The Opportunity Cost of the Refusal to a Global Dietary Change

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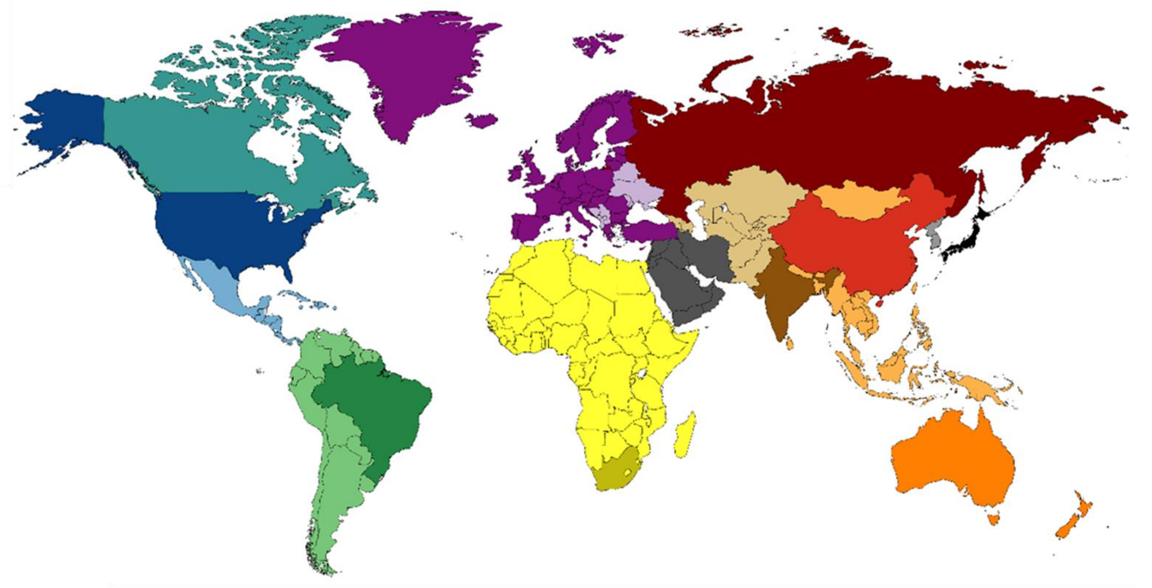
1 Introduction

Food in the Anthropocene represents one of the greatest health and environmental challenges of the 21st century, due to the adverse effects related to current food production systems and dietary patterns (WILLETT et al., 2019; SUWINBURN et al., 2019). There is growing understanding that lifestyle changes are essential to achieving several UN Sustainable Development Goals (SDGs) and dietary change poses a global opportunity to reduce risk to human health and the planet (IPCC, 2018).

2 Methodology and Data

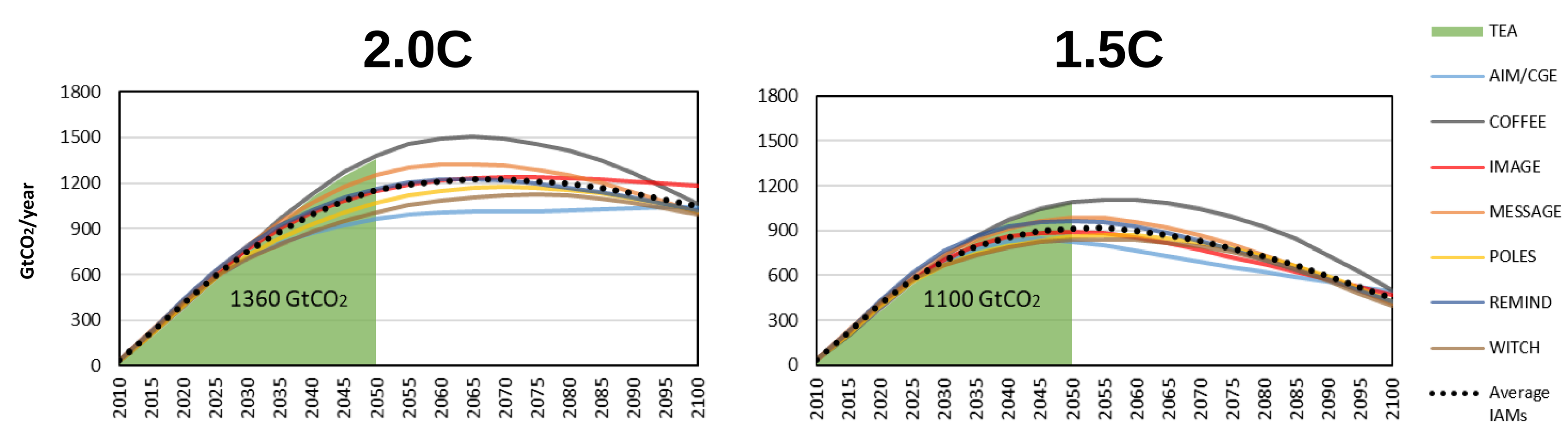
Total Economy-Assessment (TEA) is a recursive dynamic, multi-regional and multi-sectorial computable general equilibrium (CGE) model that tracks the production and distribution of goods, energy and food in particular, in the global economy. Brazil is one of the 18 world regions represented in TEA, which has a sectoral breakdown of 20 sectors. The food supply chain is explicitly represented by Agriculture, Cattle and Others Animal Products (pigs, chicken; milk, eggs, etc.), Plant-based Food Industry and Animal-based Food Industry sectors.



