Group Project Brief

# Assessing The Environmental Impacts Of Industrial Laundering:
## *Life cycle assessment of polyester/cotton shirts*

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## Background

The linen supply and industrial laundering industries employ more than 132,000 people nationwide and have combined annual revenues of approximately $12 billion *(1)*. Industrial laundering, or the service of collecting, washing and drying, and redistributing rented apparel and linen products, is one of the most polluting industries in the world, consistently ranking among the top industrial contributors to greenhouse gas (GHG) emissions. Furthermore, creation of the textiles and apparel products laundered by this industry draws heavily on natural resources and is a large contributor to many environmental stresses. This group project seeks to better understand the potential environmental impacts of textile creation and laundering activities and develop feasible recommendations based on project findings.

## Objectives

The project objectives are to:

1) Quantify and establish a baseline for energy and water use and assess the global warming potential for the life cycle of our client's main product and service;

2) Identify processes in the product and service life cycle that use the greatest amount of energy and water and contribute the most to greenhouse gas emissions; and

3) Recommend changes to reduce life cycle resource use and potential environmental impacts of our client's operations while yielding cost savings, when possible.

*Image source: Factory 20*

### Mission Linen Supply

Mission Linen Supply is primarily a linen and uniform rental business. The company serves 50,000 customers and launders 5.5 million kilograms of textiles annually at 28 laundering facilities across the Western U.S., including one near downtown Santa Barbara.

Our client has several motivations for this group project, including the potential for:

1) Cost savings from identified resource use hot spots in the shirt's life cycle;
2) Improving product and equipment design and operations;
3) Anticipating future legislation and regulation specific to the textile rental industry in the states it operates; and
4) Applying the recommendations towards efforts for creating a competitive marketing advantage through environmental product differentiation.

## APPROACH

To examine the environmental performance of our client's operations and the products it purchases, a process-based life cycle assessment (LCA) was performed following the principles and framework of the International Organization for Standardization (ISO) 14040 series for Environmental management – Life cycle assessment *(2)*. LCA is a method to systematically quantify and assess the resource use and potential environmental impacts of an industrial system through its entire life cycle, from raw material acquisition, through manufacturing, use and disposal (Figure 1).

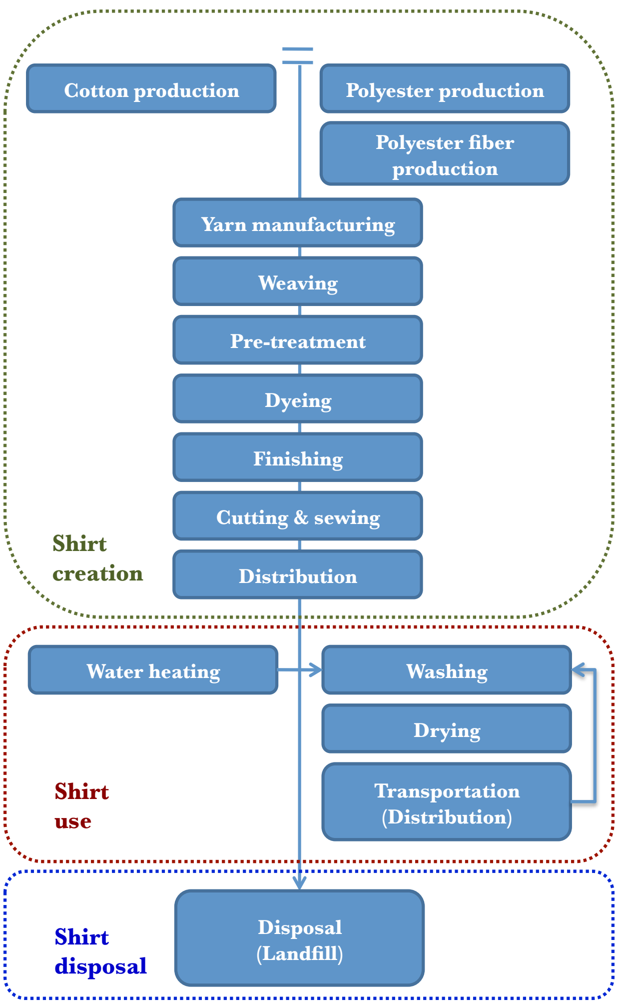



***Figure 1:*** *Process flow diagram of a shirt's life cycle. Adapted from Farrant, 2008 (3)*

## SCOPE

We examined our client's highest volume shirt, a 227 gram 65% polyester/35% cotton button-up short sleeve industrial work shirt (Figure 2) that is laundered 52 times and later discarded in a landfill. We modeled 4 out of 28 laundry facilities to determine the average resource use of its operations for that garment.

