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Pathways to Progress

Setting Sustainability Goals

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Pathways to Progress

Setting Sustainability Goals

Today's Speakers

Dr. Jesse Daystar
Vice President &
Chief Sustainability Officer

Cotton Incorporated

Dr. Kater Hake
Vice President Ag. &
Environmental Research

Cotton Incorporated

Webinar Support

Type your questions using the Q&A feature at any time during the webinar.

A recording of this webinar will be available on **cottonworks.com**.

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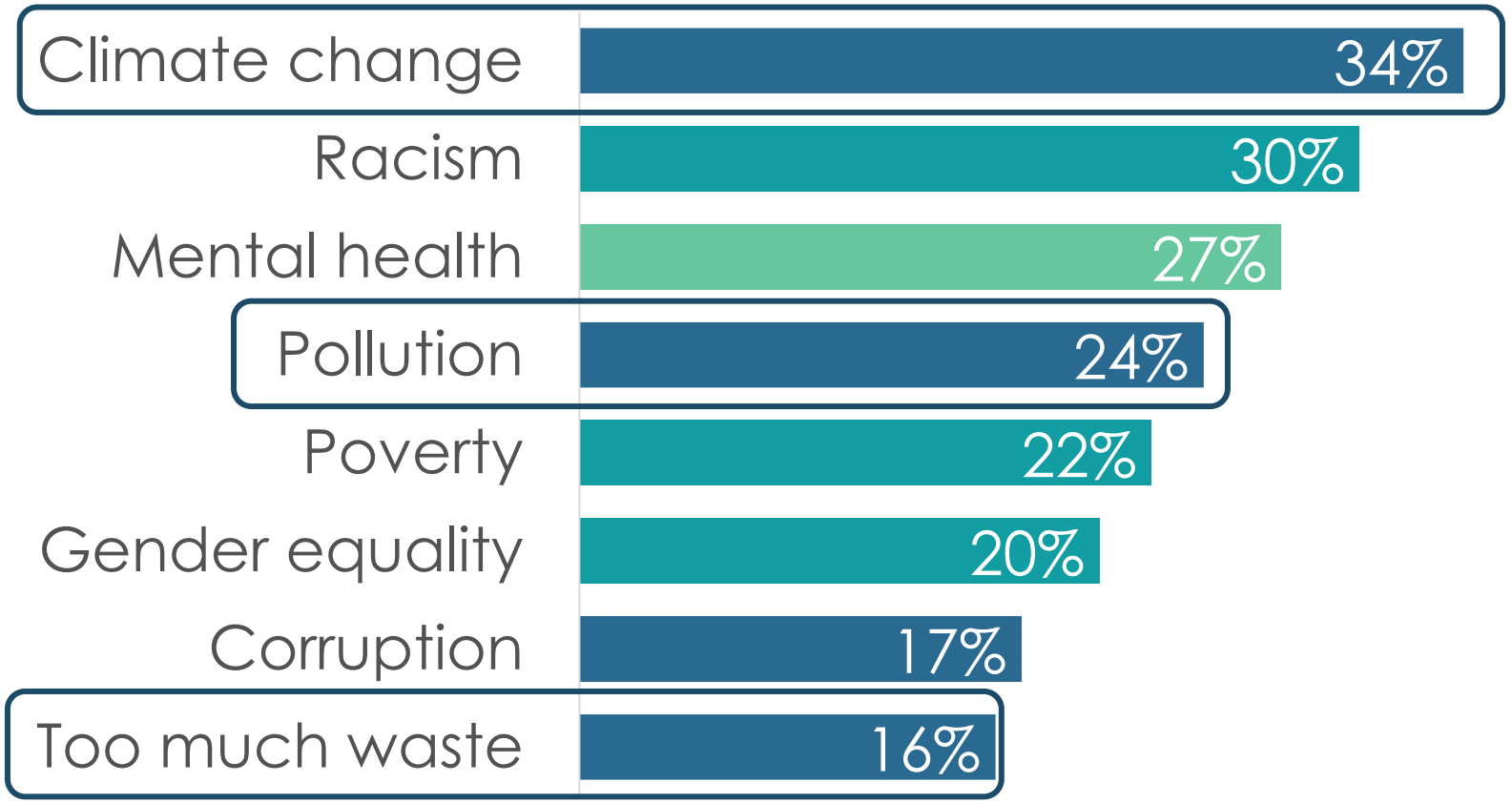
Pathways to Progress

Setting Sustainability Goals

Generation Z highly concerned about climate

Environmental issues top list of Gen Z concerns

Most important challenges facing our world today:



Environmental

Social

Health

Political

Source: CCI & Cotton Incorporated's 2017 Global Environment Survey

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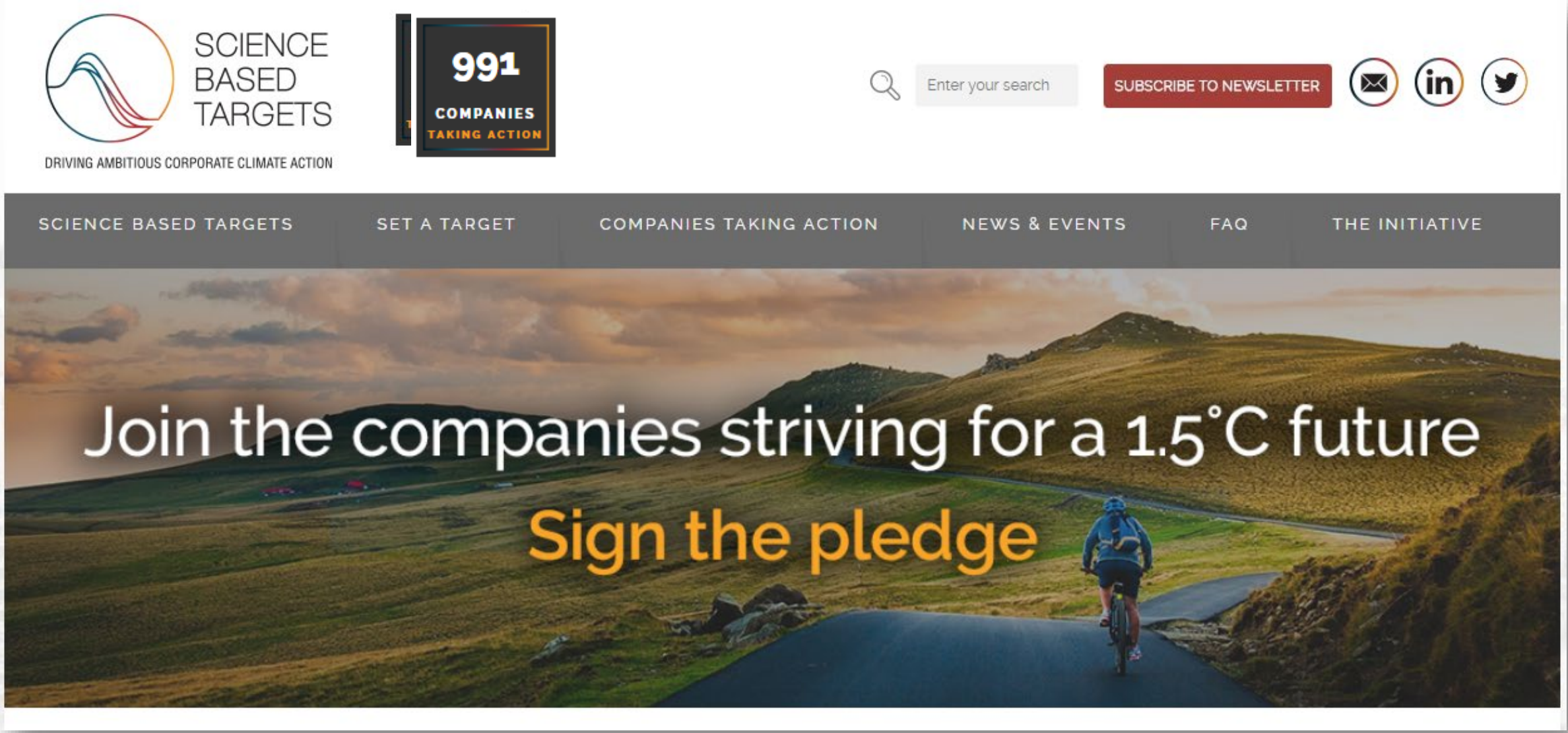
UN Sustainable Development Goals

Science-Based Targets Initiative



Net Zero Brand Commitments

In the News Today

Climate and Environment

Biden plans to cut emissions at least in half by 2030

The target, intended to reassert America's global leadership on climate action, would require profound changes at home

"The United States can reduce emissions from forests and agriculture and enhance carbon sinks through a range of programs and measures including nature-based solutions for ecosystems ranging from our forests and agricultural soils to our rivers and coasts."

