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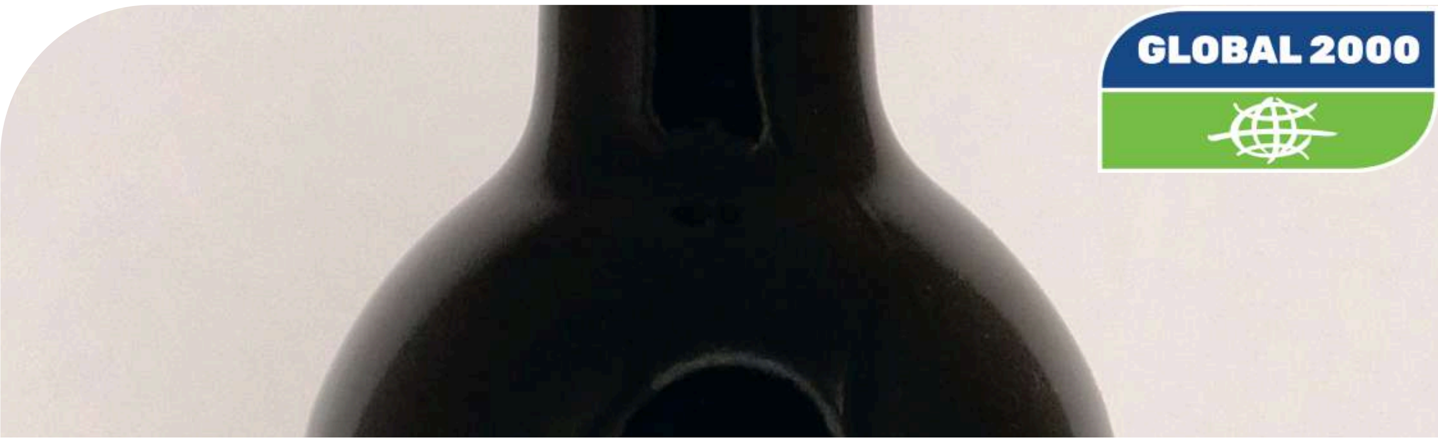
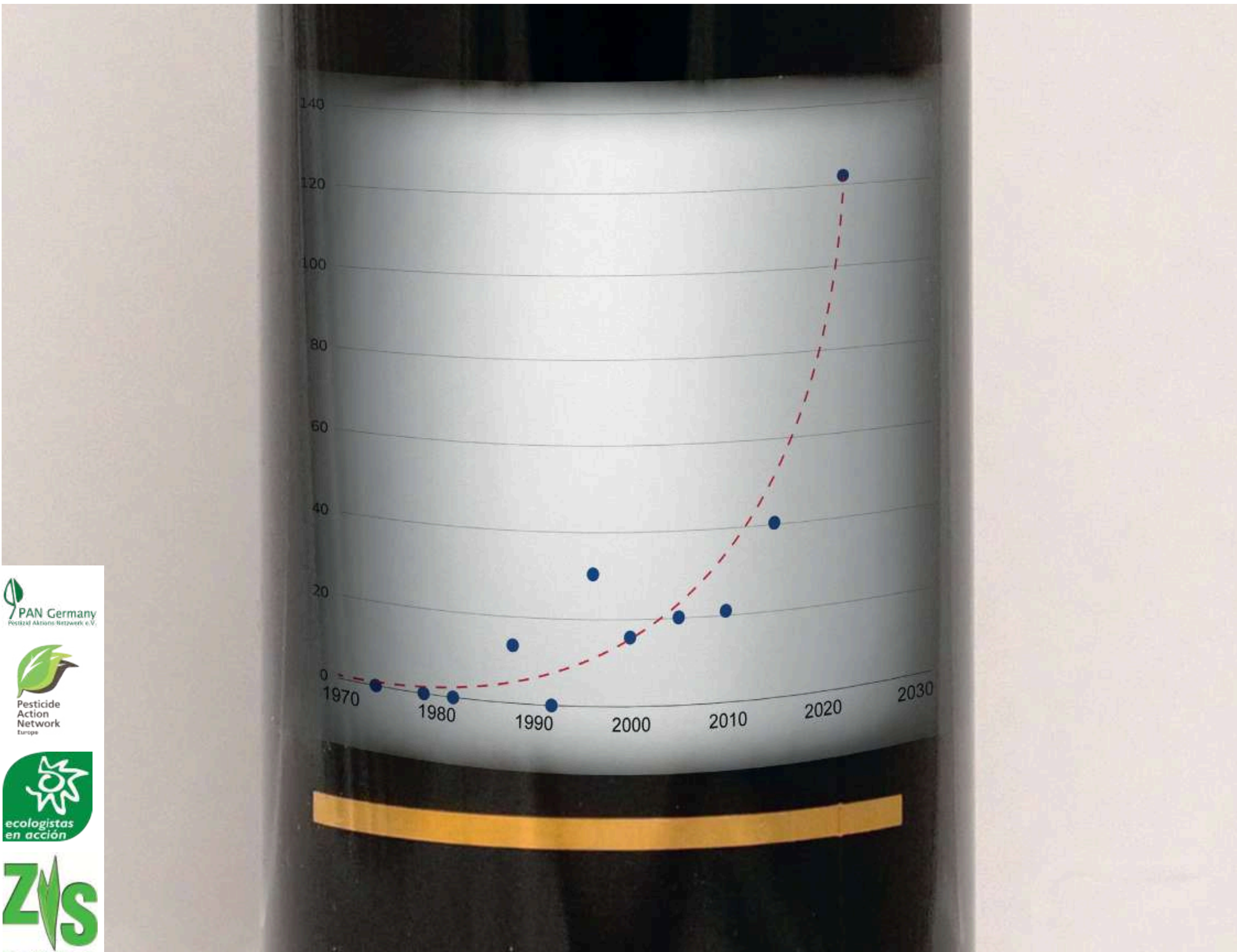


