U.S. Feedlot Adoption of Enteric Methane Emission Mitigating Technology

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Risk & Profit Conference

August 15, 2024

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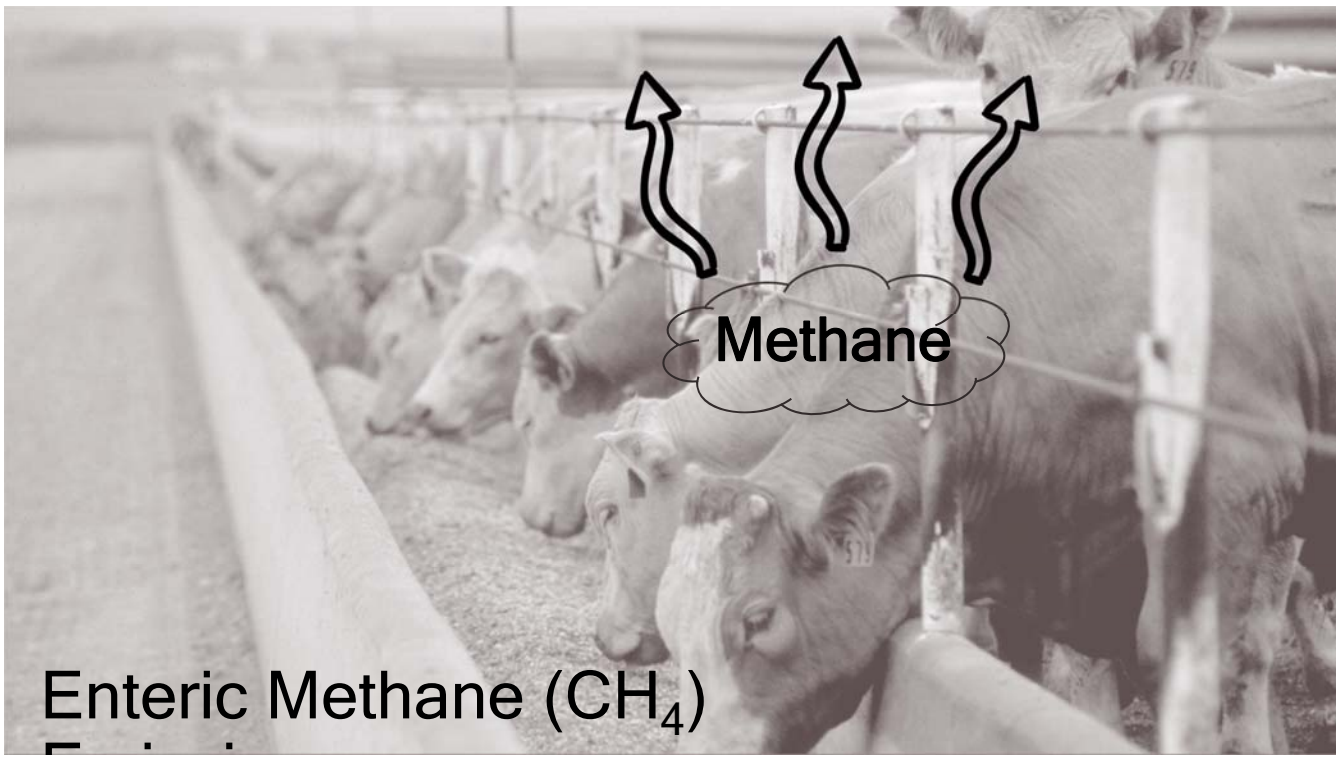
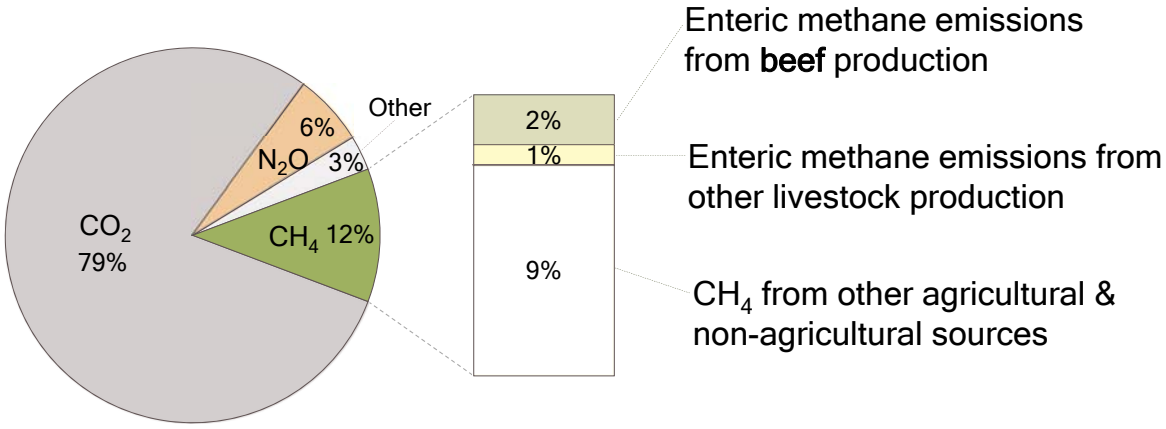
Department of Agricultural Economics



