Matra

"Taking apart today, building tomorrow"

Patriots - Team 52 (OH,USA)

Executive Summary

Modern Clothing is made from a large assortment of materials, but the largest percentage of the clothing, on a global scale, comes from synthetic sources. This contributes greatly to the global plastic problem, with synthetic materials making up over 30 percent of all macroplastic waste. Another major problem is the existence of AI datacenters (Boston University, 2022), which are energy vacuums. These centers are using around 90 terawatt-hours of energy on an annual basis, much of which is drained through the cooling and temperature regulation. These problems were what we aimed to address with **Matra** (Nature, 2025). **Matra** will use the discarded synthetic clothing materials from the retail industry to make high-value tech products like insulation to make a real-world impact on sustainability.

Figure 1. Schematic visual of two-pronged approach to sustainability with textile waste

Process Description

Figure 2. Matra uses AI sorting, CRISPR enzymes, and solvent-free extrusion to upcycle textiles, enhanced by self-healing coatings and digital tracking for smart, circular manufacturing.

We pair the versatility of an AI sorting algorithm with the sustainability of breaking down harmful chemicals using enzymes such as peroxidase and lipase. Leveraging novel technologies such as Solvent-Free Reactive Extrusion (SRE) and Flash Joule Heating means that we can then turn the clothing into a higher-value product of graphene aerogels, used for insulation panels. The issue of server facility cooling is rapidly growing along with the expansion of AI. Our solution, graphene aerogels, would reduce reliance on external energy sources for cooling, which is highly cost-efficient and beneficial for the environment.

Novel Technologies

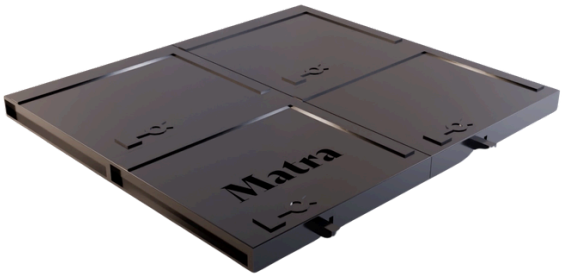

Figure 3. Matras Insulation Panel formed by aerogels and encapsulated in materials like aluminum foil or polymer laminates for durable, high-performance insulation panels.

Figure 4. Repurposing waste into high-surface-area water purification membranes that filter out heavy metals, microplastics, and organic pollutants. These membranes are lightweight, durable, and biodegradable—offering a sustainable alternative to conventional plastic-based filtration systems.

Matra's innovation is our ultra-lightweight, high-performance graphene aerogel insulation panels, which are made from recycled clothing. We extract carbon from textile waste, turn it into graphene oxide, and form a gel that's freeze-dried and chemically reduced to yield a porous, thermal insulating aerogel. The aerogel is then encapsulated in a thin protective envelope—such as aluminum foil or fire-resistant material—to ensure durability, moisture resistance, and thermal stability. The result is an environmentally friendly, inexpensive panel ideal for the cooling of electronics and data centers, reducing the energy needs while giving textile waste a second life in high-tech uses.

Market Research and Target

AI in Manufacturing Market

Expected to reach over $20 billion by 2028, offering opportunities for tech-enabled circularity.

Consumer Trends

73% of Gen Z prefers sustainable brands, with 62% willing to pay more.

Corporate Investments

Companies like Patagonia and Adidas are heavily investing in sustainable materials.

B2B Opportunities

Industries like construction and electronics seek high-performance sustainable materials.

Textile Recycling Market

Projected to exceed $10 billion by 2027, driven by sustainability demand and regulations.

Sources from (Markets and Markets, 2023), (Global News Wire, 2024), and (Yahoo Finance, 2023)

Figure 5. Highlighting strong market demand for sustainable, tech-driven manufacturing. It shows growth in AI and textile recycling markets, rising Gen Z preference for eco-friendly brands, and corporate investment in sustainable materials—all supporting Refebrix's opportunity space.

Business Model

Refebrix has a twin business model: B2C, where it markets sustainable clothes made from recycled products to green consumers, and B2B, where it sells high-performance products like graphene aerogels to manufacturing industries. It earns revenues through direct sales and technology licensing.

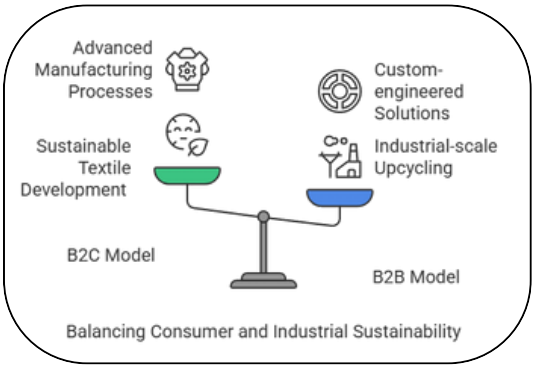

Figure 6. Schematic representation of our dual-system business model, which incorporates B2B and B2C.

