



NET-ZERO INDUSTRIES

MISSION



Project Title	Recycling of Polystyrene
Industry Partner	Polstyvert
Industry Sector	Chemicals & Refining
Technology Pathway (Primary)	Materials Efficiency & Industrial Symbiosis
NIM Pillar	Technology Demonstration
Source	NIM Awards 2024
Description	<p>Polstyvert and its partners are collaborating to build the first ever commercial plant to recycle polystyrene through a dissolution process. The plant will be located in Quebec and will have a capacity of 9,000 T, enabling it to divert 11,000 T of bulky waste from being disposed of in landfills. The recycled resin that is produced will be of high quality and can be repurposed in the manufacturing of insulation panels or packaging materials. This Canadian technology has been patented in over 20 countries and is the sole technology capable of managing heavily contaminated waste, including fire-retardant and pigments. The recycling process is not only the shortest closed-loop process available, but it is also highly energy efficient, lowering GHG emissions by up to 90%. Polstyvert is the owner and developer of the technology and its IP, with partners serving as the plastic trader that will deliver the waste and industrial partner that will utilize the recycled resin. The recycling process involves a patented purification process that is at the core of its uniqueness.</p> <p>Polstyvert markets its technology through licensing sales, with the commercial plant serving as the final phase that will demonstrate the commercial viability of the technology. The plant will then be replicated, resulting in economic spin-offs and worldwide recognition of Canadian owned IP. Polstyvert is seeking operations starting in late 2025.</p>
Innovations Employed	<p>Polystyrene recycling is still very limited due to lack of infrastructure capable to handle the level of contamination of these feedstocks, especially for post-consumer material. This plant would be the first in the world using a combination of patented dissolution and purification processes allowing to treat contaminated feedstock from post-consumer, packaging and construction polystyrene.</p> <p>Since Polstyvert's technology is already proven and tested at demonstration scale, this medium size scale represents a factor of 10 compared to the demonstration plant operated by Polstyvert, which would go from 1 000 tons of polystyrene waste treated a year to about 10 000 tons annually.</p> <p>It will allow to reduce up to 90% the GHG emissions by replacing virgin polystyrene, while providing a high quality resin.</p> <p>This medium size scale plant 40M\$ project as a whole includes local and international industrial partners who will supply the feedstock and buy the high quality recycled resin.</p>
Dimension of Novelty	It was new to the International Market



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Innovation Collaboration

Inhouse: Canada

Intellectual Properties

The development of the dissolution and purification technology used in the project has started in 2012 within Polystyvert's lab leading to series of patented technology granted worldwide and allowing to protect and describe different part of the process toward polystyrene dissolution and purification.

As a company deploying its technology via plant and licencing, Polystyvert's protection strategy combine Patent deployment based on the scientific principle and processes, associated with technical expertise and known how into running such process from off the shelf equipment.

Currently the process is covered with 7 granted Canadian patent (also granted worldwide) and Polystyvert continue to strongly innovate and deposit new IP to protect its process (3 new patent under examination in Canada).

IP Links

Timetable & Progress

The key element of the current stage of the project is to deploy the technology at full commercial scale i.e. TRL 8 and 9.

The project was started in 2012 with the Company creation and first work in laboratory.

Financing (Public/ Private)

Over its growth Polystyvert has received different governmental support such as STDC, TEQ, IAC, PSCE, CanExport grants, benefited from Provincial and Federal R&D tax credit, and BDC convertible loan.

Finance Links

Project Phase TRL

TRL 7

Problems to be Solved and Risks to be Managed

Valued at US\$45B, the global PS markets is pivotal in sectors like packaging, insulation, food and electronics. Sadly, most of this waste is too contaminated for mechanical recycling. Many additives used in current manufacturing (pigment, dye, flame retardant, processing agents) prevent the resin from being efficiently recycled via regular mechanical treatment. In 2022, over 1,350 tons of Styrofoam ended up in US landfills daily, contributing to 25-30% of global landfill space. With our advance purification process, we offer an alternative for contaminated styrenic-based waste. Initially the main risk of the project was centered in the technical ability to treat different source of contamination together to lead to a standardized purified product. This challenge was tackled and demonstrated at demo scale. Nowadays, the project inherent risk lies in the ability to further develop and deploy the purification technology at commercial scale."

Preliminary or Final Results Achieved

The TRL 7 process yields tons scale virgin like recycled polystyrene (rPS) with up to 90% GHG reduction as compared to virgin resin. Equipment were chosen to ensure a continuous process and easy scalability.

Dissolution with a selective solvent facilitates treatment and purification by keeping a low viscosity. Screening and filtration remove most of the insoluble contaminants.



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It may be followed by advanced purification to remove sub-micron solids like graphite, carbon black and odors (Zn, Ca, Ti, Br, polymeric flame retardants, fish odor, PE, PP, etc.). Once solid contaminant free, a non-solvent is added to precipitate PS. Washing steps remove soluble contaminants like lubricants, flame retardants, dyes, residual monomers, oligomers and the smallest polymer chains. The polydispersity index is narrowed which increases the mechanical properties like the melt flow index. The basic purification removes up to 80% of the soluble bromine and the advanced up to 99%.

CO2 Emissions Reduction Potential - Implementation and Future Market

In 2023, 2.3 billion Kg of polystyrene waste ended up into landfills and waterways. Considering solely the scale of our first commercial plant project, there is a potential of above 200 plants deployment worldwide, including 6 in Quebec province.

In our deployment and licencing model, our clients include converters looking to transition to recycled PS, waste collectors seeking contamination solutions, and brand owners interested in circular economies. Our ability to offer solutions for highly contaminated waste and to design compact plants for each of these customer groups, would result in small plants dedicated to local circular economy.

The anticipated figures at the commercial scale shows that the expected GHG emission reductions are 2,071 kgCO₂eq/ton of PS recycled in Quebec. In the uploaded document (Summary LCA-GES Polystyvert.pdf) it is anticipated a cumulative reduction of GHG emission above 500 KT of CO₂ eq by 2036 for the deployment of solely 4 commercial plants in Canada.

Market Positioning

Polystyvert is positioning itself as the leader in the dissolution and purification styrene-based plastic for highly contaminated waste. Polystyvert hold and is continuing to develop the intellectual property of the technology thanks to internal development and partnership through development agreements.

The technology deployment is going through plant construction via joint venture, consortium and operators licencing the technology. Our licence model includes all right to use the underlying IP for commercial purpose, all expertise support from plant project engineering up to plant start up.

The current project of the first Montreal commercial plant is supported via a joint venture between Polystyvert and leader actors in the market of polystyrene in North America. A first licence is also being delivered in Europe for a second plant deployment.

Project Location

Canada

Project & Technology Links

<https://polystyvert.com/en/technology/>