Energy (In)Efficiency in the Local Food Movement: Food for Thought

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INTRODUCTION

“Eating local” is a growing trend in the American food system, with environmentalists and foodies alike advocating for shorter food transportation distances from farm to table (the average in the United States is about 1,500 miles). Not only have local food systems gained followers through farmer’s markets, locally sourced restaurants, and community supported agriculture (“CSA”) enterprises, but the locavore trend has begun to gain momentum on Capitol Hill as well: various federal and state programs support local food initiatives, the United States Department of Agriculture (the “USDA”) has published materials considering the impact of going local, and the Obamas have famously planted a vegetable garden in the White House lawn. There are many arguments in favor of eating locally grown food, ranging from improved

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1 “Terms such as “local food,” “local food system,” and “(re)localization” are often used interchangeably to refer to food produced near its point of consumption in relation to the modern or mainstream food system.” STEVE MARTINEZ ET AL., LOCAL FOOD SYSTEMS – CONCEPTS, IMPACTS, AND ISSUES, ECONOMIC RESEARCH REPORT NUMBER 97, 3 (May 2010). The meaning of “local” differs based on context, and can range from 100 miles (according to the New Oxford American Dictionary’s definition of “locavore”) to 400 miles (according to the 2008 Farm Act). Id. Other definitions include considerations of production methods, sustainability, the amount of processing, and the characteristics of the farmer or farm, id. at 3–4, but for the purposes of this Article, the term “local” will refer to the distance between place of origin and consumption.

2 David Pimentel et al., Reducing Energy Inputs in the US Food System, 36 HUMAN ECOLOGY 459, 467 (2008); RICH PIROG ET AL., LEOPOLD CENTER FOR SUSTAINABLE AGRICULTURE, FOOD, FUEL, AND FREeways: AN IOWA PERSPECTIVE ON HOW FAR FOOD TRAVELS, FUEL USAGE, AND GREENHOUSE GAS EMISSIONS 9 (June 2001).

3 See MARTINEZ ET AL., supra note 1, at 35–41.

4 Id.

health, to food security,\(^6\) to stronger rural economies. This Article will focus on one such claim, that eating locally grown foods can decrease the carbon footprint of food.\(^7\)

The term “food system” refers to the entire structure surrounding the food that we eat, including “the production, processing, distribution, sales, purchasing, preparation, consumption, and waste disposal pathways of food.”\(^8\) Intuitively, minimizing the distance that foods must travel seems like an appealing and obvious mechanism to decrease the fossil fuels used in the American food system. However, transport is a relatively small component of the overall energy use of the food system. Moreover, farmers who produce food for local consumption are likely to frequently ship small quantities of food over short distances using old pick-up trucks, which some suggest may be less fuel-efficient than shipping a huge quantity of food over a longer distance by rail. Thus, eating locally may not be the panacea that it has been made out to be. This Article will consider the eating local movement to explore whether it merits the federal and state support that it has received from a climate and energy perspective.

This Article will begin, in Part I, by exploring what “local food” really means to consumers and what, besides distance, is associated with eating local. Part II will then briefly review some of the programs that have been implemented in the United States to support local food movements. Part III will then consider two aspects of the energy associated with the food system: first, how the total amount of energy consumed by the food system—and thus the quantity of greenhouse gases (“GHG”) emitted—can be broken down into its various inputs to see what level of total impact eating local can have; and second, whether by choosing these local

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\(^6\) Food security refers to the availability of sufficient food for all people at all time support a healthy life. Martinez Et Al., supra note 1.

\(^7\) “The carbon footprint of a food item is the total amount of greenhouse gases (GHGs) emitted during its production, processing and retailing[.]”Gareth Edwards-Jones et al., Testing the Assertion that ‘Local Food is Best’: The Challenges of an Evidence-Based Approach, 19 Trends in Food Science & Technology 265, 266 (2008).

\(^8\) Pirog Et Al., supra note 2, at 3.
products, consumers are, in fact, reducing their overall carbon footprint. This Article concludes that eating local, whether by individual consumer choice or by concerted government policy, is unlikely to reduce GHG emissions on its own due to the many variables at play in the food system and its energy use. However, despite these difficulties, a well-tailored policy that takes into account more than just transport distance may have potential for reducing the hidden energy cost of food.

