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The Price of Meat in International Climate Change Law

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The price of meat in international climate change law*

Michael Faure†

The influence of food production and more particularly meat has been dramatically neglected from international climate change law. That is striking, as several reports indicate that livestock production creates 14,5% of all global greenhouse gas emissions and even 25% if land use is included as well. This paper argues that meat production should be included in the international climate change regime and examines a variety of instruments that could be employed to do so. Attention is paid to production changes and regulation of production as well as to a possible extension of the emission trading schemes. But it is argued that the most promising instrument is the introduction of a meat tax. The paper sketches how the optimal tax rate should be determined, what the effects of the tax are expected to be and how support for a meat tax could be achieved. However, it is equally argued that the meat tax should be one instrument among a smart mix of various instruments, including also behavioral policy. Given cross-border externalities, the meat tax should be mandated at at least a regional and preferably even international level. So far, the effects of meat production on climate change have been dramatically ignored as none of the G20 countries have referred to the effect of food production on global warming in their nationally determined contributions. That is dramatic as there is a great likelihood that the goals of the Paris Agreement cannot be reached without incorporating meat production into climate change policy. The only reason that this has so far not been done is that it has been prevented by effective lobbying from the meat industry. The paper therefore argues that the price of meat should take the negative external effects of meat production and consumption into account, more particularly on climate change.

Key words: meat, livestock, greenhouse gas emissions, methane, nitrous oxide ammonia, emission trading, taxation, nudges, behavioral policy, nationally determined contributions, multilevel governance, lobbying

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I. INTRODUCTION

In the 34 years that I was Professor of comparative and environmental law, many things have changed for the domain I studied in my chair. Fortunately many changes constitute improvements. For example, empirical studies show both in the US and in Europe that domestic water pollution was far worse than it is today and also at the cross-border, international level, in some domains improvements have been achieved. These improvements are largely due to regulatory efforts, for example to effluent charges (environmental taxes) on emissions of waste water.[1]

At the international level, improvements can for example be seen in the domain of marine oil pollution. The following graph concerning the number of oil spills clearly illustrates that the number of incidents has decreased. Whereas in the nineteen seventies incidents with major tankers leading to massive oil pollution were a regular phenomenon, today these are de facto hardly heard of. The data indeed indicates that releases due to oil tanker incidents have indeed gone down over the past decades.

1. See on those improvements the seminal book on the empirics in the domain of accident law by Don DeWees, David Duff & Michael Trebilcock, *Exploring the Domain of Accident Law. Taking the Facts Seriously* (1996).

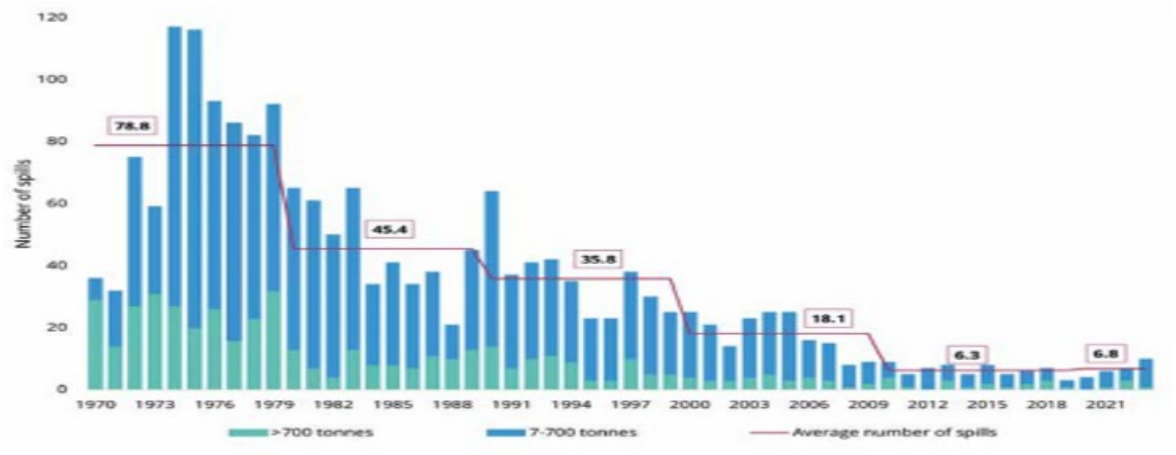


Figure 1: Number of medium (7-700 tonnes) and large (> 700 tonnes) tanker spills from 1970-2023[2]

This is also confirmed by a table indicating the global number of oil spills from tankers from 1990 to 2022.

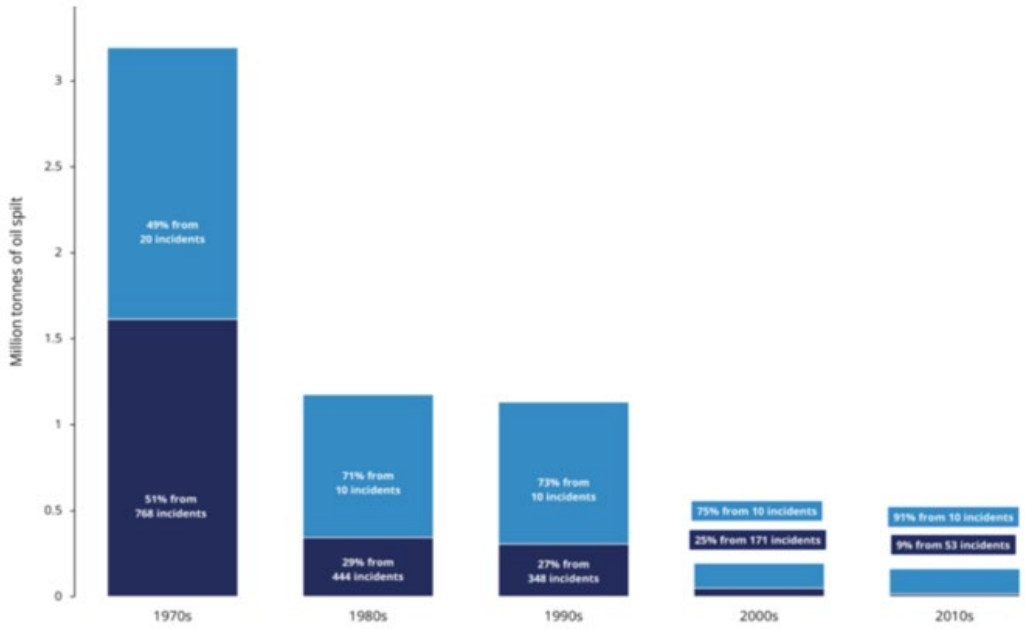


Figure 2: Tanker spills 7 tonnes and over per decade showing the influence of a relatively small number of comparatively large spills on the overall figure.[3] 2020s excluded; only four years of data.

It is striking that this reduction in oil pollution incidents could be realized even though in the period from 1980 to 2020 the world's oil tanker fleet has increased significantly by more than 77%.[4]

In realizing those improvements, technological improvements played a key role, spurred on by safety regulation,[5] but to some extent also by an improved liability regime.[6]

2. <www.itopf.org/knowledge-resources/documents-guides/oil-tanker-spill-statistics/>.
3. <www.itopf.org/fileadmin/uploads/itopf/data/Documents/Company_Lit/Oil_Tanker_Spill_Statistics_2023>.
4. <https://marine-digital.com/article_10largestoiltankercompanies>.
5. For example, the phasing out of so-called single-hull tankers and the introduction of segregated ballast tanks.
6. See in that respect inter alia Ruud Hendrickx, *Marine Oil Pollution: An Empirical Analysis*, *in Shifts in Compensation for Environmental Damage* 243-260 (Michael Faure & Albert Verheij eds., 2007).

There are, however, unfortunately many domains where there are few or no improvements and where to some extent the situation got even worse. One is biodiversity. There are several main reasons for biodiversity loss.[7] Changes in land use (e.g. deforestation, intensive mono-culture, urbanization), direct exploitation (hunting and over-fishing), climate change, pollution and invasive alien species. In all continents there has been a sharp decline in biodiversity, but it has been the sharpest in Latin-America as well as in Africa, as is shown in the following graphs:

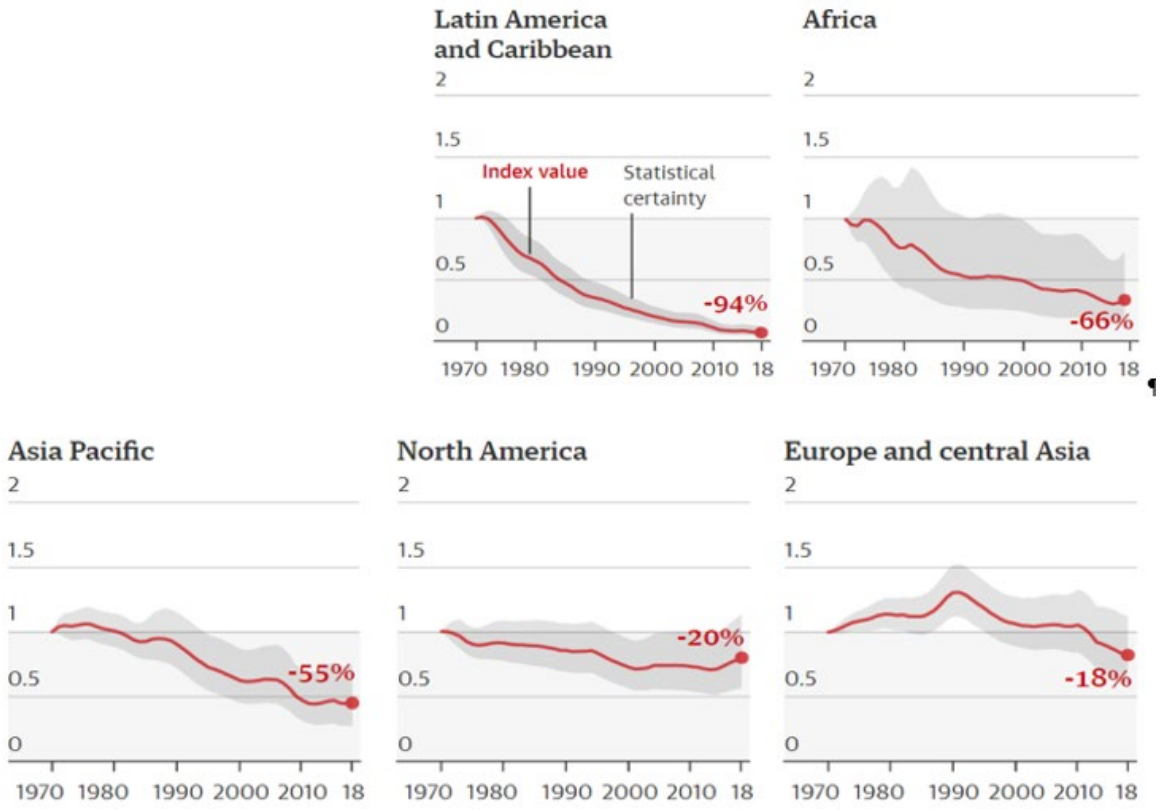


Figure 3: Decline in biodiversity between 1970 and 2018.[8]

The number of endangered species on the International Union for the Conservation of Nature (IUCN) red list is also rising:

Hendrickx (2007), 244, who claims that the stricter liability regime in the US 1990 Oil Pollution Act has contributed to reduced oil spill quantities.

7. <www.europarl.europa.eu/topics/en/article/20200109STO69929/biodiversity-loss-what-is-causing-it-and-why-is-it-a-concern>.

8. <www.theguardian.com/environment/2022/oct/13/almost-70-of-animal-populations-wiped-out-since-1970-report-reveals-aoe> and <www.flpr.awsassets.panda.org/downloads/lpr_2022_full_report_1. pdf>.

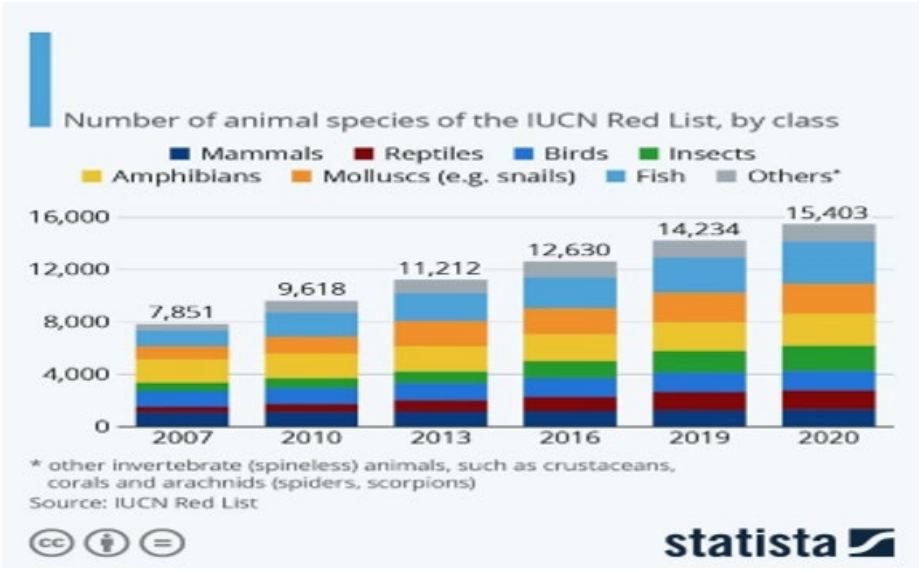


Figure 4: Increase in number of endangered species 2007-2020[9]

Another domain concerns climate change. There are various sources indicating an increased frequency of climate-related disasters:

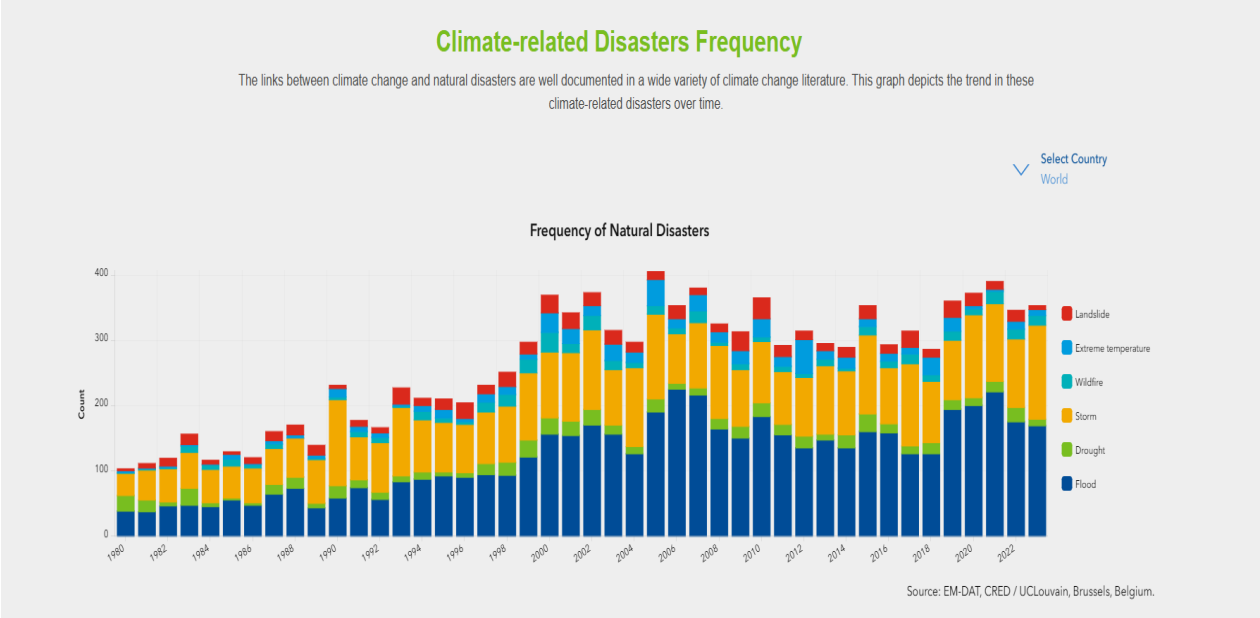


Figure 5: Climate-related disaster frequency[10]

The greenhouse gas emissions causing climate change have indeed not reduced. Notwithstanding many efforts, especially by some regions like the EU,[11] inspired by scholarship,[12] global greenhouse gas emissions have in fact since 1990 been rising, but the growth rate is slightly slowing down.

