

Update on the Environmental Footprint of the U.S. Sheep Industry

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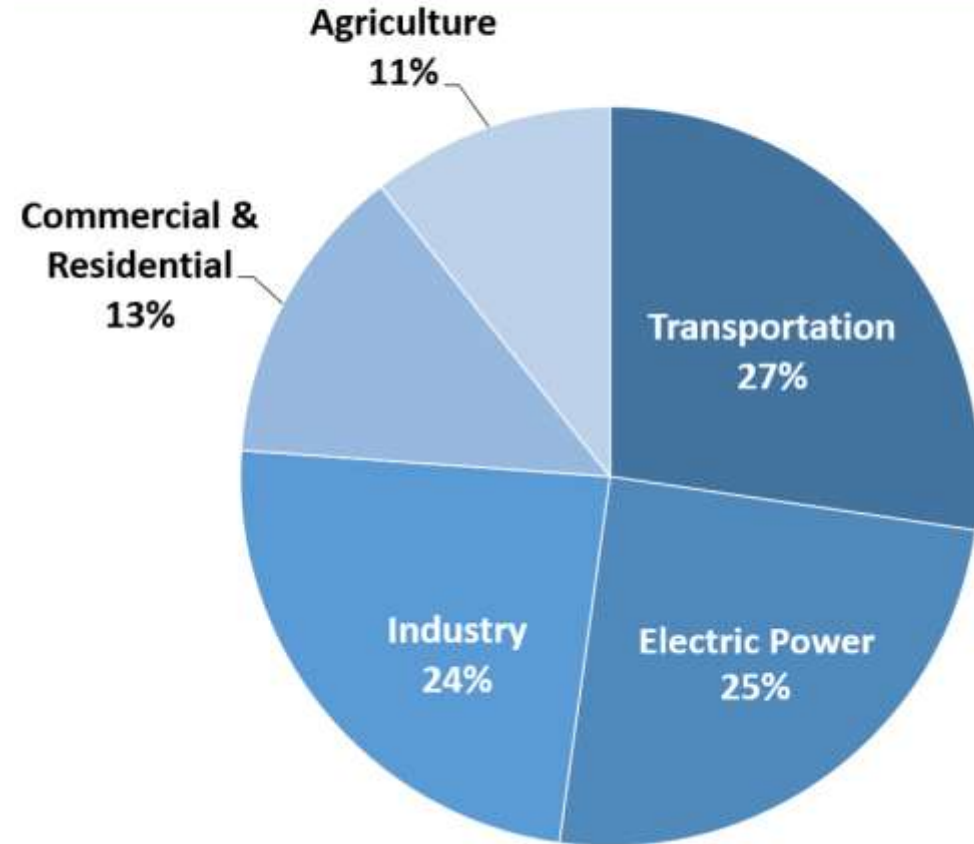


Photo courtesy of Cat Macaluso

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2020

Greenhouse gases

- Carbon dioxide (CO₂) 80%
 - Fossil fuels
 - Electricity production
 - Fertilizer, lime, herbicides/pesticides
- Methane (CH₄) 10%
 - Enteric fermentation
 - Manure
- Nitrous oxide (N₂O) 7%
 - Manure, Fertilizer

