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

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INTRODUCTION

"Eating local" is a growing trend in the American food system,[1] with environmentalists and foodies alike advocating for shorter food transportation distances from farm to table.[2] Not only have local food systems gained followers through farmer's markets, locally sourced restaurants, and community supported agriculture ("CSA") enterprises, but the "locavore"[3] trend has begun to gain momentum in Washington as well: various state administered programs supporting

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1. STEVE MARTINEZ ET AL., LOCAL FOOD SYSTEMS: CONCEPTS, IMPACTS, AND ISSUES, ECONOMIC RESEARCH REPORT NUMBER 97, 3 (May 2010). "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." 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, but for the purposes of this Note, the term "local" will refer to the distance between place of origin and consumption. *Id.* at 3–4.

2. The average distance in the United States is about 1,500 miles. David Pimentel et al., *Reducing Energy Inputs in the US Food System*, 36 HUMAN ECOLOGY 459, 467 (2008). In some cases, food can travel up to 3,100 miles. 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. MARTINEZ ET AL., *supra* note 1, at 3. ("The New Oxford American Dictionary (NOAD) defines a 'locavore' . . . as a local resident who tries to eat only food grown or produced within a 100-mile radius.").

local food initiatives receive federal funding,[4] the United States Department of Agriculture (the "USDA") has itself, developed and implemented a number of local food programs,[5] and the Obamas have famously planted a vegetable garden in the White House lawn.[6] There are many arguments in favor of eating locally grown food, ranging from fighting childhood obesity,[7] to food security,[8] to stronger rural economies.[9] This Note will focus on one such claim: that eating locally grown foods can decrease the carbon footprint of food.[10]

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."[11] 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.[12] Moreover, farmers who produce food for local consumption frequently ship small quantities

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4. *See id.* at 39–41.

5. *See id.*at 35-39.

6. *See* Marian Burros, *Obamas to Plant Vegetable Garden at White House*, N.Y. TIMES, March 19, 2009, at A1, *available at* http://www.nytimes.com/2009/03/20/dining/20garden.html.

7. *See, e.g.*, EMILY BROAD ET AL., FOOD ASSISTANCE PROGRAMS AND MISSISSIPPI FARMERS MARKETS 4 (2010), *available at* http://www.deltadirections.org/programs_initiatives/initiative.php?id=32.

8. MARTINEZ ET AL., *supra* note 1, at 46-47. Food security refers to the availability of sufficient food to support a healthy life for all people at all times. *Id.*

9. *See, e.g.*, Brian Halweil, *The Argument for Local Food*, 16 WORLD WATCH 20, 25 (2003). The author notes that money spent on locally grown food generates twice as much income for the local economy than does money spent on food that is not locally grown. *Id.*

10. Gareth Edwards Jones et al., *Testing the Assertion that 'Local Food is Best': The Challenge of an Evidence-Based Approach*, 19 TRENDS IN FOOD SCIENCE & TECHNOLOGY 265, 266 (2008) ("The carbon footprint of a food item is the total amount of greenhouse gases (GHGs) emitted during its production, processing and retailing").

11. PIROG ET AL., *supra* note 2, at 3.

12. *See id.* at 7. One study cited by the author showed that "transportation accounted for 11 percent of energy use within the food system, considerably less than agricultural production (17.5 percent) and processing (28.1 percent)." *Id.*

of food over short distances using outdated, energy-inefficient pick-up trucks, which may be less fuel-efficient than shipping huge quantities of food over longer distances by rail.[13] Eating locally may not be the panacea that it has been made out to be. This Note considers the eating local movement, and explores whether, from a climate and energy perspective, it merits the federal and state support that it has received.

This Note explores in Part I what "local food" really means to consumers and what, besides distance, is associated with eating local. Part II then briefly reviews some of the programs that exist in the United States to support local food movements. Part III considers two aspects of energy use 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 the total impact eating local can have; and second, whether by choosing these local products, consumers are, in fact, reducing their overall carbon footprint. This Note 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. However, despite these difficulties, this Note proposes that a well-tailored policy, which takes into account more than just transport distance, may have potential for reducing the hidden energy costs of food.