9. From: <https://earth.org/what-animals-will-be-extinct-by-2100/>.
10. <https://climatedata.imf.org/pages/climatechange-data>.
11. For an overview of all legislative and policy actions in the domain of climate change in the EU, see inter alia the work of Peeters and Eliantonio (Marjan Peeters & Mariolina Eliantonio (eds.), *Research Handbook on EU Environmental Law* (2020)).
12. Marjan Peeters, *Markt conform milieurecht? Een rechtsvergelijkende studie naar de verhandelbaarheid van vervuilingsrechten* (1992); Marjan Peeters & Kurt Deketelaere (eds.), *EU Climate Change Policy: The Challenge of New Regulatory Initiatives (2006);* Michael Faure & Marjan Peeters (eds.), *Climate Change*

This can be illustrated by a simple graph showing the evolution of worldwide carbon dioxide (CO_2) emissions from 1940 to 2023.

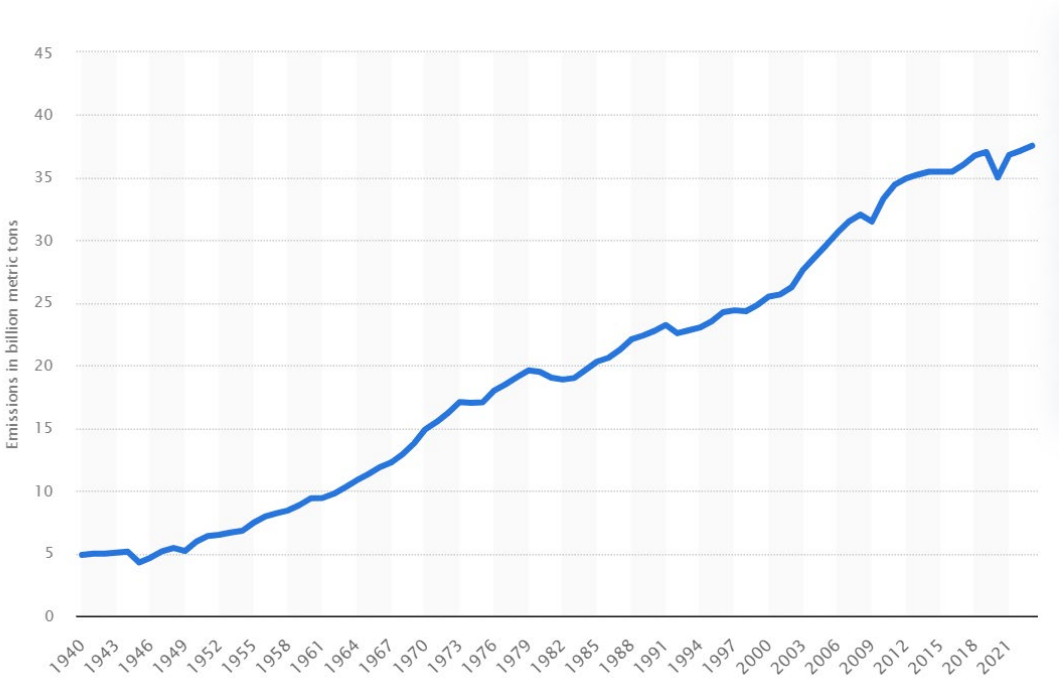
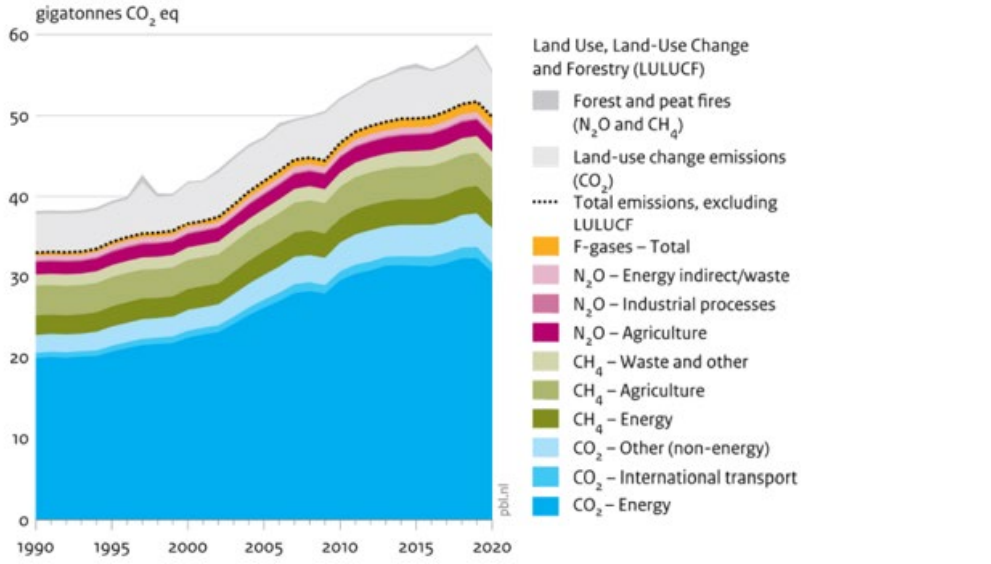


Figure 6: Annual carbon dioxide (CO_2) emissions worldwide from 1940 to 2023*(in billion metric tonnes)*[13]

This is equally shown in a graph representing global greenhouse gas emissions (not just CO_2) per type of gas and source:



Source: CO_2, CH_4, N_2O, F-gases excl. land-use change: EDGAR v6.0 FT2020; incl. CH_4 and N_2O from savannah frires: FAO 2021; GHG from land-use change: CO_2 from Global Carbon Budget (GCB 2020); CH_4 and N_2O from forest and peat fires: GFED4.1s 2021
Note: CO_2 eq with GWPs from IPCC AR4

and European Emission Trading. Lessons for Theory and Practice (2008); Marjan Peeters, *EU Climate Law: Largely Uncharted Legal Territory*, 9 Climate Law 137-47 (2019).

13. <www.statista.com/statistics/276629/global-co2-emissions/>.

Figure 7: Global greenhouse gas emissions, according to type of gas and source, including LULUCF[14]

One crucial contributor to global greenhouse gas emissions has largely been ignored in international regulation: global food supply chains are responsible for approximately 26% of global emissions.[15] And this is particularly the case for the production of meat. Food production is mentioned as one of the objectives of the United Nations Framework Convention on Climate Change.[16] But the potentially negative effects of food and more particular meat production for greenhouse gas emissions were largely ignored until COP28 (2023) in Dubai.[17] The previous graph had already made clear that agriculture creates an important part of the global greenhouse gas emissions, not only of CO_2, but also of N_2O (nitrous oxide) and CH_4 (methane).

To analyze the effects of meat production and to examine the possible legal instruments that could address this issue. I will proceed as follows: first, I analyze the impact of meat production on global greenhouse gas emissions based on an overview of the literature in that domain (II); next, I discuss which legal instruments would, again according to the literature, be optimal to address the problem (III). Finally, I examine why the legal instrument that has been mostly advanced as optimal in the literature, being a meat tax, has so far not been extensively discussed, let alone included in the international climate change regime and I discuss how this could theoretically be done (IV). Section V discusses a few limits of this research and section VI concludes.

There is concerning the effects of meat production on climate change some sort of a paradox: on the one hand there is overwhelming literature in environmental economics supporting the introduction of a meat tax[18] and a wealth of studies examining through which type of interventions a reduction of meat consumption can be achieved.[19] On the other hand, there is almost no attention given to this topic in

14. <www.klimaatweb.nl/wp-content/uploads/po-assets/721477.pdf>.
15. Joseph Poore & Thomas Nemecek, *Reducing Food's Environmental Impacts through Producers and Consumers*, 360(6392) Science 987-92 (2018) (doi: 10.1126/science.aaq0216. The EAT-Lancet Report refers even to a contribution by food production to global greenhouse gas emissions of 30% (Walter Willett et al., *Food in the Anthropocene: the EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems* 3 (2019), online published 16 January 2019, doi: 10.1016/so140-6736 (18)31788-4.
16. "Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner".
17. See IV D.
18. See for example Marco Springmann et al., *Health, Motivated Taxes on Red and Processed Meat: A Modelling Study on Optimal Tax Levels and Associated Health Impacts*, 13(11) PLOS ONE 1-16 (2018), doi: 10.1371/journal.pone.0204139.
19. See the systematic literature review by Tatjana Kwasny, Karin Dobernig & Petra Riefler, *Towards Reduced Meat Consumption: A Systematic Literature Review of Intervention Effectiveness, 2001-2019*, 168(105739) Appetite (2022), doi:10.1016/j.appet.2021.105739.

environmental or climate law,[20] nor in the field of law and economics.[21] This absence of discussion is striking as there is for example a lot of attention to the effects of aviation on climate change, but those are in fact only minimal compared to the much larger influence of livestock production which, depending on the calculation, amounts to 14,5-25% of all greenhouse gases.[22]

II. IMPACT OF MEAT PRODUCTION ON CLIMATE CHANGE

There are various reports from renowned institutions that provide estimates either on the impact of food production in general on climate change[23] or on the effects of livestock on the environment specifically.[24] The impact of food production in general is sketched inter alia in the Eat-Lancet Commission's Report. The report mentions that food production is responsible for up to 30% of global greenhouse gas emissions.[25] An analysis of the relationship between agriculture (and more particularly livestock production) and greenhouse gas emissions is also established in the chapter on agriculture, forestry and other land uses in the Intergovernmental Panel on Climate Change (IPCC) 2022 report.[26]

The various reports point at a wide variety of effects of food and more particularly meat production on climate change. First, it is necessary to provide an explanation of the scope and terminology used in this study. Many reports refer generally to food production[27] or to agriculture. The Food and Agriculture Organization of the United Nations (FAO) and several other studies mostly refer to livestock

20. An important exception constitutes the work of Jonathan Verschuuren who has spent a lot of attention on the legal instruments needed to reduce greenhouse gas emissions from agriculture. See inter alia Jonathan Verschuuren, *Achieving Agricultural Greenhouse Gas Emission Reductions in the EU Post 2030: What Options Do We Have?*, 31 RECIEL 246-57 (2022), doi: 10.1111/ reel.12448 and Jonathan Verschuuren, *Cultured Meat and Dairy as a Gain-Changing Technology in the Agricultural and Food Transition in the EU: What Role for Law?*, in Climate Technology and Law in the Anthropocene (Leonie Reins & Alexander eds., 2025). See also the works of Melina Moreira Campos Lima, *The Ignored Impact of the Livestock Sector on Climate Change: An Analysis from the Perspective of International Law*, German Law Journal 1-17 (2024), doi: 10.1017/glj. 2024.28 and Cordelia Ch. Bähr, *Greenhouse Gas Taxes on Meat Products: A Legal Perspective*, 4(1) Transnational Environmental Law 153-79 (2015), doi: 10.1017/S2047102545000011, who equally pay attention to the impact of livestock on climate change, as well as to the possibility of introducing greenhouse gas taxes on meat products. Recently Nollkaemper also called meat "the next frontier in global climate change policy" (André Nollkaemper, *The Other 'Transitioning Away' Imperative: Meat as the Next Frontier in Global Climate Change Policy*, Blog of the European Journal of International Law, 7 January 2025, <www.ejiltalk.org/the-other-transitioning-away-imperative-meat-as-the-next-frontier-in-global-climate-change-policy/>).
21. An important exception constitutes the work of Romain Espinosa & Nicolas Treich, *Animal Welfare as a Public Good*, 216 Ecologic Economics 108025 (2024), doi: 10.1016/j.ecolecon.2023.108025 and of Nicolas Treich, *Veganomics: vers une approche économique du véganisme?*, 4(XXXIII) Revue Française d'Economie 3-48 (2018).
22. Marco Springmann et al., *Mitigation Potential and Global Health Impacts from Emissions Pricing of Food Commodities*, 7 Nature Climate Change 72 (2017), doi: 10.1038/nclimate3155.
23. Willett et al., *supra* note 15.
24. See in that respect for example the report from the FAO, Livestock's Long Shadow. Environmental Issues and Options (2006). See also Mario Herrero et al., *Greenhouse Gas Mitigation Potentials in the Livestock Sector*, 6 Nature Climate Change 452-61 (2016), doi: 10.1038/nclimate2925.
25. Willett et al. *supra* note 15, at 3. Note that this refers to food production generally and not just meat. These data are based on the study by Sonja J. Vermeulen, Bruce M. Campbell & John S.I. Ingram, *Climate Change and Food Systems*, 37 Annual Review of Environment and Resources 195-222 (2012), doi: 101146/annurev-environ-020411-130608.
26. Gert-Jan Nabuurs et al., *Agriculture, Forestry and Other Land Uses (AFOLU) in IPCC*, Climate Change (2022): *Mitigation of Climate Change. Contribution of Working Group III to the 6th Assessment Report of the Intergovernmental Panel on Climate Change*, Shukla, P.R. et al. (eds.), Cambridge, Cambridge University Press, 2022, 747-860, <www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter07.pdf.>
27. For example the EAT-Lancet Report. See Willett et al., *supra* note 15.

production.[28] Livestock is defined by the FAO as "domesticated terrestrial animals that are raised to provide a diverse array of goods and services such as traction, meat, milk, eggs, hides, fibers and feathers".[29] Food is therefore broader than livestock, but livestock equally does not include all animals. Fish are for example excluded.[30] Within livestock production I mostly focus on the effects of beef. That is not limited to meat. Livestock farming also leads to other products such as for example cheese and yoghurt being farmed and thus creating greenhouse gas emissions. The reader should be aware that some studies that will be referred to discuss the effects of food production in general, others will focus on livestock production and yet others on meat. To the extent possible, I will indicate which issue is addressed in the various studies. As livestock farming, but more particularly meat, have the most important impact on greenhouse gases, this study will mostly focus on those.

In the following, I will first focus on the contribution of livestock production to greenhouse gas emissions (A). Then I point at the fact that it equally has important effects of land use change, more particularly deforestation (B) and that the consumption of meat creates substantial health risks as well (C). It will therefore be concluded that livestock production has an important influence on greenhouse gas emissions and should therefore be included in international climate change policy (D). One way of doing that is through the so-called true cost pricing method, allowing for a correct pricing of all kinds of products and services, including the production of meat (E). Section F provides a summary.

A. *Greenhouse* G*as* E*missions*

A good overview of the various ways in which livestock production affects climate change is provided in the FAO-LEAD (The Live-stock, Environment and Development Initiative) Report of 2006.[31] The Report makes it clear that livestock produces three gases that all have a potential of global warming.[32] There are first of all direct emissions from livestock from the respiratory process of the animals in the form of carbon dioxide (CO_2). In addition, there are important carbon emissions from food production as well as from all farm use of fossil fuels. Fossil fuel use in manufacturing fertilizer is estimated at 41 million tonnes of CO_2 per year worldwide,[33] whereas on farm fossil fuel use is estimated at 90 million tonnes of CO_2 per year worldwide.[34]

The second greenhouse gas that animals emit is methane. Methane (CH_4) has 20 times more global warming potential than carbon dioxide.[35] Animals produce significant amounts of methane as part of their digestive process (so-called enteric fermentation). That fermentation process produces methane as a by-product, which is exhaled by the animal.[36] The methane released in this way is estimated as 80 million tonnes per year worldwide.[37] In addition, there is methane released from animal manure. It is the growth of the bacteria in the manure which is responsible for methane formation, estimated at 18 million tonnes per year worldwide.[38]

28. FAO, *supra* note 24.
29. See <www.fao.org/livestock-systems/en/>.
30. Serious problems resulting from fisheries also emerge for example as far as biodiversity is concerned, but they do not directly relate to greenhouse gas emissions and will therefore not further be addressed in this study. See on the regulation of fisheries, inter alia Jing Liu, Michael Faure & Peter Mascini, *Environmental Governance of Common-Pool Resources. A Comparison of Fishery and Forestry* (2018).
31. FAO, *supra* note 24.
32. FAO, *supra* note 24, at 82.
33. FAO, *supra* note 24, at 86.
34. FAO, *supra* note 24, at 88.
35. Abdelmajid Moumen, Ghizlane Azizi, Kaoutar Ben Chekroun & Mourad Baghour, *The Effects of Livestock Methane Emission on the Global Warming: A Review*, 9(2) International Journal of Global Warming 229-53 (2016), doi: 10.1504/IJGW.2016.074956.
36. FAO, *supra* note 24, at 95-96.
37. Ibidem.
38. FAO, *supra* note 24, at 97-99.

