Agricultural Outlook Forum 2011
Promoting Sustainable Agriculture through Regional Food Sheds

Energy Usage in Regional Food Production

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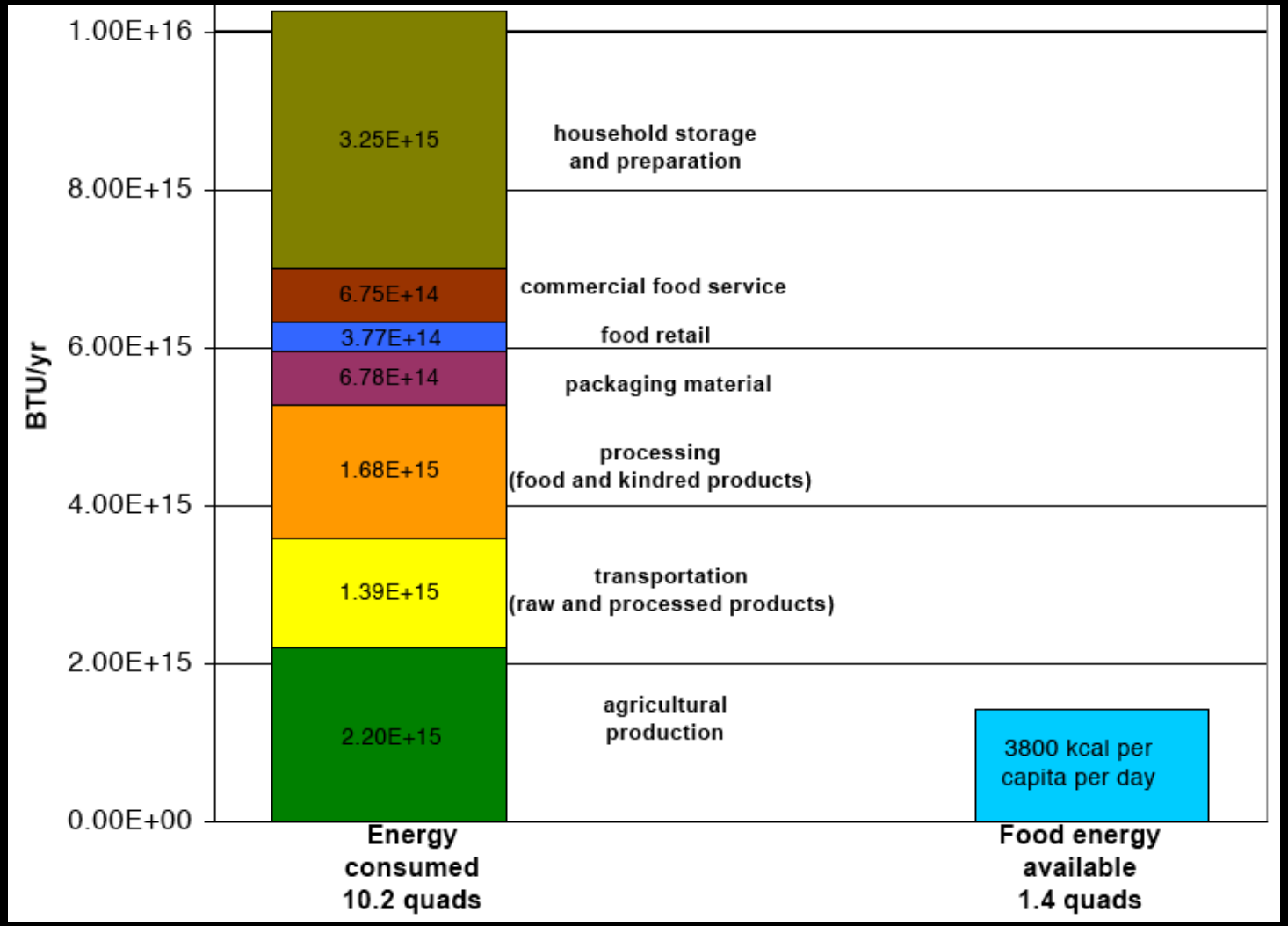
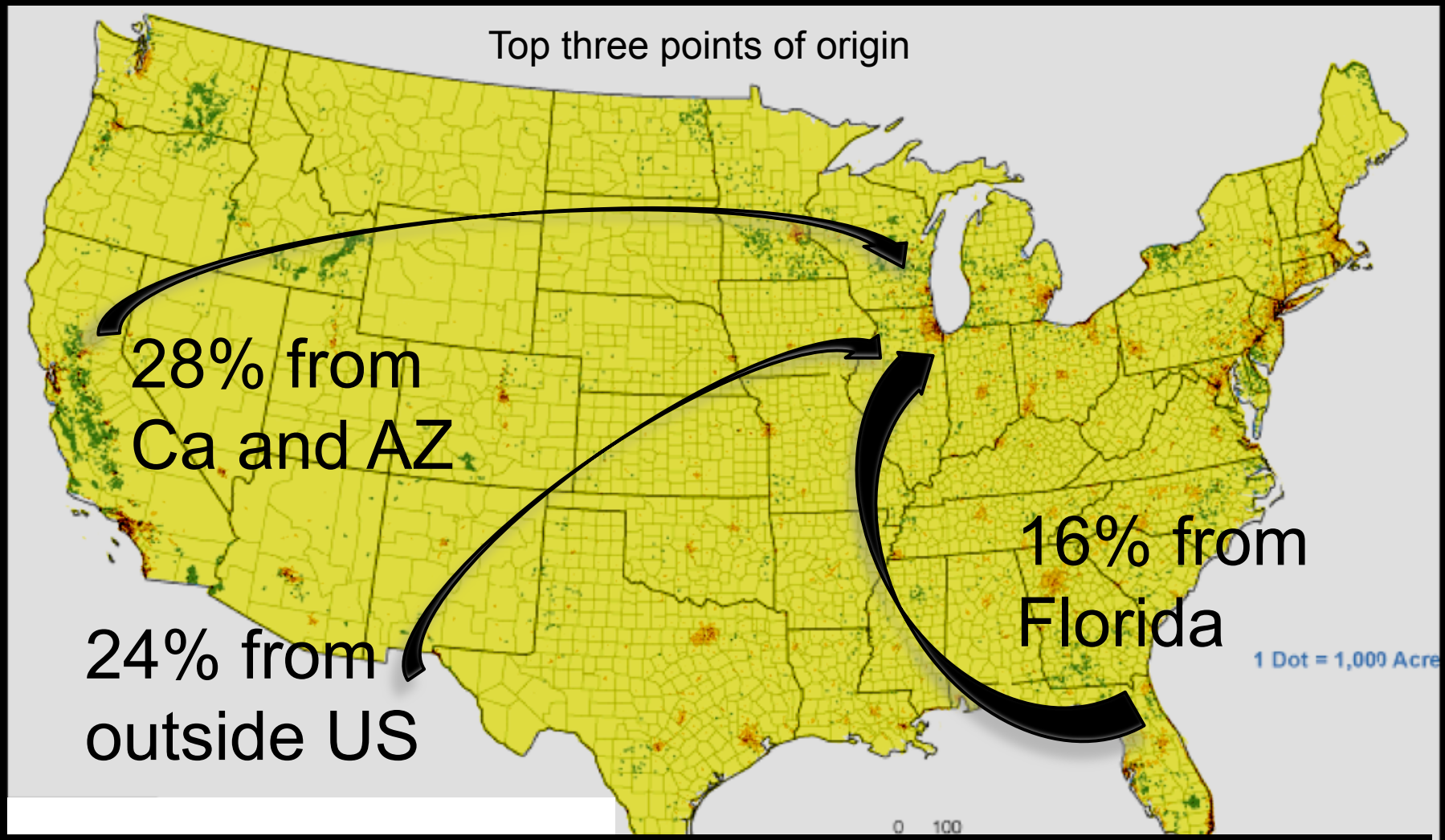
Energy Use in the Food System