Enteric Methane (CH_4)

Total U.S. Greenhouse Gas Emissions



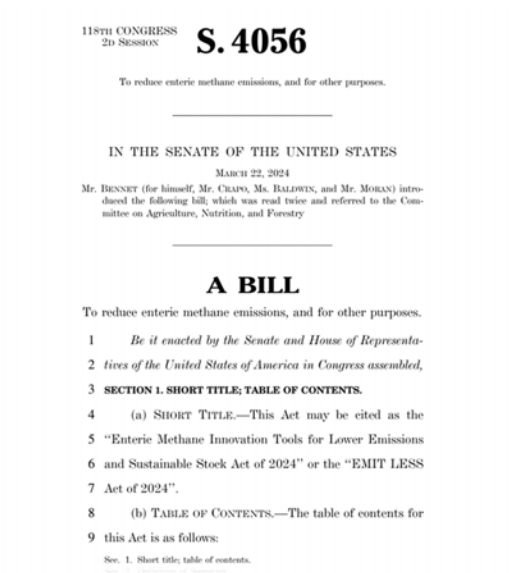
Data source: U.S. Environmental Protection Agency

Pressure to reduce enteric emissions…

1. Government
   - Global Methane Pledge aims to reduce methane emissions by 30% by 2030 compared to 2020 levels (1)
2. Private sector
   - Globally, over 1500 firms have pledged net zero GHG emissions by 2050 (2)
3. Consumers
   - A subset of consumers is willing to pay more for products produced via climate-friendly production practices (3) (4)

Emissions Reduction Target

"The feedyard sector will reduce greenhouse gas emissions by 10% per pound of beef by 2030."



118TH CONGRESS
2D SESSION

S. 4056

To reduce enteric methane emissions, and for other purposes.

IN THE SENATE OF THE UNITED STATES

MARCH 22, 2024

Mr. BENNET (for himself, Mr. CRAPO, Ms. BALDWIN, and Mr. MORAN) introduced the following bill; which was read twice and referred to the Committee on Agriculture, Nutrition, and Forestry

A BILL

To reduce enteric methane emissions, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

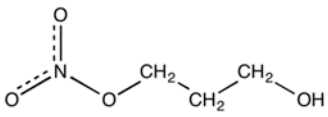
(a) SHORT TITLE.—This Act may be cited as the "Enteric Methane Innovation Tools for Lower Emissions and Sustainable Stock Act of 2024" or the "EMIT LESS Act of 2024".

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

Sec. 1. Short title; table of contents.

