The Madrid statement on poly- and perfluoroalkyl substances (PFASs)
Blum, A.; Balan, S.A.; Scheringer, M; Trier, X; Goldenman, G.; Cousins, I.T.; Diamond, M; Fletcher, T; Higgins, C.; Lindeman, A.E.; Peaslee, G.; de Voogt, W.P.; Wang, Z.; Weber, R.

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The Madrid Statement on Poly- and Perfluoroalkyl Substances (PFASs)

As scientists and other professionals from a variety of disciplines, we are concerned about the production and release into the environment of an increasing number of poly- and perfluoroalkyl substances (PFASs) for the following reasons:

1. PFASs are man-made and found everywhere. PFASs are highly persistent, as they contain perfluorinated chains that only degrade very slowly, if at all, under environmental conditions. It is documented that some polyfluorinated chemicals break down to form perfluorinated ones (D’Eon and Mabury 2007).

2. PFASs are found in the indoor and outdoor environments, wildlife, and human tissue and bodily fluids all over the globe. They are emitted via industrial processes and military and firefighting operations (Darwin 2011; Fire Fighting Foam Coalition 2014), and they migrate out of consumer products into air (Shoeb et al. 2011), household dust (Björklund et al. 2009), food (Begley et al. 2008; Titelmier et al. 2007; Trier et al. 2011), soil (Sepulvado et al. 2011; Strynar et al. 2012), ground and surface water, and make their way into drinking water (Eschauzier et al. 2012; Rahman et al. 2014).

3. In animal studies, some long-chain PFASs have been found to cause liver toxicity, disruption of lipid metabolism and the immune and endocrine systems, adverse neurobehavioral effects, neonatal toxicity and death, and tumors in multiple organ systems (Lau et al. 2007; Post et al. 2012). In the growing body of epidemiological evidence, some of these effects are supported by significant or suggestive associations between specific long-chain PFASs and adverse outcomes, including associations with testicular and kidney cancers (Barry et al. 2013; Benbrahim-Tallaa et al. 2014), liver malfunction (Gallo et al. 2012), hypothyroidism (Lopez-Espinosa et al. 2012), high cholesterol (Fitz-Simon et al. 2013; Nelson et al. 2009), ulcerative colitis (Steenland et al. 2013), lower birth weight and size (Fei et al. 2007), obesity (Halldorsson et al. 2012), decreased immune response to vaccines (Grandjean et al. 2012), and reduced hormone levels and delayed puberty (Lopez-Espinosa et al. 2011).

4. Due to their high persistence, global distribution, bioaccumulation potential, and toxicity, some PFASs have been listed under the Stockholm Convention (United Nations Environment Programme 2009) as persistent organic pollutants (POPs).

5. As documented in the Helsingør Statement (Scheringer et al. 2014),
   a. Although some of the long-chain PFASs are being regulated or phased out, the most common replacements are short-chain PFASs with similar structures, or compounds with fluorinated segments joined by ether linkages.
   b. While some shorter-chain fluorinated alternatives seem to be less bioaccumulative, they are still as environmentally persistent as long-chain substances or have persistent degradation products. Thus, a switch to short-chain and other fluorinated alternatives may not reduce the amounts of PFASs in the environment. In addition, because some of the shorter-chain PFASs are less effective, larger quantities may be needed to provide the same performance.
   c. While many fluorinated alternatives are being marketed, little information is publicly available on their chemical structures, properties, uses, and toxicological profiles.
   d. Increasing use of fluorinated alternatives will lead to increasing levels of stable perfluorinated degradation products in the environment, and possibly also in biota and humans. This would increase the risks of adverse effects on human health and the environment.

6. Initial efforts to estimate overall emissions of PFASs into the environment have been limited due to uncertainties related to product formulations, quantities of production, production locations, efficiency of emission controls, and long-term trends in production history (Wang et al. 2014).