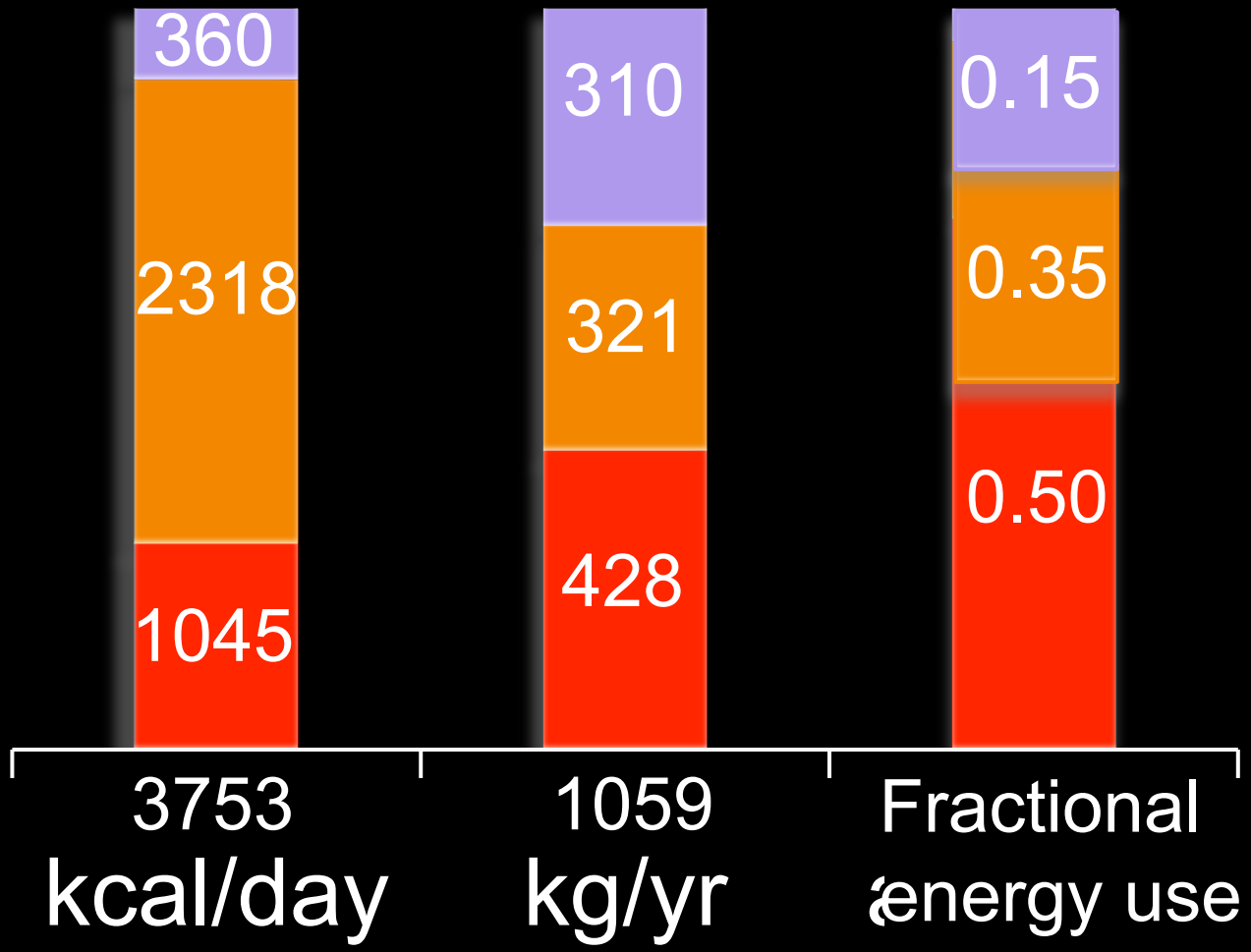
Heller and Keoleian, Report No. CSS00-04 of the Center for Sustainable Systems, School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI

Transportation:
distance and mode from producer to consumer



- **Calculations by N. Bamberger and J. Archer, summer High School interns (U of Chicago, 2009); Based on food movement data, AMS USDA**

Consumption pattern: Per Capita Mean American Diet



Calculated from USDA and FAOSTAT data; Energy after Mattew and Weber 2008

The goal:
Evaluate efficiency and potential of a regional food system

The Tools:

Whole farm analysis

Foodshed mapping

Life cycle system analysis

Previous work has focused on single crops

INPUTS:

OUTPUTS:

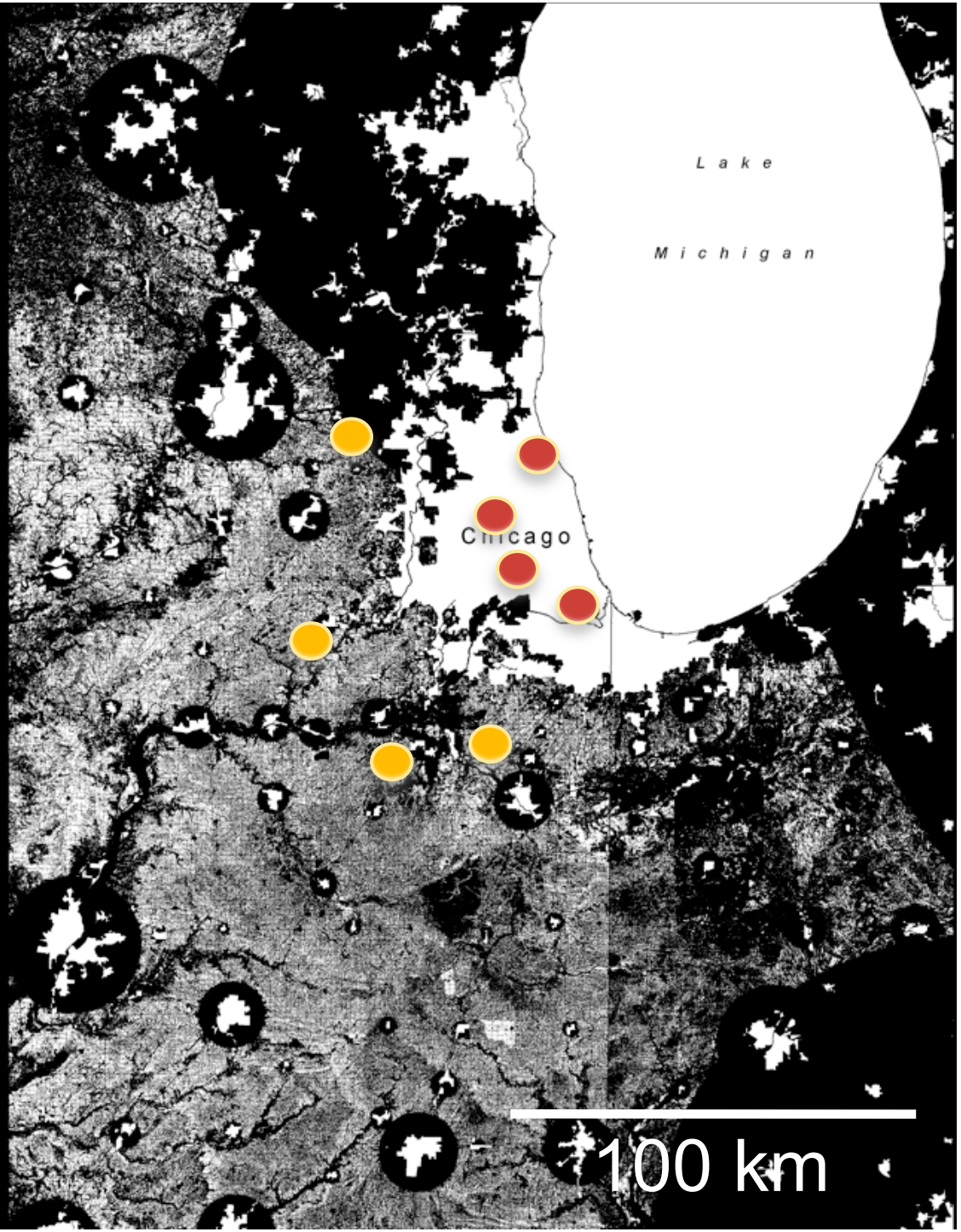
TABLE 11.1
Energy Inputs in Apple Production in the Eastern United States

	Quantity/ha	kcal/ha
Inputs		
Labor	385 h	17,150,000
Machinery	88 kg	1,408,000
Diesel	483 L	5,506,000
Gasoline	1346 L	13,406,000
Nitrogen	45 kg	837,000
Phosphorus	114 kg	472,000
Potassium	114 kg	372,000
Insecticides	47 kg	4,700,000
Herbicides	6 kg	600,000
Fungicides	49 kg	4,900,000
Electricity	66 kWh	57,000
Transportation	2974 kg	787,000
Total		50,195,000

