



Recycling Development Center Advisory Board Meeting

January 10, 2024 | 9am – 11am (Pacific time)



AGENDA

- 9:00 am Welcome
- 9:10 am Board roundtable & new member welcome
- 9:20 am Commerce and Ecology updates
- 9:35 am Mya Keyzers – Data & Reports
- 9:50 am Bio break
- 10:00 am Patricia Townsend & Martha Aitken
- 10:20 am Dr. Hang Liu
- 11:00 am Wrap-up



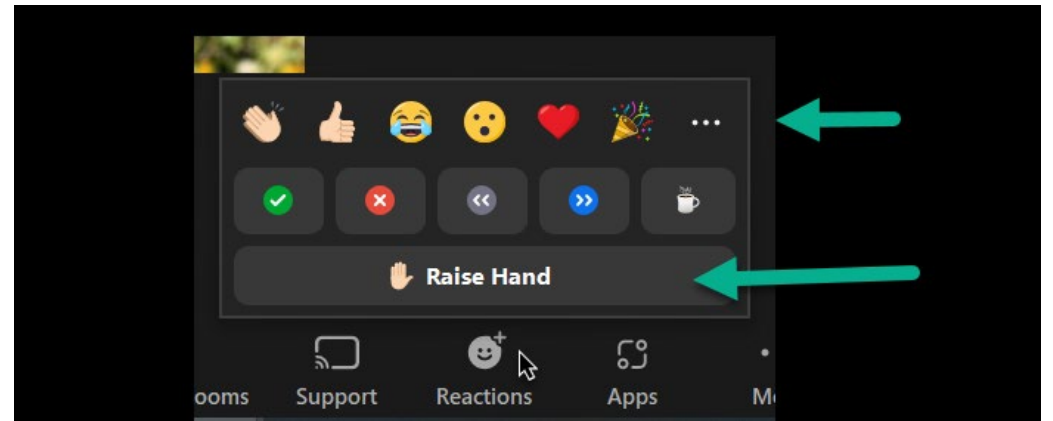
Participating in this meeting:

Roles

- Host-Caleb
- Facilitator-Mya
- Note taker/chat monitor-Tina

Rules

- Cameras On
- Board members and presenters may unmute themselves.
- Questions, please raise your hand or type them in the chat box.
- I will call on you or I can read your question from the chat.
- Use reactions to keep it interactive





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Center updates

Board members

Commerce

Ecology



Happy 4th Birthday Advisory Board



Jan 9, 2020 – Highline
Community College

Jan 10, 2024 - Zoom



Corinne Drennan
Kris Major
Kyla Fisher



Andy Booth – Grant Co.
Preston Peck – City of Tacoma

Board roundtable:



- Where were you on your 4th birthday?
- What material type has the largest increase during the Holiday season?

Board roundtable:

Natalie Caulkins



Allen Langdon



Karl Englund



Andy Booth



Preston Peck



Scott Morgan



Chris Piercy



Mike Range



Tim Shestek



Jay Simmons



Jon Smieja



Heather Trim





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Agency Updates

Kirk Esmond



Washington State
Department of
Commerce

Kara Steward



DEPARTMENT OF
ECOLOGY
State of Washington





welcome

★ TO THE ★
★ TEAM ★

MEGAN!

RDC Work Plan for 2024



CONVENE

- Board meetings
- Facility tours
- Glass summit #2



INNOVATE

- NextCycle Accelerator
- Possible pilot projects*



RESEARCH

- Update market papers
- Possible research*



ASSISTANCE

- Commerce assistance
- Attend conferences

* Funding dependent



Applying for NextCycle Washington's Business Accelerator?

SAVE THESE DATES

Jan. 11
5:00 - 6:30 p.m. PST
Application Party
Ask questions about NextCycle & the application.

Jan. 26
Applications DUE
Submit yours today!

 **NEXTCYCLE WASHINGTON**



Washington State Circular Economy

RECYCLING DEVELOPMENT CENTER, ADVISORY BOARD MEETING
— COMMERCE UPDATES —
JANUARY 10, 2024

Kirk Esmond | Circular Economy Development Director

Office of Economic Development & Competitiveness | Washington State
Department of Commerce



Washington State
Department of
Commerce

We strengthen communities



HOUSING AND HOMELESSNESS



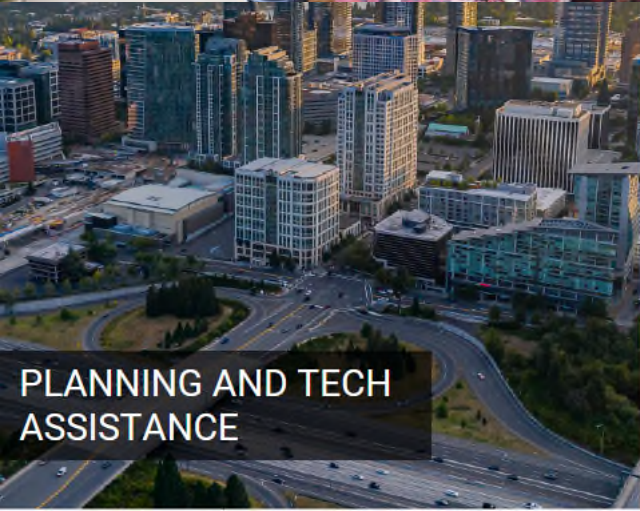
INFRASTRUCTURE AND BROADBAND



SMALL BUSINESS ASSISTANCE



ENERGY



PLANNING AND TECH ASSISTANCE



COMMUNITY SERVICES AND FACILITIES



CRIME VICTIMS AND PUBLIC SAFETY



ECONOMIC DEVELOPMENT

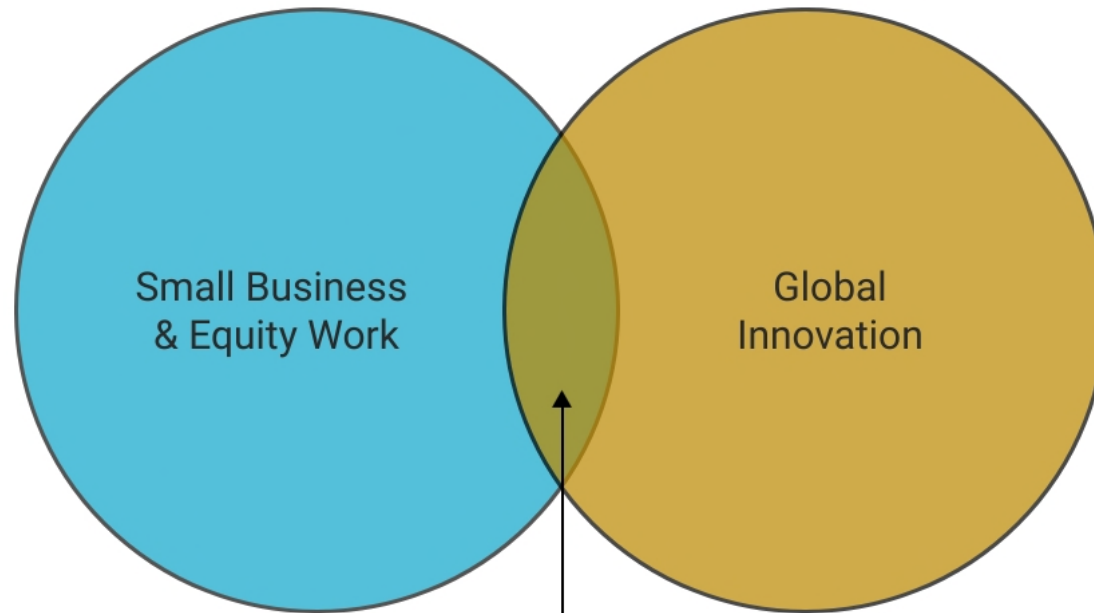
Economic Development (OEDC)

Serves as a think tank for reshaping the state's economy for decades to come.



Overarching Strategy

Small businesses are the primary drivers of the economy and, given the support they need, can create living-wage jobs and provide upward mobility to those who have been historically marginalized.