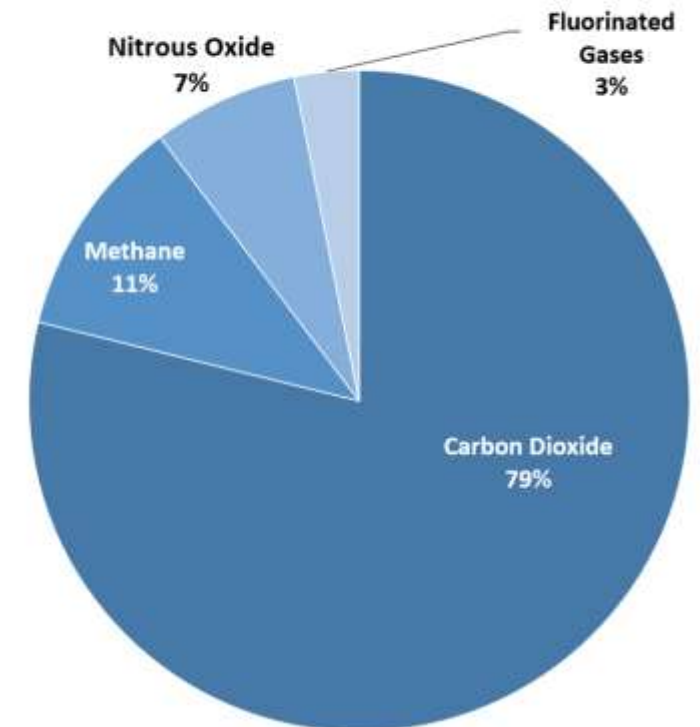


- **Animal agriculture is 3.9% of U.S. GHG emissions**
- **Ruminants ~2.3%, mostly cattle**
