

To identify OTB and OTW regulatory programs, Ramboll will conduct a detailed literature search within internal databases and external sources to review and mine for relevant information, at a minimum, from the following reference documents and websites:

- Federal regulations documentation under the Clean Air Act¹ for various sources, e.g., EPA's Managing Air Quality - Control Strategies to Achieve Air Pollution Reduction² and 2015 National Ambient Air Quality Standards (NAAQS) for Ozone Regulatory Impact Analysis³
- Onroad regulations⁴,
- Nonroad mobile source regulations⁵,
- Stationary source regulations⁶,
- Area (nonpoint) source air toxics regulations^{7,8}
- Fuel-related regulations⁹,
- LADCO States' air quality regulatory websites and reference studies, e.g.,
 - Michigan Department of Environment, Great Lakes and Energy - Laws and Rules¹⁰
 - Illinois Environmental Protection Agency Bureau of Air¹¹
 - Ohio Environmental Protection Agency Division of Air Pollution Control Rules and Laws¹²
 - Indiana Department of Environmental Management Air Programs¹³
 - Minnesota Pollution Control Agency Air Rules and Rulemaking for Business¹⁴

¹ <https://www.epa.gov/regulatory-information-topic/regulatory-information-topic-air#criteria pollutants>

² <https://www.epa.gov/air-quality-management-process/managing-air-quality-control-strategies-achieve-air-pollution>

³ <https://www.epa.gov/ground-level-ozone-pollution/2015-national-ambient-air-quality-standards-naaqs-ozone>

⁴ <https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-onroad-vehicles-and-engines>

⁵ <https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-emissions-nonroad-vehicles-and-engines>

⁶ <https://www.epa.gov/regulatory-information-topic/regulatory-information-topic-air#stationarysources>

⁷ <https://www3.epa.gov/airtoxics/area/arearules.html>

⁸ <https://www.epa.gov/stationary-sources-air-pollution/national-emissions-standards-hazardous-air-pollutants-area-source-0>

⁹ <https://www.epa.gov/diesel-fuel-standards>

¹⁰ https://www.michigan.gov/egle/0,9429,7-135-3310_70314_4108---,00.html

¹¹ <https://www2.illinois.gov/epa/topics/air-quality/pages/default.aspx>

¹² <https://www.epa.ohio.gov/dapc/DAPCrules>

¹³ <https://www.in.gov/idem/airquality/2767.htm>

¹⁴ <https://www.pca.state.mn.us/air/air-rules-and-rulemaking-business>

- Wisconsin Department of Natural Resources Air Pollution Control Rules¹⁵
- Consent decrees that could translate into direct air emissions reductions within LADCO states¹⁶,
- Approved Air Quality Implementation Plans (SIPs) for LADCO states¹⁷
- 2016v1 Modeling Collaborative documentation¹⁸ and 2017 NEI technical reports¹⁹
- Other reference sources chosen in collaboration with LADCO under this task.

Ramboll expects to consult reference documents such as the 2016v1 Modeling Collaborative and previous modeling platform technical reports, LADCO States' websites and reference studies, and other reference sources chosen in collaboration with LADCO under this task. Regulation specific information, such as emission reductions and cost, will be referenced from rulemaking documents, or other sources, as available. For certain emission source and control program combinations (e.g. cement kilns), information on applicable emission controls may not be readily available from publicly available information or datasets. In such instances, we will collaborate with LADCO to identify industry contacts and/or information sources not published publicly that can be leveraged.

After receipt of input and comments on the listing of regulations, Ramboll will develop a table summarizing existing regulatory control programs that are currently impacting, or expected to impact, NO_x and VOC emissions in the next 5 years for the LADCO region. The table will include the following fields, to the extent feasible within task resources:

- Program name, summary program description, regulatory authority (state/federal)
- Expected emissions reductions and cost²⁰
- Applicable spatial scope, sector, source classification code(s) (SCC), and for stationary sources, Emissions Inventory System (EIS) facility and process identifiers

Key deliverables for this task are listed below. Additional information regarding deliverable schedule and LADCO review is provided under discussion of Task 4 below.

