

Regional challenges to the UK sheep sector (including impacts on Greenhouse Gas emissions from sheep systems)

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@AgusBC3



With help from BC3, Phil Stocker (NSA), Cled Thomas (EEAP) and Georgios Arsenos (AUTH)

*Innovations to improve sustainability in the sheep and goat sector.
An iSAGE training course and an iSAGE workshop.
Wood Hall Hotel & Spa, Linton, Wetherby, West Yorkshire, UK*



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Achieving net zero emissions by 2050 (or before)

Climate Change (Emissions Targets) Bill

A BILL

To Amend the Climate Change Act 2008 to require net United Kingdom carbon emissions to be zero by 2050 and to include international aviation and international shipping in the calculation of such emissions.

*Presented by Rachel Reeves
supported by
Mary Creagh, Edward Milliband,
Drew Hendry, Norman Lamb,
Caroline Lucas, Nicky Morgan,
Peter Kyle, Zac Goldsmith,
Anna McMorrin, Antoinette Sandbach
and Dr Sarah Wollaston.*

*Ordered, by The House of Commons,
to be Printed, 11th June 2019.*

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Bill 399

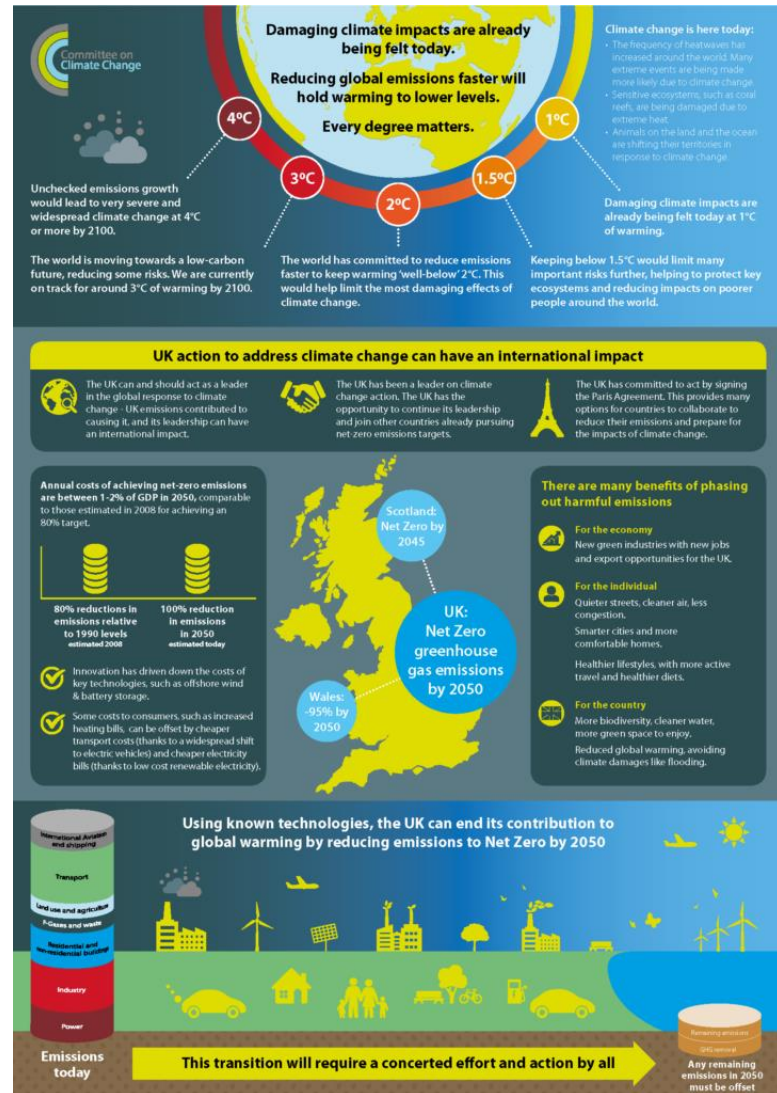
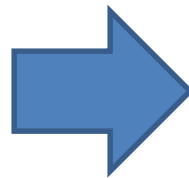
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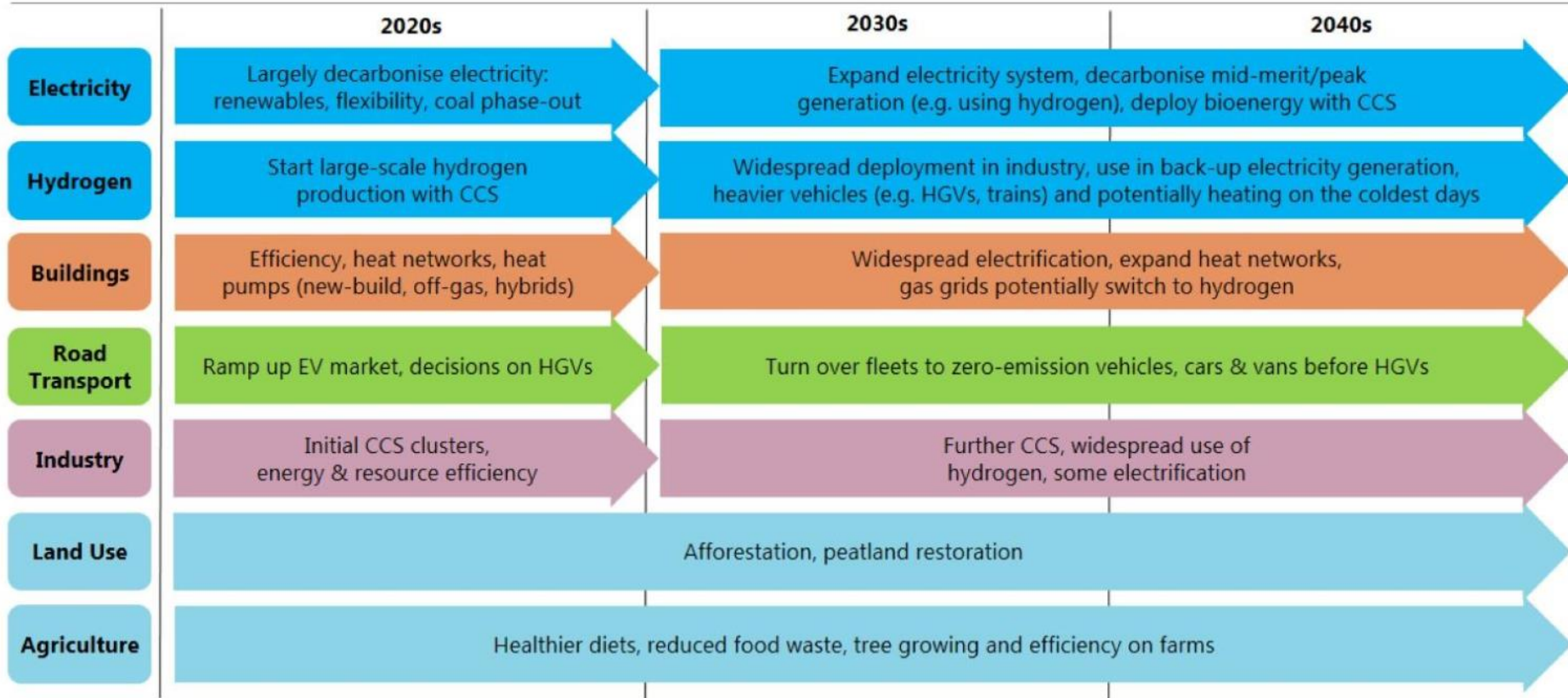


Achieving net zero emissions by 2050 (or before)

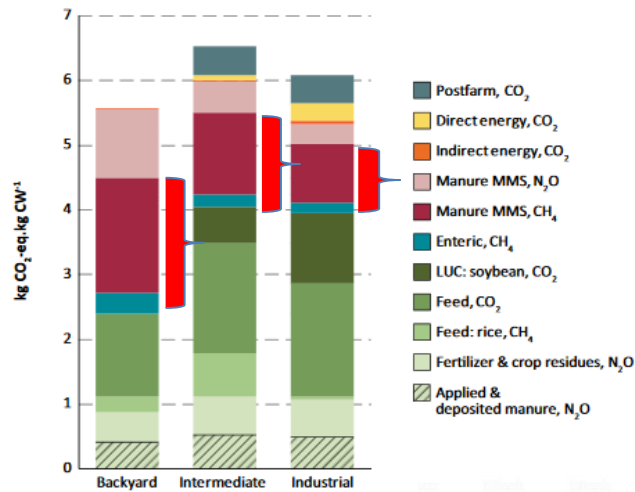


Reaching net-zero emissions in the UK

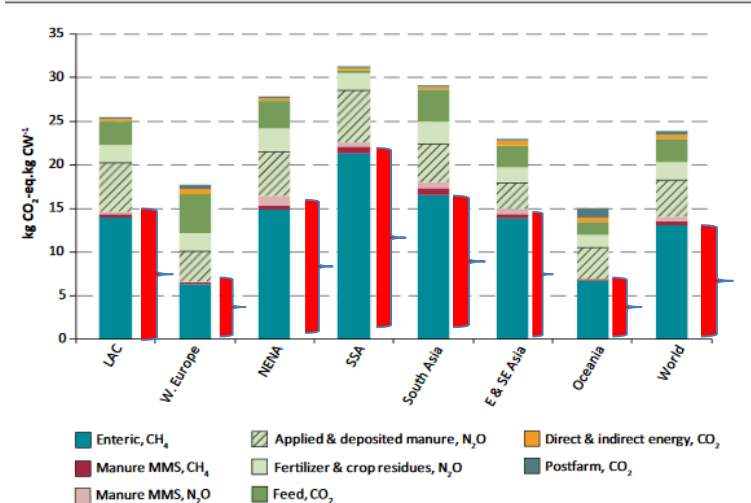
How UK net-zero scenarios can be delivered



Methane-the evil



Source: FAO



Source: FAO



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Is it sensible to consider all GHG together?

