

CJ' s Training Camp: Sustainability

Lesson 2

How are my clothes made?



Kahoot!

How **big** is the apparel industry?

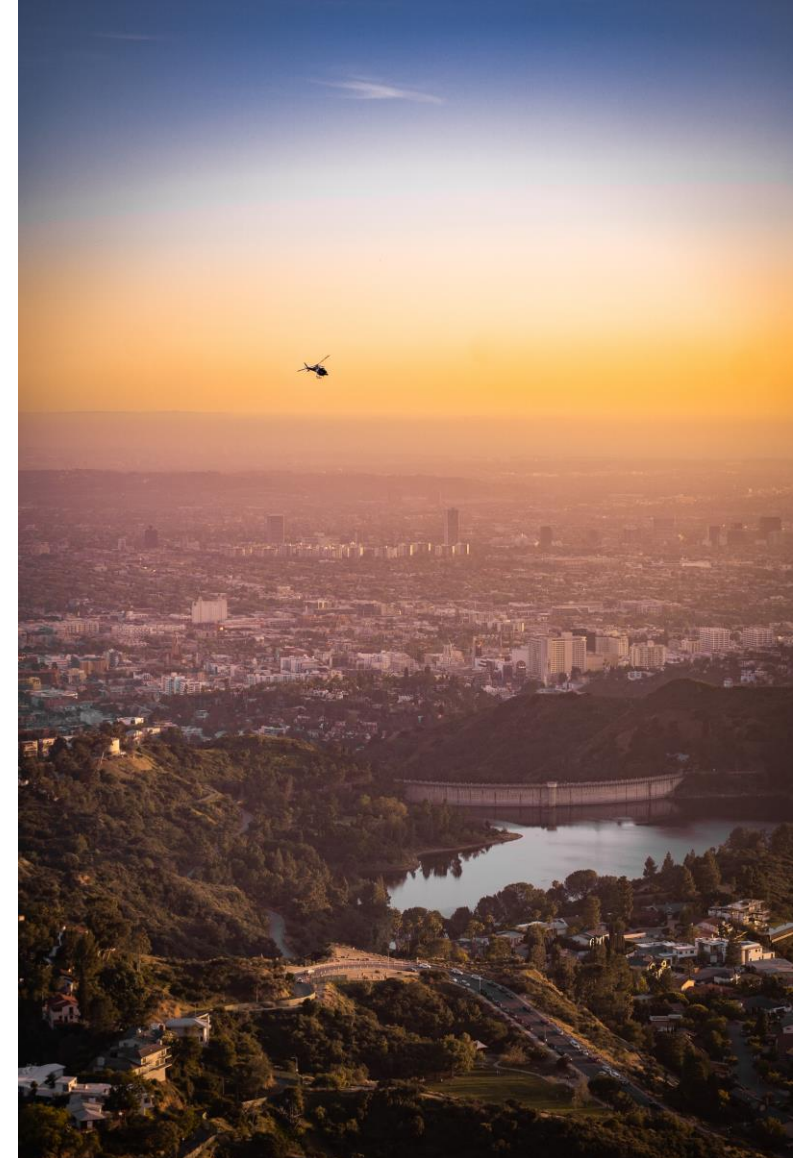
- It's the world's **3rd largest** manufacturing industry after automotive and technology
- It received 1.5 Trillion USD of revenue in 2021, which is larger than the GDP of **over 200 countries**

(as of 2022 there are only 14 countries with a GDP larger than 1.5 Trillion USD)

How many clothes do you think are produced every year?

Take a guess!

According to the World Economic Forum, we produce around 150 Billion new clothing items annually. Enough fabric to cover the entire state of California.







Step 1

Fiber

noun

a long and thin strand or thread of material that can be woven into fabric

Natural vs Synthetic Fibers

1. Natural fibers come from natural sources (e.g. animals, plants, minerals)
 - Examples: **cotton, wool, hemp, silk**
2. Synthetic Fibers are man-made, typically produced in manufacturing facilities
 - Examples: **polyester, nylon** (made from petroleum-based polymers)



