Food (waste) and energy nexus:
resilience, challenges and opportunities

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Guelph, Ontario,
20 September 2016

Building Vibrant Rural Futures: Mobilizing Knowledge and Informing Policy

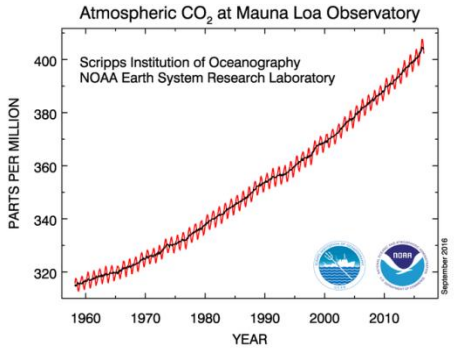
From linear to circular economy

Linear economy



Mine → Use → Dispose

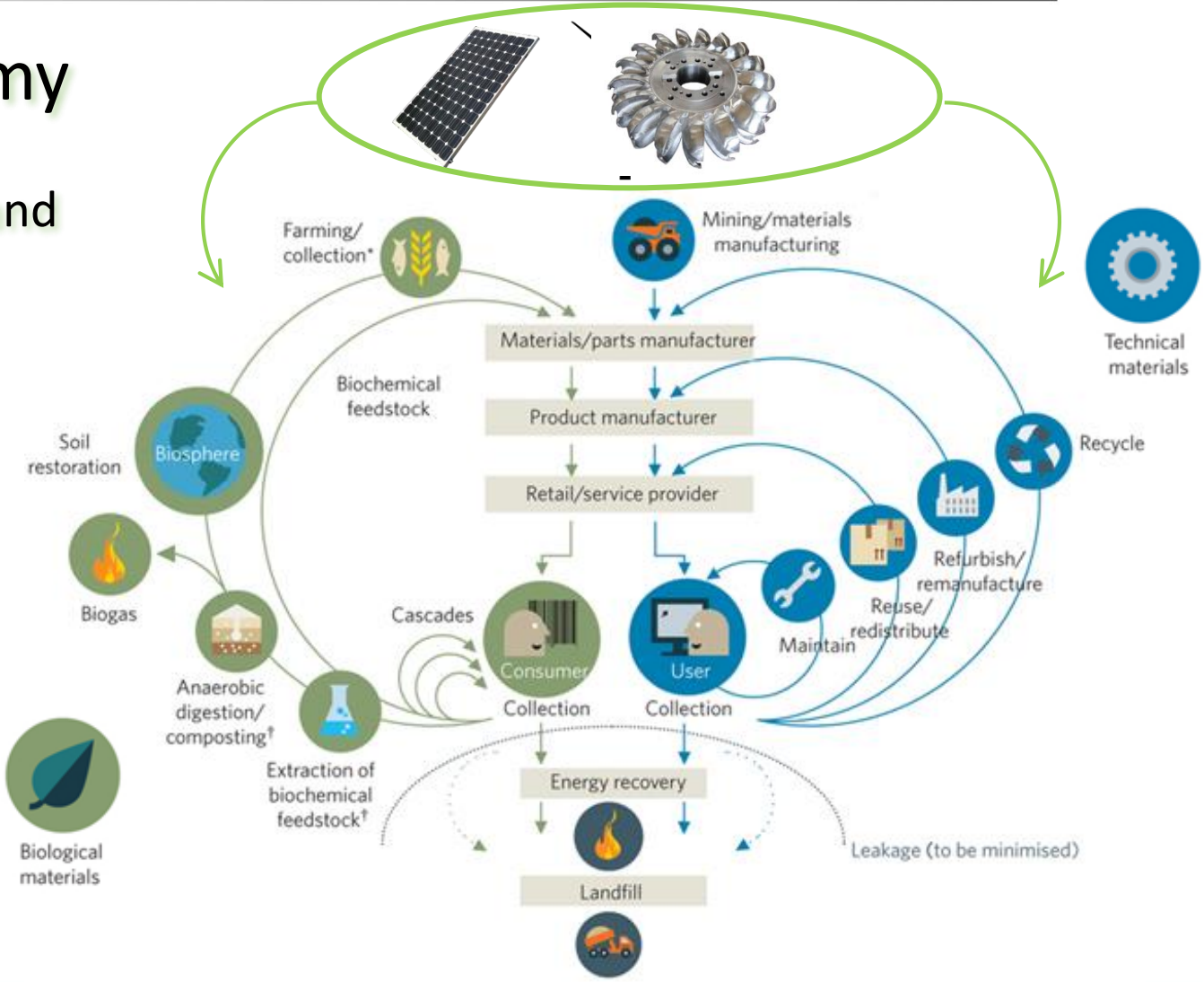




From linear to circular economy

Circular economy

- Systemic thinking and design
- Renewable energy and resources
- Reuse & recycle
- Reduce waste and pollution



Closing the loop

An EU action plan for the circular economy

Aims

- “close the loop" of product lifecycles → greater recycling and re-use
- boost competitiveness, foster sustainable economic growth and generate new jobs

First action: waste reduction

- Recycling **65%** of municipal waste and **75%** of packaging waste by 2030;
- Max. 10% landfilling of municipal waste by 2030;

Long-term policy with economic tools

- Ban on landfilling of separately collected waste
- economic discouragement of landfilling;
- Promotion of re-use and industrial symbiosis;
- Incentives to producers for greener products and recovery and recycling schemes.

