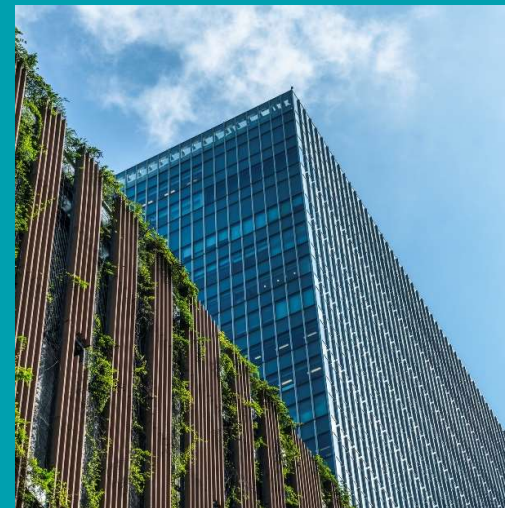


Fluoropolymer Product Group of PlasticsEurope

Update of market data for the socio-economic analysis (SEA) of the European fluoropolymer industry

Final report



Report for

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1. Introduction and scope

The purpose of this work is to update previous data collected in 2016-2017 by Wood (under our previous name Amec Foster Wheeler) for the Fluoropolymer Group of PlasticsEurope (PE) during the development of the socio-economic analysis (SEA) of the European fluoropolymer industry¹. The update will also be used to satisfy data needs for evolving regulatory initiatives, such as the PFAS restriction proposal².

In order to ensure both comparability with the data previously collected and compatibility with new data requirements, data was collected for different geographical scopes and sector breakdowns. The geographical scopes are:

- The EEA (the European Economic Area), which is the EU27 plus Iceland, Liechtenstein and Norway.
- The EU28 (the European Union in its extent from 2013 until 31 January 2020, including the UK).

For the purposes of this exercise, fluoropolymers are defined as follows:

- Fluoropolymers are polymers that have a carbon backbone and contain fluorine atoms directly attached to the carbon. Fluoropolymers are made by polymerisation of olefinic monomers at least one of which contains F bound to one or both of the olefinic carbon atoms.
- The term includes fluoroplastics and fluororubber product.
- Examples of fluoropolymers are polytetrafluoroethylene (PTFE), polyvinylidene fluoride (PVDF), copolymer of tetrafluoroethylene and ethylene (ETFE), copolymer of tetrafluoroethylene and hexafluoropropylene etc.
- Fluorotelomers $[C_nF_{2n+1}-(CH_2)mH]$ and fluorotelomers-based polymers are out of the scope.
- Polymer processing additives (extrusion aids) are included in the scope.

This report briefly summarises the methodology of how the data was collected (Section 2); it presents the updated aggregated market data including a comparison with the previous data collected in 2016-2017 (Section 3); and it concludes with key messages (Section 4).

¹ Executive summary available on the PlasticsEurope website:

https://www.plasticseurope.org/application/files/7315/1708/4052/Final_SEA_Fluoropolymers_summary2017.pdf

² See e.g. <https://www.rivm.nl/en/pfas/pfas-restriction-proposal>

2. Methodology

2.1 Survey with members of the Fluoropolymers Product Group

The data presented in this report was based on a survey with members of the Fluoropolymers Product Group (FPG) within PlasticsEurope undertaken between October 2021 and January 2022. This survey sought detailed information on the volume and value of fluoropolymers manufactured and sold in the EU as well as exports and imports. This relates to fluoropolymers in their basic form; this is just the first stage of the value chain. Fluoropolymers are further processed into products and used as components in more complex objects (products that consist of multiple components from different materials such as cars, electronic devices, buildings, etc.). The production of these products that fluoropolymers are a part of generate further economic activity which is not covered within the data presented in this report (see the 2016-2017 Fluoropolymer SEA study for further discussion of downstream economic activity and benefits).

All data in this report relates to 2020 unless otherwise stated; key data is provided in metric tonnes and Euro. To protect the commercially confidential information of individual companies, all data is aggregated and rounded. Where fewer than three companies have provided data for any given data point, the results are not shown.

One of the key aims of this exercise was to satisfy data needs for evolving regulatory initiatives, such as the PFAS restriction proposal. To develop the assessment underpinning the restriction proposal, the five EEA Member States driving the proposal conducted two public consultations and commissioned a number of supporting studies each focusing on a user sector of PFAS or on the production or waste management of PFAS³. The classification of PFAS user sectors differed from the classification used in the 2016-2017 Fluoropolymer SEA study, so that the European Fluoropolymer industry did not have market data available in the requested format. In order to ensure both comparability with the previous data collected for the 2016-2017 Fluoropolymer SEA study, and compatibility with the new data needs for the current PFAS restriction proposal, the present exercise has therefore collected data on fluoropolymer sales in Europe broken down by sectors of downstream application according to both sector classifications. The two sector classifications, along with (non-exhaustive) lists of typical applications for illustration, are shown in Table 2.1 and Table 2.2 below. The collected and aggregated data are provided in Section 3.4.

³ https://www.reach-clp-biozid-helpdesk.de/SharedDocs/Downloads/DE/REACH/Verfahren/Beschr%C3%A4nkung/Consultation-PFAS.pdf?__blob=publicationFile&v=3

Table 2.1 First sector breakdown (as in 2016-2017 Fluoropolymer SEA study) and examples of typical applications

Sector	Typical applications (not exhaustive)
Transport	Fuel lines, hoses, hydraulic systems, O-rings, gaskets, electronic systems, coating for a variety of purposes (e.g. cables, wires), fuel cell materials.
Chemical and power	Piping, tubing and fittings, fluid-handling components, vessels, storage tanks, sensors, sealants, binders in energy storage devices (e.g. batteries)
Cookware	Non-stick coating for cook and bakeware (e.g. pots, pans, baking trays)
Electronics	Semiconductors, printed circuit equipment, wiring, cabling
Food & pharmaceuticals	Valves, stainless steel piping, tubing, filters, seals, gaskets and other standard fluid handling components, paper tableware, conveyor belts, labware products, packaging
Textiles & architecture	Water, grease and chemical resistant clothes and footwear, space suits, coating for architectural applications, architectural films
Medical applications	Cardiovascular grafts, heart patches, ligament replacements, catheters, filtering membranes
Renewable energy	Front and back sheets for PV, paint and coating for wind turbines, coating for wires and cables, binders in lithium-ion batteries