Pimentel and Pimental, 1996;2007

Local yields, small farms

- 4 rural farms, 2-20 acres
- 4 urban farms
- Highly diversified in produce (40-300 varieties)
- “Sustainable” practices



Our approach: Whole Farm study
Full “input/output” analysis for energy

INPUTS:

(1)“Direct” on-farm energy use

(2) “Indirect” energy: material inputs

(3) Labor

OUTPUTS:

Itemized production

Output analysis: Calculating yields from diversified, sustainable farms

$$\text{Equivalent land use} = \sum_{i=1}^{N} \frac{\text{Mass of item } i, \text{ kg yr}^{-1}}{\text{Conventional Yield, kg acre}^{-1}\ \text{yr}^{-1}}$$

$$\text{Relative land use} = \frac{\text{Equivalent land use}}{\text{Actual production area}}$$

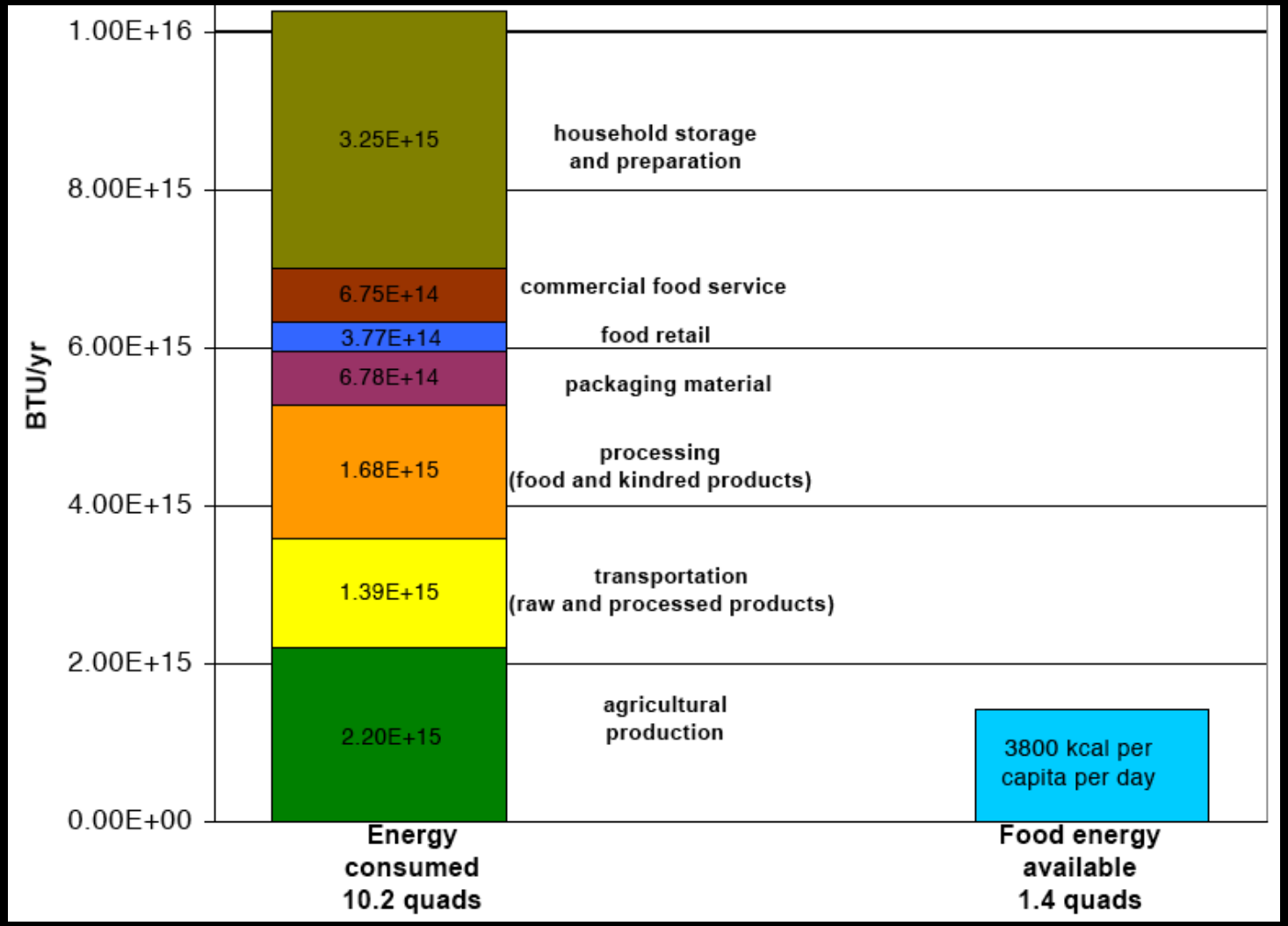
Relative Land Use > 1, diverse farms use more land
Relative Land Use < 1, divers farms use less land

Input –Output analysis: Preliminary results small, diversified vs conventional ag

- **Urban Farms:**
  - **Land use: 0.5 to 1 acre per acre of conventional**
  - **Direct energy use: 5 – 15% of conventional**
  - **Indirect energy use: 25 – 50% of conventional**

- **Rural Farms:**
  - **Land use: 1.1 -1.8 acre per acre** of conventional
  - **Direct energy use: 30 – 95%** of conventional
  - **Indirect energy use: 25 – 70%** of conventional