“To stabilise global temperatures, emissions of long-lived gases like CO₂ must be reduced to net-zero. Emissions of short-lived gases like methane must be stabilised, but need not reach net-zero”.

4. Defining 'net-zero' emissions

A net-zero target could be set for CO₂ only or could include emissions of additional GHGs. This section looks at the effects of different definitions of net-zero emissions on global temperature. Global net-zero emissions of **long-lived** greenhouse gases and stable or falling emissions of short-lived greenhouse gases are needed to stop global temperature increasing.

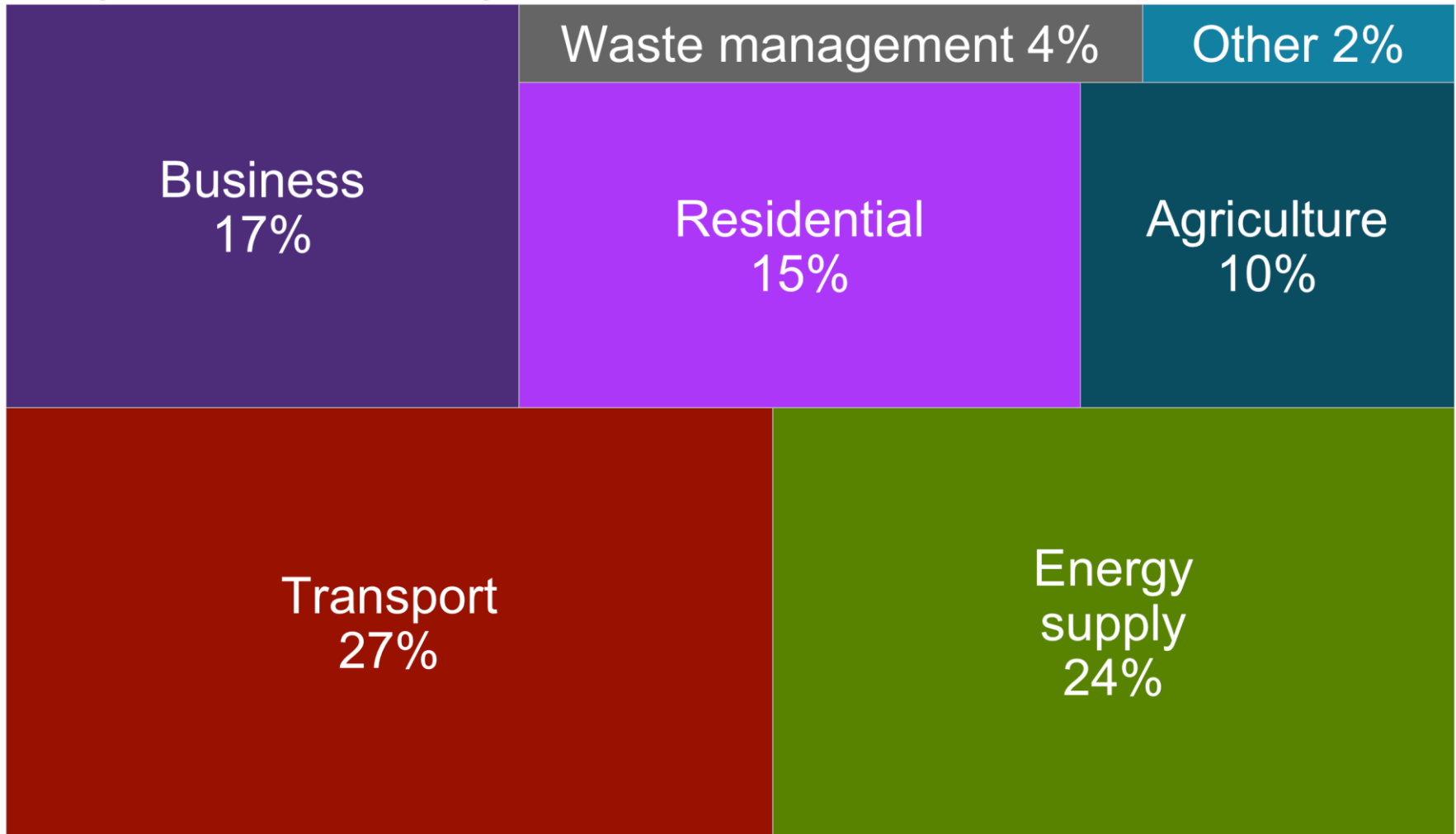
- **Long-lived greenhouse gases** accumulate in the atmosphere, so continued emissions of these gases leads to continually increasing warming. In order to stop global temperature increasing, global emissions of these gases must be brought to near net-zero. Warming created by long-lived gases is not naturally reversible on the timescale of decades-to-centuries. Therefore, reducing this warming requires the removal of long-lived gases from the atmosphere. CO₂ and other long-lived gases (such as N₂O) can be aggregated as 'CO₂ equivalent' whilst still relatively accurately capturing their effects on global temperature.
- **Short-lived greenhouse gases** such as methane affect the climate in qualitatively different ways to CO₂, with constant rates of emission leading to an approximately constant level of raised global average temperature but not continually increasing warming (Box 2.3).⁷² Aggregation as 'carbon dioxide equivalent'⁷³ fails to capture this fundamental difference in how emissions of short-lived and long-lived GHGs affect global temperature. However, other constraints such as international comparability (Box 2.4) support the continued use of existing 'CO₂ equivalence' metrics for now.



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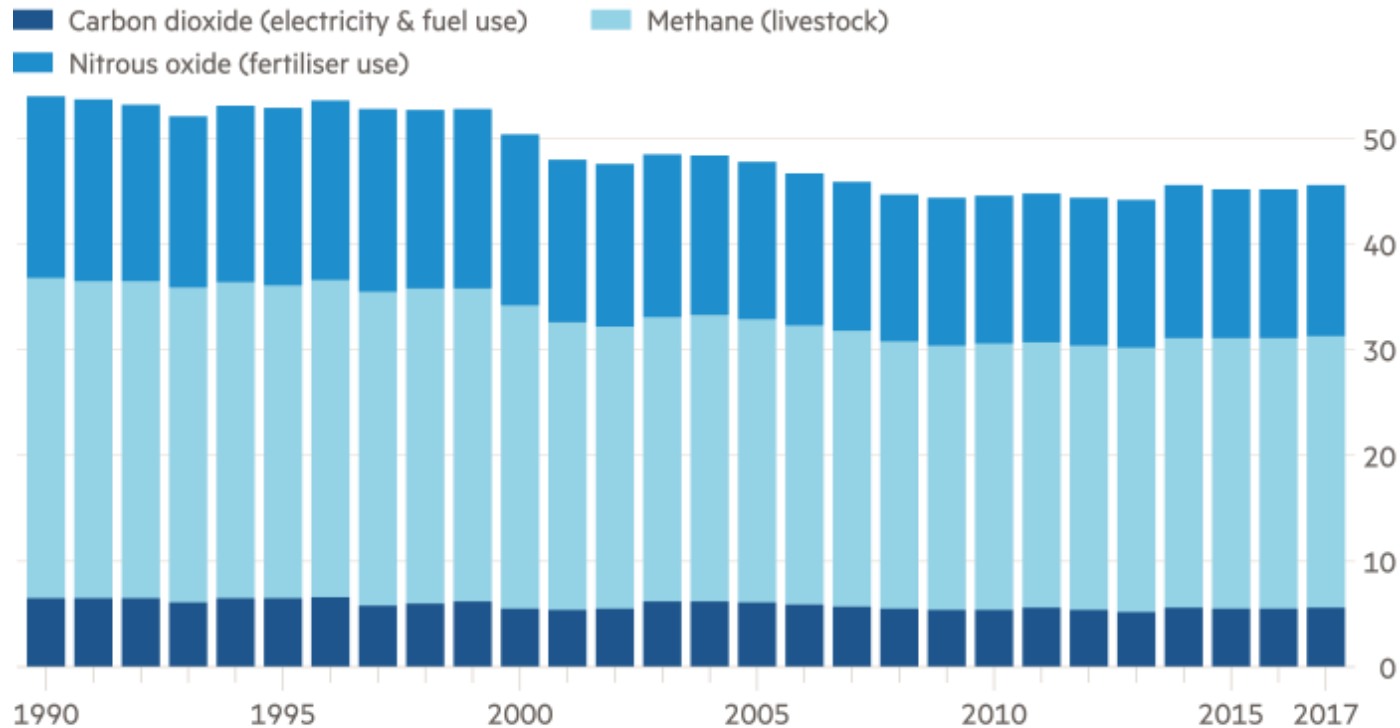
Transport was the largest emitting sector of greenhouse gases in 2017



Source: Department for Business. Does not add up to 100% due to rounding.

