

CLIMATE NEUTRAL BEEF: *WHERE DO WE GO FROM HERE?*

NCBE Brown-Bagger Series

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Jason Sawyer

King Ranch® Institute for Ranch Management

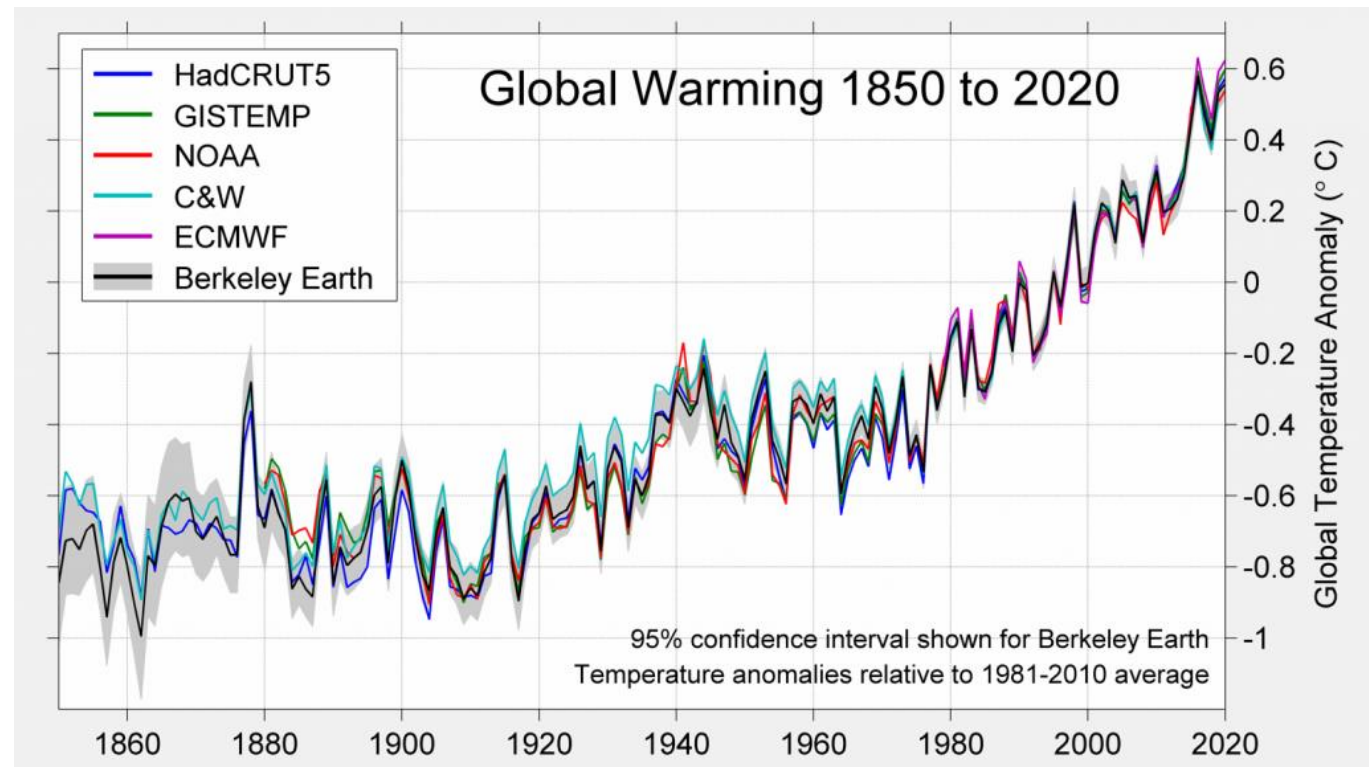
WHERE WE ARE...

CARBON AND CLIMATE CONCERNS

Warming is greatest expressed concern

Related to increase in atmospheric GHG

Sources > Sinks → Accumulation

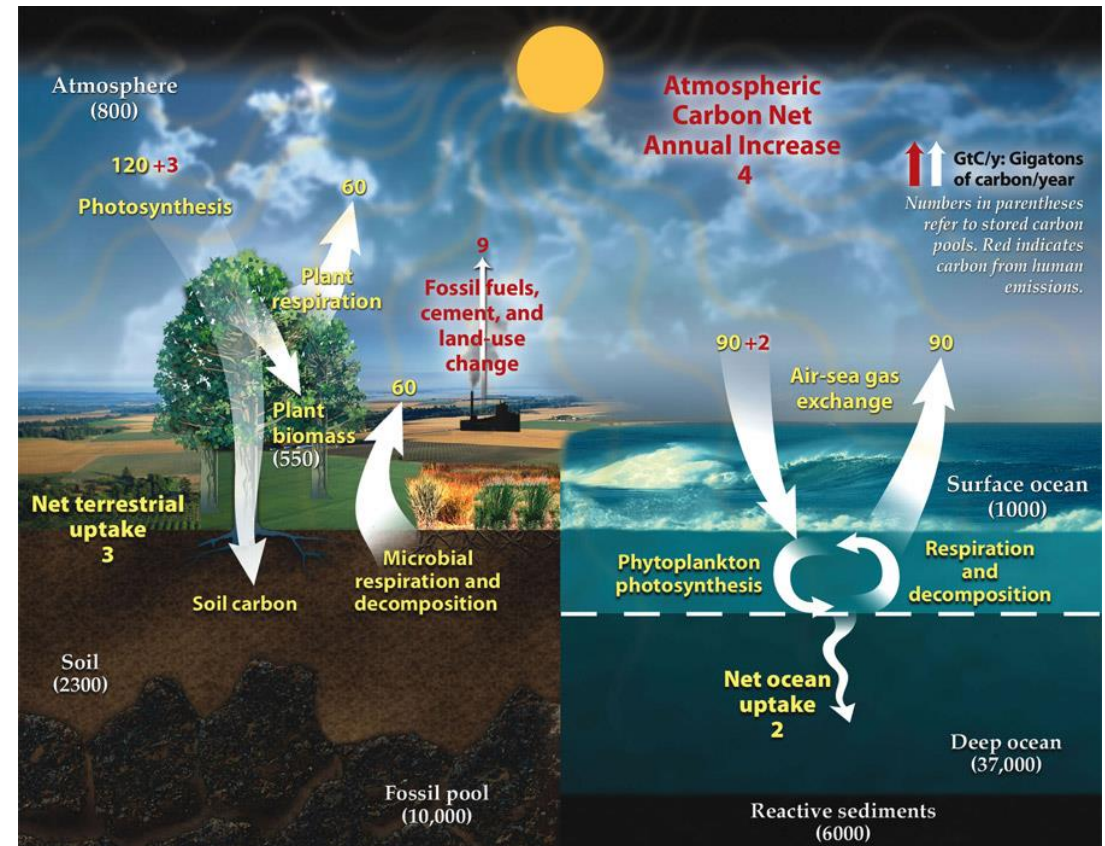


CARBON AND CLIMATE CONCERNS

Carbon cycle

- Sources = 219
- Sinks = 215
- Balance accumulated in atmosphere

Results in concern over GHG emissions



EMISSIONS EMPHASIS...