- Table listing regulations by emission source category
- Table providing additional detail regulations in the LADCO region, to the extent feasible within task resources
- Presentation and webinar
- Draft report chapter

¹⁵ <https://dnr.wi.gov/topic/AirQuality/rules.html>

¹⁶ <https://cfpub.epa.gov/enforcement/cases/>

¹⁷ <https://www.epa.gov/air-quality-implementation-plans/approved-air-quality-implementation-plans-region-5>

¹⁸ <http://views.cira.colostate.edu/wiki/wiki/10202>

¹⁹ https://www.epa.gov/sites/production/files/2020-04/documents/nei2017_tsd_full_30apr2020.pdf

²⁰ Emissions and cost information will be summarized from existing regulatory documents and/or follow-on studies to the extent feasible.

3.0 TASK 2: IDENTIFY NOX AND VOC EMISSIONS CONTROL OPTIONS FOR NEI SOURCES IN THE LADCO REGION

This section describes how Ramboll will identify and assess emissions reductions and cost-effectiveness of emissions control options for point, onroad, nonroad mobile and nonpoint (area) sources in the LADCO region. This task will include the following steps:

- Identify candidate control options
- Screen of candidate control options and develop recommended control options short-list
- Summarize findings in webinar presentation
- In collaboration with LADCO determine control options for which detailed analysis will be performed
- Perform detailed evaluation of select control options (white papers)
- SMOKE control packet development
- Develop final report chapter

3.1 Identification of Candidate Control Options

Ramboll will draw on a wide range of sources to identify potential control options in a “draft master list” for control options for mobile, point and nonpoint (area) sources.

We will use EPA’s Menu of Control Measures²¹ as a starting point to identify a broad list of control options that may be applicable to the LADCO region. Then, we will systematically complement the list with additional control options identified from our internal database and other resources, including innovative efforts in other states and in specific industries, and sector-specific technology and emissions reductions guidelines, as well as EPA Clean Diesel Initiative programs, California Air Resource Board (CARB) Carl Moyer program, Texas Commission on Environmental Quality (TCEQ) Texas Emissions Reduction Plan (TERP) program, etc. For controlling VOC nonpoint emissions, we will identify control programs, such as South Coast Air Quality Management VOC rules limiting VOC content for solvents, coatings, and inks that could reduce emissions from these sources, as well as relevant applicable information from the Ozone Transportation Commission (OTC) VOC control activities, including its Model Rule for Consumer Products - Phase V, and the Maryland, Connecticut and other east coast states’ regulatory documents for lowering the VOC limits for certain nonpoint sources. Some examples of resources that will be reviewed to develop the list of control options are summarized in Table 1 below.

²¹ Menu of Control Measures for NAAQS Implementation. Accessed online in April 2020 at <https://www.epa.gov/air-quality-implementation-plans/menu-control-measures-naaqs-implementation>

Table 1. Example control options data sources.

Reference Source	Type	Sectors Affected			
		Onroad	Nonroad	Stationary/ Point	Area/ Nonpoint
EPA's Clean Air Technology Center ²²	Repository of control technologies			✓	
EPA's Transportation Initiatives Documents ²³	Collection of transportation related programs	✓	✓		
EPA's P2 source reduction program (waste management) ²⁴	Tools and resources for businesses				✓
EPA's Diesel Emissions from Construction and Agriculture Reduction Policy ²⁵	Federal guidelines and incentives	✓	✓		✓
EPA's Diesel Emissions from School Buses program ²⁶	Rebate program	✓			
RACT/BACT/LAER Clearinghouse (RBLC) ²⁷	Repository of control technologies for stationary sources			✓	
EPA's Smart Way Retrofit Technologies ²⁸	Repository for verified retrofit technologies	✓	✓		
South Coast AQMD 2016 air quality management plan ²⁹ and South Coast AQMD rules ³⁰	Regional plan and Local Rules	✓	✓	✓	✓
California heavy-duty trucks low-NOx standards ³¹	Proposed state rule	✓			
California Truck and Bus Rule ³²	OTB state rule	✓			
California Harbor Craft Rule ³³	OTB state rule		✓		
In-Use Off-Road Diesel-Fueled Fleets Regulation	OTB state rule		✓		
Alternative fuel initiatives, such as Texas TxLED diesel program ³⁴	OTB state rule	✓	✓		
Plans to reduce freight industry related emissions, e.g. San Pedro Ports Climate Action Plan ³⁵ and other Ports Initiatives ³⁶	Local industry initiative	✓	✓		
Enhanced locomotive emission standards ³⁷	Petition to EPA		✓		
Texas Emissions Reduction Plan (TERP) ³⁸	State financial incentives	✓	✓		
CARB Carl Moyer Program	State financial incentives	✓	✓		
OTC VOC Controls	Regional plan and Local Rules				✓

