CrossTalk

THE TOMATO'S ENERGY FOOTPRINT

THE WORLD'S FOOD SUPPLY is now unimaginable without the tomato, which although often called a vegetable is actually a fruit of the *Solanum lycopersicum* species, native to Central and South America. It gradually diffused through the world after 1500, finally becoming the world's largest "vegetable" crop, with recent harvests around 180 million metric tons a year, nearly twice that of dry onions, five times that of peppers, and more than six times that of cauliflower and broccoli. The tomato's versatility explains its rise: eaten unadorned when fully ripe, as part of countless salads, made into purees (Italian *passata*), soups and sauces, sliced, chopped, baked, fried, and dried.

Given about 90 days of warm weather, growing tomatoes in your garden isn't too hard. When cultivated in modern intensive ways, it requires fuels and electricity to make synthetic fertilizers and pesticides and to produce and power the machinery and supplementary irrigation. Field tomatoes need as little as 0.8 megajoule (about 190 kilocalories) per harvested kilogram. A typical tomato, bought at retail, weighs about 125 grams, of which 95 percent is water and most of the rest is carbohydrate and fiber. Its nutritional value lies in its vitamin C and A content. A tomato of that size contains only about 22 kcal (or 22 calories, in the

NUMBERS DON'T LIE BY VACLAV SMIL

PHOTOGRAPH BY Dan Saelinger

colloquial but incorrect usage that is common in the United States). That is just slightly less than the commercial energy, in fuel and electricity, that is needed to produce it. An energy economist might call them 1:1 tomatoes.

But, increasingly, store-bought tomatoes are grown not in fields but in greenhouses, usually hydroponically—without soil—either under glass or in long, plastic-covered tunnels. Here the energy cost of production is substantially higher. Direct energy inputs include electricity, gasoline, and diesel fuel; indirect energy costs involve the production of fertilizer (particularly nitrogen), pesticides, fungicides, and plastics and metals (not only for covers but also for cultivation troughs and copious pipes and heaters).

In the United States, tomato greenhouses are concentrated in California, Minnesota, and New York. The world's largest concentration of plastic greenhouses lies in the southernmost part of Spain's Almería province; you can see it on satellite images, and you can even move between some of them using dystopic Google street views.

A 125-gram tomato of Almería that is grown in an unheated plastic tunnel requires about 150 kcal; one grown in heated structures, about 560 kcal. It provides about 22 kcal of food energy, making the two kinds approximately 1:7 and 1:25 tomatoes. And with economies of scale favoring large-scale centralized production and long-distance shipping, the required storage, packing, and trucking to a regional distribution center raises the total energy cost to 460–875 kcal/125 g, raising the ratio to between 1:21 and 1:40. And because these tomatoes are grown in the relatively warm Mediterranean climate, they are far from being the world's most energy intensive: Tomatoes produced in heated greenhouses in many European countries require 40 to 150 times as much commercial energy input as they yield in edible food energy.

Perhaps the best way to convey the energy cost of a 1:60 tomato is to express it in equivalent terms, as tablespoons (each equal to 14.8 milliliters) of diesel fuel to be poured over a sliced tomato instead of the classic oil-and-vinegar dressing. For a 125-gram tomato it would come to 10 tablespoons. For a family-size salad, requiring a kilogram of those regularly sized greenhouse tomatoes (cluster of eight, still attached to a strong green vine), you'd incur an energy production cost equivalent to 80 tablespoons, or 5 cups of diesel fuel. This is a perfect illustration of how our food production and distribution depend heavily on substantial fuel and electricity inputs! ■

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U.S. SAYS TOMAY-TO, WORLD SAYS TOMAH-TO

This luscious fruit originated in the Americas, then transformed the culinary practices of the world. It requires warmth, light, and fertilizer, often from artificial sources, which is why each tomato on your plate represents a great investment of energy.