Energy Use in the Food System



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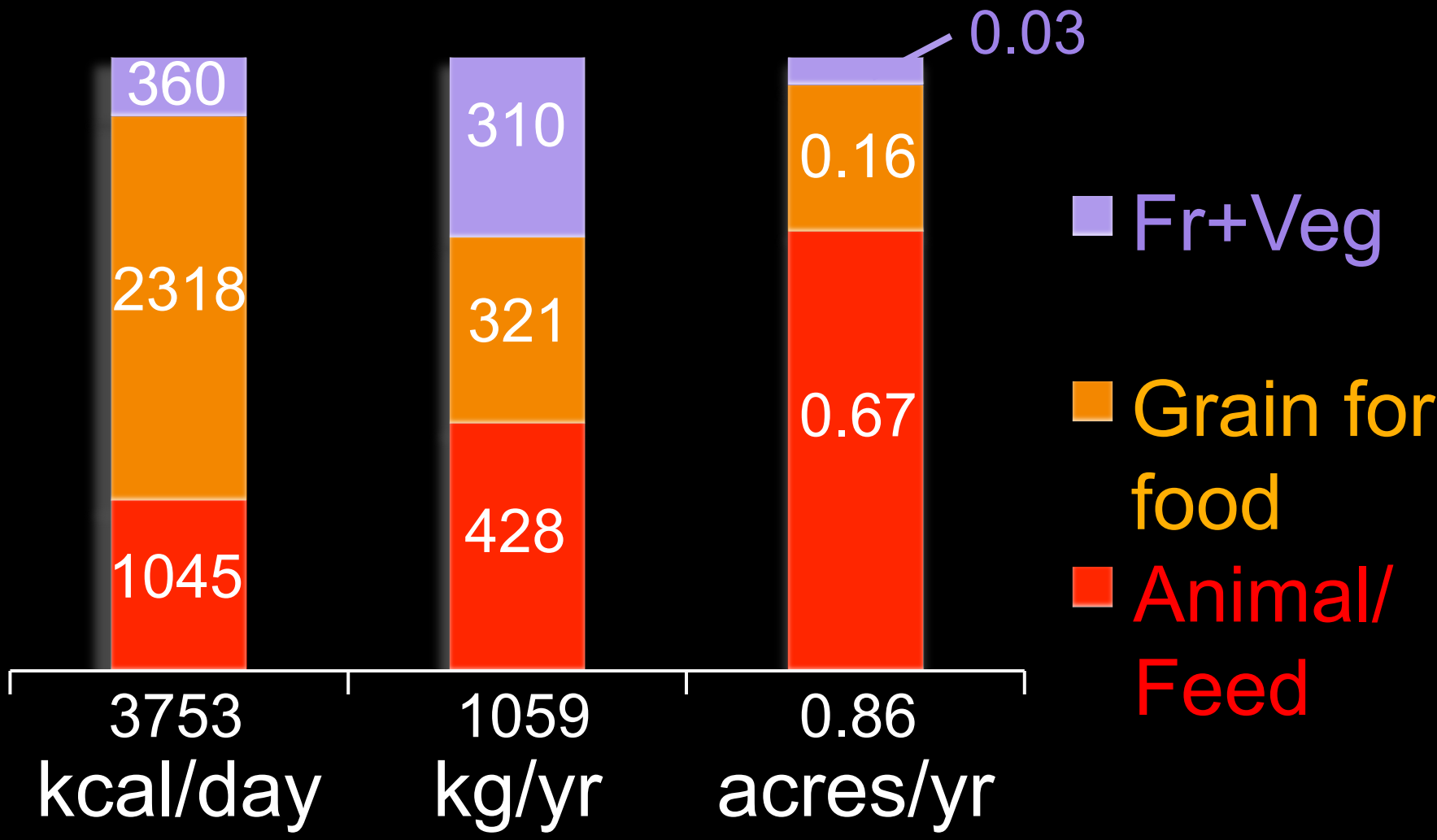
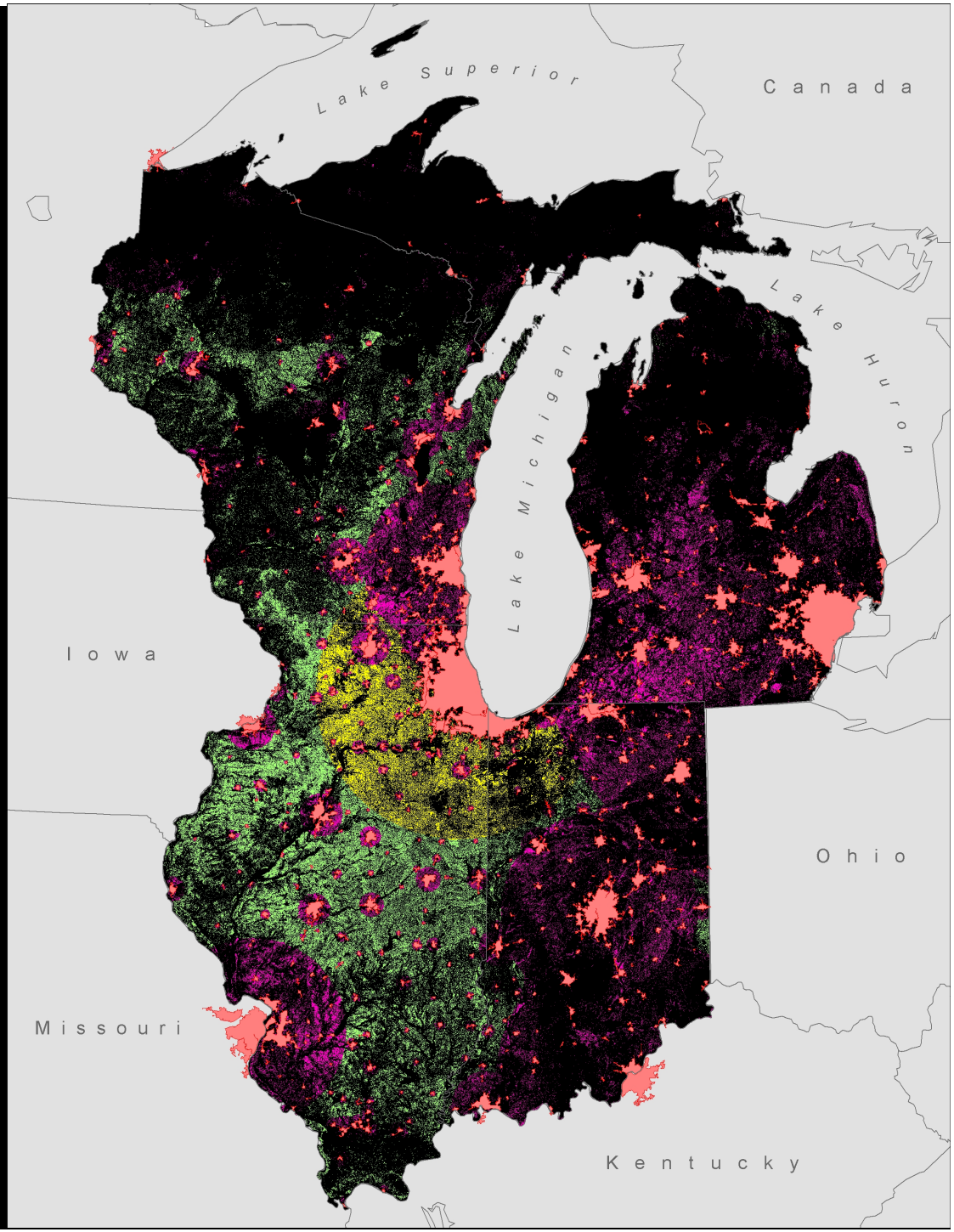
Per Capita Mean American Diet



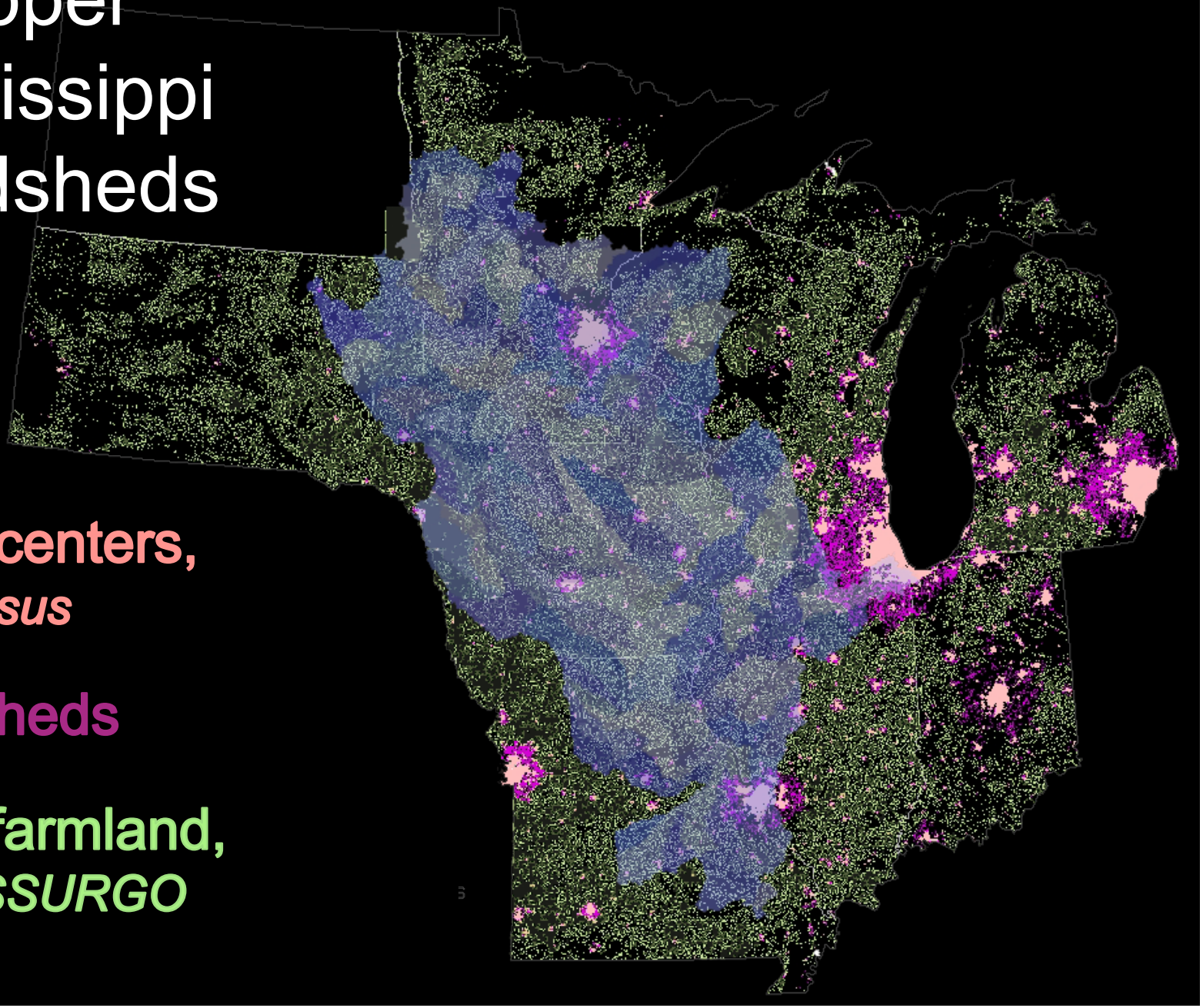
Calculated from USDA and FAOSTAT data; Land from Martin et al and Eshel et al. 2010