II. WHAT DOES "LOCAL" MEAN?

Unlike organic, kosher, or vegan, "local food" has thus far escaped commonly agreed-upon definition.[14] "Food miles" has become the term used to describe how far a food travels from farm to point of sale,[15] or from farm to fork,[16] depending on the definition.[17] At first

13. *See, e.g.* Els Wynen & David Vanzetti, *No Through Road: The Limitations of Food Miles* 4-5 (ADB Institute Working Paper No. 118, 2008).

14. MARTINEZ ET AL., *supra* note 1, at 3.

15. PIROG ET AL., *supra* note 2, at 9; Wynen & Vanzetti, *supra* note 13, at 2.

16. CAROLINE SAUNDERS & PETER HAYES, RESEARCH REPORT NO. 299, AIR FREIGHT TRANSPORT OF FRESH FRUIT AND VEGETABLES 1 (2007); Wynen & Vanzetti, *supra* note 12, at 2.

17. Wynen & Vanzetti, *supra* note 13, at 10. Some studies employ a "more sophisticated version [of food miles], which takes into account energy use and

glance, the geographic implications of the concept of local food seem clear, but the actual boundaries between local and non-local food are far from distinct. As a starting matter, the definition of "local" changes based on population density and how close an area is to farmable land.[18] 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.[19] Likewise, in the United States, residents of King County, a densely populated urban county in Washington State, were more likely than those in Grant County, a sparsely populated rural county, to define the local market as their own or surrounding counties.[20]

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 his or her home,[21] 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,"[22] 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

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harmful emissions produced during transport," but this Note will use the more straightforward definition, which considers specifically the distance food travels. *Id.*

18. *See, e.g.*, GERALDINE PADBURY, INSTITUTE OF GROCERY DISTRIBUTION, RETAIL AND FOODSERVICE OPPORTUNITIES FOR LOCAL FOOD 4 (March 2006); Theresa Selfa & Joan Qazi, *Place, Taste, or Face-to-Face? Understanding Producer–Consumer Networks in "Local" Food Systems in Washington State*, 22 Agriculture and Human Values 451, 457-60 (2005); MARTINEZ ET AL., *supra* note 1, at 3.

19. PADBURY, *supra* note 18, at 4.

20. Selfa & Qazi, *supra* note 18, at 458.

21. MARTINEZ ET AL., *supra* note 1, at 3 (referring to the New Oxford American Dictionary definition).

22. 7 U.S.C.S. § 1932 (g)(9)(a)(i) (LexisNexis 2011); MARTINEZ ET AL., *supra* note 1, at 3.

grocery-shop.[23] 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 because "[American] consumers generally define 'local' in terms smaller than their state and many state-Branding programs target consumers in other States, or perhaps internationally."[24]

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."[25] The IGD study found that 60% of respondents surveyed in 2006 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.[26] American consumers associate local foods with certain 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" behind the food"),[27] and a shorter food supply chain.[28] While all of these associations are undoubtedly important in general perceptions of the local food movement, this Note 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.[29] Moreover, while scholarship often differentiates between local and regional food systems, the

23. *See* PADBURY, *supra* note 18, at 4-5. The poll results indicate that 17% of respondents believed that local foods were produced 30-miles from where they live or grocery-shop. *Id.* Only one other response, that local food means food produced in the same country in which the respondent lives, was a more popular response. *Id.*

24. *See* MARTINEZ ET AL., *supra* note 1, at 3–4.

25. *See infra* note 26 and supporting text.

26. PADBURY, *supra* note 18, at 19; *see also* Edwards-Jones et al., *supra* note 10, at 265–66.

27. MARTINEZ ET AL., *supra* note 1, at 4.

28. *Id.*

29. *See* 7 U.S.C.S. § 1932 (g)(9)(a)(i) (LexisNexis Supp. 2011). Though there are many potential definitions of "local food," the 2008 Farm Act's 400-mile radius represents an easily-definable cut-off for the purposes of this Note's analysis.

Act's broad definition vitiates the distinctions between the two,[30] and thus this Note will use the terms 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,[31] a significant portion of locally sourced foods is marketed outside of the conventional supermarket system.[32] 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.[33] 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).[34] 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).[35] In particular, farm to school programs have been on the rise, from 400 of these programs nationally in 2004 to 2,051 in 2009.[36]

Using a definition of "local" restricted to food produced within 400 miles of where it is sold, this Note next briefly summarizes some of the government programs that have been implemented to support local food supply chains and provide assistance to food producers who supply their products locally.

