WOOLMARK

WOOL: A NATURAL SOLUTION

CONTENTS

WOOLMARK

Having been at the centre of the wool industry for nearly 90 years, Woolmark has always taken a collaborative approach to advancing wool innovation and championing quality, long-lived products.

As a not-for-profit organisation, we focus on both on- and off-farm research and marketing along with the certification of wool quality.

Our Purpose

A BETTER TOMORROW

We are committed to bettering the lives of all those involved in the wool industry, from farmers and sheep to manufacturers, through to retailers and consumers.

INNOVATIVE BY NATURE

We drive a sustainable culture of innovation to deliver tangible solutions to research, development and marketing across the global wool industry.

SLOW FIBRE FOR SLOW FASHION

As one of the world's most well-known brands, the Woolmark logo promises uncompromising quality for natural, long-lasting, recyclable products.

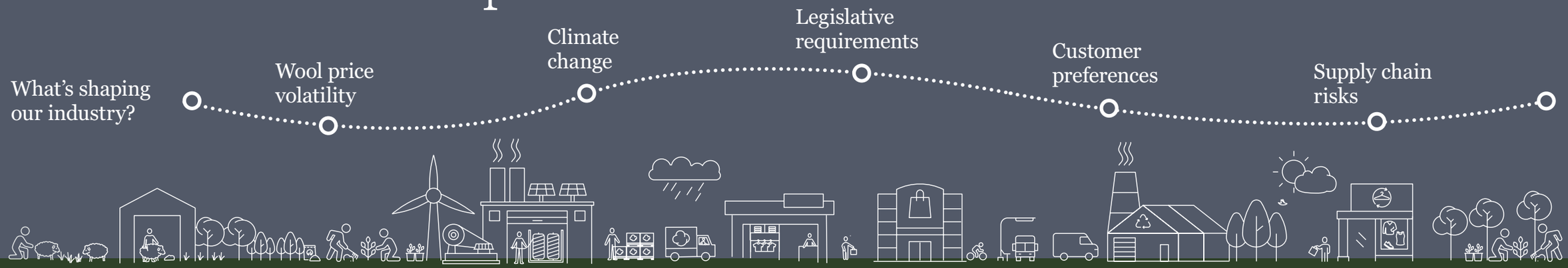
SUSTAINABLE DEVELOPMENT AND THE TEXTILE INDUSTRY

Through Woolmark+, we are bringing a new dimension to our partnerships with woolgrowers, supply chain, brands and consumers through this journey towards a nature positive industry.

The global fashion industry is at a critical juncture, facing increasing pressure to adopt more sustainable practices. Meaningful progress has been slow, despite more than 15 years of dialogue and pledges from brands. Governments worldwide are now stepping in, introducing new legislation to reduce waste, greenhouse gas emissions and chemical usage in the textile industry. These pressures are demanding that brands and manufacturers rethink their materials strategies and choose fibres that are less impactful on the environment.

As a response, Woolmark has developed its Woolmark+ roadmap.

Woolmark+ Roadmap



Our stakeholder needs

- Investment and financial stability
- Affordable and simplified measurement and reporting tools
- Traceable and certified materials
- Emissions reduction solutions

What are the opportunities for wool?

1. Regenerating nature
2. Emissions reduction
3. Transparency and traceability
4. Advancing circularity
5. Collaborative investment

Woolmark+ focus area

Woolmark+ initiatives

Accelerate nature positive production

- Woolmark+ Insetting Program
- Woolmark+ Impact Program
- Nature Positive Farming framework
- Reducing methane emissions
- Carbon Storage Partnership
- Enhance sheep productivity and profitability

Deliver the circular fibre of choice

- Woolmark quality assurance program
- Woolmark Recycled Specification
- Removing chemicals of concern

Support thriving flocks and communities

- Traceable wool production
- New environmentally-friendly pest and disease management solutions
- Supporting woolgrowers to manage flystrike and those seeking to transition away from mulesing
- Enhancing ewe and lamb wellbeing

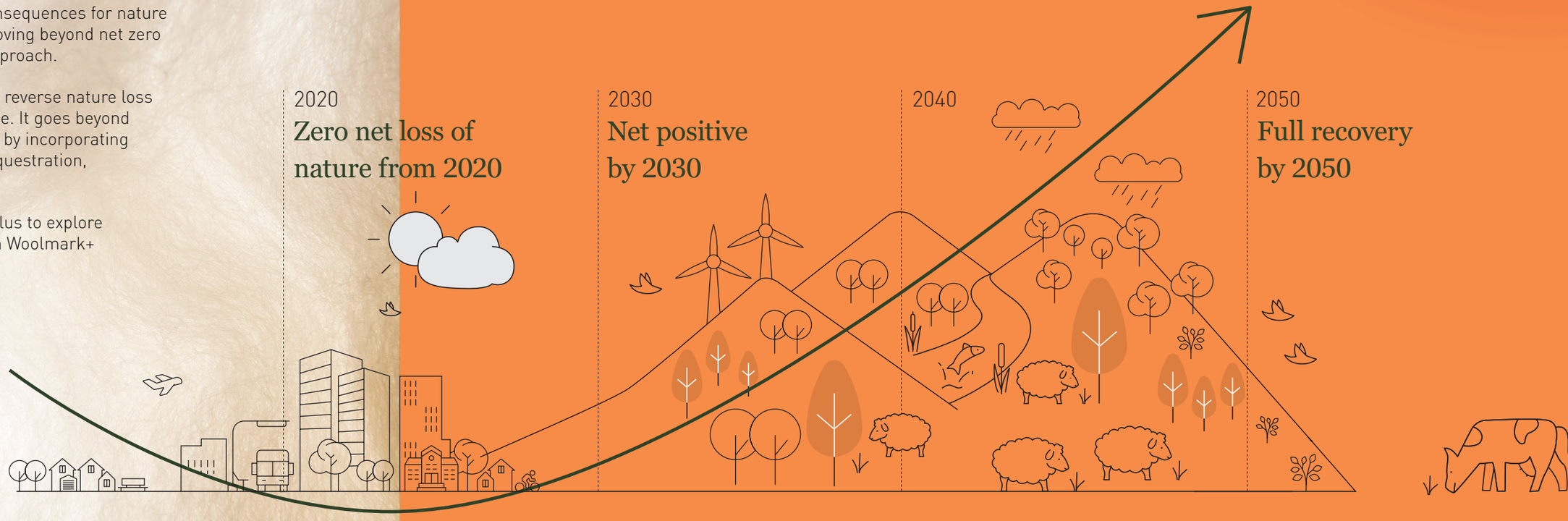
Looking beyond net zero to nature positive

While the focus on net zero has dominated climate discussions, it often overlooks broader environmental and social impacts. At a time when carbon tunnel vision is causing unintended consequences for nature and livelihoods, Woolmark is moving beyond net zero to embrace a nature-positive approach.

Nature positive aims to halt and reverse nature loss by 2030, using 2020 as a baseline. It goes beyond simply reducing GHG emissions by incorporating biodiversity recovery, carbon sequestration, and livelihood improvements.