I. What does “Local” Mean?

Unlike organic, kosher, or vegan, “local food” has thus far escaped universal definition. “Food miles” has become the term used to describe how far a food travels from farm to point of sale, or from farm to fork, depending on the definition. At first glance, the geographic implications of the concept of local food are clear, but the boundaries between local and non-local food are far from apparent. As a starting matter, the definition of “local” changes based on population density and how close an area is to farmable land. The Institute of Grocery Distribution (the “IGD”) in the United Kingdom found that definitions of local depended on where the respondent resided: while the majority of respondents agreed that local food was produced within their county, Welsh and Scottish respondents defined local as from within Wales or Scotland, whereas respondents from the Greater London area were more likely than all others to include foods produced in adjoining counties as local as well. Likewise, in the United States, residents of a densely populated urban county in Washington were more likely to define

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9 MARTINEZ ET AL., supra note 1, at 3.
10 Pirog et al., supra note 2, at 9.
12 Some studies employ a “more sophisticated version [of food miles], which takes into account energy use and harmful emissions produced during transport,” Wynen & Vanzetti, supra note 11, at 10, but this Article will use the more straightforward definition, that considers specifically the distance travelled.
13 GERALDINE PADBURY, INSTITUTE OF GROCERY DISTRIBUTION, RETAIL AND FOODSERVICE OPPORTUNITIES FOR LOCAL FOOD 4 (March 2006).
the local market as their own or surrounding counties than those surveyed in a sparsely populated rural county.\textsuperscript{14}

Many have attempted to limit the definition of local food using a clear-cut mileage cutoff, but even then there is disagreement: The New Oxford American Dictionary defines the term “locavore” as someone who tries to eat only those foods grown within a 100-mile radius of their home,\textsuperscript{15} whereas the 2008 Farm Act uses 400 miles as the limit for eligibility to market a product as a “locally or regionally produced agricultural food product,”\textsuperscript{16} and a significant number of the consumers polled in the IGD survey, above, believed that local foods are produced within 30 miles from where they live or grocery-shop.\textsuperscript{17} Perhaps an easy designation in the United States would restrict local foods to those produced within the state, but this still would not correspond to most consumers’ perceptions of local food or work particularly well for towns at state borders.\textsuperscript{18}

In addition to the difficulty of defining local foods geographically, most consumers also make other less obvious but equally important associations with the term “local.” The IGD study found that 60\% of respondents associated local food with freshness, 24\% believed that it was better for the environment, 19\% thought local foods would taste better, and 17\% anticipated that local products would be more natural.\textsuperscript{19} In the American context, local foods are associated in consumers’ minds with types of production methods (such as organic or sustainable farming, fair labor practices, and animal welfare), particular characteristics of the producer (such as the personality of the grower and the “story” of the food), and a shorter food supply chain.\textsuperscript{20} While

\begin{footnotes}
\item[14] MARTINEZ ET AL., supra note 1, at 3.
\item[15] Id. (referring to the New Oxford American Dictionary definition).
\item[16] 7 U.S.C.S. § 1932 (g)(9)(a)(i) (LexisNexis 2011); MARTINEZ ET AL., supra note 1, at 3.
\item[17] PADBURY, supra note 13.
\item[18] MARTINEZ ET AL., supra note 1, at 3–4.
\item[19] PADBURY, supra note 13, at 19; see Edwards-Jones et al., supra note 7, at 265–66.
\item[20] MARTINEZ ET AL., supra note 1, at 4.
\end{footnotes}
all of these associations are undoubtedly important in general perceptions of the local food movement and in engendering support for it, this Article will limit the understanding of local food to its geographic implications, and will use the 400-mile radius definition from the 2008 Farm Act for further analysis. Moreover, while scholarship often differentiates between local and regional food systems, the distinction between the two is vitiated with the broad definition of local used in this Article, and thus the terms will be used interchangeably.

Local foods are distributed in a variety of ways. While some supermarkets and other large retail chains like Wal-Mart make local food available when such foods are in season,\textsuperscript{21} locally sourced foods seem to be marketed most often outside of the conventional supermarket supply chain. Local foods are marketed directly to consumers through farmer’s markets, community supported agriculture (“CSA”) boxes (which deliver produce from a local farm in crates or boxes to a specified pick-up location on a weekly basis), roadside farm stands, community gardens, and pick-your-own operations.\textsuperscript{22} These direct-to-consumer sales represent a small but growing segment of all U.S. agricultural sales of edible products, at approximately 0.8\% in 2007 (a 49\% increase from 2002).\textsuperscript{23} Local food sales are also increasing at the institutional level, with restaurants, health care facilities, and schools becoming interested in buying local (but with a considerable lack of support mechanisms).\textsuperscript{24} In particular, farm to school programs have been on the rise, with the number of such programs doubling from 2005 to 2009.\textsuperscript{25}

\begin{itemize}
\item \textsuperscript{22}MARTINEZ ET AL., supra note 1, at 4–10.
\item \textsuperscript{23}Id., at 5.
\item \textsuperscript{25}MARTINEZ ET AL., supra note 1, at 14.
\end{itemize}
With the definition of “local” restricted to refer to food produced within 400-miles of where it is sold, this Article will next briefly summarize some of the government programs that have been implemented to support local food supply chains and to provide assistance to food producers who will supply their products locally.

