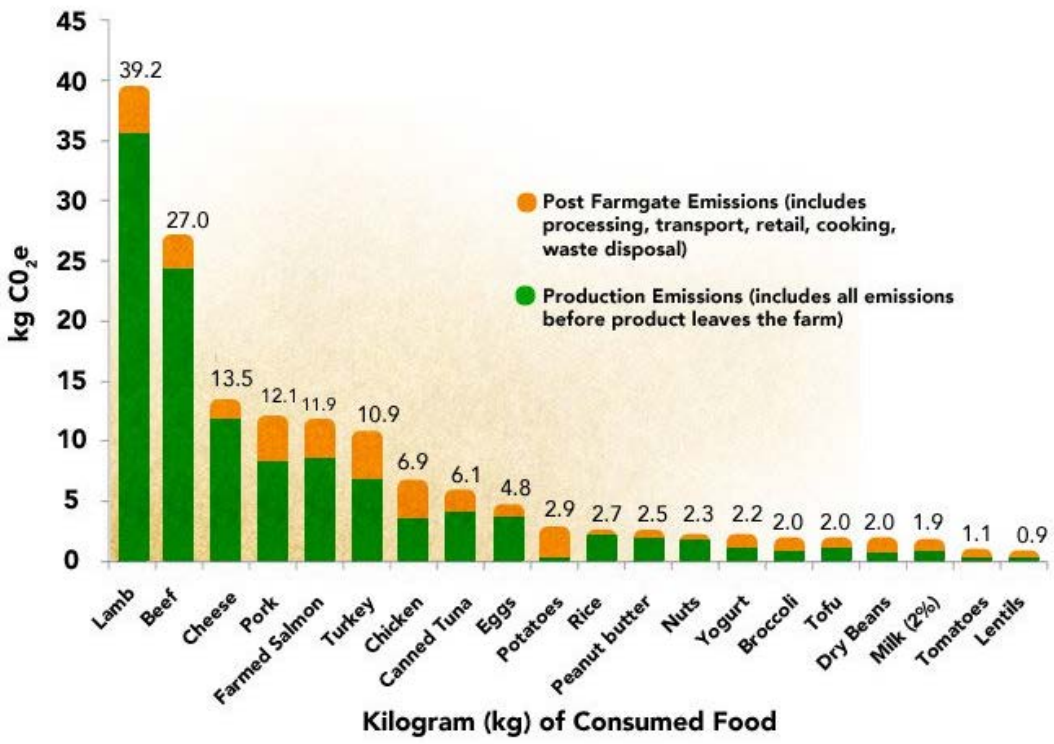
Climate and Environmental Impacts

The chart below shows the lifecycle total of greenhouse gas emissions for common protein foods and vegetables, expressed as kilograms (kg) of carbon dioxide equivalents (CO_2e) per kg of consumed product. We compared our production emissions data for the main meat proteins to several mostly peer-reviewed or government-sponsored studies in the U.S. and Europe that assessed greenhouse gas emissions from animal production systems. Only a handful of other studies showed lower emissions, and these were within 25 percent of EWG's figures, indicating that our results may be conservative.

Figure 1. Full Lifecycle Greenhouse Gas Emissions from Common Proteins and Vegetables



Key Findings from the Lifecycle Assessments:

Lamb, beef and cheese have the highest emissions. This is true, in part, because they come from ruminant animals that constantly generate methane through their digestive process, called enteric fermentation. Methane (CH_4) – a greenhouse gas 25 times more (CH_4) potent than carbon dioxide (CO_2), accounts for nearly half the emissions generated in this study's Nebraska beef production model **(see chart below)**. Pound for pound, ruminants also require significantly more energy-intensive feed and generate more manure than pork or chicken **(see figure 2)**.

- Lamb has the greatest impact, generating 39.3 kg (86.4 lbs) of carbon dioxide equivalents (CO_2e) for each kilo eaten – about 50 percent more than beef. While beef and lamb generate comparable amounts of methane and

require similar quantities of feed, lamb generates more emissions per kilo in part because it produces less edible meat relative to the sheep's live weight. Since just one percent of the meat consumed by Americans is lamb, however, it contributes very little to overall U.S. greenhouse gas emissions.

- Beef has the second-highest emissions, generating 27.1 kilos (59.6 lbs) of CO_2e per kilo consumed. That's more than twice the emissions of pork, nearly four times that of chicken and more than 13 times that of vegetable proteins such as beans, lentils and tofu. About 30 percent of the meat consumed in America is beef.
- Cheese generates the third-highest emissions, 13.5 kilos (29.7 lbs) of CO_2e per kilo eaten, so vegetarians who eat a lot of dairy aren't off the hook. Less dense cheese (such as cottage) results in fewer greenhouse gases since it takes less milk to produce it.

