Energy in the Food System

- How to Feed the World – New York Times article
  - Read first 6 paragraphs

Supported by:

A serious problem

- According to statistics from the Food and Agriculture Organization of the United Nations, more than 800 million people are malnourished.

Supported by:

A solution?

- From the International Vegetarian Union website:

  "Much of the world's massive hunger problems could be solved by the reduction or elimination of meat-eating. The reasons: 1) livestock pasture needs cut drastically into land which could otherwise be used to grow food; 2) vast quantities of food which could feed humans is fed to livestock raised to produce meat."

Supported by:

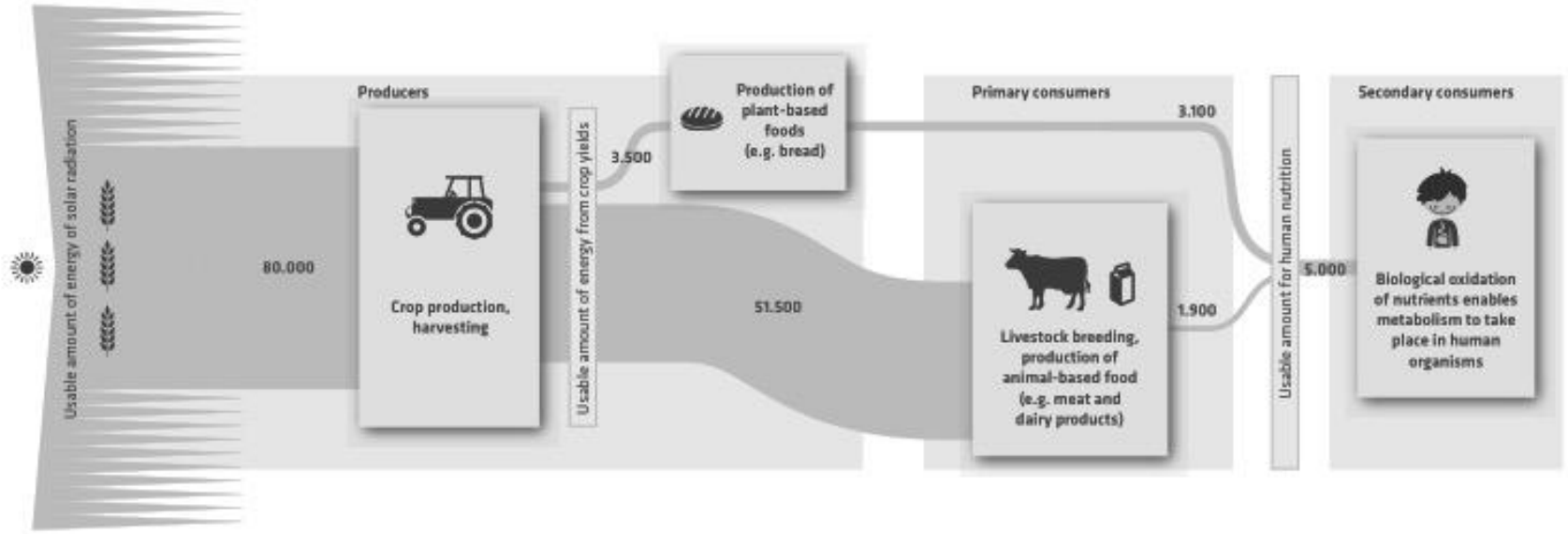
CASTeL PDST Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí DCU