# MESSAGE FROM THE BOTTLE

The Rapid Rise of TFA Contamination Across the EU




PAN Germany

Pesticide Action Network Europe

ecologistas en acción

ZS Earth Trek

Swedish Society for Nature Conservation

Magyar Természetvédők Szövetsége
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# EXECUTIVE SUMMARY

This report presents an investigation into trifluoroacetic acid (TFA) contamination in wine carried out across ten European wine-producing EU countries by members of the European Pesticide Action Network Europe (PAN Europe). Our findings reveal an alarming and rapidly intensifying environmental issue that has remained unnoticed for too long by the public and policymakers alike.

TFA is a highly persistent breakdown product of certain fluorinated chemicals, especially F-gases and PFAS pesticides, which are respectively used in refrigeration and increasingly in agriculture. Once released, TFA cannot be broken down by natural processes and therefore inevitably accumulates in water, soil, plants, and even in human blood. Previous studies by the NGOs show TFA contamination is widespread in Europe's rivers, lakes, groundwater, tap water, and even rain. This report takes a crucial next step by examining the extent to which TFA also accumulates in agricultural products, specifically wine. TFA was long thought to be a toxicological 'non-relevant' pesticide metabolite. Now it is suspected to be toxic to reproduction.

Key findings:

- **A steep rise in contamination**: we see an exponential rise in TFA levels in wine since 2010. TFA was not detected in wines from before 1988, while wines from 2021–2024 show **average levels of 122 µg/L**, with some **peaks of over 300 µg/L**.

- **Ubiquity across Europe**: Wines from 10 EU countries were analysed. While average TFA levels varied, wines from all countries showed levels of TFA several orders of magnitude higher than the already high background levels in water; Austrian wines were particularly affected.

- **Co-occurrence with pesticide residues**: Wines with higher levels of TFA also contained a greater number and quantity of synthetic pesticide residues.

These results align with previous findings that PFAS pesticides are the primary source of TFA contamination in agriculture and food chains. Due to the chemical structure of these substances, their degradation into TFA is practically unavoidable under real-world conditions. The data also support as-yet-unpublished findings by a researcher at the University of Freiburg and mirror trends previously observed in official EU studies. Taken together, the evidence paints a clear picture: TFA contamination in food is real, and it is increasing.

Given the irreversible nature of TFA and the absence of viable removal technologies, the authors call for:

- An **immediate ban on PFAS pesticides** and F-gases;

- A **comprehensive monitoring** programme for TFA in food products;

- A **precautionary regulatory approach** that acknowledges the significant toxicological data gaps and potential risks to public health, including children.

TFA is a forever chemical. Every year of inaction further compounds its legacy in our ecosystems and food supply.

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# 1. BACKGROUND

**Trifluoroacetic acid (TFA)** is a so-called "forever chemical" and belongs to the group of **PFAS** (per- and polyfluoroalkyl substances). It enters the environment primarily through the degradation of other PFAS compounds. Once released, it persists indefinitely, as it cannot be broken down by natural processes.

Over the past decades, TFA has become the most widespread – yet largely overlooked – contaminant in Europe's water resources. This was confirmed by investigations conducted in the summer of 2024 by members of the European Pesticide Action Network (PAN Europe), who analysed surface water, tap water, and mineral water across Europe, with a focus on PFAS pesticides-related pollution.[1]

## 1.1 F-Gases and PFAS Pesticides as Major Sources

On a global scale, the main source of TFA pollution is a group of fluorinated refrigerants known as F-gases, which have entered the global water cycle. The use of these substances increased following the **1987 Montreal Protocol**, which phased out ozone-depleting substances such as chlorofluorocarbons (CFCs) — the first widely used generation of refrigerants.

CFCs were replaced by **hydrofluorocarbons (HFCs)**, which do not destroy the ozone layer but have extremely high global warming potential, and **partially degrade in the atmosphere into highly persistent substances like TFA.**

In response to growing regulatory pressure to reduce climate-damaging gases, a third generation of refrigerants – **hydrofluoroolefins (HFOs)** – has been adopted since around 2010. HFOs have a much lower climate impact but **degrade rapidly and almost completely into TFA.** The history of refrigerants is therefore a textbook example of "regrettable substitution": replacing one problematic substance with another, thereby swapping one environmental issue for another. This can be avoided, because viable alternatives do exist.

The second major source of global TFA contamination is PFAS pesticides. These are active ingredients that contain one or more fully fluorinated methyl groups (CF3) bonded to a carbon atom of an aromatic ring. These substances degrade into TFA as a final breakdown product. Since the 1990s, PFAS pesticides have been increasingly used in European agriculture.[2] As of now, 31 PFAS pesticides are approved in the EU, accounting for approximately 15% of all authorised synthetic active substances.