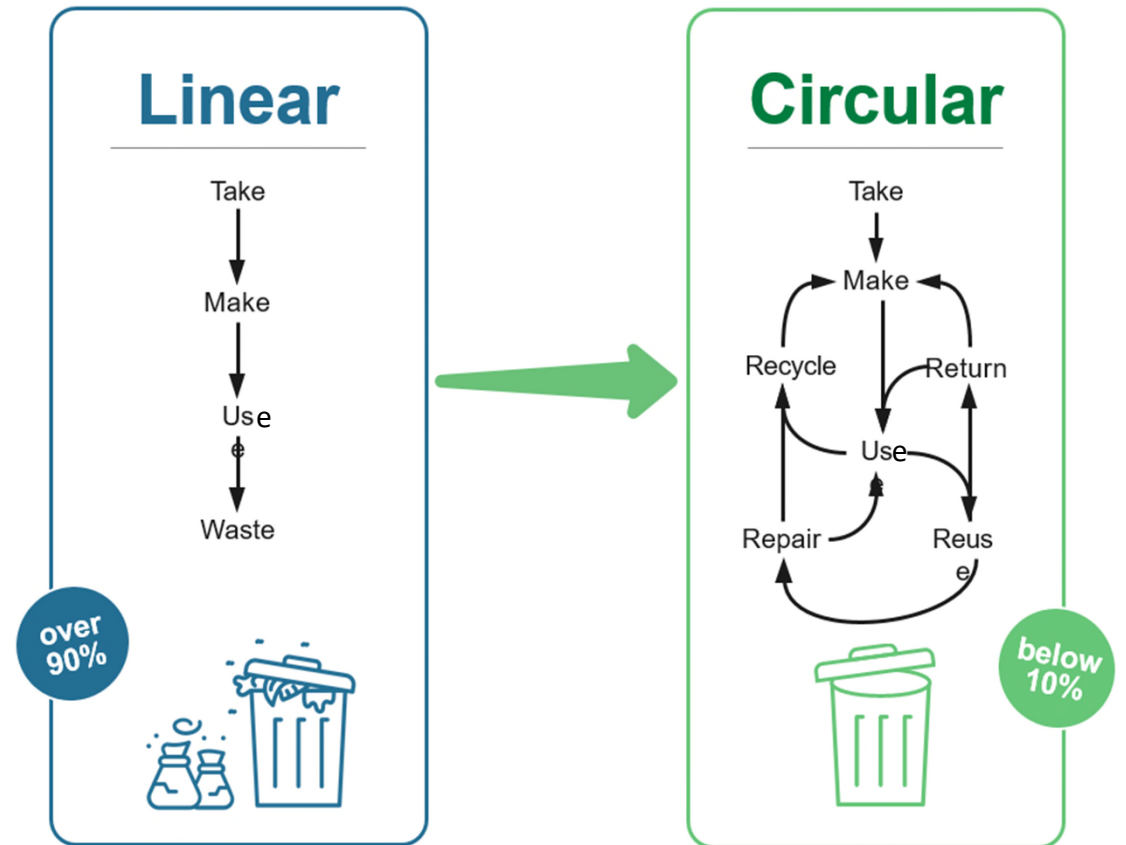
Innovation has been the foundation of our state's economic growth for more than a century. New investments in specific high-growth sectors will continue to pay dividends to the state for decades to come.

New Business Opportunities
(Economy 20 to 40 years from now)

Circular Economy Growth – 2024

Key initiatives and projects underway

- **Governor’s Budget Request** – \$5M to expand programs
- **Current Legislative Session** -- Carbon, climate and recycling
- **International Workgroup** – Cooperation Agreement of the Americas
- **Danish Energy Innovation** – Clean energy parks and investment
- **Circular Economy, Sector Buildout** – Upcoming, new hire(s)
- **Plastic Bag Film Study** – Report to the Legislature



Industry Connections

Recent and ongoing conversations

Cyclic Materials

Airex Energy

“Project EnergyForce”

Polar Defense

Divert

SAI Tech

PNW Renewables

Creative Energy

Lamb Weston

Pacific Ag

Framatome

OCOchem

ZILA Bioworks

Double Diamond Fruit Co.

Corumat

Allegheny Technologies (ATI)

Collaboration amongst programs, divisions and agencies

Evergreen Recycling

RMP Eco

Cedar Grove

Sierra Pacific Industries

Aero Aggregates

Carbon Robotics

[more]

Recent Conferences and Training

Helping to drive best practices

Northwest Bioenergy Summit – Kennewick

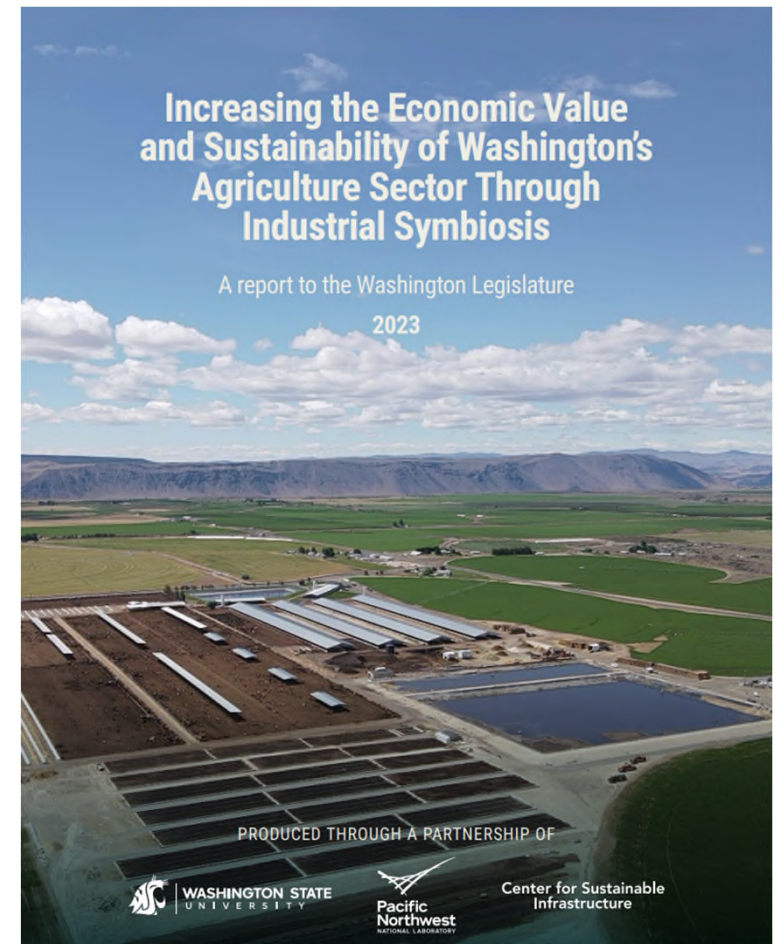
Center for Advanced Manufacturing Conference – Bellevue

Biochar Innovation Summit – Spokane

Eco-Industrial Park, facilitated workshops – Longview and Pasco

Clean Energy Expo, North Central WA – Wenatchee

C6 Forest to Farm – Biochar production facility – Winton



[Ag Symbiosis Report | sustaininfrastructure.org](https://sustaininfrastructure.org)



Washington State
Department of
Commerce

www.commerce.wa.gov



Thank you.