Polyester fiber



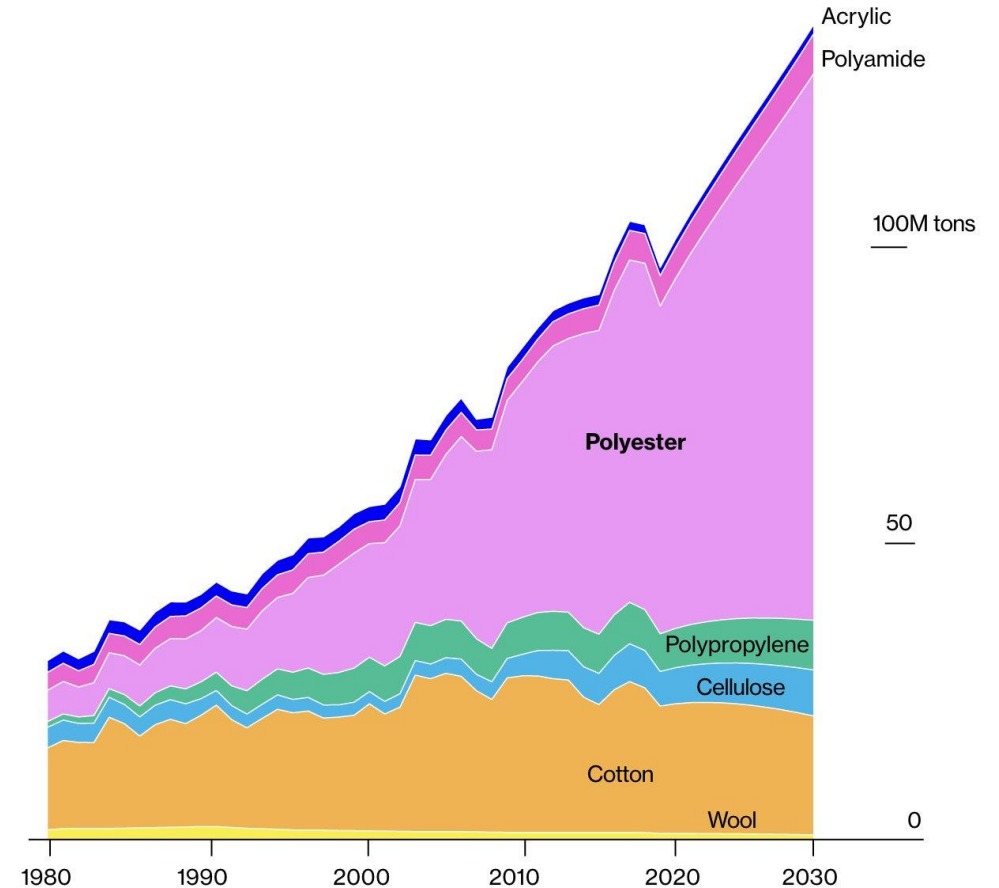
Cotton fiber

Fiber cont.

- The majority of global fiber production are synthetic, with polyester being the most widely used fiber
(at 52% compared to 24% for cotton and 1% each for wool and silk)
- However, the environmental impact depends not only on the type, but where and how they are manufactured.

Polyester Has Overtaken Cotton in the 21st Century

Annual global fiber production per year in metric tons, projected through 2030



Source: Tecnon OrbiChem analysis



Natural

- Conventional cotton production accounts for one sixth of global pesticide usage
- Cotton is grown in 80 countries and covers 2.5% of all agricultural land

(if it were a country it would be the 55th largest in the world, bigger than Germany or Japan)