EMIT LESS Act of 2024

- Introduced March/June 2024
- Sponsored by 4 U.S. Senators (D-CO, D-WI, R-ID, R-KS) & 2 U.S. Representatives (D-TX, R-NY)
- Goals:
  1. To create voluntary incentives to help get products (e.g., feed additives) that reduce enteric methane emissions into the hands of producers
  2. To expand research funding for such products



3-Nitrooxypropanol (3-NOP)

- Synthetic feed additive
- Reduces enteric methane emission yields by 20% when included in feedlot rations (5)
- No positive nor negative production impacts (6)
- Developed by Dutch company dsm-firmenich
- Approved in other major beef producing countries (i.e., Australia, Brazil, Canada, EU)
- Currently undergoing FDA approval in the United States
- Elanco owns exclusive U.S. licensing rights

But… will producers adopt?

- Necessary but not sufficient conditions for adoption:
  1. Sound science
  2. Government approval
- Ultimately, *economic incentives* must align


The New York Times

For Many Big Food Companies, Emissions Head in the Wrong Direction

Several of the world's largest food and restaurant companies have not made progress on their goal to cut greenhouse gas emissions. Some are even producing more.

And then, he said, there's the matter of who will assume the costs around climate-friendly farming: governments, corporations, farmers or consumers?

"It comes down to who is going to pay," Mr. Weller said. "That is the issue that haunts this entire conversation."

Objectives

1. To determine 3-NOP adoption in U.S. feedlots given potential scenarios in the marketplace.
2. To quantify how differing approaches to achieve emissions reduction targets impact the cost to society.

Key Takeaways

1. Producer adoption of 3-NOP to achieve feedlot emissions reduction targets is possible but varies given scenarios in the marketplace.
2. The least expensive avenue to achieve emissions reduction targets results in greater outlays to large producers vs. small producers.
3. Improving 3-NOP efficacy through R&D investments *may* be social welfare improving vs. incentivizing greater producer adoption.

Groundwork

- USDA Office of the Chief Economist (OCE) grant
- Key takeaways from stakeholder interviews:
  1. Producers are aware of emissions topic but not front of mind
  2. Operations are diverse, so likely no "one size fits all" strategy
  3. Economic incentives could come in many forms (e.g., demand-driven, policy-driven)
- Insights used to develop a feedlot producer survey

Producer Survey

- Double-bounded dichotomous choice (DBDC) methodology [7]
- Respondents randomly assigned to treatment groups
- Treatments varied on:
  1. 3-NOP cost (10¢, 25¢, *or* 40¢/head/day)
  2. Incentive amount ($2, $5, *or* $8/cwt)
  3. Incentive source (premium from the processor *or* subsidy from the government)
  4. Information (net profit calculations included *or* net profit calculations not included)

Research studies have found people inaccurately report their true actions when faced with hypothetical situations, such as this survey. It is important that you make your selection as if you were actually facing these choices in the operation of your feed yard.

Beef cattle produce enteric methane emissions that contribute to total greenhouse gas (GHG) emissions. Several strategies are being researched and developed to reduce enteric methane emissions from cattle. Among these is the use of a synthetic feed additive, 3-Nitrooxypropanol (3-NOP), that reduces methane emissions from feedlot cattle by over 20%. Studies have shown no significant production impacts (positive or negative) when cattle are fed the additive. The additive is not yet approved in the U.S. but has been approved in other beef producing countries, including Australia, Brazil, and the European Union.

Assume in the near future the feed additive is approved in the U.S. and would be fed daily for the entirety of the time cattle are in the feedlot with no withdrawal period before slaughter. Additionally assume the cost of including the additive in feed rations is 40¢/head/day.

Would you include the additive in your feed ration if you received a $5/cwt premium from the processor on fed cattle you sold? If sold after 175 days on feed at a live weight of 1400 lbs. and assuming no animal performance impact, this would net $0/head of profit.

Yes

No

If *yes*:

Would you still include the additive in your feed ration if you received a $2.50/cwt premium from the processor on fed cattle you sold? If sold after 175 days on feed at a live weight of 1400 lbs. and assuming no animal performance impact, this would net -$35/head of profit.

