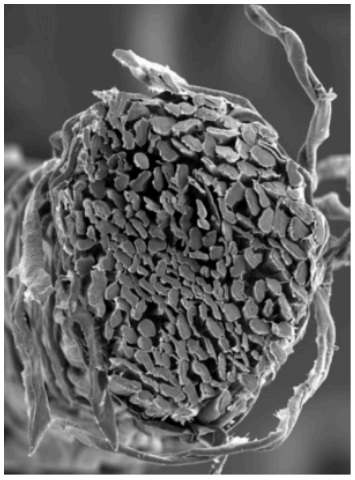
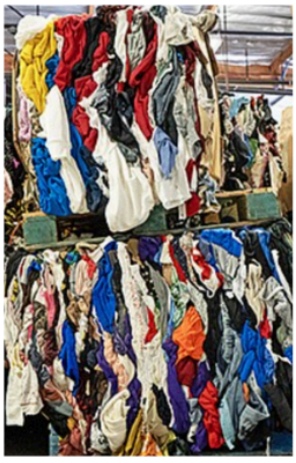
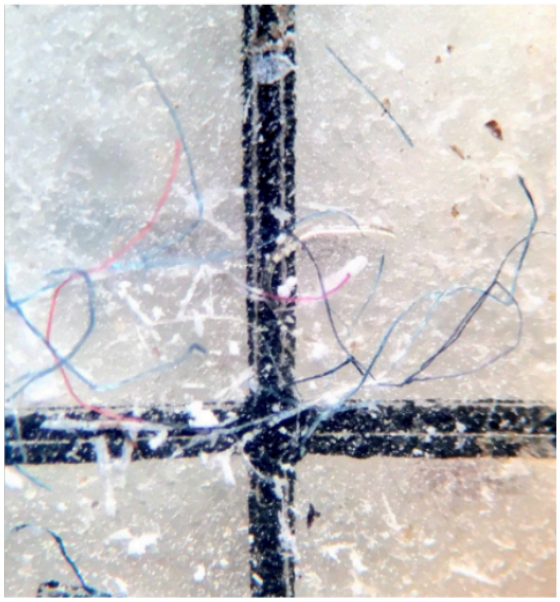


Materevolve

California Statewide Microplastics Strategy Workshop: Textile Sector

SUMMARY REPORT


About this report:

This report was produced by Materevolve, LLC (Krystle Moody Wood and Carolynn Box) for the California Ocean Protection Council (OPC).

Report handover date: March 2025

Photo credits (starting top left and clockwise): Natural Fiber Welding, Paige Green, Ryan Wood, Paige Green, Paige Green, Sam Athey, California Product Stewardship Council

Workshop Design Overview

Microplastics are persistent and extremely challenging, if not impossible, to effectively remove once in the aquatic environment. The California Ocean Protection Council's (OPC) Statewide Microplastics Strategy (Strategy) thus focuses on pollution prevention to eliminate plastic waste at its originating source[1]. Specifically, the Strategy calls for targeted, sector-specific workshops to investigate, conduct an alternatives analysis, and identify sector-specific recommendations to reduce microplastic pollution from the following priority industries: (1) vehicle tires, (2) textiles, (3) single-use foodware and packaging, (4) agriculture, and (5) fisheries & aquaculture.

OPC, together with Materevolve LLC, a technical textiles consultancy aimed at creating transformational change in textiles, designed the two-day virtual workshop titled, "OPC California Microplastics Strategy Workshop for the Textile Sector." The workshop was designed in line with the Strategy's two-track approach (solutions and research) to address microplastic pollution in California, to accelerate knowledge exchange and identify recommendations to reduce microplastic pollution from the textile industry, including treated natural and man made cellulosic fibers. It also resulted in recommendations for textile related microplastic research priorities.

Approximately 50 participants, including a range of stakeholders from the textile industry/private sector, non-governmental organizations (NGOs), federal and state government agencies, and research institutions, participated in the invite-only *virtual* OPC California Microplastics Strategy Workshop for the Textile Sector from 9AM to 1PM PST on March 17 and 18, 2025. The workshop included a series of panel discussions, followed by small group activities, to allow all participants to voice additional solutions, prioritization of solutions, and next steps. The workshop concluded with a prioritization activity that was designed to give insight into what participants thought were the most important and pressing recommendations to target.

Workshop Goals

The goals of the workshop were to:

- Identify immediate recommendations that could be enacted or voluntarily implemented in each sector to reduce plastic pollution (e.g., solutions already in place that can be scaled for broader adoption or implementation);
- Identify long-term policy needs to advance recommendations and remove barriers to identified solutions; and,
- Identify microplastics research needs and recommend research priorities to advance pollution reduction strategies.

[1] https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20220223/Item_6_Exhibit_A_Statewide_Microplastics_Strategy.pdf

Workshop Focal Areas

To organize and encourage discussions for the workshop, four focal areas were designated, from the extraction and design of raw materials to the unintended release of microfiber pollution at a textile's end of life (Figure 1).

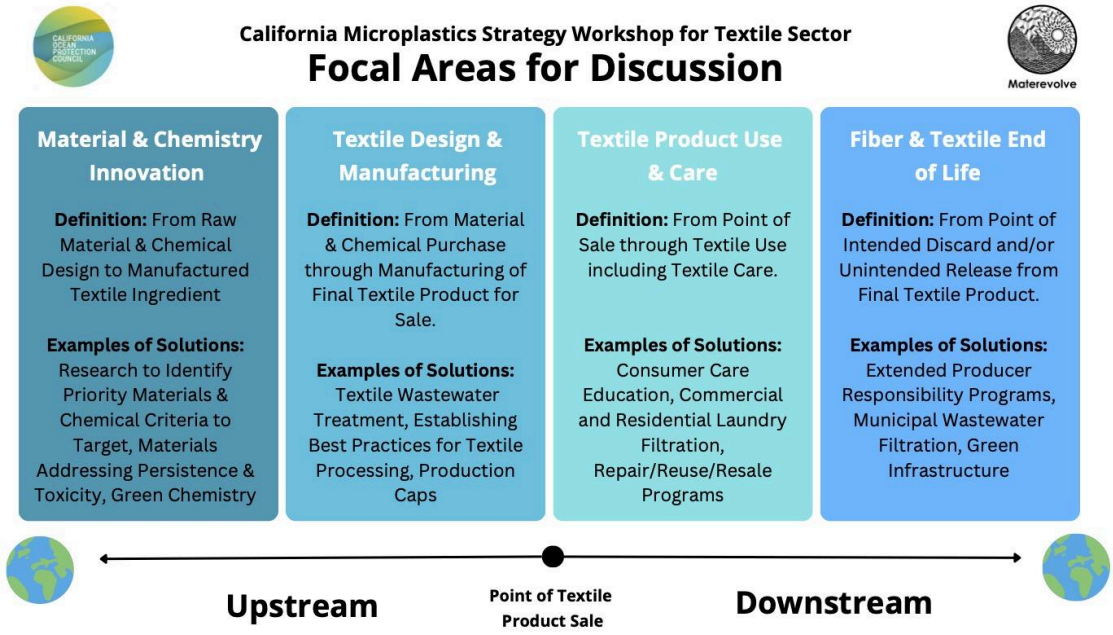


Figure 1. Focal areas for discussion.