While F-gases are released into the environment in significantly larger quantities than PFAS pesticides, the latter are clearly the **predominant source of TFA in groundwater and drinking water** in rural areas, as shown by a study from the German Environment Agency (UBA).[3]

This is due to the diffuse nature of F-gas emissions, which disperse globally and are largely deposited in the oceans. In contrast, PFAS pesticides are applied locally to agricultural land – an area which covers just 3% of the Earth's surface – yet release nearly 100% of their TFA load

1 PAN Europe, *TFA in water: dirty PFAS legacy under the radar*, May 2024, URL.; *TFA: the 'forever chemical' in the water we drink, July 2024*, URL.: *TFA: the 'forever chemical' in European mineral waters*, December 2024, URL.
2 While no data are available on pesticide use, statistics on pesticides sales suggest an increasing trend in the use of PFAS pesticides in France, Belgium, Austria, Sweden, and Germany (unpublished data). Meanwhile, the detection of PFAS pesticide residues in fruit and vegetables has nearly tripled between 2011 and 2021.
3 UBA, Trifluoroacetate (TFA): *Laying the foundations for effective mitigation. Spatial analysis of the input pathways into the water cycle*, December 2023, URL.

directly into the soil, crops, and groundwater, with direct impacts on drinking water supplies.[4]

According to the UBA, **PFAS pesticides account for 76% of the TFA release potential into groundwater,** followed by precipitation (mainly from F-gases) at 17%, and wastewater treatment plants and slurry at 3% each. Highly contaminated hotspots may also result from direct industrial emissions.

## 1.2 Planetary boundaries under threat

The findings of the European NGO monitoring campaign of surface and drinking water in 2024 were alarming not only due to the ubiquity of TFA in almost all tested water samples, but also because of the concentration levels found. These were two to three **orders of magnitude higher** than the typical concentrations of other PFAS or pesticides in the same waters. In May 2024, we described this as "the largest area-wide contamination of surface and groundwater by a man-made chemical".

In October 2024, a group of leading environmental scientists published an analysis with data supporting this assessment and expanding it to other environmental compartments. TFA has been detected at high concentrations not only in rainwater, oceans, lakes, rivers, and groundwater but also in soils, tree foliage, plant-based foods and even human blood. Due to this widespread presence and its sharply rising environmental levels, TFA is now regarded by scientists as a threat to planetary boundaries.[5]

The planetary boundaries concept, developed by Johan Rockström and colleagues in 2009, defines the ecological limits within which humanity can safely operate.[6] A substance is considered a threat to these boundaries if:

- it accumulates to levels that disrupt key Earth system processes;
- its effects are or may become global in scale;
- its impacts are difficult or impossible to reverse.

Ongoing emissions and global accumulation of TFA meet all three of these criteria, as demonstrated by Hans Peter H. Arp and colleagues in their scientific publication. As long as TFA continues to be released from industrial, agricultural and municipal sources, environmental concentrations will continue to rise. Since nature cannot degrade TFA, it will persist in the global water cycle and biosphere for the foreseeable future. The long-term ecological consequences remain uncertain but one thing is already clear: if current levels prove to be harmful to human health, drinking water supplies will face major challenges.

This is because TFA cannot be removed with conventional water treatment technologies. As a

4 Depending on the country and region, drinking water in Europe is sourced from groundwater and spring water or from surface water such as lakes and rivers.
5 Arp, HP et.al, *The Global Threat from the Irreversible Accumulation of Trifluoroacetic Acid*, 2024/11/12, doi: 10.1021/acs.est.4c06189, Environ. Sci. Technol. 2024, 58, 45, 19925–19935
6 Rockström, J., Steffen, W., Noone, K., Persson, Å., et.al. 2009. *A safe operating space for humanity.* Nature 461: 472-475 DOI 10.1038/461472a.

result, a widespread rollout of reverse osmosis systems across the EU would be required for effective removal. This comes with considerable environmental and financial cost, potentially amounting to hundreds of billions of euros per year. The process would also require a lot of extra water that is not available in many areas. Preventive measures aimed at reducing TFA emissions therefore appear to be a far more cost-effective and sustainable solution.

## 1.3 Health risks largely unexplored

The unprecedented extent of TFA contamination across the biosphere stands in stark contrast to the limited knowledge of its toxicity. Since the introduction of F-gases and other TFA-releasing PFAS, the PFAS industry and affiliated scientists have invested considerable resources in promoting the myth that TFA is harmless to health and the environment.[7] This narrative has been maintained for decades – culminating in the claim that TFA should not be classified as a PFAS due to its small molecular size and supposedly distinct toxicological profile.[8]

Many regulatory bodies accepted this argument uncritically for far too long. In retrospect, this represents a serious and difficult-to-understand failure. Notably, the industry never provided studies to support its claims of harmlessness.

Even today, as recently confirmed by European health authorities, *knowledge is lacking regarding TFA's effects on endpoints such as immunotoxicity, reproductive and developmental toxicity*.[9] There are virtually no robust studies on endocrine or neurotoxic effects, nor are there the standard long-term toxicity and carcinogenicity studies required for pesticide authorisation. This is despite the fact that structurally related PFAS have shown such effects.

However, the myth of TFA's harmlessness was recently shattered by a REACH-compliant animal study on reproductive toxicity. The study found that TFA caused severe malformations in rabbit fetuses, affecting both the skeleton and the eyes. This is highly concerning, especially given that eye malformations had already been observed in the 1980s in rats and humans in connection with the industrial production of long-chain PFAS – though these findings were withheld by manufacturers.[10] As a result of this new data, EU chemical regulators have proposed a harmonised classification of TFA as a substance presumed to be toxic for reproduction (Category 1B).[11] TFA manufacturers themselves have already carried out a self-classification under EU chemicals legislation, categorising TFA as suspected of being toxic for reproduction (Category 2), with the hazard statement: "Suspected of damaging the unborn child."[12]

In light of these troubling findings, combined with the immense data gaps, the derivation of health-based guidance values is an essential yet challenging responsibility. In the past, the lack of toxicological data – and in some cases, the ignorance of existing data – has led to the establishment of guidance values that allowed exposure levels several orders of magnitude higher than what today's scientific knowledge would deem acceptable.