II. Government Support for Local Food Systems

Climate change, fuel consumption, and energy dependence have become hot topics in American policy and politics. President Obama emphasized the importance of clean energy, energy efficiency, and innovation in his 2010 and 2011 State of the Union Addresses,26 and has continued stressing the urgency of energy issues in other speeches since then.27 This trend of state and federal support for local food systems began long before President Obama’s inauguration, though.

Various local food programs have been created at the federal level through legislation and USDA mandates. While developed federally, many programs require state or local administration, and they often involve partnerships between the USDA and other federal or state agencies. As is apparent by their brief descriptions, below, these programs have been implemented not with environmental issues in mind, but rather as a mechanism to create economic opportunities and development. Some examples of such programs include:

- The U.S. Department of Defense (“DOD”) partnered with the USDA to use DOD’s excess trucking capacity in the Fresh Program, to procure locally grown produce for

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institutions, with an increasing preference to purchase produce from small and medium-sized farms.\textsuperscript{28}

- The Community Food Service Act, part of the Farm Act of 1996, established the Community Food Project Grants Program, a USDA program that awards grants to projects that aim to address food security issues through community based food projects in low-income communities.\textsuperscript{29}

- The Community Food Service Initiative, launched by the USDA in 1999, builds partnerships between the USDA and communities in an effort to “build local food systems, increase food access, and improve nutrition.”\textsuperscript{30}

- The Child Nutrition Reauthorization Bill of 2010 requires the USDA to assist schools participating in the National School Lunch or Breakfast Programs, through grants and technical assistance, to implement farm to school programs to improve access to local foods.\textsuperscript{31}

- The USDA Food and Nutrition Service administers the WIC Farmer’s Market Nutrition Program and the Senior Farmer’s Market Nutrition Program, which provide eligible individuals with coupons for farmer’s markets, CSA programs, and roadside stands. Congress appropriated $19.8 million for the WIC Farmer’s Market program in 2009,\textsuperscript{32} and in 2008, the grant provided to the Seniors program was set at $21.8 million.\textsuperscript{33}

\textsuperscript{28} MARTINEZ ET AL., supra note 1, at 35.
\textsuperscript{29} Id.
\textsuperscript{30} Id.
\textsuperscript{31} 42 U.S.C.S. § 1769(g) (LexisNexis 2011).
\textsuperscript{32} MARTINEZ ET AL., supra note 1, at 36.
\textsuperscript{33} Id., at 37.
• The Farmer’s Market Promotion Program provides grants to promote farmer’s markets and to implement the use of electronic benefit transfer ("EBT") cards at farmer’s markets, with a total anticipated spending of $33 million in five years, beginning in 2008.34

• The 2008 Food, Conservation, and Energy Act created a set-aside in the Business and Industry Guarantee Loan Program to facilitate storing, processing, and distributing local and regional foods.35

While these programs were created and are often controlled at the federal level, the regulations that affect the strength of local food distribution chains are largely a matter of state and local laws.36 Moreover, even without federal support, various state initiatives can sustain local food movements. A wide variety of policies affect if and how farmer’s markets and other local food distribution systems operate, such as where and when farmer’s markets operate, whether EBT cards can be used at these markets, what food can be sold there, the incentives in place for low-income households to eat local products, and the food safety requirements that food products must comply with.37 In addition to just facilitating local food systems, states are engaged in developing local food programs as well. The National Farm to School Network estimated that in 2009, forty-one states were engaged in a farm-to-school program, with 8,943 schools in over two thousand school districts participating.38

34 Id., at 77.
35 Id., at 38, 78.
36 Id., at 39.
37 Id., at 39–41; see also Delta Regional Farmers Market Alliance, DELTA DIRECTIONS.ORG, http://www.deltadirections.org/programs_initiatives/initiative.php?id=32 (last visited April 2, 2011); see, e.g. EMILY BROAD ET AL., FOOD ASSISTANCE PROGRAMS AND MISSISSIPPI FARMERS MARKETS (2010), available at http://www.deltadirections.org/programs_initiatives/initiative.php?id=32 (providing recommendations for federal, state, and local legislators “focus[ed] on increasing access to fresh food through farmers markets and, once access is established, encouraging people to do their regular food shopping at the markets” in Mississippi).
38 MARTINEZ ET AL., supra note 1, at 14–15.
In addition to the programs already in place, various state and local legislatures are currently or have recently considered laws that would further support the local food movement: The New York City Council has proposed a regulation that would encourage city agencies to purchase food from within New York State;\(^{39}\) In March of this year, the small town of Sedgwick, Maine, passed a “food sovereignty” law that asserts the rights of the citizens of this town to buy and sell their produce free from state and federal regulations and licensing requirements;\(^{40}\) The New Jersey state assembly is currently looking at a bill that would enable local wineries to sell their products directly to customers;\(^{41}\) In 2010, South Dakota passed the “Home-Processed Foods Law,” which exempts home-processed foods sold at farmer’s markets and roadside stands from certain licensing requirements and other regulations.\(^{42}\) These and the many similar proposals demonstrate the increasing interest in locally grown and processed food.

