Designing a farming strategy to respond to the triple crisis of resource depletion, climate change and the failure of the market economic model

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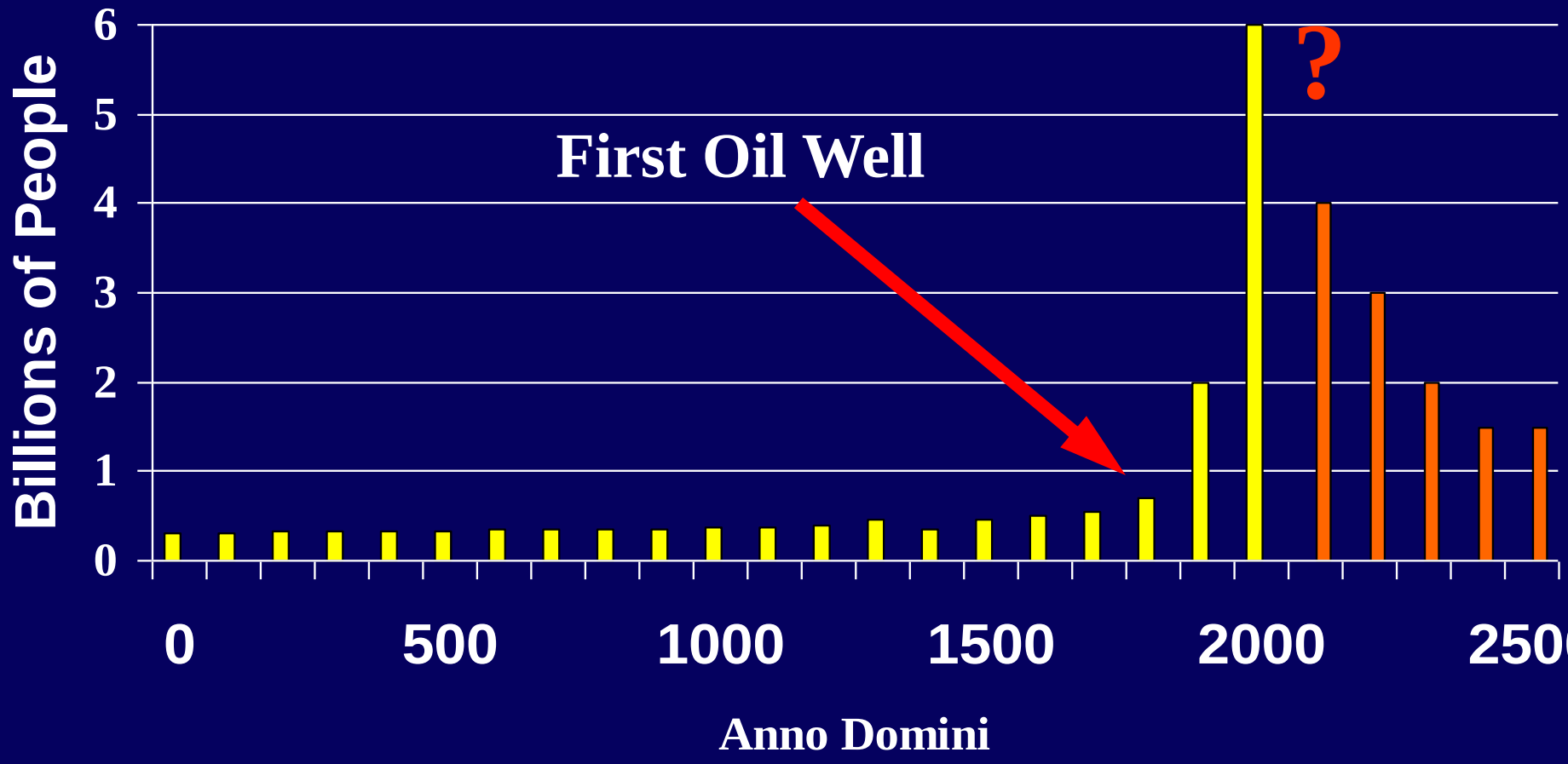
The challenges

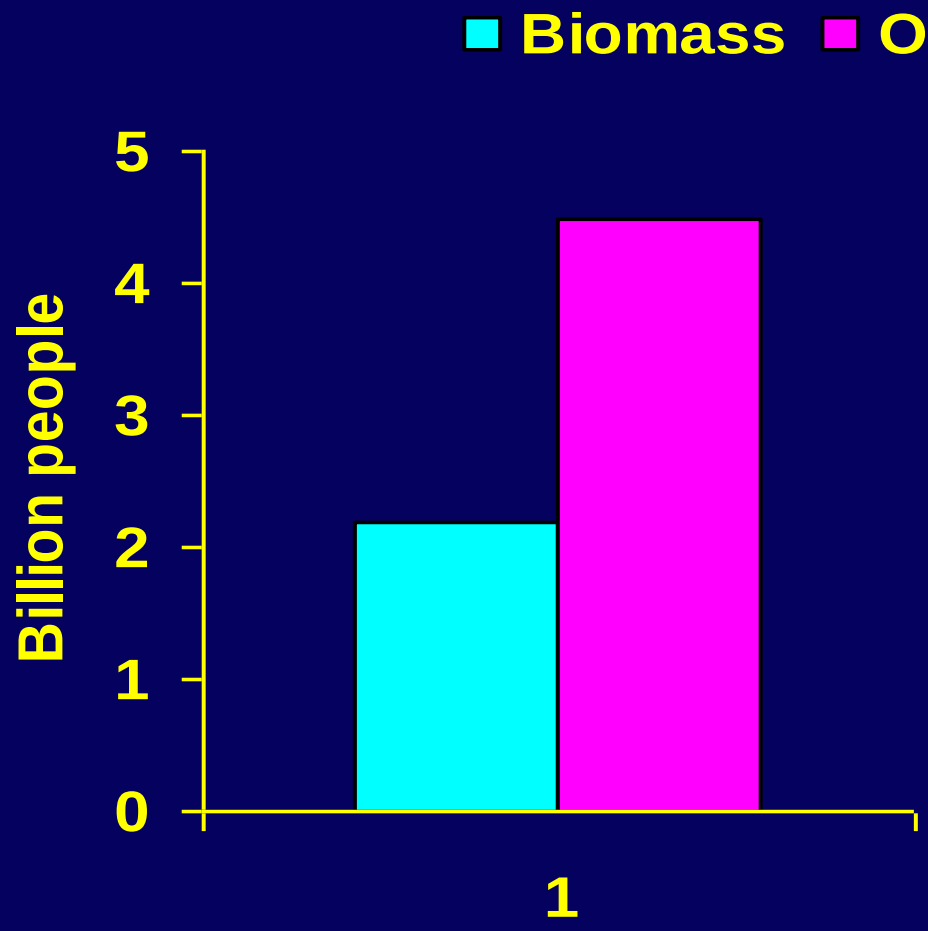
The triple world crisis

- Peak oil - the end of inexpensive energy & beginning of expensive inputs into food/feed production
- Global resource depletion
  - Financial credit
  - Mineral fertilizers (N P K and S)
  - Irrigation water
  - Soil
- Global climate change

Human population explosion coincided with the increasing availability of "Cheap Oil"



World population supported by biomass and oil



The real problem

- Neither the oil crisis nor the food crisis (nor the climate change crisis) is the real problem
- As a world, a society, as people – we are in the midst of a thinking crisis

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For most of us

- BAU: Business as usual
- NIMBA: Not in my backyard!

Misleading predictions due to lack of reliable data

Livestock and Climate Change

What if the key actors in climate change are...

cows, pigs, and chickens?

Uncounted, Overlooked, and Misallocated Livestock-related GHG Emissions

	Annual GHG emissions (CO_2e)	Percentage of worldwide total
	million tons	
FAO estimate	7,516	11.8
Uncounted in current GHG inventories:		
1. Overlooked respiration by livestock	8,769	13.7
2. Overlooked land use	≥2,672	≥4.2
3. Undercounted methane	5,047	7.9
4. Other four categories (see text)	≥5,560	≥8.7
Subtotal	≥22,048	≥34.5
Misallocated in current GHG inventories:		
5. Three categories (see text)	≥3,000	≥4.7
Total GHGs attributable to livestock products	≥32,564	≥51.0