Methane makes up large share of agricultural sector emissions

UK greenhouse gas emissions, metric tons of CO2 equivalent



Source: Department for Business, Energy & Industrial Strategy
© FT

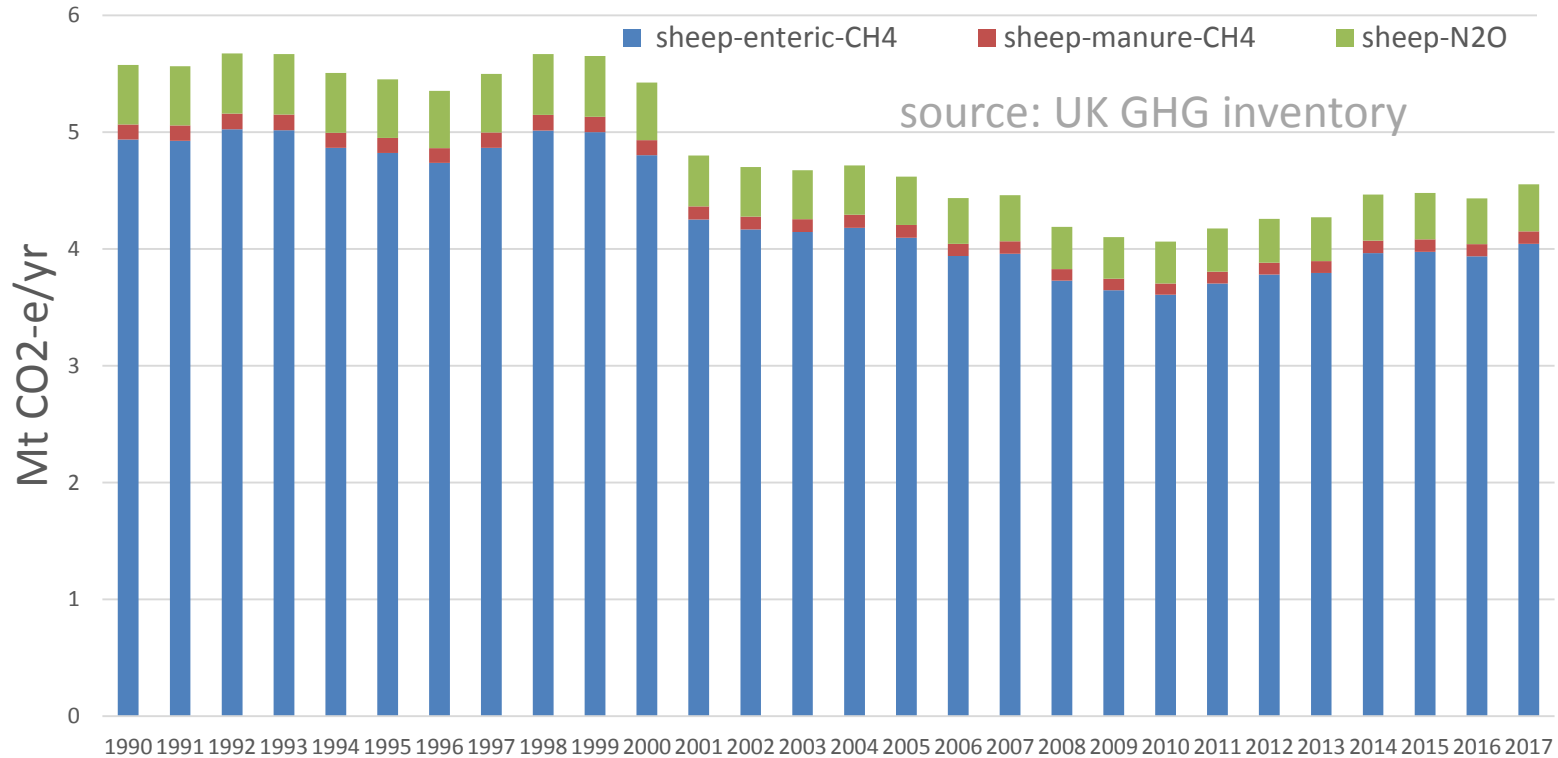


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GHG emissions from UK Sheep