- **Sheep approximately 1/100th of cattle (0.023%)**

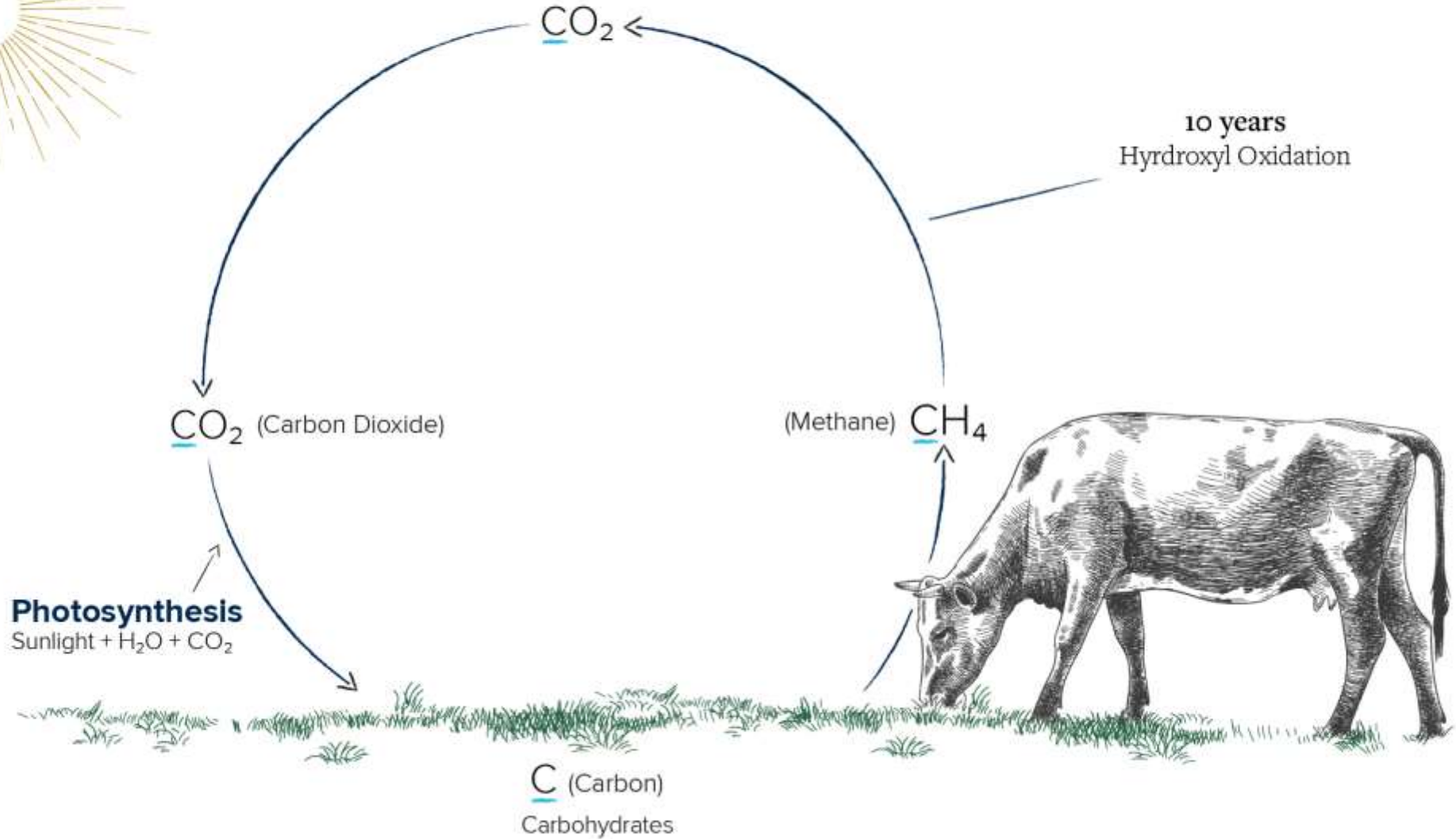
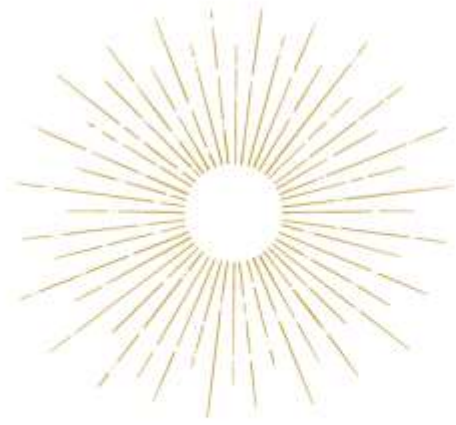
Are all greenhouse gases the same?