These programs, while not expressly designed to address environmental concerns or climate change as one of their principal goals, have developed at a time when rhetoric about local food and environmental concerns are undeniably intertwined: “many environmental advocates, retailers, and others . . . urge a ‘localization’ of the global food supply network” due to the increasingly global nature of the food system.\(^{43}\) In fact, one of the reasons that consumers are so often willing to pay more for locally produced food is the consumer perception of

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\(^{43}\) Weber & Matthews, at 3508.
environmental sustainability. Environmentalists have been found to be more willing to pay a premium on locally produced food, which suggests a connection in their mind between local food systems and environmental protection. The growing trend of federal support for local food systems thereby contributes to the impression that the government is making changes to help reduce emissions. This Article endeavors to determine if this is, in fact, the case, with the aim of flushing out the variables that must be taken into consideration, should governments seek to use local food policies to reduce the energy consumption and emissions production in the food system. The next section will tackle the question of the connection between food miles and GHG emissions head on by considering, first, the overall impact of transport on the food system’s energy use, and second, if choosing food that has travelled fewer miles does, in fact, reduce the carbon footprint of the food.

III. The Impact of Going Local on the Carbon Footprint of Food

a. The Energy Inputs in Food

That energy and food are intimately related is no new idea: food provides humans with the energy we need to survive, and humans have throughout history put significant energy into obtaining and preparing food for consumption. The incentive to put so much effort into acquiring food is to obtain an energy output from food greater than our physical inputs. This output over input ratio is called the energy ratio of food. Thus, even for subsistence farmers and hunter gatherers, “the [e]nergy [r]atio (output/input) is consistently high, thus achieving a traditional aim of agriculture, which is to secure a net energy flow to man.”

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44 Martinez et al., supra note 1, at 32.
46 Gerald Leach, Energy and Food Production, FOOD POLICY 62, 63 (Nov. 1975).
With the increased availability of non-human energy sources, human societies have been more and more willing to raise the energy inputs (largely through the use of fossil fuels) with or without commensurate increases in output. Many have argued that incorporating higher energy inputs into food, whether through mechanization, climate control in greenhouses, or transportation, has externalized the costs associated with energy use into society—in this instance, through GHG emissions and climate change—rather than reflecting the true cost of energy use through higher prices.\(^\text{47}\)

Whatever the external effects of fossil fuel use in food production, increased energy inputs into food systems have resulted in higher yields and a drastically reduced number of hours of physical labor required to produce the same amount of food.\(^\text{48}\) However, despite this decrease in agricultural labor per unit of food energy produced, the total direct and indirect labor force participation in food production and supply in highly industrialized countries brings labor productivity back to rates comparable with subsistence farming.\(^\text{49}\) Thus, according to one assessment, while the agricultural practices of Chinese subsistence farmers in the 1930s had an energy ratio of 41, the ratios of wheat in the United Kingdom, maize in the United States, fishing in the Adriatic Sea, and winter tomatoes in Denmark were 3.4, 1.3, 0.01, and 0.004, respectively, in the 1970s.\(^\text{50}\) The energy ratio of the overall food system in the United States, from the farm to

\(^{47}\) See, e.g., T. Lang, *Globalisation and the Challenge to the Organic Strategy*, in *FUNDAMENTALS OF ORGANIC AGRICULTURE* 200 (T.V. Østergaard ed., 1996) (“Food travels an increasing distance between producer and final consumer. Some—most—of this travel is ludicrous but it makes financial sense because the cost, in energy and money, is externalised [sic] onto the environment. Cheap beef or rice going from the USA to Japan relies upon cheap oil, a non-renewable resource.”); Wynen & Vanzetti, *supra* note 11 (“There are various environmental and perhaps social costs that may not be incorporated in the product price, however. Transport involves several externalities, such as emissions, accidents, and noise, which may not be taken into account. The relation between these externalities and distance traveled is a complex one. Indeed, consumers may be inadvertently encouraged by environmentalists to buy goods that may contribute to greater environmental pollution. As this Article will show, buying locally produced goods is an oversimplified way of addressing the issue of unpriced externalities.”).

\(^{48}\) Leach, *supra* note 46, at 64–66.

\(^{49}\) *Id.*, at 65.