Table 2.2 Second sector breakdown (as in PFAS restriction proposal) and examples of typical applications

Sector	Typical applications (non-exhaustive)
Chrome plating	
Consumer mixtures	Non-sticking coating, impregnation agents, polishes etc.
Cosmetics	
Construction	Architectural membranes, windows and frames, cables, bearings, sealants, pipe linings, surface coatings
Electronics	Semiconductor production, wires and cables
F-gases	
Firefighting foams	
Food contact materials	Incl. non-stick kitchenware
Lubricants	
Medical devices	Dialysis membranes, catheters, surgical patches
Petroleum	Pipe linings, tanks, fluid handling components, seals, gaskets, cables
Mining	
Ski wax	
Textiles	Outdoor clothing
Transportation	Various automotive and aerospace applications (e.g. bearings, wires hoses, vents, sealants)

2.2 Methodology for the estimation of indirect and induced employment

Indirect and induced employment resulting from the production of fluoropolymers in basic forms in Europe is estimated based on the following key assumptions:

- Value added is equal to 20.9% of fluoropolymer production value.
- The indirect and induced gross value added (GVA) multiplier is 2.5 (i.e., in order to produce €1 of fluoropolymers in basic form, €2.5 of production is necessary in all sectors of the EU economy at all stages of production)
- The average GVA per employee in relevant industries is €100,000

Appendix A presents in more detail the data, references and rationale to back up these assumptions, as well as the process how they are applied in the calculation.

3. Market data

3.1 Volume of use (fluoropolymers in basic form)

Current use

As can be observed in Table 3.1 below, the results in terms of tonnages of fluoropolymers on the European market are approximately the same for the EU28 and the EEA (after rounding). Around 40,000 tonnes of fluoropolymers are estimated to be sold in both the EU28 and the EEA. Europe is a net exporter of fluoropolymers, with 49,000 tonnes estimated to be produced annually in the EU28/EEA, 24,000 tonnes exported outside of the EU28/EEA, and around 15,000 tonnes imported.

This reflects a drop of about 23% in sales of fluoropolymers in Europe in 2020 compared to 2015 (the 2016-2017 fluoropolymer SEA study), with has resulted mostly in a drop of fluoropolymer imports (-30%) and only a small drop in fluoropolymer production (-4%) in Europe, while exports have even increased (+17%) over the same period.

A key caveat of the market data presented here and the comparison to the 2015 data, is that in the 2016-2017 Fluoropolymer SEA study, original survey results were extrapolated using an external reference⁴ on the size of the whole EU market, because the Fluoropolymers Product Group members that participated in the survey did not cover the whole European market. Such an extrapolation has not been undertaken for the present report, because (1) more companies have participated in the new survey for the present study, representing the European market more completely than the previous survey for the 2016-2017 Fluoropolymer SEA study, and (2) because of a lack of an up-to-date external reference on the size of the whole EU market that is similarly reliable as the one used for the 2016-2017 Fluoropolymer SEA study. This could mean that the new numbers presented in this report are a slight underestimate of the whole EU market, and the comparison to the 2015 numbers is slightly skewed towards a decline (or smaller growth). However, it is expected that the market coverage of the data presented here is high, considering that the main companies supplying fluoropolymers to the European market have participated in the survey for this report.

⁴ ECHA, 2014. ANNEX XV PROPOSAL FOR A RESTRICTION – Perfluorooctanoic acid (PFOA), PFOA salts and PFOA-related substances.

Table 3.1 Quantities of fluoropolymers sold in Europe per year

Quantities (tonnes)	EEA in 2020	EU28 in 2020	EU28 in 2015	% change in EU28 2015-2020
Tonnes produced in the EU28 / EEA	49,000	49,000	51,000	-4%
Tonnes imported into the EU28 / EEA	15,000	15,000	21,500	-30%
Tonnes exported from the EU28 / EEA	24,000	24,000	20,500	+17%
Tonnes sold in the whole EU28 / EEA	40,000	40,000	52,000	-23%

Source: Wood / Amec Foster Wheeler Surveys with Members of the FPG, 2016 and 2021. Tonnages are rounded to the closest 500 tonnes. Note the following important caveat when comparing 2015 and 2020 data: 2015 data had been extrapolated from original survey data, whereas 2020 data has not been extrapolated as the underlying survey covered a larger number of companies than in 2015 (see also further explanation of this caveat in the text above this table).

Expected future trends

The fluoropolymer producers in Europe anticipate strong growth in the fluoropolymer market in the medium term (e.g., by 2025) due to the recovery from the COVID-19 pandemic which compressed the market in 2020, the year of the baseline data shown above.

Growth is expected to continue in the long term (e.g., until 2050), partly driven by increasing demand in several key sectors impacted by global mega-trends such as the energy transition and digitalisation. The Allied Market Research⁵ "fluoropolymers market" report indicated that the global fluoropolymers market is expected to grow at a compound annual growth rate (CAGR) of 6.5% from 2020 to 2027 due to various growth opportunities, including an increase in demand for high insulation materials in electrical and electronics applications; lightweight materials such as carbon-fibre-reinforced polymers in automobiles and manufacturing components of aircraft, and also the use of fluoropolymers in various new and innovative applications in the construction, renewable, E-mobility, medical and chemical processing sectors.

The following table shows the anticipated growth of selected applications of fluoropolymers, which are expected to lead to similar increases in fluoropolymer sales into the respective sectors.

⁵ Allied Market Research "Fluoropolymers Market - Global Opportunity Analysis and Industry Forecast, 2020-2027", August 2020.