Agriculture and Livestock	AGR	Agriculture and forests
	CTL	Cattle
	OAP	Other animals
	FSH	Fishing
Energy	COL	Coal
	CRU	Crude oil
	ELE	Electricity
	GAS	Natural gas
	OIL	Oil products
Industry	I_S	Iron and steel
	CRP	Chemical rubber and plastic
	NMM	Manufacture of non-metallic mineral
	OMT	Food industry - meat products
	OFD	Food industry - expect meat products
	MAN	Manufacture
Transport	OTP	Land Transport
	WTP	Water transport
	ATP	Air transport
Services / Buildings	SER	Services / Commercial
	DWE	Dwellings

We assess the impacts of three counterfactual scenarios in relation to Reference scenario (REF). The scenarios account for:

- **Global behavioral diet change (REF_50):** reflects gradual reductions in animal-based food preferences, achieving 50% in 2050 (relative to REF), with an offset of plant-based protein.
- **Global emissions budgets:** CO_2 budgets to limit global mean temperature rise below 2°C and 1.5°C above pre-industrial levels by the end of this century.



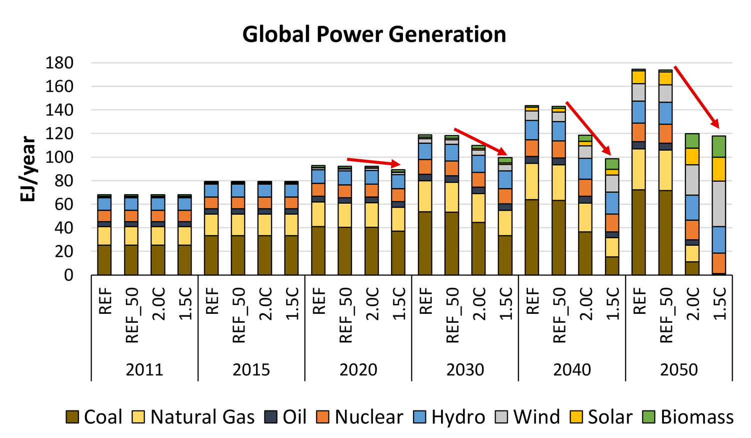
The TEA model allows for sectoral and international trading of emissions permits to set a global equilibrium carbon price (p^{CO2}). The pricing of non-CO_2 gases is based on the carbon price and is implemented through a tax (p_K^i) on the capital factor of agricultural sectors.

