

Är biobränslen ett hållbart globalt alternativ?

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Summer 2012 in the USA

- Worst drought since the 1950s - 80% of agricultural land was affected
- Price of corn soared
- **Corn for ethanol or for food?**
- **USA - corn for ethanol production:**
 - 2000: **7%** of supply
 - 2014: **40%** of supply

Source: AgMRC2013

-
- ~~Population growth~~
 - **Climate change**
 - ~~Urbanization~~

- **Water for energy**
- Water for food

- Energy for water
- Energy for food

- Agriculture impact on water quantity and quality

- **Land use for energy**
- Land use for food

Food production

70% of total global water withdrawals

Competing with:
energy
manufacturing
drinking water
sanitation services



Types of biofuels

Biomass sources

- Traditional: firewood, crop residues, charcoal
- **First generation:**
 - Sugar cane ethanol
 - Starch based ethanol (corn, wheat)
 - Biodiesel (methyl ester)
 - Vegetable oil (canola, palm)
- Second generation:
 - Raw material from cellulose and hemicellulose
 - Waste biomass or algae

Biofuel

- First generation biofuel
 - Should be **rainfed** and not irrigated
 - Huge **water need**
 - Competition with **food**
- Second generation biofuel
 - Cellulosic material
 - No competition with food

Biofuels in EU

Goal: 10% of transport from biofuel

Biodiesel

- 5.8 million m³ in 2006
- 24 million m³ in 2013
- Biodiesel mostly from vegetable oil
- Palm oil from Malaysia – rainforests vs. drivers

Ethanol

- 8.4 million m³ in 2013
- Distilled from grain (France, Germany, Spain)

