Life Cycle Assessment of Tetra Recart Cartons and Alternative Soup Containers on the U.S. Market

July 2014

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Presentation Overview

1. LCA Methodology
2. Soup Packaging LCA Goal & Scope
3. Soup Packaging LCA Results
    - Ready to serve soup packaging
    - Condensed soup packaging
4. Key takeaway messages

Soup Packaging LCA Conducted by Franklin Associates, a Division of ERG

Franklin Associates

- Founded by original developers of LCI methodology in the U.S.
- Continuous LCA practice for 40 years
- Instrumental in development of U.S. LCI Database; provided many key data sets (fuels, transport, resins and precursors)
- Extensive private database for U.S. processes and materials

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Why Life Cycle Assessment?

- Ever-increasing demand and need for environmental information for sound decision-making
- Qualitative characteristics alone are not a sufficient basis for informed decision - need a quantified assessment of their effect on environmental profile
- LCA provides comprehensive set of quantified metrics – environmental “nutrition” label
- LCA identifies main contributors to environmental impacts for focusing improvement efforts

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ISO Standards for LCA

Fundamental LCA guidance documents:

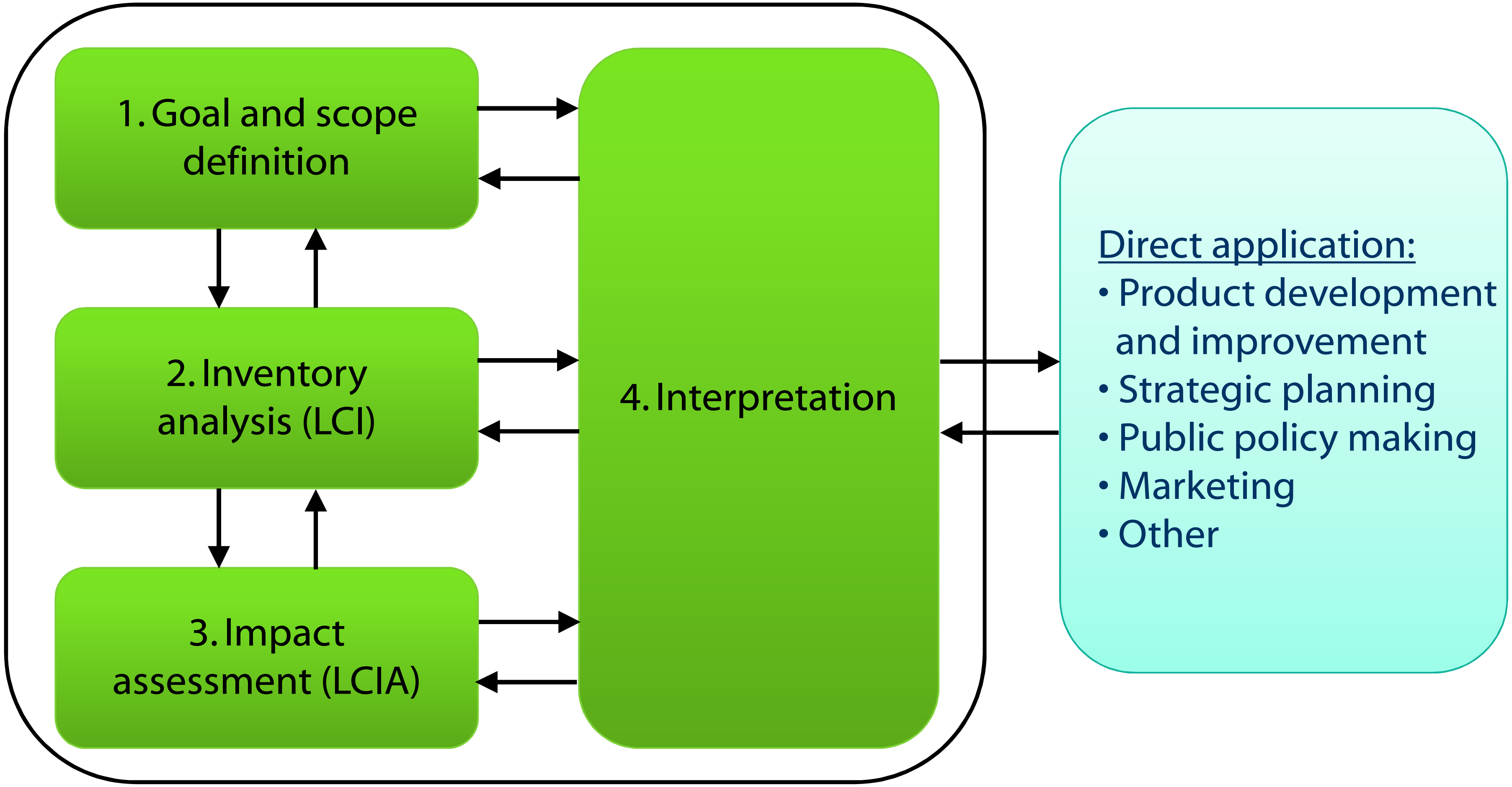
- ISO 14040: Principles and framework
- ISO 14044: Requirements and guidelines

ISO 14040 definition: LCA is the “**compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle**.”

ISO = International Organization for Standardization

Phases of an LCA

Four different phases of LCA are distinguished:



Source: ISO 14040

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Life Cycle Inventory

- Quantified inventory of flows to/from the environment for each system studied:
  - Raw materials, including water
  - Energy use (non-renewable and renewable)
  - Solid wastes
  - Atmospheric emissions
  - Waterborne emissions
- Can draw some conclusions from LCI, but emissions results can be difficult to interpret – many diverse emissions, mixed results

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Life Cycle Impact Assessment

- How to interpret complex mix of emissions results in a meaningful way?
- Translate into potential impacts on the environment and human health:
  - Global warming potential, kg CO_2 eq
  - Acidification potential, kg SO_2 eq
  - Eutrophication potential, kg N eq
  - Smog formation potential, kg O_3 eq

(Categories listed are those included in the Tetra Pak LCA)

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Global Warming Potential

- Metric describing the potential to contribute to increases in the average temperature of the Earth's surface, caused by emissions of greenhouse gases
- Example air emissions: carbon dioxide, methane, nitrous oxide
- Expressed as kg CO_2 equivalents

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Acidification Potential

- Accumulation of acidifying substances (SO_2, NOx) in the water particles suspended in the atmosphere ('acid rain')

- Deposited onto the ground by rains, these acidifying pollutants have a wide variety of adverse impact on soil, organisms, ecosystems and materials (buildings)

- Expressed as kg SO_2 eq

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Eutrophication Potential

- The release of nutrients (phosphorus, nitrogen, BOD) to the aquatic and the terrestrial environment which can lead to a decrease in the oxygen content
- This impacts flora and fauna, and disturbs the ecosystems
- Expressed as kg N equivalents

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Smog Formation Potential

- Smog formation is the photochemical creation of reactive substances (mainly ozone) which affect human health and ecosystems
- This ground-level ozone is formed in the atmosphere by nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight
- Expressed as kg O_3 equivalents

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Soup Packaging LCA
Goal & Scope

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Study Goal

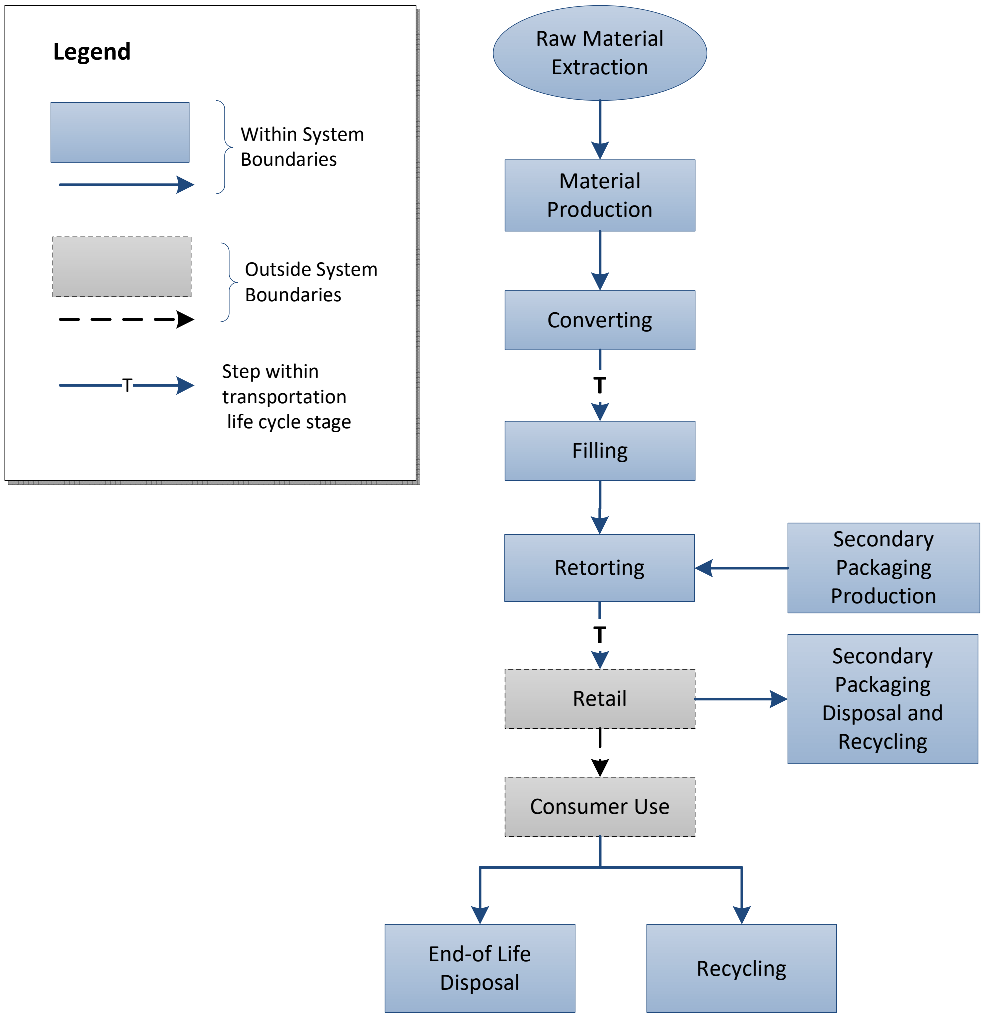
- Provide Tetra Pak with life cycle impacts of Tetra Recart (TRC) cartons on the U.S. market compared to alternative soup packaging