Yes

No

If *no*:

Would you still include the additive in your feed ration if you received a $10/cwt premium from the processor on fed cattle you sold? If sold after 175 days on feed at a live weight of 1400 lbs. and assuming no animal performance impact, this would net $70/head of profit.

Yes

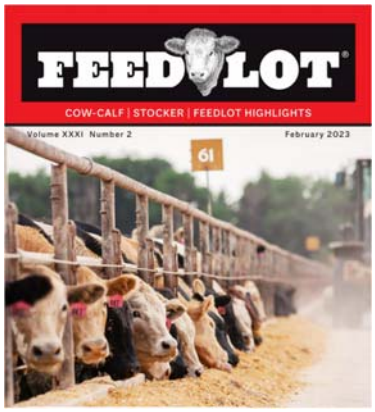
No

Interval Construction

- Four discrete intervals can be constructed from DBDC question, where Y represents the randomly assigned incentive amount:
  1. If *no*, *no*: $(2Y, \infty)$
  2. If *no*, *yes*: $(Y, 2Y]$
  3. If *yes*, *no*: $(0.5Y, Y]$
  4. If *yes*, *yes*: $[0, 0.5Y]$
- Intervals used in estimating interval-censored regressions [8]

Survey Distribution

- Administered Nov. 2023 – Jan. 2024
- Emailed to producers via *FEEDLOT Magazine* and livestock trade associations in major feedlot states
- Garnered 65 usable responses



Colorado Cattlemen's Association

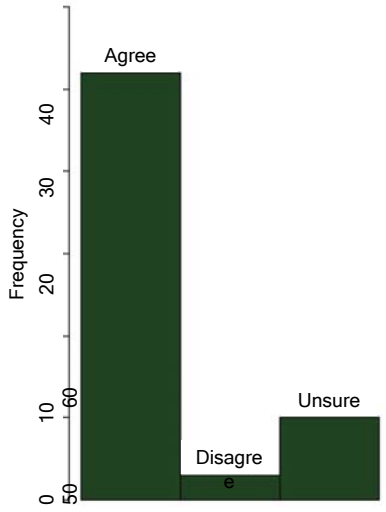
Iowa Cattlemen's Association

Kansas Livestock Association

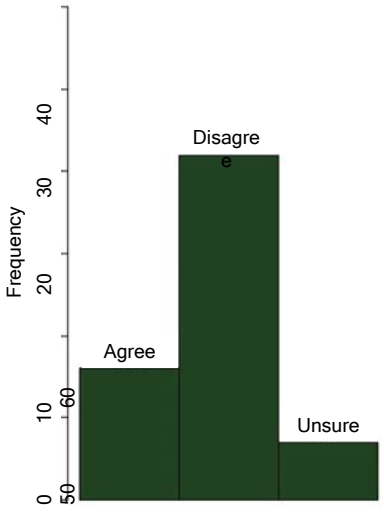
Nebraska Cattlemen

Texas Cattle Feeders Association

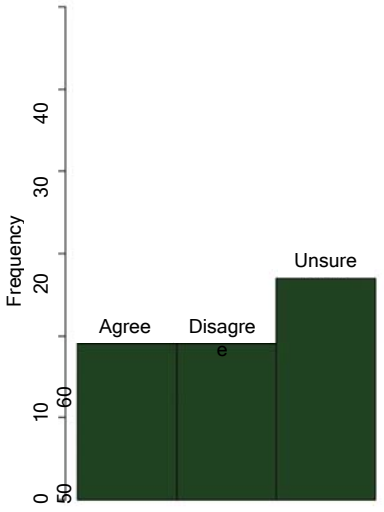
I have heard or read out potential strategies to reduce methane emissions from beef production.



My operation has already looked into or taken steps to reduce methane emissions.



In the future, my operation will likely be required to take steps to reduce methane emissions.