Kirk Esmond

CIRCULAR ECONOMY DEVELOPMENT DIRECTOR

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www.choosewashington.com



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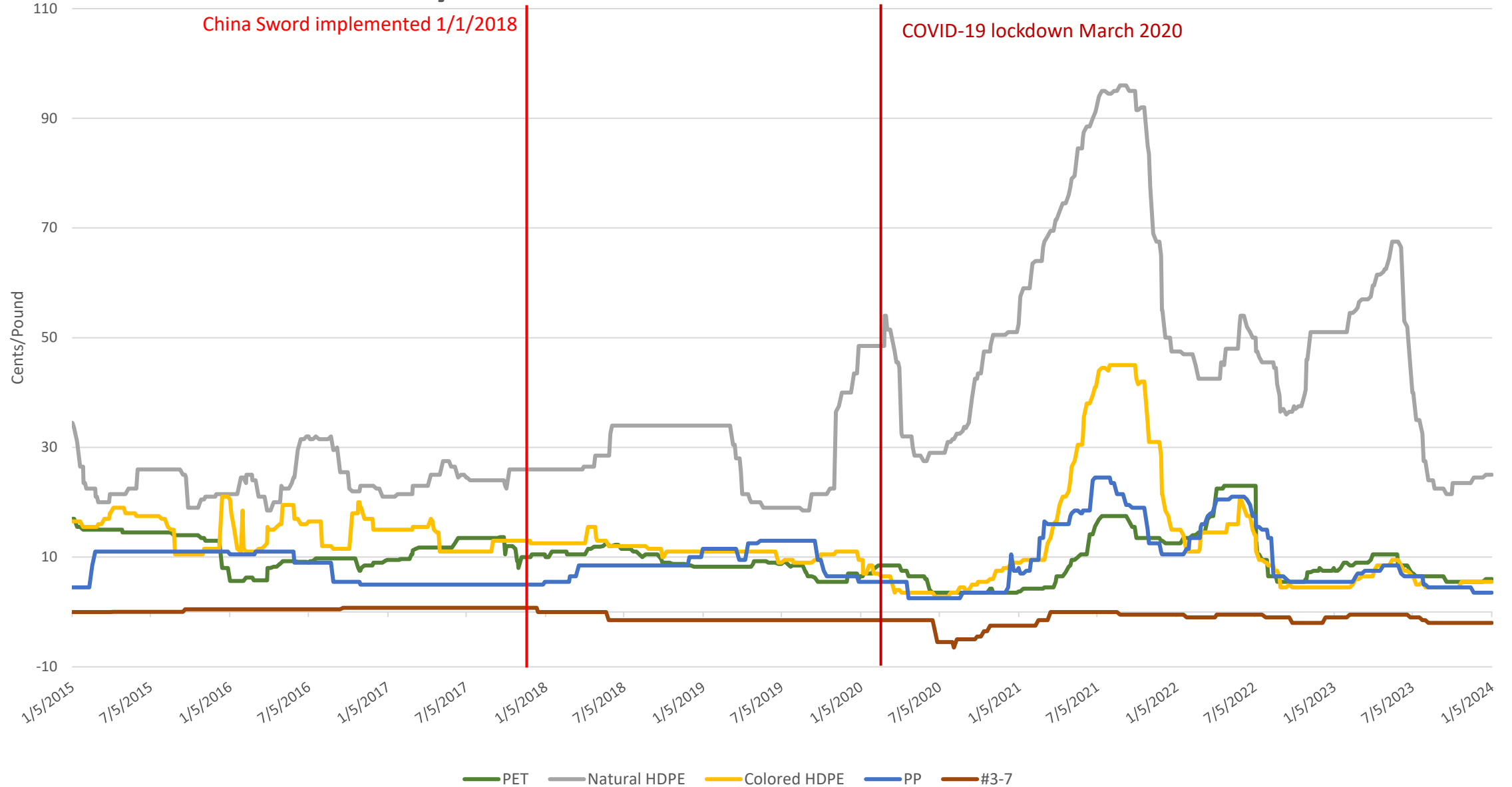


Recycling Commodity Prices

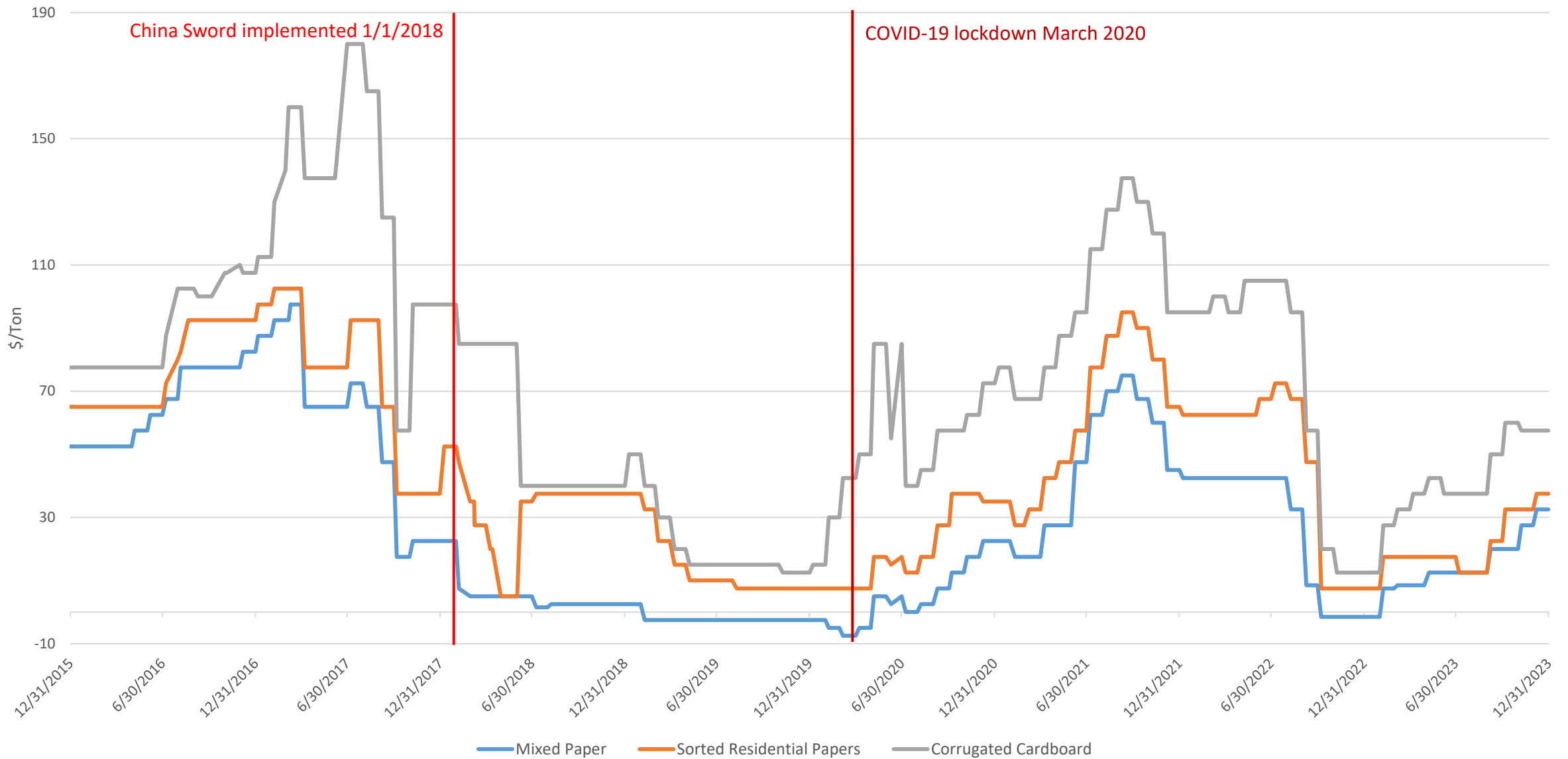
- [RecyclingMarkets.net](https://www.RecyclingMarkets.net)
- Market Region 4
- Reflects prices of sorted and baled post-consumer materials



