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FOR ANIMAL AGRICULTURE

Sustainability Challenges and Opportunities

Kim Stackhouse-Lawson, Ph.D.

ASI Convention Fort Worth, TX
January 19, 2023

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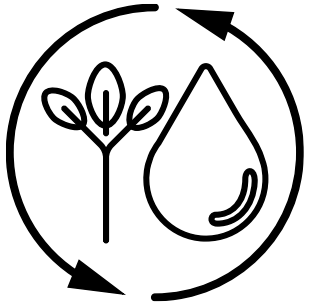


Vision

Animal agriculture is a sustainable component of our global food system by providing economic, social and environmental benefits to Colorado, the nation and the world.

Mission

Identify and scale innovation that fosters the health of animals and ecosystems to promote profitable industries that support vibrant communities.

Aurora Organic Dairy
Juan S. Velez
Chief Agricultural Officer

Beatty Canyon Ranch
Steve Wooten
President, CEO

Beef Marketing Group
John Butler
CEO

Farm Credit Services of America
Marshall T. Hansen
Senior Vice President - Agribusiness Capital

Five Rivers
Mike Thoren
President, CEO

Veterinary Research & Consulting, LLC
Tom Portillo
Partner

RaboBank
Van E. Dewey
Executive Vice President

Midwest PMS, LLC
Pete Anderson
Director of Research

LeValley Ranches
Robbie LeValley
CFO

Kraft Family Dairies
Mary Kraft
CFO

Safeway/Albertsons
Cathy East
Vice President Procurement
Meat/Seafood/Deli

Veterinary Research & Consulting, LLC
Del Miles
Founder

Dr. Kim Stackhouse-Lawson
Director

Dr. John Sheehan
Research Scientist

Dr. John Ritten
Associate Professor

Dr. Nathan Delay
Associate Professor

Dr. Diego Manriquez
Dairy Systems Specialist

Dr. Pedro Carvalho
Associate Professor

Dr. Kevin Jablonski
Associate Professor

Dr. Sara Place
Associate Professor

Dr. Franklyn Garry
Associate Professor

Dr. Shawn Archebique
Associate Professor

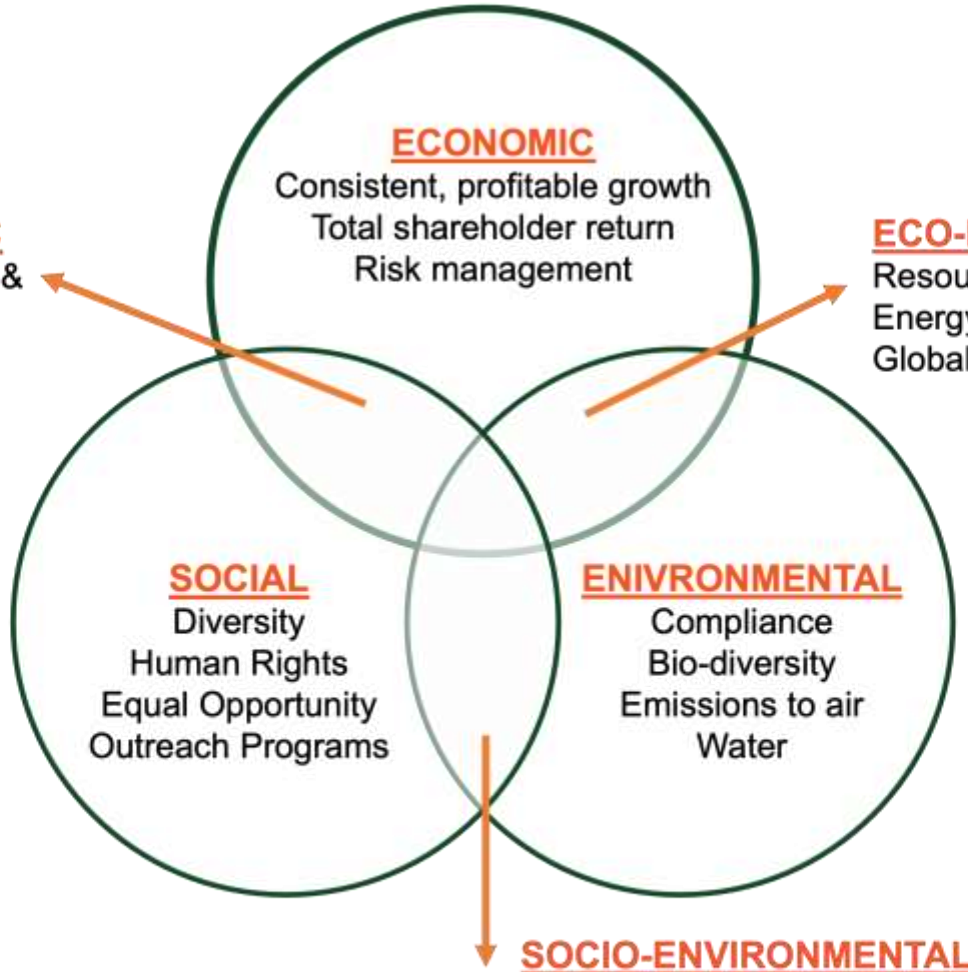
Dr. Greg Thoma
Director of Agricultural Modeling and Lifecycle Assessment

Erica Giesenhagen
Communication and Administrative Coordinator

Jenn “JR” Rieskamp
Communications Manager


LIVE
SCIENCE

Sustainability is Complex, Multi-Faceted and Often Emotionally Driven



Society cares and is asking questions to understand improvement opportunities and progress.

The issue that dominates today is climate change.