Gas	PPM-Vol	PPM - Mass	Total (Gt)	Relative abundance
Carbon dioxide	408	620	3,183	599
Methane	1.869	1.04	5.3	1
Nitrous Oxide	0.331	0.524	2.7	0.5
Halocarbons	~2,000	.007	0.04	0.007

Methane is considered an important GHG

- Exists at about 0.5 % of the amount of CO₂ (by volume)
- Atmospheric lifespan from 8 to 12 years

Carbon dioxide dominates 'warming potential'

- 76% vs. 3.5% on GWP₁₀₀ basis

For all, the change in atmospheric concentration drives warming

GHG EMISSIONS

CO₂ is the reference gas

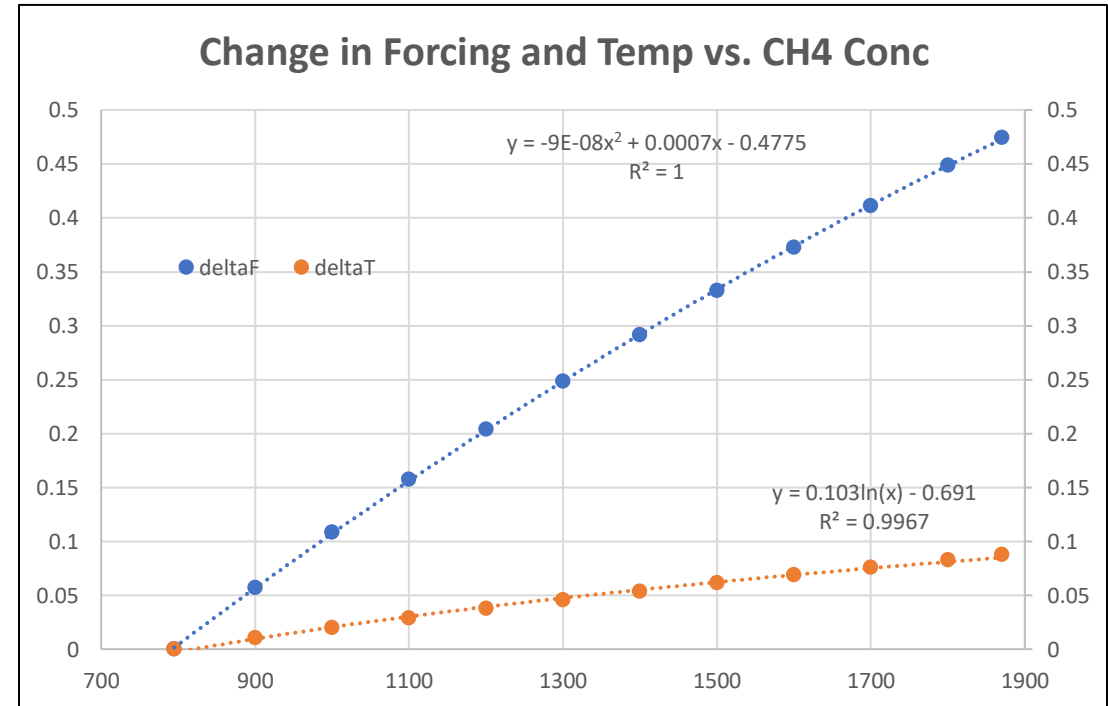
- Energy absorption of others is compared to it

GWP₁₀₀

- Methane 28X to 35X CO₂
- Energy is not temperature
- Emissions ≠ Concentration

GWP*

- Better metric for warming effects of methane
- Based on change in emissions



Eating less meat won't save the planet – here is why:

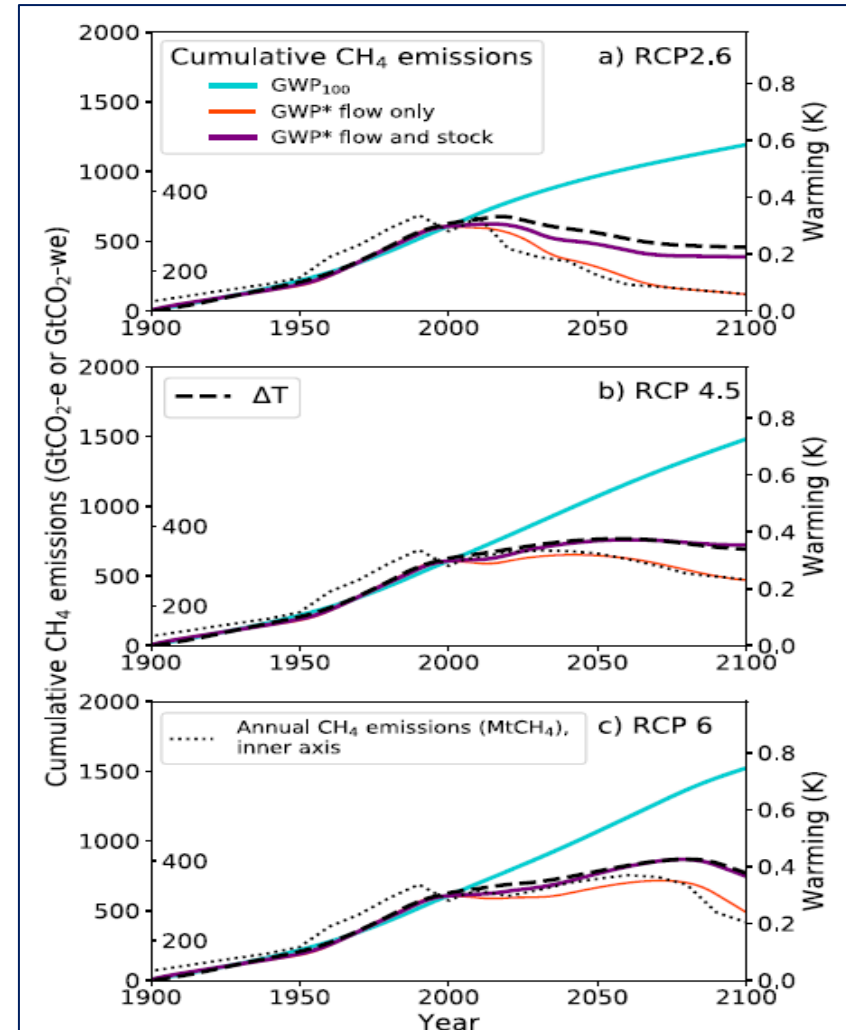
<https://youtu.be/sGG-A80TI5g>

Rethinking methane:

<https://www.youtube.com/watch?v=UOPrF8oyDYw>

EMISSIONS METRICS

- **GWP₁₀₀**
 - Multiplier of direct emissions
 - Overestimates warming effects of methane
 - Always indicates increase in warming, even with declining emissions
- **GWP***
 - Change in emissions over time
 - Results in better agreement with climate models
 - Can result in reduced warming or cooling



