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The Environmental Resources Embodied in Food Waste

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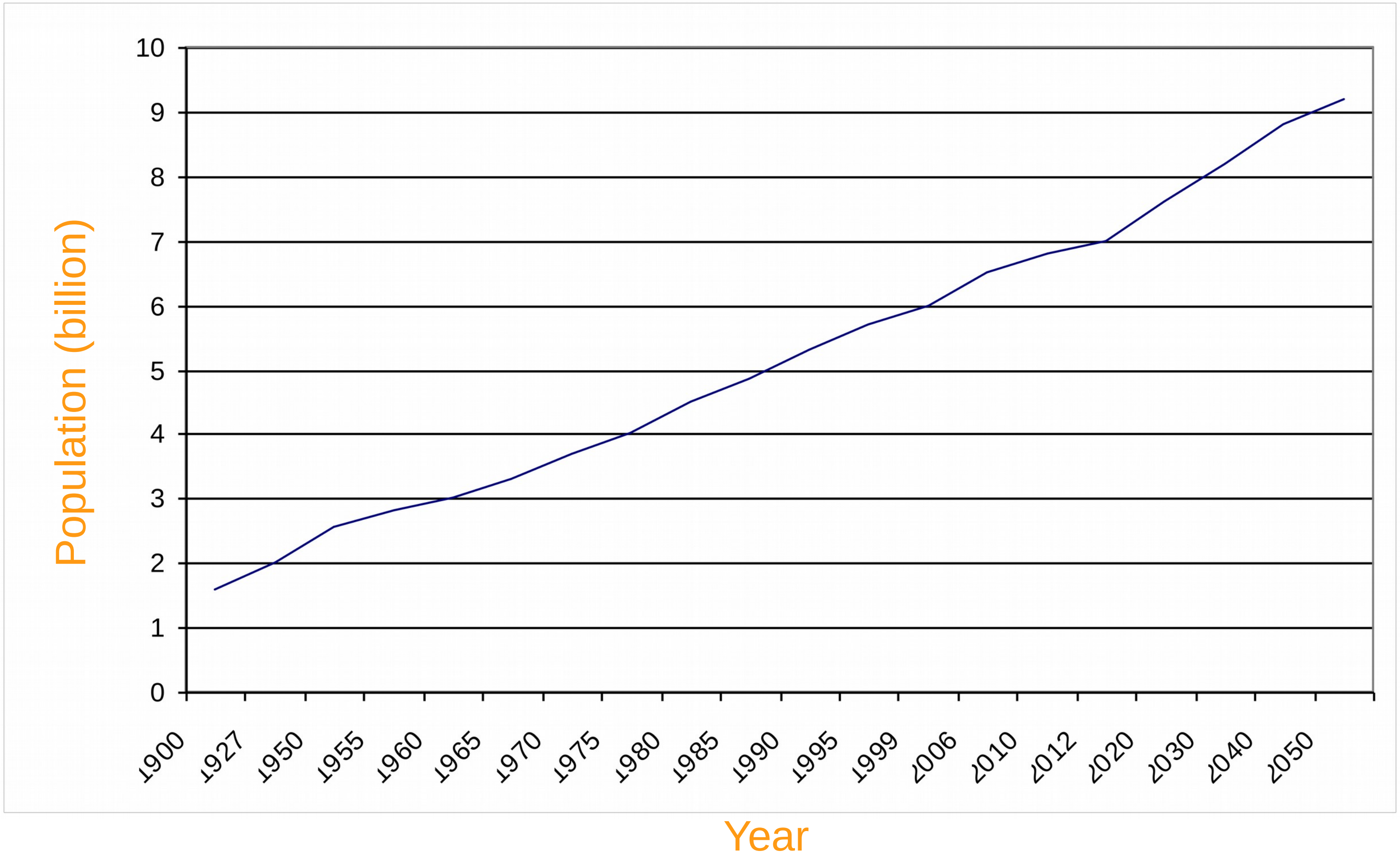
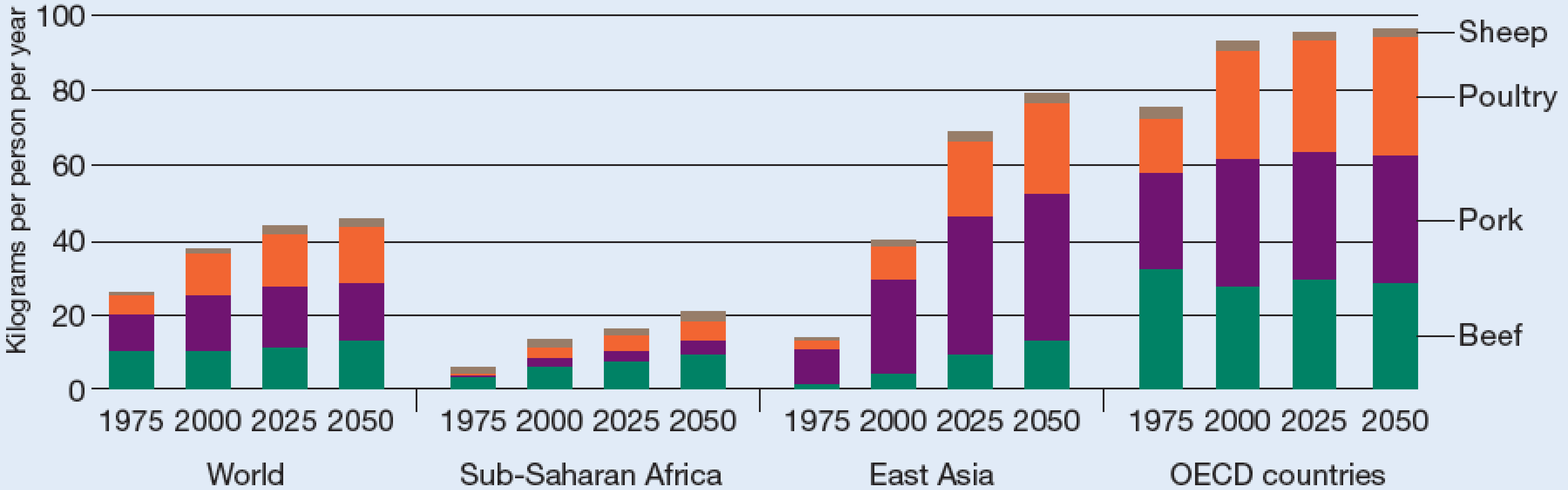
World Population Growth

