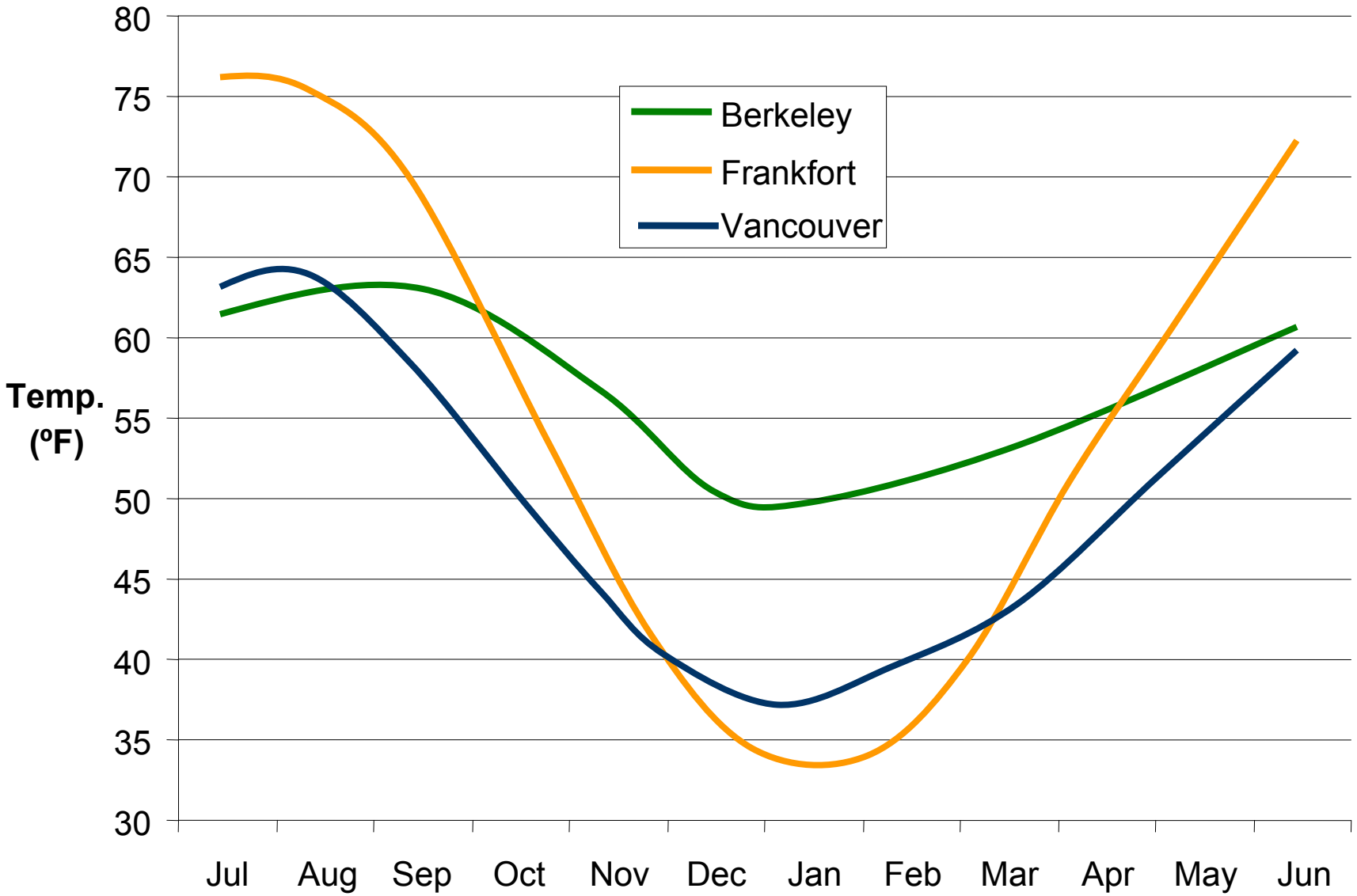
KENTUCKY STATE UNIVERSITY

Inspiring Innovation.
Growing Leaders.
Advancing Kentucky.

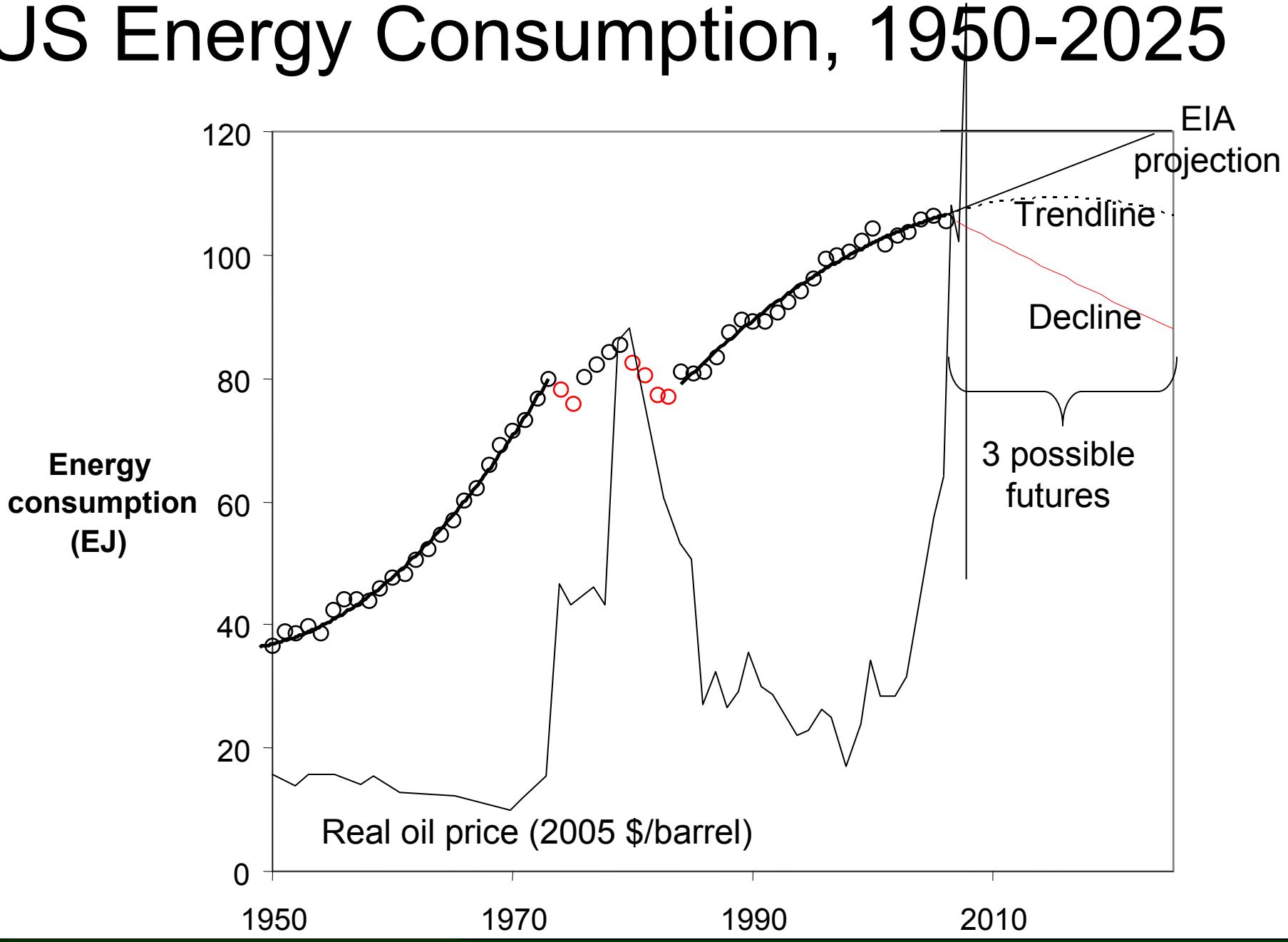
Fresh Tomatoes in January:

Can B-ISA Make them Sustainable?

Michael Bomford, PhD
Kentucky State University

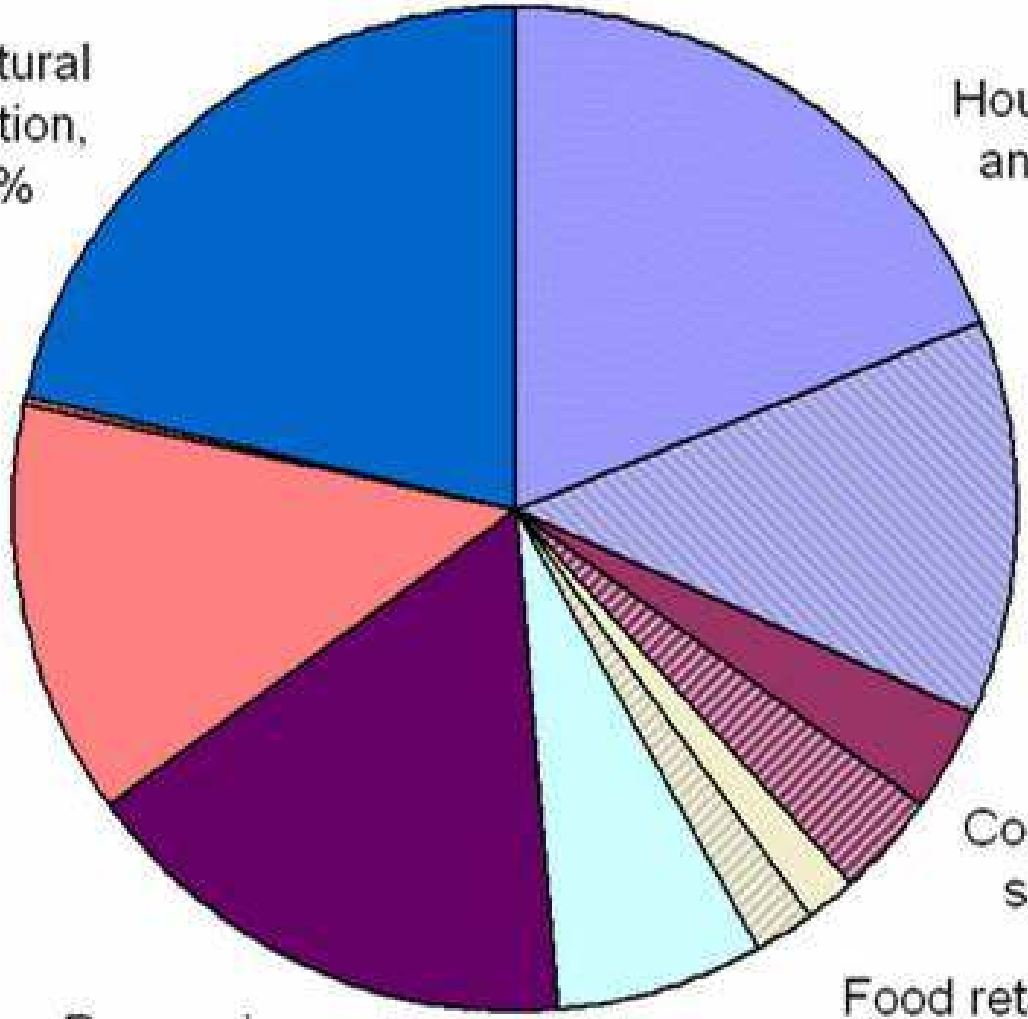

Temp. (ºF)
80
75
70
65
60
55
50
45
40
35
30
Berkeley
Frankfort
Vancouver
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun

US Energy Consumption, 1950-2025



DOE-EIA data to 2007

US Food System: ~10 EJ/yr

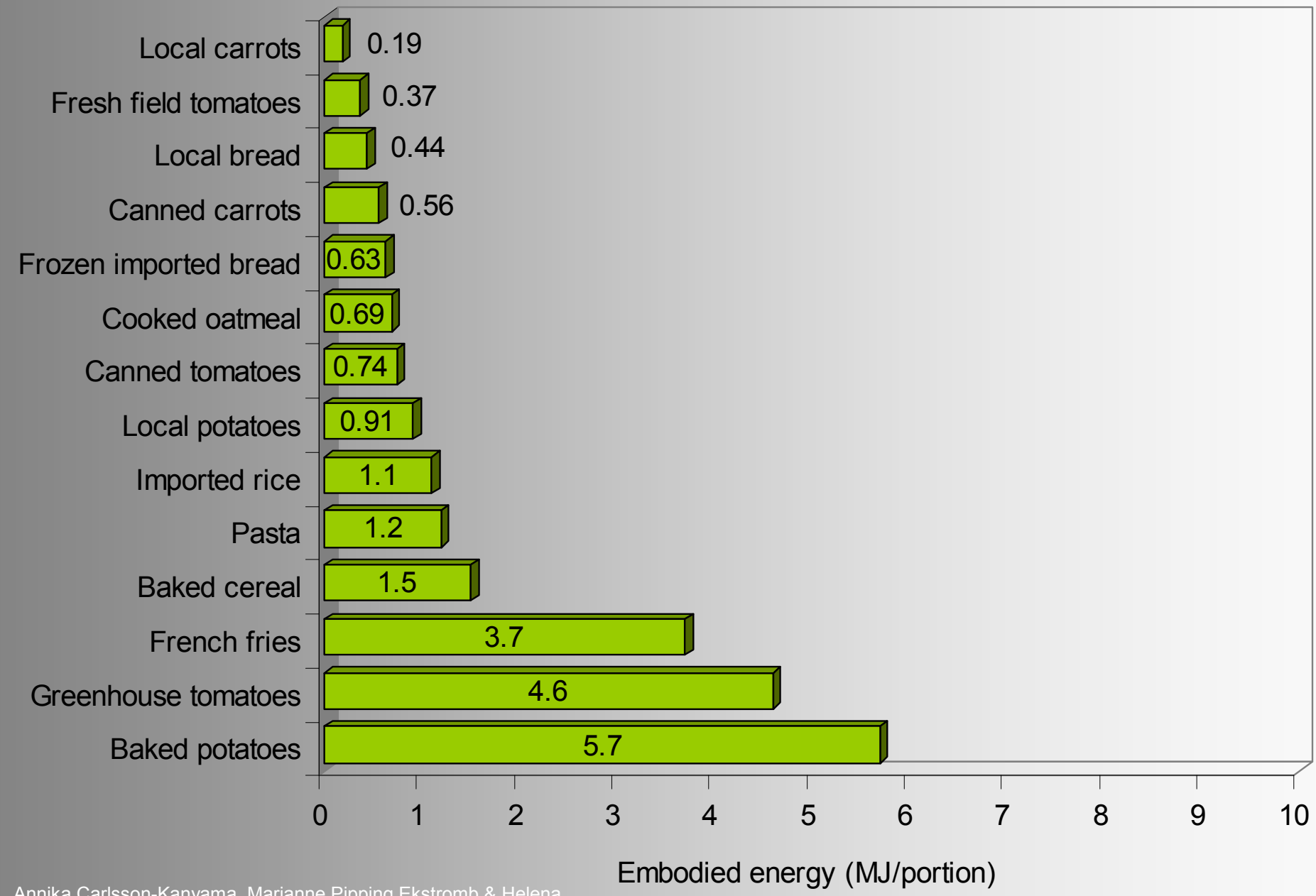


Food Energy Available: ~1 EJ/yr

Hatching: refrigeration

Data from Heller and Keoleian, 2000; Graph from www.ethicurian.com

Canagro Greenhouses Inc.
Delta, BC



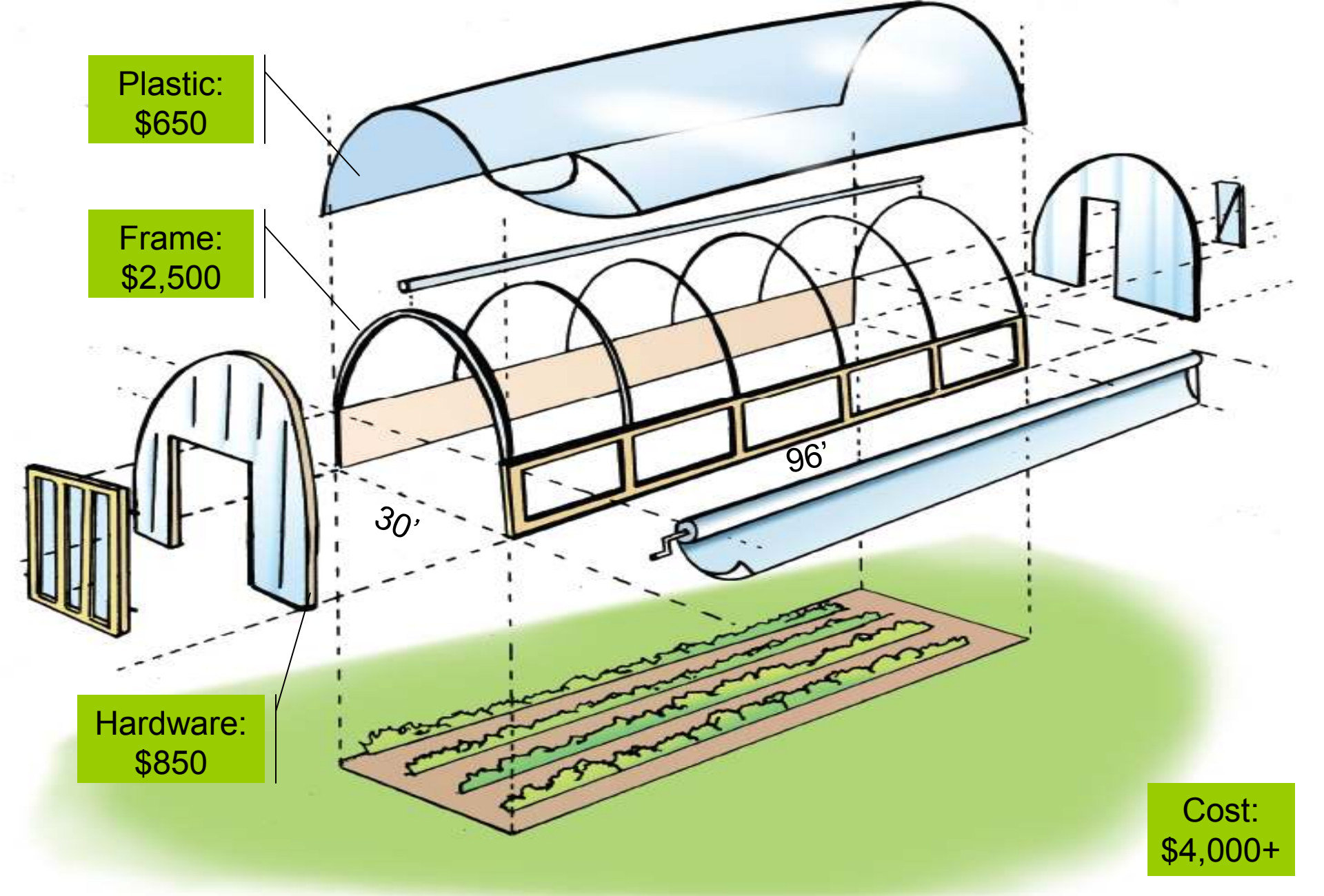
Annika Carlsson-Kanyama, Marianne Pipping Ekstromb & Helena Shanahan. 2003. Food and life cycle energy inputs: consequences of diet and ways to increase efficiency. Ecological Economics 44: 293-307.

