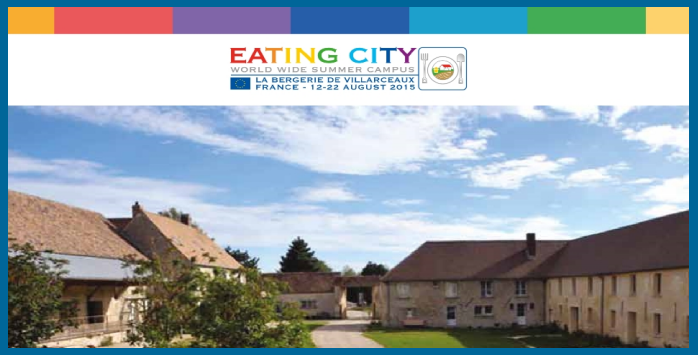


2nd natural element “AIR”

FOOD IN CLIMATE CHANGE MITIGATION AND ADAPTATION

Lučka KAJFEŽ BOGATAJ

UNIVERSITY OF LJUBLJANA, SLOVENIA


Arctic Ocean
Kara Sea
Greenland Sea
Barents Sea
Russia
Denmark Strait
ARCTIC CIRCLE
66°30'N
Norwegian Sea
Baltic Sea
Atlantic Ocean
ASIA
EUROPEAN RUSSIA
North Sea
EUROPE
English Channel
Kazakhstan
SLOVENIA
Bay of Biscay
Caspian Sea
Black Sea
Turkey
Strait of Gibraltar
Iran
Syria
Tunisia
Mediterranean Sea
Lebanon
Morocco
Israel
Iraq
Jordan
ASIA
MIDDLE EAST
Algeria
Libya
800 mi
800 km
Egypt
23°5'N
TROPIC OF CANCER
Saudi Arabia
PRIME MERIDIAN
AFRICA
worldatlas
Red Sea
©GraphicMaps.com


AUSTRIA
HUNGARY
Murska Sobota
Mura
Maribor
Ptuj
Jesenice
Velenje
Drava
Mt. Triglav
Kranj
Celje
ITALY
JULIAN ALPS
Sava
Trbovlje
LJUBLJANA
SLOVENIA
Nova Gorica
Postojna
Novo Mesto
Gulf of Venice
Koper
CROATIA

GOOD PLANETS ARE HARD TO FIND

WMO UNEP

IPCC Plenary

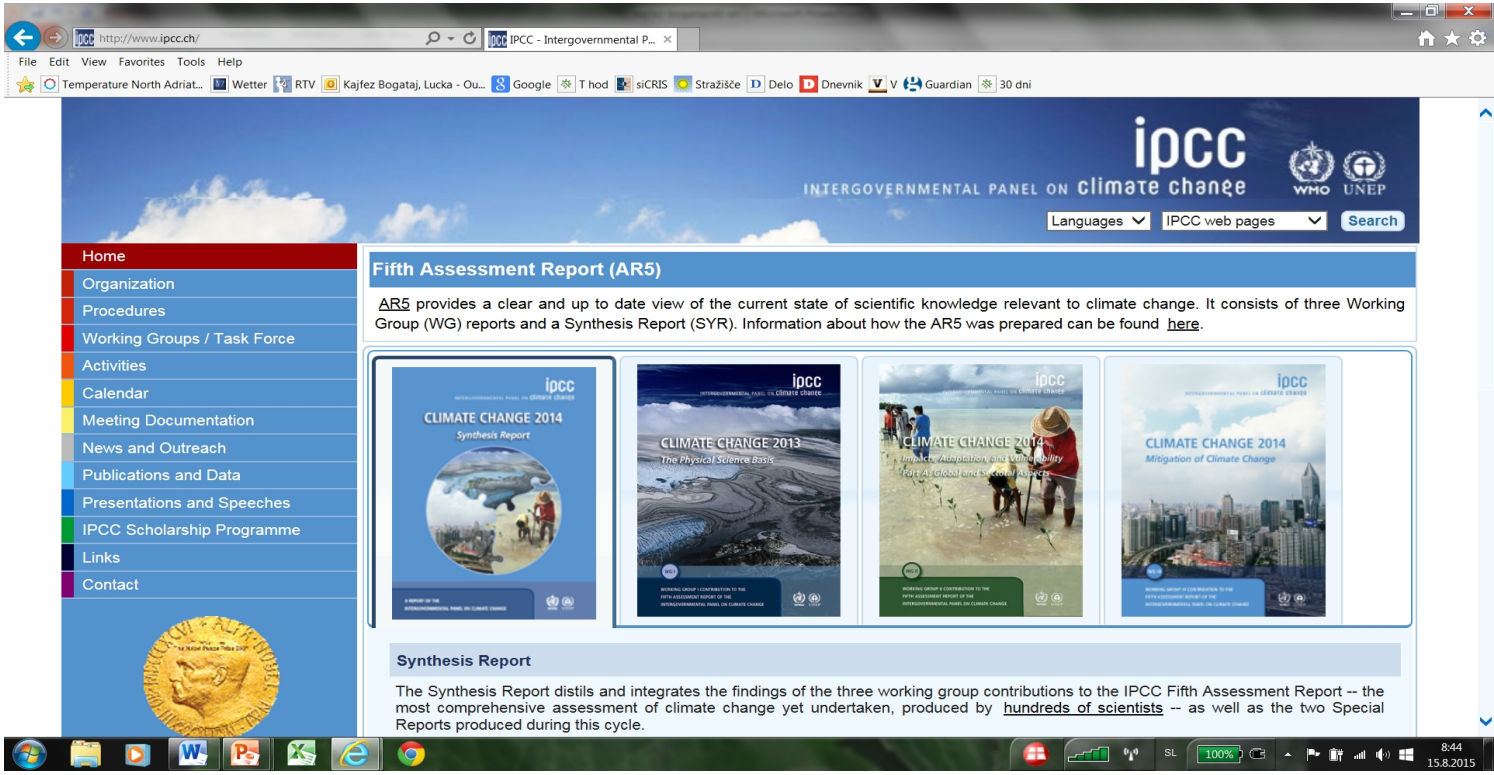
IPCC Bureau

IPCC Executive Committee

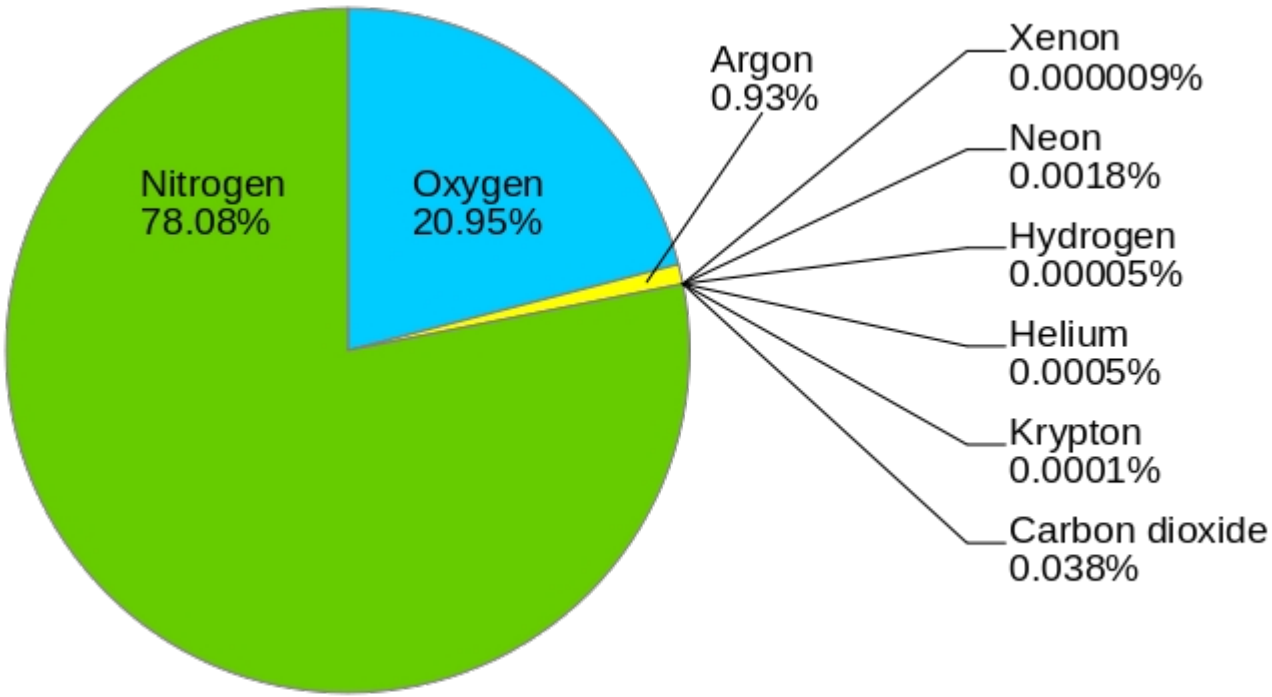
IPCC Secretariat

Working Group I	Working Group II	Working Group III	Task Force on National Greenhouse Gas Inventories
The Physical Science Basis	Climate Change Impacts, Adaptation and Vulnerability	Mitigation of Climate Change	
TSU	TSU	TSU	TSU