***Figure 2:*** *The 65% polyester/35% cotton shirt for this study. Image Source: Red Kap*

## DATA SOURCES

Our study utilized recent resource input and output data from our client's actual operations. Other sources of data we consulted were:

- Specific process information from our client's garment suppliers
- Equipment specification sheets
- GaBi Professional database
- EcoInvent v.2 LCI database
- Peer-reviewed literature and LCA studies on textiles and/or apparel
- Region-specific energy grid mix
- Average statewide transportation emissions factors
- Water-related energy use in California

## SYSTEM BOUNDARIES

*Within the study's system boundaries:*

Raw material sourcing, manufacturing, distribution, use and disposal phases; energy generation.

*Outside the study's system boundaries:*

Capital equipment, buildings, vehicles and maintenance; overhead and labor; packaging; shirt buttons; ancillary and scrap materials.

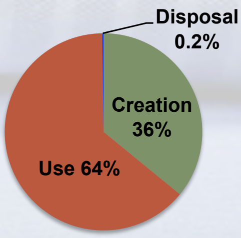
# Results

**Energy**
net calorific value
(MJ)

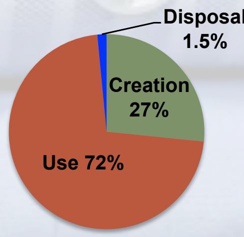
**Global warming**
100 years
(kg $CO_2$-Equiv.)