7 Examples of this strategy by the fluorochemical industry have been compiled by Belgian environmental researcher Thomas Goorden in his publication The Dark PFAS Hypothesis - Strategies of Deception.
8 Colnot and W. Dekant, "Commentary: Cumulative risk assessment of perfluoroalkyl carboxylic acids and perfluoroalkyl sulfonic acids: What is the scientific support for deriving tolerable exposures by assembling 27 PFAS into 1 common assessment group?" Archives of Toxicology, vol. 96, no. 11, pp. 3127–3139, Nov. 2022
9 ZORG, 'In-depth analysis of the selection procedure for the health-based recommended value for trifluoroacetic acid (TFA) in drinking water (2024).
10 Gaber N, Bero L, Woodruff TJ. The Devil they Knew: Chemical Documents Analysis of Industry Influence on PFAS Science. Ann Glob Health. 2023 Jun 1;89(1):37
11 ECHA: Registry of CLH intentions until outcome - ECHA
12 ECHA: Summary of Classification and Labelling

This was also true for other structurally related PFAS, for which current limits are over 2,000 times lower than they were just seven years ago.[13] International guidelines from the World Health Organisation (WHO) and the European Chemical Agency (ECHA) recommend applying additional uncertainty factors in cases of major data gaps or suspected serious or irreversible effects, such as fetal malformations.

As we criticised in our report *TFA – The Forever Chemical in The Water we Drink*, these principles were not adequately applied when EFSA derived an **Acceptablee Daily Intake** (ADI) of **50 µg/kg bw/day** (microgram per kilogram body weight per day) for TFA in 2014.[14] The same holds true for the UBA's 2020 value of **18 µg/kg bw/day**, which also fails to account for the significant data gaps.[15]

In contrast, more recent assessment approaches — such as those adopted in 2023 by the Dutch authority RIVM (**0.32 µg/kg bw/day**)[16] or in 2024 by the Flemish health authority Departement ZORG (**2.6 µg/kg bw/day**)[17] — are more closely aligned with the precautionary principle. These approaches explicitly account for existing scientific uncertainties. A comparison of the values derived or used by the four expert institutions is presented in the figure below.

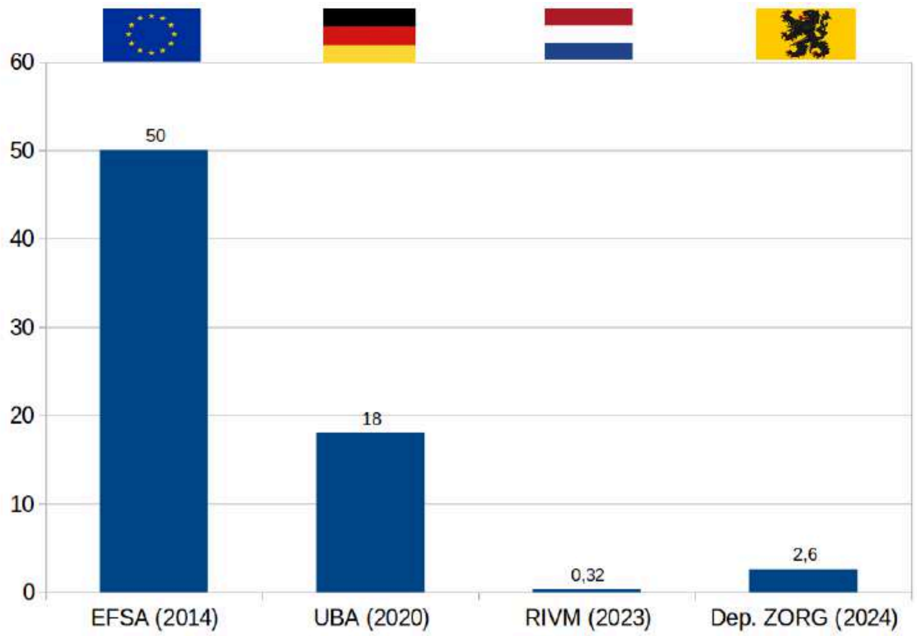


**Figure 1: Diverging Health-Based Guidance Values for TFA in the EU**
The key question of how much TFA a person can ingest daily without incurring a health risk has so far been answered very differently by various health authorities.

The EFSA is currently reviewing the toxicological reference values for TFA at the request of the European Commission. **It is to be hoped that the past tendency to interpret a lack of data as evidence of low toxicity will be avoided.**

13 EFSA, Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and their salts Scientific Opinion of the Panel on Contaminants in the Food chain (2008); Risk to human health related to the presence of perfluorooctane sulfonic acid and perfluorooctanoic acid in food (2018).
14 EFSA, Reasoned opinion on the setting of MRLs for saflufenacil in various crops, considering the risk related to the metabolite trifluoroacetic acid (TFA), Page 10.
15 UBA, Trifluoressigsäure (TFA) – Gewässerschutz im Spannungsfeld von toxikologischem Leitwert, Trinkwasserhygiene und Eintragsminimierung (2020).
16 This value is derived by applying the relative potency factor (RPF) of 0.002 for TFA, as proposed by RIVM, and using the tolerable daily (!) intake for PFOA established by EFSA — 0.63 ng/kg bw/day — as a reference (assuming no other PFAS are present!). In this model, TFA therefore has a tolerable daily intake that is 500 times higher than that of PFOA, which is considered to be extremely toxic.
17 ZORG, In-depth analysis of the selection procedure for the health-based recommended value for trifluoroacetic acid (TFA) in drinking water (2024).