Cain et al., 2019; IPCC, 2021

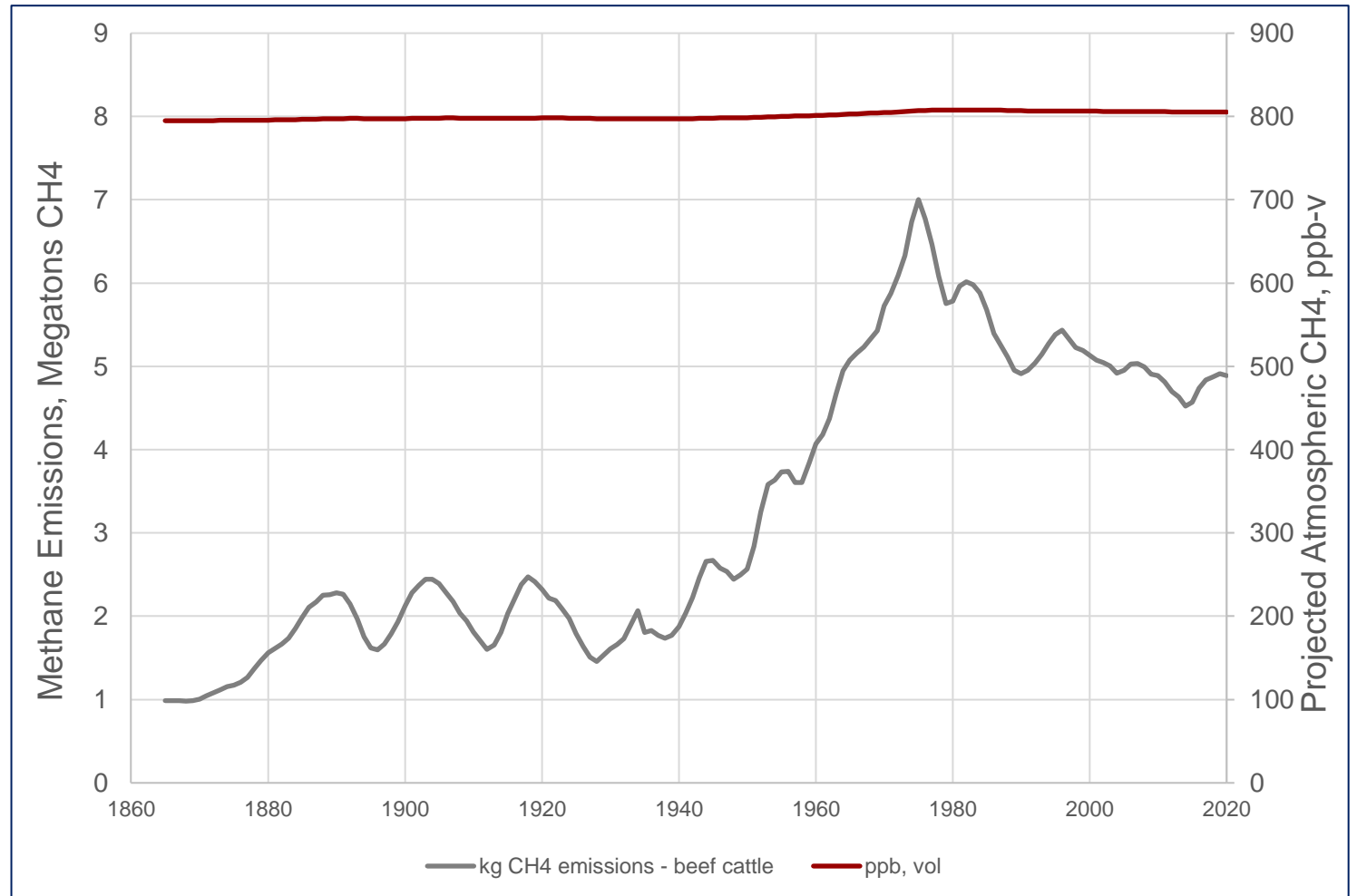
METHANE EMISSIONS & CONCENTRATION

US beef contribution to atmospheric CH₄ very small

- ~ 10 ppbv over the past 160 years
- Less than 1% of increase
- Within range of measurement error

Gross emissions can be misleading...

- But follow inventory



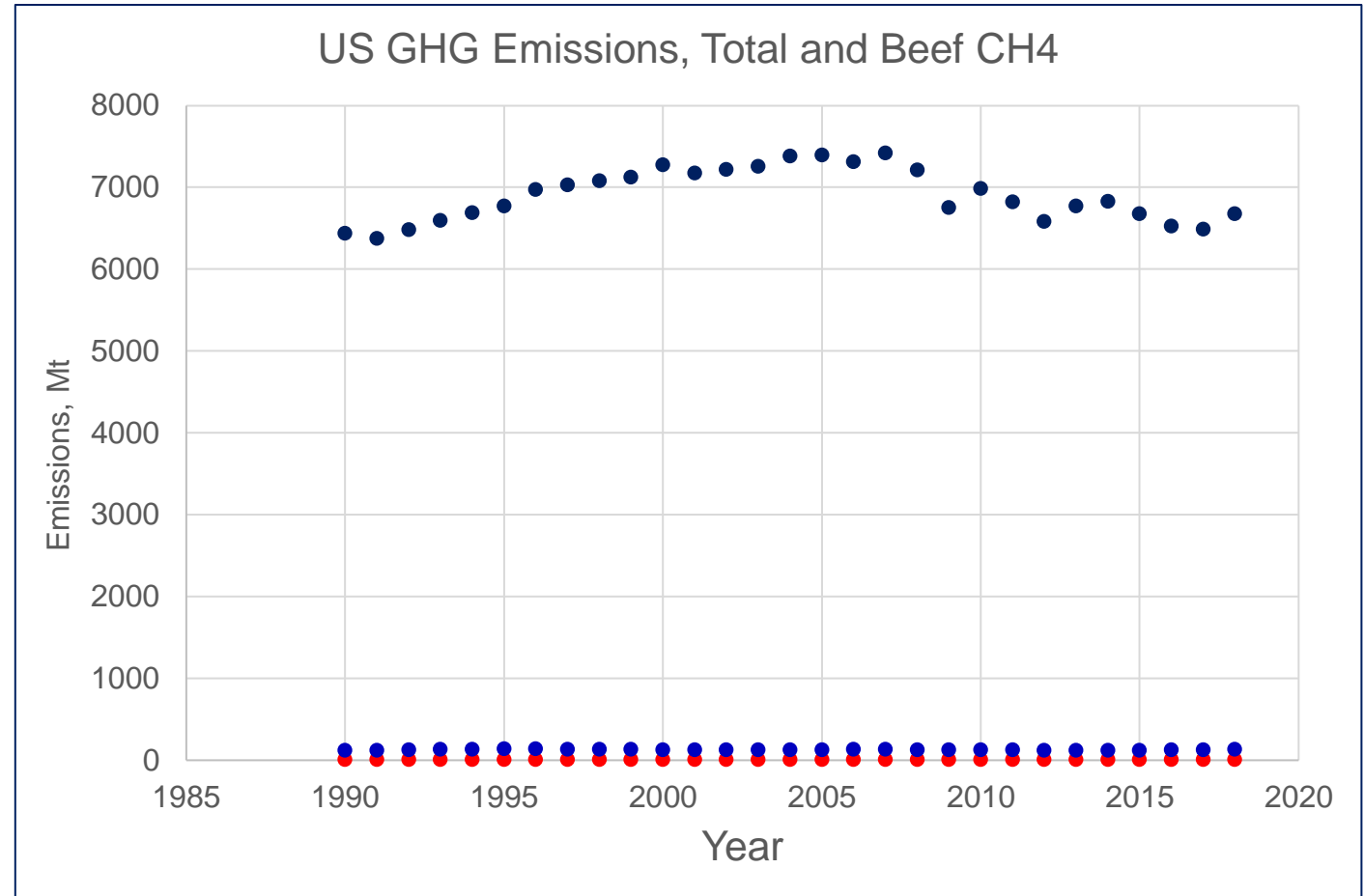
US GHG INVENTORY (EPA)