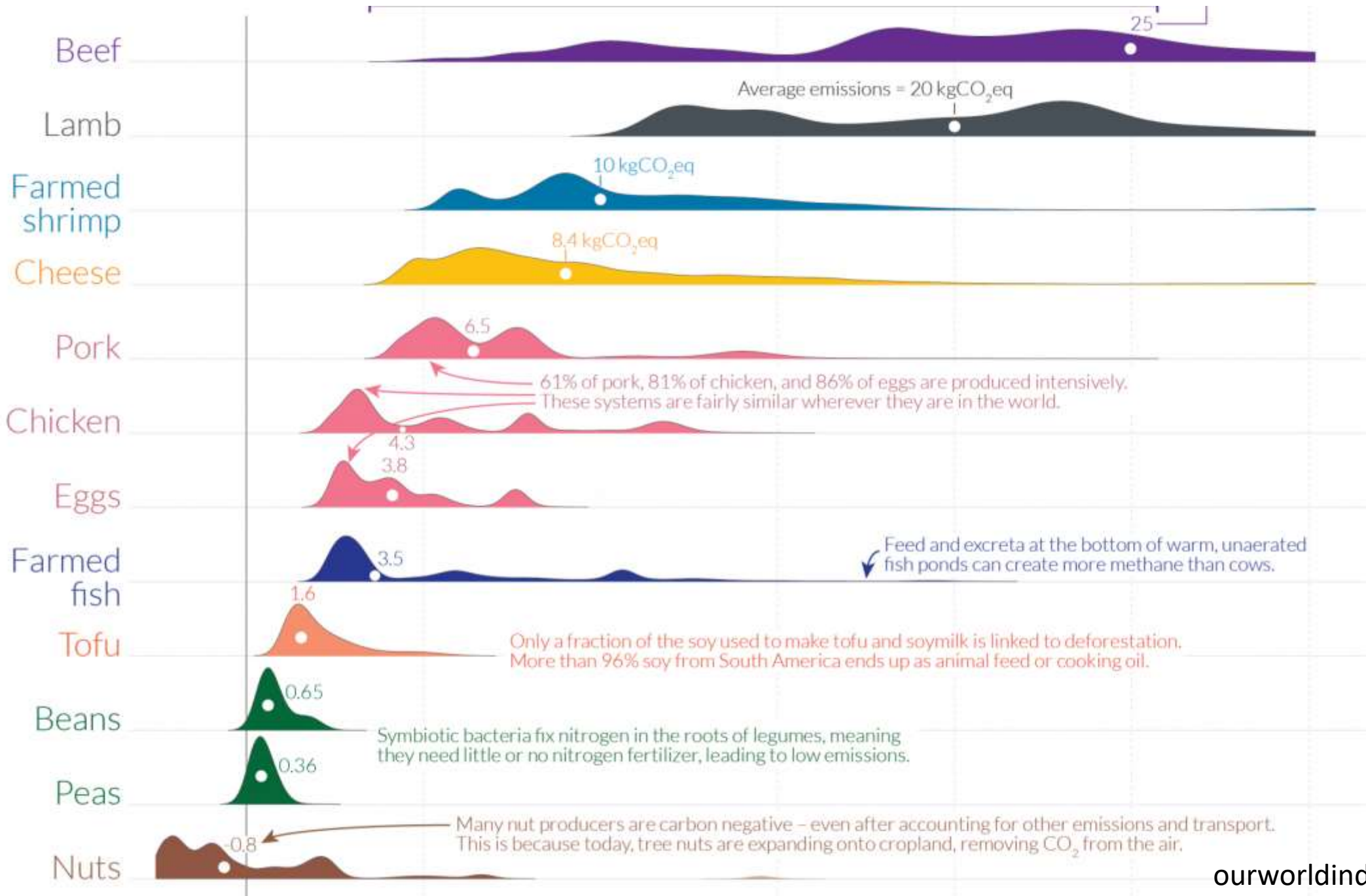
- Carbon dioxide (CO₂) is the **standard metric** for reporting GHG emissions
 - CH₄ and N₂O are reported as CO₂ equivalents – CO₂e
 - Multiply each gas by its relative effect on warming
- Nitrous oxide (N₂O)
 - Ammonia and nitrogen oxides are converted into N₂O
 - **Very strong** GHG, ~300x more than CO₂
 - ~80% of N₂O emissions in U.S. are from N fertilization
- Methane (CH₄)
 - Bacterial **fermentation** product – rumen and manure
 - 28x stronger GHG than CO₂