Workshop Program & Expert Panel Sessions

Materevolve, with guidance from OPC, designed an interactive workshop that included four expert panel sessions, with 13 leading experts speaking to immediate and long term solutions to fiber release (See Workshop Program in Appendix A). The workshop was facilitated by Materevolve representatives, Krystle Moody Wood and Carolynn Box, both also bringing in their expertise to the facilitated discussions with the participants that followed each panel. To further understand priorities, workshop participants were broken into small groups to discuss the topics presented during the panels.

The Material and Chemistry Innovation Panel included Stephen Taylor, Product Circularity Engineer, Natural Fiber Welding (NFW); Marty Mulvihill, Managing Partner & Co-Founder, Safer Made; and Rebecca Burgess, Executive Director, Fibershed, speaking to new material types, green chemistry, and healthy fiber systems in California.

The Textile Design & Manufacturing Panel included Scott Echols, Chief Impact Officer, Zero Discharge of Hazardous Chemicals (ZDHC); Kelly Sheridan, CEO, The Microfibre Consortium (TMC); Patrick Jurney, Plastics Project Director, The Nature Conservancy; and Thomas Braun, Technical Director, Swisstex California Inc., speaking to wastewater guidelines for the textile

industry in the design and manufacturing state, and efforts related to a cross-industry microfiber roadmap, and best practices in managing water and chemistry in manufacturing in California.

The Textile Product Use & Care Panel included Dr. Lisa Erdle, Director of Science and Innovation, The 5 Gyres Institute; Dr. Joanne Brasch, Director of Advocacy and Outreach, California Product Stewardship Council (CPSC); and Eileen Mockus, COO, Accelerating Circularity, speaking to washing machine & dryer research, extended producer responsibility programs in California, preventing textiles from going to landfills through recycling and reuse.

The Fiber & Textile End of Life Panel included Dr. Susanne Brander, Associate Professor, Oregon State University; Dr. Timnit Kefela, Assistant Professor of Environmental Science & Resource Management, CSU Channel Islands; and Dr. Leah Hampton, Senior Scientist, Southern California Coastal Water Research Project (SCCWRP) speaking to the impact of microfiber composition and chemistry on ecotoxicity, community-driven solutions, and methods for characterizing microfiber occurrence.

Workshop Participants

The workshop included 50 invited participants, including the planning team members from Materevolve and OPC (See Workshop Participant List in Appendix B). The composition of this group included 10 representatives from environmental agencies, 24 representatives from the textile industry (brands, trade associations, manufacturers, scientists, and nonprofits), and 16 representatives from the environmental community (NGOs, scientists, and academia). The workshop participants included a wide range of expertise related to the issue of microfiber pollution, allowing for rich discussions on topics such as textile “shedding” or methods to reduce fiber release in textile design and manufacturing between scientists or experts from the textile industry and environmental community. Additionally, new connections were made between entities that will likely collaborate on projects in the future. For example, industry representatives from a brand and manufacturer offered to work with scientists to provide textile samples with key material and chemical information that scientists need to better understand impacts in ecotoxicological research.

Development of Materials for Workshop

All workshop participants, including panel experts, were asked a series of questions in the registration process, including: 1) What recommendations or solution areas do you or your organization work on or support today? 2) What policies (if any) do you or your organization work on or support today? What key barriers have you encountered or do you see for solutions to microfiber pollution that you work in today? and 3) What microplastics/microfiber-related research do you or your organization work on or support today? What research priorities do you recommend to advance pollution reduction strategies for the textile sector?

Participants provided a range of recommendations and solutions that were described in the Workshop Pre-Read Document that included tables that highlighted the common themes, policy

recommendations, and key reports and publications identified in the questions asked during workshop registration.

Small Group Activities & Prioritization Activity

As described above, the workshop program included four small group activities, each following a panel discussion. The goals of each small group activity were to review each focal area table from the Pre-Read Document and ensure that all voices in the workshop were represented in the final report. Each small group activity included breaking workshop participants into six small groups using the breakout session function in Zoom. Notetakers, who were self-selected in each group, documented suggested additions and changes to the tables and what each small group thought should be prioritized. The suggestions from the breakout sessions were incorporated into the updated recommendation tables (Tables 1-4 in Appendix C). Additionally, participants identified scientific reports and other documents that may be helpful to support related solutions (Table 5 in Appendix C).

The final activity on day 2 of the workshop included a prioritization exercise that encouraged discussion (in the chat and verbally) with all workshop participants. Participants were asked the following questions: (1) How has this workshop provided you new insight or connections? (2) What is the biggest research gap or barrier to develop upstream solutions? (3) What is the biggest research gap or barrier to develop downstream solutions? (4) Zooming out from the past two days, what immediate action(s) are the highest priority and why for the state of California as a whole? and (5) Zooming out from the past two days, what long term policy needs are the highest priority and why?

The purpose of the final prioritization activity was to gain more understanding of the most important topics and needs to move forward with solutions related to microfiber pollution. The final prioritization activity, along with the themes identified throughout the breakout sessions and workshop, are summarized below in Priorities & Suggested Actions.

Priority Workshop Themes

For the purposes of guiding California state agencies, state legislature, and key stakeholders on priority next steps, including the California Ocean Protection Council, 10 key themes were identified that spanned most, or all, of the focal-area centered discussions (Figure 1). Tables 1-4 in Appendix C describe specific immediate actions, long-term policy needs, and research needs and barriers. Priority themes that emerged from the workshop are described in more detail below.

1) Lead Deeper Cross-sector Knowledge Sharing & Collaboration

Due to the complexity of textile products and the range of stakeholders involved in understanding and developing solutions to microfiber pollution, it is imperative to continue cross-sector knowledge sharing and collaboration. For example, the workshop program featured

multiple cross-sector projects and initiatives that had been working separately to drive research, collaboration, and solutions for microfiber pollution – sometimes in the same focal area and with some overlapping stakeholders. Through the workshop, these stakeholders were able to engage deeper, exchange ideas, and foster new ways to collaborate to advance solutions together. From the 2020 California Microfiber Workshop ("California Microfiber Update: Textile Perspective" Report in Table 5 in Appendix C), hosted by the NOAA Marine Debris Program, to this recent workshop with OPC, California has a unique opportunity to continue to build on the momentum around this issue and support stakeholders to both minimize duplicative efforts and drive more effective solutions.