Total emissions ~6.5 Gt

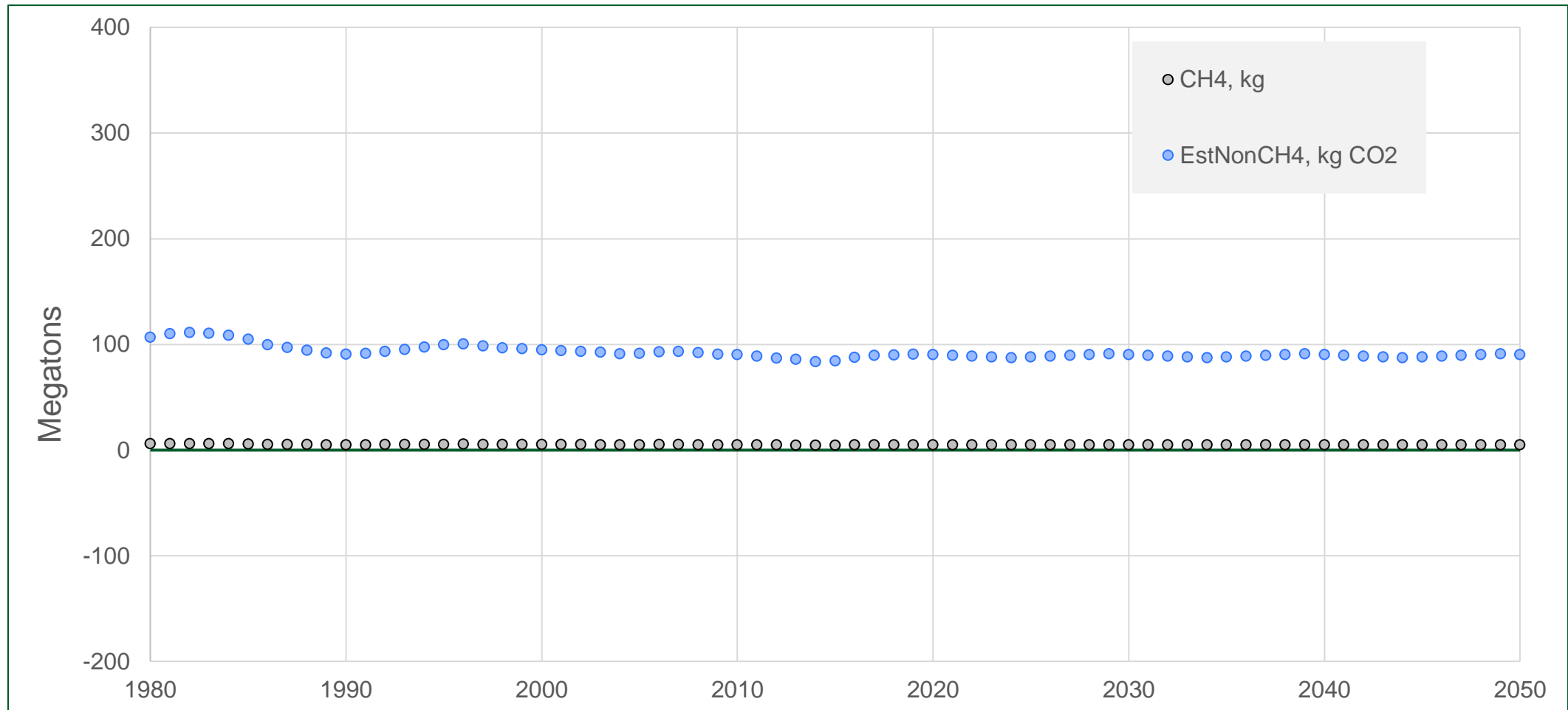
- Scaled to AR4
- “Bundles” all gases

Beef – Methane

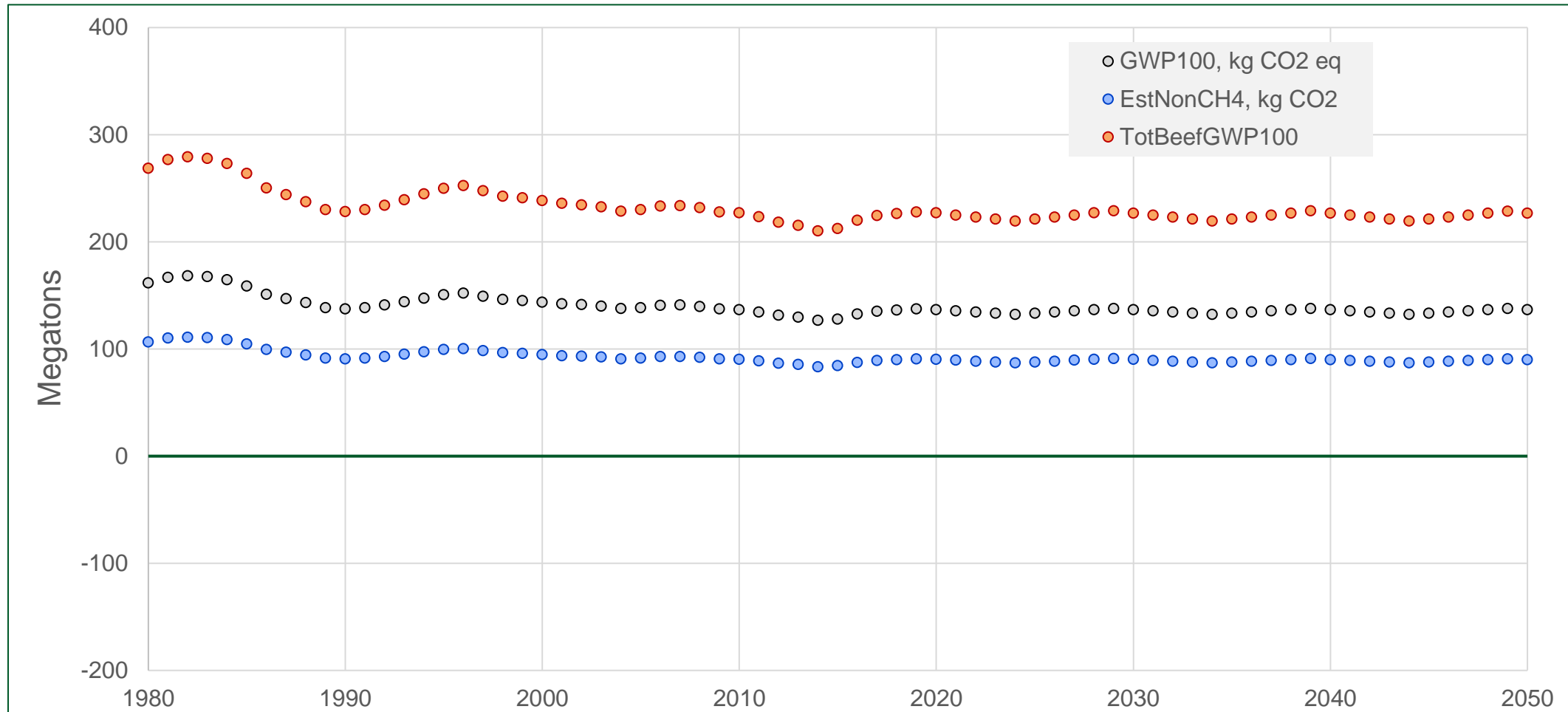
- By GWP100 eq ~1.9%
