Califia Oatmilk Pakaging

Life cycle analysis

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HSCI-251-01: Design for Sustainability

This report is the life cycle analysis of Califia Oatmilk's packaging. Studying from the raw material all the way to recycling. Then proposing specific goals and strategies to make this packaging more sustainable.

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Summary of Results

The extra creamy Oatmilk is one of Califia's star products. The packaging of this product is designed by Farm Design studio. Based on my interest in sustainability and packaging design, I decided to choose this product's packaging to do a life cycle analysis. Studying the life cycle of this packaging, starting from raw material extraction and ending with recycling, I learned how unsustainable this product is. Therefore, I set three goals in order to make it more sustainable, including using materials with less waste and emissions, reducing transportation carbon footprint and increasing the chance for bottles to be recycled. For the redesign, I pointed out four major specific strategies, which are using only PVC, changing it into cylinder shape, sourcing all the materials locally and working with retailers to reward consumers who take used bottles back for recycling.

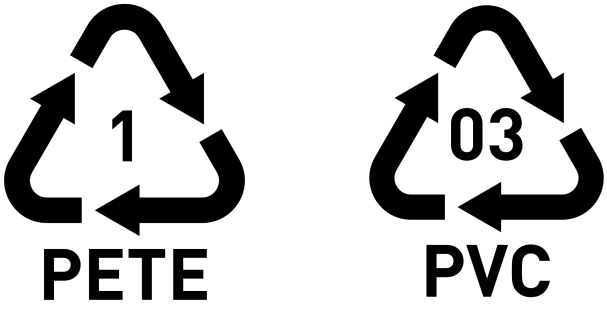
After the second LCA study on the redesign, I noticed that the redesign is more sustainable to a certain extent because of the strategies. These four strategies did fulfill three major goals I set, but it is not very clear how much sustainability it increases due to the unquantification of LCA.

Product Description

CALIFIA FARMS®

Oatmilk with extra creamy by Califia Farms

All the smooth creaminess you expect from dairy milk, just without the dairy. An excellent source of calcium, vitamin A and vitamin D, Extra Creamy Oatmilk swaps in for all your cooking and baking needs. Plus it's delicious sipped straight.



The cap and the bottle body is made of PETE 1. Polyethylene terephthalate is the most common thermoplastic polymer resin of the polyester family and is used in fibers for clothing, containers for liquids and foods, and thermoforming for manufacturing.

The shrink wrap label is supposedly made of PVC. Polyvinyl chloride is the world's third-most widely produced synthetic polymer of plastic. PVC comes in two basic forms: rigid and flexible, and each form is used in different ways.