Overview of U.S. Greenhouse Gas Emissions in 2020



Biogenic Carbon Cycle





Previous sheep footprints

- Environmental Working Group 2011
 - Ohio high and low productivity farms, Idaho farm
 - **18-24** kg CO₂e/kg lamb at farmgate
- Dougherty et al. 2019
 - 5 major systems in CA
 - **13-23** kg CO₂e/kg lamb
- Jones et al. 2014
 - Upland, Lowland, Hill systems in England and Wales
 - **13, 11, 18** kg CO₂e/kg lamb
- Trends: higher productivity = lower CO₂e/kg lamb

Evaluating the Environmental Footprint of the U.S. Sheep Industry

- Principle Investigator: Richard Ehrhardt
- Chief investigator: Erin Recktenwald
- Funded by: American Lamb Board
- Collaborators: Jason Rowntree and Kim Cassida
- Objectives:
 - Develop a GHG emission **model** for lamb production, partial LCA from cradle to farm gate
 - Collect **data** from a diversity of lamb production systems in the USA
 - Create a **peer-reviewed report** on the US lamb production footprint
 - Identify **mitigation strategies** to reduce GHG and develop an outreach plan



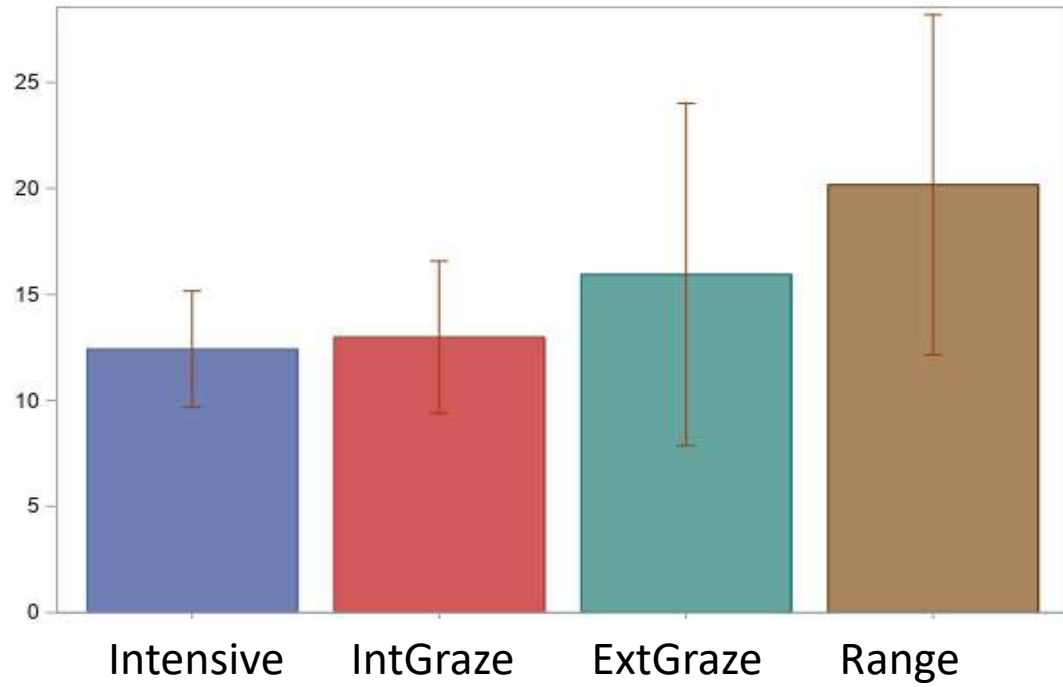
Production categories

- **Intensive production:** high prolificacy, mainly housed ewes and lambs
- **Intensive grazing:** high prolificacy, moderately intensive grazing management
- **Extensive grazing:** moderate prolificacy, less intensive grazing management
- **Range:** native pasture, low inputs, mainly sold as feeder lambs
- **Feedlot:** intensively managed/fed lambs, indoors or dry lot

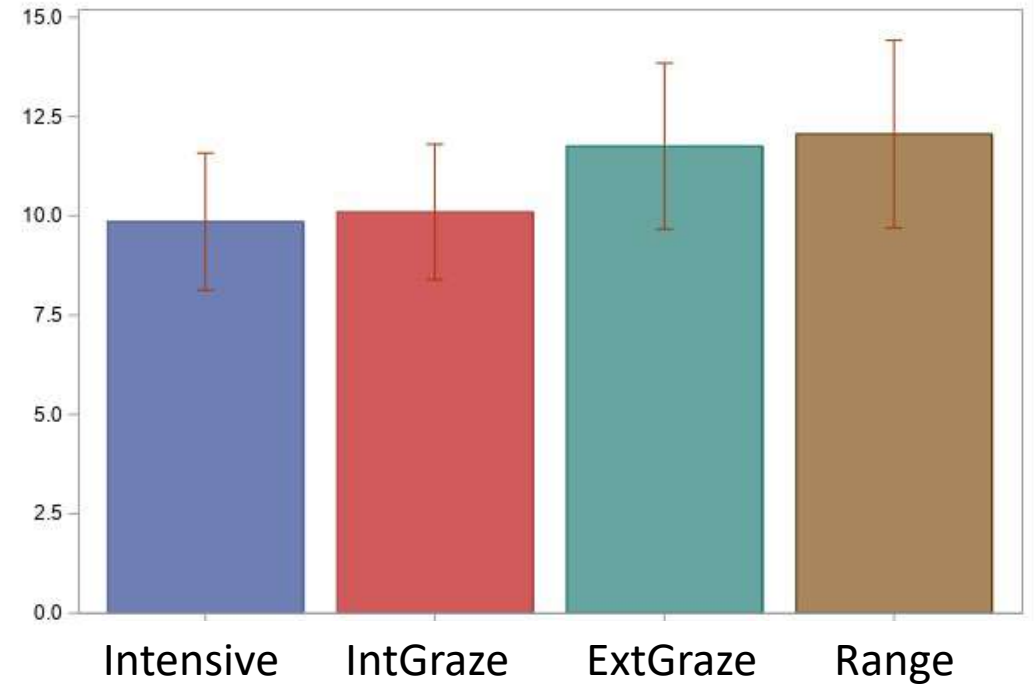
Descriptive elements of US sheep production systems