- By mass ~ 0.08%



US BEEF – MASS GHG EMISSIONS

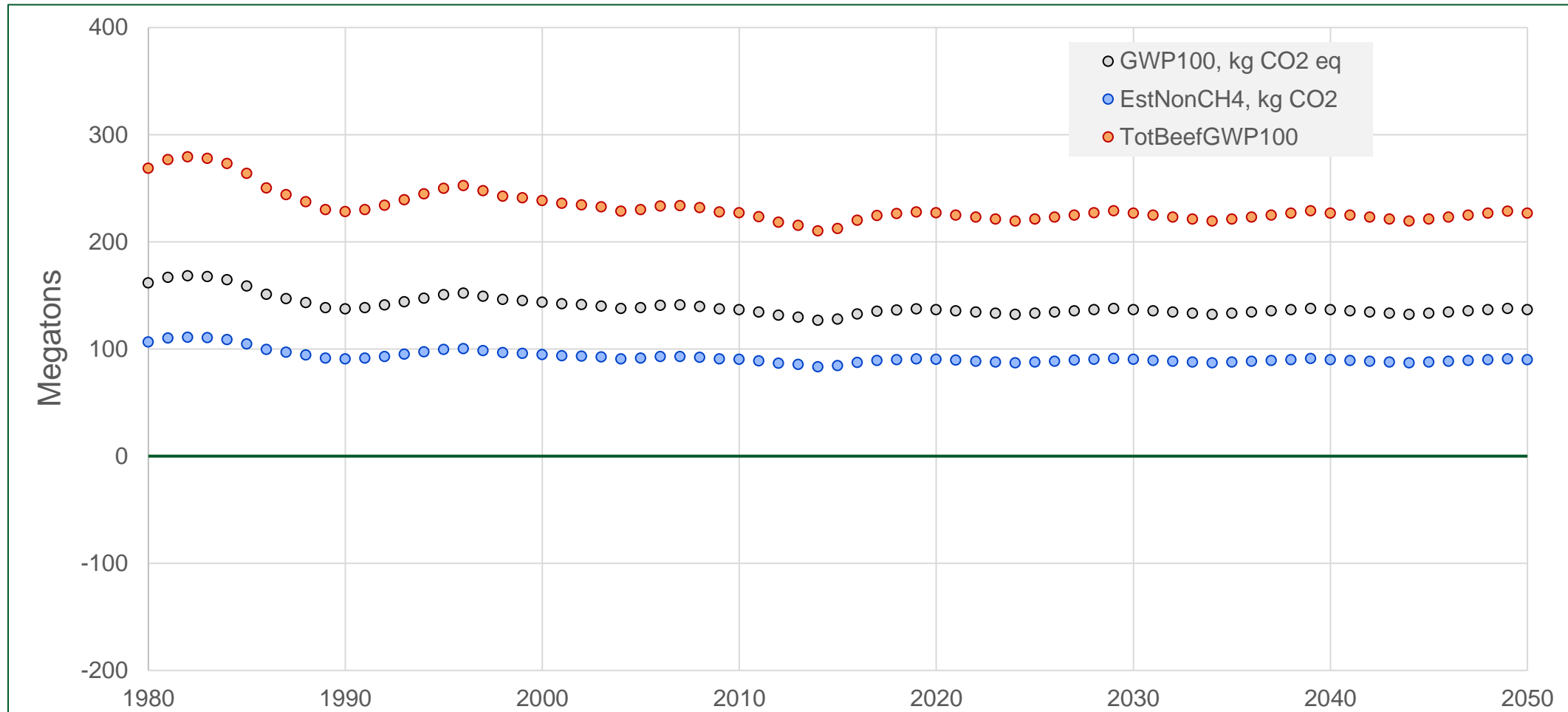


US BEEF – GWP₁₀₀ GHG EMISSIONS

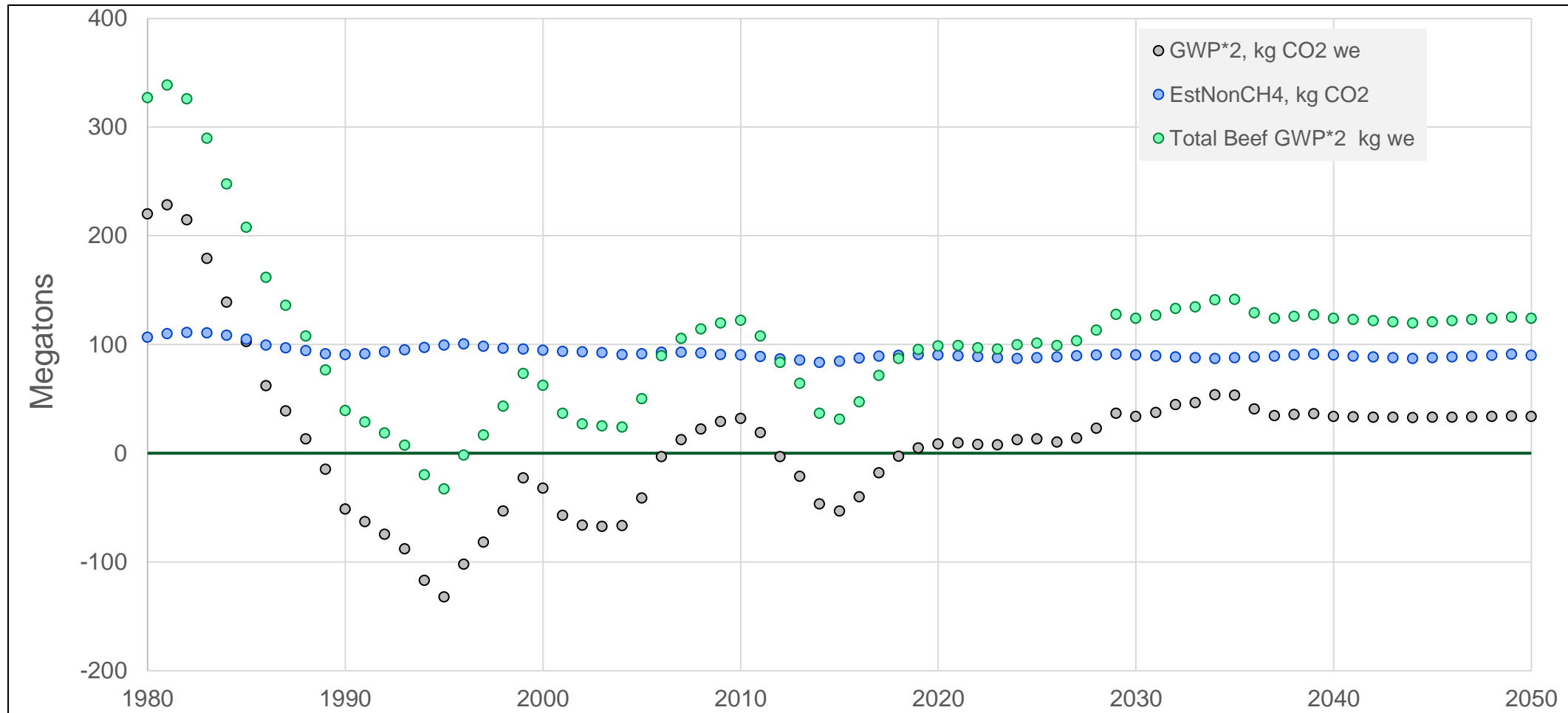


WHERE DO WE GO? CAN WE GET THERE?