High Tunnels

Solar

- ~~U~~nheated greenhouses
- Metal quonset frame
- Plastic cover

- Passive ventilation
- Soil-based production
- Simple
- Cheap



Lewis Jett. 2006. High Tunnel Melon and Watermelon Production. University of Missouri Extension, M173

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Ventilation

Management
(8-10 hours per week)

- Daily
  - Opening and closing tunnel… especially on sunny days
  - Scouting
- Weekly
  - Weeding
  - Watering (Drip system)
  - Seeding and Transplanting
  - Harvesting

High tunnels vs. greenhouses

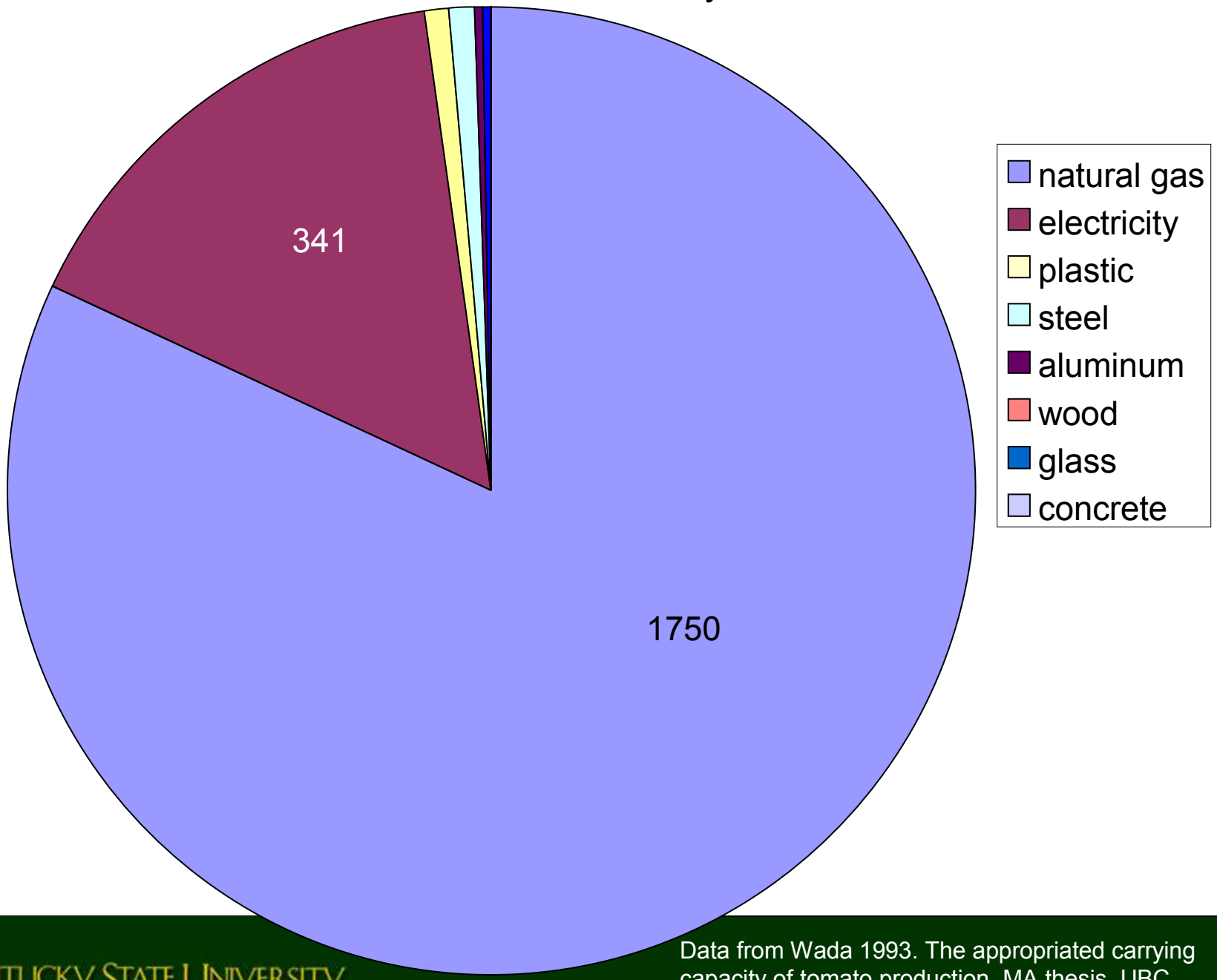
- Big (1-50 ac.)
- Energy intensive
- Hydroponic
- Same crop all year

- Small (30 x 96’)
- Energy efficient
- Soil-based
- Seasonal year-round production

Western Lettuce Now Inc., Langley BC

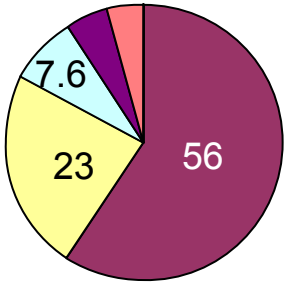
Yoshihiko Wada, PhD
Professor of Ecological Economics
Doshisha University,
Kyoto, Japan