## 2. RESEARCH QUESTION AND ANALYTICAL APPROACH

Following the detection of **ubiquitous and unexpectedly high** TFA levels in all types of water sources, and given the fundamental fact that all life depends on water, the next logical step was to investigate whether, and to what extent, this forever chemical accumulates in plant-based products. Wine was chosen as the focus of this investigation for a specific reason: for no other agricultural product are the harvests from past decades so readily available and well-preserved. This makes aged wine a valuable indicator of historical environmental contamination and its temporal progression.

### 2.1 Sample Selection and Conduct of the Study

To better understand how TFA contamination in wine has developed over time, we included wines from both before and after the main sources of TFA – F-gases and PFAS pesticides – came into use. This meant selecting wines produced prior to 1987, the year the Montreal Protocol was signed, as well as wines from later vintages. This allowed us to examine whether TFA levels in wine have increased over time, potentially due to rising PFAS pesticide use and regulatory shifts following the Montreal Protocol.

The "**old wines**," all of which came from Austria, were partly cellar finds from the personal networks of the study authors, as well as wines located and purchased through online searches. Only wines with intact corks and labels were used, ensuring that both vintage and origin could be clearly verified. We obtained 10 "old wines" from vintages spanning three- to six-year intervals, covering the **period from 1974 – 2015.**

To assess current TFA contamination levels, 16 wines – 12 conventional and 4 organic – **from vintages 2021 to 2024** were initially purchased from Austrian grocery retailers. In each of Austria's four largest supermarket chains, three popular conventional wines and one organic wine were selected. In addition, two non-commercial wines made from fungus-resistant grape varieties from the 2021 and 2022 vintages were privately contributed by one of the study's authors.

After the analysis of the Austrian samples revealed **unexpectedly high TFA concentrations**, other organisations from the PAN Europe network were invited to contribute wine samples from their respective countries. The aim was to determine whether the elevated levels observed in Austrian wines would also be found elsewhere in Europe.

Positive responses came from 10 PAN Europe member organisations in ten EU countries: Belgium (Nature & Progrès and Bond Beter Leefmilieu), Croatia (Earth Trek), France (Générations Futures), Germany (PAN Germany), Greece (Ecocity), Hungary (MTVSZ/Friends of the Earth Hungary), Luxembourg (Mouvement Écologique), Spain (Ecologistas en Acción), and Sweden (Naturskyddsföreningen). This resulted in the submission of 21 additional wine samples from 10 European wine-producing countries.

All wines were submitted in their original packaging to the analytical laboratory Institut Dr. Wagner. Each was tested for TFA contamination, and all young wines (vintages 2021 to 2024) were also analysed for pesticide residues.
An overview and description of all 49 wines – including all analysis results and excluding brand names – is available and can be **downloaded here.**

## 2.2 Analytical Methods

All analyses were carried out by the internationally accredited testing laboratory Institut Dr. Wagner (accredited according to EN ISO/IEC 17025), an Austrian lab specialised in the analysis of plant- and animal-based food products.

All wine samples (10 old wines and 39 recent wines) were analysed for their TFA content, while the recent wines (from vintages 2021 to 2024) were additionally tested for pesticide residues.

**The analysis of TFA** was performed using the Quick Method for the Analysis of Highly Polar Pesticides in Food Involving Extraction with Acidified Methanol and LC-MS/MS Measurement – Part I: Food of Plant Origin (QuPPe-PO-Method), Version 12.3, developed by the EU Reference Laboratory for Pesticides Requiring Single Residue Methods (EURL-SRM), CVUA Stuttgart. For quantitation an isotope labeled compound (13C-TFA) was used as an internal standard.

For **pesticide residue analysis**, the samples were subjected to the Multimethod for the Determination of Pesticide Residues by GC- and LC-Based Analysis following acetonitrile extraction/partitioning and dispersive SPE clean-up – Modular QuEChERS method (accredited according to ÖNORM EN 15662:2018).

# 3. RESULTS

## 3.1 TFA Contamination in Aged and Recent Wines

No detectable levels of TFA could be found in old wines harvested before 1988 – specifically the vintages 1974, 1979, and 1982.

From 1988 to 2010, there was a modest increase in TFA concentrations from **13 µg/L** to **21 µg/L**. From 2010 to 2015, TFA contamination rose sharply to **40 µg/L** and continued to rise increasingly steeply thereafter, reaching an average of **122 µg/L**. This last figure represents the **arithmetic mean of 39 wines** from vintages 2021 to 2024.

The following figure (Fig. 2a) depicts the upward trend in TFA concentrations measured in grapevines from 1974 to the present.