²² <https://www.epa.gov/catc/about-clean-air-technology-center>

²³ <https://www.epa.gov/state-and-local-transportation/transportation-related-documents-state-and-local-transportation>

²⁴ <https://www.epa.gov/p2/learn-about-pollution-prevention#p2>

²⁵ <https://www.epa.gov/dera/reducing-diesel-emissions-construction-and-agriculture>

²⁶ <https://www.epa.gov/dera/reducing-diesel-emissions-school-buses>

²⁷ <https://cfpub.epa.gov/RBLC/index.cfm?action=Home.Home&lang=en>

²⁸ <https://www.epa.gov/verified-diesel-tech>

²⁹ <http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/final-2016-aqmp>

³⁰ <https://www.aqmd.gov/home/rules-compliance/rules>

³¹ <https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox>

³² <https://ww2.arb.ca.gov/our-work/programs/truck-and-bus-regulation>

³³ <https://ww2.arb.ca.gov/our-work/programs/commercial-harbor-craft/chc-regulatory-documents>

³⁴ <https://www.tceq.texas.gov/airquality/mobilesource/txled/cleandiesel.html>

³⁵ <https://cleanairactionplan.org/>

³⁶ <https://www.epa.gov/ports-initiative>

³⁷ <https://ww2.arb.ca.gov/resources/documents/carb-petitions-us-epa-strengthen-locomotive-emission-standards>

³⁸ <https://www.tceq.texas.gov/airquality/terp>

In addition, Ramboll will review applicable information from the EPA's Managing Air Quality-Control Strategies to Achieve Air Pollution Reduction website³⁹, as well as leverage available tools to evaluate control options, such as EPA's Control Strategy Tool (CoST)⁴⁰ and EPA's Diesel Emissions Quantifier (DEQ)⁴¹ to the extent that the use of such tools is efficient and applicable to this study.

Ramboll will prepare a draft master list of candidate control options for LADCO's preliminary review. Ramboll will create a table of qualitative markers to refine these options into a shorter list of viable control options. The qualitative evaluation will account for the ability of the control option to produce credible emissions reductions and use available information on cost effectiveness, estimate the technical or implementation feasibility, and consider the likely public acceptance. Ramboll will follow the evaluation of each control option in the master list by grouping like control options and tracking each control option as it is evaluated.

3.2 Screening of Candidate Control Options

Each control option on the master list will first be reviewed to ensure that the control methods within each control option meet the permanent (real), quantifiable, surplus, and enforceable criteria required for control options to be credible and creditable in the SIP. These criteria will be used to determine/screen if the control options are viable; any control options determined not to be permanent (real), quantifiable, surplus, and/or enforceable will be dropped from consideration. Control options determined not to meet these criteria will stay on the comprehensive candidate list and Ramboll will note in the table the reason why they were not considered permanent, quantifiable, surplus, and/or enforceable. For control options that are determined to be permanent (real), quantifiable, surplus, and/or enforceable, additional screening analysis will be performed as follows.

Ramboll will compile readily available, screening-level metrics for each control option from the reference data sources into a master table, including the metric fields listed below. Ramboll will populate the metric fields below for each control option, to the extent that these fields can be populated from readily available data sources. The only field which Ramboll will calculate in the list below will be absolute emission reduction, all other fields will be populated from existing data or studies.

- Major emissions process or classification (i.e., applicable SCCs)
- Permanent, Quantifiable, Surplus, and Enforceable (Yes or No)
- Emission reduction control efficiency (percent reduction)
- Absolute emission reduction (based on application of the emission reduction control efficiency to the reference emission inventory [e.g., 2016v1 inventory post Jan 2020 version] for the geographic area of interest). If feasible within task resources, we will report state and/or area specific emission reductions.
- Cost effectiveness (\$/ton)
- Technical or implementation feasibility (flagged as low/medium/high; noting key barriers, if any)
- Likely public acceptance (flagged as low/medium/high; noting key barriers, if any)

Ramboll will also include estimated ozone response as a quantitative metric based on application of ozone sensitivity (ppb of ozone per ton of NO_x or VOC emitted) to estimated emission reductions, if

³⁹ <https://www.epa.gov/air-quality-management-process/managing-air-quality-control-strategies-achieve-air-pollution>

⁴⁰ <https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations/cost-analysis-modelstools-air-pollution#control%20strategy%20tool>

⁴¹ <https://cfpub.epa.gov/quantifier/index.cfm?action=main.home>

ozone sensitivity estimates are available for the LADCO region and the geographical scale for the ozone sensitivity estimates are reasonably consistent with the scale of the control strategies analysis.

