Introduction to Use of Energy Corps Learning Modules and Knowledge Based Questions

Welcome to the Food Systems and Energy unit! The following pages will provide you with a guide for educating a variety of age groups on the subject of Food Systems and Energy. The following pages will outline the most important concepts to cover in any presentation related to a specific topic. It will also supply you with a set of questions appropriate for each age group that you must ask as part of any presentation/workshop/other questionnaire you conduct related to Food Systems and Energy. In addition to providing you with a starting point for your presentation, these questions provide change-in-knowledge data that fulfills your performance-measurement requirements. Finally, you will find some tips on how to work with different age groups. These are, however, just a starting point. Including this information in your presentation should be considered a minimum requirement. There are sources included to help you find images and other material. We hope this teaching module will help you give effective presentations throughout your term of service. This is a work in progress, and your feedback will help us improve our efforts to deliver information and evaluate the effectiveness of that delivery.

By the end of your presentation, you should have touched on each of the concepts listed below. Student knowledge of each concept will be tested by the questions found in this unit. Each age bracket will contain at least one question relating to each concept. This list and the included questions represent what you must do at a minimum—feel free to go beyond what is listed here and explore concepts in greater depth or detail. These questions and concepts are deliberately broad to allow you, the Energy Corps member, to tailor your presentation to a specific audience, region, or topic. Be creative! Contact your site supervisor or state coordinator with any questions.

Learning Objective

To teach students where the many energy inputs are in our modern food system, how the decisions they make have real energy impacts, and how making energy-conscious food decisions requires an uncomplicated knowledge base.

Core Concepts

The following are the key concepts that any presentation on Food Systems and Energy should include.

1. **Food energy breakdown**
    a. **Food energy as a percentage of total US energy**

2. **Different phases in the food system that use energy—explanation of the “Food System Concept”**
    a. **Production phase defined/stats**
    b. **Processing phase defined/stats**
    c. **Distribution phase defined/stats**

    d. Consumption phase defined/stats
    e. Waste phase defined/stats
        i. Waste exists during all phases—as sexy as food miles are to talk about and decry, waste is probably the biggest problem.
        ii. “25 percent or more of the food grown…(Scientific American article)
        iii. Waste has increased (see ERS pg 15)

3. Four ways to reduce energy usage at all points in the system

- **a. Reduce consumption of heavily processed/packaged/energy intensive foods**
    - **i. Processed food energy inputs —farm energy + processing**
    - **ii. Vegetarians/vegans are not off the hook!**
    - **iii. Too much packaging!**
    - **iv. Energy-intensive meat/dairy**
- **b. Efficient home storage, use, and preparation**
    - **i. Energy Star appliances**
    - **ii. Reducing your home food waste impact (composting, etc.)**
- **c. Buy in season, organic, and local if possible to reduce farm inputs**
    - **i. Buying seasonally, even if that means far away**
    - **ii. Fertilizer and pesticides require energy to make and use**
    - **iii. Pick-your-own and farmers markets**
- **d. Grow your own**
    - **i. Grow it yourself**

Explanation of Concepts

Section 1: Food Energy Breakdown

All our food comes from somewhere. That simple statement hides an extraordinarily complicated system of production, consumption, and waste —with massive energy inputs and losses at all phases. See the chart below.

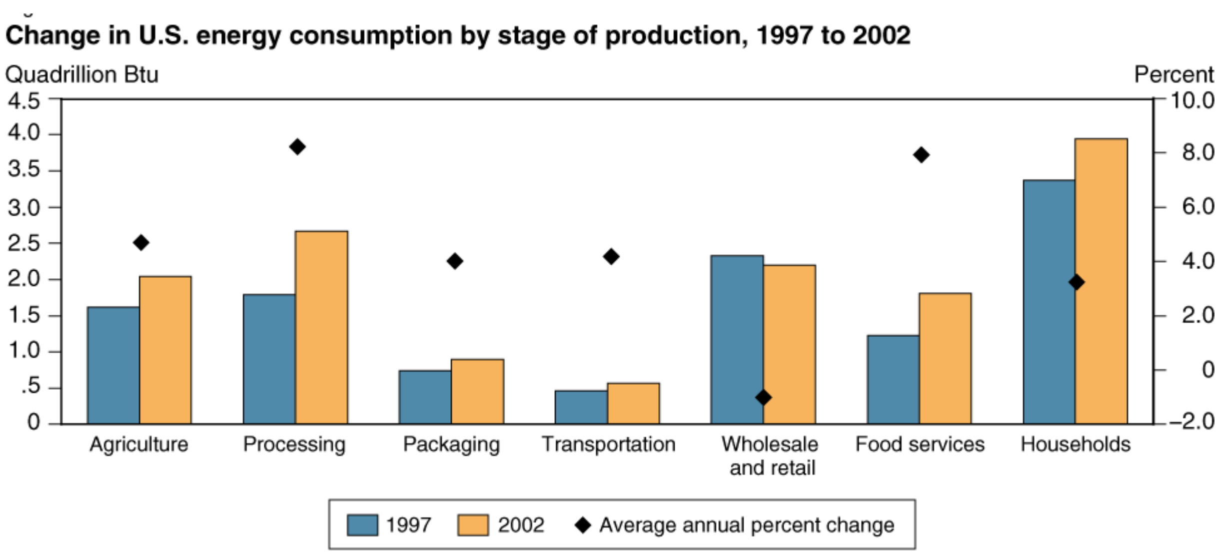

Figure 1. (Canning et al,) "Energy Use in the US Food System" (2010) USDA Economic Research Service

The chart above shows the amounts of energy that goes into each phase of the food system (for our purposes, we have simplified the phases somewhat compared to this chart) and the percent change between 1997 and 2002. (This information is from a 2010 publication. It is not apparent if more recent data is available, but feel free to search.)

