Integrating Innovation, Carbon Pricing, and Subsidy Reform to Cut US Enteric Methane Emissions

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Executive Summary: Enteric fermentation, the digestive process of cattle, is the United States' second-largest source of methane emissions. Past US efforts to reduce livestock methane have relied on voluntary, supply-side, incentive-based programs that have largely failed due to limited attention to enteric emissions, the absence of pricing mechanisms, and a lack of demand-side reform. Highly effective strategies such as mandatory targets and inclusion in carbon pricing face political and economic barriers while mitigation technologies face cost, adoption, and effectiveness challenges, and pose greenwashing risks unless coupled with policy reforms. This policy brief proposes a three-part federal strategy combining technological, regulatory, and market reforms—providing a strategic roadmap for Congress, the USDA, and the EPA to regulate enteric methane emissions at the federal level. First, it recommends increased funding for research, development, and deployment of enteric methane measurement and mitigation technologies, providing the critical genetic and technological foundation upon which policy implementation depends and enabling optimal emissions reduction per unit of meat or milk. Second, it proposes coupling carbon pricing of enteric methane emissions with targeted mitigation technology subsidies, incentivizing farms and ranches to invest in methane mitigation technologies while enabling access by smaller operations and reducing the risk of emissions leakage. Third, it calls for a modest redirection of a portion of US livestock subsidies toward produce and alternative proteins, aligning supply- and demand-side strategies and supporting dietary transitions. By combining these interventions into an integrated federal framework, the US can reduce enteric methane emissions, promote equitable participation by farmers, and strengthen long-term agricultural climate governance.

I. Introduction: Enteric methane and its regulation in the United States

Methane (CH_4) is a potent greenhouse gas with 27-29.8 times the global warming potential (GWP) of carbon dioxide (CO_2) over 100 years (Arora, Melton, and Plummer, 2018; Holmes et al., 2013; IPCC, 2022; US EPA, 2010). In livestock agriculture, it arises primarily from enteric fermentation—the digestion of feed by the gut microbiome—and secondarily from manure. Enteric fermentation accounted for 27.4% of total US methane emissions in 2022, making it the second-largest domestic source (US EPA, 2024), while contributing up to 30% of global methane emissions (FAO, 2022). Rapid deployment of all available mitigation measures is critical to slow near-term decadal warming (Ocko et al., 2021), requiring integrated strategies combining policy and technology interventions.

US federal methane policy has historically underemphasized enteric methane emissions.

Voluntary, incentive-based approaches under the Biden administration and broadly deregulatory policies under the second Trump administration have largely neglected enteric methane, despite its far larger overall contribution to US methane emissions compared to manure (27.4% vs. 9.2%) (US EPA, 2024; US EPA, 2025a; 2025b; US White House Office of Domestic Climate Policy, 2021). The US Methane Emissions Reduction Action Plan centers manure mitigation methods, with no mention of specific strategies for enteric methane reduction other than a proposal for enhanced overall agriculture mitigation funding (US White House Office of Domestic Climate Policy, 2021). Furthermore, by actively inflating dairy demand through protective tariffs and the National School Lunch Program's fluid milk mandates, the federal government effectively subsidizes a net increase in absolute emissions via increased production and low-cost manure management on large farms (Fisher, 2022; US Department of Agriculture, 2024; US EPA, 2024). Proposed recent legislation like the EMIT LESS Act of 2024 sought to expand research and voluntary incentives, not mandatory targets, at the USDA, but was never enacted (US Senate, 2024); with the signing of Executive Order 14154 ("Unleashing American Energy"), which revoked Executive Order 14008 ("Tackling the Climate Crisis At Home and Abroad"), the Biden-era US Methane Emissions Reduction Action Plan has since been deprioritized under the current administration, leaving no federal framework with mandatory reduction targets (Stein, Squire, and Zhao, 2025; US White House, 2025).