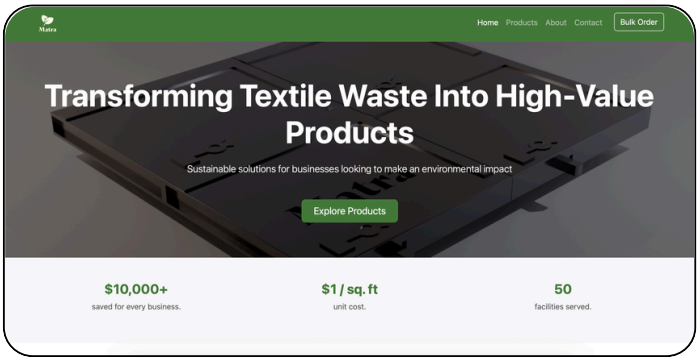

Figure 7. Our product interface offers a seamless experience, allowing customers to browse sustainable textiles, insulation panels, and water purification membranes.

Financials

Year	Tons Processed	Revenue per Ton ($)	Gross Revenue ($)	Material Cost ($)	Labor Cost ($)	Energy Cost ($)	Maintenance ($)	Logistics ($)	R&D and Ops ($)	Total Cost ($)	Net Revenue ($)	YoY Growth (%)
2,025	4,750	45	215,460	42,750	57,000	27,550	17,100	22,200	72,000	257,688	-42,228	—
2,026	6,900	46	320,436	62,100	80,400	39,690	24,600	31,980	72,000	335,632	-15,196	48.72%
2,027	9,300	49	451,980	83,700	106,200	53,460	33,150	43,140	72,000	423,982	27,998	41.05%
2,028	12,200	51	619,272	109,800	139,800	70,110	43,560	56,760	72,000	532,392	86,880	37.01%
2,029	15,700	54	847,800	149,150	179,550	91,030	56,520	73,590	72,000	671,587	176,213	36.90%
2,030	19,800	56	1,111,968	198,000	225,720	114,840	72,120	93,960	72,000	838,771	273,197	31.17%
2,031	24,600	58	1,434,672	258,300	282,000	142,290	90,450	117,000	72,000	1,039,032	395,640	29.00%
2,032	30,200	60	1,826,496	332,200	351,300	177,140	112,740	145,200	72,000	1,286,026	540,470	27.33%
2,033	36,500	63	2,272,260	420,750	433,200	218,850	139,650	179,400	72,000	1,580,958	691,302	25.18%
2,034	43,700	65	2,831,760	524,400	528,000	266,400	170,430	219,000	72,000	1,922,648	909,112	23.84%

Figure 8: Starting with 4,750 tons and $215K in revenue in Year 1, Matra scales to 43,700 tons and $2.83M by Year 10. We operate at a loss for two years, break even in Year 3 with $28K in net revenue, and exceed $900K in annual profit by Year 10. Fixed R&D and proportional operating costs support a stable, scalable financial model.

Model	Strength	Limitations	Matra ☆
Patagonia, Sustainable apparel	Provides historical economic insights and long-term projections.	Lacks real-time adaptability; does not consider social factors	Refebrix goes beyond using recycled inputs — it creates them.
Rencewell, Textile-to-textile pulp (Circulose®)	Patented recycling process, fashion partnerships	No consumer brand, no advanced material R&D	MATRA is modular, enabling multiple high-value outputs
Worn Again, Chemical Recycling of Textiles	Focus on circular systems, strong IP	Primarily B2B, slow to commercial launch	Refebrix's AI + enzymatic stack is designed for scalability
MycoWorks, Alternative materials (mycelium)	High-performance, sustainable, leather like materials	Niche focus, not textile based	MATRA handles a wide range of textile waste streams and outputs multiple material classes

References

1. Tournier, Virginie, et al. "An Engineered PET Depolymerase to Break Down and Recycle Plastic Bottles." *Nature*, vol. 580, no. 7802, 2020, pp. 216–219. [PMC](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7710609/).
2. Singh, Monika, et al. "An Overview into Polyethylene Terephthalate (PET) Hydrolases and Their Role in PET Degradation." *Polymers*, vol. 14, no. 21, 2022, p. 4631. [PMC] (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9603852/).