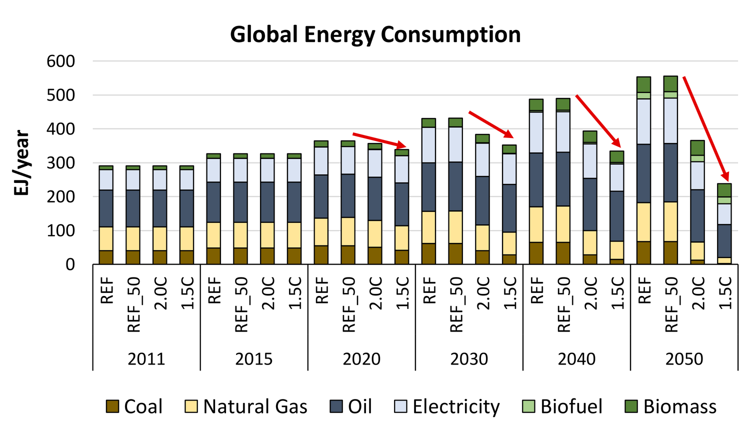
$$p_K^i = p^{CO2} \cdot GWP_{100}^i \qquad i = CH_4; N_2O$$

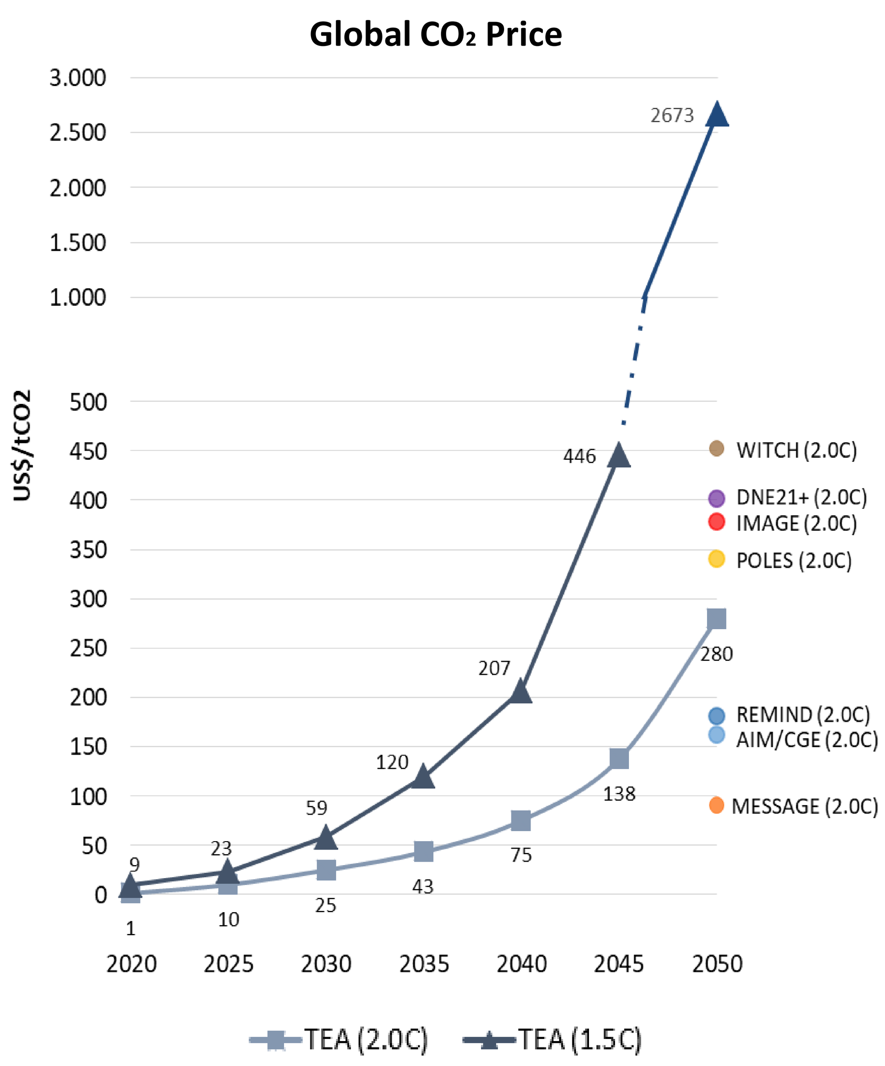
In addition to the prices of traditional goods and services of the economy, consumers and producers are now becoming aware of the cost of GHG emissions. The social cost of carbon (SCC) expresses the environmental damage to society from the emission of an additional unit of GHG emission in the atmosphere (E^i):