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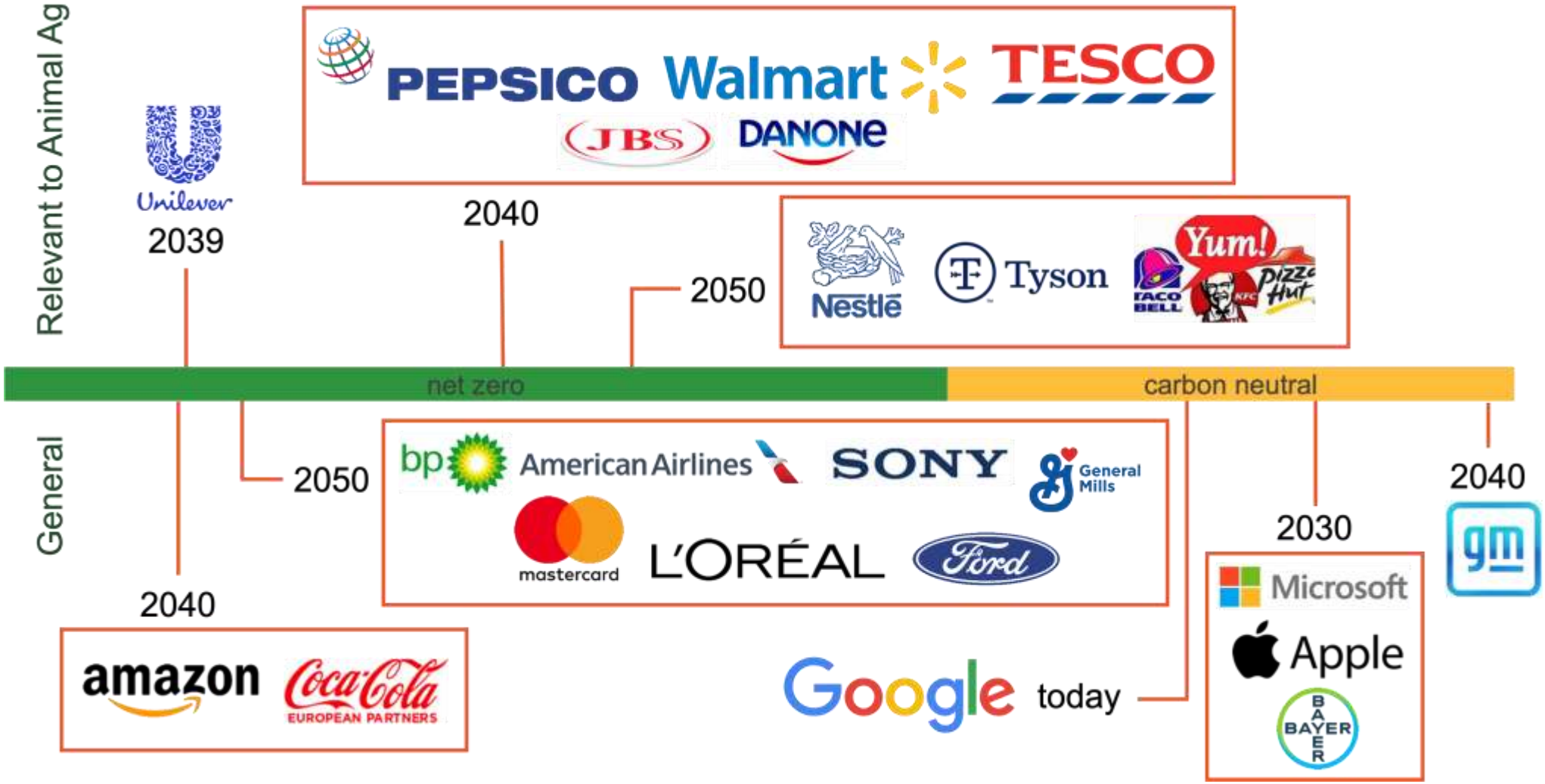
Current Company Commitments



Scope 1	Scope 2	Scope 3
Emissions from owned operation	Emissions from electricity used	Emissions from growing products, from transportation to supermarket, packaging and waste

When a company commits to Net Zero, it often includes its entire value chain, and they rarely know how or have plans to achieve scope-3 emission reductions.

Global Reporting Initiative™

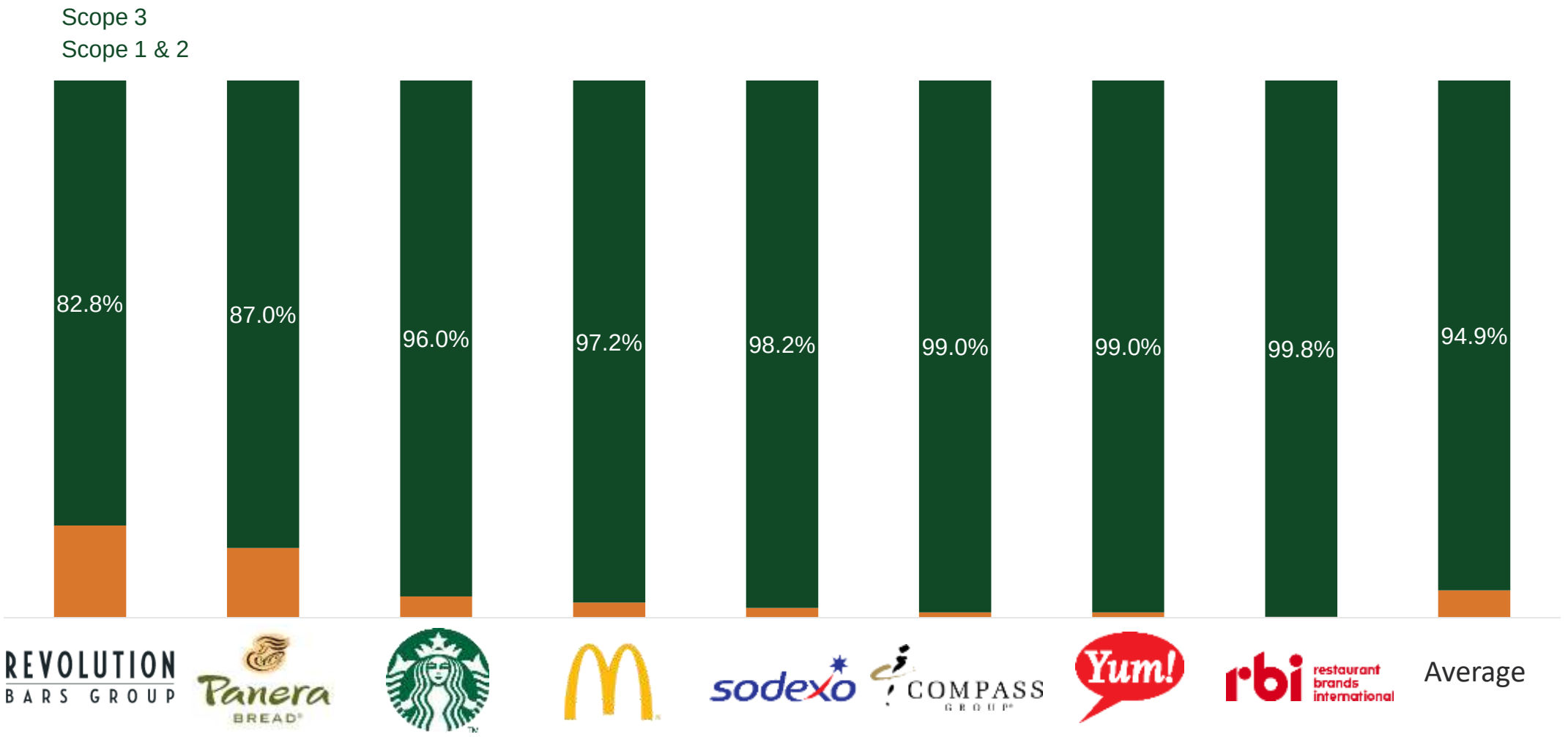
CDP
DISCLOSURE INSIGHT ACTION

SASB
SUSTAINABILITY ACCOUNTING STANDARDS BOARD

TCFD
TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

Scope 3

Accounts for more than 90% of emissions for consumer food companies



Rabobank

The IPCC AR6 Report

- Near term 1.5 to 2 ℃ warming unavoidable
- Many climate impacts also now irreversible
- “Net zero” goals cited by many misinterpret the IPCC

> “…limiting human-induced global warming to a specific level requires limiting cumulative CO_2 emissions, reaching at least net zero CO_2 emissions, along with strong reductions in other greenhouse gas emissions. Strong, rapid and sustained reductions in CH_4 emissions would also limit the warming effect resulting from declining aerosol pollution and would improve air quality.”