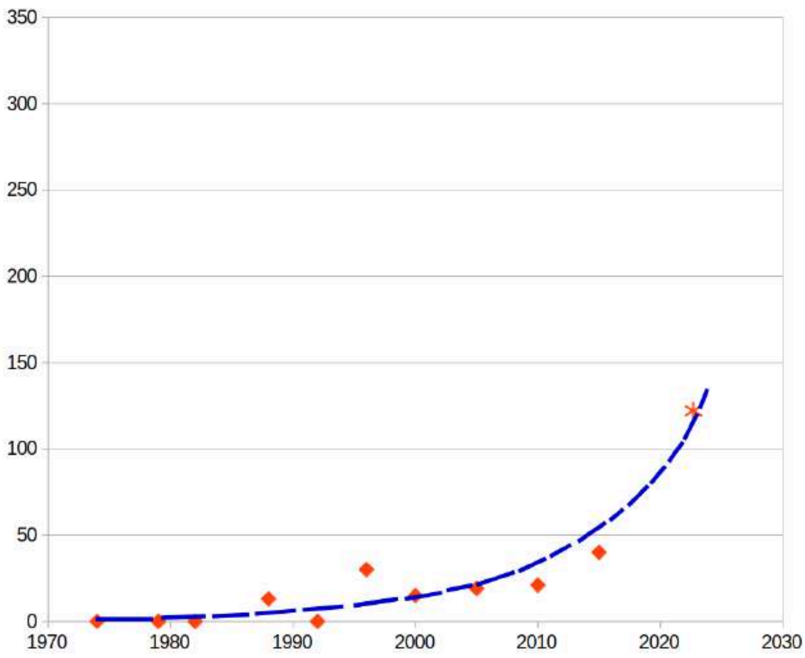


**Figure 2a: Temporal Increase of TFA Concentrations [µg/l] in Wine**

The data points from 1974 to 2015 represent **individual measurements**, while the data point around 2023 represents the **arithmetic mean** of 39 European wines from vintages 2021 to 2023.

The figure below showes the **individual values of all 49 wines** tested. Noteworthy is both the wide range of TFA contamination found in the recent wines from vintages 2021 to 2024, and the overall steep increase in total contamination as represented by the full set of samples.

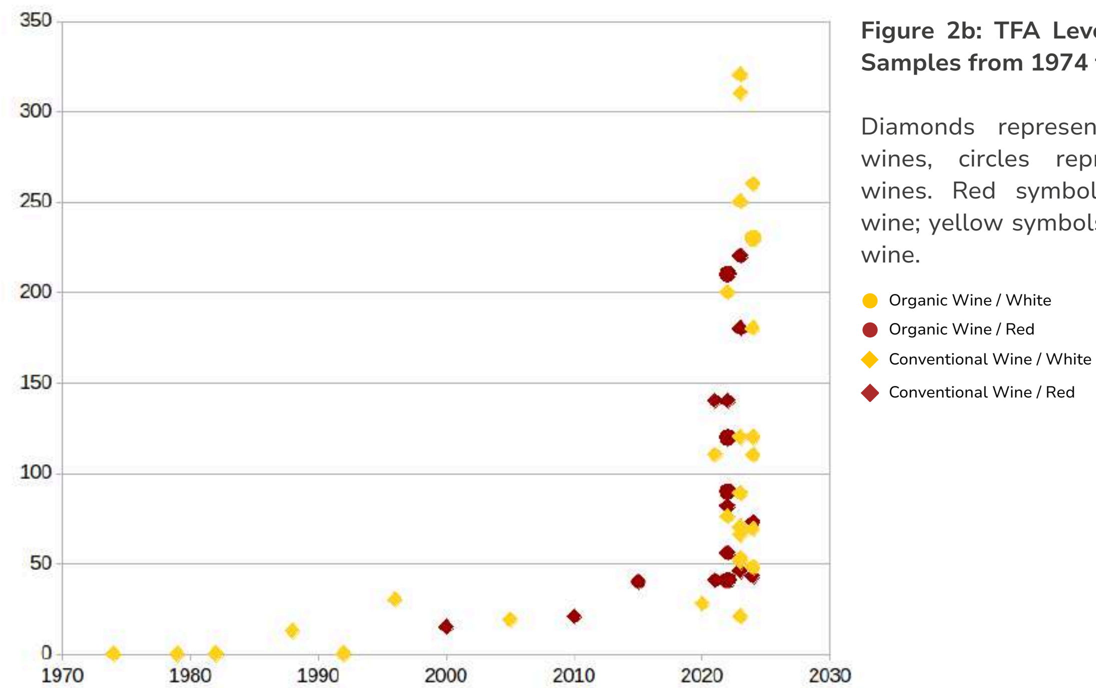


**Figure 2b: TFA Levels in 49 Wine Samples from 1974 to 2024 [µg/L].**

Diamonds represent conventional wines, circles represent organic wines. Red symbols indicate red wine; yellow symbols indicate white wine.

**An overview by country of origin** is provided in the below figure.

The wine purchased in Sweden was an imported French wine; all other samples were grown and purchased in the same country.

The highest TFA level measured was **320 µg/L** in a 2024 Austrian white wine (Gemischter Satz).[18] The lowest value measured was **21 µg/L**. It was found in a 2023 Croatian white wine (Malvazija Istarska). The overall average concentration across the 39 recent wines was 122 µg/L, with a median of 110 µg/L.

TFA concentrations above the average level of 122 µg/L were found in two French red wines – one of which is among the most consumed wines in Sweden – as well as in a Belgian white wine and **in 10 out of 18 Austrian wines**. The average TFA concentration in Austrian wines was 156 µg/L, considerably higher than the average of 92 µg/L observed in wines from other European countries.

Notably, the three Luxembourgish wines – a red, a white, and a rosé, all made from fungus-resistant grape varieties by the same winemaker and from the same vintage – showed very consistent TFA levels of 46 µg/L, 51 µg/L, and 53 µg/L, respectively. This suggests minimal variation under comparable growing conditions.