7. The technical capacity to destroy PFASs is currently insufficient in many parts of the world.

Global action through the Montreal Protocol (United Nations Environment Programme 2012) successfully reduced the use of the highly persistent ozone-depleting chlorofluorocarbons (CFCs), thus allowing for the recovery of the ozone layer. However, many of the organohaline replacements for CFCs are still of concern due to their high global warming potential. It is essential to learn from such past efforts and take measures at the international level to reduce the use of PFASs in products and prevent their replacement with fluorinated alternatives in order to avoid long-term harm to human health and the environment.

For these reasons, we call on the international community to cooperate in limiting the production and use of PFASs and in developing safer nonfluorinated alternatives. We therefore urge scientists, governments, chemical and product manufacturers, purchasing organizations, retailers, and consumers to take the following actions:

**Scientists:**

1. Assemble, in collaboration with industry and governments, a global inventory of all PFASs in use or in the environment, including precursors and degradation products, and their functionality, properties, and toxicology.
2. Develop analytical methods for the identification and quantification of additional families of PFASs, including fluorinated alternatives.
3. Continue monitoring for legacy PFASs in different matrices and for environmental reservoirs of PFASs.
4. 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.
5. Bring research results to the attention of policy makers, industry, the media, and the public.

**Governments:**

1. Enact legislation to require only essential uses of PFASs, and enforce labeling to indicate uses.
2. Require manufacturers of PFASs to
   a. conduct more extensive toxicological testing,
   b. make chemical structures public,
   c. provide validated analytical methods for detection of PFASs, and
   d. assume extended producer responsibility and implement safe disposal of products and stockpiles containing PFASs.
3. Work with industry to develop public registries of products containing PFASs.
4. Make public annual statistical data on production, imports, and exports of PFASs.
5. Whenever possible, avoid products containing, or manu-
factured using, PFASs in government procurement.
6. 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.

Chemical manufacturers:
1. Make data on PFASs publicly available, including chemical
structures, properties, and toxicity.
2. Provide scientists with standard samples of PFASs, including
precursors and degradation products, to enable environmental
monitoring of PFASs.
3. Work with scientists and governments to develop safe disposal methods
for PFASs.
4. Provide the supply chain with documentation on PFAS content and
safe disposal guidelines.
5. Develop nonfluorinated alternatives that are neither persistent
nor toxic.

Product manufacturers:
1. Stop using PFASs where they are nonessential or when safer
alternatives exist.
2. Develop inexpensive and sensitive PFAS quantification methods for
compliance testing.
3. Label products containing PFASs, including chemical identity
and safe disposal guidelines.
4. Invest in the development and use of nonfluorinated alternatives.

Purchasing organizations, retailers, and individual consumers:
1. Whenever possible, avoid products containing, or manufactured using, PFASs. These include many products that are
stain-resistant, waterproof, or nonstick.
2. Question the use of such fluorinated “performance” chemicals added to consumer products.

The views expressed in this statement are solely those of the authors and signatories. The authors declare they have no actual or potential competing financial interests.

Arlene Blum,1,2 Simona A. Balan,2 Martin Scheringer,1,4 Xiaen Trier,4 Greta Goldenman,6 Ian T. Cousins,7 Miriam Diamond,8 Tony Fletcher,9 Christopher Higgins,1,10 Avery E. Lindeman,2 Graham Peaslee,1,11 E-mail: arlene@greensciencepolicy.org Denmark; 6European Centre on Sustainable Policies for Human and Environmental
Chemistry, National Food Institute, Technical University of Denmark, Kongens Lyngby,
of Civil and Environmental Engineering, Colorado School of Mines, Golden, Colorado,
Rights, Brussels, Belgium; 7Department of Applied Environmental Science, Stockholm
Lüneburg, Germany; 4Safety and Environmental Technology Group, Institute for

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sure of Canadians to perfluorinated carboxylates and perfluoroctane sulfonate via con-

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11356-010-0439-3.
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(Signatories as of publication date. Institutional affiliations are provided for identification purposes only.)