75%
recycling

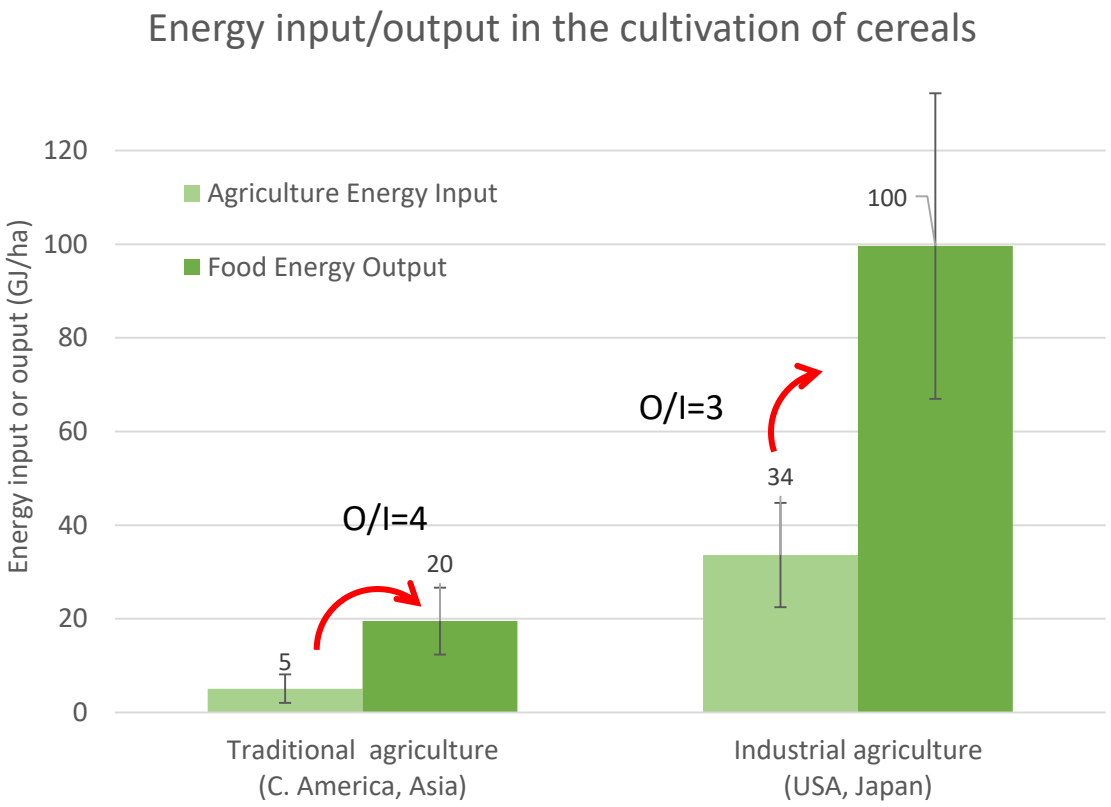
Energy-food nexus: historical trends

What about food?

Mechanization and chemical inputs increased the output of agriculture

but …

energy inputs increased even more, reducing the overall efficiency



Source: authors elaboration from Pimentel and Pimentel, *Food, energy and society* , 2008