- Containers evaluated in the LCA:
  - Ready-to-serve (RTS) soup:
    - 500 ml TRC compared to 18.6 oz (550 ml) steel can, 14.5 oz (429 ml) steel can, 500 ml laminate pouch
  - Condensed soup:
    - 340 ml TRC compared to 10.75 oz (318 ml) steel can

Functional Unit

- Containers within each category (RTS or condensed) are compared on a functional equivalence basis of 1,000 liters of prepared soup
- Condensed soup diluted 1:1 with water, so 500 liters of *packaged* condensed soup per 1,000 liters of *prepared* soup
- No comparisons made between RTS and condensed soup packaging systems

System Boundaries



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Critical Review and Use of Results

- The study has been peer reviewed and approved by an external panel of 3 LCA experts
  - Beth Quay, Former Director of Environmental Technical Affairs for Coca-Cola
  - Dr. Greg Keoleian, Director of the Center for Sustainable Systems at the University of Michigan
  - Dr. David Allen, Director of the Center for Energy and Environmental Resources at the University of Texas at Austin
- Peer review ensures compliance with ISO 14040/44 Standards for LCA
- Peer review allows public comparative assertions

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Soup Packaging LCA: Study Findings for Ready-to-Serve

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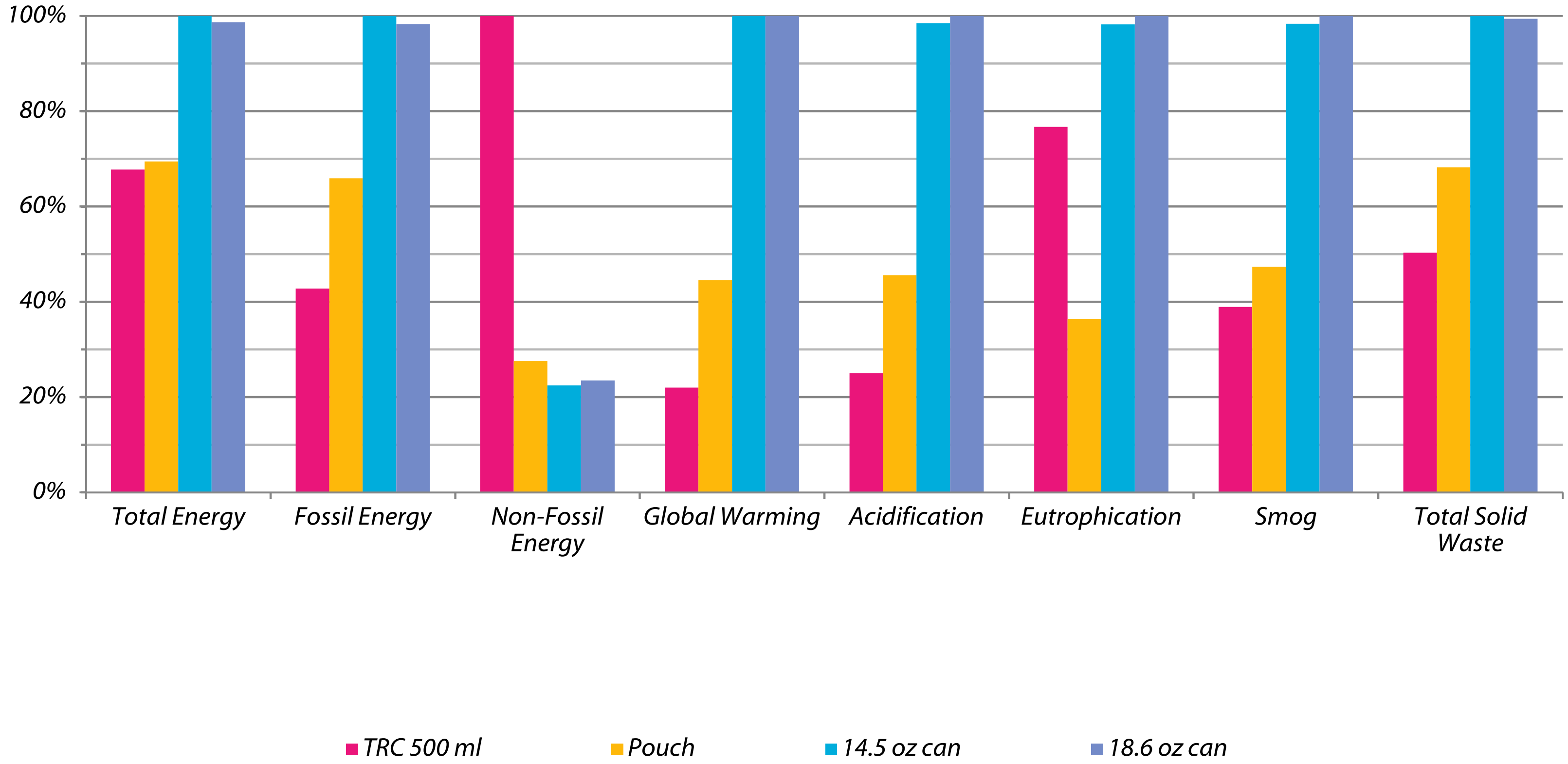
Normalized Summary Results: Ready to Serve



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Ready to Serve Soup Packages

500 ml TRC
20 g

Steel cans

14.5 oz
(429 ml)
54.4 g

18.6 oz
(550 ml)
70.5 g

500 ml Laminate Pouch,
10.4 g

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RTS Container Components and Weights

Weights in grams/container

	500 ml Tetra Recart	14.5 oz (429 ml) Steel Can	18.6 oz (550 ml) Steel Can	500 ml Pouch
Primary Container	20.0	47.5	62.8	10.4
Closure (can lid)		6.90	7.70	
Total Container	**20.0**	**54.4**	**70.5**	**10.4**
Corrugated Box/Tray	5.34	3.83	6.40	25.3
Shrink Film	1.26	1.87	1.33	
Total Weight, all components	**26.6**	**60.1**	**78.2**	**35.7**

Ready to Serve Soup Packages (kg per 1,000 liters of soup)

500 ml TRC
39.9 kg

Steel cans

14.5 oz
(429 ml)
127 kg

18.6 oz
(550 ml)
128 kg

500 ml Laminate Pouch,
20.8 kg

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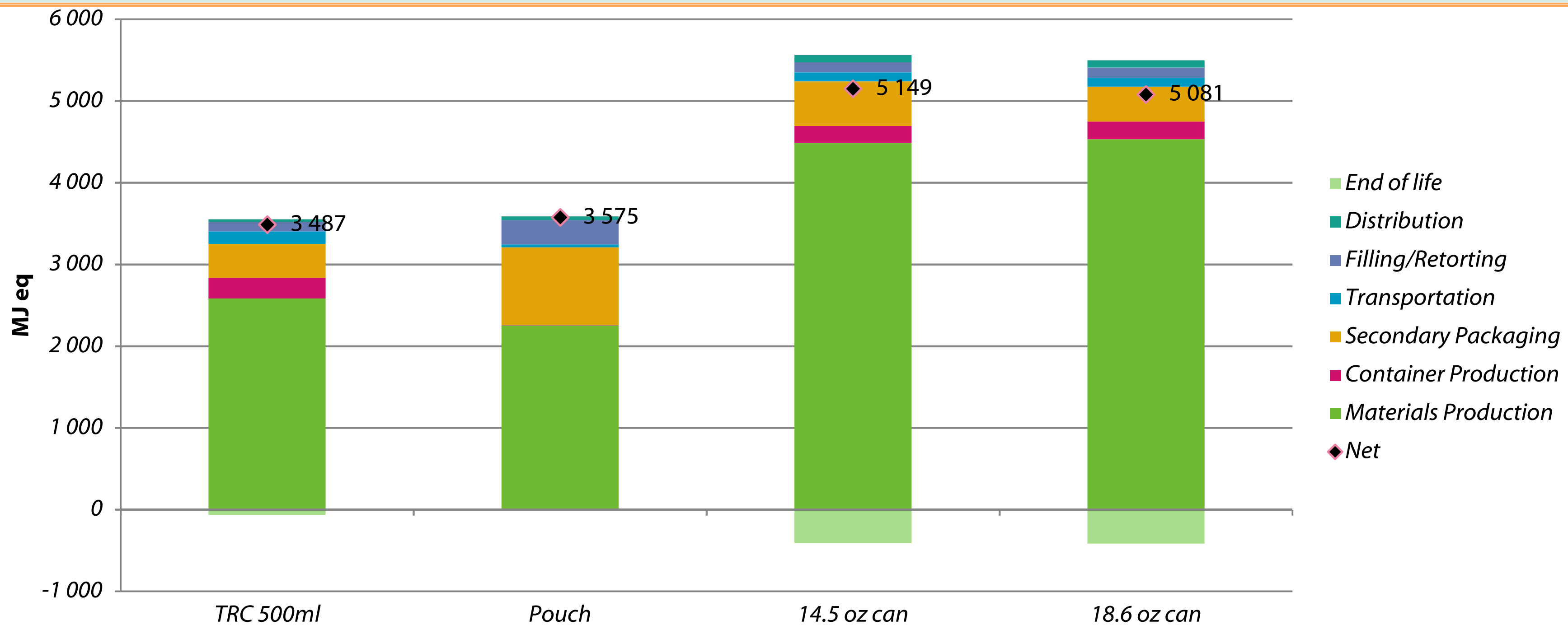
RTS Total Energy Demand Results by Life Cycle Stage