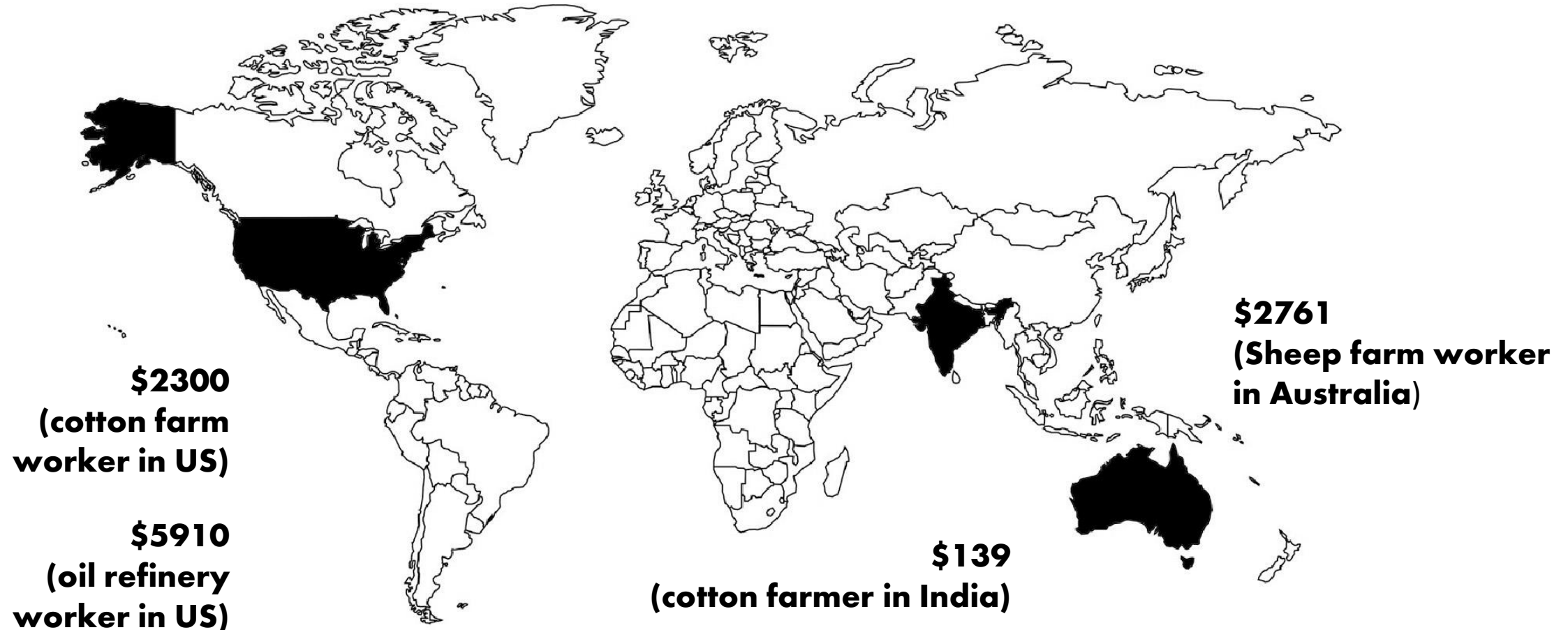


Synthetic

- 70 million barrels of oil are used annually to manufacture polyester
- Nylon manufacturing uses 3 times more energy than conventional cotton
- A polyester/nylon blend of fabric can take over 40 years to decompose
- 70 million trees are cut down annually to make rayon

Fiber

Who: Farmers, Chemists, Machine Operators, Production Workers, Truck Drivers





Step 2

Yarn

noun

Fiber that is spun into a thread

(Typically done by machines which draw out the strands, making them longer and thinner)