Table 3.2 Expected growth in key applications of fluoropolymers

Application	Growth expectations	Reference
Automotive	<p>Fluoropolymers have multiple applications in the automotive sector. The use of fluoropolymers in the automotive sector can lead to a reduction in CO₂ emissions as well as reductions in fuel consumption. The growth of fluoropolymers in the automotive industry has been recognised as contributing to the projected global growth of the fluoropolymers market to EUR 9281.87 million by 2027¹. The CAGR is expected to be 5.2% over the 2021-2028 period.</p> <p>Fluoropolymers are a key driver of vehicle durability and efficiency, including enhanced resistance to heat, cold, fire, aggressive fluids and fuels, moisture and compression in addition to improved fuel efficiency. As a result, solid growth in demand for fluoropolymers is expected in the automotive sector, in line with the wider growth forecast for that sector. . ACEA (the European Automobile Manufacturers' Association) anticipates that passenger car registrations in the EU will return to growth in 2022 due to the expected stabilisation of chip supplies in the same year. However, it was indicated that the number of registrations would still be almost 20% below 2019 pre-pandemic sales levels. The growth of fluoropolymers in the automotive sector is likely to follow a similar trend.</p>	[1] [2] [3] [4] [10] [11] [12] [13]
E-mobility	<p>The sale of electric vehicles in Europe has increased from 0.2 million registrations in 2015 to 2.3 million registrations in 2021. This trend is expected to continue. PVDF is used in lithium-ion batteries which are used in electric vehicles. In 2021, ACEA reported a 10-fold increase in the sales of electric vehicles between 2017 and 2021 and it is anticipated that this growth will continue in the longer-term. The growth of fluoropolymers in the E-mobility sector is likely to follow a similar trend.</p> <p>Fluoropolymers are an important component in fuel cells to allow the electrochemical reaction turning hydrogen and oxygen into electricity. The European hydrogen strategy aims to support an increase in renewable hydrogen from 1 million tonnes in 2024 to 10 million tonnes in 2030. As a result, growth in demand for fluoropolymers is expected, to help achieve these ambitious European targets.</p>	[5] [6] [14] [15]
Semiconductors	<p>The global semiconductor market is projected to grow from €411.68 billion in 2021 to €731.11 billion in 2028¹ and is predicted to have a CAGR of 8.6% between 2021 and 2028.</p> <p>Fluoropolymers are a key component in semiconductor production infrastructure and the wider electronics industry due to their chemical resistance, high dielectric strength, resistance to high temperatures and high purity. As a result, demand for fluoropolymers in this sector is expected reflecting the increase in demand for semiconductors themselves.</p> <p>The EU Chips Act is anticipated to allow the EU to reach its ambition of doubling its current market share of semiconductor technology to 20% in 2030. This indicates that fluoropolymers will likely follow a similar trend over this period.</p>	[4] [6] [11] [13] [16]

Application	Growth expectations	Reference
Construction	<p>One of the most common uses of fluoropolymers in the construction sector is for coating applications which ensure long lasting and weather-proof buildings. Fluoropolymer-based metal roofing coatings also enhance performance and save energy through solar reflection and reduced heat transfer to buildings. Due to an increased focus on energy and material efficiency of buildings, it is therefore expected that fluoropolymers will continue to play an important role in construction.</p> <p>The global fluoropolymers market is projected to reach €9,281.87 million by 2027¹ and increasing spending on construction activities is seen as one of the biggest contributors to this.</p>	[2] [4] [17]
Renewable energy	<p>The growing concern of climate change has prompted the expansion of renewable energy use across Europe. 22.1% of the EU's energy consumption in 2020 came from renewable energy and the current target for 2030 has been set at 32% (a more ambitious target of 40% is being sought after). In 2020, the renewable energy sector was valued at EUR 802.61 billion and this is expected to reach €1,800.21 billion by 2030¹. The CAGR over the 2021-2030 period is projected to be 8.4%.</p> <p>As fluoropolymers, especially fluoropolymer films are widely used in this sector (e.g. photovoltaic front sheets, wind turbines and hydrogen fuel cells), the growth of fluoropolymers in this sector could be seen to follow a similar pattern to the growth of the sector itself.</p>	[7] [8] [9]
Advanced medical applications	<p>In the medical field, fluoropolymers are used as a coating or insulation in surgically-implantable medical devices such as vascular grafts and heart patches, diaphragm pumps, membranes for filtering and venting purposes, catheters, and MRI machines. Allied Market Research reports that <i>"Due to strong biological applications such as artificial corneas and heart valves, the global fluoropolymer market is likely to report robust growth in the near future. Fluoropolymer is experiencing large-scale demand in the market"</i>.</p>	[18] [19]

Notes: ¹ Exchange rate of USD 1 = EUR 0.9103 applied, 23/03/2022

References:

- [1] <https://multimedia.3m.com/mws/media/1430984O/article-on-fluoropolymers-social-megatrends-give-fluoropolymers-a-boost.pdf>
- [2] <https://www.prnewswire.com/news-releases/fluoropolymers-market-is-projected-to-reach-us-10-196-5-million-by-2027--owing-to-rise-in-growing-application-of-fluoropolymer-in-automotive-industry-and-increasing-spending-on-construction-activities-cagr-4-3-astute-analytic-301491462.html>
- [3] <https://www.fortunebusinessinsights.com/fluoropolymers-market-102132>
- [4] https://www.agc.com/en/ir/library/bizbriefing/pdf/2020_1223efluoro.pdf
- [5] <https://www.iea.org/commentaries/electric-cars-fend-off-supply-challenges-to-more-than-double-global-sales>
- [6] <https://www.fortunebusinessinsights.com/semiconductor-market-102365>
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- [10] <https://www.acea.auto/press-release/car-sales-return-to-growth-expected-in-2022-but-concerns-on-charging-infrastructure-persist/>
- [11] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_729
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- [15] https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf
- [16] <https://fluoropolymers.plasticseurope.org/index.php/Applications/electronics-industry>
- [17] <https://fluoropolymers.plasticseurope.org/index.php/Applications/architecture>
- [18] <https://fluoropolymers.plasticseurope.org/index.php/Applications/medical-equipment-and-devices>

[19] Allied Market Research "fluoropolymers market - Global Opportunity Analysis and Industry Forecast, 2020-2027", August 2020.

