NATIONAL MILL INVENTORY:

An Exploratory Representation of United States Fiber Processing

FIBERSHED

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An Exploratory Representation of US Fiber Processing

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Illuminating Mills

Creating soil to soil textiles relies on the collaboration and talents of each piece of the value chain. From the rancher managing the landscape to the wearer caring for an item in their wardrobe, a series of milling processes make fiber into finished goods. Through decades of so-called free trade deals and an expanding market of underpaid labor, the American textile industry has downsized and dwindled. Though less than 2% of garments worn by Americans are currently made in the USA (AAFA 2008), we know that many mills have remained on the landscape.

As we approach the idea of regionalizing textiles and supporting circular systems that invest in the local economy, we know that our milling partners are key, and understanding their offerings will allow us to support their endeavors. Yet, Fibershed frequently receives requests from fiber producers, textile designers, and others searching for a mill to engage in collaboration to create goods. To serve the community and our mission, we began a research project to understand fiber milling at a national scale.

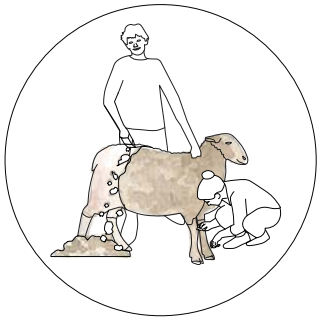
The National Mill Inventory began with the goal of illuminating fiber milling capabilities across the United States. Reaching out to mill owners and operators at all scales, we sought to understand what services are offered, what supply chains are possible, and what components need fortification to support a thriving domestic and decentralized textile industry.

A Yearlong Survey & Research Project

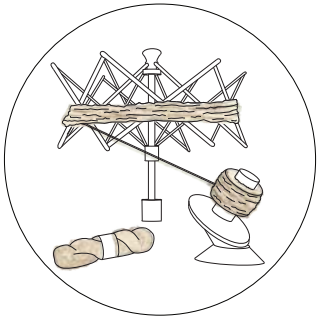
We began with a series of questions designed to understand the capabilities and capacity of mills, and then compiled a list of known fiber mills through interpersonal knowledge, community information, and online searches. Reaching out to mill owners, we began conducting phone interviews and sending out questionnaires by email.

For mills that did not provide a response, we sought out as much information as we could through individual websites, network connections and communications.