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30. *See* 7 U.S.C.S. § 1932 (g)(9)(a)(i)(I)-(II) (LexisNexis Supp. 2011). Locally or regionally produced agricultural food products are defined as any agricultural food product that is raised, produced, and distributed in the locality or region in which the final product is marketed, or the State in which the product is produced.

31. *See* Stephanie Clifford, *Wal-Mart to Buy More Local Produce*, N. Y. TIMES, October 15, 2010, at B1, *available at* http://www.nytimes.com/2010/10/15/business/15walmart.html; *see also* MARTINEZ ET AL., *supra* note 1, at 11–13.

32. MARTINEZ ET AL., *supra* note 1, at 10 ("[L]ocal food sales through all marketing channels in the United States were $5 billion in 2007, compared to $1.2 billion in direct-to-consumer sales. . .").

33. MARTINEZ ET AL., *supra* note 1, at 4–5.

34. *Id.* at 5.

35. *See* Rainbow A. Vogt & Lucia L. Kaiser, *Still a Time to Act: A Review of Institutional Marketing of Regionally-Grown Food*, 25 AGRIC & HUM VALUES 241, 241 (2008).

36. MARTINEZ ET AL., *supra* note 1, at 14–15 fig. 4.

III. GOVERNMENT SUPPORT FOR LOCAL FOOD SYSTEMS

Climate change, fuel consumption, and energy dependence have become hot topics in American politics.[37] President Obama emphasized the importance of clean energy, energy efficiency, and innovation in his 2010 and 2011 State of the Union Addresses,[38] and has continued stressing the urgency of energy issues in other speeches since then.[39] This trend of state and federal support for local food systems began long before President Obama's inauguration, though.

Legislation and USDA mandates have created various local food programs at the federal level.[40] While they have federal origins, many programs require state or local administration, and they often involve partnerships between the USDA and other federal or state agencies.[41] These programs have been implemented not with environmental issues in mind, but rather as mechanisms 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 institutions, with an increasing preference to purchase produce from small and medium-sized farms.[42]

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

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37. *See infra* notes 38-39 and accompanying text.

38. President Barack Obama, State of Union Address (Jan. 25, 2011), *available at* http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address; President Barack Obama, State of Union Address (Jan. 27, 2010), *available at* http://www.whitehouse.gov/the-press-office/remarks-president-state-union-address.

39. *See, e.g.* David Jackson, *Obama: We Must 'Get Serious' About Long-Term Energy Policy*, USA TODAY, Mar. 30, 2011, http://content.usatoday.com/communities/theoval/post/2011/03/obama-we-must-get-serious-about-long-term-energy-policy/1.

40. *See infra* notes 42-50 and accompanying text.

41. *Id.*

42. MARTINEZ ET AL., *supra* note 1, at 35.

security issues through community based food projects in low-income communities.[43]

The Community Food Service Initiative, which the USDA launched in 1999, builds partnerships between the USDA and communities in an effort to "build local food systems, increase food access, and improve nutrition."[44]

The Child Nutrition Reauthorization Bill of 2010 requires the USDA to provide grants or technical assistance to schools participating in the National School Lunch or Breakfast Programs to implement farm to school programs that improve access to local foods.[45]

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.[46] Congress appropriated $21.8 million to the Seniors Program in 2008[47] and $19.8 million for the WIC Farmer's Market program in 2009.[48]

The Farmer's Market Promotion Program provides grants to promote farmers' markets and to implement the use of electronic benefit transfer ("EBT") cards at farmer's markets, spending an anticipated $33 million over five years beginning in 2008.[49]

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43. *Id* at 35.

44. *Id* at 35. In 1999, the USDA awarded 20 grants totaling $2.4 million, including a grant of $104,000 to Healthy Farms, Healthy Kids, "a pilot program in three, local low-income schools serving minority children, featuring a farmer's market and a fruit and salad bar to increase fruit and vegetable consumption by children, a school garden and composting programs, and farm and farmers market tours." USDA COMMUNITY FOOD SECURITY INITIATIVE GRANTS, BACKGROUNDER, Release No. 0416.99 (1999), *available at* http://www.usda.gov/news/releases/1999/10/0416.

45. 42 U.S.C.S. § 1769(g) (LexisNexis Supp. 2011).

46. MARTINEZ ET AL., *supra* note 1, at 36.

47. *Id.* at 37.

48. *Id.* at 36.

49. *Id.* at 77.

