PEER REVIEW COMMENT TEMPLATE

A *Methodology for the Quantification, Monitoring, Reporting, and Verification of Greenhouse Gas Emission Reductions and Removals from Re-Refining Used Lubricating Oils* was prepared by Clean Harbors Environmental Services/Safety-Kleen Systems, Inc. ACR extensively reviewed the methodology on several occasions from October 2016-December 2017 providing numerous comments and working through several methodology revisions. The methodology was posted for public comment from December 2017 – January 19, 2018.

Note to reviewers: This template is organized by section of the methodology. Please insert your review comments in the table for that section. In the first round of review, all peer reviewers should insert their comments in the first column, leaving the second column for methodology author responses. This will be followed by an abbreviated second round of review in which the reviewers comment on the authors' responses and methodology revisions, followed by a second round of responses from the authors.

Please add rows to each table as needed.

1. Background and Applicability

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First paragraph – There are a variety of environmental impacts associated with each part of the life cycle of used oil. There are a number of routes to produce base oils with a range of energy intensities and impacts depending on crude source and technology. There are also a range of treatment and reuse options for used oil – including re-refining, distillation to MDO, treatment and combustion in a variety of systems, laundering for reuse. Suggest rewording to better reflect this.	Agree. We will focus the opening paragraph on the basis for the methodology. Our singular focus is to capture more of the "practical loss" volume as defined in the 2012 Kline/CalRecycle report "Lubricant Consumption and Used Oil Generation in California: A Segmented Market Analysis". Specifically, we will reduce the amount of used oil that is improperly disposed, discarded or burned for energy recovery while increasing the amount of collected used oil that can be re-refined into API Certified Base Lubricants. The following definitions have been added to the methodology to clarify its scope: **Technical Loss** – which describes the estimated proportion of lubricants consumption "disappearance" due to auto-consumption and related losses in handling, and **Practical Loss** – which estimates the amounts of theoretically-recoverable used oil which may be recoverable in each application after certain common practices for internal consumption of generated used oil are recognized. Though some recovered used automotive engine oil may be burned for space heating in Northern California, an analysis of the specifics of such possible internal use is beyond the scope of this study. Accordingly, Kline has assumed that all	See comment on left. No changes appear to have been made. To be more explicit statements such as "The manufacture of lubricating oil is the most energy intensive process in a crude oil refinery" would need to be justified (it is an absolute and that is unlikely to be supportable – and presumably was meant to read base stocks). Re-refining also produces a range of pollutants including carbon dioxide and the overall result is skewed and potentially misleading. The fact remains that there are a number of different processes for producing base oil and a number of options for reprocessing and recycling used oil. The definitions of technical and practical loss used here were specifically for California. I do not believe they improve the	We have reworded the opening paragraph to eliminate any misleading statements and clarify the various routes to produce base oils and range of treatments and reuse options. We have further clarified technical and practical loss. We have also revised some of the later calculations in the

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	technically-available used PCMO and HDMO volumes are practically-recoverable in California.	clarity or usefulness of the document. It would be essential to clearly distinguish legal uses of generated used oil from illegal (ie improper disposal) – at present they are conflated or confused.	document so that the definitions of practical and technical loss are not critical to the methodology. Where needed, we have clarified the difference between legal uses of generated used oil from illegal (ie improper disposal). However, this distinction is not relevant to the core premise behind the methodology, which is to uncover every molecule of used lubricant in North America we can capture to avoid it from being lost forever by being burned for energy recovery or improperly managed or disposed
To say 'an alternative option exists for used lubricating oil' is potentially misleading. Most used oil is collected and treated and this implies that it is not. 'While some used oil is improperly disposed of, most is collected and processed for a variety of uses historically mostly for fuels though increasingly for refinery feedstock and distillate fuels'.	Our view is that a significant amount of generated used oil is not captured in the used oil collection specifically for use in the re-refining network. This is borne out in the 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities- North America". The data in that report indicate that 41% of total lubricant volume in North America is generated as used oil with the balance lost during improper handling, unauthorized	I do not believe that used oil programs are instigated to reduce 'practical' loss. They are typically put in place to decrease illegal/improper disposal and to increase collection rates. That is not the same. The estimates in the Kline report are misused or misunderstood in this document.	Practical loss includes illegal/improper disposal, so used oil programs are done to reduce practical loss. We agree and have revised the methodology to accurately apply the data to fit the Methodology. It has