So…

- Should we all go vegetarian?
- Let's look at the energy involved

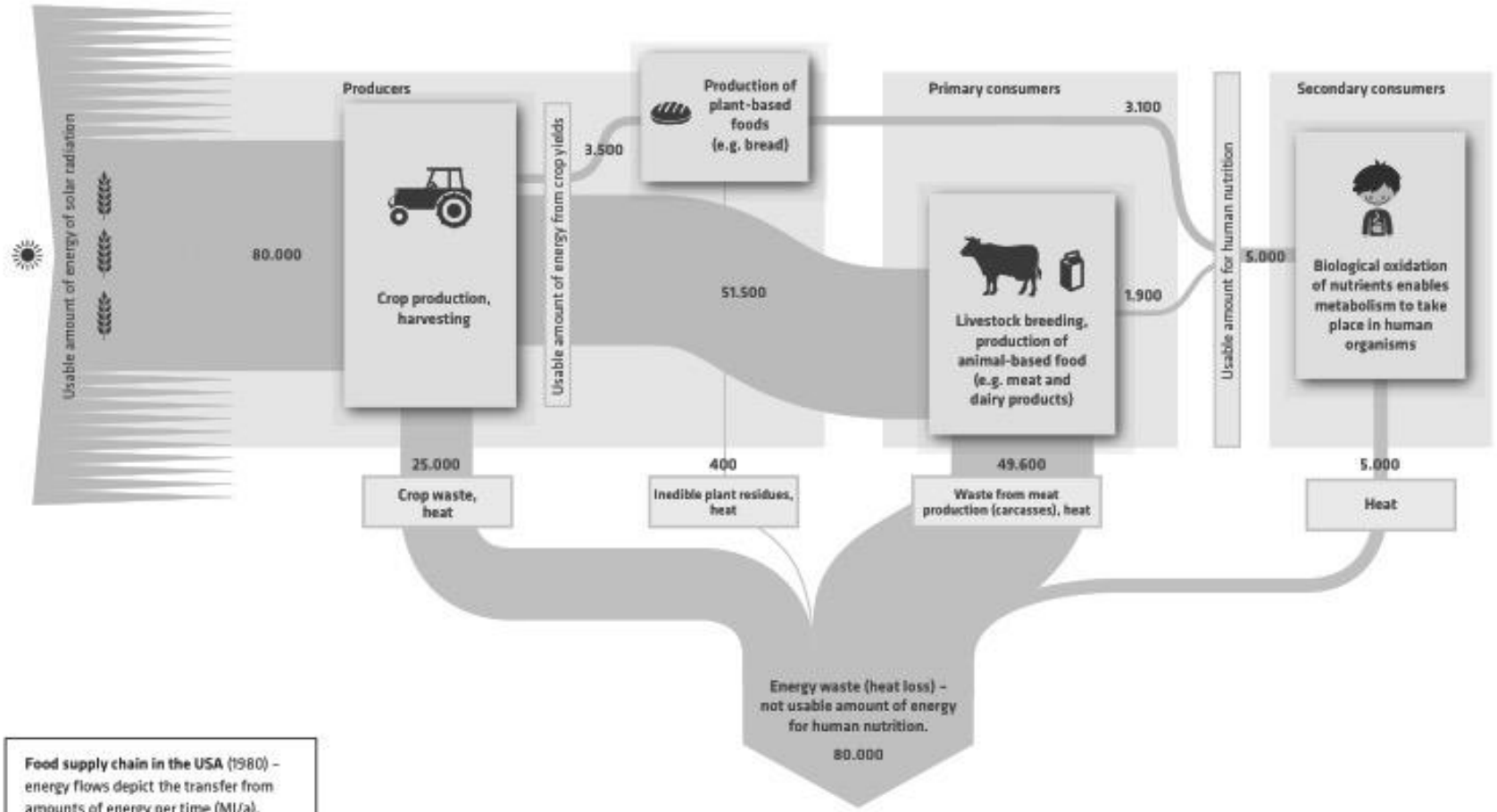
Supported by:

Energy in the U.S. food system



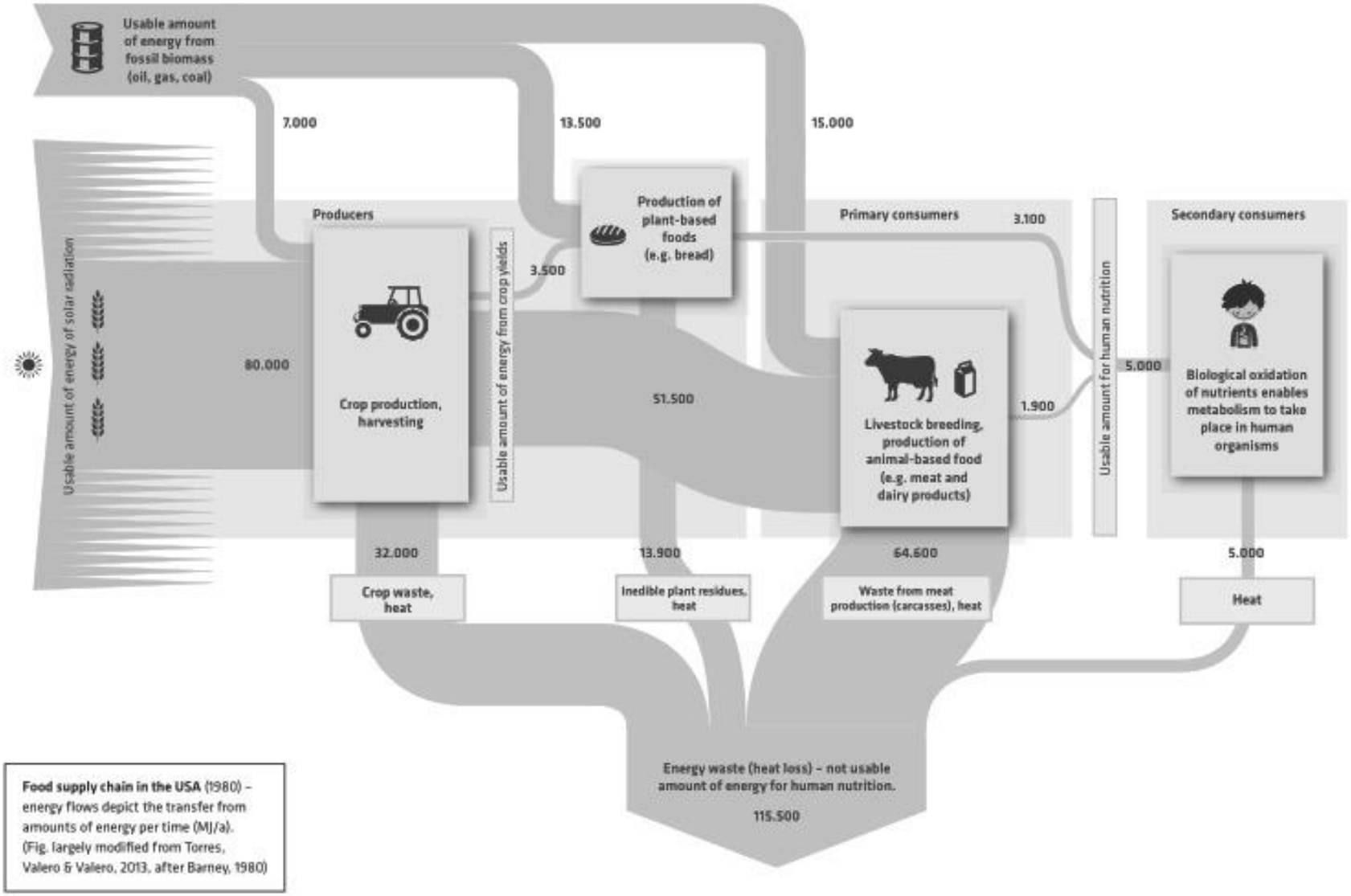
Food supply chain in the USA (1980) – energy flows depict the transfer from amounts of energy per time (MJ/a). (Fig. largely modified from Torres, Valero & Valero, 2013, after Barney, 1980)

Energy in the U.S. food system



Food supply chain in the USA (1980) – energy flows depict the transfer from amounts of energy per time (MJ/a). (Fig. largely modified from Torres, Valero & Valero, 2013, after Barney, 1980)

Energy in the U.S. food system



Food supply chain in the USA (1980) – energy flows depict the transfer from amounts of energy per time (MJ/a). (Fig. largely modified from Torres, Valero & Valero, 2013, after Barney, 1980)

What if…

- What if we went partly vegetarian?
  - Calculate the implications
- Can we:
  - Show these calculations
  - How can we use this in the classroom

Supported by:

Sample calculation

- Assume people need 5000 MJ/a
  - So what you don't get from meat you need to get from plants
- Assume proportionality
  - e.g. 3100 MJ of nutrition from plants requires 3500 MJ from crops and 13500 MJ from fossil fuel
  - then every 1 MJ of nutrition from plants requires 3500/3100 MJ from crops and 13500/3100 MJ from fossil fuel, etc.
  - Let's look at crops only to answer initial question

Supported by:

Meatless Monday

- Meatless Monday instead of meat 7 days/wk
  - Probably no need for other changes to diet
  - People get 6/7 of 1900 MJ = 1629 MJ from meat
  - Required from plants: 5000-1629=3371 MJ
- Assume proportionality
  - 1629 MJ of nutrition from plants requires 44143 MJ from crops, a saving of 7357 MJ
  - 3371 MJ of nutrition from plants requires 3806 MJ from crops, an additional 306 MJ

Supported by:

Food for the malnourished

- Saved: 7051 MJ on a total of 55000 MJ
  - Assume energy is proportional to yield
  - That's 13% of the yield/harvest freed up (though not all may be fit for human consumption)
  - Could feed 13% of 1980 US population (of 226 million)
  - So 29 million people could go from having no food to US levels of nutrition by going vegetarian 1 day a week.