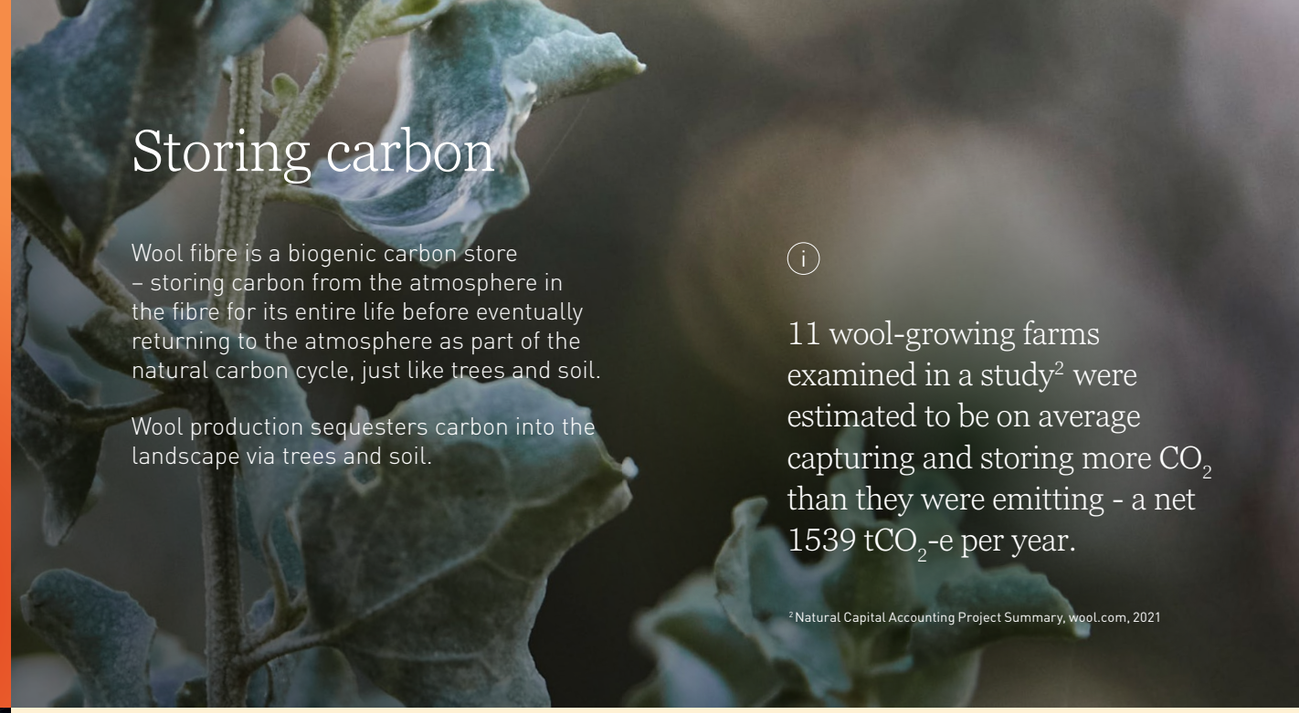
Visit woolmark.com/woolmarkplus to explore the 13 practical initiatives within Woolmark+

LEARN MORE HERE



From nature for nature

Wool is a natural, renewable, biodegradable and recyclable fibre and commonly refers to those fibres produced by sheep. However, not all wool is the same. There are more than 1000 breeds of sheep across the world which produce different types of wool, used for various purposes.



Storing carbon

Wool fibre is a biogenic carbon store – storing carbon from the atmosphere in the fibre for its entire life before eventually returning to the atmosphere as part of the natural carbon cycle, just like trees and soil.

Wool production sequesters carbon into the landscape via trees and soil.

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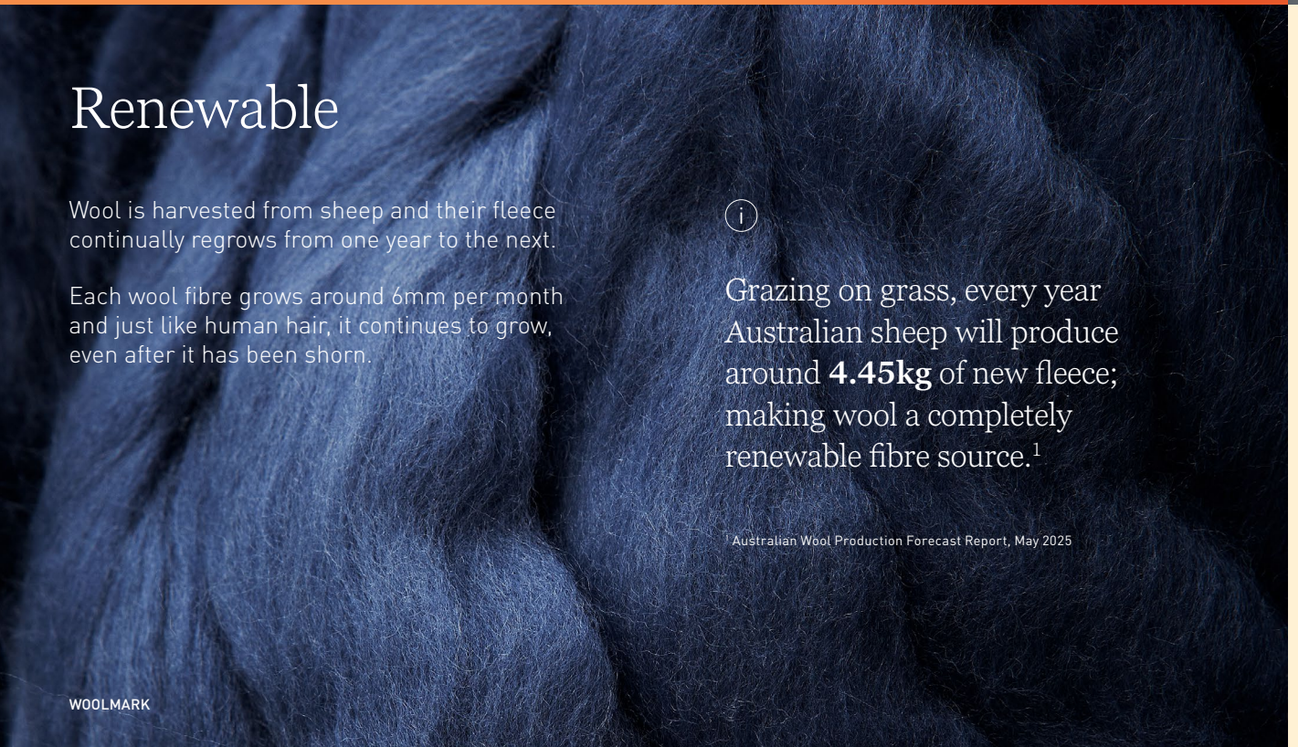
11 wool-growing farms examined in a study[2] were estimated to be on average capturing and storing more CO_2 than they were emitting - a net 1539 tCO_2-e per year.

[2] Natural Capital Accounting Project Summary, wool.com, 2021



Renewable

Wool is harvested from sheep and their fleece continually regrows from one year to the next.

Each wool fibre grows around 6mm per month and just like human hair, it continues to grow, even after it has been shorn.

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Grazing on grass, every year Australian sheep will produce around **4.45kg** of new fleece; making wool a completely renewable fibre source.[1]

[1] Australian Wool Production Forecast Report, May 2025

Building natural capital

With careful grazing management, sheep build natural capital by improving ground cover, soil health and biodiversity. Rotational grazing manures the soil, adding biota and increasing the presence of deep rooted perennials, which in turn improve mineral cycling and soil ecosystems.