Yarn: Social Impacts

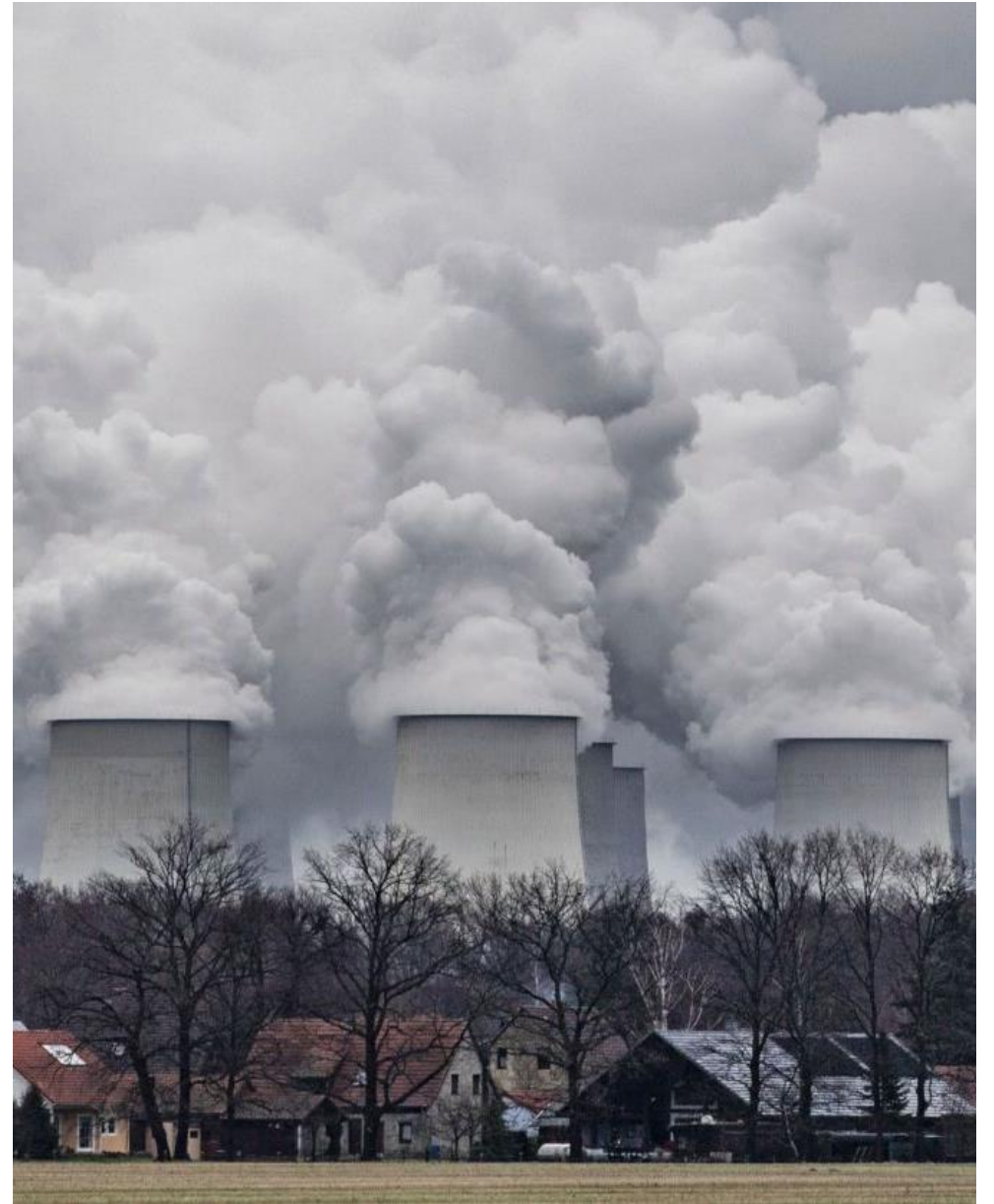
- A higher percentage of textile workers, especially weavers suffer from **hearing loss** due to excessive noise from textile manufacturing
- Spinning workers suffer from higher rates of **respiratory diseases** due to exposure from cotton dust, pesticides, and other dust particles



Yarn:

Environmental Impacts

- **28%** of the apparel industry's greenhouse emissions came from yarn production
- Most textile mills use coal or gas as fuel, decreasing the air quality of surrounding areas
- Natural fibers often transported long distances across oceans to mills for spinning and weaving



A photograph of a beach scene with waves crashing onto the shore. In the foreground, a fish and a white plastic bag are lying on the sand. The fish is positioned horizontally, and the plastic bag is partially overlapping it. The background shows the white foam of the waves and the dark water of the ocean. The overall image has a dark, muted color palette.

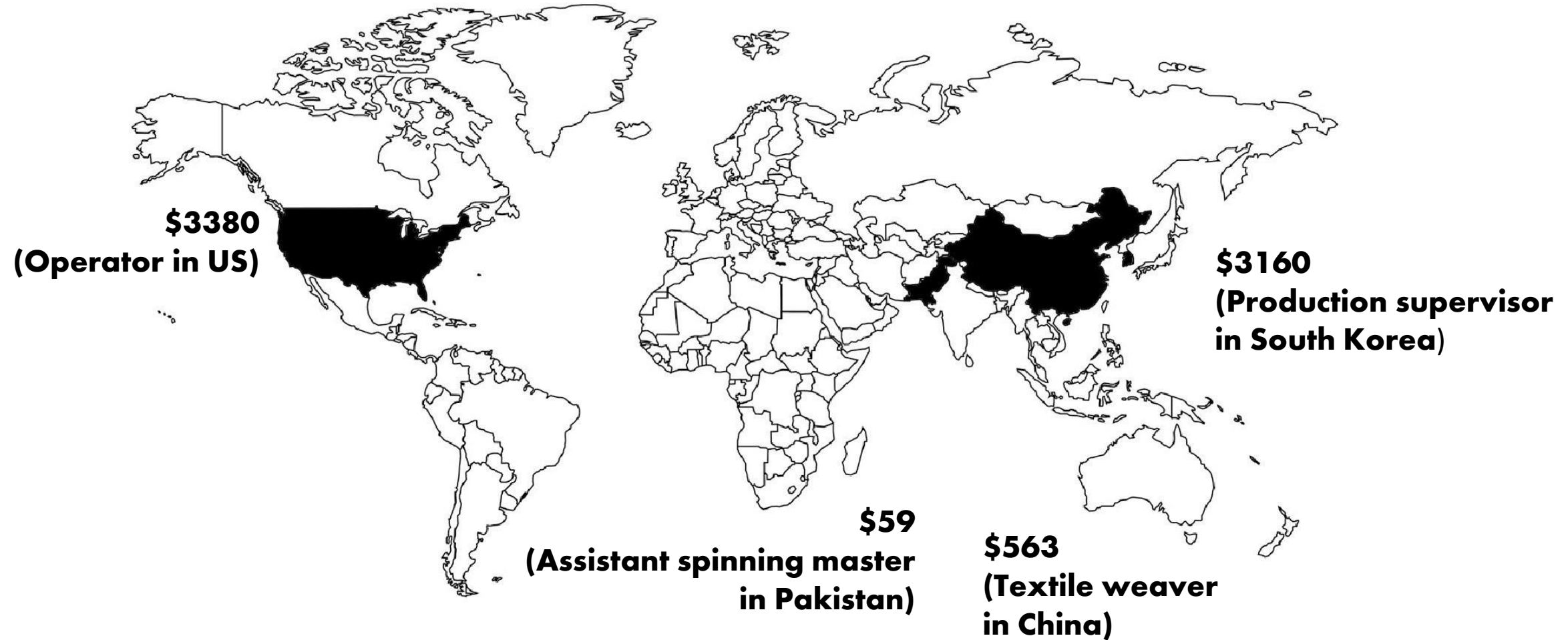
By 2050 there could be more plastic than fish in the ocean by weight