- TRC has lower total energy demand than steel cans, mainly due to lower material production energy
- Total energy similar for TRC and pouch; material energy higher for TRC, but pouch has much higher secondary packaging requirements

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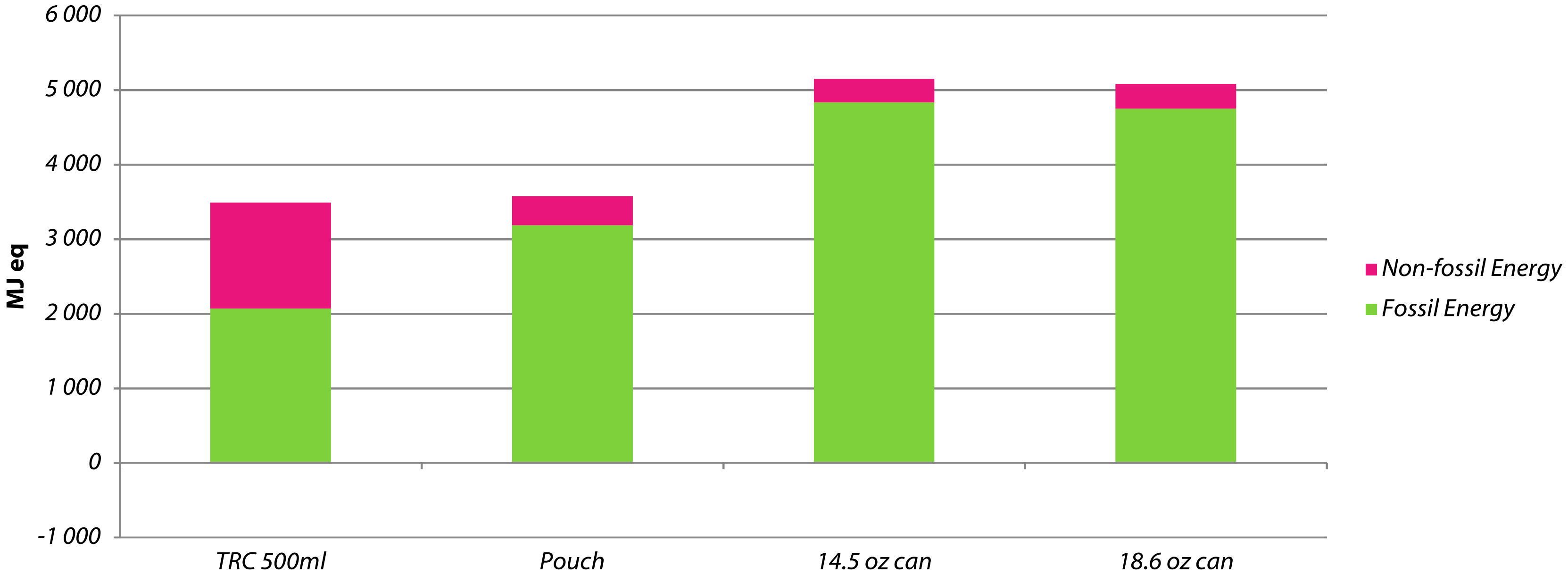
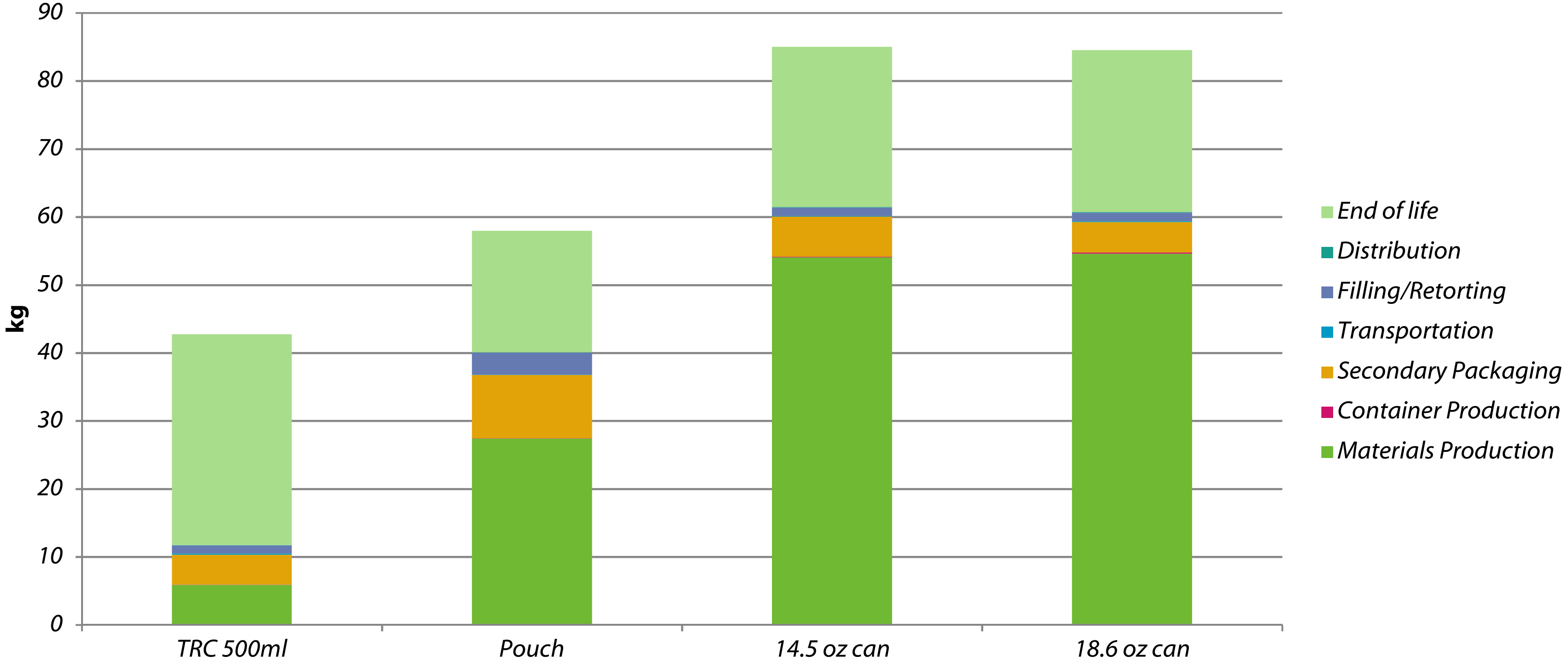
RTS Net Energy Demand Results by Fossil/Non-Fossil Energy



- Majority of energy for pouch and can systems is fossil (non-renewable) energy
- TRC has larger share of non-fossil energy, associated with biomass feedstock and process energy for paper content of the TRC rollstock

RTS Solid Waste Results by Life Cycle Stage



- Solid waste for TRC is dominated by postconsumer disposal
- Material production wastes are highest for pouch and steel cans
- At end-of-life, heavier weight of cans offset by high recycling rate

