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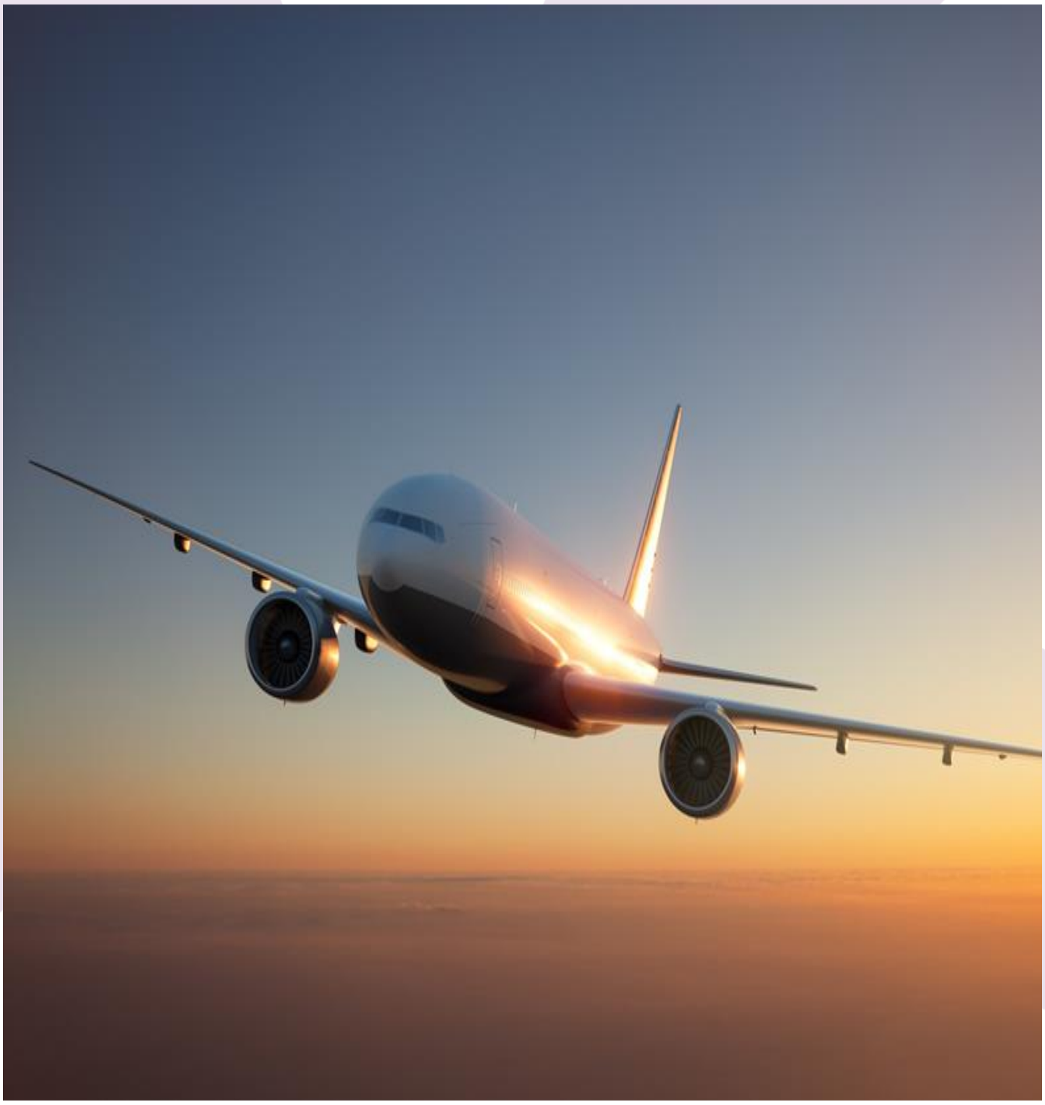
Socio-economic assessment of the US Fluoropolymer Industry

Executive Summary



Wood Environment & Infrastructure Solutions UK Limited – February 2020

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Doc Ref. 41442-WOD-XX-XX-RP-OP-0002_A_C02

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Document revisions

No.	Details	Date
1	Executive summary	21/02/2020
2	Executive summary without confidentiality headers	25/02/2020

Executive summary

This independent report commissioned by FluoroCouncil, an affiliate of the American Chemistry Council, evaluates the socio-economic contribution to US society and economy of a group of plastics and elastomers known collectively as fluoropolymers, e.g. PTFE, FEP, FEPM, PFA, PVDF, FKM, FFKM, THV, ETFE and ECTFE.