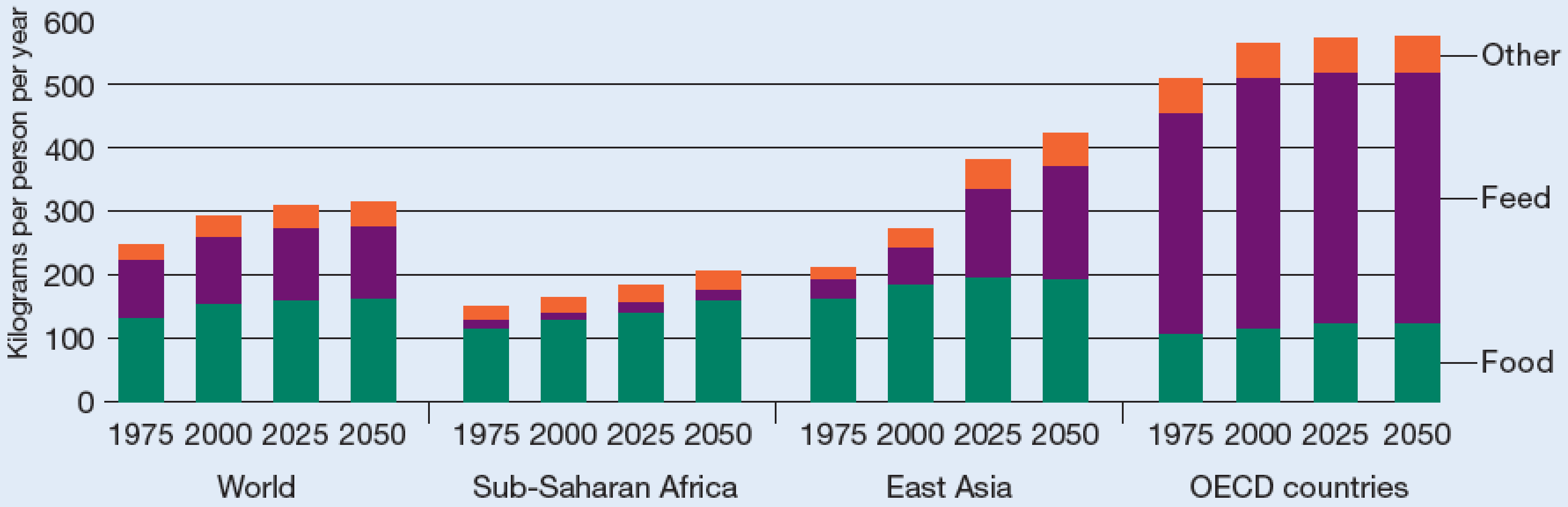


Increased wealth will lead to dietary change and increase meat (and dairy) consumption



Source: For 1975 and 2000, FAOSTAT 2006; for 2025 and 2050, International Water Management Institute analysis done for the Comprehensive Assessment of Water Management in Agriculture using the Watersim model.