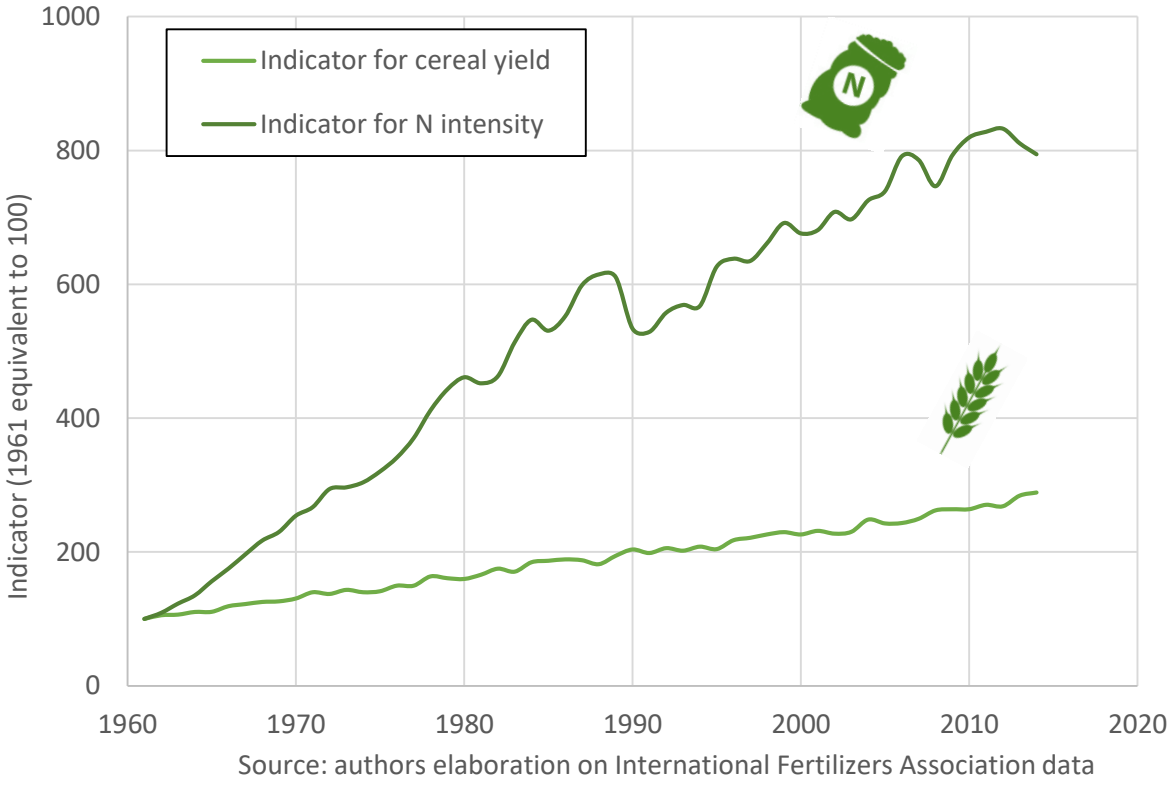
Energy-food nexus: historical trends

At what cost?