Foodsheds, small to large

- **Chicago Foodshed**
- **Urban centers,** *US Census*
- **Prime farmland,** *USDA/SSURGO*
- **Secondary foodsheds**

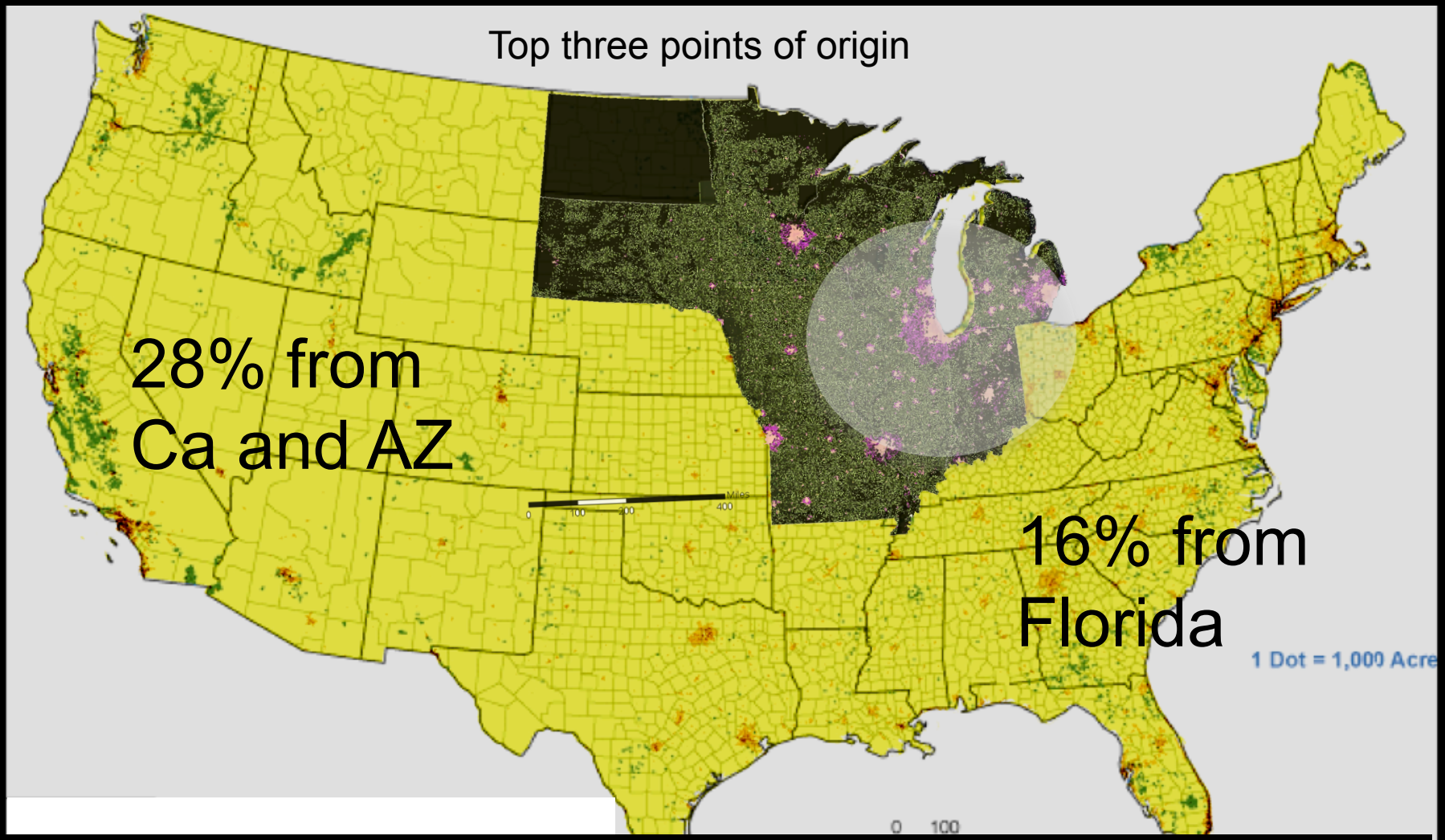


Upper Mississippi Foodsheds



- Urban centers, *US Census*
- Foodsheds
- Prime farmland, *USDA/SSURGO*

Transportation: Distance and Load



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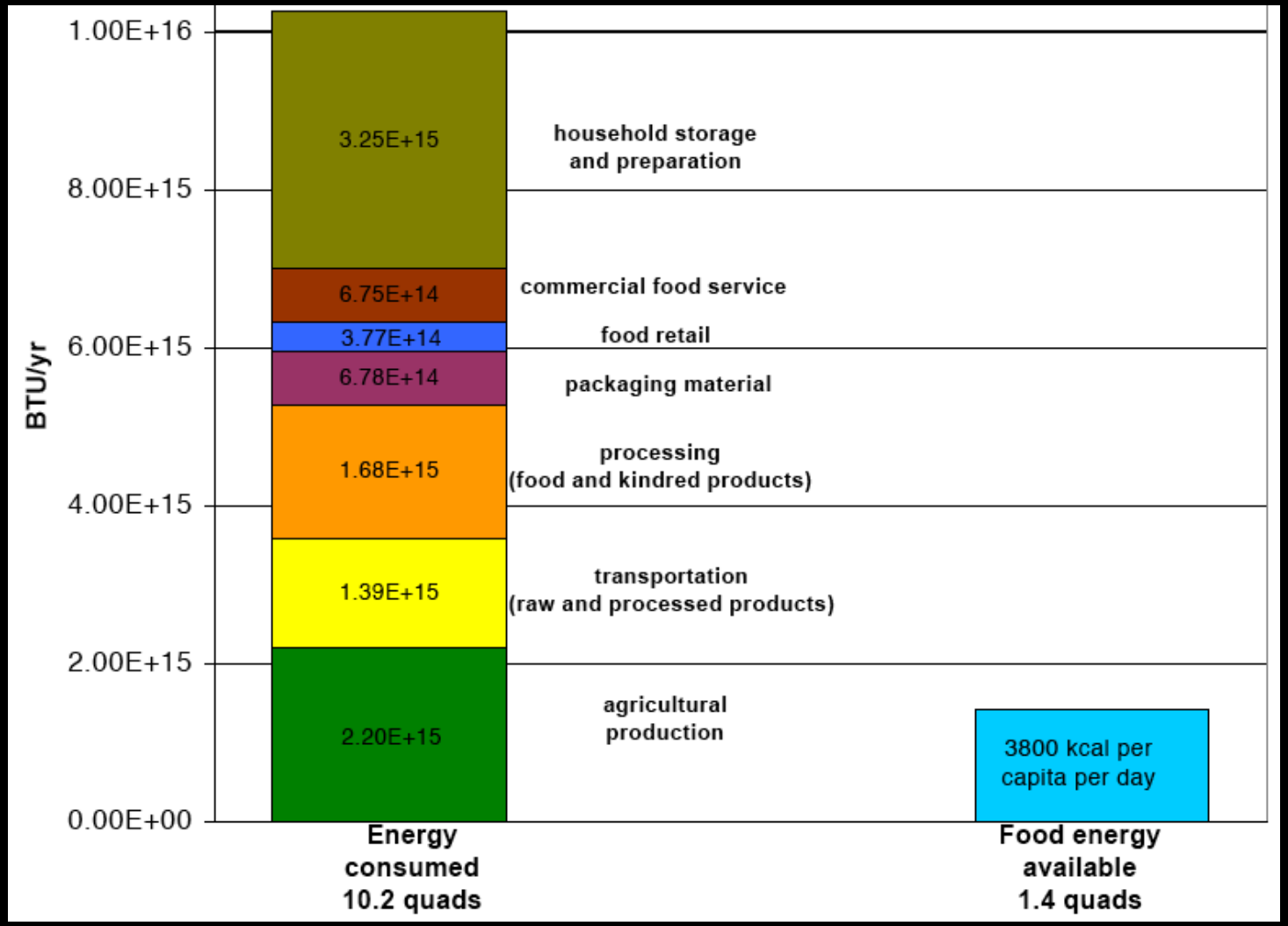
Energy Use in the Food System