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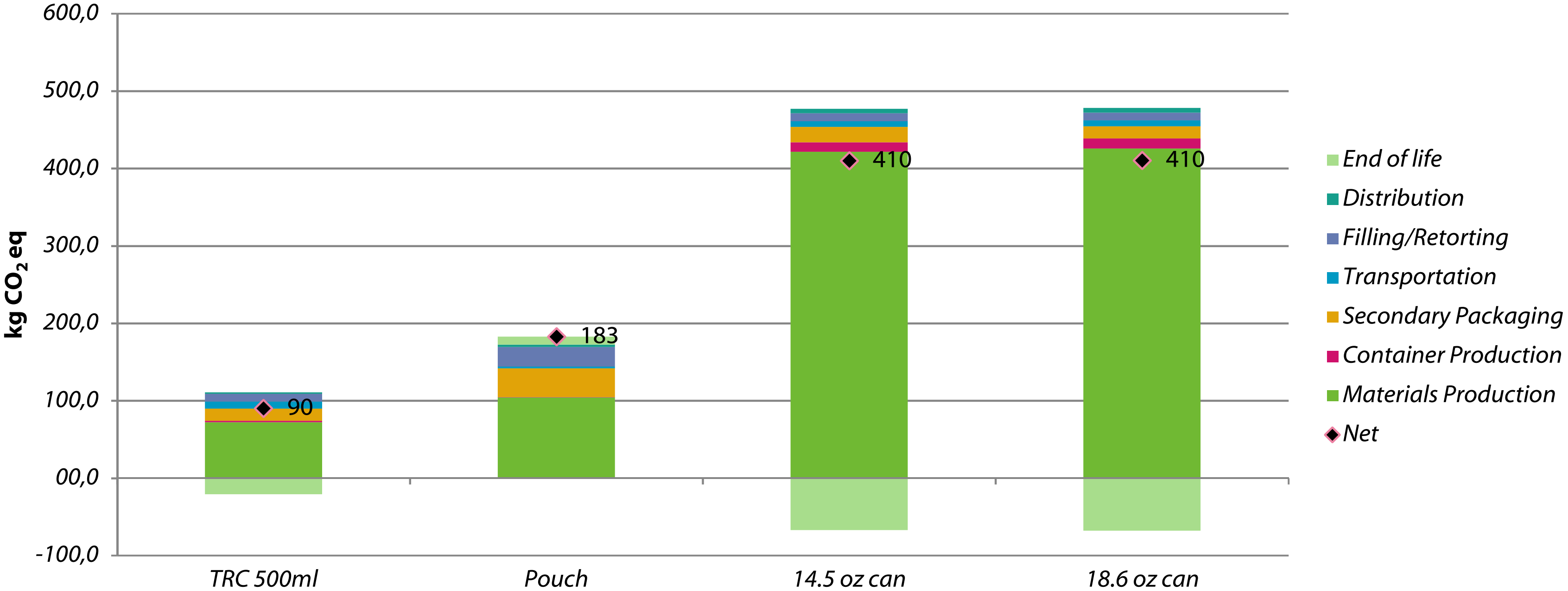
RTS Global Warming Results by Life Cycle Stage



- TRC has significantly lower GWP compared to other systems, with main advantage seen in material production stage
- End-of-Life negative value for TRC is from landfill carbon storage, while cans have credit for virgin steel production avoided by recycling

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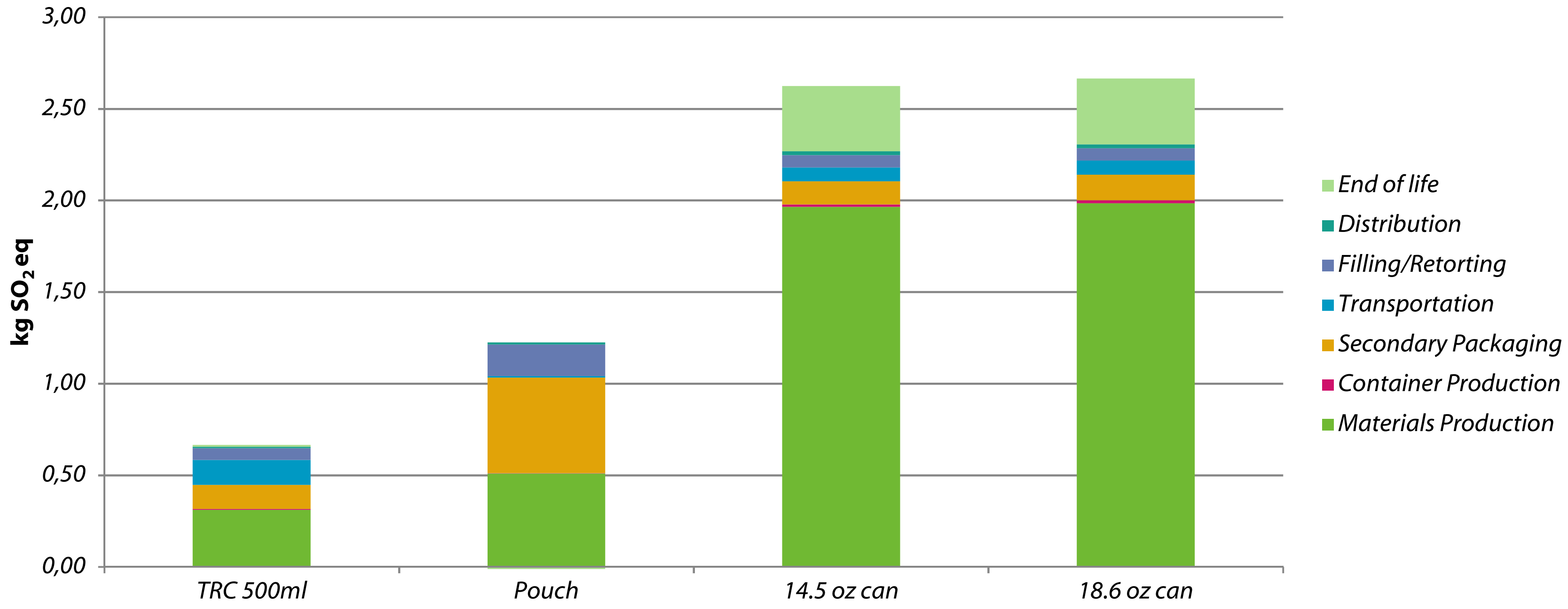
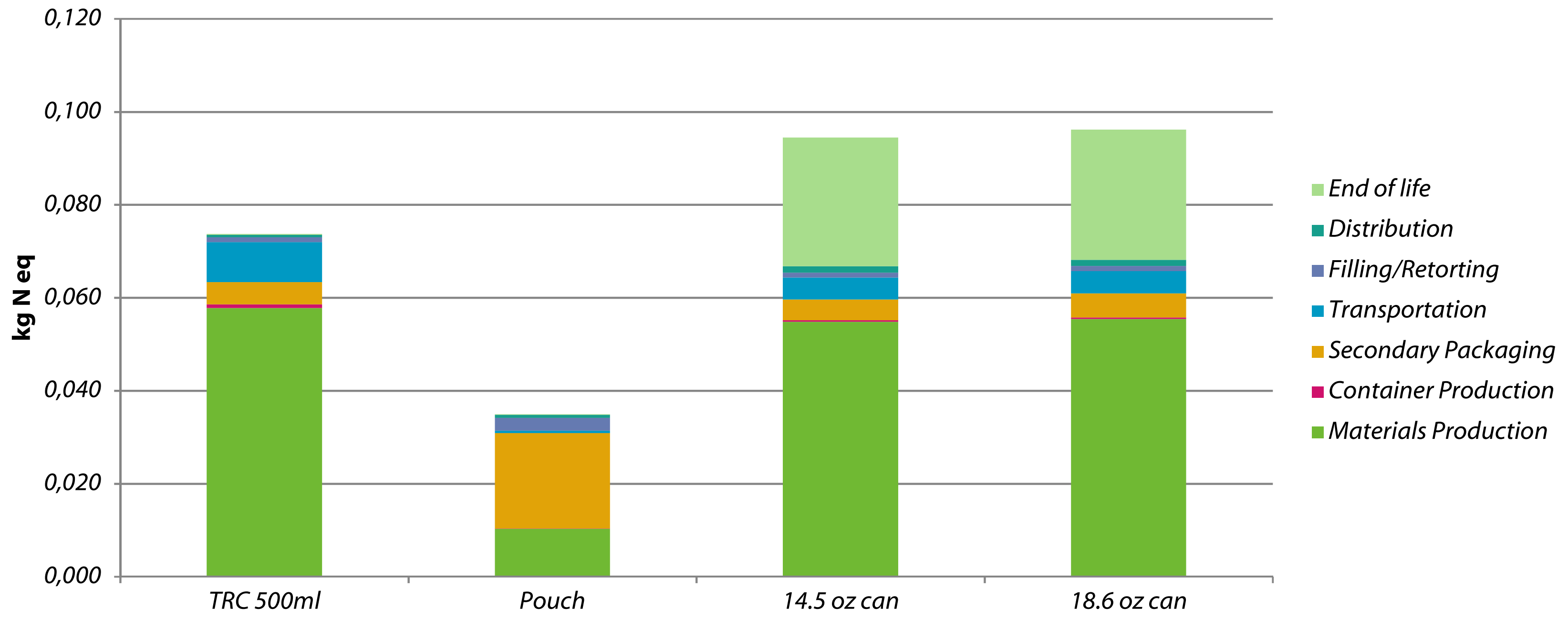
RTS Acidification Results by Life Cycle Stage



- Acidification impacts associated largely with SO_2 emissions from coal combustion (for electricity generation) and steel production
- TRC rollstock is produced in Europe with a low coal electricity grid

RTS Eutrophication Results by Life Cycle Stage



- Main eutrophication impacts for TRC and pouch due to water emissions from papermaking (TRC fiber, corrugated packaging)
- Eutrophication for cans associated with can material production and recycling

