WASTE PLASTIC TO FUEL

TECHNOLOGY CATALOGUE

Engineering Waste into Sustainable Energy

Poly Transform Knowledge Series

CHAPTER 1

TRANSFORM

“Every discarded material still possesses hidden value.”

Unlocking value from materials once considered waste.

POLY TRANSFORM • KNOWLEDGE SERIES

POLY TRANSFORM PRINCIPLE #1

Waste is Opportunity

Every material has value. Through scientific thinking and responsible engineering, materials once considered waste can become valuable resources that contribute to a cleaner and more sustainable future.

Executive Summary

From Waste Management to Resource Recovery

Plastic waste is one of the defining environmental challenges of our time. While recycling remains an important solution, significant quantities of post-consumer plastics cannot be economically recycled through conventional methods. These materials often accumulate in landfills or are disposed of through environmentally undesirable practices.

Poly Transform is developing a Waste Plastic to Fuel (WPTF) technology that applies controlled thermochemical conversion to recover valuable hydrocarbon fractions from selected non-recyclable plastics. Rather than viewing plastic solely as waste, our approach recognizes it as a recoverable energy resource.

Our objective is to develop a scientifically validated and commercially scalable process that contributes to resource recovery, supports circular economy principles, and creates liquid fuel suitable for further evaluation for transportation and industrial applications, subject to applicable standards and validation.

Technology Snapshot

Parameter	Description
Technology	Waste Plastic to Fuel
Stage	Research & Technology Development
Feedstock	Selected Non-Recyclable Plastics
Process	Thermochemical Conversion
Primary Outputs	Liquid Fuel • Process Gas • Carbon Residue
Long-Term Vision	Sustainable Resource Recovery

🟠 **ENGINEERING INSIGHT**

Waste should not be viewed solely as a disposal challenge. Through engineering and scientific validation, selected waste streams can become valuable industrial resources.

🟣 **DID YOU KNOW?**

Most conventional plastics originate from petroleum-derived hydrocarbons. Through carefully controlled thermochemical conversion, selected plastic materials can be transformed back into valuable hydrocarbon products, supporting resource recovery and circular economy objectives.

The Global Plastic Challenge

Plastics have transformed modern industries through their versatility, durability, and affordability. However, these same characteristics create significant challenges once plastic products reach the end of their useful life. Increasing volumes of plastic waste continue to accumulate in landfills and the environment, placing pressure on waste management systems worldwide.

While mechanical recycling remains an essential component of sustainable waste management, many plastic materials are contaminated, degraded, or mixed with other polymers, limiting their suitability for conventional recycling. These materials require complementary solutions capable of recovering value while minimizing environmental impact.

Waste Plastic to Fuel technology represents one such complementary approach, converting selected non-recyclable plastic streams into valuable hydrocarbon products through controlled thermochemical processes.

Plastic Production → Consumption → Waste Generation → Engineering Opportunity → Resource Recovery → Circular Economy

🟢 **SUSTAINABILITY INSIGHT**

Waste Plastic to Fuel is intended to complement recycling — not replace it. Recycling should always remain the preferred option for clean, recyclable plastics, while resource recovery technologies provide additional pathways for difficult-to-recycle materials.

🟣 **DID YOU KNOW?**

Global plastic production now exceeds 400 million tonnes each year, making effective waste management one of the world's most significant environmental and engineering challenges.

Why Existing Solutions Are Not Enough

Existing Practice	Limitation
Landfill Disposal	Permanent loss of recoverable resources
Open Burning	Air pollution and greenhouse gas emissions
Incineration	Energy recovery but limited material recovery
Mechanical Recycling	Limited by contamination and mixed plastic streams

The Poly Transform Approach

Poly Transform's Waste Plastic to Fuel technology is designed to complement existing waste management systems by providing an additional pathway for recovering value from selected non-recyclable plastic materials. Through controlled thermochemical conversion, the process aims to transform difficult-to-recycle plastics into useful hydrocarbon products while supporting responsible resource recovery and circular economy principles.