At world level
N fertilizer per ha increased 8 times

while…

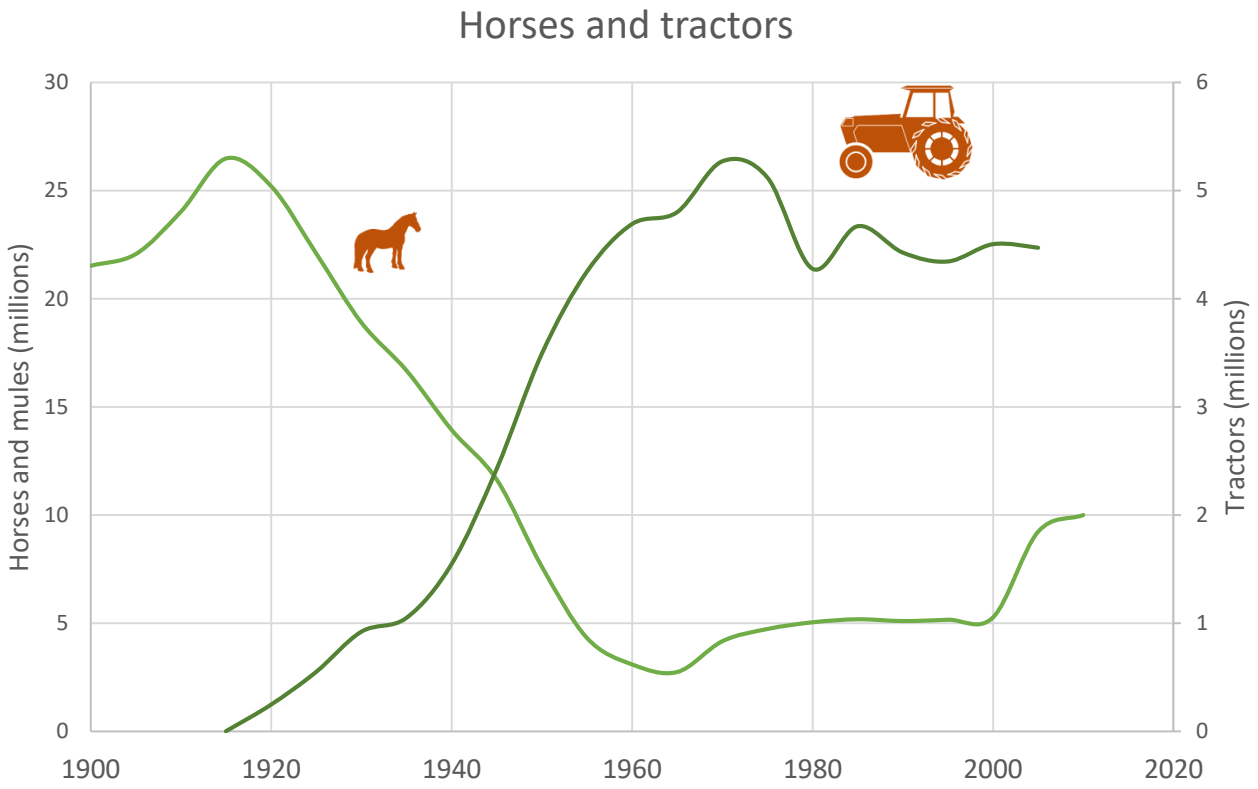
cereal yield increased 3 times



Source: authors elaboration on International Fertilizers Association data

Energy-food nexus: historical trends

Human and animal power was substituted with tractors



Sources: Kilby, 2007. The demographic of the U.S. equine population; FAOSTAT (horses)
USDC, Historical Statistics of the United States 1789-1945; FAOSTAT (tractors)

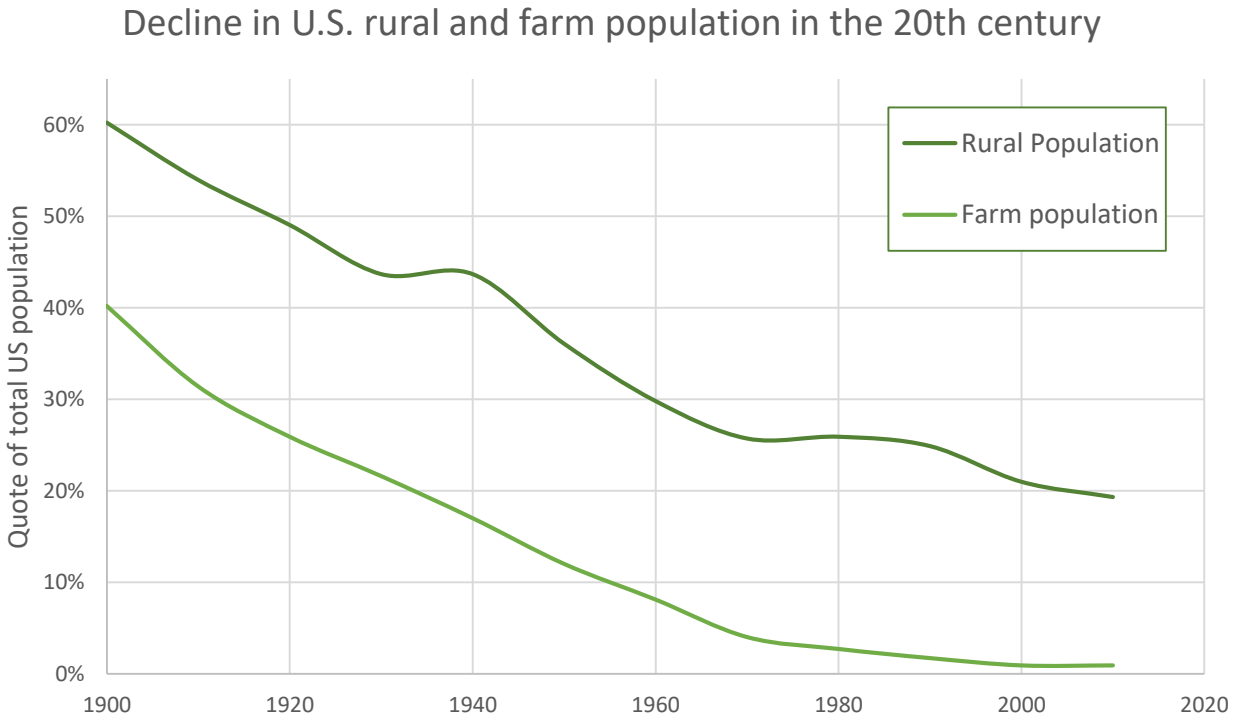
Energy-food nexus in rural areas

What about rural people?

Farm population gradually moved towards cities

thus…

Energy use in agriculture is related to urbanization and industrialization



Source: authors elaboration on Dimitri et al (2005) and 2010 Census

Energy-food nexus: theoretical framework

Rice grains in these two bowls may appear identical,
but they have different ***embodied energies***

