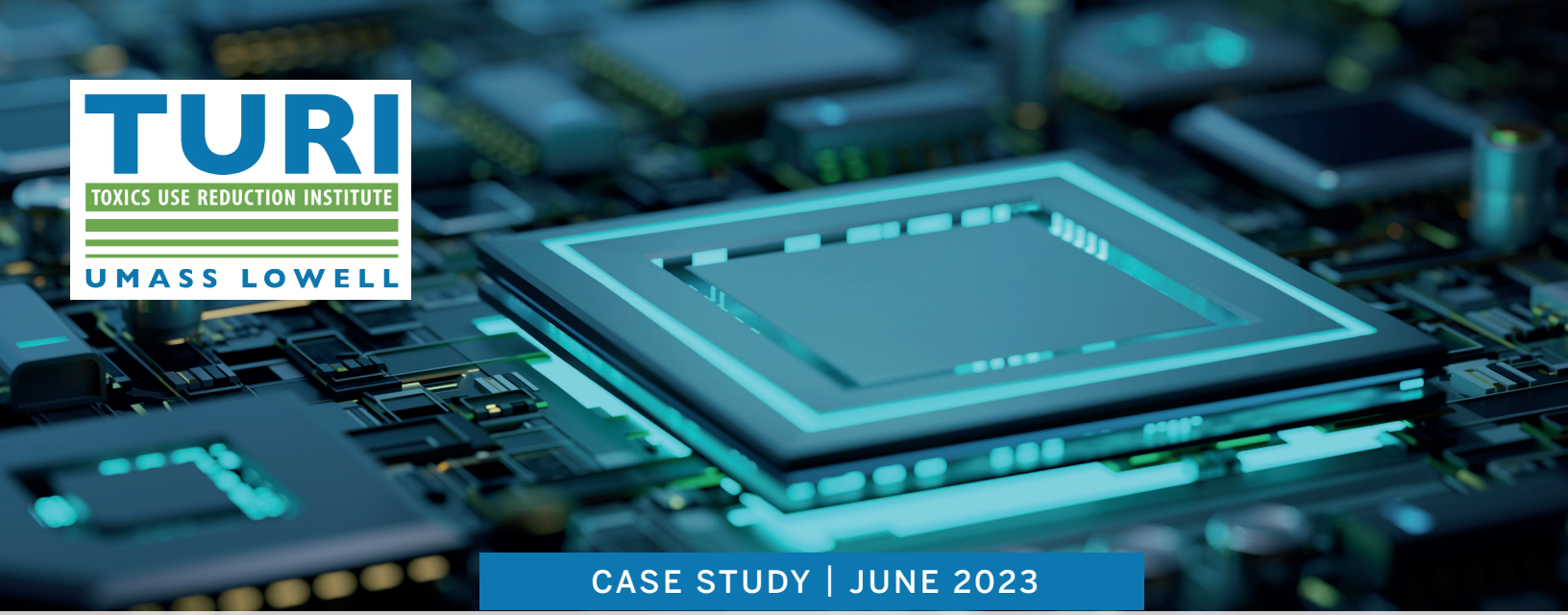

TURI
TOXICS USE REDUCTION INSTITUTE
UMASS LOWELL

CASE STUDY | JUNE 2023

# Transene Company Eliminates its Use of PFAS and Saves Money

TRANSENE COMPANY, INC.


## SUMMARY

**Transene worked with the Toxics Use Reduction Institute (TURI), the Massachusetts Office of Technical Assistance (OTA), and the University of Massachusetts Lowell (UMass Lowell) to find safer alternatives to PFAS for etching in the semiconductor industry. The research, evaluation, and implementation of the safer alternatives took place over an 18-month period and resulted in cost savings, in addition to a healthier environment for employees and customers.**


Transene Company, a manufacturer of advanced materials for the electronics industry, wanted to find viable alternatives to perfluoroalkyl substances (PFAS) use in semiconductor manufacturing in response to customer demands for PFAS-free products. Because PFAS have unique properties that can be difficult to replace, Transene's president, Christopher Christuk, turned to TURI and the University of Massachusetts (UMass) Lowell for help.

PFAS, a class of thousands of chemicals, are often dubbed "forever chemicals" because they never fully break down in the environment. Found in a wide array of consumer and industrial products such as waterproof fabrics, food packaging, dental floss and nonstick cookware, PFAS are associated with numerous health risks, including cancer, liver damage, decreased fertility and increased risk of asthma and thyroid disease.