Authors, Contributors, Reviewers



AIR



+ Water wapour
+ aerosol

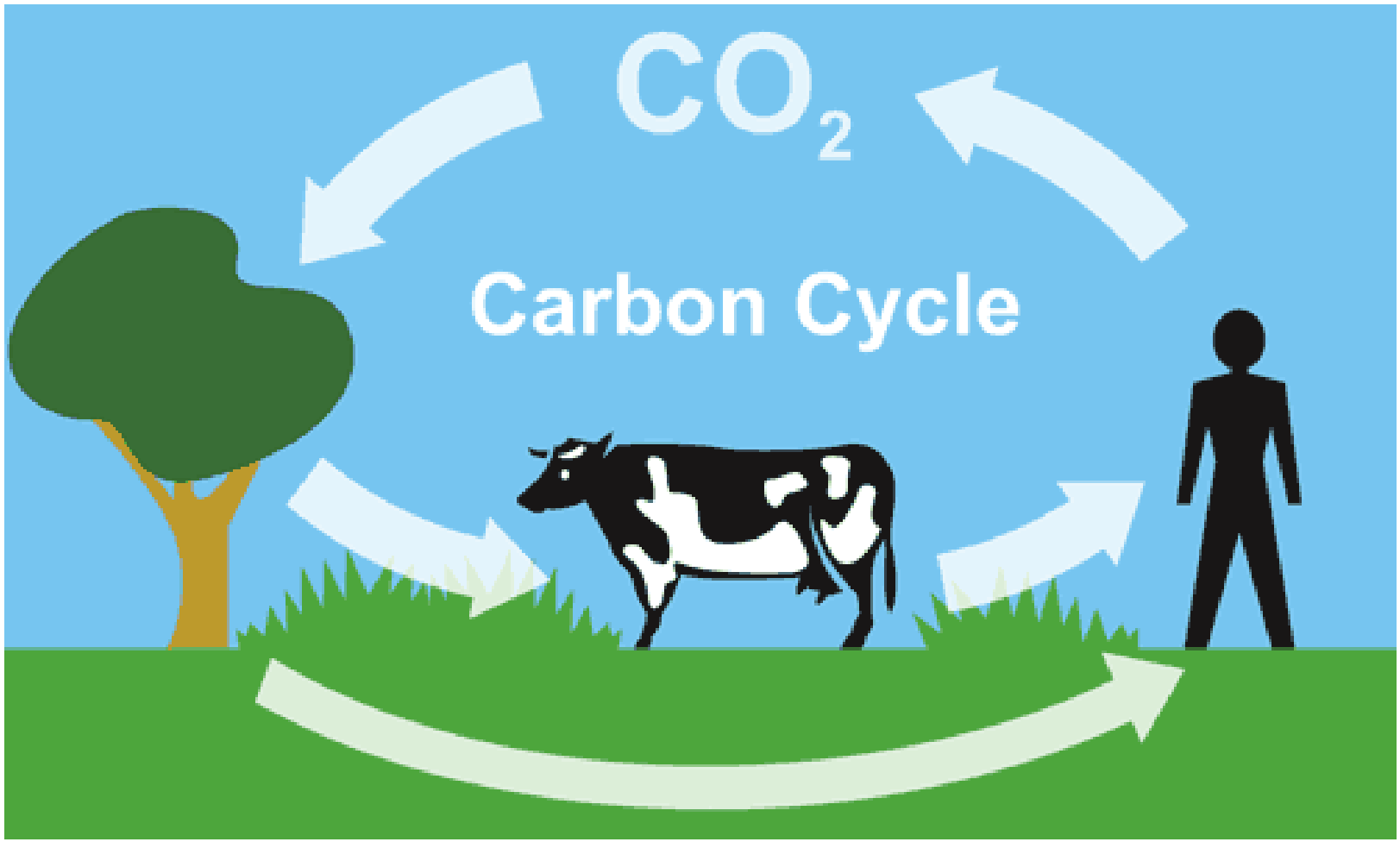
Why is air so important?

.

Why is air so important?

The balance of the different components of the atmosphere is crucialto life on the planet

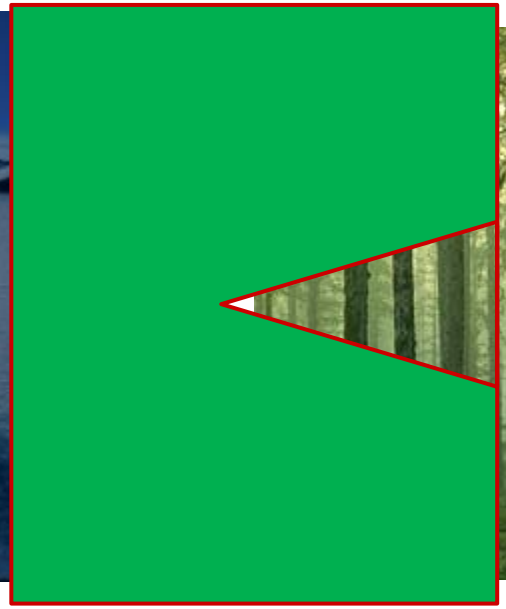
- Living animals require oxygen to survive
- Plants require carbon dioxide to survive
- If the world had no atmosphere, it would be very cold (and no weather)


CO_2
Carbon Cycle

If the world had no atmosphere, it would be very cold

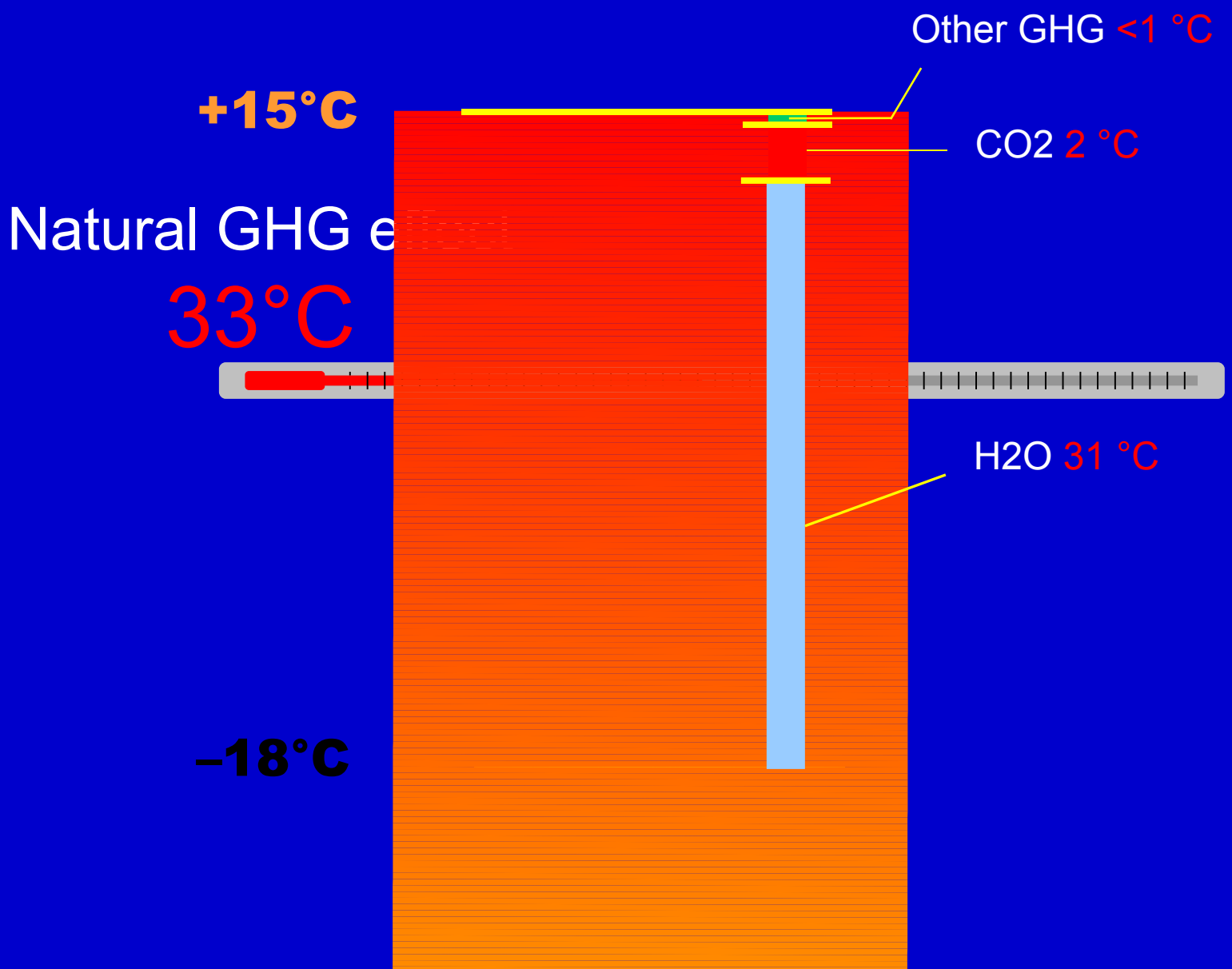
–18°C

+15°C



Earth without air

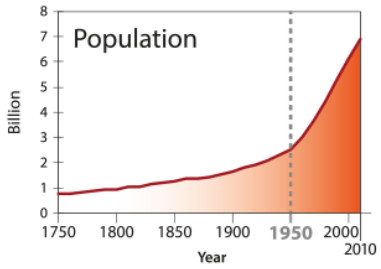
Our planet

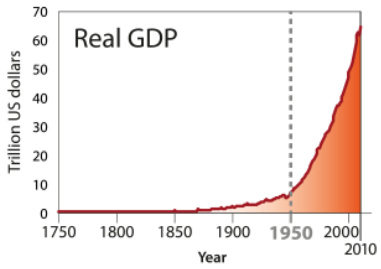

Other GHG <1 °C
+15°C
CO2 2 °C
Natural GHG e
33°C
H2O 31 °C
–18°C

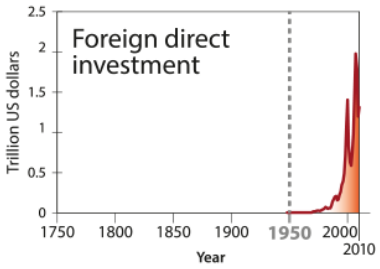
BUT THE COMPOSITION OF AIR IS CHANGING RAPIDLY due to human activities:

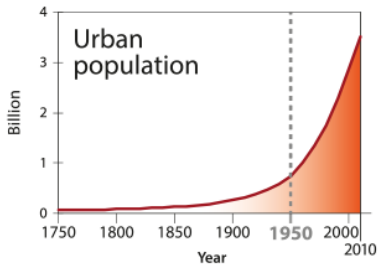
→ more GHG (CO_2, CH_4, NO_x...)
→ more aerosol (air pollution)

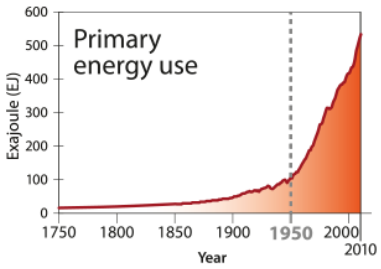
Socio-economic trends

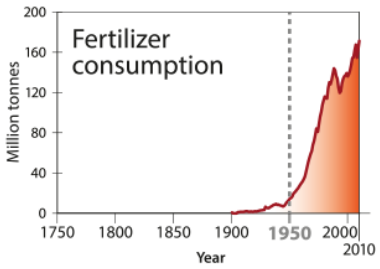


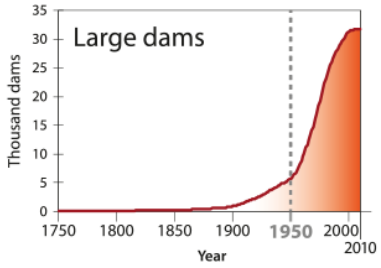


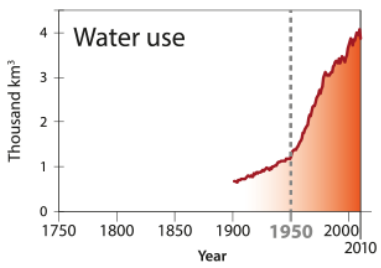


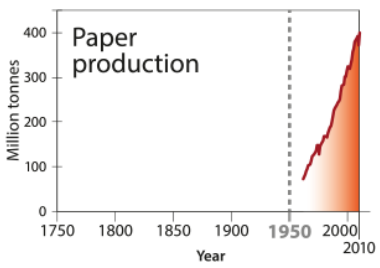


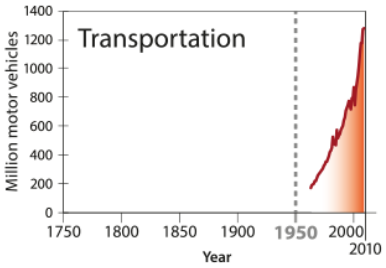


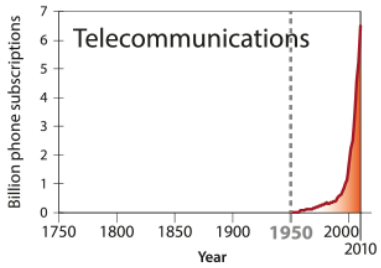


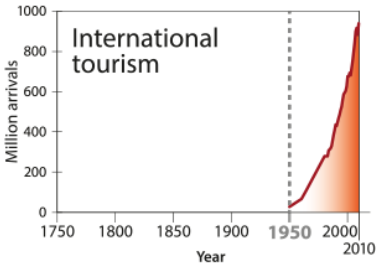






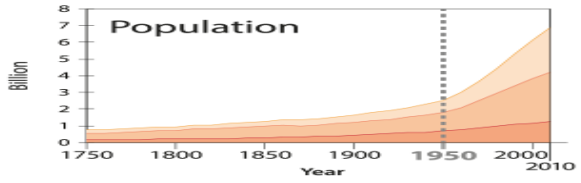


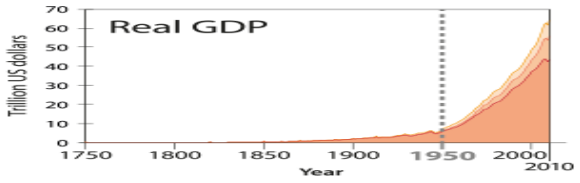


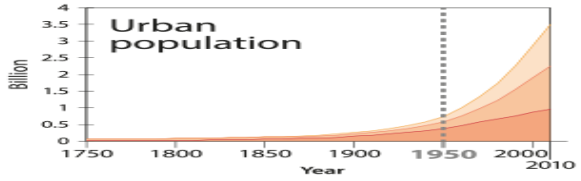


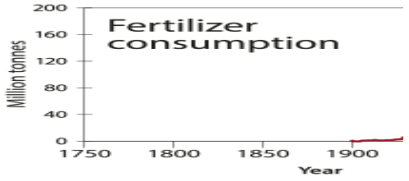
Socio-economic trends

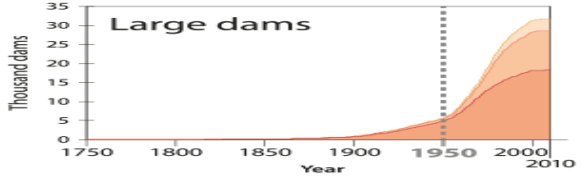
OECD BRICS Others

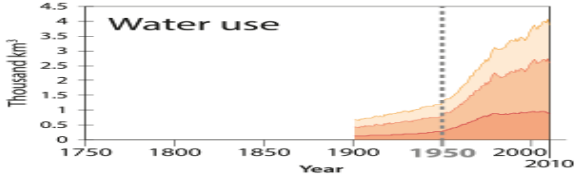


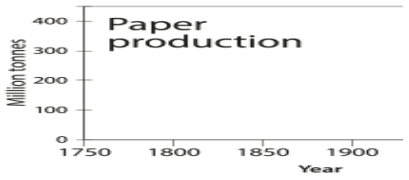


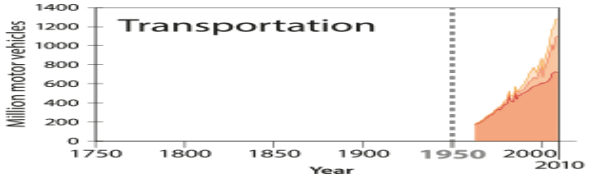






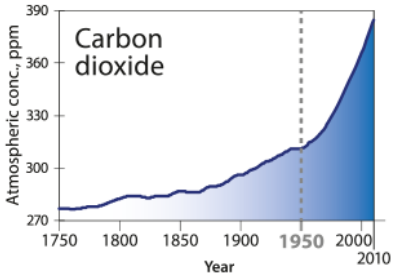


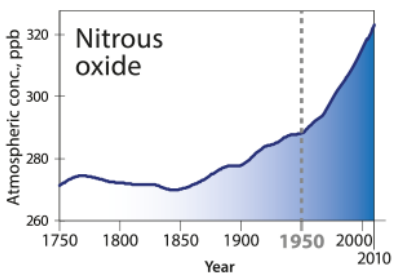


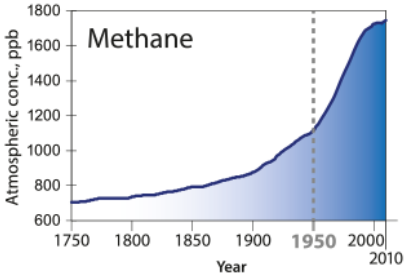


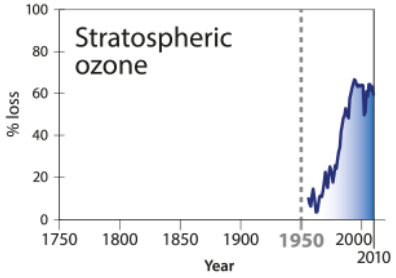
Earth system trends

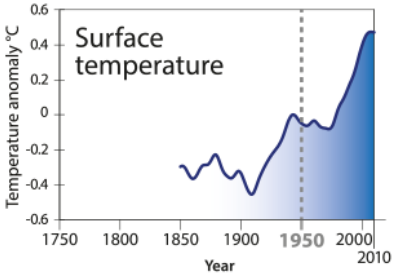
Steffen *et al. 2015* The Great Acceleration (*Anthropocene Review*)

