International Workshop Supporting the Dialogue Between Science and Policy on PFASs
9–10 November 2017 in Zurich, Switzerland

Thought Starter

Prepared by:

Safety and Environmental Technology Group
ETH Zurich

2 November 2017

(Abbreviated; 29 Nov 2017)

ETH zürich

Safety and Environmental Technology Group

Document Note:

Please note that this is a technically abbreviated version of the original document provided to participants in advance of the workshop. The document has only been shortened, and none of the information presented has been modified. It aims to provide readers with an overview of the range of topics outlined by the workshop organizers for discussion during the workshop.

Table of Contents

1 Introduction

1.1 Purpose of this document

This paper serves to provide background information to workshop participants and to highlight topics and potential outcomes to be discussed and finalized at the workshop.

1.2 Background, aims and motivation of the workshop

Per- and polyfluoroalkyl substances (PFASs, C_nF_{2n+1}–R) are a large family of thousands of chemicals; many PFASs have been manufactured since the 1940s and in large amounts. To date, a sub-set of PFASs, so-called "long-chain" PFASs, are now recognized as global contaminants of emerging concern, due to their persistence (P), bioaccumulation potential (B), toxicity (T) and global presence. Thus, several of them are listed or being evaluated for the listing under the UN Stockholm Convention for a global phase-out in the near future. However, there are still many other PFASs that are structurally similar to the long-chain PFASs on the global market, including both legacy compounds and novel ones; some of these legacy and novel PFASs have been used to replace some of the long-chain PFASs, and these alternatives are largely non-assessed and unregulated.

Recent research shows that it is important and appropriate to now pay attention to such overlooked PFASs due to their hazardous properties (P, long-range transport potential, similar mode(s)-of-action as long-chain PFASs), wide presence in numerous products, and poorly reversible occurrence in major environmental and human exposure routes (caused by P, mobility, and technical and financial challenges in remediation). This urgent need for assessing and managing the whole family of PFASs is increasingly recognized and echoed by a growing number of scientists, regulators and civil societies (see section 2 below). To strengthen and facilitate the dialogue between and promote the co-development of science and policy in the field of PFASs, this two-day workshop will be conducted to engage leading scientists and regulators across the globe to identify common goals between the science and policy sides and to identify potential cooperative actions for working towards a global effort to address PFASs over the next 5–10 years.

1.3 Structure of this document

This document consists of and is separated into the following four parts:

- a brief overview of earlier meetings and major outcomes;
- a proposed set of common goals, actions points and financial mechanisms to be discussed to outline a path for addressing PFASs internationally;
- a bullet-point summary of workshop discussion points.

2 Overview of earlier meetings & major outcomes

Since the first "Fluoros" meeting in 2005 (http://www.chem.utoronto.ca/symposium/fluoros/), there have been many scientific and regulatory meetings that specifically focused, or had specific sessions, on PFASs. These meetings have served as a major platform for scientists and regulators to exchange information and discuss new strategies and concepts on a regular basis, and substantive outcome documents have been generated and published. Due to a limitation of space, in this section we focus on compiling recent meetings and major outcomes, mostly since 2016, and using publicly available outcome documents or those shared by the organizers (please note that the statements presented in this section are primarily direct or abbreviated quotes from the respective original documents). The outcomes of other meetings may have been taken into consideration in the development of this paper, but are not explicitly described here.

2.1 Helsingør and Madrid Statements

Helsingør Statement: http://www.sciencedirect.com/science/article/pii/S004565351400678X

The Statement summarizes key concerns about the potential impacts of fluorinated alternatives to long-chain PFASs on human health and the environment in order to provide concise information for different stakeholders and the public. These concerns include, amongst others: the likelihood of fluorinated alternatives or their transformation products becoming ubiquitously present in the global environment; the need for more information on uses, properties and effects of fluorinated alternatives; the formation of persistent terminal transformation products including perfluoroalkyl carboxylates (PFCAs) and perfluoroalkane sulfonates (PFSAs); increasing environmental and human exposure and potential of adverse effects as a consequence of the high ultimate persistence and increasing usage of fluorinated alternatives; the high societal costs [for research and subsequent actions] that would be caused if the uses, environmental fate, and adverse effects of fluorinated alternatives had to be investigated by publicly funded research; and the lack of consideration of non-persistent alternatives to long-chain PFASs.

Madrid Statement: https://ehp.niehs.nih.gov/1509934/

The Madrid Statement is a follow-up and expansion of the Helsingør Statement and is co-signed by over 200 scientists and regulators. It summarizes key concerns about the production and release into the environment of an increasing number of PFASs, including those addressed by the Helsingør Statement. It further calls on the international community to cooperate in limiting the production and use of PFASs and in developing safer non-fluorinated alternatives. In particular, it proposes a set of actions to be taken by various stakeholders including scientists and governments:

1) **Scientists:** A) assemble, in collaboration with industry and governments, a global inventory of all PFASs in use or in the environment, including precursors and degradation products along with their functionality, properties, and toxicology; B) develop analytical methods for the identification and quantification of additional families of PFASs, including fluorinated alternatives; C) continue monitoring for legacy PFASs in different matrices and for environmental reservoirs of PFASs; D) continue investigating the mechanisms of toxicity and exposure (e.g., sources, fate, transport, and bioaccumulation of PFASs), and improve methods

for testing the safety of alternatives; E) bring research results to the attention of policy makers, industry, the media, and the public.

2) **Governments:** A) enact legislation to require only essential uses of PFASs, and enforce labeling to indicate uses; B) require manufacturers of PFASs to conduct more extensive toxicological testing, make chemical structures public, provide validated analytical methods for detection of PFASs, and assume extended producer responsibility and implement safe disposal of products and stockpiles containing PFASs; C) work with industry to develop public registries of products containing PFASs; D) make public annual statistical data on production, imports, and exports of PFASs; E) whenever possible, avoid products containing or being manufactured using PFASs in government procurement; F) in collaboration with industry, ensure that an infrastructure is in place to safely transport, dispose of, and destroy PFASs and PFAS-containing products, and enforce these measures.

2.2 International Workshop for Authorities on the Assessment of Risks of Short-Chain PFASs (by the German Environment Agency, 24–25 October 2016 in Berlin, Germany)

Source: http://www.reach-info.de/dokumente/short-chain_workshop_summary.pdf

Participants: representatives of six EU-Member State authorities responsible for the assessment of chemical risks (for consumers, workers and the environment) under the European Chemicals Regulation - REACH, the European Commission DG Environment, the European Chemicals Agency (ECHA), and the Australian Government

Content: 1) The latest scientific findings on short-chain PFASs were presented, focusing on bioaccumulation potential in food chains and in humans, enrichment in plants and mobility. 2) A discussion on concerns and possible regulatory actions took place.

Outcomes:

1) The participants shared the view that short-chain PFASs represent a substance group of concern, due to extreme persistence and high mobility in the environment:
   A. They can occur in raw water and can therefore be found in drinking water.
   B. They cannot be eliminated from water with the commonly applied measures, and modern technologies are ineffective in removing them from water.
   C. Their ubiquitous presence in aquatic systems might lead to continuous background exposure to them.
   D. They can be taken up by plants and have already been found in edible crops.
   E. Exposure via food might lead to increased exposure, due to the consumption of water-rich edible plant (parts) contaminated with them.
   F. They show a relevance in organisms: toxicokinetic experiments illustrate bioavailability; protein interactions are similar to that of long-chain PFASs; their elimination half-lives enable sufficient exposure durations for provoking adverse effects in organisms.
   G. Exposure via background concentrations of short-chain PFASs may affect [sensitive] population groups or development stages.