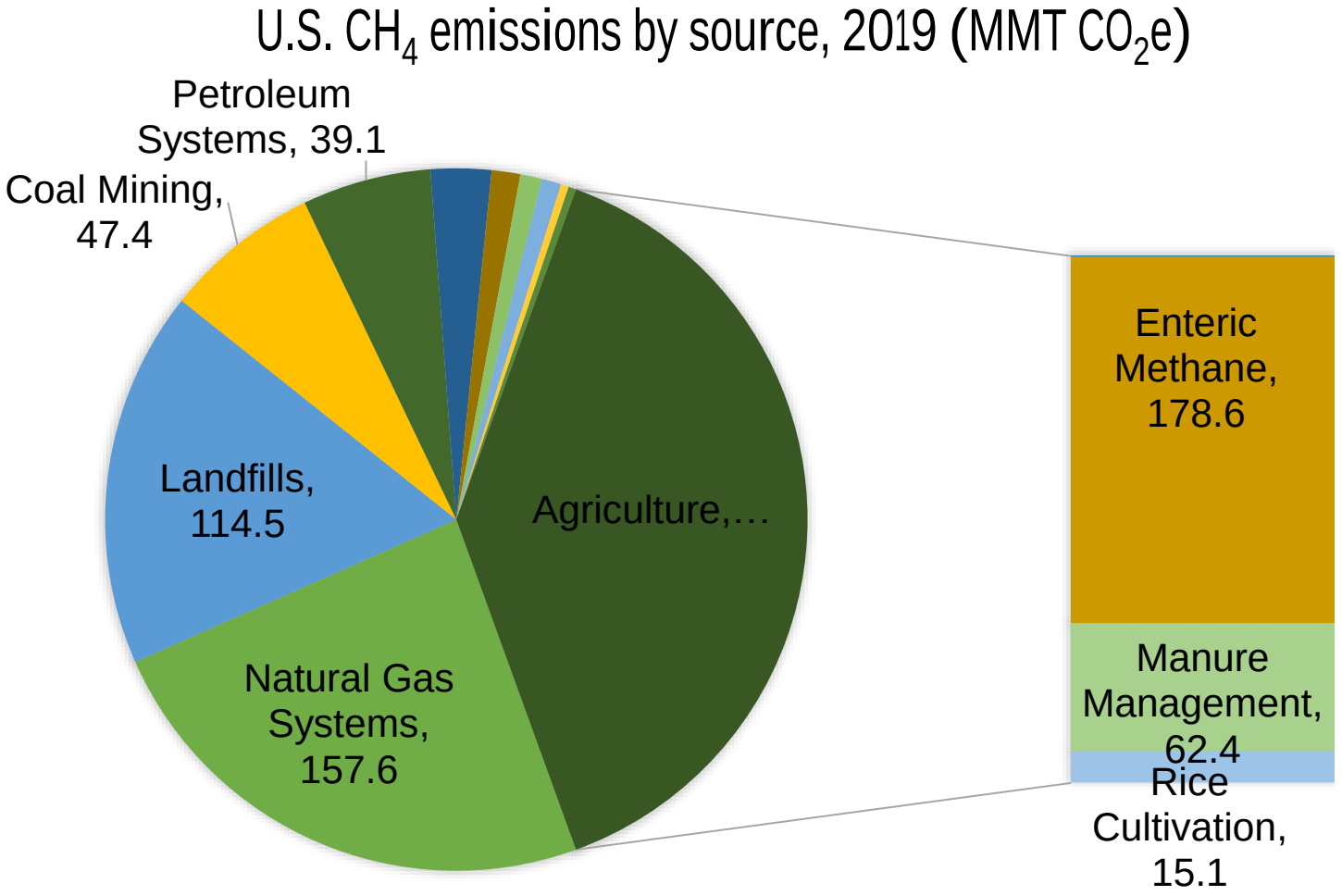
- Methane reductions are seen more as a way of offsetting reduced cooling by sulfate aerosols (fossil fuel reductions coincide with reductions in sulfate aerosols)

Biden's Executive Action: Biden-Harris Administration Commits on Climate Change — Creating Jobs, Building Infrastructure and Delivering Environmental Justice