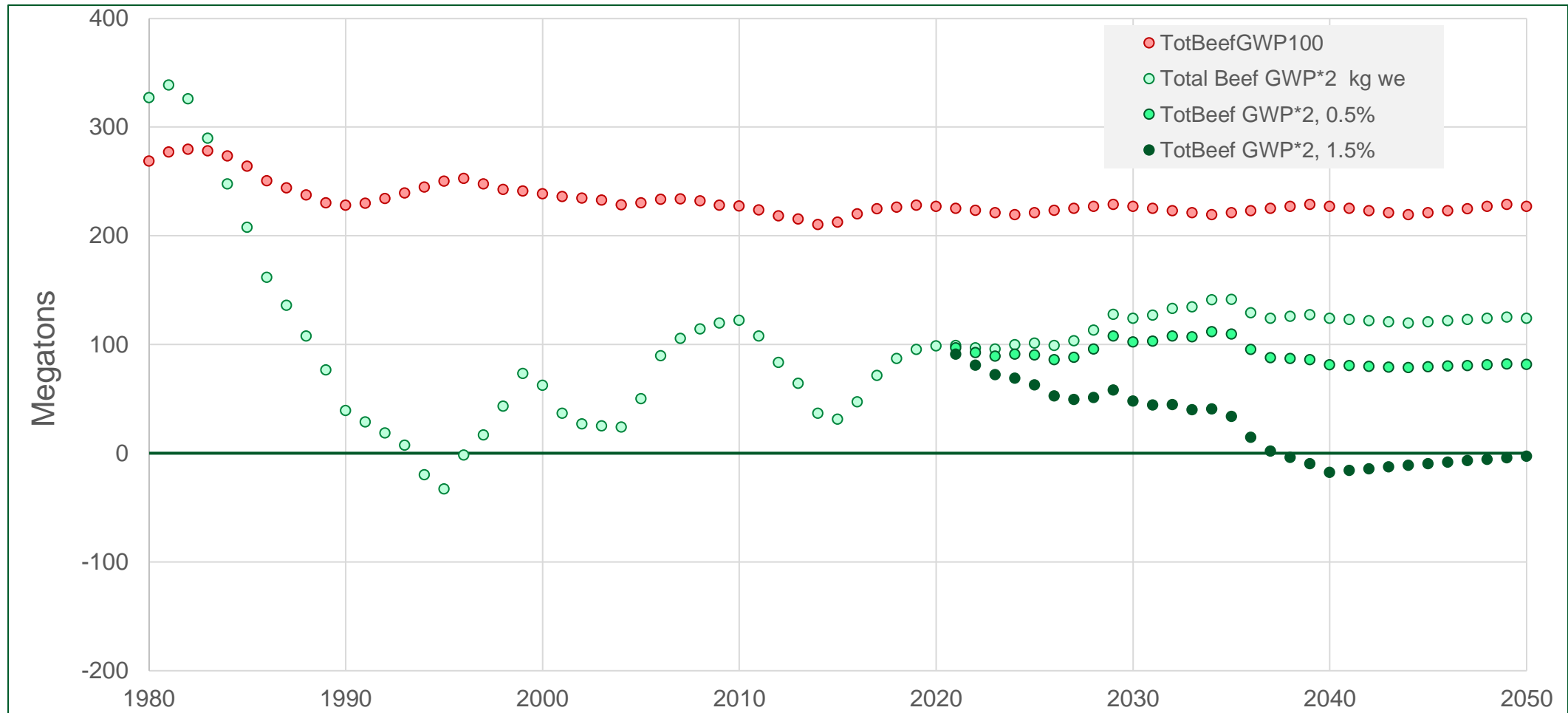
US BEEF – GWP₁₀₀ GHG EMISSIONS



US BEEF – GWP* WARMING EQUIVALENT EMISSIONS



WARMING EQUIVALENTS – METHANE MITIGATION



Is CH₄ MITIGATION FEASIBLE?

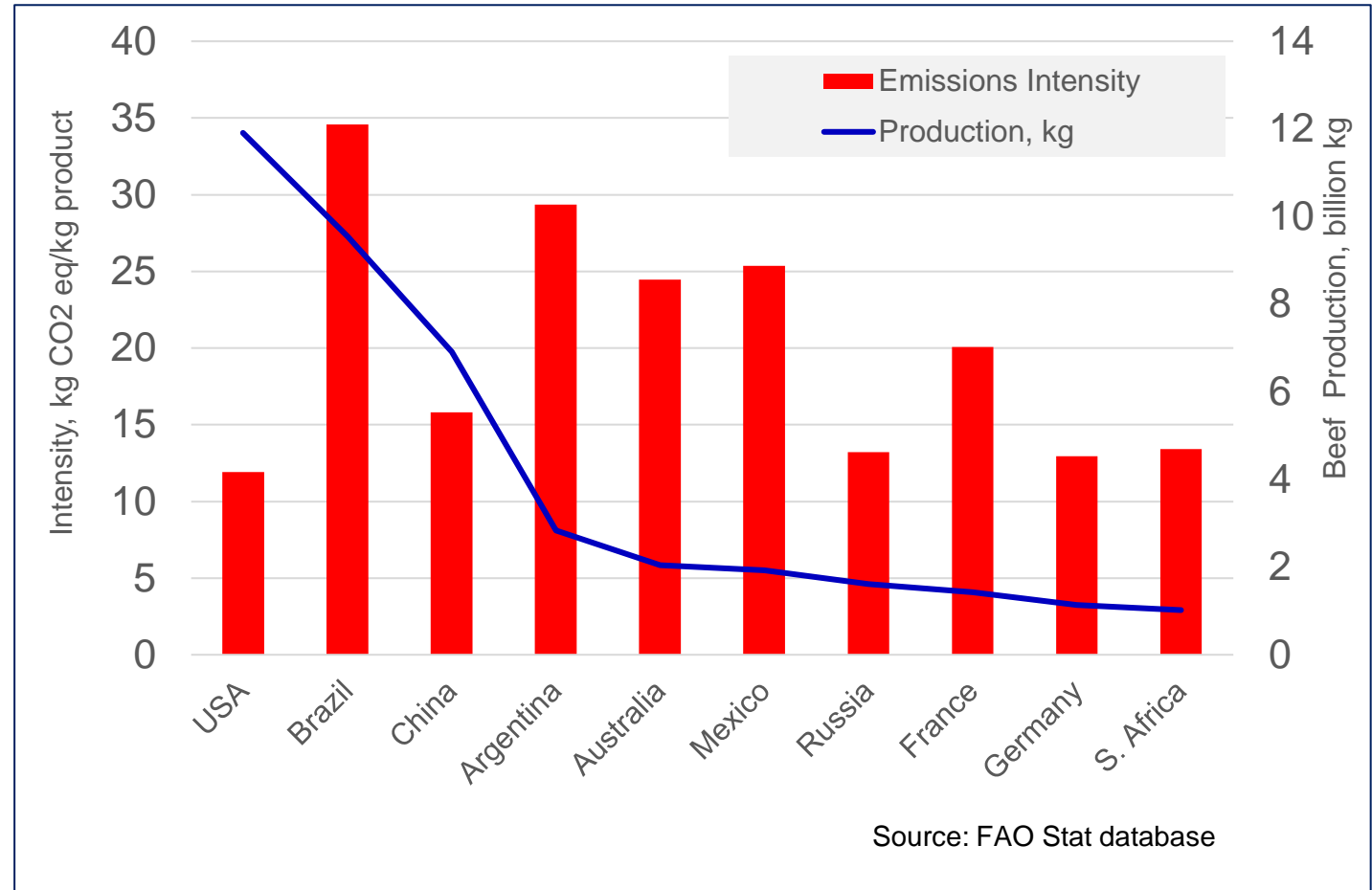
Reduce cattle numbers

- Problems with 'leakage'
- Local vs. Global?