Ovokereye Abafe, Researcher, School of Chemistry and Physics, University of KwaZulu-Natal, Durban, South Africa

Marlene Agerstrand, PhD, Researcher, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

Lutz Ahrens, PhD, Research Scientist, Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden

Beatrix H. Aristizabal, PhD, Professor, Department of Chemical Engineering, National University of Colombia, Manizales, Colombia

Abel Arkenbout, PhD, Chairman, Toxicowatch Foundation, Harlingen, the Netherlands

Misha Asken, MD, Physician, Urgent Care, Kaiser Permanente, Los Angeles, California, USA

Jannicke Bakkejord, Senior Engineer, National Institute of Nutrition and Seafood Research, Bergen, Norway

Georg Becker, PhD, Professor Emeritus, Department of Exposure and Risk Assessment, Norwegian Institute of Public Health, Oslo, Norway

Thea Bechshoft, PhD, Postdoctoral Fellow, University of Southern Denmark, Odense, Denmark

Peter Behnisch, PhD, Director, BioDetection System, Amsterdam, the Netherlands

Susanne Bejert, MD, Assistant Professor, Department of Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden

Stephen Bent, MD, Associate Professor of Medicine, Epidemiology and Biostatistics, and Psychiatry, University of California at San Francisco, San Francisco, California, USA

Urs Berger, PhD, Associate Professor, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

Åke Bergman, PhD, Executive Director and Professor, Swedish Toxicology Sciences Research Centre, Södertälje, Sweden

Vladimir Beikoski, PhD, Assistant Professor, Faculty of Chemistry, University of Belgrade, Belgrade, Serbia

Emmanuelle Bichon, Scientific and Technical Support Manager, Oniris, Nantes-Atlantic College of Veterinary Medicine, Food Science and Engineering, Nantes, France

Filip Bjurlid, PhD Student, Man–Technology–Environment Research Centre, Örebro University, Örebro, Sweden

Tara Blank, PhD, Consultant, Elsir Environmental, Ridgefield, Connecticut, USA

Daniel Borg, PhD, Toxicology Consultant, Trossa AB, Stockholm, Sweden

Carl-Gustaf Borneshag, PhD, Professor, Department of Health and Environment, Karlstad University, Karlstad, Sweden

Hindrik Bouwman, PhD, Lecturer, Zoology Group, North-West University, Mahikeng, South Africa

Lindsay Bramwell, MSc, Research Associate, Institute of Health and Society, Newcastle University, Newcastle upon Tyne, United Kingdom

Knut Breivik, PhD, Senior Scientist and Professor, NILU–Norwegian Institute for Air Research, Kjeller, Norway

Katja Broeg, PhD, Researcher, Baltic Sea Centre, Stockholm University, Stockholm, Sweden

Phil Brown, PhD, University Distinguished Professor of Sociology and Health Sciences, and Director, Social Science Environment Health Research Institute, Northeastern University, Boston, Massachusetts, USA

Thomas Bruton, MS, PhD Student, Department of Civil and Environmental Engineering, University of California, Berkeley, California, USA

David Camann, MS, Technical Advisor, Southwest Research Institute, San Antonio, Texas, USA

Louise Camenzuli, PhD Student, Safety and Environmental Technology Group, Institute for Chemical and Bioengineering, ETH Zürich, Zürich, Switzerland

Argelia Castaño, PhD, Head of Department, Area of Environmental Toxicology, Instituto de Salud Carlos III, Madrid, Spain

Carmela Centeno, Industrial Development Officer, United Nations Industrial Development Organization, Vienna, Austria

Ibrahim Chahoud, PhD, Professor, Department of Toxicology, Charité–Universitätsmedizin Berlin, Berlin, Germany

Kai Hsien Chi, PhD, Associate Professor, Institute of Environmental and Occupational Health Sciences, National Yang-Ming University, Taipei, Taiwan

Eliza Chin, MD, MPH, Executive Director, American Medical Women's Association, Reston, Virginia, USA