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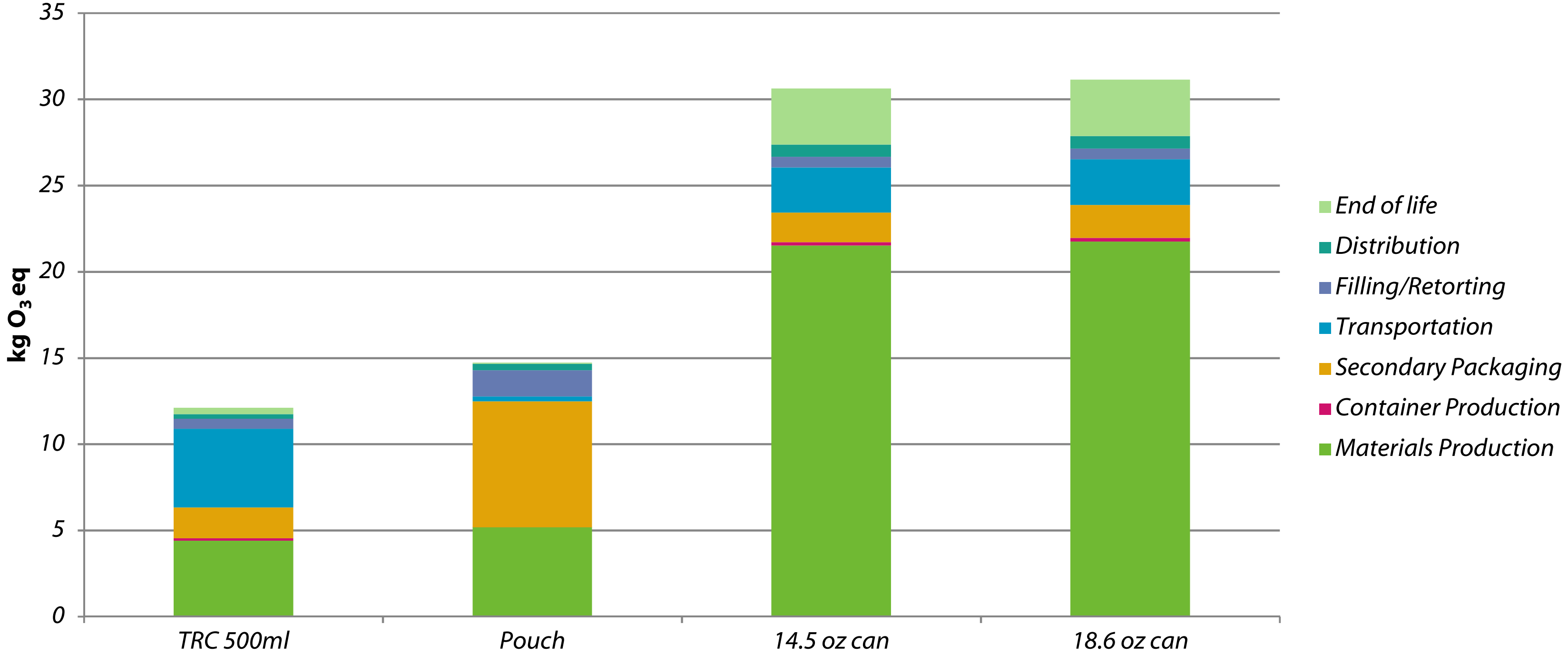
RTS Smog Formation Results by Life Cycle Stage



- Majority of smog from nitrogen oxide emissions from fuel combustion
- TRC influenced by smog formation during ocean freighter transport of rollstock from Sweden to the U.S.

RTS Comparative Conclusions Summary

	Meaningful Difference Threshold	Ready-to-Serve Soup Containers Compared to TRC 500 ml		
		Pouch	**14.5oz can**	**18.6 oz can**
Total Energy	10%	Insignificant	TRC lower	TRC lower
Fossil Energy	10%	TRC lower	TRC lower	TRC lower
Non-Fossil Energy	10%	TRC higher	TRC higher	TRC higher
Global Warming	25%	TRC lower	TRC lower	TRC lower
Acidification	25%	TRC lower	TRC lower	TRC lower
Eutrophication	25%	TRC higher	Insignificant	TRC lower
Smog	25%	Insignificant	TRC lower	TRC lower
Total Solid Waste	10%	TRC lower	TRC lower	TRC lower

- Green = TRC results are notably lower compared to alternative
- Red = TRC results are notably higher compared to alternative
- Grey = No meaningful difference exists between systems

Soup Packaging LCA: Study Findings for Condensed

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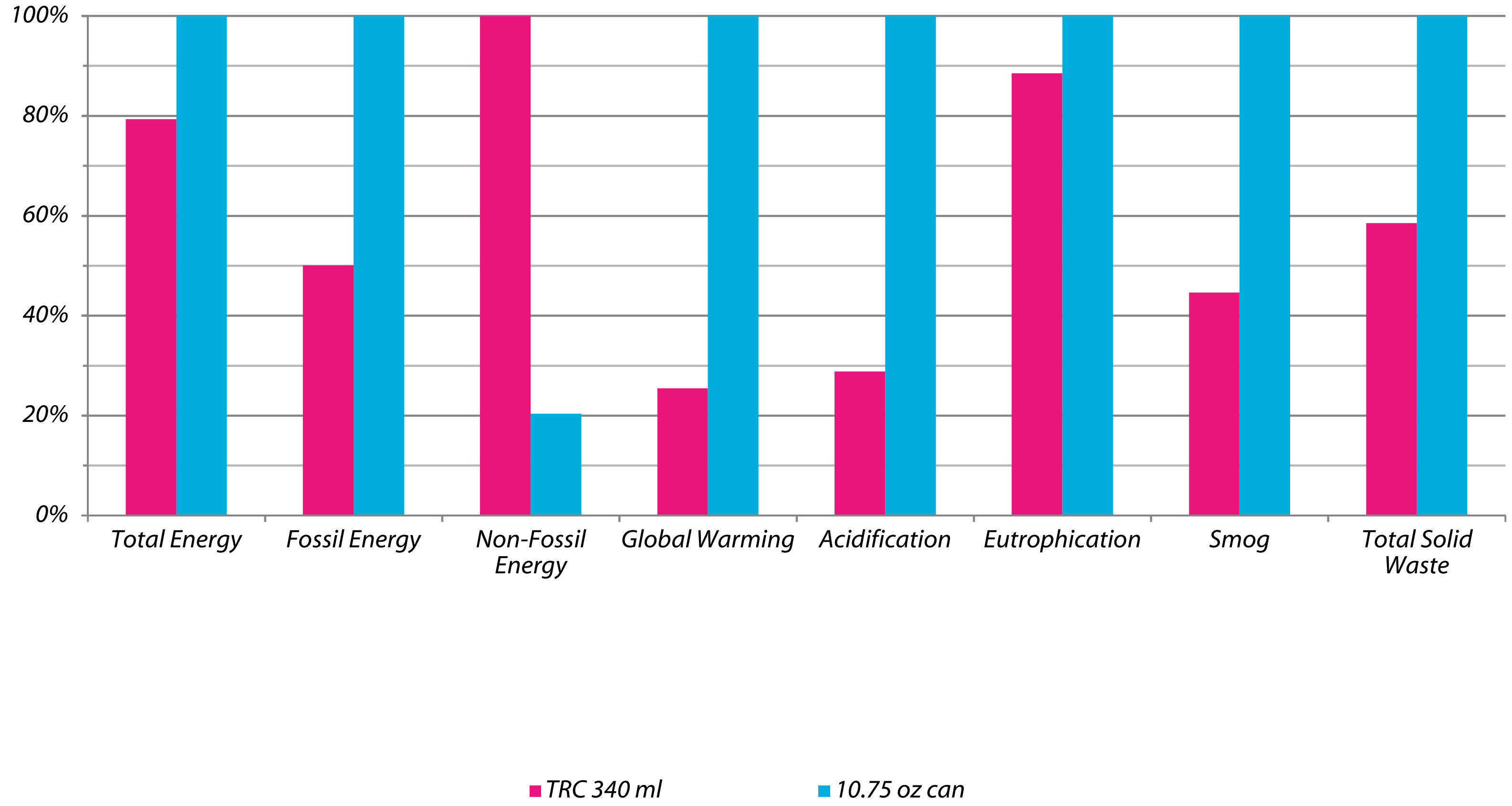
Normalized Summary Results: Condensed



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Condensed Soup Packages

340 ml TRC
16 g

10.75 oz Steel Can
(318 ml)
41.2 g

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Condensed Soup Container Components and Weights

Weights in grams/container

	500 ml Tetra Recart	14.5 oz (429 ml) Steel Can
Primary Container	16.0	35.6
Closure (can lid)		5.60
Total Container	**16.0**	**41.2**
Corrugated Tray	3.58	3.80
Shrink Film	0.84	0.64
Total Weight, all components	**20.4**	**45.6**

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Condensed Soup Packages
(kg per 1,000 liters of prepared soup)