\(^{50}\) *Id.*, at 64, Table 1.
the “shop door,” were estimated at 0.22 in 1963, at 0.15 in 1970, and between 0.06 and 0.1 in 1991. These ratios, however, do not take into account the energy required to store food once it has entered the shop door, to transport food from the shop to the home or restaurant, and to prepare food for consumption.

Energy ratios represent the amount of energy obtained from food as a function of the energy consumed in its production. A more comprehensive understanding of the energy ratio, however, considers the sources of energy inputs in food: what parts of the food system use energy, and which parts consume more or less energy than others? In answering these questions, a picture begins to develop of how energy inputs and GHG emissions can be reduced in the American food system, and what policies might work towards this end. There are various ways of analyzing the energy consumed in modern food systems, and this Article will consider two of them: supply-chain and life-cycle analysis.

Supply-chain analysis takes an in-depth look at food-related energy flows by examining energy-flows by production stage. The seven stages that are considered are: (1) agriculture, (2) processing, (3) packaging, (4) transportation, (5) wholesale/retail, (6) food service, and (7) household energy use. The 2010 United States Department of Agriculture (the “USDA”) report, Energy Use in the U.S. Food System, used a supply-chain analysis to consider the changes in the energy consumption of the American food system between 1997 and 2007. Based on this report, the seven categories listed above can be ranked in terms of their contribution to overall energy use, as well as by their rates of growth. Of these categories, household energy use was the

51 Id.
greatest in absolute value, but registered a modest 3% growth in the time period studied (figure 1).\textsuperscript{55} The processing stage showed the second highest overall energy consumption, as well as a high growth rate, at about 8% per year.\textsuperscript{56} The food services stage, while not one of the greatest contributors overall to energy consumption, has grown at similarly high rates,\textsuperscript{57} perhaps due to the vast increase in dining out and in purchasing pre-prepared foods.\textsuperscript{58} The transport stage of the food system, however, contributed the least energy use to the U.S. food system, and registered a (comparably) moderate growth rate of an average of 5% per year in this ten-year period.\textsuperscript{59}

Figure 1: Change in U.S. Energy Consumption by Stage of Production, 1997 to 2002.

\begin{center}
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The USDA report concluded with several mechanisms that could be used to reduce overall energy use and GHG emissions in the American food system. These methods included: developing energy-efficient food system technologies, replacing old farm, household, and processing equipment, reshaping household consumption trends away from highly processed foods and foods away from home, and using price-signaling to reduce demand for energy-

\textsuperscript{55} Id., at 20.
\textsuperscript{56} Id.
\textsuperscript{57} Id.
\textsuperscript{58} See id. (“Analysis of the entire food supply chain supports findings that indicate food preparation activities of households and the foodservice industry have been substantially outsourced to food processors.”).
\textsuperscript{59} Id.; see also HENDRICKSON, supra note 52, at 7.
intensive foods. Each of these shifts targets the stages of production where energy consumption is high or growing: households, processing, agriculture, and food services.

Another method for measuring energy flows is life-cycle analysis. Instead of assessing the inputs of energy into particular stages of production, a life-cycle analysis considers “both the direct emissions from activities like transport, alongside those generated during the manufacture of the relevant inputs, e.g. fertilizer, pesticides, electricity and machinery” that go into the production of individual foods. Thus, rather than comparing energy systems, they compare the energy inputs of particular foods and food groups, and can compare methods of production, storage, distribution, and preparation of foods.

Weber and Matthews conducted a life-cycle analysis of the GHG emissions associated with production of various food-groups in the United States to determine if sourcing food locally (i.e. reducing “food miles”) could contribute to a reduction in emissions. Their findings suggest that while going local has some potential for GHG emissions reduction, this potential is capped at a four or five percent decrease in emissions “due to large sources of both CO₂ and non-CO₂ emissions in the production of food.” Their findings show that while food may travel long distances, transport accounts for only about 11% of food’s life cycle GHG emissions, while production accounts for 83%. The energy consumed and emissions produced vary greatly by food group, though, and the authors find that “on average red meat is more GHG-intensive than all other forms of food,” with dairy products a close second. Thus, the authors suggest what they anticipate would be a more fruitful and feasible way of reducing GHG emissions: shifting

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61 Edwards-Jones et al., supra note 7, at 267.
63 Id., at 3511.
American dietary habits away from red meat and dairy products and towards less energy-intensive options.\textsuperscript{64}

Both the supply-chain and life-cycle analyses suggest that the local food movement, in emphasizing food miles at the expense of other components of the food system, misses the mark if the goal is to reduce GHG emissions to stem climate change. Both of these analyses show that the components of food production and distribution other than transport play a far greater role in contributing to the food system’s 19\% percent of the total U.S. energy flows.\textsuperscript{65} However, that the local food movement may not play the largest role in reducing emissions is not to say that it cannot play a role at all, and perhaps even a significant role: food, home energy, and transportation form a large share of personal energy impacts, and, among these three, food choice provides consumers with “a unique opportunity . . . to lower their personal [energy-use] impacts due to its high impact, high degree of personal choice, and a lack of longterm [sic] ‘lock-in’ effects which limit consumers’ day-to-day choices.”\textsuperscript{66} Thus, the next section will consider whether policies that support local foods can work as a method to reduce the carbon-footprint of foods and the consumers that eat them.