KNITTING

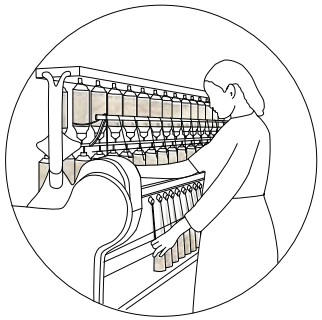


SHEARING

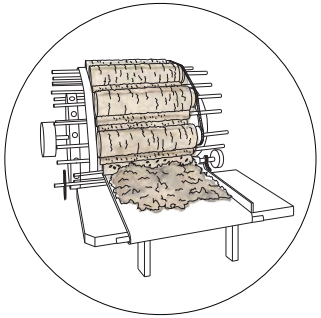


SKEIN WINDING + LABELING

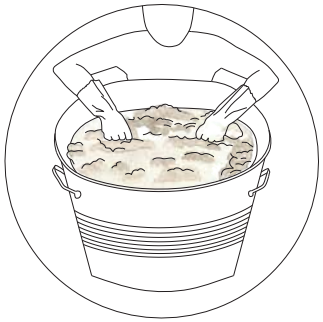
GRADING + REMOVING WEEDS



SPINNING



COMBING

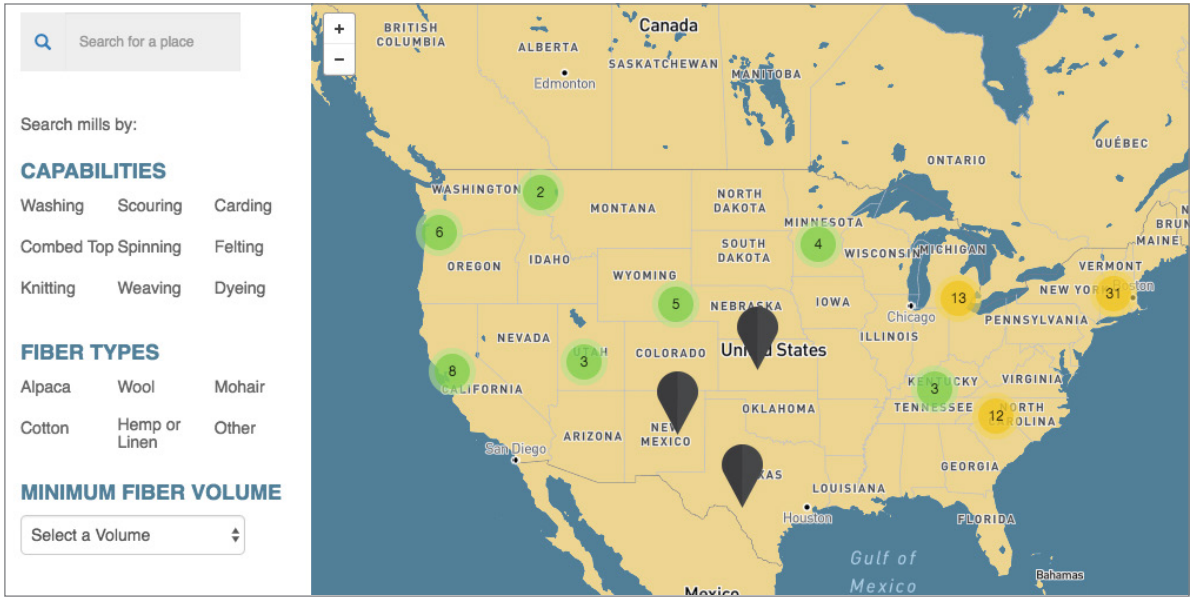


WASHING

TRUE COST: SWEATER

What goes into a wool sweater?

Illustration by Amanda Coen



Our findings are based on synthesizing this body of information, from the survey process, research, discussions, and supply chain experiences. Our goal in sharing these findings is to foster greater understanding of milling capabilities in the United States.

Paired with this goal is our desire to offer a free, open-source resource to the greater Fibershed community: a tool that serves to facilitate connections throughout the supply chain, increase awareness in domestic and regional capabilities, and educate fiber producers, textile designers, and end users alike on the possibilities of building regional, regenerative fiber systems.

The Mill Inventory Explorer

With the National Mill Inventory, we sought to identify specific resources and milling capabilities, as well as an understanding of the broader landscape. This act of cartography charts not only the infrastructure but the possibilities that exist within our home communities and 'farther afield' in a network of fibersheds around the country.

To share both 'micro' and 'macro' views of textile milling, we envisioned a navigational tool to serve as an exploratory representation of the fiber processing and textile milling landscape: to discover, connect, and build relationships with supply chain partners. We invite you to visit and utilize this free resource at: **http://nationalmillinventory.com/explore-mills/**

A Culmination, Not a Certification

The National Mill Inventory is based on information collected through internet searches and follow-up conversations as possible. It is intended as an overview and a starting point to understand fiber processing and milling opportunities; it is not a certification nor a membership program. It represents the culmination of data that is accurate to the best of our knowledge, but does not mean that we have established a relationship with each mill.

All of the mills we identified have been included as points on the Explorer and can be searched by zooming through the map or using the filter capabilities.