H. Due to the prognosticated increasing use of short-chain PFASs (based on substitution of long-chain PFASs), background concentrations might reach toxic levels.
I. Effects cannot be sufficiently predicted and experimental data are not suited to describe potential long-term effects with adequate clarity.

2) The participants concluded that the intrinsic properties and known exposure profile of short-chain PFASs would justify an initiation of EU-wide risk management measures for them.

2.3 Nordic Workshop on Joint Strategies for PFASs (by the Swedish Chemicals Agency (KEMI), April, 2017 in Stockholm, Sweden)

Source: http://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-4932

Participants: Nordic delegates and representatives from other regions and organizations (e.g., EC DG Environment, European Environment Agency, ECHA, etc.)

Outcomes: The elements below reflect personal views of the participants, and can be considered as being supported by the Swedish Chemicals Agency, the Swedish National Food Agency, the Swedish Environmental Protection Agency, the participants from the Danish Environment Protection Agency and from the Danish Veterinary and Food Administration, the Environment Agency of Iceland, the participants from the Norwegian Environment Agency, the Norwegian Food Safety Authority and from the Norwegian Institute of Public Health, the Environment Agency of the Faroe Islands, the Austrian Environment Agency, and the German Environment Agency.

1) General considerations: PFASs are widely used in society and are as a whole group a cause for concern. The participants identified the needs for improving and expanding the current applicable PFAS terminology, in particular improving nomenclature for some sub-classes of PFASs, as well as more research to fill data gaps. This includes, e.g., substance identification and definition of the PFAS group, toxicity of some substances, in particular those that to date have been overlooked, and bioaccumulation potential. However, the participants agreed also that the current level of knowledge on this group of substances and the extent of concerns about PFASs are sufficient to justify prompt action.
2) Specific considerations:
   A. There is a need to raise more awareness on the problems that PFASs may cause for the environment and human health among the general public, relevant authorities, and policy-makers. This could be combined with an action at the global level to label products containing PFASs, particularly to empower consumers and waste managers.
   B. Regulatory action, preferably a global regulation on PFASs, is needed. Existing EU regulatory tools can be used and further developed. The most effective instruments should be identified and used. A key regulation would be the European Chemicals Regulation, REACH, accompanied by other instruments (e.g., the Drinking Water Directive and Groundwater Directive could be amended to establish limits for PFASs and monitoring obligations).
   C. REACH enables the generation of information (that can be used in other legislations), and some provisions could be given their full potential [i.e. a creative use of existing

provisions for new issues]. For instance, PFASs could be considered "substances of equivalent concern" under Article 57(f) (e.g., based on extreme persistence and mobility) and included in the Candidate List, with a view of making them subject to authorization obligations or to be used as the basis of concern for restriction.

D. Restrictions under REACH could also be applied to non-essential uses of PFASs (in particular in consumer products, both produced in the EU or imported), in addition to the restriction that was already adopted for PFOA, its salts and related substances.

E. REACH was suggested to be amended to: (i) include registration for polymers, and a re-definition of a polymer in line with established polymer science definitions; (ii) allow for more automatic testing for persistence in substance evaluation; (iii) include "very persistent" substances in the Candidate List or make a specific category for "very very persistent" substances; and (iv) ensure that imported articles are covered.

F. Monitoring measures were suggested, including (i) ensuring that producers share information on the chemical identity of their products including impurities, synthesis methods, and analytical methods as well as analytical standards; (ii) developing a standardized method for monitoring total organic fluorine with a low detection limit in various matrices including products and in human blood; (iii) developing a historical inventory of PFASs on the market; and (iv) preparing a monitoring strategy guidance document to support policy measures.

G. The following scientific needs were identified: (i) mechanistic studies of the effects and fate of PFASs in the environment and biota to facilitate read-across and to avoid pseudo-substitutions; (ii) more information on the substance identity of PFASs and alternatives; and (iii) more information on the fate and transport of PFASs at the waste stage (incineration and recycling).

2.4 SETAC Europe Annual Meeting in May, 2017 in Brussels, Belgium – PFAS session

Source: No publicly posted source, condensed from the chairs' notes.

Outcomes:

1) Total organic fluorine methods are useful methods to screen the content of unknown PFASs; however, new analytical methods need to be developed to identify PFASs present in the environment and organisms.
2) Improved understanding of the sources, long-range transport potential to remote regions and fate of PFASs is needed including their exposure routes and associated risks on the ecosystem and humans.
3) Development of alternatives to PFASs needs to take into account their performance as defined by the end-users.
4) New treatment techniques for the degradation of PFASs are developed, however, methods are lacking for the application as a full-scale treatment technique for drinking water, wastewater and contaminated sites.

2.5 ICCE in June, 2017 in Oslo, Norway – Satellite Event "the big picture of PFASs"

Source: No publicly posted source, condensed from event notes.

Outcomes: During a panel discussion, the experts and audience made the following suggestions:

1) Development and better understanding of analytical techniques (incl. total oxidizable precursors (TOP) and total organofluorine (TOF) methods) for measuring more substances and total burden of PFASs in groundwater, soil and agricultural land (e.g., to identify how much (in terms of weight) of total PFASs is still present near sources such as certain industrial sites, airports, wastewater treatment facilities and landfills? Why are they still there? Limitations?)
2) Mechanistic studies of the fate, transport and effects in the environment (especially in soils and sediments) and biota
3) Better data sharing, e.g., via Information Platform for Chemical Monitoring (IPChem; https://ipchem.jrc.ec.europa.eu/RDSIdiscovery/ipchem/index.html) for prioritization
4) Better prioritization of actions including: grouping of PFASs; fast measurement methods (screening, possibly in situ); better international collaboration; system biology and bioinformatics to process all the data existing and upcoming (e.g., omics data); better understanding and definition of the necessity of PFASs in products (i.e., to define "essential uses" of PFASs); non-fluorinated alternatives; how to limit emissions and exposure

2.6 Highly Fluorinated Compounds – Social and Scientific Discovery Conference (hosted by Northeastern University, June 2017 in Boston, US)

Summary: https://www.northeastern.edu/environmentalhealth/highly-fluorinated-compounds-social-and-scientific-discovery/

Content: the social, scientific, political, economic and environmental health issues raised by PFASs

Outcomes: The "invisibility" of PFASs arises from many different factors: (1) Chemical companies conduct their own internal health effect testing and often keep their proprietary information as Confidential Business Information (CBI), sealed from the public. (2) Many companies practice rather "production-oriented" science, i.e. focusing on making production cheaper rather than focusing on developing new science and technology to make safer products. (3) Under the Toxic Substances Control Act (TSCA) industry is rarely required to disclose research on existing chemicals to the US EPA; the limitations of TSCA combined with US EPA's delayed research and action impede health-protective remediation and prevention of continued exposures. (4) Many scientists are often unwilling to take on nearby industry. This structural lack of independent science and public information ultimately hinders communication between scientists, media, and contaminated communities.