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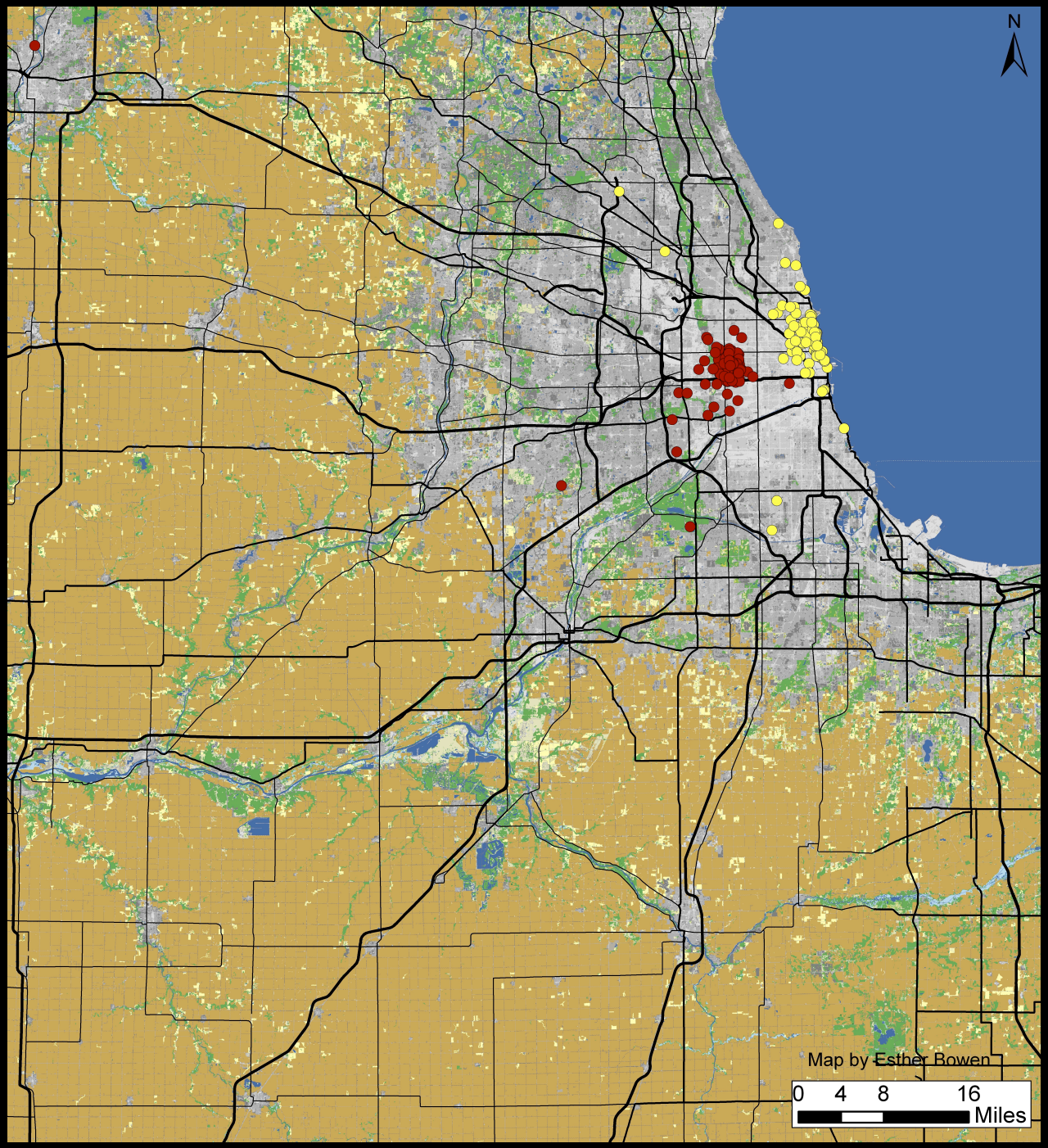
Farmers' Market Survey Data