This industry differs from others in several ways. The manufacture and sale of fluoropolymers in their basic form generates economic and social effects from revenues, investment and jobs, but larger effects are generated by the downstream use of the fluoropolymers as they are incorporated into a wide range of products in several sectors. While the fluoropolymer content of final products may be tiny, they offer ***specific unique combinations of properties***. These include: non-wetting, light weight, high performance dielectric properties, non-stick, fire resistant, temperature resistant, weather resistant and with near universal resistance to chemicals. Reflecting this, fluoropolymers provide specific functionality in a wide range of products and ***within complex systems.*** They improve efficiency, durability and enable innovation while reducing business and consumer cost via extending lifetimes of products. Drawing on publicly available data, a survey of FluoroCouncil members and interviews with a selection of downstream users, the socio-economic analysis (SEA) evaluates effects in seven strategically important sectors.

The US fluoropolymer industry

The starting point of the US value chain, sales of fluoropolymers in their basic form, is a $2 billion industry and 85,000 tons of product was manufactured in 2018. The US industry is a net exporter of higher value product; the sales value of exports exceeds $1 billion, with imports of around $500 million. A highly innovative sector, some $150 million was invested in research and development (R&D) in 2018. This represented over 6% of revenues, well above the Organization for Economic Co-operation and Development (OECD) average and more than double the average US R&D investment rate. Indirectly, the industry is also estimated to have generated some $150 million in R&D spill over effects, a further $2.4 billion indirect and induced economic activity along with 15,000 direct and indirect US jobs. The location of the fluoropolymer industry in the US has an important role in allowing US-based customers to meet lead times for the various end user sectors. This is necessary in maintaining innovation and R&D, as companies are continually customizing products for their customers.

The value chain – sectors dependent on fluoropolymers

Fluoropolymers provide vital performance characteristics to products or production processes. Collectively this creates socio-economic value far beyond the direct impact created by the industry itself. While not all of these benefits can be easily quantified, the report analyzes this value in seven strategically important sectors:

- **Electronics:** The largest downstream sector by sales, **fluoropolymers are critical to the semiconductor manufacturing process.** Components of the semiconductor manufacturing process must withstand the aggressive etching chemicals while providing the required purity; any contamination severely affects yield. The US semiconductor industry is a $210 billion sector, employing 250,000 Americans. Semiconductors are used in millions of ever more powerful but smaller products. Fluoropolymers dielectric properties has enabled miniaturization of components and final products, alongside improved fire safety, high transmission speeds, ease of installation and reliability of wires, optical and data transmission cables. These last up to three times longer, enabling a wide range of information and communications technology (ICT) functionality, industrial, automotive, medical imaging and analysis;
- **Transportation:** Fluoropolymers are critical for the performance of key components in the automotive and aerospace industries, as they provide them with resistance against heat, cold, fire, smoke, aggressive fluids and fuels, humidity, vibrations and compression. They prolong the useful life of various components, protect corrosion, prevent leaks, improve safety and enable communication. In automobiles, fluoropolymers contribute to improved reliability, engine efficiency, weight reduction and emission control, improving fuel efficiency, reducing CO_2, leaks and fugitive emissions. Alongside other technologies they have **contributed to a 48% increase in fuel efficiency (based on average miles per**

gallon, 1980-2016) in US cars. This has been achieved alongside increases in average horsepower, while maintaining weight. A **key element of fuel cell technology**, they contribute toward further and faster fuel efficiency gains and emission reductions. In aerospace, for example **Airbus A320 users experienced a 93% corrosion reduction in cargo bays and the US Army fleet of Apache helicopters benefited from avoided friction damage**, from the use of one specific product;