2) Advance Research on Impacts of Toxicity & Persistence

From the Material & Chemistry Innovation Session to the End of Life session, understanding impacts of the toxicity and persistence of microfiber pollution was a consistent topic of discussion amongst workshop attendees. While there are efforts underway to develop lower impact materials and textile chemistry, better understand mechanisms for fiber release to reduce total mass of fibers released, collaborate on best practices to measure and mitigate fiber and chemistry release in textile manufacturing, and extend the life of current textile products, there are still large research questions about overall impact of microfibers (e.g., material type vs. chemistry type vs. size, etc.) that would support the collective ability to drive prioritization of high impact solutions. The workshop program drove collaborative discussions between industry, science, and policymakers on effective mechanisms to close this research gap and support the development of the key criteria needed for designing textile systems to prevent and mitigate overall prevalence, toxicity, and persistence of microfiber pollution.

3) Forge California-Specific Working Group Specific to Microfiber Research and Solutions

By design, many of the workshop participants attending the workshop represented California-based organizations or businesses. This included academia and NGOs working on research and policy related to fiber fragmentation or textile circularity, materials innovators developing new natural and human made material and chemistry systems, as well as California brands and manufacturers actively involved in developing research to better understand mechanisms for release and key solutions to address this issue. With an active textile manufacturing hub in Los Angeles, and multiple key players researching this issue, participants still had many questions around the California-specific landscape for sources, sinks, and pathways that included better understanding air, stormwater, and sludge pathways. By focusing on California sources, pathways, impacts, and solution providers, California has the opportunity to advance research and solutions that would not only have an impact locally, but also globally, due to its heavy influence on global commerce and policy.

4) Encourage Research in Fiber Release Mechanisms & Textile Design Best Practices

Attending this workshop were some of the world's leading experts on understanding fiber release mechanisms through textile design characteristics such as material and chemistry composition, yarn and textile construction, textile processing, and use case conditions (e.g., general wear, laundering under high stress conditions, etc.). Industry representatives shared experiences and key learnings from using currently developed global textile testing standards for fiber fragment release, as well as the integrated test methods that also include evaluating biodegradability and ecotoxicity. These early test methods, and efforts of organizations like UK-based The Microfibre Consortium (TMC), are driving a greater global understanding of root causes of fibre release and are helping provide key data needed for addressing fiber release (or fiber shedding) upstream ("Behind the Break: Exploring Fibre Fragmentation" Report in Table 5 in Appendix C). Early research by a workshop attendee from The Nature Conservancy ("Toward Eliminating Pre-consumer Emissions of Microplastics from the Textile Industry" Report in Table 5 in Appendix C) showed that pre-consumer emissions could rival fiber emissions from municipal wastewater streams and supported the importance of research, development, and cross-sector engagement in this area. At the same time, key challenges were discussed around the complexity of material types, chemistry used, textile use cases, target product specifications, and lack of research on key criteria for toxicity and persistence that would act as a barrier to designing best practices for textile design to reduce impact of fiber release. California has the opportunity to take a leadership role in deepening our global understanding of fiber release through actions outlined in the tables in Appendix C.

5) Encourage the Development & Adoption of Textile Manufacturing Best Practices

Coupled with the growing understanding of root causes and fiber release mechanisms from textile design (see #4 above) are industry efforts to build best practices in textile manufacturing to reduce fiber and chemistry release into global environments. European based organizations ZDHC and TMC shared their co-developed guidelines for mitigating fiber release from textile manufacturing wastewater (multiple reports and resources listed in Table 5 in Appendix C) and the goal to develop easy-to-implement, low cost methods for testing and evaluation. With a regional textile manufacturing hub and a range of global textile brands represented, California has the opportunity to support efforts that are already underway to develop and drive adoption of best practices at the textile wastewater stage, both globally and regionally. This could also include driving engagement between textile wastewater industry experts and municipalities also pursuing solutions in wastewater treatment for cross-learning and collaboration.

6) Drive Incentives for California Material & Chemistry Innovators Addressing Toxicity & Persistence

California is home to an exciting landscape of natural fiber (e.g., cotton, wool, cashmere, and more), new human made materials (e.g., cellulosics, less persistent thermoplastic fibers, recycled fibers, etc.), and green chemistry (e.g., bio-based, less persistent/toxic, natural, reduced water requirements, etc.) innovators who are looking to re-develop current textile

systems and drive positive impact while balancing people, planet, and profit. The workshop program featured a panel with three innovators who are all actively working toward addressing microfiber pollution to inspire cross-sector sharing and collaboration around how to minimize key hurdles and barriers for these important upstream stakeholders. Multiple shared barriers arose in discussion around the need for key criteria and aligned testing methodology of toxicity and persistence, the limitations of current life cycle assessments (LCAs), and the challenges of scaling new innovations in our current textile systems incentivized to support commodity materials and overproduction/supply.

7) Communicate Filtration & Best Practices in Laundering as a Solution

Many workshop participants were, or actively are, involved in highlighting research and/or encouraging policy efforts related to filtration on washing machines as a solution for mitigating and preventing fiber release in California water systems. While finding interventions to prevent fiber release upstream was an important focus of the workshop, generally workshop participants centered on the fact that interventions at the washing machine stage have already been studied and there are solutions emerging in the market to address the issue (e.g., Planetcare, Filtrol, etc.). At the same time, studies on the contribution of residential laundering from dryers are under way and were also discussed at the workshop. Due to the overall maturity of research and discussion for this type of intervention in the materials flow, multiple recommended actions were developed to advance progress on this solution.

8) Connect Microfiber Pollution with CA Textile Circularity & Waste Strategies

Throughout the workshop, both the organizers and participants highlighted the interconnectedness of solutions for this issue with strategies currently being implemented or pursued for advancing textile circularity. One key example highlighted through the workshop program was the recent California bill, SB-707, originally developed by the California Product Stewardship Council with a wide range of stakeholders, and now being managed by CalRecycle (see SB-707 Responsible Textile Recovery Act of 2024 in Table 5 of Appendix C). California has the opportunity to support the alignment of existing policy efforts like SB707, and related voluntary efforts around repair, reuse, and recycle, to align with solutions being developed to address microfiber pollution.

9) Encourage the Use of Cross-Sector Shared Language & Definition(s)

Ahead of the workshop, OPC confirmed that interest in addressing “Microplastics from the Textile Sector” also included non-plastic, natural, or man made cellulosic fibers that have been mechanically or chemically treated or modified, consistent with the microplastics definition provided in the Strategy (“solid polymeric materials to which chemical or other substances have been added”; see also State Water Resources Control Board (202) Board Resolution No. 2020-0021: Adoption of Definition of ‘Microplastics in Drinking Water’). For the workshop, the proposed federal definition of microfiber was used to align all stakeholders (see “Interagency Marine Debris Coordinating Committee Report on Microfiber Pollution” in Table 5 in Appendix

C). At the same time, the workshop organizers ensured that industry recognized and preferred terminology, such as the industry standard definition of “microfiber” (as explained in the “California Microfiber Update: Textile Perspective” report developed by NOAA Marine Debris Program and Materevolve) and the verbs “fiber release” and “fiber/fibre fragmentation” were more consistently used instead of “fiber shedding” to encourage deeper discussions across stakeholders from industry, science, government and academia. Looking forward, it is important for California cross-sector stakeholders to continue to develop shared language and align on key definitions to address issues both upstream and downstream for the textile sector.