\textbf{b. Does Distance Matter?}

The many studies of the food system and local food movement “do not agree on whether local food systems are more energy- and emissions-efficient” than conventional food distribution methods.\textsuperscript{67} This section will briefly review a few of these studies to demonstrate the variation in findings. This section will conclude that while reducing the number of food miles \textit{may} play a

\textsuperscript{64} \textit{Id.}, at 3508, 3512; \textit{compare} Pimentel et al., \textit{supra} note 2, at 459–460 (suggesting that a reduction in the overall caloric intake of Americans, and specifically a reduction in junk food consumption, would “significantly reduce the energy used in food production”).

\textsuperscript{65} CANNING ET AL., supra note 53, at 1; Pimentel et al., \textit{supra} note 2, at 459.

\textsuperscript{66} Weber & Matthews, \textit{supra} note 62, at 3508.

\textsuperscript{67} MARTINEZ ET AL., \textit{supra} note 1, at 49.
role in reducing the energy inputs in food, any policy designed to reduce emissions must bear in mind various other considerations, such as the overall makeup of the grid, production methods, seasonality, method of transport, and the interactions of each of these factors.

Some studies have found that local and regional food systems reduce the energy consumed and emissions produced by food. Pirog et al. considered the impact of food miles on greenhouse gas emissions in Iowa. They found that by replacing 10% of Iowa’s produce consumption with local or regional produce emitted five to seventeen times less carbon dioxide than the conventional system (where both systems used trucking as the sole mode of transport). This 10% replacement, though, accounted for a relatively small reduction in emissions overall (6.7 to 7.9 million pounds), given the state’s 1996 Greenhouse Gas Action Plan.68 They also considered the impact of reducing the average distance of produce transported within a multi-state regional system (as opposed to Iowa alone). They determined that an average reduction of transport distance of produce by 273 miles within the Upper-Midwest (including Iowa, Minnesota, Wisconsin, Indiana, Illinois, and Michigan) “would translate into savings of 8.8 million gallons of diesel fuel per year”69 and would decrease carbon dioxide emissions by 194.8 million pounds,70 a considerably larger impact than reducing Iowa’s food miles alone.

Despite the promising results of this study, the authors did not consider the fuel-saving potential of other forms of transport, such as rail. Moreover, the authors did not consider the fuel cost of consumers traveling to farmer’s markets or to other distribution centers, and did not consider the energy use in backhaul, the return trip of the truck to farm. The authors did recognize, however, that other energy inputs into local agriculture may render local food less energy efficient than foods from further away; a study of tomatoes consumed in Sweden showed

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68 Pirog et al., supra note 2, at 18–19.
69 Id., at 20.
70 Id.
that those produced in Spain have lower carbon dioxide emissions overall than those from Denmark, the Netherlands, and Sweden, as tomatoes from Spain did not require energy-intensive heated greenhouses.\textsuperscript{71} Thus, “[t]ransportation energy savings for the systems with shorter transport distances [can be] overshadowed by higher energy needs in crop production.”\textsuperscript{72}

Various studies have both replicated and contradicted the findings of this study of tomatoes in Sweden. Blanke and Burdick compared the energy use of domestic and imported apples in Germany, over the winter months, and found that domestic apples consumed less energy, despite storage requirements: The domestic apples were cultivated during Germany’s growing season, kept in refrigerated and reduced oxygen storage throughout the winter months, and then transported an average of about 105 miles to retail outlets.\textsuperscript{73} The imported apples were grown in New Zealand, transported by climate-controlled ship to Antwerp over 28 days, and transported via truck an average of about 215 miles to retail outlets in Germany.\textsuperscript{74} The authors found that “[t]he energy requirement for providing imported, freshly harvested . . . [apples from New Zealand] exceeded the [energy requirement for] locally-grown, stored apples of the same variety by [approximately] 27%.”\textsuperscript{75}

Saunders et al., however, found that dairy, lamb, apple, and onion production in New Zealand for consumption in the United Kingdom was more energy efficient than consuming these foods when locally produced in the U.K.\textsuperscript{76} The study considered direct energy inputs into food production, as well as indirect inputs including fertilizers, agrichemicals, supplementary