After populating the above fields for each control option, Ramboll will rank control strategies by two metrics, absolute emission reductions and cost effectiveness. It is expected that strategies with the potential to reduce the most emissions and that are most cost effective will be selected for additional analysis. In the ranking, Ramboll will note other key information (besides absolute emission reductions and cost effectiveness) that may raise or lower the status of an option for further analysis.

In consultation with LADCO and in consideration of the resources and schedule, a short list of higher-ranking control strategies will be selected for detailed evaluation.

3.3 Detailed Evaluation of Select Control Options

Ramboll will perform an in-depth analysis to refine estimates of potential emissions reductions from the short-listed control options and costs associated with implementing these control options, as well as calculate the cost-effectiveness of these control options based on the potential emissions reductions and cost data. We will provide state and non-attainment area specific estimates for each control option, to the extent feasible within task resources, prioritizing development of state and non-attainment area specific estimates for emissions reductions and cost effectiveness.

The result of the in-depth analysis will be documented in a white paper for each control option. The white paper will include detailed descriptions of the components listed below. The analysis for these components would be refined and expanded from the screening analysis as described below.

- Major emissions process or classification (i.e., applicable SCCs)
- Permanent, Quantifiable, Surplus, and Enforceable
- Emission reduction control efficiency (percent reduction)
- Absolute emission reduction
- Cost effectiveness (\$/ton)
- Implementation feasibility
- Public acceptance
- Timeframe
- Responsible agency
- Assessment methods

In collaboration with LADCO, we will ensure that the white papers include all of the key components that will be necessary to include in the final control strategy report.

Real control strategies provide actual **emissions reductions** compared to the assumed baseline. Quantifiable control options have emissions benefits that can be measured and/or calculated and the results are replicable. Permanent control strategies have emissions benefits that continue throughout the implementation life of the control strategies. For certain voluntary measures, such as transportation or smart mobility control measures, EPA has provided general guidance on how to credit these measures in an implementation plan. Ramboll will closely review those rules and list of potential voluntary measures. Enforceable control strategies can be verified to have occurred and have provisions and penalties to address non-compliance. Once the percent control, the rule penetration, and the compliance rate are determined, a control factor can be developed for each emissions source category. The control factor or factors, emissions benefits and feasibility assessment associated with each control strategy used in the cost-effectiveness analysis will be based on the best available data from past studies and/or implemented programs, as well as engineering estimates or judgment. References for the assumptions and data used will be clearly documented.

Cost effectiveness analysis requires two inputs, namely emissions reductions in tons per year and control strategy cost in dollars per year. A control strategy's cost depends on its implementation. For example, the cost of an incentive program includes the amount distributed in incentives and the amount required for the program's administration needed to meet the EPA's control strategy criteria. The cost of a mandate requiring that all new fleet vehicles are low emissions vehicles will consist of administrative costs due to enforcement and educational activities. However, such a program can also generate revenue in the form of non-compliance fees. In addition to direct costs, control strategies can result in indirect costs to, for example, the source owner or the source's customer. Ramboll will clearly indicate which costs are included in the cost effectiveness calculation. If pertinent, we will identify indirect costs. We anticipate obtaining program costs (e.g., administrative and enforcement costs) from the counties, states and/or other agencies that have implemented such control programs to estimate costs that could be incurred LADCO region state or local agencies. If such information is not available, Ramboll will perform a limited amount of analysis to develop this information. Much of this information will depend on the LADCO States responsible for implementing the control strategy.

Cost effectiveness will be calculated by dividing the annualized control strategy cost by the annual emissions reduction for each pollutant or any relevant combination of pollutants as agreed by LADCO. The cost-effectiveness will be calculated using certification data, published data from other reports, and data from vendors and other manufacturers of emissions control and process equipment.