Supported by:

CASTeL PDST Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí DCU

The next step

- Students have evidence and have modelled different situations
  - Let students write a letter requesting up-to-date info for Ireland or EU in which they argue why they need particular bits of data.
  - *Or:* link to demise of Irish sugar industry.
  - *Or:* re-read article from New York Times and respond
- Things that can be assessed
  - Strength of argument, use of data etc..

Supported by:

Possible discussion questions

- How much of our energy comes from plant-based foods?
- What fraction of our energy from food comes from plant-based foods?
- What fraction of energy from the sun used in agriculture do plant-based foods require?
- What do you think the width of the lines represents?
- Is there something to the arguments made by the IVU?
- This could be the start of a “Big Ideas” thing – arguments like “not enough nutrition”, etc.
- Do you think the energy flow chart is complete? Explain.

Supported by:

Energy in the Food System – Teacher notes

1. Setting the scene:

   - According to statistics from the Food and Agriculture Organization of the United Nations, more than 800 million people are malnourished.
   - From the International Vegetarian Union website:
     "*Much of the world's massive hunger problems could be solved by the reduction or elimination of meat-eating. The reasons: 1) livestock pasture needs cut drastically into land which could otherwise be used to grow food; 2) vast quantities of food which could feed humans is fed to livestock raised to produce meat.*"
     (http://www.ivu.org/religion/articles/argument3.html; retrieved 17/9/15).

   Question: should we all go vegetarian?

2. Give Energy Flow Chart ('Sankey Diagram") 1. No need for a big intro, can they figure it out?
   - How much of our energy comes from plant-based foods?
   - What fraction of our energy from food comes from plant-based foods?
   - What fraction of energy from the sun used in agriculture do plant-based foods require?
   - What do you think the width of the lines represents?
   - Is there something to the arguments made by the IVU?
   - This could be the start of a "Big Ideas" thing – arguments like "not enough nutrition", etc.
   - Do you think the energy flow chart is complete? Explain.

3. Where does (the rest of) the energy go? Give EFC2.

4. Do we need more energy than is accounted for? Give EFC3, get students to explain differences with EFC2. Intro to/link back to energy conservation.

5. What if we went partly vegetarian? Calculate the implications.
   - Allows for modeling and own decisions – e.g. one group might assume people nowadays eat meat 7 days a week and go to 6 ("Meatless Monday"); others may use different numbers.
   - Note: can calculate energy aspects, how much crop could be used to feed starving people, etc.

6. Let students write a letter requesting up-to-date info for Ireland or EU in which they argue why they need particular bits of data. *Or:* link to demise of Irish sugar industry. *Or:* read article from New York Times, assess.

The New York Times

October 14, 2013

How to Feed the World

By MARK BITTMAN

It's been 50 years since President John F. Kennedy spoke of ending world hunger, yet on the eve of World Food Day, Oct. 16, the situation remains dire. The question "How will we feed the world?" implies that we have no choice but to intensify industrial agriculture, with more high-tech seeds, chemicals and collateral damage. Yet there are other, better options.

Something approaching a billion people are hungry, a number that's been fairly stable for more than 50 years, although it has declined as a percentage of the total population.

"Feeding the world" might as well be a marketing slogan for Big Ag, a euphemism for "Let's ramp up sales," as if producing more cars would guarantee that everyone had one. But if it worked that way, surely the rate of hunger in the United States would not be the highest percentage of any developed nation, a rate closer to that of Indonesia than of Britain.

The world has long produced enough calories, around 2,700 per day per human, more than enough to meet the United Nations projection of a population of nine billion in 2050, up from the current seven billion. There are hungry people not because food is lacking, but because not all of those calories go to feed humans (a third go to feed animals, nearly 5 percent are used to produce biofuels, and as much as a third is wasted, all along the food chain).

The current system is neither environmentally nor economically sustainable, dependent as it is on fossil fuels and routinely resulting in environmental damage. It's geared to letting the half of the planet with money eat well while everyone else scrambles to eat as cheaply as possible.

While a billion people are hungry, about three billion people are not eating well, according to the United Nations Food and Agriculture Organization, if you count obese and overweight people alongside those with micronutrient deficiencies. Paradoxically, as increasing numbers of people can afford to eat well, food for the poor will become scarcer, because demand for animal products will surge, and they require more resources like grain to produce. A global population growth of less than 30 percent is projected to double the demand for animal products. But there is not the land, water or fertilizer — let alone the health care funding — for the world to consume Western levels of meat.