The third greenhouse gas with direct warming potential is nitrous oxide (N_2O). It is 296 times more effective than carbon dioxide in trapping heat and has a very long atmospheric lifetime (114 years compared to methane – 9 – 15 years).[39] Livestock can emit nitrous oxide in various ways, the most important source being manure.[40]

There are still other ways in which livestock can affect climate change, the most important one to be mentioned below being land use change. This refers to the transformation of natural landscapes due to human activities (such as deforestation)[41]. The FAO summarizes the impact of livestock production on climate change as follows:

- 9% of global anthropogenic emissions;
- 35-40% of global anthropogenic emissions of methane;
- 65% of global anthropogenic emissions of nitrous oxide and
- 64% of global anthropogenic emissions of ammonia.[42]

Ammonia is also reported to be an important source of air pollution.[43] If all emissions are taken together, livestock is (depending on whether one includes emissions from land-use change as well, or not) to constitute 14,5% of all global greenhouse gas emissions[44] or 25% (if land-use is included as well).[45] There has been criticism of this FAO report. The criticism mostly focused on the fact that the 14.5% estimate could be an underestimation as other studies come to higher estimates of the contribution of livestock farming on global greenhouse gas emissions.[46] To put things in perspective: the climate change mitigation potential of dietary changes is higher than the current emissions of global aviation.[47] Focusing on the EU, agriculture accounts for 10,3% of Europe's greenhouse gas (GHG) emissions of which approximately 70% is produced by livestock farming.[48] Global average per capita meat consumption is, moreover, growing which can potentially have major negative effects on the environment.[49]

B. Land-Use Change

In addition to these direct effects of live-stock production through greenhouse gas emissions, there are also considerable effects on global warming through land-use change. The FAO reports that in various parts of the world land-use is changing, often to convert forests into pasture land. As a forest contains more carbon than a field of crops or a pasture, large amounts of carbon are released.[50] Live-stock plays an important role in deforestation; that would lead to emissions of approximately 2.4 billion tonnes CO_2 per year.[51] In addition, there are also livestock related releases from cultivated soils (losses inter alia due to decomposition and mineralization processes) also leading to 28 million tonnes of CO_2 emissions per year.[52] Livestock also plays an important role in desertification leading to changes in biomass and

39. FAO, *supra* note 24, at 82.
40. FAO, *supra* note 24, at 110-111.
41. FAO, *supra* note 24, at 90-91.
42. FAO, *supra* note 24, at 112-114.
43. Annika Hedberg, *The Farm to Fork Strategy and the Inconvenient Truth*, Sustainability (2020), <www.epc.eu/en/search?tag=528>.
44. Treich, *supra* note 21, at 13.
45. Verschuuren, *supra* note 20, at 4.
46. For a summary of those various studies, see Moreira Campos Lima, *supra* note 20, at 2-5.
47. Springmann et al., *supra* note 22, at 72. In 2023 aviation accounted for 2,5% of global energy-related CO_2 emissions (IEA, Aviation, Tracking Aviation, see <www.iea.org/reports/aviation-and-shipping>).
48. Hedberg, *supra* note 43.
49. H. Charles J. Godfray et al., *Meat Consumption, Health, and the Environment*, 361 Science 243 (2018).
50. FAO, *supra* note 24, at 90.
51. FAO, *supra* note 24, at 90-91.
52. FAO, *supra* note 24, at 92.

carbon losses, estimated at 100 million tonnes of CO_2 emissions per year.[53] Often the land-use change takes place by burning the forests,[54] which not only increases CO_2 emissions, but also creates biodiversity loss. This is especially problematic when primary tropical forest is converted for agriculture, thus also contributing to increased extinction rates and biodiversity loss.[55] As forests are highly complex ecosystems deforestation is particularly problematic since forests that have been removed cannot simply be restored on a short-term basis.

Agriculture occupies 40% of global land.[56] ¾ of all agricultural land is used for livestock and 40% of the total cereals production in the world is consumed by livestock.[57] 70% of all freshwater is used for agriculture.[58] To produce one kilogram of beef 15,415 litres of water is needed.[59] Compare this to the water foot print of potatoes: it only requires 250 litres of water on global average to produce 1 kilo of potatoes.[60]

C. Increased Health Risks

The production of meat creates the mentioned environmental problems; the consumption of meat is also connected to increased health risks.[61] The EAT-Lancet Report mentions that especially the consumption of red meat creates high risks of cardio-vascular disease. Several studies indicate that meat consumption is associated with higher mortality rates.[62] In a meta-analysis Wolk established that consumption of processed meat of 50 gr per day significantly increases chronical diseases (18% for colorectal cancer, 19% for pancreas cancer, 24% for cardio-vascular mortality and 32% for diabetes).[63] Studies comparing cohorts of vegetarians and non-vegetarians equally established that the vegetarians have a significantly lower mortality rate.[64] Also the impact of livestock related air pollution on people's health is often overlooked. This causes 400.000 to 790.000 premature deaths and leads to significant economic costs.[65] As a result, the EAT-Lancet Report comes to the remarkable conclusion that the optimal intake of red meat might be null gr/d.[66]

D. Results

The question obviously arises as to what conclusions these alarming figures lead as far as policy is concerned. One point is clear: greenhouse gas emissions related to livestock and meat consumption are largely ignored in global climate change law which, according to Moreira "remains a glaring blind spot in the global response".[67] If one agrees that these greenhouse gas emissions should to some extent be

53. FAO, *supra* note 24, at 93-95.
54. FAO, *supra* note 24, at 91.
55. Willett et al., *supra* note 15, at 28-29.
56. Willett et al., *supra* note 15, at 3.
57. Treich, *supra* note 21, at 8.
58. Willett et al., *supra* note 15, at 3 and at 18-19.
59. Substantially more than what is needed to produce vegetables. See Verschuuren, *supra* note 20, at 4.
60. Arjen Y. Hoekstra, *The Water Foot Print of Food*, Water for Food 53 (2008).
61. In that sense "global diets link environmental sustainability and human health", so David Tilman & Michael Clark, *Global Diets Link Environmental Sustainability and Human Health*, 515 Nature (2014), doi: 10.1038/nature13959 and see Godfray et al., *supra* note 49.
62. Willett et al., *supra* note 15, at 9-10.
63. Alicja Wolk, *Potential Health Hazards of Eating Red Meat*", 281(2) Journal of Internal Medicine 106-22 (2017), doi: 10.1111/joim.12543.
64. Vesanto Melina, Winston Craig & Susan Levin, *Position of the Academy of Nutrition and Dietetics: Vegetarian Diets*, 116(12) Journal of the Academy of Nutrition and Dietetics 1970-1980 (2016), doi: 10.1016/j.jand.2016.09.025.
65. Hedberg, *supra* note 43.
66. "Because intake of red meat is not essential and appears to be linearly related to total mortality and risks of other health outcomes in populations that have consumed it for many years, optimal intake might be o gr/d, especially if replaced by plant sources of protein" (Willett et al., *supra* note 15, at 10).
67. Moreira Campos Lima, *supra* note 20, at 1.

taken into account, the question obviously arises: how? That relates to the question of whether it is possible to determine "optimal" standards for meat production and consumption. As is indicated in the EAT-Lancet Report, the difficulty is that whereas for greenhouse gas emissions from CO_2 relatively precise emission targets have been provided by the Intergovernmental Panel on Climate Change (IPCC) which have also formed the basis for the Paris Agreement, the same is not the case for the global food system. There is uncertainty and clear scientific targets do not exist.[68]

There are several aspects to be taken into account when assessing "the price of meat" which obviously is important in relation to the question of which policy action should be taken to deal with those costs. The economic perspective with respect to the external costs created by meat production and consumption is the one of the externalities. In simple terms, the story is that meat production and consumption would cause a lot of external costs (some of which were summarized supra in 2.1 and 2.2) that are not sufficiently incorporated into the price of meat. A question which in that respect rises is whether the costs (in this case related to livestock production) are internal (i.e. only affecting the consumers of meat) or whether there are external costs, affecting third parties. Some environmental economists argue that the effects of unhealthy diets on the individual are not an externality as they are a form of self-inflicted harm. They would argue that costs related to increased health risks are usually only imposed upon the consumers of unhealthy food products and therefore largely internal. Economists refer to these costs as "internalities" for which no justification for government intervention would exist. The question, however, arises of whether that would be an argument against a regulatory intervention. Health impacts can indeed also affect economic outcomes as health consequences of meat consumptions can indirectly lead to productivity losses.[69] That would therefore be an argument to still take those costs into account in calculating the correct costs of meat, even when those are "internalities". Moreover, others argue that those health costs are not merely internal as they are (especially in the European context) often covered by public health insurance systems and should therefore be treated as external health costs that should also be internalized into actual food prices.[70] That seems to be the correct approach as unhealthy food habits undoubtedly also create costs for others than the consumer which is obviously one of the reasons behind the sugar tax and fat tax that have been introduced in some countries (to be discussed below in section 3). Unhealthy eating habits lead to more pressure on public budgets.

The question then arises of which policy action with respect to food should be considered; or in other words, how can one determine which type and quantity of food can be considered sustainable? The answer to that question will depend on the goals determined for policy action and inter alia whether one includes health and environmental objectives and if so, how the latter are precisely determined. The approach used by the EAT-Lancet Report is to rely on the so-called planetary boundaries. Those are "the safe operating space for humanity with respect to the earth system". These spaces are defined by scientific targets and include the total global amount of cropland use, biodiversity loss, water use, greenhouse gas emissions, and nitrogen and phosphorus pollution that can be due to food production.[71]

Also Verschuuren uses the planetary boundaries approach to identify the impact of agriculture on those boundaries and to determine the policy objectives to be achieved.[72]

68. Willett et al., *supra* note 15, at 5.
69. Ibidem.
70. A study by Seidel et al. (2023) showed that in Germany 601,50 euro/capita and 50,38 billion? euro in total are incurred as external health costs on a yearly basis due to bad nutrition. 32,56% of these costs are related to excessive meat consumption.
71. Willett et al., *supra* note 15, at 6.
72. Verschuuren, *supra* note 20, at 4.

The EAT-Lancet report translates the planetary boundaries as follows in concrete standards:

	Control variable	Boundary (uncertainty range)
Climate change	Greenhouse-gas (CH_4 and N_2O)	5 Gt of carbon dioxide equivalent per year (4 7-5 4)
Nitrogen cycling	Nitrogen application	90 Tg of nitrogen per year (65-90;* 90-130†)
Phosphorus cycling	Phosphorus application	8 Tg of phosphorus per year (6-12:* 8-16†)
Freshwater use	Consumptive water use	2500 km^3 per year (1000-4000)
Biodiversity loss	Extinction rate	Ten extinctions per million specie-years (1-80)
Land-system change	Cropland use	13 million km2 (11-15)

*Lower boundary range if improved production practiced and redistribution are not adopted. †Upper boundary range if improved production practices and redistribution are adopted and 50% of applied phosphorus is recycled.

Figure 8: Scientific targets for six key Earth system processes and the control variables used to quantify the boundaries[73]

The question, however, arises of how that can subsequently be translated into criteria for optimal meat consumption. Several initiatives have been developed to come to a better calculation of the costs of meat production and consumption. That is a crucial first step in order to determine which policy instruments can subsequently be employed to reach a better (in economic terms) pricing of meat production and consumption.

E. True Cost Pricing

If meat production and consumption do indeed cause those large externalities,[74] the question arises of how those costs can be correctly assessed.[75] One initiative is the so-called true cost accounting. The basis of true cost accounting can be found in life-cycle assessment (LCA) which uses monetary valuation to aggregate environmental impacts. There is a wide variety of monetary valuation approaches available in LCA, leading to significant variability depending upon the environmental impacts that are taken into account.[76] Practical guidelines on how to apply True Cost Accounting for the food and farming sector can be found in a March 2022 handbook.[77] The Handbook provides theoretical and practical principles of the true cost accounting methodology, as well as true cost accounting indicators for agrifood supply chains. True cost accounting can also be found in a 2023 FAO Working Paper on true cost accounting applications for agrifood systems policy-makers.[78] Also this paper provides a literature review of true cost accounting and guidance on how a true cost accounting study can be undertaken, more particularly for the agrifood sector. Generally, the idea of True Cost Accounting is

73. Willett et al., *supra* note 15.
74. Recall that this can also include health effects even though these are by some (debatably) described as "internalities". But given that those health effects also create external (public health services) costs, they may equally require internalisation.
75. Many of the studies refer to externalities created by food production generally. However, for the purposes of this study, I will mostly focus on meat production, but the reader should be aware that also the production of other food may equally create externalities that have to be internalised.
76. For an excellent overview of monetary valuation studies in life-cycle assessment, see Andrea M. Amadei, Valeria De Laurentiis & Serenella Sala, *A Review of Monetary Valuation in Life Cycle Assessment: State of the Art and Future Needs*, 329 Journal of Cleaner Production 129668 (2021), doi: 10.1016/j.jclepro.2021.129668.
77. True Cost Accounting, Agrifood Handbook. Practical Guidelines for the Food and Farming Sector on Impact Measurement, Valuation and Reporting, March 2022, <https://tca2f.org/wp-content/uploads/2022/03/TCA_Agrifood_Handbook.pdf>.
78. Reinier de Adelhart Toorop et al., *True Cost Accounting Applications for Agrifood Systems Policy-Makers*, Background paper for the State of Food and Agriculture (2023), FAO Agricultural Development Economics Working Paper 23-11.

that by reflecting the environmental impact of food, true pricing could promote more sustainable means of production, encouraging consumers to make more sustainable food choices.[79]

The European Commission's Farm-to-Fork strategy now details a vision of an European Union (EU) tax system that should also adequately reflect the "real cost" of environmental damage associated with food items.[80] Note that the Farm-to-Fork strategy was criticized in the literature as too strongly relying on empowering consumers via information provision.[81] As the many empirical studies have shown, consumers often do not understand the information provided (or the nudges), as a result of which their effectiveness may be limited.[82] The Farm-to-Fork Strategy largely relies on providing consumers information on e.g. health risks related to the consumption of meat, assuming that that information provision will change consumption behavior.

From an environmental economics perspective the correct pricing of meat, i.e. that reflects the true social costs, should be at the core of any regulation.[83] That is exactly where true cost accounting can help to inform the policy-maker about the accurate social costs of meat, thus allowing a correct pricing of meat. The correct pricing of meat has two effects: the higher prices could solve an information problem (ignorance concerning harmful effects of meat), but the higher prices (resulting from true cost pricing) also have an immediate effect, being that meat might simply become unaffordable for many, thus generating positive health and environmental effects.