U.S. Fiber Mills By the Numbers

Mills Identified: 92

Mills by Region

Northeast	Southeast	Midwest	Southwest	West
31	15	23	5	16

Mills by Capability/Services Offered

Scouring	Washing	Carding	Combing	Spinning	Knitting	Weaving	Felting	Dyeing
4	47	65	6	60	12	18	28	29

Mills by Fiber Type Accepted

Wool (Sheep)	Alpaca	Mohair	Hemp or linen	Cotton	Other
60	51	43	7	14	57

Mills by Minimum Fiber Volume Accepted (lbs. raw fiber)

0	1-4	5-14	15-49	50-99	100-499	499-999	1000	N/A
11	24	5	4	1	2	2	3	32

Mills with Additional Restrictions

Staple Length	"Brand Only*"
29	10

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*See page 7.

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SURVEYING MILLS AROUND THE UNITED STATES

About the Survey

As we researched mills to understand capabilities and baseline data of the offerings and services available, we reached out to request each mill's participation in our survey. The survey questions focused on qualitative and quantitative information to understand the mill's function and perspectives.

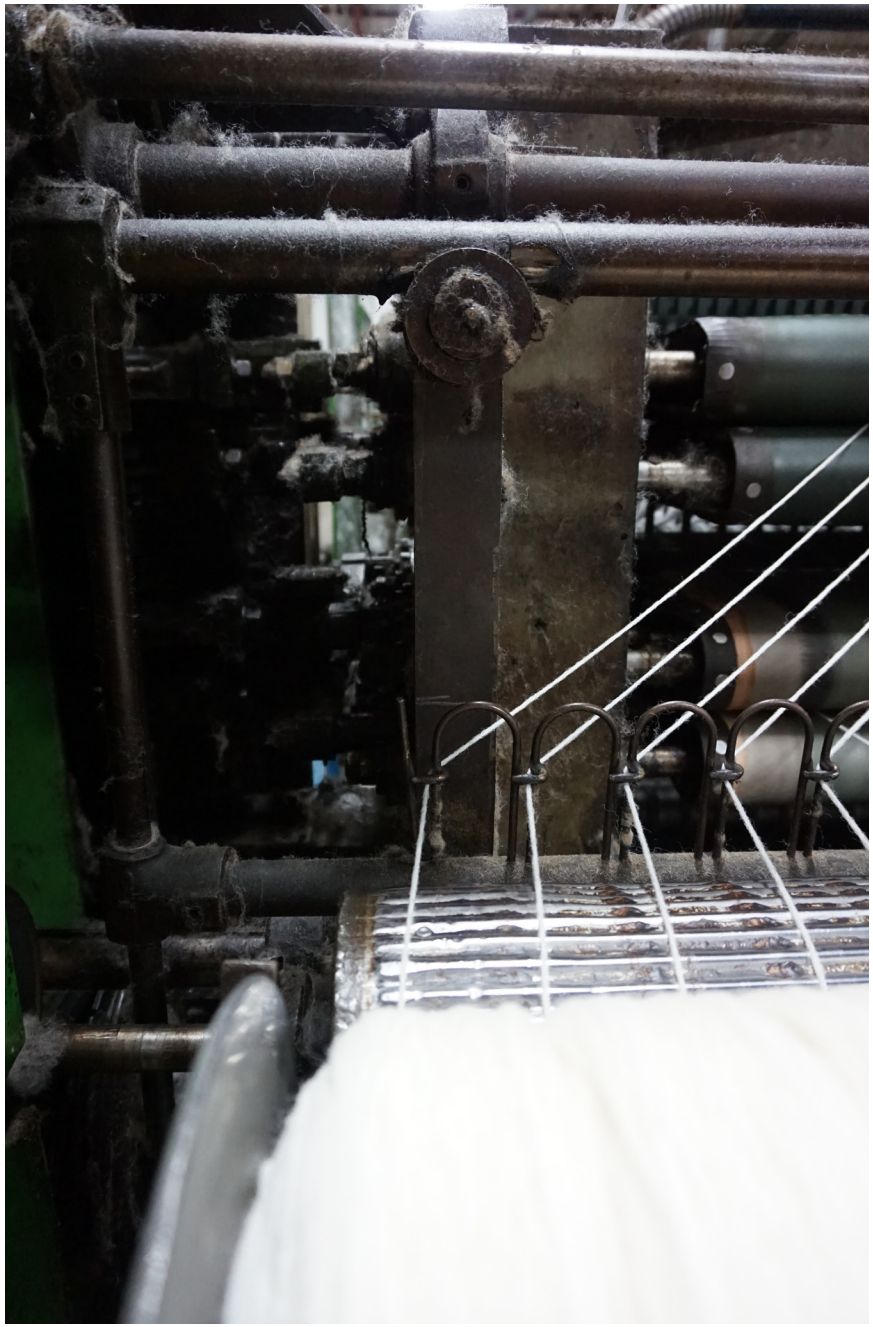
Facing a low initial response rate, we translated the questionnaire into a digital survey and continued to approach mills to understand their services and offerings. Our response rate of 35% represents a culmination of these efforts—in-person mill visits, phone interviews, digital surveys, and email questionnaires, and provides a sample dataset of feedback on fiber milling in the United States.

