Vermont Sheep Wool – Value-Added Products from Raw Wool

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Thank you to project applicant: Anna Freund, Open View Farm

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Introduction

This report is funded by a USDA Value-Added Planning Grant with the aim of determining the feasibility of using coarse wool from Vermont sheep farmers to produce a residential building insulation product and other value-added wool products. Economic, market, technical, financial, environmental, and management aspects of developing new products with sheep wool are assessed including:

- Raw materials, the available supply of sheep wool,
- Regional supply network to provide the wool,
- Aggregation, storage, and processing,
- Capacity of processing centers,
- Product requirements and energy efficiency properties,
- Operational parameters,
- Potential market and product positioning.

In addition, a survey and "design-thinking" process was undertaken with stakeholders across the supply chain to help develop product prototypes. Three main product categories were identified, which were defined in part by the level of cleaning and processing of the raw wool required. For washed and scoured wool, this product category is wool fiber insulation; for washed, scoured, and felted wool, the category is insulating and acoustic panels, and for the non-scoured "dirty wool", it is landscape and gardening products.

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Background and Context

Over the past 15 years, there has been a revival in the use of "natural" materials for residential buildings. These are materials recognized as renewable, naturally-grown fibers such as straw, hemp, cotton[1], wool, flax, cork or wood. Unlike petroleum-derived non-renewable plastic foams, these "natural" insulation products are based on renewable raw materials with less carbon impact.

Wool pieces being piped into wall cavity of a tiny house at Yestermorrow School.
Photo by Kimberly Hagen

Wool, in particular, has several exceptional qualities; high R-value for insulation[2], hygroscopic, (absorbs and releases moisture), absorbs sound, naturally fire resistant, naturally mold resistant, lends itself to a myriad of forms both primitive – such as small loose pieces or refined - such as felt for fabrics or thick felted paddings, or blended with other materials (marble dust, clay, straw and other plant materials), and can be re-used or composted. In addition it provides a second revenue stream for sheep farmers.

The USDA Census Data 2012 shows that the available supply of wool increased over the five-year period from 2007, as the trend for having small flocks of sheep grew in Vermont and surrounding states.[3] The USDA Census of 2017 will soon confirm whether this trend in Northeastern states continues. However, the markets for coarse and mixed

[1] US Green Building Council and Building Green, https://www.usgbc.org/education/
[2] http://midstateswoolgrowers.com/marketing.html#gradeyield
[3] https://www.fsa.usda.gov/programs-and-services/price-support/Index

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sheep wool have been limited. While fine wool can command reasonable prices, the majority of fleeces from the sheep raised in the Northeast, are considered too coarse with limited uses and low or no value. The end result is that while some of this raw commodity makes its way to an annual wool pool where the financial return often does not even cover the cost to get it there, most is often wasted, left in storage until reaching a point where it is merely used as mulch or disposed of as waste. Current estimates are that at least 50% of sheared sheep wool is likely wasted.[4]

Production of synthetic materials over the last several decades, most of which are petroleum derived, increased substantially with the cheap supply of this raw material and the investment in supporting infrastructure worldwide. Wool as a raw and finished product fell out of favor and many processing facilities downsized or closed up shop. But global industrialization of petroleum-based materials and synthetics has revealed steep public costs in the form of wide-spread negative impacts on air quality, land, and the water and marine environment, most notably, plastics in oceans and other water bodies.[5] Plastic pervades the global environment from ocean water to our drinking water on every continent.[6]

Retrofitting an old farmhouse in Vermont with wool insulation.
Photo by Kinna Ohman.

[4] Insulation in the US by market, material, and region publication as reported in Demand and Sales Forecast, Market share, Market size, Market Leaders, Freedonia Group, 12/2017

[5] Insulation - Industry Market Research, Market Share, Market Size, Sales, Demand Forecast, Market Leaders, Company Profiles, Industry Trends, 11/2013

[6] US Census https://www.census.gov/construction/nrc/index.html

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Using “natural” renewable materials such as wool instead of non-renewable plastics for consumer products has recently revived, and brought new attention and focus to its uses and development.

Consumers show an increasing awareness of the importance of using renewables for many reasons; environmental issues such as resource depletion and climate change, cost savings, and improved health are some of the reasons (Pew Research Center, 2016). Nationwide, polls show that 2/3 of Americans give priority to renewables over fossil fuels, up from 2014 (Pew Research Center, 2017). Though most attention is on energy sources and supplies, awareness of material production and their product’s embodied or embedded carbon is growing.[7]

While there is less public awareness and knowledge about climate change mitigation and adaptation, sheep have a role, particularly in grazing and carbon sequestration. Sheep consume the organic carbon of plants - i.e. CO^2 converted by plants during photosynthesis. Sheep then convert organic carbon to wool – 50% of the weight of wool is organic carbon. In the form of wool, this carbon is stored and longer lived. (LCA for Wool International Wool Textile Organization (IWTO) Fact Sheet. [8]

Anna Freund with a supplier of raw product.
Photo by Suzy Hodgson

[7] http://www.greenbuildingstore.co.uk/page--insulation-embodied-energy.html

[8] https://www.iwto.org/sites/default/files/files/iwto_resource/file/20160825_IWTO_Fact%20Sheets_Fact%20Sheet%201.1_0.pdf

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The potential success of new sheep wool products in Vermont depends on some key market and cost factors:

Wool Supply: In order to maintain a sufficient wool supply for a wool insulation product in Vermont, it is important to partner with New York State which currently produces nearly three and half times more pounds of wool than Vermont does on an annual basis.[9] Although the other New England states produce significantly less than Vermont and New York, aggregating their coarse wool and adding to a pool for processing into a value-added product would contribute to greater volume, and even lower processing costs overall and could bring a financial return to make it worthwhile.

Given the good transport links between Addison and Rutland counties in Vermont and New York State, this area could serve as a collection depot site for sheep farmers to bring their wool for processing. Coordinating with the wool pools currently organized by the trade associations in Vermont and New York, would help provide the volumes required to develop a Vermont product.

A sheep shearing shed: Shearing platform in the back, sorting and baling in front.
Photo by Kimberly Hagen

9 Mid-state Wool Growers Cooperative Association
http://midstateswoolgrowers.com/marketing.html#gradeyield

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Processing Costs: The cleaning of wool, particularly scouring, contributes substantially to the cost of wool processing. If the wool clip does not need scouring for the end product, processing costs are greatly reduced. At this time, Vermont (and the Northeast) have limited capacity to scour wool. While the mills have capacity to produce small-batch runs for custom work and product prototypes which require scoured, clean wool, all large volume commercial-scale processing necessitates the raw wool is sent out of state where there is capacity, efficiency and thus significantly lower costs. There are only two scouring operations in the US that meet this criteria, one in South Carolina and the other in Texas.

Product demand: Awareness of wool products is relatively low but interest and recognition of the attributes of wool are high. Respondents to this project's VAPG wool survey November 2017 ranked on average four qualities of wool higher than cost for value-added products. These attributes are moisture properties including resistance and permeability; insulating performance as R-value; environmental impact, and availability of product with local retailer or distributor.

Scoured and freshly carded wool.
Photo by Kimberly Hagen

Wool insulation batts in France.
Photo by Kimberly Hagen

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1. **Wool Inventory**

The 2012 US Census data show the majority of sheep (58%) are in New York State with Vermont (13%) and the remainder spread across the other New England states. In New England and New York, the five-year USDA figures show a downward trend from 1997 to 2007 in the number of sheep, but a turnaround from 2007 to 2012.

2012 USDA Agricultural Census: Vermont & nearby states

	Number of Sheep			Number of Sheep Farms			Wool Production lbs		
	2007	2012	growth %	2007	2012	growth	2007	2012	growth %
VT	**13,925**	**18,803**	**35%**	**626**	**793**	**27%**	**81,167**	**101,330**	**25%**
MA	11,787	12,504	6%	734	776	6%	63,971	70,127	10%
NH	7,671	8,079	5%	531	618	16%	42,351	40,465	-4%
ME	10,918	11,925	9%	647	759	17%	66,838	62,856	-6%
RI	1,459	1,823	25%	107	122	14%	5,797	7,699	33%
CT	5,767	6,093	6%	399	498	25%	28,972	26,864	-7%
NY	63,182	82,286	30%	1,799	2,017	12%	319,144	303,277	-5%
Total	114,709	141,513	23%	4,843	5,583	15%	608,240	612,618	1%

http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_US_State_Level/st99_2_013_013.pdf

The 2017 census will show whether this is an overall trend reversal from the 1990s decline. Demand for lamb meat has remained steady, but the competitive price of lamb imports meets much of this demand. The localization of food markets and consumer interest in buying local indicates potential for a product grown and produced in Vermont.