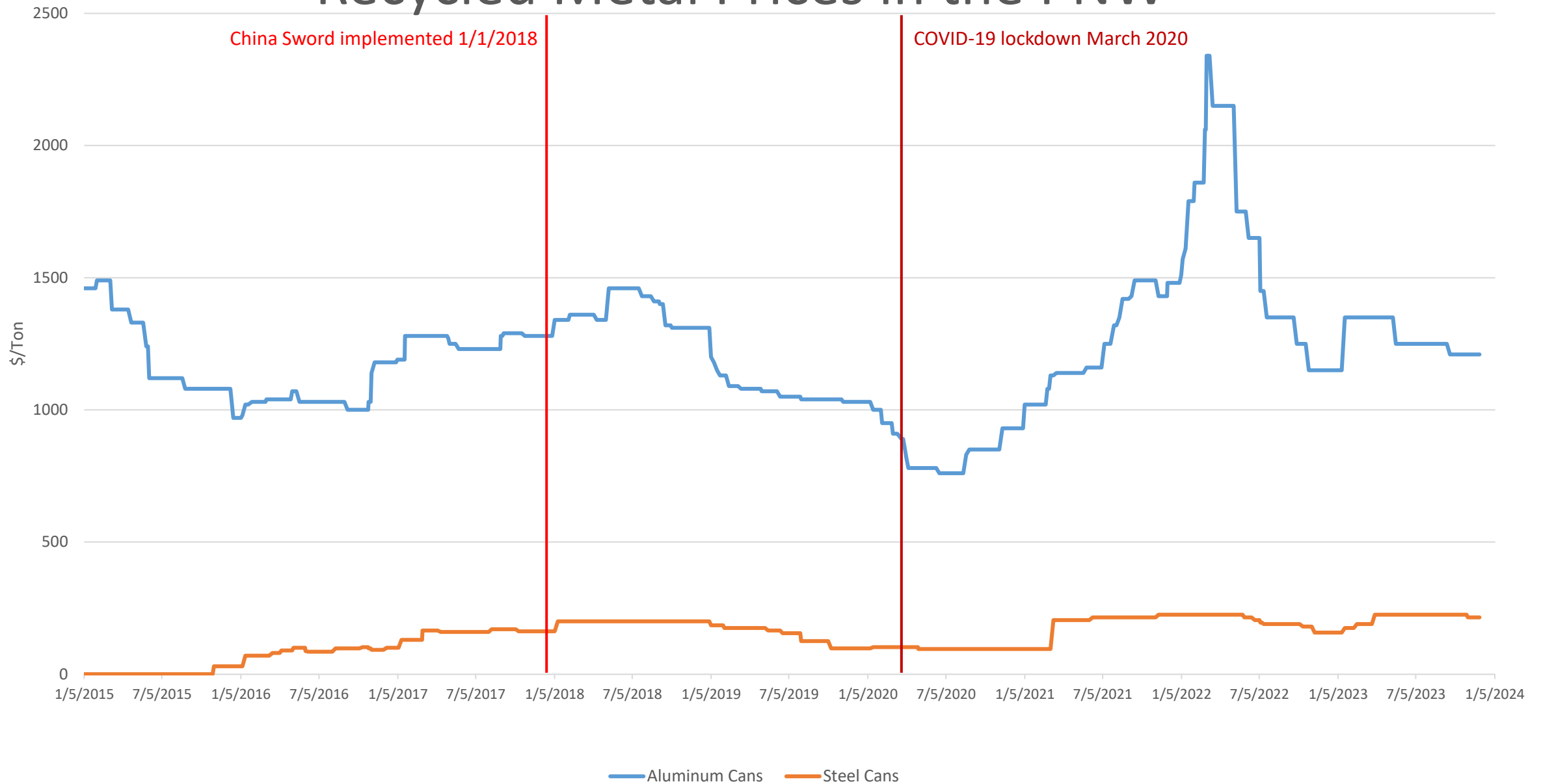
Recycled Plastic Prices in the PNW



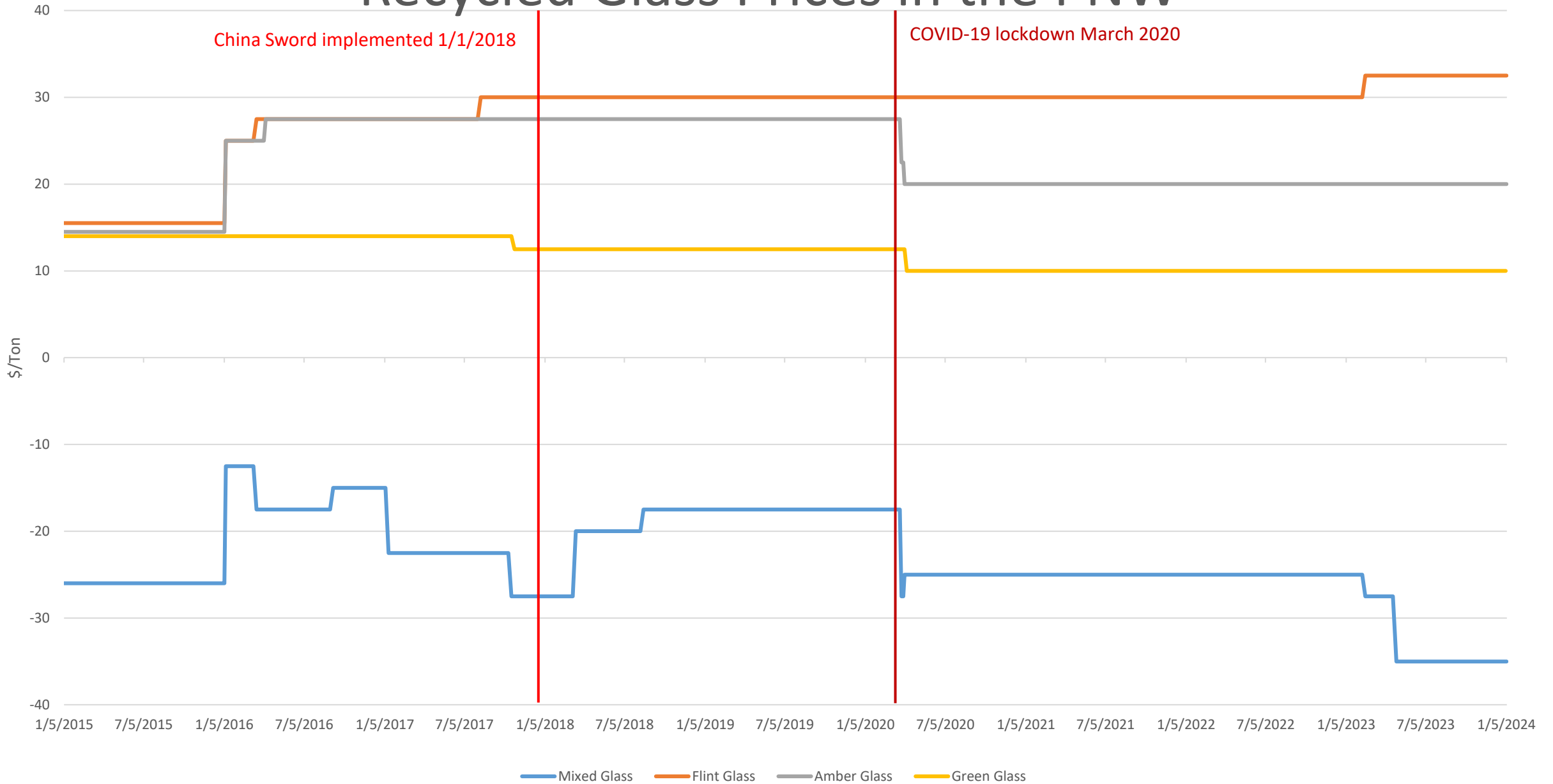
Recycled Fiber Prices in the PNW



Recycled Metal Prices in the PNW



Recycled Glass Prices in the PNW



Reports of Interest

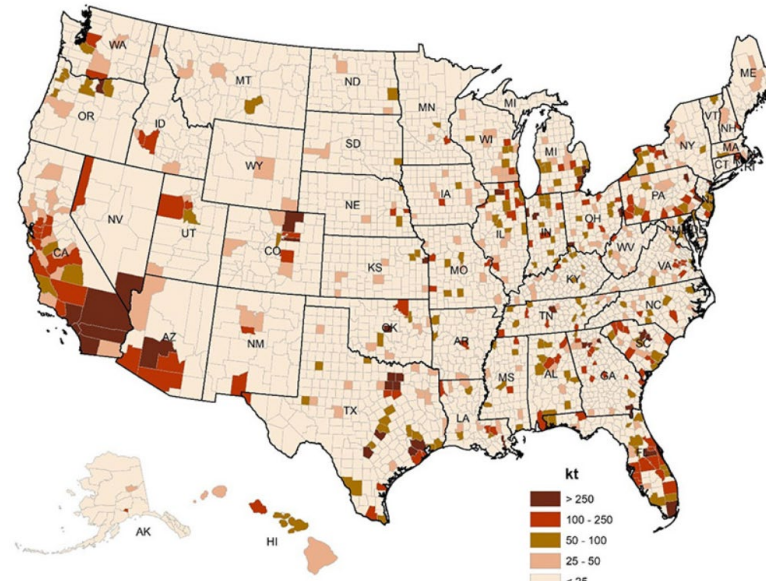
- Washington Recycle, Reuse, and Source Reduction Target Study and Community Input Process

- National Renewable Energy Laboratory (NREL) latest research quantifies losses from cardboard, paper waste

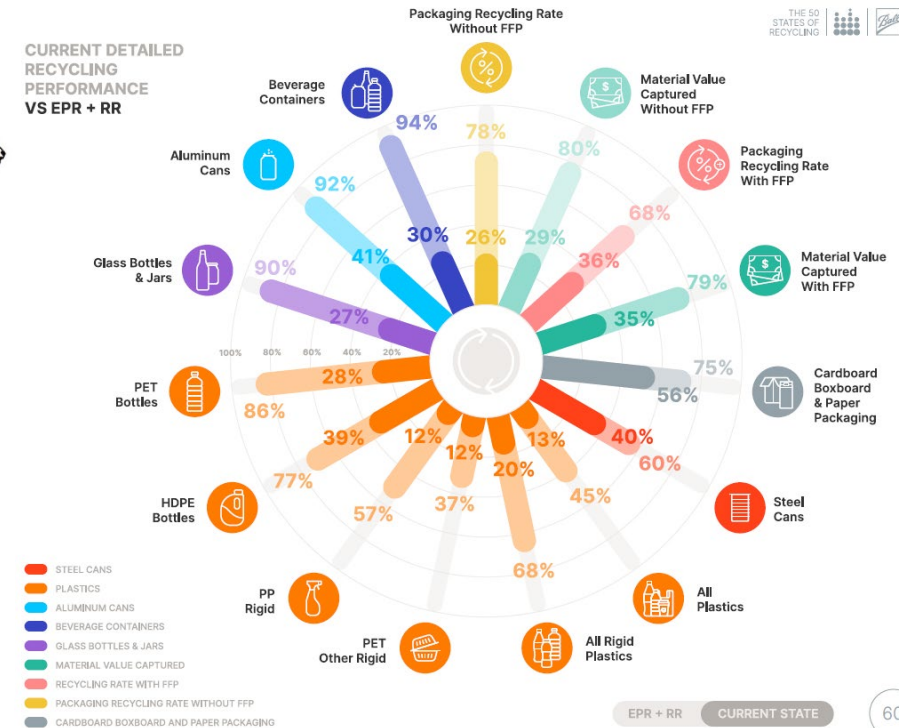
- Ball – The 50 States of Recycling 2.0 with Washington State Case Study.