If we want to ensure that poor people eat and also do a better job than "modern" farming does at preserving the earth's health and productivity, we must stop assuming that the industrial model of food production and its accompanying disease-producing diet is both inevitable and desirable. I have dozens of friends and colleagues who say things like, "I hate industrial ag, but how will we feed the poor?"

Let's at last recognize that there are two food systems, one industrial and one of small landholders, or peasants if you prefer. The peasant system is not only here for good, it's arguably more efficient than the industrial model. According to the ETC Group, a research and advocacy organization based in Ottawa, the industrial food chain uses 70 percent of agricultural resources to provide 30 percent of the world's food, whereas what ETC calls "the peasant food web" produces the remaining 70 percent using only 30 percent of the resources.

Yes, it is true that high-yielding varieties of any major commercial monoculture crop will produce more per acre than peasant-bred varieties of the same crop. But by diversifying crops, mixing plants and animals, planting trees — which provide not only fruit but shelter for birds, shade, fertility through nutrient recycling, and more — small landholders can produce more food (and more kinds of food) with fewer resources and lower transportation costs (which means a lower carbon footprint), while providing greater food security, maintaining greater biodiversity, and even better withstanding the effects of climate change. (Not only that: their techniques have been demonstrated to be effective on larger-scale farms, even in the Corn Belt of the United States.) And all of this without the level of subsidies and other support that industrial agriculture has received in the last half-century, and despite the efforts of Big Ag to become even more dominant.

In fact if you define "productivity" not as pounds per acre but as the number of people fed per that same area, you find that the United States ranks behind both China and India (and indeed the world average), and roughly the same as Bangladesh, because so much of what we grow goes to animals and biofuels. (Regardless of how food is produced, delivered and consumed, waste remains at about one third.) Thus, as the ETC's research director, Kathy Jo Wetter, says, "It would be lunacy to hold that the current production paradigm based on multinational agribusiness is the only credible starting point for achieving food security." This is especially true given all of its downsides.

As Raj Patel, a fellow at the Institute for Food and Development Policy, puts it, "The playing field has been tilted against peasants for centuries, and they've still managed to feed more people than industrial agriculture. With the right kinds of agroecological training and the freedom to shape the food system on fair terms, it's a safe bet that they'll be able to feed themselves, and others as well."

Yet obviously not all poor people feed themselves well, because they lack the essentials: land, water, energy and nutrients. Often that's a result of cruel dictatorship (North Korea) or war, displacement and strife (the Horn of Africa, Haiti and many other places), or drought or other calamities. But it can also be an intentional and direct result of land and food speculation and land and water grabs, which make it impossible for peasants to remain in their home villages. (Governments of many developing countries may also act as agents for industrial agriculture, seeing peasant farming as "inefficient.")

The result is forced flight to cities, where peasants become poorly paid laborers, enter the cash market for (increasingly mass produced) food, and eat worse. (They're no longer "peasants," at this point, but more akin to the working poor of the United States, who also often cannot afford to eat well, though not to the point of starvation.) It's a formula for making not only hunger but

obesity: remove the ability to produce food, then remove the ability to pay for food, or replace it with only one choice: bad food.

It's not news that the poor need money and justice. If there's a bright side here, it's that the changes required to "fix" the problems created by "industrial agriculture" are perhaps more tractable than those created by inequality.

We might begin by ditching the narrow focus on yields (as Jonathan Foley, director of the Institute on the Environment at the University of Minnesota, says, "It's not 'grow baby grow' "), which seem to be ebbing naturally as land quality deteriorates and chemicals become less effective (despite high-tech "advances" like genetically engineered crops). Better, it would seem, would be to ask not how much food is produced, but how it's produced, for whom, at what price, cost and benefit.

We also need to see more investment in researching the benefits of traditional farming. Even though simple techniques like those mentioned above give measurably excellent results, because they're traditional — even ancient — "technologies," and because their benefits in profiting multinationals or international trade are limited, they've never received investment on the same scale as corporate agriculture. (It's impossible not to point out here that a similar situation exists between highly subsidized and damaging fossil fuels and oft-ignored yet environmentally friendly renewables.)