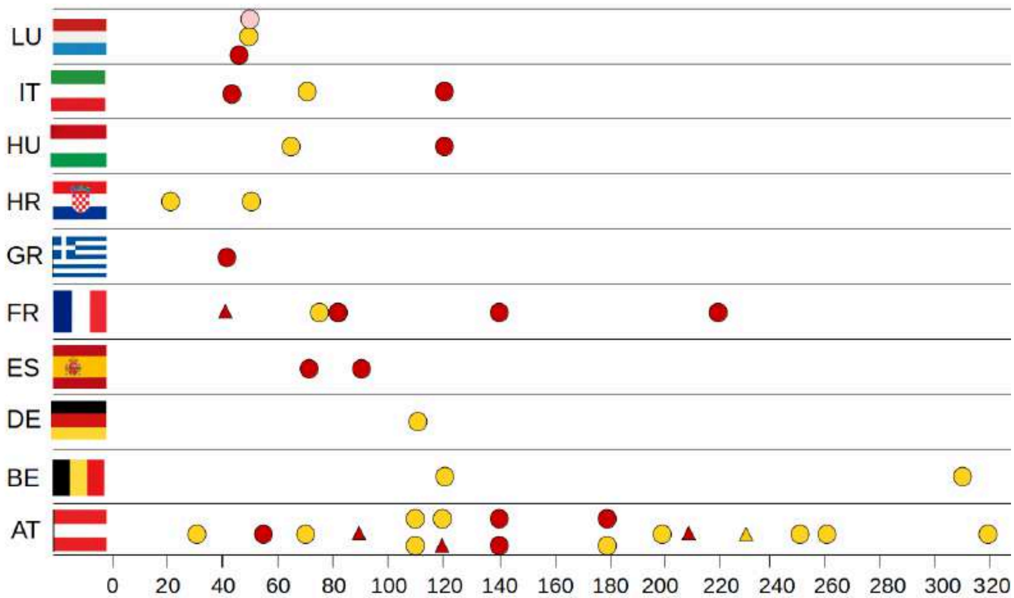


**Figure 3: TFA Levels in 39 Wine Samples From 10 European Countries:**

Conventional wines are shown as circles, organic wines as triangles. Red stands for red wine, yellow for white wine, and pink for rosé.

Among the 18 Austrian wines, the two fungus-resistant varieties exhibited the lowest TFA concentrations, while our findings – in contrast to previous studies – did not show a significant difference in TFA levels between conventional and organic wines from Austria. However, in the case of French wines, the organic wine was clearly less contaminated with TFA than the four conventional ones. However, given the limited number of organic wines in our dataset, no firm conclusions can be drawn from our data regarding differences in TFA contamination between conventional and organic wine production.

18 "Gemischter Satz" is a traditional Austrian field blend made from different white grape varieties grown and vinified together

## 3.2 Pesticide Residues in Recent Wines

Residues of active substances or metabolites were detected in 32 out of 34 conventional wines (94%). Up to eight active substances and metabolites were found in a single wine bottle. On average, conventional wines contained residues of three different substances. All individual concentrations were well below the maximum residue levels (MRLs) for wine grapes under EU Regulation (EC) No. 396/2005, including when taking into account the applicable processing factors for wine grapes.

In total, 18 pesticide active substances and one relevant metabolite – in addition to TFA – were detected. The most frequently found was the synthetic fungicide folpet (including its metabolite phthalimide, with 21 detections), followed by the fungicides dimethomorph and iprovalicarb (12 detections each).[19] Four wines contained traces of the PFAS pesticide fluopicolide, and one of fluopyram; both are fungicides.[20]

Of the 39 recent wines analysed, 5 were organic – 4 from Austria and 1 from France. Four of these wines were free from any detectable pesticide residues. One of the organic wines from Austria contained detectable traces of folpet at levels below the analytical limit of quantification (LOQ=10 µg/l).[21]

A comparison between the less contaminated wines (TFA concentrations below the median value of 110 µg/l) and the more heavily contaminated wines (TFA concentrations ≥ 110 µg/l) suggests a possible association between higher TFA levels and increased pesticide contamination. As shown in the Table below, wines with higher TFA concentrations contained, on average, a greater number of pesticide residues (3.4 vs. 1.8) and a higher total pesticide load (155 µg/l vs. 58 µg/l).

Table 1: Wines with Higher Average TFA Concentrations Also Showed Higher Average Pesticide Loads

| | **Lower contaminated wines** (21–90 µg/L) | **Higher contaminated wines** (110–320 µg/L TFA) |
|---|---|---|
| Average TFA level [µg/L] | 58 | 176 |
| Average pesticide level * [µg/L] | 58 | 155 |
| Average No. of pesticides | 1,8 | 3,4 |
| Average No. of PFAS-pesticides | 0,11 | 0,15 |

*For pesticide concentrations below the limit of quantification (LOQ = 10 µg/L) but above the limit of detection (LOD, commonly assumed as 1/3 of the LOQ), a value of 5 µg/L was used in the calculations.

A detailed overview of the underlying analysis results can be **found and downloaded here**.

19 Folpet has been identified as Parkinson-relevant by the scientific community, while its cancer potential has been underrated. Dimethomorph is now banned because it can damage fertility and has been officially classified as toxic to reproduction and hormone (endocrine) disruptor, while iprovalicarb is a suspected carcinogen.
20 Fluopicolide and Fluopyram are both known to break down to TFA. The first was introduced by Bayer in 2006 as a fungicide, the other was authorised for use in the EU in 2013.
21 Due to the low concentration in the single-digit µg/l range, it is difficult to assess whether the pesticide detected in this specific organic wine sample is the result of unauthorised pesticide use or of drift. The bottler and the responsible organic control body have been informed.