How feed production and manure generate greenhouse gases and harm the environment

Feed production. Most U.S. livestock are fattened on fishmeal, corn, soybean meal and other grains. Grain production, in particular, requires significant quantities of fertilizer, fuel, pesticides, water and land. It takes 149 million acres of cropland, 76 million kilos (167 million lbs) of pesticides and 7.7 billion kilos (17 billion lbs) of nitrogen fertilizer to grow this feed. Fertilizer applied to soil generates nitrous oxide (N_20), which has 300 times the warming effect of carbon dioxide. Irrigation pumps, tractors and other farm equipment also release carbon dioxide, but in relatively small amounts. Pesticides and fertilizers often end up in runoff that pollutes rivers, groundwater and oceans. Feed crops are heavily subsidized by taxpayers through the federal Farm Bill, to the tune of $45 billion over the past 10 years. Fertilizer and pesticide production requires a significant amount of energy, but our model found that together they account for just 12 percent of the emissions from growing feed. The biggest impact is from the nitrous oxide emissions resulting from fertilizer application.

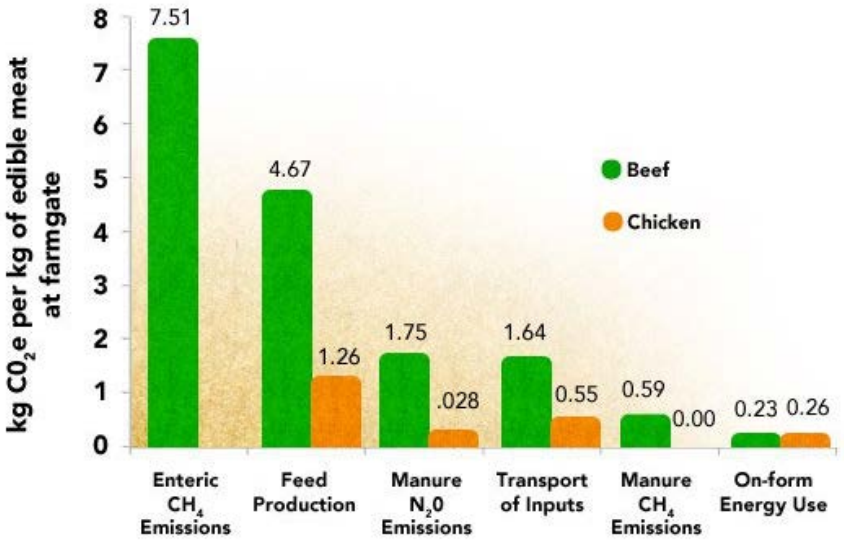
Manure: Animal waste releases nitrous dioxide and methane and pollutes our water and air, especially when it is concentrated. In 2007, U.S. livestock in confined feeding operations generated about 500 million tons of manure a year, three times the amount of human waste produced by the entire U.S. population (EPA 2007). Manure is the fastest growing major source of methane, up 60 percent from 1990 to 2008 (EPA 2010) . While manure is a valuable nutrient for plants, it can leach pollutants – including nitrogen, phosphorus, antibiotics and metals – into groundwater when storage facilities leak or too much is spread on farm fields. More than 34,000 miles of rivers and 216,000 acres of lakes and reservoirs in the U.S. have been degraded by waste from confined feeding operations (EPA 2009). Decomposing waste releases dust, smog odors and toxic gases, including ammonia and hydrogen sulfide, which degrade air quality and can cause itching, dizziness and discomfort to workers and nearby residents.

Most Emissions from Meat, Dairy and Fish Consumption Occur during Production

EWG's analysis found that 90 percent of beef's emissions, 69 percent of pork's, 72 percent of salmon's and 68 percent

of tuna's are generated in the production phase. In the case of beef and dairy, this is due to the high methane (CH_4) emissions from the ruminants' digestion and manure, as well as the nitrous oxide generated from growing feed. Chickens, in contrast, generate no methane and have far fewer emissions during production. In the case of farmed salmon, the primary emissions in the production phase come from feed. Emissions for farmed salmon are also high because consumers throw away a lot of what they buy. This means that a lot of additional salmon is produced for every pound that gets eaten.