10) Engage Textile Stakeholders Outside of Apparel

Due to early research in home laundering (washing machines specifically) and the current interest and investment of the apparel industry in better understanding mechanisms and solutions for fiber release from textiles, the workshop included industry stakeholders mainly from apparel manufacturers and brands. Fibers and textiles are used in a range of applications beyond apparel that include, but are not limited to: non-wovens (e.g., diapers, sanitary wipes, etc.), geotextiles (e.g., agricultural tarps, soil holding substrates, etc.), outdoor textiles (e.g., awnings, tarps, construction materials, etc.), and even reinforcement in car tires. In developing this workshop, efforts were made to engage and invite stakeholders from other parts of the textile sector including carpet, bedding and home textiles, hospitality, uniform, footwear, and more, though few responded to requests for participation. Workshop organizers and participants were conscious of this knowledge bias and perceived low interest from other parts of the sector to engage at this time. To better understand sources and solutions, California will need to build a better bridge with these other stakeholders.

Appendix A: Workshop Program

OPC California Microplastics Strategy Workshop for Textile Sector
Final Program

Tuesday, March 18th & Wednesday, March 19th
9AM to 12:30PM PST

DAY ONE PROGRAMMING: UPSTREAM RECOMMENDATIONS

9AM Welcome & Introductions (Materevolve & OPC)

Ocean Protection Council (OPC), together with Materevolve LLC, designed this workshop to accelerate knowledge exchange and identify recommendations to reduce microplastic pollution from the textile industry. It will also result in recommendations for textile related microplastic research priorities, in line with the Strategy's two-track approach (solutions and research) to address microplastic pollution in California. [Action: Please share your name, title, entity you are representing, and the location you are joining from]

OPC History & CA Microplastics Strategy
Materevolve Role & History
Agenda & Workshop Goals (Materevolve)

- Identify immediate recommendations that could be enacted or voluntarily implemented in each sector to reduce plastic pollution (e.g. solutions already in place that can be scaled for broader adoption/implementation);
- Identify long-term policy needs to advance recommendations and remove barriers to identified solutions; and,
- Identify microplastics research needs and recommend research priorities to advance pollution reduction strategies.

9:15AM Workshop Design Overview

To organize discussions for the workshop, four focal areas were designated that range from the extraction/design of raw materials to the unintended release of microfiber pollution at end of life.

Background: Microfiber Pollution & Global Policy Overview
Focal Areas for Discussion

- Materials & Chemistry Innovation (non-commodity innovation seeking to address persistence and toxicity in materials and chemistry)
- Textile Design & Manufacturing (fiber release test standard, textile wastewater, fiber reduction in processing, manufacturing best practices)

- Textile Product Use & Care Phase (commercial laundries, residential laundries, general wear)
- End of Life Phase (municipal wastewater, textile waste, biosolids, biota, etc)

9:30AM - 10:25AM Material & Chemistry Innovation Panel

All textile products start with a range of choices centered around material and chemistry that also need to balance financial requirements and other limitations. Today, we will explore how

California can further support efforts to innovate and scale new materials, improve existing natural fiber material systems, and advance dyes/finishes to address microfiber pollution (aka fiber fragmentation). [Action: Review Pre-Read Tables ahead of workshop]

Introduction (Materevolve)
Expert Panel

- Stephen Taylor, Product Circularity Engineer, Natural Fiber Welding (NFW) - Developing and Scaling New Materials to Address Fiber Fragmentation
- Marty Mulvihill, Managing Partner & Co-Founder, Safer Made - Developing and Scaling Green Chemistry
- Rebecca Burgess, Executive Director, Fibershed - Developing & Scaling Healthy Natural Fiber Systems

Facilitated Discussion & Questions from Participants

10:25AM - 10:55AM Small Group Activity

Participants will be split into breakout rooms to further discuss Material & Chemistry Innovation. [Action: Participants should be prepared to provide key learnings via chat during the general discussion]

Breakout Rooms: Identification of missing recommendations, barriers, research needs

10:55AM - 11:00AM Break

Please stretch, grab some tea, and/or use the restroom

11:00AM - 11:55AM Textile Design & Manufacturing Panel

Textiles are designed and manufactured around the globe. California is home to many companies but only a small fraction of textile manufacturing happens here. There is momentum building to share best management practices to reduce microfiber and chemical pollution at the manufacturing stage and develop test methods to mitigate fiber release from textiles upstream. [Action: Review Pre-Read Tables ahead of workshop]

Introduction (Materevolve)
Expert Panel

- Scott Echols, Chief Impact Officer, Zero Discharge of Hazardous Chemicals (ZDHC) - Wastewater Guidelines for Textile Industry
- Kelly Sheridan, CEO, The Microfibre Consortium - Cross Industry Microfiber Roadmap & Fiber Release Testing Update
- Patrick Jurney, Plastics Project Director, The Nature Conservancy- Guidelines for Brands in Textile Design and Manufacturing

- Thomas Braun, Technical Director, Swisstex California Inc. - Best Practices in Managing Water & Chemistry in California

Facilitated Discussion & Questions from Participants

11:55AM - 12:25PM Small Group Activity
Participants will be split into breakout rooms to further discuss Textile Design & Manufacturing. [Action: Participants should be prepared to provide key learnings via chat during the general discussion]

Breakout Rooms: Identification of missing recommendations, barriers, research needs

12:25PM - 12:30PM Closing & What to Expect for Tomorrow

DAY TWO PROGRAMMING: DOWNSTREAM RECOMMENDATIONS

9AM Welcome (Materevolve and OPC)
Day 2 will explore downstream solutions, starting at point of sale through unintended and intended discard. [Action: If you are new, please share your name, title, entity you are representing in chat, and the location you are joining from]

Day 1 Review (OPC & Materevolve)
Agenda & Workshop Goals (Materevolve)
- Identify immediate recommendations that could be enacted or voluntarily implemented in each sector to reduce plastic pollution (e.g. solutions already in place that can be scaled for broader adoption/implementation);
- Identify long-term policy needs to advance recommendations and remove barriers to identified solutions; and,
- Identify microplastics research needs and recommend research priorities to advance pollution reduction strategies.

Discussion: What have you been thinking about since yesterday?