https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/

35 Years of Reduced Environmental Impact

Land Use	Soil Loss	Water	Energy	GHG
49%	37%	79%	54%	40%

Field to Market

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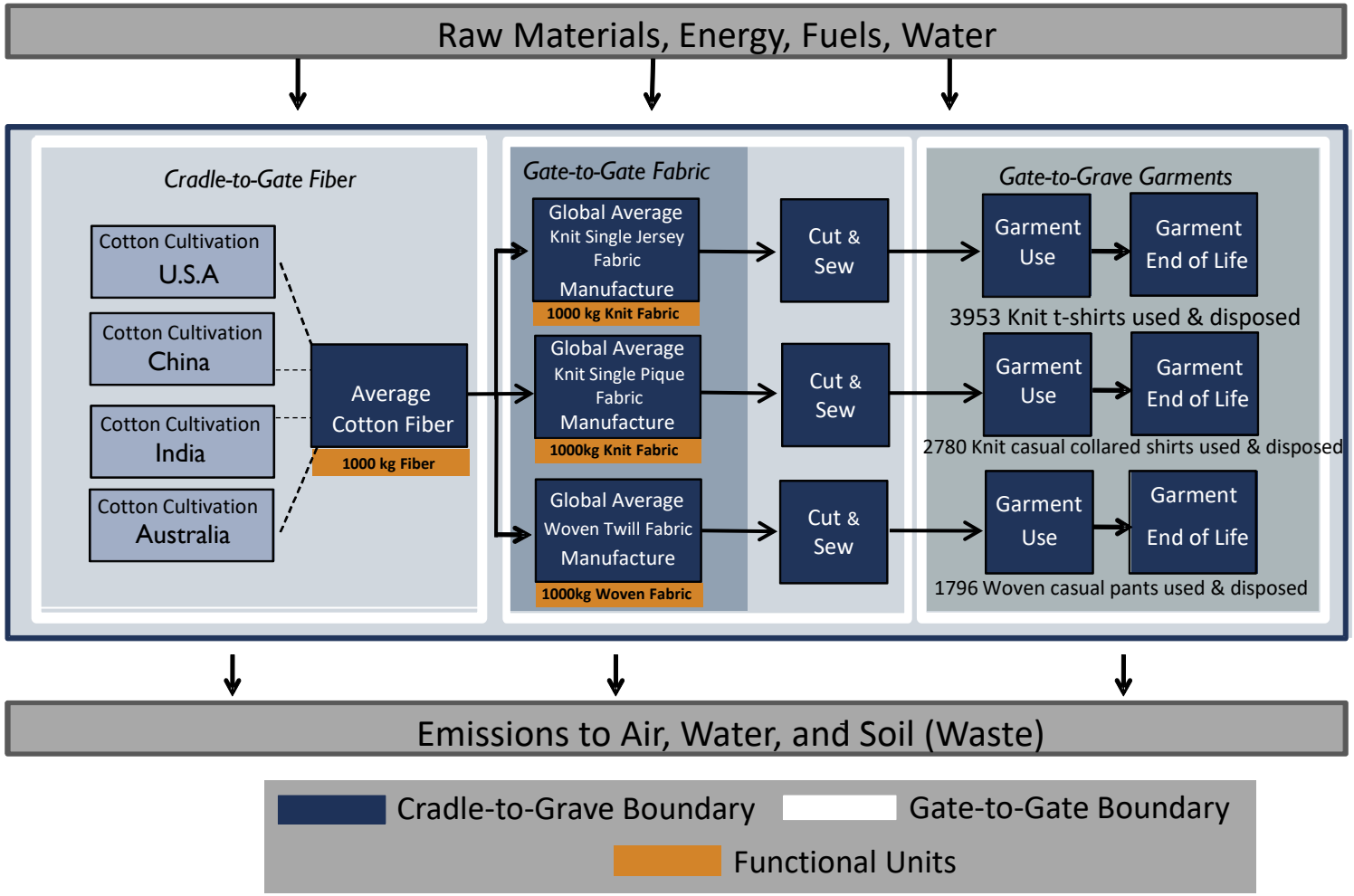
Source: Field to Market: The Alliance for Sustainable Agriculture National Indicators Report (2016). https://fieldtomarket.org/national-indicators-report-2016/

Life Cycle Assessment Overview

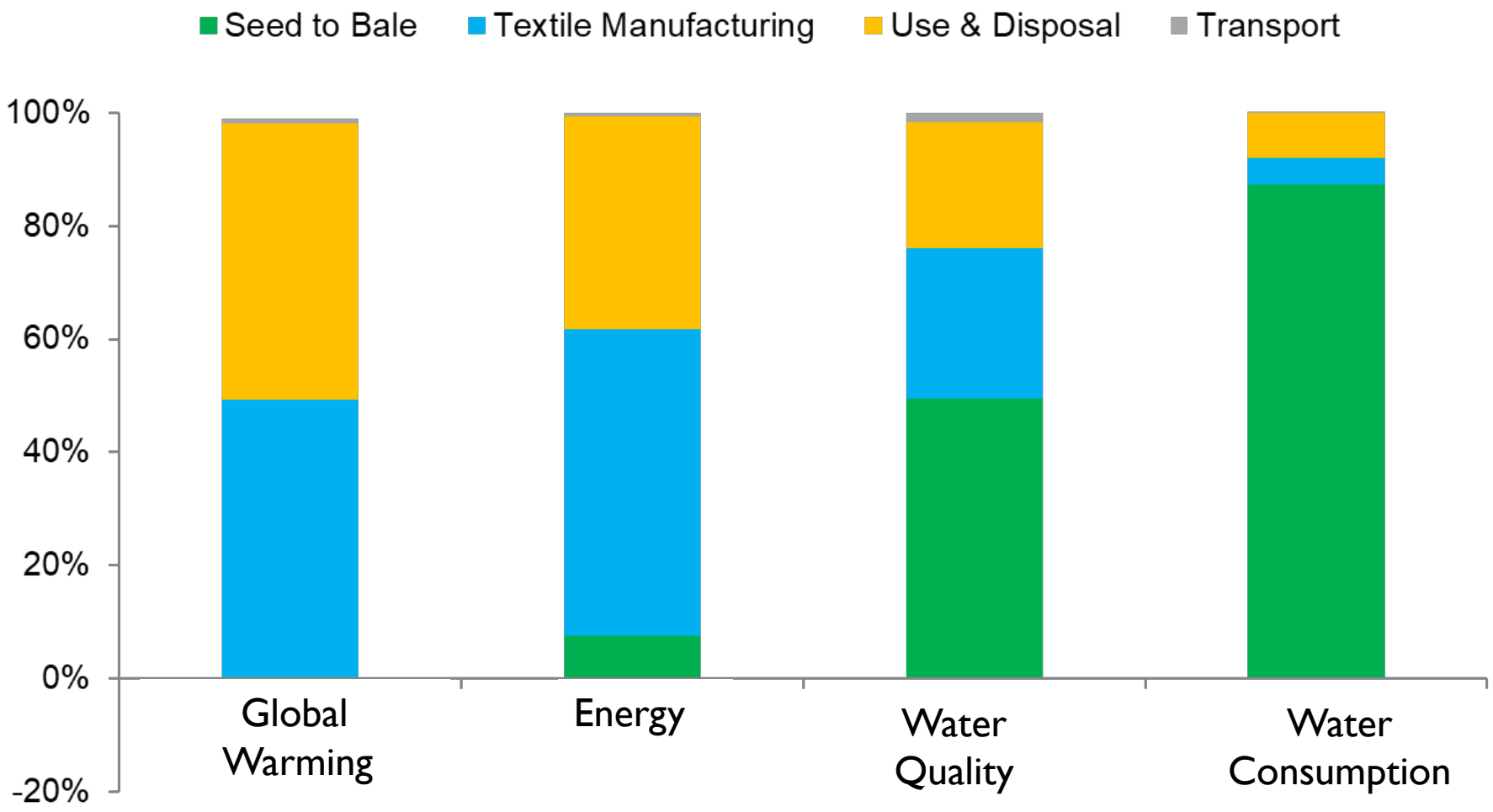
Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

