From Barrel to Blouse

Polyester is the world's most produced fibre — and one of fashion's quietest fossil-fuel pipelines. Every year, the industry turns roughly **73–79 million tonnes** of polyester into clothing, bedding, and packaging. Behind that volume sits a petrochemical chain that begins in the oilfields.

Polyester is made from two refinery-derived chemicals: **ethylene glycol** and **purified terephthalic acid**. When you trace these molecules back to their source, the picture sharpens. Even with conservative industrial averages, producing the world's polyester requires the crude-oil equivalent of **500–550 million barrels every year**.

The chemistry is simple. Let (P) be global polyester production, and let (a), (b), (c), and (d) represent the feedstock and crude-oil-equivalent factors for polyester's building blocks. The fossil-fuel demand becomes:

$$O_{total} = P \cdot (a \cdot c + b \cdot d)$$

Converted into barrels:

$$Barrels_{polyester} = O_{total} \cdot 7.3$$

This is the part of the fashion system that never appears on a care label: the steady conversion of crude oil into clothing. Polyester is not just made with fossil fuels — it *is* fossil fuel, re-engineered into fibre.

From Barrel to Blouse:

The Fossil Chain Behind Polyester

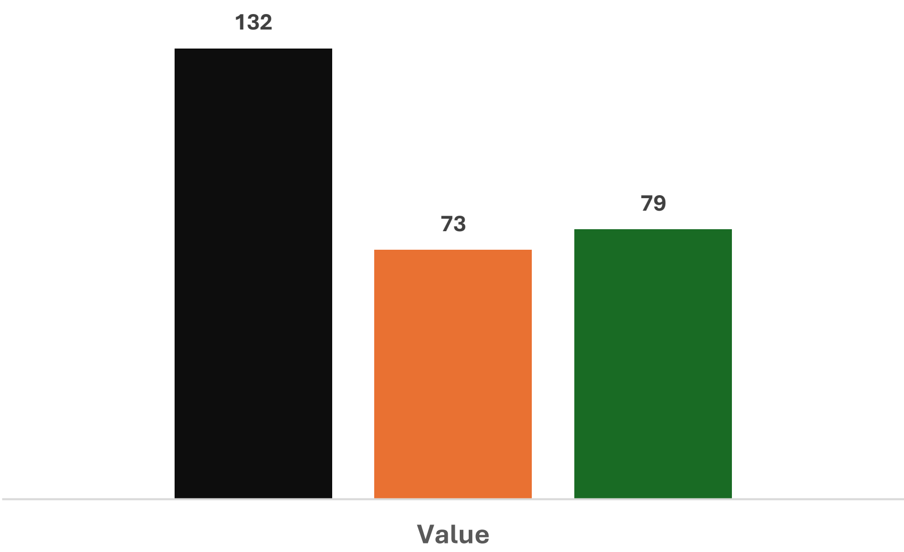
1. Introduction

Polyester is the most produced textile fibre on Earth, yet its origins remain largely invisible to the public. This report traces polyester back to its source: the crude oil extracted from the world's oilfields. By following the chain from barrel to blouse, we reveal the petrochemical architecture that underpins the global fashion system. The analysis combines global fibre production data, industrial chemistry, and a transparent crude-oil-equivalent model to quantify polyester's fossil-fuel demand.

2. Global Polyester Production

The latest global fibre production figure stands at approximately **132 million tonnes per year**. Polyester consistently accounts for **55–60%** of this total, making it the dominant fibre across apparel, home textiles, and technical applications. Applying this share yields a structurally defensible annual polyester volume of **73–79 million tonnes**. This range forms the foundation for the crude-oil-equivalent model developed later in the report.

Figure 1. Global Polyester Production (Annual Volume Range)



A bar chart showing total global fibre production at **132 million tonnes**, with a highlighted segment representing polyester's **73–79 million-tonne** share. The polyester segment is presented as a range band to preserve methodological transparency and avoid false precision. The chart visually communicates polyester's dominance within the global fibre system and establishes the scale of the fossil-fuel dependency quantified in subsequent sections.