Wool sheep often graze land unsuited to other forms of agriculture, providing opportunities to support the functioning of these landscapes.

Woolmark actively investigated the use of Natural Capital Accounting across 11 Australian wool-growing properties. The project[2] sought to objectively measure each enterprise's environmental credentials including soil, water, diversity of life and vegetation and their contribution to financial performance.

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89% of Australian woolgrowers are following multiple practices to boost soil health.[3]

[3] AWI Wool Industry Profile, May 2020

WOOL'S **UNIQUE BENEFITS**

Wool is much more complex than any of the synthetic fibres and most other natural fibres. It is this complexity that provides wool with the unique set of benefits which cannot be matched by any other fibre – natural or man-made.

Known for its superior softness, Merino wool is eagerly sought by the world's textile trade.

Lower impact garments

Wool garments are worn for longer and washed less often compared with synthetic fibre garments, and therefore are expected to have less impact on the environment during the use phase of their lifecycle.[4]

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Wool garments have the lowest water and energy use per wear.[4]

Biodegradable

As a natural fibre, wool biodegrades on land and in water.

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100% Merino wool fabrics can biodegrade by 95% after 15 weeks of burial in soil, but the rate varies with soil, climate and wool characteristics.[5]

Wool fibres also biodegrade in a marine environment and do not contribute to microplastic pollution. Research has shown that the Chlorine-Hercosett anti-shrink treatment applied to wool (which enables wool garments to be machine washable) can accelerate biodegradation.[6]

Recycled and recyclable

Wool is the most recycled apparel fibre in the world,[7] supported by a well-established and commercially viable recycling industry.

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Wool garments are **3 times more likely** to be donated compared to garments of other major fibre types.[8]

[4] Global Wardrobe Study, The Woolmark Company x Nielsen, 2018

[5] Hodgson A, Leighs SJ, van Koten C. Compostability of wool textiles by soil burial. Textile Research Journal. 2023;93(15-16):3692-3702. doi:10.1177/00405175231163590

[6] Collie, S., Brorens, P., Hassan, M.M et al. Biodegradation behavior of wool and other textile fibers in aerobic composting conditions. Int. J. Environ. Sci. Technol. (2024). Collie, S., Brorens, P., Hassan, M.M. et al. Marine Biodegradation Behavior of Wool and Other Textile Fibers. Water Air Soil Pollut 235, 283 (2024).

[7] Russell, S., Swan, P., Trebowicz, M., Ireland, A. (2016). Review of Wool Recycling and Reuse. In: Fangueiro, R., Rana, S. (eds) Natural Fibres: Advances in Science and Technology Towards Industrial Applications. RILEM Bookseries, vol 12. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-7515-1_33

[8] Russell, S., Swan, P., Trebowicz, M., Ireland, A. (2016). Review of Wool Recycling and Reuse. In: Fangueiro, R., Rana, S. (eds) Natural Fibres: Advances in Science and Technology Towards Industrial Applications. RILEM Bookseries, vol 12. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-7515-1_33

MEASURING WOOL'S ENVIRONMENTAL FOOTPRINT

Wool's environmental footprint is a key focus as sustainability gains global attention. The wool industry invests heavily in science-based assessments, primarily using Life Cycle Assessment (LCA). However, LCA has limitations, particularly for natural fibres like wool.

SKEWED RATINGS SCORES

Wool is natural, renewable, biodegradable, and recyclable, yet it often scores poorly in tools like Higg MSI and EU's Product Environmental Footprint (PEF). This is due to flaws in LCA methodologies, environmental rating tools, and inconsistent data collection. Brands need to understand these limitations when using LCA-based tools to assess wool. The wool industry is actively working to improve wool's LCA dataset and engaging with LCA rating systems (like the EU's PEF) to refine methodologies and ensure more accurate comparisons between fibre types. We invest in peer-reviewed research, provide third-party verified data, and engage with organisations like Cascale and the EU to address biases in tools like the Higg MSI and PEF.

WOOL INDUSTRY LEADERSHIP

Wool led the way with the first peer reviewed and published cradle-to-grave LCA for a textile fibre. The industry continues to invest in reducing and removing on-farm emissions, better garment care, and end-of-life solutions. This LCA allowed the industry to develop strategies and invest in research and programs to improve wool's environmental footprint at the on-farm stage.

THE RISKS OF OVERSIMPLIFIED TOOLS

LCA tools are widely used but often oversimplify environmental impacts and overlook environmental 'good' such as biodegradability, renewability and circularity. They can lead to poor choices - like favouring synthetics - that don't actually benefit sustainability. Real impact comes from improving practices within the existing supply chain.

ACCESS FREE, VERIFIED DATA

Woolmark offers free, third-party verified wool LCA data. Ongoing investment improves data quality and methodology. Use these resources to make science-backed decisions.

lca.wool.com

The social, animal and environmental impact of wool-growing

Wool grown across the world can vary from small to large free-range farms in different environments, leading to differences in production.

Regardless of location and size, adopting sustainable management practices helps woolgrowers journey towards a nature positive future. All sheep are healthy and well cared for in accordance with the Five Domains of Animal Welfare.

The following key areas detail the environmental and social impacts of wool-growing, on animals, people and planet.

Supporting rural livelihoods

Many remote, rural and regional communities continue to be supported by Australian wool-growing, with more than 80,000 Australian woolgrowers and many tens of thousands more working in the industry. No other country has such an efficient, transparent and highly developed wool marketing system; a trained and registered workforce of more than 16,000 wool classers who prepare wool for the world's processors; and objective laboratory test results attached to almost every bale of Merino wool exported.

Education

Research and education have been fundamental to the Australian wool industry since the 1930s. The industry provides numerous training, education and leadership opportunities for Australian woolgrowers. These programs include environmental management, business management and practical animal husbandry courses, leadership programs as well as secondary and tertiary education programs for rural and remote students. The industry also provides free training for novice, improver and advanced shearers and wool handlers through regional coaching programs across Australia. Since 2015, we have facilitated more than 11,000 shearer and wool handler training days, delivered through Woolmark-funded programs.

Animal health and welfare

1. NUTRITION

Sheep need a balanced diet containing energy (fat and carbohydrates), protein, vitamins, minerals and water and gain these nutrients predominantly by grazing pastures. Woolgrowers supplement their sheep's diet – depending on life stage or season – when necessary to ensure optimal nutrition.

2. CHEMICAL USE

Veterinary-registered medication may be administered to sheep for the treatment of external and internal parasites as either a spray or oral application. Minimum withholding periods are specified for wool to avoid coming into contact with these chemicals. In Australia, the Australian Wool Testing Authority independently tests wool for chemical residue.

3. FLYSTRIKE

Flystrike is a condition where blowflies lay eggs on sheep, particularly around the hindquarters (the breech area) and tail. The hatched larvae (maggots) bury themselves in and under the sheep's wool and feed on the sheep's flesh, causing pain, distress, infection and potentially, death. Australia's climate, with warm temperatures and rainfall, creates ideal conditions for the Australian sheep blowfly *(Lucilia cuprina)*, which is responsible for more than 90% of flystrike cases.

Flystrike can be controlled by a range on animal husbandry practices, including regular shearing of wool around the breech (known as crutching), mulesing, breeding sheep to be less susceptible to flystrike, careful selection of less flystrike-prone paddocks, and applying appropriate insecticide treatments.

