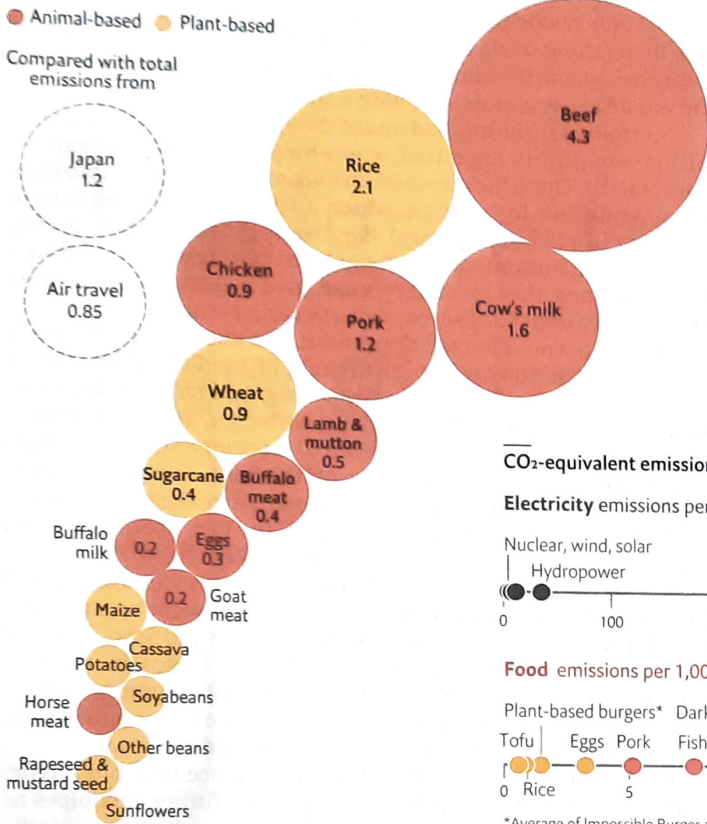
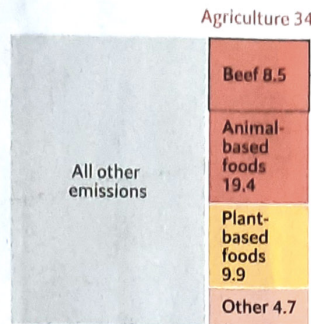


→ Agriculture causes a surprisingly large share of greenhouse-gas emissions, and beef is the worst offender

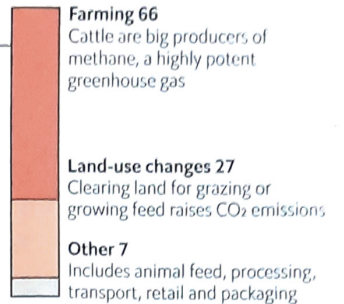
Annual emissions from animal- and plant-based foods
CO₂-equivalent gigatonnes from ten biggest sources, 2010



Share of global emissions
2015, %

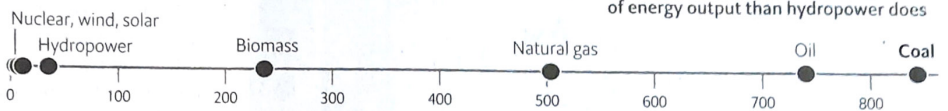


Emissions from beef production
By type, %

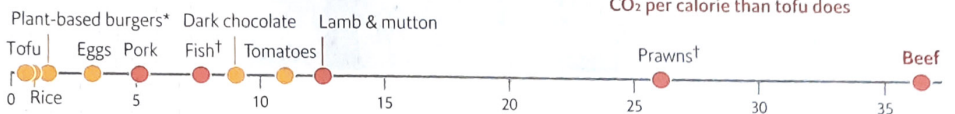


CO₂-equivalent emissions per unit of energy production

Electricity emissions per gigawatt-hour, tonnes



Food emissions per 1,000 kcal, kg



*Average of Impossible Burger and Beyond Burger †Farmed Sources: "Food systems are responsible for a third of global anthropogenic GHG emissions", by Crippa et al., 2021; "Global greenhouse-gas emissions from animal-based foods are twice those of plant-based foods", by Xu et al., 2021; Heller et al., 2018; J. Poore, & T. Nemecek, 2018; Pehl et al., 2017; Quantis; The World Resources Institute; IPCC; Our World in Data

The beef with beef

Treating cattle like coal would make a big dent in greenhouse-gas emissions

FEW DISHES whet more palates than a juicy cut of beef. One poll in 2014 found that steak was Americans' favourite food. Unfortunately, by cooking so many cows, humans are cooking themselves, too.

The impact of food on greenhouse-gas (GHG) emissions can slip under the radar. In a survey in Britain last year, the share of respondents saying that "producing plants and meat on farms" was a "significant contributor" to climate change was the lowest among ten listed activities. Yet two papers published this year in *Nature Food* find that food, especially beef, creates more GHGs than previously thought. Forgoing steaks may be one of the most efficient ways to reduce your carbon footprint.

In 2019 the UN's Intergovernmental Panel on Climate Change estimated that the global food system was responsible for 21-37% of GHG emissions. This March re-

searchers from the European Commission and the UN's Food and Agriculture Office released a study with a central estimate near the top of this range. It attributed 34% of GHGs produced in 2015 to food.

This elevated share stems in part from accounting choices. The paper assigns the full impact of deforestation to the agriculture that results from it; includes emissions after food is sold (such as from waste and cooking); and counts non-food crops like cotton. But even when the authors excluded embedded emissions from sources like transport and packaging, they still found that agriculture generated 24% of GHGs. According to the World Resources Institute, a research group, cars, trains, ships and planes produce a total of 16%.

Another recent paper, by Xiaoming Xu of the University of Illinois at Urbana-Champaign and eight co-authors, allocates this impact among 171 crops and 16 animal products. It finds that animal-based foods account for 57% of agricultural GHGs, versus 29% for food from plants. Beef and cow's milk alone made up 34%. Combined with the earlier study's results, this implies that cattle produce 12% of GHG emissions.

Relative to other food sources, beef is uniquely carbon-intensive. Because cattle

emit methane and need large pastures that are often created via deforestation, they produce seven times as many GHGs per calorie of meat as pigs do, and around 40% more than farmed prawns do. This makes beef a bigger outlier among foods than coal is among sources of electricity: burning coal generates just 14% more GHGs than burning oil, another common fuel.

These figures may understate the environmental benefits of shrinking the cattle population. Methane dissipates relatively fast, meaning that past bovine emissions soon stop warming the planet if those animals are not replaced. Such a change could also raise output of plant-based foods, by making land now used to grow animal feed available for other crops. It takes 33 plant calories to produce one calorie of beef.

The simplest way to cut beef output is for people to eat other animals instead, or become vegetarians. But convincing carnivores to give up their burgers is a tall order. Fortunately, lab-grown meats are moving from Petri dishes to high-end restaurants (see *Technology Quarterly*). Doing without beef from live cattle is hard to imagine, but the same was true of coal 100 years ago. Cultured meat could play an essential role in staving off a climate catastrophe. ■