Instead, the money and energy (of all kinds) focused on boosting supply cannot be overstated. If equal resources were put into reducing waste — which aside from its obvious merits would vastly prevent the corresponding greenhouse gas emissions — questioning the value of animal products, reducing overconsumption (where "waste" becomes "waist"), actively promoting saner, less energy-consuming alternatives, and granting that peasants have the right to farm their traditional landholdings, we could not only ensure that people could feed themselves but also reduce agriculture's contribution to greenhouse gases, chronic disease and energy depletion.

This isn't about "organic" versus "modern." It's about supporting the system in which small producers make decisions based on their knowledge and experience of their farms in the landscape, as opposed to buying standardized technological fixes in a bag. Some people call this knowledge-based rather than energy-based agriculture, but obviously it takes plenty of energy; as it happens, much of that energy is human, which can be a good thing. Frances Moore Lappé, author of "Diet for a Small Planet," calls it "relational," and says, "Agroecology is not just healthy sustainable food production but the seed of a different way of relating to one another, and to the earth."

That may sound new age-y, but so be it; all kinds of questions and all kinds of theories are needed if we're going to produce food sustainably. Supporting, or at least not obstructing, peasant farming is one key factor, but the other is reining in Western-style monoculture and the standard American diet it creates.

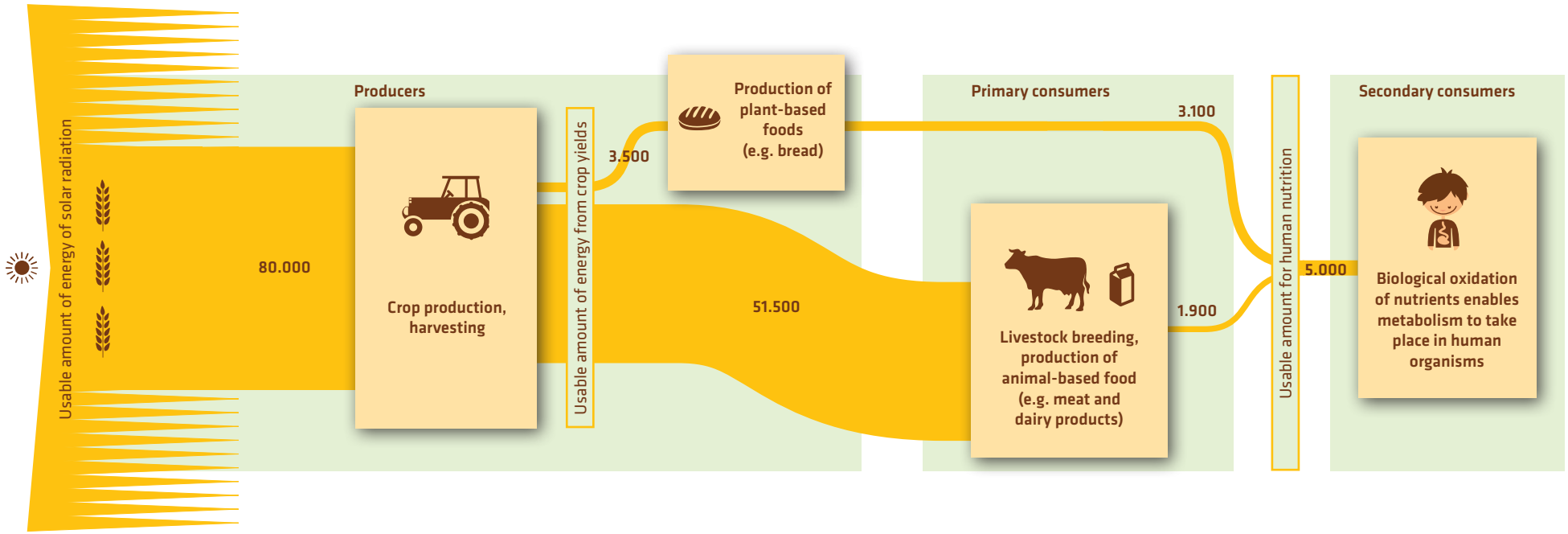
Some experts are at least marginally optimistic about the second half of this: "The trick is to find the sweet spot," says Mr. Foley of the University of Minnesota, "between better nutrition and

eating too much meat and junk. The optimistic view is to hope that the conversation about what's wrong with our diet may deflect some of this. Eating more meat is voluntary, and how the Chinese middle class winds up eating will determine a great deal." Of course, at the moment, that middle class shows every indication that it's moving in the wrong direction; China is the world's leading consumer of meat, a trend that isn't slowing.