	Intensive	Intensive graze	Extensive graze	Range
Number of breeding ewes	1400 (200-4800)	1600 (300-3900)	280 (120-400)	2800 (1500-4500)
% of year on pasture	13 (0-31)	65 (42-97)	89 (55-100)	94 (75-100)
Feed purchased/ewe/year, lb	1200 (540-2000)	690 (210-1800)	290 (60-670)	40 (0-90)
ADG of market lambs, lb/d	0.77a (0.74-0.82)	0.44b (0.35-0.58)	0.53b (0.45-0.61)	0.54b (0.46-0.61)
Weaned lambs/ewe/year	1.88a (1.6-2.2)	1.62a (1.5-1.7)	1.18b (0.9-1.5)	1.01b (0.8-1.3)

CO₂e/kg all lamb sold



CO₂e/kg all product sold

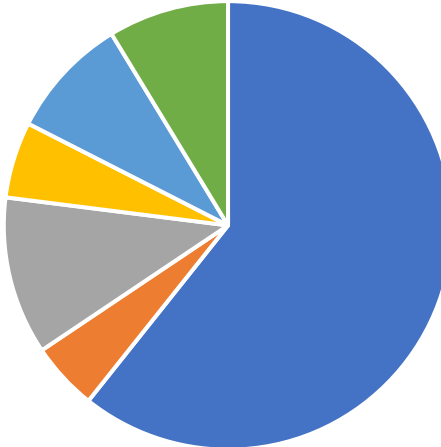


	Intensive	Intensive grazing	Extensive grazing	Range
% of revenue from wool	0.3	1.4	0.2	8.3
% of protein from wool	8.2	10.0	2.4	19.2

