Closing the loop on unrecyclable plastics: scale-up of SynPet's Thermal Conversion Process from demonstration to commercial deployment

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Abstract

Despite decades of investment in plastic waste management infrastructure, a substantial fraction of post-consumer plastics remains effectively non-recyclable through existing routes. Multi-layer flexible packaging, heavily contaminated streams, post-shredder residues, and mixed household waste present feedstock challenges that conventional pyrolysis and gasification cannot adequately address — due to their sensitivity to feedstock composition, moisture content, and contaminant levels. The result is that millions of tonnes of carbon-rich plastic waste continue to be landfilled or incinerated annually, representing both an environmental burden and a lost feedstock opportunity for the petrochemical industry.

SynPet Technologies has developed the Thermal Conversion Process (TCP®), a patented multi-stage technology that combines water under elevated pressure and temperature with thermal cracking to convert all carbon-containing waste into circular products — without pre-sorting, pre-treatment, or drying. Feedstock flexibility is not a constraint but a core design feature of the process, enabling TCP® to handle the heterogeneous and contaminated plastic streams that existing thermochemical routes consistently struggle with.

The primary output of TCP® is the Circular Naphtha Substitute (CNS®), a premium-grade circular feedstock with a final boiling point of 360 °C — aligned with the maximum acceptable specification for European steam crackers. Unlike conventional pyrolysis oil, CNS® requires no further hydroprocessing or refinery upgrading and can be blended directly into existing naphtha cracker feedstocks, enabling seamless integration into established petrochemical value chains without process modifications on the customer side. Non-condensable gases (NCG) and renewable natural gas (RNG) generated within the TCP® cycle are recovered and routed back into a broader on-site energy recovery system — including gas turbines and heat recovery steam generation — rendering the plant largely self-sufficient in both heat and power.

The scale-up trajectory of TCP® spans over thirteen years of continuous development. A 15-tonne-per-day demonstration plant has been operating near Istanbul since 2016, providing an extended real-world dataset across diverse waste stream compositions, varying operating

conditions, and long-duration continuous runs. This facility serves as the critical bridge between laboratory-scale proof of concept and industrial deployment, generating the process engineering insights — on reactor behaviour, energy integration, product separation, and residue management — that underpin the commercial plant design.

Our first commercial facility is currently under development at the Euroports terminal on the right bank of the Port of Antwerp-Bruges. In June 2026, the project received its environmental and zoning permit — clearing the final regulatory hurdle before construction. The plant is designed to process 250,000 tonnes of untreated mixed plastic waste per year, producing CNS® for direct integration into Europe's largest adjacent petrochemical cluster, with full operation targeted for the second half of 2028.

This presentation addresses the principal engineering challenges encountered during our scale-up journey, the approach taken to manage heterogeneous waste inputs, and the product quality criteria that establish CNS® as a viable direct-blend cracker feedstock. TCP® is positioned as a complementary technology within the advanced recycling landscape — one that targets the plastic waste fractions where mechanical recycling and conventional chemical routes reach their limits, and converts them into a product that re-enters the petrochemical cycle at the highest possible value.