LCA Goal, Scope Functional Units



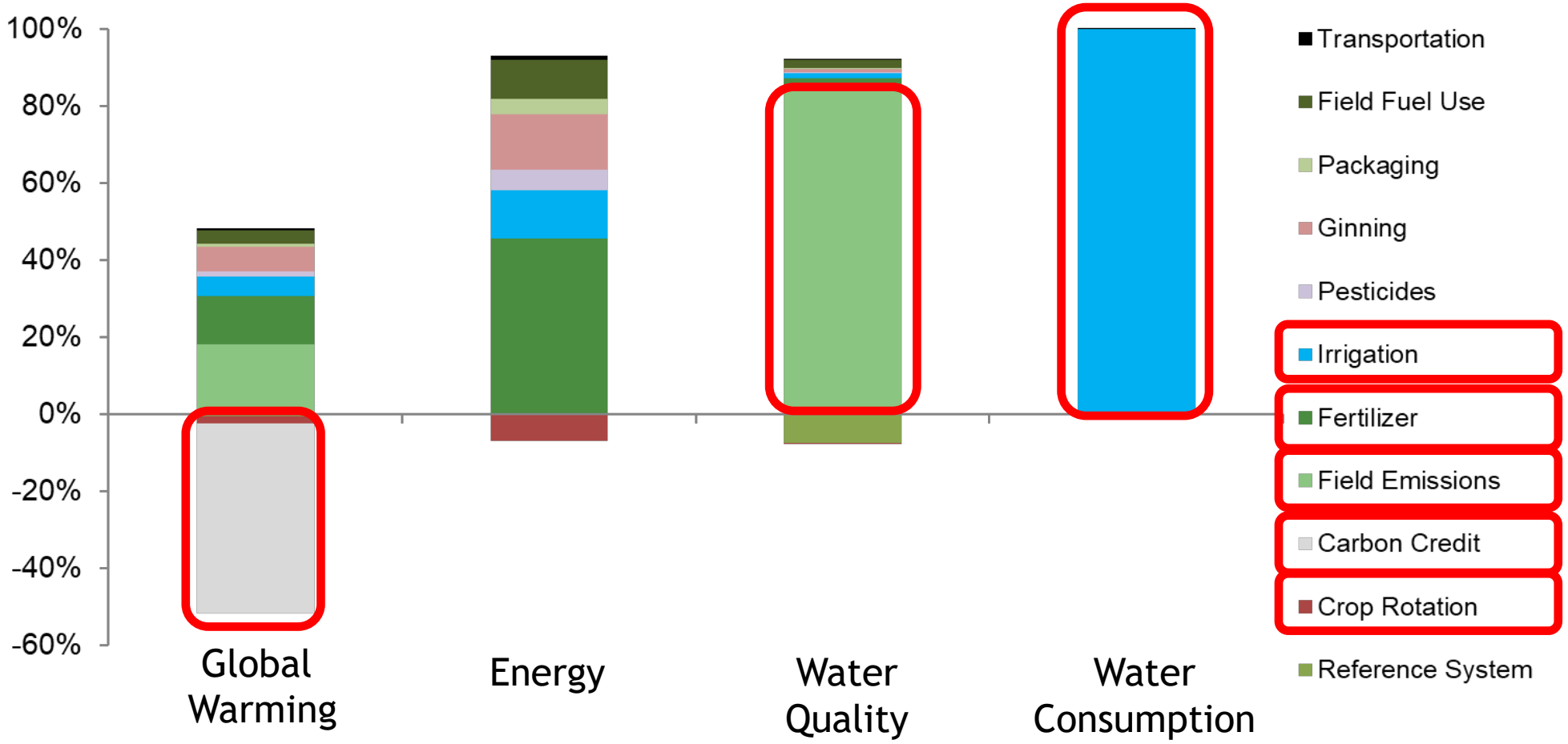
Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

Overall Results for a Knit Collared Shirt



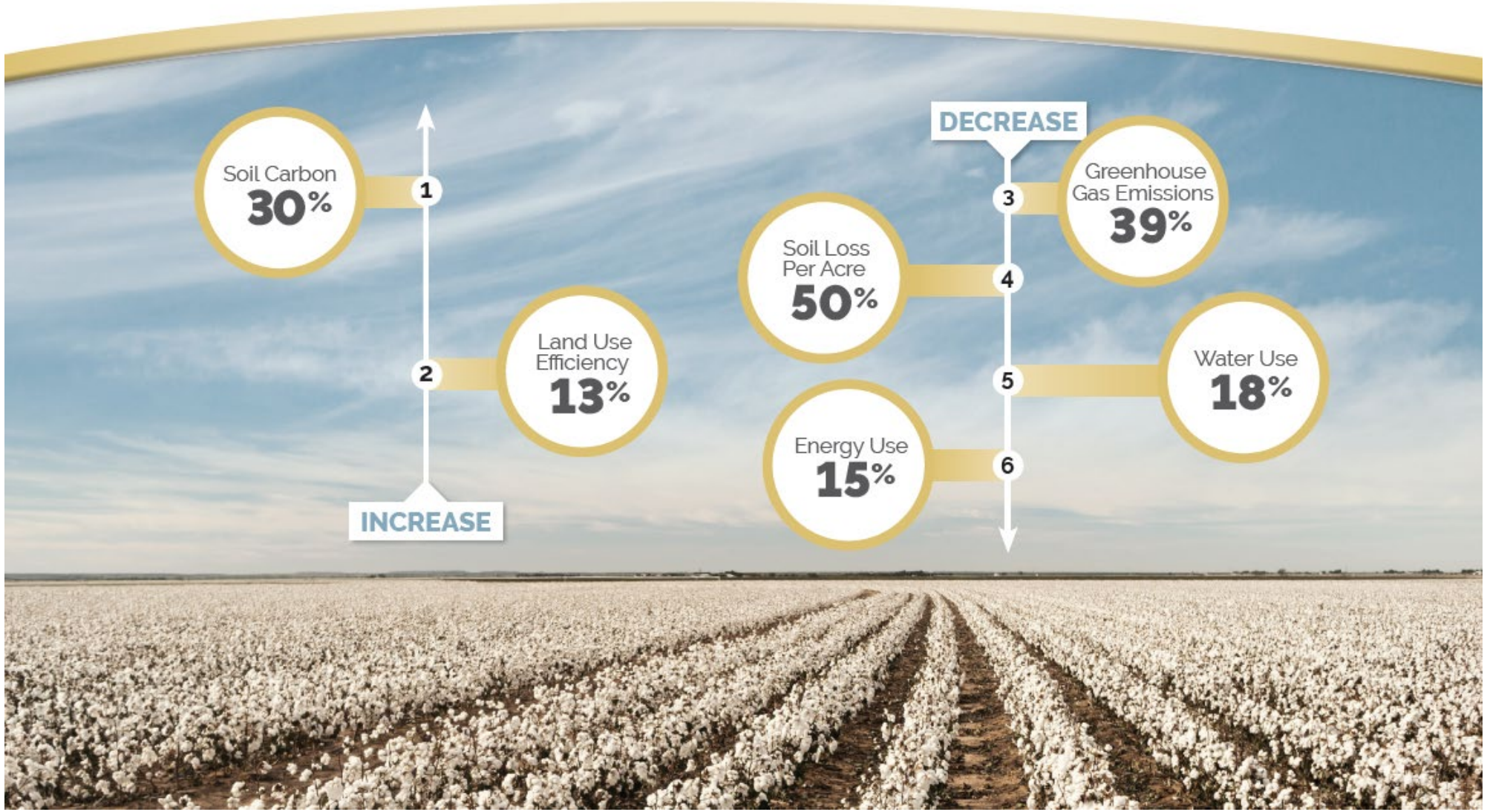
Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

Agricultural Phase Details



Source: Cotton Incorporated (2017). LCA Update of cotton fiber and fabric life cycle. https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

U.S. Cotton's Sustainability Goals for 2025



U.S. Cotton Contribution to SDGs

Cotton Incorporated Research & Promotion

- Farmers understand that economic survival requires continual improvement.
- Thus, they collectively pool their resources to fund University and U.S.DA labs to create innovations and to solve short-term and long-term problems.
- Currently they are funding 300 cotton scientists working on everything from better cotton fiber quality through genome-based breeding to controlling pests with non-chemical methods.
- This is a powerhouse of scientific knowledge that supports continual improvement in U.S. cotton production.

Sustainability Goals Development Process

- We utilized this powerhouse of scientific knowledge to assess how cotton's environmental footprint could be reduced in the future.
- And what are the quantifiable and meaningful goals we can use to measure our success or failure.
- Assembled 20 thought leaders in the cotton research community for a two-day brainstorming session.

Sustainability Goals Development Process

- Easy part was identifying areas of global environmental concern that U.S. agriculture impacts:
  - Water, land, air, and carbon are well-recognized goals

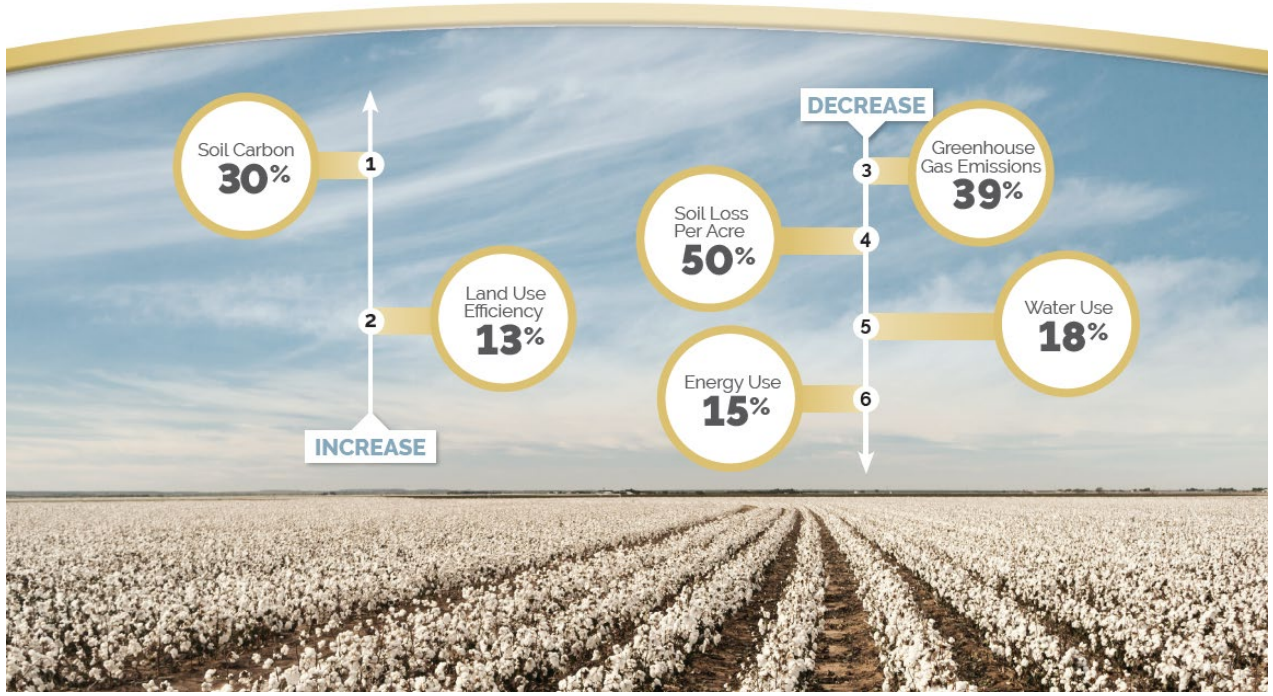
- More difficult was setting the time horizon for our goals:
  - 30-year goals avoid accountability
  - 5-year goals do not incorporate the challenge of farmer adoption
  - 10-years is the "goldilocks zone"

Sustainability Goals Development Process

Most difficult was the scientific analysis of what is achievable considering the many constraints of climate change, farm equipment, water, genetics, pest resistance, etc.