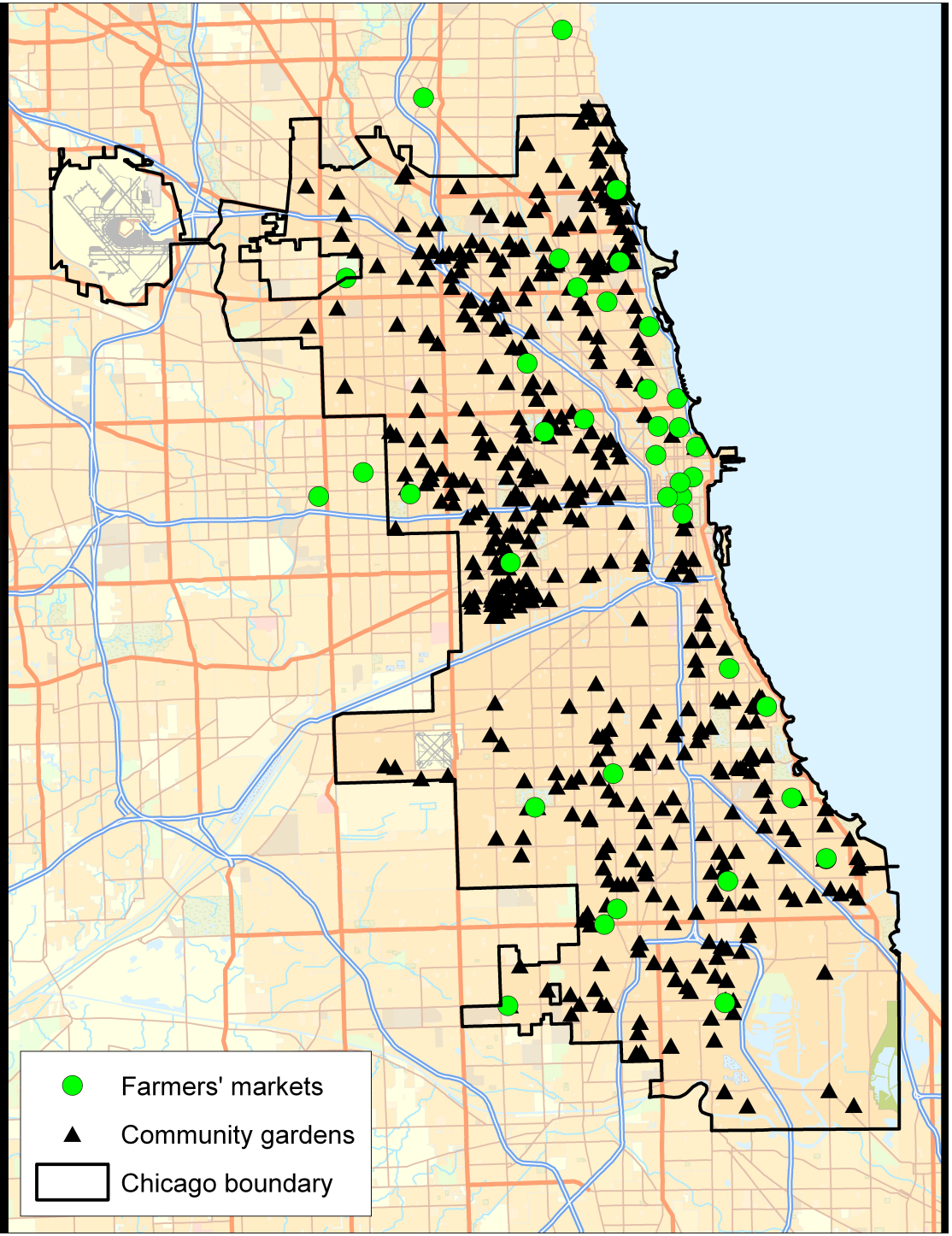
Less than 2 miles
80% walk or bike



Distribution: Fresh from the farm

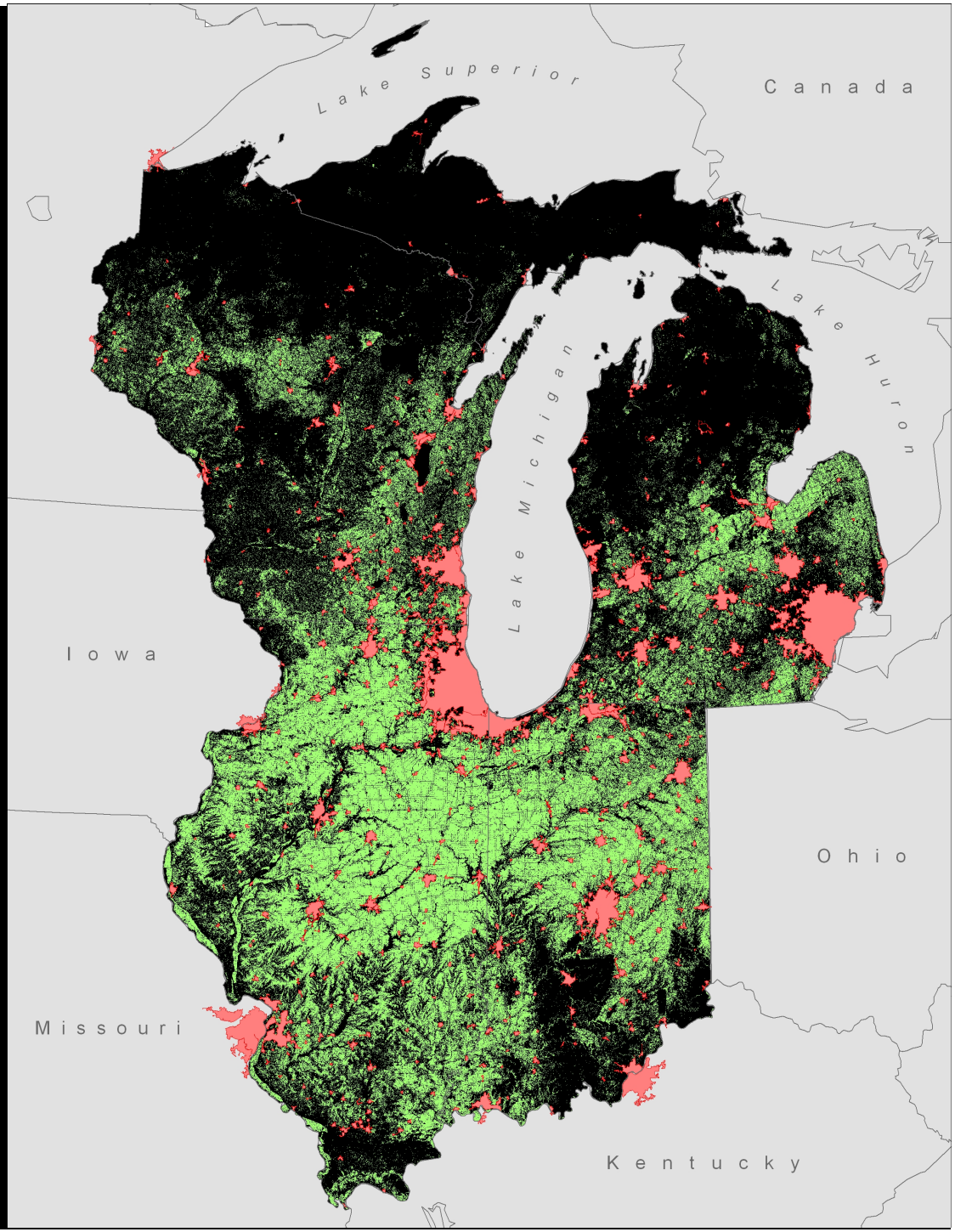
- Farmers' Markets

▲ Community Gardens



Cultivated Land surrounding Chicago

- **Urban centers,** *US Census (Chicago = 8.3E6)*
- **42.5E6 acres** *USDA/SSURGO*



Increasing the data collection (2011)

(1) Adding nine farms in three regions of the US

(2) Adding self reporting farms in midwest

(3) Monitoring water use on two farms

(4) Additional economic data

Challenge:
Comparing “apples to apples”

(1) Categories of inputs

(2) “Stages” of the Life Cycle

- production/post harvest

-marketing

- delivery

- waste

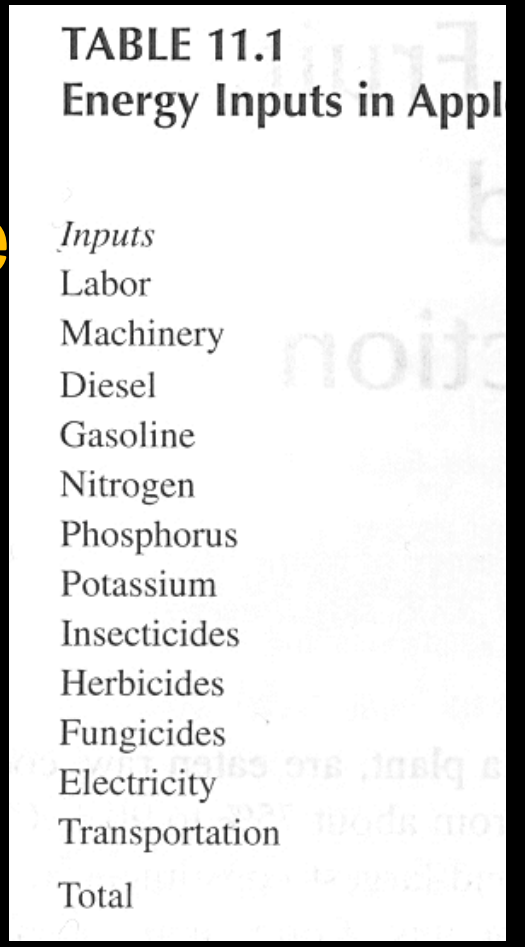
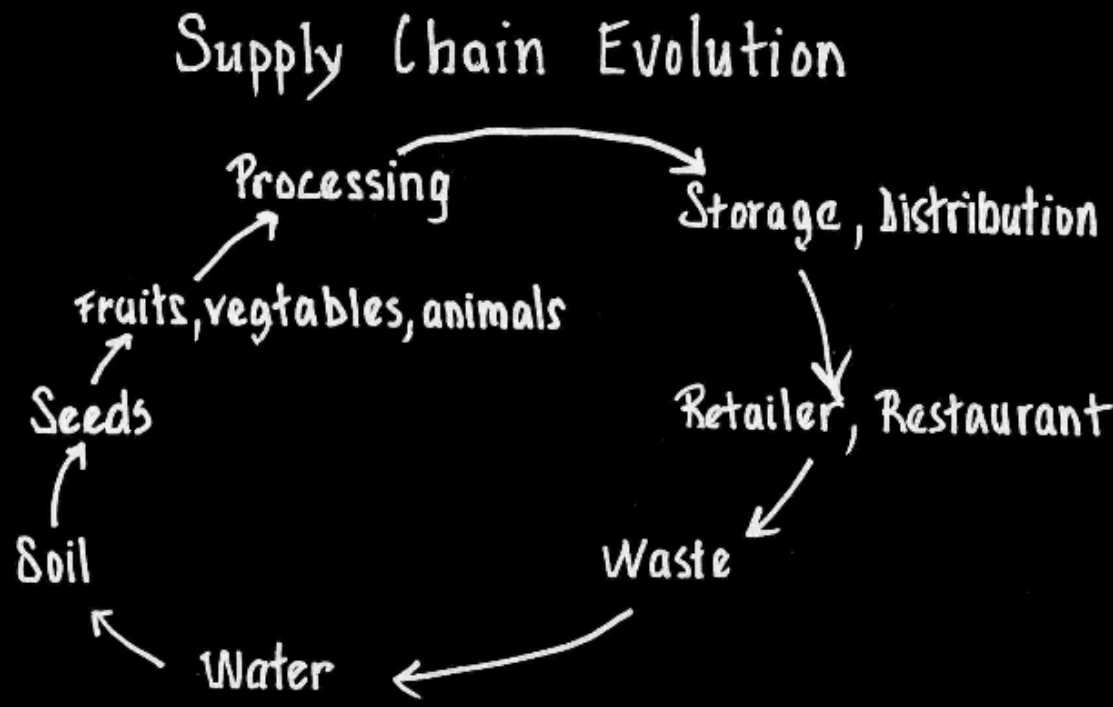


TABLE 11.1
Energy Inputs in Appl

Inputs
Labor
Machinery
Diesel
Gasoline
Nitrogen
Phosphorus
Potassium
Insecticides
Herbicides
Fungicides
Electricity
Transportation
Total