Figure 2. Sources of Emissions from Beef and Chicken Production



- **Just half of chickens' emissions are generated during production.** That's because pound for pound, chickens require far less feed than hogs and beef or dairy cattle, and chickens generate no methane. However, chicken processing is more energy- and water-intensive than other meat processing.
- **Sources of greenhouse gases are different for farmed and wild fish.** Feed production dominates emissions from salmon farming, while diesel combustion from fishing boats accounts for most of the emissions from wild-caught fish, including salmon and tuna. Overall, canned tuna has lower emissions. This is partially due to the fact that tuna and other wild-caught fish live on food that they consume directly from the ocean, in contrast to farmed fish that are fed energy-intensive feed (such as sardines, menhaden, soybean meal and wheat) that must be grown and/or caught. Also, this analysis considered canned tuna vs. fresh (farmed) salmon, keeping tuna emissions lower because there is less waste and no cooking in the canning process.
- I**n contrast to meat, most of plant proteins' emissions are generated after crops leave the farm (processing, transport, cooking and waste disposal).** For example, post-farmgate emissions account for 65 percent of dry beans' total emissions and 59 percent of lentils', primarily because of the energy needed to cook them. Using a pressure cooker that cuts cooking time in half reduces beans' emissions by 25 percent. Ninety percent of potato emissions occur after the crop leaves the farm, primarily from cooking.

Figure 3. Beef: Most Emissions Come during Production

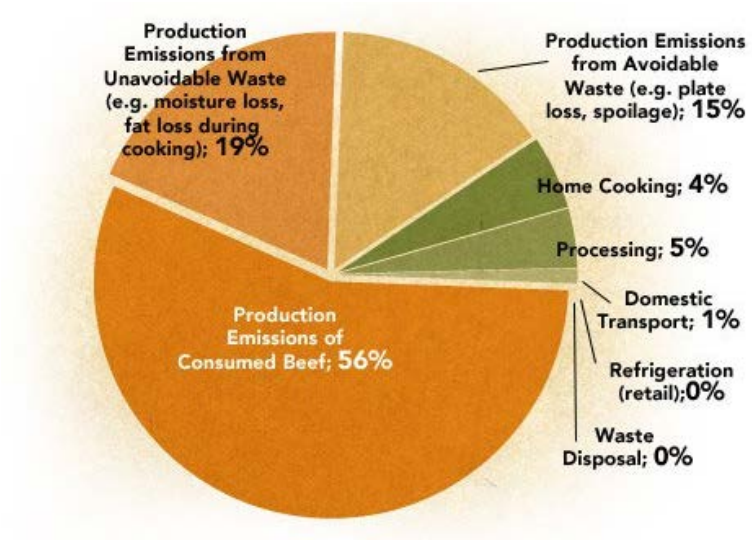
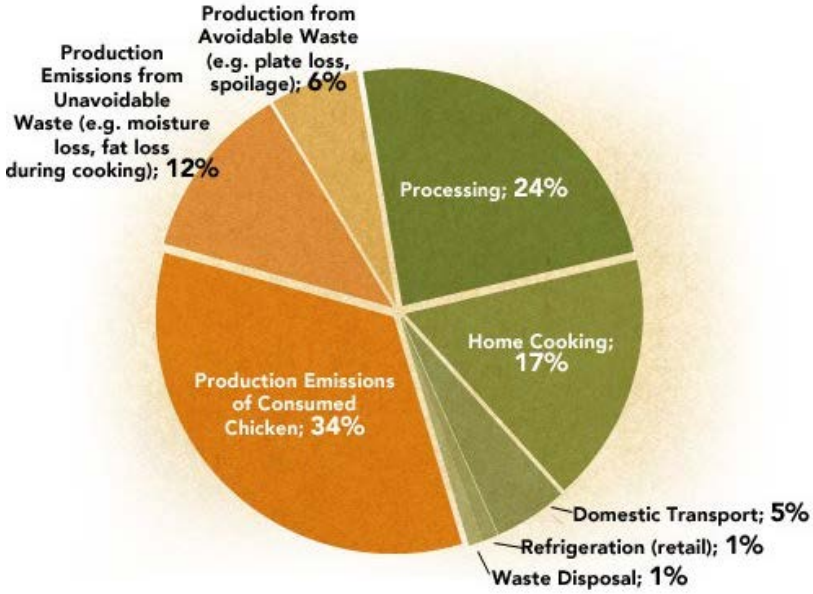


Figure 4. Chicken: Production and Post-Farmgate Emissions are Roughly Equal



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