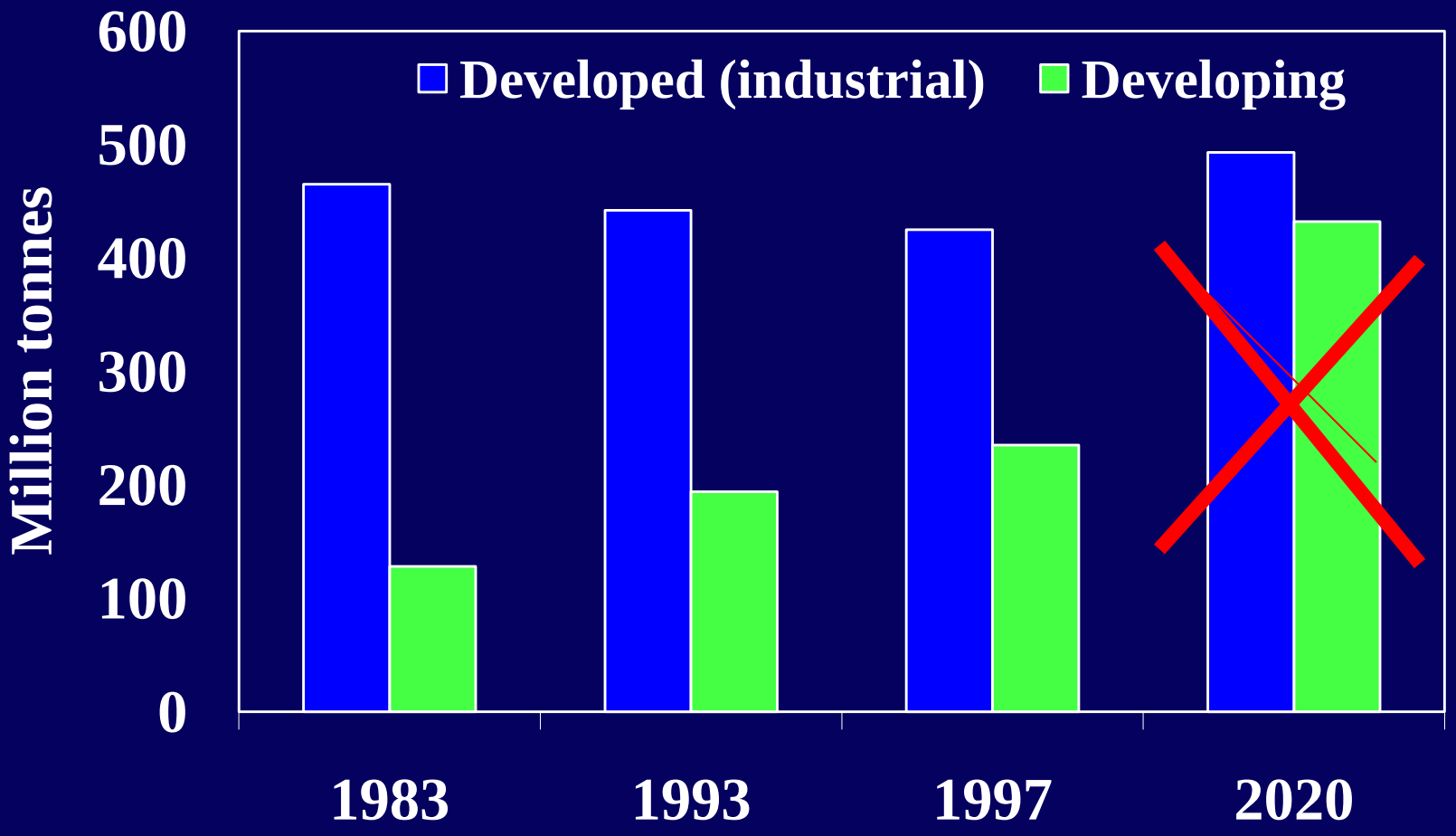
Robert Goodland & Jeff Anhang, (Ex-World Bank),Oct 20, 2009

~~Live stock production~~

- **…. an effective strategy must involve <u>replacing</u> livestock products with better alternatives**

Robert Goodland & Jeff Anhang, (Ex-World Bank),Oct 20, 2009

Predicted use of cereal grain as animal feed is neither feasible nor desirable



Delgado et al 2002

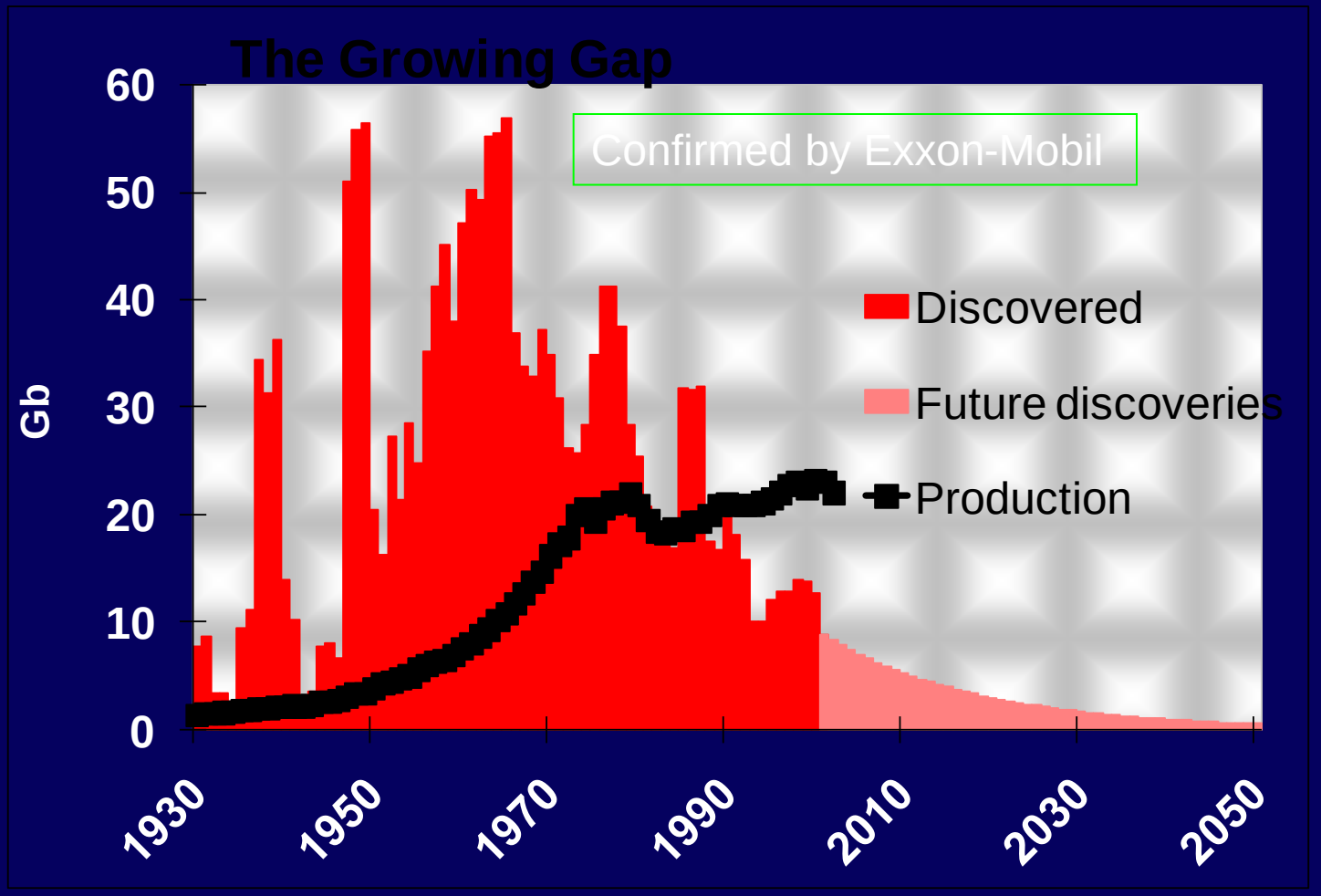
Peak oil

The heart of the problem

Indicators of looming oil supply gap (Peak oil)

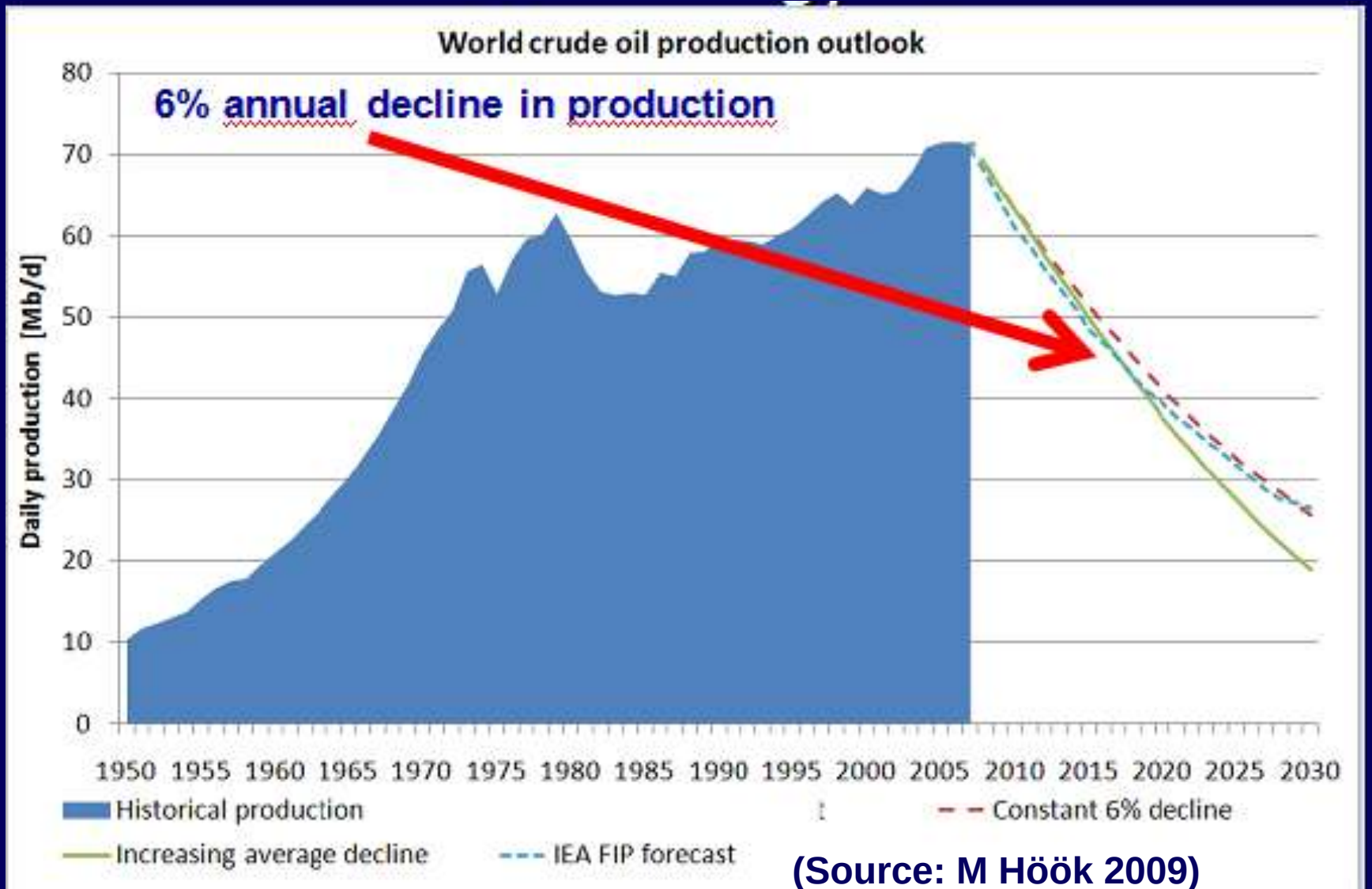
- Declining output from aging oil-fields (5-6%/year),
- Declining discoveries,
- Project delays (costs),
- Sharply increasing global demand