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	disposal, reclaimed at site for use as a lubricant or as a fuel for space heaters, or through other pathways. Of the used oil that is captured in the collection network, the most recent Kline data indicate that 2/3 is burned for energy recovery when it could be re-refined. Appropriate content and data from the above Kline report will be added to the methodology to support this position.	An unknown amount of used oil is improperly disposed. The Kline data show an estimated 78% of generated used oil is collected and makes no comment on how much of the 22% that is not is improperly disposed as opposed to being reclaimed on site, legally burned on site or lost in handling etc. The alternative treatments such as distillation to MDO and VGO which show similar life cycle profiles to re-refining should be mentioned.	been reviewed and confirmed by Kline.
It would be more defensible to say that re-refined base oil can meet the specifications required but it cannot be safely stated that it is exactly the same as virgin base oils. Formulators would work with the base stock and develop additive packages to meet specifications – and tailor those to the base stock in use to account for variations in the base stocks (both virgin and re-refined).	Agree. We will avoid comparison to virgin base and will focus on standard performance statements, such as: "All base oil lubricant manufacturers must meet the same rigid quality assurance/quality control standards referenced in API Standard Publication 1509 (Fifteenth Edition)."	Previous comment stands. I understand that there are significant difficulties getting OEM certification for changes in base oil – including a move to re-refined as test data are not usually available.	We have modified the document accordingly.

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Definitions and acronyms: - **Base oil – the API groups define characteristics not manufacturing routes. Most oils in group I, II and III are made through the different general routes (though re-refining is not mentioned). Clarify the wording.**	- Agree. We will clarify the wording and will also include the five categories of oil as defined by the API.		
- **'Comprehensive take back program' is that a standard definition or one developed for this work? Does it preclude retail or wholesale distribution and how would the inevitable and significant losses be made up?**	- The definition of "Comprehensive take back program" is developed for this document and is unique to this Methodology. The concept can include retail and/or wholesale distribution. Accounting has been made for losses by virtue of the fact that crediting is based on how much used oil is re-refined, not collected. The take back program will not be a part of the initial methodology. It is now included in the appendix for reference as future consideration to expand the program.		
- **Lubricating oil – is the definition deliberately to exclude a variety of other oil uses – for example many industrial oils (and presumably excludes electrical oils?)**	- The definition as stipulated in the methodology includes "petroleum-derived or synthetic crankcase oil, engine oil, hydraulic fluid, transmission fluid, gear oil, heat transfer fluid, or other oil or fluid used for lubricating machinery or equipment". The	As previously it is not clear if this definition covers the full range of uses that base oil is put to and which appears to be included in the Kline estimates for sales – such as process oils that are fully consumed in application (one	The range of oils that should not be included, such as processed oils and other oils not suitable for collection are addressed by the revised calculations.

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	definition is consistent with the federal regulation as written in 40CFR 279. Furthermore, the US EPA guidance defines "used oil as any oil that has been refined from crude oil or any synthetic oil that has been used and as a result of such use is contaminated by physical or chemical impurities. Simply put, used oil is exactly what its name implies—any petroleum-based or synthetic oil that has been used. During normal use, impurities such as dirt, metal scrapings, water, or chemicals can get mixed in with the oil, so that in time the oil no longer performs well. Eventually, this used oil must be replaced with virgin or re-refined oil to do the job at hand. EPA's used oil management standards include a three-pronged approach to determine if a substance meets the definition of used oil. To meet EPA's definition of used oil, a substance must meet each of the following three criteria: 1. Origin - Used oil must have been refined from crude oil or made from synthetic materials. 2. Use - Oils that are used as lubricants, hydraulic fluids, heat transfer fluids, buoyants, and for other similar	reason the calculated figures for rates of recovery are incorrect). My point was to simply inquire as to whether all used oils (eg including electrical oils) are included or not. My understanding had been that several sources of used oil would not be suitable for re-refining – so only a subset of all commonly understood used oil would be potentially available/suitable for re-refining.	