Social science research consistently shows that coalitions of stakeholders are necessary for bringing in progressive, public health-oriented regulatory protections. In addition, the following suggestions were made: (1) sharing data despite uncertainties; (2) having more up-front information requirements in regulatory initiatives (e.g., provision of analytical methods by companies); (3) more funding for research as well as dissemination of research results; (4) systematic exposure testing; (5) lowering of the voluntary/legally-binding human health-related thresholds of PFASs through their life-cycle; (6)

taking local to global actions; (7) national enforceable drinking water standards that are science-based, responsible for infants and children, and for combined total PFASs; (8) better communication of data, in particular consolidated data for non-experts.

2.7 Dioxin 2017 in Vancouver, Canada – Science and Policy of Organohalogens by GSPI

http://greensciencepolicy.org/workshop-prior-to-dioxin-2017-science-and-policy-of-organohalogens/

Outcomes: During the talks at the workshop, the following suggestions were made by the speakers:

1) Monitor drinking water for multiple PFASs;
2) Develop enforceable health levels for PFOA, PFOS, C_6 PFCA, and other PFASs in drinking water. An enforceable maximum contaminant level would: require utilities to perform monitoring and to treat water if necessary, and to expedite cleanups by responsible parties;
3) Re-evaluate GenX and ADONA;
4) Do not substitute C_6 PFCA and other PFASs for PFOA and PFOS, due to concerns about extreme persistence, bioaccumulation in plants, suspected toxicities, higher environmental mobility, and more challenges in remediation and treatment.
5) Change to fluorine-free foams rather than PFASs;
6) Currently, there is limited to no regulation regarding the discharge of PFASs through offshore fire-fighting foams, and no research regarding the magnitude and impact of the discharge;
7) Communication strategy for peer-reviewed articles can increase media coverage.

3 Outlining a path for addressing PFASs internationally

This section intends to provide substantive inputs for discussion points during the workshop on: (1) the current needs on both the science and policy sides of the topic, (2) potential common goals between the science and policy sides, (3) potential cooperative actions to address PFASs over the next 5–10 years, (4) potential cooperative actions to maintain a strong science-policy interface in the PFAS field, (5) potential mechanisms to finance/host the cooperative actions (as to be defined in discussion points (3) and (4)), and other enabling factors.

Please note that the text currently proposed below reflects only the ETH Zurich team's view based on a review of previous efforts (see Section 2) and based on the status quo of the science and policy (see Section 3), in addition to personal consultation with various experts. The text is designed as thought-starter to guide, but not limit the extent of, discussions during the workshop. Feedback from the participants including ideas, suggestions and recommendations are highly welcome during the workshop.

3.1 Current needs on the science and policy sides

This discussion point aims to identify current needs on both the scientific and regulatory sides of the topic, consisting of general and specific needs. The following numbering system does not reflect any indication of prioritization.

3.1.1 Needs of the scientific community that can be addressed by the regulatory community

General needs:

1) Being informed about the ongoing and upcoming policy processes and data needs;
2) Funding and resources (including analytical standards), including support for PFASs that do not have high political status yet, and support for the dissemination of relevant research results in formats suitable for non-academics;
3) Access to information on, and a better understanding of, the global (or local) landscape of PFASs to better select target substances for research;
4) Increased awareness of actions set out in "An academic researcher's guide to increased impact on regulatory assessment of chemicals" by Ågerstrand et al. (2017) (http://pubs.rsc.org/en/content/articlelanding/2017/em/c7em00075h#!divAbstract)

Specific needs:

1) Funding and support is needed to carry out long-term biomonitoring and epidemiology studies for humans and to consider chronic exposure in the design of animal studies. This is because many PFASs may mimic endogenous substances (e.g. fatty acids, hormones) to cause subtle changes of basal metabolism and hormone regulation, which makes potential adverse effects caused by such PFASs difficult to detect (i.e. adverse health outcomes are not readily overt, such as being carcinogenic) and even more insidious.

3.1.2 Needs of the regulatory community that can be addressed by the scientific community

General needs:

1) Being informed about progress in science, preferably in a consolidated and concise manner with possible indication of uncertainties (e.g., low-, medium- and high-level of uncertainties) and policy implications;
2) Complete information and clarification for the validation/interpretation/translation of non-standardized test results into existing regulatory systems;
3) Studies that are carried out under the highest standard possible with regard to, e.g., study design and reporting (e.g., using SciRAP tool for reporting in vivo toxicity studies; http://www.scirap.org/Page/Index/9ced3317-ab2b-4617-86f4-f2d3b86a419f/reporting-checklist). Methods used need to be defendable, and reported results need to be comparable, not only with respect to analysis, but also with respect to sampling, sample preparation, QA/QC and other protocols;
4) More data on "new" PFASs for possible regulatory scrutiny/actions

Specific needs:

1) **PFOS, its salts and POSF**

   By decision POPRC-13/4, the POPs Review Committee of the UN Stockholm Convention established an intersessional working group to undertake the activities specified in the process set out in the annex to decision SC-6/4 for the evaluation of PFOS, its salts and PFOSF. In particular, the Committee is seeking for information on PFOS, its salts, PFOSF and their related chemicals to be used in the evaluation of the continued need for the various acceptable purposes and specific exemptions for those chemicals listed in Annex B to the Convention, including the following: (1) Information on PFOS, its salts and PFOSF; (2) Information on sulfluramid; (3) Information on alternatives to PFOS, its salts, PFOSF and their related chemicals (chemical/non-chemical alternatives or processes).

   Deadline for submission: 15 February 2018

2) **PFOA, its salts, and related chemicals**

   These substances are being evaluated by the POPs Review Committee for the listing under the UN Stockholm Convention. Currently, the Committee is seeking for the following:

   i) information that would assist the possible defining of specific exemptions for production and use of PFOA, its salts and PFOA-related compounds in particular in the following applications: (1) Membranes intended for use in medical textiles, filtration in water treatment, production processes and effluent treatment: information on the scope of the applications, used amounts, availability of alternatives and socio-economic aspects; (2) Transported isolated intermediates in order to enable reprocessing in another site other than the production site: information on the quantities used, extent of transport and risks, and use; (3) Medical devices: information on specific applications/uses and timelines foreseen as needed for potential related exemptions; (4) Implantable medical devices: information on the quantities used, extent of transport and risks, and use; (5) Photo imaging sector: information on paper and printing, and information relevant for developing countries; (6) Automotive industry: information on spare parts; (7) Fire-fighting foams: information on chemical composition of mixtures and the volumes of pre-installed amount of fire-fighting foam mixtures.

ii) information on unintentional formation and releases of PFOA, its salts and PFOA-related compounds, in particular from primary aluminium production and from incomplete combustion, and

iii) information on chemical identity of PFOA-related compounds chemical list

Deadline for submission: 12 January 2018

3) **Perfluorohexanesulfonic acid (PFHxS), its salts, and related chemicals**

These substances have been nominated by the Government of Norway and are being evaluated by the POPs Review Committee for the listing under the UN Stockholm Convention. Specific information will be needed for the development of the Risk Profile and Risk Management Evaluation documents within the next two years.

Currently, the drafter of the Risk Profile that is to be discussed at the next POPRC in 2018 is seeking for information on: (1) production, (2) use, (3) releases, (4) hazardous properties including a consideration of toxicological interactions, (5) environmental fate, (6) monitoring data, and (7) exposure in local areas and as a result of long-range environmental transport. The deadline for submission is 8 December 2017.