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.[50]

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 jurisdiction.[51] Moreover, various state initiatives can sustain local food movements even without federal support.[52] A wide variety of policies affect whether 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 types of food can be sold there, the incentives in place for low-income households to eat local products, and the applicable food safety requirements.[53] In addition to facilitating local food systems, states are engaged in developing their own local food programs as well. The National Farm to School Network estimated that in 2009, 41 states were engaged in a farm-to-school program, including 8,943 schools in over 2,000 school districts.[54]

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.[55] In March of 2011, the small town of Sedgwick, Maine, passed a "food

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50. MARTINEZ ET AL., *supra* note 1 at 38, 78 ("Through FY 2012, at least 5 percent of the funds made available to the program will be reserved for local food initiatives, amounting to over $100 million in FY 2010.").

51. *Id.* at 39.

52. *See infra* notes 55-58 and accompanying text.

53. MARTINEZ ET AL., *supra* note 1, at 39-41; *see also Delta Regional Farmers Market Alliance,* DELTADIRECTIONS.ORG, http://www.deltadirections.org/programs_initiatives/initiative.php?id=32 (last visited April 2, 2011); *see* BROAD ET AL., *supra* note 7, at 3 (providing recommendations for federal, state, and local legislators to "focus 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).

54. MARTINEZ ET AL., *supra* note 1, at 14–15.

55. *NYC Council Proposes Law to Increase City's Local Food Purchasing,* NEW YORK BOUNTY (Feb. 9, 2011), http://mcorreia.wordpress.com/2011/02/09/nyc-council-proposes-law-to-increase-city%E2%80%99s-local-food-purchasing/.

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.[56] 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.[57] These and other similar programs[58] demonstrate the increasing interest in locally grown and processed food.

These programs, while not expressly designed to address environmental concerns or climate change as a principal goal, 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. [59] In fact, one of the reasons that consumers are so often willing to pay more for locally produced food is the consumer perception of environmental sustainability.[60] Environmentalists have been found to be more willing to pay a premium on locally produced food, which suggests a connection in their minds between local food systems and

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56. David E. Gumpert, *Here's a Way to Eliminate the Regulators and Lawyers, and Build Community at the Same Time: Organize and Declare "Food Sovereignty," Like Sedgwick, Maine*, THE COMPLETE PATIENT (Mar. 7, 2011), http://www.thecompletepatient.com/journal/2011/3/7/heres-a-way-to-eliminate-the-regulators-and-lawyers-and-buil.html.

57. *South Dakota Requirements for the Sale of Baked Goods and Home-canned Processed Foods at Farmers Markets*, SOUTH DAKOTA COOPERATIVE EXTENSION SERVICE 1, 1-2 (Sept. 2010), http://pubstorage.sdstate.edu/AgBio_Publications/articles/FS956.pdf.

58. *See, e.g.*, *Local Food Purchasing and Organic Conversion Policies - Woodbury County, Iowa*, NEW RULES PROJECT, http://www.newrules.org/agriculture/rules/local-food/local-food-purchasing-and-organic-conversion-policies-woodbury-county-iowa (last visited Oct. 23, 2011) (requiring the county to purchase locally grown food).; *Farm to School Law – Vermont*, NEW RULES PROJECT, http://www.newrules.org/agriculture/rules/local-food/farm-school-law-vermont (last visited Oct. 23, 2011) (strengthening the connections between local farms and schools).

59 Christopher L. Weber & H. Scott Matthews, *Food-Miles and the Relative Climate Impacts of Food Choices in the United States*, 42 ENVTL. SCI. & TECH. 3508, 3508 (2008).

60 MARTINEZ ET AL., *supra* note 1, at 32.

environmental protection.[61] The growing trend of federal support for local food systems thereby may be contributing to the consumer impression that the government is making changes to help reduce emissions.

This Note endeavors to determine if this is, in fact, the case, with the aim of flushing out the variables that governments must consider should they seek to use local food policies to reduce the food system's energy consumption and emissions production. The next section tackles 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 its carbon footprint.

IV. 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[62] put significant energy into obtaining and preparing food for consumption. The incentive to put so much effort into acquiring food is to obtain a comparably greater energy output. This ratio of food's energy output to input is called the energy ratio of food.[63] 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."[64]

With the increased availability of non-human energy sources, human societies have been increasingly willing to raise the energy inputs (largely through the use of fossil fuels) with or without corresponding increases in output. Many have argued that

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61. *Id.* at 32; *see* Cheryl Brown, *Consumers' Preferences for Locally Produced Food: A Study in Southeast Missouri*, 18 AM. J. ALT. AGRIC. 213, 220 (2003).