Extension programs to support woolgrowers to manage flystrike and reduce reliance on mulesing are offered, along with developing a framework to support woolgrowers seeking to transition away from mulesing.

4. MULESING

Australia is now the largest exporter of non-mulesed Merino (<24.5 micron) wool. However, the mulesing procedure is still necessary for some Merino sheep. Mulesing is a one-off surgical procedure to protect sheep from breech flystrike, removing excess skin from the breech of the sheep. More than 90% of woolgrowers who mules report they use anaesthesia and/or analgesia.

5. SHEARING

A key responsibility in caring for healthy and happy sheep involves harvesting their fleece. Shearing is necessary for the health of sheep and if it's not done, the fleece can become overgrown and impact the animals. Shearing is the process of removing the fleece, which is just like getting a haircut as the wool grows right back. It's for this reason that wool is truly renewable and is one of the fibre's many natural benefits.

Environmental health

Biodiversity

For Australian woolgrowers, biodiversity and natural resource management are vital to business success. Their long-standing commitment to ecological balance allows them to protect the environment while achieving strong economic outcomes. Key practices include rotational grazing on natural pastures, protecting and enhancing natural vegetation, maintaining ground cover through minimal tillage, and safeguarding water resources by protecting dams, riparian zones, and conserving wetlands.

ⓘ

73%

of Australian sheep producers undertake deliberate activities to maintain, measure or enhance biodiversity on their property.

Sheep Sustainability Framework, National Producer Survey 2024.

Looking to measure the environmental performance of wool farms?

The Woolmark+ Nature Positive Farming Framework provides science-based, practical metrics to assess and report environmental outcomes on wool farms. This ensures that environmental performance claims are underpinned by credible evidence, delivering clarity and confidence to woolgrowers, brands, and consumers.

The Nature Positive Farming Framework sets the stage for brands to unlock significant benefits as the program evolves, including showcasing environmental credentials, environmentally-focussed sourcing, efficient reporting, and more.

LEARN MORE HERE

Environmental health (continued)

Grazing

Sheep raised for wool are typically grazed on rangelands best suited for livestock, playing a vital role in grassland ecosystems by supporting nutrient cycles and vegetation regeneration. Woolgrowers actively manage grazing to prevent overgrazing and maintain land health. Many adopt regenerative farming practices, such as rotational grazing, to holistically manage their properties and promote healthy ecosystem functioning.

Environmental health (continued)

Methane emissions

Biogenic methane from sheep is a major contributor to on-farm GHG emissions, breaking down into CO_2 after about 12 years and being recycled by plant photosynthesis. Despite being part of the natural carbon cycle, the impact of methane is accounted for in the same way as carbon dioxide. Once released in the atmosphere, CO_2 remains in the atmosphere for centuries. The Australian wool industry is focused on reducing both total emissions and emissions intensity, with increased flock productivity helping to lower emissions while improving financial outcomes. Research into innovative solutions, including anti-methanogenic feed additives, and low methane genetics is underway to further mitigate enteric methane. Learn how Australian woolgrowers are reducing emissions and mitigating methane, here.

Looking to reduce your business' scope 3 emissions?

Brands are invited to join our ground-breaking Woolmark+ program, aimed at enabling emissions reductions within the textile supply chain.

The Woolmark+ Australian Wool Insetting Program connects fashion and textile brands directly with woolgrowers to drive emissions reductions within the industry. By leveraging climate and nature-based solutions on-farm, we're keeping sustainability rooted in fashion and textiles.

LEARN MORE HERE

Wool and the carbon cycle

Wool forms a part of the natural carbon cycle.

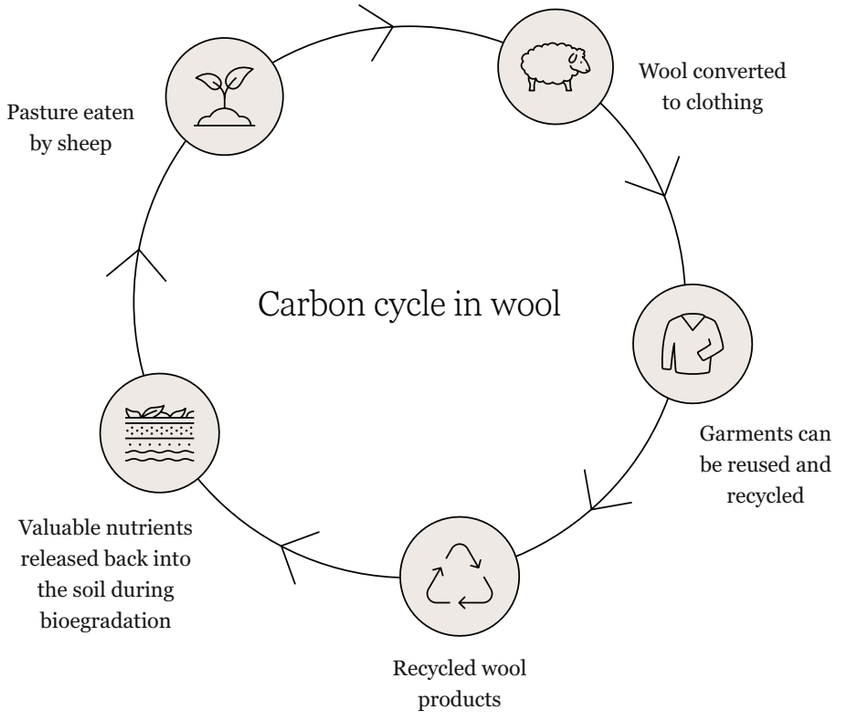
Wool is part of the natural carbon cycle - in fact, wool is made from atmospheric carbon. Carbon is a vital building block for life and for many of the products we use every day. Many textiles and fibres are made from carbon-based products, but only some, such as wool, are made from atmospheric carbon. By comparison, the carbon in the major synthetic apparel fibres is extracted from fossil fuels, in which the carbon was safely locked away and stored underground millions of years ago.

As a short-term store of atmospheric carbon, wool sequesters carbon for as long as it's kept in use. The carbon dioxide (CO_2) is removed from the atmosphere for the fibre's life – from when it is used by the grass during growth, to when it is converted into wool on the sheep, through to the use phase – until it is disposed of and biodegrades. By storing the greenhouse gas carbon dioxide (CO_2), wool prevents this stored gas from contributing to climate change for the entire life of the fibre – a period that is often extended because wool is highly desired for recycling.