9:15AM-10:05AM Textile Product Use & Care Panel
Product care, fiber fragment release from laundering, and washing machine filtration have been an early focus for research and policy efforts - we now know that dryers are also an important source and solutions are being actively explored. We aim to expand the discussion in product use and care to also include extending the use of textile products including resale, repair, and reuse programs and related solutions like Extended Producer Responsibility programs to drive systems re-design and textile waste mitigation. [Action: Review Pre-Read Tables in advance of the workshop]

Introduction (Materevolve)
Expert Panel

- Dr. Lisa Erdle, Director of Science and Innovation, The 5 Gyres Institute - Washing Machine & Dryer Research and Solutions
    - Dr. Joanne Brasch, Director of Advocacy and Outreach, California Product Stewardship Council (CPSC) - Extended Producer Responsibility (EPR) Programs in California
    - Eileen Mockus, COO, Accelerating Circularity - Preventing Textiles to Landfill & Building US Infrastructure for Extended Textile Use

Facilitated Discussion & Questions from Participants

10:05AM - 10:35AM Small Group Activity

Participants will be split into breakout rooms to further discuss Textile Product Use & Care. [Action: Participants should be prepared to provide key learnings via chat during the general discussion]

Breakout Rooms: Identification of missing recommendations, barriers, research needs

10:35AM - 10:40AM Break

Please stretch, grab some tea, and/or use the restroom.

10:40AM - 11:30AM Fiber & Textile End of Life Panel

Today, textile systems are linear and designed to be discarded after use (ultimately ending up in a landfill, either locally or somewhere around the globe). Additionally, all textiles release unintended microfiber and chemical pollution, with impacts not fully understood. In this session, we will learn what actions California municipalities are already taking to understand the environmental and social impacts of microfiber pollution and textile waste as well as research in the ecotoxicity impacts of material and chemistry choice. [Action: Review Pre-Read Tables in advance of the workshop]

Introduction (Materevolve)
Expert Panel

- Dr. Susanne Brander, Associate Professor, Oregon State University - Impact of Microfiber Composition and Chemistry on Ecotoxicity
- Dr. Timnit Kefela, Assistant Professor of Environmental Science & Resource Management, CSU Channel Islands - Microplastics (Including Microfibers) Pathways, Fates and Impacts & Community Driven Solutions
- Dr. Leah Hampton. Senior Scientist, Southern California Coastal Water Research Project (SCCWRP) - Methods for Characterizing Microfiber Occurrence

Facilitated Discussion & Questions from Participants

11:30AM - 12:00PM Small Group Activity

Participants will be split into breakout rooms to further discuss Fiber & Textile End of Life. [Action: Participants should be prepared to provide key learnings via chat during the general discussion]

Breakout Rooms: Identification of missing recommendations, barriers, research needs
Discussion: Key learnings

12:00PM - 12:30PM Prioritization & Next Steps

There is a need to act immediately to reduce microfiber pollution. To close our workshop, we will come together to prioritize short term and long term solutions, as well as research needs, discussed throughout the workshop and share what will happen next for OPC.

Reflections & Group Discussion: What is most immediate and important?
Next Steps

Appendix B: Workshop Participant List

Full Name	Title	Entity
Alison Waliszewski	Director of Regional Policy & Program Development	The 5 Gyres Institute
Alyssa Demko	Environmental Scientist	California Department of Toxic Substances Control Safer Consumer Products Program
Amelie Cloutier	Materials Innovation Lead	Arc'teryx Equipment
Andrea Ferris	CEO	Intrinsic Advanced Materials
Angela Noakes	Plastics Policy Analyst	Ocean Conservancy
Anna Posacka	Microfibre Expert	Ocean Positive Solutions
Beth Pitton-August	Director of Development	UC Santa Barbara Bren School of Environmental Science & Management
Carlie Herring	Research Coordinator	NOAA Marine Debris Program
Carol Shu	Sr Manager, Global Sustainability	The North Face
Carolynn Box	Consultant	Materevolve
Dimitri Deheyn	Research Scientist	Scripps Institution of Oceanography, UC San Diego
Eileen Mockus	COO	Accelerating Circularity
Ellen Johnson	Sustainability and Innovation Manager	Columbia Sportswear Company
Erica Kalve	Groundwater Protection Section Manager	State Water Resources Control Board
Ezra Miller	Senior Scientist	San Francisco Estuary Institute
Gretchen Salter	Policy Director	Safer States
Jesse Daystar	Chief Sustainability Officer and Vice President of Sustainability	Cotton Inc

Jimmy Summers	VP - EHS/Sustainability	Elevate Textiles, Inc.
Joanne Brasch	Director of Advocacy	CA Product Stewardship Council
Jordan Feigh	Sustainability and Product Stewardship Manager	Unifi Manufacturing, Inc.
Kaitlyn Kalua	Deputy Director	California Ocean Protection Council
Karen Muhlin	Lab Director	The North Face
Kate Riley	Special projects strategist	Textile Exchange
Kelly Sheridan	CEO	The Microfibre Consortium
Kiya Bibby	Associate Director, Science-Policy Engagement	California Ocean Science Trust
Krystle Moody Wood	Founder & Principal	Materevolve
Kyla Kelly	Water Quality Program Manager	California Ocean Protection Council
Leah Hampton	Senior Scientist	Southern California Coastal Water Research Project (SCCWRP)
Lewis Shuler	VP of Advanced Concepts	Paradise Textiles
Lexi Fujii	Advocacy Manager	Fibershed
Libby Sommer	Founder & Principal	Libby Sommer LLC
Lisa Erdle	Director of Science	5 Gyres
Manoela Romano De Orte	Research Scientist III	State Water Resources Control Board
Mariam Panasyan	Environmental Engineering Associate	Los AngelesSanitation & Environment (LASAN)
Marty Mulvihill	Managing Partner and co-founder	Safer Made
Monica Arienzo	Associate Research Professor	DRI

Nicole Rosen	Master's Student & Workshop Tech Support	UC Santa Barbara Bren School of Environmental Science & Management
Nizanna Bathersfield	Attorney Adviser	US EPA/Office of Water
Patrick Jurney	Plastics Project Director	The Nature Conservancy
Rebecca Burgess	Executive Director	Fibershed
Rebecca Sutton	Senior Scientist	San Francisco Estuary Institute
Scott Coffin	Pharmacokinetics Research Scientist (Research Scientist IV; Chemical Sciences)	Office of Environmental Health Hazard Assessment (OEHHA)
Scott Echols	Chief Impact Officer	Zero Discharge of Hazardous Chemicals (ZDHC)
Scott Mitchell	Hospitality Consultant	Cardinals Hospitality Consulting, LLC
Sriram Gopal	Senior Director of Regulatory Policy & Circular Economy	Association of Home Appliance Manufacturers
Stephen Taylor	Product Circularity Engineer	Natural Fiber Welding, Inc (NFW)
Susanne Brander	Associate Professor	Oregon State University
Thomas Braun	Technical Director	Swisstex
Timnit Kefela	Assistant Professor of Environmental Science and Resource Management	California State University-Channel Islands
Win Cowger	Research Director	Moore Institute for Plastic Pollution (MIPPR)