However, it is difficult to quantify the expected growth, with expectations varying between a few percent to several hundred percent and depending on several complex variables. Further detail about the limitations of the survey results with regard to expected future trends is provided in Appendix B. According to the survey responses, the growth of the fluoropolymer market in Europe will likely be served partly by increasing production within Europe and partly by increasing imports of fluoropolymers from outside Europe.

3.2 Revenues (Fluoropolymers in basic form)

According to the survey with FPG members, sales of fluoropolymers onto the EEA market generate a revenue of around €750 million per year, and sales onto the EU28 market generate €740 million per year. Just over a billion Euros worth of fluoropolymers are produced in the EU28/EEA, with the value of exports (€550 million) more than twice the sales value of imports (€270 million).

It is important to note that this is the sales value of sales of fluoropolymers in basic form; this is just the first stage of the value chain. The value of the final products made using fluoropolymers would be substantially greater.

Compared to 2015, the total value of fluoropolymers sold in the EU28 has slightly decreased (-5%), as has the value of imports (-13%), while the values of production (+23%) and especially exports (+45%) have experienced strong growth. The average sales value per tonne has increased for production (+28%), import (+25%), export (+24%) and sales (+23%). It can also be observed that the average values per tonne of fluoropolymers produced in Europe (€21,000) and exported from Europe (€23,000) are significantly higher than the average values per tonne of fluoropolymers imported into (€18,000) and sold (€19,000) in Europe. This could indicate the European producers are increasingly focusing on the higher value market.

The data presented here and the comparison to the 2015 data is subject to the same caveat as the tonnages presented above, namely that in the 2016-2017 Fluoropolymer SEA study, original survey results were extrapolated to the whole EU market, while the survey presented in the present report is expected to already cover a high share of the market and has not been extrapolated.

Table 3.3 Annual sales value of fluoropolymers in the EU (€ million)

Quantities (€m)	EEA in 2020	EU28 in 2020	EU28 in 2015	% change in EU28 2015-2020
Sales value of product produced in the EU28 / EEA	1,030	1,030	840	+23%
Sales value of imports into the EU28 / EEA	270	270	310	-13%
Sales value of exports from the EU28 / EEA	550	550	380	+45%
Total value sold in the whole EU28 / EEA	750	740	780	-5%

Source: Wood / Amec Foster Wheeler Surveys with Members of the FPG, 2016 and 2021. Notes: Rounded to the closest €10m. Due to rounding, the sum of production and imports minus exports does not match the total sales. Note the following important caveat when comparing 2015 and 2020 data: 2015 data had been extrapolated from original survey data, whereas 2020 data has not been extrapolated as the underlying survey covered a larger number of companies than in 2015 (see also further explanation of this caveat in the text above this table).

3.3 Employment

Direct employment (manufacturing of fluoropolymers in basic form)

In terms of employment, in total, 43,800 people are employed in the FPG companies in the EU28, and roughly the same number in the EEA. This is an increase of about 38% compared to 2015. In their survey responses, FPG companies also estimated the number of their employees directly related to the production of fluoropolymers in their basic form. This indicates that some 4,500 employees are involved across the EU28, and roughly the same number in the EEA. This is about twice the figure from 2015.

Considering that a reduction in production volumes was observed over the same period, it stands to reason that the increase in employment directly associated with fluoropolymer manufacture reflects at least to some extent either (1) a difference in interpretation which employees are counted as “directly associated with fluoropolymer manufacture” in the new survey responses compared to those undertaken for the previous study, or (2) an underestimate in the 2016-2017 Fluoropolymer SEA study due to the extrapolation of original survey results to the whole EU market (see also more detailed discussion on extrapolation in the 2016-2017 Fluoropolymer SEA study in Section 3.1), or (3) that the Covid-19 pandemic has led to a temporary contraction of production and sales for 2020 but not to a reduction in employees.

Table 3.4 Total employment in surveyed companies and direct employment associated with European fluoropolymer production

Number of employees	EEA in 2020	EU28 in 2020	EU28 in 2015	% change in EU28 2015-2020
Total number of employees in the FPG Member Companies	43,800	43,800	31,700	+38%
Employment directly associated with fluoropolymer manufacture in the FPG Member Companies (first stage in value chain only)	4,500	4,500	2,200	+ 103%

Source: Wood / Amec Foster Wheeler Surveys with Members of the FPG, 2016 and 2021. Note the following important caveat when comparing 2015 and 2020 data: 2015 data had been extrapolated from original survey data, whereas 2020 data has not been extrapolated as the underlying survey covered a larger number of companies than in 2015 (see also further explanation of this caveat in the text above this table).

Indirect employment

In any industry, the effect of economic activity extends beyond the direct sales of the product. Economic multipliers are used to quantify these further indirect effects, as they are ‘multiplied’ through the economy via several spending rounds. These multipliers enable an estimate of the economic effects of the industry via three channels of effect:

- **Direct impact:** This relates to the activities of the industry itself, such as production of fluoropolymers, the sales/value added and the number of people directly employed from it. These were discussed in the previous sections of this report.

- **Indirect impact:** Also called a supply linkage multiplier, this reflects additional purchases made by the fluoropolymer industry itself (on raw materials, energy etc.) and further purchases with other linked firms along the supply chain (i.e. the purchases made by the companies providing fluoropolymer manufacturers with raw material, for example), as well as the employment resulting from that.
- **Induced impact:** Also called a consumption or income multiplier, this reflects expenditure – often local – of those who earn income from the direct and indirect effects described above. For example, this would include the purchase of a new car, house or holiday, by one of the employees of the fluoropolymer manufacturers⁶.

Direct, indirect and induced GVA and the associated employment are estimated based on the methodology described in Section 2.2. Table 3.5 summarises the results. Note that these results should be considered indicative only, given that they are based on a range of assumptions as outlined in the methodology.