Effective reduction of enteric methane depends on targeting the rumen microbial processes that generate it (Roques et al., 2024). Current mitigation strategies generally fall into three categories. First, breeding programs offer a permanent, cumulative mitigation strategy. Methane production is moderately heritable among cattle, and models can accurately forecast over 70% of the emissions differences between individual animals, enabling highly effective selective breeding (Hess et al., 2023). Research is still characterizing the full phenotypic correlations between low-methane traits and production metrics such as milk fat percentage and growth rate, though the balance of evidence suggests neutral to positive associations, as discussed further in Recommendation i below. Second, dietary strategies (*e.g.*, adjusting grain-to-roughage proportions and adding plant-derived feed additives or lipids) offer moderate methane intensity reductions of 18-30%, but rarely lower absolute emissions without a reduction in herd size, and can negatively impact fiber degradation (Capper, Cady, and Bauman, 2009; Knapp et al., 2014; Arndt et al., 2022; OECD/FAO, 2022; Beauchemin, McGinn, and Petit, 2007; Patra, 2013; Gruninger et al., 2022). Third, highly potent chemical inhibitors like 3-nitrooxypropanol (3-NOP) and bromoform directly block methane generation pathways to achieve up to 47% reductions (Hristov et al., 2022; Kebreab et al., 2023; Kebreab et al., 2025). In 2024, the US FDA determined that 3-NOP (as Bovaer®) met safety and efficacy standards for use in lactating dairy cattle (Elanco Animal Health Incorporated, 2024). Finally, emerging technologies such as anti-methanogen vaccines and CRISPR microbiome gene editing offer massive promise but require further research (Baca-Gonzalez et al., 2020; Osaka and Wright, 2024; Zhao et al., 2025). Despite this rapid progress, implementation has not kept pace; resulting in a gap between what science makes possible and what agricultural governance systems can deliver under the current policy regime.

II. Challenges in regulating enteric methane

Regulating enteric methane faces unique political and economic barriers beyond those associated with manure methane. Policies such as carbon pricing, mandated emissions targets, and cuts in production are highly effective but politically unpopular, due to industry and policymaker influence, cultural norms, and rural economic dependence (Simon, 2013; Matthews and Sumner, 2019; Specht, 2019; Frerick, 2024). Livestock agriculture enjoys disproportionate federal support, which disincentivizes reductions to production. The federal government spends up to $38 billion per year subsidizing livestock industries; in comparison, only about $8 billion is allocated for produce, and only $124 million for plant-based proteins and alternatives (Simon, 2013; US Congress, 2014; US Congress, 2018). These investments reflect the extent to which livestock production is politically and economically entrenched within the US food system. Enteric methane is also more tightly linked to production-relevant factors, (*e.g.*, head of cattle, meat and milk production) than manure, which increases its sensitivity as a regulation target (Knapp et al., 2014; Lakamp et al., 2022). Consequently,

regulating enteric methane is a technical, political, and economic challenge, since it directly impacts farm income and regulatory compliance.

i. California: A case study in competing methane imperatives

Communities dependent on livestock agriculture are likely to resist policies that threaten profitability, even in broader contexts that prioritize action against climate change. California exemplifies the collision between a powerful livestock farmer constituency and aggressive emissions regulation. Producing approximately one-fifth of the nation's dairy supply, dairy is California's highest-grossing agricultural commodity (California Department of Food and Agriculture, 2024; US Department of Agriculture, 2025). The industry is a critical economic engine in the state's San Joaquin Valley, which faces a higher-than-average poverty rate as well as significant environmental burdens from dairy operations (Finnochio and Paci, 2020; Matthews and Sumner, 2019; Mosavi, 2023; Nicholls, 2023).