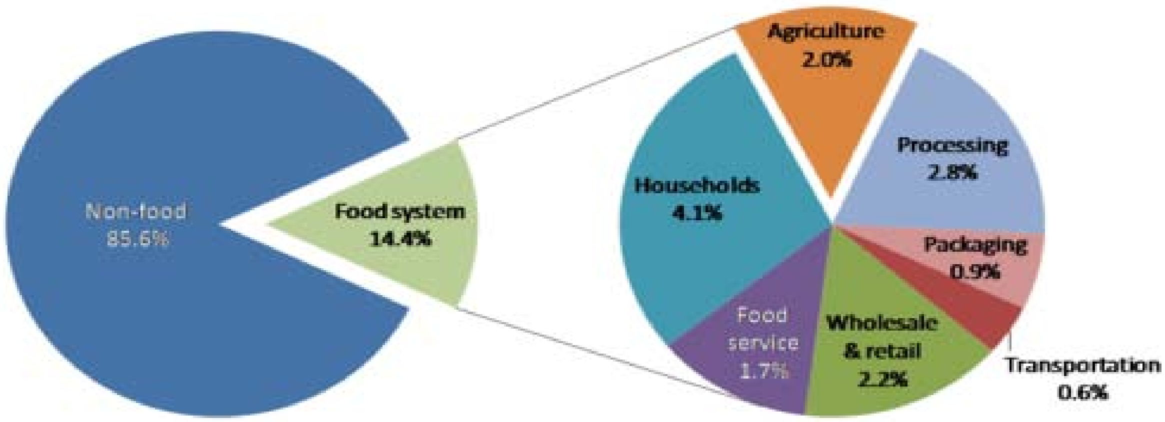

Figure 2. Michael Bomford "Beyond Food Miles" (2011) Post Carbon Institute (based on data from Canning, et al.)

This chart shows food energy as a percentage of ALL energy use in the United States

http://www.postcarbon.org/article/273686-beyond-food-miles#_edn5

Our food system is comprised of phases. These phases are found on Figures 1 and 2, but for the purposes of this module we have simplified them into the five found in Figure 3. They are Production, Processing, Distribution, Consumption, and Waste. Waste is a special because it occurs throughout the process, at each of the four other phases. Each of these will be defined further in a subsequent section.

As can be seen from Figure 1, food system energy consumption has increased since 1997, and these food related changes represent "roughly 80 percent of national energy flow increases over the 1997 to 2002 period." (Canning, et al. "Energy Use in the US Food System" (2010) USDA Economic Research Service, 11) It is plain to see that the food we eat requires enormous energy inputs and that those energy inputs do not always give an equal return. As can be seen in the figure to the right, the ratio of input-output energy to produce food in the United States is 15:1. A significant portion of this energy is fossil fuel energy.

Figure 3. Calories (kilocalories) in and out

Courtesy, University of Vermont Extension blog, http://blog.uvm.edu/cwcallah/2013/03/05/energy-and-waste-in-the-food-system/)

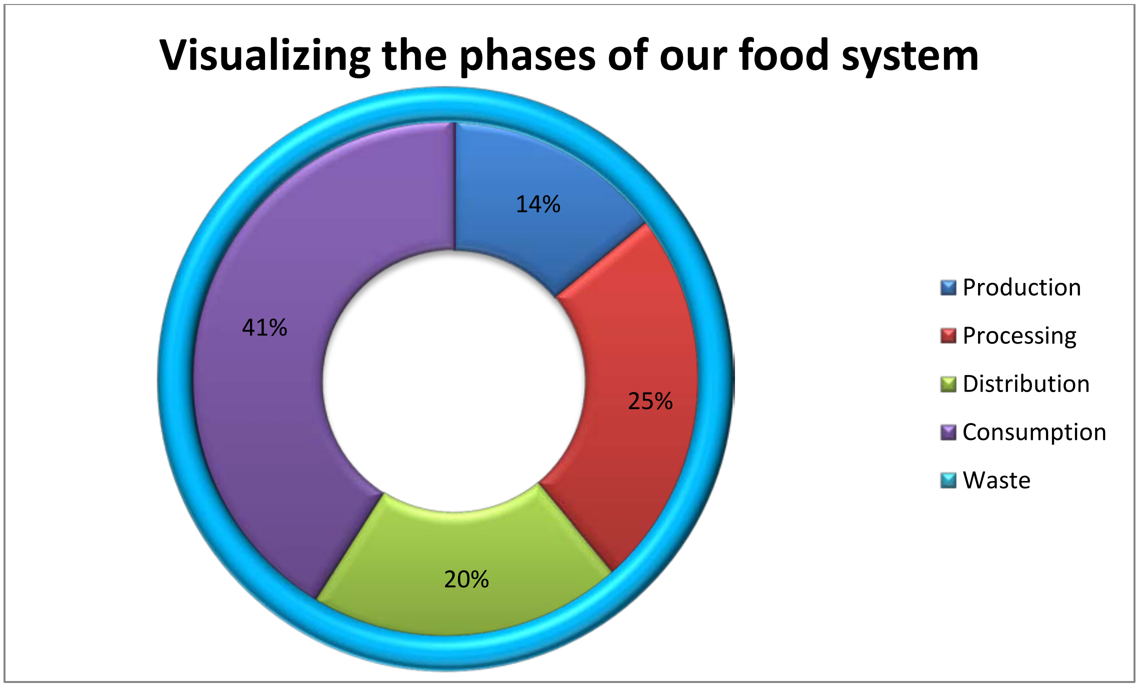

Figure 4. The phases of food production. This is a third way of looking at the data from the Figures 1 and 2, with the phases arranged in the order they occur. Waste is given no percentage because it is not quantified in the other figures and is portrayed as a ring that surrounds the entire system because waste occurs at *all* points in the system.