\textsuperscript{71} Id., at 22.
\textsuperscript{72} Id.
\textsuperscript{73} Michael M. Blanke & Bernhard Burdick, Food (Miles) for Thought: Energy Balance for Locally-Grown Versus Imported Apple Fruit, 12 ENVIRONMENTAL SCIENCE POLLUTION RESEARCH 125, 125 (2005). While these local foods did in fact use less energy than the foods imported from New Zealand, their storage over the winter months seems to contradict one of the more strongly held associations with local food—that it is fresh.
\textsuperscript{74} Id., at 124–25.
\textsuperscript{75} Id., at 126.
\textsuperscript{76} Caroline Saunders et al., Food Miles, Carbon Footprinting and their Potential Impact on Trade 1 (AARES 53rd annual conference at Cairns, 10–13 February 2009).
animal feed, buildings, machinery, transport, and, for onions, storage. These findings suggest that, rather than buying local, “British consumers who wish to minimize energy use should be buying dairy products, apples, onions, and especially lamb from New Zealand.”

As is apparent from just these few studies, there is no consensus over whether eating local is a way for consumers to reduce their carbon footprint, or if these attempts will in fact lead to increased energy inputs through more energy intensive farming practices to allow for production of strawberries, apples, and other warm-weather produce year round. Moreover, many of the studies use different methodologies and system boundaries, making proper comparisons nearly impossible. Given these difficulties, the next section of this Article will examine the other considerations that a “buy local” policy must take into account if it is to actually reduce energy use and emissions in the American food system.

IV. Making Local Food Work to Reduce Emissions

To develop a government policy that seeks to reduce GHG emissions produced by the food system, no single variable can be considered in isolation:

If food supply chains are similar in other respects (e.g., production and storage costs), it makes sense for the consumer to purchase the product that uses the smallest amount of energy in transportation. However, this does not necessarily favor the item that has traveled the fewest miles, as different modes of transport require differing amounts of energy per unit of produce. In addition, other factors are rarely equal, as production methods and costs . . . vary a great deal.

The studies reviewed above suggest that eating local can be the energy-friendly choice, but is not necessarily so. This section, then, will consider the other factors that come into play in the makeup of the carbon footprint of food.

77 Id., at 6–9.
78 Wynen & Vanzetti, supra note 11, at 7 (referring to Saunders et al., supra note 76).
79 Edwards-Jones et al., supra note 7, at 267, 270.
80 Wynen & Vanzetti, supra note 11, at 2.
An important first consideration is the type of energy used by the grid: food from a farm in an area that uses renewable energy for their electricity production will, all else equal, have a lower carbon footprint than a farm whose electricity comes primarily from coal. While the source of electricity may matter less for an open-air farm, electricity is a significant energy input in food grown in greenhouses.\(^81\) Moreover, for open-air farms, “the manufacture of fertiliser [sic] tends to be one of the on-farm inputs with the greatest energy demand and GHG emission factor.”\(^82\) Thus, a farm that purchases fertilizer from a factory that makes use of renewable energy inputs will have a smaller carbon-footprint to one that relies on fossil fuels.\(^83\) This consideration extends beyond the agricultural phase to the processing, distribution, food service, and household stages as well, as these sectors account for the majority of the energy use in the food system, and obtain a significant amount of this energy through the electricity grid.

This first issue implicates the second: the overall methods of production, processing, and packaging are critical in determining the emissions related to a particular food product. As an initial matter, a food product that is unprocessed bypasses the food system stage with one of the highest overall and fastest growing energy uses,\(^84\) but processed foods may have a longer shelf-life, and reduce the energy requirements for storage or frequency of shipment. For agricultural products, organic farming methods use considerably less nitrogen fertilizer than conventional farms,\(^85\) and tend to engage in a greater number of sustainable farming practices, such as

\(^{81}\) See Edwards-Jones et al., supra note 7, at 267 (“in glasshouse production, direct use of electricity for heating and lighting may represent the greatest energy input”).

\(^{82}\) Id.


\(^{84}\) See supra, note 56 and accompanying text; see also Pimentel et al., supra note 2, at 467 (“The most effective method for decreasing energy inputs in processing and packaging is to dramatically reduce consumer demand for products that require large energy inputs in their production.”).

\(^{85}\) Bertilsson et al., supra note 83, at 1.
intercropping and the use of manure instead of fertilizer.\textsuperscript{86} Moreover, conventional farms tend to have a high level of mechanization, using overly large and powerful tractors dependent on fossil fuels.\textsuperscript{87} Thus, some studies have shown that choosing organic products will reduce the carbon-footprint of food.\textsuperscript{88} However, not all organic farms are created equal, and conventional farms can reduce their own emissions with the use of light or efficient machinery and more judicious use of nitrogen fertilizer.\textsuperscript{89} Moreover, any farm that uses greenhouses to grow produce out of season or irrigation to increase yields augments their energy use considerably, and a producer that stores produce harvested in the summer to be consumed throughout the winter must consider the energy and emissions associated with climate controlled storage facilities. Depending on the study and the various other elements at play in each situation, the energy used in irrigation, storage, or greenhouse growing may or may not overshadow the energy and emissions associated with transport from better suited climates.