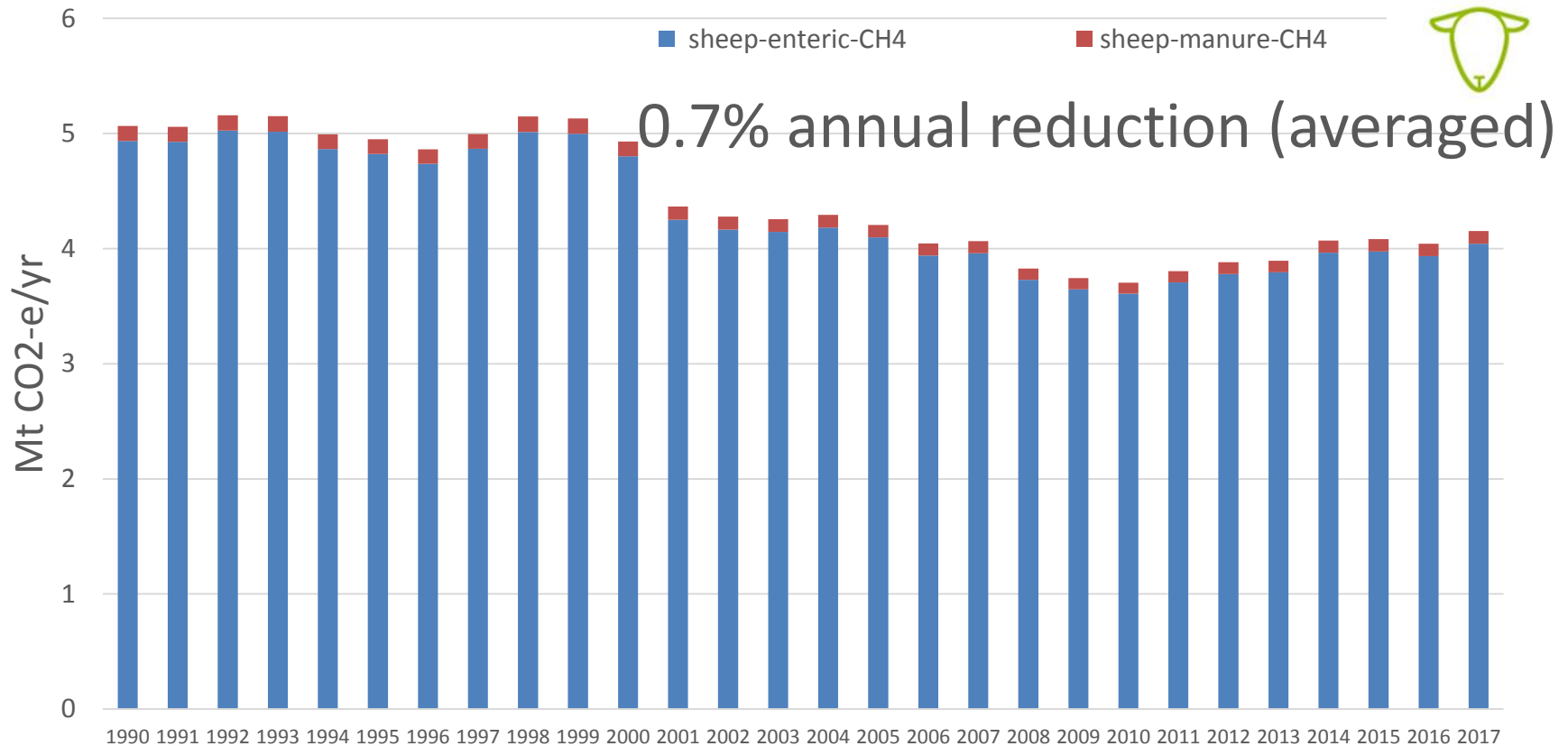


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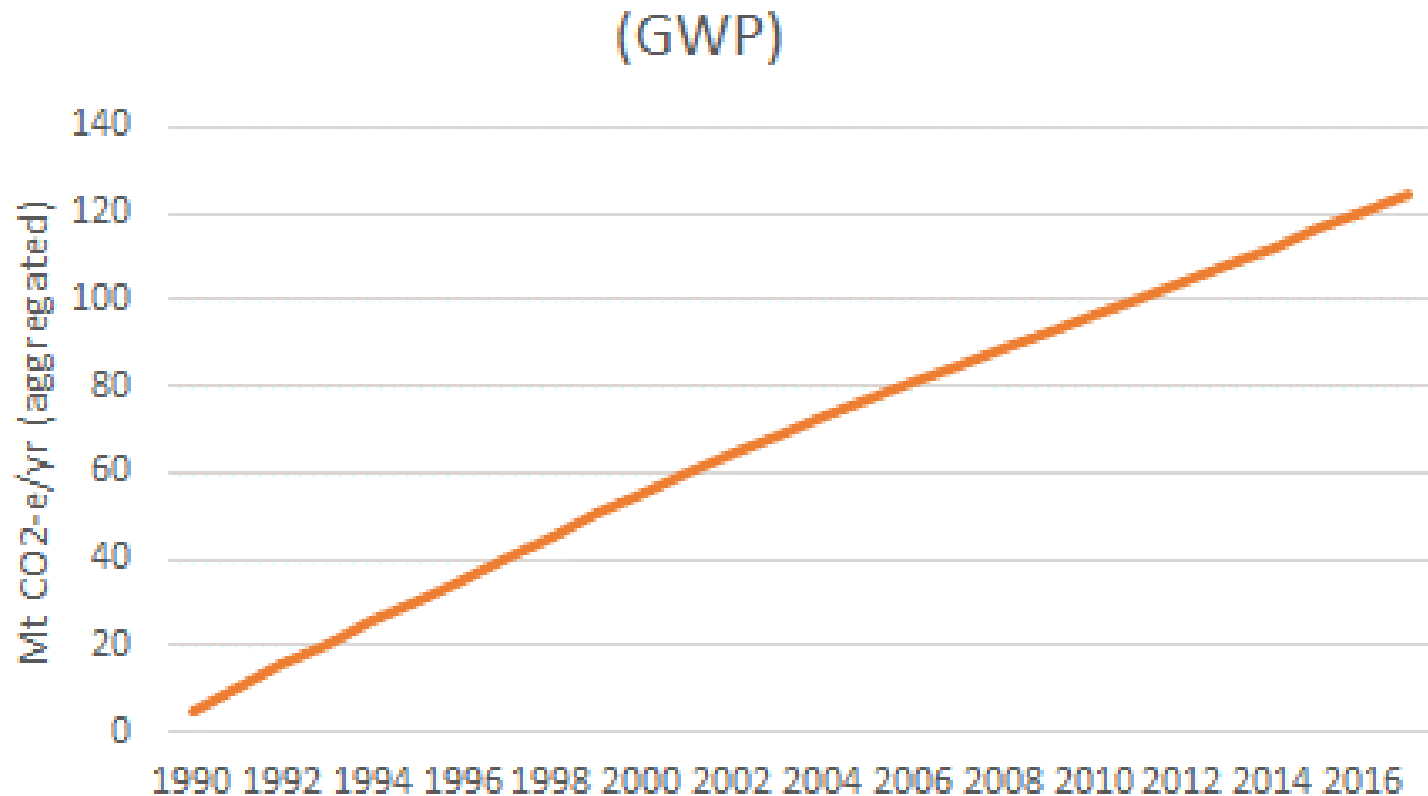
CH4 emissions from UK Sheep



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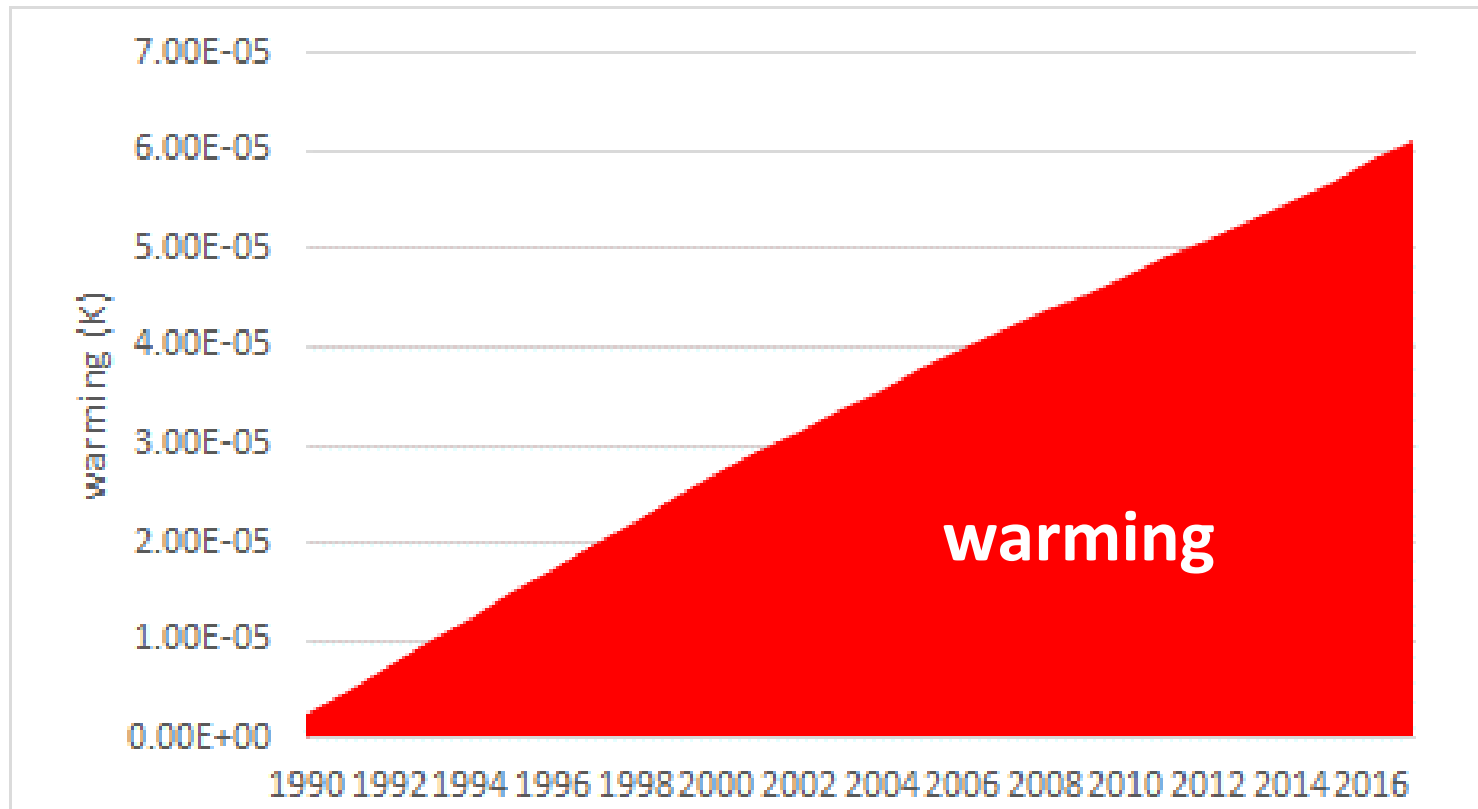
Aggregated CH₄ from sheep (GWP)