Section 2: Phases of our Food System

Production Phase: Production is the process of growing, raising, managing, and harvesting the raw materials that make up various foodstuffs that we eat. This includes agriculture and livestock as well as the fishing industry. In agriculture, our foodstuffs are derived first and foremost from photosynthesis, where plants take energy from sunlight and use it to drive the production of organic compounds —in other words they use it to grow. The bottom line is that "Plant growth is not energy-efficient: photosynthesis typically converts less than 2 percent of incoming solar energy into stored energy. That low rate is worsened when animals convert plant matter into beef (5 to 10 percent efficiency) or chicken (10 to 15 percent)." (Michael Webber, "How to Make the Food System More Energy Efficient" *Scientific American* December, 2011 http://www.scientificamerican.com/article.cfm?id=more-food-less-energy) By doing the math, we find that when we eat beef, we are getting just *two tenths of one percent* of the solar energy that made it all possible. Factor in our own bodies' energy conversion rates, and that number will drop again. There is nothing anyone can do about this—it's just how nature works. However, it *should* hammer home the reasons why the energy inputs we CAN control, must be.

Our modern agricultural system is highly complex, but some energy inputs are common to all of them. All agricultural operations rely on water, and in the case of the largest commercial growers these water inputs can be enormous. In many cases water is distributed by Irrigation systems requiring electricity to function. Another direct energy input is petroleum or natural gas-based fuels used for operating equipment associated with tilling, planting, harvesting, and handling farm products. Petroleum and natural gas are also used in the production and transport of many fertilizers, herbicides, and pesticides. The combination of fuels, electricity, fertilizer, and pesticides used in the US adds up to about 1.7

quadrillion Btus of energy in one year. Put differently, that is almost 15 billion gallons of gasoline (1.7 quadrillion divided by 114,000, the approximate number of BTUs in a gallon of gas.) (See Miranowski, "Energy Consumption in US Agriculture" in eds J.L. Outlaw, K.J. Collins, and J.A. Duffield, *Agriculture as a Producer and Consumer of Energy.* CABI International, 2005. NCAT has this book.) All of that being said, there have been advances in commercial agriculture to reduce energy use: more fuel efficient tractors and GPS-guided "precision planting" are already par for the course for the biggest farmers, saving many gallons of fuel. Also, economy of scale plays a role: when measured in terms of the ratio of crop output to energy input, larger farms CAN be far more efficient than smaller ones. But, again this is not always the case. The challenge is that there is no single correct answer. As far as energy goes, neither commercial agriculture nor small, localized, diffuse agriculture is always worse or always better. This will be a theme throughout this module.

The production phase for livestock also involves many inputs. First and foremost, livestock require food themselves, which, if they are raised or finished in feedlots/confinement, is derived from other farms. These inputs, in the form of feed for livestock, frequently require most of the inputs listed above for food grown for human consumption. Livestock has some added inputs however, including climate control and lighting for buildings and equipment, as well as fuel costs associated with equipment used to manage livestock. According to Miranowski (see above citation) in 2002 livestock operations accounted for 39% and 47% respectively of the total US farm related fuel and electricity purchases . As illustrated in Figure 6, we put as almost as much energy into producing feed for the livestock we raise as we do into crops for us to eat. This "resource stacking" or "resource density" makes animal products less energy efficient than non-animal foodstuffs. That said, and continuing the theme of "no one right answer," vegans and vegetarians are not off the hook as we will see in the next section.

A note on genetically modified organisms/genetically engineered foods (GMOs or GEs): genetically engineered varieties of corn and soybeans are extremely popular for their resistance to herbicides such as RoundUp as well as for containing a gene that makes them toxic to certain pests. According to an article published in the peer-reviewed *Environmental Sciences Europ*e by Washington State University Research Professor Chuck Benbrook, GMO varieties have *increased* the use of herbicides, contrary to their makers' claims. This is in large part due to herbicide-resistant weeds that are evolving. Herbicide manufacture has energy inputs of its own, including hydrocarbons (fossil fuels).

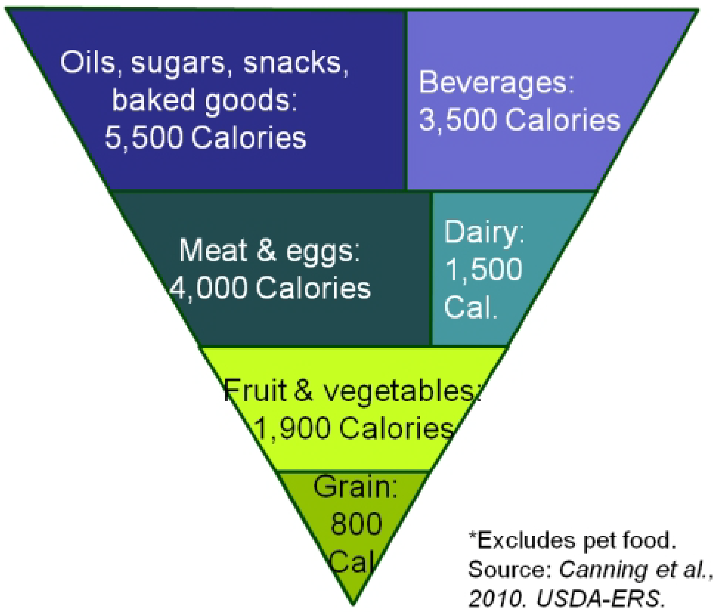

Figure 2. Courtesy, Michael Bomford "Beyond Food Miles" (2011) Post Carbon Institute (based on data from Canning, et al)

This figure shows per-capita calorie input for each product. In other words, this each box contains the number of calories of energy needed to make the recommended daily serving for the average person, according to USDA. Note its inversion relative to the regular Food Pyramid. A poor diet can be an energy-intensive diet!

Processing/Packaging Phase: After farm products are harvested, they undergo the processing/packaging phase. This includes the trip from the harvesting location to the processing location, all the steps in processing raw materials into a product for human consumption, and packaging before shipping the product to stores. Major energy inputs include fuel for transportation to processing facilities and electrical and other energy inputs used in the processing process. Transportation may be done by ship, truck, train, or plane. Air freighting of foodstuffs is by far the most energy intensive, but it also represents a very small (1%) share of food transport. Some foods may be processed on site and not undergo a pre-processing transport phase. Processing can involve cleaning, cutting, shaping, freezing, cooking, concentrating, and the addition of energy-intensive additives and preservatives.