Overall, while around 4,500 employees are directly employed in manufacture of fluoropolymers, we estimate that employment associated with indirect and induced value added could be in the order of 4,400 people. This suggests some 8,900 people in total are sustained directly and through indirect and induced effects by the production of fluoropolymers. The results are approximately the same for the EU28 and the EEA (after rounding).

Table 3.5 Summary of results from the multiplier analysis for indirect and induced employment supported by the fluoropolymer industry in the EU (number of employees)

	EEA	EU28
Employment (direct)	4,500	4,500
Estimated employment associated with indirect and induced GVA	4,400	4,400
Total employment (direct, indirect and induced)	8,900	8,900

Sources: Wood, based on result of survey with FPG members, Eurostat annual detailed enterprise statistics for industry (value added at factor cost in percentage of production value and gross value added per employee, EU28 in 2018), Eurostat basic breakdowns of main GDP aggregates and employment (gross value added and employment, EU28 in 2019), and multipliers derived from Eurostat output multipliers for 2019.

Key assumptions: Value added is 20.9% of fluoropolymer production value, indirect and induced GVA multiplier is 2.5, average GVA per employee in relevant industries is €100,000 (see Appendix A for more details).

Note numbers have been rounded to the closest 100 employees.

Beyond the economic impacts of the fluoropolymer industry itself, fluoropolymers are further processed into products and used as components in more complex objects (products that consist of multiple components from different materials such as cars, electronic devices, buildings, etc.). The production of these products, which fluoropolymers are a part of, generate further economic activity and associated employment. These are not covered within the estimates provided above.

⁶ See for example: Homes & Communities Agency (2014). Additionality Guide.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/378177/additionality_guide_2014_full.pdf

3.4 Sales of fluoropolymers to downstream sectors

Sector breakdowns are only shown for the EEA here. As Sections 3.1 and 3.2 have shown, the overall size of the market is nearly identical for the EU28 and the EEA (after rounding), and so no differences in the sector breakdown can be observed after rounding between these two geographies.

The FPG survey obtained data on the volume and value of fluoropolymer sales disaggregated into the various downstream sectors where they are further processed into final products. As explained in Section 2.1, data has been collected according to two different sector breakdowns, in order to ensure both comparability with the previous data collected for the 2016-2017 Fluoropolymer SEA study, and compatibility with the new data needs for the current PFAS restriction proposal.

The first sector breakdown (as in the 2016-2017 Fluoropolymer SEA study) is shown in Table 3.6 and visualised in Figure 3.1 below. According to this breakdown, transport (15,500 tonnes worth €280 million) and chemical and power (11,000 tonnes worth €200 million) were by far the largest sectors in 2020. Compared to 2015, in terms of tonnages, most sectors remained stable (electronics, renewable energy) or experienced a decrease in volumes which was most pronounced for medical applications (-67%) and textiles and architecture (-50%). The only exception was "other sectors" (not elsewhere classified) which grew by about 50%. However, in terms of sales values, several sectors experienced significant growth, namely renewable energy (+300%), electronics (+40%) and "other sectors" (+100%).

It should be noted that the attribution of sales of fluoropolymers in basic forms to downstream sectors is complicated and can be uncertain, among other reasons because certain products that fluoropolymers are used in can be applied in many different sectors (e.g. cables in electronics and transportation). This means that the comparison between 2015 and 2020 data could be distorted if companies (on average) have reported the downstream user sectors of their products differently, especially since additional companies have participated in the current survey that did not participate in the previous one.

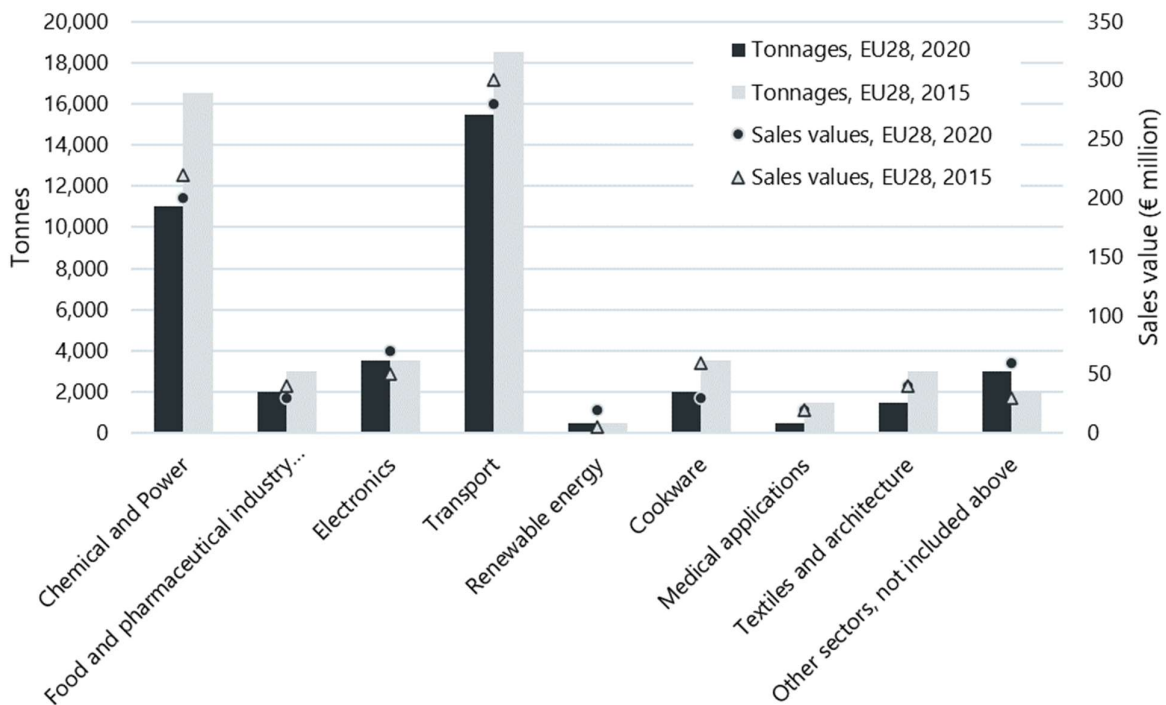
The data presented here and the comparison to the 2015 data is also subject to the same caveat as the tonnages and revenues presented in previous sections, namely that in the 2016-2017 Fluoropolymer SEA study, original survey results were extrapolated to the whole EU market, while the survey presented in the present report is expected to already cover a high share of the market and has not been extrapolated.