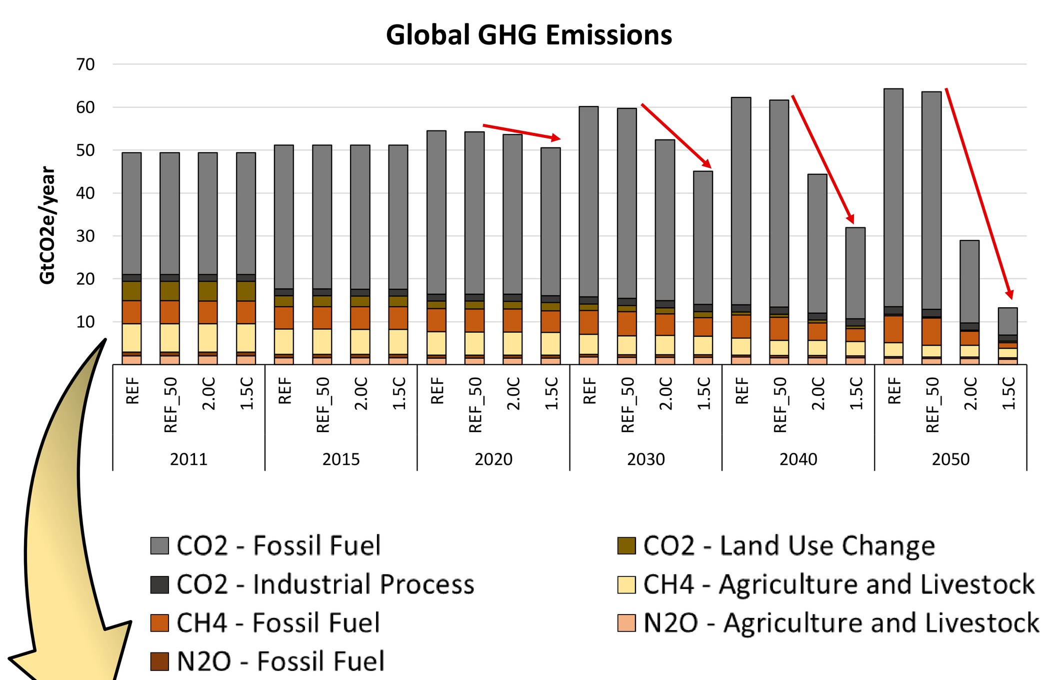
$$SCC^i = \sum_{t=2011}^{2050} \frac{p^i \cdot E^i}{(1+r)^t} \qquad \begin{array}{l} i = CO_2; CH_4; N_2O \\ r = \text{discount rate (10\% p.y.)} \end{array}$$