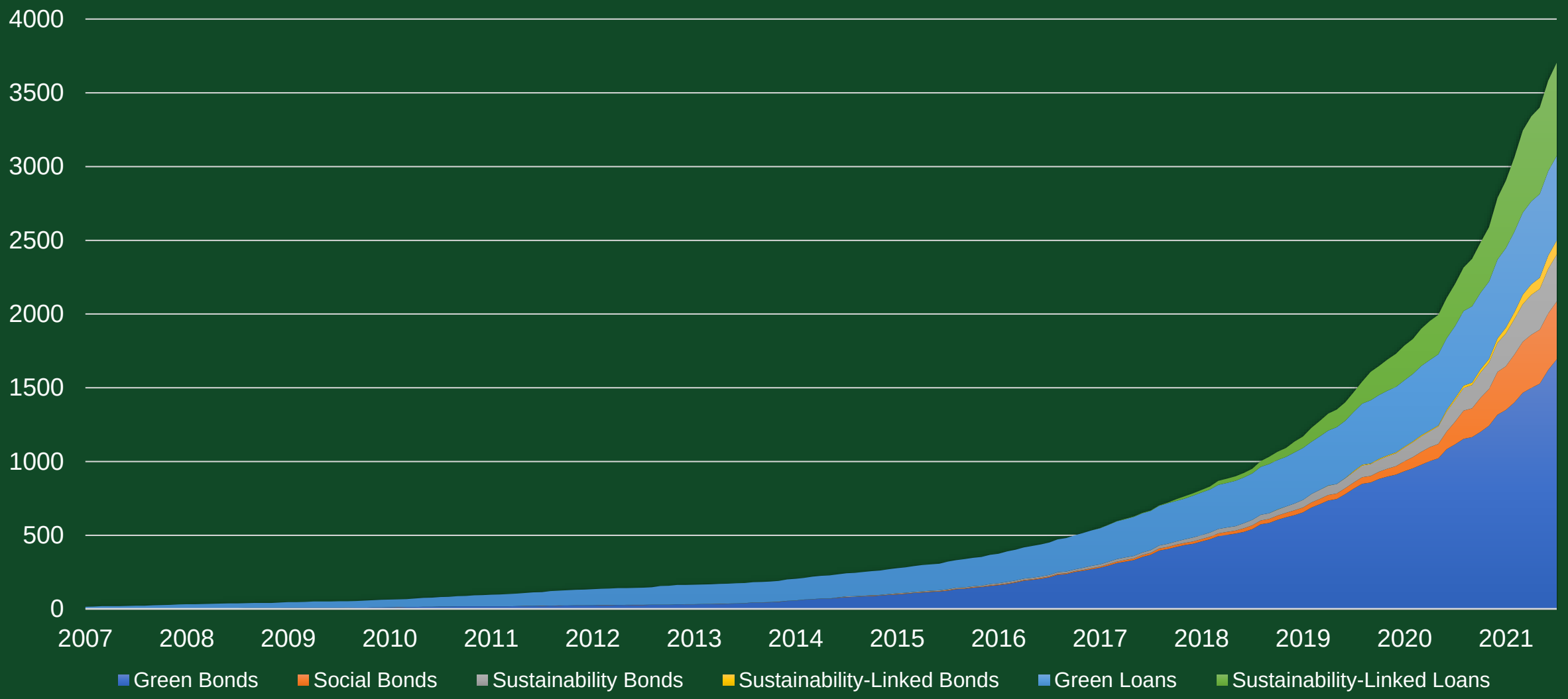
- **Issue of national security**
- **Net Zero economy by 2050**
  - Carbon pollution-free power sector by 2035
  - 30 by 30 program, conserving 30% of lands and oceans by 2030
- **At least 30% reduction of CH_4 by 2030 compared to 2020**

Global Methane Pledge Announced at COP26

- U.S. and EU leadership announce a commitment to reduce CH_4 emissions below 2020 levels by 2030.
- USDA is prioritizing the following to achieve this:
  - The adoption of alternative manure strategies and other methane-reducing strategies
  - Expansion of on-farm generation and use of renewable energy
  - Development of climate-smart agricultural commodities partnership
  - Increased investments in agriculture methane quantifications and related innovations

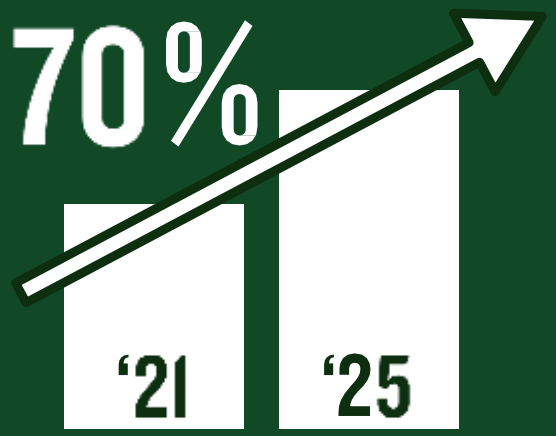


Financial Market Evolution



Source: Forbes

"The long-term story is clear," Philipp Hildebrand, former head of the Swiss National Bank turned vice chairman of BlackRock, told Bloomberg Television this morning. "We're going to continue to see a vast reallocation of capital toward sustainable products."



Assets under the environmental, social and governance umbrella reached $41 trillion globally and are expected to reach $50 trillion by 2025. ESG-related assets account for one in three dollars managed globally.

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SEC's Milestone Proposed Climate-Related Disclosure Framework

- The U.S. Securities and Exchange Commission (SEC) proposed a new rule on March 21 that would require U.S.-listed companies to disclose their physical and transition climate-related risks, actions to mitigate those risks, and greenhouse gas (GHG) emissions
- This proposal seeks to **standardize climate impact reporting** in answer to what is a variable alphabet soup of existing frameworks (SASB, GRI, TCFD, CDP, WEF IBC, etc.)
- It would also require companies to provide **annual** progress updates on their climate commitments
- Reporting Scope 1 and Scope 2 are considered reporting table stakes
- Disclosure of **Scope 3 emissions is mandatory only if output of those greenhouse gasses is material or is significant to investors or if companies outline specific targets** for them
- The proposed rule was approved by the SEC in a 3-to-1 vote; the public will now have up to 60 days to comment on the plan