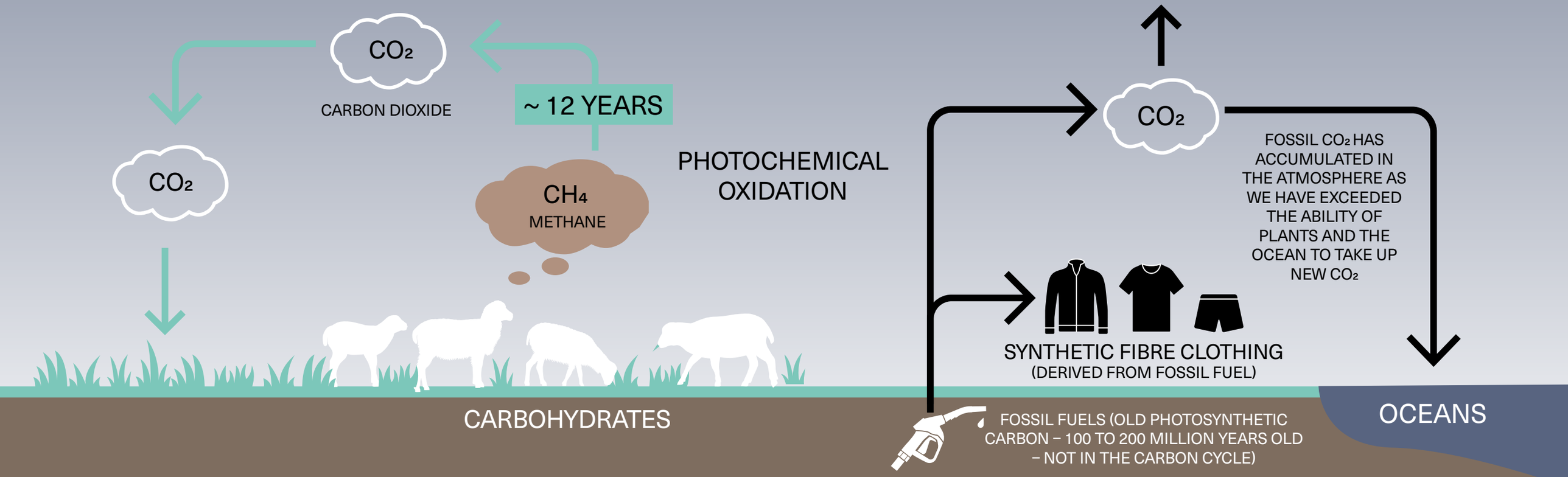
But sheep also belch, emitting methane. Yet this carbon only stays in the atmosphere for about 12 years, compared to fossil carbon, which is new to the atmosphere and can exist for up to 1000 years.[9] Methane from fossil fuel, however, is pulled from the earth's crust, is new to the atmosphere and is a large contributor to global warming.

[9] https://science.nasa.gov/earth/climate-change/greenhouse-gases/the-atmosphere getting-a-handle-on carbon-dioxide/

LEARN MORE HERE



Photosynthesis in the natural carbon cycle



WOOL
MANUFACTURING

The wool manufacturing process

1. SHEARING

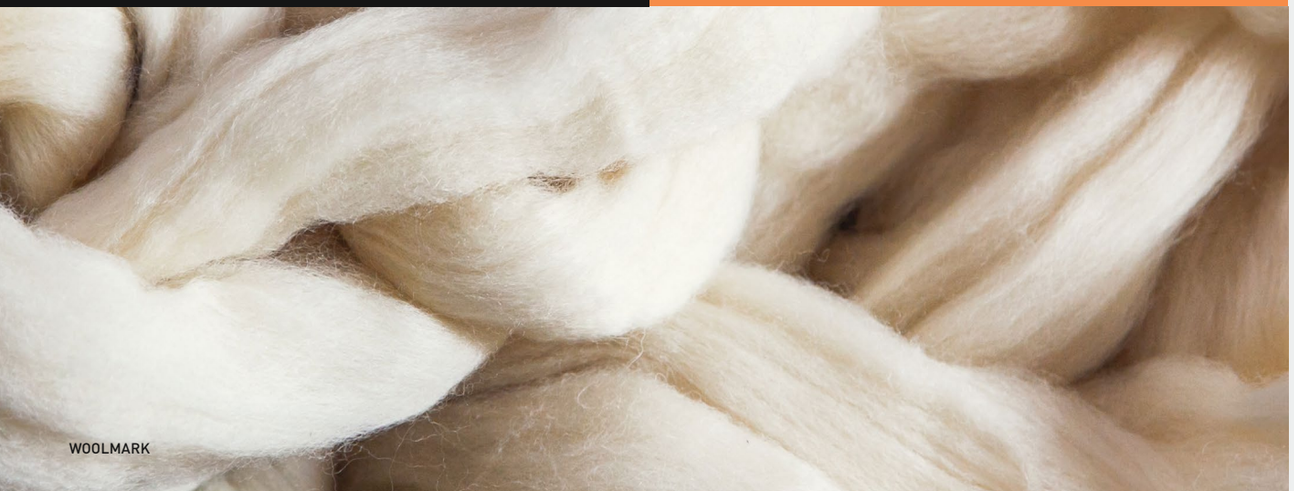
A key responsibility in caring for healthy and happy sheep involves shearing their fleece. If not done, the fleece can become overgrown and impact the animals. Once the greasy/raw wool is harvested, it is classed (graded) based on fibre diameter, plant matter, staple strength, staple length, colour and potential yield.

2. SCOURING

Before wool can be processed to yarn, it must be washed (scoured) to remove the bulk of contaminants (dirt, sweat and plant matter). Wool is passed through a series of bowls containing water and detergent. Excess dirty water is squeezed from the fibre before several rinses. After drying, the wool is conditioned and ready for the next processing stage.

3. CARDING

This removes knots and tangles from clean wool by gently teasing them apart using wire-covered rollers. This removes vegetable matter contaminants as much as possible. Yarn can then be made using one of two main processes: woollen or worsted. In the woollen process, the wool leaves the card as slubbing ready for spinning. The worsted process sees the wool leave as a continuous length of card sliver.



4. GILLING *for worsted*

The card sliver needs to be 'gilled' to straighten the fibres. This is done by pulling the fibres through metal pins, similar to combing wet hair. Card sliver is commonly gilled about five times before moving onto the comb.

5. COMBING/TOP-MAKING *for worsted*

The combing process removes plant matter, tangled and short fibres (noil). After combing, the sliver is re-gilled two to three times. The sliver is now known as 'top'.

6. DRAWING *for worsted*

Before the newly-formed top can enter the spinning stage, it must be made some 40 times thinner by drawing it down into a fine sliver, called a roving.

7. SPINNING

During spinning, twist is inserted into the relatively weak roving/slubbing which binds the fibres closer together. This increases inter-fibre friction and gives strength to the yarn. Yarns can also be twisted together to further increase strength.

8. DYEING

Colour is applied and fully absorbed into the wool fibre by dyeing in hot water. This process can be carried out at almost any stage from loose wool, top, yarn, fabric and even at the garment stage. Wool naturally takes and holds dye very well.

9. KNITTING

Knitting is a fabric-forming process that uses interlocking loops of yarns to create textile structures. It can produce fabric to be cut and sewn, or shaped panels and complete garments. The process is commonly carried out using computer-controlled machines that manage loop formation with precision.

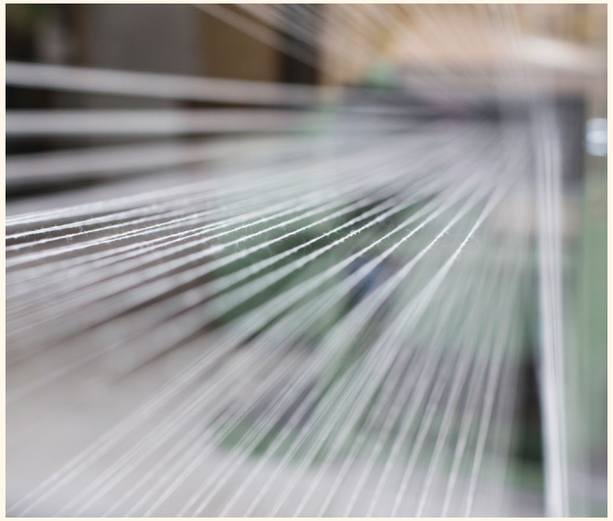
10. WEAVING

Weaving is the process of interlacing warp and weft yarns to form fabric. It is commonly used to create textiles for apparel and interior design through a process that uses simple frames or more advanced weaving machines that are computer-controlled for precision.