As expanded upon before, meat is currently significantly underpriced. The approach followed is, as mentioned, to start with life cycle analysis in order to analyze the pressure of a certain production process on the environment. For example, the Dutch National Institute for Public Health and the Environment has developed a score list with different environmental effects, such as climate change, water use, land use and soil acidification.[84] These insights subsequently allow for a monetary calculation of the true costs by multiplying their environmental impacts in different emission categories to determine the environmental costs of various protein sources.[85] This led the Dutch Institute for Public Health and the Environment to a calculation of the environmental impact of particular food products distinguishing inter alia between effects on global warming, acidification, eutrophication, land use and water consumption.[86] If the external costs of beef due to the impact on climate change and nutritional pollution would be incorporated, this would add up to an average USD 5,75-USD 9,17 per kilogram.[87]

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79. See Editorial, *The True Cost of Food*, 1 Nature Food 185 (2020).
80. The strategy holds: "Tax incentives should also drive the transition to a sustainable food system and encourage consumers to choose sustainable and healthy diets… EU tax systems should also aim to ensure that the price of different foods reflects their real costs in terms of use of finite natural resources, pollution, GHG emissions and other environmental externalities" (European Commission, Farm-to-Fork Strategy – For a Fair, Healthy and Environmentally Friendly Food System 15 (2020), <https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en>. See further David Klenert, Franziska Funke & Mattia Cai, *Meat Taxes in Europe Can Be Designed to Avoid Overburdening Low-income Consumers*, 4 Nature Food 894-901 (2023), doi: 10.1038/s43016-023-00849-z.
81. See for that criticism, Nikhil Gokani, *Healthier Food Choices: From Consumer Information to Consumer Empowerment in EU Law*, 47(2) Journal of Consumer Policy 271-96 (2024).
82. See below III E.
83. So Franziska Funke et al., *Toward Optimal Meat Pricing: Is It Time to Tax Meat Consumption?*, 16(2) Review of Environmental Economics and Policy 220 (2022).
84. RIVM (National Institute for Public Health and the Environment), ReCiPe 2016, A Harmonised Life Cycle Impact Assessment Method at Midpoint and Endpoint Level Report 1: Characterisation (2016).
85. Sahar Azarkamand et al., *Calculating the True Costs of Protein Sources by Integrating Environmental Costs and Market Prices*, 49 Sustainable Production and Consumption 28-41 (2024).
86. See RIVM (National Institute for Public Health and the Environment), Database milieubelasting voedingsmiddelen (2019). The report provides a detailed account of the environmental impact of a variety of products, measured in Kg CO_2 equivalent, showing, not surprisingly, that the impact on global warming of meat production (for example 20,345 Kg CO_2 eq. for hamburgers) is substantially higher than for example for potatoes (0,339) or beer (0,414).
87. Funke et al., *supra* note 83, at 221.

Accounting for biodiversity loss and diet related health impacts would further increase those costs[88] and that would obviously certainly be the case when animal welfare would equally be taken into account.[89]

These numbers indicate high social costs of meat production and consumption that are currently not internalized (as they are not incorporated in the price of meat).[90] According to a report by the financial services provider Trucost,[91] none of the large economic activities (such as coal power generation in Eastern Asia, cattle ranching and farming in South-America or rice farming in Southern-Asia) would be profitable if the environmental costs were fully integrated for the simple reason that the natural capital costs would be higher than the total revenues:[92]

RANK	SECTOR	REGION	NATURAL CAPITAL COST, $BN	REVENUE, $BN	IMPACT RATIO
1	COAL POWER GENERATION	EASTERN ASIA	452.8	443.1	1.0
2	CATTLE RANCHING AND FARMING	SOUTH AMERICA	353.8	16.6	18.8
3	COAL POWER GENERATION	NORTHERN AMERICA	316.8	246.7	1.3
4	WHEAT FARMING	SOUTHERN ASIA	266.6	31.8	8.4
5	RICE FARMING	SOUTHERN ASIA	235.6	65.8	3.6

Figure 9: Ranking of the 5 region-sectors with the greatest overall natural capital impact[93]

Assuming that these findings are accurate, this would imply that many of the mentioned companies, if they would fully incorporate social costs, would no longer be profitable. This also implies that those polluters are not incorporating social costs and that the polluter-pays-principle is not respected.[94] The contrary is even true: instead of a polluter-pays-principle, in the EU de facto a polluter receives principle is applied[95] as the core of the common agricultural policy (CAP) is that substantial subsidies are provided to the agricultural sector in general, including to the livestock industry. Hedberg criticizes the Common Agricultural Policy (CAP) for spending over Euro 348 billion on agriculture to support, in his words, unhealthy and unsustainable meat and dairy production.[96] Similar criticism comes also from the World Bank arguing that fossil fuel and farming subsidies are "toxic" and cause "environmental havoc".[97]

F. Summary

This overview showed that food production and consumption, and more particularly of meat, has substantial environmental and health impacts and that there is, via various channels, a substantial impact (directly and indirectly) on climate change. Costs of meat production and consumption, more particularly externalities (but also internalities via increased health risks) are substantial and can be calculated based on true cost accounting. That, however, indicates that many (also farming) industries would no longer be profitable (in case of full internalization of social costs). However, the policy is

88. Ibidem.
89. See Funke et al., *supra* note 83, at 225. For an attempt to monetise animal welfare impacts, see Mark Budolfson et al., *Monetising Animal Welfare Impacts for Benefit-Cost Analysis*, Journal of Benefit-Cost Analysis 1-18 (2024), doi: 10.1017/bca.2024.19.
90. Even though, as indicated above, there is a large variety of different environmental effects of meat production, but the most important social costs of meat are often defined as carbon emissions, biodiversity losses and increased health risks.
91. Trucost is a part of Standard and Poor (S&P). it is, according to its website, a leader in carbon and environmental data and risk analysis, <https://ap.lc/nwcSo>.
92. Trucost, Natural Capital at Risk: The Top 100 Externalities of Business 54-5 (2013), <www.naturalcapitalcoalition.org/wp-content/uploads/2016/07/Trucost-Nat-Cap-at-Risk-Final-Report-web.pdf>.
93. Trucost, *supra* note 92, at 9.
94. So also Treich, *supra* note 21, at 14.
95. Ibidem.
96. Hedberg, *supra* note 43.
97. <https://ap.lc/kZflX>; <www.foodandlandusecoalition.org/global-report/>.

currently not geared towards internalizing the costs related to livestock production and consumption; to the contrary, these activities are even largely subsidized. That obviously leads to the question of which possible regulatory (and other) tools could be employed in order to reach an internalization of those social costs.

III. POSSIBLE REGULATORY (AND OTHER) TOOLS

The goal of a regulatory intervention can be clearly distilled from the true cost analysis at the end of the previous section: food production in general, but meat production and consumption specifically, currently lead to substantial social costs that are not incorporated in the prices. The policy goal of a regulatory intervention can therefore be described as closing the gap between current prices of meat and the true social cost.[98] As was also shown in the previous section, consumers would benefit from dietary changes, more particularly moving to a plant-based diet,[99] which would be both in their own interest (reducing health risks) and in the planet's interest (as it would reduce greenhouse gas emissions). In that sense, a dietary change would be an example of providing co-benefits.[100] However, given a large number of behavioral biases, the dietary changes are not likely to occur automatically, i.e. without any regulatory or other intervention.[101] The classic paradigm of the economic approach to law, i.e. the Coase theorem[102] cannot help out here either, as transaction costs might be prohibitive.

In the following I will therefore discuss various options to take into account livestock production. One possibility is to focus on production transformation (A) which is, however, for a variety of reasons difficult to achieve (A). That equally raises the question of the regulation of livestock production which is, given the large variety of producers, equally problematic (B). Market-based instruments would be a logic alternative, for example the emission trading scheme (C) or, as strongly advocated in the literature, the introduction of a meat tax (D). Another possibility is to use behavioral policy as a strategy to change consumption patterns (E). It will finally be concluded that even though there is a strong argument in favor of the introduction of a meat tax, this should not be introduced in isolation, but rather in as part of a smart mix of different instruments (F).

A. Production Changes

The literature mentions that a Great Food Transformation is needed that would require immediate action to avoid serious, even disastrous, consequences.[103] The Lancet Commission suggests five strategies for a Great Food Transformation (such as seeking international and national commitment to shift towards healthy diets, shifting agricultural priorities to producing healthy food, generating high quality sustainable food and reducing food loss and waste), as well as several tools to realize the transformation (such as building an alliance of forces to operationalize the Lancet Commission's broad recommendations).[104]

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98. Maximilian Pieper, Amelie Michalke & Tobias Gaugler, *Calculation of External Climate Costs for Food Highlights Inadequate Pricing of Animal Products*, 11(1) Nature Communications 1-13 (2020): policy measures should close the gap between current market prices and their true costs of food.
99. Willett et al., *supra* note 15, at 26.
100. Marco Springmann et al., *Analysis and Valuation of the Health and Climate Change Co-Benefits of Dietary Change*, 113(15) PNAS 4146-4151 (2016), doi: 10.1073/pnas.1523119113.
101. Funke et al., *supra* note 83.
102. The theorem developed by Nobel Prize Winner Ronald Coase holds that when transaction costs are zero or at least low, an optimal (efficient) solution could be reached without a need for the law to intervene. Ronald H. Coase, *The Problem of Social Cost*, Journal of Law and Economics 1-44 (1960).
103. According to the Lancet Commission (Willett et al., *supra* note 15, at 31).
104. Willett et al., *supra* note 15, at 38-39. An analysis of the way to implement a transformation of food and land use is also provided by The Food and Land Use Coalition, Growing Better: Ten Critical Transitions to Transform Food and Land Use, September 2019, <www.foodandlandusecoalition.org/wp-content/uploads/2019/09/FOLU-GrowingBetter-GlobalReport.pdf>.

At the EU level, this production transformation is equally suggested in the EU's Farm to Fork strategy, which also has a strong focus on improving methods of production, inter alia by suggesting a code of conduct for responsible business and marketing practices accompanied with a monitoring framework.[105] Also in the FAO 2006 Report, there is a strong focus on technical options to improve the efficiency of meat production towards sustainability. There is for example the suggestion to reduce the CH_4 emissions from enteric fermentation through improved efficiency and diets,[106] to mitigate CH_4 emissions through improved manure management and biogas[107] and to seek technical options for N_2O emissions and NH_3 volatilization.[108] Also more recent FAO studies examine nutritional, manure and animal husbandry practices for mitigating methane (CH_4) and nitrous oxide (N_2O) emissions from livestock production.[109] The report suggests a wide variety of measures. Also, more recent reports of the FAO (2023, 8-12) suggest a wide variety of measures that could be taken at the production level to reduce emissions (including improved rice management, manure management and crop nutrient management).[110]

The easiest available, healthiest and cheapest option currently available to implement the Great Food Transformation is to move to vegetarian meat substitutes. However, some propose even more radical alternatives for meat production. One option receiving increasing attention is the production and consumption of insects, at least as feed in livestock production.[111] An other alternative is to replace animal protein with plant protein. The Farm-to-Fork strategy for example suggests marine feed stocks such as algae as feed for animals (for example to replace soja grown on deforested land).[112] Yet another alternative is either "mock meat" (transformed plant proteins) or muscle tissues cultured in bioreactors.[113] The latter is also referred to as lab-grown meat or cultured meat.[114] That does, however, not yet seem to be a viable alternative as almost 23% of the global energy production would be needed for cultured meat production, the water use associated with conventional meat and cultural meat would be comparable and the costs involved in large-scale cultured meat production would at this stage still be very high.[115] Verschuuren refers to a cost of 63 USD per kilo.[116] He therefore argues that cultured meat will likely remain a niche product for developed country consumers. Also others argue that these alternatives are at this moment of marginal help.[117]

The question of course arises how for the (realistic) production changes (such as those proposed by the EAT-Lancet Commission and by the FAO) can be achieved. One possibility is to use the clean development mechanism under the Kyoto Protocol.[118] Still, in addition to these financial incentives,

105. European Commission, *supra* note 80.
106. FAO, *supra* note 24, at 119.
107. FAO, *supra* note 24, at 121.
108. FAO, *supra* note 24, at 122.
109. FAO, Climate Change Mitigation Options in Agrifood Systems, Summary of the Working Group III Contribution to the Intergovernmental Panel on Climate Change, 6th Assessment Report (ASS) 8-12 (2023).
110. See for the potential of those measures also, Alexander N. Hristov et al., *Mitigation of Greenhouse Gas Emissions in Livestock Production – A Review of Technical Options for Non-CO_2 Emissions*, *in* FAO Animal Production and Health, Paper No. 177 (Pierre J. Gerber, Benjamin Henderson & Harinder P.S. Makkar (2013).
111. See Arnold van Huis & Laura Gasco, *Insects as Feed for Livestock Production. Insect Farming for a Livestock Feed as the Potential to Replace Conventional Feed*, 379(6628) Science 138-139 (2023), doi: 10.1126/science.adc9165.
112. European Commission, *supra* note 80.
113. Harry Aiking & Joop de Boer, *The Next Protein Transition*, 105 Trends in Food Science & Technology 520 (2020).
114. See for details on this technology, Verschuuren, *supra* note 20.
115. Verschuuren, *supra* note 20, at 9-11.
116. Ibidem.
117. Aiking & De Boer, *supra* note 113, at 520.
118. As suggested by the FAO, *supra* note 24, at 238-239. The CDM has been replaced by a successor provided for in Art. 6 of the Paris Agreement, which outlines mechanisms for international cooperation on carbon markets and non-market approaches. It is referred to as the "Sustainable Development Mechanism" (SDM)

more drastic legal and policy measures will be necessary to close the gap between current market prices and the true costs of food.[119]

B. Regulation of Production

The first legal rule that would come to mind is to make use of liability rules. A liability rule can have an ex ante incentivizing effect by holding an injurer ex post liable for the harm caused by their actions.[120] The use of liability rules to deal with the externalities created by livestock production would imply to hold producers liable for the external costs resulting from livestock production. However, as the damage is typically widespread, the likelihood that liability rules would be used against meat producers sounds very low. Liability rules are therefore surely not a viable option to realize the Great Food Transformation that is needed according to the EAT-Lancet Commission.[121] One option is to have standards set ex ante via government regulation.[122] Regulation is also suggested in some literature as a policy instrument to control meat production.[123] This could imply a direct regulation of farming practices by either controlling the greenhouse gas emissions from meat production (for example in permits) or banning particular unsustainable production practices via regulation (backed up with public sanctions) or by prescribing the use of sustainable practices. Direct regulation of producers could ensure minimum standards for rearing conditions and environmentally sustainable farming practices.[124]

It is, however, considered more complicated to regulate food externalities at the production side for a variety of reasons,[125] as a result of which, as will be mentioned below, most instruments focus on reducing consumption of animal products.[126]

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and designed to eventually replace the CDM. CDM will, however, continue for a transitional period and can thus be employed for projects aimed at sustainable food transfer within the livestock sector. See <www.goldstandard.org/publications/a-practitioners-guide-aligning-the-voluntary-carbon>.