75%

Of millennials believe their investments can influence climate change

84%

Of millennials believe their investments can help lift people out of poverty

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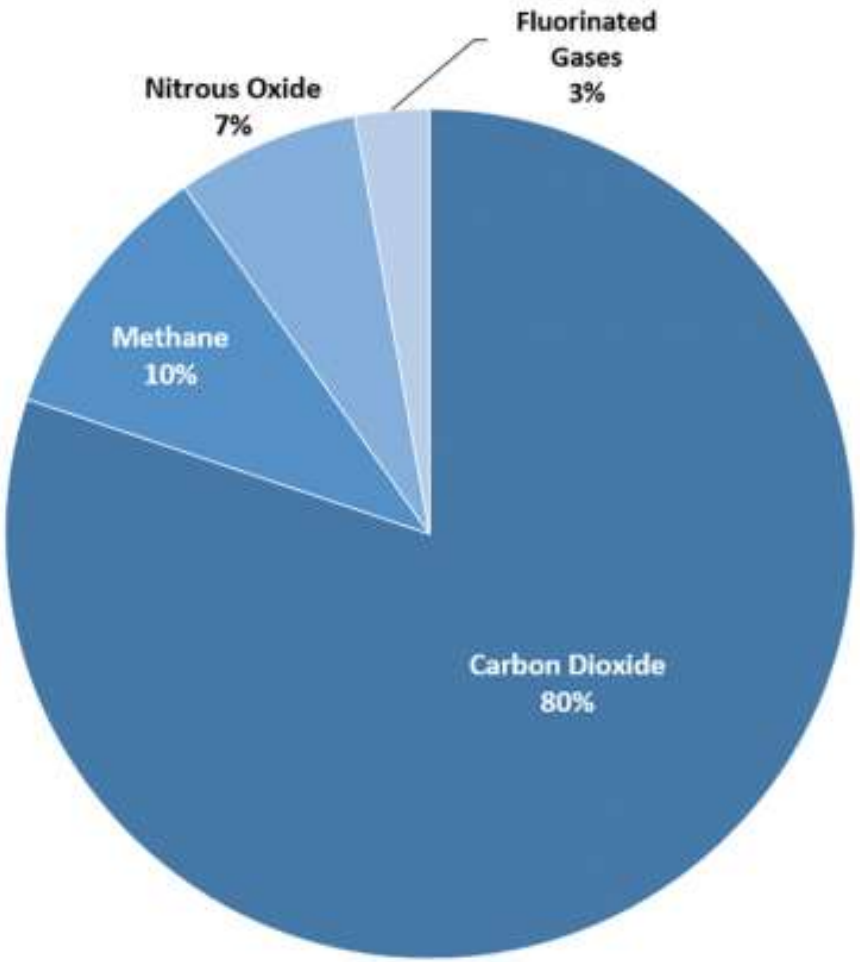
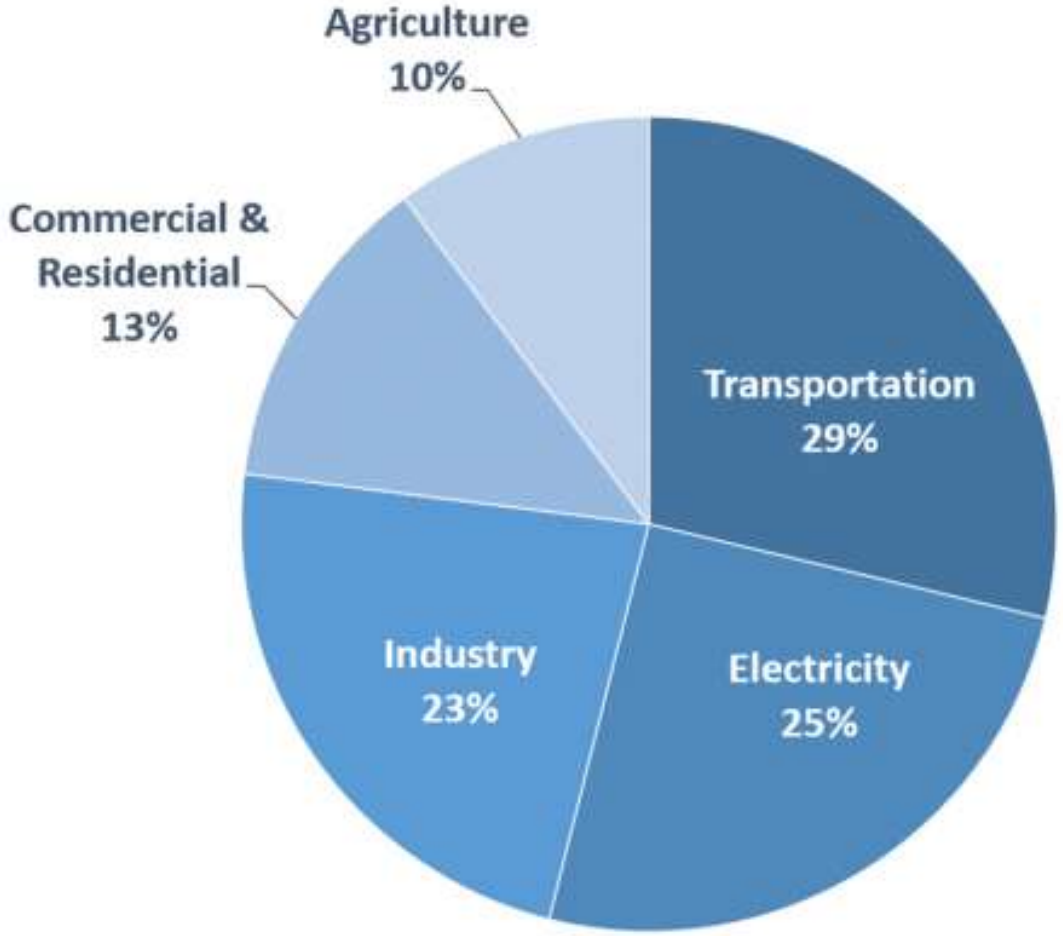
Source: Credit Suisse, Making an Impact: Earing Returns on Sustainable Terms