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	purposes are considered used oil. Unused oils such as bottom clean-out waste from virgin fuel oil storage tanks or virgin fuel oil recovered from a spill, do not meet EPA's definition of used oil because these oils have never been "used." EPA's definition also excludes products used as cleaning agents or used solely for their solvent properties, as well as certain petroleum-derived products like antifreeze and kerosene. 3. Contaminants - In other words, to meet EPA's definition, used oil must become contaminated as a result of being used. This aspect of EPA's definition includes residues and contaminants generated from handling, storing, and processing used oil. Physical contaminants could include metal shavings, sawdust, or dirt. Chemical contaminants could include solvents, halogens, or saltwater."* *U.S. EPA Guidance Document concerning Managing Used Oil: Answers to Frequent Questions for Business, 2003: https://www.google.com/search?q=epa%27s+used+oil+definition&ie=UTF-8&oe=UTF-8&hl=en-us&client=safari		Verbiage has been removed.

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- **Project site 'identical in quality' – more correctly able to meet the required specifications**	- Agree. We will avoid comparison to virgin base and will focus on standard performance statements, such as: "All base oil lubricant manufacturers must meet the same rigid quality assurance/quality control standards referenced in API Standard Publication 1509 (Fifteenth Edition)."	As before it does not need to be collected to be used oil. Suggest deleting "and is collected".	
- **Used lubricating oil – it does not need to be collected to be used oil – it has simply reached the end of its service life**	- Agree. Some oil does reach the end of its service life depending on its application. The user ultimately determines the timing and service life of most oil. Our definition of used oil is based on the EPA's definition, which says their service life is determined by the oil becoming contaminated and thus needing to be replaced with re-refined or virgin crude as noted in the previous response.		
Applicability conditions - **It is not worth inviting a challenge over properties of all re-refined oil being identical to any and all virgin base oil – this makes no sense. Base oils may be produced with a range of properties by virgin production or re-refining.**	- Agree. Please refer to our response regarding the definition of base oils noted above.		

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They must meet certain standards and would be selected and blended to meet the necessary characteristics and performance for a given application. - **Bullet 1 – replace 'same quality as' with 'may be used in place of'** - **Clarification – location in North America (Canada, US, Mexico?)**	- Agree. It will be reworded. - Agree. We will clarify that location includes Canada, US and Mexico.	As previously.	Verbiage has been updated in Methodology.
Crediting period – 10 years – the market is rapidly evolving so may be quite different after 10 years.	Agree. The standard GHG accounting is based over a 10-year span. If needed, the methodology can be modified and updated to reflect changes in baseline market conditions, regulations or technologies.		
Page 3, footnote: suggest mentioning impacts to surface waters from improper disposal of used oil.	Agree. The footnote will be modified to include impacts to surface water, groundwater and soil contamination due to the improper disposal of used oil.		

2. **Project Boundaries**

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Exclusion of collection appears to make the assumption that collection is the same for all the various uses of used oil (reprocessed to various fuels or re-refined for base oil). This may not be the case if re-refining has fewer more centralized plants compared to other potential uses.	Agree. As the methodology notes on page 9, table 2, the collection step has been excluded. This supports the overall conservative nature of the Methodology.	Sorry but if there is less transport associated with other treatments then excluding it is not conservative. The effects should be small compared to the leakage/offset through other fossil fuel use. The selection of the boundary to include combustion of used oil has the effect of emphasizing the obvious fact that burning the used oil produces CO2 and re-refining uses less energy without accounting for the inevitable fact (that is acknowledged) that other fuels will be burned to make up for used oil diverted to re-refining. It appears that used oil dumping has been excluded from the methodology but is still included in table 2 and the figure	Figure 1 and Table 2 show that "Used Oil Collection, Aggregation, Transport" are outside the Methodology boundaries. We don't believe there is any measurable leakage/offset from the collection of used oil versus the collection for other reprocessing methods. While the larger number of sites may help reduce the transportation associated with other reprocessing methods, that is offset by the re-refining network being more efficiently run through a national footprint of strategically located assets across North America. There is no data that would lead us to believe there is a variation in the total transportation footprint. Used oil dumping is included to identify correct oil volumes for the project but are not included as generating a reduction in CO2.
Taking into account the concerns of double counting of emissions under the Cap and Trade program, it seems	Agree. That approach has been taken and to the extent that increased re-refining of used oil may in fact		

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reasonable to take a more conservative approach and to exclude the upstream processes from the methodology.	displace some crude oil extraction, the Methodology is excluding upstream processes and avoiding associated the GHG emission reductions.		