Greenhouse: 2129 MJ/m^2/yr

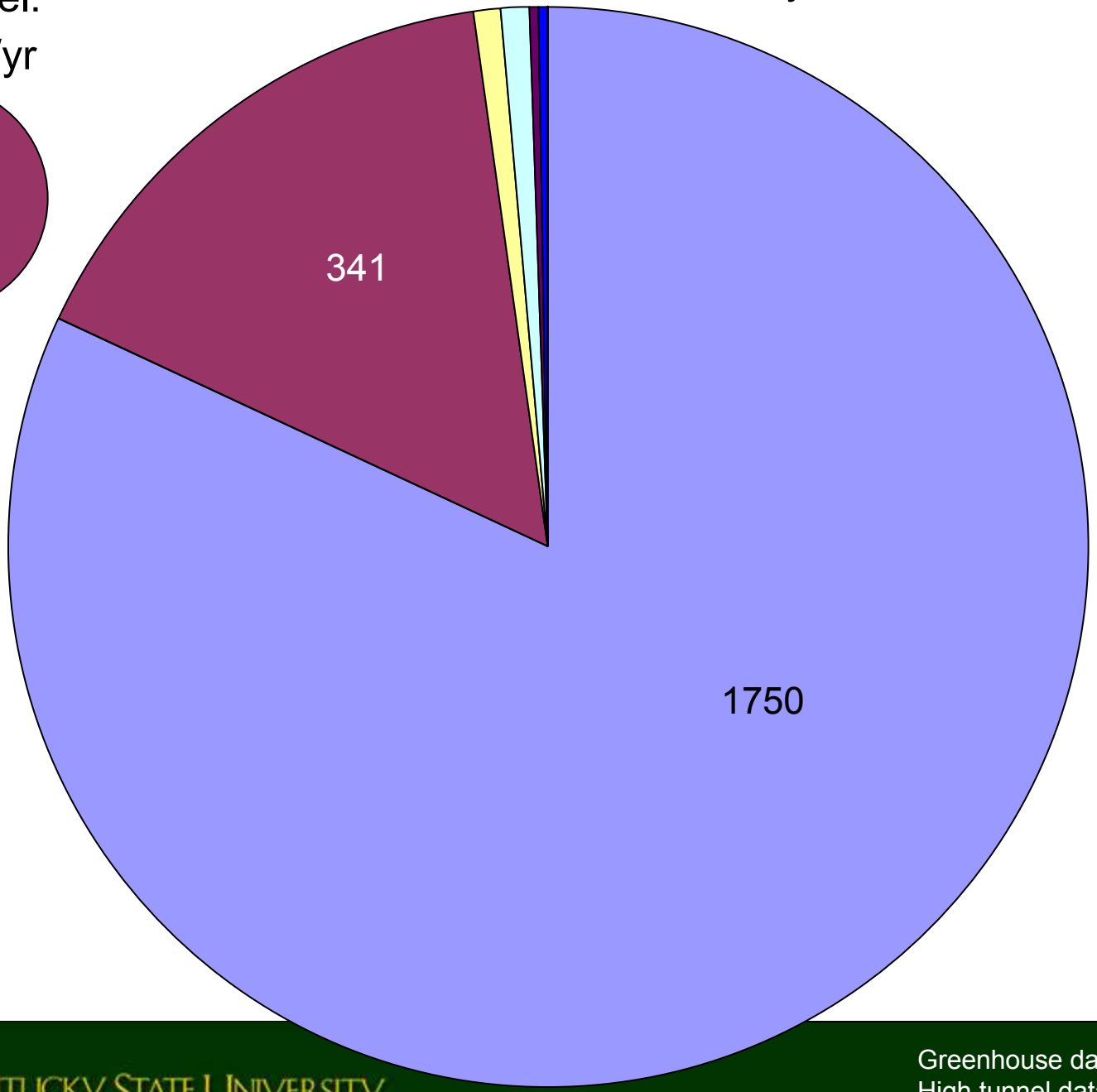


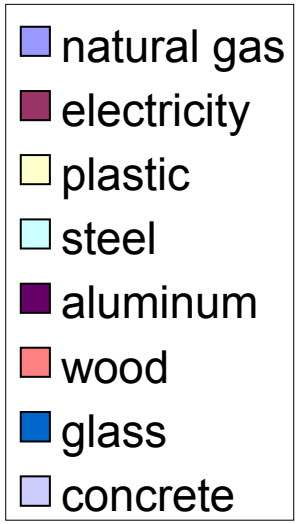
Data from Wada 1993. The appropriated carrying capacity of tomato production. MA thesis, UBC