> 🟡 **INDUSTRY INSIGHT**
>
> *Future waste management systems are expected to combine recycling, resource recovery, and advanced engineering solutions to maximize material value while reducing environmental impact.*

> 🟣 **DID YOU KNOW?**
>
> *Mechanical recycling remains the preferred option for clean, recyclable plastics. Waste Plastic to Fuel technologies are intended for selected plastic streams that cannot be effectively managed through conventional recycling methods.*

CHAPTER 2

ENGINEER

"Engineering transforms ideas into solutions that create value."

Designing technologies that convert scientific understanding into practical systems for sustainable resource recovery.

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POLY TRANSFORM PRINCIPLE #2

Innovation with Purpose

Technology should solve meaningful problems through scientific understanding, engineering excellence, and responsible implementation.

CHAPTER 2 — ENGINEER

Engineering Value from Plastic Waste

Every engineering innovation begins by redefining a challenge. Poly Transform views non-recyclable plastic not merely as waste, but as a valuable hydrocarbon resource that can be scientifically recovered through controlled thermochemical conversion. Our development philosophy combines material science, process engineering, laboratory validation, and continuous optimization to create technologies that are practical, scalable, and environmentally responsible.

Rather than focusing solely on waste disposal, we focus on resource recovery — maximizing value from materials while supporting circular economy principles.

The Four Engineering Pillars

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Scientific Research

Laboratory-driven understanding of materials and reactions.

⚙️

Process Engineering

Designing stable, efficient, and repeatable conversion systems.

✅

Continuous Validation

Testing, analyzing, and improving every stage of development.

🌱

Sustainable Innovation

Balancing industrial performance with environmental responsibility.

Poly Transform laboratory-scale thermochemical conversion system under development.

🟠 **ENGINEERING INSIGHT**

Engineering excellence is achieved through continuous refinement — not one-time invention.

🟣 **DID YOU KNOW?**

Many modern engineering breakthroughs result from optimizing existing scientific principles rather than discovering entirely new ones.

Understanding the Feedstock

Feedstock is the foundation of every successful Waste Plastic to Fuel process. Different plastics possess unique molecular structures that influence thermal behaviour, hydrocarbon composition, and conversion characteristics. Careful feedstock selection and preparation are therefore essential for achieving stable operation and consistent product quality.

Accepted Feedstock

Material	Description
HDPE	High-density polyethylene
LDPE	Low-density polyethylene
PP	Polypropylene
PS	Polystyrene
PVC	Potential chlorine-containing compounds
PET	Polyethylene Terephthalate

Materials Requiring Exclusion

Material	Reason
Glass	Non-processable
Metals	Equipment protection
Organic Waste	Moisture and contamination
Biomedical Waste	Safety and regulatory concerns

🟠 **ENGINEERING INSIGHT**

The quality of the output begins with the quality of the feedstock.

🟣 **DID YOU KNOW?**

Even plastics that appear visually similar may behave very differently during thermochemical conversion because of differences in polymer chemistry.

Preparing the Material

Collection → Sorting → Cleaning → Drying → Size Reduction → Prepared Feedstock

Feed preparation is a critical engineering stage that directly influences operational stability and conversion efficiency.