California's SB 1383 mandates a 40% reduction in livestock methane below 2013 levels by 2030, the most aggressive codified methane target in the United States to date (California Senate, 2016). However, the California Air Resources Board (CARB) has not yet designed suitable enteric methane regulations to meet these requirements, with rulemaking mandated to begin in 2025 (CARB to Climate Action California, 2024; CARB, 2025). As of early 2026, CARB was still soliciting information from stakeholders to inform a plan to develop livestock methane regulations (CARB, 2026). In 2025, SJR 5 was introduced to the California Senate; this joint resolution called for greater state support to evaluate and accelerate the adoption of enteric methane reduction strategies, and would, if it had passed, have called on Congress to explore this issue at the federal level (California Senate, 2025). Agricultural methane is excluded from California's carbon cap-and-trade program (Foster, 2014), which is why SB 1383's dedicated livestock methane targets were established as a separate regulatory instrument.

California's existing methane mitigation research and development infrastructure consists of the Alternative Manure Management Program (AMMP), the Dairy Digester Research and Development Program (DDRDP), and state investments in measurement, reporting, and verification (MRV) and technological research and development (California Department of Food and Agriculture, 2023a). Research funding for technological development from the California Department of Food and Agriculture forms the primary thrust of California's enteric mitigation strategy, with $9.46 million awarded in 2023 to California academic and industrial researchers specifically for enteric mitigation projects through the Livestock Enteric Methane Emission Reduction Research Program (LEMER-RP) (California Department of Food and Agriculture, 2023b).

California's experience demonstrates that significant methane reduction is legally and operationally feasible: CARB's implementation of SB1383 sets enforceable reduction targets for the dairy sector (CARB, 2017). However, California's dairy industry and political context are atypical, meaning the scope and design of comparable state level programs would probably differ.

ii. Challenges in equity of access to methane mitigation technologies

Existing mitigation schemes can disproportionately affect smaller operations. A 2025 study found that supplementation with 3-NOP (to lower enteric fermentation) decreased mean income over feed cost (IOFC) by $0.35 per cow per day; under the current US regulatory regime, this requires compensation of $128,320 per year for a dairy with 1,000 milking cows (Pupo, Ferraretto, and Nicholson, 2025). Smaller farms (*e.g.*, fewer than 500 head) are more vulnerable due to weaker economies of scale, whereas larger dairies (*e.g.*, 1000 head or more) can more easily absorb costs or negotiate bulk prices for feed additives (Tauer and Mishra, 2006; MacDonald, Cessna, and Mosheim, 2016; Njuki, 2022). Small and mid-sized operations face disproportionate compliance burdens: as of 2017, operations with fewer than 200 cows produced less than 10% of US milk supply, while operations with 1,000 or more cows produced approximately two-thirds—meaning the equity challenge, while significant, is concentrated in a declining share of total production (MacDonald, Law, and Mosheim, 2020).

Not all costs must be borne by farmers. Processors, retailers, and consumers can absorb impacts adding up to roughly 3 cents per gallon of milk, and voluntary markets can offer additional offset mechanisms (Luke and Tonsor, 2024; Miller and Ramseur, 2024; Environmental Defense Fund and Boston Consulting Group, 2025; Giles, 2025). This disparity between small-to-medium and large operations has previously been reflected in the results of dairy digester implementation programs (Key and Sneeringer, 2011). Without equitable access to mitigation technologies, new regulatory costs risk accelerating existing trends of farm consolidation and emissions leakage—a dynamic already visible in California where small- to medium-sized dairies have been consolidating rapidly since 1952 (Kebreab et al., 2022), leading to leakage of production to less regulated states (ERA Economics, 2024).