Demand for meat drives demand for grains

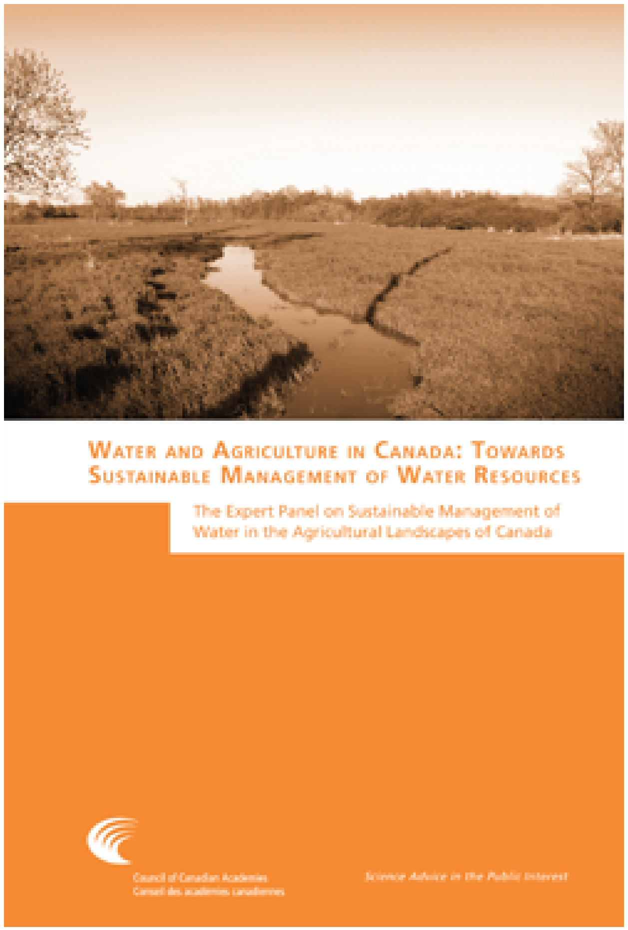


Source: For 1975 and 2000, FAOSTAT 2006; for 2025 and 2050, International Water Management Institute analysis done for the Comprehensive Assessment of Water Management in Agriculture using the Watersim model.

Agricultural Technology has Achieved the Goal of Supplying Plentiful Cheap Food

- Modern agricultural methods were developed 100 years ago (irrigation was a lot earlier, 3100BC!)
- Increasing intensification
- Better crop/animal hybrids
- Irrigation technologies
- Fertilisers (industrial NH_3 production – 1913)
- Pesticides
- Simple inundation strategy

Council of Canadian Academies Report



What additional science is needed to better guide sustainable management of water to meet the needs of agriculture?