But if the standard American diet represents the low point of eating, a question is whether the developing world, as it hurtles toward that nutritional nadir — the polar opposite of hunger, but almost as deadly — can see its destructive nature and pull out of the dive before its diet crashes. Because "solving" hunger by driving people into cities to take low-paying jobs so they can buy burgers and fries is hardly a desirable outcome.

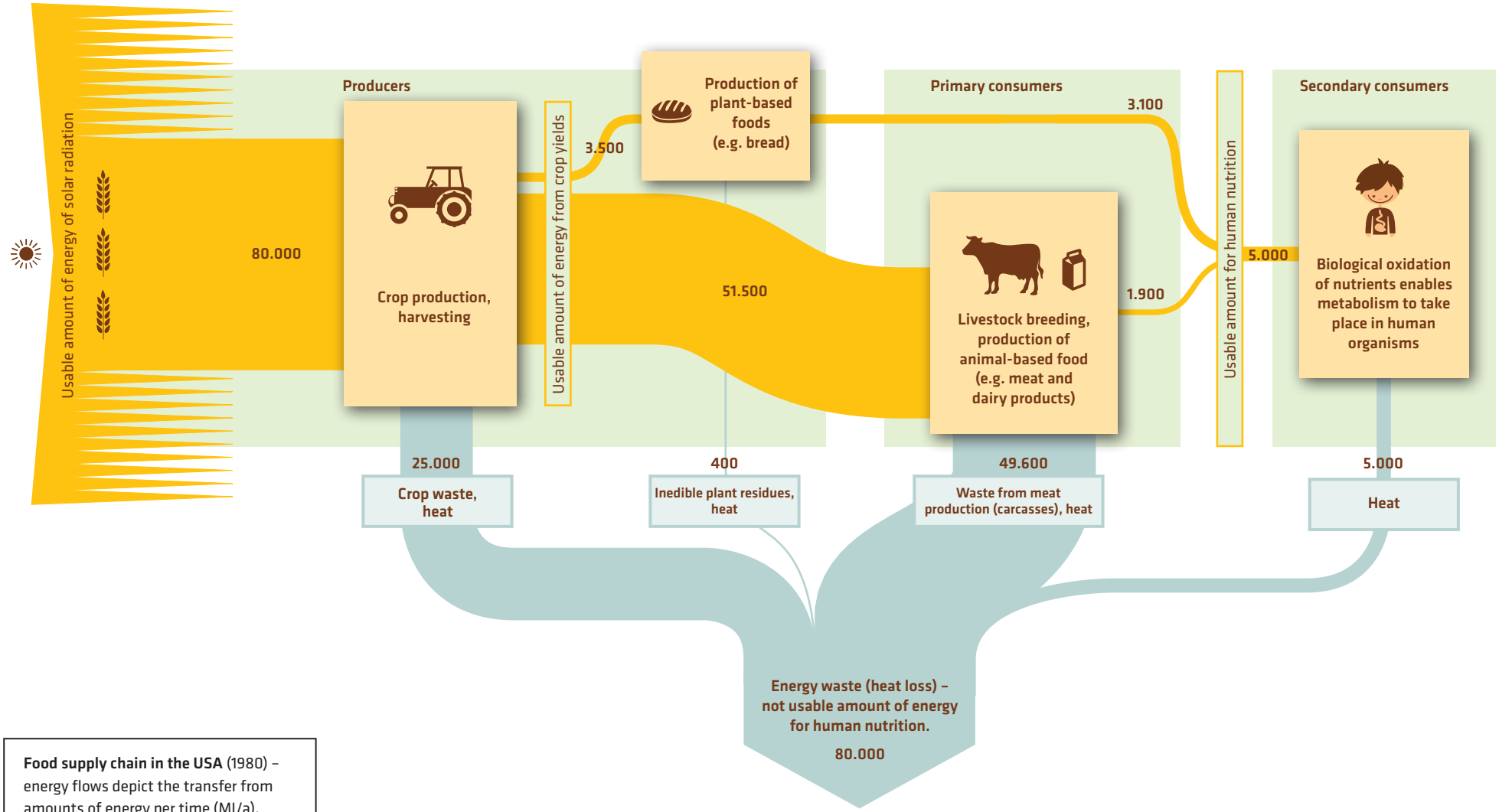
Mark Bittman *is a food journalist, author and contributing opinion writer for The New York Times.*