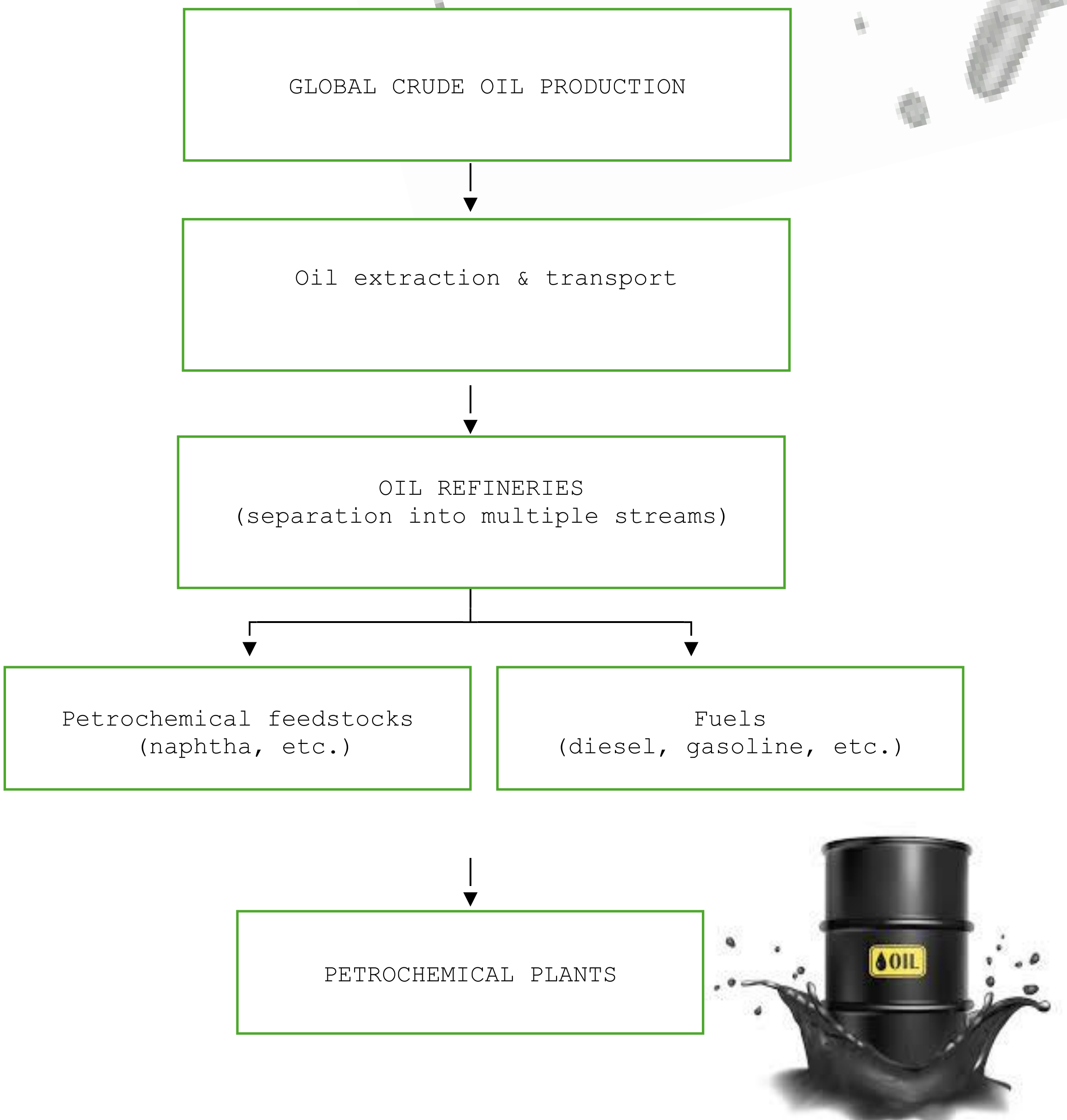
3. Polyester as a Petrochemical Product

Polyester (polyethylene terephthalate, PET) is synthesised from two petrochemical intermediates: **ethylene glycol (EG)** and **purified terephthalic acid (PTA)**. Both originate in the refinery system. EG is produced from ethylene, typically derived from naphtha cracking, while PTA is produced from paraxylene, itself refined from crude-oil fractions. Polyester is therefore not merely "made using fossil fuels"; it is chemically constructed from fossil-fuel molecules.