This, in addition to interviews with supply chain stakeholders and Fibershed project and program contributors, helped us understand a snapshot of the current state of milling capabilities and challenges, possibilities, and resources for further development.

Questions asked on the survey included:

- Customer base, locality, engagement and acquisition (how customers hear about their business)
- Fiber accepted by type, by staple length, by minimum volume
- Services offered along the supply chain
- Turnaround time, annual capacity and production
- Industry trends and commentary

Survey responses skewed toward smaller-scale mills; we bolstered our findings with online research, continued outreach, and informal conversations, however we know that most of the survey results represent mini- to mid-size mills.



Jess Daniels

Scale

The National Mill Inventory Explorer as well as our survey and research includes fiber processing facilities of all scales—from the 'mini mill' to the few remaining large-scale, industrial operations. A 'mini mill' generally refers to a set of fiber processing machines available for purchase as a set (most commonly Belfast Mini Mill) that offers mechanized fiber processing at a compact scale. Mini mills can be a community asset for adding value to local fiber, however the machinery limits both the volume of fiber that can be processed and the type of roving, yarn, or felt that results.

The country's largest mills, on the other hand, include state of the art machinery that can process fiber to a variety of specifications; several are vertically integrated and capable of handling very large volumes—orders of magnitude greater than mini mills. Yet, most of these industrial mills have high minimums that reflect their pace and capabilities, and these services can be difficult to access or in some cases are completely restricted to in-house production lines. In this project, we refer to these large-scale facilities as "brand only" to signify that their skills and services are best suited for larger brands.

Between mini mills and industrial facilities is an array of fiber processors that defies classification. It is challenging to create strict categories for these mills because our findings suggest that most are working with an amalgam of older, refurbished machinery, sometimes supplemented with pieces of new equipment or a custom design. Average or maximum output, or daily/weekly/monthly volume may be the best way to understand the operating scale of mills in the middle range, however that proved to be the most difficult piece of data to collect with consistency. Survey results represent primarily these small or 'cottage' to mid-scale mills, and yet within these responses there is great variation: from 1200 lbs of raw fiber processed annually, to 30,000 lbs of scoured fiber processed annually, to 50,000 lbs of yarn created each year.

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Bottlenecks & Backlogs: Challenges in the Current Milling Landscape

Scouring: an essential process and a bottleneck

Scouring is the process of cleaning animal fiber prior to milling, removing lanolin (a natural grease present in sheep's wool), dirt, and vegetable matter ("VM," commonly present from hay, feed, or life outdoors). Cleaning fiber prior to processing is a necessary step, and it can also affect the quality and end use of the fiber.

The essential components of cleaning fiber are hot water and soap. While effective, this is a more labor intensive method of scouring, and more difficult to scale with consistent results. In the United States, there are very few facilities remaining with the ability to scour wool at a high volume—facilities that have a mechanized belt to move the fiber along, also called a scouring line. Our research confirmed that two facilities are the 'go to' places at present: Chargeurs, in South Carolina, and Bollman Industries, in Texas. These facilities are serving a crucial need in the domestic fiber supply chain, however their scale of business necessitates large inputs of fiber and is currently aligned with the commodity wool market and bulk shipping and processing.