Energy in the U.S. food system



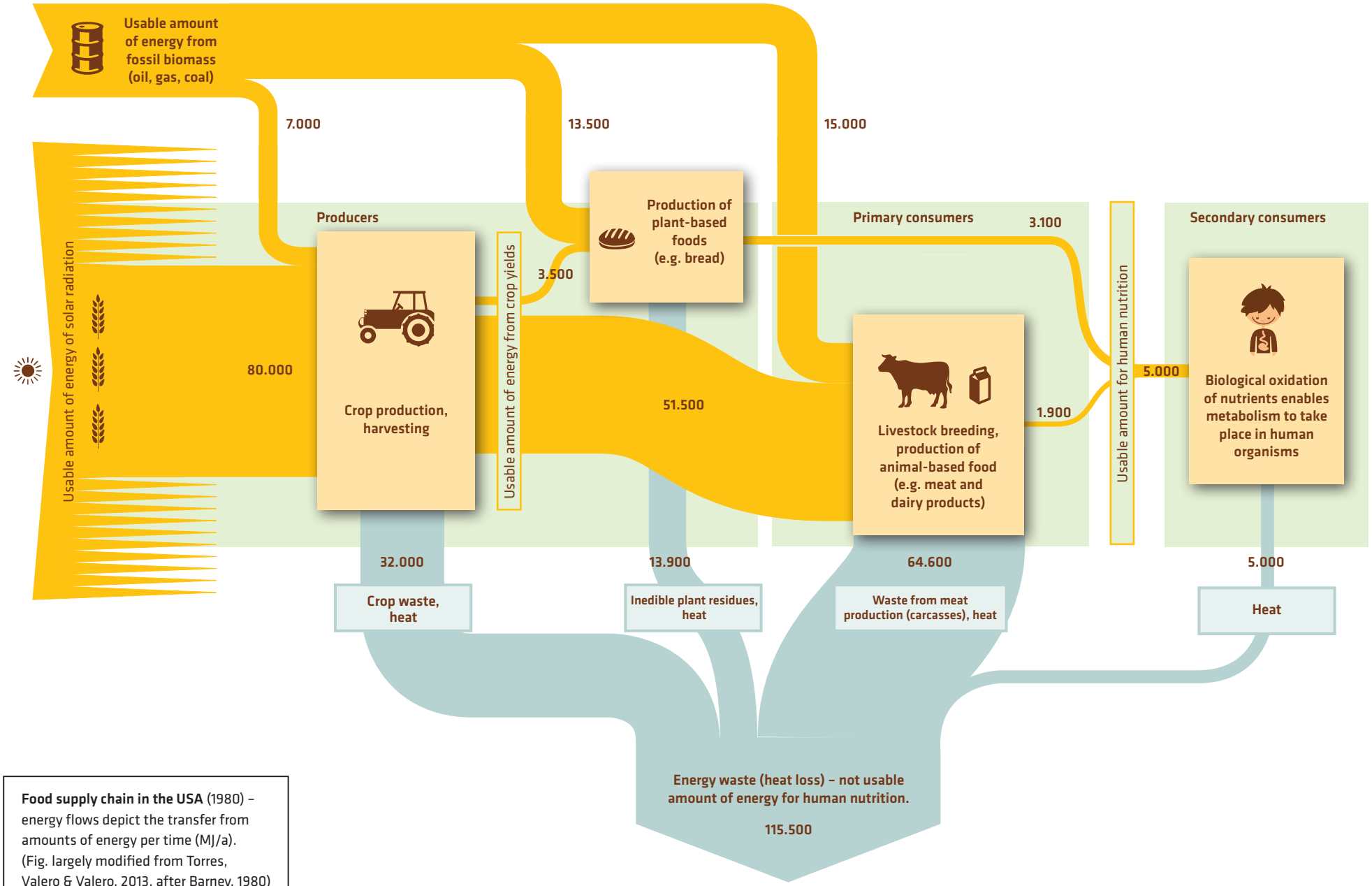
Food supply chain in the USA (1980) – energy flows depict the transfer from amounts of energy per time (MJ/a). (Fig. largely modified from Torres, Valero & Valero, 2013, after Barney, 1980)

Energy in the U.S. food system



Food supply chain in the USA (1980) – energy flows depict the transfer from amounts of energy per time (MJ/a). (Fig. largely modified from Torres, Valero & Valero, 2013, after Barney, 1980)

Energy in the U.S. food system



Food supply chain in the USA (1980) – energy flows depict the transfer from amounts of energy per time (MJ/a). (Fig. largely modified from Torres, Valero & Valero, 2013, after Barney, 1980)