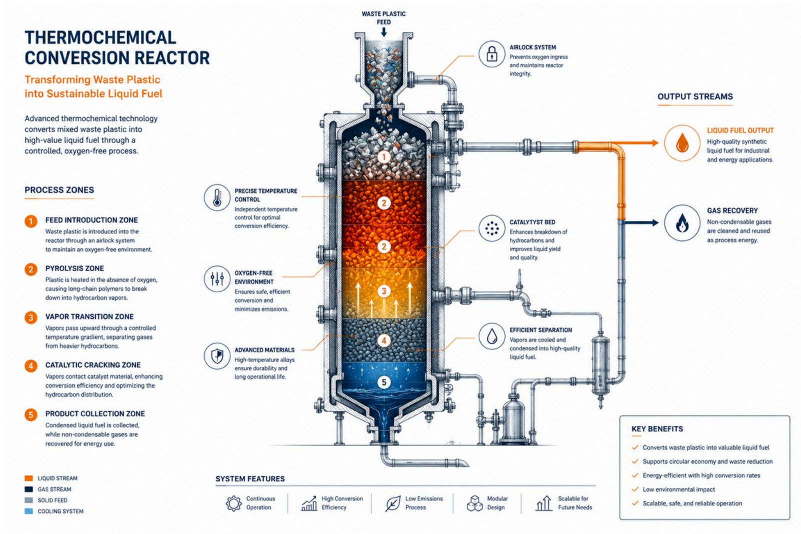
Removing contaminants, reducing moisture, and ensuring a consistent particle size improve heat transfer, reduce operational variability, and support repeatable processing conditions.

Although often overlooked, this stage establishes the foundation for reliable reactor performance and consistent fuel characteristics.

> 🟠 **ENGINEERING INSIGHT**
> *Stable reactor performance begins long before the material enters the reactor.*

> 🟣 **DID YOU KNOW?**
> *Particle size distribution can influence heat transfer and decomposition behaviour during thermochemical conversion.*

Waste Plastic to Fuel Process



The Poly Transform Waste Plastic to Fuel process is based on controlled thermochemical conversion carried out in an oxygen-limited environment. Selected plastic materials are converted into hydrocarbon-rich vapours, which are then condensed and processed to recover liquid fuel, while additional process outputs — combustible process gas and carbon residue — are collected for further evaluation.

Process Objectives

♻️ **Resource Recovery** Recover value from selected non-recyclable plastics.	🎛️ **Controlled Processing** Maintain stable operating conditions through engineering controls.	🔬 **Scientific Validation** Support development with laboratory testing and analytical methods.	📈 **Future Scalability** Design systems with long-term industrial implementation in mind.

🟠 **ENGINEERING INSIGHT**

Every stage of the process contributes to efficiency, product quality, operational reliability, and future scalability.

🟣 **DID YOU KNOW?**

Unlike combustion, thermochemical conversion operates in a controlled oxygen-limited environment, allowing plastics to decompose into hydrocarbon vapours instead of burning directly.

CHAPTER 3

VALIDATE

“Trust is earned through evidence — not assumption.”

Proving performance through rigorous testing, data, and scientific rigor.

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POLY TRANSFORM PRINCIPLE #3

Validation Creates Trust

Every technology earns confidence through testing, analysis, transparency, and continuous improvement. Scientific validation transforms promising ideas into reliable engineering solutions.

Products Generated

Controlled thermochemical conversion produces multiple output streams, each representing a potential resource rather than a waste product. While the primary objective of the Poly Transform process is the recovery of liquid fuel, additional outputs generated during conversion may also contribute to overall process efficiency and future resource utilization.

The characteristics of each output depend on feedstock composition, operating conditions, and process optimization, and continue to be evaluated through ongoing research and laboratory validation.

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Liquid Fuel

Hydrocarbon-rich liquid fuel obtained through vapour condensation. Properties under ongoing characterization.

🔥

Process Gas

Combustible gaseous fraction with potential for internal energy recovery and process optimization.

⚫

Carbon Residue

Solid carbon-rich residue; further characterization underway for future utilization.

🟠 **ENGINEERING INSIGHT**

Efficient resource recovery considers the value of every process output — not only the primary product.

🟣 **DID YOU KNOW?**

Many thermochemical conversion technologies are designed to maximize overall resource recovery by utilizing multiple product streams.

CHAPTER 3 — VALIDATE

Understanding the Recovered Fuel

Fuel Property Dashboard

Property	Status
Appearance	Laboratory Evaluation
Density	Under Validation
Viscosity	Under Validation
Flash Point	Planned Testing
Calorific Value	Planned Testing
Sulphur Content	Planned Testing

(Values to be updated as laboratory testing progresses.)