Next year, the drafter of the Risk Management Evaluation will seek for the following information: (1) technical feasibility and costs of possible control measures in meeting risk reduction goals, (2) technical feasibility, costs, efficacy, risk, availability and accessibility of alternatives (products and processes), (3) positive and/or negative impacts on society of implementing possible control measures including economic aspects and social costs, (4) technical feasibility and costs of waste and disposal implications (in particular, obsolete stocks and clean-up), (5) access to information and public education, and (6) status of control and monitoring capacity. The deadline for submission would be around December 2018.

The call for information and call for comments will be posted on the Convention website (http://chm.pops.int/TheConvention/POPsReviewCommittee/Meetings/POPRC12/POPRC12Followup/tabid/5339/Default.aspx)

4) **C_9–C_{14} perfluorocarboxylic acids and related chemicals**

A restriction proposal for these substances under REACH has been submitted by the Governments of Germany and Sweden (https://echa.europa.eu/registry-of-submitted-restriction-proposal-intentions/-/substance-rev/17841/term). Over the next two years, the proposal will be evaluated by ECHA's Risk Assessment Committee (RAC) and Socio-Economic Assessment Committee (SEAC) for their opinions and conclusion. Specific information as well as public inputs and comments may be requested during the processes with the calls published on the ECHA website.

5) **Six fluorinated alternatives to long-chain PFASs**

The following substances are either being evaluated or set to be evaluated under REACH (https://echa.europa.eu/information-on-chemicals/evaluation/community-rolling-action-plan/corap-list-of-substances):

In 2017: polyfluoro-5,8,11,14-tetrakis(polyfluoroalkyl)-polyoxaalkane (tradename: TFEE-5), ADONA, and EEA (CAS No. 908020-52-0) by Germany; GenX by Germany and the Netherlands;

In 2018: 2-[methyl[(nonafluorobutyl) sulphonyl]amino]ethyl acrylate (CAS No. 67584-55-8) and bis(nonfluorobutyl)phosphinic acid (CAS No. 52299-25-9) by Germany

Specific information on these substances may be needed to inform the process; however, relevant details need to be further confirmed with respective governmental agencies.

6) **Data to support the (possibly) upcoming SVHC-dossiers for short-chain PFASs**

3.2 Potential common goals between the science and policy sides

This discussion point aims to identify potential common goals shared by both the science and policy sides of the PFAS topic. Below are suggested options of potential common goals, and participants may explore further options during the workshop.

3.2.1 A common chemical scope (for molecular structures, see Figure 1 above)

Below are potential chemical scopes that could be considered and expanded by participants at the workshop for future actions on PFASs:

Option A. long-chain PFAAs (i.e. those that are "bioaccumulative" under current regulatory frameworks, including perfluoroether carboxylic and sulfonic acids (PFECAs and PFESAs)) and their major precursors (e.g., fluorotelomer-based substances)

Option B. all PFAAs and their major precursors

Option C. all PFAAs, their major precursors, fluoropolymers and perfluoropolyethers

Option D. all PFAAs, their major precursors, fluoropolymers and perfluoropolyethers, as well as other highly fluorinated substances that may transform into PFAAs in the environment and/or during incomplete combustion such as fluoroelastomers, hydrofluoroolefins and side-chain fluorinated aromatics.

3.2.2 Common goals in respective action areas

Below are suggested areas wherein actions may take place. These can be discussed and expanded at the workshop. Detailed goals and focuses/priorities within individual areas may vary slightly between the science and policy sides and are subject to discussion at the workshop. It should be noted that different goals could be set for different PFAS sub-groups as discussed in Section 3.2.1 above, subject to priorities. For example, a major goal for addressing fluoropolymers, fluoroelastomers and perfluoropolyethers might be to focus on addressing incomplete combustion, whereas for PFAAs and precursors a major goal might be to focus on the phase-out of non-essential uses and development of alternatives for essential uses.

Area A. hazard, exposure and risk assessment (e.g., hazard-based vs. risk-based; grouping vs. substance-by-substance)

Area B. emission control (e.g., restriction of production and use to "essential uses" with a long-term vision towards a total phase-out)

Area C. exposure control (e.g., drinking water guideline values)

Area D. cleaning-up of contaminated sites

Area E. development of safer alternatives

Area F. management and disposal of PFAS-containing wastes

3.3 Potential cooperative actions to address PFASs

This discussion point aims to propose a series of actions that could be taken into consideration by the workshop participants as well as the larger scientific and regulatory communities in their future work. Below are several suggested options for potential cooperative actions. Detailed characteristics (e.g., participants, benefits, impact, time-frame, funding, prioritization) of these action points and further action points may be considered and discussed at the workshop as appropriate. In addition, developing country perspectives and engagement of developing countries should be considered in the development and implementation of such cooperative actions.

3.3.1 Actions for a better understanding of the global/local landscape of PFASs

1) **Expansion of the current common terminology** by, for example, a group of experts (academics, industry, regulators) to accommodate all PFASs and other highly fluorinated substances (that may transform into PFAAs, but are not yet considered as PFASs), using e.g., a set of multi-level codes and abbreviations. After the expanded common terminology is developed, it should be promoted between the scientific and regulatory communities so that everyone will have the same understanding of the same terminology. Specific points may include, but are not limited to, the following:

   i) *a clearer definition of polymeric vs. non-polymeric PFASs*

   It is important to note that current regulatory definitions of polymers in existing systems may create loopholes for some manufacturers (e.g., exemptions from REACH, etc.). This may be particularly relevant/critical for per- and polyfluoroether-based substances, e.g., whether or not a mixture of substances like $CF_3(CF_2CF_2O)_nCOOH$, n = 3,4,5 are polymers or non-polymers under REACH.

   ii) *an expanded definition of short- vs. long-chain PFASs*

It is important to note that the current definition of short- vs. long-chain PFASs is suitable only for PFCAs and PFSAs, and this may need to be expanded to include other PFAAs (e.g., PFPAs, PFPiAs, PFECAs?, PFESAs?) and their precursors as appropriate.

iii) *a clearer terminology for PFAA precursors including degradation intermediates*

It is important to note that the current terminology proposed in Buck et al. (2011) refers to only PFAAs and major PFAA precursors that mainly serve as building blocks or synthesis intermediates (e.g., n:2 fluorotelomer alcohols, acrylates or sulfonates), whereas there is a lack of terminology for other major PFAA precursors including degradation intermediates. The terminology for PFAA precursors may need to be further clarified.

iv) *a clearer terminology for per- and polyfluoroether-based substances*

There is no common terminology for these substances. In some cases, trade name (e.g., GenX), starting material (e.g., HFPO-dimer acid) or structure (PFPrOPrA) have been used for the same substance. None of these are intuitive, and there may be more PFPEs in the future. It is important to note that it may be challenging to define these substances under a uniform terminology, given different positions and different numbers of ether linkages inserted into their perfluorocarbon chain.

v) *an inclusion of cyclic analogues of PFASs*

It is important to note that the current definition of PFASs does not (necessarily) include the cyclic analogues of some PFASs. For example, potassium perfluoroethylcyclohexane sulfonate (CAS No. 67584-42-3; C_2F_5-C_6F_{10}-SO_3H) is a cyclic analogue of and a by-product during the electrochemical fluorination of PFOS. Thus, the terminology may need to be expanded to include these relevant cyclic analogues of PFASs.

vi) *an inclusion of other highly fluorinated substances*

Many highly fluorinated substances that are not in the current domain of PFASs may also transform into PFAAs due to the recalcitrance of perfluoroalkyl chains, including fluoroelastomers, hydrofluoroolefins, perfluoroalkene and derivatives, side-chain fluorinated aromatics, and others (for examples, see Figure 1 above). Thus, the terminology may need to be expanded to include these relevant substances.

vii) *to clearly distinguish the identity of structures represented by the assigned CAS number.* For example, whether the CAS number refers to linear isomers, branched isomers, or a mixture of linear and branched isomers.