3. Baseline Determination

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The data used to determine the baseline used oil generation and rates of collection are apparently global estimates not North American estimates, they would therefore not be appropriate for use in this methodology I assume.	Agree. The data has been updated based on 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities- North America"	Using US data is an improvement. However, the numbers chosen are incorrect. The supplied Kline data indicate used oil generation (estimate) of 5485 kt, used oil collection of 4286 kt and 1243 kt of used oil shipped to re-refiners – or 29% of the available resource that is collected. The text references Appendix A but Appendix A does not contain the relevant data. See additional comments on the inaccurate interpretation of the Kline & Company data in Section 4 (Additionality Assessment) below.	We have revised the data and the accompanying documentation to apply the Kline data to the Methodology. The reference should have been to Appendix B. This has been corrected and Appendix B has been updated to reflect the new calculation.

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The market is rapidly evolving with considerable investment in new plant in North America so 2010 data is probably significantly out of date.	Agree. The data will be updated based on 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities- North America"		
The 22.4 Mt are described as 'potential used oil generation' – not collectable.	Agree. Title will be changed to reflect accurate terminology and data will be updated based on 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities- North America"		
The distinctions are not clear enough – calculating a rate of re-refining to base oil based on what appears to be a broad base of techniques classified as re-refining (including apparently distillation to Vacuum Gas Oil - VGO and Marine Distillate Oil - MDO) which are distinct processes (and will lead to combustion) is mixed with by-products for example 'asphalt' – which may be better described as a heavy, potentially contaminated, stream which concentrates many of the contaminants in the used oil.	Agree. This will be clarified by the new data from the 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities- North America". The report makes a distinction between distillation processes which generate a fuel (i.e. marine distillate, VGO, etc.) versus re-refining processes that generate API certified base lubricants.		

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The assumed rates of improper disposal need to be checked and revised with better data for North America. All such estimates need to be acknowledged as being uncertain as rates of generation are not known and improper disposal is also unknown so assumptions are used and rates will vary strongly by use, user and location.	Agree. This will be clarified based on revised data in the 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities-North America".		
Reduction in improper disposal of used oil – if I read the first paragraph correctly there is an assumption that generators of used oil are being subsidized to have that oil collected thereby reducing improper disposal? How does that relate to additionality of these projects?	Currently, used oil generators are charged a fee for used oil collection and they do not have a financial incentive to avoid improper disposal or other options such as burning. The Additionality Test in section 4.0 addresses the impact if there was an incentive.		
I do not believe that the data on total increase in used oil collection in California can be used to imply the effect of any new take back program. The generation or used oil has changed enormously over the period from 1994 to 2008. A very significant change in rates of improper disposal arise from a shift from DIY oil changing to DIFM. It is not at all clear why participation in a take back program would automatically reduce improper disposal – presumably the vast majority of participants would already	We agree that there is not empirical data to support the impact a takeback program would have on the amount of used oil collected or disposed of improperly. The concept has been removed from the current methodology and placed in the appendix as a possible future addition contingent on the required impact data being developed and approved by the ACR.		

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be obeying the law (and would certainly say they were) and having used oil properly collected for re-use. If there is evidence that some or all of the customers are currently disposing of used oil illegally that should be presented. **The idea that there is a 3% reduction in improper disposal caused by participation in a take back program is not justified by the evidence presented.**			
It seems clear that where used oil is collected and re-refined to base oil there are considerable losses in volume in use, on collection and on processing. This should not be overlooked.	Agree. Production efficiency is accounted for. Credits are generated by the volumes of re-refined oil that is re-refined to base oil. Dedicated programs like take back could reduce leakage and increase productivity and entice producers (re-refiners) to be more efficient.		
The factor for CO_2e emissions for improper disposal does not seem to be right (assuming all the carbon present in the used oil is converted to CO_2 as stated).	The emission factor was originally estimated in the Environ LCA to be 2.40 kgCO2e per gallon over 100 years. That value is divided by 10 to account for the 10-year crediting period.		