340 ml TRC
23.5 kg

10.75 oz Steel Can
(318 ml)
64.8 kg

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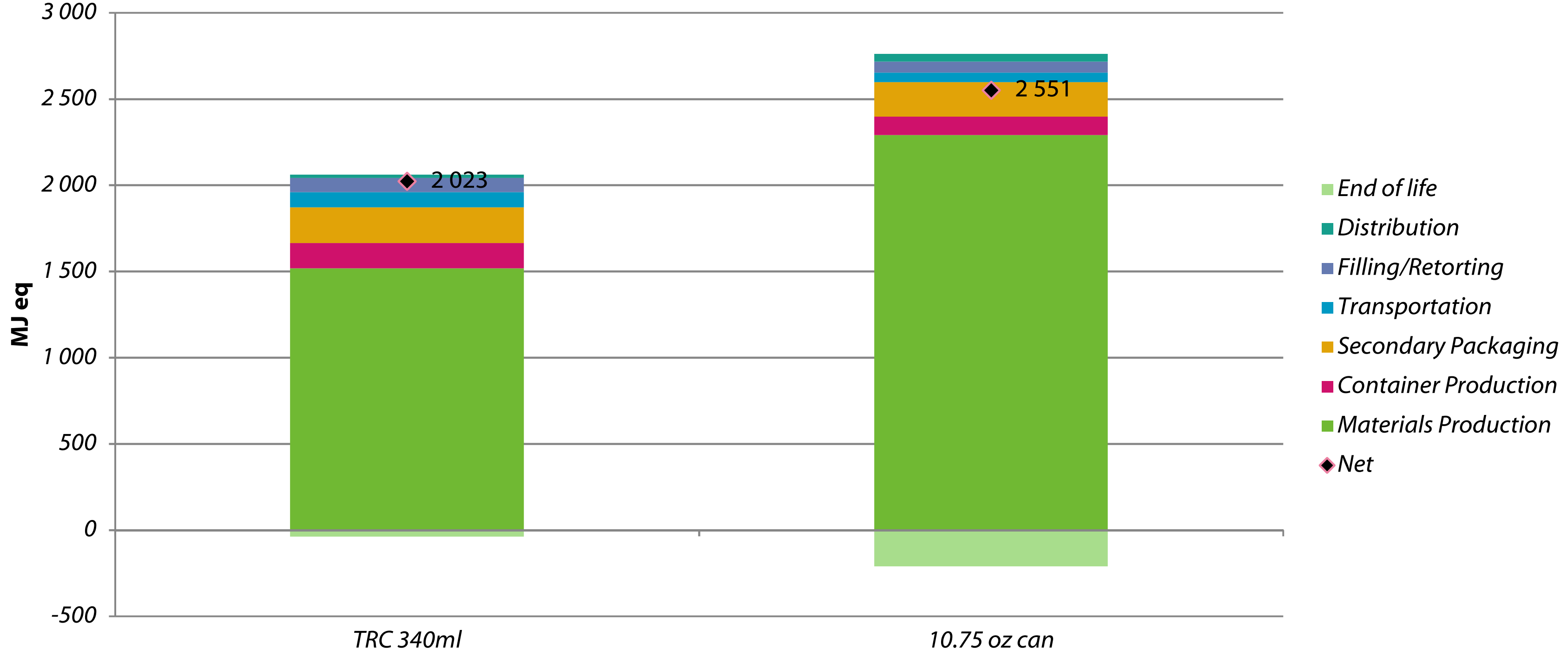
Condensed Soup Net Energy Demand Results by Life Cycle Stage



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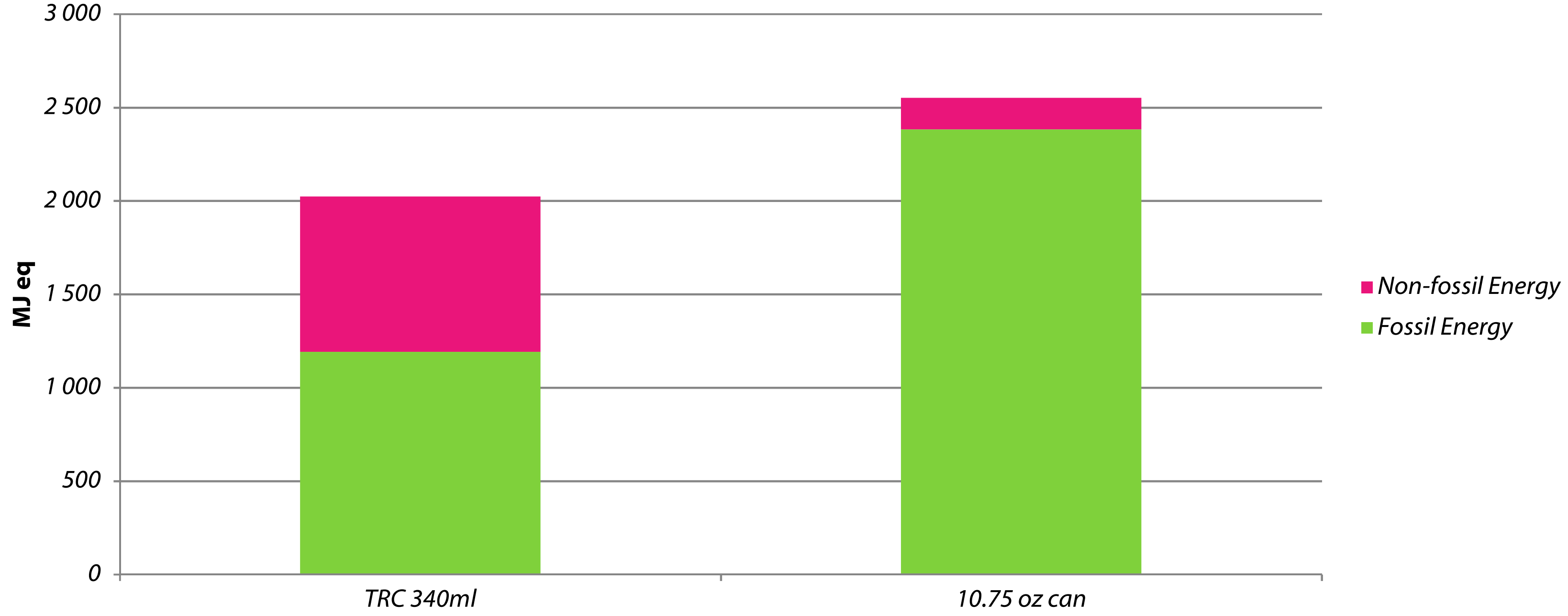