With the majority of sheep in New York State and hence the bulk of the available wool in this state, it is clear that the market for a potential new product relying solely on local sheep wool as raw material would need to include the wool from New York's sheep.

Both New York and Vermont run seasonal wool pools where farmers bring their wool to a drop-off location where it is sorted, weighed and aggregated for sale. In recent years, Vermont has sold their wool to the Mid-State Wool Growers Cooperative Association

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based in Ohio. Prices determined by Mid-State range widely depending on fiber size, quality, and color of wool received. In 2014, Mid-State Wool[10] prices per lb. for the Vermont wool pool ranged from $0.75 to $1.35 for fine wool and for Med 48s, 54s, 58s from $0.50 to $0.80; and for black, short, common, med defect from $0.07 to $0.35. These market values are minus handling charges (i.e. transportation, grading, etc.). USDA prices for ungraded wool in June 2018 are $0.40 per pound.[11]

Hugo counts the bags of wool at 2017 Vermont Wool Pool.
Photo by Mary Lake.

A potential wool insulation product would use fibers deemed too coarse for clothing and blankets, or too short, kempy or otherwise ungraded and hence at the lower end of the price scale. The New York State wool pools collected about 92,000 pounds of wool,

[10] Mid-state Wool Growers Cooperative Association
http://midstateswoolgrowers.com/marketing.html#gradeyield
[11] https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Price-Support/pdf/2018/2018_wool_mohair_lr.pdf

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about 1/3 of total wool production in that state. In Vermont, the annual wool pool collected about 20,000 pounds, about 1/5 of total wool production based on USDA survey data, although as much as 72,000 lbs was produced here as recently as the late 1990's and early 2000's according to a previous survey conducted by the Vermont Agency of Agriculture. (See Appendix).

It is also important to recognize that wool is a secondary added-value product to the value of sheep as meat or as a dairy animal providing milk for yogurt and cheese. Historically wool receipts provided about one-quarter of the income from sheep production when a price support program existed.[12]

2. Stakeholder Engagement and Project Methods

At the proposal development stage, the project applicant Open View Farm with project investigators, Kimberly Hagen and Suzy Hodgson from UVM Extension Center for Sustainable Agriculture, engaged with wool stakeholders along the supply chain and formed a project team including:

- Building Green, Alex Wilson and Brent Ehrlich
- Vermont Agency of Agriculture, Food, and Markets, Alex DePillis
- Vermont Fiber Mill, Deb and Ed Bratton
- Vermont Integrated Architecture, Andrea Murray and Meg Nedzinski
- New Frameworks Natural Building, Ben Graham
- Settlement Farm, Dave Martin
- Green Mountain Spinnery, David Ritchie and Lauren VonKrusenstiern

A meeting with the project team was held on November 8, 2017 at Vermont Fiber Mill in Brandon, Vt. The meeting agenda was as follows:

1. What is the grant for and how much funding does it provide?
2. How are funds to be used?
3. Who will do the work?
4. What are expectations of supporters?
5. Review with supporters: level of involvement, comments on direction of study and any other inputs

[12] Wool and Mohair Price Supports 10/30/2008, by Carol Canada, Technical Information Specialist

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Primary data collection included phone interviews with stakeholders including sheep farmers, wool pool coordinators, wool processing facilities, green builders and architects and manufacturers about product specifications, performance, and market demand. In addition, information and data were collected from several phone and email conversations, from contacts in France, England and Germany where wool is used in multiple value-added products. The literature search included organization and company websites, as well as a previous feasibility study by Vermont Agency of Agriculture in 1998 of wool production and capacity for processing in Vermont. In that study there were 301 respondents with a total of 12,429 sheep, reporting an annual production of over 71,000 lbs. of fiber. At the time of that study, fiber producers reported nearly an even divide of those that sold their raw product to the annual wool pool and those that had it processed for their own resale purposes. A close third category did nothing with the fiber, and it ended up collecting in barns and treated as waste. When queried about interest in a new fiber processing facility – if it was operated as a cooperative – the level of interest was very high and nearly all respondents said they would increase the size of their flock if there were one.

The aim of the data collection was to gather comparable product and market information in order to assess the feasibility of developing prototype added-value wool products. Through a design-thinking workshop with the project team and other stakeholders, three main product prototype categories were identified; loose fill or batted insulation for walls, roofs, and doors, home/décor felted panels, and garden/landscape pelleted products. Using the product descriptions and key attributes, three scenarios with projections based on estimated costs and potential sales estimates were developed.

Market

US demand for insulation is forecast to rise 3.7% per year to $9.5 billion in 2021. Mineral wool is expected to have the greatest sales increase due to its fire resistance.[13] These projections are less bullish than the 2013 projection of 7.6% annual growth for insulation as reported in 2015[14] which may be due in part to the slow recovery of the housing sector since its pre-recession period. The number of housing starts is a good indicator for the strength of the insulation market, but from April 2017 to April 2018, the seasonally adjusted annual rate of housing permits authorized was down 23% in the Northeast region. [15] Therefore, looking to the retrofit residential market and higher state

[13] Insulation in the US by market, material, and region publication as reported in Demand and Sales Forecast, Market share, Market size, Market Leaders, Freedonia Group, 12/2017

[14] Insulation - Industry Market Research, Market Share, Market Size, Sales, Demand Forecast, Market Leaders, Company Profiles, Industry Trends, 11/2013

[15] US Census https://www.census.gov/construction/nrc/index.html

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insulation standards could be a better driver for growth in the next decade. Building codes (Vermont Stretch code), energy efficiency, and green building practices support this trend.

The insulation market continues to be dominated by fiberglass closely followed by plastic foams, with multi-nationals such as Owens Corning with extensive R & D and building material distribution channels controlling this market place. These companies and their products have high brand recognition, high economies of scale, low prices, as well as deep business experience and market capitalization to develop new products.

While the "natural" fibers market is a very small percentage of the insulation market, it is likely growing at a rate at least equal if not more than the overall insulation market.[16] However, sheep wool insulation is only one product type among a large variety of competing "green" products, which have a "natural" fiber component (e.g., cellulose insulation, cotton fiber, recycled fibers, hemp). Other products which have a high recycled component such as Roxul and cellulose are likely to continue to see growth.

Moreover, wool insulation product awareness is low, empirical data on product performance is thin, and marketing channels are less developed. Only three small companies have a presence in the USA; Havelock Wool, Oregon Shepherd and Black Mountain. But none of these companies utilizes domestically grown wool. Havelock's fiber comes from New Zealand, and both Oregon Shepherd and Black Mountain's fiber originates from Europe – which significantly impacts their retail price.

3. Evaluation of processing sites, transport, and equipment

Scouring is the first step in the process for most value added products, however, the capacity for this in the northeast is limited. The custom processing mills available include Battenkill Fibers Carding & Spinning Mill in Greenwich, NY; The Vermont Fiber Mill in Brandon, VT; Green Mountain Spinnery in Putney, VT; and Bartlettyarns in Harmony, Maine, in addition to a handful of smaller operations.

[16] One Northeast distributer is experiencing 20% per annum growth in natural insulation.