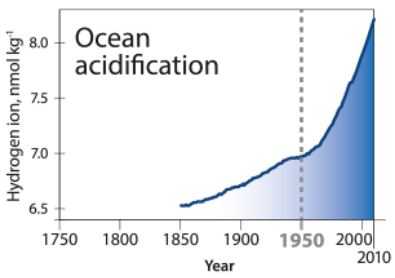


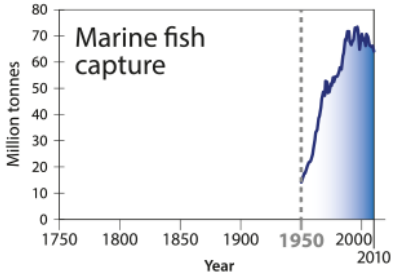


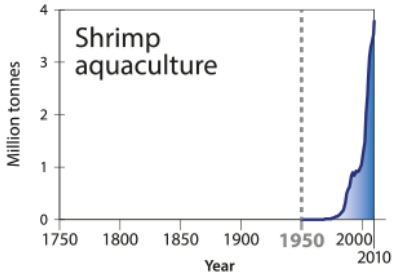


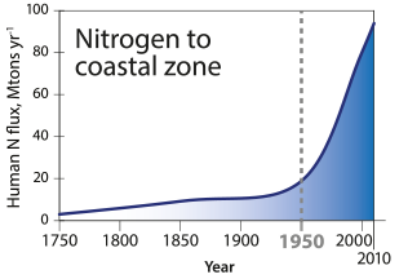


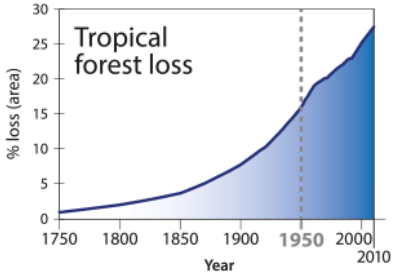


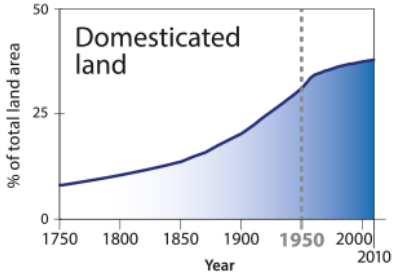


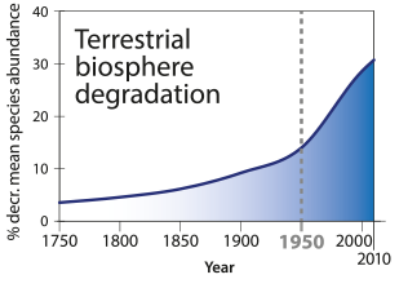




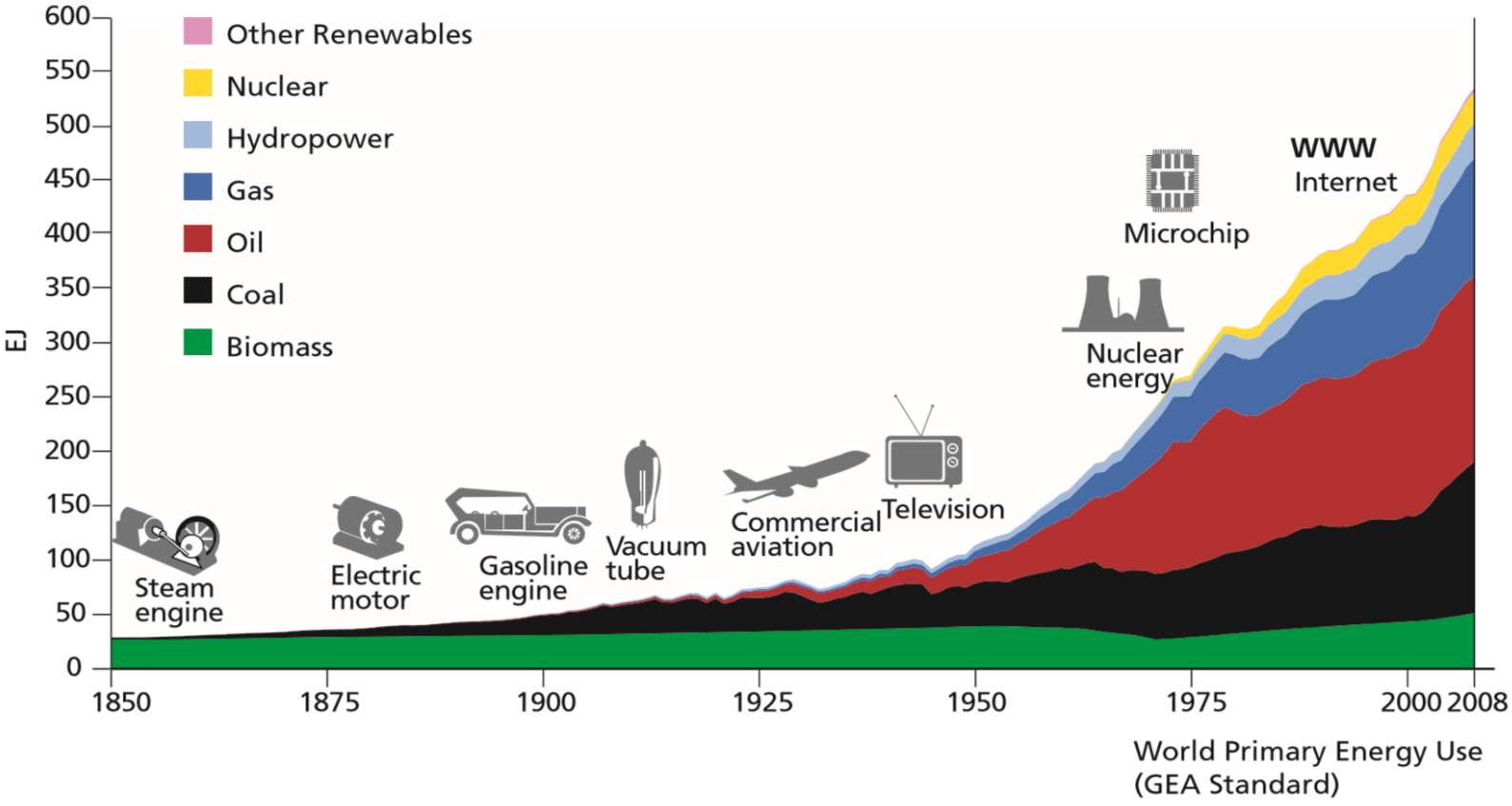








Evolution of primary energy



Evolution of primary energy shown as absolute contributions by different energy sources (EJ). Biomass refers to traditional biomass until the most recent d

Fate of Anthropogenic CO2 Emissions (2004-2013 average)