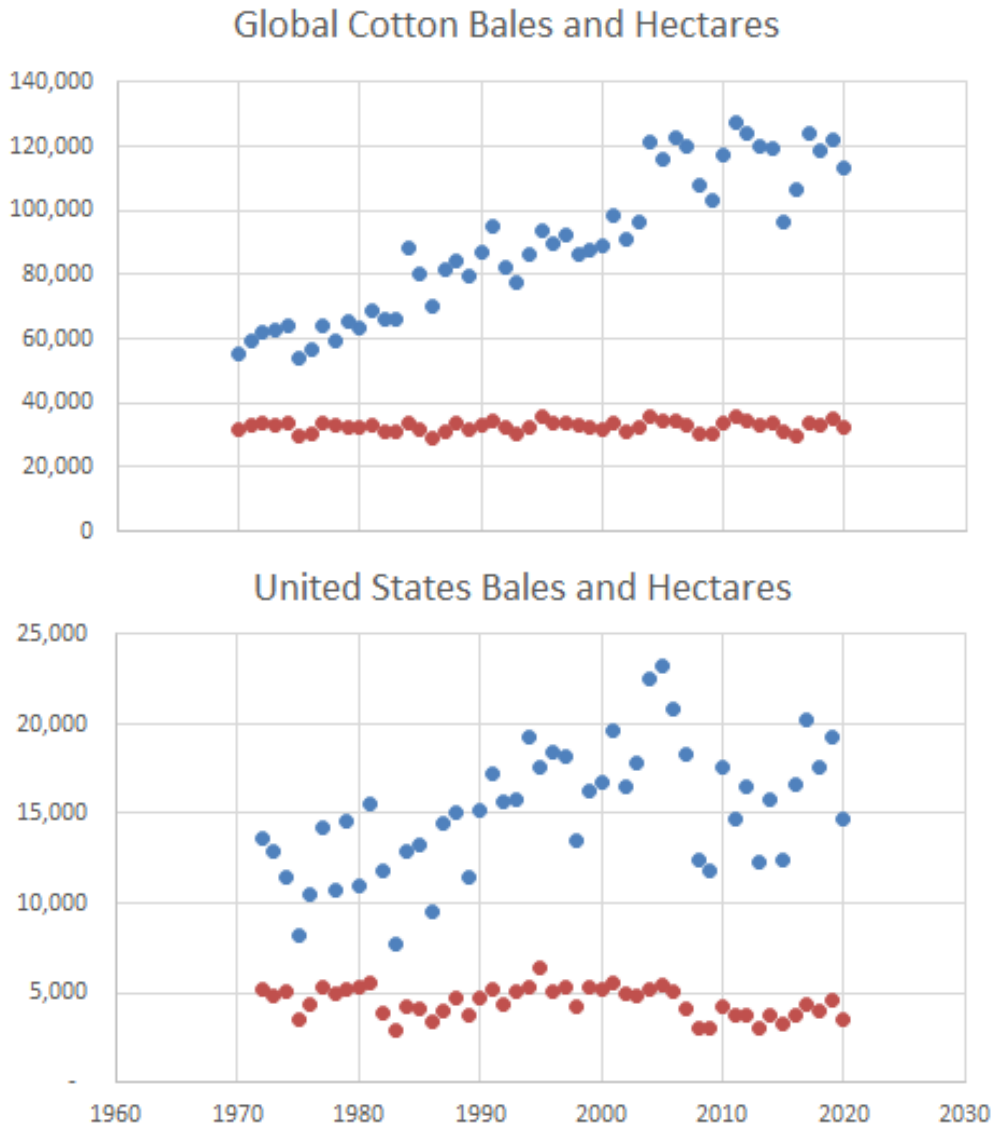
For each goal we spent hours debating what could science and farmers jointly achieve.

Of the 6 goals (soil carbon, land use, soil loss, energy use, greenhouse gases, and irrigation water use) today we will unpack the science and farming behind land use efficiency. Look to later seminars for the science behind the other goals.



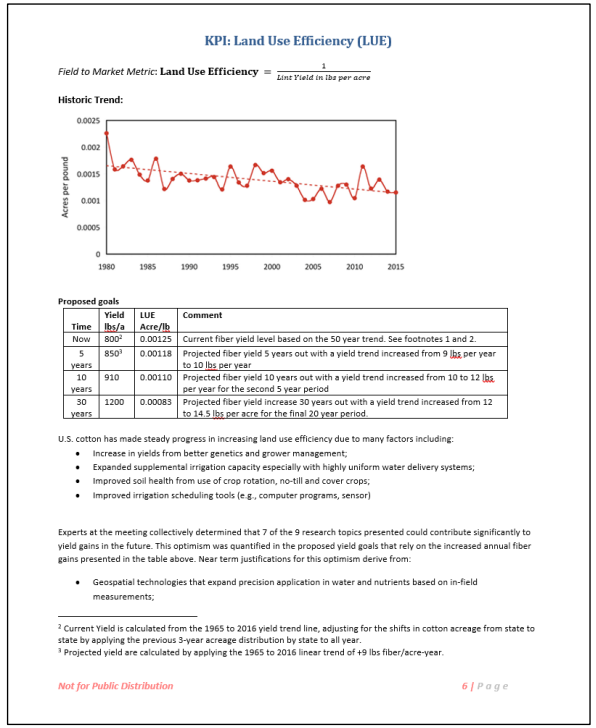
Sustainability Goals: Land Use Efficiency

- Land Use Efficiency benefits farmers
  - yield per area increases income
  - most purchased inputs are scaled to area
- Land Use Efficiency benefits society
  - Higher yields means less global land cultivated to feed and clothe the world
- Demand for cotton textiles could increase as
  - consumers move away from plastics for environmental and health concerns
  - Mid-latitude countries get hotter & wealthier



Sustainability Goals: Land Use Efficiency

Fortunately, we captured the logic behind each goal.



KPI: Land Use Efficiency (LUE)

Field to Market Metric: **Land Use Efficiency** $= \frac{1}{\text{Lint Yield in lbs per acre}}$

Historic Trend:

Proposed goals

Time	Yield lbs/a	LUE Acre/lb	Comment
Now	800[2]	0.00125	Current fiber yield level based on the 50 year trend. See footnotes 1 and 2.
5 years	850[3]	0.00118	Projected fiber yield 5 years out with a yield trend increased from 9 lbs per year to 10 lbs per year
10 years	910	0.00110	Projected fiber yield 10 years out with a yield trend increased from 10 to 12 lbs per year for the second 5 year period
30 years	1200	0.00083	Projected fiber yield increase 30 years out with a yield trend increased from 12 to 14.5 lbs per acre for the final 20 year period.

U.S. cotton has made steady progress in increasing land use efficiency due to many factors including:

- Increase in yields from better genetics and grower management;
- Expanded supplemental irrigation capacity especially with highly uniform water delivery systems;
- Improved soil health from use of crop rotation, no-till and cover crops;
- Improved irrigation scheduling tools (e.g., computer programs, sensor)

Experts at the meeting collectively determined that 7 of the 9 research topics presented could contribute significantly to yield gains in the future. This optimism was quantified in the proposed yield goals that rely on the increased annual fiber gains presented in the table above. Near term justifications for this optimism derive from:

- Geospatial technologies that expand precision application in water and nutrients based on in-field measurements;

[2] Current Yield is calculated from the 1965 to 2016 yield trend line, adjusting for the shifts in cotton acreage from state to state by applying the previous 3-year acreage distribution by state to all year.
[3] Projected yield are calculated by applying the 1965 to 2016 linear trend of +9 lbs fiber/acre-year.

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- Big data applications across cooperating growers that should provide greater predictive power to grower decisions;
- Preservation of the very low insect, weed and disease pest related yield loss that growers currently experience, with the caution that any changes in pest control will likely be negative for yield;
- Expansion of soil health knowledge and expanded implementation of practices that foster a diverse and healthy rhizosphere;
- Further adoption of plant based sensors to optimize irrigation in variable rate systems;
- Use of CRISPR genome editing has been demonstrated in cotton.[4] The technology is superior to traditional biotech traits for its reduced regulatory burden, genome location precision, trait flexibility and potential to broaden the providers of genetic innovations for agriculture[5];
- Improvements in plant breeding techniques combined with more rapid adoption of improved varieties (discussed in more details below).