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Combustion of used oil – the discussion about the source of lubricating oil and the blending with heavy oils does not make much sense or appear relevant. To estimate emissions of CO_2 from combustion of lubricants a confirmatory calculation using the carbon content and conversion to CO_2 would be useful. Estimates for each process should be presented in the same units (and I would expect the two items here to be the same given the justifications – but they are not).	The reference to blending of heavy oils into lubricating oils is only as context to the point that the hydrocarbon composition of lubricating oils, and the associated energy content and CO2 emission factors, are variable. The Methodology relies on average default values from the IPCC, based on a wide range of data sources that account for this variability. The Methodology employs two different relevant parameters (energy content, CO2 emission factor), and are indeed two different units of measure.		
It is not clear why the avoided emissions from combustion (by another process, project or plant) are included in the methodology but the displaced emissions are excluded. The logic would seem to be then that a plant burning used oil could equally apply for carbon credits on the basis of not burning virgin fuels. In any event, this is clearly an activity shifting leakage issue and should be accounted for as a leakage emission. Leakage emissions should be subtracted from the emission reductions claimed by a	We do not believe there is any associated leakage connected to fuel switching under the project base as described in this Methodology. The comment is describing the Methodology's baseline scenario which is based on the fact that most used oil is collected and burned. The corollary to the baseline scenario is the project scenario where there is additional re-refined oil produced beyond business as usual and correspondingly less used oil to burn, requiring facilities to procure other		

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project (i.e. combustion of used oil less combustion of an alternate fuel). Of course, the choice of alternate is crucial as used oil can substitute for several fuels – from coal, through various liquids to natural gas with widely varying CO_2 releases. For purposes of conservatism, a carbon intensive fuel should be chosen as the fuel displaced and subtracted as a leakage emission source.	substitute fuels, presumably the identical mix of fuels that would be not burned in the baseline scenario. Any GHG emissions (reductions under the baseline scenario and increases under the project scenario) associated with this "fuel switching" would cancel each other out and are therefore not accounted for in the Methodology.		
Page 10, section 3.1, first bullet parenthetical – ". . . dumped . . . groundwater." I didn't think dumping into groundwater (directly) was common. Obviously, used oil can reach groundwater, but usually after disposal onto the land. Perhaps more difficult to quantify is the amount improperly disposed to land that is not a landfill – as in "dumping in the back 40."	Agree. We will rephrase to "… improperly disposal, with some used oil ending up in landfills, waterways, and groundwater."		
Page 11, section 3.2 – "dumping into . . . groundwater." Same comment as above, and do you really mean surface water, as direct improper disposal to groundwater?	Agree. We will rephrase to "… improperly disposal, with some used oil ending up in landfills, waterways, and groundwater."		

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The estimated public collection of used oil in 2016 was 24.2 million gallons; the collection rate of used oil has generally leveled out since ~2003. This makes the description of the collection increase in terms of "an average of 23.6% per year" to be a bit misleading. This would have an impact on the 3% reduction in improper disposal assumption.	The 23.6% annual increase was derived from data from California's public collection program. It is not presented as representing the trend across the U.S. or North America. The California data is being used here only to project the potential positive impact of a dedicated, take-back program operating throughout North America.		
Question – Will you be addressing the term "collectable" oil?	Agree. The term "collectible oil" should be clarified and will be as part of the new data from the 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities-North America"		
Synthetic oil is a growing market in the lubricating industry; do you anticipate revising the methodology as its market share increases?	Agree. The Methodology will be revised as new data on market conditions become available for those synthetic oils derived from crude oil or polyolefin-based feed stock.		