Table 3.6 Downstream applications of fluoropolymers in Europe (tonnes and value) - First sector breakdown (as in 2016-2017 Fluoropolymer SEA study)

Sector	Total quantity sold (tonnes)			Total value (€ million)		
	In 2020	In 2015	% change 2015-2020	In 2020	In 2015	% change 2015-2020
Chemical and Power	11,000	16,500	-33%	200	220	-9%
Food and pharmaceutical industry (F&P)	2,000	3,000	-33%	30	40	-25%
Electronics	3,500	3,500	+/- 0%	70	50	+40%
Transport	15,500	18,500	-16%	280	300	-7%
Renewable energy	500	500	+/- 0%	20	<5	+300%
Cookware	2,000	3,500	-43%	30	60	-50%
Medical applications	500	1,500	-67%	20	20	+/- 0%
Textiles and architecture	1,500	3,000	-50%	40	40	+/- 0%
Other sectors, not included above	3,000	2,000	+50%	60	30	+100%
Total	40,000	52,000	-23%	740	780	-5%

Source: Wood / Amec Foster Wheeler Surveys with Members of the FPG, 2016 and 2021. Note all sales values are rounded to the nearest €10m all tonnage data are rounded to the nearest 500 tonnes. Note the following important caveat when comparing 2015 and 2020 data: 2015 data had been extrapolated from original survey data, whereas 2020 data has not been extrapolated as the underlying survey covered a larger number of companies than in 2015 (see also further explanation of this caveat in the text above this table).

Figure 3.1 Downstream applications of fluoropolymers in Europe (tonnes and value) - First sector breakdown (as in 2016-2017 Fluoropolymer SEA study)



Source: Wood / Amec Foster Wheeler Surveys with Members of the FPG, 2016 and 2021. Note all sales values are rounded to the nearest €10m all tonnage data are rounded to the nearest 500 tonnes. Note the following important caveat when comparing 2015 and 2020 data: 2015 data had been extrapolated from original survey data, whereas 2020 data has not been extrapolated as the underlying survey covered a larger number of companies than in 2015 (see also further explanation of this caveat in the text above this table).

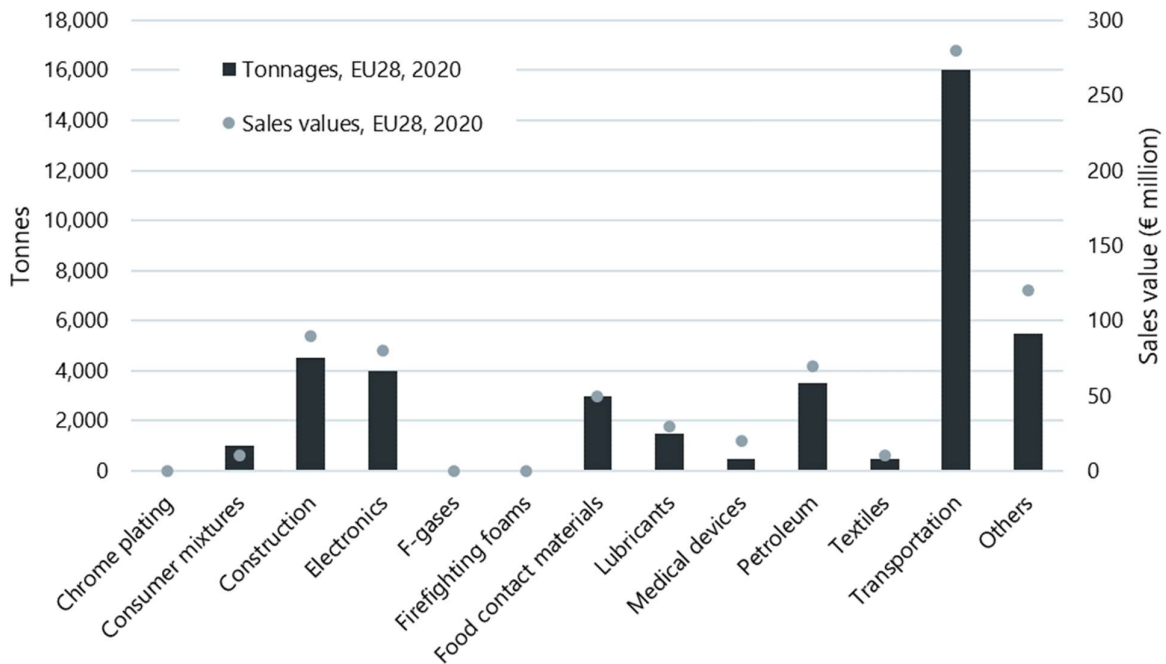
The second sector breakdown (as in the studies supporting the PFAS restriction proposal) is shown in Table 3.6 and visualised in Figure 3.2 below. According to this breakdown, transportation is the largest sector by far (16,000 tonnes worth €280 million). Other large sectors include construction (4,500 tonnes worth €90 million), electronics (4,500 tonnes worth €80 million), petroleum (3,500 tonnes worth €70 million), food contact materials (3,000 tonnes worth €50 million) and "others" (not elsewhere classified; 5,500 tonnes worth €120 million). According to the FPG survey, fluoropolymers are not sold into the sectors chrome plating, F-gases or fire-fighting foam. For sectors where fewer than three FPG Members have indicated sales tonnages and values, the data cannot be disclosed (marked "confidential" in the table below).