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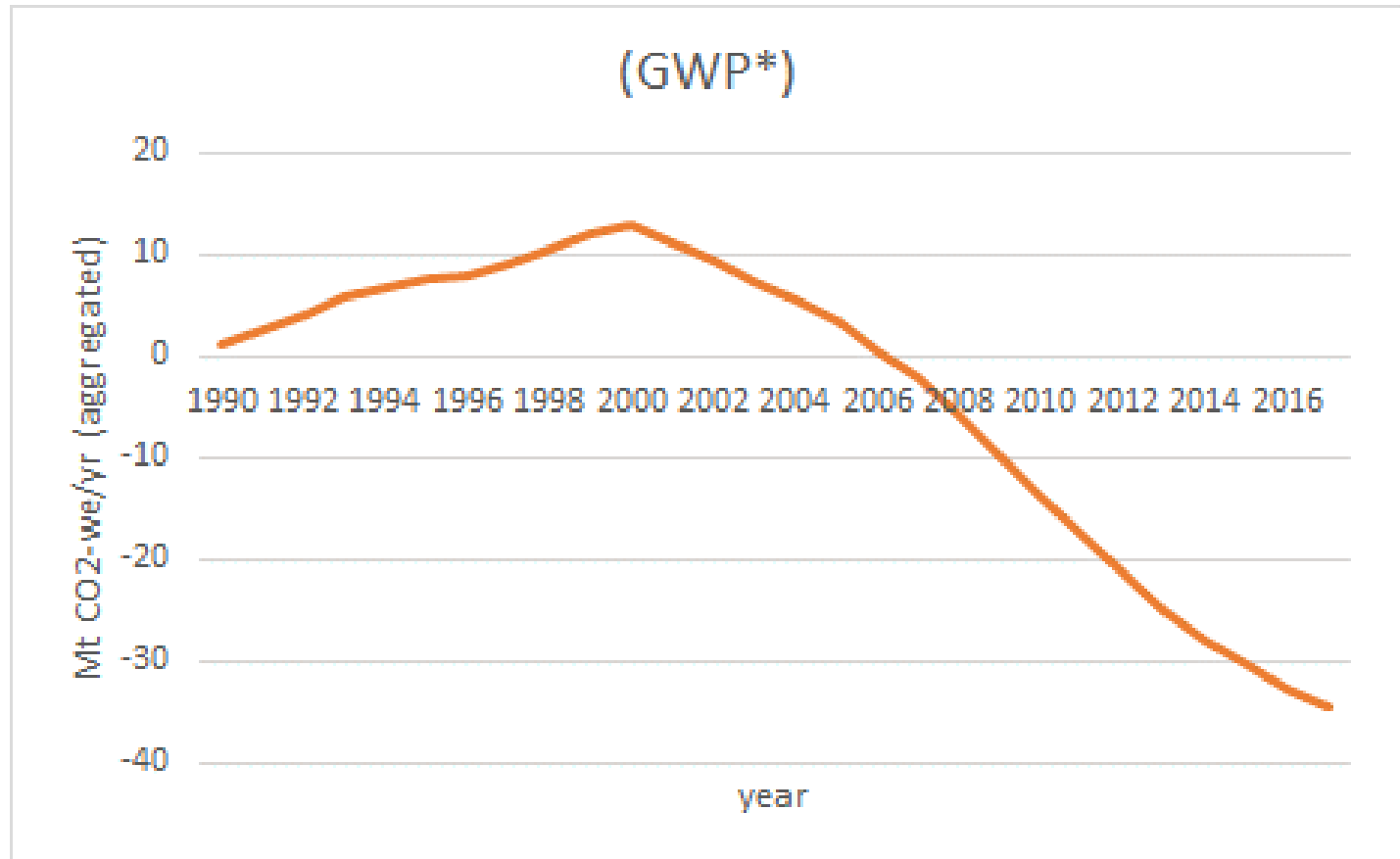
Warming effect by UK sheep (GWP)



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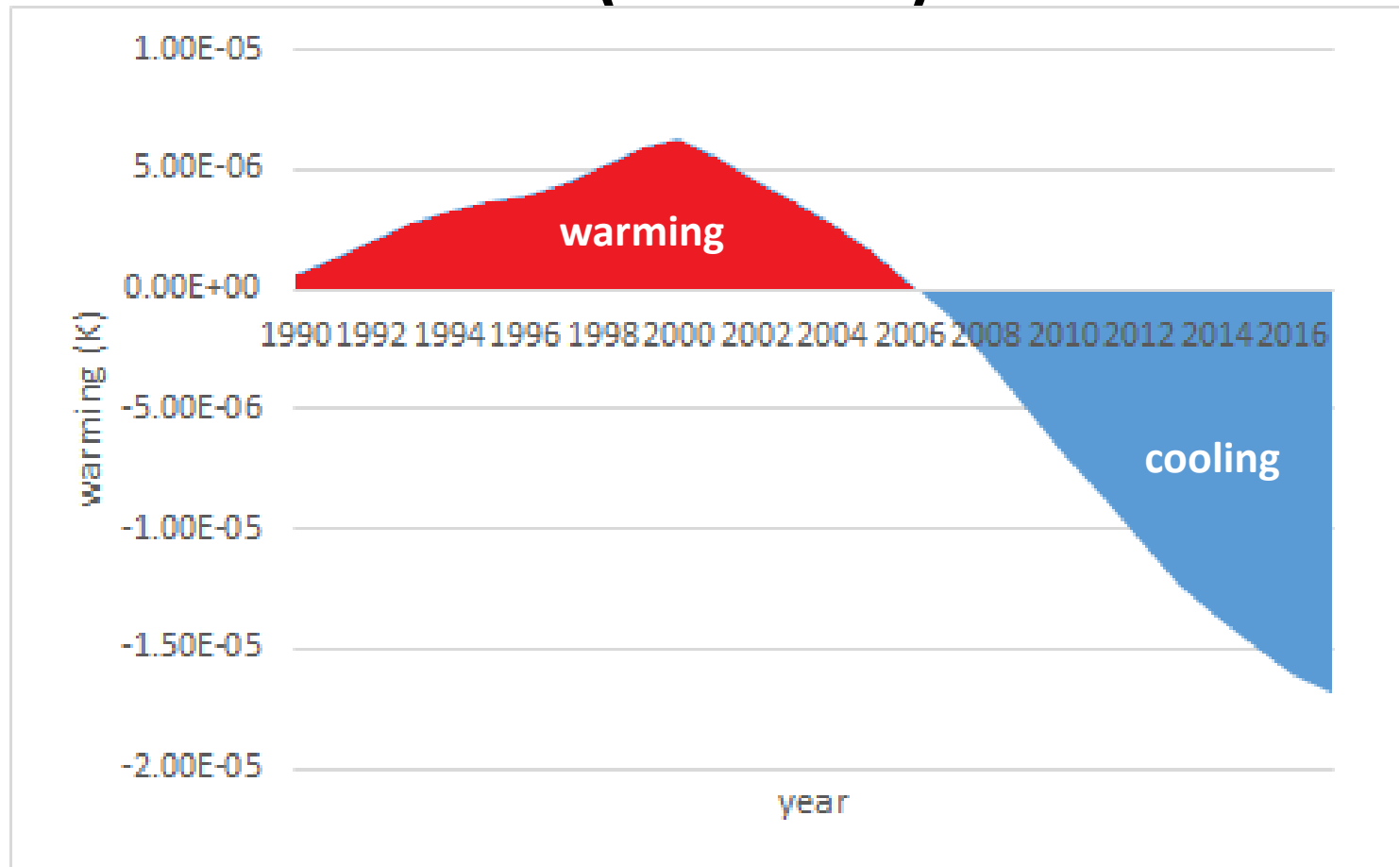


Aggregated CH₄ from sheep (GWP*)



Based on Cain et al. (2019)

Aggregated CH₄ from sheep (GWP*)