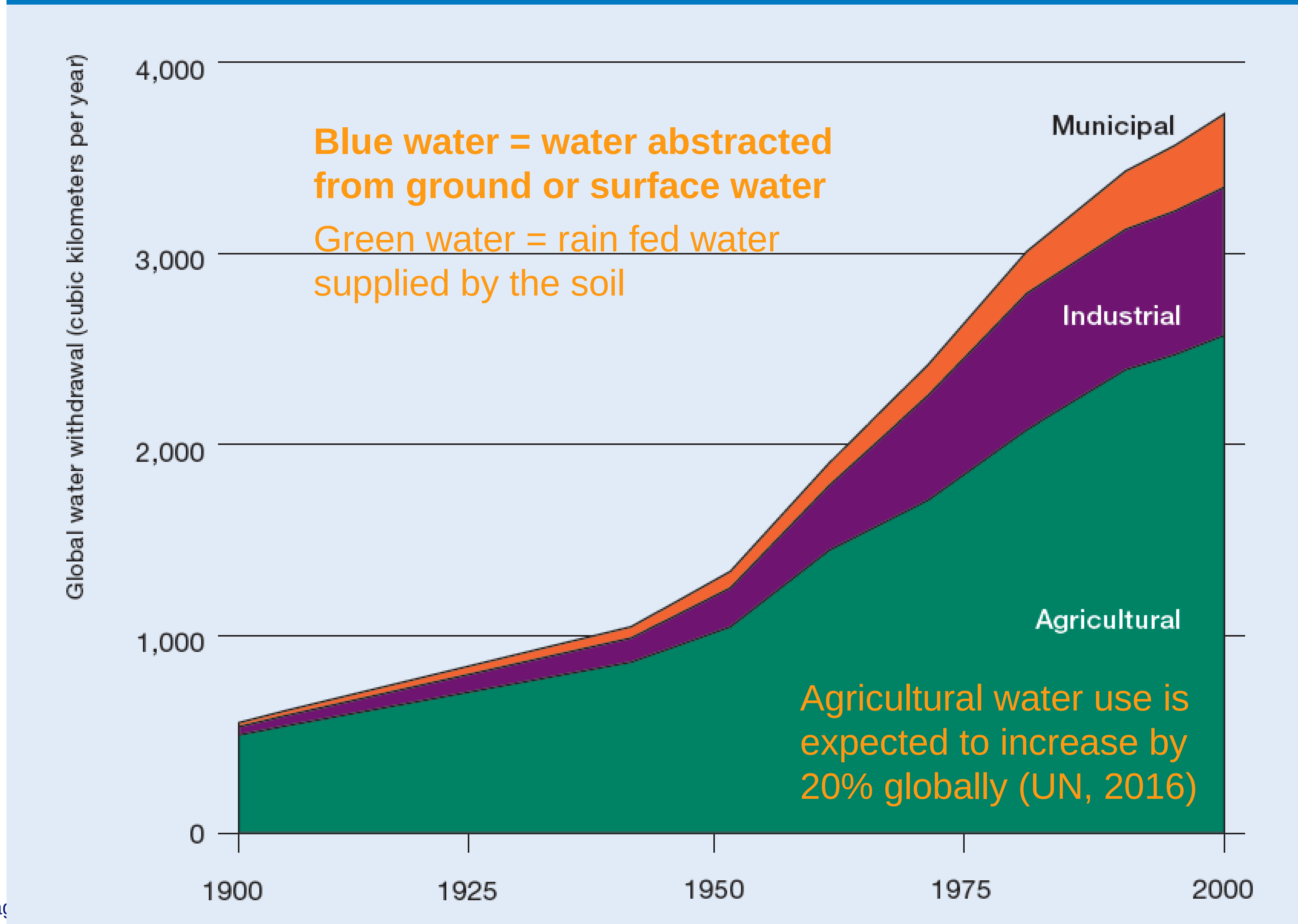
Chapter 5:
Farm-scale technologies that could contribute to efficient water use, reduced environmental impacts, and sound investment decisions

1 grape: 5 L of water

How much water does agriculture consume?

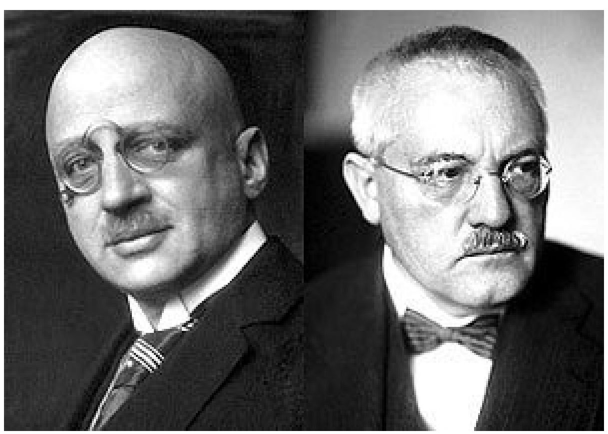
- 1 kg of grain requires 1,600 L of water
- 1 kg of meat requires 5,000 - 20,000 L of water
- 120 L of water for one glass of wine

figure **2.4** **Sectoral competition is increasing for blue water withdrawals for human uses**