- Majority of energy for can system is fossil (non-renewable) energy
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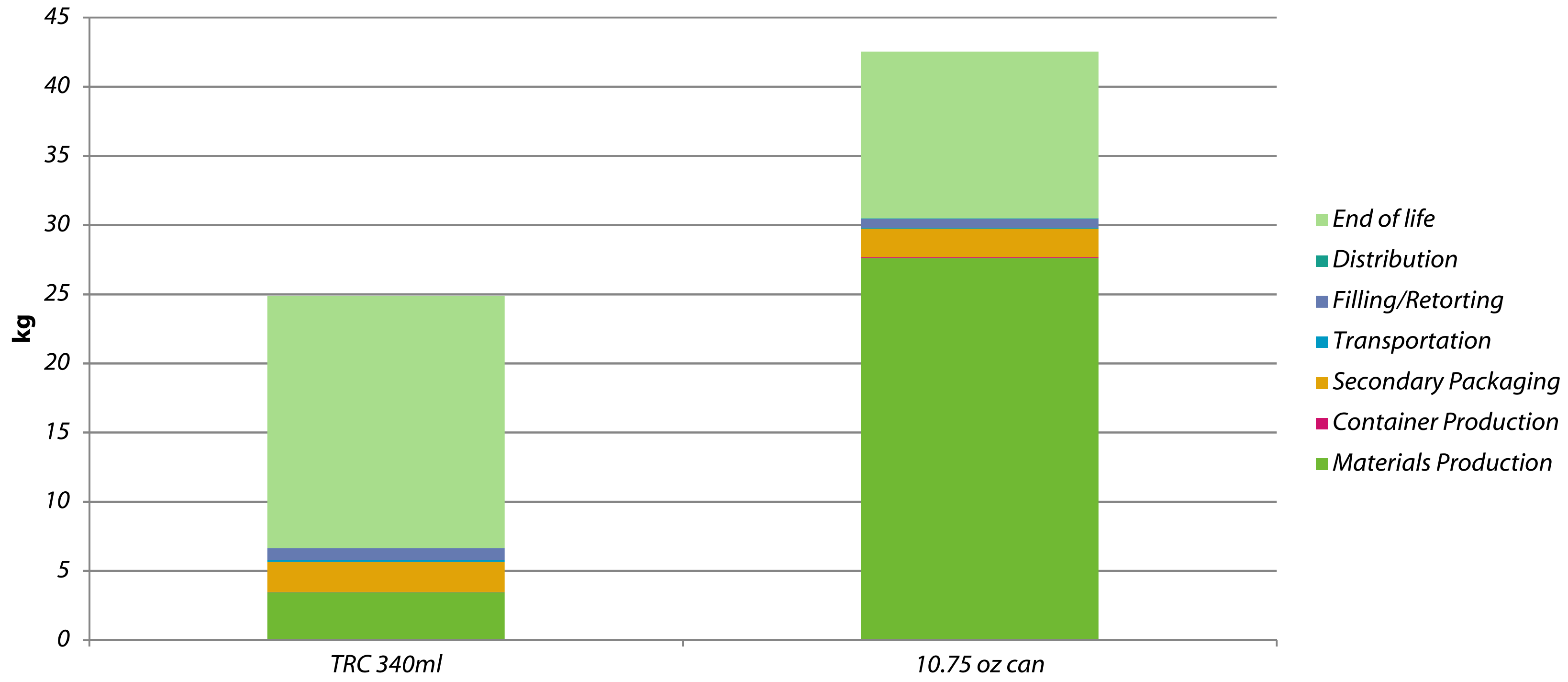
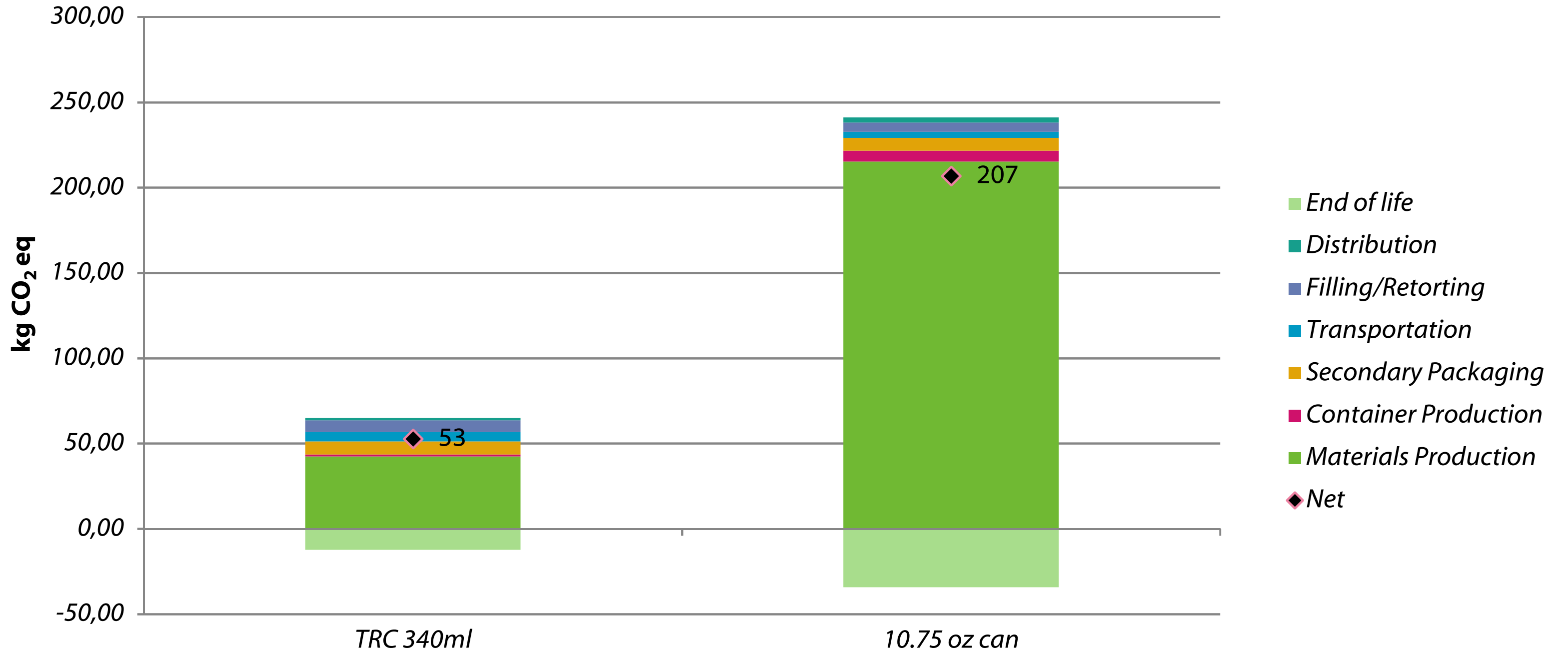
Condensed Soup Solid Waste Results by Life Cycle Stage



- Solid waste for TRC is dominated by postconsumer disposal
- Material production wastes are much higher for steel cans, but end-of-life wastes lower due to high recycling rate for cans

Condensed Soup Global Warming Results by Life Cycle Stage



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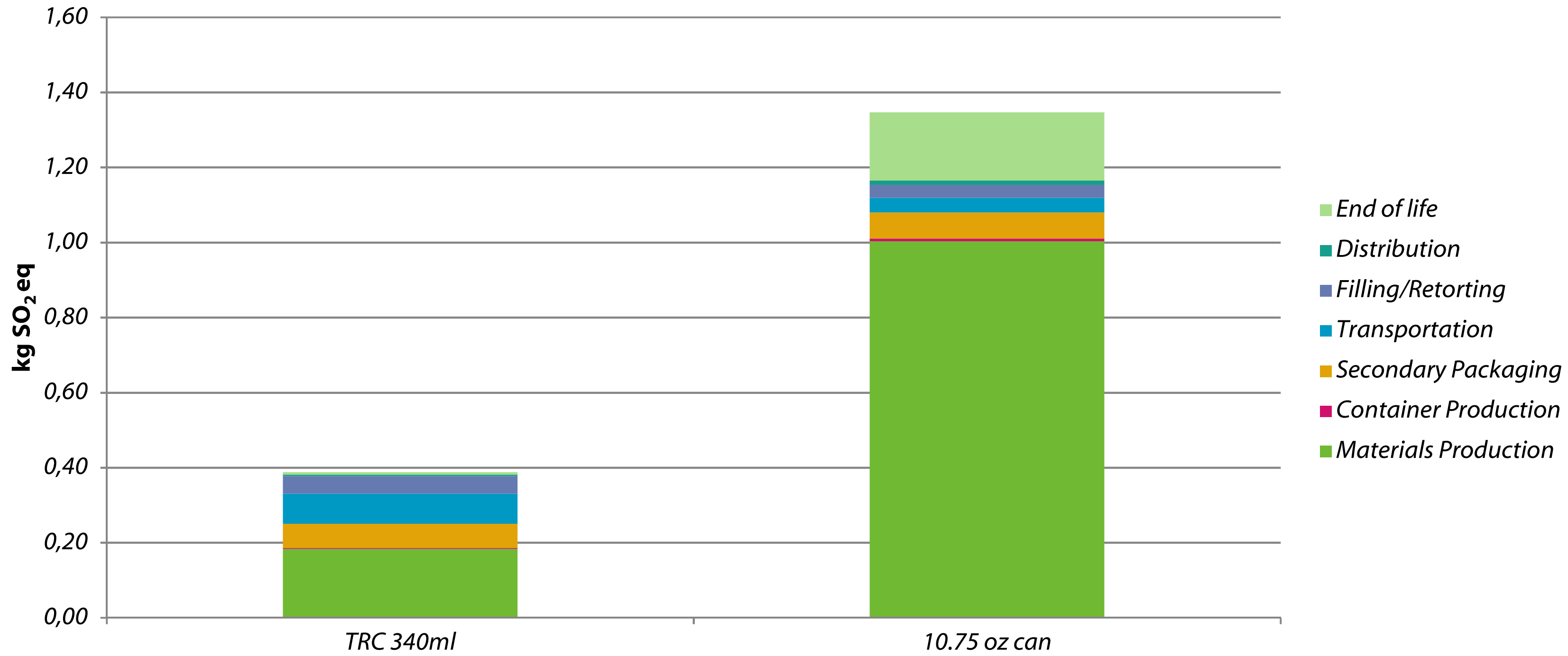
Condensed Soup Acidification Results by Life Cycle Stage



- Acidification impacts associated largely with SO_2 emissions from coal combustion (for electricity generation) and steel production
- TRC rollstock is produced in Europe with a low coal electricity grid