# 4. SUMMARY & CONCLUSIONS

This study reveals two key findings, both of which are alarming on their own, and together underscore the urgent need for immediate action to limit human and environmental exposure to TFA.

First, the extent of contamination: Even in products not treated with PFAS pesticides, the TFA concentrations detected are around two orders of magnitude higher than the typical background levels in rainwater. That TFA can bioaccumulate in plants to this extent is highly concerning.

Second – and even more alarming – our results indicate an explosive, apparently exponential increase in TFA contamination since 2010.

Similar findings – both in terms of the range and levels of TFA concentrations in wine and the dramatic rise in contamination – were observed in an as-yet-unpublished study by Dr Michael Müller, Professor of Pharmaceutical and Medicinal Chemistry at the University of Freiburg. The results of this study were presented on 19 March 2025 at an information event in the European Parliament.

The only official study to date which has measured TFA levels in food supports this troubling picture.[22] Carried out in 2017 by the EU Reference Laboratory CVUA Stuttgart on behalf of the European Commission, the study analysed a wide range of plant-based foods and beverages, including wine. The median concentration across 27 wine samples was already **50 µg/L**, with the highest value reaching **120 µg/L**. The current data from our 2025 investigation – as well as the Freiburg study – indicate that these levels have doubled, with average concentrations exceeding **100 µg/L** and peaks detected above **300 µg/L**.

**These high and continuously rising concentrations raise urgent questions about the sources of this contamination.** In our study, wines in the upper half of the TFA concentration range (mean: 176 µg/l) contained, on average, twice the level of pesticide residues compared to those in the lower half (mean: 58 µg/l). This observation points to a potential link between pesticide use and TFA contamination. At the same time, the detection of similarly high TFA concentrations in organic wines which were free from pesticide residues suggests that the **widespread environmental contamination** of rainwater, groundwater, and agricultural soils also plays a substantial role in the accumulation of TFA in crops. Notably, the five wines in this study produced from fungus-resistant grape varieties were among those with the lowest TFA concentrations. A larger sample size would be required to determine whether this observation reflects a causal relationship.

The ubiquitous TFA contamination of agricultural soils and the underlying groundwater bodies is largely attributable to PFAS pesticides. This is reflected in data from the German Environment Agency (UBA), which identify PFAS pesticides as the main source of TFA pollution in rural areas.[23]

22 EURL-SRM – Residue Findings Report. 2017, URL
23 UBA, Trifluoroacetate (TFA): Laying the foundations for effective mitigation. Spatial analysis of the input pathways into the water cycle, December 2023, URL.

Simple comparison between the annual amounts of TFA deposited via precipitation and the quantities potentially released through pesticide use on the same area of agricultural land leads to the same conclusion. Available data[24] suggest that the potential TFA emissions from pesticide use are four to five times higher than those from atmospheric deposition via rainfall. This is mainly because nearly 100% of PFAS pesticides are applied directly to arable land, whereas only around 3% of global precipitation ends up on arable land – with the majority of rainwater flowing into rivers or oceans.

These findings also reinforce warnings from leading environmental scientists about the potential transgression of planetary boundaries due to the increasing accumulation of TFA in the environment – especially in plants and also in the human body.
TFA – like other PFAS – poses a serious threat to both human health and the environment. The findings presented here are, in themselves, sufficient to justify the immediate cessation of all further TFA emissions.

Moreover, the few publicly available and officially mandated studies on TFA in European food products suggest that grapes – and thus wine – are by no means the only agricultural commodity with systematically high TFA concentrations. Eight years have passed since the only official analysis of food for TFA was conducted by CVUA Stuttgart – years in which, as our results for wine suggest, contamination levels may have increased significantly.

**Against this backdrop, members of the Pesticide Action Network Europe call for immediate action to:**

- Ban PFAS-based pesticides and F-gases immediately, as they represent major sources of irreversible environmental contamination.

- Expand food monitoring to assess TFA contamination across a broader range of agricultural products.

- Ensure precautionary regulatory approaches, given the incomplete but troubling toxicological data.

**TFA, like other PFAS, is a forever chemical. Every year of inaction adds to its lasting legacy in our environment, food, and bodies – putting our health, and that of future generations, at risk.**

24 A ratio of 1:4 or 1:5 can be determined for Germany and Austria, respectively, based on pesticide sales data and precipitation data

# MESSAGE FROM THE BOTTLE

**Publication date: 23 April 2025**

**Lead author:** Helmut Burtscher-Schaden (GLOBAL 2000)

**Contributing authors*:** Sarah Langemann (Global 2000), Angeliki Lyssimachou (PAN Europe), Salomé Roynel (PAN Europe)

**Layout and graphics***: Nicole Imre (GLOBAL 2000), Robert Schwarzwald (GLOBAL 2000)

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*in alphabetical order

**Contact**

**GLOBAL 2000 – Friends of the Earth Austria**
Neustiftgasse 36, A-1070 Wien, Austria www.global2000.at
Dr. Helmut Burtscher-Schaden, Environmental Chemist: helmut.burtscher@global2000.at
Tel. +43 699 14 2000 34

**Pesticide Action Network Europe (PAN Europe)**
Rue de la Pacification 67, 1000, Brussels, Belgium www.pan-europe.info
Salomé Roynel, Policy Officer: salome@pan-europe.info
Dr Angeliki Lysimachou, Head of Science and Policy: angeliki@pan-europe.info
Tel. +32 2 318 62 55

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