**Water Use**
(L)

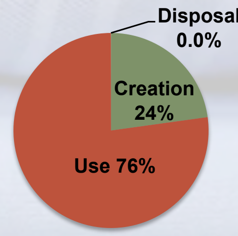
## Overall Results




Total: **102 MJ**

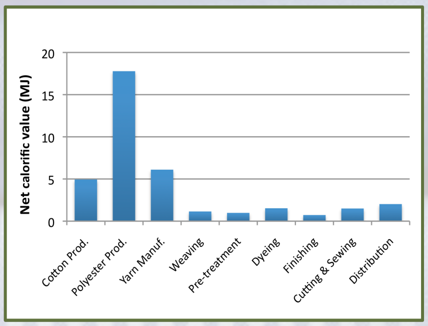



Total: **5.7 kg $CO_2$-Equiv.**

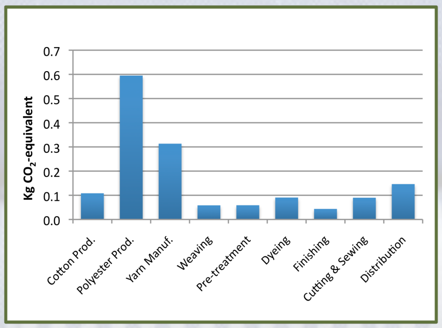



Total: **2,729 L**

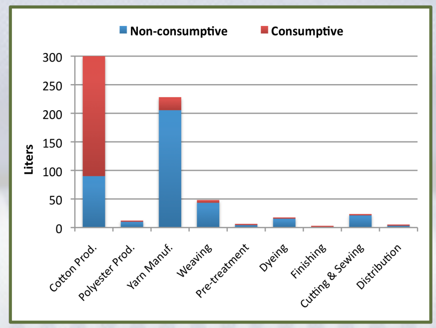
## Shirt Creation




Shirt Creation Total: **37 MJ**

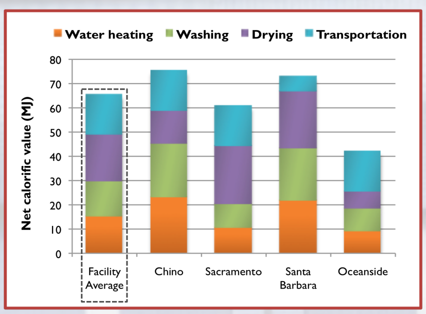



Shirt Creation Total: **1.5 kg $CO_2$-Equiv.**

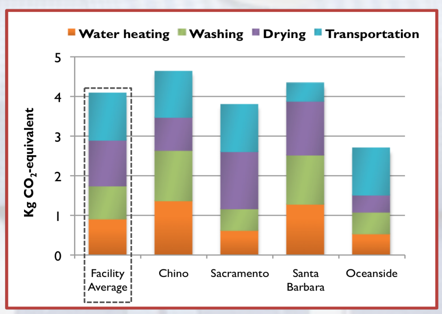



Shirt Creation Total: **645 L**

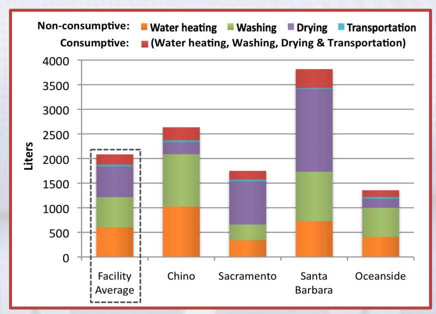
## Shirt Use




Shirt Use Total: **65 MJ**




Shirt Use Total: **4.1 kg $CO_2$-Equiv.**




Shirt Use Total: **2,084 L**

## Shirt Disposal

After an average of two years, the shirt is disposed of in a landfill. The overall resource use and contribution to global warming from transportation of the used garments to the landfill and the operations and maintenance of the landfill is **1.5% or less** of the total life cycle impact.

*~ Equivalences ~*

*Energy: 102 MJ ≈ burning 0.84 gal. gasoline*
*GWP: 5.7 kg $CO_2e$ ≈ burning 1 gal. propane*
*Water: 2,729 L ≈ 15 average bathtubs*

*~ Energy-Water Nexus ~*

*Energy production requires water.*
*Water treatment and distribution require energy.*

*~ Water Use ~*

*Consumptive:* *Water that evaporates or becomes substantially degraded in quality.*

*Non-consumptive:* *Water that is returned to its source and not substantially degraded.*

## Interpretation of Results

The life cycle inventory and assessment for this study indicate that the garment use phase is the most resource intensive and the largest contributor to global warming potential in the shirt's life cycle. Cotton production uses the most water, whereas polyester production uses the most energy in shirt creation. All four facilities exhibited different efficiencies in each process. The environmental impact from shirt disposal is insignificant. However, reusing or repurposing shirts can reduce resource consumption and environmental degradation by displacing virgin material

## Conclusions

With Mission Linen Supply serving as a model for the broader industrial laundry industry, our group examines the water and energy inputs and assesses the climate change impacts of garments and services used in this business. The findings of this report show that increased efficiencies in the laundry operations phase can lead to the most environmental performance improvement of a garment's life cycle. Continued efforts to measure and track facility operations and integrate environmental performance goals into the company's business strategy can lead to cost and resource savings and reduce risk from impending legislation that can affect the industrial laundry sector.

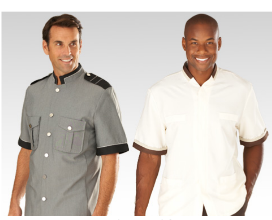


*Image source: ico uniforms*

*Image source: All Uniform Wear*

Mission Linen Supply
MISSION LINEN & UNIFORM SERVICE

## Recommendations

- Share project results and collaborate with garment suppliers to focus environmental efforts on identified hot spots.
- Install meters on equipment to monitor and maintain its optimal efficiency.
- Perform economic feasibility analysis on the installation of solar water heating systems.
- Consider alternate fuel delivery vehicles, optimize delivery routes, and maximize vehicle utility rate.
- Investigate ways to repurpose, recycle, or donate garments instead of disposing of them in a landfill.
- Integrate environmental strategy into its business structure and increase environmental awareness among its customers.
- Continue to measure and reduce resource use in anticipation of impending government regulations on greenhouse gas emissions.

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## Sources

1. LAUNDRY Environmental Stewardship Program (LaundryESP). (2010). *Textile Rental Services Association of America/Uniform & Textile Service Association*.

2. International Organization for Standardisation (ISO). (2006). *International Standard 14040 series: Environmental management – Life cycle assessment*

3. Farrant, L. (2008). *Environmental Benefits from Reusing Clothes*. Master Thesis. Technical University of Denmark. Copenhagen, Denmark.