As indicated earlier, one of our evaluation criteria is the feasibility of proposed control strategies. A control strategy's feasibility considers, but is not limited to cost, cost effectiveness, resources, and authority. The feasibility assessment will draw from most of the other elements evaluated in the full analysis. Ramboll will also assess the probability of success (i.e. **implementation feasibility** and **public acceptance**) based on information from similar programs implemented in other regions. Finally, we will identify the barriers and opportunities for the successful implementation of each control strategy.

Some control strategies may require the adoption or revision of federal, state, and local regulations. The assessments performed in the authority and resource analysis will be used to determine any legislative change and which entity (i.e., **responsible agency**) is best positioned to implement the strategies.

In addition to classifying the **timeframe** for each control option as short-term or long-term, Ramboll will also classify the control options as regulatory or voluntary.

Ramboll will also include estimated ozone response as a quantitative metric based on application of ozone sensitivity (ppb of ozone per ton of NOx or VOC emitted) to estimated emission reductions, if ozone sensitivity estimates are available for the LADCO region and the geographical scale for the ozone sensitivity estimates are reasonably consistent with the scale of the control strategies analysis.

Finally, Ramboll will compare and recommend the most cost-effective control strategies for the LADCO region to meet the short-term and long-term goals in reducing ozone. Similar to the screening analysis, absolute emission reductions and cost effectiveness are expected to be key ranking criteria. Ramboll will also note other key findings (e.g., public acceptance) and, if warranted, adjust the final control strategy ranking based on these considerations.

Ramboll will develop a SMOKE control packet, inclusive of each control strategy evaluated for applying controls by county (FIPS) code, SCC, and, if applicable, facility or unit ID.

3.4 Deliverables

Key deliverables for this task are listed below. Additional information regarding deliverable schedule and LADCO review is provided under discussion of Task 4 below.

- Master table of candidate control options
- Candidate control options screening and shortlist for further analysis
- Presentation and webinar
- White papers for control measures selected for further analysis
- SMOKE control packet for applying controls by county (FIPS) code, SCC, and, if applicable, facility or unit ID
- Draft report chapter

4.0 TASK 3: IDENTIFY NOX AND VOC EMISSIONS CONTROL OPTIONS FOR NON-NEI SOURCES IN THE LADCO REGION

This section describes how Ramboll will make revisions to LADCO's emission inventory for select source categories and identify potential emission control options for these categories. This task will include the following steps:

- Review and evaluate available information from literature and emission inventory models for heavy duty vehicles and nonpoint volatile chemical product sources
- Develop a white paper describing potential emission inventory adjustments and control strategies for heavy duty vehicles and nonpoint volatile chemical product sources
- Develop final report chapter and summarize findings in webinar presentation

4.1 Nonpoint Sources

Recent study⁴² shows that VOC emissions from volatile chemical products (i.e., pesticides, coatings, printing inks, adhesives, cleaning agents, and personal care products) are potentially substantially underestimated in current emission inventories by a factor of two to three, nationwide. We will review available literature and suggest methodology to make emission adjustments for applicable categories. In collaboration with LADCO, we will determine whether to revise LADCO VOC emissions for these source categories. We will also identify control programs, such as South Coast Air Quality Management VOC rules⁴³ limiting VOC content for solvents, coatings, and inks that could reduce emissions from these sources, as well as relevant applicable information from the Ozone Transportation Commission (OTC) VOC control activities, including its Model Rule for Consumer Products - Phase V, and the Maryland, Connecticut and other east coast states' regulatory documents for lowering the VOC limits for certain nonpoint sources.

4.2 Heavy-Duty Vehicles

4.2.1 Basic Emission Rates

Heavy-duty truck emissions rates for MY2010+ (those using selective catalytic reduction [SCR] NOx Control) will be increasing in the next version of MOVES because actual emissions data has been collected.⁴⁴ MOVES2014 relied on the same speed/power bin emissions profile as older pre-SCR trucks and adjusted the overall emissions rates by a percentage reduction equivalent to the standard change. In doing this, MOVES2014 ignored the effect of lower speed/power of cool SCR systems reducing its effectiveness relative to higher power modes. Figure 1 shows how the EMFAC2014 model estimated higher emissions rates for the new SCR technology heavy-duty emissions rates at lower speed relative to MOVES2014.