iii. Challenges in measurement and supply-side mitigation

Methane emissions from enteric fermentation are far more difficult to measure than manure emissions. Manure is often stored in large lagoons or open facilities; recent facility-scale studies using ground-based and remote sensing approaches provide robust emissions estimates (Heerah et al., 2021; Marklein et al., 2021; Jeong et al., 2022) Each individual enteric methane emitter, on the other hand, is a highly mobile animal capable of traveling over a large geographic range (in dairy cows, about 7.6-8.2 km/day) (Rouda et al., 1990), who emits methane via belching (which is difficult to contain), and whose daily methane emissions may vary depending on individual genetics, health, feed consumption, and other factors (Beauchemin et al., 2020), and whose welfare and behavior must be considered when choosing and developing appropriate monitoring methods (Llonch et al., 2016; Smith et al., 2024). Existing measurement, reporting, and verification (MRV) technologies differ widely in the conditions under which their measurements may be considered valid, and no single method suits all measurement conditions; accurate enteric methane MRV thus demands the development of standardized experimental protocols alongside measurement technologies (Zhao et al., 2020). Many of the most precise techniques only work in controlled research settings, while larger-scale approaches, utilizing remote sensing technologies like open-path lasers, drones, and satellites, are promising but still require development and validation, and robust estimation with any of these technologies relies on appropriate protocol use; more research is needed to develop appropriate methods of data validation and methodological comparison under a variety of production scenarios (Tedeschi et al., 2022).

Supply-side mitigation technologies offer some promise but require concomitant policy supports. Current approaches fall into one of two categories: less effective but more established strategies that broadly alter the microbiome via poorly defined mechanisms, or more effective strategies that directly target methanogens, but are in earlier stages of development and implementation (Roques et al., 2024). All approaches face logistical hurdles such as cost and the need for continuous application, which pose disadvantages for smaller dairies and pastured cattle. Breeding program implementation is hampered by MRV and predictive limitations, as well as the economic value associated with enteric emissions, and is not feasible to implement without policy supports (Beauchemin et al., 2020; de Haas et al., 2021; Richardson et al., 2022; Roques et al., 2024). Critical facets of methanogen suppression technologies, such as appropriate vaccine formulations and mechanisms of action of red seaweeds and their active compounds, are still active research areas (Baca-González et al. 2020; Indugu et al., 2024; Posman et al., 2025). Furthermore, as evidenced by the author's technical research tenure within the University of California rumen microbiome CRISPR genomic editing project (Osaka and Wright, 2024), the logistical and biological complexities of *in situ* microbiome genomic editing mean practical trials in cattle are not expected for several years.

iv. Challenges in demand-side mitigation

Consumer demand for cattle products remains strong, fueled in part by the lobbying and public relations efforts of large cattle farming corporations (Frerick, 2024). Beef, and meat consumption more broadly, are culturally significant to the United States and deeply intertwined with its history (Specht, 2019). Endorsement of meat consumption is tightly linked to deeply entrenched social

constructs, including political orientation and masculinity, though growing acceptance of veganism and vegetarianism has been increasingly integrated into a more progressive concept of the latter (Dhont and Hodson, 2014; Velzeboer et al., 2024). This has been amplified by recent federal health messaging; for example, recent Department of Health and Human Services (HHS) communications under Secretary Kennedy, such as revised dietary guidelines favoring traditional animal agriculture, provide institutional endorsement that further entrenches these high-emission consumption patterns (US Department of Agriculture, 2026). Despite supply-side reductions of intensity per unit of output, per-capita and total demand for beef and dairy in North America are expected to remain stable to 2050 (Komarek et al., 2021; Li et al., 2024).

Without concurrent policy action to modulate demand, particularly policy action that targets high-consumption groups, there is a significant risk that supply-side gains will be offset. This discrepancy raises the risk of "greenwashing," where producers may claim climate benefits from mitigation technologies, yet total emissions remain unchanged or rise due to unchanged or growing consumption. Greenwashing the use of mitigation technology is not unprecedented in the livestock industry; it has previously been employed to shape public perception of the use of anaerobic digesters at concentrated animal feeding operations (CAFOs) (Abate, 2024). Policymakers must therefore integrate supply and demand approaches for robust methane emissions reduction, including transparent regulations to prevent misleading claims of emissions reductions disconnected from actual market realities. These technical, economic, and political barriers underscore the need for an integrated strategy combining technology, market incentives, and subsidy reform.