62. MICHAEL S. COMMON, SUSTAINABILITY AND POLICY: LIMITS TO ECONOMICS 199 (Cambridge University Press, 1995).

63. Gerald Leach, *Energy and Food Production*, 1 FOOD POLICY 62, 63 (1975).

64. *Id* at 63.

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.[65]

Whatever the external effects of fossil fuel use in food production, increased energy input into food systems have resulted in higher yields and have drastically reduced the number of hours of physical labor required to produce the same number of calories.[66] However, after incorporating the additional direct and indirect energy inputs involved in food production and supply in highly industrialized countries, total labor productivity rates are comparable with those of subsistence farming.[67] According to one assessment, the agricultural practices of Chinese subsistence farmers in the 1930s had an energy ratio of 41, whereas the ratios of wheat in the United Kingdom, maize in the United States, fishing in the Adriatic Sea, and winter tomatoes in Denmark had respective rates of 3.4, 1.3, 0.01, and 0.004 in the 1970s.[68] The energy ratio of the overall food system in the United States (from the farm to the "shop door") was estimated at 0.22 in 1963, at 0.15 in 1970,[69] and between 0.06 and 0.1 in 1991.[70] These ratios, however, do not take into account the energy required

65. *See* Wynen & Vanzetti, *supra* note 13 ("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 paper will show, buying locally produced goods is an oversimplified way of addressing the issue of unpriced externalities.").

66. Leach, *supra* note 63, at 64–66.

67. *Id.* at 67.

68. *Id.* at 64 (table 1).

69. *Id.* at 64 (table 1).

70. *See* JOHN HENDRICKSON, CENTER FOR INTEGRATED AGRICULTURAL SYSTEMS, ENERGY USE IN THE U.S. FOOD SYSTEM: A SUMMARY OF EXISTING RESEARCH AND ANALYSIS 2 (1994) *available at* http://www.cias.wisc.edu/farm-to-fork/energy-use-in-the-us-food-system-a-summary-of-existing-research-and-analysis/ ("The modern food production and distribution system expends 10 to 15 calories of energy for every one calorie of energy produced.").

to store food once it enters the shop door, to transport food from the shop to the home or restaurant, or to prepare food for consumption.[71]

Energy ratios represent the amount of energy obtained from food as a function of the energy consumed in its production.[72] 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 toward this end. There are various ways of analyzing the energy consumed in modern food systems, and this Note considers two of them: supply-chain analysis and life-cycle analysis.

Supply-chain analysis takes an in-depth look at food-related energy flows by examining energy flows by production stage.[73] The seven stages considered are: (1) agriculture, (2) processing, (3) packaging, (4) transportation, (5) wholesale/retail, (6) food service, and (7) household energy use.[74] The 2010 "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. [75] 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.[76] Of these categories, household energy use was the greatest in absolute value, but registered only a modest 3% growth in the time period studied (figure 1).[77] The processing stage showed the second highest overall energy consumption,[78] as well as a high growth rate of about 8% per year.[79] The food services stage, while not one of the greatest contributors

71. *See id.*at 3.

72. *See supra* notes 64 and 65 and accompanying text.

73. PATRICK CANNING ET AL., UNITED STATES DEPARTMENT OF AGRICULTURE, ECONOMIC RESEARCH SERVICE, ENERGY USE IN THE U.S. FOOD SYSTEM, ECONOMIC RESEARCH REPORT NUMBER 94, 19 (2010).

74. CANNING ET AL., supra note 73, at 19–20.

75. *Id.*

76. *Id.* at 20-21.