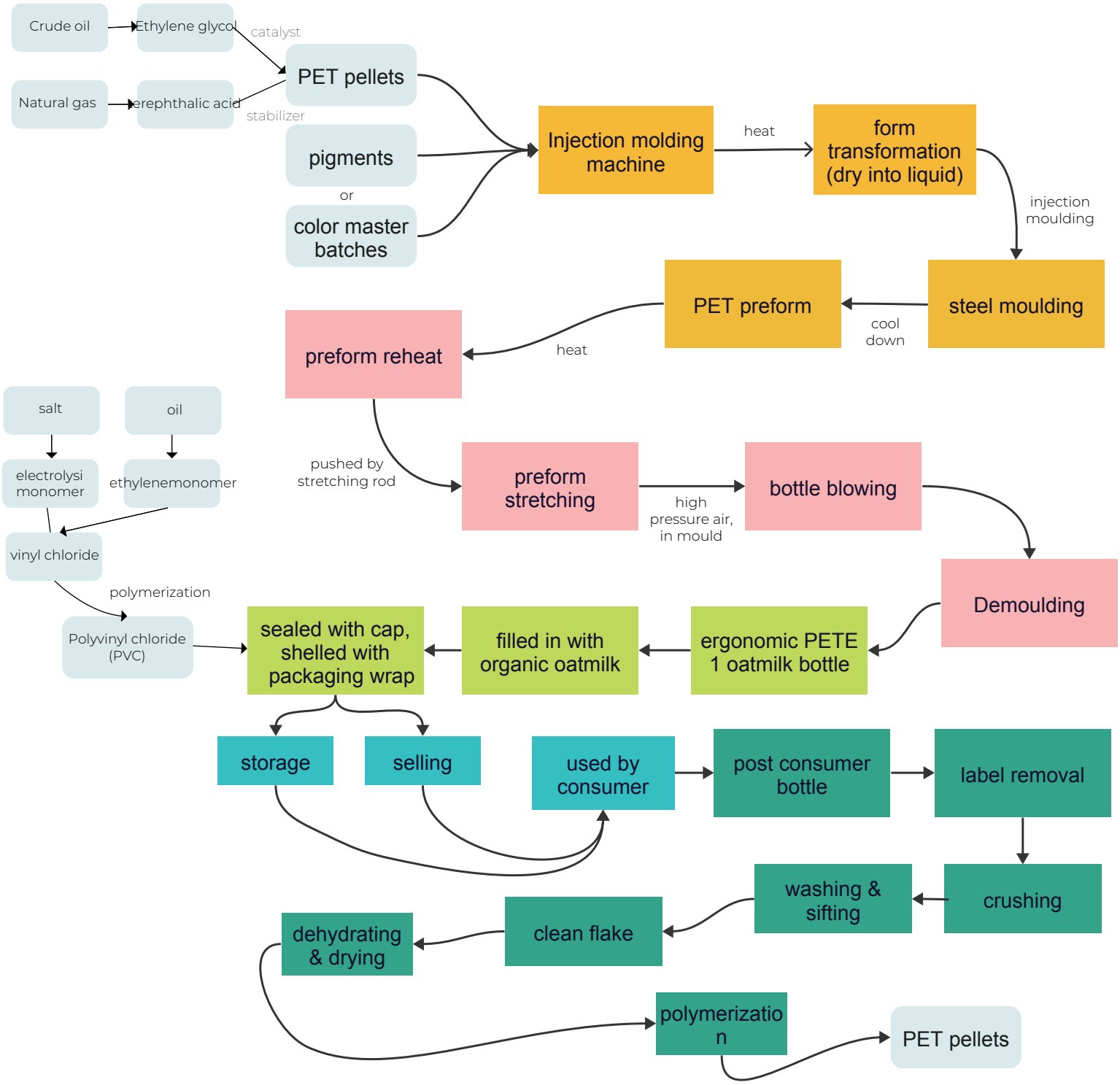
Product Details

The cap
(PETG)

The bottle body
(PETE 1)

The label wrap
(PVC)

Packaging Process Tree



Scope

A Life Cycle Assessment (LCA) is defined as the systematic analysis of the potential environmental impacts of products or services during their entire life cycle.

The packaging of Califia Oatmilk consists of three different separate parts, which are the cap, the bottle body and the label strip. The bottle body is the only part that states the raw material which is composed of PETE 1, polyethylene terephthalate. Unfortunately, there are clear statements on the cap and the label says which exact material Califia is using. I did online research on the shrink wrap material and figured out that they are using Polyvinyl chloride (PVC). Therefore I use PVC as the material for wrap labels in the process tree and matrixes.

Functional unit

A Life Cycle Assessment (LCA) is defined as the systematic analysis. The purpose of the bottle is to store the oatmilk inside until it is expired or finished. The bottle body is meant to be recycled after the label strip is removed, which is clearly mentioned on their packaging label.

$$\text{Impact per unit of product services} = \frac{\text{Impact}}{\text{8 months of storing oatmilk}}$$

Inventory Matrix

PETE 1 bottle body of Califia Oatmilk

	Material input	Energy use	Waste & emission
Raw material extraction	Crude oil Natural gas Phosphite Titanium compound	Heat Electricity Moderate pressure	Water pollution Air pollution
Material processing	Ethylene glycol Dimethyl terephthalate Terephthalic acid	High temperature Catalyst Stabilizer Bluing agent	Water pollution Leaching of antimony Bio-waste
Component manufacturing	PET Pellets Pigments	Electricity Heat Air pressure	Air pollution, Carbon dioxide nickel, ethylbenzene, ethylene oxide, benzene
Assembly & Packaging	Pigments Adhesive PETG(shrink wrap)	Electricity Human labor	Air pollution, Packaging waste
Distribution & purchase	Airplane Steamship Truck	Diesel Gasoline Electricity	water pollution, air pollution, carbon dioxide
Installation & use	N/A	Used by consumers	N/A
Maintenance & upgrading	Freezer	Electricity	Greenhouse gases
Cycle: reuse (product/components)	N/A	N/A	N/A
Cycle: reuse (materials)	Crushing machine	Electricity	Air pollution,
Cycle: reuse (incineration/landfill)	N/A	N/A	N/A