2) **Developing a web-based database** of PFASs (and other related highly fluorinated substances) that may have been on the global market (including those may not be intentionally added in final products, e.g., production by-products, synthetic intermediates, degradation intermediates).

   i) *benefits*: scientists and regulators may use such a database to determine the chemical scope and possible priorities of their research/actions (incl. the development of non-target screening methods).

ii) *potential content*: chemical identity including trade names, molecular structure, production and uses, volumes, potential exposure media, regulatory status, physicochemical properties, availability of analytical standards, and alternatives, etc.

iii) *starting point*: The OECD/UNEP Global PFC Group is working on updating the OECD 2007 list, which could be used as a starting point for the database and has identified issues to be further considered and addressed (e.g., the descriptions of many PFASs in the public domain remain unclear, inconsistent, or claimed as Confidential Business Information by companies; one CAS number for complex mixtures).

iv) *future development*: plans for hosting and financing to ensure long-term sustainability, maintenance and expansion of such a database should be considered and addressed.

v) *potential synergy*: US EPA Chemical Dashboard (https://comptox.epa.gov/dashboard); AMAP database for Chemicals of Emerging Arctic Concern (http://chemicals.amap.no)

3) **Developing a mechanism of labeling (or tracing) PFASs in products**

i) *benefits*: a better understanding of the actual use of PFASs; a better understanding of potential releases and exposure; scientists and regulators may use such information to determine and possibly prioritize their research and actions; a better understanding for waste managers to handle PFAS-containing wastes; useful for private and corporate consumers to make purchase decisions.

ii) *existing mechanisms*: In many countries, manufacturers need to notify regulators for the approval of PFAS use in cosmetics and personal care products, pesticide formulations, food contact materials, and pharmaceuticals. Manufacturers may also need to label PFASs in ingredient lists (e.g., in the case of cosmetics) or in safety data sheets (e.g., in the case of pesticides). However, due to their high efficacy, PFASs may be present at levels below general labeling requirements.

iii) *issues to be considered*: product and chemical scopes (e.g., food contact materials, textiles, building products, toys, etc.); format (legally-binding initiatives vs. voluntary programme); legal basis; engagement and involvement of downstream industrial users; how to share information among countries; compliance and monitoring (including development of cheap, easy-to-handle, sensitive standardized analytical methods)

iv) *potential synergy*: UN Environment's Chemicals in Products (CiP) Programme (http://www.unep.org/chemicalsandwaste/what-we-do/science-and-knowledge/chemicals-products-cip-programme); The global PFAS database as outlined in point 2) above

4) **Developing a(n) independent/central depository of analytical standards**

3.3.2 Actions for a better understanding of the burden of PFASs in the environment and biota globally/locally

1) **Developing a global network of scientists and regulators** who have access to the waste streams of and/or sites close to major PFASs manufacturers and users, as well as those who have access to non-target detection methods.

i) *benefits*: a better monitoring of industry production and release activities; a better capturing and sharing of lessons learned and samples among people at different sites

ii) *format*: e.g., an online forum, a mailing list, regular calls, etc.

iii) *potential synergy*: Pollution release and transfer register (PRTR) systems across countries

2) **Developing systematic monitoring strategies and campaigns including in remote areas.**

i) *benefits*: a better understanding of the total global burden of PFASs including those overlooked and unknown PFASs; identification of overlooked hotspots and exposure pathways; monitoring and effectiveness evaluation of existing measures

ii) *issues to be considered*: a summary of currently known potential exposure "hot-spots"; how to engage developing countries, e.g., to get an overview of exposure levels in developing countries; different bioaccumulation and biological effects in different species be considered, in particular differences between air-breathing and water-breathing species; etc.

iii) *starting point and potential synergy*:

- Air: multiple frameworks exist, see http://chm.pops.int/Default.aspx?tabid=269;

- Water: Aquatic Global Passive Sampling Network (http://www.aqua-gaps.passivesampling.net);

- Human breast milk: Global Monitoring Plan (GMP) under the Stockholm Convention (http://chm.pops.int/Implementation/GlobalMonitoringPlan/Overview/tabid/83/Default.aspx);

- Norman network (http://www.norman-network.net/);

- Human Biomonitoring for EU (HBM4EU; https://www.hbm4eu.eu);

- Developing criteria and guidance/guidelines for the identification of PFAS-contaminated sites as outlined in 3.3.2, point 3) below; developing online platform for identified PFAS-contaminated sites as outlined in 3.3.2, point 4) below

3) **Developing criteria and guidance/guidelines for the identification (and remediation) of PFAS-contaminated sites.**

i) *issues to be considered*: Remediation will often require "incineration of dirt" and the costs may be prohibitive if the benefit is not there; Monitoring of affected citizens along with their water sources may be required prior to remediation activities; When and how to conduct impact and cost-benefit analysis need to be better defined; How to capture and share expertise, experience and lessons learned of identification and remediation of PFAS-contaminated sites over time, e.g., inclusion of a summary of currently known potential exposure "hot-spots"; How to engage industry (incl. chemical manufacturers, drinking water companies, wastewater and waste treatment companies) in developing and sharing remediation/treatment techniques

ii) *example*: German guideline for PFAS-contaminated sites (in German)

http://www.laenderfinanzierungsprogramm.de/cms/WaBoAb_prod/WaBoAb/Vorhaben/LABO/B_4.14/index.jsp

iii) *potential synergy*: developing systematic monitoring strategies and campaign as outlined in Section 3.3.2, point 2) above; developing online platform for identified PFAS-contaminated sites as outlined in 3.3.2, point 4) below.

4) **Developing an online platform for identified PFAS-contaminated sites**

i) *benefits*: a better understanding of the magnitude of PFAS-contamination; a better capturing and sharing of lessons learned among different sites; a basis for potentially developing an early-warning system for identifying overlooked PFAS-contaminated sites (e.g., those have similar industrial sites);

ii) *starting point and potential synergy*:

- PFAS contamination site tracker by the Northeastern University and EWG in the US (http://www.ewg.org/interactive-maps/2017_pfa/index.php; http://www.ewg.org/research/mapping-contamination-crisis; https://docs.google.com/spreadsheets/d/10XLF3jfsrUGkpRxKL6D5uS1W8nZzJPOBZ3yN1PaBWBM/edit#gid=1875666542);

- A Greenpeace US report (http://www.greenpeace.org/international/Global/international/publications/detox/2016/PFC-Pollution-Hotspots.pdf)

3.3.3 Developing joint hazard assessments of selected PFASs incl. management options

i) The main goal of such studies would be to increase the mechanistic understanding of the structure-properties relationships of target PFASs, facilitating read-across and/or grouping of PFASs, as well as to provide a scientific basis for regulatory actions on these PFASs. Such understanding may also be used to guide / support future development of in-silico tools including quantitative structure-property relationships (QSAR) and adverse outcome pathways (AOPs) so that not all PFAAs need to be individually tested in the future. In addition, such mechanistic understanding may provide insights into the structural design, synthesis and toxicity testing for new chemicals, particularly alternatives to PFASs.