32.4±1.6 GtCO2/yr 91%

3.3±1.8 GtCO2/yr 9%

+

15.8±0.4 GtCO2/yr
44%

10.6±2.9 GtCO2/yr
29%
Calculated as the residual of all other flux components

26%
9.4±1.8 GtCO2/yr

- Source: Global Carbon Budget 2014

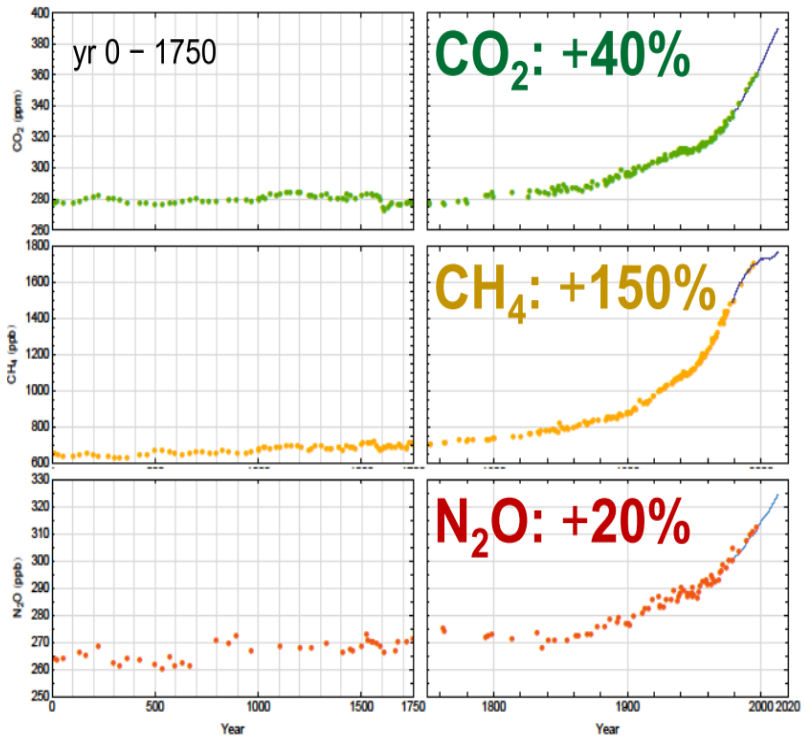
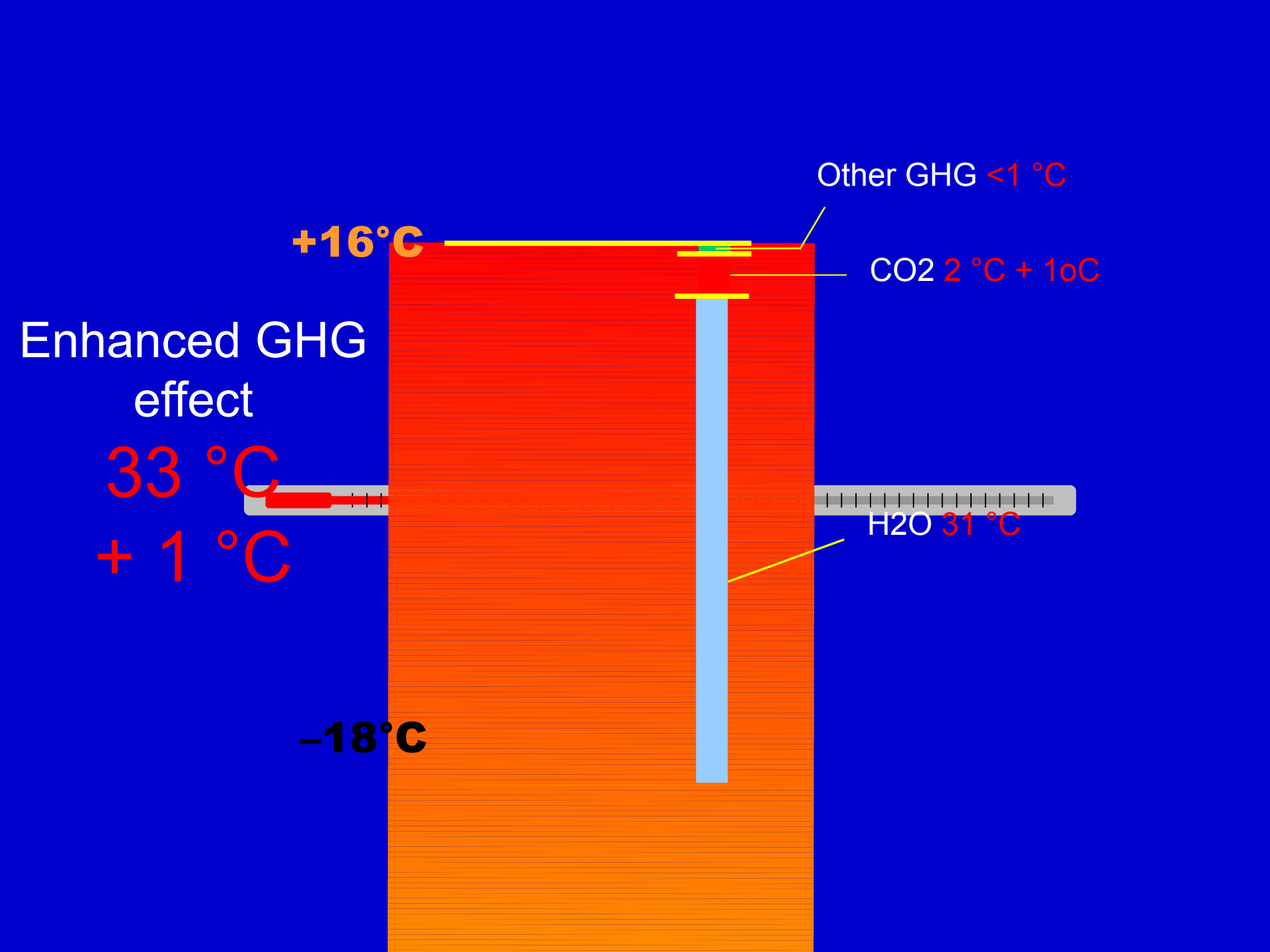
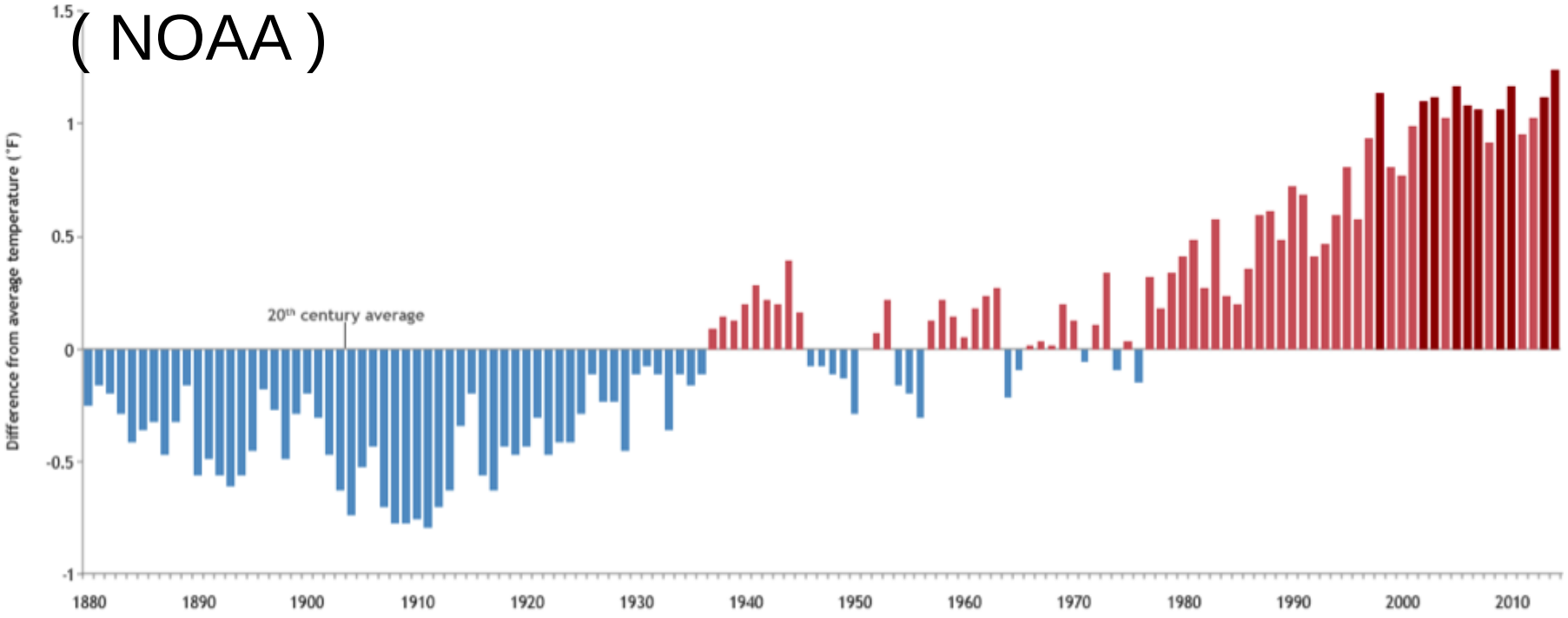


Fig. 6.11

The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have all increased since 1750 due to human activity.


Other GHG <1 °C
+16°C
CO2 2 °C + 1oC
Enhanced GHG effect
33 °C
+ 1 °C
H2O 31 °C
–18°C

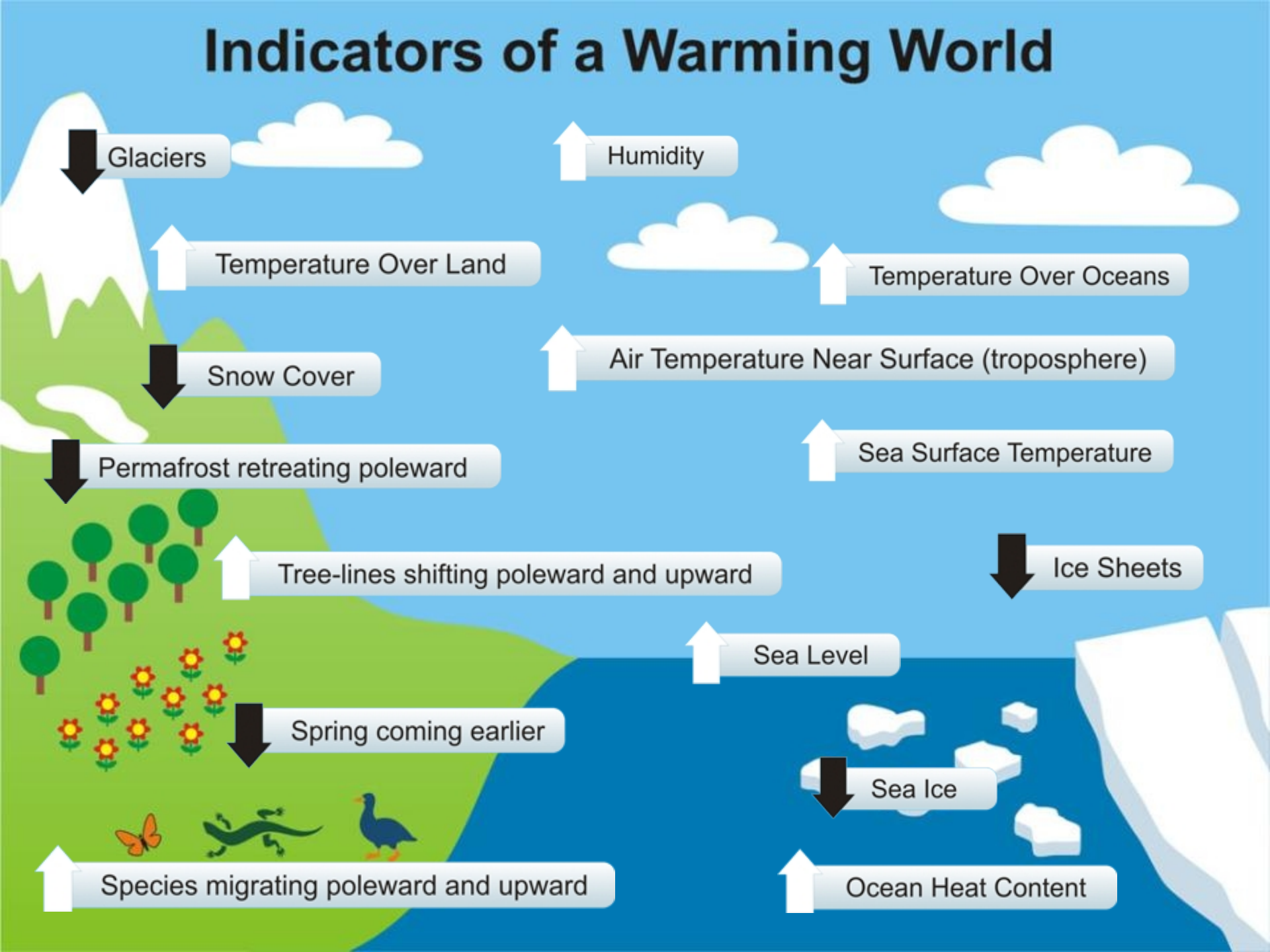
Global average annual temperatures since 1880 (NOAA)



The dark red columns represent the 10 warmest years in the record.