Impact Matrix

PETE 1 bottle body of Califia Oatmilk

○ Positive impact
— Zero impact
✕ Negative impact

	Resource depletion	Global warming	Ozone layer depletion	Acid rain	Land degradation	Water pollution	Air pollution	Reduced biodiversity
Raw material extraction	✕	✕	✕	✕	✕	✕	✕	✕
Material processing	✕	✕	✕	—	✕	✕	✕	✕
Component manufacturing	✕	✕	✕	—	—	✕	✕	—
Assembly & Packaging	✕	—	—	—	—	—	✕	—
Distribution & purchase	✕	✕	✕	✕	✕	✕	✕	—
Installation & use	—	—	—	—	—	—	—	○
Maintenance & upgrading	—	✕	✕	—	—	—	✕	○
Cycle: reuse (product/components)	—	—	—	—	—	—	—	○
Cycle: reuse (materials)	○	—	—	—	—	✕	—	—
Cycle: reuse (incineration/landfill)	✕	✕	✕	✕	✕	✕	✕	✕

Inventory Matrix

PVC wrap label of Califia Oatmilk

	Material input	Energy use	Waste & emission
Raw material extraction	Salt Crude oil hydrocarbon resources	Electricity	Water pollution Air pollution
Material processing	Ethylene Chlorine Chloride monomer	Polymerisation	Water pollution Toxic substances vinyl chloride disease
Component manufacturing	VCM	Electricity	Air pollution
Assembly & Packaging	PVC compound	Electricity Heat blown film extrusion	Air pollution, Packaging waste Ocean pollution
Distribution & purchase	Airplane Truck	Diesel Gasoline Electricity	air pollution
Installation & use	N/A	N/A	N/A
Maintenance & upgrading	N/A	N/A	N/A
Cycle: reuse (product/components)	N/A	N/A	N/A
Cycle: reuse (materials)	Crushing machine Used PVC	Electricity	Air pollution
Cycle: reuse (incineration/landfill)	Used PVC	Fuel	Air pollution Solid waste

Impact Matrix

PVC wrap label of Califia Oatmilk

	Resource depletion	Global warming	Ozone layer depletion	Acid rain	Land degradation	Water pollution	Air pollution	Reduced biodiversity
Raw material extraction	✕	✕	✕	✕	✕	✕	✕	—
Material processing	✕	✕	✕	—	✕	✕	✕	✕
Component manufacturing	✕	✕	✕	—	—	✕	✕	—
Assembly & Packaging	✕	✕	✕	✕	✕	✕	✕	✕
Distribution & purchase	✕	✕	✕	✕	✕	—	✕	—
Installation & use	—	—	—	—	—	—	—	○
Maintenance & upgrading	—	—	—	—	—	—	—	—
Cycle: reuse (product/components)	—	—	—	—	—	—	—	○
Cycle: reuse (materials)	○	✕	✕	✕	—	—	✕	—
Cycle: reuse (incineration/landfill)	✕	✕	✕	✕	✕	—	✕	✕

Redesign goals

1, Using materials that have less waste and emission to the environment.

2, Reducing transportation carbon footprint.

3, Increasing the chance for bottles to be recycled.

Redesign strategies

1,

-Using less PETE.

-Replacing PETE with bio-degradable materials.

-Using recycled PETE

-Using one material for the entire packaging, like paper.

2,

-Finding more eco-friendly transportation methods, like electric and alternative-fuel vehicles.

-Narrowing down the selling map.

-Locally sourced and manufactured materials.

3,

-Better graphic hints for consumers to recycle the bottle.

-Advertising the recycling bottle campaigns.

-Adding rewards for recycling bottles.

-Collaborate with retailers for product take back, like Whole Foods.

Redesign Description

Old bottle design

LESS Plastic

New design

First, the new design is transformed into a straight up cylinder shape. Such shape leads to **less spaces wasted** in the storage box and more bottles can be fitted into the box. More bottles in the box can cause less transportation cost in the same amount of Oatmilk bottles. Therefore, the waste and emissions generated by transportation are reduced.