Rice grown with conventional agriculture with chemical inputs

4,9 MJ/kg

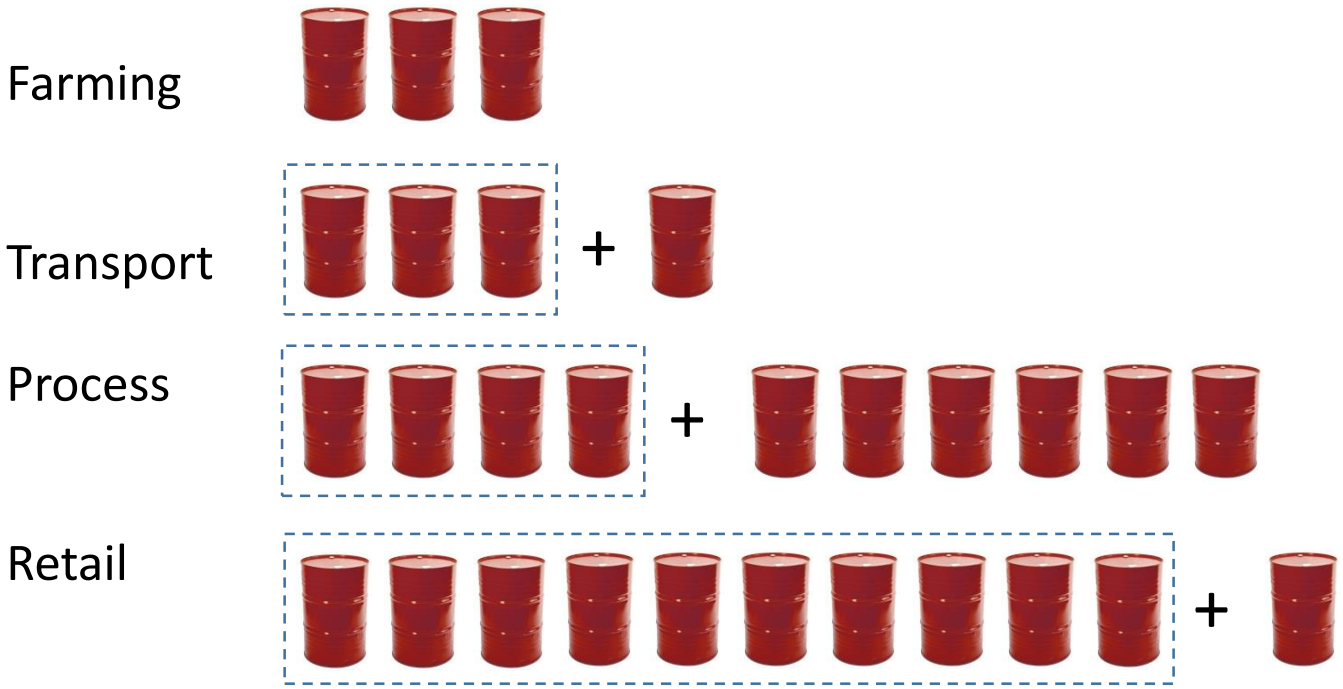
Rice grown with organic agriculture

1,5 MJ/kg