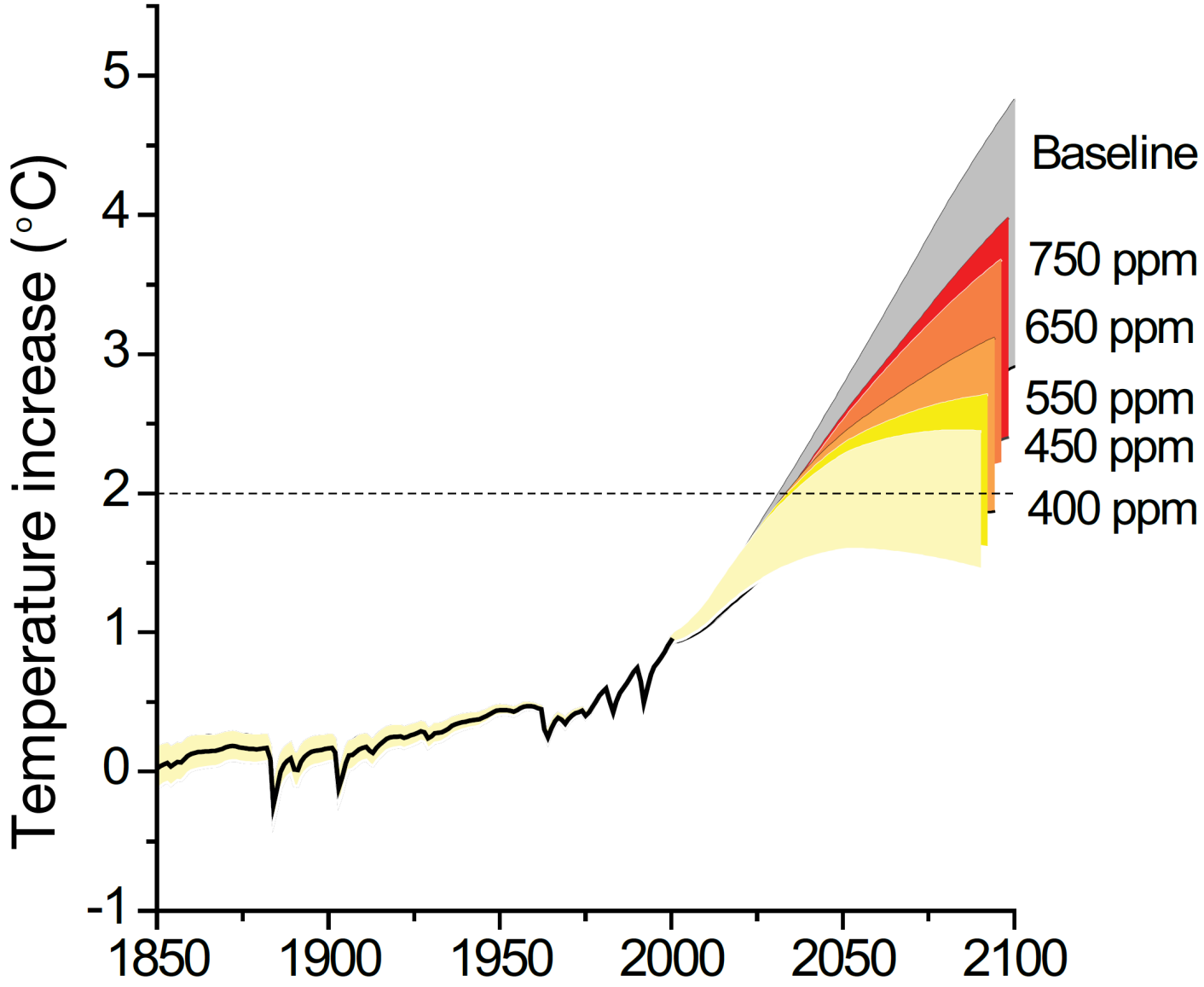
2014 is the warmest year in the record.

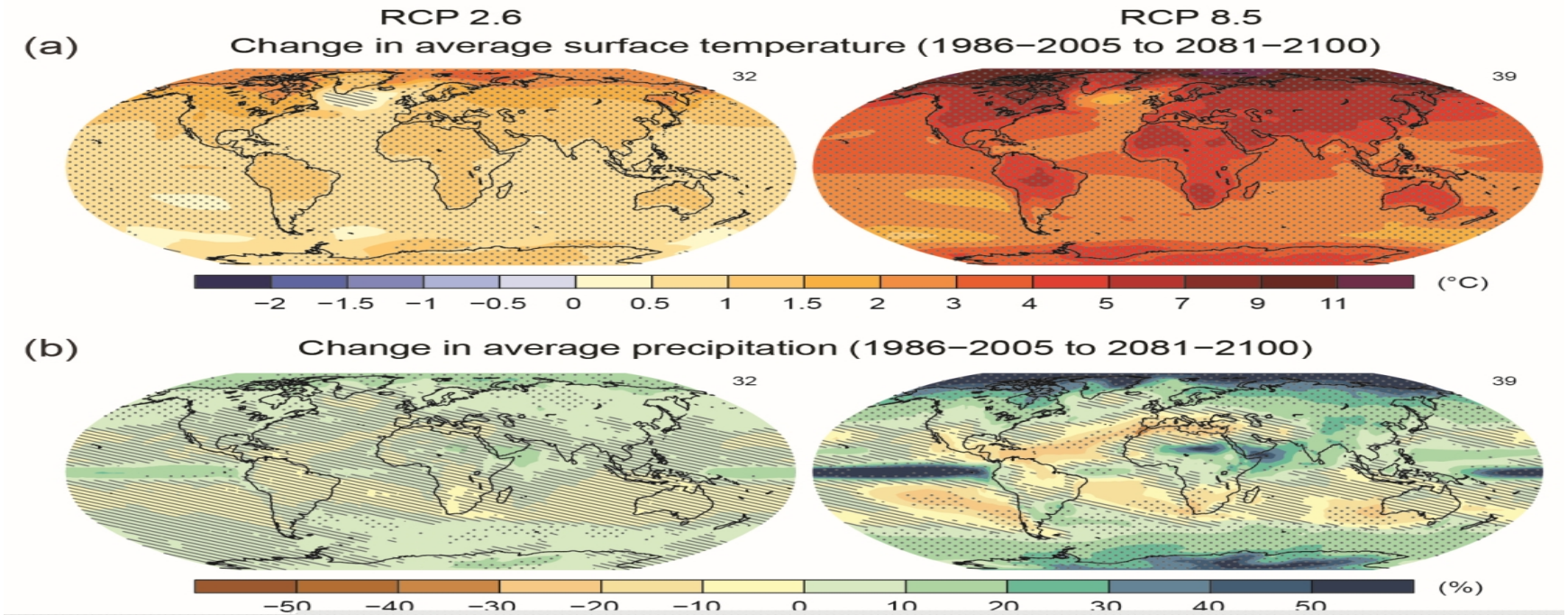
Indicators of a Warming World



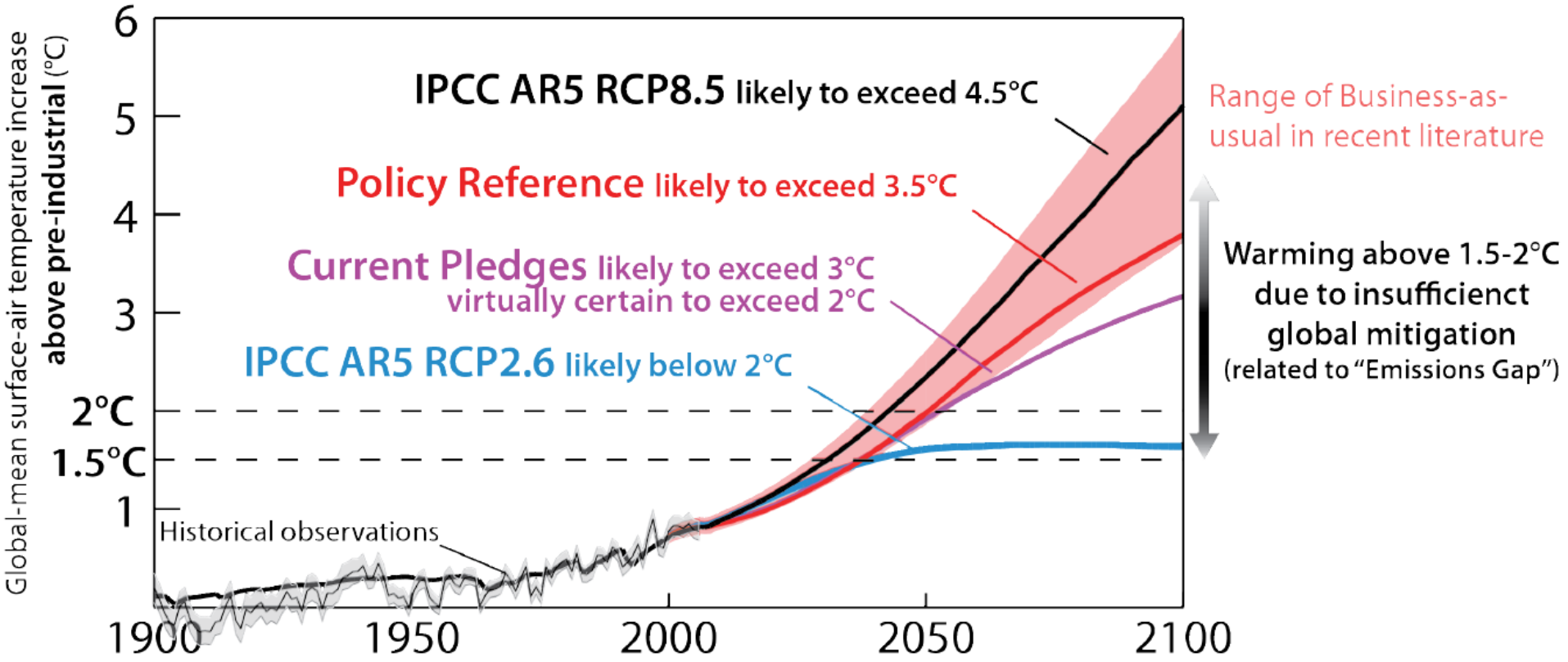
Climate Change is a Large Issue

- Majority of the sciences and engineering disciplines are involved.
- Social sciences are interested.
- Business/Industry has a stake.
- Involves citizens, politicians, public policy experts, and advocates.
- **Every sector of the economy affected**.
- All aspects of our lives touched: environment, jobs, health, politics, national security, arts, religion, etc.