The world is using more fossil energy than is being discovered



(Campbell 2005)

Historical and projected oil production (IEA World Energy Outlook 2008)



(Source: M Höök 2009)

Timing of World Oil Production Decline

Now or Soon:

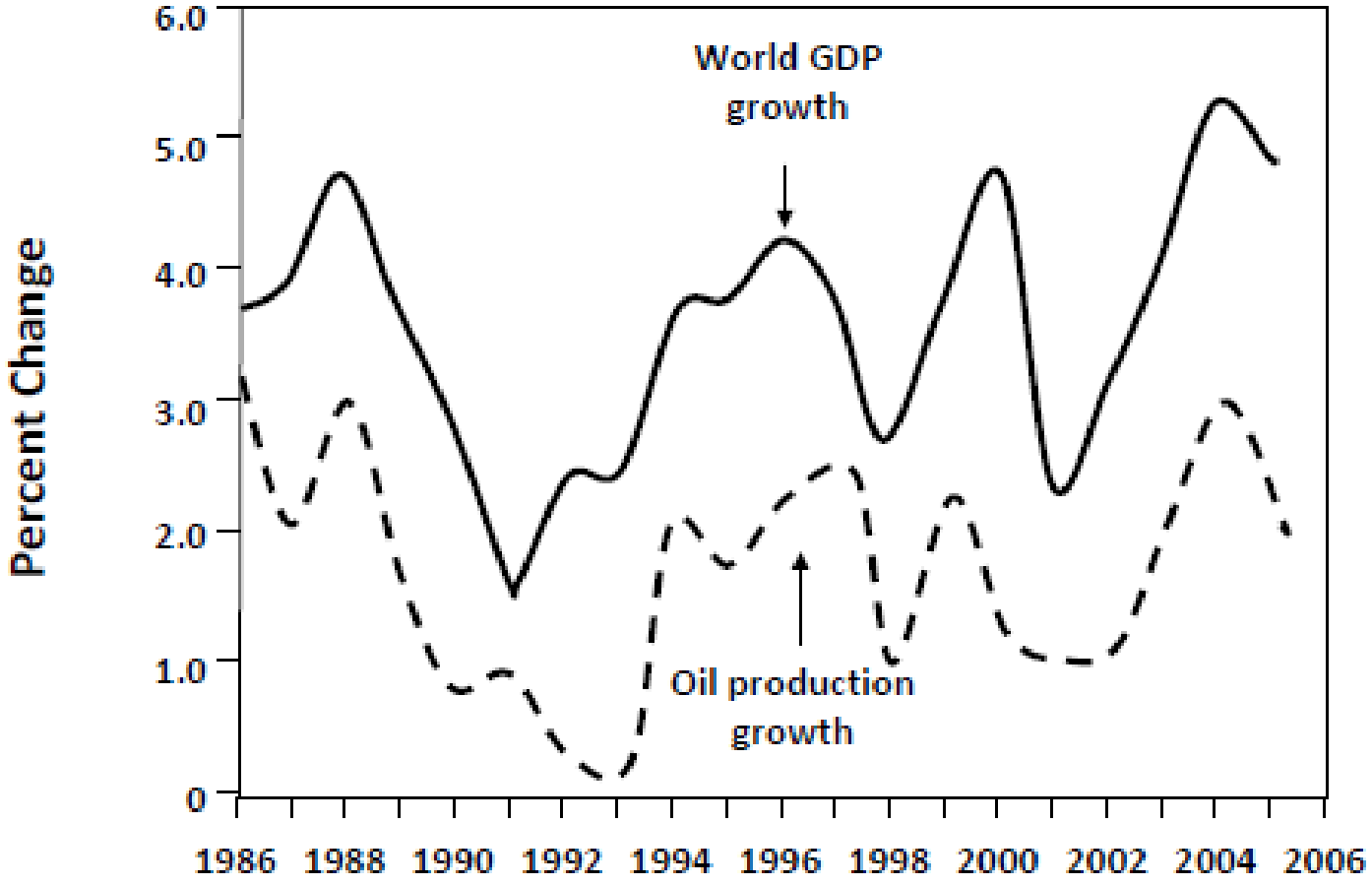
- IEA
- Chevron
- Shell
- Total Oil
- Statoil
- Hess Oil
- Toyota
- Jim Schlesinger
- Boone Pickens
- Matt Simmons
- Corps of Engineers
- CIBC (Canada)
- EWG (Germany)
- Many oil geologists

No imminent problem:

- OPEC
- EIA
- CERA
- BP
- ExxonMobil

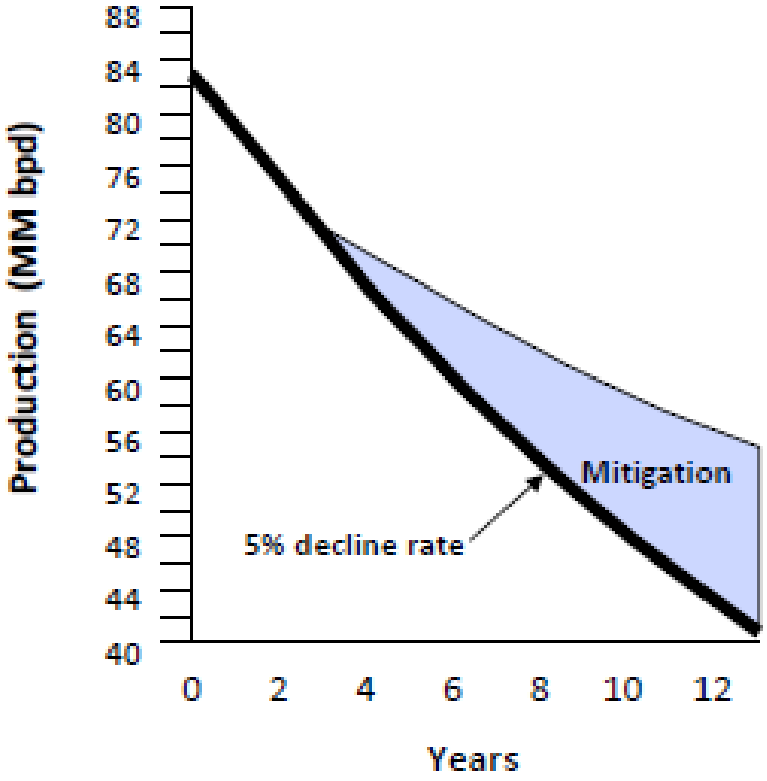
Robert Hirsch, October 2009

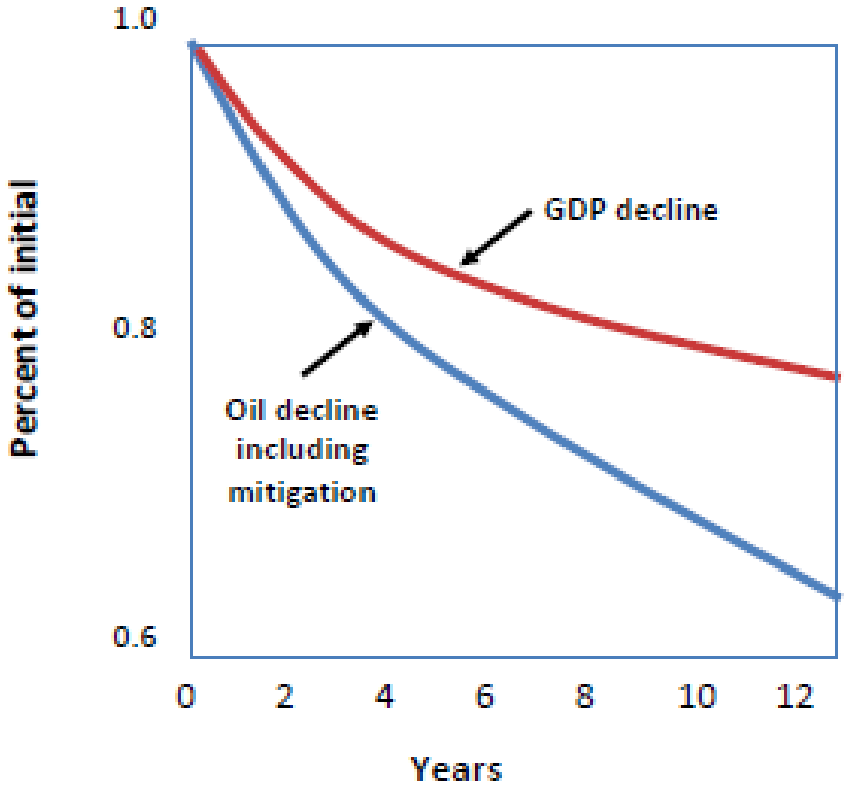
Oil is fundamental to economic well-being. World GDP growth & world oil production growth have tracked each other for decades.



Oil production data is from EIA, April 2007 International Petroleum Monthly. May 8, 2007.
GDP Market Exchange Rate data is from the IMF World Economic Outlook Database. April 2007.

If the world oil production decline rate is 5% & world GDP decline is of the order of 60 % of oil decline, then world GDP would decline significantly in spite of crash program mitigation.