High tunnel:
95 MJ/m^2/yr

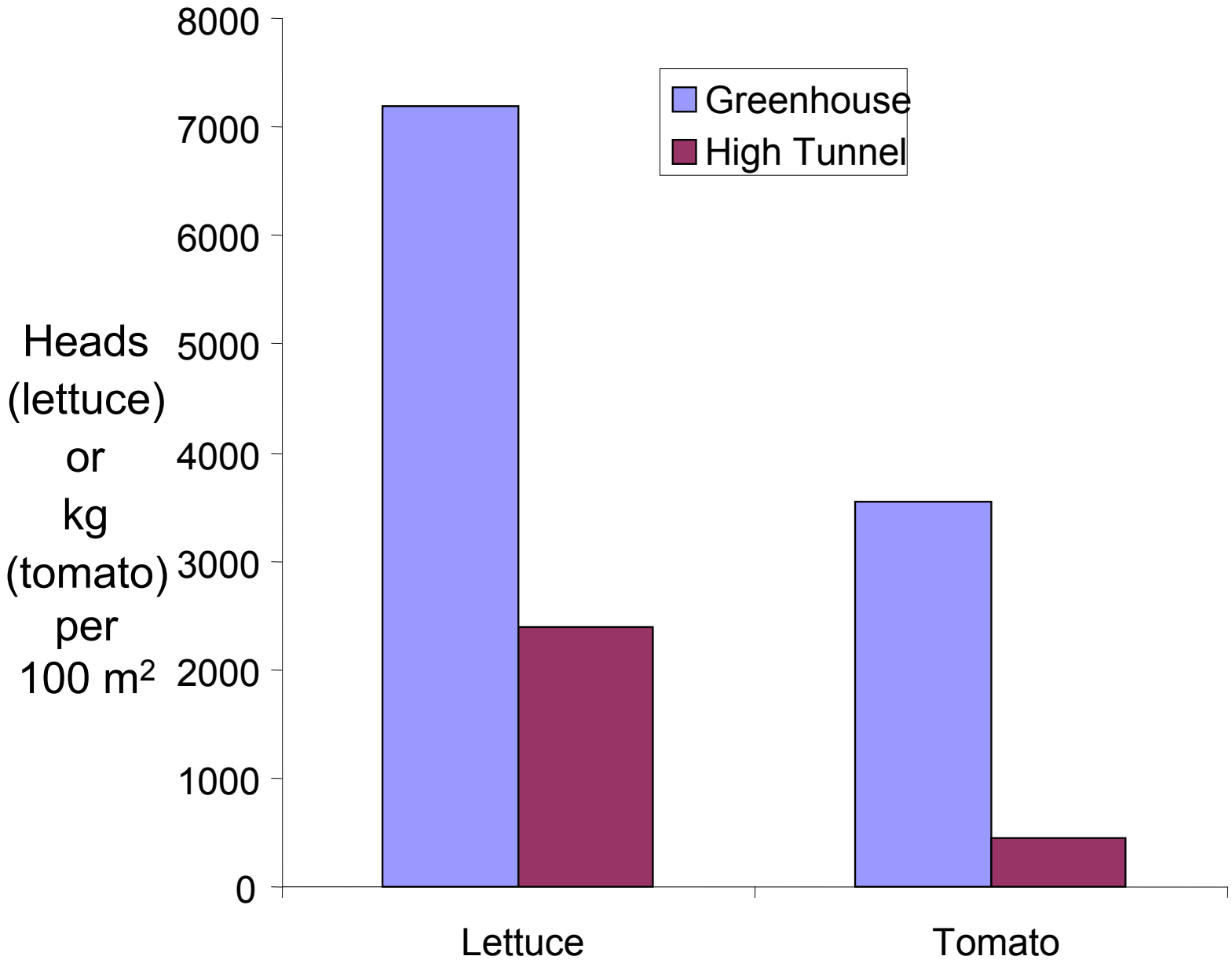


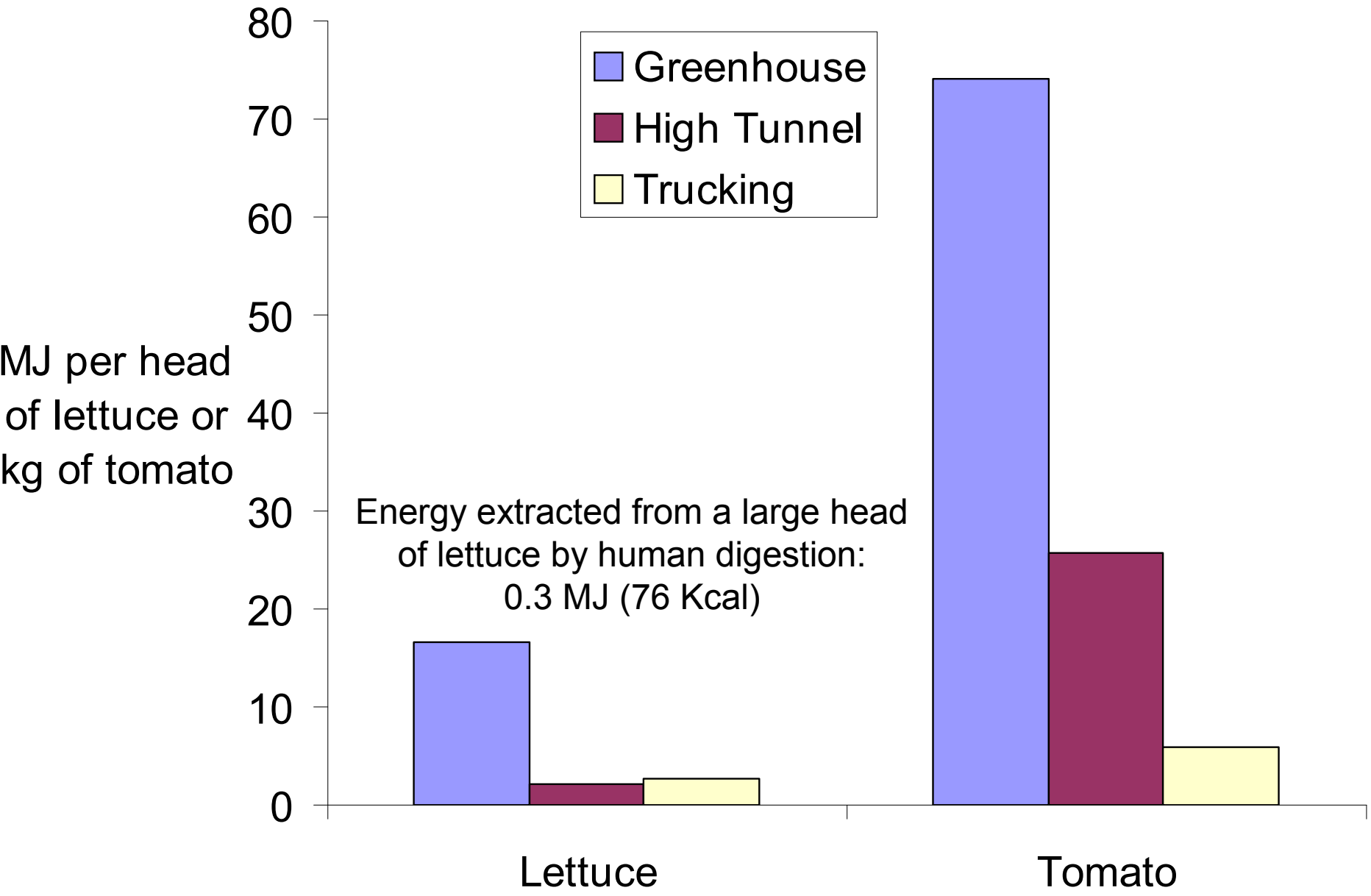
Greenhouse: 2129 MJ/m^2/yr



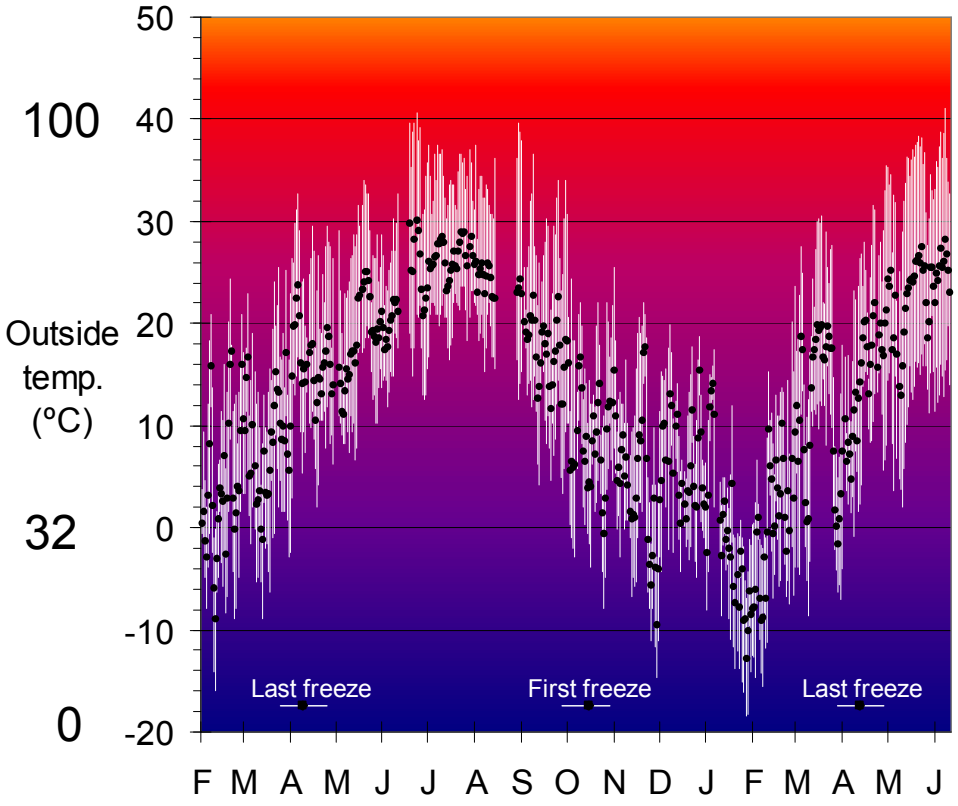


Greenhouse data from Wada 1993;
High tunnel data from Bomford 2006.