Regression Equation

Producer i's true willingness-to-adopt:

$$WTA_i = \beta_0 + \beta_1 Cost_i + \beta_2 Premium\ Incentive_i + \beta_3 Net\ Profit\ Calculations_i + \varepsilon_i$$

$Cost$: Continuous variable equal to the presented cost (10, 25, *or* 40¢/head/day)

$Premium\ Incentive$: Binary variable =1 if the presented incentive was a processor premium (and =0 for a government subsidy)

$Net\ Profit\ Calculations$: Binary variable =1 if respondent was presented net profit calculations within their information set (and =0 otherwise)

ε_i: i.i.d. normal error term with standard deviation of σ

Assumptions

- Recall, USRSB set target for U.S. feedlot sector to reduce emissions by 10%
- Assumptions:
  1. Feedlot sector exclusively uses 3-NOP to reach this target
  2. 3-NOP reduces emissions in feedlot cattle by 20% (9)
- 50% of U.S. cattle on feed would have to be fed 3-NOP to reach target
- Based on 2023 USDA NASS survey data for commercial slaughter, that equates to approximately **12.4 million head of fed cattle**

Results

Table 1. Regression estimates

Parameter	Estimate
Intercept	5.91***
	(0.85)
Cost	0.13***
	(0.03)
Premium Incentive	-2.54***
	(0.61)
Net Profit Calculations	-3.82***
	(0.61)
n	65
LL	-521.13

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses.

- On average, $5.91/cwt incentive required for feedlot producers to adopt
- During survey collection, average live weight at slaughter: 1392 lbs. (according to USDA NASS survey data)

$5.91/cwt * 13.92 cwt = **$82.27/head**

Results

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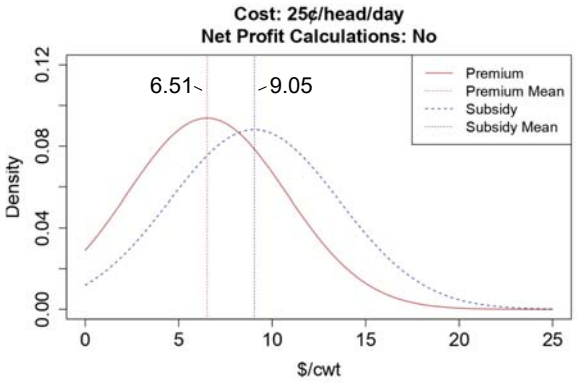
Potential scenarios:



Results

- Subset data by operation size
  - Small (<2000 head sold for slaughter over past year)
  - Large (2000+ head sold for slaughter over past year)
- Re-estimate interval-censored regressions

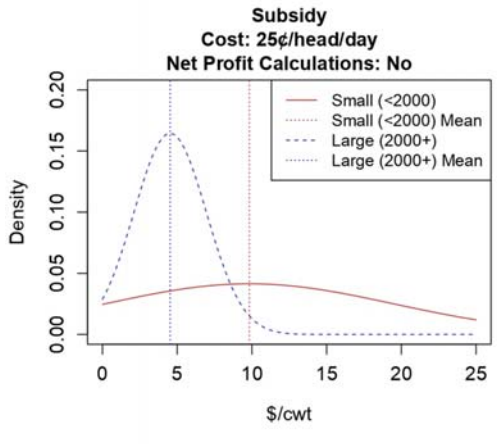
Table 2. Regression estimates

	(1) Small	(2) Large
Parameter	(<2000)	(2000+)
Intercept	6.39***	2.36***
	(2.31)	(0.74)
Cost	0.14*	0.09***
	(0.07)	(0.02)
Premium Incentive	-2.31	-1.27**
	(1.67)	(0.53)
Net Profit Calculations	-4.54***	-1.15**
	(1.68)	(0.51)
n	40	25
LL	-81.26	-42.35

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses.