The recovered liquid fuel undergoes laboratory characterization to better understand its physical and chemical properties. These analyses provide valuable information regarding process consistency, product quality, and opportunities for further optimization.

As technology development progresses, additional testing will continue to support scientific validation and future application assessments.

🔵 **RESEARCH OBSERVATION**

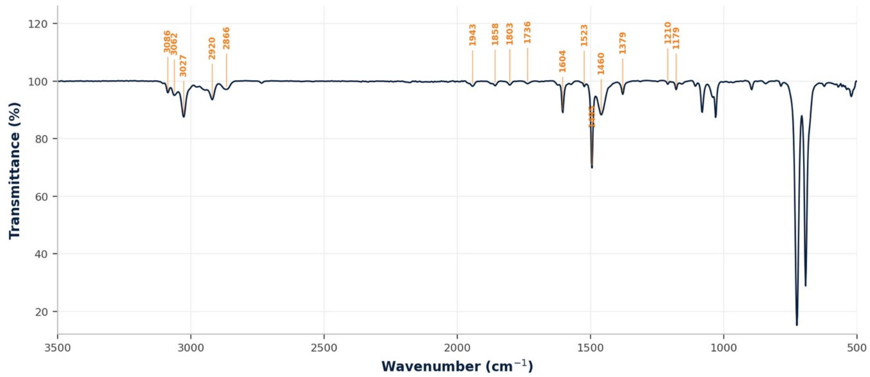
Fuel characterization is a continuous process. Each laboratory analysis contributes to a deeper understanding of product quality and supports ongoing technology refinement.

🟣 **DID YOU KNOW?**

Fuel properties can vary depending on feedstock composition, operating conditions, and post-processing methods.

Scientific Validation Through FTIR Analysis

Fourier Transform Infrared Spectroscopy (FTIR) was performed on three recovered liquid fuel samples (Sample-1, Sample-2, Sample-3) to identify molecular functional groups and support ongoing scientific validation of the Waste Plastic to Fuel process. A representative spectrum and consolidated peak extract are presented below; the full analytical dataset is retained on file.



FTIR transmittance spectrum — Sample-1 (representative recovered liquid fuel sample).

Key Peak Extract — Sample-1

Peak (cm^{-1})	Likely Assignment
3086.21	Aromatic / olefinic =C–H stretching
3061.74	Aromatic / olefinic =C–H stretching
3026.66	Aromatic / olefinic =C–H stretching
2919.56	Aliphatic C–H stretching (CH_3 / CH_2 groups)
2865.86	Aliphatic C–H stretching (CH_3 / CH_2 groups)
1736.06	C=O stretching (carbonyl — minor oxygenated fraction)
1604.18	C=C stretching (aromatic ring / olefinic)
1494.87	Aromatic ring skeletal C=C stretching
1378.86	CH_3 symmetric bending (umbrella deformation)
1209.86	C–O stretching / aromatic C–H in-plane bending

🔵 **COMPARATIVE SUMMARY**

Sample-1 shows a rich profile combining aliphatic C–H stretching (2919, 2865 cm^{-1}), aromatic =C–H stretching (3086–3027 cm^{-1}), and a minor carbonyl band (1736 cm^{-1}). Sample-2 and Sample-3 exhibit progressively cleaner, more saturated hydrocarbon spectra with weaker aromatic signatures, consistent with expected variation in feedstock composition and process conditions across batches.

Creating Value Through Resource Recovery

Resource recovery technologies contribute to sustainable waste management by extending the useful life of materials that would otherwise be discarded. When integrated responsibly alongside recycling and waste reduction strategies, Waste Plastic to Fuel technologies have the potential to support circular economy objectives while reducing reliance on landfill disposal. Poly Transform views environmental responsibility as a core engineering objective throughout the technology development process.