⁴² McDonald, B. C. et al. Volatile chemical products emerging as largest petrochemical source of urban organic emissions. *Science* 359, 760–764 (2018). <https://science.sciencemag.org/content/359/6377/760>

⁴³ <https://www.aqmd.gov/home/rules-compliance/compliance/vocs/rules>

⁴⁴ Han, J., G. Sandhu, D. Sonntag, D. Bizer-Cox, 2019. Planned Updates to EPA's MOVES Emissions Model for Heavy-Duty Onroad Vehicles. 2019 International Emissions Inventory Conference.

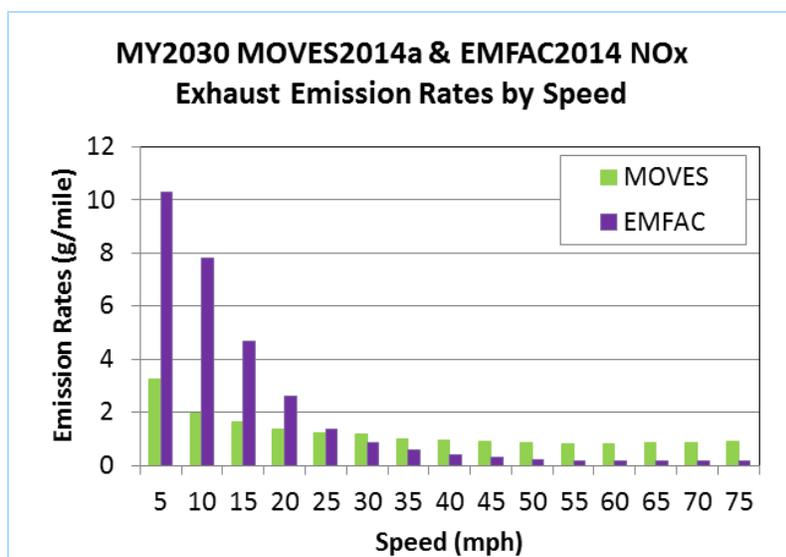


Figure 1. Heavy-duty truck emission rates by speed for MY2030

The International Council on Clean Transportation (ICCT)⁴⁵ has estimated that for MY2010+ line-haul vehicles, approximately 40% of emissions occur at low load condition (speeds less than 25 mph) and on a per mile basis, NO_x emissions at low load conditions are more than 10 times greater than NO_x emissions at speeds over 50 mph.

Proposed Emission Inventory Adjustment: We expect that the next version of MOVES will incorporate the low speed/power (including short-term⁴⁶ idling) NO_x increase for MY2010+ heavy-duty vehicles. However, if EPA does not release a new version of MOVES in time for this work, Ramboll will propose using EMFAC or other speed adjustments in consultation with LADCO. This could include adjusting the raw speed/power bin emission rates in MOVES2014 prior to running MOVES outputs for inventory development, or an adjustment to the emission factors produced by MOVES speed bin output prior to developing the emission inventory. Ramboll will prepare the adjustments to the emission inventory method such that LADCO can review and edit these adjustments, and to provide a means to more precisely estimate the expected benefit of control strategies.

4.2.2 Out of Specification Heavy-Duty Vehicles

Tampering (including aftermarket defeat devices), mal-maintained, and glider (those new vehicles using older technology rebuilt engines) vehicles have been identified by EPA and CARB for adjustments to increase basic emission rates for MY2010+ heavy-duty vehicles. Identifying both the fleet fraction of higher emitting vehicles and the emission rates for those vehicles is critical to emission inventory accuracy given that when emission controls are not functioning as designed, emissions from MY2010+ vehicles increase substantially. We expect that the next version of MOVES will incorporate glider trucks, but it is unclear whether tampering and mal-maintenance rates will be adjusted based on recent data. LADCO identified aftermarket defeat devices as an additional class of out of specification (failing) vehicles that should be considered in this work. Defeat devices are clearly designed to obviate the SCR and other emission control systems.

⁴⁵ https://theicct.org/sites/default/files/publications/NOx_Emissions_In_Use_HDV_US_20191125.pdf

⁴⁶ As opposed to 'extended' idling already included in MOVES.

CARB identified NOx sensor and SCR catalyst failures as the primary maintenance issue for MY2010+ vehicles. Each of these failures could result in a disablement of the NOx controls, increasing emissions significantly. Table 2 shows CARB EMFAC model estimates of failure rates at useful life and effect on emissions of failures by component.