Sustainable Washing Tips

- Use a front loading washing machine
- Wash for a shorter amount of time
- Avoid washing with heavy objects
- Wash with cool water
- Skip the spin cycle
- Air dry

Yarn

Who: Auto Cone Operator, Loom Operator, Production Supervisor, Spinning Master, Spinning Operator, Weaver



*on average

Step 3

Fabric

noun

Cloth or other material produced by weaving or knitting

(Weaving creates fabric by interlacing 2 sets of yarn, whereas knitting forms rows of interlocking loops of yarn)

Synthetic Fabrics

Acrylic

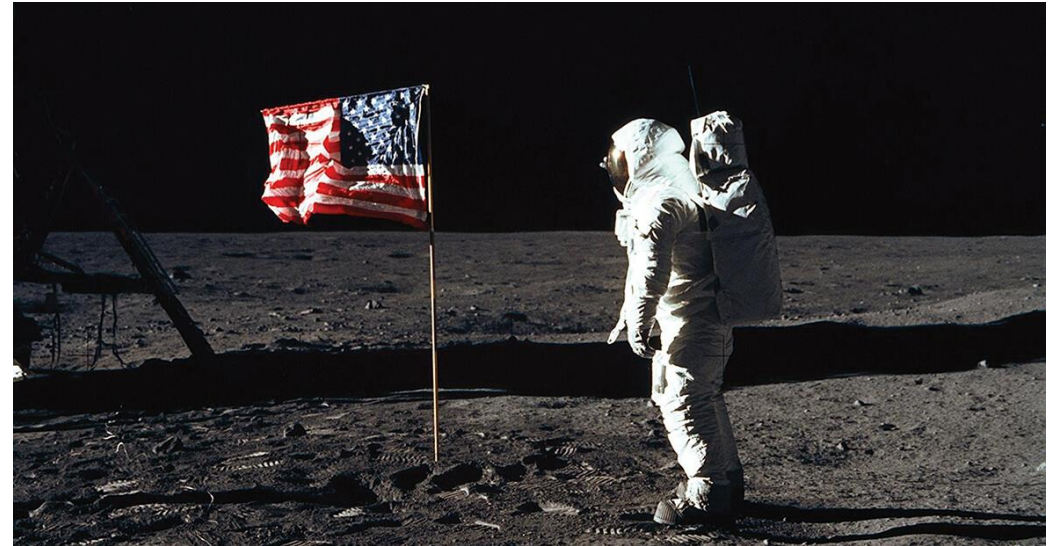
- Lightweight, soft, and warm, with a wool-like feel, making it an excellent substitute for wool
- Widely used in knitting to create sweaters, scarfs, socks, and home furnishing fabrics
- Typically priced cheaper than other similar natural fiber



Synthetic Fabrics

Nylon

- Has a silk-like feel
- Favored by many because of its flexibility, versatility, and its rapid drying properties.
- Used for apparel, automobile parts, food packaging, and carpets.
- The first flag planted on the moon was made of nylon