Appendix C: Workshop Tables 1-5

Table 1. Material & Chemistry Innovation: Immediate Actions, Policy Recommendations, and Barriers
IMMEDIATE ACTIONS & RECOMMENDATIONS
1. Continue engagement with textile industry stakeholders to understand barriers and needs of green chemistry and material alternatives to conventional plastic fiber.
a. Develop a study on how California can support and accelerate materials and chemistry innovation. Evaluate other industries to see how innovation has happened in the past to see if there are additional levers to use.
2. Support further information sharing between policy makers, scientists, and California sustainable fiber and textile stakeholder groups working on solutions for the textile sector.
a. Establish and fund the organization of an ongoing working group that has key players from the textile industry (manufacturers, brands, etc.), policy makers, and environmental scientists (academia, NGOs, etc.) to guide research and solutions for textile sector including aligning on definitions/terminology, fiber release testing standards, and toxicity and persistence targets.
b. Collaborate with textile and chemical industry experts to identify the most common materials and chemical combinations used commonly in textiles today to help gather key missing data needed to build fit-for-purpose toxicity and persistence research. Work to collectively identify existing standards and approaches developed by industry to evaluate the safest alternatives. Start an invite list with participants of the workshop.
LONG-TERM POLICY NEEDS TO ADVANCE RECOMMENDATIONS
1. Support materials and chemistry research and innovation that reduces toxicity and persistence of conventional fibers.
a. Collaborate with California Safer Consumer Products (SCP) Program, Safer States, Zero Discharge of Hazardous Chemicals (ZDHC), Bluesign, and Safer Made to identify safer chemistry for textile use and prioritize the most toxic and persistent chemistry to eliminate from textile products sold in California.
b. Develop a chemistry mitigation strategy from a yarn/textile level using the data collected on safer chemistry to drive materials innovation from there. This would include avoiding regrettable substitutions for chemistry, gathering more data on toxicity, and continuous improvement on specific benchmarks to work towards collectively.
c. Develop an ongoing materials and green chemistry innovation fund to incentivize and address toxicity and persistence of conventional fibers. Establish a judging panel composed of industry, science and government to develop key criteria for evaluation of applicants. Look to Conservation X Labs Microfiber Innovation Challenge as a similar example.
2. Advance policies in chemical management, transparency, and reporting on textile products sold in California.
a. Encourage detailed disclosure of chemicals used on textile products by incentivizing transparency from California textile goods companies, or companies shipping into California.

b. Track UN Global plastics treaty related to requirements on increased transparency and traceability throughout the supply chain and evaluate if the same model be used in California.
3. Encourage reduction of virgin plastic fiber production and support the development and adoption of material and chemical alternatives.
a. Support public education programs centered around microfiber pollution, that accelerate knowledge of safer material and chemical composition of textile goods and discourage purchase of low quality, fast fashion textile goods.
b. Work with federal counterparts to eliminate policy measures (e.g., de minimis tariff) that allow mass quantities of lower quality, fast fashion to be shipped into the US.
4. Advance development and scale of California's regional natural fiber and dye systems.
a. Advocate for textile infrastructure in California to support fiber and textile producers with local upstream processing (e.g., cleaning wool, fine yarn spinning, blending capabilities) using green chemistry and modern, lower impact processing.
b. Collaborate with Fibershed to support fiber and dye farmers' transition to climate beneficial agricultural practices that prioritize soil health and healthy ecosystems.
c. Fund toxicity, persistence and environmental impact research that includes California fiber and natural dye combinations alongside commonly used material and chemistry.
BARRIERS & RESEARCH NEEDS
1. Need research differentiating between the effect of fiber polymer type (e.g., polyester, nylon, cellulose, treated natural fibers) and the additive chemistry on human health, toxicity and persistence in the environment.
2. Need target criteria (e.g., persistence/biodegradability and toxicity) and aligned testing methodology for developing material alternatives to conventional fibers and chemistry.
3. Need educational resources for brands and manufacturers that provide material type, dyes, and treatment options known to have less impact on toxicity, persistence, and fiber fragmentation.

Table 2. Textile Design & Manufacturing: Immediate Actions, Policy Recommendations, and Barriers

IMMEDIATE ACTIONS & RECOMMENDATIONS
1. Encourage evaluation and adoption of ZDHC and TMC Wastewater Guidelines (see Table 5) to reduce release of fiber fragments in effluent waters during textile manufacturing.
a. Facilitate knowledge sharing of ZDHC and TMC Wastewater Guidelines to reduce fibers in wastewater with California textile brands and manufacturers through formation of California working group to advance solutions to microfiber pollution and/or the development of a public resource.

b. Collaborate with Materevolve, Southern California Coastal Water Research Project (SCCWRP), Los Angeles Sanitation (LASAN), ZDHC, and TMC to hold a targeted workshop for CA textile manufacturers, commercial laundries, and municipal wastewater treatment stakeholders to share collective best practices in wastewater treatment for measuring and mitigating fiber release; gather key feedback on viability and efficacy from all parties involved.
2. Support California textile industry stakeholders to engage in active workstreams to identify best practices to reduce fiber release during textile design & manufacturing and advance material and chemical alternatives that address persistence and toxicity.
a. In collaboration with key stakeholders at the workshop, sponsor a California industry targeted workshop (e.g. Materevolve Textile x Ocean Connector Sail) to facilitate learning, education, and deeper connection across California textile brands and manufacturers.
b. Follow The Nature Conservancy and 5 Gyres Institute ongoing workstream to develop guidelines for brands and manufacturers and support in aligning these resources with ZDHC and TMC Wastewater Guidelines for California brands and manufacturers.
c. Encourage California brands and manufacturers to review resources provided in this report and participate in textile fiber release testing and evaluation by using the TMC, American Association of Textile Chemists and Colorists (AATCC), and International Organization for Standardization (ISO) test methods to contribute to global data gaps around root causes of fiber fragmentation.
d. Commission a case study with California brands and manufacturers to evaluate fiber release best practices in textile design and manufacturing to better understand reduced impacts for California water systems.
LONG-TERM POLICY NEEDS TO ADVANCE RECOMMENDATIONS
1. Build incentive program for California textile product brands and manufacturers to implement education and business strategy specific to mitigating fiber release and impacts that a) provides internal education on microfiber pollution and textile solutions b) requires testing of highest volume textile programs with standardized test methods for textile design c) requires partnership with textile manufacturing partners to implement best practices for fiber release in textile production d) encourages engagement with fit-for-purpose toxicity research to better understand impacts and e) rewards the development and adoption of material and chemical alternatives that reduce toxicity and persistence.
2. Collaborate with state agencies, NGOs, and textile industry stakeholders to develop a Ecodesign for Sustainable Products Regulation (ESPR) policy in California that includes parameters to address fiber release.
a. Develop repeatable, low cost, and enforceable standard industry-wide testing requirements related to fiber release and quality for textile products. Current industry test standards are centered around washing in residential laundry and are labor intensive & high cost - new testing methodology will need to be developed for different stages of textile production and use (e.g., required textile pretreatment, production standards for filtration, etc.) and to reduce labor and high costs.