ii) The overall scope can be a subject to be discussed and finalized at the workshop, as well as the format of such studies, potential collaborations, and synergies.

iii) The selection of PFAAs should focus on those that have not been assessed and/or regulated previously and should include in particular PFECAs and PFESAs to understand how ether linkages may influence the properties. Besides the chemical structure, also the potential of environmental and human exposure (e.g., production, uses, releases) may be considered.

iv) The overall scope of joint hazard assessments can include, but is not limited to, analytical methods, physicochemical properties including adsorption, degradation mechanisms and pathways, protein binding and associated toxicokinetics, modes/mechanisms-of-action and biomarkers (incl. development of relevant Adverse Outcome Pathways and effect-oriented analysis, for example), life-cycle (incl. disposal such as combustion and landfills, trade and recycling) and exposure pathways, and treatment, remediation and risk management options.

v) Another important aspect to be considered is the mixture toxicity, e.g., development of effect-oriented chemical and biological analysis and predictive models to evaluate the total burden of simultaneous exposure to multiple PFASs.

vi) A further aspect may be to develop harmonized limit values of PFASs in various media including drinking water, groundwater, sludge, wastes, landfill leachates, etc.

vii) A further aspect may be to develop PFAS-relevant assessment frameworks and tools for future PFASs (e.g., specific consideration of most relevant (critical) toxic effects and pathways such as hepatotoxicity, developmental toxicity, neurotoxicity and immunotoxicity; highlight which endpoints may not need to be considered; development of predictive in-silico tools such as QSAR models and AOPs).

viii) A further aspect may be to better understand the fate and behavior of PFASs in the disposal phase, e.g., (potential) formation of PFASs and HFCs from the incomplete combustion of PFASs- and other highly fluorinated substances-containing waste. This additional aspect could also be a separate study.

ix) A further aspect to be considered is the socio-economics in relation to risk management options, e.g., in line with the OECD SACAME project (Socio-economic Analysis of Chemicals by Allowing a better quantification and monetisation of Morbidity and Environmental impacts; http://www.oecd.org/chemicalsafety/sacame.htm). In particular, it may address issues in relation to assessing externalities arising from the use of PFASs (i.e. societal costs) in addition to a current focus on industry costs of a substitution/removal. This additional aspect could also be a separate study with the goal to develop "best practices" guidelines for socio-economic and regulatory impact analysis for PFASs.

3.3.4 Developing a mechanism for determining whether the uses of PFASs in certain products or product categories are an "essential use" for society (or consumers) or not

i) *benefits:* a basis for removing non-essential uses of PFASs from the market; a basis for determining and prioritizing future activities in certain sectors; a model case for chemicals management; transparency potentially as a key enabler and driver of confidence building among consumers for industry

ii) *examples:* the Montreal Protocol (see figure below)

Box 1: Criteria for essentiality and conditions for authorizing essential use (paragraph 1 (a) and (b), Decision IV/25, 4th Meeting of the Parties (1992))

Use of a controlled substance should qualify as essential only if:

- It is necessary for health, safety or is critical for the functioning of society (encompassing cultural and intellectual aspects); and
- There are no available technically and economically feasible alternatives or substitutes that are acceptable from the standpoint of environment and health.

Production and consumption, if any, of controlled substances for essential uses should be permitted only if:

- All economically feasible steps have been taken to minimize the essential use and any associated emission of the controlled substance; and
- The controlled substance is not available in sufficient quantity and quality from existing stocks of banked or recycled controlled substances, also bearing in mind the developing countries' need for controlled substances.

iii) *issues to be considered*: clear and workable definition and criteria of "essential uses" needed; information sources; decision-making bodies; stakeholders to be involved; processes and public participation; etc.

iv) *potential synergy*: UN Environment's Chemicals in Products Programme; global PFAS database in Section 3.3.1, point 2) above; mechanisms of labeling (or tracing) PFASs in products in Section 3.3.1, point 3). above; new stewardship program for phasing-out additional PFASs in Section 3.3.6 below; promotion of transition to safe (non-fluorinated) alternatives in Section 3.3.7 below

3.3.5 Developing Best Available Techniques (BAT) and Best Environmental Practices (BEP) guidance documents for minimizing PFAS emissions from essential uses and wastes

Examples:

- BAT/BEP Guidance documents under the Stockholm Convention

(http://chm.pops.int/Implementation/BATandBEP/Overview/tabid/371/Default.aspx);

- Guidance for Best Environmental Practices (BEP) for the Global Apparel Industry Including Focus on Fluorinated Repellent Products by Fluorocouncil

(https://fluorocouncil.com/PDFs/Guidance-for-Best-Environmental-Practices-BEP-for-the-Global-Apparel-Industry.pdf);

- Best Practice Guidance for Use of Class B Firefighting Foams by Fire fighting Foam Coalition: https://docs.wixstatic.com/ugd/331cad_188bf72c523c46adac082278ac019a7b.pdf;

- Environmentally Responsible Use of Fluorinated Fire-Fighting Foams by UBA (https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/fluorinated_fire-fighting_foams_schaumloeschmittel_engl._version_25.6.2013.pdf)

3.3.6 **Developing a new (voluntary) stewardship program** for (phasing-out) additional PFASs (in addition to long-chain PFASs) using the US and Canada 2010/15 PFOA Stewardship Program as a model case

i) *benefits*: such a programme may promote true innovation towards safer alternatives instead of incremental substitution of hazardous substances, particularly providing innovative small & medium-sized companies an opportunity to enter the market (Hintzer and Schwertfeger from 3M/Dyneon GmbH conclude that "the changing landscape with regard to regulation of APFO and related fluorosurfactants have led fluoropolymer manufacturers to re-evaluate and in some cases introduce polymerization approaches, which in previous times were considered not economically feasible." (DOI: 10.1002/9781118850220.ch21)).

ii) *issues to be considered*: How to initiate such a program? Chemical and geographical scope? Which data and support by whom may be needed?

iii) *potential synergy*: UN Environment's Chemicals in Products Programme; mechanisms for determining essential uses in Section 3.3.4 above; promotion of transition to safe (non-fluorinated) alternatives in Section 3.3.7 below

3.3.7 Promotion of a transition to safe (non-fluorinated) alternatives in certain sectors

i) *examples:*

Project "Substitution in Practice of Prioritised Fluorinated Chemicals to Eliminate Diffuse Sources (SUPFES)" (focusing on durable water-repellent textiles; http://www.reach-clp-biozid-helpdesk.de/de/Veranstaltungen/pdf/2015/151126/151126_Jönsson.pdf?__blob=publicationFile&v=2);

Project "Reduction and Phase-out of PFOS in Priority Sectors in China" funded by the Global Environment Facility (GEF), Worldbank (in which, alternatives will be identified, assessed, demonstrated and disseminated for the chrome plating industry, red imported fire ant control, and firefighting foams; http://projects.worldbank.org/P152959/?lang=en&tab=overview)

ii) *issues to be considered*: How to engage chemical manufacturers and downstream industrial users (in particular designers as well as industrial scientists and engineers)? How to promote and provide incentives for non-chemical alternatives and new business models such as chemical leasing?