Yield increases realized by growers from adopting new varieties is a function of several factors: the genetic gain achieved in breeding programs, the rate of variety life cycle turnover, and the yield gap between what a grower experiences on farm and what can be achieved in reference trials under similar soil/weather environments but not constrained by inputs or management. The variety life cycle of US cotton could be improved over the next 10 years from its current level of 5 to 8 years to the 2 year life cycle of corn hybrids or cotton varieties in Australia. At a 2% genetic gain per year, a grower with a variety Life Cycle of 5 years would have an average yield 2.9% behind a grower with a variety life cycle of 2 years (all other factors being equal). With a variety life cycle of 8 years this grower would be 5.4% behind the grower with a 2 year variety life cycle, on average. Shorter variety life cycles (more rapid rate of adoption of new varieties) will require changes in variety testing and information dissemination that provide growers the site specific growth characteristics and yield potential they need to select and manage new varieties optimally on their farm. Research is ongoing in the cotton industry to provide valuable data for placement and management of new varieties on a grower's individual farm. More data is being collected by the grower on each farm along with data on all varieties under development by the seed companies. This provides a future platform for more precise product placement of products on the farm.

Genetic gains in cotton over the next 10 year period rely heavily on new technologies such as genomic selection and predictive analytics. Participants identified several yield enhancements that were further than 10 years out, but likely within 30 years. Genome editing has tremendous potential to impact cotton in the 10-20 year time frame by enabling precision breeding to improve yields, and alleviate biotic and abiotic stresses limiting productivity. Other technologies already researched in cotton include redesigning canopy architecture for synchronous flowering[6] and better light capture[7] and technologies under development in other crops such as C4 photosynthesis[8] and rapid low light recovery.[9] Caution should be taken with yield forecasts for 20 and 30 years in the future due to potential impacts of climate change on cotton yields.[10]

[4] Plant Molecular Biology 2017 DOI 10.1007/s11103-017-0599-3 ; Scientific Reports 2017 DOI: 10.1038/srep43902
[5] Science 2017 355:1122-1123
[6] New Phytologist 2016 212:244-258
[7] PNAS 2017 114(1):E57-E66
[8] Field Crops Research 2015 182:19-29; Science 2012 336:1671-1672
[9] Science 2016 354:857-860
[10] PNAS 2009 106:15594-15598

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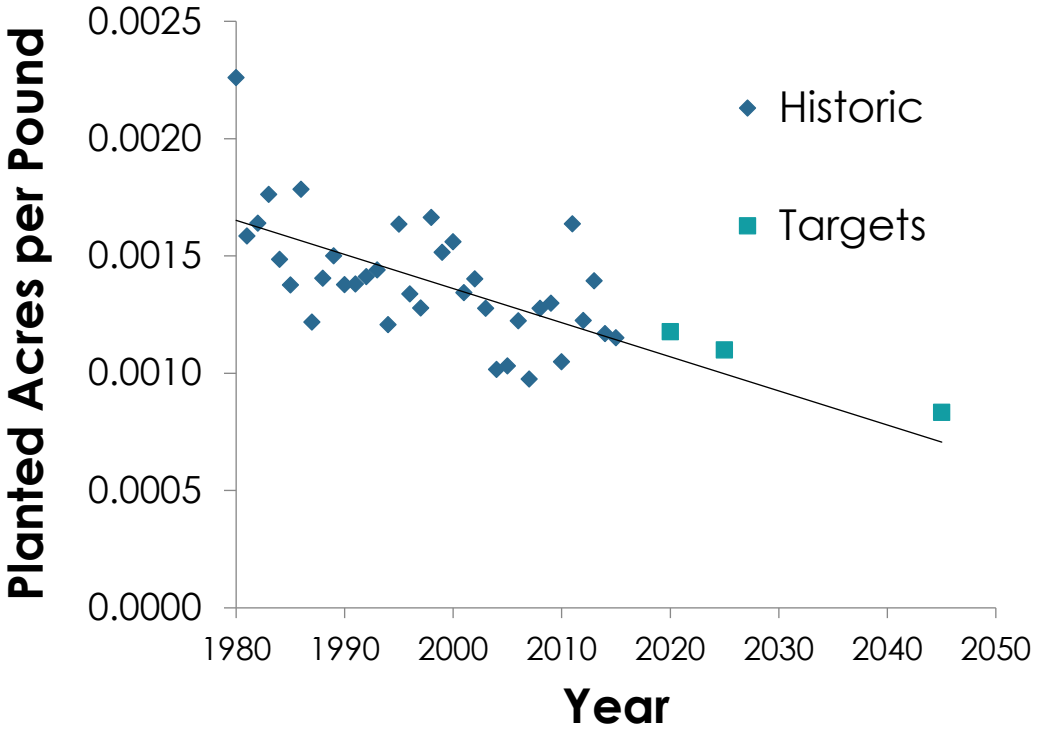
Expanding Agricultural Boundaries: Meeting Summary Report

Land Use Efficiency Goal

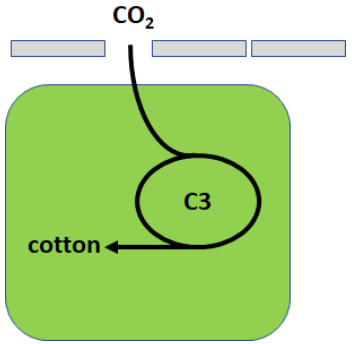


U.S.DA NASS & Expanding Agricultural Boundaries Industry Meeting

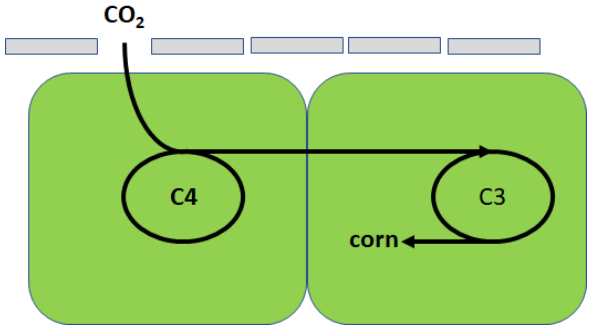
Sustainability Goals: Land Use Efficiency

Factors that have influenced yield:

- Atmospheric carbon increases cotton yield
- Improved cotton varieties
- Expanded supplemental irrigation
- Grower expertise in crop and pest management
- Improved soil health in the Southeast and Midsouth from crop rotation, no-till and cover crops



poor CO_2 capture



excellent CO_2 capture

Sustainability Goals: Land Use Efficiency

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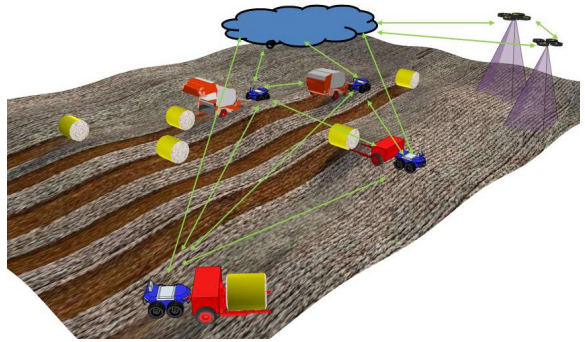
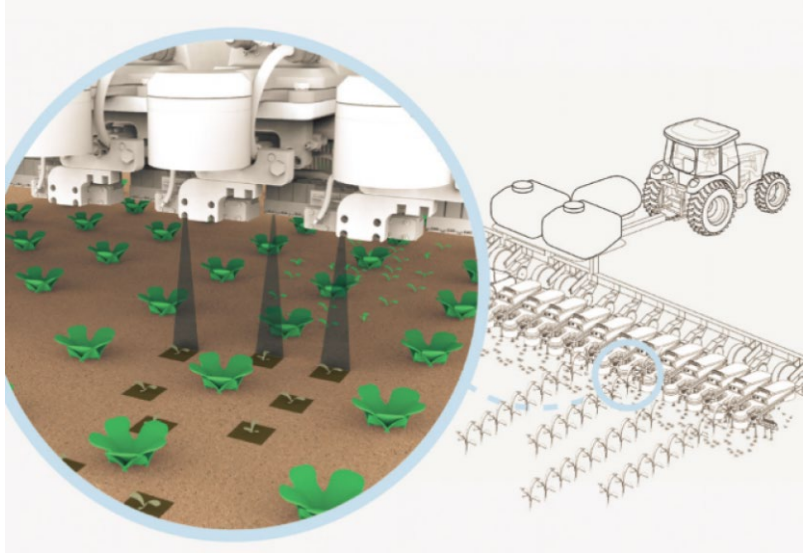
How to achieve land use goal?