11. FINISHING

Wool fabrics and garments are finished by washing, to clean and soften. Drying and pressing removes creases and stabilises the fibre, ready to be made into garments or end-products during making-up and sewing.

Innovations reducing environmental impacts in wool manufacturing



Early-Stage Processing

SIROLAN SWIMS TECHNOLOGY

A three-stage process that turns waste by-products of wool scouring into valuable products, Sirolan SWIMS technology can create products from waste materials, including lanolin, suint and sludge. Lanolin is a natural waxy substance secreted by the sebaceous glands of sheep to protect their wool and skin, acting as a natural water repellent, and can be used in industrial applications, textile treatments and skincare products. Suint can be used as fertiliser, while sludge contains dirt, salts, some wool wax that can be mixed with green waste to form compost.

Reducing production waste

Performance Treatments

ECO AND ERA YARN RANGES

The wool used to make ECO and ERA yarns, developed by Xinao, has been specially treated with shrink proofing processes that do not require the use of chlorine.

Made from 100% Extrafine Merino wool yarns (19.5µ) for flatbed knitting, the ECO yarn range is treated with the CF-1 process, involving the activation of a peroxy compound which releases oxygen and does not involve the use of chlorine or other halogens in the process. This means that no Absorbable Organic Halogen (AOX) compounds are formed or disposed of in the effluent from the process.

The ERA yarn range is made from 100% Extrafine Merino wool yarn (19.5µ) for flatbed knitting and has been specially treated with the CF-2 process based on proteolysis, which does not involve the use of chlorine or other halogens, which results in no Absorbable Organic Halogen (AOX) compounds formed or disposed of in the effluent process.

Reducing chemical waste

NATURETEXX® PLASMA WOOL TREATMENT

Developed by Südwolle Group, this process involves carefully prepared wool passing through a plasma field. Electrons and ions in the plasma interact with the wool fibre to alter the friction profile of the fibre surface. This reduces the normal felting effect of untreated wool and makes it machine washable.

Reducing chemical waste

Reducing waste water

JEANOLOGIA WOOLUP

This process treats product in the garment state, using an ozone treatment that modifies the surface of the wool fibres. It degrades the tips of the scales to smooth the fibres, allowing them to slide against each other without interlocking. This prevents felting and shrinking. The WoolUp process can be used to treat worsted and woollen apparel (100% wool and wool blends).

Energy efficient

Less complex

More accessible

Dyeing and Printing

NATURAL COLOURATION

Natural dyes are extracted from natural materials such as plants, minerals, shells and insects. There are two types of natural dyes including adjective dyes which require a mordant (dye fixative) and substantive dyes which exhaust and fix on the fibres without the use of a mordant.

Natural dyes are not chrome-based and have a number of benefits including renewability and reduced wastewater effluent. As a protein fibre, wool has an affinity for natural dyes for colour-rich results.

Plant-based natural dyes include woad, indigo, saffron and madder. Invertebrate natural dyes include Tyrian purple, cochineal and crimson kermes. Other naturally occurring dyestuff alternatives include bacteria derived from dyestuff and bi-product dyes from origins like food waste.

Tintoria di Quaregna

Woolmark licensee, Tintoria di Quaregna, has created a natural dyeing process called NATURALE® that uses 212 different plants, herbs, roots, flowers and tree bark sourced from across the world. Colours range from delicate pastels to dark blue and black, with no chemicals, additives, dye powders or extracts used in dyeing.

Reducing chemical waste

Reducing waste water

BioDye

Woolmark partner, BioDye, is a dyehouse in India that uses 100% natural dyes and biodegradable ingredients to colour wool yarn and fabrics. Using non-toxic mordants, or dye fixatives, BioDye's natural dyes give the full spectrum of colour. Dye-yielding plants can be used to re-vegetate degraded forests and provide income to rural women collecting chromogenic leaves. The solid waste is used as fertiliser and the treated wastewater meets parameters for irrigation.

Reducing production waste

Toyoshima | Food Textile

Woolmark licensee Toyoshima | Food Textile, uses a specialised technique that extracts natural pigments from food waste. This process repurposes raw food ingredients, such as vegetables, to create dyes for fibres, yarns, and fabrics. By carefully extracting colour components, FOOD TEXTILE can produce multiple shades from a single food ingredient.

Reducing production waste

WATERLESS DYEING

COLOURizd™ QuantumCOLOUR™

COLOURizd™ QuantumCOLOUR™ for yarn is a waterless dyeing process that injects pigment and a binder into a yarn fibre bundle to create coloured yarns. COLOURizd™ yarns can be used for knitted and woven fabrics, while minimising the need for water consumption, energy usage and waste. This method can replace traditional fibre reactive dyeing, indigo dyeing, or pigment dyeing in many cases, and allows for a wide range of colours and textures.

With guidance from Woolmark's technical team, the technology was successfully validated on 100% Merino wool, as well as blends with cotton, TENCEL™ and nylon, on a range of yarn counts from 30/2NM to 80/1NM. This broad trial on wool yarn types showcases the improvement of pigment colour performance by way of of COLOURizd™ QuantumCOLOUR™ while maintaining excellent yarn quality.

Reducing waste water

Energy efficient

DIGITAL PRINTING

Digital printing is quick and personalised, using direct-to-fabric machines that minimise investment in screens, print tables and additional washing equipment. Colour dyes are applied simultaneously in varying concentrations to a prepared fabric surface through inkjet technology, producing a printed fabric.

Multiple water soluble colour dyes are applied to a specially prepared fabric surface, and a customised piezoelectric inkjet head travels back and forth across the fabric to distribute the dye, instructed by a rasterised digital file embedded with colour management.

This colour management works within the method of "controlled bleeding" under a strict chemical environment leading to "chemical bonding" of dyes to the fabric. Chemicals and water usage are significantly reduced when choosing digital printing, and inks can be recycled.

Reducing waste water

Textile Production

OPTIM™ TECHNOLOGY

Optim™ fibre stretching technology was developed in a collaboration between Nanshan Group and Woolmark, to create a water-resistant fabric made of 100% Merino wool or wool blends. Optim™ technology pre-stretches the Merino wool fibre and spins it before weaving at a very high level of thread density in warp and weft. The fabric is then wet finished, which releases the stretch, causing the yarns to contract to an extreme tightening of the fabric structure. This creates an immensely dense fabric which can resist water without using fluoro-chemicals. This reduces reliance on synthetic coatings and chemicals, offering a natural alternative for water resistance.

Reducing chemical waste

WHOLEGARMENT® KNITTING: SHIMA SEIKI

The Wholegarment® knitting machine by Shima Seiki can manufacture knitted garments without waste and tailored garments to order. This technology extends the range of options for using Merino wool in structured or unstructured casual wear and sportswear, creating a complete garment with no seams. The Wholegarment® knitting machine uses four flat needle beds to create garments from the bottom up. The equipment knits a garment in a single piece with no further cutting or sewing necessary, meaning that the final product can be picked up from the machine and be ready to wear with minimal finishing. This knitting process generates less waste, enhanced comfort and the option for integrating different structures such as pointelle which enhances breathability and moisture management due to its open, mesh-like structure.