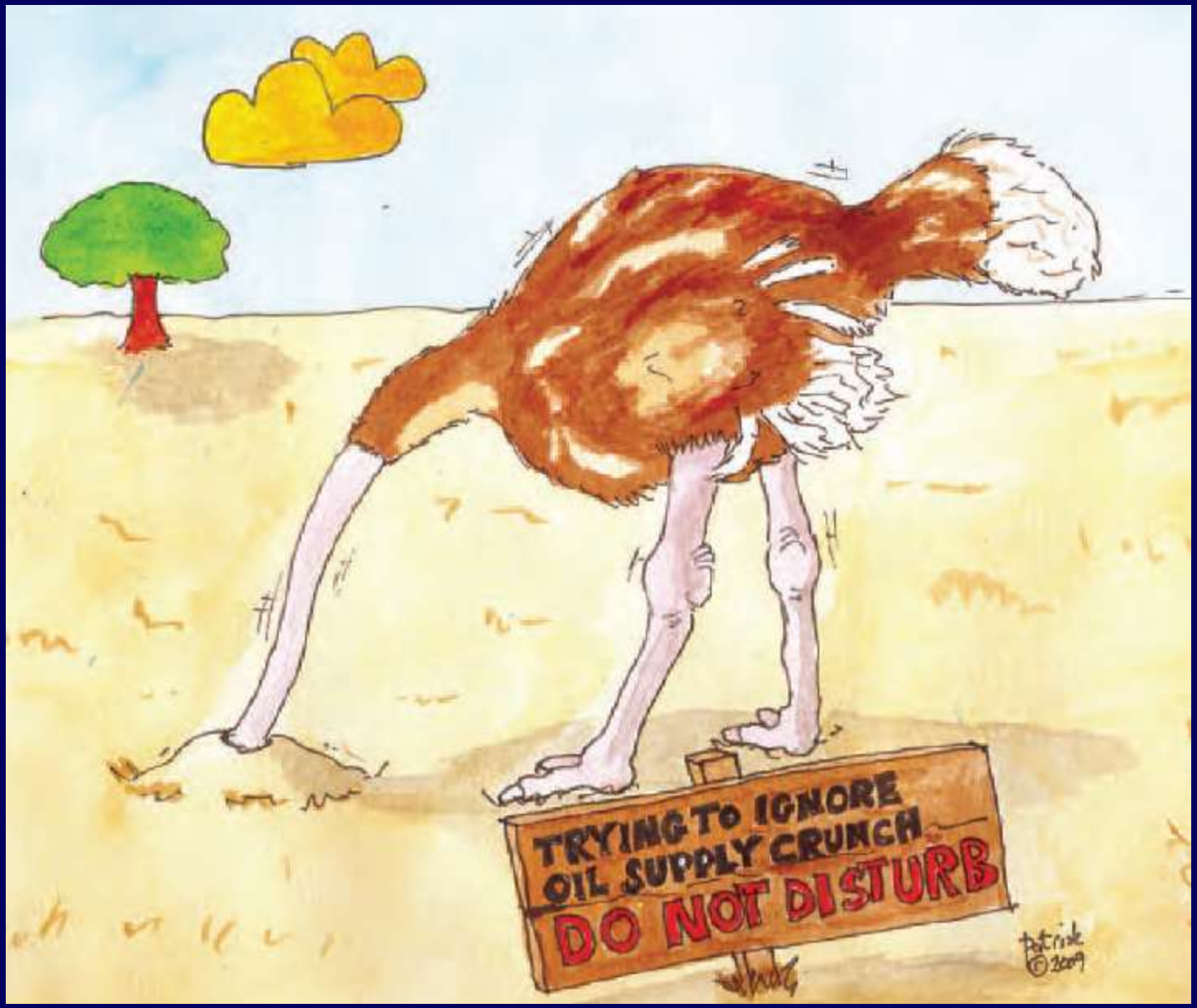


A 15 – 20 % world GDP decline in 10 years is conceivable.

The way ahead

- **Solutions exist already to meet many of these challenges**
- **Key solutions are electrification of surface transport, biofuels, biogas and massive improvements in efficiency**

Skrebowski C, 2009, October 12


TRYING TO IGNORE
OIL SUPPLY CRUNCH
DO NOT DISTURB
Patrick
©2009

The end is nigh for the Age of Oil

- This is the end of the 20th Century of Oil; we are entering the 21st Century of Electricity.
- Once the peak oil market is reached and demand begins its decline… OPEC will reverse its strategy of under-supply, and pursue market share and lower prices.

Source: Deutshe Bank, 4 Oct, 09

End is nigh for the Age of Oil

- **This shift will threaten the value of:**
  - **High cost un-developed oil such as ultra-deepwater (Brazil, Lower Tertiary, West Africa, and elsewhere)**
  - **Undeveloped Canadian heavy oil sands, and the companies that are adding rig capacity to service them**

Source: Deutshe Bank, 4 Oct, 2009

The four ages of *H. sapiens*

- Stone
- Wood
- Fossil fuel (Coal→ Oil → Gas)
- Electricity

IEA (Fatih Birol 2008)

"We should not cling to crude down to the last drop

- *– we should leave oil before it leaves us."*


ELECTRIC
CHARGE
Changing Times. Unchanging Values.

Livestock production?

Future scenarios

The Green Revolution

Was an “energy” revolution

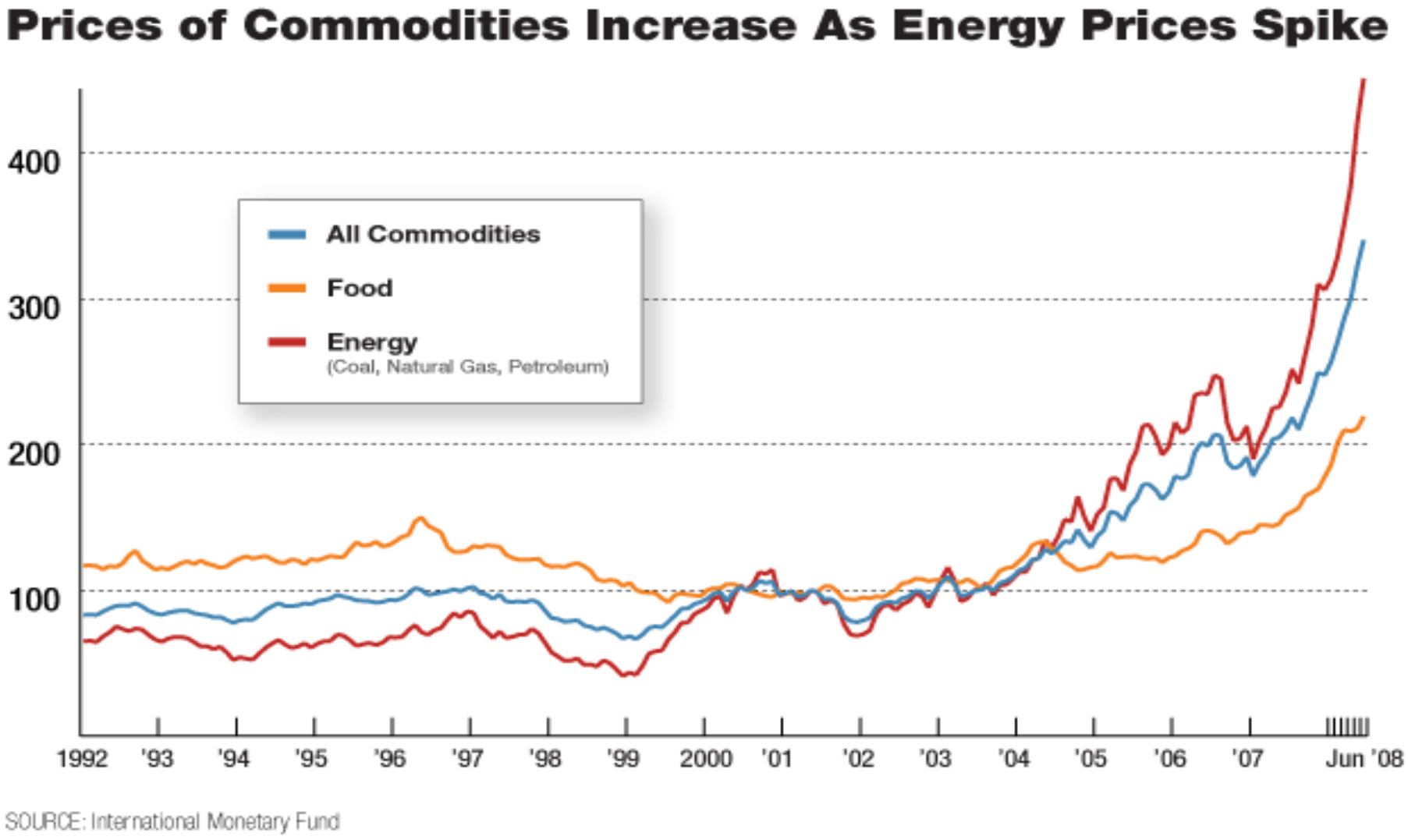
Crop production growth since 1950 has been in land productivity due to *inexpensive energy*

- 10 fold increase in fertilizer application
- 3 fold increase in irrigation
- Increased multiple cropping of land on an annual basis
- Availability of high yielding maize (USA) and dwarf wheat and rice (Asia)
- Huge increase in soybean production

"if there is anything that must be understood with regard to energy it is its relationship to food."

- **Agriculture is an energy intensive sector with row crop production particularly affected by energy price increases.**
- **Fertilizers embody the most energy among production inputs as natural gas is a primary input (70-90 percent of cost of producing nitrogen fertilizer).**