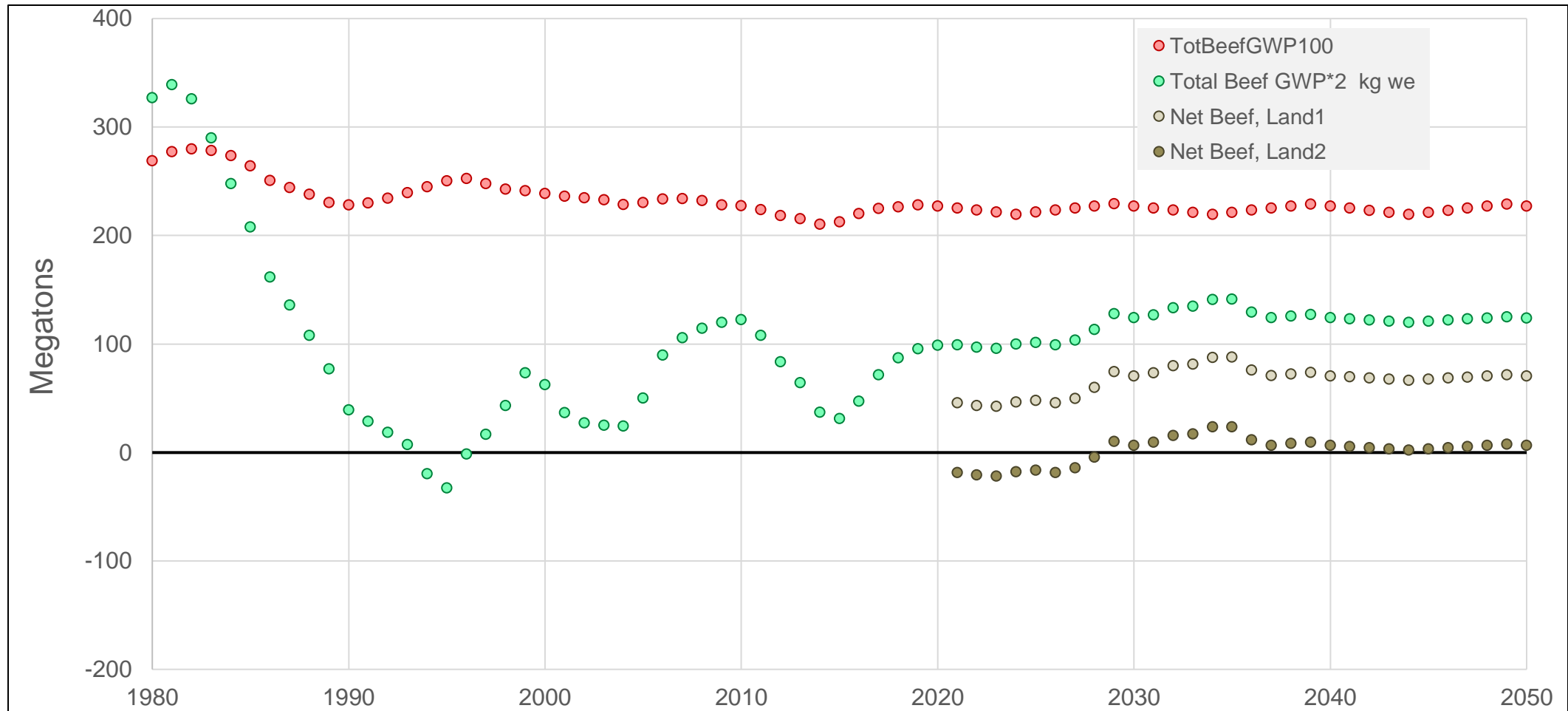
Alter diets

- More energy dense?
- Additives
 - Ionophores
 - Consistent 8 to 10% decrease in Ym
 - Not accounted for in inventory estimates
 - Bromoform
 - 3-NOP

Genetic solutions?



WARMING EQUIVALENTS – LAND OFFSETS



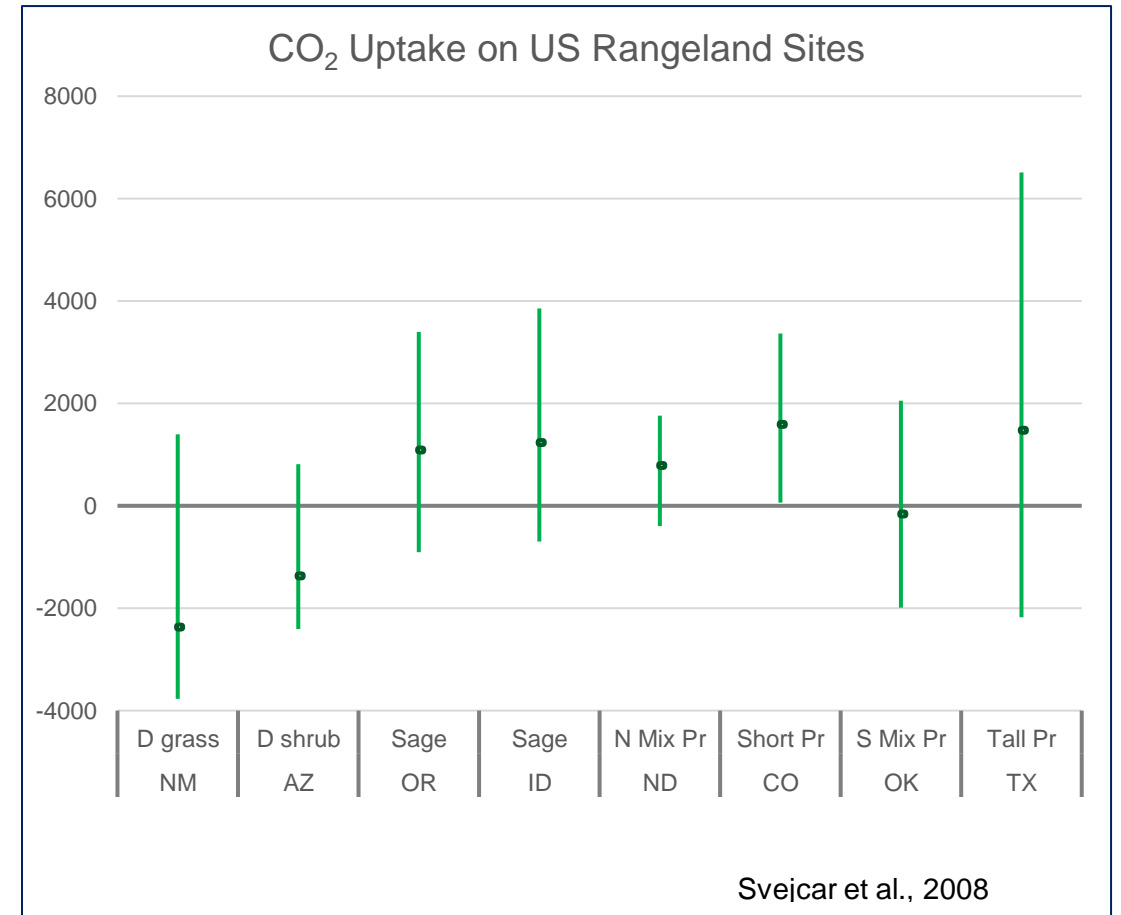
CARBON SINKS IN GRAZINGLANDS

Significant potential...and excitement

Variable annual rates

- **Driven by rainfall, soil type, and status**

Already occurring?