Temperature increase (°C)
5
4
3
2
1
0
-1
1850
1900
1950
2000
2050
2100
Baseline
750 ppm
650 ppm
550 ppm
450 ppm
400 ppm


RCP 2.6
RCP 8.5
(a)
Change in average surface temperature (1986–2005 to 2081–2100)
32
39
−2 −1.5 −1 −0.5 0 0.5 1 1.5 2 3 4 5 7 9 11
(°C)
(b)
Change in average precipitation (1986–2005 to 2081–2100)
32
39
−50 −40 −30 −20 −10 0 10 20 30 40 50
(%)

Future CO2 concentrations



Countries‘ individual proposed efforts not sufficient !!!

Global temperature rise

+2°

PROBLEMATIC

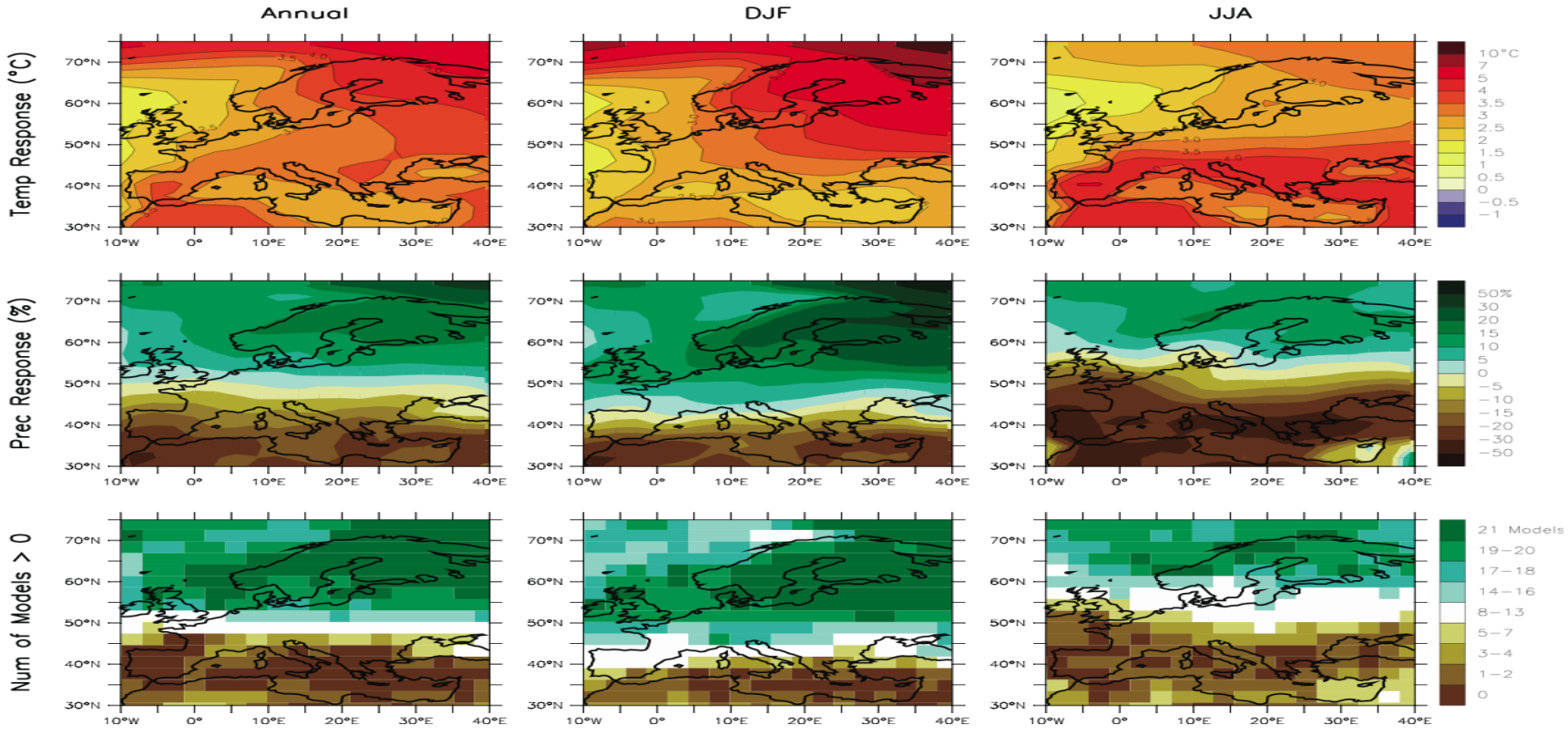
- 1 - 2 billion additional people with water stress
- Impacts on cereal productivity at low latitudes
- Increased coastal flooding and storms
- Greater depth of seasonal permafrost thaw

+4°

DISASTROUS

- A 16 ºC increase in the Arctic
- 1.1 - 3.2 billion additional people with water stress
- Widespread coral mortality; risk of major extinctions around the globe
- Substantial global impact on major crops
- Long-term prospect of sea level rise

Europe: Geographic Changes

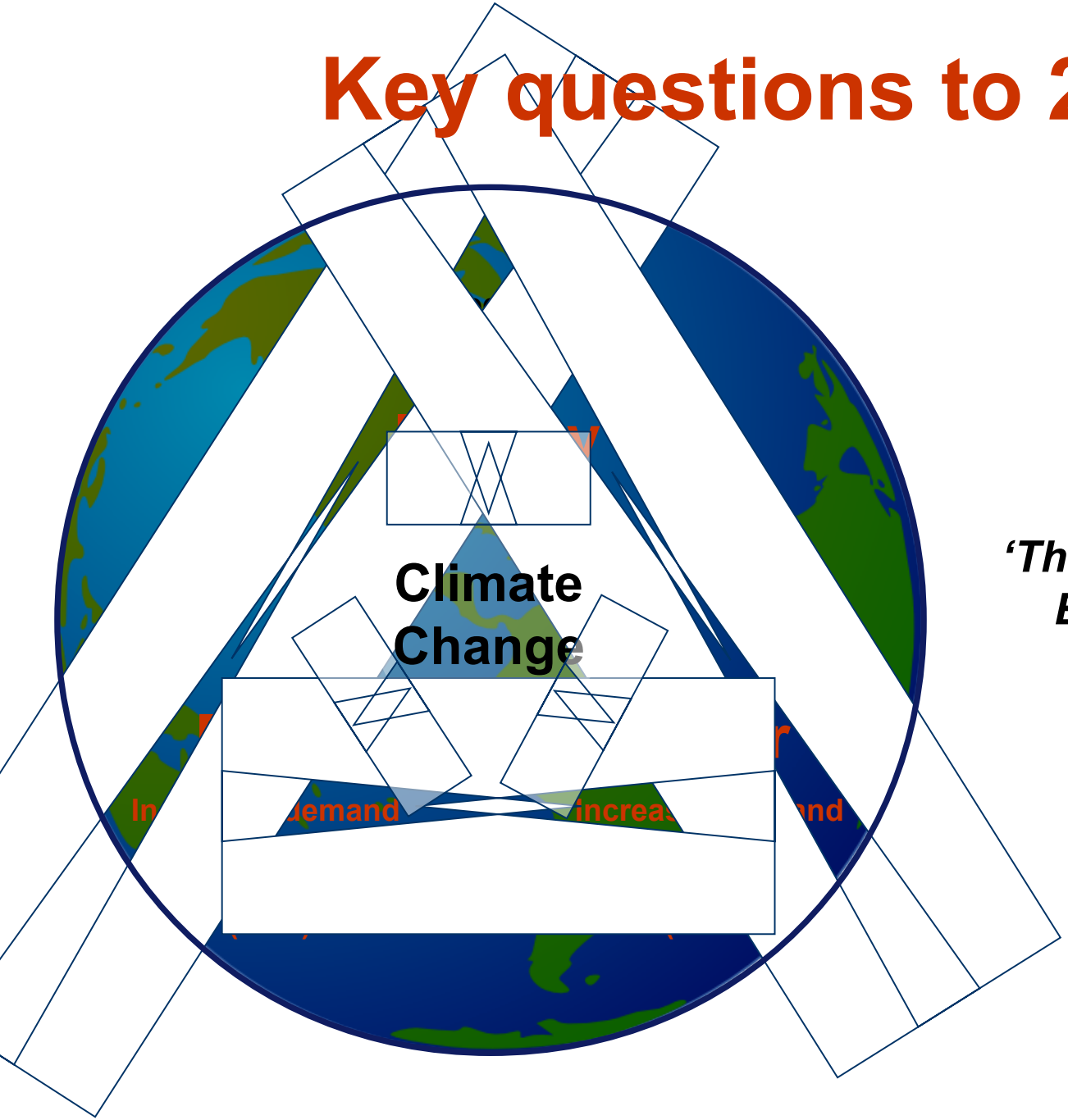


2080-2099 Minus 1980-1999 (A1B)

Five human development tipping points

- **Reduced** agricultural productivity
- **Heightened** water insecurity
- **Increased** exposure to extreme weather events
- **Collapse of** ecosystems
- **Increased** health risks

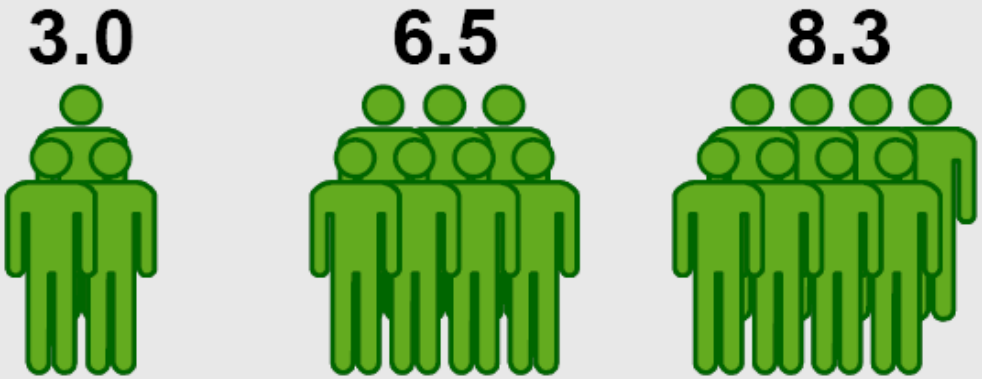
Key questions to 2030



'The Perfect Storm?'
Beddington, 2009

Increase World Population

Population [Bn]