4. Additionality Assessment

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As noted previously the data for the amounts of oil that are re-refined appear likely to be erroneous as well as out of date. The market can move quickly and there have been periods when volumes being re-refined have increased rapidly. The primary drivers being increasing restrictions on markets for used-oil derived fuels and attractive economics when base oil prices are high. **In that context and with some jurisdictions reviewing and updating requirements for used oil management (including regulations as well as a suite of financial interventions) additionality, in the sense of what would happen under business as usual is hard to establish and could vary over a project lifetime.** **Similarly it would seem highly likely that over a period of say 10 years the industry and common practice could change dramatically so a much more frequent review and reassessment might seem more appropriate (say annual).**	Agree. We are using new data from the 2016 Kline and Co. Report entitled "Global Used Oil and Re-refined Lubricants 2015: Market Analysis and Opportunities- North America". Additionally, the Methodology will be revised as new data on market conditions become available. Of note, the report does show that the amount of re-refining capacity had increased in years prior to 2014 but is now static and expected to stay that way. We will gladly entertain any requests from the ACR to update or reevaluate the report based on changing market conditions.	In sections 3.1 and 4.2, a baseline rate of re-refining has been stated as 10.3% and used to support the additionality assessment. The calculation of this rate is provided in Appendix B. However, this calculation completely takes out of context the data provided by Kline & Company. First, the calculation in Appendix B begins by assuming that 9,295 kt of oil is generated as used oil in North America. Kline & Company specifically state this volume to be the "total finished lubricants volume in North America…". This is not the total volume of used oil generated but rather the total lubricant demand in North America. Therefore, the starting point for the equation is completely incorrect. Second, 59% of total lubricant volume is generated as used oil just as the Kline & Company report states in the text and in Figure 3E-7. Of this 5,485 kt that is generated, 4,286 kt is collected. The remaining 22%, again as stated clearly in the text of the report, goes uncollected because of unauthorized disposal, handling loss, lack of financial viability. It cannot be	A revised calculation will be used that eliminates the concerns regarding the proper use of the data. The baseline rate has been revised to 13.6% as shown in Appendix B. The baseline rate is generated by using the Kline Report's percent of collectible used oil (66%) to determine what portion of the 9,295 kt of oil generated is "Used Oil Available for Collection" -(6,134 kt). We then use 833 kt as the refined base stock volume. This volume accurately reflects the relevant portion of the 1,243 kt of material that was shipped to re-refiners that is available for re-refining into base oil. According to the Kline Report, the remaining volume of material collected is made up of molecules that can never be turned into base stock, specifically "process residues, such as diesel, asphalt, water, and filtration tart." Including these process residues would distort the calculation since that material is not truly available for base stock. Note that these residues are not

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		assumed that this 22% of generated used oil will be collected. The actual rate of re-refining is also stated clearly in the Kline & Company report and Figure 3E-7. An estimated 1,243 kt of used oil that was shipped to re-refiners in 2015 is re-refined. It does not matter that only 833kt (the numerator in the equation found in Appendix B) represents the re-refined basestock. Per Kline, 1,243 kt of the 4,286 kt of collected used oil is re-refined. This yields a re-refining rate of 29% in North America. The above is presented clearly in the Kline & Company report. The manipulation of the Kline data and text found in Sections 3.1, 4.2, and Appendix B badly misrepresent the Kline data and should be removed from the methodology.	included in the beginning volume for oil generated, but instead are inadvertently mixed into the collection process along the way.
Common practice cannot realistically be determined on such a global basis as practice is not regulated or controlled at that level. In some areas penetration is very much higher – such as California where the great majority of used oil is subject to distillation and treatment rather than combusted as RFO.	Agree. The Methodology establishes baseline conditions based on common practice and prevailing regulatory and market conditions across the applicable jurisdictions within North America.		

5. **Quantification of GHG Emission Reductions**

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As noted above the justification for the approach is not sufficient and the data appears limited and wrong in key areas. The methodological issues and the data need to be addressed before this can be assessed.	Agree. The prior responses above address this. The most current industry data will be incorporated into the methodology. We fundamentally disagree that the methodology is unsupported as similar science has been used for developing GHG reduction from the destruction of ozone depleting substances, reforestation projects, control of methane gas emissions from landfills, and other projects.	The new Kline data indicate that 29% of the collected used oil is re-refined. As noted an increase in re-refining and corresponding decrease in combustion of used oil for energy would result in a proportional increase in combustion of other fuels and switch in refineries to fuels from base oil (assuming a static market). The net change in GHG then is dependent on any differences in GHG emissions from the fuels used and refinery (and re-refinery processes). This is materially different to the examples that are given where destruction of ODS removes these chemicals from the system and prevents their release to atmosphere, reforestation, control of methane (if by combustion then a net reduction after allowing for CO2 produced).	We have revised the Methodology to specifically address the leakage associated with the switch in fuels.
The use of 'baseline' to describe gross avoided emissions is not immediately intuitive.	Baseline refers to the current business as usual scenario in the absence of a project.		
In a rapidly developing market the default values for rates of combustion and re-refining would change so values would need to be updated regularly	Agree. We agree that the methodology should be revisited based on changes in baseline market		