119. Pieper, Michalke & Gaugler, *supra* note 98.
120. The incentivizing effects of liability rules have been explored in detail in the economic analysis of law. See in that respect especially Steven Shavell, Economic Analysis of Accident Law (1987).
121. With this I do not deny the importance of climate change litigation. But that is especially important as an instrument to force policy-makers to set appropriate standards. It cannot be expected that the food production changes needed in the Great Food Transformation would be realized via standard-setting by the judiciary. See on climate change liability and litigation further the contributions in Michael Faure & Marjan Peeters, *Liability and Climate Change*, *in* Oxford Research Encyclopedia of Climate Change 1-30 (2019), as well as the dissertations by Miriam Haritz, *An Inconvenient Deliberation - The Precautionary Principle's Contribution to the Uncertainties Surrounding Climate Change Liability* (defended at Maastricht University on 17 December 2010); Giedre Kaminskaite-Salters, *Climate Change Litigation under English Law* (defended at Maastricht University on 11 February 2010) and Jana Nysten, *Private Climate Litigation Actions vs. National Regulatory Approaches: A legal assessment of their interrelation and potential based on the example of greenhouse gas emission reductions* (defended at Maastricht University on 26 November 2024).
122. The classic criteria for safety regulation were presented by Steven Shavell, *Liability for Harm versus Regulation of Safety*, 13 Journal of Legal Studies 357-374 (1984), but also by Niels J. Philipsen, *Regulation and Competition in the Legal Profession: Developments in the EU and China*, 6(2) Journal of Competition Law and Economics 203-31 (2010); Niels J. Philipsen, *Limiting Auditors' Liability: The Case for (and against) EU Intervention*, 39 Geneva Papers on Risk and Insurance 585-97 (2014); Niels J. Philipsen, *The Role of Private Actors in Preventing Work-Related Risks: A Law and Economics Perspective*,24(3) European Public Law 539-54 (2018).
123. It is argued that food security can increase while at the same time reducing agriculture's environmental footprint by closing "yield gaps" on underperforming lands, increasing cropping efficiency, shifting diets and reducing waste (Jonathan A. Foley et al., *Solutions for a Cultivated Planet*, 478 Nature 337-42 (2011)).
124. Funke et al., *supra* note 83, at 234.
125. See Stefan Wirsenius, Fredrik Hedenus & Kristina Mohlin, *Greenhouse Gas Taxes on Animal Food Products: Rational, Tax Scheme and Climate Mitigation Effects*, 108(1) Climate Change 159-84 (2011).
126. Marco Springmann et al., *Options for Keeping the Food System within Environmental Limits*, 562(7728) Nature 519-25 (2018).

There are different EU Directives that deal with particular aspects of meat production. Methane emissions are for example regulated through the Effort Sharing Regulation,[127] as well as through the Industrial Emissions Directive.[128] However, the regulation of greenhouse gas emissions from meat production at EU level is qualified as haphazard[129] and does certainly not cover all emissions in such a way that one could argue that they close the gap between market prices and the true costs of food. There is, incidentally, a recent EU Regulation on the reduction of methane emissions of 13 June 2024, but the scope is limited to methane emissions related to oil and gas production[130] and does not relate to methane emissions from agriculture at all.

That of course raises the question of whether instead of government regulation via standards, the use of market-based instruments would not be more indicated. In theory, market-based instruments could provide incentives for an efficient internalization of externalities in a dynamic manner, i.e. providing dynamic incentives to keep investing in research and development to further abate pollution at low marginal costs.[131] Regulatory standards indeed have the disadvantage that they are not dynamic, can be outdated fast, do not provide any incentives to go beyond the regulatory standards, are often not sufficiently differentiated (according to the particular situation of different operators) and need high monitoring and enforcement costs in order to be effective.[132]

C. Extending the ETS

One option, if one considers market-based instruments is to extend the system that can currently be considered the most important one to control greenhouse gas emissions within the EU, the EU Emissions Trading System (ETS)[133] to the agricultural sector as well. Verschuuren mentions that the expansion of the EU Emissions Trading System (ETS) to cover major meat and dairy processing installations is a serious option, but has disadvantages as well.[134] One problem is that the ETS would also focus on controlling production which may lead to substantial monitoring costs.[135] Moreover, controlling greenhouse gas emissions from fixed installations in industry is one thing; monitoring greenhouse gas emissions such as methane from manure or enteric fermentation is quite another.[136] Monitoring production would de facto entail a measurement of all living and moving beings on separate farms and thus potentially very high monitoring costs. There is also doubt that production focused measures would be able to satisfy growing food demands in a sustainable manner; demand-side mitigation options are often considered more promising.[137] That is why the instrument most often cited

127. Regulation (EU) 2018/248 of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, OJ L156/26. See further Marjan Peeters & Natassa Athanasiadou, *The Continued Effort Sharing Approach in EU Climate Law: Binding Targets, Challenging Enforcement?*, 29(2) RECIEL 201-11 (2020).
128. See Directive 2024/1785 on industrial emissions (Integrated Pollution Prevention and Control) of 24 April of 2024, OJ L of 15 July 2024. See further Verschuuren, *supra* note 20, at 2 and Verschuuren (2022), *supra* note 20, at 253-255.
129. Verschuuren, *supra* note 20, at 2.
130. See Art. 1(2)(a) of Regulation (EU) 2024/1787 of 13 June 2024 on the reduction of methane emissions in the energy sector, OJ L of 15 July 2024.
131. For the advantages of market-based instruments, see the contributions in Jody Freeman & Charles D. Kolstad (eds.), *Moving to Markets in Environmental Regulation: Lessons from 20 Years of Experience* (2007).
132. Shavell, *supra* note 122, at 363-364.
133. See further Marjan Peeters, *Greenhouse Gas Emissions Trading in the EU*, *in* Climate Change Law, Elgar Encyclopaedia of Environmental Law 377-87 (Dan A. Farber & Marjan Peeters eds., 2016).
134. Verschuuren (2022), *supra* note 20, at 254.
135. Funke et al., *supra* note 83, at 221.
136. Springmann et al., *supra* note 22, at 69.
137. Bojana Bajželj et al., *Importance of Food-Demand Management for Climate Mitigation*, 4 Nature Climate Change 924-29 (2014), doi: 10.1038/nclimate2353. See also Herrero et al., *supra* note 24.

in the literature is the use of taxation, but not on production, but rather on consumption, in other words a meat tax.

D. Meat Tax

1. Meat Tax and Carbon Pricing

Recall that the policy goal for the problem to be solved was defined at the end of the last section to seek a policy measure that is able to close the gap between the current market prices and the true cost of food.[138] From that perspective, it seems obvious to primarily look at the instruments that may be most suited to reach this policy goal, i.e. a Pigouvian tax.[139] The question then arises what should be taxed. The classic answer in economics would be to impose the tax on the source of the emission, in other words on the method of production. However, that may be a complicated strategy. It is costly and technically difficult to control all the various sources of greenhouse gas emissions from agriculture, given the heterogeneity of the agricultural practices and the problem of diffuse pollution.[140] Even if the meat production sector were able to substantially improve its practices (along the suggestions discussed in section 3.1 supra) reducing meat consumption on a large scale, would surely have a more important impact on both the environment and health.[141] This was also argued in a Science article:[142] to consider the consumer in this case as polluter is also in line with economic principles and more particularly the Coase theorem as producer and consumers are bound to each other via the price mechanism.[143]

Funke et al. explain that a meat tax is not the same as carbon pricing. Carbon pricing would suppose that appropriate prices on carbon and other externalities are in place. That would be a so-called first-best option. If that is not available, the strategy of targeting meat is a second-best solution.[144] They equally mention another advantage of consumption taxes (on meat) compared to taxes on production: the latter might create negative impacts on competitiveness for the country which would introduce such a tax.[145]

2. Determining the Optimal Meat Tax

That raises the question on the optimal meat tax, in other words: how to set the correct tax level?[146] Obviously, the true cost analysis, discussed at the end of section 2, can be helpful in determining the amount of the externality and thus the optimal price of the tax. Several elements determine the design and optimal tax rate.

A first point is that in case of multiple market failures and inefficiencies (as is the case in meat production and consumption), the optimal tax rate does not always equal the total sum of all

138. Pieper, Michalke & Gaugler, *supra* note 98.
139. As propagated in the classic work of Arthur C. Pigou, *A Study in Public Finance* (1951).
140. Treich, *supra* note 21, at 14-15. Springmann et al., *supra* note 22, at 69.
141. Ibidem.
142. Poore & Nemecek, *supra* note 15: "Today, and probably into the future, dietary change can deliver environmental benefits on a scale not achievable by producers".
143. Dirk Heine, Michael Faure & Goran Dominioni, *The Polluter-Pays Principle in Climate Change Law: An Economic Appraisal*,10(1) Climate Law 94-115 (2020).
144. Funke et al., *supra* note 83, at 220-221.
145. Funke et al., *supra* note 83, at 221. Of course, a tax on the consumption of meat can indirectly also affect producers (although probably less than a direct production tax). That is a reason why countervailing measures to deal with the consequences of a meat tax for farmers should be considered as well, as will be argued in III D 4 and IV A. Even though, in line with the literature, I will mostly focus on the effects of a meat tax. One should be aware that only taxing meat would not completely internalize the externalities related to livestock farming, as it would exclude other products such as milk, cheese and yoghurt, the production of which equally leads to emissions of greenhouse gases.
146. It is the subject to which the study of Funke et al., *supra* note 83 is devoted.

externalities.[147] If an optimal tax to reduce greenhouse gas emissions from livestock is set that fully controls the externality, it will have the co-benefit of reducing local nutrient pollution, for example through the use of fertilizers. If a tax (for example on fuel) was set at the level of the sum of the external costs for both pollution and greenhouse gas emissions, the tax would be sub-optimally high.[148]

Second, meat production also has the indirect effects of deforestation and biodiversity loss. A tax should take into account the potential interaction effects with those aspects as well.[149]

Another crucial element in the tax design are the so-called cross-price elasticities of demand. Meat taxes should be carefully designed to avoid encouraging consumers to substitute other unhealthy products for red and processed meat.[150]

Finally, the literature mentions that the question arises whether animal welfare concerns should also be incorporated when setting the meat tax. Although consumers might care about animal welfare and would be willing to pay a premium for better conditions for animals, there is often an unwillingness to pay such a price premium if there is free-riding by others. Moreover, there is often a gap between consumers' stated preferences (concerning animal welfare) and their actual purchase decision (i.e. buying cheap meat).[151] As far as the meat tax is concerned, part of the fiscal revenue could be used to help farmers improve animal welfare. Moreover, higher meat prices can help correct consumers' cognitive dissonance when buying meat.[152]

Springmann et al. calculated optimal tax levels on red and processed meat.[153] They estimate increased meat prices by 4% on average, ranging from less than 1% in low income countries to 21% in high income countries (for red meat). For processed meat, the price would on average increase with 25%, ranging from 1% in low income countries to 111% in high income countries.[154] In their additional analysis, they indicate that optimal taxation could also reduce food-related greenhouse gas emissions by 109 metric tonnes CO_2-eq, resulting from reduced beef consumption.[155] Others argue that a correct pricing of meat (for example via an environmental tax that covers GHG emissions and nutrient pollution)[156] would lead to an estimated increase in current retail prices of meat in high income countries by roughly 20-60%.[157] There are, in other words, several studies that provide indications, with ranges of uncertainties, on the optimal tax rate.

3. Effects of a Meat Tax

Several studies have also estimated the expected effects of incorporating these optimal tax levels, both on health risks and on greenhouse gas emissions. Several studies hold that an optimal meat tax can reduce mortality from 6 to 10% and emissions from 29 to 70%.[158] Taxes are therefore, based on these modelling exercises, predicted to have substantially beneficial effects, both as far as reduced health risks are concerned (decrease of the number of deaths attributed to red and processed meat consumption)

147. Funke et al., *supra* note 83, at 226.
148. Ian W.H. Parry & Kenneth A. Small, *Does Britain or the United States Have the Right Gasoline Tax?*, 95(4) American Economic Review 1276-89 (2005).
149. Budolfson et al., *supra* note 89; Funke et al., *supra* note 83, at 227.
150. Funke et al., *supra* note 83, at 229.
151. Funke et al., *supra* note 83, at 230.
152. Ibidem.
153. Whereby they only took into account the negative health effects of meat consumption, not GHG emissions (Springmann et al., *supra* note 18). However, they indicate that even if a meat tax was introduced to reduce health risks, it would have the co-benefit of reducing GHG emissions.
154. Springmann et al., *supra* note 18, at 6-7.
155. Springmann et al., *supra* note 18, at 10.
156. As will be further discussed in the next section.
157. Funke et al., *supra* note 83, at 236.
158. Springmann et al., *supra* note 100, at 4149; Springmann et al., *supra* note 22, at 69-72 and Treich, *supra* note 21, at 15.

as well as concerning climate change.[159] In a randomized controlled experiment that evaluated the potential effects of carbon and/or health taxes, it was shown that a combined carbon and health tax policy maximizes benefits in terms of both environmental and health outcomes.[160] Evidence on the effectiveness of health-related food taxes come from natural experiments, controlled trials and modelling studies. They all unequivocally come to one conclusion: health-related food taxes could improve health. Experiments equally showed that even though information on the carbon and/or health characteristics of food may also have an impact, the imposition of taxes has a far larger effect on food purchasing decisions.[161] The tax would, however, at least have to be 20% to have a significant effect on health.[162] Designing a tax that reaches both a reduction of greenhouse gas emissions and positive health effects is complex but possible (for example by using the revenue of the tax to subsidize healthy products).[163] Ayden and Esen come to a similar conclusion as far as CO_2 emissions in the EU Member States are concerned: taxes could be effective in controlling the market failure, resulting from carbon emissions, but an effective design is crucial: if there were extensive tax exemptions (for particular emitters), the taxes would only have limited effects.[164] Assuming an effective design, environmental taxes could reduce CO_2 emissions effectively.[165] It was shown in an experiment that a combined carbon/health tax could contribute to approximately 1/3 of the reductions in residual emissions required to achieve the United Kingdom's 2050 net-zero commitment while also discouraging the purchase of unhealthy snacks.[166]

There has been some experience with food taxes already today. One example is the use of sugar taxes in Chile, which were introduced as a tool to limit consumption of unhealthy foods. A tax of up to 18% led to a 21.6% reduction in consumption after introduction of the policy.[167] Denmark had a saturated fat tax that it introduced in 2011. Several other European Member States might consider the introduction of a meat tax.[168] The tax on saturated fat that Denmark introduced in 2011 was a tax applied to food products containing more than 2.3% saturated fat. The tax resulted in a decrease in consumption of oil, butter and other fats by 10-15%. Vegetable consumption also increased by 7,9%.[169] However, there were also side effects, such as for example an increase in salt consumption and cross-border purchases: many Danes were travelling to Germany and Sweden to buy butter and other fat products at lower prices. The fat tax was therefore ultimately abolished in 2013.[170] The Danish example shows the problem that may occur when price policies are applied only nationally. This could lead to carbon leakage as the Danes apparently purchased their products at lower price in neighboring countries.[171]

159. Springmann et al., *supra* note 18.
160. Michela Faccioli et al., *Combined Carbon and Health Taxes Outperform Single-Purpose Information or Fiscal Measures in Designing Sustainable Food Policies*, 3 Nature Food 331-40 (2022).
161. Ibidem.
162. So Oliver T. Mytton, Dushy Clarke & Mike Rayner, *Taxing Unhealthy Food and Drinks to Improve Health*, BMJ (2012), doi. 10.1136/bmj.e2931.
163. Erica Doro & Vincent Réquillart, *Review of Sustainable Diets: Are Nutritional Objectives and Low-Carbon-Emission Objectives Compatible?*, 101 Review of Agricultural, Food and Environmental Studies 117-46 (2020), doi: 10.1007/s41130-020-00110-2.
164. Celil Ayden & Ömer Esen, *Reducing CO_2 Emissions in the EU Member States: Do Environmental Taxes Work?*, 61(213) Journal of Environmental Planning and Management 2398 (2018), doi. 10.1080/09640568.2017.1395731.
165. Ayden & Esen, *supra* note 164, at 2413-2415. Note that this study examines environmental taxes for CO_2 emissions in EU Member States generally, but does not focus specifically on meat taxes.
166. Faccioli et al., supra note 160.
167. The Food and Land Use Coalition, *supra* note 104, at 69.
168. Verschuuren, *supra* note 20, at 8.
169. For an overview see Sinne Smed et al., *The Effects of the Danish Saturated Fat Tax on Food and Nutrient Intake and Modelled Health Outcomes: An Econometric and Comparative Risk Assessment evaluation*, 70(6) Eur J Clin Nutr. 681-86 (2016), doi: 10.1038/ejcn.2016.6.
170. Ibidem.
171. See on this danger of carbon leakage in case of national price policies also Marlin J. Broeks et al., *A Social-Cost Benefit Analysis of Meat Taxation and a Fruit and Vegetables Subsidy for a Healthy and Sustainable*

Recently, Denmark has introduced a carbon tax on livestock.[172] That is a tax focusing directly on agricultural emissions, setting a levy of USD 43/tonne of methane produced by livestock such as cows and pigs. On average, Danish dairy cows emit 5.6 tonnes of CO_2 eq./year, which would result in a tax per cow of approximately USD 96 per year.[173]

4. Support for a Meat Tax?

Specific attention is also paid in the literature to how support can be obtained from the population for particular food taxes and how this support could be obtained from the sector. The issue played a role in France after the yellow vests crisis stopped the planned increase of the carbon tax. Douenne and Fabre examined opinions relative to carbon taxation and support for climate policies.[174] They found a limited knowledge, but high concern for climate change. The subjects largely rejected the carbon tax, but did support stricter norms and green investments. They therefore recommended information campaigns on climate change as climate awareness would increase support for climate policies.[175] Funke et al. also discuss policies to get "meat producers on board". They argue that one advantage of a consumption tax on meat is that it applies to both domestic and imported products.[176] Taxes also have the advantage (especially when compared to regulation) that they will create additional revenue that can be used to compensate producers and finance the transition to more sustainable farming practices.[177] There are examples of similar structures. For example, in the framework of the revisions in the ETS Directive of 2023 a social climate fund was created. The idea is to provide EU Member States dedicated funding so that the most affected vulnerable groups such as households in energy or transport poverty are directly supported and not left behind during the green transition.[178]

Meat taxation may not only lead to distributional concerns on the side of producers (which can be alleviated with targeted subsidies to finance the transition to sustainable practices). There is also the problem that meat taxes can be regressive in the sense that they might especially affect the poorer segment in the population. Poor people may spend a proportionally higher amount of their budget on food. And poor people may consume less healthy food.[179] However, since the poor might be more sensitive to price changes, they would equally experience greater dietary improvements from the tax.[180] Low income groups might also eat less fruit and vegetables and less fish[181] than higher income groups.