III. Recommendations

i. Invest in R&D of MRV and mitigation technologies and breeding of low-methane cattle

The success of coupling carbon pricing with mitigation technology subsidies depends on the availability of effective MRV and mitigation technologies. Ensuring the availability of effective technologies prior to rollout of policy recommendations generates a pipeline of effective mitigation strategies to implement rapidly with minimal perverse incentives or wasted effort. Funding organizations must dedicate research funds to supporting advancements in these technologies. Current federal investments in enteric methane mitigation funding are spread across a variety of mechanisms, primarily the USDA and EPA. Through the Inflation Reduction Act, the USDA invests in Conservation Innovation Grants (CIG), Regional Conservation Partnership Program (RCPP), and the Rural Energy for America Program (REAP) to target enteric methane innovation. In 2024, CIG and RCPP funding targeting enteric emissions totaled $12.5 million and $115 million, respectively (US White House, 2024). Exact non-federal funding totals are not publicly consolidated, but funding from state governments, as well as nonprofit institutions such as the Global Methane Hub, ClimateWorks Foundation, Spark Climate Solutions, and Greener Cattle Initiative, makes up a substantial percentage of funding; for example, California allocated $10 million in its 2023-2024 state budget for an enteric methane incentive program (California Department of Food and Agriculture, 2023b). Commitment of annual federal investments on the order of $100—200 million, commensurate with the estimated total funding for these prior programs, would adequately support research and development of enteric MRV and mitigation technologies.

Breeding programs complement technology development; genetic improvements are permanent and scalable, and they provide an optimized biological system in which mitigation technologies can generate maximized emissions reductions. Policy support is necessary to enable more widespread adoption of breeding as a mitigation strategy (Roques et al., 2024). Crucially, breeding for low methane does not inherently compromise, and often enhances, production metrics. Because enteric methane represents a loss of dietary energy, low-methane phenotypes are frequently correlated with improved feed efficiency (residual feed intake), offering a direct economic benefit to farmers rather than a production penalty (Capper et al., 2009; Silva et al., 2025). Limited low-methane cattle breeding programs are available (Vargas et al., 2024), and none are known to exist outside the context of federally funded academic research in the United

States. Two corporations in New Zealand, the Livestock Improvement Corporation and CRV Ambreed, are collaborating to build low-methane cattle and sheep breeding programs, and another New Zealand corporation, B+LNZ Genetics, has built the Cool Sheep Programme to breed lower-methane sheep (Rykers, 2023; Sangster, 2024). Another recent initiative, backed by $27.4 million from the Bezos Earth Fund and Global Methane Hub, was launched in early 2025 to fund research and breeding programs across North America, Latin America, Europe, Africa, and Oceania (Bezos Earth Fund, 2025). Expanded federal support, or federally run breeding programs, could accelerate, generate critical nationwide infrastructure for, and expand access to low-methane cattle breeding. Support should include targeted USDA grants, technical assistance to farms for selective breeding implementation, and the development of national databases to track low-emission genetic lines. To ensure access for smaller and medium-sized farms, the USDA should institute programs that include subsidization or cost-shares for low-emission stock or insemination with sperm from low-methane bulls, establish regional breeding cooperatives or shared artificial insemination banks, and encourage partnerships between smaller farms and larger research farms or universities that can provide access to low-methane genotypes or advice on breeding practices.