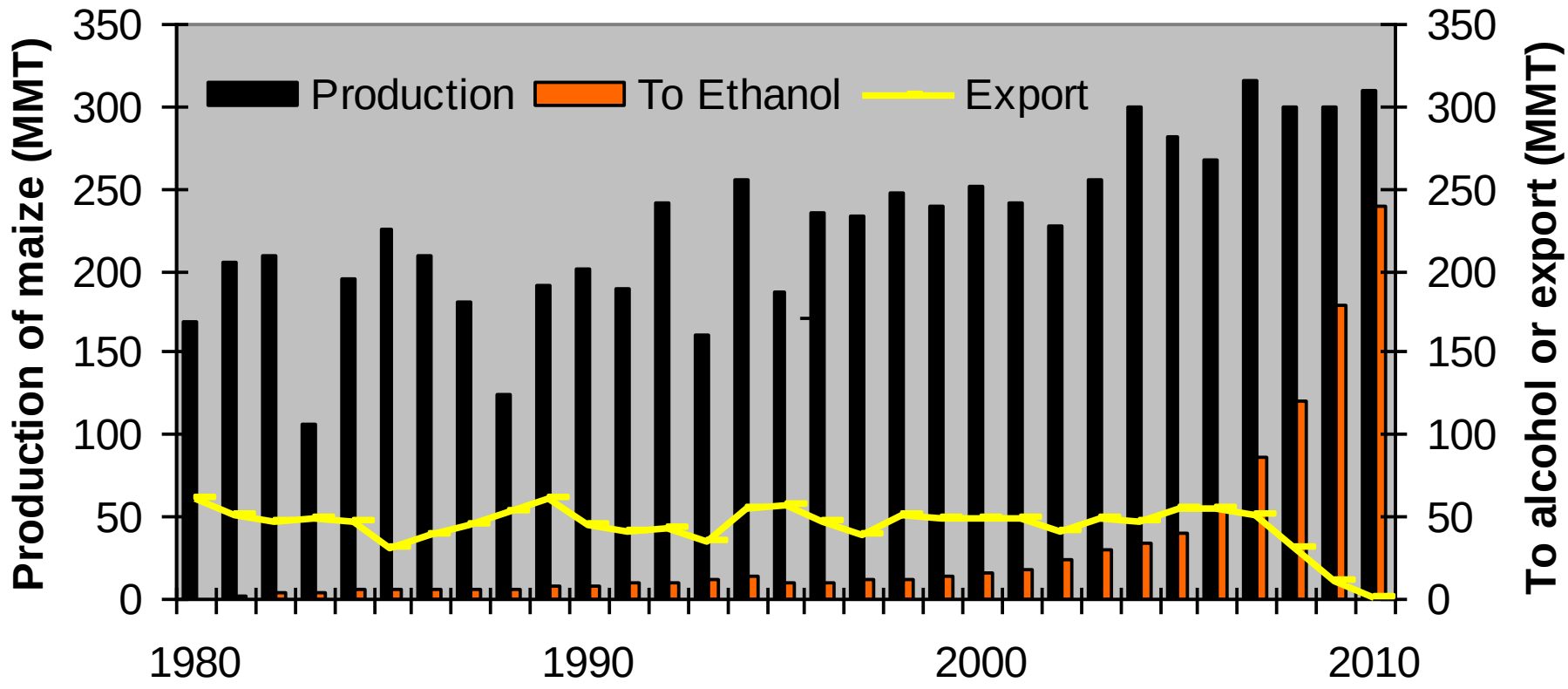
Oil price is linked to every aspect of life; standards of living will be affected as price rises



World grain production will decline in the next 20-30 years

- Peak oil
- **Global climate change**
- Land degradation

Trends in production and use of maize in USA



(adapted from Earth Policy Institute 2007)

Future farming systems

- Integrated production of
  - Food
  - Feed
  - Energy
- Localization (not globalization)

The biggest and most secretive gathering of ships in maritime history lies at anchor east of Singapore. Never before photographed, it is bigger than the U.S. and British navies combined but has no crew, no cargo and no destination - and is why your Christmas stocking may be on the light side this year

The 'ghost fleet' near Singapore. The world's ship owners and government economists would prefer you not to see this symbol of the depths of the plague still crippling the world's economies

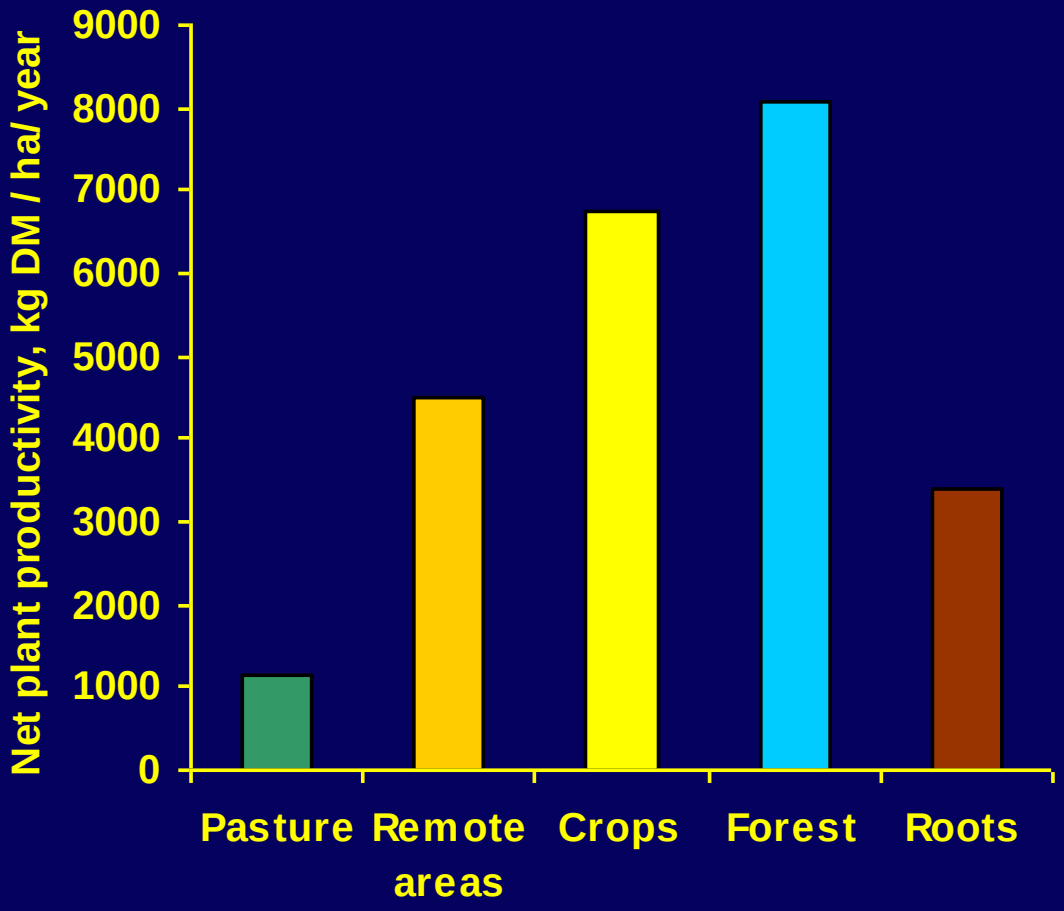
Think Globally

Act locally

The only renewable energy is from the sun

- Increase biomass production by improving efficiency of capturing solar energy
- Crops and cropping systems focused on needs for:
  - Food / feed
  - Fuel