Fortunately, we also captured the innovations that will allow land use efficiency to improve

1. Geo-spacial precision application of water and nutrients
2. Improved plant-based sensors to optimize inputs
3. AI and other data tools expand predictive precision by growers





https://www.agweb.com/news/crops/crop-production/robotic-weed-killer-nears-farmland

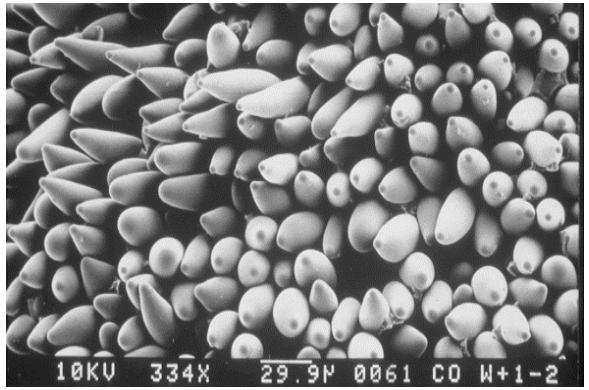
How to achieve land use goal?

Fortunately, we also captured the innovations that will allow land use efficiency to improve

4. Further expansion of soil health knowledge that benefits the rhizosphere

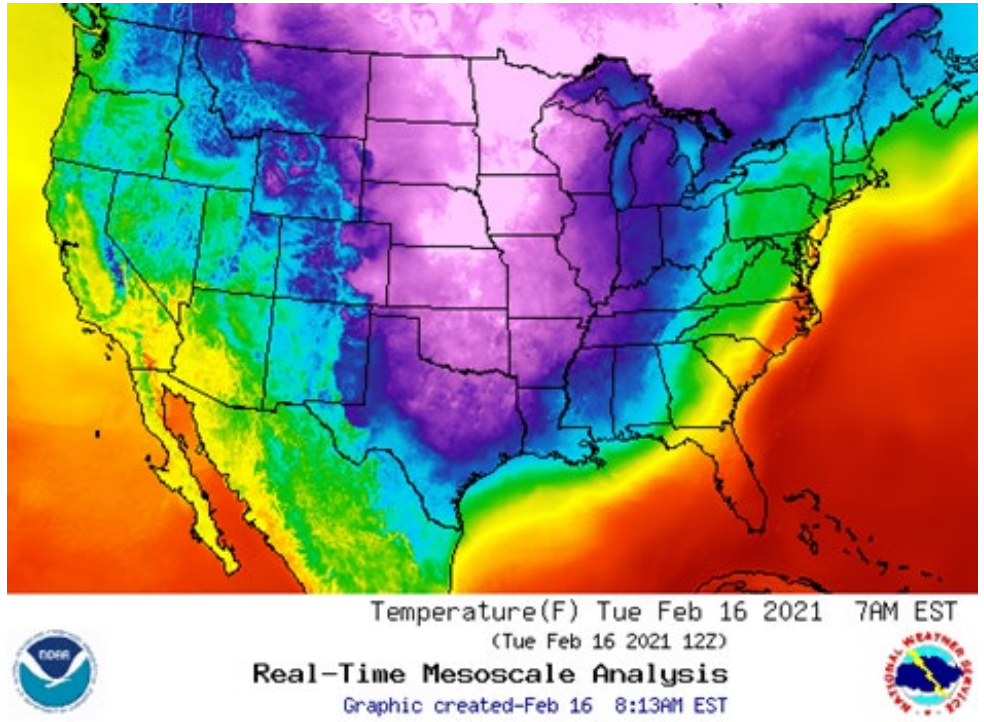
5. Lower insect, weed, and disease crop injury from gene editing crop improvements and management tools

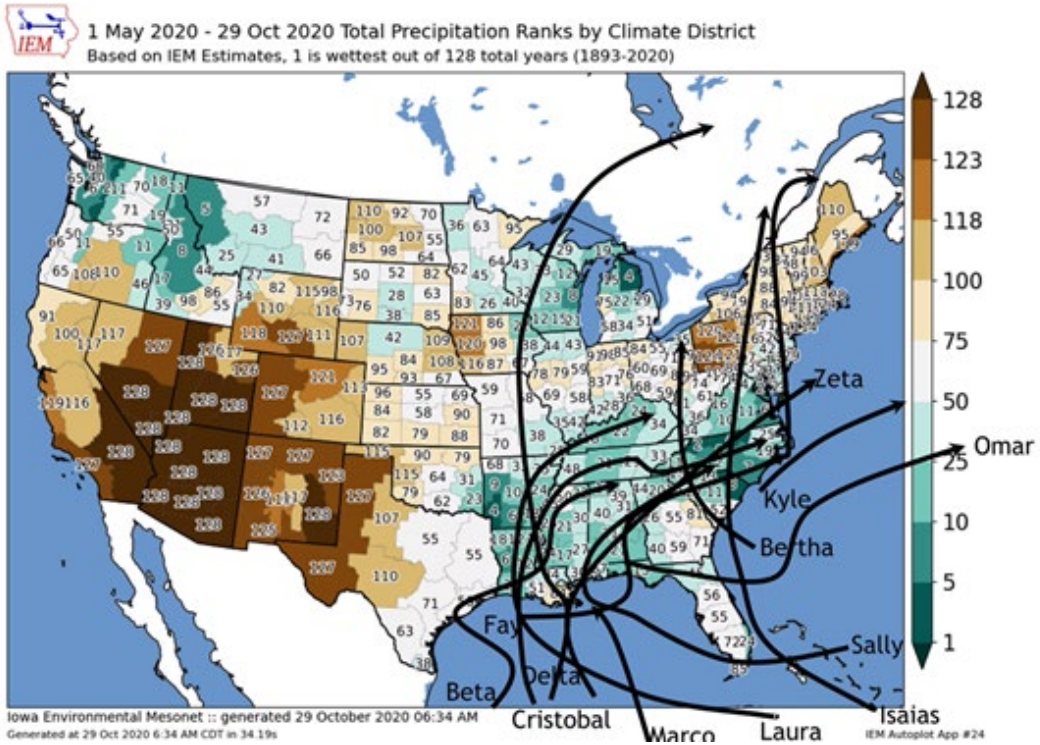
6. Even better plant breeding combined with grower adoption of optimum varieties for each field and soil type



Climate Change Urgency

- A lot has changed since our 2017 goals were set
- Most dramatic has been the accelerated impact of climate change on weather extremes
- Much earlier than broadly anticipated