iii) *potential synergy*: UN Environment's Chemicals in Products Programme; "Substitution Support Portal" (http://www.subsport.eu); mechanisms for determining essential uses as outlined in Section 3.3.4; Swedish National Centre for Chemical Substitution with the needs of chemical companies in focus (https://www.riksdagen.se/sv/dokument-lagar/dokument/kommittedirektiv/centrum-for-okad-substitution-av-farliga-amnen-i_H4B125); there is currently an application in which many companies (textile manufacturers, firefighting foam manufacturers, paper manufacturers, etc.) are grouping together with researchers to make PFAS-free products (more details to be clarified in the future)

3.4 Potential cooperative actions to maintain a strong science-policy interface in the field of PFASs

This discussion point aims to identify potential strategies and actions to sustain a strong science-policy interface in the field of PFASs, in particular how to sustain the efforts made at the workshop in the medium and long term. A specific focus may also be given to discussion on how to strengthen the collaboration and cooperation between developed and developing countries. Detailed characteristics (e.g., participants, benefits, impact, time-frame, funding, prioritization, etc.) of these action points and further action points may be considered and discussed at the workshop. Additionally, developing country perspectives and the engagement of developing countries should be considered in the development and implementation of such cooperative actions.

3.4.1 Developing a strategy for communicating with and engaging other stakeholders

i) *benefits*: leverage efforts made at the workshop in the larger and wider community; increased buy-in and long-term sustainability of efforts made at the workshop; promote true innovation of safe technology; allowing for unified messaging, efficient use of resources for material development, and full coverage for individual, community, or decision-makers; prevention of "reinventing" the wheel

ii) *stakeholder groups*: chemical manufacturers including their scientists; downstream industrial users (in particular, designer and industrial scientists); civil society; the public; consumer regulatory agencies; etc.

iii) *potential components*: a targeted communication/outreach plan (e.g., how to communicate what we do know to empower private and corporate consumers as well as policymakers to make better decisions); how to engage and provide incentives to chemical manufacturers so that they share analytical standards as well as information on the chemical identity, production and uses; etc.

iv) *challenges*: possible passive-aggressiveness by certain stakeholders (e.g., established PFAS manufacturers might have natural conflicts of interest against any progressive assessment and management of PFASs and other related highly fluorinated substances); challenges in balancing among stakeholders (e.g., too many stakeholder with too many distinct voices); challenges in connecting with the general public (e.g., no consolidated voice of the general public); challenges in connecting with downstream industrial users (e.g., often they may not know what they are using)

v) *Examples of options for improving stakeholder engagement to be considered:*

a) targeted awareness-raising campaigns (in close collaboration with, e.g., civil society) for policy-makers, the public and future generations, respectively;

b) first harmonize views among scientists and regulators, then expand the discussion to other stakeholders;

c) develop a stakeholder engagement plan/matrix incl. identification of the mission and cooperation among different bodies in the field

vi) *Examples of existing frameworks:*

Canadian Chemicals Management Plan Stakeholder Engagement Framework

(http://www.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=37843&Itemid=270&lang=en)

3.4.2 Developing an international web-portal for information exchange as well as monitoring and sharing progress for action points discussed in section 3.4

i) *benefits*: all stakeholders use the same terminology and get the same information (e.g., downstream industrial users may learn from each other); to keep a clear overview of various action points taken by the science and policy sides and at the interface, as well as their link to the overarching goals

ii) *potential components*:

a) an online platform for an overview of the outlined path for addressing PFASs including sharing progress, outputs and outcomes of action points discussed in section 3.4;

b) an online platform/forum for sharing project concepts and "call for information" among stakeholders, joint calls across organizations, and crowd-funding for projects (including group purchasing of analytical standards);

c) an online platform for monitoring and sharing progress made in transition to safer alternatives, including links to information on alternative chemicals and technologies;

iii) *starting point and potential synergy:* OECD PFAS web-portal (http://oe.cd/23B); "Substitution Support Portal" (http://www.subsport.eu); various actions outlined in Section 3.3 above

3.4.3 Developing a global conference on PFASs to share state-of-the-art knowledge and keep interactive science-policy dialogue ongoing

i) *goal*: regular assessment of the status quo of the science and policy sides, highlight gaps within and between the science and policy sides, and identify opportunities and synergies (e.g., through the development of an outcome synthesis report); raise awareness and political priorities (e.g., through the invitation of ministry participants); training of scientists and regulators to better understand each other

ii) *examples:*

- International Conference on Mercury as a Global Pollutant (ICMGP) – It has been running every 2-3 years since the first meeting in Gävle, Sweden in 1990. The conference has provided a forum for researchers and policy makers to explore important advances in mercury research and to facilitate internal and international collaborations. Recent meetings have attracted many hundreds to over a thousand conferees for a five-day conference and exhibition.

- International Symposium on Flame Retardants (BFR), every two years

iii) *issues to be considered*: How to distinguish this global conference from other existing scientific conferences such as SETAC Annual Meetings and Dioxin (e.g., back-to-back with one of these conferences or with other large conferences in the policy side); a workshop for young scientists within the frame of such a conference can include an overview on regulatory processes and current policies in the field of PFASs, existing science-policy interfaces, reports of scientists working at the interface to show potential areas of work, or a course on the psychology of the "cross-cultural" communication between scientists and policymakers.

3.5 Potential mechanisms to finance/host the cooperative actions and enabling factors

This section aims to identify potential mechanisms that may finance/host the cooperative actions identified during the discussion of Sections 3.3 and 3.4, as well as potential enabling factors to be considered as references for the development and implementation of these action points. Below are some examples. Detailed use of them and further mechanisms could be discussed at [and after] the workshop as appropriate.

3.5.1 Potential organizational mechanisms for hosting

1) **OECD/UNEP Global PFC Group**

The Group is a multi-stakeholder group to facilitate the exchange of information on PFASs and to support a global transition towards safer alternatives. During ICCM4, a workplan was proposed and agreed upon by SAICM stakeholders (see below), subject to resource availability. Specific approaches and methodologies to undertake the activities below are to be further elaborated within the Group.

	2015	2016	2017	2018 - 2020
Risk reduction approaches for PFASs across countries	Publish report on *Risk Reduction Approaches for PFASs – A Cross-Country Analysis*	Further dissemination of results from the risk reduction report.	Planned update of the report	Planned publication of the updated report
Update the OECD 2007 list of PFASs	-	Start the process for updating the list through consultation with the PFC Group	Planned publication of the updated list	
Enhance information and knowledge sharing on alternatives to PFASs, including on short chains alternatives	Early discussions on how to structure future work on alternatives	One webinar planned in early 2016 to discuss and organise future work of the group on alternatives; commissioning of reports, or the development of synthesis reports from presentations at the webinars	TBD	TBD
Survey on production and use of PFASs	Publish policy paper on PFAS emissions and gaps	Based on the publication - design future information gathering on emissions or production volumes as they relate to product use and exposure potential.	Carry out information gathering and compile report, as identified in 2016 design.	Build upon 2015-2017 work as identified by group
PFC Web Portal	Streamline Web Portal	Continue to update Web Portal and identify areas to supplement	Continue to update Web Portal and identify areas to supplement	Continue to update Web Portal and identify areas to supplement
PFC Uses and Product Content	-	Develop strategy for examining - Market trends and analysis on products containing PFCs - Gathering information on product content.	Implement strategy identified in 2016.	Disseminate findings and build upon 2015-2017 work as identified by group
Capacity Building	UNEP/OECD to develop strategy for further capacity building, particularly with OECD partner countries	Implement capacity building activities	Implement capacity building activities	Implement capacity building activities