- **Medical and first responder:** Fluoropolymers are used in surgically-implantable medical devices; increasing lifetime of implants, reducing the likelihood of infection and invasive surgery. They provide excellent performance and long lifetimes in equipment such as catheters, guide wires, filters and pumps. They reduce **medical complications, replacements, cross-infections and clogging of medical equipment**, contributing to the reduction/avoidance of pain and discomfort alongside the avoided treatment costs. At the same time, they enable advanced medical imaging (via electronic chips and semiconductors in X-ray, MRI, CT scan and echography) and protect **firefighter safety** (via water-resistant, abrasion-resistant and insulated clothing);
- **Chemical and industrial processes**: Fluoropolymers enable a high level of efficiency and safety in various chemical and industrial manufacturing processes, helping them remain internationally competitive. Fluoropolymers contribute to corrosion and leaching prevention, fewer leaks, lower maintenance and prevention of emissions, particularly in applications involving aggressive chemical fluids. They are used in coatings, linings, piping, vessels, fluid-handling components, filters, vents and cable coatings. Corrosion costs the US economy over $250 billion per year, so even a nominal reduction in **corrosion would result in avoided costs of some $2.5 billion per year to US industry**;
- **Consumer products:** A $1.5 billion industry, fluoropolymer-coated cookware provides easy-clean, non-stick properties, saving time, water and energy. **Products last longer and facilitate cooking with less added fat.** Consumer survey data shows strong preference both for non-stick properties in cookware and for using less fat in cooking;
- **Energy:** Fluoropolymers have **contributed to significant technical advances in solar power generation, production efficiencies in wind turbines and to the development of lithium ion batteries**. The costs of solar photovoltaic (PV) cells have halved in recent years, with installed capacity enough to power 11.2 million American homes. Production efficiency increases of ETFE modules relative to glass provide a potential yearly saving of up to $4 billion for US PV module manufacturers. Fluoropolymers enable efficiency gains in wind turbine production. Installed capacity of both PV and wind energy is increasing quickly; a pre-requisite is unit cost reductions driven by efficiency gains. Fluoropolymers facilitate advanced energy storage and conversion technologies and are key components of lithium ion batteries; and
- **Building and construction:** Fluoropolymers provide **durable, thermally stable, easy-to-clean, building materials which can both reduce building cooling costs and energy use**, enabling novel "landmark" architectural designs. These include the Mercedes Benz Stadium, Atlanta, GA, and Denver Airport's ETFE and PTFE fiberglass roofs.

What about alternatives?

Overall, while some alternatives might have a similar performance to fluoropolymers for a parameter or property, it is the combination of properties required for the applications that sets fluoropolymers apart from the alternatives. Implications of a transition could include lower performance, lower durability and reliability, and increased weight (with associated effects on fuel consumption and fuel efficiency). Some applications, like semiconductor manufacturing would be severely impaired, based on current technical knowledge. Economic implications include regression of advanced technologies and the reduced ability of the United States to attract high and medium technology manufacturing investment, efficiency losses, higher capital and maintenance costs. The diversity of fluoropolymer applications would pose major product qualification issues in addition to design implications. Environmental / health and safety implications include potential higher safety risks to medical patients and consumers and increases in emissions from technical regression.

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The socio-economic contribution of fluoropolymers in the US (all data - 2018)

Produced in the US

Tons of fluoropolymers 85,000

Annual sales / turnover $2,640M

Indirect and induced GVA $2,400M

Trade

Exports $1,090M

Imports $570M

Employment

Direct 1,500

Indirect 13,500

Research and development (R&D) investment by fluoropolymer manufacturers in the US $150M = 6.4%

Wider spillover effect to the US economy from R&D investment $75M -$150M

Downstream applications of fluoropolymers in the US

Electronics
24,000 Tons
$550M
Fluoropolymers are critical to the semiconductor manufacturing process. US semiconductor manufacturing is a $210 billion sector

Transportation
19,000 Tons
$530M
Fluoropolymers have contributed to a 48% increase in fuel efficiency (based on average miles per gallon) in US cars

Chemical and industrial processes
12,500 Tons
$330M
Fluoropolymers prolong the lifetime of plant equipment and reduce maintenance costs. Maintenance costs in the US chemical industry are estimated in the region of $1.5bn annually.

Consumer products
7,500 Tons
$200M
Fluoropolymer-coated cookware provides durable non-stick properties and increases the useful life of cookware, avoiding more frequent replacement

Energy
4,000 Tons
$140M
Fluoropolymers have contributed to the technical advances that have enabled US growth in wind and solar photovoltaic (PV) energy generation and the development of lithium ion batteries and reverse flow batteries

Medical and first responder
3,000 Tons
$100M
Fluoropolymers reduce the risk or frequency of implants having to be replaced, with each surgery avoided saving an estimated $2,700

Building and construction
2,500 Tons
$90M
Fluoropolymers enable innovative architectural designs and can reduce building cooling costs and energy use

Other
5,000 Tons
$170M

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