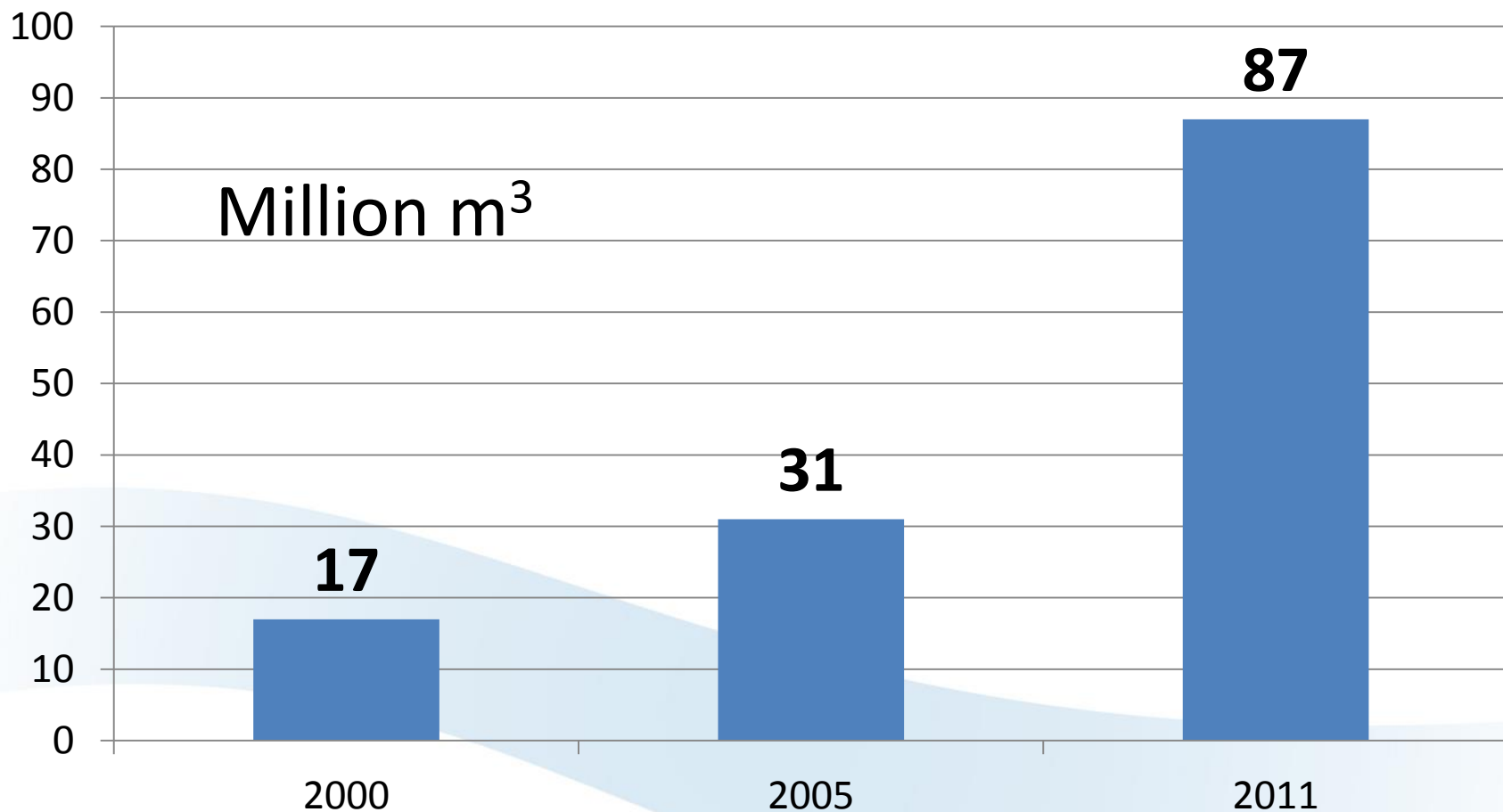
Biofuel subsidies 2011

EU: \$11 billion, mostly to **biodiesel**

USA: \$8 billion, mostly to **ethanol**

Source: IEA 2012