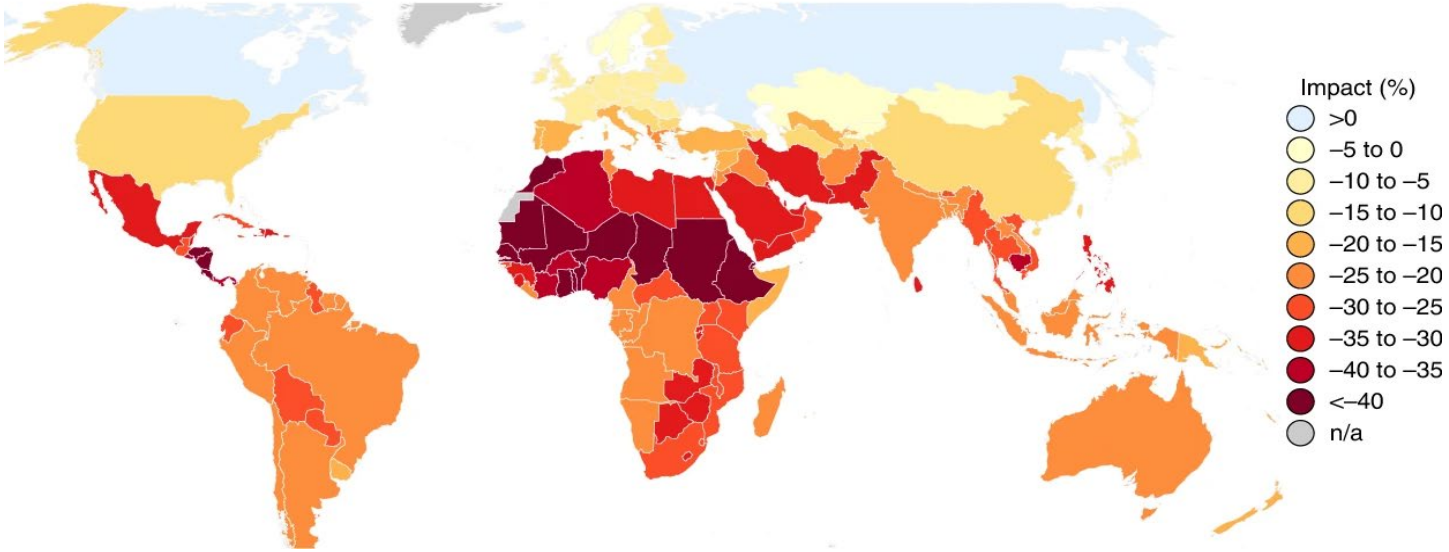
Climate Change Urgency

And it's had a huge impact on agriculture already

ARTICLES
https://doi.org/10.1038/s41558-021-01000-1
nature climate change

Anthropogenic climate change has slowed global agricultural productivity growth

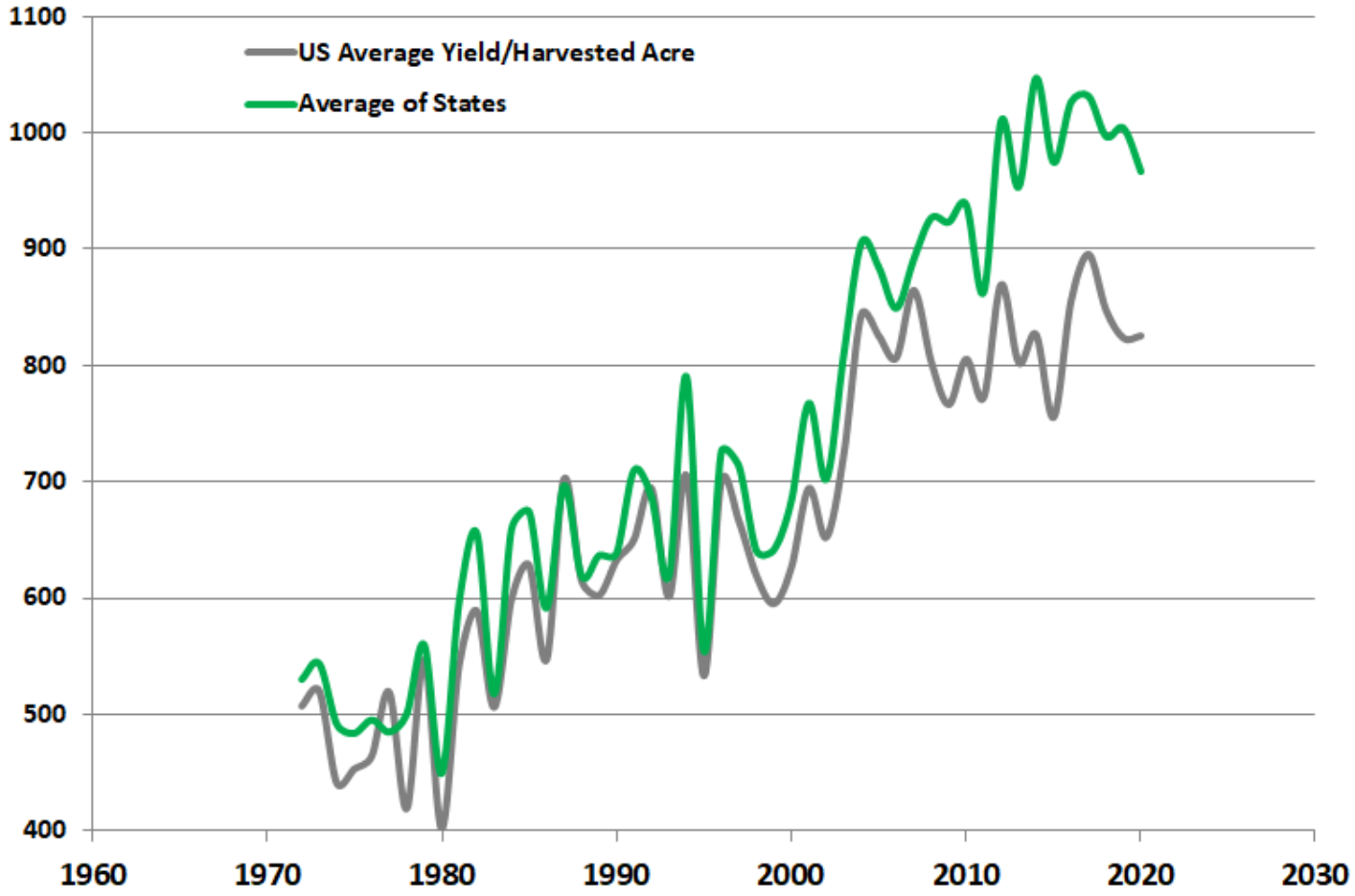
306
NATURE CLIMATE CHANGE | VOL 11 | APRIL 2021 | 306–312 | www.nature.com/natureclimatechange



Cotton & Climate Resiliency

The production trajectory of U.S. cotton will help growers survive the impacts of climate change

- Soils with surface residue better absorb heavy downpours and keep roots from overheating
- Rotations improve the soil microbial community and nutrient availability
- Precision irrigation maximizes the utility of limited irrigation water



https://www.nass.usda.gov

Cotton & Climate Resiliency

The enthusiam of U.S. cotton growers will help them survive the impacts of climate change

- U.S. growers are actively seeking out information from other growers on regenerative agriculture
- U.S. growers are pioneering practices that impact global Land Use Efficiency: IPM, conservation tillage, water and crop management

Opportunities to Learn About Sustainability Goals

- **Energy efficient cotton production consumes less oil. No-till cotton reduces greenhouse gasses and sequesters carbon** (June 8 webinar with Jesse Daystar & Arlene Adviento-Borge of the U.S.DA)
- **Healthy soils require less greenhouse gas intensive fertilizer** (June 22 webinar with Jesse Daystar & David Lamm of the Soil Health Institute)
- **Improved water use efficiency saves pumping energy and spares water for other users** (Early July webinar with Jesse Daystar & Ed Barnes)
- **Agriculture's commitment to robust metrics creates accountability towards shared goals** (Mid July webinar with Jesse Daystar & Allison Thompson of Field to Market)

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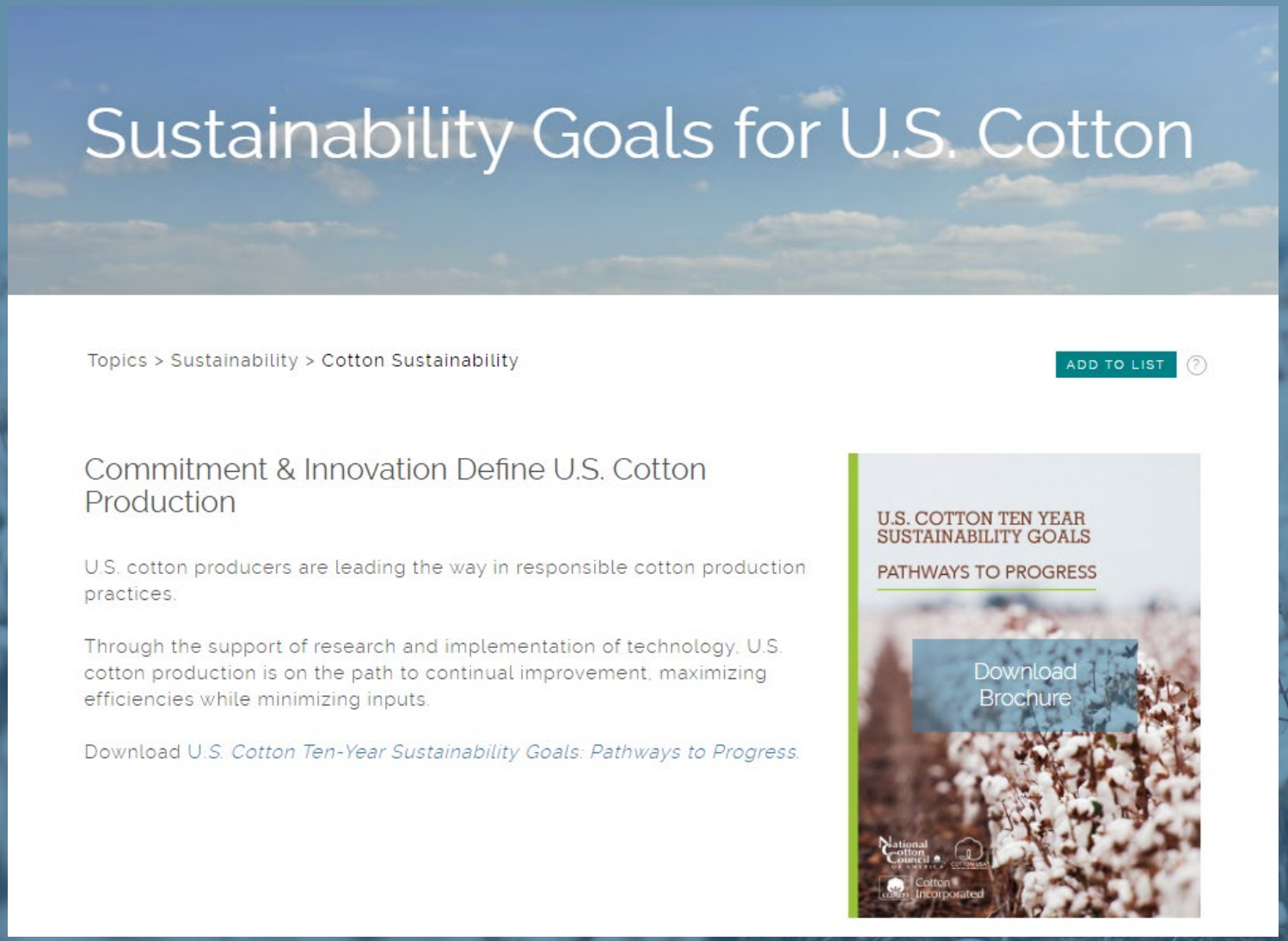
Setting Sustainability Goals



Sustainability Goals for U.S. Cotton

U.S. cotton producers are leading the way in responsible cotton production practices.