Third, and closely related to the issue of food miles discussed throughout this Article, is the type of transportation used for shipment. Sea and rail are considerably more efficient than road or air transport,\textsuperscript{90} with air transport consuming by far the most energy and producing the greatest amount of emissions.\textsuperscript{91} Moreover, except for air freight, the amount of energy consumed by the transport stage of the food system is relatively small, to the extent that “[f]or goods imported by sea, rail, or road, it is likely that a switch from imported to locally produced goods

\textsuperscript{86} See Pimentel et al., supra note 2, at 464.
\textsuperscript{87} See id. (“Reports suggest that equipment quantity and size is often in excess of requirements for the tasks. Reducing the number and size of tractors will help increase efficiency and conserve energy.”).
\textsuperscript{88} See, e.g. David Pimentel, \textit{Impacts of Organic Farming on the Efficiency of Energy Use in Agriculture} 34 (An Organic Center State of Science Review, 2006) (“Organic farming systems significantly reduce the fossil energy inputs in production and also improve several aspects of agriculture’s environmental performance compared with conventional farming systems.”).
\textsuperscript{89} See Pimentel et al., supra note 2, at 464; Bertilsson et al., at 10.
\textsuperscript{90} Wynen & Vanzetti, \textit{supra} note 11, at 1.
\textsuperscript{91} Id., at 5.
[in Europe] will increase global energy use and pollution,"\(^92\) rather than decrease it. Even in the U.S., where most domestic food products are transported by truck or rail,\(^93\) the distance of travel may be less important that the energy efficiency of the mode of transport and the frequency of shipment. Moreover, even the distance and frequency that consumers travel to the grocery store or market contributes to the overall emissions in the food system. Finally, and as has been suggested throughout this section, each of these variables interact, and none is determinative in isolation. Produce from a local farm may have a higher carbon footprint due to the large fossil fuel run tractors and energy-intensive irrigation than produce grown using sustainable practices and shipped great distances via rail or sea. Any government policy that endeavors to reduce the GHG emissions associated with the food system, and any consumer that seeks to reduce their own carbon footprint, do not have the benefit of one easy answer, but rather must consider all of these elements in conjunction.\(^94\) Some have suggested that carbon labeling or carbon standards would be ways for governments to amalgamate the various contributions to GHG emissions into an easy to understand framework.\(^95\) While a thorough review of existing and potential carbon labels is outside the scope of this Article, any mechanism employed to measure the carbon impact of food must consider not only the distance travelled, but also the mode of transport, the various other sources of emissions throughout the food system, and the interaction between these variables as well.

\(^{92}\) Id., at 1.
\(^{93}\) CANNING ET AL., supra note 53, at 18.
\(^{94}\) See Edwards-Jones et al., supra note 7, at 269.
\(^{95}\) Saunders et al., supra note 76, at 22 (discussing the British carbon standard Publicly Available Specification 2050:2008, which “aims to provide a standardised [sic] and consistent method that organisations [sic] can use to measure the GHG emissions embodied in their products and services”); Edwards-Jones et al., supra note 7, at 266 (“Once the carbon footprint for a food item has been estimated, it is possible to use this to inform both food chain professionals and consumers about the relative impacts of different products. In the latter case, a carbon label could act in a similar way to other food labels, on the assumption that concerned consumers will preferentially purchase goods with the desired characteristics, here a low carbon footprint.”).
CONCLUSION

The American food system contributes 19% of the energy to overall American energy flows. Energy efficiency, energy independence, and emission reductions have become hot button topics in the political arena, and the local food movement has continued to spread, finding adherents who seek food that is fresh, that supports their local economy, and that is an environmentally- and energy-conscious choice. This Article has considered whether the question of food miles is sufficient for even a rough assessment of the carbon footprint of food, and argues that a more nuanced understanding of the food system is required for knowledgeable decisions to be possible. The current policies on eating local were not developed to reduce the energy consumption in the food system, even if many consumers make this association when contemplating what local food means to them. This Article has argued that if governments decide to embrace this version of local food and choose to create local food policies specifically to reduce emissions and to improve the sustainability of the food system, these policies cannot solely examine the distance travelled. To effectively work towards our energy goals, local food policies must absolutely engage in the deeper issues of production methods, of energy efficiency, and of sustainability of the food system in the United States.