Biomass production

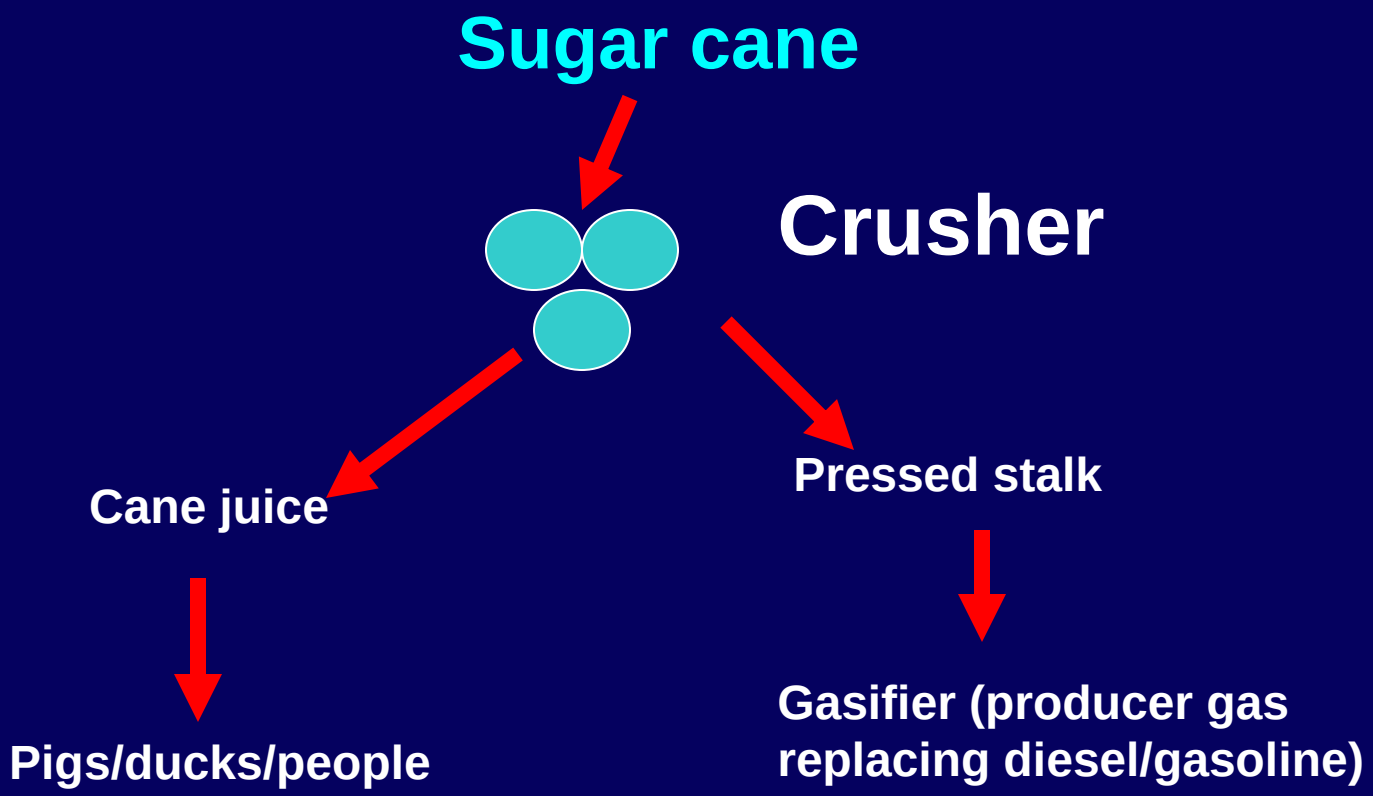


Source: Patzek 2007

Fractionation of the biomass

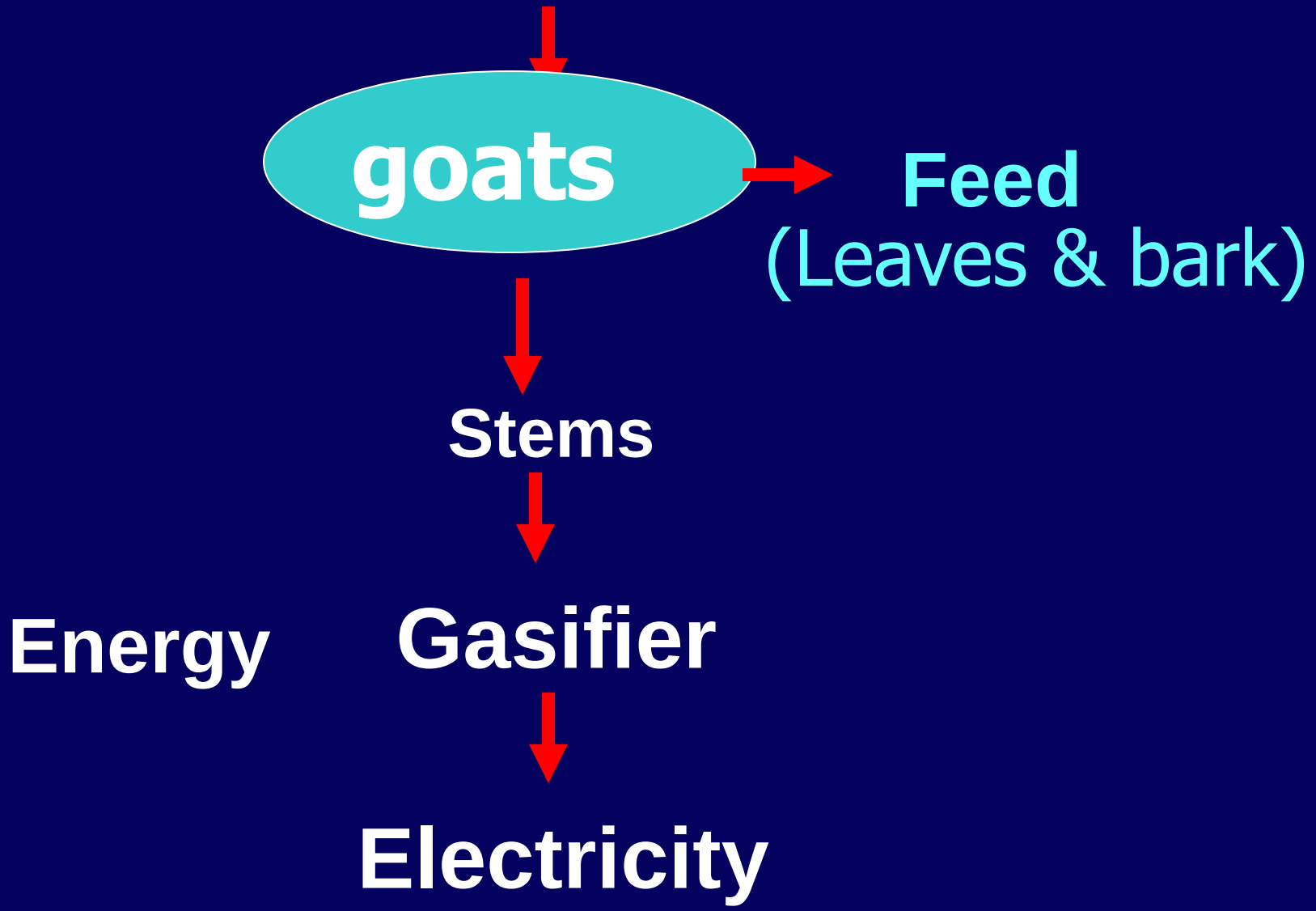
- Highly digestible component (sugar, starch, proteins) for consumption by humans and (some) animals
- The fibrous (cell wall) component for fuel and construction

Biomass for feed and fuel energy (Ecological farm in Colombia)



Fractionating sugar cane in Colombia

Fractionation of forage trees



Goats for fractionating tree foliages (TOSOLY, Colombia)

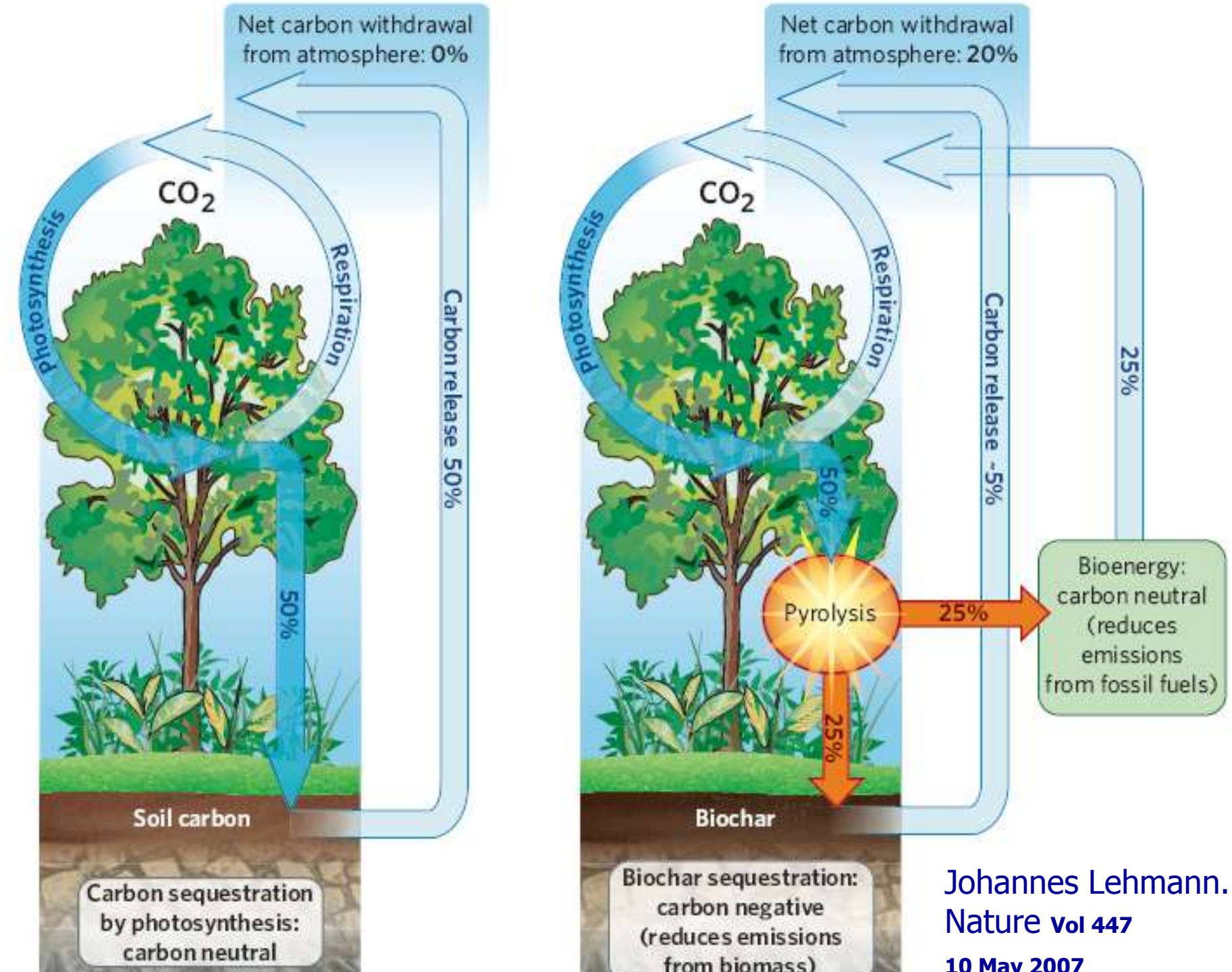

Bagasse
Stems from forage trees

Gasifier (9 KW in Cambodia)

A handful of carbon

Locking carbon up in soil makes more sense than storing it in plants and trees that eventually decompose, argues **Johannes Lehmann**. Can this idea work on a large scale?

Sequestering 'biochar' in soil, which makes soil darker in colour, is a robust way to store carbon.