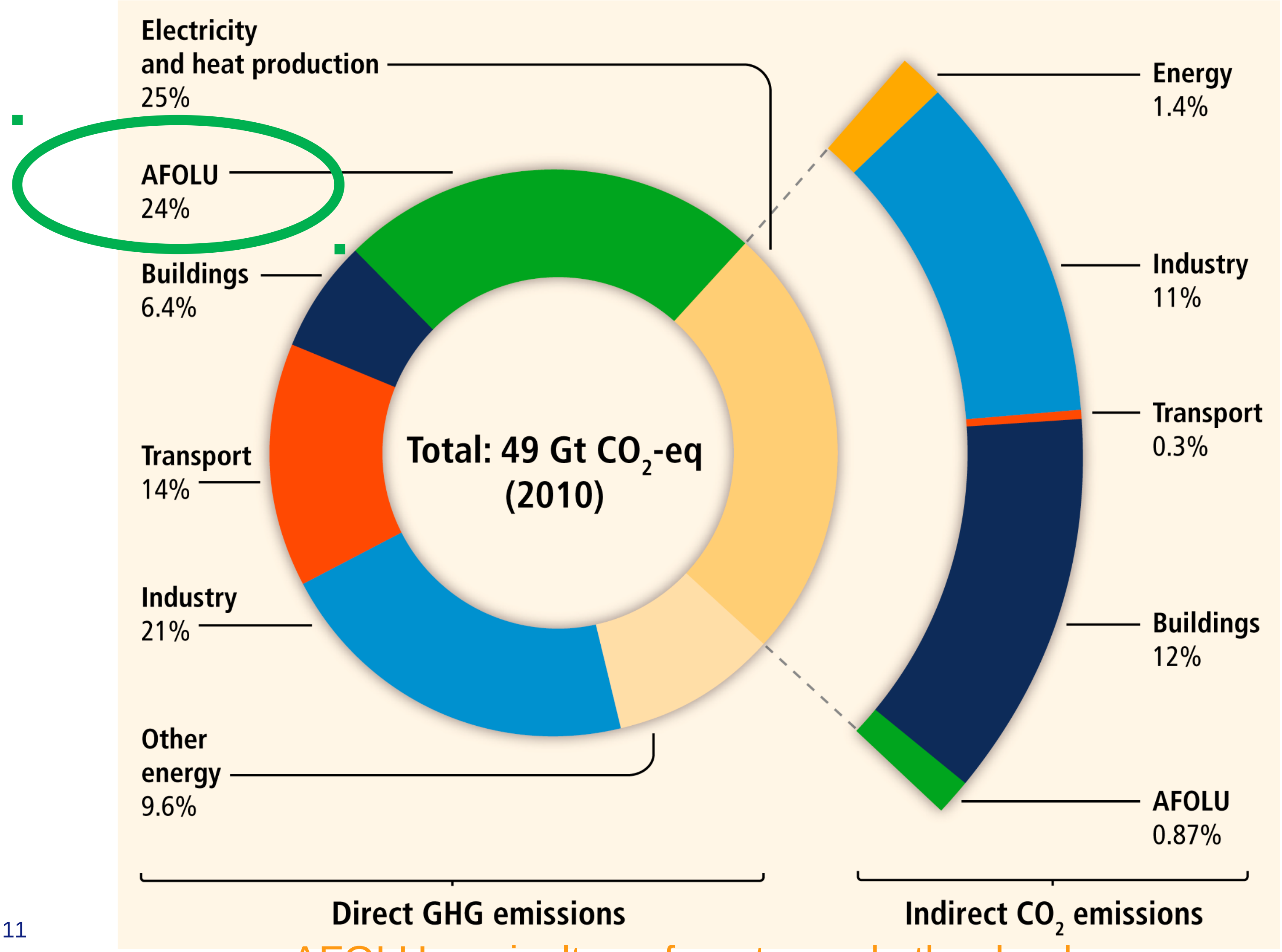
Embodied Energy Value of Nitrogen Fertiliser

- Haber-Bosch process for industrial N fixation
- High pressures and temperatures (15–25 MPa and 300–550 °C)
- Fertiliser production consumes 1.2 % global energy production
- >90% used in N fertiliser manufacture
- International production = 160 M t/y NH_3
- 40 - 60% of the nitrogen in the average human body is from NH_3 produced by the Haber-Bosch process
- ***8000 KWh/t NH_3***