Table 2. EMFAC2017 estimate of NOx failures prevalence and effect

Example Failure	Failure Rate		Failure Effect on NOx Emissions
	MY2010 – 12	MY2013+	
NOx Sensor	36%	24%	+200%
Non-standard NOx Sensor	1.8%	1.2%	+200%
SCR System (Catalyst)	40%	27%	+300%
EGR Disabled	16%	11%	+150%

Ramboll will review failure rates using data available from studies of in-use failure rates in the LADCO region. Remote sensing is a method uniquely able to identify failing vehicles and is a good source of data and method for agencies to begin to identify the importance of these conditions. Because a failing MY2010+ vehicle is likely to have significantly higher emission rates than vehicles meeting the emission standards, it should be evident when a vehicle is out of specification. Other approaches to identify these vehicles could be laboratory and other in-use verification measurements.

Making an adjustment for these failing vehicles allows one to address and quantify emission inventory impact of failing vehicles. Emission reduction programs ranging from forwarding enforcement actions to EPA, instituting mandatory inspection and maintenance, or voluntary programs have been proven approaches to address mal-maintenance and defeat devices.

Proposed Emission Inventory Adjustment: Ramboll will, in consultation with LADCO and EPA, include emission inventory adjustments for out of specification heavy-duty vehicles. The adjustment will be based on a) the fraction of the fleet expected to have non-functioning emission control devices and b) emission increases for those vehicles with non-functioning control devices.

4.2.3 Heavy-Duty Vehicle Control Strategies

Ramboll will estimate potential emission reduction and cost effectiveness for heavy-duty vehicle control strategies. Emission reductions for low load/speed conditions could be addressed by either updating vehicles to reduce emissions under these conditions or by reducing low-load activity through transportation planning. Ramboll will review control programs (reference sources for control programs identified in Section 3.1) to address low load and failing MY2010+ heavy-duty vehicles.

EPA⁴⁷ issued, in January 2020, an Advanced Notice to update the heavy-duty vehicle emission standards that could begin as early as the 2024 model year. This rule is expected to lower overall emissions and to specifically address the low load/speed high-NOx emission condition identified by ARB, ICCT, and others. The new emission standard vehicles would provide an opportunity for local programs to jump start emission reductions by targeting fleets serving fleets of heavy-duty vehicles with substantial low load operations. Situations in the LADCO states where low load conditions are expected to result in low load driving include delivery vehicles in general, and drayage trucks used at intermodal or other large warehousing/distribution facilities. California has implemented state-wide rules for these fleets to update their vehicles, primarily targeting PM emission reductions. A new Federal rule could provide an opportunity to deploy a similar program, extending emission reductions

⁴⁷ <https://www.epa.gov/regulations-emissions-vehicles-and-engines/advance-notice-proposed-rule-control-air-pollution-new>

to NO_x under low load conditions. Some Ports have begun to investigate converting locally dedicated fleets to zero emission fleets when the origin and destination is limited to short haul as part of lease agreements or voluntary programs.

Other example programs that will be investigated would be streamlined traffic flow to reduce the time vehicles spend at traffic lights or in congested traffic situations especially near intermodal and other high vehicle use facilities. Examples of such programs to reduce idling and low load operating mode activity are listed below:

- Infrastructure
 - Dedicated lanes, especially turn lanes
 - Grade separation (road or rail)
 - Signalization improvements
 - Rerouting
 - Scheduled appointments (intermodal)
 - Others to be determined
- Idle Restrictions
- Off-Peak Deliveries
- Central Business District Limits or Permit-only Zones

Identifying and remedying failure vehicles could provide a more immediate emission reduction program. Whether remote sensing or another inspection program is used to identify failing or tampered emission control systems, a program could be devised to either be mandatory or voluntary (full voluntary or hardship subsidy programs could be designed) to repair or replace vehicles not complying with the relevant emission standard.

Key deliverables for this task are listed below. Additional information regarding deliverable schedule and LADCO review is provided under discussion of Task 4, below.

- White papers describing emission inventory adjustments and applicable control measures
- Presentation and webinar
- Draft report chapter

5.0 TASK 4: PROJECT ADMINISTRATION AND FINAL REPORT

Under this task, Ramboll will coordinate Tasks 1, 2, and 3 according to the project schedule and budget, as well as to develop the draft and final workplan, and draft and final report.