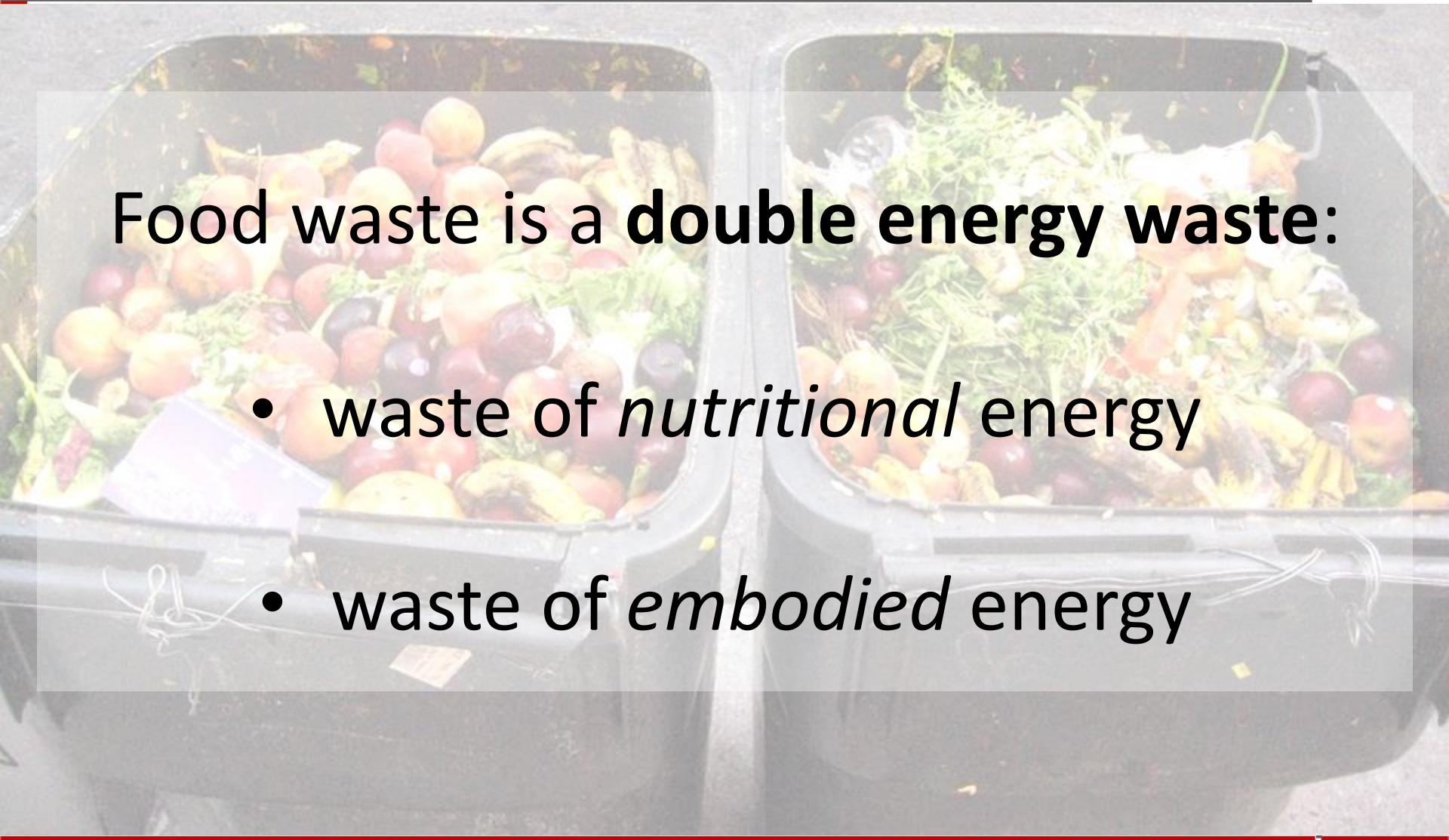
Sources: Pagani, Johnson, Vittuari, 2016.
Accepted for publication in the *Journal of Environmental Management*