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Three Fiber Processors in Northeast

Facility Name	Address and Contact	Current Capacity	Future Capacity
Vermont Fiber Mill	Deb and Ed Bratton 185 Adams Rd Brandon, Vt 05733 vtfibermill@gmail.com (802) 236-9158	Scour to roving ~ 4,000 lbs fiber annually @ $7.50/lb Some capacity to increase with current set up as scouring equipment only in use ½ day. Limiting factor is hot water generation and storage and drying conditions – due to need for heated air.	There is potential to double capacity as equivalent sized building next door, but would need retrograde. Owners not planning it – due to age and difficulty with finding labor.
Green Mountain Spinnery ***(a cooperative)***	David Ritchie Lauren VonKrusenstiern 7 Brick Yard Lane Putney, Vt 05346 spinnery@spinnery.com (802) 321-9665	Scour to roving ~ 10,000 lbs fiber annually @$5/lb Some capacity to increase, ~ 20% more with current set up. Limiting factor is efficient heating and storage of hot water and facilities need an upgrade.	Interested in increasing capacity – (Permitted to use 500,000 gals/day but only use 350,000 due to inefficient and labor intensive facilities that need upgrade.
Battenkill Fibers	Mary Jean Packer 2532 State Rd. 40 Greenwich, NY 12834 mjpaker@battenkillfibers.com (518) 692- 2700	Scour to roving ~20,000 lbs annually @ $9.50/lb. Could possibly increase capacity, by 30% or even more. Limiting factor – efficiency in heating water and storage, and moving fiber through.	Very interested in increasing capacity of scouring output, perhaps double of current.

Processors outside of the Northeast

None of these mills has the equipment, nor the capacity to do really large commercial scale scouring of several thousand pounds a day. All of them utilize either Chargeurs, http://www.chargeurswoolusa.com/about-us/ (scouring costs vary between $.44/lb and $1/lb) in Jamestown, South Carolina, or Bollman's in San Angelo,Texas (scouring costs vary between .50/lb and $1.20/lb) https://www.bollmanhats.com/wool-scouring.html to

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scour large volumes (50,000 to 70,000 lbs of raw fiber a day), which is then returned to Vermont for further processing. Trucking/shipping costs can vary significantly, but often the wool can be added to existing freight for a reduced cost, although it takes time to research and book such an arrangement.

Another large scale facility, Brookside Woolen Mill http://montanawool.net/ in Malta, Montana (scouring costs vary between $1/lb and $7/lb) is the only one that claims a "green" process, with its use of biodegradable Dawn dish soap and water recycling ponds for the dirty scouring water, but the roundtrip shipping makes it prohibitively expensive when added to other processing costs. One eighteen-wheeler has capacity for approximately 45,000lbs, and although quoted prices can vary widely, using the current fuel prices, a trip to Montana and back to Vermont with one truck is estimated at $13,000 to $15,000. It also brings up the question of whether it can be truly considered a "green or environmentally friendly" product when there is a heavy use of fossil fuels for trucking attached to it. However, Malta has the added potential attraction of sitting along the east/west BNSF Railway with a siding in the center of the town. It is part of the Amtrak "Empire Builder" route and could be considered a possibility for future consideration.

Scouring of Wool

The greatest obstacle to developing wool insulation, or nearly any other value-added product utilizing the raw fiber from the producers of the northeast, is the scouring of the material. This essential first step is where the raw agricultural product becomes material for value-added products. However, water and effluent management from this process is not unlike what dairy farmers face with barn and milkhouse runoff, and presents a difficult and costly challenge as the environmental impact is significant.

Much like humans, sheep and many other animals, produce a fiber growing from their skin. However, with sheep, and some other animals, this fiber is coated with grease - also known as wool fat, or lanolin, and sweat salts – also known as suint. And due to the sticky nature of these substances, they tend to collect dust, dirt and vegetative matter. To morph this raw product into a useful value-added product such as insulation, upholstery filling or fine woolen fabric, it has to be scoured first. In the scouring process, these constituents are separated from the wool fiber and it is because of the physical and chemical properties of these compounds that such a complicated process is needed. Lanolin is a complex mixture of waxes, not soluble in water, and thus requires hot water and detergent to separate it from the fiber and it becomes emulsified, much like well-blended salad dressing. The fiber is then rinsed with large amounts of water to separate it from the emulsified solution. Suint, on the other hand, from the animal's sweat glands, is made up of approximately sixty percent potassium salts of fatty acids, and is soluble in

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cold water. This process will vary depending on the final use for the fiber. The finer the fiber, and a targeted use for clothing fabric, the more care and attention with soaps, rinsing and rigor with which the fiber is moved along.

Washed wool laid out on drying racks at Vermont Fiber Mill.
Photo by Kimberly Hagen

The greatest cost of the processing in the northeast is the heating of the water for scouring, and the treatment of the effluent – which has a high Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Because lanolin is emulsified in the wash water, it is exceptionally difficult to extract and most scouring systems simply catch it in a grease trap which is periodically cleaned out and the thick greasy sludge taken to a waste depository.

Although lanolin is a valuable by-product of this process, the complexity to separate it and the large volumes of very greasy wool needed for it to be worthwhile, it is not usually a part of the operations at a small mill, and only sometimes at a larger one. And since pesticides will be fixed into the animals' greasy wool, the product needs exceptionally rigorous cleansing after extraction for high purity as the largest users of lanolin is the cosmetic and pharmaceutical industries.

Once the fiber is scoured, its weight can be reduced by one third or more of the original. This depends on the breed of sheep, and the environment and management system used.

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For example, the fiber from the Merino sheep contains substantially more grease and suint than a Dorset sheep and it will require a corresponding increase in the water usage and treatment of effluent at the end of the scouring process. How the animals are housed and managed, will also impact the scouring process – animals with greasier fleece and kept in close confinement, will attract and hold dust, dirt and hay chaff, requiring greater amounts of time for picking, washing, and rinsing.
However, another by-product of the scouring process, the solids left in the wash water have great potential as agricultural supplement/fertilizer for soil or forage improvement.

4. Develop Product Prototype

With unique physical and intrinsic chemical properties, sheep wool as insulation retains its volume and shape compared to conventional materials and does not lose its R-value over time due to settling or moisture. Moreover, it absorbs sound waves and thus has better acoustic properties than fiberglass or cellulose. It is generally considered healthier as wool insulation requires no special health and safety equipment compared to conventional fiberglass insulation which requires breathing, eye, and hand protection and unlike foam products, there is no off-gassing which affects indoor air quality.

Rolls of wool insulation ready for the market in Saugues, France.
Photo by Kimberly Hagen

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While well-designed walls and assembly should include effective moisture barriers, in New England, moisture issues and high variations in humidity are quite common. In these cases, wool can mitigate moisture problems, especially when compared to fiberglass. Wool with high hygroscopic material property has the ability to absorb and release moisture as relative humidity rises and falls.[17] Homes, which suffer from moisture problems or have high moisture and humidity variability, will find wool insulation a benefit.

Depending on residential design and wall systems, and performance specifications, which take account of issues such as overheating, acoustics and breathability, sheep wool insulation can make a comparable choice.

Starting with fleeces, the raw product, wool, is sorted according to grade, that is, by length, color, type of fiber and the degree of contamination with vegetative matter. The finer, softer fiber is usually segregated for high value yarns for clothing and some blanket type products. It is the coarser fiber grades, which can be captured as raw material for a potential insulation product. While the coarser grades and the shorter fibers can be used for an insulation product, a threshold would need to be established for acceptable wool, e.g., minimum length for fiber, maximum amount for vegetative material (that would have to be removed).

Wool then needs to be baled and transported to a wool processing facility. At the processing plant, the bales are opened and the wool is mixed together to produce a blend, which meets the required specifications, then undergoes the scouring process. The scoured fiber is then either rinsed in a borax (washing soda) solution, or sprayed with it to increase the pest and fire resistance and meet ASTM insulation standards.
The next stage will vary depending on whether the final product is an insulation batt or a blown-in product. The blown-in product is a much simpler and less costly process than forming batts. According to Black Mountain Wool, the processing/production line costs for batt assembly are about four times the upfront costs of the blown-in variety. The wool batt product currently marketed and sold in the USA is labeled as an Oregon Shepherd or Black Mountain product, but is imported from the UK as there is no manufacturing plant in the USA. Havelock Wool also sells batts, and a blown-in product, but again, the raw product and manufacturing is not from or done in the USA, but New Zealand. Hence, the focus here is on the blown-in wool product.

In order to develop product prototypes, a design-thinking session was held on March 23, 2018 with 22 stakeholders along the value-added supply chain including farmers, wool

[17] Wool has the ability to absorb up to 30% of its weight with moisture.