This petrochemical origin is often invisible to consumers, yet it is central to understanding polyester's environmental and material footprint. The diagram that follows makes this chain visible, mapping the journey from crude oil to fibre.

Figure 2 visualises the structural pathway from crude oil to polyester fibre. Crude oil is refined into petrochemical feedstocks, which are transformed into ethylene glycol and purified terephthalic acid — the two molecular building blocks of polyester. These intermediates are polymerised into PET and spun into fibre. The diagram makes visible the fossil-fuel architecture that underpins the global dominance of polyester.

Figure 2. The Fossil Chain Behind Polyester



4. Feedstock Requirements and Stoichiometry

The polymerisation of PET requires EG and PTA in defined mass ratios. Industrial life-cycle inventories typically report approximately 0.33 tonnes of EG and 0.85 tonnes of PTA per tonne of PET produced. These values include process inefficiencies and are used here as placeholders pending substitution with eco-invent-derived figures.

Let (P) denote global polyester production in tonnes per year. Let (a) and (b) represent the feedstock requirements for EG and PTA respectively. The total annual demand for each feedstock is therefore:

$$M_{EG} = \mathrm{P} \cdot \mathrm{a}$$

$$M_{PTA} = \mathrm{P} \cdot \mathrm{b}$$

These expressions quantify the petrochemical inputs required to sustain global polyester production.

5. Crude-Oil-Equivalent Model

To understand polyester's true fossil-fuel footprint, the model traces EG and PTA back to the crude oil required to produce them. Let (c) and (d) denote the crude-oil-equivalent factors for EG and PTA respectively, expressed as tonnes of crude oil per tonne of feedstock. The total crude-oil-equivalent demand for polyester is then:

$$O_{total} = P \cdot (a \cdot c + b \cdot d)$$

To express this in barrels, the model uses a standard conversion factor of 7.3 barrels per tonne of crude oil:

$$B_{polyester} = O_{total} \cdot 7.3$$

This equation forms the core of the methodology used to quantify polyester's fossil-fuel demand.

6. Numerical Worked Example:

Using the polyester production range of 73–79 million tonnes per year, and placeholder values of $(a = 0.33)$, $(b = 0.85)$, and $(c = d = 0.8)$, the combined crude-oil-equivalent factor becomes:

$$a \cdot c + b \cdot d = 0.33 \cdot 0.8 + 0.85 \cdot 0.8 = 0.944$$

The resulting crude-oil-equivalent demand for polyester lies between:

$$O_{total,min} = 73 \cdot 0.944 = 68.9\text{Mt crude/year}$$

$$O_{total,max} = 79 \cdot 0.944 = 74.6\text{Mt crude/year}$$

Converted into barrels:

$$Barrels_{min} = 68.9 \cdot 7.3 \approx 503\text{million barrels/year}$$

$$Barrels_{max} = 74.6 \cdot 7.3 \approx 545\text{million barrels/year}$$

Even with conservative placeholders, polyester production is associated with approximately 500–550 million barrels of crude oil annually. This represents a significant, structurally embedded fossil-fuel demand within the global fashion system.

7. The Fossil Chain:

Every polyester garment begins in the oilfields. Out of the roughly 37 billion barrels of crude oil produced each year, a portion is diverted into refinery streams that feed the petrochemical sector. From these streams come the molecules that form polyester's backbone: ethylene glycol and terephthalic acid. These intermediates are synthesised, purified, reacted, and polymerised into PET, which is then spun into fibre and woven into fabric. When the numbers are traced through this chain, the scale becomes clear: global polyester production carries a fossil-fuel burden of roughly half a billion barrels of crude oil every year. This is the hidden architecture of synthetic fashion — a continuous conversion of geological carbon into textile form.

8. Conclusion

Polyester's dominance in the global fibre economy is inseparable from its dependence on crude oil. By quantifying this dependence through a transparent, equation-driven model, this report exposes the structural link between fashion and fossil-fuel extraction. The methodology is designed to be updated as more precise life-cycle data becomes available, ensuring that the fossil-fuel footprint of polyester can be communicated with both scientific integrity and public clarity.

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