Look at the figures above, which was adapted by Michael Bomford at the Post Carbon Institute from Table 6 in Canning. et al., "Energy Use in the US Food System" (2010) USDA Economic Research Service. Some of the highlights:

- Baked/baking goods, processed fruits/vegetables, snacks, spices, condiments, oils, sugary products, beverages (including alcohol) and cereals are all major culprits. Each of these has 40% or more of the total energy used to produce them embedded in processing and packaging combined. Packaging is a particularly energy intensive process, with the added issue of disposal. Plastic for beverage containers is a particular concern, as its production involves petroleum.
- According to the USDA, in the case of beef, pork, poultry (not eggs), fish/seafood, and other meats, roughly 30% of the energy is concentrated in this phase, though packaging holds a relatively small share of that 30%, at less than 5 percent in all cases. Compare this with sugars/sweets at nearly 10% of energy into packaging, or beverages at 22% and 24% for alcoholic and nonalcoholic, respectively.

- While animal flesh protein is a very energy intensive food, especially in the processing phase, vegetarians and vegans are not off the hook when it comes to energy intensive foods. Textured Soy Protein or Textured Vegetable Protein is very energy intensive. The protein extraction phase is accomplished using the hydrocarbon Hexane, which is refined from crude oil. The extracted proteins then must be heated and extruded into shapes. All of this takes lots of energy.

One of the primary themes we want students to take away is that being a truly energy-conscious eater in our modern food system is not as simple as being vegetarian, being a locavore, or eating organic. There is an extra layer of nuance that must be added to decision making. An example: a commercial organic soda is still a soda—and thus probably represents few energy-related gains over non-organic soda. However, consider apple cider pressed by hand from apples grown a few miles up the road. Whether the apples are organic or not, that *does* represent significant energy gains over both sodas.

Distribution Phase: Distribution starts when the products leave whatever processing sequence they have gone through, whether that's a minimal washing and drying; cutting, freezing and packing; or an intensive substance separation process involving various solutions and high heat inputs. Distirbution is made up largely of two components; transport, and shelf/warehouse storage. Most products will spend some amount of time at a storage facility and/or wholesaler and/or retailer. This transport is another component of what we call "food miles", i.e. how far a given food item has travelled before it arrives on our plates. How energy intensive these food miles are depends on the mode of transport. As previously mentioned, trains and ships are more energy efficient relative to how much they carry than are trucks or airplanes. It *is* possible for an item to be more energy efficient even if it comes from far away, depending largely on mode of transport. For example, according to a presentation from the University of Illinois Railroad Engineering Program, transporting food (or any good for that matter) by rail is 3.5 times more efficient than by truck. So an apple that travels 1,000 miles by train may require *less* energy (in the transport phase) than an orange that travels 500 miles by truck, even though the apple travelled twice as far. Food miles are an attractive talking point for many, but they are often misleading. Check the "Resources" section of this module for more information on various forms of transportation. Whatever the destination of the products, climate controlled structures, such as the frozen sections of grocery stores (and of the suppliers they buy from) require energy. Lighting and general heating/air conditioning for the facilities also requires energy. Fresh produce, fish, beverages, and frozen goods are examples of cases in which about 30% of the embedded energy is used during the wholesale/retail process. (Canning et al, 2010)

Consumption Phase: Consumption represents the largest share of our overall food energy pie (See Figure 3). This encompasses driving to stores and the energy used to run our refrigerators, freezers, stoves, microwaves, summertime grills, dishwashers, etc. For the purposes of this module, it also includes our visits to restaurants and all the associated energy costs to get us in the door and the food on our plates. (Canning and Bomford separate this out.) The two most important factors are our purchasing choices and our food prep and storage appliances. Energy efficient appliances are essential. Purchasing choices entails both what we buy and how much. Some foods, such as beef, have a great deal more energy embedded in them than others. Also, the more food you buy in general, the more energy you are using, both in terms of embedded energy and storage/prep energy. Finally, as far as food choices go, this is where everything gleaned in the previous sections can be put into action. Below you will find four strategies that the consumer can enact during the consumption phase that save energy over the entire system. Lastly, the consumption phase also involves waste.