For fiber producers or brands seeking smaller-scale or custom blending options, mini- to mid-size mills offer a great point of connection. For smaller volumes of fiber, regional mills can process raw fiber into finished roving or yarn, serving a key role in the community; 52% of the mills identified (47 in total) across the U.S. provide this service. However, most mills of this scale that we spoke to or researched are relying on hand-washing wool with one machine or a series of basins. Many mill owners and managers that we spoke with described this as the limiting factor in their production—all incoming fiber must be scoured and prepared for carding or spinning, but without access to larger or automated equipment, it is a time-intensive process that sets the flow of production.

For the purpose of our Mill Inventory Explorer, we created two classifications: "scouring" refers to a scouring line capable of handling larger volumes, while "washing" refers to the ability to clean fiber on-site, without a scouring line.

With just two facilities offering large-scale scouring as a service, we repeatedly heard that scouring is a “bottleneck” in the industry, for fiber producers who are looking to send wool for processing, for mills that purchase washed wool for carding or spinning, and for those who wish to orchestrate a supply chain that is regional and/or small-scale.

Facilities with a Scouring Line

Name	Website	Location	Minimum Accepted Volume (lbs. of fiber)
Bollman Industries	www.bollmanhats.com/wool-scouring.html	San Angelo, TX	1000
Chargeurs Wool USA Inc.	www.chargeurs.fr/en/content/chargeurs-wool	Jamestown, SC	10000
Mountain Meadow Wool Mill	www.mountainmeadowwool.com	Buffalo, WY	25
Pendleton Woolen Mills	www.pendleton-usa.com	Portland, OR	N/A

Production weaving is limited

At the other end of the supply chain, production weaving poses a challenge in terms of access and scale. While 18 mills were found to offer weaving as a service, many provide rug weaving or blanket weaving on a handloom as a value-added service. For fabric yardage or larger runs of home textiles, industrial looms and production weaving are a better fit but are in dwindling supply around the country. Large mills such as Pendleton (a woolen mill) and White Oak Mill (a denim manufacturer for Cone Mills) specialize in high quality fabrics but have high minimums that are best suited to larger brand collaborations. For small-scale designs, a few regional facilities have opened in recent years that offer exciting possibilities—Huston Textile Co. on the West Coast; The Weaving Mill in the Midwest; TN Textile Mill in the Southeast; and Thistle Hill Weavers in the Northeast. Recent years have also brought forth a milling revival, with both Faribault Woolen Mill and American Woolen Mill continuing heritage production of blankets and fine cloth, respectively, with investment from new owners.

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Production weaving facilities

Mill Name	Website	Location	Minimum
American Woolen Mill	www.americanwoolen.com	Stafford Springs, CT	Inquire (mid to large scale)
Faribault Woolen Mill	www.faribaultmill.com/pages/custom	Fariabult, MN	Approx. 2400 lbs. fiber
Huston Textile Co.	www.hustontextile.com	Rancho Cordova, CA	100 lbs. per run
Pendleton Woolen Mill	www.pendleton-usa.com	Portland, OR	N/A
The Weaving Mill	www.theweavingmill.com	Chicago, IL	50 yd warp
Thistle Hill Weavers	www.thistlehillweavers.com	Cherry Valley, NY	18 yds per run
TN Textile Mill	www.tntextilemill.com	Goodlettsville, TN	50 yd (AVL); 15 yd (handloom)
White Oak Mill (Cone Mills Denim)	www.conedenim.com/white-oak	Greensboro, NC	N/A

Lead time & consistency

Our survey response pool indicated an average turnaround time of 4.5 months for fiber processing, yet the individual results varied greatly, from 1 month to 1 year. From anecdotal experience and prototype projects we know that consistent and reliable turnaround time can be a challenge for regional and smaller-scale mills. As described above, hand washing fiber and additional washes can add time to processing, and in discussions with mill owners we also repeatedly heard that equipment issues and lack of parts or skilled repair persons can be a hurdle.