Reducing production waste

SEAMLESS KNITWEAR: SANTONI

Santoni's seamless circular knitting machine creates knitted structures that form compression and contour areas within a garment, as well as possibilities for patterns, jacquards, ribbing and detailing for both fashion and activewear garments. Seamless knitting technology is unique in its ability to combine different patterns and knit stitches into a single piece of fabric. The technology can engineer a garment to have features such as compression and breathability points on a single surface, encouraging greater structure diversity and comfort as well as enhanced protection when compared with seamed garments. From footwear to high-end fashion or medical shapewear, seamless knitting technology is evolving in its applications. Unlike cut-and-sew manufacturing, garments created on circular seamless machines require minimal finishing to complete the knitwear. This process minimises material waste by eliminating cutting, sewing, and assembling separate fabric pieces.

Reducing production waste

Energy efficient

WOOL FAUX FUR

Merino wool is a natural alternative to fur made from animal hide or synthetics. Wool faux fur is a type of pile fabric, usually constructed using sliver knitting technology with a longer pile of wool on the outside of the fabric. Innovatively knitted from Merino wool yarn, wool faux fur fabrics are cropped and brushed to replicate a traditional fur or shearling look and feel. Jersey knitting is used to create a loop structure on one side of the fabric, which is then cut to result in a yarn that is raised and brushed to create the faux fur effect.

A number of methods can be used to create wool pile fabrics, from weft knitting to warp knitting, weaving and tufting to create fleece fabric, sherpa fabric and more for apparel, accessories, footwear and interior applications. Products created with wool faux fur have the wool fibre's added natural benefits including thermoregulation, breathability, odour resistance and the peace of mind that the fabric comes as a less impactful solution than synthetic or traditional fur. Wool faux fur avoids synthetic faux fur and animal-derived fur, tapping into the versatility of the wool fibre and established textile techniques.

100% Natural

100% Renewable

Textile Production (continued)

WOOL FILL

Wool offers a natural alternative to synthetics or down used in quilted garments, outdoor sleepwear or outerwear, providing natural wadding or filling for enhanced insulation. Wool fill and wadding are lightweight while offering the benefits of the wool fibre including warmth and odour resistance. The natural crimp of the wool fibre creates insulating air pockets which offer superior protection from the cold, and due to the fibre's breathability, it also creates a drier and more comfortable microclimate when wearing or using wool fill products. Wool fill reduces reliance on synthetic insulations while offering the natural warmth and performance of the wool fibre.

100% Natural

100% Renewable

WOOL FOOTWEAR

Sneakers are enhanced with Merino wool's natural technical advantages, making them a durable and resilient choice for active footwear. The wool fibre provides strength and longevity, and when blended with other high-performance fibres, Merino wool sports shoes offer exceptional breathability, thermoregulation, and moisture-wicking properties.

French sportswear brand Circle has introduced the SuperNatural running shoe, crafted from a Merino wool and TENCEL™ blend. Designed with durability in mind, it stands among the first fully eco-designed running shoes made in Europe. Featuring a 100% Merino wool lining and a Merino wool blend woven upper, the shoe leverages the biodegradability of the wool fibre alongside other bio-based materials. This design ensures the SuperNatural runner can reach the end of its life without contributing to post-consumer waste. By using renewable and biodegradable components, wool footwear reduces dependency on synthetic components.

100% Natural

100% Renewable

HOW GARMENT USE **IMPACTS THE ENVIRONMENT**

Increasing garment wear lowers environmental impact

How often clothes are worn is the most influential factor in determining environmental impacts from clothing.

This indicates consumers who are aware of wool's attributes have the largest power to influence the sustainability of their wool garments by maximising the active garment lifespan and therefore reducing overall impacts. Indeed, brand and retailers can also play a vital role in educating consumers about best practice care methods to extend a product's lifetime.

By producing garments using high-quality materials, such as wool, and designing for longevity rather than seasonal trends, brands can influence consumer behaviour and encourage them to cherish their garments for longer. Wearing wool clothes to maximum potential and practicing optimal garment care can reduce their environmental impact by 75% compared to current practices, according to a 2021 study.[10]

The world's first peer-reviewed textile fibre cradle-to-grave LCA[11] study found the number of times a garment is worn is the most influential factor in determining garment impacts.

The survey completed for this study showed some woollen sweaters in consumer wardrobes had been purchased more than 30 years ago, and some survey respondents reported garments had been used for more than 200 times. However, if this garment was disposed of after only one season, or 15 uses, this would result in a 5.8- to 6.8-fold increase in environmental impacts and resource use.

A 2020 Wardrobe Study[12] found that wool garments are amongst the longest kept in the wardrobe. The study revealed the average lifetime of wool garments was more than 50% longer than cotton garments, with wool products given multiple lives through re-sale or change of ownership.

[10] Wiedemann, S.G., Biggs, L., Nguyen, Q.V. et al. Reducing environmental impacts from garments through best practice garment use and care, using the example of a Merino wool sweater. Int J Life Cycle Assess 26, 1188–1197 (2021). https://doi.org/10.1007/s11367-021-01909-x

[11] Wiedemann, S., Biggs, L., Nebel, B. et al. Environmental impacts associated with the production, use, and end-of-life of a woollen garment. Int J Life Cycle Assess 25, 1486–1499 (2020). https://doi.org/10.1007/s11367-020-01766-0

[12] The Nielsen Company, 2020. Global wardrobe study. Prepared for The Woolmark Company. Available at: https://www.woolmark.com/industry/research/wardrobe-study/

Global Wardrobe Study

1 in every 10 items

in female wardrobes comprise wool, with sweaters, jackets, coats and scarves the most likely to be made from wool or wool blends.

5% of these wool garments were purchased more than 10 years ago, double that of cotton and polyester.

9% of wool garments

in male wardrobes were purchased more than 10 years ago, compared to just 3% of cotton and polyester clothing.

10% of wool and wool blend garments

compared to 25% of cotton and cotton blends, or 33% of denim garments, were purchased by males in the past 6 months.

It was found in the same Global Wardrobe Study that wool garments are less frequently washed than most other fabrics, with denim, cotton and synthetics washed most often. Further, woollens were only present in 8% of tumble dry loads. Optimal garment care is outlined in more detail in the following pages.

Best-Practice Care Reduces Environmental Impact

Best-practice garment care is another highly influential factor in reducing a garment's environmental impact. Because wool is resistant to odour, stains and wrinkles it requires less laundering over its lifetime. Brands cans positively influence the environmental impacts of garment care by communicating to their consumers best-practice care for their clothing.

The results of a 2021 study[10], outlined on this page, show that consumers can greatly reduce the impact their wool clothes have on the environment. This is achieved by choosing and wearing quality garments that have a lengthy life and need minimum laundering, such as those made from Merino wool.

14 wears

The optimal numbers of wears per wool sweater is 14 before it requires laundering. Wool products are best air dried, saving energy from using a tumble dryer.

68%

Increasing the number of wears from current practice (109 wears) to 400 wears per wool sweater over its lifespan can reduce the environmental impact of that garment by up to 68%.

<30°

Wool clothes are best washed with cold or 30° water, which saves energy compared to washing with hot water.