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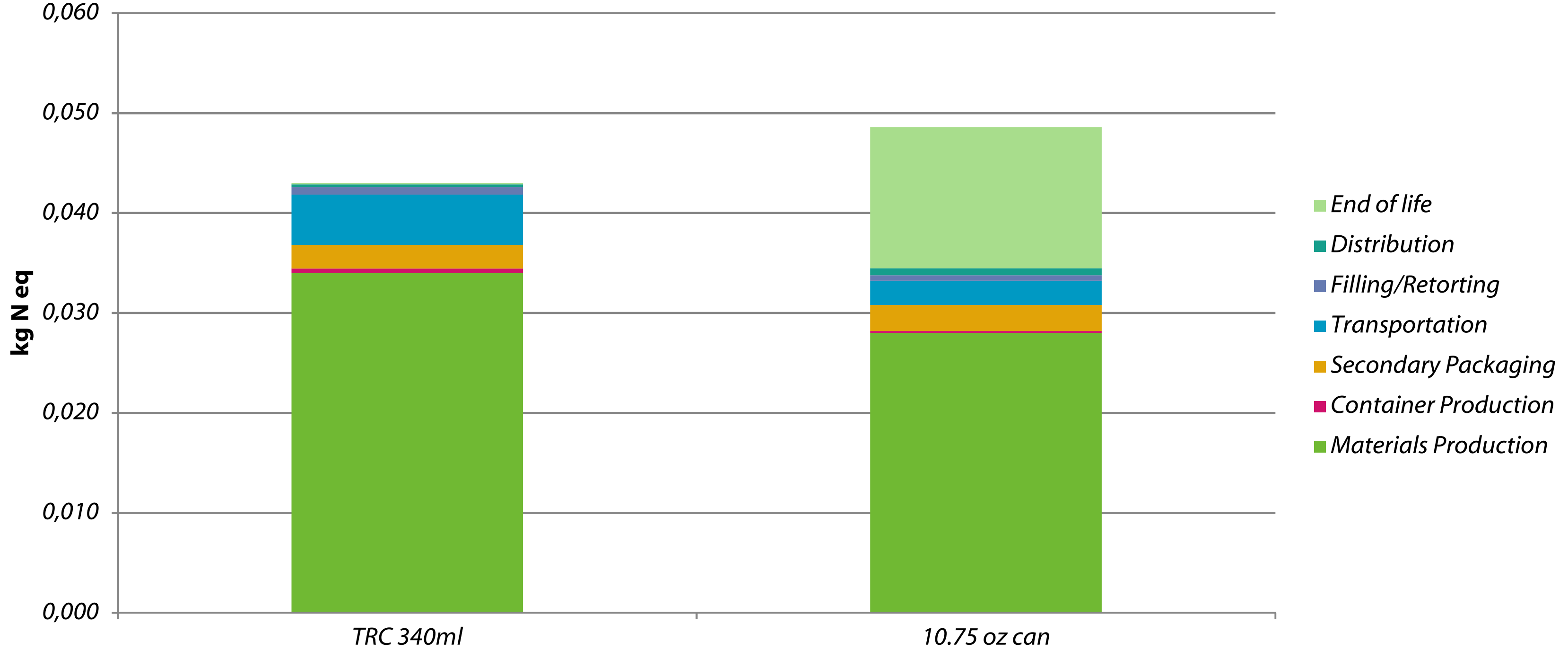
Condensed Soup Eutrophication Results by Life Cycle Stage



- Main eutrophication impacts for TRC due to water emissions from papermaking (TRC fiber content)
- Eutrophication for cans associated with can material production and recycling

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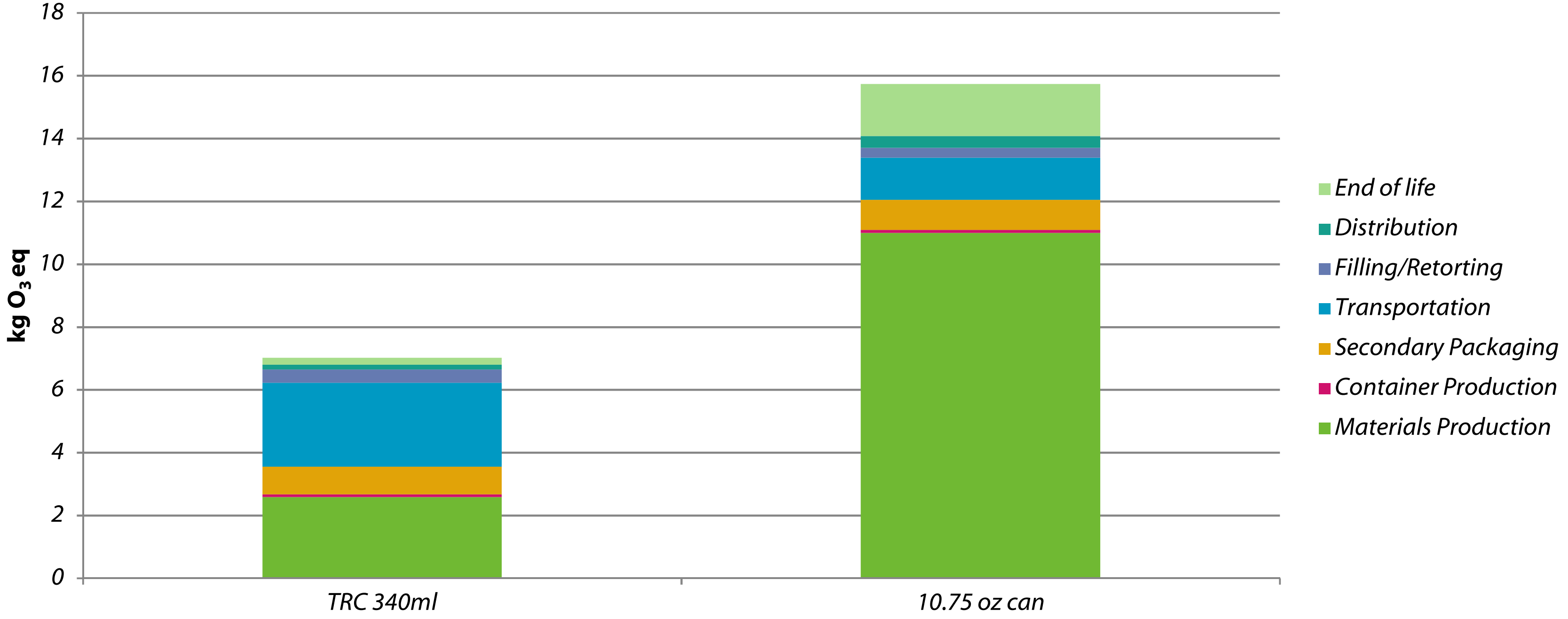
Condensed Soup Smog Formation Results by Life Cycle Stage



- Majority of smog from nitrogen oxide emissions from fuel combustion
- TRC influenced by smog formation during ocean freighter transport of rollstock from Sweden to the U.S.

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Condensed Soup Comparative Conclusions Summary

	Meaningful Difference Threshold	Condensed Soup Container Compared to TRC 340 ml 10.75 oz can
Total Energy	10%	TRC lower
Fossil Energy	10%	TRC lower
Non-Fossil Energy	10%	TRC higher
Global Warming	25%	TRC lower
Acidification	25%	TRC lower
Eutrophication	25%	Insignificant
Smog	25%	TRC lower
Total Solid Waste	10%	TRC lower

- Green = TRC results are notably lower compared to alternative
- Red = TRC results are notably higher compared to alternative
- Grey = No meaningful difference exists between systems

Tetra Recart Soup Packaging LCA
Key Takeaway Messages

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Summary Conclusions

- LCA is an important tool to understand the full environmental impact of different product systems
- There can be trade-offs between Tetra Recart and other soup packaging systems depending upon the impact category examined
- Overall, TRC shows benefits in most results compared to heavier steel can systems, despite the high recycling rate for cans.
- Comparative results are more mixed for TRC compared to soup pouches, which are about half the weight of TRC
- TRC has a larger share of energy that is derived from renewable resources

Depletion of Finite Natural Resources

- Tetra Recart contributes less to depletion of finite natural resources (fossil fuels)
  - TRC cartons are made of 68% paper, a renewable resource. As a result TRC results in less depletion of fossil fuel resources than steel cans and pouches on a lifecycle basis
  - Help secure sustainable supply for future growth
  - TRC consumes at least 50% less fossil energy than steel cans throughout the lifecycle and 35% less vs. lightweight pouches

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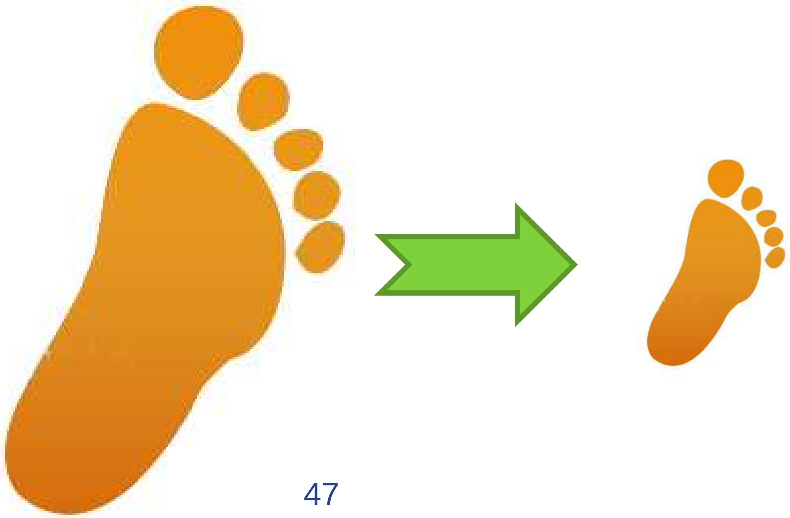
Carbon Footprint Reduction

- Tetra Recart results in less greenhouse gas emissions than steel cans and pouches on a life cycle basis
  - 75% less greenhouse gas emissions vs. heavier steel can systems
  - 51% less GWP than lightweight flexible pouch system



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Main Takeaway Messages

- TRC soup cartons perform favorably when comparing to heavier steel cans
  - Significantly lower total energy, fossil energy, solid waste, GWP, acidification, smog, and solid waste
  - TRC has higher non-fossil energy and mixed eutrophication results, associated with renewable fiber content of TRC
- Even when compared to significantly lighter pouches, TRC performs well in many areas
  - Lower fossil energy, GWP, acidification, and solid waste; comparable results for total energy, smog
- Study has been peer reviewed by a panel of 3 external experts, who have validated it was conducted according to ISO standards for LCA, so results can be shared

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