World production of ethanol



***Biofuels vs.
food and land use***

Biofuel and food

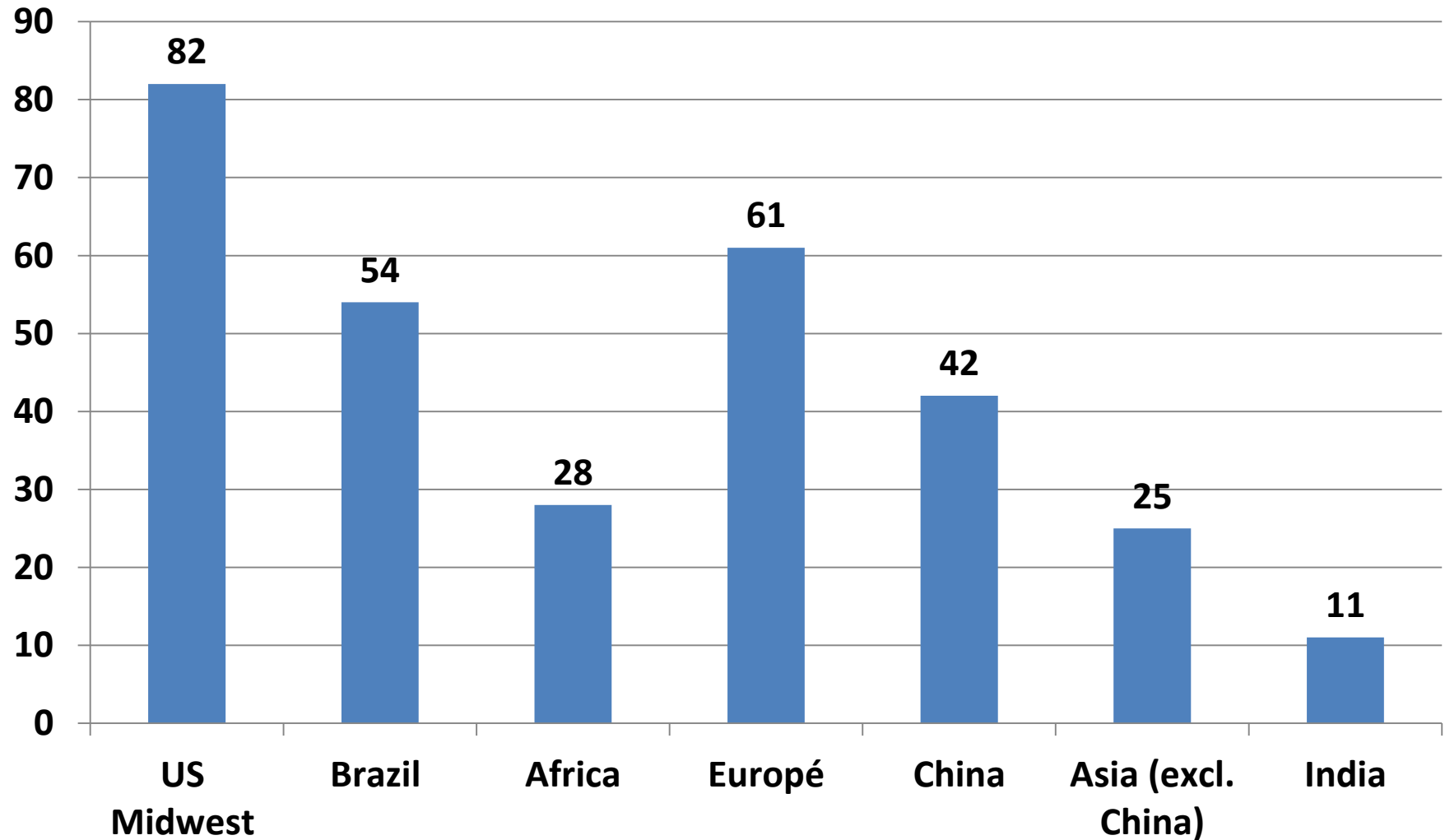
Three responses to biofuel production:

1. The crops are **not replaced**;
2. Crops are replaced by **land use change**;
3. Crops are replaced by **boosting production** on existing agricultural land.

Biofuel and food costs

- Corn, soybean oil and wheat the primary ingredients used for biofuels
- As more land shifts towards those crops, this tend to increase the prices for other crops that compete for the same land.
- From a *producer* perspective: a welcome change

Crop production used for cattle feeding or biofuel (%)



Fuel from Biomass

- 100 kg soybeans → 21 l biodiesel
- 100 kg corn → 38 l ethanol
- 1000 kg corn stover → 300-340 l ethanol
- 1000 kg switchgrass → 285-380 l ethanol

Grain turned into ethanol (only in the US)
could have fed 400 million people in 2011

Source: U.S. DOE National Biofuels Program

Water need

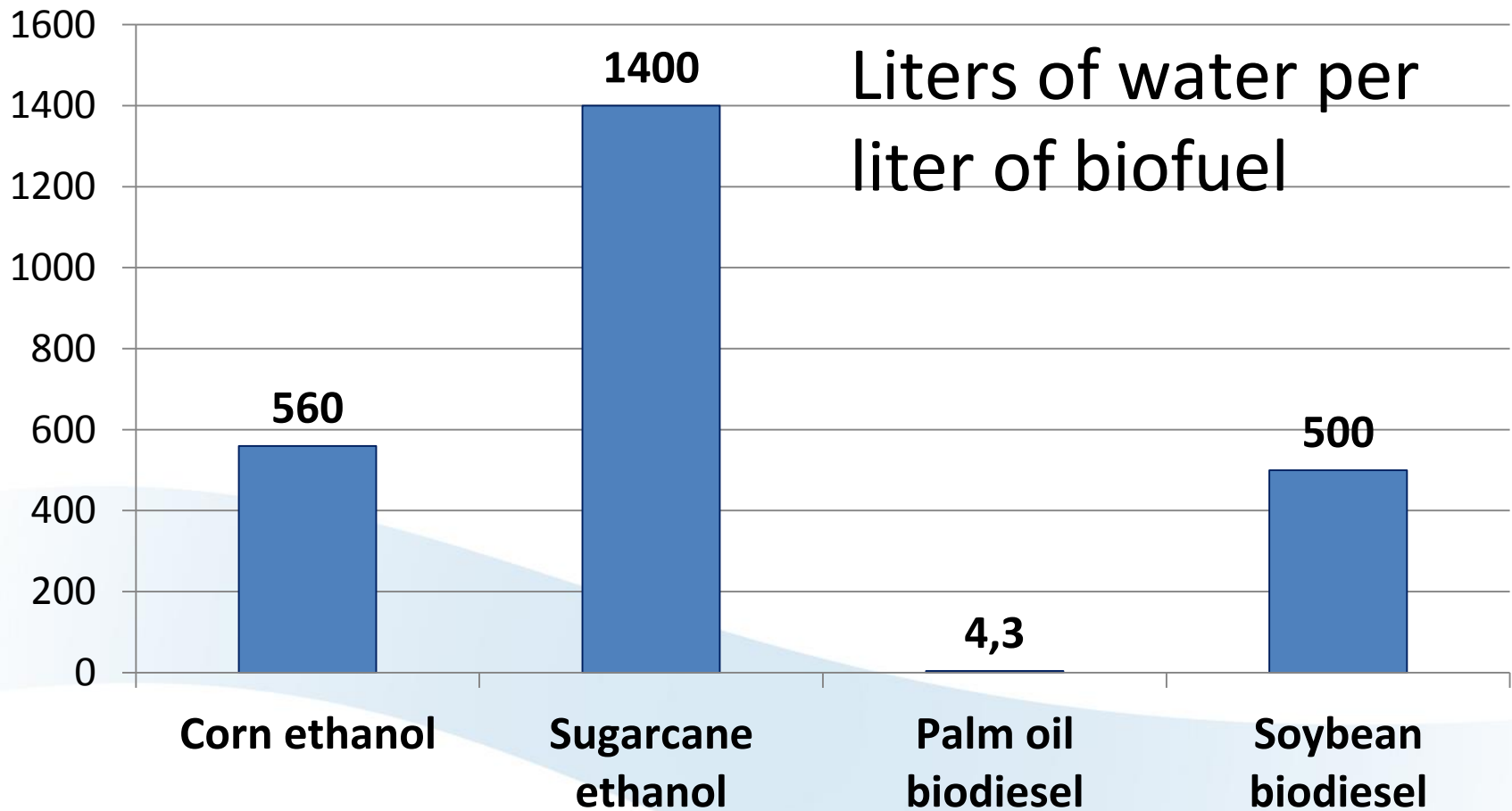
Water for biofuel production

- Water is essential to produce bioenergy
- Site specific conditions – like any food production
- **Irrigation volume** (irrigation per hectare)
- **Production** (mass of biomass per hectare)
- **Biofuel volume**
(biofuel per mass of biomass)
- **Thermal energy** (delivered by the biofuel)

Irrigation for 3 major biofuel crops

Biofuel crop	Typical area irrigated	Max observed irrigated area
Sugarcane	4% (Brazil)	54% (India)
Corn (maize)	6% (US Midwest)	31% (US Texas)
Soybean	2% (US Midwest, Brazil, Argentina)	6% (US)