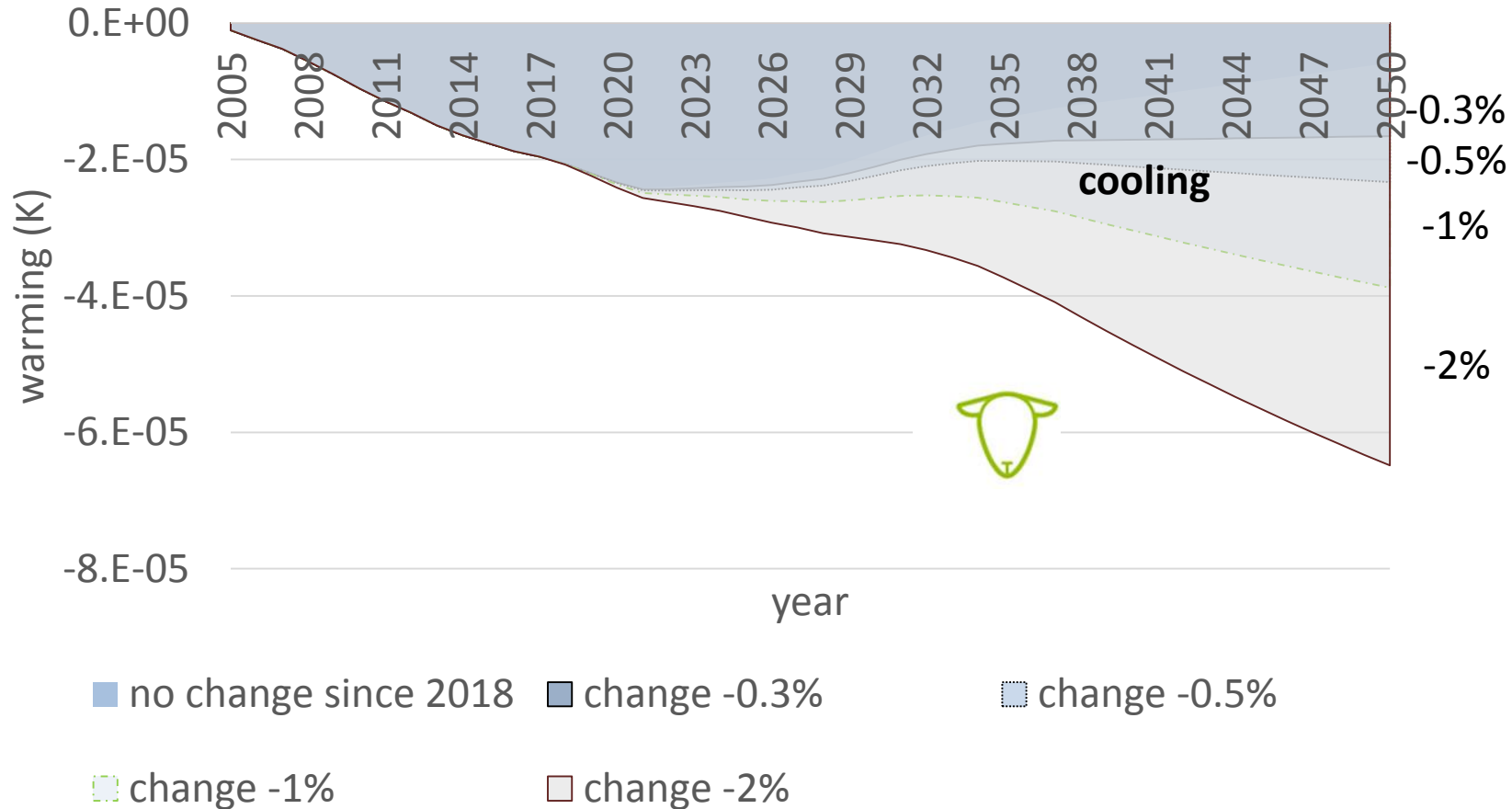


Based on Cain et al. (2019)

Potential pathways for biogenic sheep CH₄ in the UK

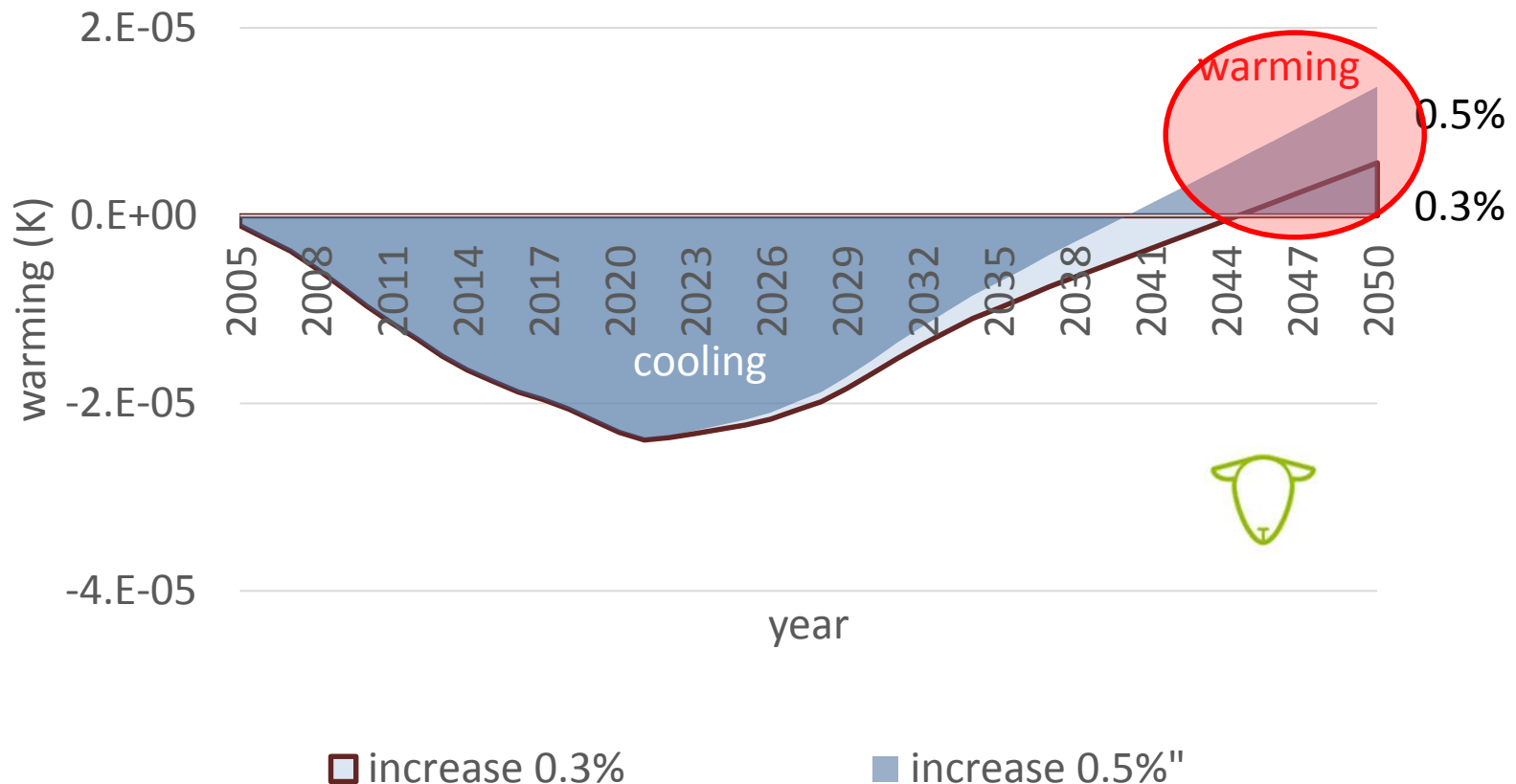
SCENARIOS	Annual reduction	Short-term reduction in period (2005-2030)	Medium-term reduction in period (2005-2050)
No change (2018-)	0%	0%	0%
Small reduction	0.3%	5%	11%
Medium reduction	0.5%	7%	16%
Ambitious reduction	1%	13%	29%
Very ambitious reduction	2%	24%	49%
Small increase	-0.3%	3%	9%
Medium increase	-0.5%	5%	16%

Warming effect: Pathways with CH₄ reduction



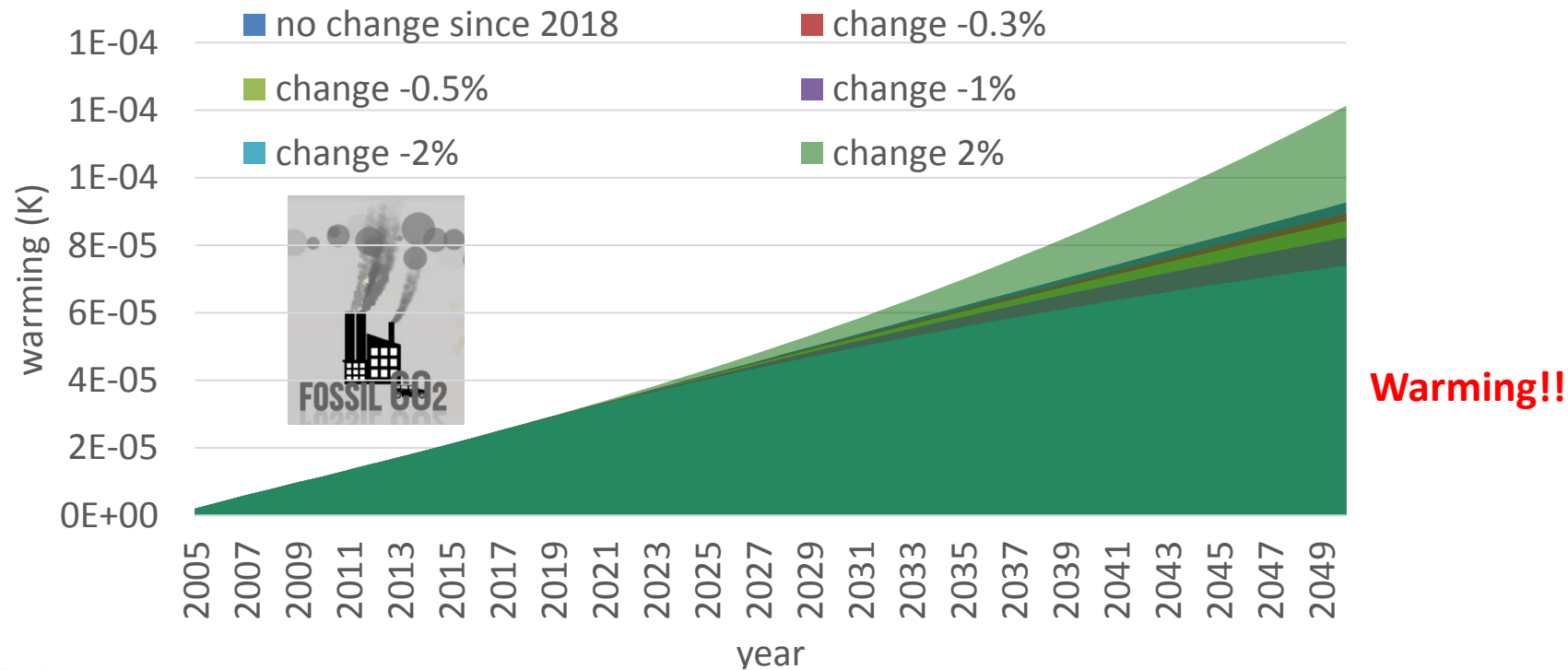
Based on Cain et al. (2019)