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processors, designers, architects, green builders, and energy efficiency professionals. Working in small groups, the stakeholder identified several product categories.
To frame the design thinking session, a key question was posed, "How might we use Vermont wool in home/building applications that highlight the unique attributes of this material?" The wool attributes were identified and ranked in a survey sent to stakeholders in November 2017. These product attributes included moisture properties, insulating performance, environmental impact, availability, locally produced in New England region, ease of handling and acoustic properties. See survey results in Appendix 1. Starting with a recognition of these identified attributes, the stakeholders worked in small groups to brainstorm products.

Design Thinking Workshop led by Eugene Korsinsky.
Photos by Kimberly Hagen and Suzy Hodgson

The bulk of the products imagined by the group require scouring of the raw wool as the first step. Once scoured, the wool may need to be carded depending on the end product. If carded, the wool could be made into sheets of felted wool and from this a myriad of products can be produced from weatherization cord or caulking around doors and windows, to insulation wrapping for pipes.

Ideas generated by the group:

<u>Carded products</u> include:

<u>Rope Caulking</u>: Backer Rod, Log homes, Windows, Doors

<u>Upholstery:</u> Cars, Child car seats, Furniture, Pillows

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Multi-purpose felt: Door core (layered with wood), Wall panels, Ceiling sound panels, Window/Door frame, Carpet underlay, Insulation - batts, pipes, water heater, Yurts

Uncarded products include:

1) Wool Blocks/bricks (wool can be blended with other natural materials such as hemp or clay, or marble dust)
2) Insulation – chopped or shredded

A new product category, which does not require the cleaning (i.e., scouring) of the wool clip, covers the landscaping/garden/farming area.

Unscoured Wool:

1) Garden Mulch
2) Landscape fabric
3) Seed Pots
4) Fertilizer Pellets
5) Seed impregnated blanket
6) Erosion control/silt fence

Gryphon Doors – Loose fill wool insulation for Homes

An un-carded clean loose fill building application of wool is in a standard-made wood, insulated door. Produced by one of this project's stakeholders, Ben Graham at New Frameworks, the door division of the company is called Gryphon Doors and is a low carbon, high performance door. This door is constructed of all natural materials including a 2-inch layer of wool used as a high R-value insulating material between layers of wood. This door meets the standard for passive house, which is the leading standard in energy efficient construction not only based on energy efficiency criteria but also based on comfort and quality criteria. Passive Houses require very little energy to achieve a comfortable temperature year round, making conventional heating and air conditioning systems obsolete.

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The loose fill is also used as stuffing for window gaps during the installation for low carbon material specifications for new or remodel products. Currently, New Frameworks has crafted around 20 doors, as standard and custom orders made for eight New England clients and plans to increase production to 50/yr in five years. This high performance door is priced at $3000 and up. While this use of loose fill sheep wool for a high performance door has a high price point and thus considered a niche product, it is but one example of the interest and demand in using sheep wool in residential applications. As project partner Ben Graham commented in October 2018, "Our doors are taking off and we are buying 25 lb bags of loose wool treated with borates for our doors. It does not need to be combed, but is washed. If there is a small entrepreneur that wants to step in, I would love to buy local!"

Wild Valley Farm Fertilizer - Wool pellets

Researching the new product category for farming and horticulture indicates real potential for a new value-added wool product for Vermont. Wool meets the National Organic Program (NOP) and Organic Materials Review Institute (OMRI) standards so is of particular interest to organic farmers and gardeners. Product processing costs are lower than wool felting and building loose-fill products as there is no need for cleaning and scouring. Price points for comparable products produced in Europe as well as market demand for the product produced in Utah show real promise. Wild Valley, a Utah-based company, produces a pelleted wool fertilizer product, which now sells in the Northeast and Canada. Working with distributors, the company has experienced demand growing five-fold in three years

.

Oregon Shepherd Loose fill wool insulation for walls

For retrofitting homes to improve their thermal envelope, wool insulation can be blown into the cavities instead of cellulose (See photo on page 4). Similar equipment is used. Wool as a material has an R-value comparable if not better than cellulose, though more testing is needed in wall assemblies. In addition, wool insulation is lighter than cellulose for a given R-value.

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Wool fibers contain a natural fire retardant so do not require the level of borate compounds, which are added to cellulose insulation for example. See table below.

Flame Retardants used in Building Insulation

Insulation Material	Flame Retardants
Polystyrene (XPS and EPS)	Virtually all polystyrene building insulation is produced with HCBD (hexabromocyclododecane) at a concentration of 0.5%–1.5% by weight.
Polyisocyanurate and both closed-cell and open-cell spray polyurethane foam (SPF)	The most commonly used flame retardant is TCPP, which has both chlorine and phosphorous as active ingredients.
Fiberglass, mineral wool, Foamglas, AirKrete, wool	No flame retardants are required.
Cellulose	Manufactured with borate compounds or ammonium sulfate at a concentration up to 20% by weight.
Cotton	Treated with borate or other non-halogenated flame retardants that are used on fabric.

Source: *Environmental Building News*

Without a measurable track record in USA, the R-value of sheep wool as loose fill insulation had not been definitively verified in practice. Product manufacturers claim a R-value of 4.0 for wool per inch compared to 3.65 per inch for cellulose loose fill. However, Building Green's Guide to Insulation lists the R-value for sheep wool at 3.5 compared to 3.6 to 3.7 for cellulose loose fill. While the jury may be out on this comparison, what is clear is that more testing of loose fill sheep wool as insulation in different building applications needs to be tested.

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Felted panels for acoustic, decorative, and room division purposes

During this project's design thinking process, a number of felted wool application products for interior buildings were described. Felted wool can be framed or sandwiched between panels to be self-supporting and used as a sound absorbing room divider or be free-hanging on walls. One example of a custom-designed application is felted wool panels used for its acoustical properties in a music room in Vermont. These can also be suspended from the ceiling for sound absorption – for example in restaurants or meeting rooms where the cacophony of numerous conversations can make it difficult to hear.

Wool Felted panels, music room, Bread & Butter Farm, Shelburne, VT.
Photo by Kimberly Hagen

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On a commercial scale in Germany, Rossoacoustic produces a high-quality room divider that acoustically dampens, screens, and gives structure to multi-person offices. These Rosso panels are light weight and are marketed as "creative spatial acoustics" offering designer and architects a building block system which can be use on ceilings, walls, windows or used as free-standing room dividers as shown here.

Left: screenshot from website https://www.architonic.com/en/microsite/rosso/

5. Marketing Plan

In order for a new sheep wool product to find a niche and grow in a crowded market with many competing products, a prolonged market adoption and extensive marketing efforts and investments are likely to be required.

With the existing producers of sheep wool insulation in the current marketplace (Oregon Shepherd, Havelock, Black Wool, Good Shepherd – all importers), one strategic approach could be to enter into a mutually beneficial relationship or partnership with an established provider or distributer. Working with another producer/distributor would obviate the need and related upfront costs for product licensing, initial testing and certification, and upfront marketing. It could be possible for the product in Vermont to be its own brand "Vermont Shepherd" with its own unique selling proposition if it can be made locally with a reasonable proportion of Vermont wool.

Product marketing, including website development, product fact sheets and building instructions could be shared between the respective parties. The partner brand (e.g., Vermont Shepherd) could take ownership of championing the product in its region and marketing channels. The parent could provide technical expertise and support to the Vermont locations on sourcing and production issues. Such a partnership could lead to a progression through research and development on new product types and enhancements, which would help the processing facility meet the relevant technical, ASTM standards, and customers' expectations. For example, in the case of the fertilizer wool pellets using

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the raw "dirty" wool, a relationship is developing between Wild Valley, the existing producer in Utah and a potential producer in Vermont.

With the strong "Vermont-brand" reputation and a "green" recognized network for energy, building, and product promotion, Vermont is well positioned to develop demand in the New England market. Green energy, farm, and building conferences in New England regularly attract 6000 to 7000 attendees who are on the lookout for new "green" and "natural" building products.[18] Such a conference would be an ideal place to test the waters for a pilot product.

In Vermont, for the home wool fill insulation product, home retrofit projects are driven in part by Vermont's regulated utility, Efficiency Vermont, with its incentives and marketing offerings. If a new product such as sheep wool insulation, which meets energy efficiency standards, could be part of an incentive package, this would help establish product positioning. Moreover, energy efficiency campaigns, which include sheep wool insulation as a preferred "green" alternative, would be important in developing the brand.