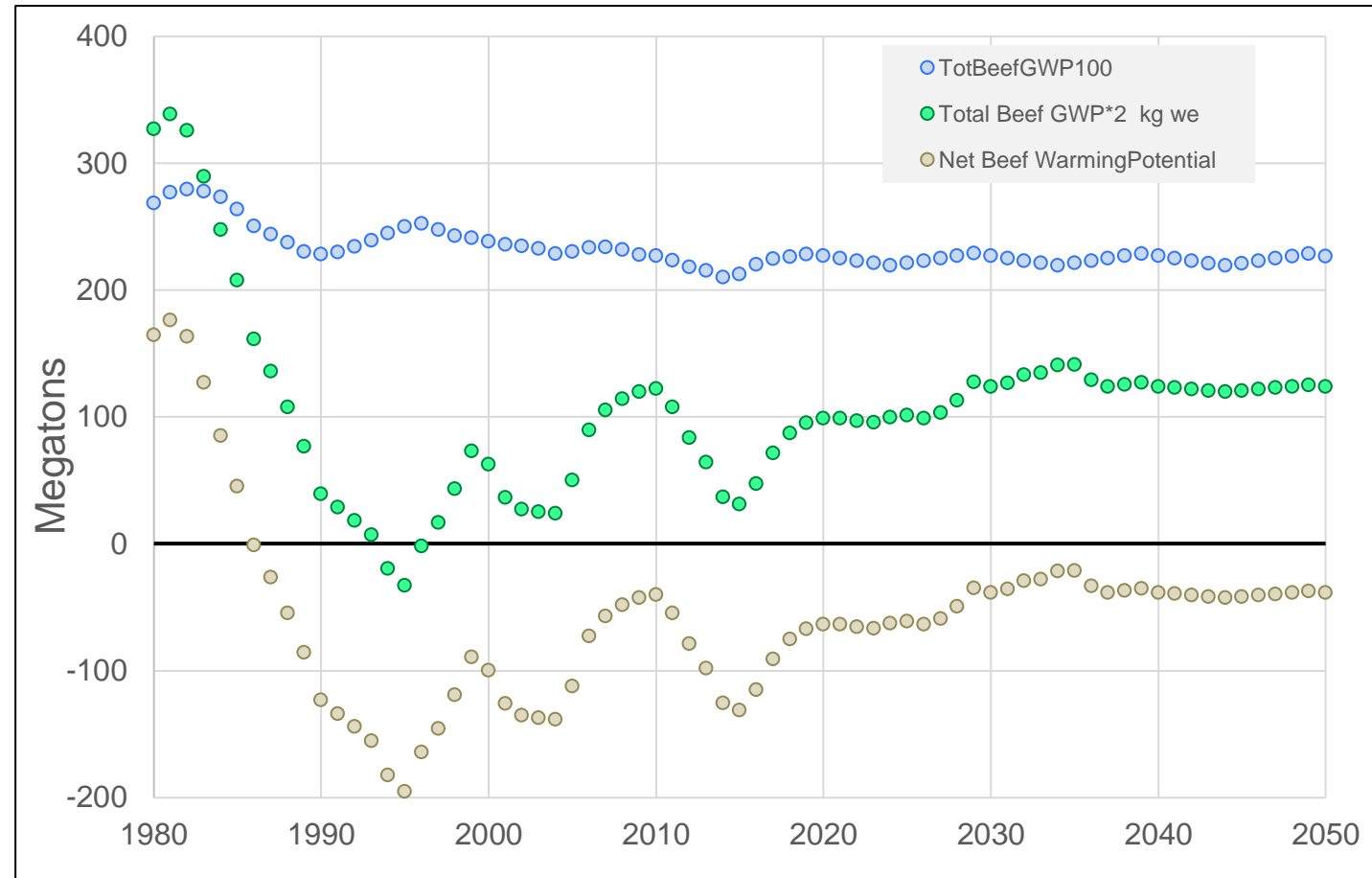
US BEEF – GWP* WARMING EQUIVALENT, INTERNAL C REMOVAL

Internal removals

- Reduces ‘footprint’ of products from system
- Cannot be attributed externally

External offsets

- C ‘uptake’ in one system accounted for and applied to an external system
- Basis of ‘credit’ sales



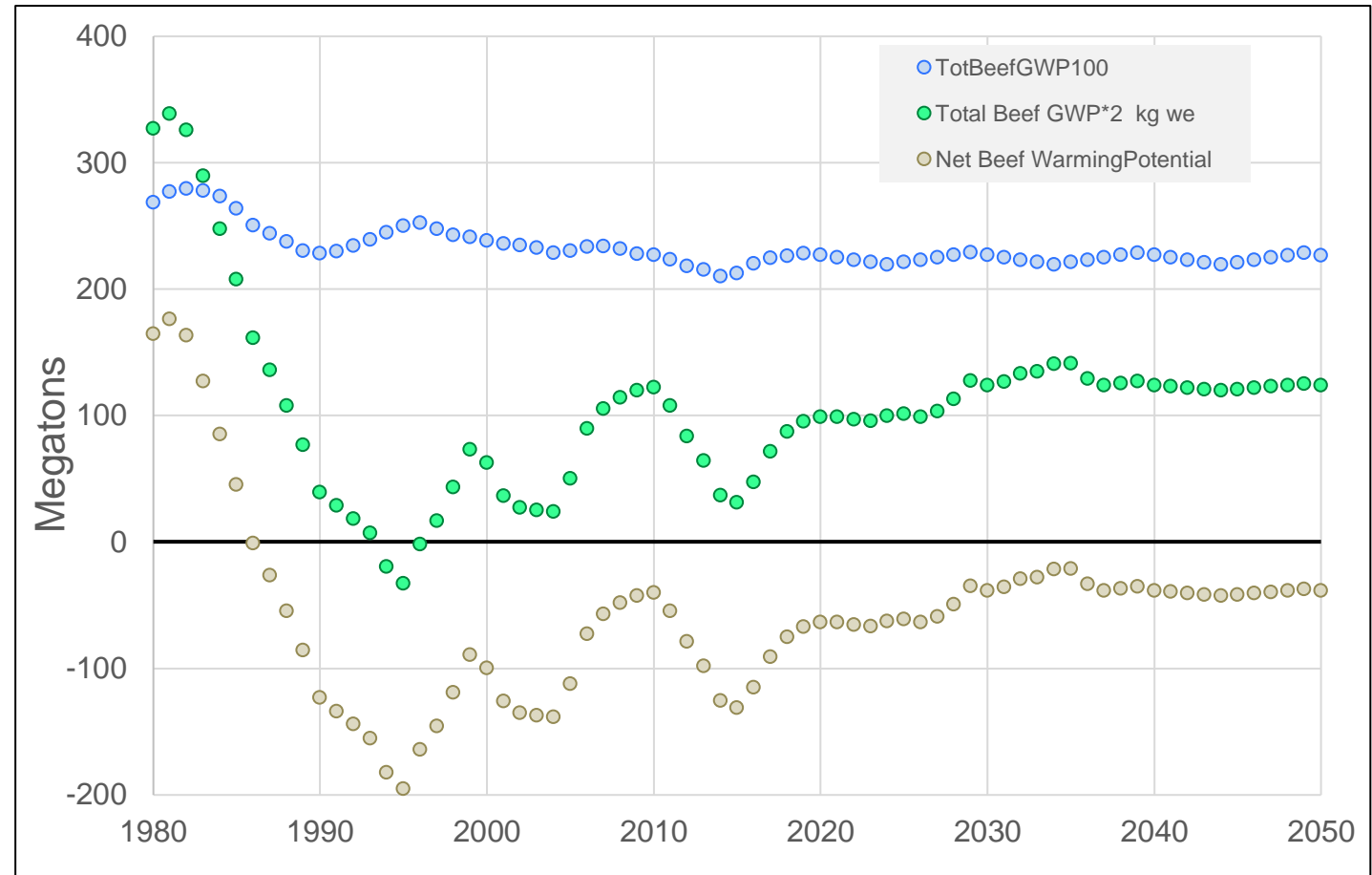
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DO WE KNOW WHAT WE DON'T KNOW?

Can we measure change at scale?

Can we manage the rate or amount of uptake (soil, genetics, tech)?

Where are the limits?

What are the risks?



CHALLENGES AND OPPORTUNITIES

- ❑ **Measurement and Verification**
- ❑ **Response to management and conditions**
- ❑ **Additionality & Leakage**
- ❑ **Risk Exposure and Controls**
- ❑ **Accounting scope – internal vs external**
- ❑ **Total Ecosystems Services**

Partnerships and Value



THANKS!