Warming effect: Pathways with CH₄ increase



Based on Cain et al. (2019)

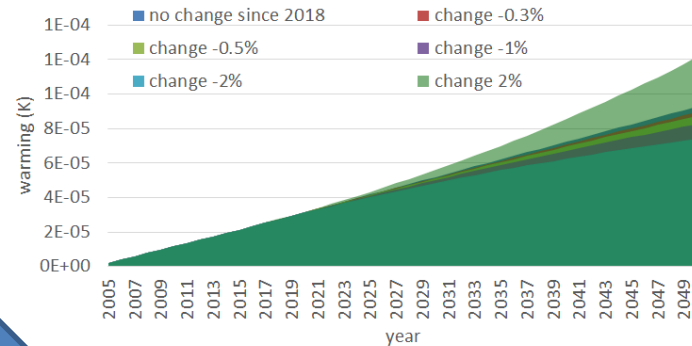
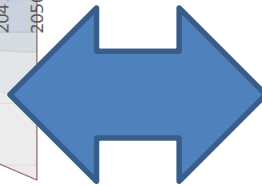
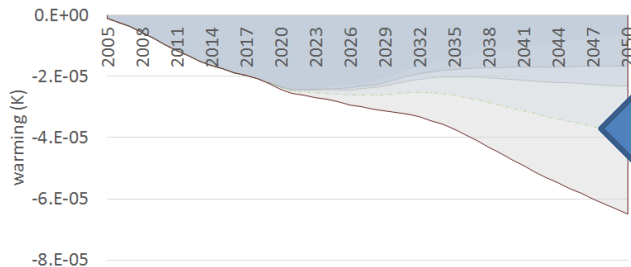
Warming effect: if Pathways were referred to fossil CO₂ emissions



Warming effect: if Pathways were referred to fossil CO₂ emissions



Cooling!!



Warming!!



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Novel mitigation measures (CH₄)

Seaweed

In vitro (Kinley et al., 2016; Vucko et al., 2017)
In vivo: UC Davis (US)



Holstein cows feeding at a dairy farm in Merced, California. MARMADUKE ST. JOHN / ALAMY

How Eating Seaweed Can Help
 Cows to Belch Less Methane

3-nitrooxypropanol (NOP)

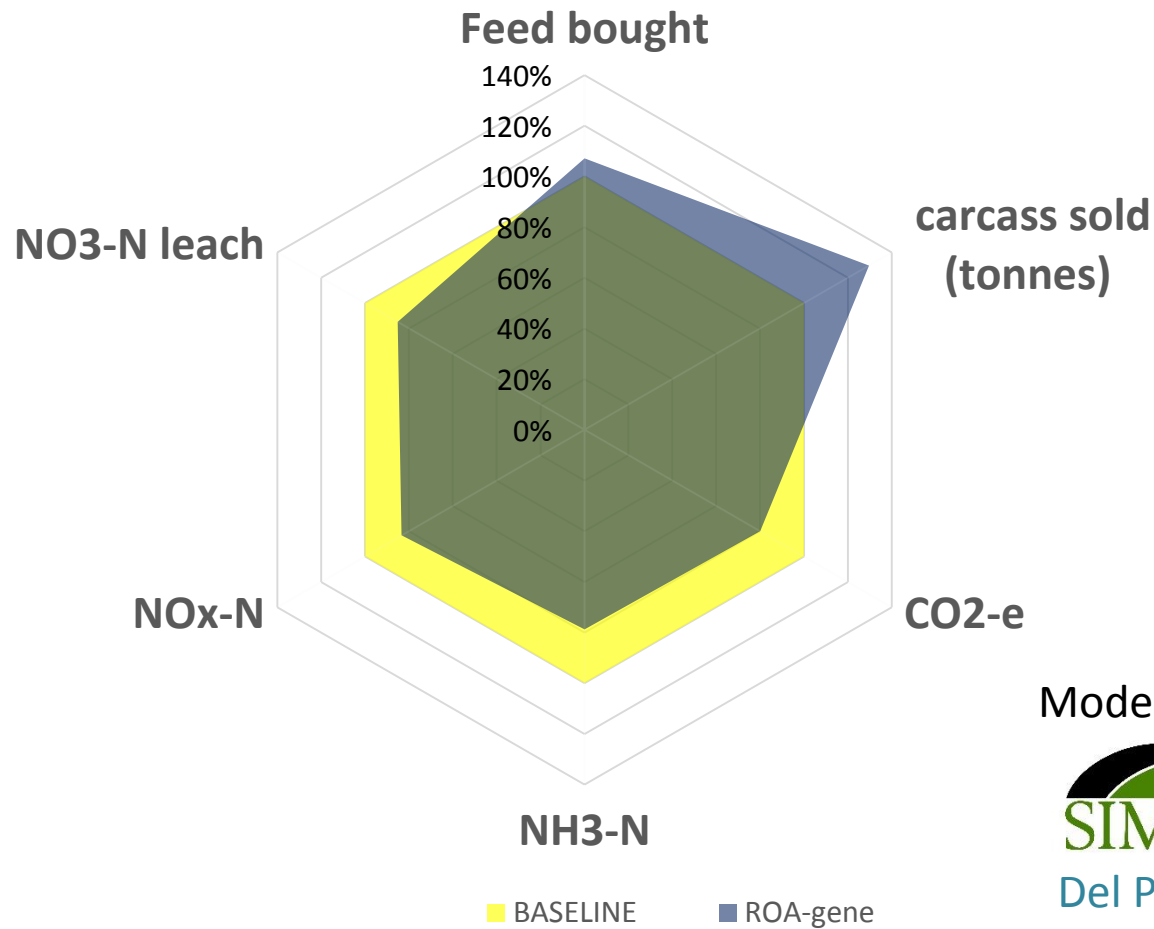
Antiburp compound could reduce methane emissions
 from cows

Duin *et al.* (2016) Proc Natl Acad Sci
 31;113(22):6172-7

	Martinez- Fernandez et al. (2013)	Haisan et al. (2014)	Haisan et al. (2013)	Reynolds et al. (2014)	Romero Perez et al. (2014)
Location of study	Spain	Alberta	Alberta	UK	Alberta
Animals	sheep	dairy cows	dairy cows	dairy cows	beef cattle
Dietary forage, % DM	60	40	60	52	60
NOP dose, g/d	0.1	2.5	1.25, 2.5	0.5, 2.5	0.5, 1.4, 2.8
Method of NOP supplementation	2xday pulse dose	mixed into diet	mixed into diet	2xday pulse dose	top dressed onto TMR
% CH ₄ (g/kg DMI) reduction	25	60	35, 51	4, 7	4, 9, 33
% DMI reduction	0	0	0	0	2.5, 5.8, 5.0

DMI = dry matter intake

Innovations-ROA allele (increases prolificacy)