Lastly, being proactive in working with designer, builders, architects, farmers, and consumers about the unique properties and benefits of a sheep wool products and providing them with samples and test results and measurement over time will improve consumer confidence and buyer-seller relationships.

The potential of producing wool products in Vermont depends on both the market demand for the product and the capacity, supply, inputs prices, and processing costs in the region. To assess the current prices of the wool supply, data was collected from wool pools (i.e., the aggregation of wool by the trade associations) in New York and Vermont, as these states are the largest producers of wool in the region. In addition, interviews and tours of wool processing facilities were conducted in Vermont and New York to learn about the processing and costs.

As a relatively new product without a well-recognized track record, product performance data of wool insulation applications in residential use is lacking. While some manufacturer's data is available, empirical data about how sheep wool insulation performs in actual residential wall assemblies across the seasons is needed to demonstrate product performance.

The costs of wool scouring and the costs of wool purchasing are the key inputs, which affect the final costs of the product. The price points of comparable sheep wool products in the USA were used as baseline to compare the production costs.

[18] Conversation with architect, David Pill, November 2014.

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The total costs can be divided into the total fixed costs of developing a sheep wool insulation business and the variable costs, which depend on the inputs and the outputs per pound of wool. It is estimated that fixed annual costs to run a small business/organization would amount to $60,000 annually including marketing, brand development, media, management, insurance, product testing, certification, and administration.

This scenario of fixed costs does not include any building or equipment costs as it is assumed that the wool could be cleaned, stored, and cut into an insulation product at an existing facility.

Based on market research and regional wool pool data, the variable costs of wool processing per pound are estimated to be:

Raw wool price per lb depending on classification and grade	$0.07 to $1.35
Raw inputs - eg borate solution	$0.01
Processing/Scouring costs	$0.95 to $9.95
Packaging & labelling	$0.01
Shipping & Insurance costs	$0.03

The prices, which processors and product developers will pay for raw wool per pound depends on its classification and grade including cleanliness, dryness, fiber length, color, strength and texture. The low price of $.07 per lb is for short black fibers and the high price $1.35 is for fine staple. The prices processors will pay also typically assumes a certain volume delivered (e.g, 200 lbs). For example, Southern Adirondack Fiber Producers Cooperative accepts five classes of grease wool: Clean white medium and fine wool (at least 2-1/2" in length), clean white longwool and other coarse wool, white off - sorts (including short and dirty fiber, head and belly wool, etc.), natural color medium and fine wool, natural color longwool and other coarse wool. But there is great potential for adjustments to all of these current categories in the development of a final product.

Given the prevailing costs and potential revenues from the sheep wool insulation, the starting price point a farmer could expect is unlikely to exceed more than $0.90 for raw wool and the processing and scouring costs would need to be on the lower end of the scale at $1.50 per pound. For the fertilizer product for which any low-grade wool is acceptable and for which there is not another market, the assumed price is $0.60 per pound.

The product scenarios do not include initial product specification and development costs

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such as insulation product ratings for ASTM standards, technical design specifications, developing Material Safety Data Sheets, which cover product and company identification, hazards identification, and composition/information on ingredients.

A new product line or business is likely to need to secure some start-up funds to cover product development and the burn rate until break-even is reached. For example, Oregon Shepherd relied on USDA working capital grant of $300,000 in 2009 to launch its company. According to our preliminary estimates based on market research to date, a new organization producing a new wool insulation product in Vermont would need at least $230,000 to cover its initial running costs in the first six years not including the initial start up costs of developing its own product.

A Vermont start up with less risks would be to develop a partnership with an existing manufacturer before contracting with a wool processing facility to produce a pilot product.

6. Production Plan

With fixed product development and management costs, producing an insulation product requires a certain scale of operation. For the wool pellet fertilizer product, fixed management and marketing costs are estimated at close to $50,000 each year. This product would be considered a pellet product for spring/summer customers complementing the wood pellet fuel product for fall/winter customers. Given existing pellet equipment can be used, this pellet fertilizer product has a positive cash flow from year one. The cash flow assumes that an existing wood pellet plant operation has the capacity and is not investing in new equipment for this alternative product. In the scenario illustrated here, sheep farmers could be paid $0.60/lb for their coarse "dirty" wool, which does not meet the specifications for a higher value product such as wool fiber fill or felting. These higher value products require additional processing steps, with the scouring costs having a large impact on end product costs.

In the cash flow scenario shown here of a wool insulation fill product for residential applications, such a production business is not likely to break even until year 7. For this building use, the grade of wool required is higher (e.g., no tags, no vegetative material) and farmers should be paid a higher price per pound. Moreover, the specifications for residential insulation require the wool to be scoured and cleaned to ensure there is no risk of contamination by insects. In this cleaning process, there is an estimated fiber loss of 40% which also increases the costs of inputs to account for this loss.

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WOOL PELLET FERTILIZER PRODUCT CASH FLOW

				Yr 1	Yr 2	Yr 3
SALES	REVENUE	price per lb				
	Retail Sales	$16.00	0.2	$32,000	$64,000	$96,000
	Wholesale	$4.00	0.8	$32,000	$64,000	$96,000
TOTAL SALES				**$64,000**	**$128,000**	**$192,000**
		lbs of wool processed		10000	20000	30000
Fixed costs						
fixed operating costs of pellet plant for one day processing				$2,800	$2,800	$2,800
marketing				$20,000	$20,000	$20,000
management/admin				$25,000	$25,000	$25,000
Total fixed costs				$47,800	$47,800	$47,800
variable	COST OF GOODS SOLD					
	Addt'l Mat. acct for loss %	30%		13000	26000	39000
	Esimated raw materials - wool	$0.60		$7,800	$15,600	$23,400
	Estimated raw inputs - eg binder	$0.01		$100	$200	$300
	Estimated processing costs	$0.13		$1,250	$2,500	$3,750
	Packaging & labelling	$0.01		$75.00	$150.00	$225.00
	Est. Material, Shipping, Insurance	$0.03		$300.00	$600.00	$900.00
	Total	$0.77		9,525	19,050	28,575
	Cash Flow			$6,675	$61,150	$115,625

	bag & label	1 ton	per lb
	40 lb bag	50 bags	cost
	0.3	50	15 $0.008

Pellet plant funds at 10 tons hour
operating at half speed 5 tons per hour or 10,000 lbs
2 hrs set up
1 hr operating

				avg hrly rate	
1 day	employees - 2 in mill, 2 maintenance	8	30	7.5	1800
1 day	CEO				1000

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WOOL INSULATION PRODUCT CASH FLOW

Projections	1	2	3	4	5	6	7
Advertising & promotion	($30,000)	($21,000)	($21,000)	($21,000)	($21,000)	($21,000)	($21,000)
License Contract	($3,000)						
Management & Admin	($20,000)	($20,000)	($20,000)	($20,000)	($20,000)	($20,000)	($20,000)
Insurance		($4,000)	($4,000)	($4,000)	($4,000)	($4,000)	($4,000)
Testing & Certification	($4,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)
Fixed Costs Total	($57,000)	($47,000)	($47,000)	($47,000)	($47,000)	($47,000)	($47,000)
Variable Costs		($8,415)	($19,635)	($53,295)	($89,199)	($134,116)	($189,338)
Total Costs	($57,000)	($55,415)	($66,635)	($100,295)	($136,199)	($181,116)	($236,338)
Gross Sales Estimate		$10,650	$23,650	$65,350	$108,750	$158,805	$237,375
Cash Flow	($57,000)	($44,765)	($42,985)	($34,945)	($27,449)	($22,311)	$1,038

Variable Costs per lb:

Est. raw materials - wool	$0.90
Est. raw inputs - eg borate solution	$0.01
Est. processing costs	$1.50
Packaging & labelling	$0.01
Material, Shipping, Insurance Costs	$0.03

Starting Sales in yr 2 with insulating one 2200 sqft house, two 50% house retrofits, and 10 wall assemblies 14'X8'.