Secondly, the new design bottle **only uses PVC**(polyvinyl chloride) to make three different parts, the cap, the bottle body and the label wrap. The old design uses two different materials to make these three parts, which are PVC and PETE. Reducing the amount of different kinds of materials also helps to decrease the waste and emissions this product generates.

Redesign Description

CALIFIA FARMS

LESS Plastic with Condensed Drink

Too less drinks? No worries.

Because the new design is smaller than the old one. It's normal to worry if it's still **capable of serving the same amount of drink** than it used to be. In fact, it can! The new Califia Oatmilk is condensed for the new design bottle. We simply just remove extra water from it. Inspired by the successful cases of shampoo and detergent, the Oatmilk is condensed in smaller and more eco-friendly containers. Users only need to add water into the condensed Oatmilk, it will just taste as it used to.

Redesign Description

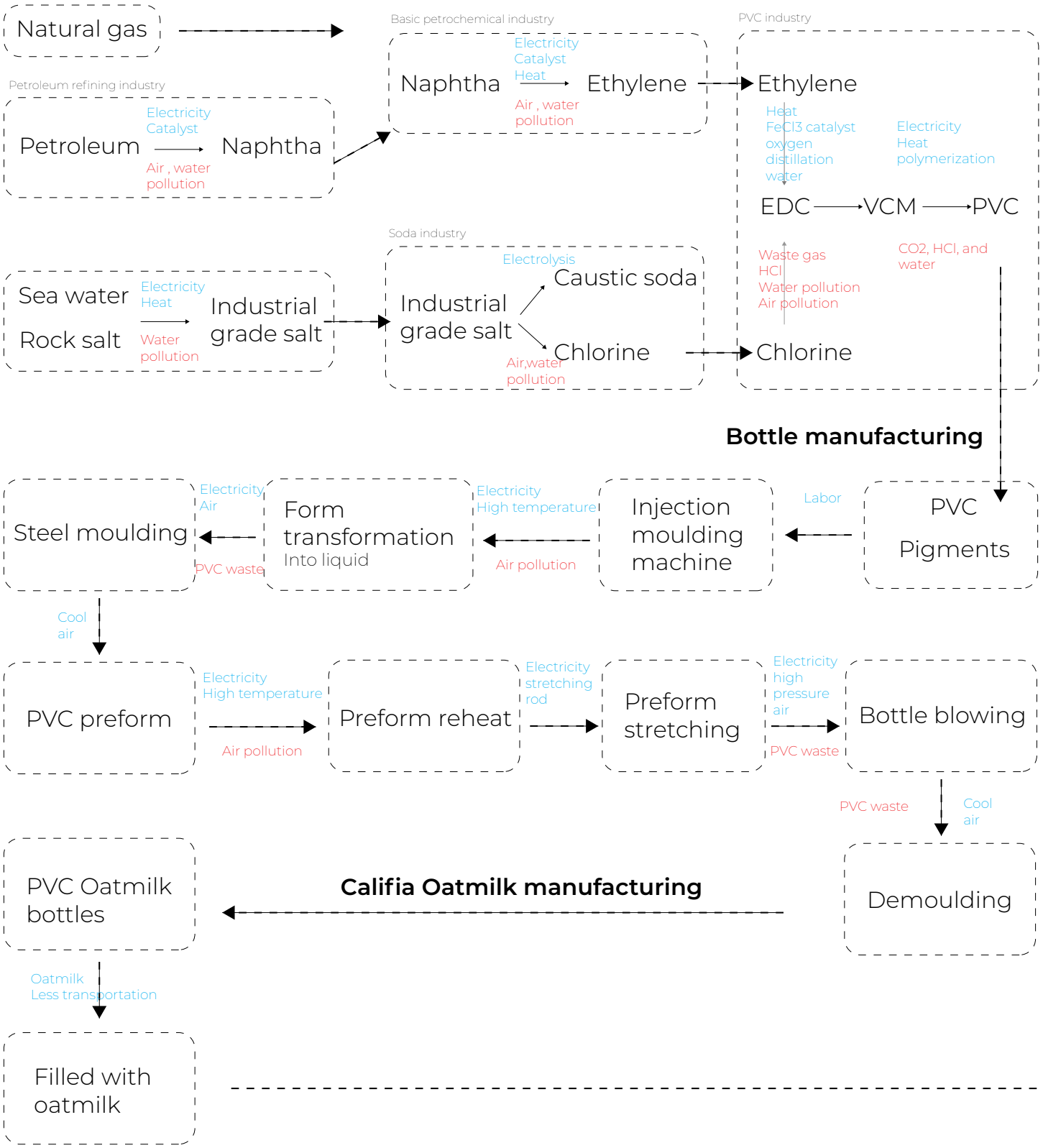
The brand Califia is based in California. The next step of the new design is to **source** the materials and manufacture **everything locally**. The PVC packaging factory and the Oatmilk manufacturing factory will also be located very closely. Therefore, the transportation cost and carbon footprint will be decreased.