75%

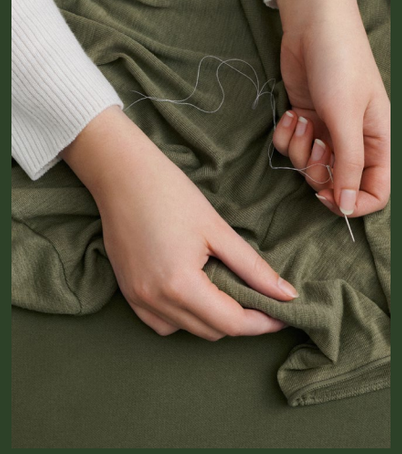
Wearing wool clothes to maximum potential and practicing optimal garment care can reduce their environmental impact by 75% compared to current practices.

28%

Reusing a wool garment by multiple users can increase its life span and reduce environmental impacts by up to 28%.

Advance Circularity

Wool is the world's most recycled apparel fibre. It is the only fibre to have a well-established and commercially viable recycle pathway. The recycling potential of wool can be readily increased through a circular approach to fibre processing, garment design and waste collection. By increasing rates of wool recycling, our industry can further reduce the lifetime environmental footprint of wool products. The Woolmark Certification Program's recycled wool scheme certifies products made from reclaimed pre- or post-consumer wool, reprocessed into new yarn, fabric, clothing, or footwear. The new Recycled Wool logo indicates that a product is either 100% recycled wool or a wool blend with at least 20% recycled wool and a fibre diameter of ≤22.5 micron.



Repair

Wool garments have a long history of being mended. Most wool products can be easily repaired, extending the already long use phase of these quality products, without placing added strain on the environment if a new garment was to be purchased. Depending on the type of repair, it will usually be less expensive to repair a wool garment than purchase a new one. Woolmark's guide to repairing wool products is helping keep them in circulation longer.

Reuse

Wool is one of the most reused fibres on the planet of the major apparel fibres, with wool garments often preferentially donated or sold for extended life. According to a Nielsen wardrobe study,[12] 50% of wool and wool blend garments owned by survey participants were donated to charity, family, friends or sold.

Recycling

The wool industry is unique in having had an established recycling pathway for more than 200 years, turning old, exhausted wool into new products.

'Closed loop' recycling: This involves high-value wool garments deconstructed to enable new yarns to be spun and new high-value garments fabricated. Wool is the most recyclable fibre on the planet of the major apparel fibres.

'Open loop' recycling: This is essentially 'down cycling', in which wool products are pulled apart and fabricated into cheaper non-woven products for insulation, padding, interiors, etc. Wool is highly valued for these purposes because of its inherent flame resistance and acoustic insulation properties.

Product Disposal

If a wool product reaches its end of life and needs to be disposed, science has found that wool fibres are 100% biodegradable in both land and marine environments.

Wool fibres will naturally decompose in soil in a matter of months or years, slowly releasing valuable nutrients such as nitrogen, sulphur and carbon back to the soil. Synthetic fibres, on the other hand, can be extremely slow to degrade and significantly contribute to the world's overflowing landfills.

Wool also biodegrades in a marine environment and does not contribute to microplastic pollution. In contrast, microplastics from synthetic textiles accumulate in marine environments, as well as terrestrial environments, where they damage ecosystems.

AN
ICONIC
LOGO

THE WOOLMARK QUALITY ASSURANCE SYMBOL

During the past 60 years, we've certified more than 6 billion wool apparel and wool care products, guaranteeing durability, performance and quality.

The Woolmark logo is the world's best-known textile quality fibre brand, representing a long-term commitment between woolgrowers, mills, brands and consumers.

WOOLMARK PURE NEW WOOL

WOOLMARK WOOL RICH BLEND

WOOLMARK WOOL BLEND

WOOLMARK WOOL CARE

WOOLMARK RECYCLED WOOL

Woolmark certification standards

Natural fibre authentication

Woolmark certification verifies that the wool in each certified product meets our exacting quality standards and is what it claims to be.

1.

Wool Content

We assess the wool's purity, to verify the product is 100% what it claims to be.

2.

Colourfastness to Light

We expose the wool product to the harshest light – for up to 10 hours – to assure its colours are lasting.

3.

Durability

We subject the wool product to extreme pressures – we push, pull and stretch it to its physical limits – to measure its strength.

4.

Wash Testing

We wash the wool product in hard, unforgiving machines to ensure no shrinkage and no loss of shape.

5.

Colourfastness to Liquid

Finally, we take the wool product and test it, intensely, against the very liquids it would normally meet throughout its lifetime.

Independent quality assurance

We guarantee the fibre composition of wool garments and wool products with testing at independent laboratories.

Technical support

Utilise the Woolmark Technical Team for on-demand technical support and product development.

Building a traceable supply chain

Every certified Woolmark product has a unique batch number that can be traced back to the garment maker, providing the first step in supply chain traceability.

Staff development and training

Tailor-made training days, webinar participation and free educational resources on the Woolmark Learning Centre.

Customer satisfaction

73% of consumers agree the Woolmark symbol ensures quality. Leverage the reputation and authority of the iconic Woolmark symbol to build consumer confidence.[13]

[13] Ipsos, AWI Global Consumer Survey 2024, Global Report, January 2025.

OPPORTUNITIES **FOR WOOL**

Regenerating Nature

73% of Australian sheep producers undertake deliberate activities to maintain, measure or enhance biodiversity on their property.[14]

Woolgrowers are responsible for safeguarding their land and sheep, giving the fibre a connection to nature. By enhancing existing grazing and land management practices, wool-growing properties can further support rich ecosystems and boost carbon storage. This can be achieved through native planting to increase vegetation and biodiversity, alongside improved soil health from optimised planting and grazing practices that enhance water retention and nutrient levels. These efforts strengthen the role of wool-growing in maintaining natural assets while contributing to environmental regeneration.

[14] Sheep Sustainability Framework, National Producer Survey 2024.

Reducing Emissions

Wool-growing properties offer a valuable opportunity for investment in nature-based solutions that provide cost-effective climate mitigation through 2030. As stewards of more than 65 million hectares, Australian woolgrowers are uniquely positioned to drive emissions reductions for the textile industry, with significant potential for carbon sequestration. This process, which captures and stores carbon dioxide (CO_2) from the atmosphere, plays a crucial role in mitigating global warming and is known as biological carbon sequestration when stored in natural environments.

Transparency and Traceability

In response to growing demand for transparent and traceable products, the wool industry has introduced new initiatives and invested in technology to enhance the wool value chain. This includes the launch of the Australian Wool Traceability Hub, designed to strengthen the confidence in, reliability and efficiency of the transfer of key information within the Australian wool supply chain from woolgrowers to first stage processors. The industry also relies on established and trusted on-farm and supply chain certifications, alongside widespread sustainability reporting, such as the world-first Australian Sheep Sustainability Framework and reporting by manufacturers throughout the wool value chain.

Accelerate Circularity

Wool has a unique set of circular features – such as being a renewable and biodegradable fibre, and suitable for reuse and recycling. These attributes mean wool can be the circular solution to the material strategies of companies along the supply chain including designers, brands and retailers.

Collaborative Investment

The need for collaborative investment and financing to support woolgrowers in delivering nature stewardship is critical. Significant pools of capital are being directed toward nature stewardship activities globally. Investing in nature-based solutions in the wool industry - including R&D, methane mitigation, increasing soil carbon and reforestation - offers a combination of financial, environmental, and social benefits, making it a compelling choice for global investment community.

WOOLMARK