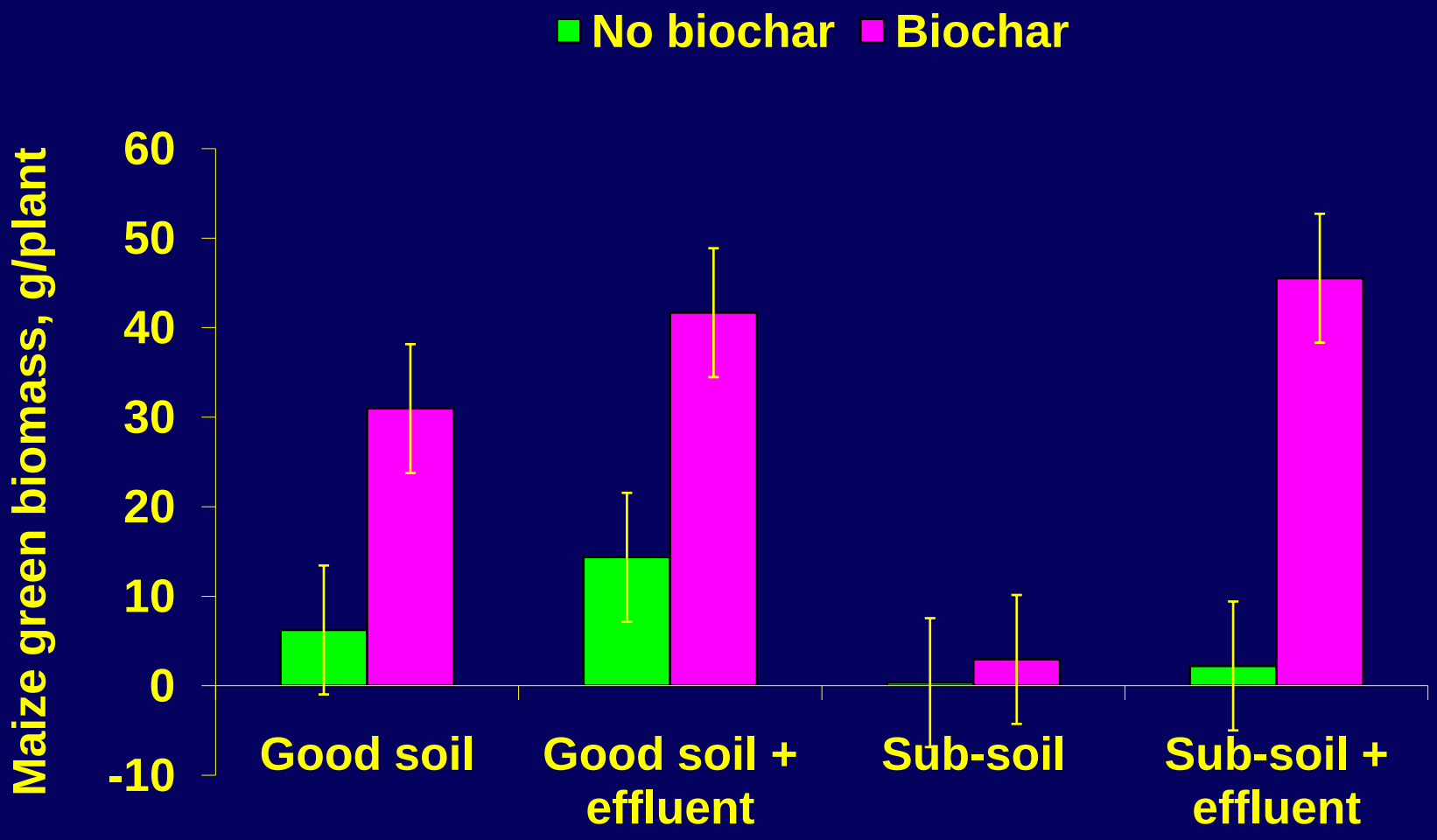
Johannes Lehmann. Nature **Vol 447**

10 May 2007

Gasification and carbon sequestration (on-farm)

Sugar cane, t/ha/yr	100
Bagasse DM, tonnes/ha/yr	15
Char (C + ash), % of biomass DM	10
KWh/ha	12 500
Carbon sequestered, kg/kwh	0.084
Carbon sequestered, tonnes/ha	1.0
Carbon dioxide sequestered, tonnes/ha/year	3.0

Effect of biochar and biodigester effluent on maize



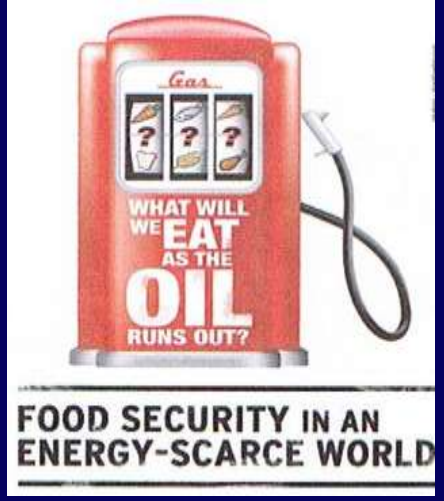
Sub-soil: no biochar

Sub-soil with biochar and biodigester effluent

Photo 10. The sub-soil with no biochar or effluent

Photo 11. The sub-soil after amendment with biochar and efflue

Implications for animal production enterprises.



- Future massive shortage of cereal grains: priority for people
- Industrial specialized farms ↓
- Integrated small scale farms ↑

Industrial vs ecological management of soils (21 yr study)

- Ecologically managed soils, using green manure and livestock manure to replenish soil nutrients, showed:
- Higher soil quality, including “greater biological activity”
- “10 to 60 percent higher soil aggregate stability” (better intake and storage of water for plants)

Which livestock species?

- Ruminants, rabbits and fish integrated with crop production and recycling of wastes
- Omnivores such as pigs will have special role in meat production based on local resources

Which livestock species?

- Ducks and chickens
  - –mul.ti-purpose role
  - –Control of weeds and pests

Why ruminants?

- **Use biomass not used** by **monogastric animals**
- **Animal resources are there-**

  [*1.2 billion large and 2.1 billion small ruminants*]
- **Feed resources are there – Crop by-products**

  (*World straw production approx 2 billion tonnes +other major under-utilised by-products)*

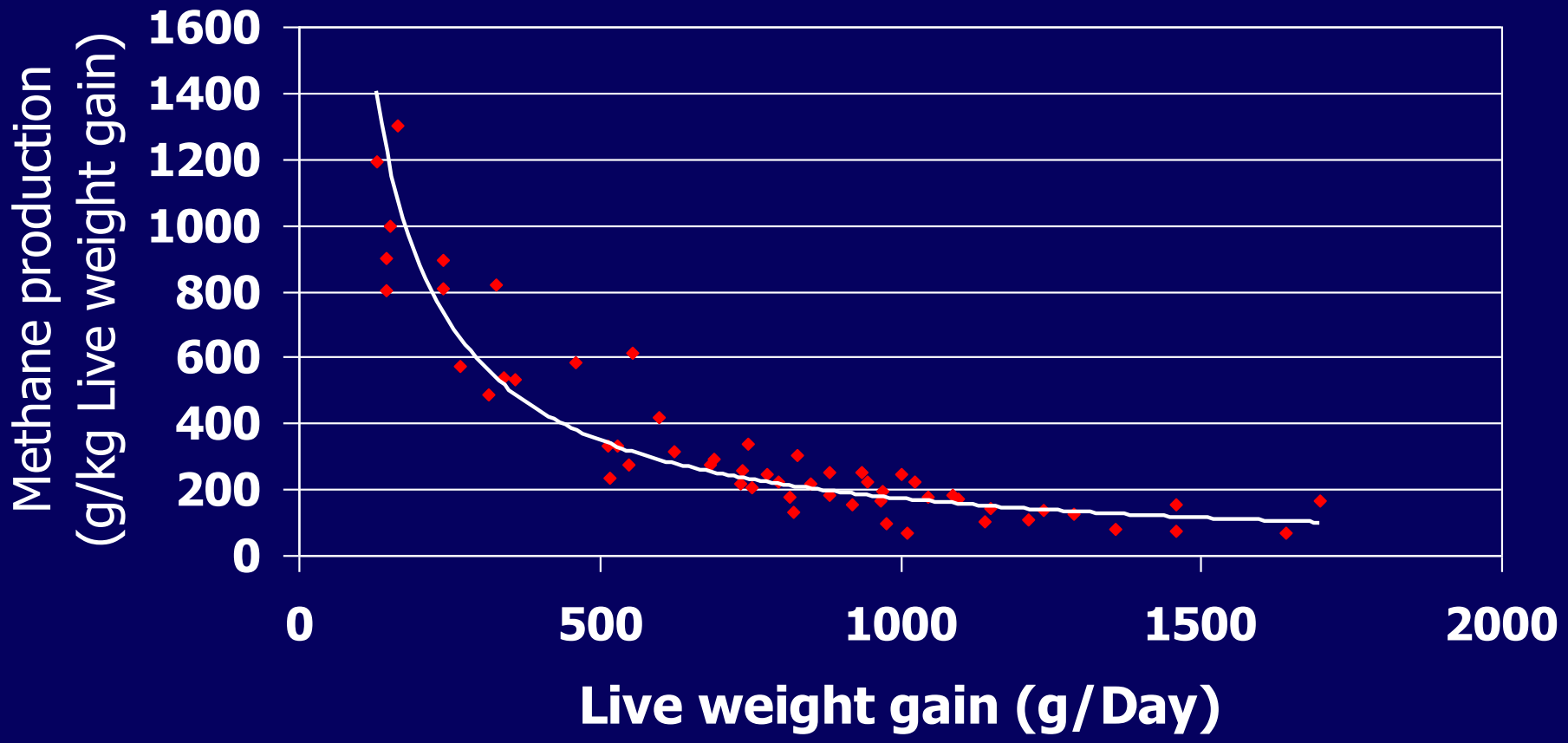
Principles of ruminant production from available resources

- Optimise forage digestibility
- Balance the nutrition of the rumen microbes to ensure maximum growth
  - Macro and micro minerals
  - Ammonia
  - Sulphur/Phosphorus
- Feed additional “escape protein” in catalytic amounts

The down side of ruminants as future meat/milk producers – (enteric methane production)

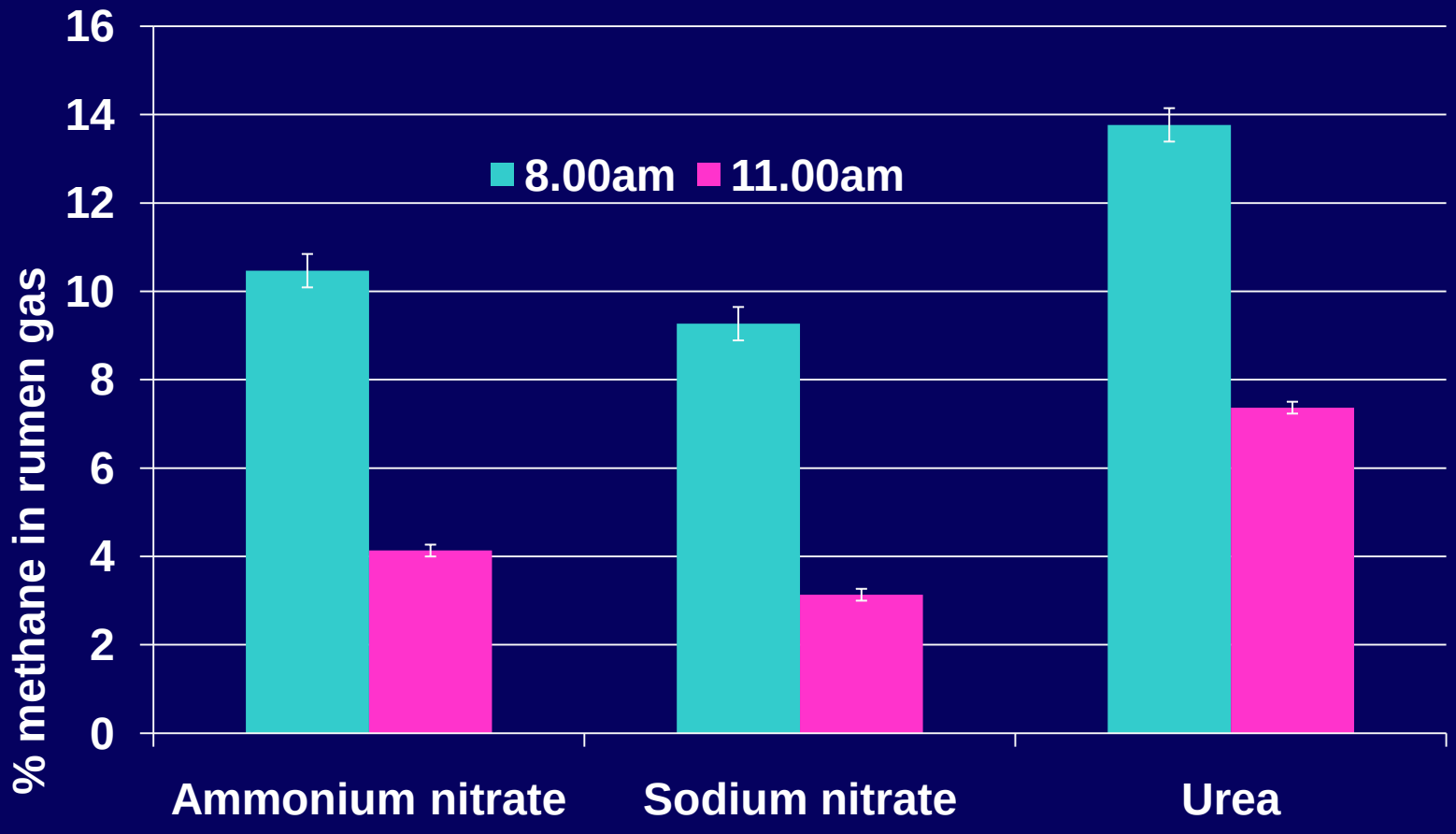
- Ruminant animals produce some 20-30% of global methane (80 million tonnes/yr)
- Methane contributes approx 20 % of global warming (21 times more potent then carbon dioxide)