Results

Potential scenario:



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n	40	25
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Diving deeper…

- Producer adoption varies based on operation size
- Based on 2023 USDA NASS survey data:
  - Small operations (<2000 head) sold, on average, 137 head for slaughter
  - Large operations (2000+ head) sold, on average, 15,339 head for slaughter
- Recall, approximately 12.4 million head of U.S. cattle on feed would have to be fed 3-NOP to reach 10% USRSB emissions reduction target

Potential Adoption Scenario

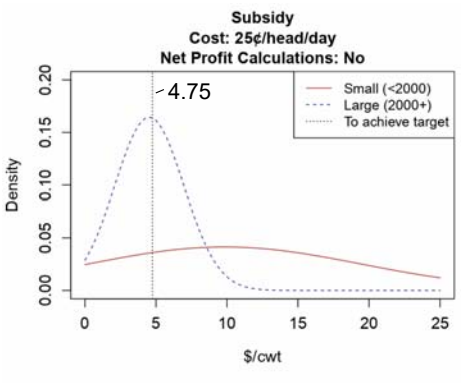


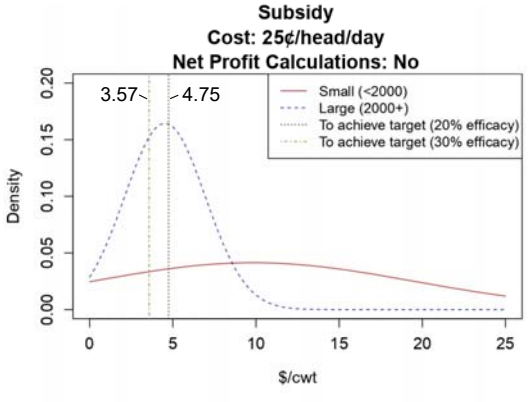
Table 4. 3-NOP adoption outcomes at $4.75/cwt subsidy

	Small (<2000 head)	Large (2000+ head)
% of operations adopt	30%	54%
# of head (millions)	1.13	11.29
Number of operations	7,092	736
Outlays (USD)	$74,584,553	$746,270,940
Average USD/producer	$10,517	$1,013,955

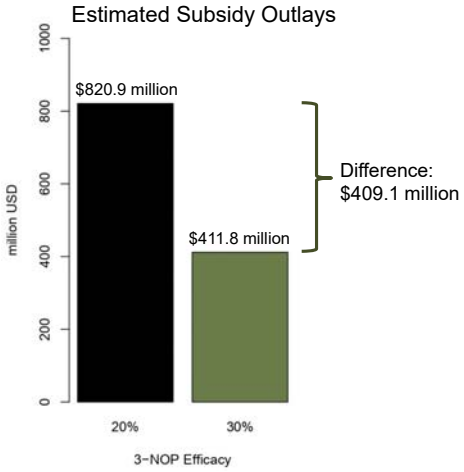
Note: Assume fed cattle are sold at 1392 lbs. live weight

Increased R&D Investment Scenario

- Recall EMIT LESS Act (S. 4056) proposed feed additive research funding
- Assume R&D investment leads to 30% emissions reduction from 3-NOP use (vs. 20%)
- Now, only one-third of U.S. cattle on feed must be fed 3-NOP to reach 10% emissions reduction target (**8.3 million head**)



Increased R&D Investment Scenario



Note: Assume fed cattle are sold at 1392 lbs., live weight

If emissions reductions from 3-NOP could be improved from 20% to 30% for less than $409.1 million, R&D investment less costly to society than subsidizing additional producers to achieve identical emissions outcomes.

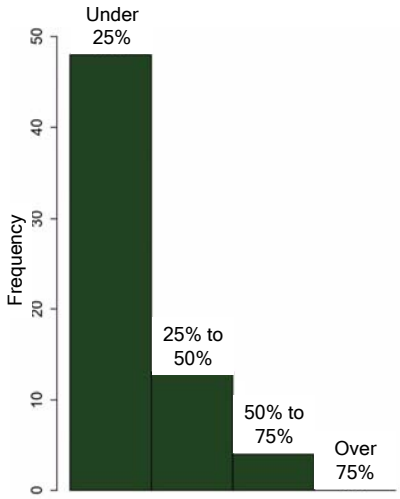
Key Takeaways

1. Producer adoption of 3-NOP to achieve feedlot emissions reduction targets is possible but varies given scenarios in the marketplace.