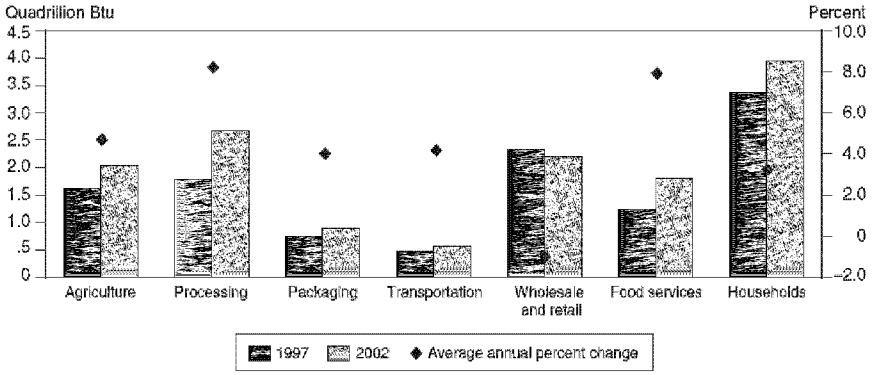
77. *Id.* at 20.

78. *Id.* ("On a per capita basis, this increase amounts to 2.7 million Btu[.]").

79. *Id.*

overall to energy consumption, has grown at similarly high rates,[80] perhaps due to a vast increase in dining out and prepared foods sales.[81] The transport stage of the food system, by contrast, consumed the *least* amount of energy in the U.S. food system, while registering a (comparably) moderate growth rate of an average of 5% per year over this ten-year period.[82]

Figure 1: Change in U.S. Energy Consumption by Stage of Production, 1997 to 2002.[83]



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 include 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-intensive foods.[84] Each of these shifts targets the stages of production where energy consumption is high or growing: households, processing, agriculture, and food services.[85]

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80. *Id.* at 20 fig.7.

81. *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.").

82. *Id.* at 20 fig.7.

83. *See* CANNING ET AL., *supra* note 73, AT 20.

84. *Id.* at 24–26.

85. *See id.* at 24.

Another method for measuring energy flows is life-cycle analysis.[86] 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"[87] 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 food production, storage, distribution, and preparation.[88]

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.[89] 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 CO_2 and non-CO_2 emissions in the *production* of food."[90] 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%.[91] 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," while dairy products are a close second.[92] Thus, the authors suggest what they anticipate would be a more fruitful and feasible way of reducing GHG emissions: shifting American dietary habits away from red meat and dairy products and toward less energy-intensive options.[93]

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86. *See infra* note 87 and accompanying text.

87. Edwards-Jones et al., *supra* note 10, at 267.

88. *See id* at 267; *see also* Weber & Matthews, *supra* note 59, at 3508.

89. *Id.*

90. *Id.* at 3512 (emphasis added).

91. *Id.* at 3508.

92. *Id.* at 3511.

93. *Id.* at 3508, 3512; *see also* Pimentel et al., *supra* note 2, at 459–60 (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").

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 its goal is to reduce GHG emissions.[94] 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 flow.[95] Thus, the local food movement may not play the *largest* role in reducing emissions. However, local food policies may still have an important impact on the carbon footprint of food: 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."[96] The next section considers whether policies that support local foods can work as methods to reduce the carbon footprints of food and the consumers that eat it.

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.[97] This section briefly reviews a few of these studies to demonstrate the variation in findings and finds that while reducing the number of food miles *may* play a role in reducing the energy inputs in food, any policy designed to reduce emissions must bear in mind various other considerations, such as whether the electrical grid[98] uses renewable sources of energy or fossil fuels, production methods, seasonality, and method of transport, and the ways in which they interact.

Some studies have found that local and regional food systems reduce the food's associated energy consumption and emissions

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94. *See supra* notes 73-93 and accompanying text.

95. *Id.*; CANNING ET AL., *supra* note 73, at 1; *see also* Pimentel et al., *supra* note 2, at 459.

96. Weber & Matthews, *supra* note 59, at 3508.

97. MARTINEZ ET AL., *supra* note 1, at 49.

98. "[A] network of cables or pipes for distributing power, esp. high-voltage transmission lines for electricity." THE NEW OXFORD AMERICAN DICTIONARY 743 (2d ed. 2005).

production. Pirog et al. considered the impact of food miles on greenhouse gas emissions in Iowa.[99] They found that replacing 10% of Iowa's produce consumption with local or regional produce would result in up to17 times less carbon dioxide emitted then the conventional system.[100] This 10% replacement, though, accounted for a relatively small reduction in emissions overall (6.7 to 7.9 million pounds).[101] They also considered the impact of reducing the average distance of produce transported within a multi-state regional system as opposed to Iowa alone.[102] They determined that an average reduction of transport distance of produce by 273 miles within the Upper-Midwest (Iowa, Minnesota, Wisconsin, Indiana, Illinois, and Michigan) "would translate into savings of 8.8 million gallons of diesel fuel per year"[103] and would decrease carbon dioxide emissions by 194.8 million pounds,[104] a considerably larger impact then reducing Iowa's food miles alone.[105]