Figure 2: Overview of Scenarios Modeled and Highest Achievable Recycling Rates by 2032

	BASELINE Washington status quo	SCENARIO 1 Comprehensive policy	SCENARIO 2 DRS focused	SCENARIO 3 EPR focused	SCENARIO 4 Market-driven policy
Tons Diverted	555,000	940,000	664,000	880,000	575,000
Recycling rate	40%	70%	50%	66%	41%
Recycling Rates by Material:					
Rigid Plastic	15%	55%	33%	49%	20%
Flex Plastic	1%	14%	1%	14%	4%
Paper	51%	75%	51%	75%	51%
Aluminum	45%	78%	73%	69%	45%
Steel	35%	65%	35%	65%	35%
Glass	31%	86%	76%	80%	33%



aper and cardboard waste landfilled in 2019 by county, as measured in kilotons. Image by NREL



Let's take a 10 minute break





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Presentation

Patricia Townsend & Martha Aitken
Washington State University





WASHINGTON STATE UNIVERSITY
EXTENSION

Beyond Bed and Bath

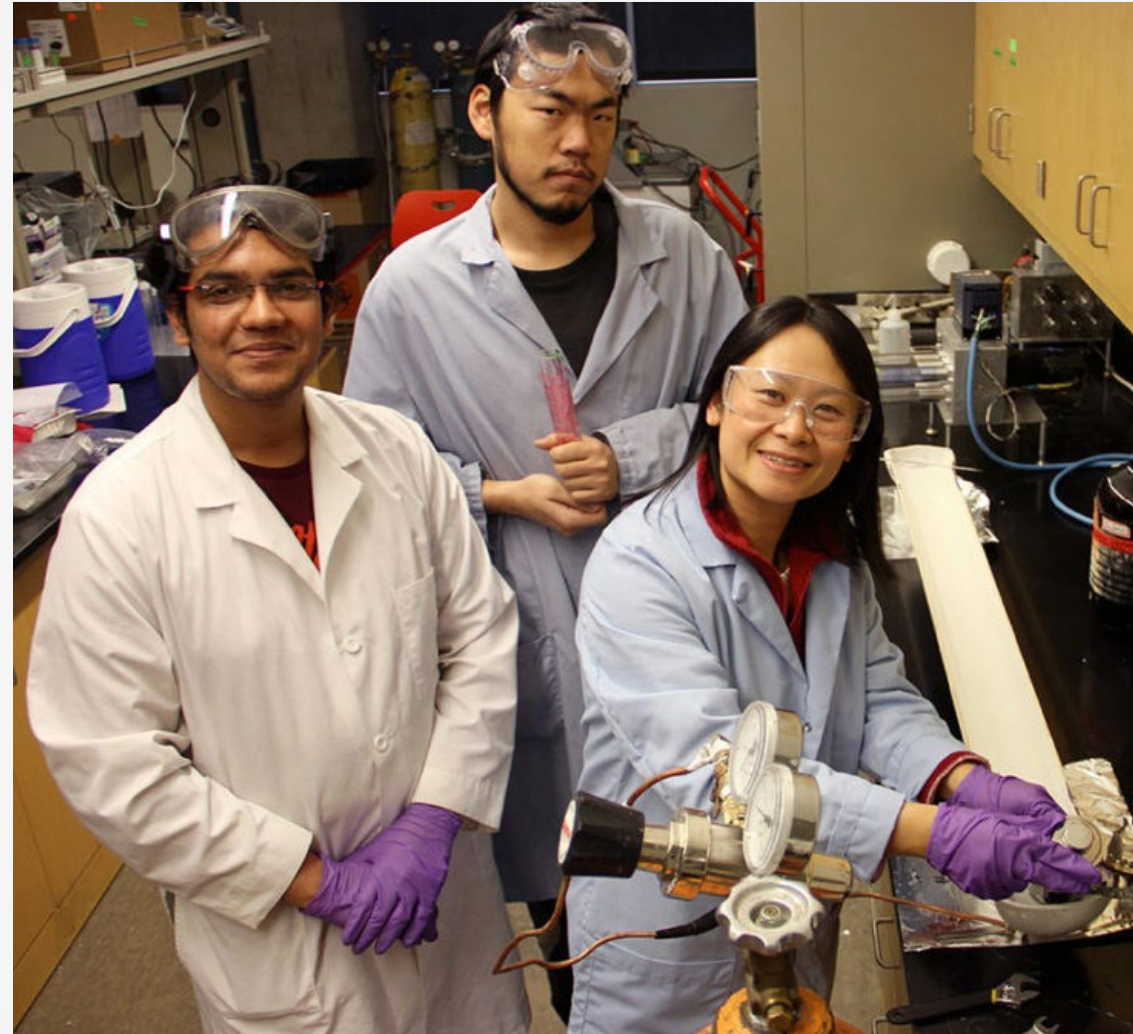
Building a Circular Economy for Discarded Hotel Linens

Patricia Townsend, Ph. D. , Assoc. Professor, Environment and Community Outreach Specialist

Martha Aitken, Asst. Director, WSU Metropolitan Center for Applied Research & Extension

Project timeline

- 2018 - REI conference on textile sustainability
- 2019 - Began collaboration with Dr. Hang Liu/cotton
- 2020 - Initial research/state of textile recycling
- 2021 - WSU student intern/local textile recycling; hotels
- 2022 - WSU student intern/hotel research; King County Re+ grant (proof of concept for textile circular economy)
- 2023 - Dept. of Commerce funding Jan-June 2023



(Photo by Seth Truscott, WSU)

Collaborators

- Patricia Townsend, Ph.D., Assoc. Prof., WSU Extension
- Hang Liu, Ph.D., Assoc. Prof., Department of Apparel, Merchandising, Design and Textiles
- Martha Aitken, Asst. Dir., WSU Metropolitan Center .
- Mark Beattie, Ph.D., Asst. Prof., School of Hospitality Business Management, Carson College of Business
- Giuseppina Menconi, Ph.D., Assoc. Prof., Cesar Ritz Colleges Switzerland
- Project Interns, WSU Students (seniors)
 - Kolby Keaouli Ross & Risa Bridge, School of Economic Sciences
 - Gene Brown, Department of Apparel, Merchandising Design and Textiles