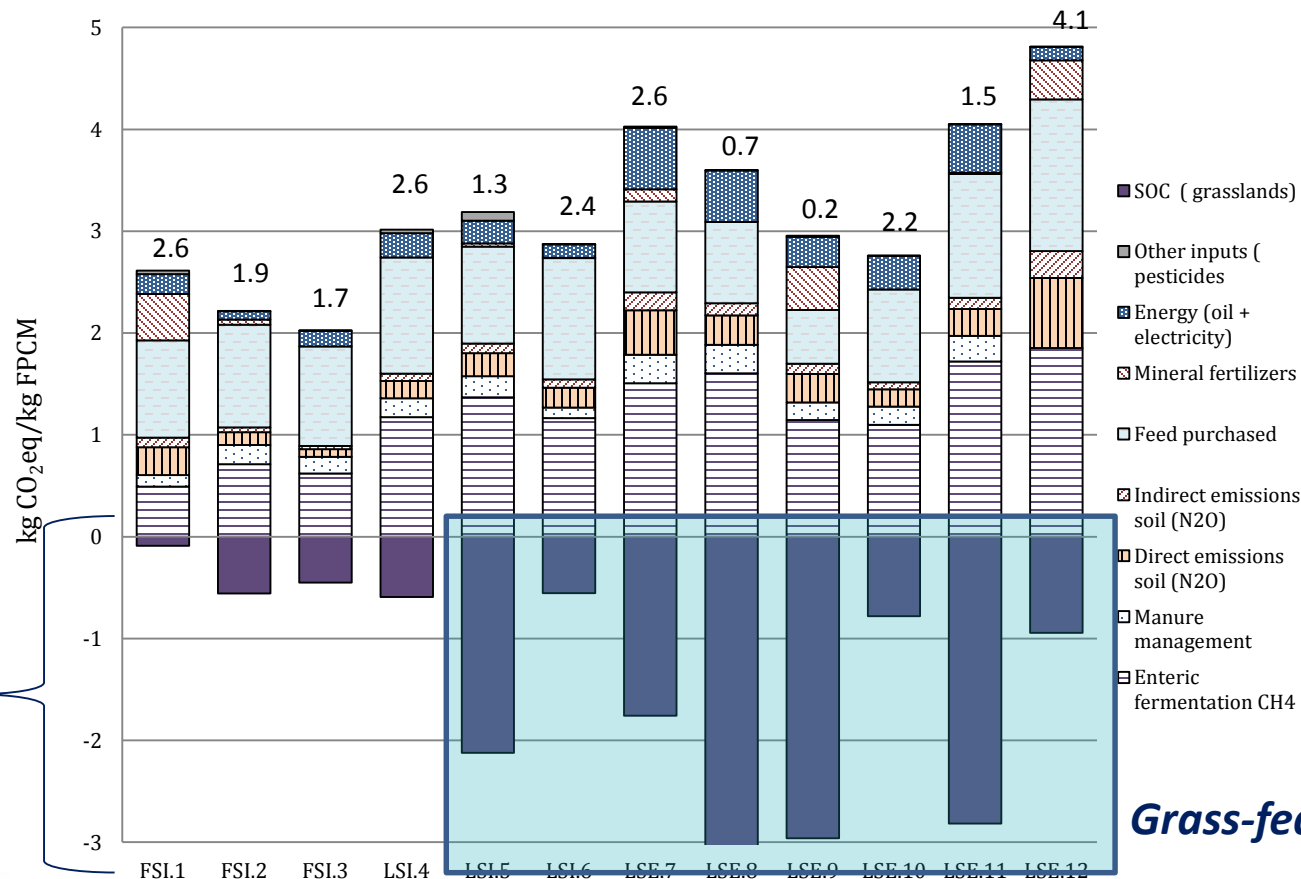


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Important to include SOC sequestration

Carbon
sequestration



Batalla et al. (2015)

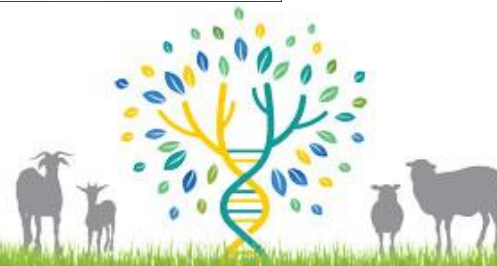
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However, these mitigation options should be accounted for in national inventories



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CH₄ uncertainties (other sources)

California landfills are belching high levels of climate-warming methane

Airborne remote sensing spots the Golden State's biggest emitters of the gas from the sky



A new airborne remote sensing technique found that landfills top the list of California's superemitters of methane, a potent greenhouse gas.

Study: EPA May Be Underestimating Landfill Methane

By Bobby Magill

Follow @bobbymagill 3,148 followers



Published: September 21st, 2015

Landfills may be emitting more methane than previously reported because the Environmental Protection Agency may be drastically underestimating how much garbage is being deposited in landfills across the U.S., according to a new Yale University study.

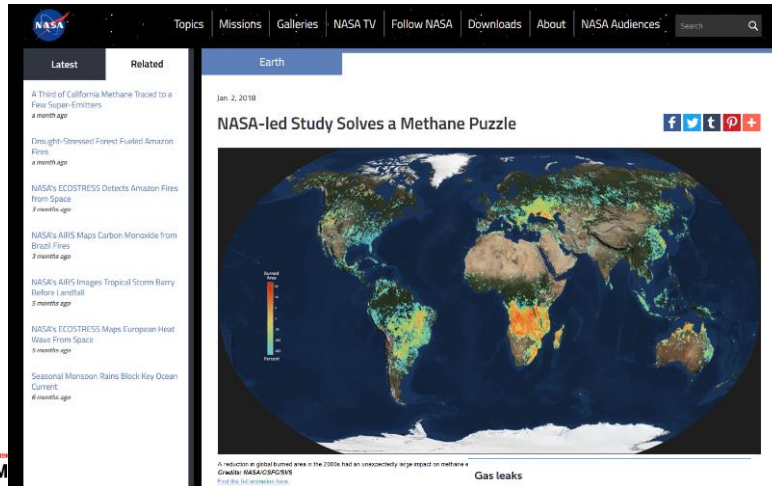
Banana peels, coffee grounds, plastic bottles and other detritus tossed in the garbage usually ends up in a landfill and emits methane as it decomposes. Methane is a greenhouse gas up to 35 times as potent as carbon dioxide as a driver of climate change over the span of a century, and landfills are the United States' third largest source of methane emissions, according to the EPA. The Obama administration is focusing on cutting methane emissions as part of its Climate Action Plan.



landfills



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estimate

This finding by researchers led by scientists from Princeton University challenges the accuracy of methane emission estimation processes



By Robert Gupta
Last updated: Florida 22 August 2015



Leaky pipelines

Gas leaks

Airplanes equipped with an imaging spectrometer created detailed, high-resolution maps of methane plumes emitted across the Golden State (a few plumes are shown in the first image above). Identified concentrated sources, or point sources, of methane are represented by the purple dots. These data are available as an interactive online map called the Methane Source Finder (a portion of the map shown).



PHOTO COURTESY



NATIONAL GEOGRAPHIC



Pump jacks are seen at dawn in an oil field over the Monterey Shale formation in California, where gas and oil extraction using hydraulic fracturing or fracking.

PHOTOGRAPH BY DAVID ACHEN/GETTY

ENVIRONMENT Fracking boom tied to methane spike in Earth's atmosphere

The chemical signature of methane released from fracking is found in the atmosphere, pointing to shale gas operations as the culprit.

Shale gas



CH₄ uncertainties-sinks

Science of the Total Environment 607–608 (2017) 1163–1172



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journal homepage: www.elsevier.com/locate/scitotenv



Methane uptake in global forest and grassland soils from 1981 to 2010



Lijun Yu^a, Yao Huang^{b,*}, Wen Zhang^a, Tingting Li^a, Wenjuan Sun^b

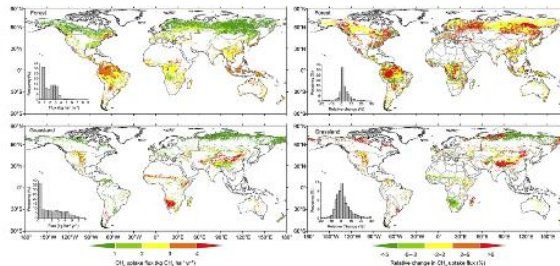
^a IAPC, Institute of Atmospheric Physics, University of Chinese Academy of Sciences, Beijing 100029, China

^b State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, University of Chinese Academy of Sciences, Beijing 100093, China

HIGHLIGHTS

- Empirical models were developed to estimate CH₄ uptake by forest and grassland soils.
- Global CH₄ uptake averaged 9.16 Tg/year and 3.73 Tg/year in forest and grassland soils during 1981–2010.
- CH₄ uptake in global forest and grassland soils increased slightly over the thirty years.

GRAPHICAL ABSTRACT



Aprox 4 Tg CH₄ yr⁻¹ **uptake** in grassland soils during 1981-2010.
(This is aprox. 2% of all GHG livestock estimate from FAO, globally)



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Take homes

- Sheep and goats in the UK have caused no additional warming to the atmosphere
- Farmers can mitigate GHG with different interventions in the farm
- Main strategy should be to keep and move towards high Production standards

Innovations to improve sustainability in the sheep and goat sector. An iSAGE training course and an iSAGE workshop. Wood Hall Hotel & Spa, Linton, Wetherby, West Yorkshire, UK



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Thanks

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