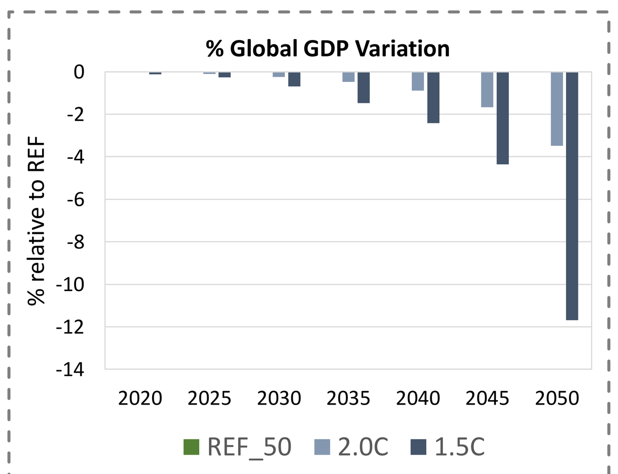
3 Results



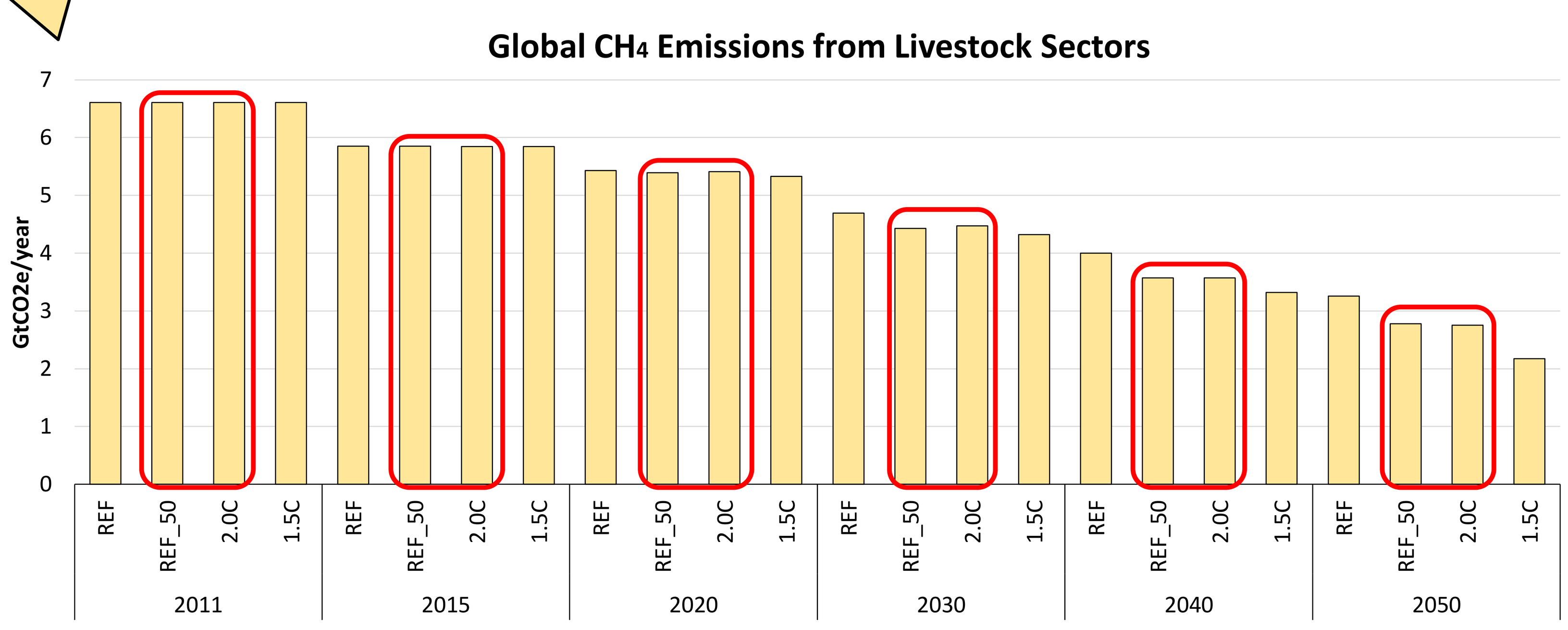




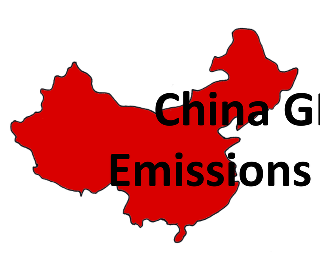




REF: 2.30% p.y.
REF_50: 2.30% p.y.
2.0C: 2.23% p.y.
1.5C: 2.04% p.y.



$$\sum_{t=2011}^{2050} \left(E_{REF}^{CH4} - E_{REF\_50}^{CH4}\right) = \textbf{13 GtCO2e}$$



$$\sum_{t=2011}^{2050} \frac{p^{CH4} \cdot \left(E_{REF}^{CH4} - E_{REF\_50}^{CH4}\right)}{(1+r)^t} = \textbf{US\$ 1.3 tri}$$

References and other information

4 Discussion and Conclusions

- A behavioral diet change scenario (REF_50) could reduce global household final demand for animal-based food and increase plant-based food consumption more than in climate scenarios (2.0C & 1.5C), that are induced by GHG pricing.
- Although it results in penalties for livestock sectors, a global dietary change (REF_50) has a relevant role to mitigate GHG emissions, reducing global CH_4 emissions by 13 $GtCO_2e$ from 2011 to 2050 (relative to REF).
- Global CH_4 emissions projections from livestock sectors on the REF_50 scenario are quite similar to the 2.0C scenario, which indicates that the global economy can avoid social costs of carbon of US$ 1.3 trillion, from 2011 to 2050, by changing its food consumption pattern.
- A CH_4 pricing leads to a greater pressure on animal-based food prices. Climate policies – in particular those including the pricing of non-CO_2 gases – may have greater impacts on the global food industry chain.
- Decreasing animal-based food consumption not necessarily leads to an increase of the caloric or the protein content due to plant-based food intake.