Overview of U.S. Greenhouse Gas Emissions in 2019

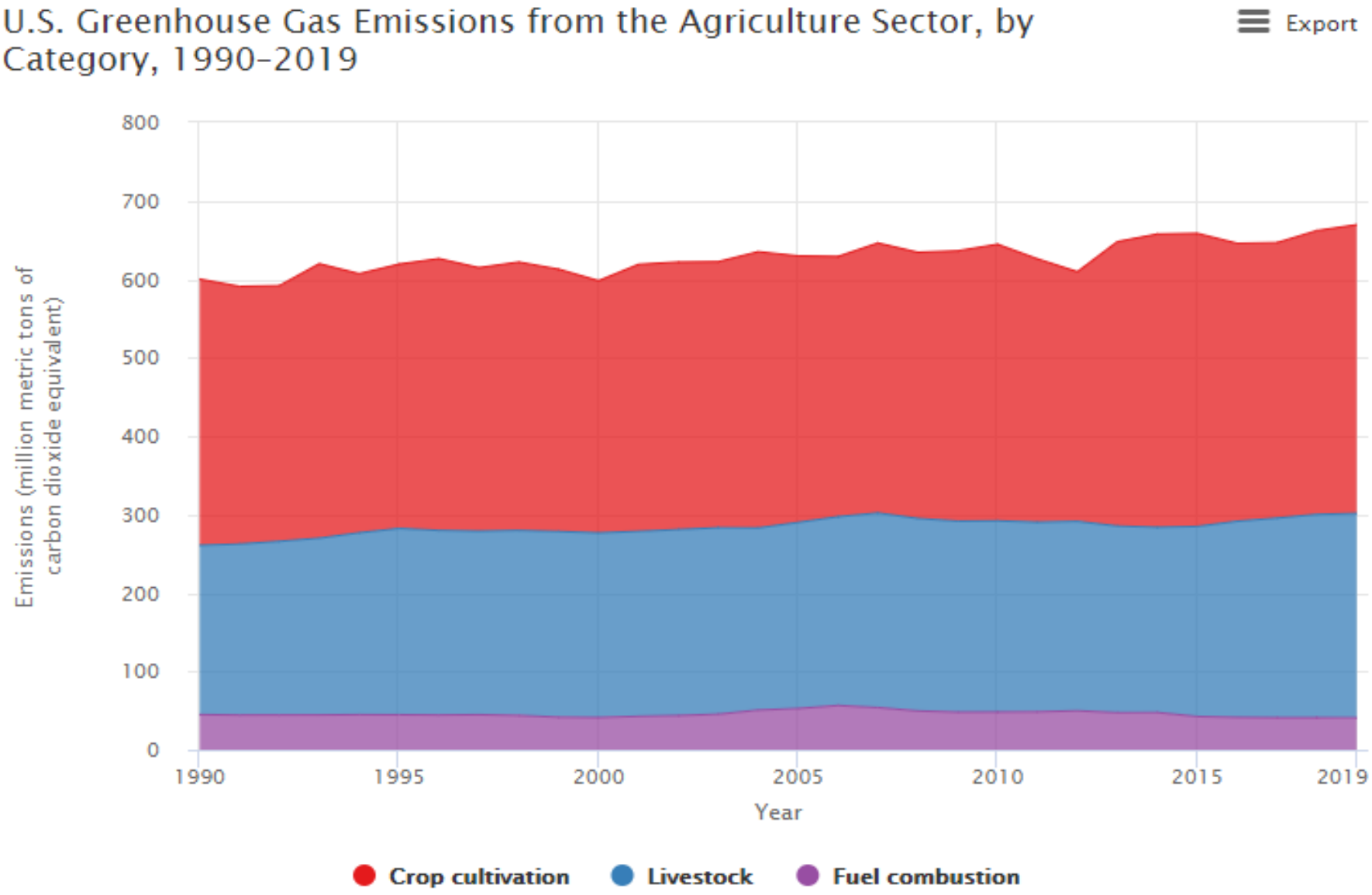


Sources of U.S. Greenhouse Gas Emissions in 2019



Source: US EPA (2021). Inventory of U.S. GHG emissions and sinks: 1990-2019

U.S. Greenhouse Gas Emissions from the Agriculture Sector, by Category, 1990–2019



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019.
https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

Percent change:

1990–2019

Crop cultivation:
▲ 8.4%

Livestock:
▲ 20.7%

Fuel combustion:
▼ 8.9%

Total: ▲ 11.5%

CO_2 increased 9.9%
CH_4 increased 17.5%
N_2O increased 10.4%

Livestock is responsible for 3.8% of U.S. GHG emissions

Environmental Footprints of Beef Cattle Production in the U.S.

150 representative production systems across seven regions

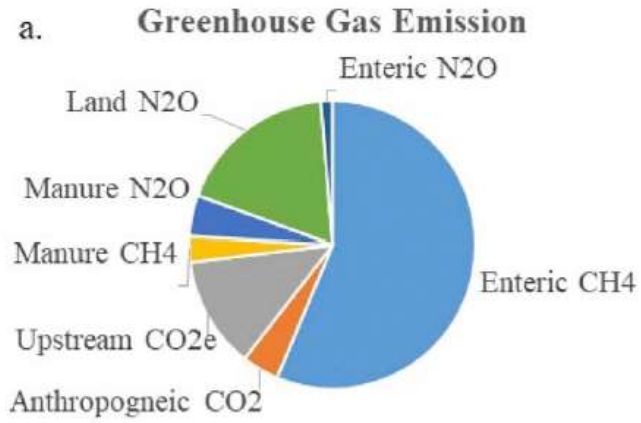


Fig 3 (abrev). Distribution of each environmental footprint among sources

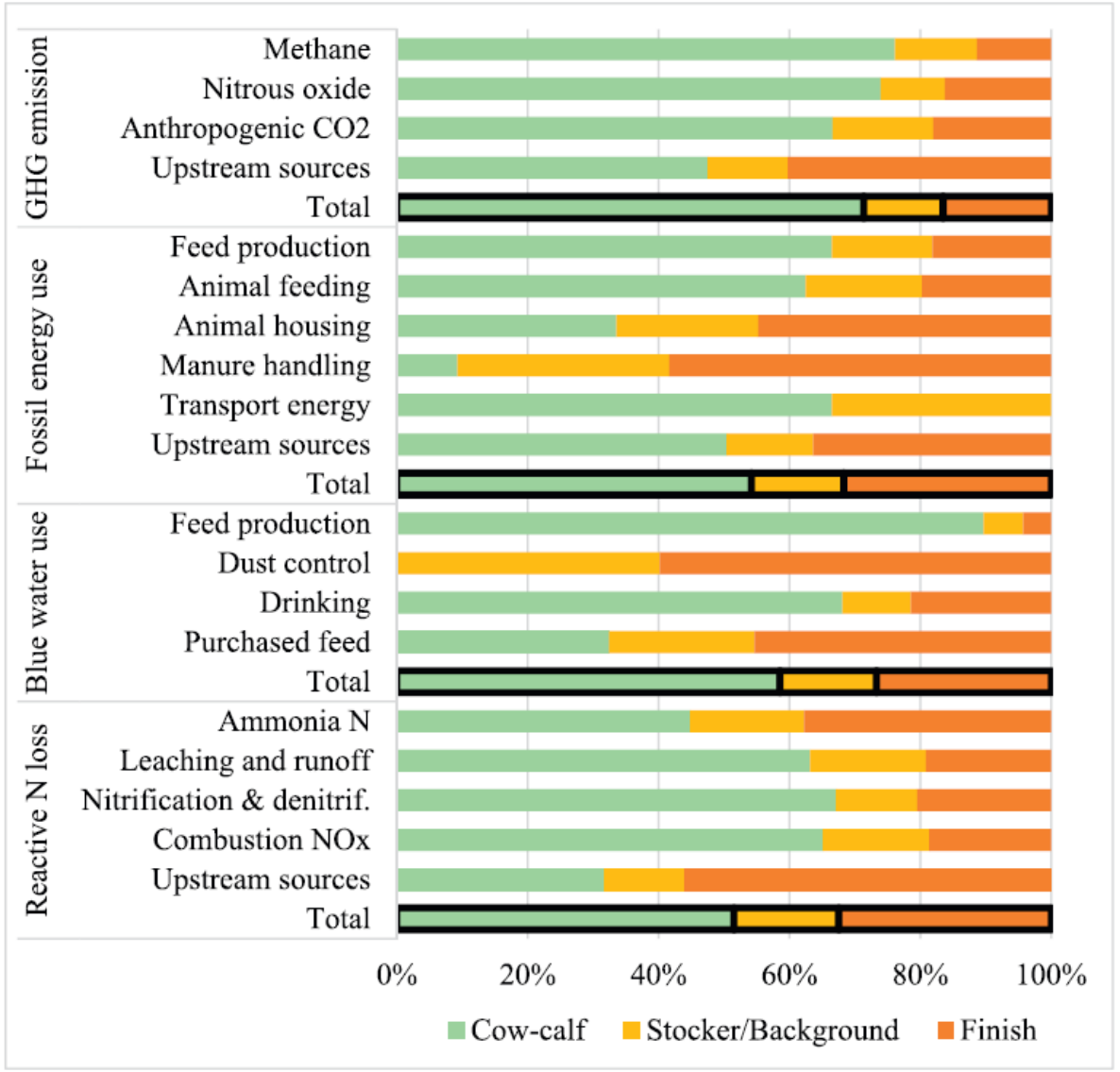


Fig. 2. Distribution of the sources of each environmental impact across the three major phases in the life cycle of beef cattle production.