Industry impact

20% of industrial water pollution

- Much of this is from textile dyeing

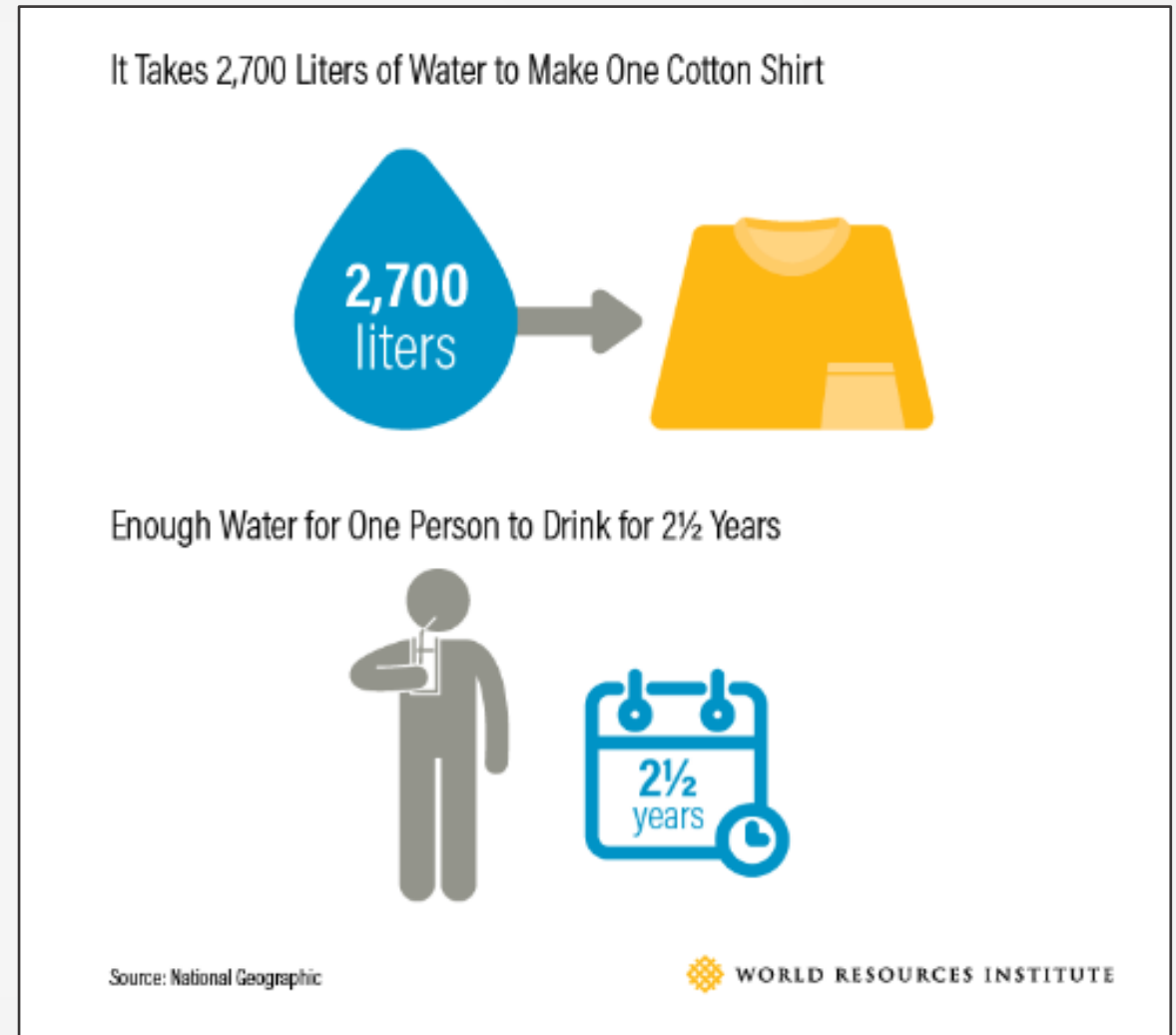
Cotton is a water intensive crop

- Pair of jeans needs 2,000 gallons H²O

International concern

- Scale and impact of the industry
- UN Alliance for Sustainable Fashion

<https://unfashionalliance.org/>



<https://www.wri.org/insights/apparel-industrys-environmental-impact-6-graphics>

TIER 4

Raw Material Extraction



Cultivation and extraction of raw materials from the earth, plants, or animals.

241 M TONNES
CO₂EQ

24%

TIER 3

Raw Material Processing



Processing of raw materials into yarn and other intermediate products.

156M TONNES
CO₂EQ

15%

TIER 2

Material Production



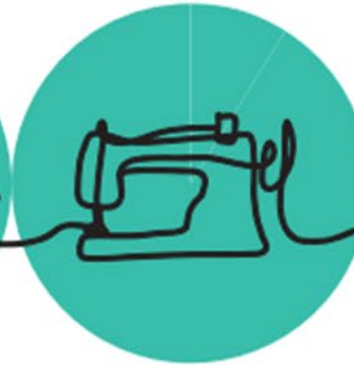
Production and finishing of materials (e.g. fabric, trims) that go directly into finished product.

536M TONNES
CO₂EQ

52%

TIER 1

Finished Product Assembly



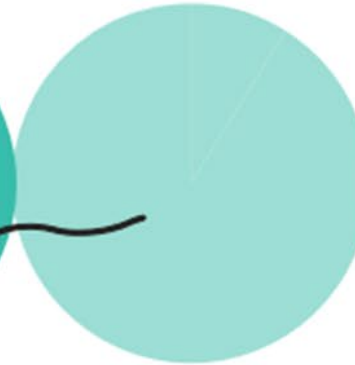
Assembly and manufacturing of final products.

91 M TONNES
CO₂EQ

9%

TIER 0

Office, Retail, Distribution Centres



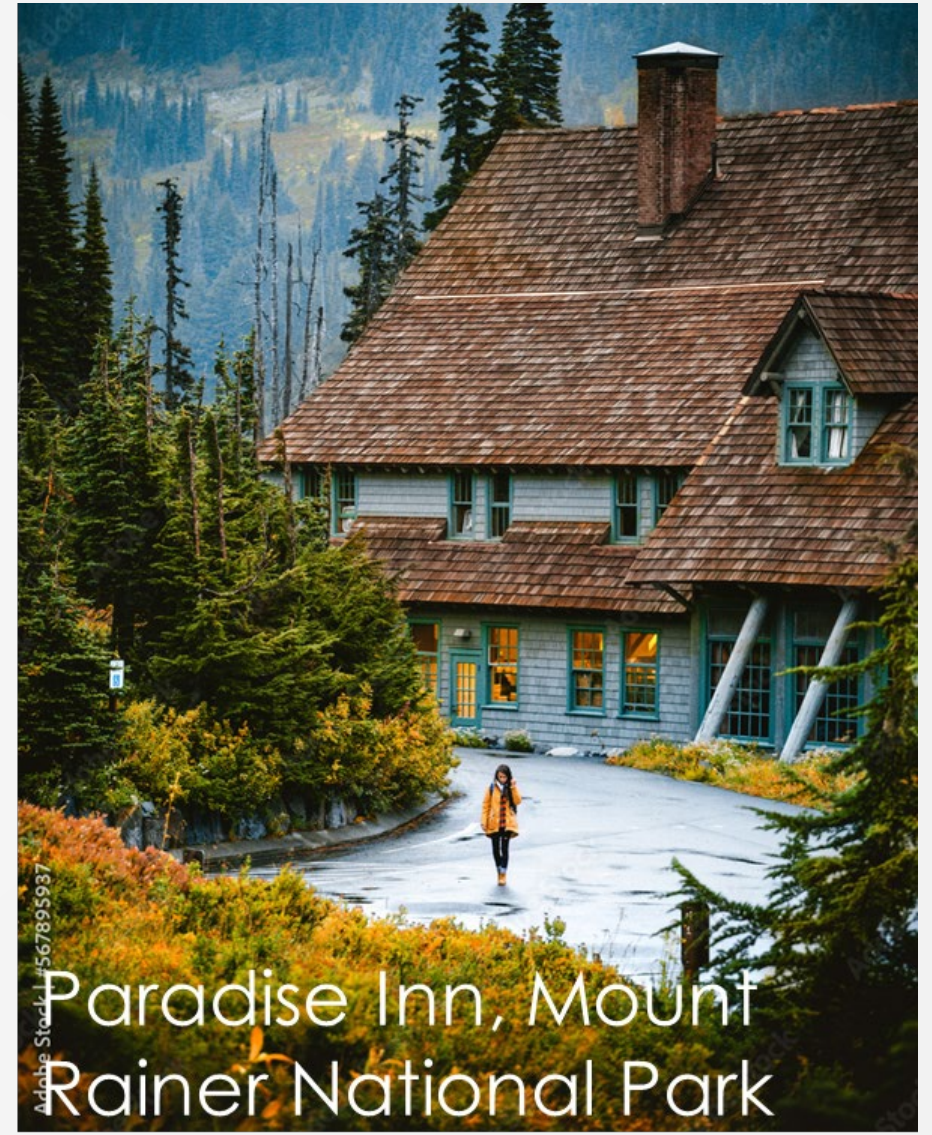
Corporate real-estate not involved in production process.

CIRCULAR ECONOMY



TEXTILES

2022-2023 Hotel Project



Textile waste

Currently, 85% of all textile waste winds up in landfills.

Worldwide, 1.5 million tons of textile waste annually is comprised of just sheets, pillowcases, and towels (linens), with hotels being a significant contributor to this waste stream.



Sheraton Hotel, Seattle WA

Hotel renovation cycles

Tractor truck load of linens to dispose of in a sustainable way



2673 sets of sheets and towels!