Synthetic Fabrics

Polyester

- One of the most popular type of synthetic fabric
- It is durable, resistant to most chemicals, rarely suffer from stretching, shrinking, and wrinkling, abrasion resistant, and hydrophobic (making it easy to wash and dry)
- Often blended with other fibers like cotton to achieve the desirable properties of both materials



Synthetic Fabrics

Spandex

- Known for being exceptionally elastic. It can expand 500% and spring back without losing integrity.
- Widely incorporated in sports apparel and skin-tight garments
- According to a report, an estimated 80% of clothing sold in the U.S. contain spandex





Natural Fabrics

Cotton

- The most popular natural fabric
- Soft, strong, cool, breathable, dye absorbent, abrasion and high temperature resistant – in other words: comfortable
- Cotton fabrics have been dated back to 5000 BC



Natural Fabrics

Silk

- Naturally produced by insect larvae to form cocoons
- Smooth, soft, shimmering, not slippery
- One of the strongest natural fibers, although it loses up to 20% of its strength when wet
- Moderate to poor elasticity (will remain stretched if elongated even a small amount)



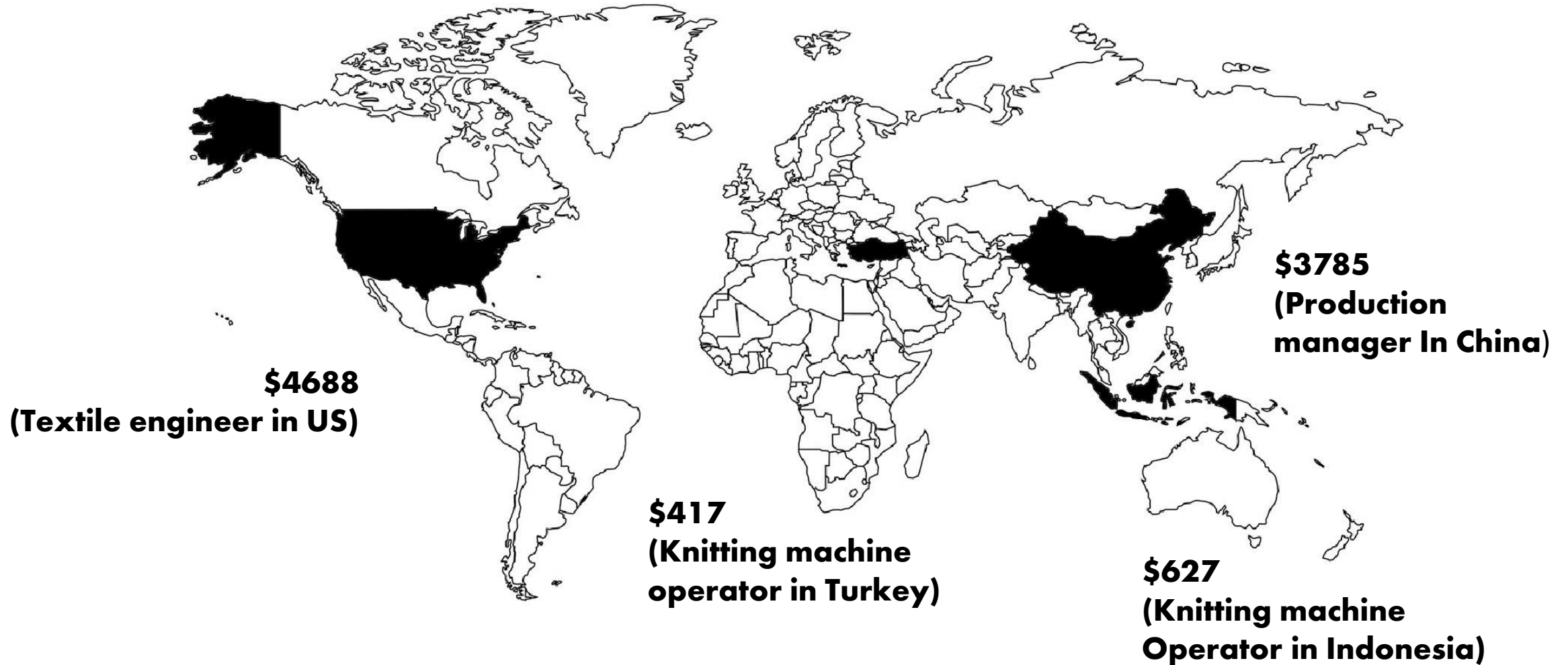
Natural Fabrics

Wool

- Naturally wicks away moisture, water repellent, can absorb almost one-third of its own weight in water
- Ignites at a higher temperature than cotton and some synthetic fibers, making it ideal for safety garments (e.g. firefighter, soldiers)
- Stains/soils easily

Fabric

Who: Knitting Machine Operator, Production Worker, Loom Operator, Production Manager, Textile Engineer



Step 4

Finishing

Once fabric is produced, it goes through a variety of finishing processes, including washing, dyeing/printing, antibacterial/anti-odor treatment, water repellency, anti-wrinkling, and fire retardance.