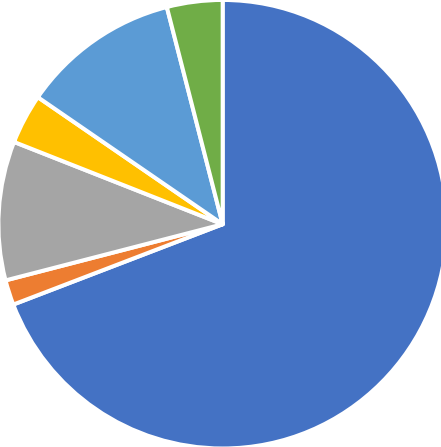
Intensive sources of GHG



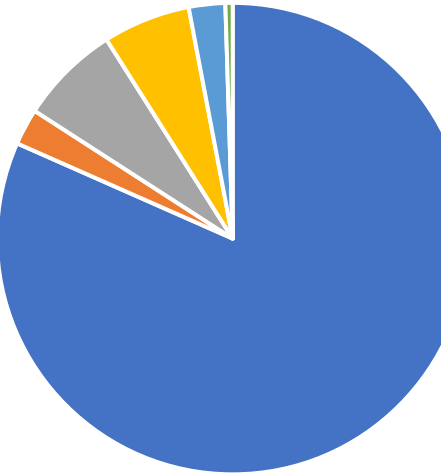
Intensive grazing sources of GHG



Extensive grazing sources of GHG



Range sources of GHG

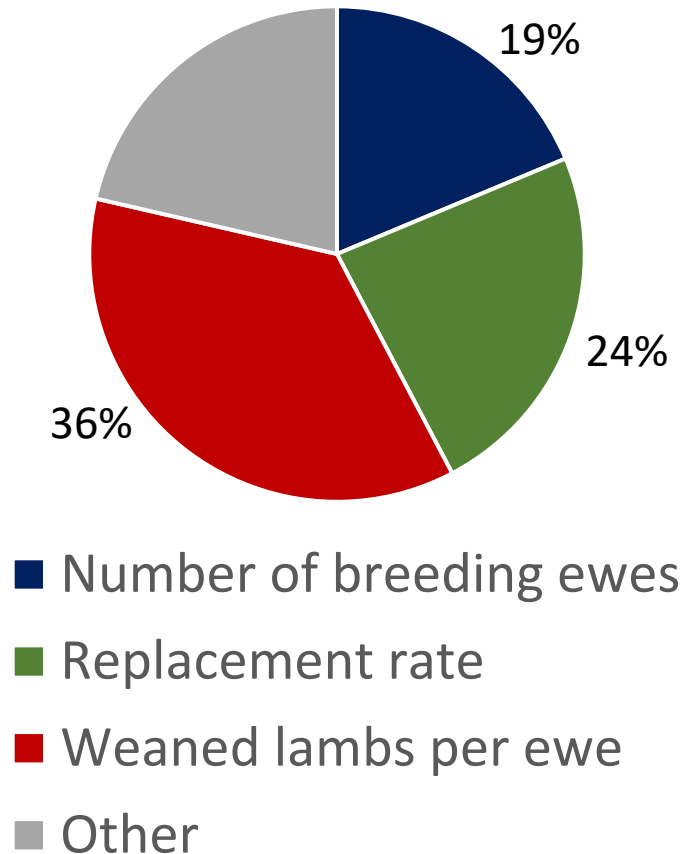


- Enteric CH4
- Manure
- Land
- Fuel and electricity
- Purchased feed
- Other

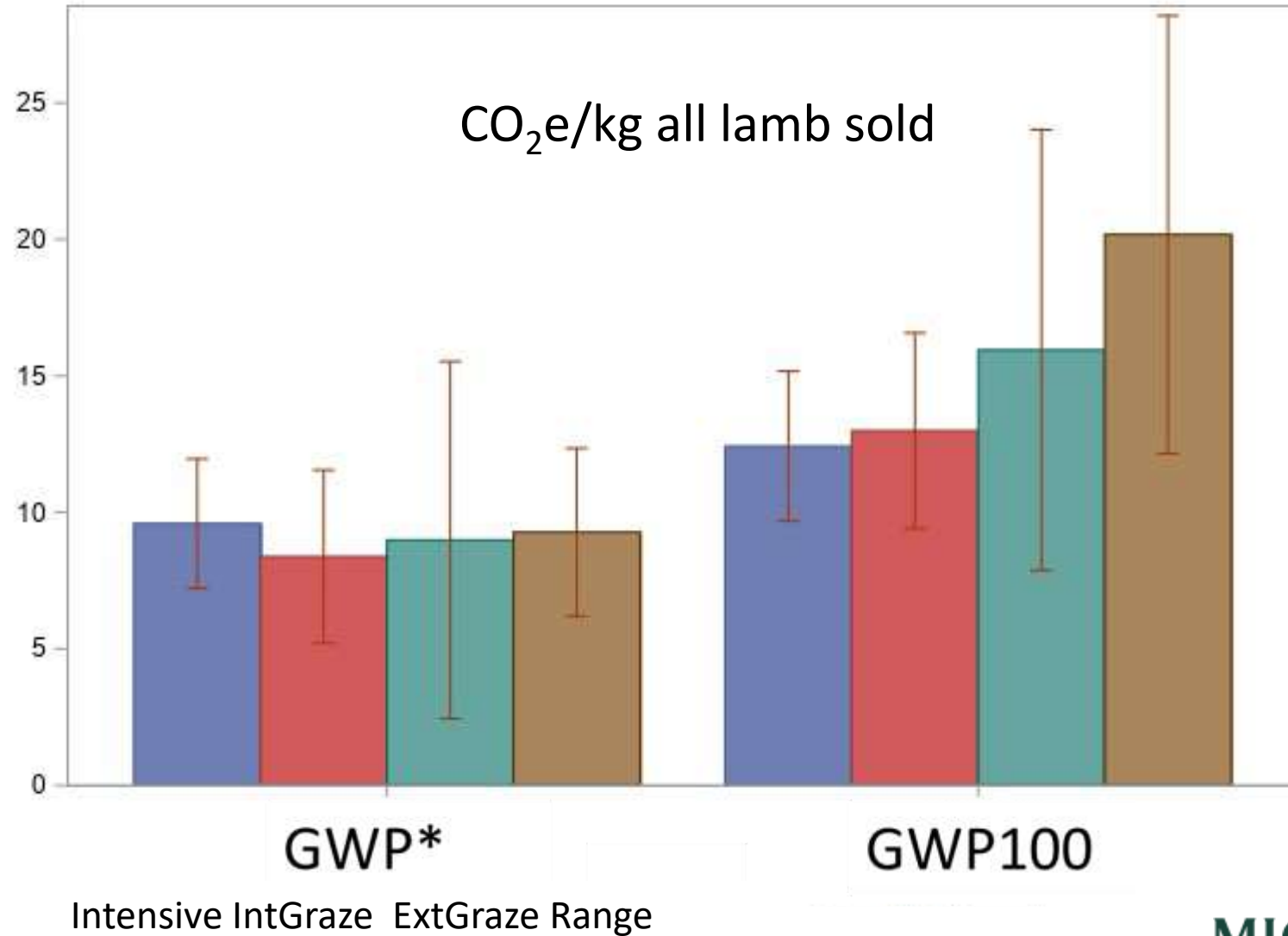
Factors that impacted GHG/kg lamb

- Used statistical selection procedure (stepwise regression) to identify the most impactful GHG factors

1. **Weaned lambs per ewe**
2. **Replacement rate**
3. **Number of breeding ewes**
4. % of time on pasture
5. Kg feed per ewe
6. Ewe first breeding age
7. Fuel per ewe
8. ADG market lambs



Comparison of Methane Accounting Methods



Multiple ways sheep production may improve environmental footprint

- **Efficiency**: more product with fewer inputs
 - Reproductive efficiency (lbs lamb/ewe)
 - Feed efficiency (lbs lamb/feed)
 - Use of inputs (lbs lamb/fertilizer and fuel)
 - Market at optimal age/size endpoint (maximize lbs of lean lamb/ewe/yr)
- Land management
 - **Cover crops** and **reduced till** generally improve soil health and C balance
 - **Grazing** may provide opportunity for C sequestration
 - Provides habitat for wildlife and natural vegetation
 - Maintains or improves **biodiversity** (birds, butterflies, and bees)
 - Protect water sheds
 - Control **invasive**/toxic species
 - Reduces fuel load for potential wildfires

U.S. steps to reduce agricultural methane

- Growing Climate Solutions Act (2021)
 - Establishes a system for trading carbon credits
 - Not just big farms who can afford monitoring and technology
- USDA enhanced Conservation Reserve Program
 - Additional 4 million acres able to receive higher rental rates
 - Climate incentive payments
- Partnerships for Climate Smart Commodities
 - \$1 billion to incentivize and research climate beneficial practices
 - Manure management, on-farm renewable energy, feed additives, adoption potential
 - 141 selected projects
 - American Lamb Board recent recipient



Thank you!

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