Excludes initial product and development costs

Assumes project Sales:

	yr 2	yr 3	yr 4	yr 5	yr 6	yr 7
2375 Square foot walls	1	3	6	12	16	28
50% house retrofit	2	6	18	23	30	39
10 walls at 95 SF' insulated to R21/22	25	50	100	150	300	500

Positive cash flow in Yr 7 of operation and year 6 of sales

A working capital grant of fee: $229,455 would be needed to cover negative cash flow in first five years of operation

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Next Steps (Summary & Recommendations)

There are a couple of options for Vermont sheep farmers working in partnership with other organizations and companies to benefit from the interest in sheep wool products. The lowest level of involvement would be developing contacts with existing producers and distributors, which work with Wild Valley for farm/garden products and Nevada-based Havelock Wool or Oregon Shepherd and selling available graded wool from the wool pool, which could meet the specifications from these companies for their existing products.

More involved would be partnering with Havelock Wool or Brookside Woolen Mill in Montana, to develop a Vermont-labeled product. A Vermont-based marketing channel and relevant sales literature could be developed while benefiting from the licensing and testing of an existing manufacturer. Regional sales and marketing could be handled and supported by a Vermont-based company or cooperative. Wholesale stocking of a regionally based product would alleviate some of the high customer shipping costs associated with distributing insulation, a low value to bulk product, where current shipping across the USA almost doubles the product cost. This product could also benefit from the Vermont brand for quality products and position in the green building network.

Yet more involved is developing a Vermont prototype product based on regionally sourced wool with local production at existing facilities in New York and Vermont. This route would require more extensive research, development, cost estimating, and prototype testing in partnership with New York's sheep wool pool in coordination with, for example, the Empire Sheep Producers Association.

Overall, the potential development of sheep wool insulation products would benefit from increasing the awareness and recognition of the unique attributes of sheep wool, which could be realized through local demonstration projects. In the case of the sheep wool fertilizer product, this could be a field trial of wool pellets in Vermont to show their efficacy as fertilizer product compared to alternatives. A better understanding among gardeners and farmers as to how wool pellets improve soil structure, porosity, and fertility would increase the likelihood of this product's success in Vermont.

In the case of a wool insulation fill product, this would involve building a demonstration wall assembly with sheep wool insulation and comparing it to a wall cavity with cellulose insulation with the participation of "green" building stakeholders. Testing the thermal properties of sheep wool, whether a Vermont prototype or an existing wool insulation product and documenting the performance in specific wall assemblies would lead to

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better understanding of the thermal and other material properties of this “new” product and the greater likelihood of a its potential success in Vermont.

Primary partners of the Wool Value-Added Feasibility Study Project.
Left to right:
Alex DePillis, Vermont Agency of Agriculture, Food and Markets
Anna Freund, Shepherdess at Open View Farm
Kimberly Hagen, Center for Sustainable Agriculture, UVM Extension
Suzy Hodgson, Center for Sustainable Agriculture, UVM Extension

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Appendix 1 Wool Survey results

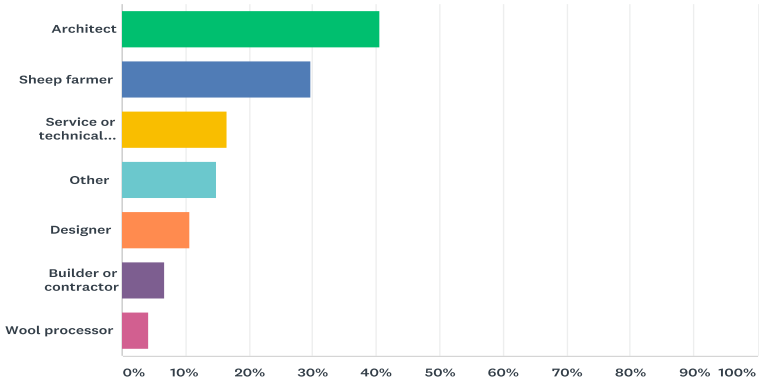
Survey Results

November and December 2017, UVM Extension survey sent to Vermont sheep farmers, architects, builders, service providers, value-added producer project team, and other people who expressing interest in residential uses for sheep wool. 122 surveys were complete.

Vermont Wool for Residential Uses

Q1 Please tell us how you describe yourself and your profession. Check all that apply.

Answered: 121 Skipped: 1



ANSWER CHOICES	RESPONSES	
Architect	40.50%	49
Sheep farmer	29.75%	36
Service or technical assistance provider	16.53%	20
Other	14.88%	18
Designer	10.74%	13
Builder or contractor	6.61%	8
Wool processor	4.13%	5
Total Respondents: 121		

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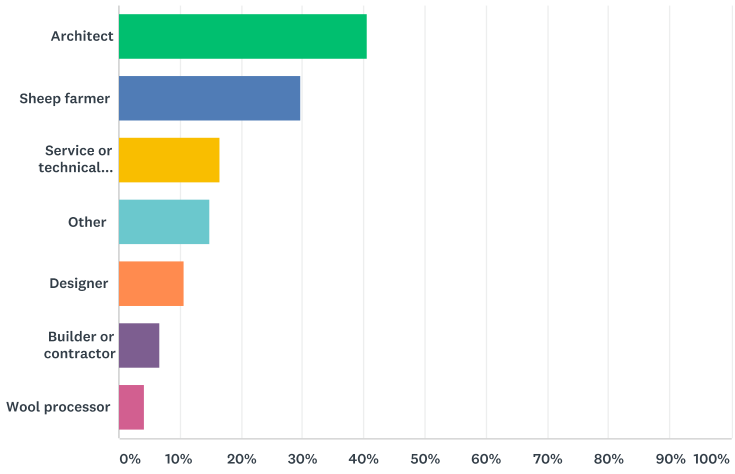
Q1 Please tell us how you describe yourself and your profession. Check all that apply.

Answered: 121 Skipped: 1



ANSWER CHOICES	RESPONSES	
Architect	40.50%	49
Sheep farmer	29.75%	36
Service or technical assistance provider	16.53%	20
Other	14.88%	18
Designer	10.74%	13
Builder or contractor	6.61%	8
Wool processor	4.13%	5
Total Respondents: 121		

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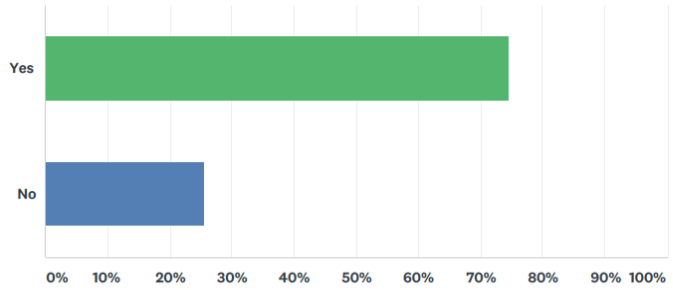
Survey respondents including farmers, architects, builders, technical advisors, and project partners:

Q3 Have you heard of sheep wool insulation as a product for residential insulation? Regardless of your answer, your responses are very important to us.

Answered: 121 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	74.38%	90
No	25.62%	31
TOTAL		121

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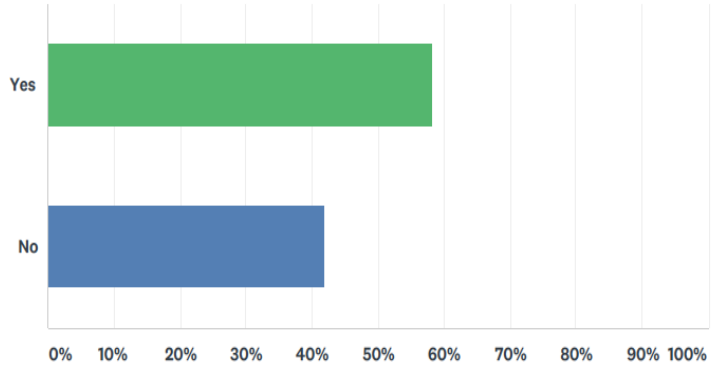
Survey respondents who are architects and contractor/builders:

Q3 Have you heard of sheep wool insulation as a product for residential insulation? Regardless of your answer, your responses are very important to us.