ii. Integrate carbon pricing with mitigation technology subsidies

Methane emissions reduction technologies have a critical role in a robust federal response, as they help cattle operations meet emissions targets while reducing the impact of more aggressive policies on smaller farms and supporting the agricultural biotechnology industry. Inclusion of agricultural methane in carbon pricing schemes provides a financial signal to reduce methane, but on its own is both logistically and politically challenging. Emissions scale with herd size and feed intake, so larger herds face higher costs. Many cattle operations operate on thin margins (MacDonald, Law, and Mosheim, 2020; Knight and Taylor, 2024; Valcu-Lisman and Terán, 2024), so may find compliance economically difficult. Additionally, MRV protocols require further methodological development before larger-scale use in order to rigorously allocate subsidies and allow optimal compliance flexibility (Zhao et al., 2020). Denmark demonstrates a useful proof of concept for incorporating enteric mitigation technologies in a subsidy structure through its national adoption of Bovaer®, which it will combine with a livestock methane tax in 2030 through its Green Tripartite Agreement (Government of Denmark et al., 2024; Lauritzen and Sperling, 2024; Lund et al., 2024). Conversely, Canada's recent Reducing Enteric Methane Emissions from Beef cattle (REME) federal offset protocol illustrates the risk of misaligned policy: while it establishes a carbon offset market for enteric methane, it explicitly excludes both dairy cattle and novel anti-methanogenic feed additives, functionally locking out the most effective mitigation technologies (Environment and Climate Change Canada, 2025). US operations are large, heterogeneous in operation type, less tax-friendly, and subject to diverse state-level regulatory frameworks. To avoid the political friction of Denmark's tax-based approach and the technological exclusions of Canada's offset market, federal US policies must rely on flexible incentive structures tiered according to herd size and emissions intensity and adjusted for regional baselines.

Existing voluntary carbon markets offer a pathway to facilitate this strategy. Early-adopters of feed additives or breeding technologies are able to generate emission-reduction credits in the voluntary market, thereby obtaining revenue support while regulatory frameworks mature (Miller and Ramseur, 2024; Environmental Defense Fund and Boston Consulting Group, 2025). Elanco, the manufacturer of the feed additive Bovaer®, has helped to establish a voluntary incentive market in place in the US for its use (Elanco Animal Health, 2024). This helps bridge the gap until standardized MRV protocols and compliance systems are fully operational, if necessary.

Coupling a price for enteric methane with subsidies for mitigation technologies through a cap-and-trade system (a market mechanism where total emissions are capped and allowances traded, despite criticisms regarding localized pollution hotspots), combined with voluntary carbon markets (which, despite historical volatility, provide crucial

early-adopter revenue prior to compliance mandates) and the potential for processors or consumers to assume part of the cost, provides farms with financial and technical support to adopt effective mitigation approaches, thereby facilitating broader participation and lowering economic disruption. Auction revenues would fund these subsidies, making the system self-sustaining. In the US context, a cap-and-trade mechanism, rather than a direct methane tax, would be more politically and administratively feasible, and could be modeled on existing state frameworks such as California's SB 32 (Kynett, 2024; Wongpiyabovorn and Plastina, 2025). Due to the need for inter-agency collaboration, the EPA and USDA must use state- and region-level programs, similar to those built in response to California's SB 1383, as pilots to develop effective administration for federal-level programs. These pilots should include a mixture of herd sizes, herd compositions, and geographies, and can be implemented through mechanisms such as USDA grants, state cap-and-trade funds, or targeted ARPA-style prizes. Policy implementation must account for recent federal climate policy setbacks (Stein, Squire, and Zhao, 2025), with future strategies potentially requiring compensatory measures to recover lost progress in demand-side programs and emissions reduction incentives.

Nationwide non-discriminatory compliance for US livestock producers should be implemented to reduce or eliminate regulatory cost gaps. This also prevents emissions leakage by holding out-of-state producers to the same standards as in-state producers; leakage decreases as the number of available polities adopting a carbon tax, or cap-and-trade scheme, expands (Arvanitopoulos, Garsous, and Agnolucci, 2021; Henderson and Verma, 2021; Antoniou, Hatzipanayotou, and Tsakiris, 2024; Olasehinde-Williams and Saint Akadiri, 2024). Nationwide standards will also encourage broader collaboration among states to develop consistent emissions standards. The EPA and USDA must tier these standards, along with mitigation technology incentives, by herd size and regional baselines, with border adjustments for imports. Early adopters of mitigation technologies are likely to oppose broad subsidy programs if they are seen as unfair to their prior investment. While early adopters may react negatively to uneven benefit distribution, transparent phasing and time-limited incentives maintain fairness while preserving core emissions objectives.