Fritz Haber Carl Bosch

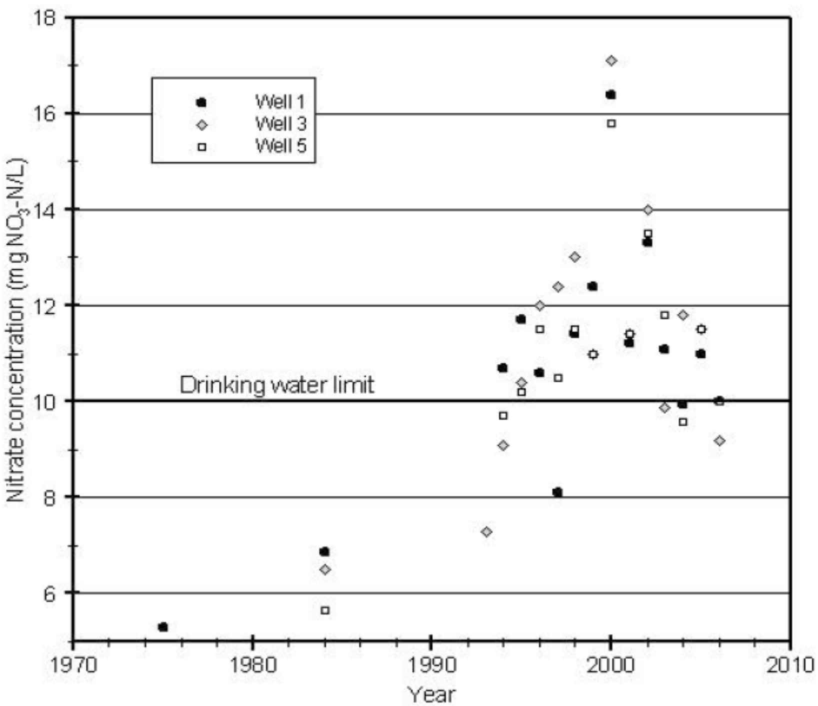
Global GHG Emissions by Sector



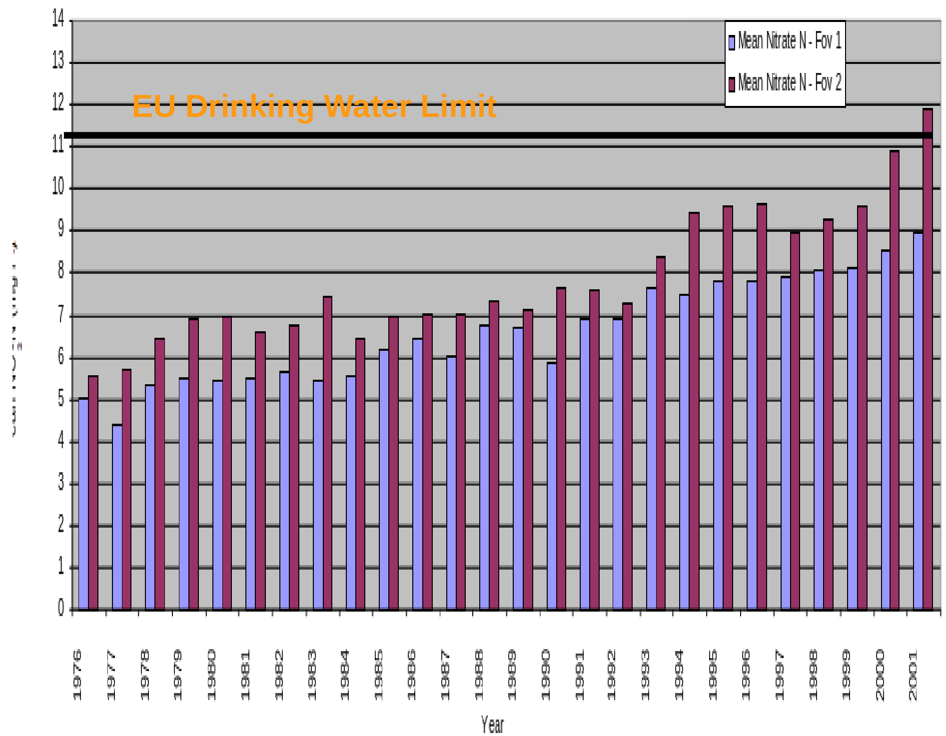
AFOLU, agriculture, forestry and other land use