Table 3.7 Downstream applications of fluoropolymers in Europe (tonnes and value) - Second sector breakdown (as in studies supporting PFAS restriction proposal)

Sector	Total quantity sold (tonnes) in 2020	Total value (€ million) in 2020
Chrome plating	0	0
Consumer mixtures	1,000	10
Cosmetics	Confidential	Confidential
Construction	4,500	90
Electronics	4,000	80
F-gases	0	0
Firefighting foams	0	0
Food contact materials	3,000	50
Lubricants	1,500	30
Medical devices	500	20
Petroleum	3,500	70
Mining	Confidential	Confidential
Ski wax	Confidential	Confidential
Textiles	500	10
Transportation	16,000	280
Others	5,500	120
Total	40,000	740

Source: Wood Survey with Members of the FPG, 2021. Note all sales values are rounded to the nearest €10m all tonnage data are rounded to the nearest 500 tonnes. Due to rounding, the sum of the values for individual sectors does not match the total. "Confidential" indicates sectors where fewer than three FPG Members have indicated sales.

Figure 3.2 Downstream applications of fluoropolymers in Europe (tonnes and value) - Second sector breakdown (as in studies supporting PFAS restriction proposal), excluding confidential sectors



Source: Wood Survey with Members of the FPG, 2021. Sectors with confidential data not shown (Cosmetics, Mining, Ski Wax). Note all sales values are rounded to the nearest €10m all tonnage data are rounded to the nearest 500 tonnes.

“Energy” has not been classified as its own sector, and it is inherently difficult to distinguish from other sectors using the same types of products that contain fluoropolymers. Examples of applications that overlap between energy and other sectors include:

- Fluoropolymer cable coatings can be used in the energy sector as well as in electronics, transportation, and other sectors.
- Fluoropolymer pipe linings, vessels, valves, pumps etc. can be used in the energy sector as well as in the petroleum, construction, food processing, and other industries.

Based on a combination of the data from relevant sectors in the first sector breakdown (as in the 2016-2017 Fluoropolymer SEA study) and input from Members of the FPG, it is estimated that, if “energy” (excluding petroleum) was classified as its own sector, it would likely account for around 1,000 tonnes to several thousand tonnes of sales of fluoropolymers. This would be equivalent to about €20 million up to the low hundreds of millions in terms of sales value.

4. Conclusion / key messages

The present report presented aggregated data for the European fluoropolymer industry based on a survey with members of the Fluoropolymers Product Group (FPG) within PlasticsEurope undertaken between October 2021 and January 2022, in order to update previous data collected in 2016-2017 during the development of the socio-economic analysis (SEA) of the European fluoropolymer industry and to satisfy data needs for evolving regulatory initiatives, such as the PFAS restriction proposal.

The headline results can be summarised as follows:

- **Market volumes:**
 - ▶ Around 40,000 tonnes of fluoropolymers are estimated to be sold in both the EU28 and EEA. Europe is a net exporter of fluoropolymers, with 49,000 tonnes estimated to be produced annually in the EU28/EEA, 24,000 tonnes exported outside of the EU28/EEA, and around 15,000 tonnes imported.
 - ▶ This reflects a drop of about 23% in sales of fluoropolymers in Europe in 2020 compared to 2015, with has resulted mostly in a reduction of fluoropolymer imports (-30%) and only a small reduction in fluoropolymer production (-4%) in Europe, while exports have in fact increased (+17%) over the same period.
 - ▶ The fluoropolymer producers in Europe anticipate strong growth in the fluoropolymer market in the medium term (e.g., by 2025) due to the recovery from the COVID-19 pandemic which compressed the market in 2020, the year of the baseline data shown above. Growth is expected to continue in the long term (e.g., until 2050), partly driven by increasing demand in several key sectors impacted by global mega-trends such as the energy transition and digitalisation.
- **Market value:**
 - ▶ The volumes above are estimated to generate revenue of around €750 million per year in terms of sales onto the EEA market, most of which (€740 million) is accounted for by the EU28. Just over a billion Euros worth of fluoropolymers are produced in the EU28/EEA, with the value of exports (€550 million) more than twice the sales value of imports (€270 million).
 - ▶ Compared to 2015, the total value of fluoropolymers sold in the EU28 has slightly decreased (-5%), as has the value of imports (-13%), while the values of production (+23%) and especially exports (+45%) have experienced strong growth.
 - ▶ The average sales value per tonne has increased for production (+28%), import (+25%), export (+24%) and sales (+23%).
 - ▶ It can also be observed that the average values per tonne of fluoropolymers produced in Europe (€21,000) and exported from Europe (€23,000) are significantly higher than the average values per tonne of fluoropolymers imported into (€18,000) and sold (€19,000) in Europe.

- **Employment:**

- ▶ Overall, while around 4,500 employees are directly employed in manufacture of fluoropolymers, we estimate that employment associated with indirect and induced value added could be in the order of 4,400 people. This suggests some 8,900 people in total are sustained directly and through indirect and induced effects by the production of fluoropolymers. This does not include employment in sectors using fluoropolymers, which is many multiples higher.

- **Sales to downstream sectors:**

- ▶ Data has been collected according to two different sector breakdowns, in order to ensure both comparability with the previous data collected for the 2016-2017 Fluoropolymer SEA study (2015 data), and compatibility with the new data needs for the current PFAS restriction proposal.
- ▶ According to the first sector breakdown (as in the 2016-2017 Fluoropolymer SEA study), transport (15,500 tonnes worth €280 million), and chemical and power (11,000 tonnes worth €200 million), were by far the largest sectors in 2020. Compared to 2015, in terms of tonnages, most sectors remained stable (electronics, renewable energy) or experienced a decrease in volumes which was most pronounced for medical applications (-67%) and for textiles and architecture (-50%). The only exception was "other sectors" (not elsewhere classified) which grew by about 50%. However, in terms of sales values, several sectors experienced significant growth, namely renewable energy (+300%), electronics (+40%) and "other sectors" (+100%).
- ▶ According to the second sector breakdown (as in the studies supporting the PFAS restriction proposal), transportation is the largest sector by far (16,000 tonnes worth €280 million). Other large sectors include construction (4,500 tonnes worth €90 million), electronics (4,500 tonnes worth €80 million), petroleum (3,500 tonnes worth €70 million), food contact materials (3,000 tonnes worth €50 million) and "others" (not elsewhere classified; 5,500 tonnes worth €120 million). According to the FPG survey, fluoropolymers are not sold into the sectors chrome plating, F-gases or fire-fighting foam.