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(and presumably not on a global basis unless this is justified by the geographical scale of the used oil management system).	conditions, regulations or technologies.		
The calculation for baseline emissions from combustion appears to be based on the premise that used oil re-refined by the project comes out of the general pool of used oil managed in the proportions stated. It's not clear that this is appropriate.	Please provide a sample calculation so we can validate your concern.	On the basis set out in the project boundaries (which appear incomplete) the change in emissions would be simply the emissions from the amount of UO that would have been burned and is now re-refined less the emissions from the re-refining of that oil if I understand. Then why is that not the calculation provided?	The project boundaries have been clarified. The change in emissions for the project includes the emissions from the amount of UO that would have been burned or otherwise lost as practical loss and is now re-refined less the emissions from the re-refining of the oil. The updated calculation takes the most recent Kline market data and applies it to the Methodology.
Baseline emissions from improper disposal of used oil – the assumed reduction in improper disposal needs to be justified as noted previously).	See above.		
Some re-refineries burn by products or used oil – presumably CO_2 emitted by this would also need to be accounted for in the project emissions? **A re-refinery may produce a number of product streams – some of these may well end up being burned – any emissions from these would**	Agree. GHG emissions associated with the re-refining of used oil are included in the Methodology in project emissions equations 5 and 6.	Equations 2 and 4 could capture this but it ought to be explicit so there is no doubt – project emissions would be from all fuels burned on site and all energy generated off-site that is used.	

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presumably be included in the calculation of project emissions.			
Leakage – it is generally assumed that used oil collected and processed for a beneficial use displaces virgin products on a broadly equivalent basis (disregarding differences in transport etc). So used oil may be processed (to different degrees and intensities) to base oil or fuels. Each of which would be used in the market to replace an alternative – so re-refined base oil would likely displace virgin base oil and fuel products would displace virgin fuels or one sort or another (depending on the process, the used-oil derived fuel quality and the market at the time). **Since the methodology excludes the effect of displacing fossil fuels (by burning used-oil derived fuels) by this definition there is considerable 'leakage' as this key aspect of the life cycle is excluded. As discussed previously it is hard to see how this can be justified and leakage emissions should be included.**	Agree. The Methodology adopts the most conservative approach possible by excluding possible upstream impacts (reduced crude oil extraction, reduced base oil production) for the reasons noted in Section 2.1. The authors agree that a complete lifecycle assessment would include these upstream emission sources. However, regarding crude oil extraction, the current standards governing carbon accounting that the ACR conforms to, including the quantification protocol in this Methodology, do not allow for accounting of upstream GHG emission reductions from displacement of virgin inputs. Regarding base oil, the ACR has taken the position that: 1) it is difficult to quantify to what extent increased used oil re-refining would reduce base oil production given market demand for other base oil-derived products; and 2) assigning credits for reduced base oil production could result in double counting given the fact that refineries across North	That response justifies excluding potential changes at a crude oil refinery but does not address the equally significant issue that a reduction in supply of used oil as a fuel is likely to result in increased consumption of other fuels. While the exact fuels used to make up the energy shortfall cannot be known in either the short or long term they could be natural gas, various fuel oils, solid fuels or electricity depending on the application. The approach proposed would appear to be based on the assumption that used oil that is burned is burned simply to be rid of it – i.e. a simple incineration process with no useful outputs. While that may be so for some very small fraction of used oil the vast majority of used oil that is burned is burned to generate useful energy. I cannot see how this can be ignored without invalidating the assessment and undermining any credits.	Leakage has now been addressed in the document.

