# Study reveals AI's potential to reduce methane emissions in cattle



A recent study conducted by the U.S. Department of Agriculture's Agricultural Research Service (ARS) in collaboration with Iowa State University (ISU) highlights the potential of generative artificial intelligence (AI) in addressing the challenge of enteric methane emissions in cattle. This emissions issue is significant, as it contributes approximately 33 per cent of U.S. agriculture's emissions and about 3 per cent of the country's total greenhouse gas emissions.

Simon Liu, Administrator of the ARS, emphasized the urgency of this research, stating, “Developing solutions to address methane emissions from animal agriculture is a critical priority. Our scientists continue to use innovative and data-driven strategies to help cattle producers achieve emission reduction goals that will safeguard the environment and promote a more sustainable future for agriculture."

The primary source of methane emissions in cattle arises from enteric fermentation, a natural digestion process occurring in the rumen, one of the four stomach compartments of cattle. Researchers have pinpointed a variety of compound molecules capable of inhibiting methane production in this compartment. A notable contender, bromoform, which is naturally sourced from seaweed, has shown potential for significantly reducing emissions—by up to 98 per cent when administered to cattle. However, the carcinogenic nature of bromoform imposes constraints on its application in food-producing animals, prompting the need for alternative substances with similar efficacy but without adverse health effects.

In light of these challenges, the research team from ARS’s Livestock Nutrient Management Research Unit and ISU’s Department of Chemical and Biological Engineering employed generative AI alongside extensive computational models to accelerate the discovery of non-toxic molecules that mimic the properties of bromoform.

Matthew Beck, a research animal scientist previously with ARS, expressed the approach taken by the team, stating, “We are using advanced molecular simulations and AI to identify novel methane inhibitors based on the properties of previously investigated inhibitors, but that are safe, scalable, and have a large potential to inhibit methane emissions."

The researchers leveraged existing scientific databases to construct large-scale computational models that simulate the discovery phase for methane inhibitors. AI was utilised to predict molecular behaviours and identify candidates for further laboratory testing, creating a feedback loop where experimental outcomes enhance future predictions, termed a graph neural network. Ratul Chowdhury, an Assistant Professor at ISU, elaborated, “Our graph neural network is a machine learning model which learns the properties of molecules, including details of the atoms and the chemical bonds that hold them.”

The study found that numerous molecules exhibit similar characteristics to bromoform within what they identified as a "functional methanogenesis inhibition space," suggesting a collective potential for effective methane inhibition.

The application of AI not only aids in discovering novel molecules but also facilitates deeper insights into the interactions within the cow's microbiome and its proteins, which can be particularly advantageous for animal nutritionists. Jacek Koziel, a research leader at the USDA-ARS, noted the broader implications, stating, “This is why combining AI with laboratory research, through iterative refinement, is a valuable scientific tool. AI can fast-forward the research and accelerate these several pathways that animal nutritionists, researchers, and companies can pursue to get us closer to a very ambitious goal of limiting greenhouse gas emissions and helping mitigate climate change.”

As part of their findings, the study outlines a detailed cost analysis for conducting this research on a per molecule basis, providing financial insights that can assist in guiding future investments in this field.

The findings by Chowdhury, Beck, Koziel, and their co-authors—including Nathan Frazier from ARS and Logan Thompson from Kansas State University—have been published in the journal *Animal Frontiers*. The USDA's ARS continues to play a crucial role as America's chief scientific research agency, committing to innovative solutions that address critical agricultural challenges.

Source: [Noah Wire Services](https://www.noahwire.com)

## Bibliography

1. <https://bioengineer.org/scientists-harness-ai-to-accelerate-methane-reduction-strategies-in-animal-agriculture/> - This article details the collaborative research between the USDA's Agricultural Research Service (ARS) and Iowa State University (ISU) on using generative AI to reduce enteric methane emissions in cattle, highlighting the significance of methane emissions in agriculture and the innovative approaches employed.
2. <https://www.azoai.com/news/20250108/Generative-AI-Drives-Breakthrough-in-Methane-Reduction-for-Cattle.aspx> - This article provides insights into the specific methods and findings of the study, including the use of generative AI, advanced simulations, and the identification of eco-friendly compounds to curb methane emissions from cattle.
3. <https://www.azoai.com/news/20250108/Generative-AI-Drives-Breakthrough-in-Methane-Reduction-for-Cattle.aspx> - This source corroborates the role of bromoform and its limitations, as well as the team's approach to finding alternative, non-toxic molecules using AI and computational models.
4. <https://bioengineer.org/scientists-harness-ai-to-accelerate-methane-reduction-strategies-in-animal-agriculture/> - This article explains the urgency of addressing methane emissions from animal agriculture, as emphasized by ARS Administrator Simon Liu, and the critical priority of developing innovative solutions.
5. <https://www.azoai.com/news/20250108/Generative-AI-Drives-Breakthrough-in-Methane-Reduction-for-Cattle.aspx> - This source details the use of graph neural networks and the feedback loop process in predicting molecular behaviors and identifying candidates for further laboratory testing.
6. <https://bioengineer.org/scientists-harness-ai-to-accelerate-methane-reduction-strategies-in-animal-agriculture/> - This article highlights the broader implications of combining AI with laboratory research and its potential to accelerate research pathways for reducing greenhouse gas emissions.
7. <https://www.azoai.com/news/20250108/Generative-AI-Drives-Breakthrough-in-Methane-Reduction-for-Cattle.aspx> - This source outlines the detailed cost analysis for conducting the research and the financial insights provided to guide future investments in methane mitigation strategies.
8. <https://www.azoai.com/news/20250108/Generative-AI-Drives-Breakthrough-in-Methane-Reduction-for-Cattle.aspx> - This article mentions the publication of the findings in the journal *Animal Frontiers* and the involvement of researchers from ARS, ISU, and other institutions.
9. <https://bioengineer.org/scientists-harness-ai-to-accelerate-methane-reduction-strategies-in-animal-agriculture/> - This source explains the natural digestion process in cattle, specifically enteric fermentation in the rumen, and its role in methane production.
10. <https://www.azoai.com/news/20250108/Generative-AI-Drives-Breakthrough-in-Methane-Reduction-for-Cattle.aspx> - This article discusses the identification of promising methane inhibitors such as statins, nitro-ol esters, and Coenzyme B analogs through the use of AI and computational models.
11. <https://bioengineer.org/scientists-harness-ai-to-accelerate-methane-reduction-strategies-in-animal-agriculture/> - This source emphasizes the importance of interdisciplinary collaboration and the integration of advanced technologies in addressing environmental challenges like methane emissions.
12. <https://www.sciencedaily.com/releases/2025/01/250108143615.htm> - Please view link - unable to able to access data