Energy-food nexus: theoretical framework

Embodied energy *builds up* along the food supply chain



Energy-food nexus: theoretical framework

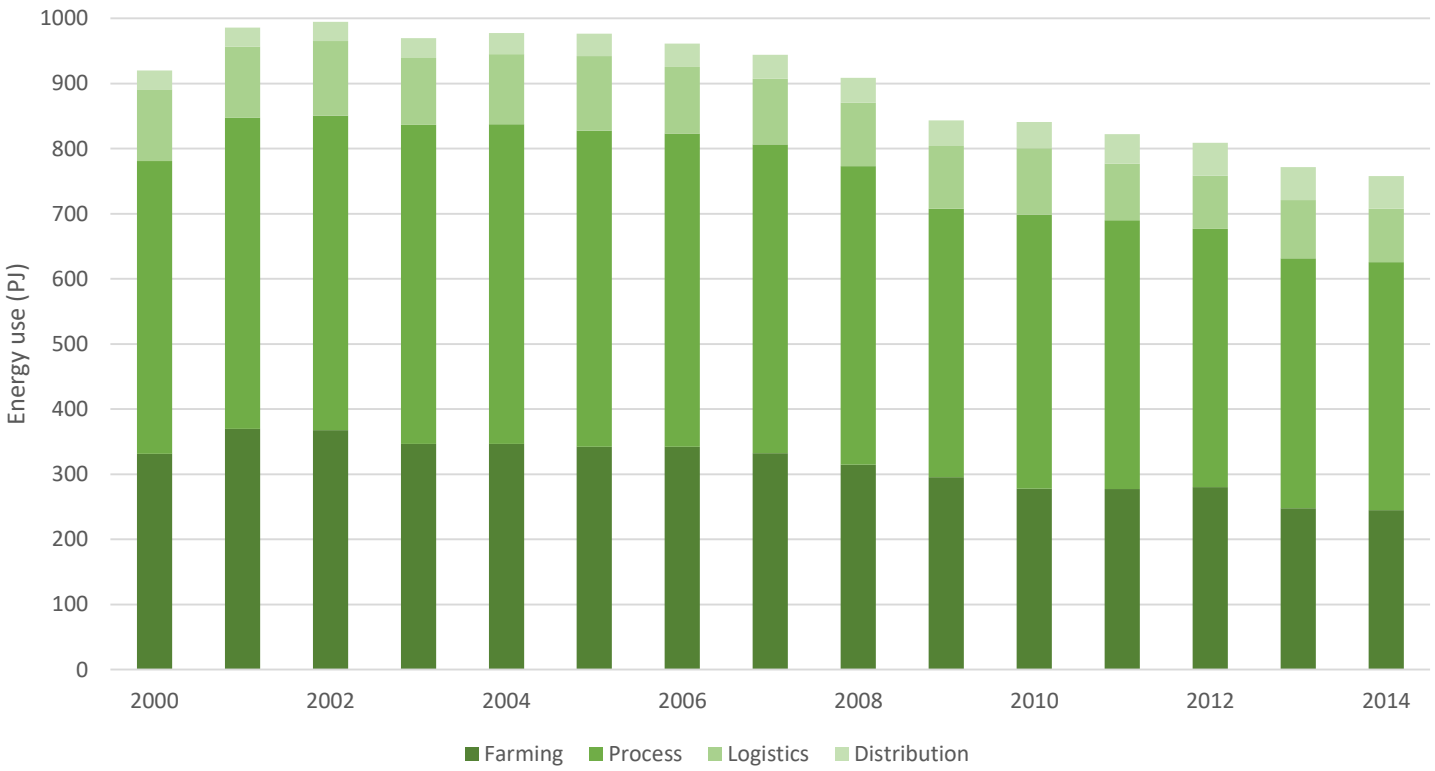


Food waste is a **double energy waste**:

- waste of *nutritional* energy
- waste of *embodied* energy

Double energy waste: the Italian case study

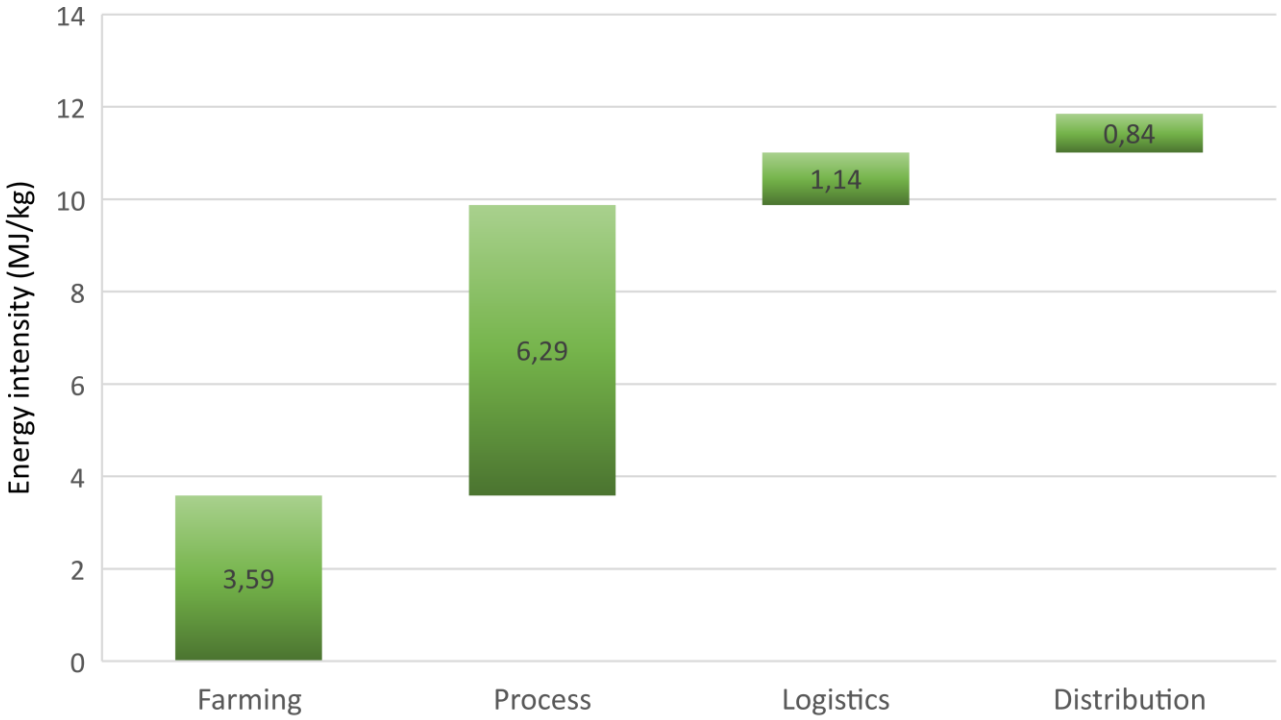
Total energy use in the Italian food supply chain



Sources: Vittuari, De Menna, Pagani 2016. *The hidden burden of food waste: the double energy waste in Italy*, Energies, 9(8) 660-684