Food Consumption in the Netherlands, 20 BMC Public Health 9 (2020), doi: 10.1186/s12889-020-08590-z) and see Verschuuren, *supra* note 20, at 8.

172. The new Danish tax applies to carbon emissions from agriculture and would amount to 300 Danish Krones per tonne of CO_2 equivalent from 2030 raising to 750 Danish Krones in 2035. A 60% tax exemption would, however, apply as a result of which farmers would effectively pay 120 Danish Krones per tonne from 2030 raising to 300 Danish Krones in 2035. For details see <https://edition.cnn.com/2024/06/26/business/denmark-cows-carbon-tax/index.html>.
173. Denmark to impose livestock carbon tax: <https://edition.cnn.com/2024/06/26/business/denmark-cows-carbon-tax/index.html>.
174. Thomas Douenne & Adrien Fabre, *French Attitudes on Climate Change, Carbon Taxation and other Climate Policies*, 169(106496) Ecological Economics 1-19 (2020).
175. Ibidem.
176. Funke et al., *supra* note 83, at 234.
177. Ibidem. See also Treich, *supra* note 21, at 10, footnote 20.
178. European Commission, Social Climate Fund, <https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/social-climate-fund_en>.
179. Mytton, Clarke & Rayner, *supra* note 162, at 2.
180. Ibidem.
181. From a purely environmental perspective, fish would also need to be taxed, even though it is healthy. This shows that it may in that particular case be difficult to have environmental and health co-benefits (which is easier in the case of a meat tax as meat, more particularly beef, both has negative health effects as well as negative effects on greenhouse gas emissions).

However, as they are more responsive to price changes, a meat tax, combined with a subsidy on fruit and vegetables could be a desirable policy intervention to deal with this distributional issue.[182]

Also other studies identified various scenarios of the design of a meat tax, arguing that the effect on inequality (overburdening low-income consumers) can be avoided through revenue recycling via uniform lump sum transfers, as lowering value-added taxes on fruit and vegetables does not fully offset the regressive effect.[183] Economists generally prefer correcting the distributional impact through a transfer system to low income households rather than correcting the taxes for distributional impact (as that could reduce the effectiveness of the tax). However, some argue that when income taxes cannot be optimally adjusted in response to the introduction of meat taxes, it may be justified to differentiate the meat tax to achieve distributional goals.[184] That could be an argument for a differentiation according to income levels, although the enforcement of such a differentiated tax might be problematic. In that respect, the introduction of the meat tax might draw lessons from the taxation of cigarettes, where there is also some evidence of regressive effects (the tobacco tax especially hurting low-income groups)[185] and avoidance behavior.[186]

E. Behavioral Policy

The idea of a meat tax still very much relies on the classic economic paradigm, i.e. the price mechanism. It assumes that utility maximizing individuals will reduce their demand for a product that (as a result of the meat tax) becomes more expensive. However, behavioral insights have on the one hand shown that particular biases can distort the way in which the (financial and other) instruments are supposed to function; on the other hand, behavioral insights could also be used to "nudge" consumers into more healthy and more sustainable choices.[187] Behavioral economics suggests that consumers do not adequately account for the health risks of eating unhealthy food. This includes large quantities of meat. That can result in internalities from diet-related diseases.[188] Consumer choices are often time-inconsistent: they prefer the immediate pleasure (of consumption) and ignore (or discount) the long-run health effects. This is a behavioral failure that would, according to Funke et al., justify governmental correction.[189] Status quo bias makes it also difficult to change behavior (meat consumption), especially when that is contained in a social norm.[190] Consumers are also exposed to the so-called meat paradox.[191] This refers to the fact that consumers want to consume meat, but are opposed to animal suffering. They deal with this paradox by manipulating beliefs (for example, refusing to obtain information on animal suffering or searching for justifications).

Many have advocated the use for the insights from cognitive psychology to nudge consumers towards more sustainable and healthier food choices. Meanwhile there is a large amount of papers sketching the effects of those interventions, either in a laboratory setting or in natural experiments.[192] There is scepsis

182. So Broeks et al., *supra* note 171, at 9.
183. For details see Klenert, Funke & Cai, *supra* note 80.
184. See further Funke et al., *supra* note 83, at 231-232.
185. Alan Fuchs Tarlovsky et al., Is Tobacco Taxation Regressive? Evidence on Public Health, Domestic Resource Mobilisation, and Equity Improvements, WBG Global Tobacco Control Program (2019), http://documents.worldbank.org/curated/en/893811554737147697.
186. Ara Cho et al., *The Effect of Tobacco Tax Increase on Price-Minimising Tobacco Purchasing Behaviours: A Systematic Review and Meta-Analysis*, 119(11) Addiction 1923-36 (2024).
187. The Food and Land Use Coalition, *supra* note 104, at 73.
188. Funke et al., *supra* note 83, at 228-229.
189. Funke et al., *supra* note 83, at 229.
190. Treich, *supra* note 21, at 26.
191. Treich, *supra* note 21, at 24-25.
192. For an overview of that literature, see inter alia Kwasny, Dobernig & Riefler, *supra* note 19 and Linda Ferrari et al., *Can Nudging Improve the Environmental Impact of Food Supply Chain? A Systematic Review*, 91 Trends in Food Science & Technology 184-92 (2019).

in the literature as to whether just providing information to consumers (which is the basis for the EU Farm-to-Fork Strategy) will be effective. That skepticism especially applies to the effectiveness of information regulation, for example through labelling. In the EU this is addressed through the so-called food claims regulation.[193] This concerns information through labelling, presentation or advertising, which suggests or implies that food has particular characteristics. The effectiveness of this type of regulation is seriously doubted in the literature. A packaging should for example indicate the weight content of fat/100 gr., but consumers are not advised whether the fat content is healthy or unhealthy.[194]

The literature indicates that information that is appealing to the emotions of consumers (by showing pictures of suffering animals) may be relatively effective. Health appeals seem generally to have a stronger effect on intentions to reduce meat consumptions than environmental appeals.[195]

The lessons drawn from a literature review (reviewing more than 99 papers on the topic) lead inter alia to the following suggestions: 1) inform consumers about negative side effects with a focus on health (rather than environmental issues such as greenhouse gas emissions);[196] 2) try to trigger emotions (for example messages about animal suffering or pictures of cute and baby animals that might foster empathy);[197] and 3) increase the visibility of vegetarian food. The latter implies to increase the visibility of vegetarian meals, e.g. by framing them as "dish of the day".[198]

Whereas most of those studies reviewed refer to either information provision or nudging to bring consumers to healthier food choices, there is also an increasing number of (relatively recent) papers specifically addressing how carbon footprint information affects consumer choice. One paper reports a 9.2% effect (consumers choosing less carbon intensive dishes) when carbon footprints information is visualized in food labels (via color codes) in an experimental setting.[199] Similar results were obtained by an experiment with carbon labels (reflecting greenhouse gas emission information) for particular dishes at a university restaurant. Compared to control, green label (low emission) meat dishes increased in sales by 11.5% whereas the sales of red-labelled (high emission) dishes reduced by 4.8%.[200] A similar result was obtained in a large-scale (with 80.000 individuals) experiment at five university cafeterias: the introduction of carbon footprint labels was associated with a 4.3% reduction in average carbon emissions per meal.[201] The authors suggest that carbon footprint labels can be a viable and low-cost policy to address information failure to encourage more sustainable food choices.[202]

Some studies have also addressed how true cost-pricing and accounting can be accepted by the public at large. A study on Dutch supermarkets showed that particular elements (such as social status and positive environmental impact) could increase the consumers' trust in true pricing characteristics; that

193. Nutrition claims are only permitted in the EU if they are listed in the Annex of Regulation No. 1925/2006, lastly amended by a Regulation No. 1047/2012 (Commission Regulation of 8 November 2012 amending Regulation No. 1924/2006 with regard to the list of nutrition claims, OJ L310, 9 November 2012).
194. Gokani, *supra* note 81, at 279.
195. Kwasny, Dobernig & Riefler, *supra* note 19, at 6.
196. Kwasny, Dobernig & Riefler, *supra* note 19, at 11.
197. Ibidem.
198. Kwasny, Dobernig & Riefler, *supra* note 19, at 12.
199. Bianca Beyer et al., *How Does Carbon Footprint Information Affect Consumer Choice? A Field Experiment*, 62(1) Journal of Accounting Research 101-36 (2024), doi: 10.1111/1475-679X.12505.
200. Florentine Brunner et al., *Carbon Label at a University Restaurant – Label Implementation and Evaluation*, 146 Ecological Economics 658-67 (2018), doi: 10.1016/jpcolecon.2017.12.012.
201. Paul M. Lohmann et al., *Do Carbon Footprint Labels Promote Climatarian Diets? Evidence from a Large-Scale Field Experiment*, 114(1026930) Journal of Environmental Economics and Management 1-21 (2022), <www.sciencedirect.com/science/article/pii/S0095069622000596>.
202. Of course there may always be the question whether results obtained from experiments in University restaurants with students have external validity and are representative for the larger community of consumers as the academic community may be more sensitive to environmental issues than the public at large.

could in turn increase the consumers' intention to purchase true priced food products.[203] Another study equally shows that consumers are generally interested in the topic of true food pricing and would to a certain extent be willing to pay true prices for food. The implementation of true cost accounting (TCA) could however suffer in the case of insufficient transparency and unjust distribution of wealth.[204]

This brief account provides of the behavioral literature a balanced view concerning the relationship between consumption patterns and food choices: behavioral problems and biases may seriously limit consumer awareness and willingness to engage in more healthy and sustainable food choices. Merely providing information (such as food labels on packaging) in line with the information paradigm inherent in the EU Farm-to-Fork Strategy,[205] is not likely to lead to an improved decision-making. However, there is overwhelming evidence that, of course depending upon the specific design and implementation, particular nudges may work, especially when they use images appealing to emotions.[206] That is not only the case as far as nudging healthier food choices is concerned, but even for promoting sustainability (including a lower carbon footprint).

F. Toward a Smart Instrument Mix

In this section a wide range of different policy instruments was presented that could help to reach the policy goal of closing the gap between market price and true costs of food.[207] Yet, there is not one single instrument that could on its own reach that particular goal. That is as such not surprising as often particular instruments have strengths and weaknesses or only function optimally if particular conditions are met. It is for that reason that, as often in environmental policy, an optimal approach probably consists in searching for the smart mix between different policy instruments.[208]

This is already the case as far as the goals to be achieved are concerned. Some would propose a particular instrument (such as a meat tax) to achieve particular health benefits for consumers,[209] whereas others would propose the instrument to reduce the greenhouse gas emissions related to meat production.[210] The literature has indicated that it is possible to use one instrument (meat tax) and achieve both health and climate change co-benefits of dietary change.[211]

The same is probably the case for the choice between regulating producers or consumers. Even though there can be convincing arguments in favor of a regulation of consumers (via a meat tax) rather than taxing meat production, this again does not imply that the introduction of a meat tax should lead to the absence of any regulation at the level of producers.[212] It is for that reason not surprising that the literature

203. Danny Taufik, Mariët Van Haaster-De Winter & Machiel Reinders, *Creating Trust and Consumer Value for True Price Food Products*, 390 Journal of Cleaner Production (2023), doi: 10.1016/j.jclebro. 2023.136145.
204. So Amelie Michalke et al., *True Cost Accounting in Agri-Food Networks: A German Case Study on Informational Campaigning and Responsible Implementation*, 17 Sustainability Science 2269-85 (2022), doi: 10.1007/s11625-022-01105-2.
205. European Commission, *supra* note 80.
206. Treich, *supra* note 21, at 27.
207. Pieper, Michalke & Gaugler, *supra* note 98. Recall that most of the literature on true cost pricing refers to food in general, whereas I mostly focus on meat, given the importance of meat production in the emission of greenhouse gases.
208. Judith van Erp et al. (eds.), *Smart Mixes for Transboundary Environmental Harm* (2019).
209. Mytton, Clarke & Rayner, *supra* note 162.
210. Treich, *supra* note 21.
211. Springmann et al., *supra* note 100; Springmann et al., *supra* note 22.
212. See again for the choice between output or consumption taxes Wirsenius, Hedenus & Mohlin, *supra* note 125.

advocates a combination of (some) regulation of production technology at the level of livestock producers in combination with a meat tax.[213]

The same is finally true also as far as nudging is concerned. The way in which the nudges are presented in the literature is not as the sole instrument that would lead to healthy and sustainable meat consumption, but rather as a useful, low cost and easy to implement instrument in addition to other regulatory and market-based instruments.[214]

As a result, the question is not which is the one and only instrument that could optimally internalize the social costs of meat production and consumption; the question is rather which combination of regulatory and other instruments might be employed to reach this particular goal. Thereby it is obviously of crucial importance to pay attention to an optimal interaction between the different instruments to guarantee that one has, in the words of Peeters, an instrument mix and not an instrument mess.[215]

It is, however, striking that the literature agrees that currently meat prices do not reflect social costs, that the current regulation is also not achieving that aim and that the best way (in addition to other instruments) to achieve this goal is the introduction of a meat tax. As meat production and consumption is an important contributor to climate change, the question arises of how these insights can be incorporated in the climate change regime and why that has apparently not been done until now.

IV. Implementation of Meat Production and Consumption in the Climate Change Regime

After having sketched the various options to regulate meat production, we will now analyze how this could be implemented in the international climate change regime. First, I stress that it is important to include producers (A) and to face specific challenges in implementing a meat tax (B). The question obviously arises at which level of governance such a tax should be advocated whereby I strongly argue in favor of an introduction at at least a regional (for example European) level, but preferably even at the international level (C). The problem is, however, that until recently (2023) the effects of meat on climate change were not discussed at the COPs (D). This was, not surprisingly, the result of effective lobbying by the meat industry (E).

A. Likelihood of a Meat Tax

One thing should be clear from the analysis so far: meat production and consumption cause substantial externalities and crucially contribute to an important extent to climate change. The social costs of meat production are today to a large extent unaddressed. That is striking if one compares it for example to greenhouse gas emissions resulting from electricity production and transport, which have been subject to detailed discussions and incorporation in the climate change regime.[216] As a result, no matter which of the many instruments presented in the previous section one would choose, it is clear that one way or another the greenhouse gas emissions related to meat production should be accounted for.