Hotel survey

With collaboration of the Washington Hospitality Association
37 hotels of various quality levels across the state

Collected data on:

- Quantity of linens use and purchasing standards
- Linen disposal – process and quantity
- Willingness to pay a premium for recycled linens
- Likelihood of participating in the “linen reuse market”



Holiday Inn Express -- Pullman, WA

Survey results

Key findings:

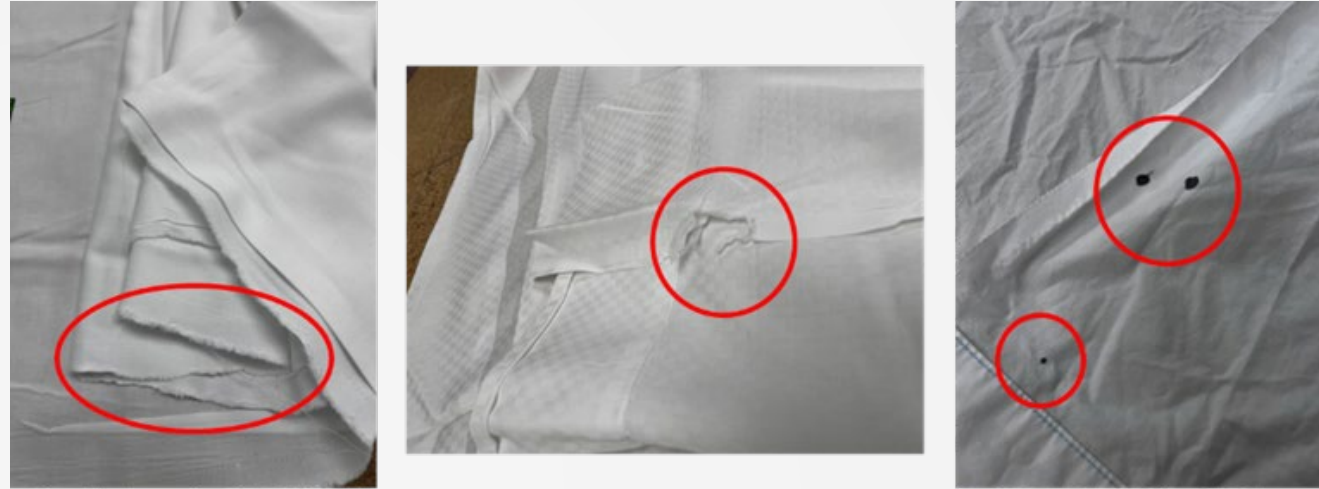
- 1) Linens per room -- 19.74 (average)
- 2) Unwilling to pay a premium for recycled textiles
- 3) Most discard their linens in landfills due to stains and tears and some donations
- 4) Discarded commercial linens creates an opportunity
- 5) Estimate 539,773 lbs. discarded hotel linens per year



Courtyard by Marriott, Pullman, WA

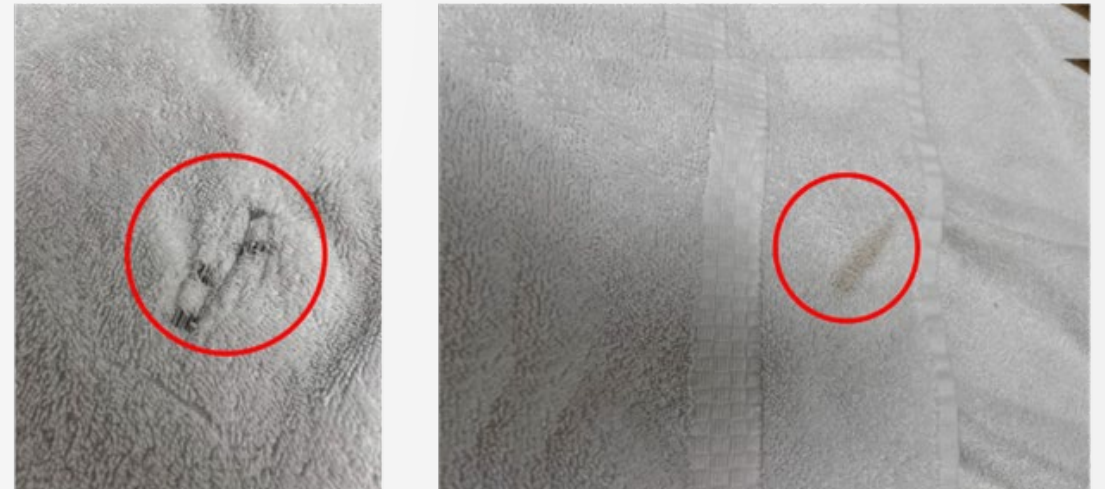
Textile testing

Compared new hotel linens with discarded ones donated by hotels in the survey.



Conclusions based on limited testing quantity:

- Retained tensile strength
- Good water absorption
- Supported the potential for secondary market uses



Secondary market potential

- Institutions
 - WA State Dept. of Corrections has 20,000 beds statewide
- Shelters
 - People
 - Pets
- Small businesses
 - Upcycling
- Downcycling
 - Shredding
 - Insulation



Secondary market challenges

- Volume
 - Renovation cycles
 - Inconsistent supply
- Transportation
 - Costs
 - Coordination
- Storage
 - Space
 - Climate control
- Recapturing
 - Tracking
 - Logistics / transportation
- Societal issues
 - Prisons



Case Study - Walla Walla State Penitentiary

Sustainable Practices Lab



AMDT Hack-a-Thon

- Creative second uses for discarded linens
- Open to WSU students
- Cash prizes donated by Pullman Marriott hotels
- Linens contributed by Pullman Marriott and Holiday Inn
- Hotels will donate discarded sheets for AMDT students to use in class projects



Hack-a-Thon winners



Policy recommendations

Further study is needed into the following areas:

- More on costs -- purchasing and discarding
- Market forces which encourage sustainable linens policies
- Municipal policies to encourage reuse and recycling and discourage discarding
- Meaningful incentives, financial or otherwise, which encourage hotels to practice and promote linen reuse and recycling



Presentations



COLLEGES

SWITZERLAND

International Research Roundtable
September 2023



Next steps

- Manufacturers
 - Interest hotel linen manufacturers in making linens from recycled cotton
- Circular Market
 - Build the circular market within the hotel industry
- Outreach
 - Communication, build awareness, gather stakeholders



Thank you!

This project was made possible by support from:



WASHINGTON STATE UNIVERSITY
**College of Agricultural, Human,
and Natural Resource Sciences**

- Washington Hospitality Association
- Pullman Marriott Hotels, owned and operated by Stonebridge Companies
- Pullman Holiday Inn Express
- Washington State Department of Corrections, Walla Walla State Penitentiary
- Seattle Marriott Bellevue
- Courtyard by Marriott Seattle



Presentation

Dr. Hang Liu

Washington State University





WASHINGTON STATE
UNIVERSITY

Eco-friendly Post-Consumer Cotton Waste Recycling Technology

Hang Liu, Ph.D.

Department of Apparel, Merchandising, Design and Textiles

Washington State University



Types of Post-Consumer Textile Waste





Cotton



Polyester



Nylon





Wool
Silk
Acrylic
...
&
Blends

Categories of Textile Fibers

Thermoplastic

(heat sensitive -
melt under high temperature)

- Polyester
- Nylon
- Acrylic
- Polyethylene
- Polypropylene

Non-thermoplastic

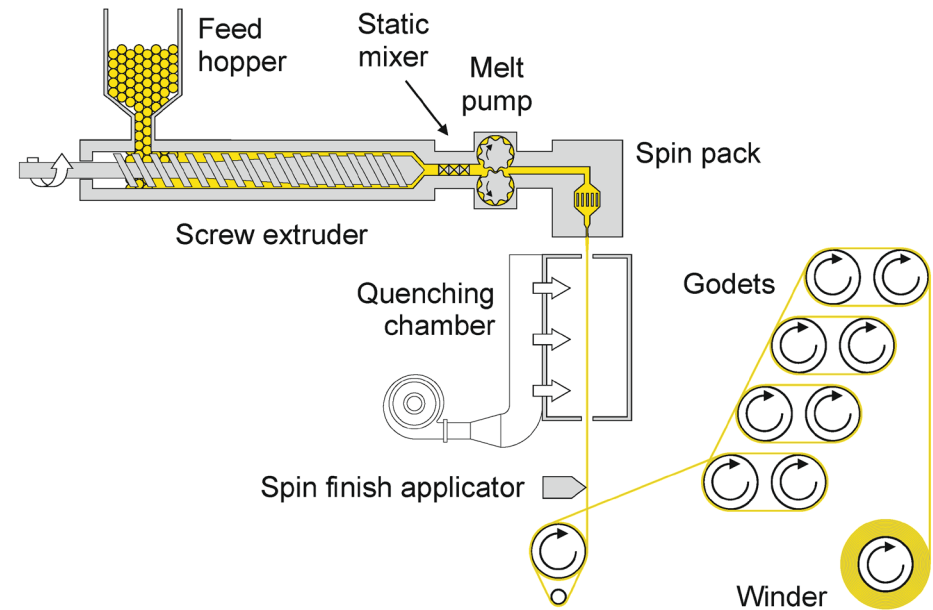
(heat resistant -
degrade under high temperature)

- Cotton
- Wool
- Silk
- Rayon



Current Recycling Technologies





Materials 2020, 13(19), 4298; <https://doi.org/10.3390/ma13194298>

Thermal Recycling

- For thermoplastics only
- Degrades polymer quality during heating
- Limited number of recycling cycles

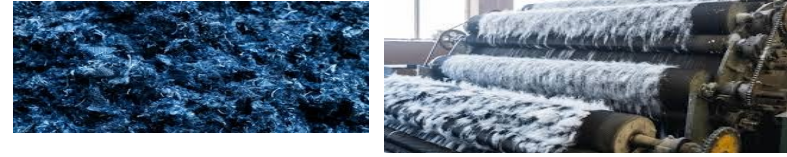


Textile Exchange's 2025 Recycled Polyester Challenge Campaign - Raising the global percentage of recycled polyester to 45% by 2025.