b. Develop labelling requirements to facilitate transparency around chemical additives on textile products and measures that brands or manufacturers have implemented within their production system to mitigate fiber release.
BARRIERS & RESEARCH NEEDS
1. Need further research and industry engagement to refine standardized testing methods for fiber release to aid in understanding textile design changes and how they are related to fiber release (e.g., weave design, pre-treatments, chemical uses) at various stages of textile production. Current test methods are focused mainly on fiber release in washing.
2. Need further research and stakeholder engagement to improve analytical method performance for addressing fibers in both textile design and waste water treatment (e.g., accuracy, precision, time, cost). Testing costs for fiber release upstream in textile design is currently high for both brands and manufacturers. ZDHC and TMC have developed guidelines further downstream to use easy-to-implement, low cost testing of common indicators in waste water treatment (e.g., Total Suspended Solids) but there is still room for improvement.
3. Need further research to identify impacts of toxicity and persistence from current fiber fragment release to better design textiles and manufacturing systems (including textile wastewater treatment) upstream. With more defined criteria around material and chemical composition (e.g., benchmarks, limits, etc) related to fiber release, textile brands and manufacturers can use this information to refine and scale best practices to mitigate environmental impact.
4. Need to integrate impacts of fiber release in material and textile product life cycle assessments (LCA) as this is a common tool used by brands and manufacturers to evaluate sustainability claims. Current LCAs focus on a range of impact categories across the product lifecycle including greenhouse gas emissions, energy requirements, water use, chemistry use and more but do not include fiber release impacts. For toxicity assessment integration, hazard assessment and/or risk assessment may be a better tool than LCA.
5. Need funding and research on other potential sources and pathways of microfiber pollution (e.g., home goods, carpets, geotextiles, sanitary wipes, etc.).

Table 3. Textile Product Use & Care: Immediate Actions, Policy Recommendations, and Barriers

IMMEDIATE ACTIONS & RECOMMENDATIONS
1. Build digital resources and/or design community education campaigns (multilingual) on known microfiber sources and strategies to reduce microfiber pollution in residential homes, along with known human health and environmental impacts of microfiber pollution.
a. Collaborate with The Nature Conservancy, The 5 Gyres Institute, and Ocean Conservancy, San Francisco Estuary Institute (SFEI) and Desert Research Institute to communicate options for installation of microfiber filtration devices and best management practices for in-home washing & drying to limit fiber release. Utilize key learnings presented in Fibers to Filters, A

Toolkit for Microfiber Solutions.
2. Support California industrial and commercial laundries to evaluate and implement improved filtration options and best practices to mitigate fiber release into municipal water systems and urban air.
a. Share findings of SFEI and The 5 Gyres Institute commercial laundry study with industrial and commercial stakeholders to further engagement and adoption of best practices.
LONG-TERM POLICY NEEDS TO ADVANCE RECOMMENDATIONS
1. Advance statewide efforts that require filtration on California laundering (including residential, commercial, and industrial) including washing and drying.
a. Establish a coalition across multiple west coast states to advance filtration research and policy efforts in residential, commercial, and industrial laundering (washers and dryers) to microfiber pollution.
b. Fund pilot study in California to evaluate fiber emissions from industrial and commercial washing (including denim laundries) and cross-compare with residential laundry filtration research to identify best practices, costs, and barriers to scale improved filtration. Build a roadmap strategy to target filtration where it drives the most impact and scale for mitigting fiber release into unintended pathways (e.g. water and air).
c. Work with industry and scientists studying filtration to identify best disposal options for fibers captured by filtration in laundering and cross-communicate with stakeholders through public and industry targeted education resources.
d. Carry out cost-benefit analysis studies of residential filtration devices (for both washers and dryers) and evaluate the feasibility of residential consumer adoption such as exploring what incentives (e.g., rebates, etc) would be successful through direct polling and engagement.
2. Encourage and engage with policy developers for existing US and EU legislation efforts (e.g., SB707, AB405, Corporate Sustainability Reporting Directive (CSRD), Product Environmental Footprint (PEF), etc.) related to sustainable textile, fashion, and chemistry management to integrate key learnings and best practices related to microfiber pollution.
a. Further integrate fiber fragmentation efforts into policy to address textile waste (e.g., SB-707) by bringing together CalRecycle, scientists and textile sector representatives to align solutions being developed to address microfiber with efforts on repair, reuse and recycling.
b. Develop repeatable and enforceable standard industry-wide testing requirements related to fiber release and quality for textile products to integrate into policy measures related to advancing textile circularity and lowering impact of textile products. Current industry test standards are centered around washing in residential laundry and are labor intensive & high cost - new testing methodology will need to be developed for different stages of textile production and use (e.g., required textile pretreatment, production standards for filtration, etc.) and to reduce labor and high costs.

3. Incentivize engagement and knowledge of non-apparel microfiber sources throughout California by funding studies that target the evaluation and include the participation of stakeholders from non-apparel textile products (e.g., working with the hospitality sector to identify areas where hotels can lead on fiber reduction efforts).
BARRIERS & RESEARCH NEEDS
1. Need funding and research to understand filtration options for residential, commercial, and industrial washer and dryers, and understand how levels of microfiber release compare to each other.
2. Need funding in research & Development around how to reuse or dispose of microfibers captured both through filtration such as exploring lint recycling programs with CA textile EPR stakeholders.
3. Need funding and research to evaluate the contribution of other potential textile sources (e.g., home goods, carpets, geotextiles, sanitary wipes, etc.) and pathways (e.g., urban air dust, stormwater, etc.) and impacts (e.g. human exposure) of microfiber pollution.
4. Need socio-economic evaluations and comparisons of different policy approaches for microfibers (e.g., Extended Producer Responsibility, credits).
5. Need funding and research to better understand CA textile waste composition, textile waste contribution to fiber fragmentation, and infrastructure needs for textile sorting and recycling.