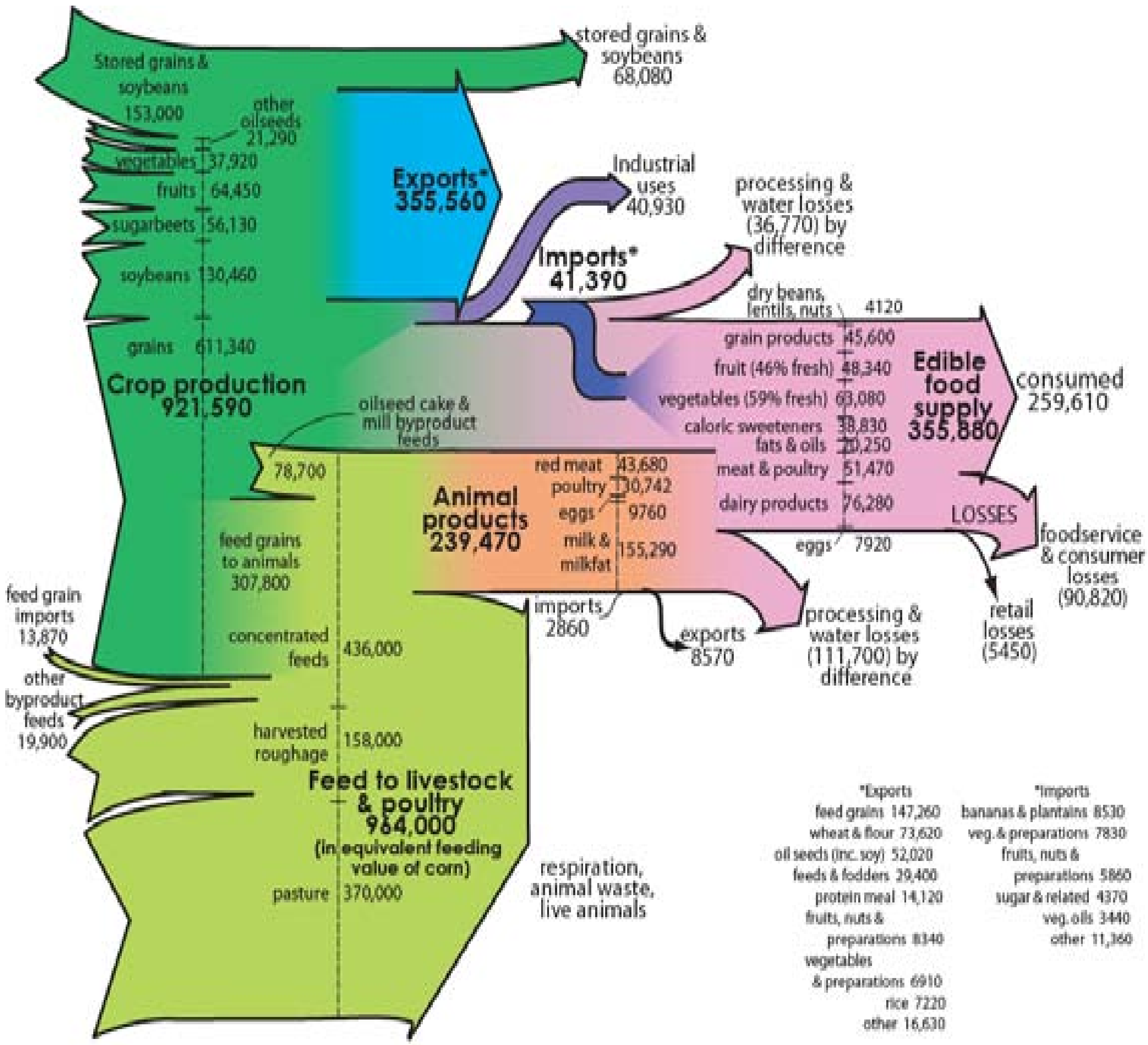

Figure 3. Inputs and outputs in our food system, measured in millions of pounds. This chart shows the various inputs in millions of pounds (1,000 million pounds = 1 billion pounds), where in the system those inputs are, and where the outputs are. It takes into account things like exports. What it really shows is the way in which the process of making food intensifies and concentrates energy as it goes through the system.

(Courtesy, University of Michigan, http://css.snre.umich.edu/css_doc/CSS01-06.pdf)

Waste Phase: Waste occurs in every phase of our food system, starting with crop production and following through all the way to our kitchens. This is why Figure 2 portrays it as a ring encircling the other four phases. From an energy perspective, food waste may be the most important of the phases, simply because for all that energy put in, humans get no caloric energy from it.