Nitrates in Potable Groundwater Resources

City of Woodstock, Ontario

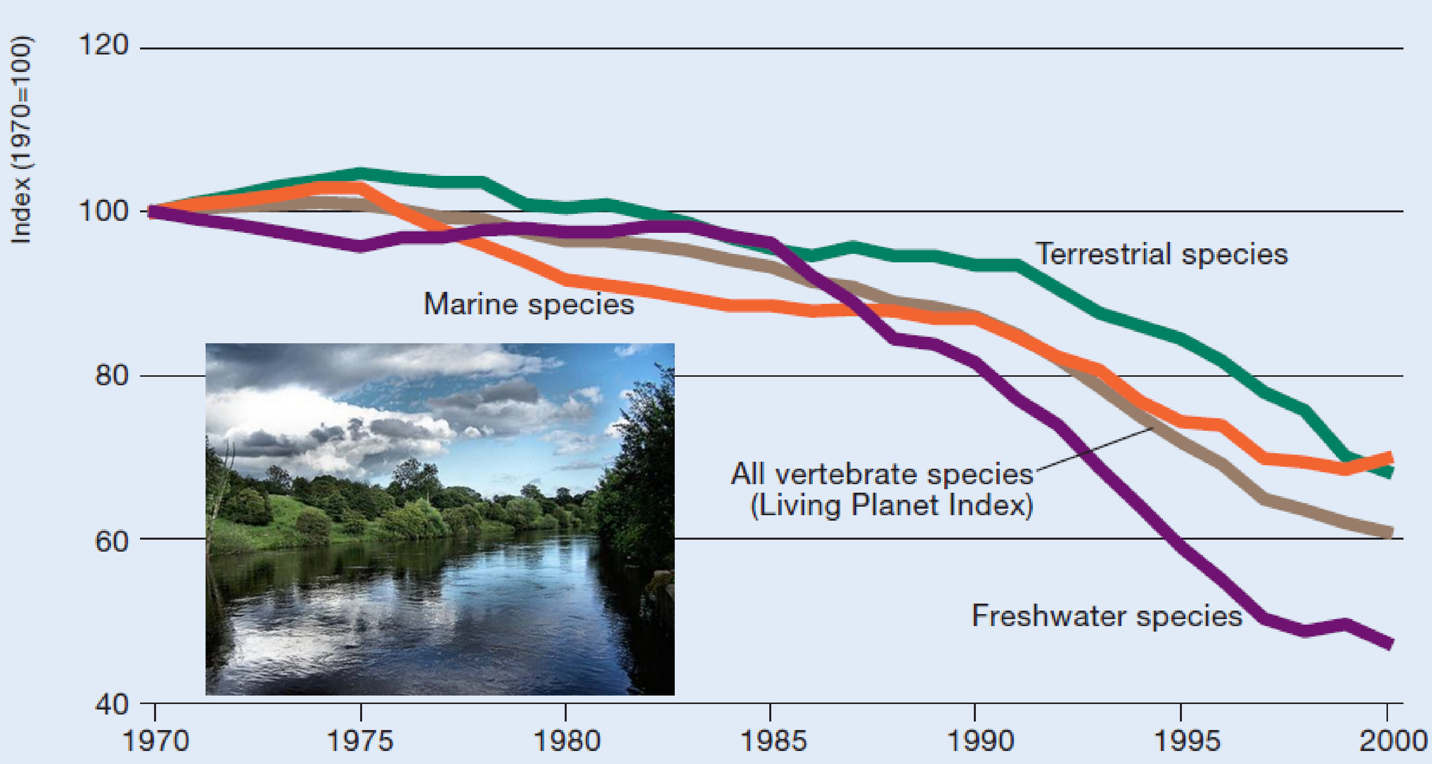


Fovant, SW Wiltshire, UK



Agriculture Contributes to Decline in Biodiversity

figure **2.7** **The Living Planet Index shows that biodiversity is declining most rapidly in freshwater-dependant species**



Note: The index incorporates data on the abundance of 555 terrestrial species, 323 freshwater species, and 267 marine species around the world. While the index fell by some 40% between 1970 and 2000, the terrestrial index fell by about 30%, the freshwater index by about 50%, and the marine index by about 30%.

Source: MEA 2005b.

Resources Embodied in Food

Embodied CO_2Eq footprint:
12,150 MtCO_2Eq
32.1% of global CO_2Eq

Embodied Water Footprint:
1,846km^3
70% of global water use

£ $
¥ €

total gross value of agricultural production:
$2,758bn
3.8% of global GDP

Global fertilizer use:
145Mt of NPK

Context:

- USA GHG emissions 5,561MtCO_2Eq
- Lake Ontario: 1,710 km^3
- UK GDP $2,849bn

http://sustainablefoodtrust.org/wp-content/uploads/2013/04/HCOF-Report-online-version.pdf

Food Waste Disposal

15 Mt/y of food waste is generated in the UK (~5 Mt/y is landfilled)
Landfill disposal of biodegradable waste represents 11% of global CH_4 emissions, a critical GHG

Global Food Waste Disposal Model - Resources Embodied in Edible Food Waste

Edible food waste: 21% 1,243Mt

Non-edible food waste: 6% 343Mt

Consumed: 73% 4296Mt

Embodied CO_2Eq Footprint:

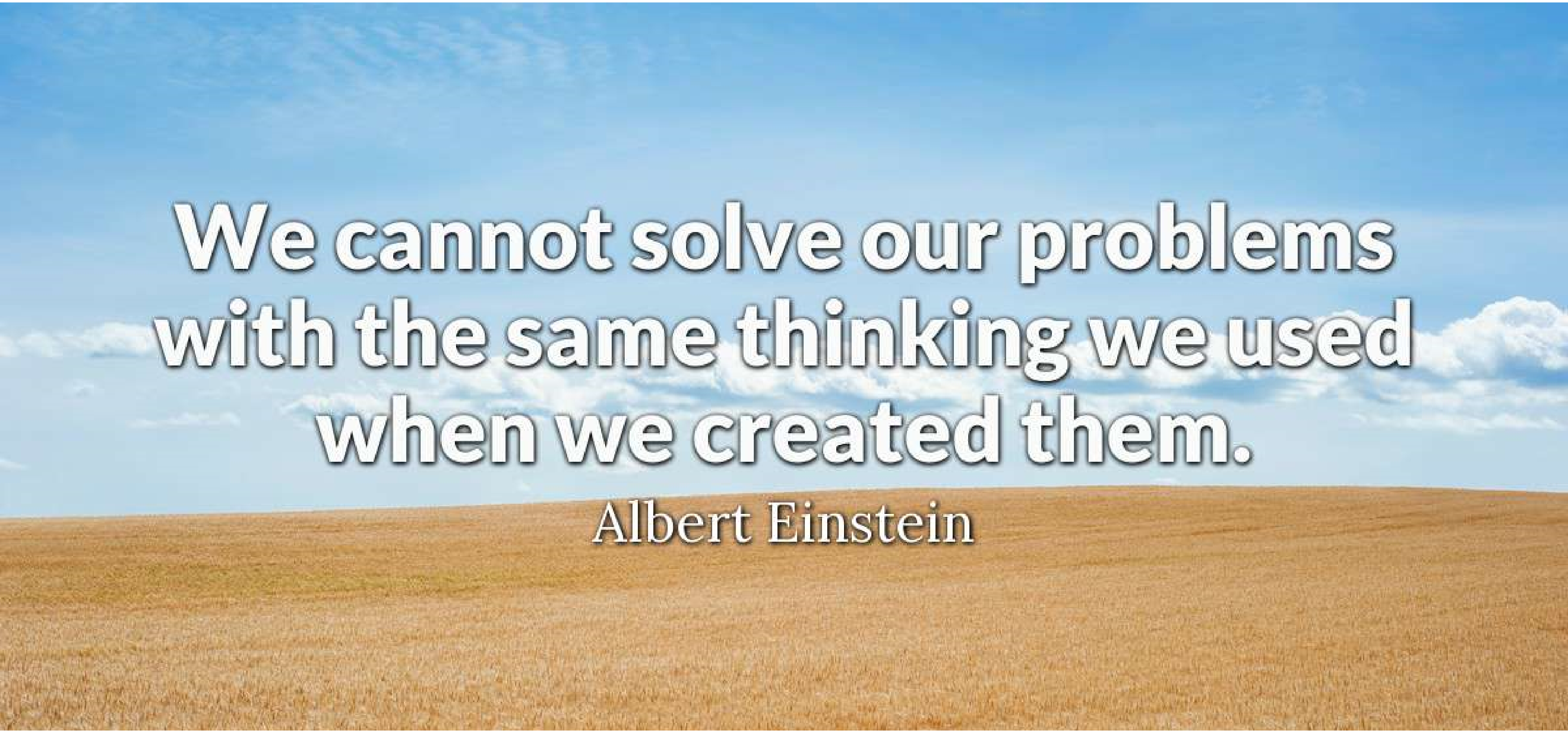
- **2,567 $MtCO_2Eq$**
- **6.8% of global CO_2Eq**

Embodied Water Footprint:

- **390.1 trillion L**
- **14.8% of global water use**

Cost to produce:

- **$582.8bn**
- **0.8% of global GDP**


We cannot solve our problems
with the same thinking we used
when we created them.
Albert Einstein

Conclusions

- Population growth and economic development are driving the demand for food and dietary change
- Massive resources are embodied in food (water, energy)
- There are significant environmental externalities caused by food production
- The price of food does not reflect the environmental and other costs of production
- Greater value should be ascribed to food to reduce waste
- More adaptive and realistic food production, pricing and consumption policies are urgently needed to avoid producing food we don’t need