Carsten Christophersen, PhD, Adjunct Professor, Systems Biology, Technical University of Denmark, Kongens Lyngby, Denmark

Theo Colborn (1927–2014), PhD, President Emeritus, TEDX (The Endocrine Disruption Exchange), Paonia, Colorado, USA

Terrence J. Collins, PhD, Theresa Heinz Professor of Green Chemistry, Department of Chemistry, Carnegie Mellon University, Pittsburgh, PA, USA; and Director, Institute for Green Science, Pittsburgh, Pennsylvania, USA

Johanna Congleton, MSPH, PhD, Senior Scientist, Environmental Working Group, Washington, DC, USA

Adrian Covaci, PhD, Professor, Toxicological Center, University of Anwerp, Antwerp, Belgium

Craig Criddle, PhD, Professor, Department of Civil and Environmental Engineering, Stanford University, Stanford, California, USA

Oscar H. Fernández Cebredo, Technician, National Food Center, Majadahonda, Spain

Jordi Dachs, PhD, Research Scientist, Institute of Environmental Assessment and Water Research, Spanish Council for Scientific Research, Barcelona, Spain

Cynthia de Wit, PhD, Professor, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

Barbara Demeneix, DSc, Professor, Department of Environmental Research Laboratory, European Union Reference Laboratory for Dioxins and PCBs in Feed and Food, Freiburg, Germany

Tara Blank, PhD, Toxicology Consultant, Trossa AB, Stockholm, Sweden

Frederic Gallo, PhD, Senior Expert, Regional Activity Center for Sustainable Consumption and Production, Barcelona, Spain

Joseph A. Gardella, Jr, PhD, Distinguished Professor and John and Frances Larkin Professor of Chemistry, Department of Chemistry, University of Buffalo–The State University of New York, Buffalo, New York, USA

Stephen Gardner, DVM, Veterinarian, Albany Animal Hospital, Richmond, California, USA

Caroline Gaus, PhD, Professor, National Centre for Environmental Toxicology, The University of Queensland, Brisbane, Queensland, Australia

Wouter Gebbink, PhD, Researcher, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

David Gee, PhD, Associate Fellow, Institute of Health, Environment, and Societies, Brunel University, Brunel, United Kingdom

Philip Germansdefer, DHC Che, MS ChE, Director of International Sales and Marketing, Fluid Management Systems, Inc., Watertown, Massachusetts, USA

Bondi Neuma Gevao, PhD, Research Scientist, Kuwait Institute for Scientific Research, Safat, Kuwait

Melissa Gomi, MS, PhD Student, Department of Environmental Science, Stockholm University, Stockholm, Sweden

Belen Gonzalez, PhD Student, Institute of Environmental Assessment and Water Research, Spanish Council for Scientific Research, Barcelona, Spain

Peter Gringinger, MSc, Principal, Cardno, Sassafras, Victoria, Australia

Adam Grochowski, PhD, Professor, Department of Analytical Chemistry, Krakow University of Technology, Krakow, Poland

Ramon Guards, Scientific Advisor, Ministry of Agriculture, Food and Environment, Madrid, Spain

Alexey Gusev, PhD, Senior Scientist, European Monitoring and Evaluation Programme Meteorological Synthesizing Centre–East, Moscow, Russia

Arno Gutleb, PhD, Project Leader, Department of Environment and Agro-Biotechnologies, Luxembourg Institute of Science and Technology, Belval, Luxembourg

Tenzing Gyalo, PhD Student, Safety and Environmental Technology Group, Institute for Chemical and Bioengineering, ETH Zürich, Zürich, Switzerland

Johannes Haidrich, PhD, Head, Research Laboratory, European Union Reference Laboratory for Dioxins and PCBs in Feed and Food, Freiburg, Germany

continued >>
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(Signatories as of publication date. Institutional affiliations are provided for identification purposes only.)