2) **OECD (provided approval is granted by the OECD Joint Meeting)**

i) Cooperative Chemicals Assessment Programme (CoCAP)

(http://www.oecd.org/env/ehs/risk-assessment/cocap-cooperative-chemicals-assessment-programme.htm)

ii) Adverse Outcome Pathways, Molecular Screening and Toxciogenomics

(http://www.oecd.org/chemicalsafety/testing/adverse-outcome-pathways-molecular-screening-and-toxicogenomics.htm)

3) **Arctic Monitoring and Assessment Programme (AMAP)**

i) AMAP assessments of Chemicals of Emerging Arctic Concern (CEAC)

(https://www.amap.no/documents/doc/Chemicals-of-Emerging-Arctic-Concern.-Summary-for-Policy-makers/1533)

3.5.2 Potential financial mechanisms

1) **Global Environment Facility (GEF)**

i) together with the SAICM Secretariat / UN Environment / OECD / IPCP

ii) similarly to an existing project on best practices of addressing SAICM EPIs including lead in paint & chemicals in products: https://www.thegef.org/project/global-best-practices-emerging-chemical-policy-issues-concern-under-strategic-approach

iii) existing linkages: POPs and candidate POPs (PFOS, PFOA & PFHxS and related substances); SAICM (PFASs as an Issue of Concern); Montreal Protocol (HFCs may be generated during the incineration of PFASs and other highly fluorinated substances)

2) **Nordic Council**

i) The Nordic Chemical Group (NKG) provides funding for projects that fall within its remit and correspond with the priorities it sets each year. The Group's objective is to minimize the negative impact on health and on the environment of the chemicals contained in products, emissions and waste. The deadline for applications is mid-June. Based on the applications it receives, the NKG draws up a draft work programme. This draft is submitted to the Nordic Committee of Senior Officials for Environmental Affairs, which sets out the parameters for the Group's work in the following year. The NKG then ranks the applications one last time and informs applicants whether or not they have been successful by the end of the year. Funds may be limited to small-scale projects (e.g., 20 k Euro).

ii) criteria: have a Nordic focus and be beneficial for the Nordic countries. At least three Nordic countries need to be involved in the application.

iii) Available in the following countries: Denmark, Norway, Iceland, Sweden, Greenland, Finland, Åland Islands, Faroe Islands

3.5.3 Other mechanisms that might be considered

1) **WHO / International Programme on Chemical Safety (IPCS)**

   - e.g., using 2002 and 2012 State-of-the-Science of Endocrine Disrupting Chemicals (EDCs) reports as examples to conduct a global assessment of PFASs

2) **European Union's regulatory frameworks on chemicals**

   - e.g., how to use REACH to generate more information; Non-Toxic Environment Strategy

   (http://ec.europa.eu/environment/chemicals/non-toxic/pdf/Sub-study%20d%20very%20persistent%20subst.%20NTE%20final.pdf)

3.5.4 Potential enabling factors for the development and implementation of actions

The enabling factors below are merely intended as references to be considered for the development and implementation of actions and are taken from the report "What makes urban food policy happen?" with slight modifications (http://www.ipes-food.org/images/Reports/Cities_full.pdf).

Enabling factors	How the enabler promotes change
Data, Monitoring and learning	
Enabler 1: Background and baseline research has been carried out to inform the policy.	Enables design of policy that addresses relevant challenges, is relevant to needs of intended users, appropriate, effective and achievable; Promotes political commitment where findings are used to make the case for the policy.
Enabler 2: Impacts are monitored and new data are collected throughout implementation.	Provides inputs to improve the policy design where needed; Provides evidence of efficacy to help secure ongoing or renewed political commitment and provide examples to others.
Enabler 3: Policy is continually or regularly reviewed and renewed.	Enables policy to be adapted in light of learned experiences, new data or unexpected impacts, or to improve efficacy.
"Vertical" multi-level governance	
Enabler 4: The necessary policy powers and responsibilities exist at the national level.	Allows the country to move forward with policy development and delivery.
Enabler 5: Policy at the international level is supportive.	Provides supportive structures and programmes that the country can draw upon.
"Horizontal" country-level governance	
Enabler 6: The 'institutional home' of the policy lends it strategic importance and/or provides channels of influence.	Ensures awareness of the policy within national government and that it is taken seriously; Facilitates support for the policy from other departments.
Enabler 7: A governance body has been established to oversee the policy, that promotes accountability and efficiency.	Ensures input from a wide range of actors into policy development (initial and ongoing); Provides rules of engagement, thereby increasing buy-in and holding actors to account.
Enabler 8: Multiple departments are engaged with and committed to the	Enables development of policy with multiple benefits in different policy areas, that is more ambitious, integrated and effective; Increases likelihood of the policy being written into

policy.	other departments' plans; Increases likelihood that other departments will serve as implementation partners, bringing capacity, access to target groups and co-funding.
Participatory policy process	
Enabler 9: Policy is developed through participatory process.	Provides a rounded perspective of the issues to be addressed; Encourages shared ownership of the policy, mobilizing resources, problem-solving and innovation capacity, and fostering partnerships between sectors; Community involvement generates popular support, making the idea to take action a powerful one for politicians to address; Community involvement enables policy that is relevant to needs and promotes take-up by intended users; Actors can facilitate bringing policy proposals to the attention of decision-makers.
Enabler 10: Conflicts and ideological differences between actors are acknowledged and managed.	Increases the likelihood of reaching consensus in policy development and reduces impediments to delivery.
Funding	
Enabler 11: Part-funding is provided by national governments.	Enables a minimum of implementation.
Enabler 12: Overall funds obtained are sufficient for implementation.	Enables complete delivery of the policy.
Enabler 13: There are no restrictive conditions attached to funding.	Enables funds to be used as needed to advance the policy's objectives, without constraint by any other agenda.
Political Commitment	
Enabler 14: High-level political commitment from national government is secured and leveraged.	Gives legitimacy to the policy; Enables civil servants to commence work on implementation; Promotes institutionalization of policy within overarching plans and visions; Promotes engagement across multiple departments, leading to incorporation of issues into plans and programmes in related policy areas.
Enabler 15: Political commitment transcends electoral cycles.	Enables long-term delivery, and tackling of complex issues that cannot be resolved in a four or five year electoral cycle.

4 Summary of discussion points

Below is a summary of the set of discussion points presented in detail in this document that will be the primary focuses of the workshop discussions:

- Current needs on the science and policy side (section 3.1 of this document)
- Common goals between the science and policy side (section 3.2 of this document)
- Cooperative actions to address PFASs (section 3.3 of this document)
- Cooperative actions to maintain a strong science-policy interface in the field of PFASs (section 3.4 of this document)

5 Acknowledgement

The workshop organizers of the ETH Zurich Safety and Environmental Technology Group gratefully acknowledge the generous financial support from the Swiss Federal Office for the Environment (BAFU) and from ETH Zurich for the organization of this workshop. In addition, the organizers would also like to recognize and thank everyone who contributed to reviewing and providing input for the development of this document in advance of the workshop.