213. Funke et al., *supra* note 83, at 234. And see equally Verschuuren (2022), *supra* note 20, at 250 who equally advocates a smart instrument mix.
214. See Ferrari et al., *supra* note 192: "We propose that green nudges should not be meant to replace stricter environmental and food policies, but rather they should be regarded as potential complements to be implemented with the aim of gradually moving society in a direction that might benefit all".
215. Marjan Peeters, *Instrument Mix or Instrument Mess? The Administrative Complexity of the EU Legislative Package for Climate Change*, *in* EU Environmental Legislation 173-92 (Marjan Peeters & Rosa Uylenburg eds., 2014).
216. Funke et al., *supra* note 83, at 233.

Obviously, an important point, as mentioned earlier,[217] is to get both the meat producers on board[218] and to get support from the general public.[219] Without those, the political price for introducing instruments to regulate meat production and consumption, more particularly a meat tax, may simply be too high. Producers might be convinced as a consumption tax on meat applies both to domestic and imported products (and thus it does not cause competitive distortions),[220] taxes also create additional revenue that can be used to finance the transition of farmers to more healthy and sustainable food production practices.[221] The literature equally mentions ways of increasing the acceptability among the public at large, a simple one being to call it a levy, rather than a tax.[222] Policy packaging may also increase support for meat taxation, for example combining meat taxes with animal welfare standards, discounts on vegetarian meals and information campaigns.[223]

B. Challenges in Implementation

Traditionally, public choice scholars have indicated that industry will be heavily opposed against taxation (more particularly emission taxes to abate pollution). The reason is that polluters prefer standards as those can be used to create barriers to market entry by introducing so-called grandfather clauses,[224] thus raising profits for incumbents by creating barriers to market entry. Taxes (for example on emissions) have from industries' perspective the disadvantage that they raise costs for all without any distinction (thus not allowing the creation of barriers to market entry). That is the reason why Nobel Prize Winner James Buchanan and Gordon Tullock argued that emission taxes have never been introduced in the textbook form in the US: effective lobbying and opposition by industry is the main reason.[225] That problem should, however, not necessarily affect the meat tax. Even though a meat tax (on consumption) may obviously also affect producers (as a result of reduced demand) the opposition should not necessarily be as high if the facilitating measures mentioned above could be implemented. Note, however, that these distributional issues are important to be addressed to facilitate implementation. However, that does not mean that the meat tax "in the tax book form" should not be implemented. It simply implies that the revenues should be used in a smart way, e.g. to compensate small farmers who would be disproportionally disadvantaged through the imposition of the tax or to finance countervailing measures for vulnerable consumer groups who may be disproportionally affected by the tax.

A difficulty in the implementation of the meat tax, mentioned in the EAT-Lancet Report is that for the global food system clear scientific targets do not exist (as is the case for emission targets for CO_2 from industry).[226] Still, they propose the planetary boundaries framework as providing scientific targets that could be viewed as guides for decision-makers on acceptable levels of risk for human health and environmentally sustainable food production.[227] These scientific targets could subsequently be reached

217. See *supra* III D 4.
218. Funke et al., *supra* note 83, at 234.
219. Funke et al., *supra* note 83, at 234-235.
220. Funke et al., *supra* note 83, at 234.
221. Ibidem.
222. David Klenert et al., *Making Carbon Prices Work for Citizens*, 8(8) Nature Climate Change 669-77 (2018).
223. Lukas Fesenfeld et al., *Policy Packaging Can Make Food System Transformation Feasible*, 1(3) Nature Food 173-82 (2020).
224. A grandfather clause implies that new (and often more stringent) regulation will only be applied to newcomers on the market and not to incumbent firms (the grandfathers). See for an application in the environmental area the seminal article by Michael T. Maloney & Robert E. McCormick, *A Positive Theory of Environmental Quality Regulation*, 25(1) The Journal of Law and Economics 99-123 (1982).
225. James Buchanan & Gordon Tullock, *Polluters' Profits and Political Response: Direct Controls versus Taxes*, 65(1) American Economic Review 139-47 (1975).
226. Willett et al., *supra* note 15, at 5.
227. Willett et al., *supra* note 15, at 5-6.

by applying the true cost pricing method discussed in section 2 and through the meat tax discussed in section 3.

C. Multilevel Governance

The question then, however, arises at what level of governance this should be implemented. The example of Denmark shows that if just one country were to introduce a meat tax, there is always a risk of substitution if consumers could relatively easily buy the same products cheaper (without the tax) in the neighboring countries. That is exactly what happened in the case of Denmark. It reduces the effectiveness (and even usefulness) of the tax if paying the tax can simply be avoided by purchasing in neighboring countries. This leads to the phenomenon of carbon leakage, as a result of which the reduced emissions in Denmark would lead to more emissions in the countries where the Danes would subsequently purchase their meat (in this case Sweden and Germany).

These types of negative trading effects might always emerge when pricing policies are only applied nationally.[228] There is also a danger of a distortion of competition as producers in the country where the meat tax applies would see a reduction of their sales occurring. In fact, this corresponds with a classic argument in the economics of federalism that when cross-border externalities occur, it makes sense to move decision-making to a higher level of governance, in this case the EU.[229]

As indicated by Verschuuren, today at EU level a variety of instruments is focused on farmers. Some are command and control instruments (such as standards in permits prescribing the use of a particular technology) or subsidies provided to farmers who transfer to a sustainable production technology.[230] The EU has no specific competence to introduce forms of indirect taxation; it is therefore doubtful that the EU could introduce a meat tax.[231] However, an analysis by Bähr showed that the introduction of a meat tax would be compatible both with international as well as with EU law.[232] Ignoring the climate change effects of livestock production could even be considered a violation of the polluter-pays-principle.[233]

Verschuuren suggests that even where the EU might not have the competence to mandate Member States to introduce a meat tax, there may be reasons for the EU to regulate some cooperation, precisely to avoid the type of cross-border purchases that happened in the case of Denmark.[234] Moreover, one could even argue that climate change is a typical example of a cross-border externality that obviously also goes beyond the borders of the EU, which would be a strong argument in favor of action at the international level.[235]

Climate change policy is of course also implemented at the level of the Member States. According to the Paris Agreement Member States have the obligation to determine nationally determined contributions (NDCs). For the case of the EU, the determination of the NDCs is done by the EU together with the Member States as a result of which there are no separate NDCs per Member State. It is inter alia contained in the so-called Fit for 55 package, a set of Proposals to revise and update EU legislation

228. Broeks et al., *supra* note 171, at 9.
229. Roger Van den Bergh, *Subsidiarity as an Economic Demarcation Principle and the Emergence of European Private Law*, 5(2) Maastricht Journal of European and Comparative Law 129-52 (1998).
230. For an overview see Verschuuren, *supra* note 20, at 6.
231. So Verschuuren, *supra* note 20, at 13.
232. Bähr, *supra* note 20, at 153-179.
233. So Amtul Chowdhury & Mohammad B. Hossain, *Role of Environmental Law and International Conventions in Mitigating Climate Change Effects on Food System and Livestock Production*, 8(2) Lex Publica 14-28 (2021), doi: 10.58829/lp.8.2.2021.14-28.
234. Verschuuren, *supra* note 20, at 13-14.
235. Transboundary externalities have always been a major justification for centralization or rule-making. See Richard Revesz, Rehabilitating Interstate Competition: Rethinking the Race-for-the-Bottom Rationale for Federal Environmental Regulation, 67 New York University Law Review 1210-54 (1992).

to reduce the net greenhouse gas emissions by at least 55% by 2030. Food system emissions have been integrated into the nationally determined contributions of the various parties to the Paris Agreement.[236] However, in a recent analysis by the FAO it was shown that the current NDCs address only around 40% of the greenhouse gas emissions related to agrifood systems. More particularly emissions by livestock are largely neglected with 66% of those being unaddressed. The FAO argues that without closing these gaps, achieving global temperature targets will be nearly impossible.[237] The NDCs of most countries in fact largely ignore the effects of animal-source food production and consumption on global warming. According to Moreira, no NDC from the G20 countries had addressed the issue,[238] as a result of which she argues that ignoring the livestock sector from the NDCs leads to a real probability that the main goal of the Paris Agreement will not be achieved.[239] This is supported by a Science article published by Clark et al. who equally argue that ignoring global food emissions could preclude achieving the targets of the Paris Agreement.[240]

Obviously, the idea that at the international level a meat tax would be mandated might be illusory,[241] but the least one could argue is that at the international level the effects of greenhouse gas emissions resulting from meat production should equally be on the agenda.[242] Moreover, if the EU Member States were to introduce a meat tax, Verschuuren rightly argues that in that particular case the EU might have to introduce a carbon border adjustment measure (i.e. imposing a tax on meat coming from outside the EU that does not reflect through prices). Such a mechanism would be needed to avoid the import within the EU of cheap meat products that would reduce the effectiveness of a meat tax within the EU.[243] That shows that the precise implementation of a pricing mechanism for meat within the multi-level governance framework of the international level, the EU and the Member States is still a point of attention that definitely merits further research.[244]

D. Meat at the COPs

The question also arises of whether, if not through a meat tax, but at least the topic of emissions related to meat, has been on the agenda in the various COP meetings. In fact, food production and consumption has not been a major topic at any of the COPs until COP28 (2023) in Dubai. Agriculture was mentioned at COP3 in 1997 (via the Kyoto Protocol) which recognized sources of emissions from agriculture, including enteric fermentation, manure management, rice cultivation and agricultural residues, but that was basically all. Food security was introduced as a potential area of risk under climate change at COP5 in Bonn (1999) and agriculture was mentioned as a source of climate change in 2006 at COP12 in

236. COP28 UAE, Letter to Parties (<www.cop28.com/en/letter-to-parties>).
237. Krystal Crumpler et al., *Agrifood Systems in Nationally Determined Contributions: Global Analysis – Key Findings* (2024).
238. Moreira Campos Lima, *supra* note 20, at 5.
239. Which equally leads to the question whether this can lead to responsibility of the countries concerned under international law, so Moreira Campos Lima, *supra* note 20, at 6-14.
240. Michael A. Clark et al., *Global Food System Emissions Could Preclude Achieving the 1.5° and 2°C Climate Change Targets*, 370 (6517) Science 705-8 (2020). See equally Verschuuren (2022), *supra* note 20, at 246 who equally argues that in order to achieve the Paris Agreement goals, a sharp reduction of agricultural emissions is necessary.
241. See further on international taxation and environmental protection, Alice Pirlot, *International Taxation and Environmental Protection*, *in* Research Handbook on International Taxation 258-77 (Yariv Brauner, ed., 2020).
242. The introduction of an environmental tax in an international legal instrument is also not completely illusory. For example within the framework of the negotiations on a global plastics treaty, a so-called polymer premium has been proposed, which in fact is a fee on plastic pollution (for details, see Luisa Cortat, *How to Incorporate the Polymer Premium into the Global Plastics Treaty* (2024).
243. Verschuuren, *supra* note 20, at 14.
244. See Hervé Guyomard et al., *Review: Why and How to Regulate Animal Production and Consumption: The Case of the European Union*, 1:100283 Animal (2021).

Nairobi, but again without further action.[245] At COP21 (where the Paris Agreement emerged) there were discussions on the environmental impact of agriculture, but these topics were largely overshadowed by the importance of the emissions from the energy and industrial sectors. Agriculture was also mentioned at COP23 in Bonn as well as at COP26 (2021) in Glasgow (where the importance of meat production in climate discussions was acknowledged) and at COP27 in Sharm El Sheikh (2022) (where livestock management and its relation to emissions was explicitly mentioned).[246]

The first COP where food production was explicitly discussed with a plan of action was COP28 that took place in Dubai (2023). It was even called "The first food COP".[247] In Dubai a declaration was accepted on sustainable agriculture, resilient food systems and climate action, signed by 159 countries.[248] The declaration urges measures to adapt food systems in response to climate change and aims to tackle various topics relating to agriculture and food production, also by outlining concrete strategies and commitments. In addition to several other concrete strategies, the declaration suggests reducing greenhouse gas emissions and restoring land and natural ecosystems, enhancing soil health and biodiversity and shifting towards more sustainable production and consumption practices.[249] Nations are expected to integrate agriculture and food systems into their climate action plans and strategies, more particularly into their nationally determined contributions (NDCs) within the framework of the Paris Agreement, but also in other long-term strategies and national biodiversity strategies and action plans.[250]

E. Effective Lobbying

It is as such striking that such an important sector (as far as greenhouse gas emissions is concerned) has been able to remain largely out of the picture until COP28. The reason is obviously that lobby groups and several states representing meat interests have successfully managed to delay the inclusion of meat production in the COP agendas throughout the years. The relative success of the meat sector should as such not come as a surprise. The agricultural sector in general has been very successful in obtaining subsidies in the EU via the common agricultural policy.[251] Political economy and more particularly the work of Mancur Olson has indicated that lobbying by interest groups will especially be successful when the information costs for the public at large are high and when the transaction costs for the lobby group concerned are relatively low.[252] The effects of meat production and consumption are undoubtedly a topic of high information costs for the public at large. The behavioral research (discussed supra at 3.5) indicated that for consumers it is, as a result of a variety of behavioral biases, often difficult to assess the negative consequences of bad eating habits for one's own health, let alone for the planet. In that respect, it is not difficult to argue that the information costs for the public at large (to realize the

245. Danush Dinesh et al., *Has Process Hijacked Purpose? Outlook on Food Systems Transformation in the Global Climate Change Processes*, 53(2) Outlook on Agriculture 98-105 (2024).
246. Ibidem.
247. Benjamin Ferrer, *World's first "Food COP": Agri-food systems finally tabled as "the climate solution," but can pledges be implemented?,* 15 December 2023, <www.foodingredientsfirst. com/ news/worlds-first-food-cop-agri-food-systems-finally-tabled-as-the-climate-solution-but-can-pledges-be-implemented. html>.
248. COP28 UAE, Letter to Parties, <www.cop28.com/en/letter-to-parties.>
249. COP28 (2023) COP28 UAE Declaration on sustainable agriculture, resilient food systems, and climate action, <www.cop28.com/en/food-and-agriculture>.
250. Ibidem.
251. Empirical research has indicated that the direct payment distributions under the Common Agricultural Policy are badly targeted in the sense that they benefit less to the most environmentally friendly farms. So Alessandra Kirsch, Jean-Christophe Kroll & Aurélie Trouvé, *Aides directes et environnement. La politique agricole commune en question*, 359 Économie Rurale 121-39 (2017).
252. Mancur Olson, *The Logic of Collective Action* (1971).

consequences of greenhouse gas emissions by meat production) are high. Transaction costs for the lobby group will be low when they are single-issue-oriented and well-organized.

At the global level there are groups representing "big meat" that indeed meet those conditions, more particularly the North-American Meat Institute (NAMI) and the Global Meat Alliance (GMA). They have played an important role (via meat producing countries such as the US, Australia and Brazil) to oppose the inclusion of measures against meat production in the COPs.[253] Even during COP28, the lobby groups have sent a large number of participants and were actively spreading positive messages about meat, framing meat as essential for global nutrition.[254] The absence of explicit mentions of meat production until COP28 in 2023 provides evidence of the success of the well-organized meat industry.[255] However, one could question what changed in 2023 so that the countries participating in COP28 agreed to sign the declaration on sustainable agriculture, resilient food systems and climate action. Several things have changed in the sense that NGOs and scientific bodies have increasingly provided evidence of the effects of meat production and consumption on climate change. In terms of the conditions of Olson: these reports and NGO actions lowered the information costs for the public at large and thus increased the lobbying costs for special interest groups.

The efforts of NGOs and intergovernmental panels (like the IPCC) could also fit into an alternative framework concerning the emergence of regulation presented by Gary Becker. According to Becker, there will de facto often be various groups competing for political power.[256] In his view, the creation of regulation is rather the outcome of a competitive process whereby NGOs and experts may provide a countervailing power against lobbying by special interest groups representing industry. To the extent that that framework would apply, the outcome of the lobbying would (as a result of the competition between various interest groups) be closer to the optimum.