Helen Häkansson, PhD, Professor of Toxicology and Chemicals Health Risk Assessment, Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden

Tomas Hansson, PhD, Researcher, Department of Applied Environmental Science, Stockholm, Sweden

Mikael Harju, PhD, Senior Scientist, NILU–Norwegian Institute for Air Research, Tromsø, Norway

Stuart Harrad, PhD, Professor of Environmental Chemistry, School of Geography, Earth and Environmental Sciences, University of Birmingham, UK

Ingrid Ericson Jogsten, Veerle Jaspers, Annika Jahnke, PhD, Assistant Professor, University of the Aegean, Mytilene, Greece

Bernhard Hennig, PhD, Professor of Nutrition and Toxicology, and Director, University of Kentucky Superfund Research Center, Lexington, Kentucky, USA

François Ickezek, Direction de la Surveillance de l’Environnement, Institut Scientifique de Service Public (ISeSP), Liege, Belgium

Ingrid (Ericson) Jogsten, PhD, Associate Professor, Department of Public Health, San Diego State University, San Diego, California, USA

Sandra Huber, PhD, Senior Researcher, Environmental Chemistry, NILU–Norwegian Institute for Air Research, Tromsø, Norway

François Ickezek, Direction de la Surveillance de l’Environnement, Institut Scientifique de Service Public (ISeSP), Liege, Belgium

Alastair Iles, SJD, Associate Professor, Department of Environmental Science, Policy, and Management, University of California, Berkeley, Berkeley, California, USA

Ellen Ingre-Khans, MSc, PhD Student, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

Ain Constanti Ionas, PhD Candidate, Toxicological Center, University of Antwerp, Antwerp, Belgium

Griet Jacobs, Researcher, Flemish Institute of Technological Research, Mol, Belgium

Annika Jahnke, PhD, Researcher, Department of Cell Toxicology, Helmholtz Centre for Environmental Research, Leipzig, Germany

Veerle Jaspers, PhD, Associate Professor, Department of Biology, Norwegian University of Science and Technology, Trondheim, Norway

Allan Astrup Jensen, PhD, Research Director and CEO, Nipsect, Trondheim, Norway

Javier Castro Jimenez, PhD Research Scientist, Institute of Environmental Assessment and Water Research, Spanish Council for Scientific Research, Barcelona, Spain

Ingrid (Ericson) Jogsten, PhD, Research Scientist, School of Science and Technology, Örebro University, Örebro, Sweden

Jon E. Johansen, Dr techn, Director, Chiron AS, Trondheim, Norway

Niklas Johansson, Senior Consultant, Melca Biokonsult, Uppsalas Väby, Sweden

Paula Johnson, PhD, MPH, Research Scientist, California Department of Public Health, Richmond, California, USA

Jill Johnstone, PhD, Postdoctoral Fellow, Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA

Olga-Joanna Kalantzi, PhD, Assistant Professor, University of the Aegean, Mytilene, Greece

Anna Kärrman, PhD, Associate Professor, Man–Technology–Environment Research Centre, Örebro University, Örebro, Sweden

Maja Kirkegaard, PhD, Cand Scient, Research Advisory, Head of Chemicals Group, Worldwide Institute Europe, Copenhagen, Denmark

Jana Klavova, PhD, Professor, Research Center for Toxic Compounds in the Environment, Faculty of Science, Masaryk University, Brno, Czech Republic

Susi Klonsterhaus, PhD, Vice President, Science and Certification, Cradle to Cradle Products Innovation Institute, San Francisco, California, USA

Candide Kollar, LEED AP, Design Strategist, Kollar Design I EcoCreative, San Francisco, California, USA

Janna G. Koppe, PhD, Professor Emeritus of Neonatology, Emma Children’s Hospital/Academic Medical Center, University of Amsterdam, Loenenhorst, the Netherlands

Ingjerd Sunde Krogseth, PhD, Postdoctoral Fellow, NILU–Norwegian Institute for Air Research, Tromsø, Norway