1. Washing

- Removes dirt from manufacturing process
- Bleaching removes all natural color from fabric to prepare for dyeing
- Mercerization increases fiber strength and make fabric shinier

2. Dyeing (transferring color to fabric)

- To ensure colorfastness, dyed fabric or yarn washed over and over again in hot water
- About 200 liters of water is used to produce 1 kg of dyed fabric (enough for a single person to drink for over 2 weeks)

3. Printing (design printing)

- Main methods: roller screen printing & heat transfer printing
 - Roller screen printing prints long runs of fabric with the same design
 - Heat transfer printing adds layered designs

4. Anti-bacterial (eliminates bacteria)

- Important as the porous surfaces of textiles tend to hold moisture and heat – an environment conducive to bacterial growth

5. Water Repellency (transferring color to fabric)

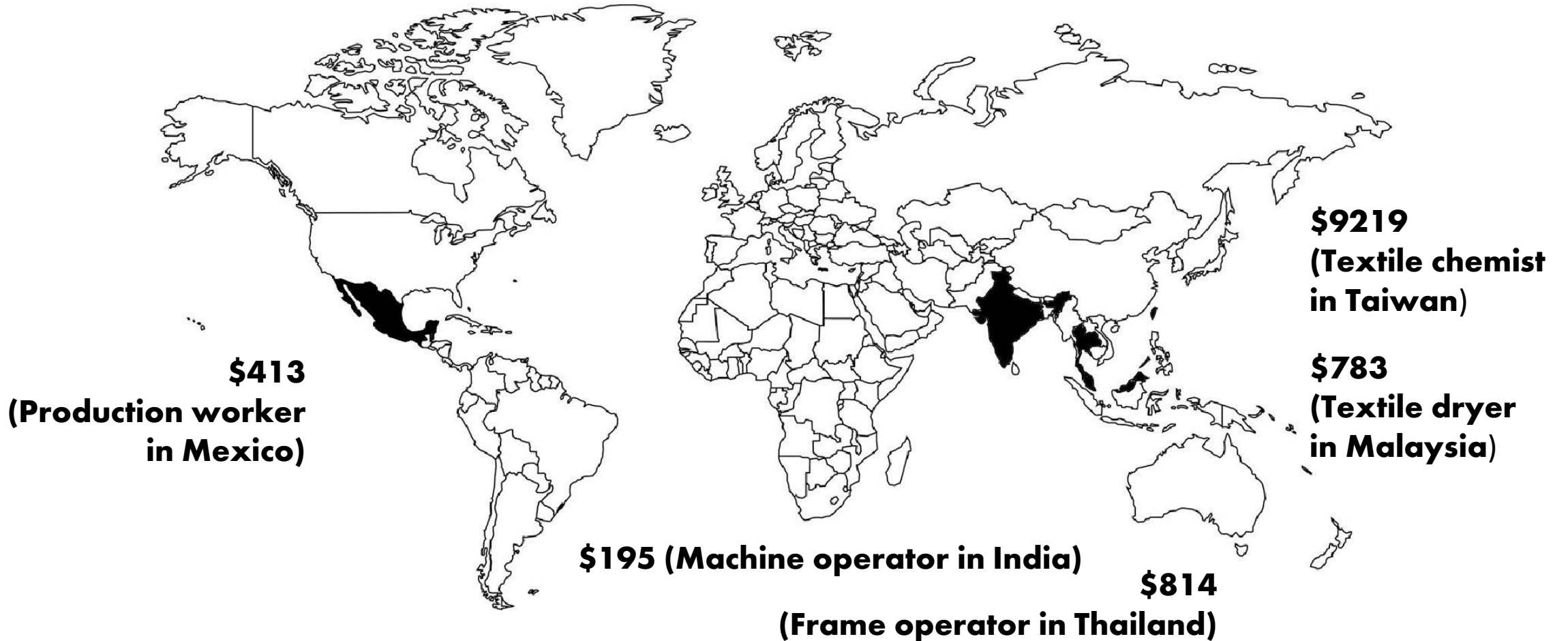
- Coating technology – coated with polymer in the form of a paste or high viscosity fluid
- Laminating technology – forms a laminating layer on the surface of textile material