Despite the promising results of this study, the authors did not consider the fuel-saving potential of other forms of transport, such as rail.[106] 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 truck's return trip to farm.[107] 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 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.[108] Thus, "[t]ransportation energy savings for the systems with shorter

99. PIROG ET AL., *supra* note 2, at 5.

100. *Id.* at 18, 33 tbl.9. Both systems used trucking as the sole mode of transport. *See id.* at 1-2, 20.

101. *Id.* at 18.

102. *Id.* at 19-20.

103. *Id.* at 20.

104. *Id.*

105. *See supra* notes 101-04, at 18-20 and accompanying text.

106. PIROG ET AL., *supra* note 2, at 1-2, 20.

107. *See id.* at 20.

108. *See id.* at 22.

transport distances [can be] overshadowed by higher energy needs in crop production."[109]

Various studies have both replicated and contradicted the findings of this study regarding 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.[110] 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.[111] 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.[112] 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%."[113]

Saunders et al., however, found that locally-produced dairy, lamb, apples, and onions consumed in the United Kingdom were less energy efficient than the same foods imported from New Zealand.[114] The study considered direct energy inputs into food production, as well as indirect inputs including fertilizers, agrichemicals, supplementary animal feed, buildings, machinery, transport, and, for onions, storage.[115] 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."[116]

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109. *Id.*

110. Michael M. Blanke & Bernhard Burdick, *Food (Miles) for Thought: Energy Balance for Locally-Grown Versus Imported Apple Fruit*, 12 ENVT'L SCIENCE POLLUTION RESEARCH 125, 125 (2005).

111. *Id.*

112. *Id.* at 125–26.

113. *Id.* at 126.

114. Caroline Saunders et al., *Food Miles, Carbon Footprintting and their Potential Impact on Trade* 1 (AARES 53rd annual conference at Cairns, 10–13 February 2009).

115. *Id.* at 6–9.

116. Wynen & Vanzetti, *supra* note 13, at 7 (referring to Saunders et al., *supra* note 114). Moreover, lamb has the highest carbon footprint of all meats; thus there

Even these few studies make it apparent that there is no consensus regarding whether eating local is a way for consumers to reduce their carbon footprint, or if the attempt to eat local food 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.[117] Given these difficulties, the next section of this Note examines 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.

V. 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.[118]

The studies discussed above suggest that eating local *can* be the energy-friendly choice, but is not necessarily so.[119] This section,

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is an argument to eliminate its consumption altogether to reduce carbon emissions. ENVIRONMENTAL WORKING GROUP, MEAT EATER'S GUIDE, AT A GLANCE BROCHURE, http://static.ewg.org/reports/2011/meateaters/pdf/report_ewg_meat_eaters_guide_to_health_and_climate_2011.pdf.

117. Edwards-Jones et al., *supra* note 10, at 267, 270.

118. Wynen & Vanzetti, *supra* note 13, at 2.

119. *Id.*

then, considers the other factors that come into play in the makeup of the carbon footprint of food.

An important first consideration is the type of energy used by the electrical grid in the area: food from a farm in an area that uses renewable energy for electricity production will, all else equal, have a lower carbon footprint than a farm whose electricity comes primarily from fossil fuels.[120] While the source of electricity may matter less for an open-air farm, electricity is a significant energy input in food grown in greenhouses.[121] 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."[122] Thus, a farm that purchases fertilizer from a factory that makes use of renewable energy inputs will have a smaller carbon footprint than one that relies on fossil fuels.[123] 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.[124]

This first issue implicates the second: the overall methods of production, processing, and packaging are critical in determining the emissions associated with a particular food product. As an initial matter, a food product that is *un*processed bypasses the food system stage with one of the highest overall and fastest growing energy uses,[125] but processed foods may have longer shelf lives, reducing the energy requirements for storage or shipment frequency. Organic agricultural farms use considerably less nitrogen fertilizer than conventional farms,[126] and tend to employ a greater number of

120. *See* Pimentel et al., *supra* note 2, at 461.

121. *See* Edwards-Jones et al., *supra* note 10, at 267 ("[I]n glasshouse production, direct use of electricity for heating and lighting may represent the greatest energy input.").