Before COP28, public awareness of the environmental impact of meat production was indeed increased by reports from advocacy organizations. Several environmental activists had a large social media influence arguing that the mass animal extinction must be prevented. Moreover, reports from well-recognized bodies such as the IPCC (but also other scientific bodies such the EAT-Lancet Commission and the FAO) all highlighted that there is a growing scientific consensus concerning the role of meat production in greenhouse gas emissions, particularly via methane.[257] For example, the director of the Institute for Climate, Energy and Disaster Solutions of the Australian National University, Mark Howden, argued publicly that it is of utmost importance to reduce methane emissions by 30% by 2030 and by half or more in the longer term.[258] Moreover, reports from investigative journalists, both from the Guardian and DeSmog, showed how the "big meat" industry engaged in public relations campaigns to change the narrative around meat production and its impact on climate change. In other words, the change that occurred at Dubai in 2023 might well be explained by the public choice framework as well. Indeed, in line with Becker it could be argued that the increased attention on effects of livestock on greenhouse gas emissions and the increasing pressure from NGOs could have provided a counterweight in the struggle for political power which might explain the decision at COP28 in Dubai in 2023.

Some observers, however, warn that notwithstanding the declaration that was accepted at COP28 in Dubai, there is no reason to be overly optimistic concerning its concrete implementation as several

253. Rachel Sherrington, *Big Meat Unveils Battle Plans for COP28*, DeSmog, 29 November 2023, <www.desmog.com/2023/11/29/big-meat-unveils-battle-plans-for-cop28/>.
254. Ibidem.
255. Ibidem.
256. Gary Becker, *A Theory of Competition among Pressure Groups for Political Influence*, Quarterly Journal of Economics 371-400 (1983).
257. Sherrington, *supra* note 253.
258. Andrew Green, *The Debate over Meat at COP 28, Explained*, 6 December 2023, <www.devex.com/news/the-debate-over-meat-at-cop-28-explained-106690>.

months after the declaration there was no clear indication of any substantial outcomes.[259] COP29 (taking place in Baku) in 2024 did not further address the inclusion of concrete measures to address meat production and consumption, even though there were suggestions to implement an emission pricing mechanism in agrifood systems from NGOs.[260]

Industry lobbying can undoubtedly continue to play a role for example in preventing the concrete implementation of the declaration on sustainable agriculture accepted at COP28 in Dubai, but more generally, also opposing the introduction of any of the instruments presented in section 3 and more particularly the meat tax. At the international level, the influence of especially the large meat industry has been well-documented.[261] Large companies such as JBS and Tyson Foods focus on preventing steps towards including the meat production in the climate change discussions. These major companies also relied on a public relations firm Red Flag in an attempt to provide a good image and reputation of the industry.[262] One of the efforts of these lobbying activities is to demonstrate how meat production can be a solution for "healthy people and a healthy planet".[263] And the lobbying continued at COP29 with lobbyists taking part in official national delegations,[264] successfully lobbying against stricter environmental regulations.[265]

These lobbying efforts all fit into the theoretical frameworks presented by Olson and Becker, but also make clear that it may be challenging to achieve the Great Food Transformation which is, inter alia according to the EAT-Lancet Commission, urgently needed. Also other literature points at the importance of the lobbying by the meat industry which will undoubtedly always focus on achieving low production costs and favorable regulation.[266] It has been well-documented that, also for historical reasons, farmers' interests have always had a higher political weight than for example interests of urban residents.[267] Specifically as far as the introduction of a meat tax is concerned, some stress that introducing new instruments will undoubtedly face strong resistance from livestock farmers.[268] It is for that reason that, as explained above (section 3.4), it is important to introduce countervailing measures to keep the meat producers on board. The ideal scenario would obviously be that the producers would be part of the great food transformation, for example by being (financially) incentivized (via the proceeds of the meat tax) to transform towards plant-based production methods.

259. Dhanush Dinesh, *The Great COP Food Systems Illusion: UN Climate Talks Deliver no Real-world Action*, Climate Home News, 3 June 2024, <www.climatechangenews.com/2024/06/03/the-great-cop-food-systems-illusion-un-climate-talks-deliver-no-real-world-action/>.
260. True Animal Protein Price Coalition, *100+ NGOs join forces with Equatorial Guinea, Nigeria, the DRC, and Uganda and Urge Global Action on Meat Consumption ahead of COP29,* 15 October 2024, <www.tappcoalition.eu/nieuws/22741/50%2B-ngos-urge-global-action-on-meat-consumption-and-climate-change-ahead-of-cop29>.
261. The political power of the livestock sector has been qualified as "enormous", as a result of which the meat industry has been successful in blocking green alternatives. See Moreira Campos Lima, *supra* note 20, at 4 and Simona Vallone & Eric F. Lambin, *Public Policies and Vested Interests Preserve the Animal Farming Status Quo at the Expense of Animal Products Analog*, 6(9) One Earth 1213-26 (2023).
262. Sherrington, *supra* note 253.
263. Anay Mridul, *'Music to Our Ears': Meat Lobby Celebrates 'Positive Outcomes' for Industry at COP28*, GREEN QUEEN, 12 April 2024, <www.greenqueen.com.hk/meat-dairy-lobby-cop28-livestock-food-agriculture/>.
264. Andrew N. Rowan, *COP29 Selected Dynamics and Context in Baku, Azerbaijan*,6(10) WellBeing News Article 3 (2024), <www.wellbeingintlstudiesrepository.org/wbn/vol6/iss10/3>.
265. Rachel Sherrington, *Hundreds of Lobbyists for Industrial Farming Attend COP29 Climate Summit*, 19 November 2024, <www.theguardian.com/environment/2024/nov/19/hundreds-of-lobbyists-for-industrial-farming-attend-cop29-climate-summit>.
266. Treich, *supra* note 21, at 30.
267. Ibidem.
268. Funke et al., *supra* note 83, at 234.

Still, this case is yet another one where one can observe why in environmental policy efficient instruments and solutions are often not adopted and inefficient solutions persist.[269] Given the important weight of the meat industry and their lobbying efforts, there is no reason for great optimism concerning a rapid introduction of instruments implementing the Great Food Transformation and more particularly the inclusion of meat production in the climate change regime. Yet, it is equally important to remember the positive lessons from the public choice literature: lobbying efforts can be made less effective by increased transparency (reducing information costs for the public at large) and by organising an effective counterweight against industry lobbying by NGOs (to provide competition in the lobbying process).[270]

V. LIMITS

The overview of the consequences of meat production presented in section 2 made clear that livestock production leads to a wide variety of different types of externalities. My main focus was on the effects of livestock production for the climate change regime. But if one takes the goal of closing the gap between market prices and true costs of food[271] seriously one should address all those other elements as well, even though they may be more difficult to calculate. The FAO indicates that livestock production not only causes greenhouse gas emissions, but also pollution. But, moreover, the land use change related to livestock production also create an important impact on biodiversity.[272]

The calculations of the optimal meat tax do usually take the first elements (greenhouse gas emissions and pollution) into account, but not (always) the second (biodiversity loss).[273] In addition, section 2 equally referred to air pollution by ammonia, water scarcity,[274] and health effects. So far, animal welfare is also hardly considered as an element of the externalities caused by meat production. There is, however, increasing interest, also from economists, in the question how animal welfare can be assessed in economic terms and therefore incorporated in the decision-making.[275]

In addition, it should be recalled that the central economic argument, that prices should reflect true costs, should obviously not only apply to meat, but to other elements of food that equally have strong impacts on greenhouse gas emissions. Moreover, as this text one-sidedly only focuses on the agricultural sector (as that was the one that was so far largely left out of the climate change regime), one could wrongly infer from that that there is no other sector where a problem of lacking internalization emerges. The contrary is of course true. The different reports on true cost accounting and the website of True Cost make perfectly clear that there is a wide variety of sectors where true costs are not correctly

269. This is the case in many other domains of environmental policy as well. A notable example is the nuclear sector. Already before my coming to Maastricht (in 1990) I showed that nuclear liability is arranged in a totally inefficient manner which only serves the interests of the nuclear industry (Michael Faure & Roger Van den Bergh, *Liability for Nuclear Accidents in Belgium from an Interest Group Perspective*, 10 International Review of Law and Economics 241-54 (1990)). That has, after 35 years, unfortunately not changed.
270. There is evidence that environmental NGOs exert a statistically significant impact on air pollution levels measured by concentrations of sulphur dioxide, smoke and heavy particulates (Seth Binder & Eric Neumayer, *Environmental Pressure Group Strengths and Air Pollution: An Empirical Analysis*, 55 Ecological Economics 527-38 (2005)).
271. As indicated by Pieper, Michalke & Gaugler, *supra* note 98.
272. FAO, *supra* note 24, at 180-214.
273. Springmann et al., *supra* note 100, at 41-50.
274. See Hedberg, *supra* note 43.
275. Treich, *supra* note 21, at 20-24; Espinosa & Treich, *supra* note 21; Budolfson et al., *supra* note 89. See for an interesting metareview of consumer willingness to pay for farm animal welfare, Carl-Johan Largerkvist & Sebastian Hess, *A Meta-analysis of Consumer Willingness to Pay for Farm Animal Welfare*, 38(1) European Review of Agricultural Economics 55-78 (2011). and see generally on animal rights the contributions in Cass R. Sunstein & Martha C. Nussbaum (eds.), *Animal Rights. Current Debates and New Directions* (2004).

incorporated into prices. Recall the report discussed in section 2 indicating that none of the world's top industries would be profitable if they paid for the natural capital they use.[276] That text does mention that there is a problem with cattle ranching, wheat and rice farming, but with coal power generation as well. In that respect, I can also refer to the World Bank Report mentioning that farming subsidies cause "environmental havoc", but they mentioned the same about the fossil fuel industry as well.[277]

The report by True Cost with a ranking of the 20 region-sectors with the greatest GHG costs lists 8 other sectors (mostly related to coal power generation, petroleum and natural gas extraction as well as cement factoring) before coming to cattle farming.[278] And one should not necessarily stay within the environmental, energy or agricultural area to look for uninternalized externalities. One should not forget that there is now increasing evidence that also the digitalization process leads to huge social costs that are not always correctly internalized. A recent paper delved into the social costs created by blockchain where it was argued that externalities through blockchain are not inherently eliminated and creates a variety of complex social costs.[279] There is equally a problem with the electricity consumption from data centers, artificial intelligence (AI) and crypto currency. Those will together use almost 2% of global electricity demand. The expectations are that this will only increase as the following figure shows:

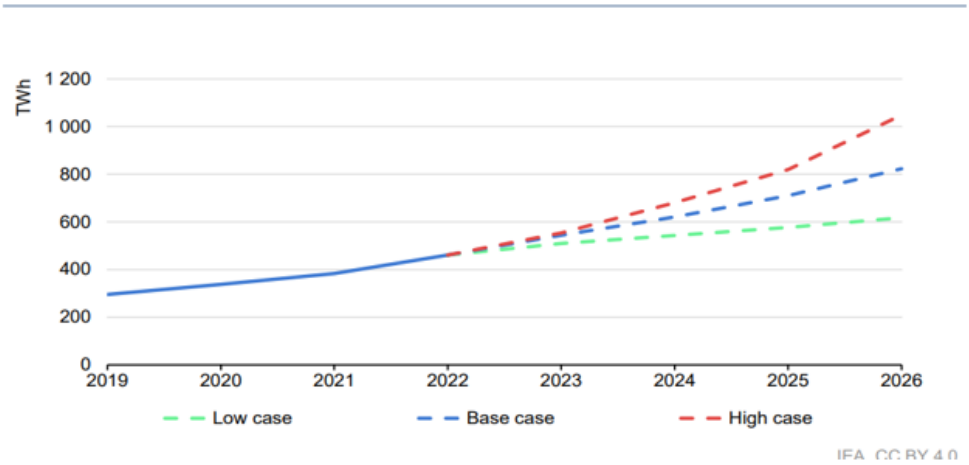

Figure 10: Global electricity demand from data centers, AI, and cryptocurrencies, 2019-2026[280]

It is estimated that the data centers on which artificial intelligence (AI) relies are already now liable for 1% of total CO_2 emissions according to the International Energy Agency. Moreover, AI uses enormous quantities of drinking water for cooling. For Microsoft, the carbon emissions went up 30% compared to 2020 to support AI services and Google mentioned even an increase of 48%.[281] It is therefore crucial that policy not only focuses on agriculture, but on an internalization of externalities from all sources including AI, crypto currency and similar strange phenomena.

276. <https://grist.org/business-technology/none-of-the-worlds-top-industries-would-be-profitable-if-they - paid-for-the-natural-capital-they-use/>.
277. <https://amp-theguardian-com.cdn.ampproject.org/c/s/amp.theguardian.com/environment/2023/jun/ 15/vast- fossil- fuel-and-farming-subsidies-causing-environmental-havoc-world-bank>.
278. Trucost, *supra* note 92, at 38.
279. Edoardo D. Martino & Wolf-Georg Ringe, *The Social Cost on Blockchain. Externalities, Allocation of Property Rights and the Role of Law*, Hamburg University Working Papers (2024), No. 80, <https://ssrn.com/abstract=4821063>.
280. <https://iea.blob.core.windows.net/assets/6b2fd954-2017-408e-bf08-952fdd62118a/Electricity2024-Analysisandforecastto2026.pdf>.
281. <www.bloomberg.com/news/newsletters/2024-07-11/big-tech-s-climate-goals-at-risk-from-massive-ai-energy-demands>.

There are, however, in addition to changing diets, also other methods to reduce emissions; all those provide more benefits than even completely moving to a plant-based diet.[282] Moreover, I mostly focused on classic economic instruments, such as regulation and taxation, in other words on the "sticks" to reduce meat consumption. But the elephant in the room materializes since today no sticks are employed but rather carrots to subsidize food production. The problem thereby is today that the subsidies are not structured in such a way that they primarily focus on the most ecological production facilities. An ecological redesign of the subsidy system could therefore also generate substantive benefits, which is a point that undoubtedly merits further research.

VI. CONCLUDING REMARKS

Summarizing, in light of the title of this article, it can be argued that the price of meat should increase in order to achieve a true cost pricing. Thereby the gap between the current price and the externalities caused by meat production, more particular for climate change, could be closed. The bottom line is that the consequences of meat production and consumption should be taken into account at the policy level and more particularly in the international climate change regime. The policy goal to be achieved is a correct pricing of meat (closing the gap between the market price and the true costs of meat). A variety of instruments could reach that goal. Ideally they could equally reach the co-benefit of reducing greenhouse gas emissions and health costs related to meat consumption.

Although a variety of instruments were reviewed, that could be employed to reach those goals, the most effective one from an economic perspective seems to be the introduction of a tax on meat consumption. However, this could be part of a smart mix of different instruments since the meat tax could be combined with other instruments such as behavioral policy instruments as well as instruments aiming at the regulation of production.

Fortunately, at the COP28 in Dubai (2023), important steps were set to include meat production in climate change policy, but effective lobbying prevented further implementation of the declaration on sustainable agriculture, resilient food systems and climate action. Given the important contribution of food systems and more particularly meat production to greenhouse gas emissions, the incorporation of instruments aiming at the reduction of those emissions within the international climate change regime, seems unavoidable. Even stronger: it is very likely that if the effects of food systems and more particularly meat production would not be incorporated in the NDCs of the various states, the goals of the Paris Agreement could probably not be reached. It is therefore of utmost importance that agreements to that extent are reached at the next COPs and that the effects of food, and more particularly meat production, are adequately incorporated by the state parties, more particularly within their NDCs.

282. Seth Wynes & Kimberly A. Nicholas, *The Climate Mitigation Gap: Education and Government Recommendations Miss the Most Effective Individual Actions*, 12 Environmental Research Letters 074024 (2017), doi: 10.1088/1748-9326/aa7541.