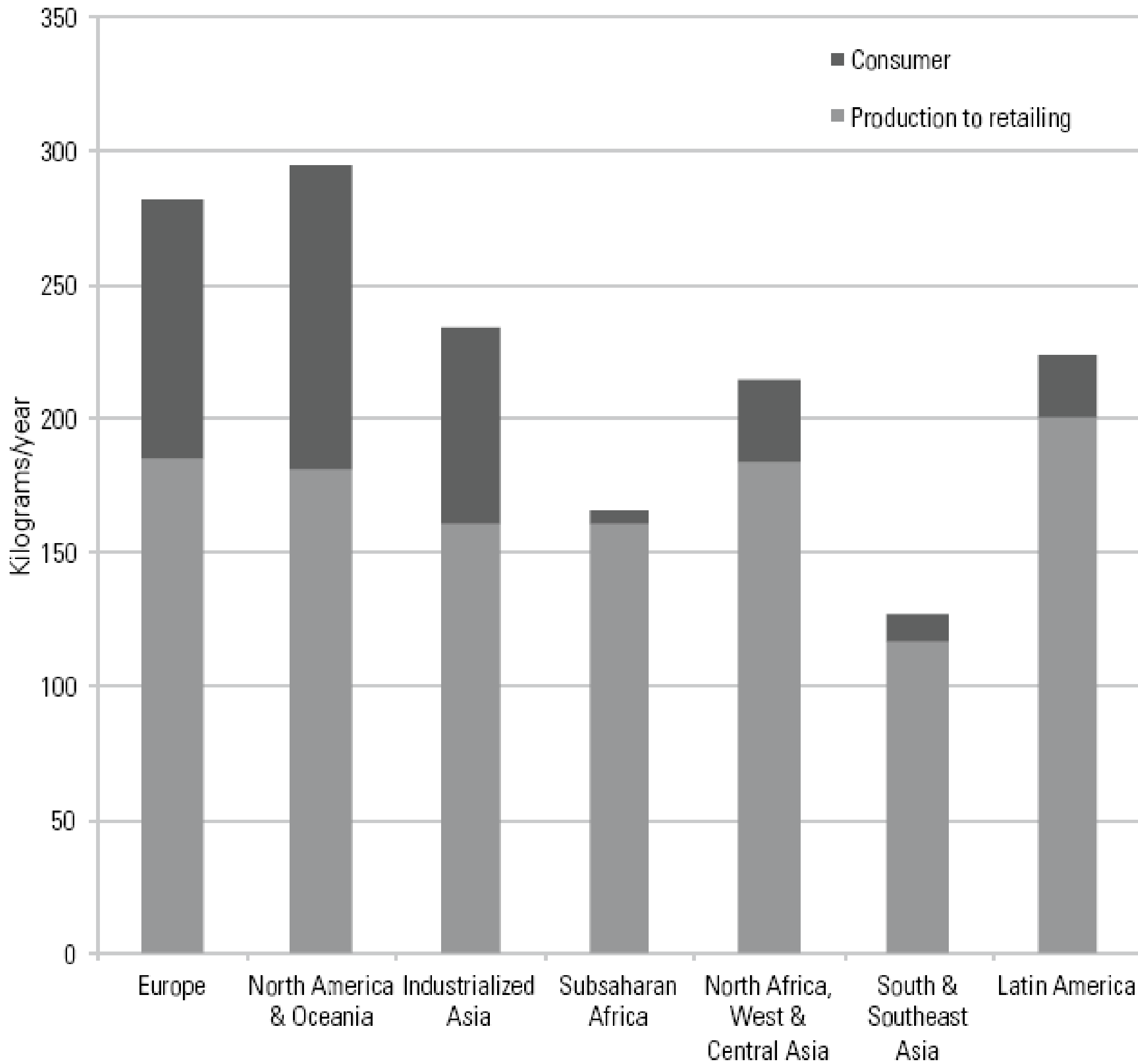

Figure 4. Per capita food losses and waste broken down by region. From Gustavsson et al, UN Food and Agriculture Organization, 2011. (Courtesy, Post Carbon Institute, http://www.postcarbon.org/article/1658954-so-much-wasted-energy-rethinking)

Look at the numbers according to a *Scientific American* article: "An egregious 25 percent or more of the food grown is wasted annually. That massive amount represents 2.5 percent of annual U.S. energy consumption—more energy than all the ethanol produced in 2011 in the U.S. and more than the energy that will be produced in 2030 from lifting drilling restrictions today on the outer continental shelf. Simply decreasing the amount of food we throw away might reduce energy consumption and greenhouse gas emissions more over the next decade or two than many of the expensive or controversial energy supply policies that have been proposed." You can see the raw numbers—of 355 billion pounds of food, 95 billion pounds are lost, which works out to between 26%-27%. That only accounts for losses in the distribution and consumption phases of our food cycle. (Described in the chart as “foodservice & consumer losses” and “retail losses.”)

Waste and losses occur in the production and distribution phase as well. Fruit that is picked thousands of miles away, such as tropical fruits like mangos or papayas, must be picked well before it is ripe so that it will have a long enough shelf life. If picked too late, the fruit will be overripe upon arrival and may not be accepted by the supermarket. If turned away, the energy (in particular fossil fuel energy) used to grow it, pick it, and transport it is wasted. This is one consequence of high food miles. Expanding the food waste definition further to include damage or spoilage of crops in the field, whether due to bad practices or misfortune, reveals an even greater potential for energy loss/waste. Our current industrial agricultural system is high-yield and very energy intensive, but it lacks much in the way of genetic diversity, particularly when it comes to crops such as soybeans and corn. Basic genetics tells us that any system with low genetic diversity is far more vulnerable to pathogens. This exact scenario precipitated the Irish Potato Famine of the 1840s, which was a waste of energy on a massive scale, with deadly consequences.

The Waste Presentation Option: The food system is very complex, and your presentation may not be able to cover everything contained in this module. If you had to present on just one phase, waste would be a strong choice. It has its own complexities and represents arguably the lowest of the low-hanging fruit in the battle to reduce energy consumption in our food system. If you think this is the case, speak with your supervisor and/or state coordinator. Fortunately, much of the remaining information and some (but not all) of the questions are still applicable.

Section 3: Four Ways to Reduce Energy Use Across All Phases of the Food System

This module has repeatedly emphasized that there is no single simple or easy way to reduce our food energy footprint —there are too many complexities, too many variables for something as simple as eating vegetarian or being a locavore to make any real difference. A slightly more nuanced approach is required. Each of these four strategies by themselves will help students make at least minor reductions in their food energy footprint across the board. Each one positively impacts all or most of the five phases. Phase(s) may be left out or combined if the benefit is very slim, repeats itself, or is difficult to discern. You can recommend all of these, or choose to focus in on one or two specifically based on your audience. Be creative in how you teach these; use examples, demonstrations, or graphics to make your point. These do take a little work, and people can be very work-averse, particularly when it comes to saving energy. If you need help selling you students on them, there are health benefits to each of these. Though explaining each of these is beyond the scope of this module, you can research them easily through the included resources.

Reduce Consumption of Energy Intensive Foods: Energy intensive foods fall into several categories, including processed foods, snacks, meats/poultry/seafood; frozen fruits/vegetables; and anything with heavy packaging, especially beverages. Eating less of these has the following benefits:

- Production Phase: Meat and poultry must eat to live, just like us. This involves energy, either crops grown for the animals or vast grasslands that must be managed and maintained. When you eat a portion of meat, you are really eating a portion of all that embedded energy that went into months or years of growing food for the animal. Less animal protein eaten means less energy used to feed the animal. (Note: This is not to in any way discourage all eating of animal protein. Vegetarianism is not automatically better. Vegetarians too must make choices.
- Processing Phase: Processed foods are derived from raw materials—crops or animals grown or raised. They then undergo one or more of a wide variety of processes: heating, grinding, component separation, extrusion, freezing, cutting, etc. These processes involve electric power, chemicals, and fossil fuels. Thus it follows that the less processed food you eat, the less of this energy is embedded in your diet. Furthermore, the packaging of processed foods involves energy, in particular plastics. Some common vegetarian/vegan meat substitutes are among these energy intensive processed foods.
- Distribution Phase: Processed foods and meat/poultry/seafood involve lots of food miles, going to and from central processing locations. Many are perishable and as such have high storage costs (climate controlled trucks or rail cars, freezer sections). They may also be heavy, such as beverages in glass containers, thereby reducing the fuel mileage of trucks.
- Consumption Phase: Buying less frozen packaged foods or refrigerated bottled beverages reduces the need for things like extra freezers or refrigerators, which add to both the electricity bill and food energy footprint.
- Waste Phase: Packaging, packaging, packaging. Plastic packaging from food, especially plastic bottles, is a disaster both from the standpoint of the petroleum used to make it and its impact on the environment. Recycling is great, but using less in the first place is better. We can call this the "an ounce of prevention is worth a pound of cure" approach to food energy.