- **Key caveats:**

- ▶ Beyond the economic impacts of the fluoropolymer industry itself, fluoropolymers are further processed into products and used as components in more complex objects (products that consist of multiple components from different materials such as cars, electronic devices, buildings, etc.). The production of these products that fluoropolymers are a part of generate further economic activity and associated employment. These are not covered within the estimates provided above.
- ▶ Due to methodological differences, the comparisons between 2020 and 2015 data have to be considered carefully. In the 2016-2017 Fluoropolymer SEA study, original survey results were extrapolated to the whole EU market, while the survey presented in the present report is expected to already cover a high share of the market and has not been extrapolated.

- ▶ The attribution of sales of fluoropolymers in basic forms to downstream sectors is complicated and can be uncertain, among other reasons because certain products that fluoropolymers are used in can be applied in many different sectors. This means that the comparison between 2015 and 2020 data could be distorted if companies (on average) have reported the downstream user sectors of their products differently, especially since additional companies have participated in the current survey that did not participate in the previous one.

Appendix A

Indirect and induced employment: Additional detail on assumptions and methodology

Sufficiently detailed data to derive economic multipliers specifically for fluoropolymers in Europe was not available, but a range of analyses for the wider plastics and chemicals industries from various sources have been reviewed to derive the most appropriate economic multipliers to illustrate the likely extent of these wider effects in terms of indirect and induced employment related to fluoropolymers.

Based on Eurostat input-output tables⁷, we estimate that, in order to produce €1 of plastics in primary forms, €2.55 of production is necessary in all sectors of the EU economy at all stages of production. This multiplier is roughly consistent with a study by Ambrosetti (2013)⁸ that suggests a €1 increase in GDP in the plastics sector generates an increase of €2.38 in GDP for the Italian economy. For the chemicals industry as a whole, a more recent study by Oxford economics (2019)⁹ estimated that every €1 of GVA in the EU chemicals industry supports €3.15 of indirect and €3.06 of induced GVA. Hence, as a conservative estimate, a multiplier of around 2.5 is assumed for fluoropolymers in this study to illustrate the likely order of magnitude. It should be noted that this is very conservative. If, for instance, the average of the four figures quoted above¹⁰ was used, the multiplier would be 3.4 instead of 2.5. Hence, the indirect and induced employment generated by the European fluoropolymer industry could potentially be significantly larger (+36%¹¹) than estimated in the following.

In the calculations, first GVA was estimated based on the turnover of fluoropolymers. For the sector manufacture of primary plastics as a whole, according to Eurostat¹² for every €1 of production in the EU28, 20.9 cents gross value added (GVA)¹³ is directly created in the EU. The multipliers presented above were then applied to this figure to estimate indirect and induced GVA for the fluoropolymer industry as a whole.

⁷ Eurostat: Output multipliers [naio_10_coout]. Data for 2019.

⁸ The European House – Ambrosetti (2013): The excellence of the plastics supply chain in relaunching manufacturing in Italy and Europe. Available at: <https://legacy.plasticseurope.org/en/resources/publications/99-excellence-plastics-supply-chain-relaunching-manufacturing-italy-and-europe>

⁹ Oxford Economics (2019): “Report for the ICCA – The Global Chemical Industry: Catalysing Growth and Addressing Our World’s Sustainability Challenges”. Available at: <https://icca-chem.org/wp-content/uploads/2020/10/Catalyzing-Growth-and-Addressing-Our-Worlds-Sustainability-Challenges-Report.pdf>.

¹⁰ These figures are: 2.55 from Eurostat input-output tables, 2.38 from Ambrosetti (2013), 3.15+3.06=6.21 from Oxford economics (2019), and 2.41 from Keybridge Research (2009).

¹¹ Calculated as $3.4 / 2.5 = 1.36$. This means figures calculated based on a factor of 3.7 instead of 2.5 would be 1.36 as large, i.e. 36% larger.

¹² Eurostat: Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E) [sbs_na_ind_r2]. Value added at factor cost in production value – percentage. Value for EU28 in 2018.

¹³ This is a sector’s contribution to gross domestic product (GDP). GVA is based on either the value of output, less the value of all the inputs or the sum of compensation to employees plus gross operating surplus (industry profits). In effect this represents the sectors contribution to the EU economy.

In order to determine the employment sustained by indirect and induced economic effects of the fluoropolymer industry, the employment related to the indirect and induced GVA of the fluoropolymer industry were then calculated from the average GVA per employee. In the EU economy as a whole, each employee generates on average about €60,000 of GVA per year¹⁴. However, the aforementioned study by Ambrosetti (2013) has shown that the majority of the indirect and induced GVA of the plastics industry is generated in manufacturing, including a large share in the plastics industry itself. In these industries, the average GVA per employee can be much higher, for instance over €150,000 in the manufacturing of plastics in primary forms¹⁵. Hence, a GVA of €100,000 per employee has been assumed as an average for the industries where indirect and induced GVA is generated by the production of fluoropolymers.

¹⁴ Eurostat: Gross value added and income by A*10 industry breakdowns [nama_10_a10] and Employment by A*10 industry breakdowns [nama_10_a10_e]. Values for 2019.

¹⁵ Eurostat: Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E) [sbs_na_ind_r2]. Value for EU28 in 2017.

Appendix B

Limitations of the survey results with regard to expected future trends

FPG members were asked in the survey to provide information on the expected trends with respect to fluoropolymer productions, sales and trade, over different timescales (2025, 2030, 2050), as well as the sectors most affected by the changes. The responses have yielded a complex picture of diverse expectations for a diverse set of applications. This has made it not possible to quantify expected growth rates further than reported in Section 3.1, because:

- There are wide ranges in the percentage growth expected by the different members, so it is difficult to report a consensus.
- Most members have marked their responses confidential and there is not enough overlap between the different applications/sectors for which expected growth rates are reported in order to aggregate information that can be shown while protecting confidentiality.

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