Max water consumption – extraction, processing, transport



The competition for water

The biggest losers

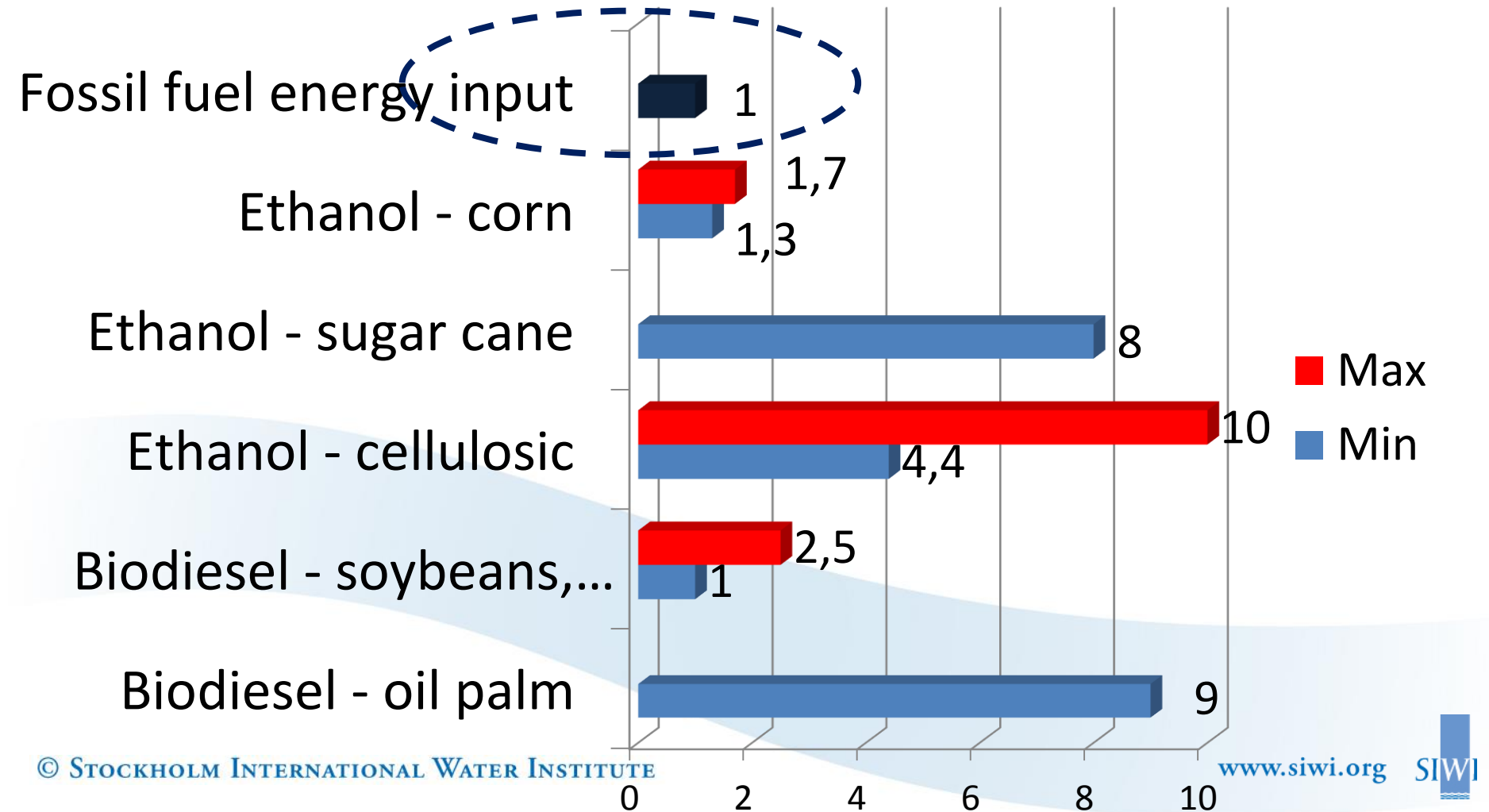
- environment
- marginalized and vulnerable people

Energy balances



Energy for biofuel production

- **Irrigation**
- **Fertilizer production**
- **Agricultural machinery**
- **Biofuel processing**
- **Transport**

Energy balance for biofuels



Agriculture and energy

- Market structure of energy is highly centralized
 - nearly three times the size of that of agriculture
- Energy – agriculture linkage is **asymmetric**
- Energy prices  agricultural prices
- Agriculture  world energy

Climate consequences

“Nitrogen fertilizers used to produce biofuel release nitrous oxide (N₂O) emissions large enough to cause climate warming instead of cooling.”

(N₂O around 300 GHG potential)

Paul Crutzen, Max Planck Institute for Chemistry

***Biofuel –
pricing and poverty***

Biofuel pricing

Biofuels are highly sensitive to


- possible changes in oil and gas prices
- government subsidies
- blending mandates

which remain the main stimulus for biofuels use

The competition for grain

- Owners of 1 billion motor vehicles
 - Average motorist annual income \$30,000
- The world's poorest people (2 billion)
 - Average income well under \$2,000
 - More than half of them are urban (=food buyers)
- Food unrest in 60 countries 2007-2009 (US State Dept.)