Efficient Home Storage, Use, and Preparation: The consumption phase occupies the largest share of the food energy pie outside of waste. A significant portion of our food energy is determined by how efficient we are with what we buy and use. Steps to take include buying energy-efficient appliances, properly preserving food and using food before it spoils, and composting food scraps. Benefits of these include:

- Production: If you properly preserve and efficiently use what you do buy (less spoiled food found in the depths of the fridge) then you will use less overall, which will reduce your production footprint, since it takes less energy to make less food.
- Processing *and* Distribution: Again, efficient home usage and storage means you purchase less, which reduces energy usage here.
- Consumption: Efficient and properly maintained appliances will use less electricity and thus reduce your energy footprint associated with food storage and prep—this includes stoves, ovens, freezers, microwave ovens, and refrigerators. Using the maximum amount of each item you buy reduces trips to the store, thereby saving gas. Finally, if you properly preserve and use all your food, you and your family get the most for your money.
- Waste: Composting food scraps reduces the amount of food waste in landfills and gives you a resource you can use for growing your own food (see below).

Buy Food That Is One or More of the Following: In Season/Locally Grown/Organic: This strategy calls for some decision making and some basic knowledge about how food systems function and where energy inputs are concentrated. It also tackles some of the conundrums that come with one-sized-fits-all solutions such as “locavorism.” Something such as a tomato grown *out of season* on a *local farm* in a heated greenhouse (fossil fuel) is likely to be less energy efficient than a tomato grown *in season far away* that is transported by the most efficient means available. A tomato grown *organically out of season in a heated greenhouse far away* might be worse than either (from an energy standpoint) despite being organic. In other words, no chemicals were used, but the energy cost of the heated greenhouse and long distance transport might outweigh that consideration. Because this is something that is not feasible to know for certain for every item, you should recommend that students use the following sequence. Look first for food grown in places where it is in season, second for food that is grown locally, and third that is grown using organic practices. Note that this does not necessarily mean USDA certified organic. There are many responsible growers who use organic practices without going through the USDA certification process. Seasonality, proximity, sustainably/organically grown, in that order, will at least help people avoid the worst offenders. If consumers can establish all three, then that is the food energy equivalent of hitting 21 in a game of blackjack. Another way to think about proximity is to get as close to the source as possible—farmers markets, CSAs, farm-work programs, and farms that let consumers pick their own produce are good ways to bypass entire sections of the food system. There are a number of benefits to the seasonal/local/organic method:

- Production: Reduction of farm inputs such as greenhouse heating (seasonal), mechanical harvesting (local, in the case of pick-your-own), and synthetic fertilizer, pesticides, and herbicides (organic).
- Processing *and* distribution: Local food will have less food miles. Pick it yourself and you cut out some processing and distribution energy (though your car may now represent some very inefficient food miles). Farmers markets, CSAs, and pick-your-own will use little or no packaging.
- Waste: Buying close to the source, particularly straight from the source, allows you to precisely control how much you purchase. You are not hindered by pre-arranged portion sizes or bundles.

Grow/Raise Your Own Food: This is arguably the strategy with the most commitment involved, yet also with great potential reward. Growing your own food allows you to control every part of the process and takes the guesswork out of all phases. This is true whether for herbs on the window, a few chickens in the back yard, or a full vegetable garden providing most of your needs most of the time.

Benefits include:

- Production: You know what the inputs are and can control them. You can choose not to use pesticides or synthetic fertilizer, thus cutting out many production energy costs. Assuming it’s a small setup, you probably don’t need much machinery.
- Processing/Packaging: If an item comes straight from your garden to your kitchen, then there are no processing/packaging costs as they exist in the commercial food system. Animals you raise yourself for food might have a processing/packaging energy cost.

- Distribution: Again, if you've grown it yourself and it's coming straight to your kitchen, then you've cut out this phase entirely.
- Consumption: Growing food yourself means it still must be stored and kept, but you can take only as much as you need each time you harvest, leaving the rest to continue to grow. This saves room in refrigerators and freezers for those things that you don't produce at home. It also reduces trips to the store.
- Waste: You have a built-in use for composted food scraps which can be used to feed a garden or perhaps even animals. One caveat is that it is now up to you to avoid food spoiling in your field or in your flower pot—you must be a responsible grower when it comes to avoiding waste, just like the commercial growers have to do.

Key Relevant Definitions

Community Supported Agriculture (CSA): an alternative, locally-based economic model of agriculture and food distribution. A CSA also refers to a particular network or association of individuals who have pledged to support one or more local farms, with growers and consumers sharing the risks and benefits of food production. CSA members or subscribers pay at the onset of the growing season for a share of the anticipated harvest. Once harvesting begins, they receive weekly shares of vegetables and fruit. (www.wikipedia.com)

Embedded Energy/Embodied Energy: the sum of all the energy required to produce any goods or services, considered as if that energy were incorporated or "embodied"' in the product itself. (www.wikipedia.com)

Food Miles: The distance that a food product travels from where it is produced to where it is sold or consumed.

Genetically Modified Organism: An organism whose genetic material has been altered using genetic engineering techniques and used to grow genetically modified foods. Examples are corn, soybeans, and some fruits.

Organic Farming: A farming system that avoids the use of synthetic and harmful pesticides, fertilizers, growth regulators and livestock feed additives.

> Note: This definition of organic farming is for our purposes primarily. There is no one definition of organic farming, and the USDA has a very strict definition. However, in this module, when you see the word organic, this should be the definition you work with. Also, see "Sustainable Agriculture/Farming" definition below since the two are closely related.

Pick-Your-Own: Events or programs where farmers allow consumers to harvest their own produce directly from the field.

Sustainable Agriculture/Farming: Sustainable farming meets environmental, economic, and social objectives simultaneously. Environmentally sound agriculture is nature-based rather than factory-based.

Economic sustainability depends on profitable enterprises, sound financial planning, proactive marketing, and risk management. Social sustainability results from making decisions aimed at maximizing the quality of life of both the farm family and local community.