Less shipments means less emissions generated

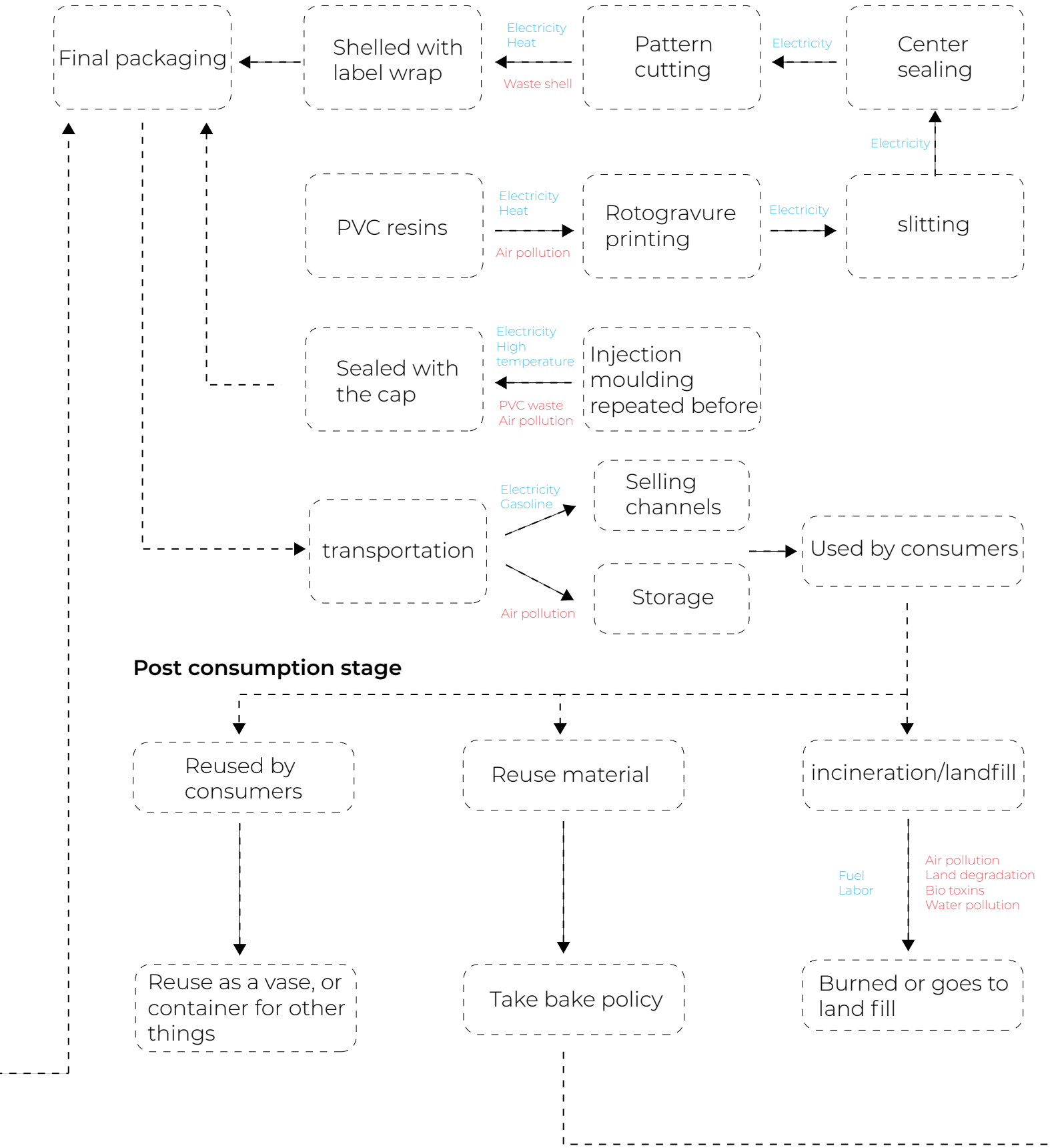
The last step would be creating Califia's **take back policy** with retailers all over the country. The policy encourages consumers to take these empty bottles after they have finished oat milk back to retailers' stores, such as Whole Foods, CVS and Trader Joe's, to exchange for store credits or other rewards. After retailers have collected enough empty PVC bottles, they will send these back to Califia. Califia will **recycle these used PVC bottles** and make them into new bottles.