Answered: 62 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	58.06%	36
No	41.94%	26
TOTAL		62

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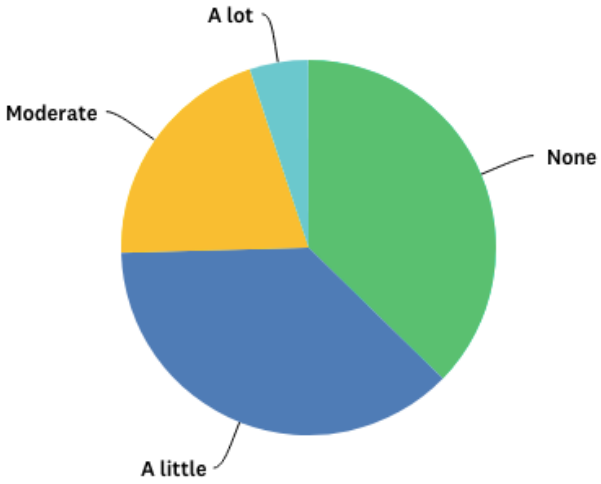
What is your level of knowledge of sheep wool as a material for residential insulation or for wall or ceiling panels?

Answered: 118 Skipped: 4



ANSWER CHOICES	RESPONSES	
None	37.29%	44
A little	37.29%	44
Moderate	20.34%	24
A lot	5.08%	6
TOTAL		118

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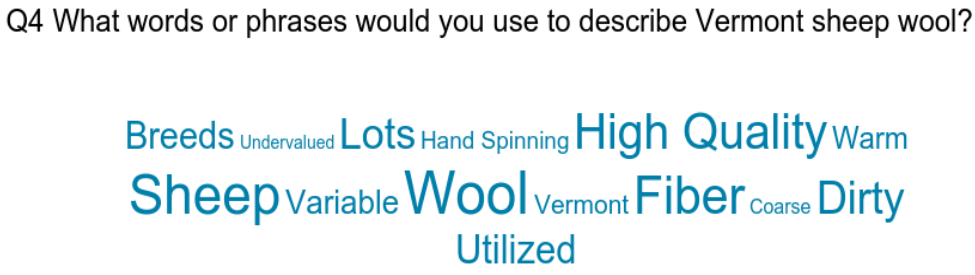
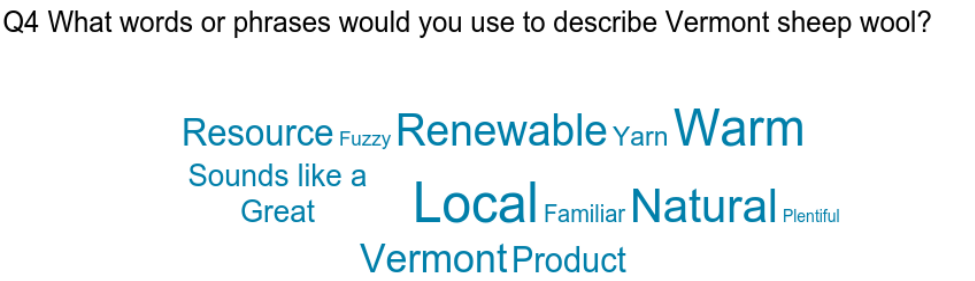
Word cloud for how wool is described by farmers:



Word cloud for how wool is described by builders and architects:



Word cloud for what farmers and processors like about wool:

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Word cloud for what architects and builders like about wool:

Q6 What are some things you could like about wool as a material to be used in homes?

Concerns that farmers and processors have about wool:

Q7 What are the things which potentially concern you in using wool as a material in homes?

Concerns that architects and builders have about wool:

Q7 What are the things which potentially concern you in using wool as a material in homes?

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Wool Attributes Table

Q9 Please rate the importance of wool as a material in terms of following product attributes:

Answered: 122 Skipped: 0

	NOT IMPORTANT	2	3	4	VERY IMPORTANT	TOTAL	WEIGHTED AVERAGE
Moisture properties - resistance and permeability	0.00% 0	2.50% 3	5.83% 7	21.67% 26	70.00% 84	120	4.59
Insulating performance - R Value	0.00% 0	1.65% 2	7.44% 9	23.14% 28	67.77% 82	121	4.57
Environmental impact	0.00% 0	0.00% 0	10.08% 12	24.37% 29	65.55% 78	119	4.55
Availability with local retailer or distributor	0.00% 0	0.83% 1	14.88% 18	42.15% 51	42.15% 51	121	4.26
Cost	0.00% 0	4.24% 5	15.25% 18	32.20% 38	48.31% 57	118	4.25
Locally produced in Vermont or NE region	2.46% 3	6.56% 8	14.75% 18	18.85% 23	57.38% 70	122	4.22
Ease of handling and installation	0.85% 1	4.24% 5	23.73% 28	49.15% 58	22.03% 26	118	3.87
Acoustic properties	4.96% 6	13.22% 16	28.93% 35	34.71% 42	18.18% 22	121	3.48
Aesthetics - color and texture	45.45% 55	19.01% 23	19.01% 23	8.26% 10	8.26% 10	121	2.15

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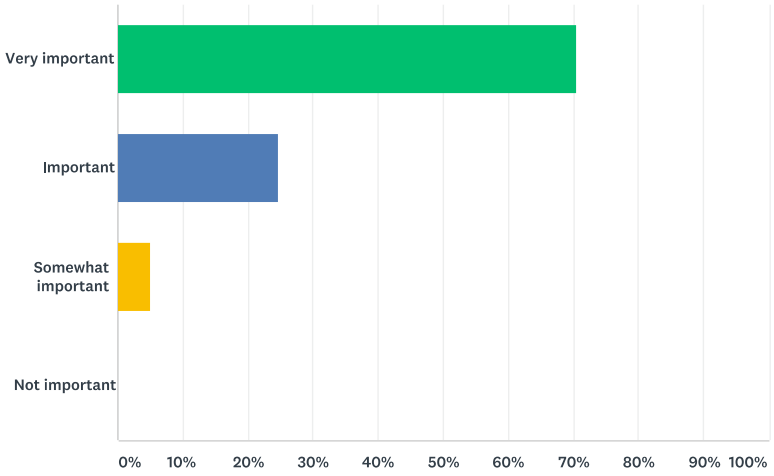
Q11 How important is choosing a renewable material over a non-renewable petroleum-derived material?

Answered: 61 Skipped: 1



ANSWER CHOICES	RESPONSES	
Very important	70.49%	43
Important	24.59%	15
Somewhat important	4.92%	3
Not important	0.00%	0
TOTAL		61

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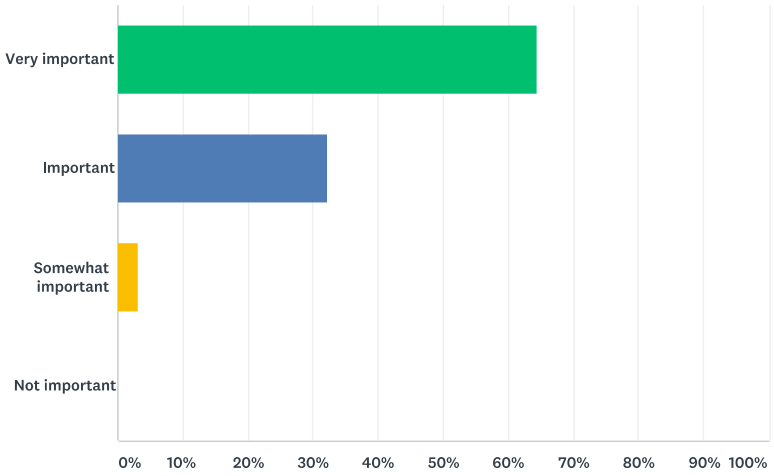
Q14 When selecting materials for residential buildings, how important do you consider the climate impact (i.e., global warming impact) pertaining to materials whose product or manufacturing process has high global warming potential?