Source: Rotz et.al, *2019. Agricultural Systems 1369:1-13.*

Enteric Methane Mitgation Strategies

Animal & Feed Management

- Feed Processing
- Genetic Selection
- Improving Animal Health
- Improving Pasture Management
- Increasing Feeding Level
- Increasing Forage Quality
- Optimizing Temperature
- TMR Feeding

Diet Formulation

- By-Products
- Decreasing Forage:Concentrate Ratio
- Minerals and Salts
- Oils and Fats
- Oilseeds
- Protein Feeds
- Tanniferous Forages
- Urea

Rumen Manipulation

- Additive
- Defaunation
- Electron Sink

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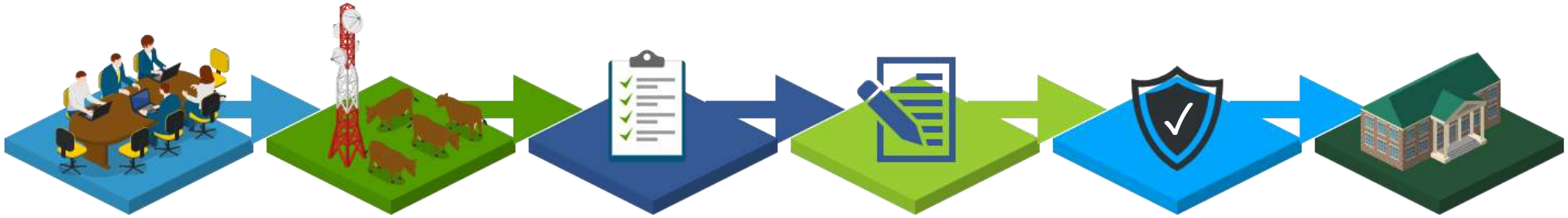
Source: Arndt, 2022

The Potental Carbon Market



CO-DEVELOP PROJECT AND PRACTICES

MEASURE AND DEMONSTRATE OUTCOMES

REPORT AND VALIDATE

DEVELOP PROTOCOLS

VERIFY

MARKETPLACE FRAMEWORK

Inset vs. Offset Markets

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Livestock allow us to produce food on land unsuitable for cultivation while enhancing ecosystems

Rangelands store 20% of the globe’s soil organic carbon

The most important thing we can do for soil organic carbon in rangelands is to:

1. Preserve rangelands (avoid conversion)
2. Restore cultivated and degraded lands
3. Practice adaptive livestock management

This does not consider the benefits of other ecosystems services (e.g., wildlife habitat, water storage capacity, etc.), rural community well-being and rural economies

Source: Sanderson et. al., *2020. Cattle, conservation and carbon in the western Great Plains. Journal of Soil and Water Conservation*

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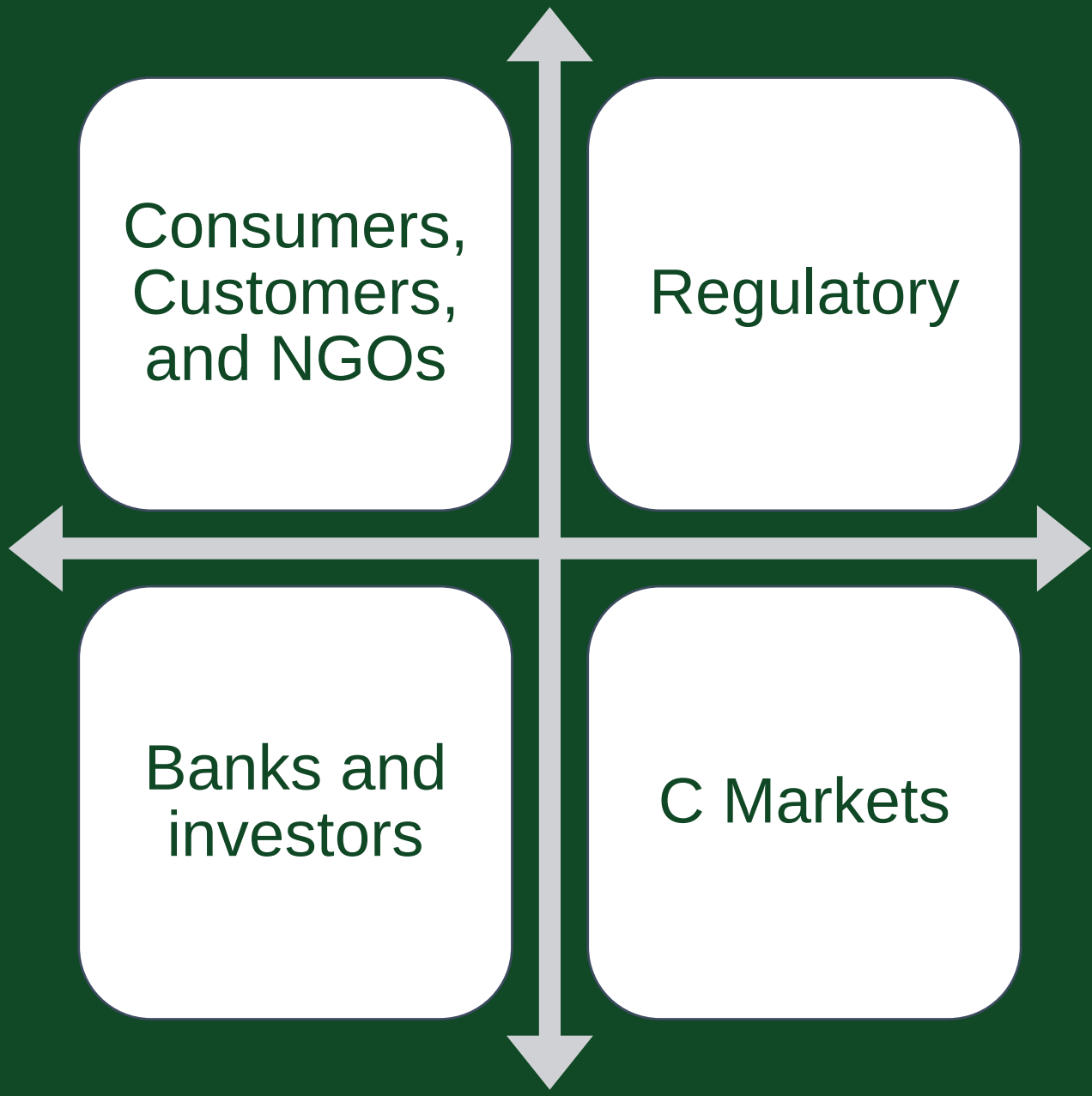
Pressure to Take Action is Coming from Every Angle



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The Landscape in Summary

- Climate will be a focus in sustainability for the foreseeable future (social equity for corporations will be comparable)
  - Total methane emissions are increasing
- The impact of animal agriculture on climate is measured and reported differently
- Behind in research, we don’t have a good “start here” for the supply chain
- Corporate programs have significant supply-chain expectations

Productivity STILL Matters

- We must maintain productivity AND reduce emissions and improve other sustainability attributes
  - Animal health – this is the next lowest hanging fruit
  - Animal performance
  - What other opportunities exist?
    - Genetic potential, feed additives, systems analysis

Next 5 years.....