Petra Kukucka, PhD, Junior Researcher, Research Center for Toxic Compounds in the Environment, Faculty of Science, Masaryk University, Brno, Czech Republic

Perihan Binnur Kurt Karakus, PhD, Associate Professor, Department of Environmental Engineering, Bursa Technical University, Bursa, Turkey

Henrik Kylén, PhD, Professor, Department of Thematic Studies—Biodiversity and Ecosystem Dynamics, Umeå University, Umeå, Sweden

Remi Laane, PhD, Professor, Department of Environmental Chemistry, University of Amsterdam, Delft, the Netherlands

Jong-Hyeon Lee, PhD, Department Deputy Director, Ministry of Natural Resources and Environment, Hanoi, Vietnam

Jong-Yeeon Lee, PhD, Director, NeoeNBiz, Gyeonggi-do, South Korea

Mariko Martina Leijis, PhD, Professor, Department of Dermatology, University Hospital RWTH Aachen, Aachen, Germany

Xiaodong Li, PhD, Professor, Faculty of Engineering, Zhejiang University, Hangzhou, China

Yifan Li, PhD, Professor, International Joint Research Center for Persistent Toxic Substances, Harbin Institute of Technology, Harbin, China

Danuta Ligocka, PhD, Senior Researcher, Department of Toxicology and Carcinogenesis, Nofer Institute of Occupational Medicine, Łódź, Poland

Monica Lind, PhD, Scientist, Occupational and Environmental Medicine, Uppsala University, Uppsala, Sweden

Lee Lippincott, PhD, Assistant Professor of Chemistry, Allied Health Sciences, Mercer County Community College, West Windsor, New Jersey, USA

Mariani Lloyd-Smith, PhD, Senior Advisor, National Toxicity Network, East Ballina, New South Wales, Australia

Karin Löfstrand, PhD, Postdoctoral Fellow, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

Rainer Lohmann, PhD, Associate Professor, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island, USA

Donald Lucas, PhD, Research Scientist, Lawrence Berkeley National Laboratory, Berkeley, California, USA

José Vinicio Macias, PhD, Researcher, Autonomous University of Baja California, Baja California, Mexico

Karl Mair, Magister, Senior Environmental Chemist, Eco Research, Bolzano, Italy

Govindan Malarvannan, PhD, Research Scientist, Faculty of Pharmaceutical, Biomedical and Veterinary Sciences, University of Antwerp, Antwerp, Belgium

Svetlana Malyshova, PhD, Research Scientist, Scientific Institute of Public Health, Ghent University, Brussels, Belgium

Jonathan Martin, PhD, Professor, Division of Analytical and Environmental Toxicology, University of Alberta, Edmonton, Alberta, Canada

Lisa Melymuk, PhD, Junior Researcher, Research Center for Toxic Compounds in the Environment, Faculty of Science, Masaryk University, Brno, Czech Republic

Annelle Mendez, PhD Student, Safety and Environmental Technology Group, Institute for Chemical and Bioengineering, ETH Zürich, Zürich, Switzerland

Tom Muir, MS, Consultant (retired), Environment Canada, Burlington, Ontario, Canada

Marie Danielle Mulder, PhD Student, Research Center for Toxic Compounds in the Environment, Faculty of Science, Masaryk University, Brno, Czech Republic

Jochen Müller, PhD, Professor, National Research Centre for Environmental Toxicology, The University of Queensland, Brisbane, Queensland, Australia

Patrick Murphy, ND, LAc, Nanopathological Physician, Portland, Oregon, USA

Takeshi Nakano, PhD. Specially Appointed Professor, Graduate School of Engineering, Osaka University, Osaka, Japan

Amgalan Nasagdorj, PhD, Associate Professor, Department of Chemistry, National University of Mongolia, Ulaanbaatar, Mongolia

Seth Newton, PhD Student, Department of Applied Environmental Science, Stockholm University, Täby, Sweden