Redesign Process Tree

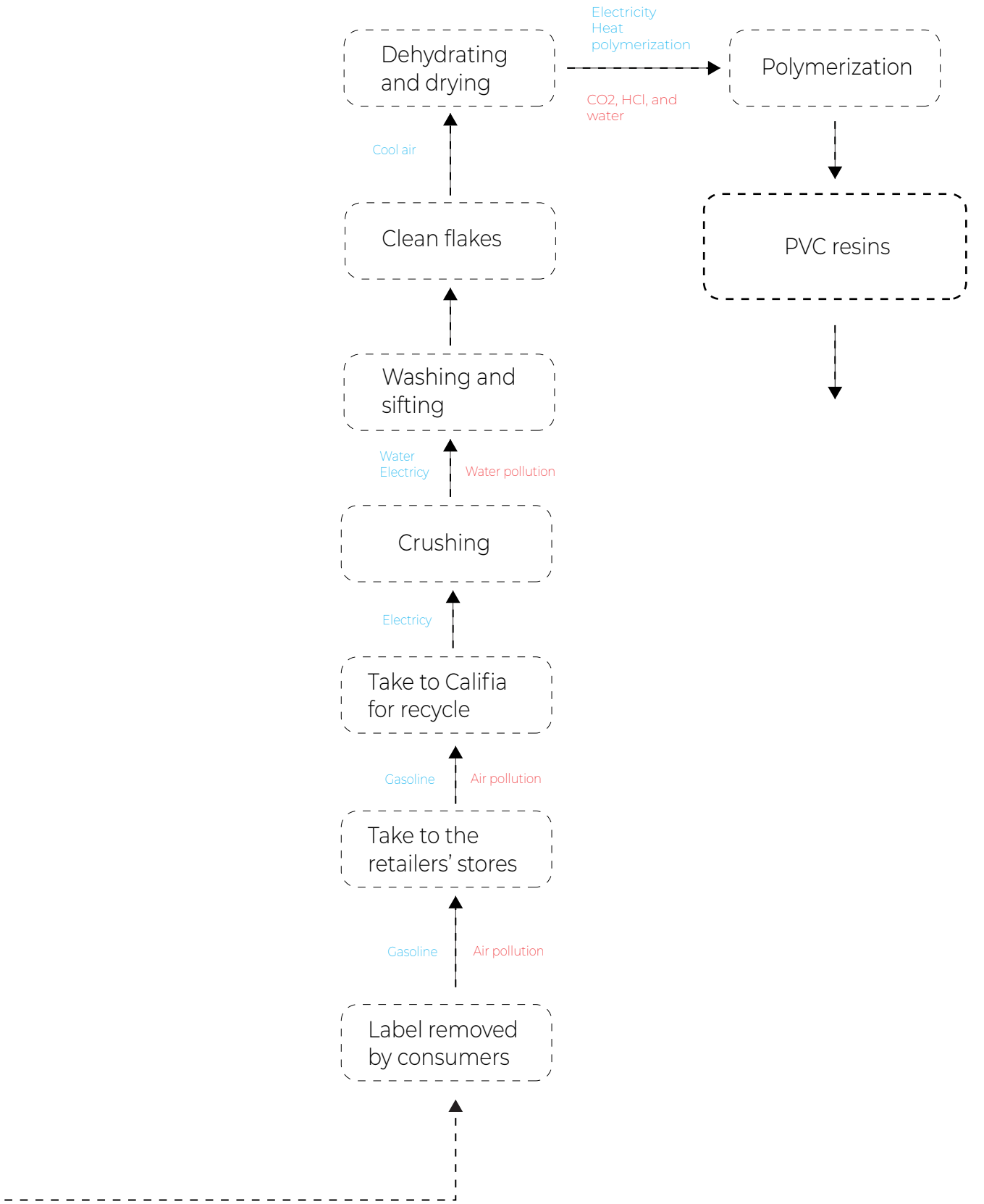
Material processing



Redesign Process Tree



Redesign Process Tree



Redesign Scope

The new Califia Oatmilk bottle design is a straight up cylinder shape, such shape saves more space for transportation, meaning that more bottles can be fitted in one box within the same storage space, therefore the transportation cost and carbon footprint will be decreased.