There is no clear path, but this train is moving

1-2 years

- C/footprint reporting, focused on reductions
  - GWP*
  - Expectation to report efficiency and absolute emission reductions
- Social equity reporting will also be mandatory

2-3 years

- Development of a C market (inset market) and we will see the price of C increase to incentivize producer adoption of climate-smart practices
  - We need to help define these markets (and rules)

3-5 years

- Implement practices and report progress to reduce impact on climate (and other tough issues)

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CLIMATE SMART INNOVATION

CLIMATE SMART PENS

6 Climate-Smart Research Pens

6 GreenFeeds & **12 SmartScales**
totaling 1 GreenFeed & 2 SmartScales per pen

50 head pens,
space for
300 cattle

5 SmartFeeds
per pen for individual animal intake

The Climate-Smart Pen installation at ARDEC is the largest public institution research facility of its kindmeasuring sustainable livestock systems and cattle GHG emissions.

IRRIGATED GRAZING PIVOT

200 acres
of irrigated cool season pasture managed with rotational grazing practices

2 pasture GreenFeeds
emission measurement systems
CH_4 • O_2 • CO_2 • H_2

2 SmartFeed Pro trailers
for precision delivery of feed additives

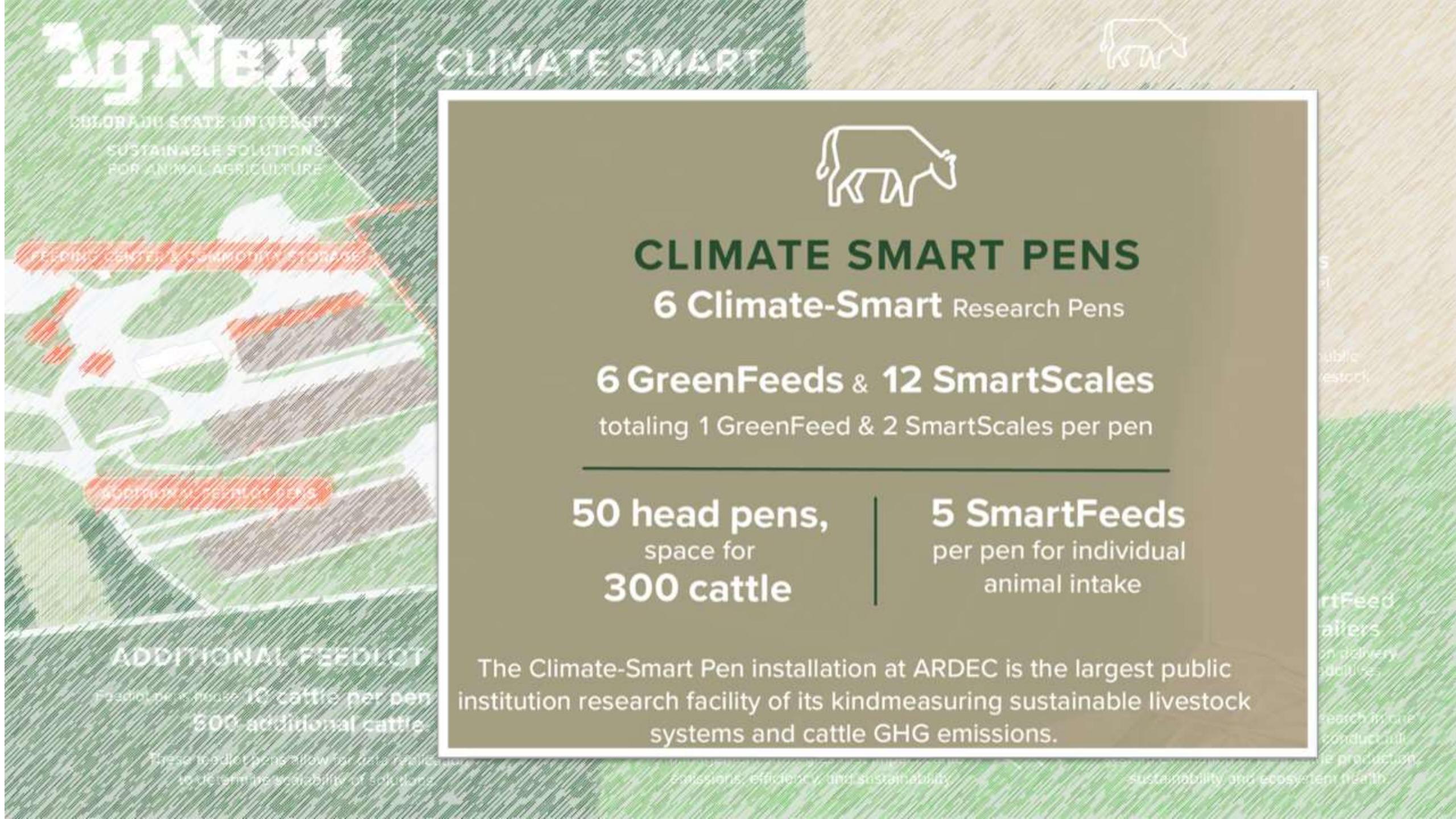
GreenFeeds combined with SmartFeeds allow for evaluation of dietary and management strategies that impact cattle emissions, efficiency, and sustainability.

Having grazing and feedlot research in one facility allows researchers to conduct full system evaluation of beef cattle production sustainability and ecosystem health.

ADDITIONAL FEEDLOT PENS

Feedlot pens house **10 cattle per pen** for a total of **500 additional cattle.**

These feedlot pens allow for data replication to determine scalability of solutions.



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Organic and traditional milk production

Intensive and extensive grazing systems

Feed additives and other technologies that apply to large and small-scale producers

What differentiates AgNext?

- Strongest innovation in the U.S.A.
  - Multi-disciplinary team with academic and supply chain experience
  - Alliances with other Universities, USDA-ARS, industry leaders, and NGOs
  - Research capabilities with full life cycle measurement, verification, and reporting
  - Partnerships → research → communication
- Strategic alignment with supply chain partners and industry needs
  - Industry Innovation Working Group
  - Support of Climate-Smart Research Facility
  - Focused on scalability and unintended consequences
  - In-kind support of cattle and feed for all research projects
- We are fully invested in the sustainability of the beef and dairy supply chains to ensure a resilient food system

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Thank you!

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