Cotton Mechanical Recycling

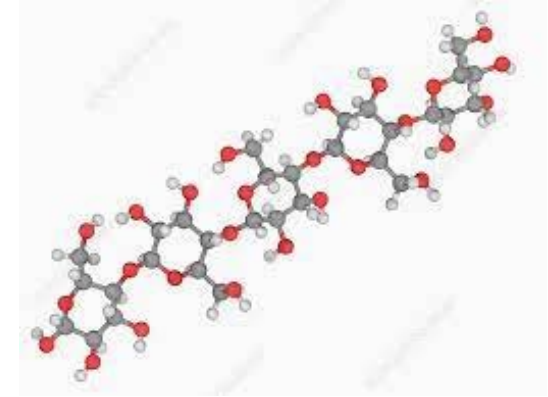


Commercial Recycled Cotton Products



Mechanical Recycling

- Works on all types of waste
- Requires “good” waste quality
- Weakens/shortens fibers during the process
- Recycles for lower value products
- Limited number of recycling cycles



Chemical Recycling

- Works on all types of waste
- No requirement on the quality
- Breaks the waste down to the molecular level & rebuild
- Recycles for high value products
- No limit on the number of recycling cycles

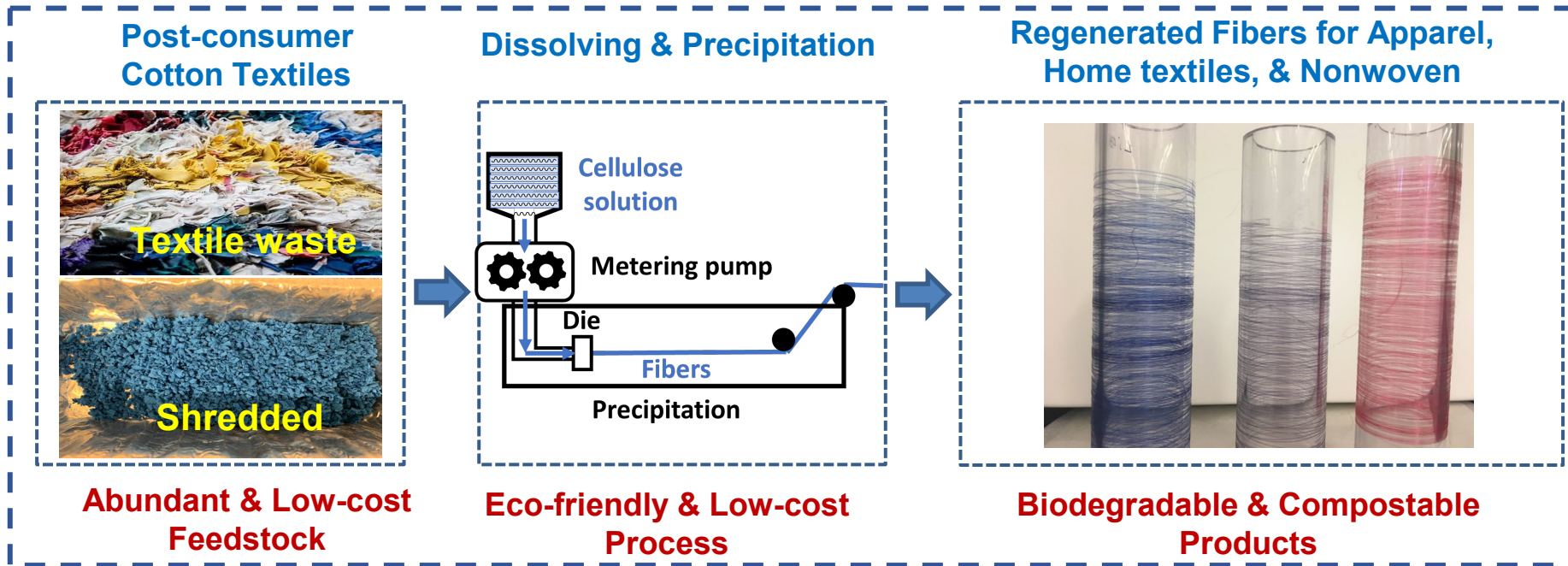


Our innovation in chemically recycling cotton waste



Challenges in Recycling Post-consumer Cotton Waste

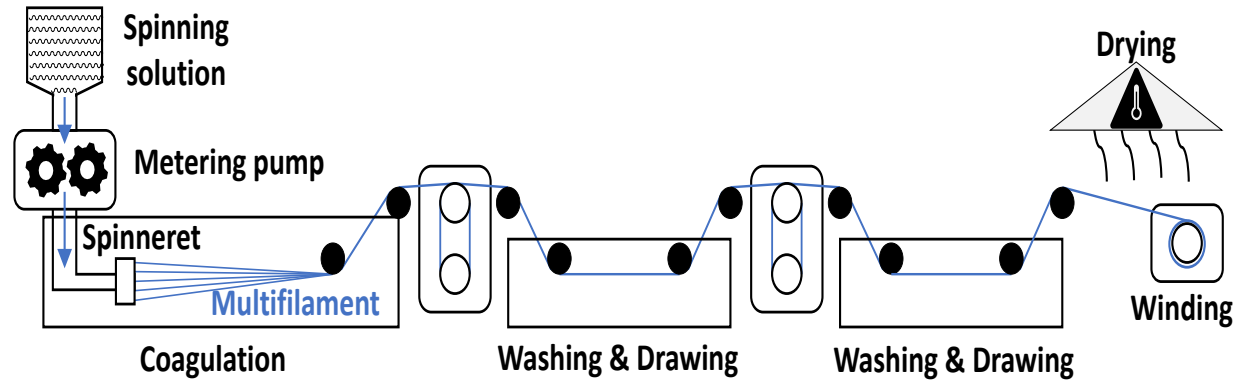
- **Cotton is thermal resistant** therefore it cannot be recycled using heat
- **Cellulose is difficult to dissolve in commonly used chemicals**
 - Solvents used in the industry are either highly toxic (e.g., those used in rayon production) or expensive (e.g., those for lyocell production)
- **Wide range of tear/wear conditions** of post-consumer textile waste
- **Fiber blends add another challenge** (e.g., cotton and synthetic fiber blends)



Eco-friendly Cotton/Cellulose Waste Recycling -- WSU Tech 1789

- Nontoxic & Inexpensive Chemicals
- Zero-effluent (can be manufactured in the US)
- Well established industry processes (wet-spinning)
- Elimination of dyeing
- Works on cotton/synthetic blends

Wet Spinning

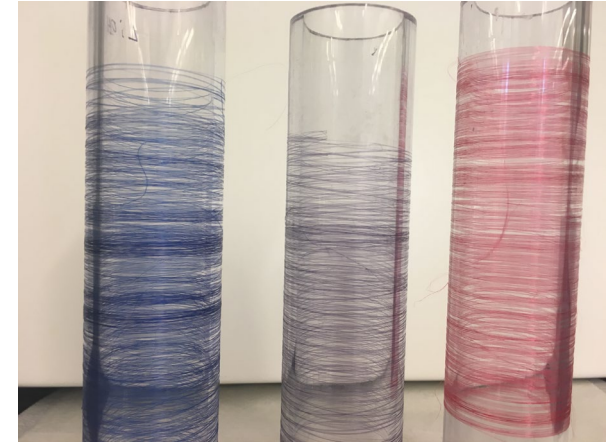


Patent “Environmentally Friendly Cellulose Waste Recycling” was issued in the US, China, India, UK, Germany, Portugal, and Turkey.



Current Efforts

- **Technology Commercialization**
 - Seek industry collaborators to license the technology
 - Acquire pilot-scale wet-spinning equipment to produce fibers for fabric samples (in yards)
- **Expand the technology to other products** (e.g., biodegradable foams and films manufactured from recycled cotton waste).
- **Integrate Research in Education**
 - Curriculum focusing on sustainability in AMDT at WSU
 - Recycling Research and Education Center





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Wrap up

Next meeting:

- Wednesday, April 10th, 2024
 - Location: Zoom
 - Tour: to be determined – likely February
-

Tasks from today:

- Notes and slides from today will be posted to the EZ page next week.