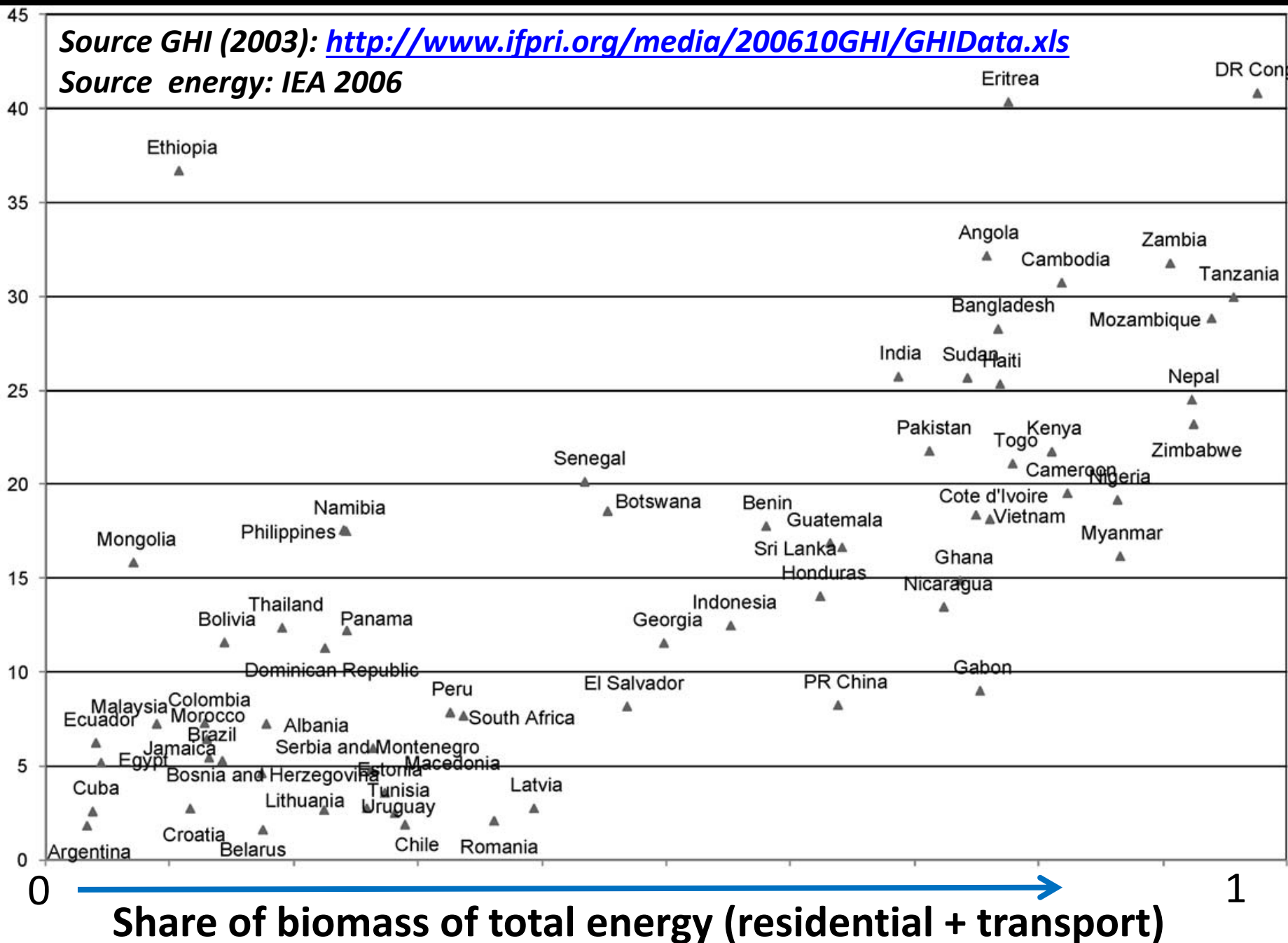
Biofuel and food – FAO 2014

- Strong demand for biofuels expansion of coarse grain and oilseed production 
 - particularly in developed countries
 - growing feed requirements in developing regions.
- **Ethanol** price increases in line with the crude oil price
- **Biodiesel** price more closely follows the path of vegetable oil prices

Source GHI (2003): <http://www.ifpri.org/media/200610GHI/GHIData.xls>

Source energy: IEA 2006

Global Hunger Index



Biofuels and food

- Biofuels **reduce food consumption** of the world's poor
- Reducing food consumption is a critical reason why some biofuels (bio-ethanol) appear to cause relatively less indirect farmland expansion
- Wheat or maize ethanol in Europe can only reduce greenhouse emissions if
 - farmers produce exceptionally high yields,
 - and/or people reduce their food consumption.

Biofuels and food 2

Two concerns:

1. The likely consequences of biofuels for GHG emissions because of the ploughing up of forests and grasslands and their release of carbon (**ILUC** 'indirect land use change').
2. The consequences for hunger and poverty.