Learn more at **cottonworks.com/sustainability-goals-us-cotton**

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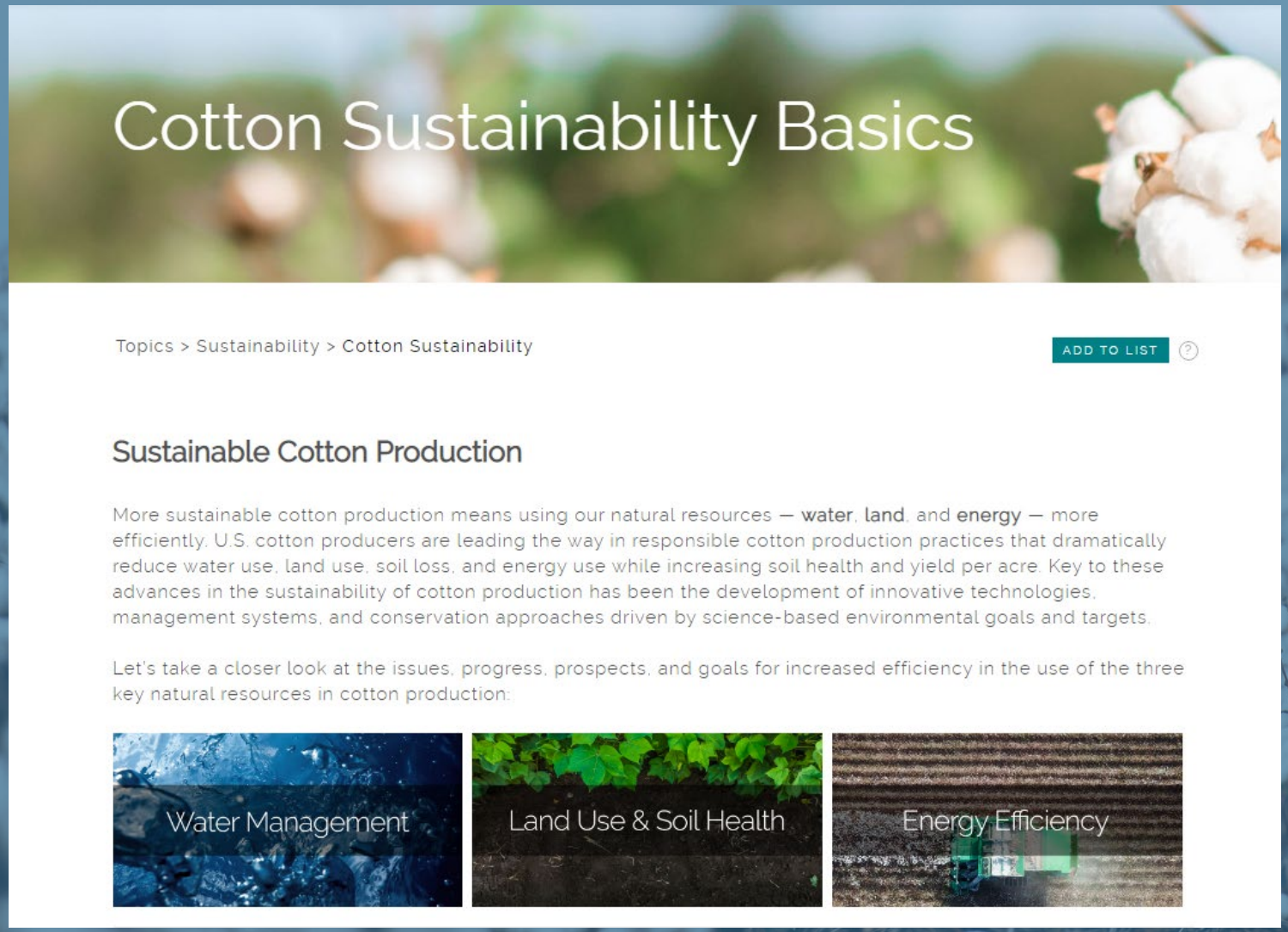

Cotton Sustainability Basics

Learn more about the issues, progress, prospects, and goals for increased efficiency in the use of the three key natural resources in cotton production: **water**, **land**, and **energy**.

Go to **cottonworks.com/cotton-sustainability-basics**

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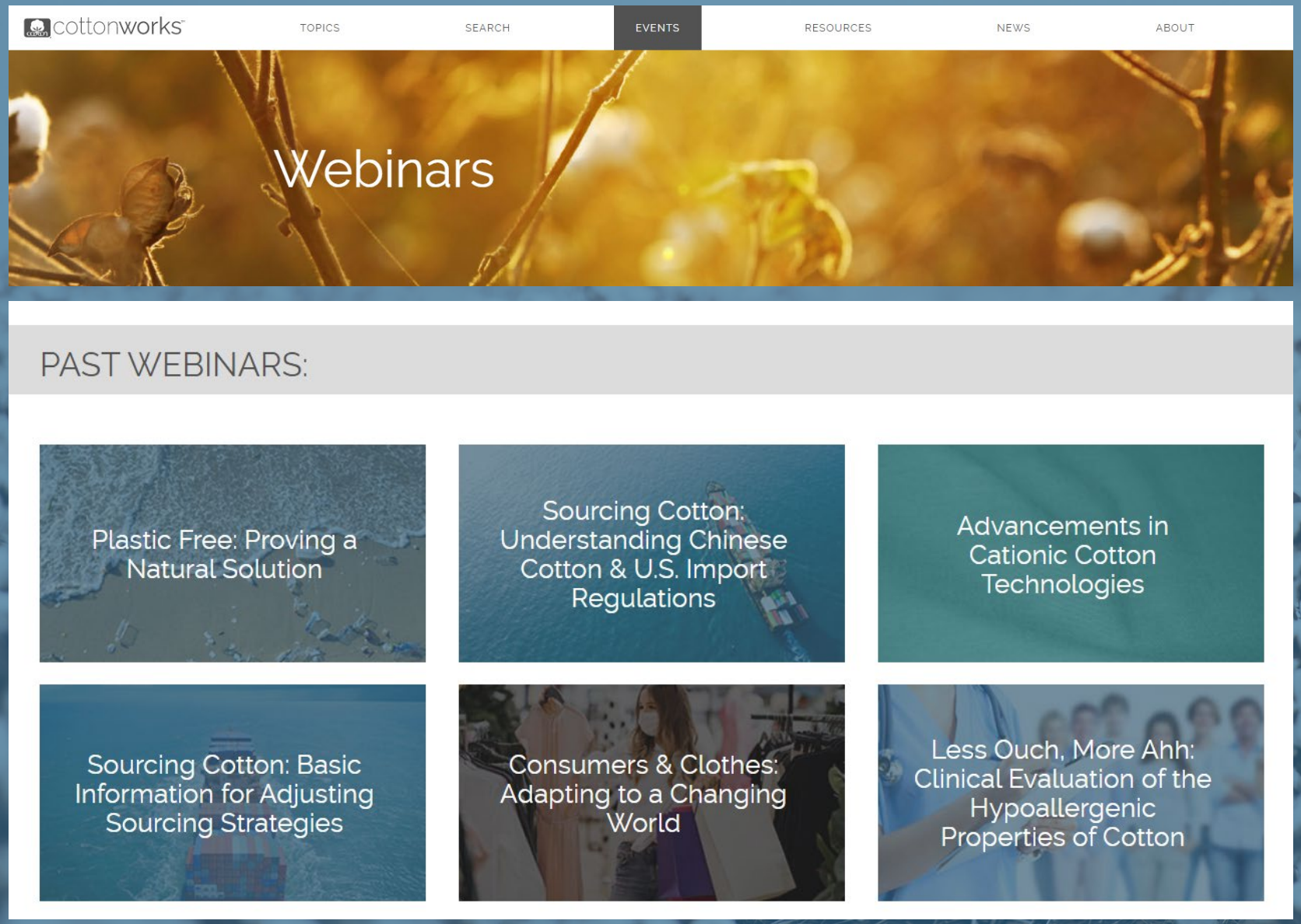

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ADD TO LIST

Basic Information for Developing or Adjusting Sourcing Strategies

The United States imports textiles from more than 80 countries. Brands, retailers, and companies importing apparel and other textiles have many choices when it comes to the geography of sourcing cotton and cotton products. As companies develop or adjust their sourcing strategies, it is helpful to understand vital information about cotton, trade in cotton and production, and manufacturing practices that can affect sourcing and traceability.

Many companies are searching for information about cotton production in China and how this may be affected by current regulations by U.S. Customs and Border Protection.

Sourcing Cotton Webinars

Basic Information for Adjusting Sourcing Strategies

If business conditions, regulations, or compliance requirements have you rethinking your cotton sourcing strategy, this webinar takes you through basic information essential to evaluating your cotton sourcing plan.

Download PDF: Sourcing Cotton: Basic Information for Adjusting Sourcing Strategies

Webinar originally played 2/10/21.

Understanding Chinese Cotton & U.S. Import Regulations

Learn how cotton flows through each stage of China's supply chain and how a leading trade association for U.S. importers is helping companies assess the situation.

Download PDF: Sourcing Cotton: Understanding Chinese Cotton & U.S. Import Regulations

Webinar originally played 3/9/21.

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Submit all final questions now using the Q&A feature.

A brief survey will appear on your screen at the conclusion of this webinar.

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May 11	Setting Sustainability Goals
June 8	Energy and Greenhouse Gas
June 22	Soil Loss
July 20	Water
July 27	Measurement