Some Pointers on Different Age Groups

Part of your job as an Energy Corps member is to be able to work with a variety of age groups. To that end this unit provides you with questions deemed by NCAT to be appropriate for a given age group. Here are a few things to keep in mind:

- Some students, particularly younger students, will not have the same concept of "energy" that we do. They may think of energy as the sugar rush they get from candy. For example, they may not have ever been taught what electricity is. This doesn't mean you can't present to them, but you must account for their level of learning.
- No matter what age, try to assess the educational level of your audience and don't assume they know what you know.
- If you can coordinate with a teacher in advance of a classroom visit, do so.
- Have fun: be creative, especially with younger groups. They don't have long attention spans, but they will get excited if something is fun and different.
- When presenting on food, keep it simple. Younger students will likely be naturally curious and you may find it beneficial to focus on the idea of the food system as a circle where energy for our bodies is derived from plants and animals, which got it from the sun and the soil and the food they ate.

The Questions

We have provided you with the following questions, approximately five for each of three age groups. They can be found in the following pages.

Grades 3 – 5

1. How many calories of energy input does it take to produce 1 calorie of food energy for human consumption?
   a. 1 —3
   b. 5 —8
   c. 10 —13
   d. **15 or more**

2. Which of these is an example of a processed food? (Circle all that apply.)
   a. **Candy bar**
   b. **Frozen vegetables**
   c. **Potato chips**
   d. Raw carrots

3. Which of the following is something you can do at home to reduce your food energy footprint ? (Circle all that apply.)
    a. Buy more processed foods like chips and cookies
    b. **Start your own garden**
    c. **Eat smaller portions**
    d. **Keep the refrigerator door closed between snacks**

4. Which of these uses more energy for transport to the grocery store?
    a. **An Apple picked 1,000 miles away**
    b. An Apple picked 50 miles away
    c. They use the same amount of energy

5. How can growing your own food reduce the energy you use? (Circle all that apply.)
    a. **You don't need to go to the store as much (**distribution)
    b. **You don't need any plastic packaging** (processing)
    c. **You can pick just as much as you need and leave the rest to keep growing** (waste)
    d. Growing your own food has no impact on your energy use

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Grades 7 —9

1. How many calories of energy input does it currently take in our industrial food system to produce 1 calorie of food energy for human consumption?
    a. 1 —3
    b. 5 —8
    c. 10 —13
    d. **15 or more**

2. Synthetic fertilizer for growing plants is a food-related energy input. To which phase of the food system does it belong?
    a. **Production**
    b. Processing/packaging
    c. Distribution
    d. Consumption
    e. Waste

3. You have the option to buy a tomato grown in Location A, where it is tomato season, or in Location B, where it is not tomato season. Which tomato will require LESS energy to be grown?
    a. **Location A (In season)**
    b. Location B (Not in season)
    c. The energy usage is the same for both

4. Which of these is a place where waste occurs in the food system? (Circle all that apply.)
    a. **Production**
    b. **Processing**
    c. **Distribution**
    d. **Consumption**
    e. There is no waste in the food system

5. Which phases of our food system occur primarily on farms?
    a. **Production**
    b. Processing/packaging
    c. Distribution
    d. Consumption
    e. **Waste**

High School – College/Adult

1. How many calories of energy input does it take to produce 1 calorie of food energy for human consumption?
    a. 1 —3
    b. 5 —8
    c. 10 —13
    d. **15 or more**

2. How can reducing your consumption of processed/heavily packaged foods reduce your food energy footprint? (Circle all that apply.)
    a. **Reduce petroleum use related to food**
    b. **Reduce electricity use related to food**
    c. **Reduce food storage costs**
    d. **Reduce waste**

3. Which of these is a way to reduce your food-related home energy use? (Circle all that apply.)
    a. Buy an extra freezer
    b. **Buy energy efficient appliances**
    c. **Eat/serve smaller portions**
    d. **Maintain your appliances**

4. You have the option to buy a tomato grown in Location A, where it is tomato season, or in Location B, where it is not tomato season. Which tomato will require LESS energy to be grown?
    a. **Location A (In season)**
    b. Location B (Not in season)
    c. The energy usage is the same for both

5. Which of these is a potential benefit of growing your own food? (Circle all that apply.)
    a. **Reduce gasoline use**

b. Save time spent preparing food
c. **Throw less packaging away**
d. None of these

That ends the questions part of this unit. We encourage you add your own questions to these.

Sources to Get You Started (Except where noted, all questions were developed with information from these sources.)

ATTRA —www.attra.ncat.org

ATTRA (one of NCAT's sustainable agriculture programs) has many publications that get into specific aspects of the broad points discussed in this module.

C2ES —Center for Climate and Energy Solutions —www.c2es.org

National non-profit with lots of information about various subjects, including a piece on methods of freight transport.
See link: http://www.c2es.org/technology/factsheet/FreightTransportation

Center for Ports and Waterways —

CPW, along with the Texas Transportation Institute, prepared a report for the US Department of Transportation Maritime Administration (MARAD) and the National Waterways Foundation that studied different modes of freight transport. It covers fuel efficiency of rail, trucks, and ships.
See link: http://www.americanwaterways.com/press_room/news_releases/NWFSTudy.pdf

National Center for Appropriate Technology – www.ncat.org

Your own organization! NCAT and Energy Corps have a wealth of resources available, including the experiences of staff and past Energy Corps members.

National Energy Education Development Project – www.need.org

This organization has a massive set of teaching manuals and "infobooks" covering all age groups.

United States Department of Energy —www.energy.gov

The pre-eminent federal organization for energy topics can also link you to many other government websites, including the EPA's Energy Star. It is useful if you're studying farm-related energy.

Post Carbon Institute —www.postcarbon.org

The source of some of the materials cited in this module, PCI has other resources related to sustainable agriculture.

United States Department of Agriculture

The USDA has many resources related to all aspects of agriculture and the food system.

Feel free to find your own sources to supplement these! Have fun and good luck!