If LW gain > 500 g/day
Methane per unit LWG



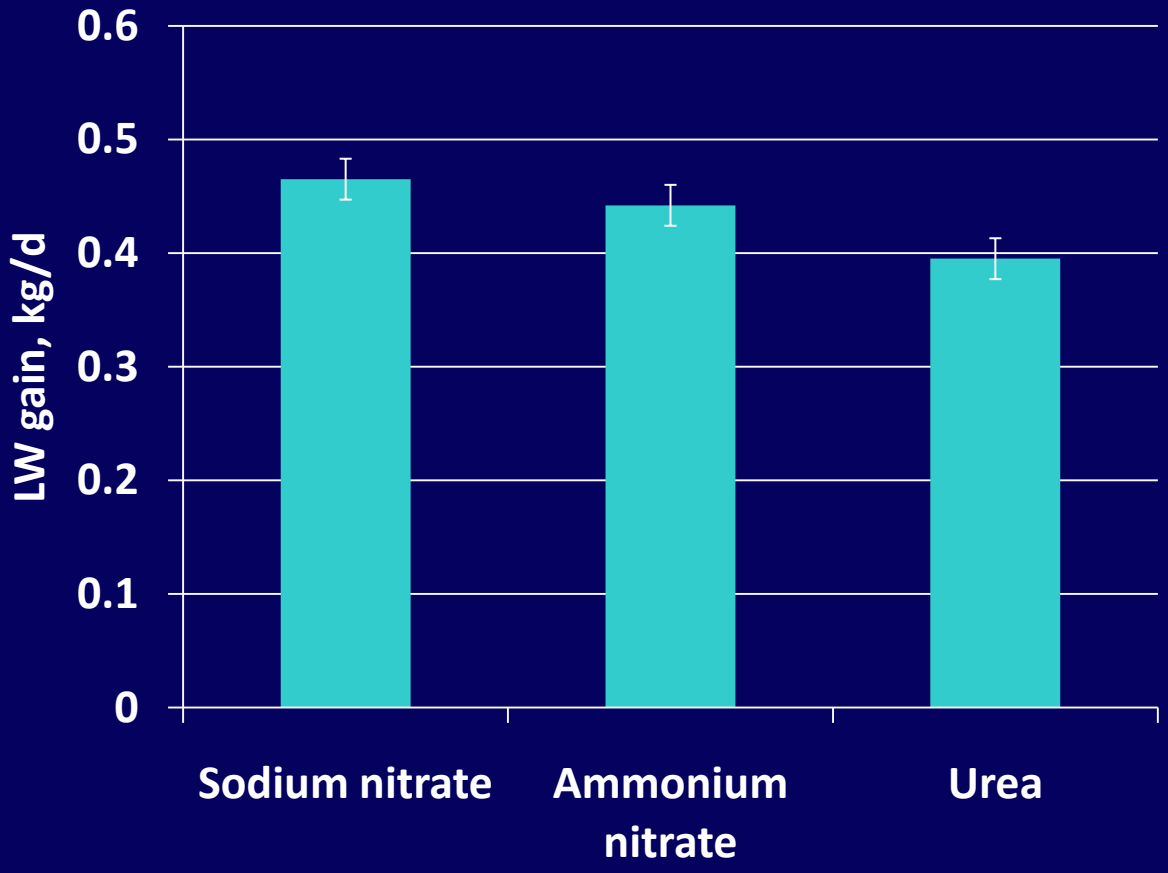
R A Leng 2005

Feeding nitrate reduces methane in cattle fed NaOH treated rice straw



Ho Quang Do et al 2009

Nitrate supports same or better LW gain than urea, in cattle fed NaOH-treated rice straw



Ho Quang Do et al 2009

Rabbits

Rabbits: advantages

- Herbivores
- Caecotrophic digestion
- High reproductive rate
- Bird flu??

Aquaculture

- Component of recycling systems
- Herbivorous species

Changing priorities in China

	1980	2005
FEEDER CARP	25%	53%
Grass	18%	32%
Common	7%	21%
FILTER CARP	75%	47%
Silver	52%	29%
Big head	23%	18%

Leaves of New Cocoyam for Cachama fish (*Colossoma macropomum*) Colombia

Leaves of New Cocoyam for Cachama fish (*Colossoma macropomum*)

The need for change

- Once we change our thinking
  - We must align our behavior
  - To value progress over convenience, life over lifestyle
- Neither nature nor natural resources recognize our superficial political boundaries

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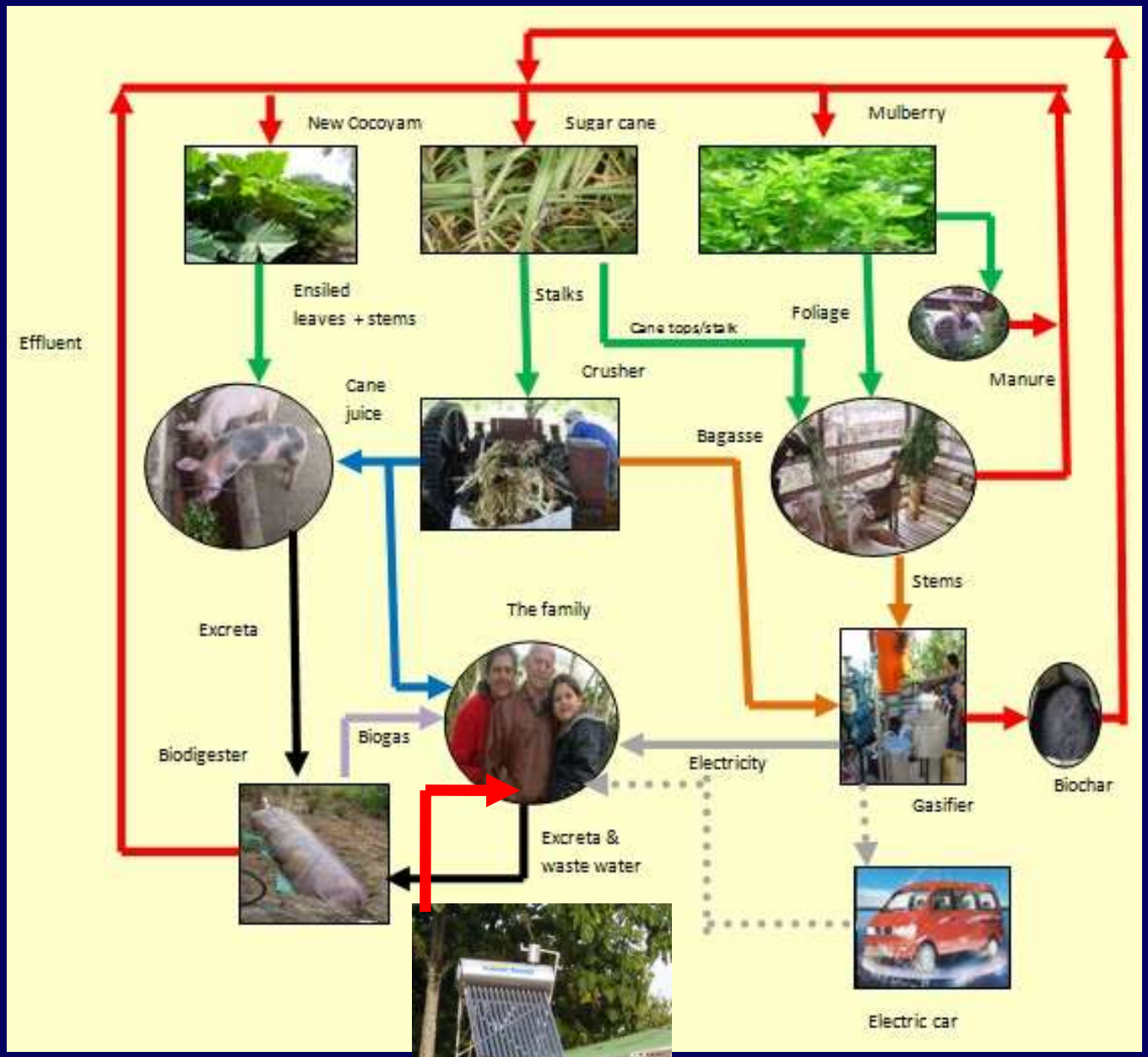
Are we ready to rediscover the benefits of animal traction?

Learning to change

- by doing
- by living

Carbon-negative farm in Colombia



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