Ramboll will provide weekly project updates via email and hold monthly project teleconferences. Within one day of each monthly teleconference, Ramboll will email teleconference notes, including action items to LADCO. Should there be a need for more frequent, or ad-hoc communications, the Ramboll principal-in-charge and project manager will be available to discuss the project by telephone, email, or other platforms. This level of communication will ensure that Ramboll can respond proactively to any issues or changes to the Project scope. Ramboll will rely on LADCO to provide point of contacts of its stakeholders, and if any direct interactions with LADCO's stakeholders, Ramboll will inform and/or copy LADCO for any direct interactions between Ramboll and its stakeholders.

Upon completion of milestones, Ramboll will coordinate meetings to review findings and receive feedback. These meetings are expected to be conducted in webinar format which Ramboll can facilitate or can be held on a LADCO platform.

As part of Tasks 1, 2, and 3, Ramboll will compile report sections. Under this task, Ramboll will compile, then solicit review and comment from LADCO and designated stakeholders on the draft report outline and the draft report.

The project schedule is described by subtask in Figure 2. Periods of LADCO review are shown in yellow highlighted cells. This schedule is aggressive and was developed to meet the September 30, 2020 project finish date. This schedule is a best case scenario and will require very extremely efficient work product development, on-time delivery of work products, and prompt review of work products by LADCO. In the case that work product delivery must be delayed and/or additional work product review time is required, Ramboll and LADCO will coordinate and revise the schedule as necessary. Figure 3 shows anticipated touch points with LADCO states for work product review and webinars.

Figure 2. Detailed project schedule (yellow highlights indicate LADCO review periods).

Deliverable	Due Date	June	July	August	September
Task 1: Summarize Existing NOx and VOC Control Programs in the LADCO Region					
Table: Regulation List	6/8/2020				
Table: Regulation Descriptions	6/26/2020				
Draft Presentation	6/26/2020				
Draft Report Chapter	6/26/2020				
Webinar	6/29 or 6/30				
Task 2: Identify NOx and VOC Emissions Control Options For NEI Sources in the LADCO Region					
Table: Candidate Control Options	6/19/2020				
Table: Candidate Control Options Screening	7/3/2020				
LADCO Control Strategy Shortlist	7/3/2020				
Draft Presentation	7/3/2020				
Webinar	7/6, 7/7, or 7/8				
Control Strategy White Papers	7/31/2020				
Draft Report Chapter	8/21/2020				
Task 3: Identify NOx and VOC Emissions Control Options for Non-NEI Sources in the LADCO Region					
Emission Inventory Revisions Status Update	6/26/2020				
Control Strategy Status Update	7/9/2020				
Emission Inventory/Control Strategy White Papers	7/23/2020				
Draft Presentation	7/23/2020				
Webinar	7/27, 7/28, or 7/29				
Draft Report Chapter, SMOKE Control Packet	9/16/2020				
Task 4: Project Administration and Final Report					
Draft Workplan	6/4/2020				
Final Workplan	6/11/2020				
Weekly Email Updates	ongoing				
Monthly Project Teleconferences ¹	7/1, 8/5, 9/2				
Draft Report	9/16/2020				
Final Report	9/30/2020				

¹ Notes, including action items to be provided to LADCO project manager within one day of each webinar/teleconference

Figure 3. Anticipated review and webinar schedule (*webinars shown in bold italics*).

Review Period / Webinar Date Options	Deliverable to Review / Webinar
Task 1: Summarize Existing NOx and VOC Control Programs in the LADCO Region	
6/9 - 6/15	Table: Regulation List
<i>6/29 or 6/30</i>	<i>Webinar</i>
6/29 - 7/3	Draft Report Chapter
Task 2: Identify NOx and VOC Emissions Control Options For NEI Sources in the LADCO Region	
6/22 - 6/26	Table: Candidate Control Options
7/6 - 7/10	Table: Candidate Control Options Screening & Control Strategy Shortlist
<i>7/6, 7/7, or 7/8</i>	<i>Webinar</i>
8/3 - 8/7	Control Strategy White Papers
8/24 - 8/28	Draft Report Chapter
Task 3: Identify NOx and VOC Emissions Control Options for Non-NEI Sources in the LADCO Region	
7/24 - 7/30	Emission Inventory/Control Strategy White Papers
<i>7/27, 7/28, or 7/29</i>	<i>Webinar</i>
8/24 - 8/28	Draft Report Chapter
Task 4: Project Administration and Final Report	
9/17 - 9/23	Draft Report