Answered: 62 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very important	64.52%	40
Important	32.26%	20
Somewhat important	3.23%	2
Not important	0.00%	0
TOTAL		62

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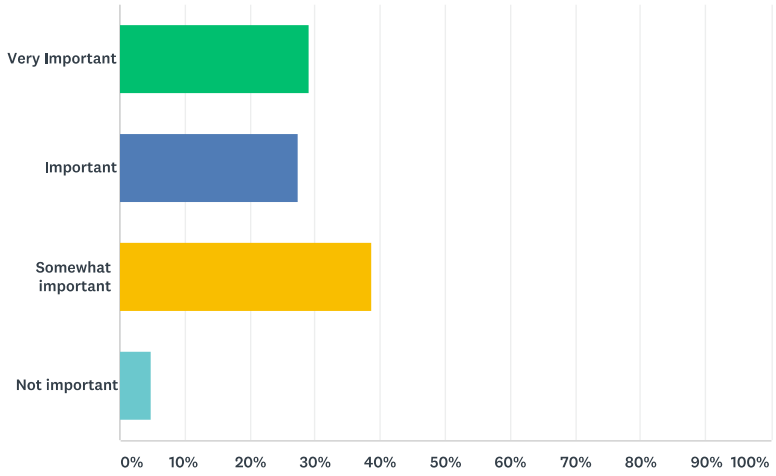
Q15 How important to you are standards and designated labels such as LEED Sustainable material?

Answered: 62 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very Important	29.03%	18
Important	27.42%	17
Somewhat important	38.71%	24
Not important	4.84%	3
TOTAL		62

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Trusted Sources word cloud:

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Appendix 2 – Tables, charts, and photos

Cellulose insulation products must be applied with fire retardants at 20-23% by weight. In contrast, sheep wool as a safe insulation product does not require such a high fraction of fire retardant additives because of the intrinsic fire resistance properties of wool.

Over the past 25 years, new processing technologies and advanced materials have improved cellulose-based insulation products as well as foam materials as well as creating many high-performance novel insulation products with organic and inorganic materials. The viability of a new natural wool insulation product needs to compete in this sphere.

Residential Insulation R-value and prices

Material	R/Inch	R-Value (3.5")	Price: $/ft2	Density: lb./ft3
Cellulose (dense pack)	3.65	13	0.5	1.02
Wool as manuf. tested	3.5	13		
Wool – as instructions	4	14	1.12	0.27
Wool – as installed	?	?	2.4	0.47
Rock Wool Batts (Roxul)	4.15	15	0.75	0.58
Fiberglass Batts	3.65	13	0.47	0.3
Fiberglass Loose Fill	4.15	15	0.46	0.44
Open Cell Spray Foam	3.7	13	1.9	0.5
Closed Cell Spray Foam	7	24.5	3	2.4

Reference: Brian Thompson, UVM and YesterMorrow Design/Build School Note: In a 6 ft. wall assembly, Black Mountain sheep wool insulation has been tested to achieve R-Value of 19 to 21 at a depth of 5.1 to 5.25 inches with a density of 0.39 lbs./sq. ft.

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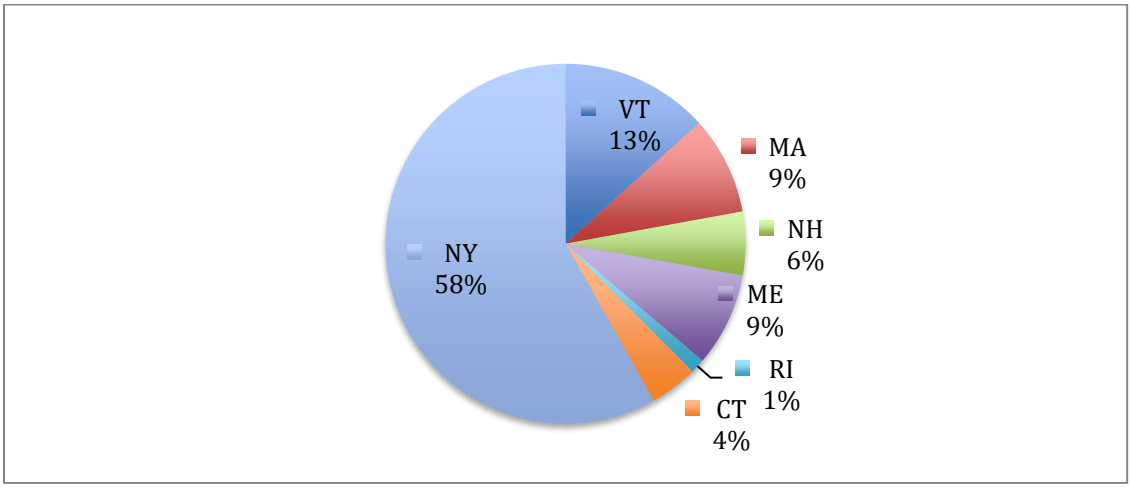
Number of Sheep and Proportion of Sheep in each State



USDA Agricultural Census for Sheep
New England states + New York state

	Number of Sheep				Growth %	No. of Farms		Growth %
	1997	2002	2007	2012	'07 – 12	2007	2012	'07 – 12
VT	16,589	14,743	13,925	18,803	35%	626	793	27%
MA	9,881	9,592	11,787	12,504	6%	734	776	6%
NH	8,237	7,423	7,671	8,079	5%	531	618	16%
ME	11,888	9,353	10,918	11,925	9%	647	759	17%
RI	1,331	1,422	1,459	1,823	25%	107	122	14%
CT	5,938	5,581	5,767	6,093	6%	399	498	25%
NY	69,248	83,630	63,182	82,286	30%	1,799	2,017	12%
Total	125,109	131,744	114,709	**141,513**	**23%**	**4,843**	**5,583**	**15%**

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Wool Production lbs.			Wool Value $1,000				
2007	2012	Growth %	2012	Avg $/lb	6 lbs./wool on avg	Estimated Capture rate	Wastage
81,167	101,330	25%	66,000	$0.65	112,818	89.8%	10.2%
63,971	70,127	10%	49,000	$0.70	75,024	93.5%	6.5%
42,351	40,465	-4%	27,000	$0.67	48,474	83.5%	16.5%
66,838	62,856	-6%	44,000	$0.70	71,550	87.8%	12.2%
5,797	7,699	33%	4,000	$0.52	10,938	70.4%	29.6%
28,972	26,864	-7%	19,000	$0.71	36,558	73.5%	26.5%
319,144	303,277	-5%	197,000	$0.65	493,716	61.4%	38.6%

Flyer for 2018 Southern Adirondacks Fiber Producers Wool Pool:

Washington County Fairgrounds, State Rte 29, Greenwich, NY
Farms with large lots (1000 lbs+), please bring your fiber on June 1

2016, 2017, and 2018 shearing only!

For more information about the Southern Adirondack Fiber Producers Cooperative, contact: Ashley Bridge asomesbridge@gmail.com, 518-415-2801 (cell)

Again this year, the coop is planning to have a unique Southern Adirondack blanket made using just the wool collected from producers at the pool. The machine-knitted blanket will be a generous throw size with one or more patterns such as cables or basket stitch. Your cost will depend on the total number of blankets ordered, but will be around $100 each + 10 lbs. of wool/blanket. Suggested retail is $250. Sample blanket will be available at wool pool. We need to have orders for at least 25 blankets to proceed with the project.

Join us on Instagram @soadkfiberproducers to see blanket and more.

We are still awaiting prices from the same large national wool buyer that has bought our pool in the last several years. We are confident that we will get the highest price possible for wool even though wool prices in general across the US right remain as low or lower than last year. At least the buyer has agreed to pay the freight costs for our wool (which is about a $.15/lb value).

We will be accepting five classes of grease wool:

- Clean white medium and fine wool (at least 2-1/2" in length)
- Clean white longwool and other coarse wool
- White offsorts (including short and dirty fiber, head and belly wool, etc.)
- Natural color medium and fine wool
- Natural color longwool and other coarse wool

This event will be run as a traditional wool pool - all sellers must plan to unload their own vehicle, assist in weighing and filling the baler, etc. If you can't participate, then a $25/hr handling fee will be charged.

Fees: : $15/farm - annual cooperative dues fee will go toward the cost of pool administration (including wool sacks, tax return preparation, incorporation fees, insurance, rental of the Fairgrounds, and other);

- $5/farm - dues for farms with 50 lbs or less;
- 4H youth members – no charge.

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Oregon Shepherd Sheep wool insulation delivered by box

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