6. Anti-wrinkling

- Application of DMDHEU (dimethyloldihydroxyethyleneurea)
- Heating the chemical creates a reaction which bonds the molecules of the fabric, keeping them from moving and causing wrinkles

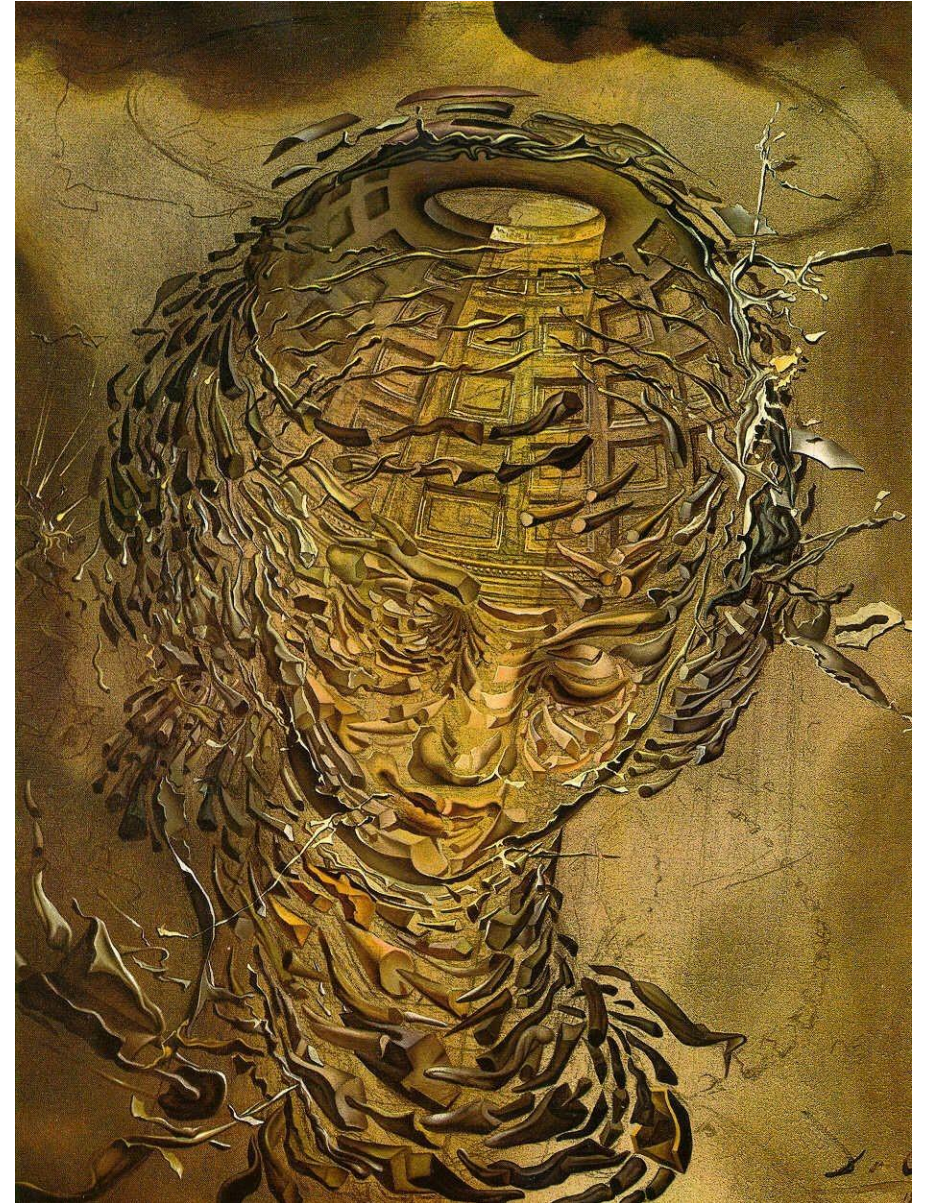
Finishing

Who: Technician, Machine Operator, Production Worker, Framer Operator, Textile Dryer, Chemist



Activity:

Gallery Poster



Raphaelesque Head Exploding (Dalí)

end.

