Dear Stakeholders:

The following process flow diagrams are meant to describe the full life cycle of lubricating and industrial oils in California.

**Diagram 1** shows a high level overview of the system, showing the basic steps through which the oil can potentially pass.

**Diagram 2** shows the entire system in detail. This diagram can best be viewed electronically since it is quite large. Use the zoom controls to expand the image and hold the spacebar while dragging the left mouse button to pan the view.

**Diagrams 3-5** detail our team’s current understanding of the 3 main oil recycling processes currently taking place in California.

The information within these diagrams is derived from a study done by Lawrence Livermore Labs in 2008 as well as conversations during data collection and stakeholder meetings on August 1st and 2nd of 2011.

It is important to keep in mind that Diagrams 1 and 2 are not intended to define the boundaries of the LCA study, but rather, to describe the system as it is. Once we have the most accurate understanding of the system possible, we can then begin to define the boundaries of the LCA by deciding which parts of the system will be included and which will not.

Arrows in all diagrams indicate the flow of materials from one process to the next. In the case of displacement arrows, this indicates that the two products may be used for the same purpose and may replace one another depending on production and demand.

We would appreciate feedback on the following aspects of the diagrams:

- Does the main overview capture all the potential pathways through which oil in California may travel?
- Are there any missing uses, sources, or fates of the oil?
- Are the disposition/production processes correct and complete?

Feedback on the process flow diagrams can be provided by either right clicking to add notes to the electronic file within Adobe Reader or in the form of word documents with a list of comments for each diagram. Please send the feedback documents to usedoil@lists.bren.ucsb.edu and CC Robert Carlson at robert.carlson@calrecycle.ca.gov.

Thank you in advance for your help!

UCSB LCA Team
Diagram 1:
CA Lubricating & Industrial Oil System Overview

Primary Lubricant, Industrial and Dielectric Oil Production

Consumptive Oil Use

Non-Consumptive Oil Use

Uncollected Used Oil

Collection

Hazardous Waste Disposal

Out of State

Production of Recycled Fuel Oil

Production of Distillate Fuel Oil

Production of Re-Refined Base Lube

Displaced Production Processes
Diagram 3: Recycled Fuel Oil

Production of Recycled Fuel Oil (RFO)

- Energy, Inputs, Ancillary materials
- Used Oil Receiving and Storage
  - Used Oil
  - Fine Mesh Strainers
    - Strained Used Oil
    - Gear Pumps
      - Strained Used Oil

Chemical Production
- Treatment Chemicals
  - Waste Water
  - Heating and Treatment
    - Recycled Oil
      - PH Adjustment
        - Waste Water
          - Filteration
            - Recycled Oil
              - Sludge
                - Tank Bottoms Treatment
                  - Emissions & Wastes
                    - Sludge
                      - Waste Water Treatment
Diagram 5: Re-Refined Base Lube

Production of Re-refined Base Lube (RRBL)

Storage -> Quality Testing

- Low Quality: Fuel Blending Tanks
- High Quality: Heat Distillation

Heat Distillation

- Light Hydrocarbons: Used at Plant as Fuel
- Dewatered Oil
- Degassed Oil: Thin Film Evaporation

Thin Film Evaporation

- Asphalts: Paving
- Distilled Oil: Sold as Fuel

Distilled Oil

High-Vacuum Distiller

- Distilled Oil

Hydrotreating

- API-Certified Base Oil

Unused Catalyst: Unused Catalyst

Water

Natural Gas

Flue Gas Scrubber

Natural Gas Production

Emissions

Energy, Inputs, Ancillary materials

Unused Catalyst

Waste Water Treatment Plant

Disposed Off-Site

Emissions & Wastes

Asphalt Production

Distillate Fuel Production

Crude Lube/Ind Oil Refining

Additives Blending

Lube/Ind Oil Use

Displacement