Carla Ng, PhD, Senior Scientist, Safety and Environmental Technology Group, Institute for Chemical and Bioengineering, ETH Zürich, Zürich, Switzerland

Bo Normander, PhD, Executive Director, WorldWatch Institute Europe, Copenhagen, Denmark

Kees Olie, PhD, Retired, Institute for Biodiversity and Ecosystem Dynamics, Amsterdam, the Netherlands

Bindu Panikkar, PhD, Research Associate, Arctic Institute of North America, Calgary, Alberta, Canada

Richard Peterson, PhD, Professor, Department of Pharmaceutical Sciences, University of Wisconsin, Madison, Wisconsin, USA

Arianna Pierisanti, PhD, Lead Chemist, Food of Environmental Control Department, Istituto Zoonootico Sperimentale dell’Umbria e dell Marche, Perugia, Italy

Merle Plassmann, PhD, Researcher, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden

Anuschka Polder, PhD, Scientist, Department of Food Safety and Infection Biology, Norwegian University of Life Sciences, Oslo, Norway

continued »
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(Signatories as of publication date. Institutional affiliations are provided for identification purposes only.)

Malte Posselt, BSc, MS Student, German Federal Environment Agency, Berlin, Germany
Deborah O. Raphael, Director, San Francisco Department of the Environment, San Francisco, California, USA
Shay Reicher, PhD, Risk Assessment Director, Ministry of Health, Tel Aviv, Israel
Efathios Reppas-Chrysovitsinos, MEng, PhD Candidate, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden
Crystal Reul-Chen, DEnv, Senior Environmental Scientist, California Environmental Protection Agency, Sacramento, California, USA
David Roberts, PhD, Kenan Professor of Physics, Department of Physics, Brandeis University, Waltham, Massachusetts, USA
Mary Roberts, PhD, Professor, Merritt Chemistry Center, Boston College, Chestnut Hill, Massachusetts, USA
Camilla Rodrigues, PhD, Researcher, Environmental Sanitation Technology Company, San Paolo, Brazil
Ott Roots, Dr. sc nat ETH, Director of the Institute/Leading Research Scientist, Estonian Environmental Research Institute, Tallinn, Estonia
Maria Ros Rodríguez, Laboratory Technician, Instituto de Química Orgánica General-Consejo Superior de Investigaciones Científicas, Madrid, Spain
Anna Rotander, PhD, Postdoctoral Researcher, Man-Technology-Environment Research Centre, Örebro University, Örebro, Sweden; and National Research Centre for Environmental Toxicology, The University of Queensland, Brisbane, Queensland, Australia
Ruthann Rudel, MS, Director of Research, Silent Spring Institute, Chestnut Hill, Maine, USA
Christina Rudén, PhD, Professor, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden
Andreas Béguin Safron, MSc, PhD Candidate, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden
Amina Salamova, PhD, Research Scientist, School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana, USA
Samira Salihov, PhD, Postdoctoral Fellow, Department of Medical Sciences, Uppsala University, Uppsala, Sweden
Johanna Sandahl, MS, President, Swedish Society for Nature Conservation, Stockholm, Sweden
Erik Sandell, Consulting Specialist, Nab Labs Oy, Espoo, Finland
Andreas Schaeffer, PhD, Institute Director, Institute for Environmental Research, RWTH Aachen University, Aachen, Germany
Julia Schalertzky, PhD, Senior Group Leader, Cytokinetics, South San Francisco, California, USA
Arnold Schecter, PhD, Professor, School of Public Health, University of Texas-Dallas Campus, Dallas, Texas, USA
Ted Schettler, MD, MPH, Science Director, Science and Environmental Health Network, Ames, Iowa, USA
Margret Schlimp, Dr. sc nat ETH, Co-Director, Group for Reproductive, Endocrine and Environmental Toxicology, University of Zürich, Zürich, Switzerland