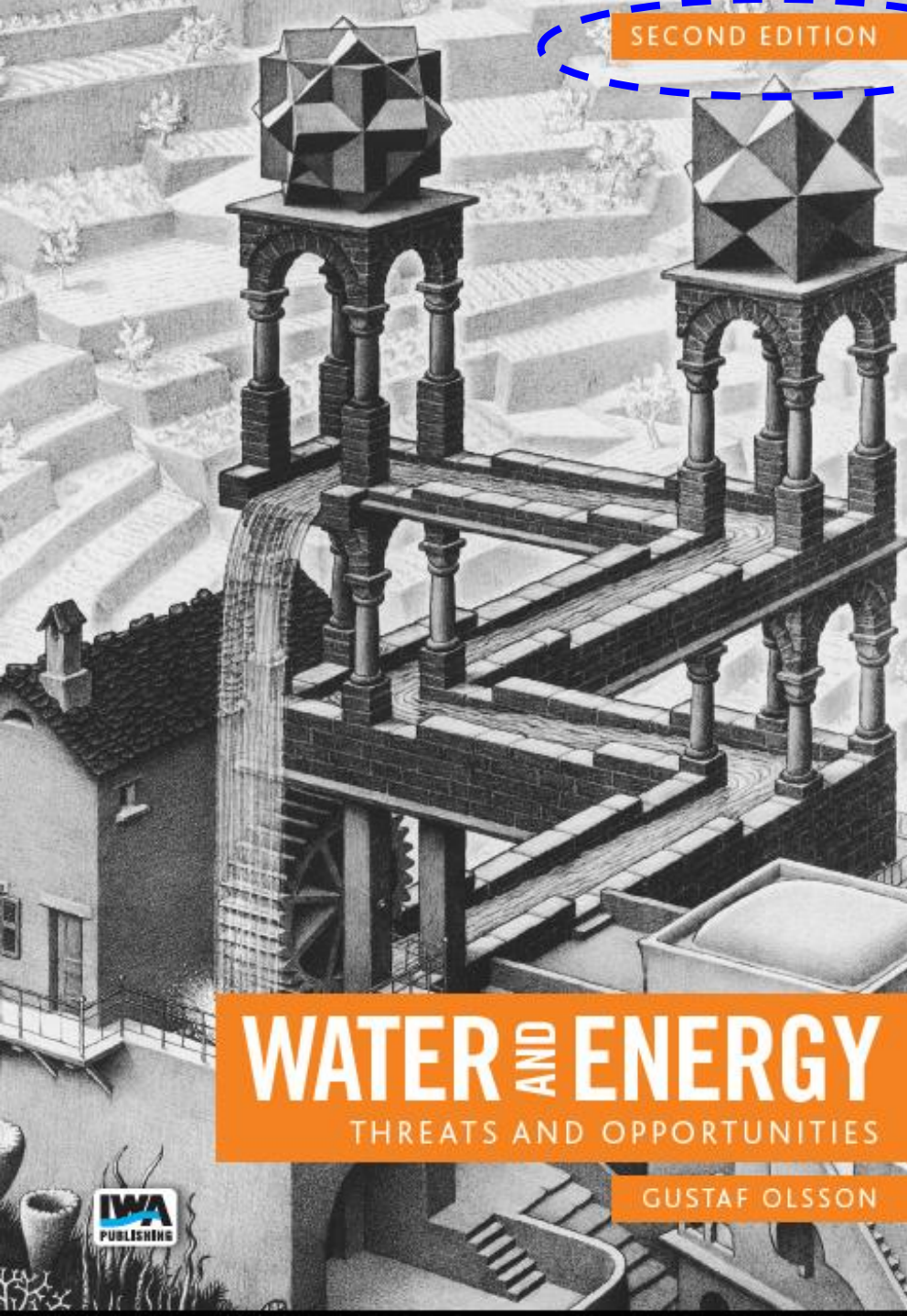
Not broadly understood that the two consequences are closely related

Future?

Biofuels in EU

Int. Institute for Sustainable Development (2013):

- The CO₂ and climate benefits from replacing petroleum fuels with biofuels like ethanol are ***basically zero***
- Much more effective, much less costly, to significantly ***reduce vehicle emissions*** through more stringent standards. More electric cars.
- ***20-100 times cheaper*** than the average CO₂ abatement cost for biofuels



Thank you!

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