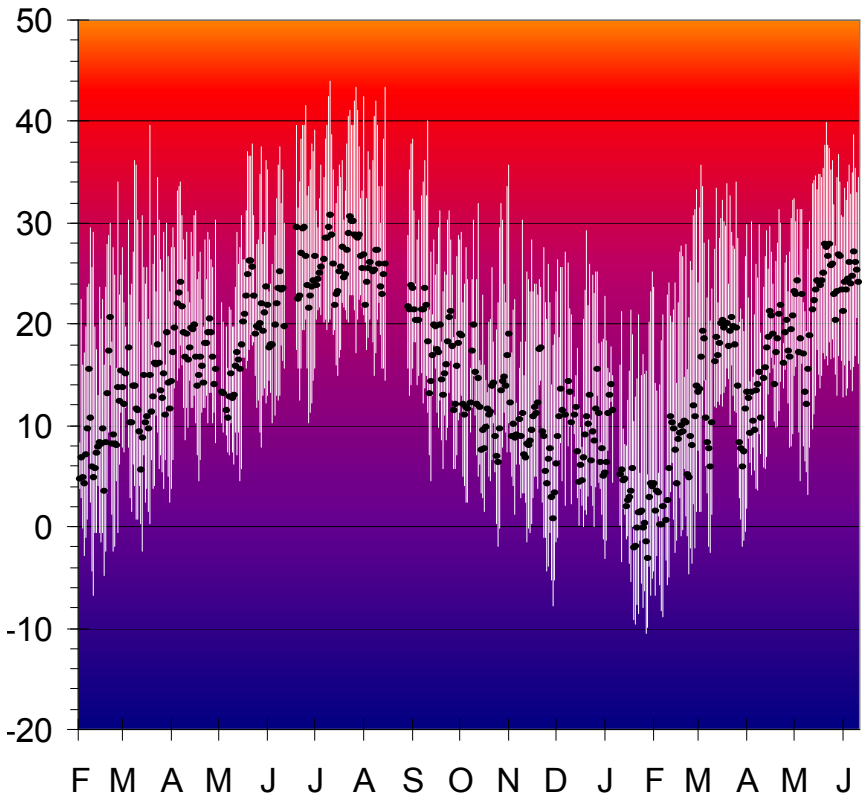

8000
7000
6000
5000
4000
3000
2000
1000
0
Heads (lettuce) or kg (tomato) per 100 m²
Greenhouse
High Tunnel
Lettuce
Tomato


80
70
60
50
40
30
20
10
0
MJ per head of lettuce or kg of tomato
Greenhouse
High Tunnel
Trucking
Energy extracted from a large head of lettuce by human digestion: 0.3 MJ (76 Kcal)
Lettuce
Tomato