The new design still consists of three major parts, the cap, the label wrap and the bottle body. Besides the shape of the bottle body, there isn't much change on the shape of the cap and the label wrap. But, the new design changes the material of these different parts into all PVC. Reducing the quantity and categories of plastic used in the production for the packaging bottle effectively decreases the waste and emissions, carbon footprint and the cost generated by the bottle.

Redesign Functional unit

After the new design, the function or the purpose of the Oatmilk bottle should remain the same, which is storing the Oatmilk inside until it is expired or finished.

The amount of Oatmilk is smaller but condensed. Users can add water to the oatmilk, and it will just taste the same as it used to be.

$$\text{Impact per unit of product services} = \frac{\text{Impact}}{\text{8 months of storing oatmilk}}$$

Inventory Matrix

PETE 1 bottle body of Califia Oatmilk

	Material input	Energy use	Waste & emission
Raw material extraction	Natural gas Petroleum Seasalt Rock salt	Heat Electricity Catalyst	Water pollution Air pollution
Material processing	Ethylene Cholrine	High temperature Catalyst Oxygen Water	Water pollution Waste gas HCl
Component manufacturing	PVC resins Pigments	Electricity Heat Air pressure	Air pollution,
Assembly & Packaging	Pigments PVC(shrink wrap)	Electricity Human labor	Air pollution, Packaging waste
Distribution & purchase	Electric cars Truck	Gasoline Electricity	Air pollution,
Installation & use	N/A	Used by consumers	N/A
Maintenance & upgrading	N/A	N/A	N/A
Cycle: reuse (product/components)	Used PVC bottles	N/A	N/A
Cycle: reuse (materials)	Crushing machine Used PVC	Electricity	Air pollution,
Cycle: reuse (incineration/landfill)	Used PVC	Fuel	Air pollution Solid waste

Impact matrix

PVC wrap label of Califia Oatmilk

	Resource depletion	Global warming	Ozone layer depletion	Acid rain	Land degradation	Water pollution	Air pollution	Reduced biodiversity
Raw material extraction	✕	✕	✕	✕	✕	✕	✕	—
Material processing	✕	✕	✕	—	✕	✕	✕	✕
Component manufacturing	✕	✕	✕	—	—	✕	✕	—
Assembly & Packaging	✕	✕	✕	✕	✕	—	✕	✕
Distribution & purchase	✕	✕	✕	✕	✕	—	✕	—
Installation & use	—	—	—	—	—	—	—	○
Maintenance & upgrading	—	—	—	—	—	—	—	—
Cycle: reuse (product/components)	○	—	—	—	—	—	—	○
Cycle: reuse (materials)	○	✕	✕	✕	—	—	✕	○
Cycle: reuse (incineration/landfill)	✕	✕	✕	✕	✕	—	✕	✕

Conclusion

This is my first time making LCA, the process of researching, filling all the charts and completing the entire LCA taught me so much. Being familiar with the life cycle of the product gave me ideas about all the pros and cons of this product starting from raw material extraction and ending with recycling. Knowing all the steps gave me clues about where and how to start redesigning the product to make it more sustainable.

For Califia Oatmilk redesign, I pointed out four major specific strategies, which are using only PVC, changing it into cylinder shape, sourcing all the materials locally and working with retailers to reward consumers who take used bottles back for recycling. These four strategies all fulfilled three of my goals, which are using materials with less waste and emission, less transportation carbon footprint and increasing the chance of bottles being recycled. I believe this new design is successful in making this product more sustainable.

However, in the process of researching and making this LCA, I realized how unsustainable this original design was and how little we can help as a designer among so many steps. I also noticed that inventory and impact matrices are not quantifiable, changes in reducing the amount of plastic cannot be shown in these two matrices. Fouturnely, working with the instructor and TA helped me to figure out a way to establish that and prove this is a working and sustainable redesign.

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