122. *Id.*

123. *See* Göte Bertilsson et al., *Energy Analysis of Organic and Conventional Agricultural Systems, in* ORGANIC CROP PRODUCTION – AMBITIONS AND LIMITATIONS 9–10 (H. Kirchmann et al. eds., 2008), http://pub.epsilon.slu.se/3513/1/Organic_Crop_Production_Chapter9_2008.pdf.

124. *See* Pimentel et al., *supra* note 2, at 466-68.

125. *Id.* 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.").

126. Bertilsson et al., *supra* note 123, at 1.

sustainable farming practices, such as intercropping and the use of manure instead of synthetic fertilizer.[127] Moreover, conventional farms tend to be highly mechanized, using large equipment that is dependent on fossil fuels.[128] Some studies have thus found that choosing organic products will reduce a consumer's carbon footprint.[129] However, not all organic farms are created equal, and conventional farms can reduce their own emissions with the use of light or efficient machinery[130] and more judicious use of nitrogen fertilizer.[131] Moreover, any farm that uses greenhouses to grow produce out of season or irrigates to increase yields augments its 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 temperature-controlled storage facilities.[132] 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.[133]

Third, and closely related to the issue of food miles, is the *type* of transportation used for shipment. Sea and rail are considerably more efficient than road or air transport,[134] with air transport consuming by far the most energy and producing the greatest amount of emissions.[135] 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

127. *See* Pimentel et al., *supra* note 2, at 464.

128. *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.").

129. *See, e.g.* David Pimentel, *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.").

130. *See* Pimentel et al., *supra* note 2, at 464.

131. Bertilsson et al., *supra* note 123, at 10.

132. *See* studies *cited supra* Part III.

133. *Id.*

134. Wynen & Vanzetti, *supra* note 13, at 1.

135. *Id.* at 5.

is likely that a switch from imported to locally produced goods [in Europe] will increase global energy use and pollution,"[136] rather than decrease it. Even in the U.S., where most domestic food products are transported by truck or rail,[137] the distance of travel may be less important that the frequency and energy efficiency of the mode of transport.[138] Even the distance and frequency that consumers travel to the grocery store or market contributes to the overall emissions in the food system.[139]

Finally, as as this section has suggested, each of these variables interact, and none is determinative in isolation.[140] Produce from a local farm may have a higher carbon footprint due to its large fossil fuel-run tractors and energy-intensive irrigation than produce grown using sustainable practices and subsequently shipped great distances via rail or sea.[141] Any government policy that endeavors to reduce the GHG emissions associated with the food system, and any consumer that seeks to reduce his or her own carbon footprint, does not have the benefit of one easy answer, but rather must consider all of these elements in conjunction.[142] 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.[143] While a thorough review of existing and potential carbon labels is outside the scope of this Note, any attempt to measure food's carbon impact must consider not only the distance travelled, but also the mode of transport, the various

136. *Id.* at 1.

137. Canning et al., *supra* note 74, at 18.

138. Wynen & Vanzetti, *supra* note 13, at 4.

139. *Id.* at 6.

140. Pirog et al., *supra* note 2, at 22.

141. *See supra* Part IV.

142. *See* Edwards-Jones et al., *supra* note 10, at 269-70.

143. Saunders et al., *supra* note 114, 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 10, 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.").

other sources of emissions throughout the food system, and the interaction between these variables as well.

VI. CONCLUSION

The American food system contributes 19% of the energy to overall American energy flows.[145] Energy efficiency, energy independence, and emission reductions have become hot button topics in the political arena,[146] and the local food movement has continued to find adherents who seek food that is fresh, that supports their local economies, and that represents an environmentally- and energy-conscious choice. This Note has considered whether the question of food miles is sufficient for even a rough assessment of food's carbon footprint, and argues that a more nuanced understanding of the food system is required for well-reasoned decisions to be possible. Ultimately, this Note argues that if governments wish to embrace this version of local food and choose to create local food policies specifically to reduce emissions and to improve sustainability, these policies cannot solely pertain to the distance food travels. To effectively work towards our energy goals, local food policies must engage the deeper issues of production methods, of energy efficiency, and of the sustainability of the food system in the United States.

145. Canning et al., *supra* note 74, at 1.

146. *See* sources cited, *supra* notes 4–6, 38–39.