**Readily available measures of greenhouse gas mitigation are more than sufficient for UK livestock industry to stop contributing to further climate change if fully implemented**

**Application:** In order to encourage the uptake of greenhouse gas (GHG) mitigation measures by livestock farmers, the narrative behind the encouragement matters. This study proposes a new and more positive framing of the industry’s potential to transform itself into a low emissions sector.

**Introduction:** For the UK to achieve the legislated target of becoming a net zero economy by 2050, the livestock industry must accelerate effort to reduce its contribution to the national GHG inventory. A recent study encompassing the industry’s six most important sectors (dairy, beef, sheep, pigs, broilers and layers) indicates that adopting an economically realistic set of currently available GHG mitigation measures would result in a 23% reduction in inventory-relevant emissions (Magowan et al., 2022). This estimate, however, was based on the 100-year time horizon global warming potentials impact assessment method (GWP100), which is known to overstate the effect of constant methane emissions on global surface temperature while understating the effect of new methane sources (McAuliffe et al., 2023). As such, the exact level of mitigation required for the livestock industry to stop contributing to further temperature increases remains unquantified to date.

**Materials and methods:** We used the 2022 edition of the UK devolved administration GHG inventory (NAEI, 2024), which separately reports emissions that occurred in England, Scotland, Wales and Northern Ireland. In addition to agricultural source categories of 3A (enteric fermentation), 3B (manure management) and 3D/ 3G/3H (soil emissions), a subset of sources within source categories 4B (Cropland) and 4C (Grassland) were extracted to account for the background (landscape-originated) emissions associated with current agricultural land use. The gas-by-gas emission data thus compiled were then integrated using the GWP\* impact assessment method (Cain et al., 2019) to estimate the approximated short-term (< 20 years) relative temperature effect. Following a baseline simulation, methane emissions by each nation were iteratively reduced to identify an equilibrium point where the global cooling effect of methane mitigation (Δ stock) equates to the global warming effect of carbon dioxide/nitrous oxide emissions (flow). In order to eliminate the effect of transborder emissions displacement, livestock numbers (and therefore food supply) were assumed to be constant. The background emissions from organic soil (peatland) were excluded from the main analysis due to their uncertainty but considered in the form of a sensitivity analysis.

**Results:** The level of methane mitigation required to achieve a short-term equilibrium in each nation was found to be 22% (England), 27% (Scotland), 15% (Wales) and 12% (Northern Ireland), respectively **(Figure 1)**. The inter-regional variability in the threshold was primarily driven by the relative importance of ruminant agriculture, which, in turn, contributed to a greater proportion of methane within the GHG inventory. Without any mitigation in place, this share was found to be 61% (England), 68% (Scotland), 79% (Wales) and 78% (Northern Ireland). Inclusion of peatland emissions slightly increased the level of methane mitigation required, to 29% (England), 33% (Scotland), 15% (Wales) and 16% (Northern Ireland), primarily due to a low water table to facilitate greater carbon dioxide emissions under these conditions. To contextualise these values, Magowan et al. (2022) estimate that existing mitigation technologies alone could lead to a ~28% reduction in methane from UK livestock farming if fully implemented, whereas Newbold et al. (2022) predict that near-market-ready feed additives would further reduce enteric methane by 13–56%. Combined together, our results indicate that readily available mitigation measures are more than sufficient for the UK livestock industry to stop contributing to further climate change if fully implemented. It should be noted, however, that the derived equilibrium will only last for ~ 20 years (during which the methane stock in the atmosphere continues to decrease), meaning that a new set of mitigation technologies will be required to maintain the zero temperature effect beyond then.

**Figure 1. Impact of methane reduction on temperature effect**

**Conclusions:** The global cooling effect considered herein is primarily underpinned by the livestock industry’s own past methane emissions and, therefore, from the legal and societal justice points of view, the absence of the incremental temperature effect does not immediately mean that the industry bears no further responsibility in climate change. Notwithstanding, this study demonstrates that a seemingly small reduction in GHG emissions can reverse the contemporaneous temperature effect — thereby likely the public perception — of livestock farming, reiterating the importance of actions and perseverance towards mitigation efforts.

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**References:**

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