Plastic Waste → Resource Recovery → Energy Products → Industrial Utilization → Reduced Landfill → Circular Economy

> 🟢 **SUSTAINABILITY INSIGHT**
>
> *The most sustainable waste is the waste that never exists. Resource recovery complements reduction and recycling by providing additional options for materials that remain difficult to recycle.*

> 🟣 **DID YOU KNOW?**
>
> *Circular economy strategies aim to keep materials in productive use for as long as possible, reducing dependence on virgin resources.*

CHAPTER 4

IMPACT

"The true measure of technology is the positive impact it creates for society."

Transforming engineering innovation into environmental and industrial value.

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POLY TRANSFORM PRINCIPLE #4

Progress Through Persistence

Meaningful innovation is achieved through disciplined research, continuous improvement, and the determination to transform promising ideas into practical solutions.

CHAPTER 4 — IMPACT

Where Can This Technology Create Value?

The primary objective of Poly Transform's Waste Plastic to Fuel technology is to recover value from selected non-recyclable plastics through controlled thermochemical conversion. As research and validation progress, the recovered liquid fuel may be evaluated for potential use across transportation, industrial, and energy-related applications, subject to laboratory testing, regulatory requirements, and applicable quality standards.

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Transportation

Potential evaluation for transportation applications following testing and compliance.

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Industrial Heating

Potential use as an energy source in industrial thermal processes.

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Power Generation

Future evaluation for stationary power generation systems.

🔬

Research & Development

Fuel characterization, process optimization, and academic collaboration.

🟡 **INDUSTRY INSIGHT**

The value of an engineering technology lies not only in what it produces, but also in the industries it enables.

🟣 **DID YOU KNOW?**

Many waste-to-resource technologies initially begin as research platforms before evolving into commercial industrial solutions.

CHAPTER 4 — IMPACT

Creating Industrial Value

The global transition toward circular economy practices is creating increasing demand for technologies capable of recovering value from difficult-to-recycle materials.

Poly Transform's technology platform is being developed with long-term industrial scalability in mind, creating opportunities for collaboration with municipalities, waste management organizations, research institutions, and industrial partners.

Future commercialization pathways may include technology licensing, engineering services, collaborative research, pilot plant deployment, and strategic partnerships.

Market Opportunities

- Municipal Waste Management
- Industrial Waste Generators
- Petrochemical & Energy Sector
- EPC & Engineering Companies
- Research Institutions
- Sustainability Projects

🟡 INDUSTRY INSIGHT

Successful commercialization depends on technology performance, regulatory compliance, economic viability, and strong industrial partnerships.

🟣 DID YOU KNOW?

Circular economy investments are growing worldwide as industries seek sustainable resource management solutions.

Technology Development Journey

Research → Lab Validation → Prototype → Pilot Demo → Commercial Validation → Deployment → Licensing

Technology development is a continuous journey built upon research, testing, engineering refinement, and collaboration.

Poly Transform's roadmap reflects a structured approach toward advancing Waste Plastic to Fuel technology from laboratory research to industrial implementation while maintaining scientific integrity and responsible engineering practices.

Each milestone represents not only technical progress but also increased confidence in the technology's long-term potential.

> 🔵 **RESEARCH OBSERVATION**
> *Robust technologies evolve through iterative validation, continuous learning, and engineering improvement.*

> 🟣 **DID YOU KNOW?**
> *Most successful industrial technologies undergo multiple stages of development before reaching commercial deployment.*

INSPIRE

The future belongs to those who transform today's challenges into tomorrow's solutions.

"Every kilogram of plastic recovered represents more than waste diverted — it represents innovation, engineering, and a commitment to future generations."

Engineering a cleaner future through responsible innovation.

POLY TRANSFORM PRINCIPLE #5

Engineering for Tomorrow

The technologies we develop today should create a cleaner, smarter, and more sustainable world for the generations that follow.

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"Together, let's transform waste into opportunity."

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DEVELOPMENT STATUS

The technologies described in this publication represent Poly Transform Pvt. Ltd.'s ongoing research and development activities. Certain technical characteristics, performance values, and commercial applications remain subject to laboratory validation, engineering optimization, regulatory requirements, and future commercialization milestones.