Surfactants based on PFAS are widely used for etching in the semiconductor industry because they are extremely stable even under strongly acidic and alkaline conditions. Although effective, the toxicity and high persistence of PFAS necessitate their replacement with non-toxic and environmentally friendly alternatives.

## The Challenge

PFAS have unique properties that can be difficult to replace in certain applications. In the specific case of semiconductor production, PFAS provides a remarkable reduction of surface tension, improvement of wetting characteristics, compatibility with alkaline and acidic solutions, heat resistance, chemical inertness, and increased etching efficiency.

When looking to replace PFAS for their customers, Transene had a clear list of requirements that any alternative needed to meet. This included:

- **Compatibility:** Strong acidic/oxidizing solutions—nitric acid and phosphoric acid, among others
- **Performance:** Surface tension reduction should be comparable to what is achieved by PFAS surfactants
- **Effectiveness:** Performs at concentrations below 0.1%
- **Less hazardous and toxic:** Contain no highly hazardous chemicals
- **Stability:** Greater than a one-year shelf life

## The Process

The research, evaluation, and implementation of the safer alternatives took place over an 18-month period, which began when TURI awarded UMass Lowell Prof. Ramaswamy Nagarajan a research grant. The grant funded a research team that worked with Transene and TURI to find and develop viable alternatives to the use of PFAS in this application. They identified safer solutions and performed experiments to compare the properties of the alternatives.

TURI staff and their research partners at UMass Lowell provided the resources and equipment to test the performance of various alternatives against Transene's requirements.

> "This collaboration accelerated our ability to manufacture and sell safer etching products, which helps companies in the electronics supply chain meet new regulatory requirements and protect health and the environment."
>
> **— Christopher Christuk, President of Transene Company**

## Research Approach and Evaluation of Alternatives

After identifying various alternatives that fit the requirements of Transene, the research team evaluated alternatives for toxicity and other potential hazards using TURI's Pollution Prevention Options Analysis System (P2OASys), which allows users to easily compare the relative hazards associated with chemical or process changes. TURI evaluated each of the viable alternatives to ensure that Transene would not be switching to another harmful solution.

Although one chemical alternative ranked as High in terms of its level of hazard, three of the other proposed alternatives fell in the Medium level of hazard according to the P2OASys evaluation, representing a significant improvement over the incumbent PFAS technology. When tested for performance, these replacements performed comparably to PFAS-based formulations, which was verified by the positive user feedback received regarding performance and no reported negative effects on the final products.

| Color | Level of Hazard |
|---|---|
|  | Low (L) |
|  | Medium (M) |
|  | High (H) |
|  | Very High (VH) |

## Benefits and Outcomes

Transene Company provided evaluation samples of the new, safer etching solutions to several of their key customers. After receiving positive test results from their customers, Transene was able to convert customers to the new, safer etching solutions.

Because of TURI's research and innovative solution—designed specifically for Transene—over 90% of their customers in industries such as radio frequency and microwave chips, lasers, aerospace, and defense have switched to using the new, safer etching products without PFAS. Christuk hopes to see 100% customer adoption by the end of 2023.

Not only did replacing PFAS result in safer products for customers and a safer workplace for workers, the safer alternative identified by TURI and partners also benefitted Transene's bottom line. The alternative resulted in a ongoing cost savings as well: the PFAS-based surfactants cost $2,400 per gallon, but the new safer surfactants cost only $80 per gallon.

**TURI developed the Pollution Prevention Options Analysis System (P2OASys) tool** to help companies determine whether the toxics use reduction (TUR) options they are considering improve upon their existing process when looking at environmental, health and safety endpoints. By using P2OASys, unforeseen negative environmental, worker or public health impacts may be identified prior to adopting the proposed changes.

Potential hazards posed by current and alternative processes identified during the TUR planning process are compared using data endpoints for eight main categories that encompass chemical, physical, psychological and environmental hazards.

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**The Toxics Use Reduction Institute (TURI) at UMass Lowell** provides the resources and tools to help Massachusetts companies and communities make the Commonwealth a safer place to live and work. Established by the state's Toxics Use Reduction Act of 1989, TURI provides research, training, technical support, laboratory services and grant programs to reduce the use of toxic chemicals while enhancing the economic competitiveness of Massachusetts businesses. Learn more at http://www.turi.org or contact info@turi.org, 978-934-3275.