Energy Use in the Food System



Richard Schneider, formerly of Sysco, Ag Forum 2010 speaker

Acknowledgments

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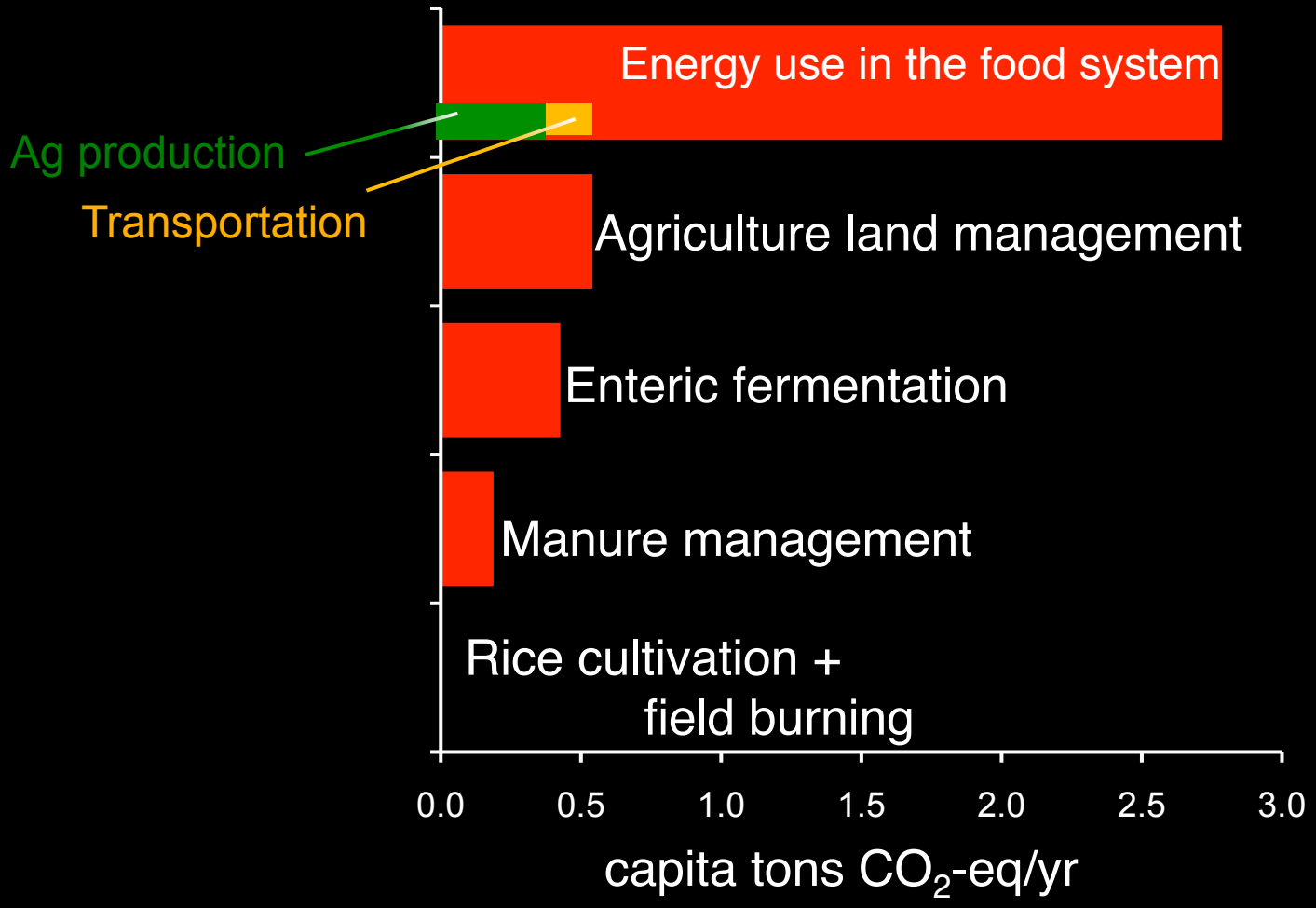
New partners In 2010:
Bon Appétit Management Foundation
Farm to School

Greenhouse gas emissions associated with the US food system



- **Energy use from USDA, 2010; Emissions data from EPA, 2009; import/exptort, FAO 2008**

Land requirements for US diet

$$= \frac{\text{Acres for fruit + veg}}{\text{US Population}}$$

$$= \frac{\text{Acres for food grain}}{\text{US Population}}$$

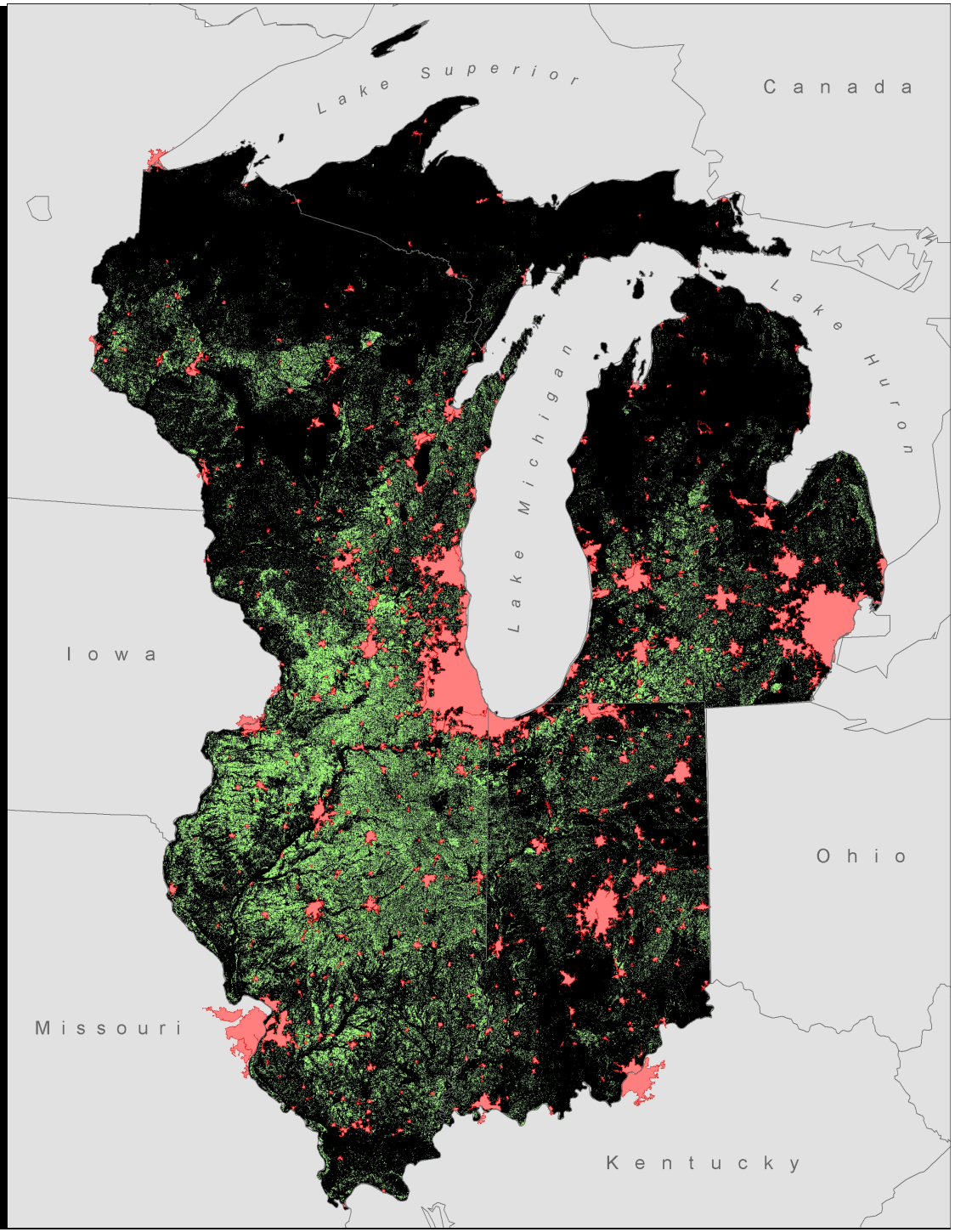
$$= \frac{\text{Acres for feed grain}}{\text{US Population}}$$

Data from USDA food availability, USDA grain yearbook, and FAOSTAT

crop	needed 10^3 feed acre-eq.
corn	33,365
hay	62,241
soybean	23,461
wheat	16,128
sorghum	1,488
barley	1,173
oats	2,222
total	**140,077**
weighted mean	

Population and land resources

- **Urban centers,** *US Census*
- **Prime farmland,** *USDA/SSURGO*



Ultimate destination of farm fresh produce