Communication to consumers about subsidized mitigation technologies is critical to ensure stakeholder buy-in. Media communications in Europe during the introduction of Bovaer® were critical for buy-in and shaped public acceptance of this feed additive, and especially crucial to address concerns, backlash, and misinformation from consumers, farmers, and environment and animal welfare interest groups (Manning, Wylie, and Goodman, 2025). Federal agencies and industry partners must ensure messaging addresses climate, consumer, and animal benefits and communicate the rigor of the safety and regulatory oversight involved. Efforts should carefully frame the technology as part of a more complex sustainable agriculture strategy rather than a "quick fix" or a panacea; overstatement of the capacity of the mitigation technology may backfire by reducing public confidence in its use. Efforts should encompass labeling programs, informational campaigns in collaboration with governments, livestock cooperatives, and nonprofits, and integration with sustainability certifications. Early engagement with stakeholders prevents information and builds trust. In the US, where skepticism about agricultural inventions, biotechnology, and modern scientific interventions is widespread (Funk, Kennedy, and Hefferon, 2018; Naab et al., 2021; Meerza et al., 2024; Kelly et al., 2025), partnerships with credible local stakeholders are particularly important. A proactive, multifaceted strategy increases the likelihood of creating and maintaining public confidence and encourages demand for lower-methane products, and thus supports public adoption for a coupled carbon pricing and subsidy scheme.

iii. Redirect subsidies to encourage plant-based diets

Demand-side incentives, including subsidies for produce and alternative proteins, complement supply-side carbon pricing by helping ensure reductions in total methane emissions rather than per-unit intensity alone. A modest redirection of a portion of the $38 billion spent on the livestock industry (Simon, 2013) towards produce and alternative proteins, through creating and expanding equivalent subsidy instruments, such as

crop-crop insurance parity, processing and cold-chain infrastructure grants, and nutrition procurement commitments, would make these foods more accessible, facilitate a shift towards more sustainable diets, and reduce land use for livestock agriculture (O'Neill Hayes and Kerska, 2021; Sutton et al., 2024). The USDA must structure subsidies to support transition assistance for livestock producers adopting plant-based or mixed farming systems, via technical assistance, cost-share, and processing/market access mechanisms, which have been successfully implemented for other environmental incentive transitions (Center for Biological Diversity et al., 2024; Happ, 2024). Congress must directly tie these subsidies to nutrition programs such as SNAP and NSLP (e.g., by increasing SNAP purchasing power for produce and mandating plant-based protein options in NSLP procurement) to increase both access and demand. A portion of this subsidy should be dedicated to developing legal and policy strategies against bans on the sale of livestock product alternatives, such as cultivated meat.

IV. Conclusion

A robust, effective policy approach to enteric methane mitigation in the US livestock sector requires coordination across scientific, economic, and institutional domains. A three-pronged strategy, integrating MRV and mitigation technology innovation, carbon pricing coupled with subsidization of mitigation technologies, and partial redirection of a portion of livestock subsidies to crops and alternative proteins, addresses this need and aligns economic signals with climate and nutrition goals. This approach builds on a foundation of state-level experimentation, international precedent, and public-private innovation partnerships. Experiences from programs such as California's SB1383 and AB32 implementation and Denmark's Green Tripartite Agreement demonstrate the economic and administrative feasibility of this approach. Establishing this integrated federal framework, driven by coordinated action from Congress, the USDA, and the EPA, would enable cost-effective methane reduction and equitable participation by farmers. Over time, this coordinated framework would not only advance national methane reduction targets and facilitate agricultural diversification but also strengthen scientific and institutional foundations for long-term climate governance in US agriculture.

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