Outside and Inside the KSU tunnel, Feb. 2006 – Jun. 2007

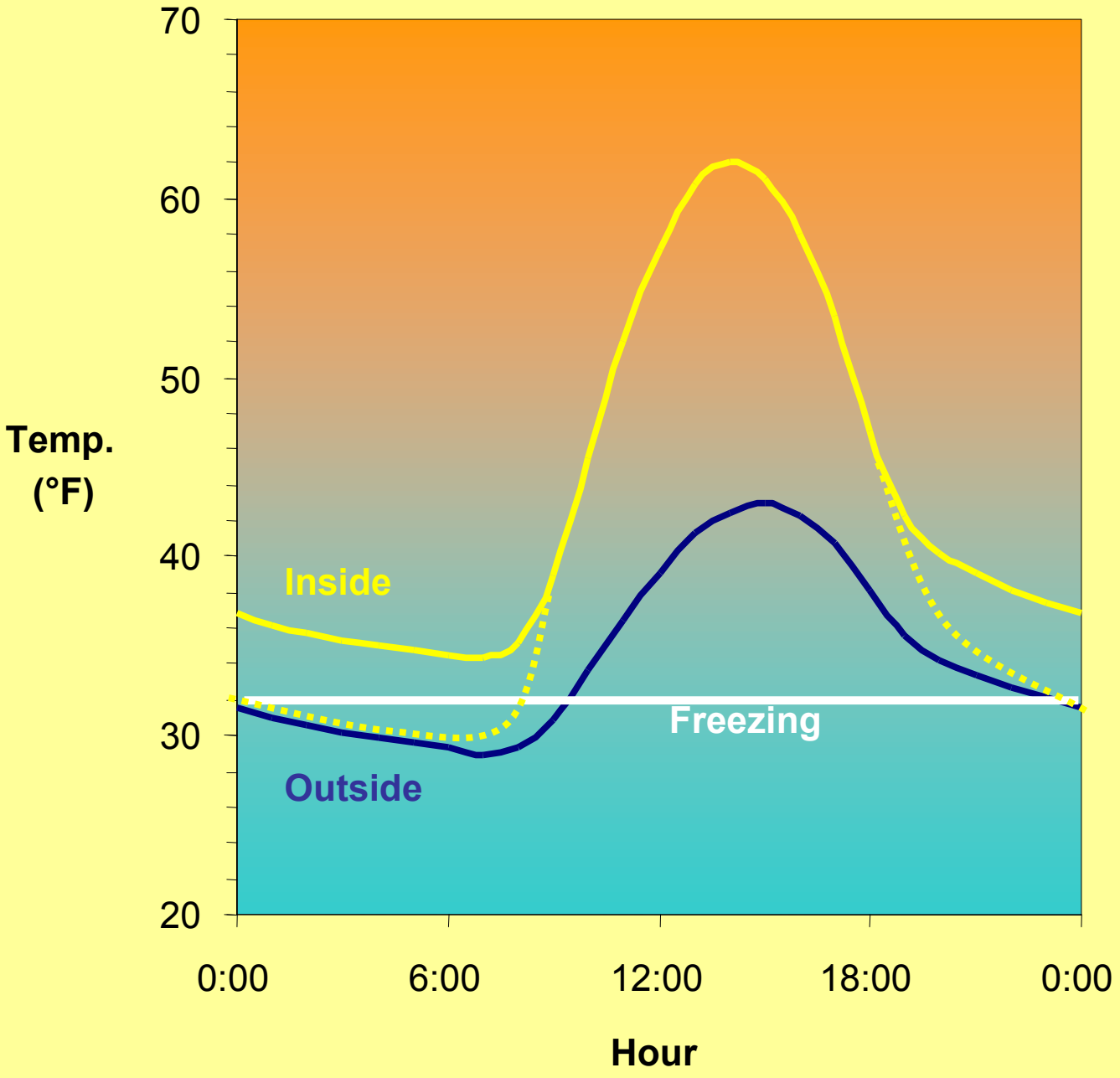


Outside



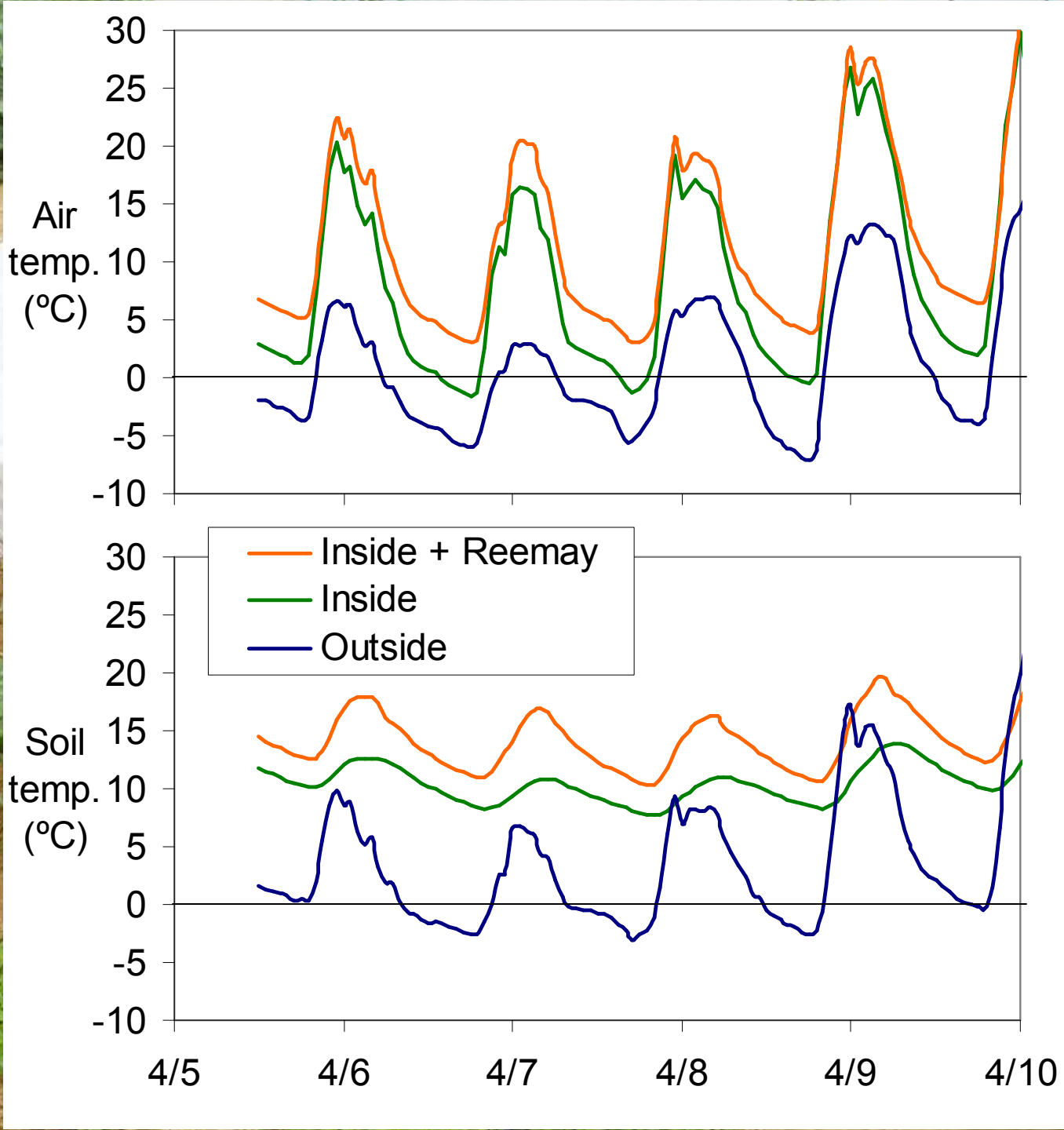
Inside

Why use two layers?

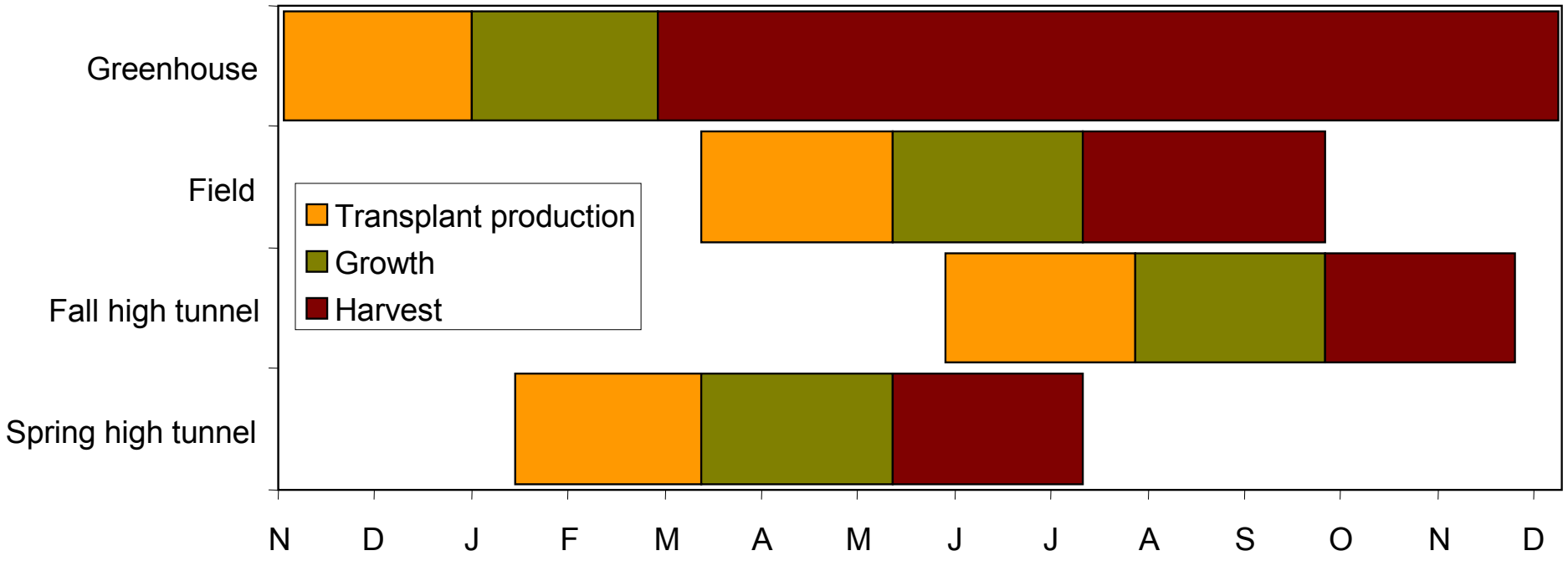


Double Layer Systems

What about frost?



Tomato season



Transplant production

Transplant production: Solar heat & electric pads

Mixtures

Opportunities for B-ISA

- Use ‘waste’ heat and CO_2 from buildings
- Recycle organic wastes from buildings
- Reduce transportation costs
- Fresh food without packaging or refrigeration
- Increase city dwellers’ awareness of food
- Cool buildings through transpiration
- Reduce water runoff and use urban rainfall

Challenges for B-ISA

- Light-weight soil mix / growing medium
- Source of nutrients in appropriate ratios
- No supplementary light
  (seasonal production)
- Renewable heat
  (solar, waste, compost etc.)
- Covering that insulates and transmits light

Questions?

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http://EnergyFarms.net