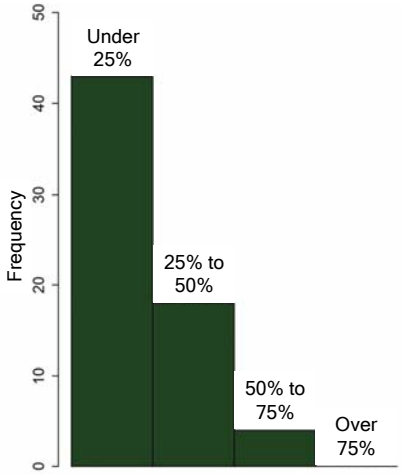
2. The least expensive avenue to achieve emissions reduction targets results in greater outlays to large producers vs. small producers.

3. Improving 3-NOP efficacy through R&D investments *may* be less costly to society vs. incentivizing greater producer adoption.

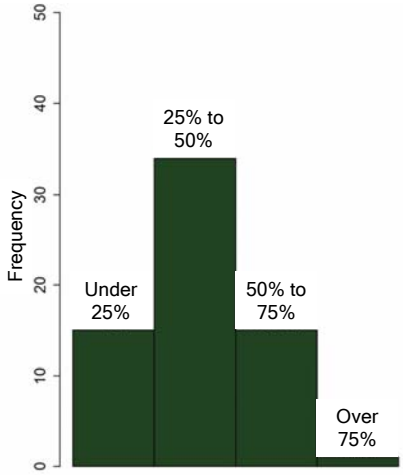
What % of *domestic* consumers would be willing to pay a premium for beef with an environmental claim?



What % of *international* consumers would be willing to pay a premium for beef with an environmental claim?



What % of U.S. voters would vote in favor of policy measures that would require U.S. beef producers to reduce methane emissions?



Would *YOU* adopt 3-NOP?

THANK YOU

Questions?

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References

1. Global Methane Pledge. (2023). About the Global Methane Pledge. https://www.globalmethanepledge.org/
2. Shanor, A., & Light, S. E. (2022). Greenwashing and the first amendment. *Columbia Law Review*, *122*(7), 2033-2118.
3. Kilders, V., & Caputo, V. (2024). A reference-price-informed experiment to assess consumer demand for beef with a reduced carbon footprint. *American Journal of Agricultural Economics*, *106*(1), 3-20.
4. Li, X., Jensen, K. L., Clark, C. D., & Lambert, D. M. (2016). Consumer willingness to pay for beef grown using climate friendly production practices. *Food Policy*, *64*, 93-106.
5. Dijkstra, J., Bannink, A., France, J., Kebreab, E., & Van Gastelen, S. (2018). Short communication: Antimethanogenic effects of 3-nitrooxypropanol depend on supplementation dose, dietary fiber content, and cattle type. *Journal of Dairy Science*, *101*(10), 9041-9047.
6. Yu, G., Beauchemin, K. A., & Dong, R. (2021). A Review of 3-Nitrooxypropanol for Enteric Methane Mitigation from Ruminant Livestock. *Animals*, *11*(12), 3540.
7. Hanemann, M., Loomis, J., & Kanninen, B. (1991). Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation. *American Journal of Agricultural Economics*, *73*(4), 1255-1263.
8. Cameron, T. A. (1988). A new paradigm for valuing non-market goods using referendum data: Maximum likelihood estimation by censored logistic regression. *Journal of Environmental Economics and Management, 15*(3), 355-379.
9. Alemu, A. W., Pekrul, L. K. D., Shreck, A. L., Booker, C. W., McGinn, S. M., Kindermann, M., & Beauchemin, K. A. (2021). 3-Nitrooxypropanol Decreased Enteric Methane Production From Growing Beef Cattle in a Commercial Feedlot: Implications for Sustainable Beef Cattle Production. *Frontiers in Animal Science, 2*, 641590.