1st Peer Review	Author Response	2nd Peer Review	Author Response
	America are operating under GHG emission caps.		
Previous work has shown that the marginal differences in greenhouse gas emissions can be small, are highly sensitive to project assumptions, and will vary depending on a range of factors beyond the control of any individual project or jurisdiction.	Agree. There is variability within various projects that cannot be completely eliminated. This project is based on solid data, and a tightly managed Methodology that puts it on firm ground with similar ACR project methodologies. The favorable environmental and sociological impacts associated with this Methodology are clear and precise.	There is sufficient data to make an assessment of the range of CO2 emissions from the fuels that might replace used oil used as fuel. It is true that it is not possible to say exactly which would be used in any instance is equally true of the fuels that might make up the electricity generation at a given plant.	The mix of fuels and corresponding impacts have been addressed in the document.

6. Monitoring and Data Collection

1st Peer Review	Author Response	2nd Peer Review	Author Response
Monitoring is always crucial. The text mixes lubricating oil and base oil and would need to be very clear.	Agree. The text will be clarified.	Does not appear to have been done (bullets suggest re-refinery produces lubricating oils for example)	Document has been updated to proper reflect use of terms, including lubricating oil versus base oil
The text seems to imply that comprehensive take back programs are not the only element of GHG crediting – the document seemed to imply that the comprehensive program was a necessary part?	The Take back program is a complimentary addition to the core program that enables crediting associated with avoided improper disposal or combustion of used oil (example: space heaters). It has been moved to the appendix of the methodology and is now included as a concept for future consideration.		

1st Peer Review	Author Response	2nd Peer Review	Author Response
Presumably the quantity of base oil produced would need to be monitored and the amount that was sold/provided as part of the comprehensive program recorded also?	Agree. The quantity of re-refined oil produced must be documented. A re-refiner must document what, if any, quantities of the used oil that is processed was sourced via a take back program. An eligible takeback program must also document the following: • Evidence of the agreement(s) with individual customers in the form of a contract, operating plan, or other formal documentation; • Effective start date of the takeback program(s); • Geographic scope of the takeback program(s); • Aggregated volumes of used oil and re-refined oil that are transacted on an annual basis with individual customer(s).	It is important to note also the quality/classification of the product (eg API grade achieved)	Document has been updated to reflect the need to capture/confirm quality/ classification of oil in any future comprehensive takeback program.

7. Verification

1st Peer Review	Author Response	2nd Peer Review	Author Response
Not clear what is to be verified here – would need to be more specific.	Agree. The Methodology does stipulate what data must be collected and verified in order to		

1st Peer Review	Author Response	2nd Peer Review	Author Response
	qualify for GHG emission credits. See above response for additional support material.		

Appendix A: Baseline Data Inputs and unit conversions

1st Peer Review	Author Response	2nd Peer Review	Author Response
It would be useful to have a broader range of reference values and to include the references and calculated values in various common units – so calorific values in MJ/kg for example.	The most recent IPCC default values are used to address the extensive peer review that incorporates a wide range of data from around the world. To avoid possible confusion, no additional references and common values have been added.	It would appear that (from a previous response) the IPCC data includes blended oils. It would help to have a broader range of references.	IPCC data includes caloric values and emission factors for a broad range of fuel types, including waste oil. Values used in the Methodology are assigned correctly based on the type of fuel being referenced.

Appendix B: Calculation of used oil and re-refined lubricants in North America

1st Peer Review	Author Response	2nd Peer Review	Author Response

Appendix C: Fossil Fuel Emission Factors

1st Peer Review	Author Response	2nd Peer Review	Author Response
As above would be useful to include a number of different units at the least.	See above		
Would be helpful to provide a source for these factors, either a specific	Agree. We will add references that the factors are from EIA 2016.		

1st Peer Review	Author Response	2nd Peer Review	Author Response
source or a general description of how these are derived. If these are directly from / derived from *IPCC (2006)* then state that.			

Appendix D: Enhanced Program to reduce improper disposal of used oil

1st Peer Review	Author Response	2nd Peer Review	Author Response

Appendix E: References

1st Peer Review	Author Response	2nd Peer Review	Author Response
I appreciate that references addressing biosynthetic/bio-based lubricants were included [e.g., *Mulvaney, D. (2014); Honary, L. and Richter, E. (2011)]*	Noted.		
Was the 2006 DOE used oil re-refining study considered in this effort, or was it not considered because DOE relied on older data?	This has been superseded by the use of the updated 2016 Kline Report.		