In customer experience conversations, one critique of working with regional and domestic fiber supply chains is consistency of product. Specifically related to spinneries, we learned that many customers have had a difficult time finding a mill partner who can reliably supply replicable yarns.

Jess Daniels

Jess Daniels

Mill closures, changes in ownership & labor

Gathering information for the Mill Inventory included nearly a year of survey inquiries, site visits, and conversations. Unfortunately, during this same time period, several mills that had been initially identified or had participated in the project, closed operations or stopped accepting fiber. One-fifth of mill owners or managers who participated in our survey said that "mills are closing" is an industry trend.

In our interviews and conversations, we heard from mill owners that finding and retaining skilled and dedicated workers is a major challenge for their business—often cited anecdotally as the number one challenge. And without a strong labor pool, many mill owners are without a transition plan for retirement or exiting the business.

Engagement & Aggregation: Possibilities and Recommendations

Cultivating soil-to-soil fiber systems relies on connecting the collaborators, from the farmer who raises or grows the fiber, to the mills that wash, card, spin, and knit the material, through to the designer who creates intentional goods and the community member who wears or uses them. We recognize that milling partners are the critical link between the soil and our skin, and through inviting exploration we hope to support those business owners on the landscape. Through conversations with mill owners, feedback from farmers and designers alike, and observations from our survey and assessment, we can provide several suggestions for strengthening and investing in regional and domestic textile milling, addressing challenges with aggregating supply, demand, and successful supply chain partnerships.

Fiber pooling

Single-source yarns and goods offer a beautiful representation of place and a traceable connection from the soil. However, as described previously, many smaller mills are limited in the type of processing or the turnaround time, whereas many mid-to-large scale mills have minimums that not all single-source fiber producers can meet.

Jess Daniels

Aggregating supply to meet minimums can offer a way forward that retains regional identity and supports businesses collectively. This could take the form of a group of producers pooling fiber regionally and creating a blended yarn, or an end-user designing a yarn based on the fiber qualities and quantities of a collective of producers. These ideas and collaborations are already taking shape in the industry, and surfaced repeatedly in conversation with different stakeholders. One mill owner suggested that a program to aggregate regional fiber for pick-up and simultaneous processing would reduce the transportation footprint and create a more efficient value-added product stream, saving processing time as well as time spent developing a business arrangements.

Regional blends from fiber pooling also offer the possibility of strong marketing narrative. Nearly 80% of mill owners surveyed said that "locally made" is a trend they notice in the industry, while consumer research shows an increase in preference for domestic and sustainably raised fiber, and that "U.S. wool producers [] have the opportunity to highlight their sustainable production practices" (Peterson et al. 2012, p. 46). Lastly, fiber pooling offers a way to play to the strengths of different fiber properties, such as strength, softness, drape, luster, and natural colors—blending can even elevate the combination into an entirely unique material.

Exchange samples, start a conversation

By identifying mills across the US and serving as a point of connection, we hope that the Mill Inventory Explorer can aid in the process of developing supply chains. Based on our conversations with and surveys of mills, we recommend approaching collaborations as a relationship-building venture, not a strictly transactional experience. Engaging with a fiber processing partner and opening a conversation about their experience will allow fiber producers or end-use designers to understand the capabilities of the mill. In working together to develop specifications, mill owners may present valuable suggestions for reaching a design goal.

Shared vocabulary can pose a challenge, as different phases of the fiber processing supply chain utilize terms or measurements in different ways, for example a "worsted" spinning process versus a "worsted"

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weight yarn (itself a nebulous measurement). Providing yarn samples or fabric swatches is a great way to bridge this and make sure that a desired process or design is accurately described; many mill owners we spoke with also offer sample cards to show standard processing treatments, yarn weights, and past projects.