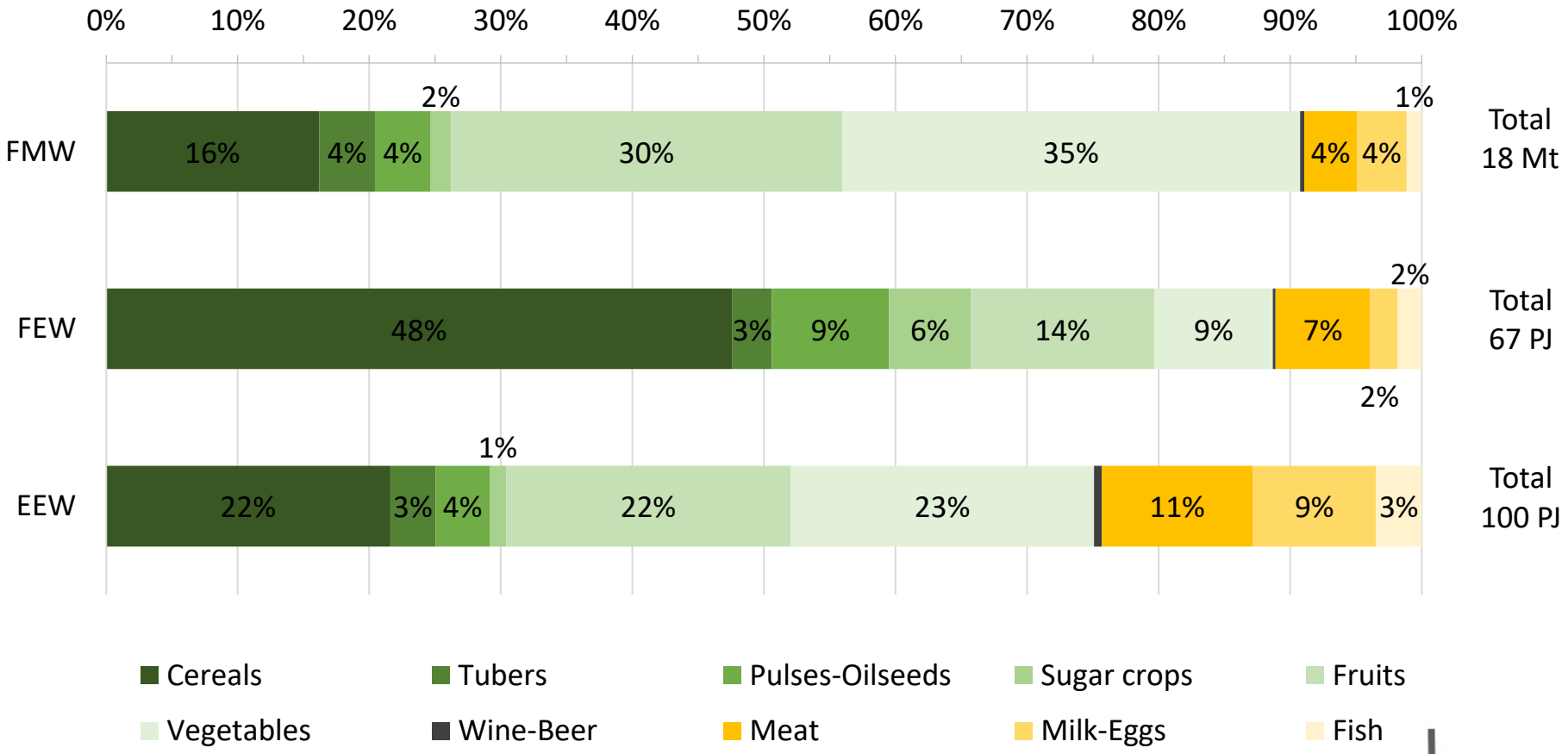
Double energy waste: the Italian case study

Energy intensity in the Italian food supply chain



Double energy waste: the Italian case study

Waste of food mass (FMW), nutritional energy (FEW) and embodied energy (EEW)



Double energy waste: the Italian case study

Farming is the largest contributor because of wasted mass

but…

due to the energy built-up along the chain, food wasted in processing and distribution accounts for 45% of nutritional energy and 52.5% of embodied energy

Waste type	Farming	Processing	Distribution	Total
Food Mass Waste (Mt)	12.8	2.5	2.6	17.9
Food Energy Waste (PJ)	37.0	21.4	8.5	66.9
Embodied Energy Waste (PJ)	47.4	28.4	24.2	100.1

Double energy waste: the Italian case study

So, what role for policy? Need for a transition

from

Linear food systems
mine *fossil* resources to farm,
Process and distribute
with *high yields* but *wasting* huge amount of food and resources

to

Circular food systems
use *renewable* resources to farm,
process and distribute
with *high efficiency*,
reusing/recycling byproducts
and *minimizing wastage* of food and embedded resources

Thanks!


Cartoon Watch
National & State Level
Cartoon Contest 2013
In Association With: chhattisgarh environment conservation board
Subject - STOP FOOD WASTE
open for ALL
CASH Prizes (for both levels)
Regulations.
DON'T WASTE FOOD MY SON ! IT SEEMS SUPPLY'LL BE LESS FROM HUMAN FRONT NOW ON !!