Table 4. Fiber & Textile End of Life: Immediate Actions, Policy Recommendations, and Barriers

IMMEDIATE ACTIONS & RECOMMENDATIONS
1. Strengthen cross-learning opportunities between CA textile manufacturers, commercial laundries, and municipal wastewater treatment stakeholders to advance knowledge and identify best practices to reduce fiber release.
a. Facilitate knowledge sharing of ZDHC and TMC Wastewater Guidelines to reduce fibers in wastewater with California textile brands and manufacturers through formation of California working group to advance solutions to microfiber pollution and/or the development of a public resource (same as Table 2).
b. Collaborate with Materevolve, Southern California Coastal Water Research Project (SCCWRP), Los Angeles Sanitation (LASAN), ZDHC, and TMC to hold a targeted workshop for CA textile manufacturers, commercial laundries, and municipal wastewater treatment stakeholders to share collective best practices in wastewater treatment for measuring and mitigating fiber release as well as biosludge or biosolids management (e.g., incineration, etc.); gather key feedback on viability and efficacy from all parties involved (same as Table 2).
c. Share new monitoring technology that allows real-time monitoring of fibers in wastewater or effluent water. Track related technology development and test effectiveness of these types of monitoring efforts.

d. Build and fund the development of a consolidated digital resource portal to provide existing published reports and studies related to fiber fragment release and impact studies.
e. Fund study to map known industrial fiber emitters in California (e.g., textile manufacturers, commercial laundries, etc.) and compare with early studies in other pathway contributions (e.g. stormwater).
2. Facilitate information sharing between brands, manufacturers, and scientists to identify most common processes and dyes used in textile production to co-design fit-for-purpose toxicity and persistence studies that can support learnings for long term impacts on human health and the natural environment.
a. Join and participate in an impact-focused working group formed by a subset of workshop participants (e.g., TMC, ZHDC, The 5 Gyres Institute, Oregon State University, and more) after March 18-19 Textile Sector Workshop.
b. With industry stakeholders, build a list of most common textile material types, dyes, and finishing processes used by brands and manufacturers to guide decision making around priorities for ecotoxicity studies.
3. Track current studies being conducted on design and green infrastructure / low impact development to reduce microfiber pollution in stormwater systems (California State University Long Beach and University of California Los Angeles). Share results with the textile sector to better understand options to reduce and control microfiber pollution in biosolids / sludge.
LONG-TERM POLICY NEEDS TO ADVANCE RECOMMENDATIONS
1. Incentivize brands, manufacturers, and scientists studying ecotoxicity and persistence of material and chemical composition of microfiber pollution to drive collaboration, innovation, and education cross-sector to align testing methodology and advance better informed solutions upstream (e.g., developing a targeted research fund).
a. Gather available background research on public health significance of microfiber pollution that can be used to guide criteria for testing methodology and best practices in translation of key learnings in research.
b. In collaboration with textile and garment manufacturers, as well as LA-based Garment Worker Center, fund research focused on the impacts of inhalation of fibers by California textile and garment workers.
2. Advance policies that reduce textile waste and increase textile circularity in California by supporting the roll out and implementation of SB-707, as well as accelerating adoption of best practices and solutions identified to mitigate impacts of microfiber pollution.
a. Support deeper research and infrastructure development in California for managing, sorting and recycling textiles by working with key stakeholders such as CPSC, LASAN, Accelerating Circularity and Ambercycle to mitigate end of life impacts of textile waste.
b. Follow textile composting study by Fibershed and UC Merced to evaluate as a solution to mitigating textile and fiber waste; support strategy development for implementation and scale.

3. Encourage environmental justice and the inclusion of impacted communities in policy discussions and research efforts related to microfiber pollution and mitigation strategies to reduce microfiber pollution.
a. Collaborate with California State Channel Islands University and others working in this area to identify best methods for approaching and engaging high impacted communities related to microfiber pollution.
b. Build and implement strategy to bring in targeted stakeholders to participate in and evaluate research and solution proposals for fiber mitigation in the environment (e.g., stormwater infrastructure) to ensure deeper evaluation of health and socioeconomic impacts.
BARRIERS & RESEARCH NEEDS
1. Need to better understand the level of fiber emissions from known fiber emitters (e.g., textile manufacturers, commercial laundries, etc) vs other pathways (e.g., stormwater, municipal wastewater, urban air, etc.)
2. Need more research and cross stakeholder collaboration to understand fate and the environmental and human health impacts of fiber fragments in the environment to build criteria for preferred material and chemical composition.
3. Need to better understand fiber fragment release and impacts of textile waste going to landfills as a potential source and pathway for microfiber pollution.
4. Need further research and monitoring of microfibers in the biosolids that are produced by California's municipal wastewater treatment plants to account for fibers not captured in research. This research needs to include what is currently happening today with treated water and biosolids and how to mitigate re-spreading fibers out in the environment once captured in waste water filtration.

Table 5. Resource Page for OPC California Microplastics Strategy Workshop for the Textile Sector

#	RESOURCE TITLE	PRIMARY ENTITIES INVOLVED
1	Behind the Break: Exploring Fibre Fragmentation	TMC, Fashion For Good
2	Interagency Marine Debris Coordinating Committee Report on Microfiber Pollution	Interagency Marine Debris Coordinating Committee (IMDCC), EPA Trash Free Waters Program, NOAA Marine Debris Program, Materevolve
3	Federal Report on Microfiber Pollution Summary	Interagency Marine Debris Coordinating Committee (IMDCC), EPA Trash Free Waters Program, NOAA Marine Debris Program, Materevolve

4	Tackling microfibre pollution through science, policy, and innovation: A framework for Canadian leadership	Ocean Diagnostics, Raincoast Conservation Foundation
5	The global apparel industry is a significant yet overlooked source of plastic leakage	Cotton Incorporated
6	Toward Eliminating Pre-consumer Emissions of Microplastics from the Textile Industry	The Nature Conservancy, Bain & Company
7	Fibre Fragmentation in Wastewater: Suppliers; Fibre Fragmentation in Wastewater: Brands & Retailers	ZDHC, TMC
8	ZDHC Wastewater Guidelines	ZDHC
9	Preliminary Guidelines: Control of Microfibres in Wastewater	TMC
10	Fibers to Filters: A Toolkit for Microfiber Solutions	Ocean Conservancy, 5 Gyres, The Nature Conservancy
11	California Microfiber Update: Textile Perspective	NOAA Marine Debris Program, National Marine Sanctuary Foundation, Materevolve
12	2017 Microfiber Action Road Map	Ocean Conservancy
13	San Francisco Bay Microplastics Project: Action Sheet	SFEI, 5 Gyres
14	Biodegradation of Textile Fabrics - Info Sheets	The Biomimicry Institute, Libby Sommer
15	Microplastics Occurrence, Health Effects, and Mitigation Policies An Evidence Review for the California State Legislature	The California State Policy Evidence Consortium (CalSPEC)
16	SB-707: Responsible Textile Recovery Act of 2024	California Product Stewardship Council
17	Microfibres from Textiles - A Key Source of Microplastics to the Environment: Fate, Effects, and Mitigation Strategies	Oregon State and others