In addition to working with physical samples, inquiring about past orders and runs can be a helpful gauge to determine if a mill is a good fit. In our survey and research, we experienced a few communication differences when discussing what machinery is capable of compared with what has actually been achieved. Experimenting with specifications and processing can produce innovative yarns and fabrics, but if there is an objective and specific goal, it may be best to frame the conversation around past successes.

Prosumption

A new field is emerging between the spheres of production and consumption—a way of engaged action and dialogue between the producer and consumer. This process, called *prosumption*, represents the merging fields of economic and social interactions, embedding an economic exchange in a values proposition (Mazzarella et al. 2016).

The recent resurgence of American-made hand knitting yarns is one example of this—knitters are both purchasing from a domestic supply chain and becoming part of the garment creation process. Indeed, the majority of mills surveyed focus on creating yarn for the hand knitter market, with an average of 15-20% local fiber producer customers (as defined by the respondent).

The growing market for traceable, American grown knitting yarns offers a value-added output for fiber producers and processors, but unfortunately does not easily correlate to regional and domestic cloth production. Two main factors that distinguish knitting yarn and cloth value chains are scale and specifications—yards of cloth production requires larger volumes to meet minimums and get onto the loom, compared to the single fleece or single flock knitting yarn possibilities, and at each step of manufacturing there are specifications and minimums that narrow down the pool of possible supply chain partners.

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With these factors in mind, organizing a supply chain for cloth necessitates a larger investment of time to align the processing specifications and end-use design, and a larger financial commitment to process fiber at scale and at accessible facilities. This understanding and brief overview draws on the experience of Fibershed's pilot Community Supported Cloth program, which realized a domestic value chain to create production yardage of fine cloth from a single source of regional fiber.

Part of what makes Community Supported Cloth possible is demand aggregation—offering reservations for cloth ahead of production to fund the supply chain, and in turn inviting *prosumers* to access cloth that not only represents the High Desert Fibershed landscape where the fiber was raised, but a reinvigoration of the domestic textile milling landscape. Learn more at **http://www.fibershed.com/programs/textile-economy/community-supported-cloth/**

Both knitting yarns and pre-funded cloth production engage community members to take part of a supply chain and make regional or domestic clothing both a possibility and an act of *prosumption*.

Designer pull-through

In addition to *prosumption*—participation between production and consumption—there is a rising movement for transparency and traceability in finished goods and clothing. From advocacy such as the Fashion Revolution movement which asks "Who Made My Clothes?" to market growth in organic and sustainable fibers and apparel, demand is increasing for clothing that tells a story and makes a positive impact.

Fibershed frequently receives inquiries from brands and designers of many sizes who want to realign sourcing and production with local and sustainable values and economies. Despite the challenges of scale and lead time described in our findings and research, we believe that designers and brands are uniquely positioned to support domestic textile mills by providing the "pull through" mechanism (financial commitments and larger-scale demand) to orchestrate a supply chain, and incorporating the narrative of production from fiber production through processing.

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In addition to the prosumption model of pre-production funding, the pilot program of Community Supported Cloth is made possible in part by a collaboration with Tara St. James, whose line, Study NY, purchased a portion of the yarn produced for the supply chain. This partnership is an example of how aggregating demand and funding mobilizes the pull-through of fiber processing and creates a mutually beneficial, accessible material.

Whether you are a small-flock fiber producer seeking a mill for value-added fiber processing, a clothing designer searching for partners to bring a "grown and sewn close to home" design to life, or a community member curious about the landscape of textile milling in the United States, we hope the National Mill Inventory research summary and Explorer tool offer a starting point for you to connect and collaborate.

For questions, corrections, or to be added to the Explorer, please email **NationalMillinventory@fibershed.com**.

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Local Fiber, Local Dye, Local Labor

www.fibershed.com
www.nationalmillinventory.com

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