Peter Schmid, PhD, Senior Scientist, Department of Organic Chemistry, Swiss Federal Institute for Material Research and Testing, Dübendorf, Switzerland
Lara Schultes, MSc, PhD Student, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden
Susan Shaw, PhD, Professor, School of Public Health, University at Albany–State University of New York, Albany, New York, USA; and Director, Marine Environmental Research Institute, Blue Hill, Maine, USA
Omotayo Sindikhu, Research Assistant, Basel Convention Coordinating Center, Ibadan, Nigeria
Line Småstuen Haug, PhD, Senior Scientist, Department of Exposure and Risk Assessment, Norwegian Institute of Public Health, Oslo, Norway
Anna Sobek, PhD, Researcher, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden
Ana Sousa, PhD, Postdoctoral Researcher, Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal
Martin Speel, Technician, Austria Metall AG, Ranshofen, Austria
Thomas Steiner, PhD, CEO, MonitoringSystems GmbH, Pressbaum, Austria
Christine Steinlin, PhD Student, Safety and Environmental Technology Group, Institute for Chemical and Bioengineering, ETH Zürich, Zürich, Switzerland
Alex Stone, Sc.D., Senior Chemist, Hazardous Waste and Toxics Reduction Program, Washington State Department of Ecology, Lacey, Washington, USA
William Stubbs, PhD Student, University of Birmingham, Edgbaston, United Kingdom
Roxana Südhing, PhD Student, Helmholtz-Zentrum Geesthacht, Lüneburg, Germany
Kimmo Suominen, PhD, Senior Researcher, Finish Food Safety Authority, Risk Assessment Research Unit, Helsinki, Finland
Rebecca Sutton, PhD, Senior Scientist, San Francisco Estuary Institute, Richmond, California, USA
Joel Svedlund, BSc, Sustainability Institute, Richmond, California, USA
Dien Nguyen Thanh, PhD Student, Environment Preservation Research Center, Kyoto University, Kyoto, Japan
Joao Paulo Machado Torres, PhD, Associate Professor, Instituto de Biofísica Carlos Chagas Filho, Rio de Janeiro Federal University, Rio de Janeiro, Brazil
Matthew Trass, PhD, Research Scientist, Phenomenex, Torrance, California, USA
Theodora Tsongas, PhD, MS, Environmental Health Scientist and Consultant, Portland, Oregon, USA
Margret Schlumpf, PhD, Investigator and Consultant, Department of Medical Sciences, Swiss Federal Institute for Research on Environment,(checkmark) Health and the Aged, Zürich, Switzerland
Shu-Li Wang, PhD, Research Manager, Flemish Institute for Technological Research, Mol, Belgium
Larry Weiss, MD, Chief Marketing Officer, AOBiome, LLC, San Francisco, California, USA
Philip White, Organics Analyst, Marine Institute, Galway, Ireland
Karín Wiberg, PhD, Professor, Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden
Gayle Windham, PhD, Research Scientist, Division of Environmental and Occupational Health Control, California Department of Public Health, Richmond, California, USA
Hendrik Wolschke, PhD Student, Helmholtz Zentrum Geesthacht-Centre for Materials and Coastal Research, Geesthacht, Germany
Bo Yuan, PhD, Postdoctoral Fellow, Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden
Elena Zaffonato, Organics Analyst, Chelah Sri, Resana Treviso, Italy
Lingying Zhu, PhD, Professor, College of Environmental Science and Engineering, Nankai University, Tianjin, China
Robert Zoeller, PhD, Professor, Department of Biology, University of Massachusetts Amherst, Amherst, Massachusetts, USA

Anthony C. Tweedale, MS, Consultant, Rebutting Industry Science with Knowledge Consultancy, Eastpointe, Michigan, USA
Marta Venier, PhD, Scientist, School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana, USA
Robin Vester gren, PhD, Postdoctoral Researcher, Environmental Chemistry, NILU–Norwegian Institute for Air Research, Tromsø, Norway
Stefan Voor stu ipels, PhD, Research Manager, Dutch Institute for Environmental Affairs, Mol, Belgium

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