Farmland per capita [m²]

Source: OECD-FAO Agricultural Outlook 2008-17 WORLDBANK

Climate influences agriculture

Climate change is a challenge also for food systems

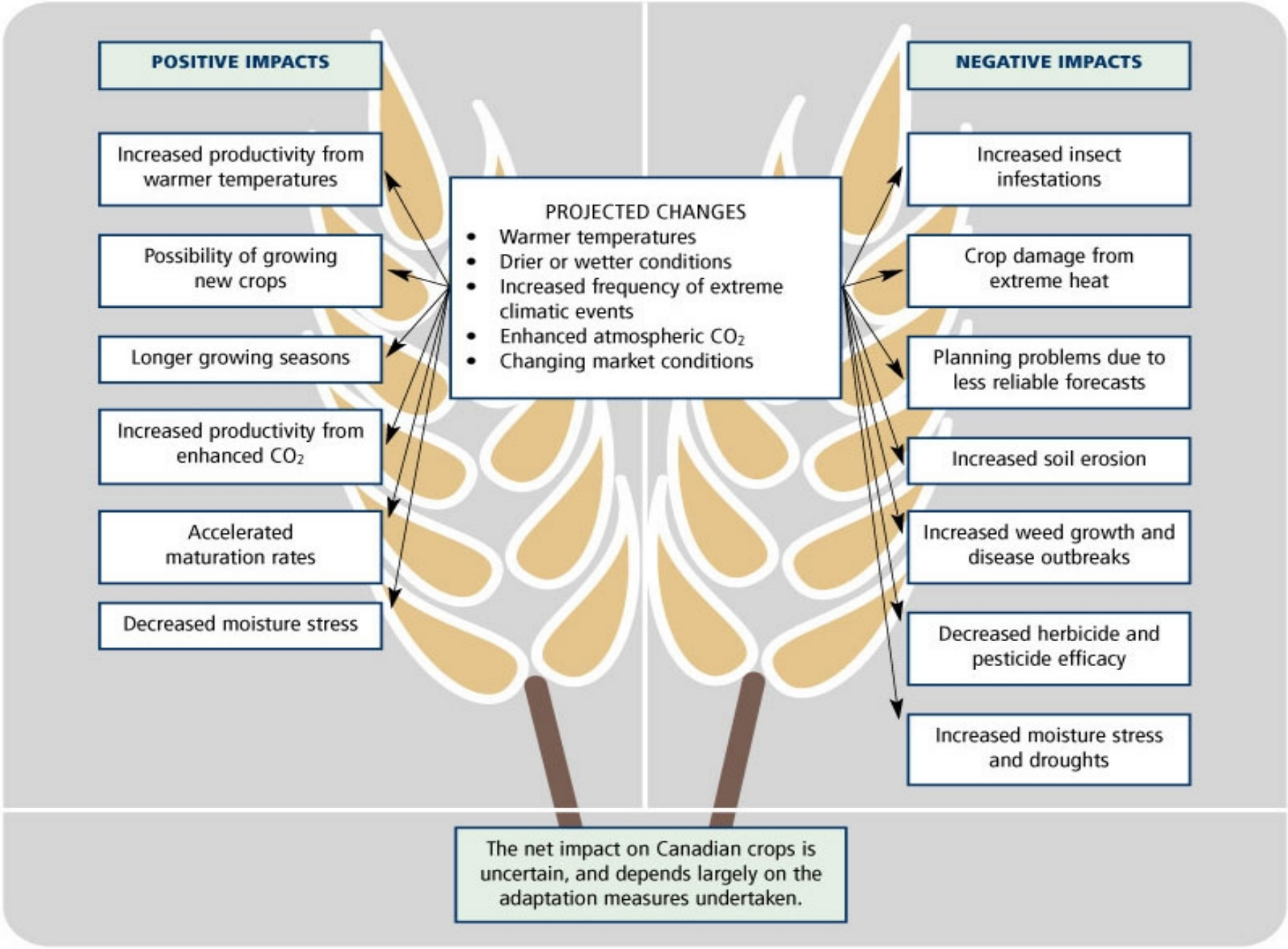
extreme precipitation ...

... extended drought periods

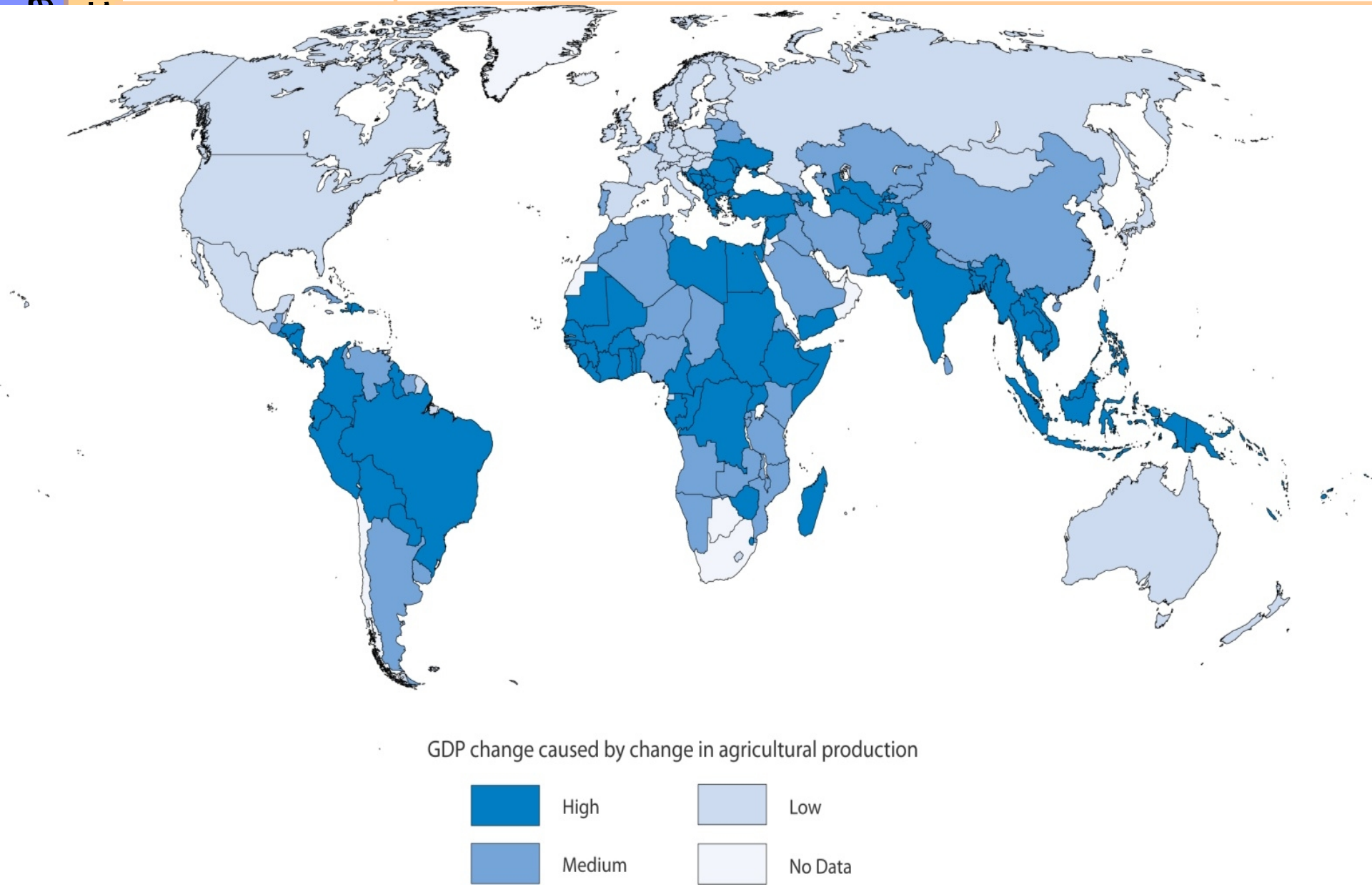
= less reliable rainfall

- 1.4 billion ha for crop cultivation
- more than 2.5 billion ha for pasture
- 4 billion ha forested land (of which 5% plantations)
  - ~ 60% Earth surface

Figure 1: Potential impacts of climate change on agricultural crops in Canada



Agro-Economic Vulnerability to Climate Change

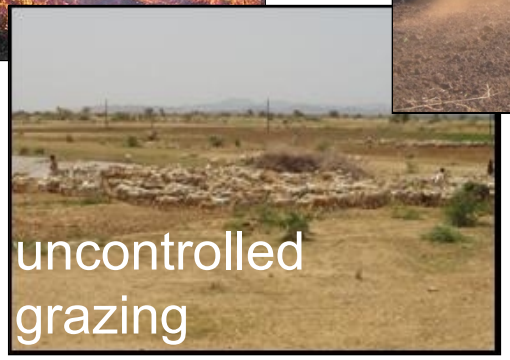


Climate change is projected to

- Cause food production to fall, with lower yields from major crops.
- Increase price volatility for agricultural commodites
- Reduce food quality

Agriculture influences climate

Agriculture, rural livelihoods, sustainable management of natural resources and food security are linked



= destruction of soil organic matter

Successful adaptation and mitigation responses can and must be achieved

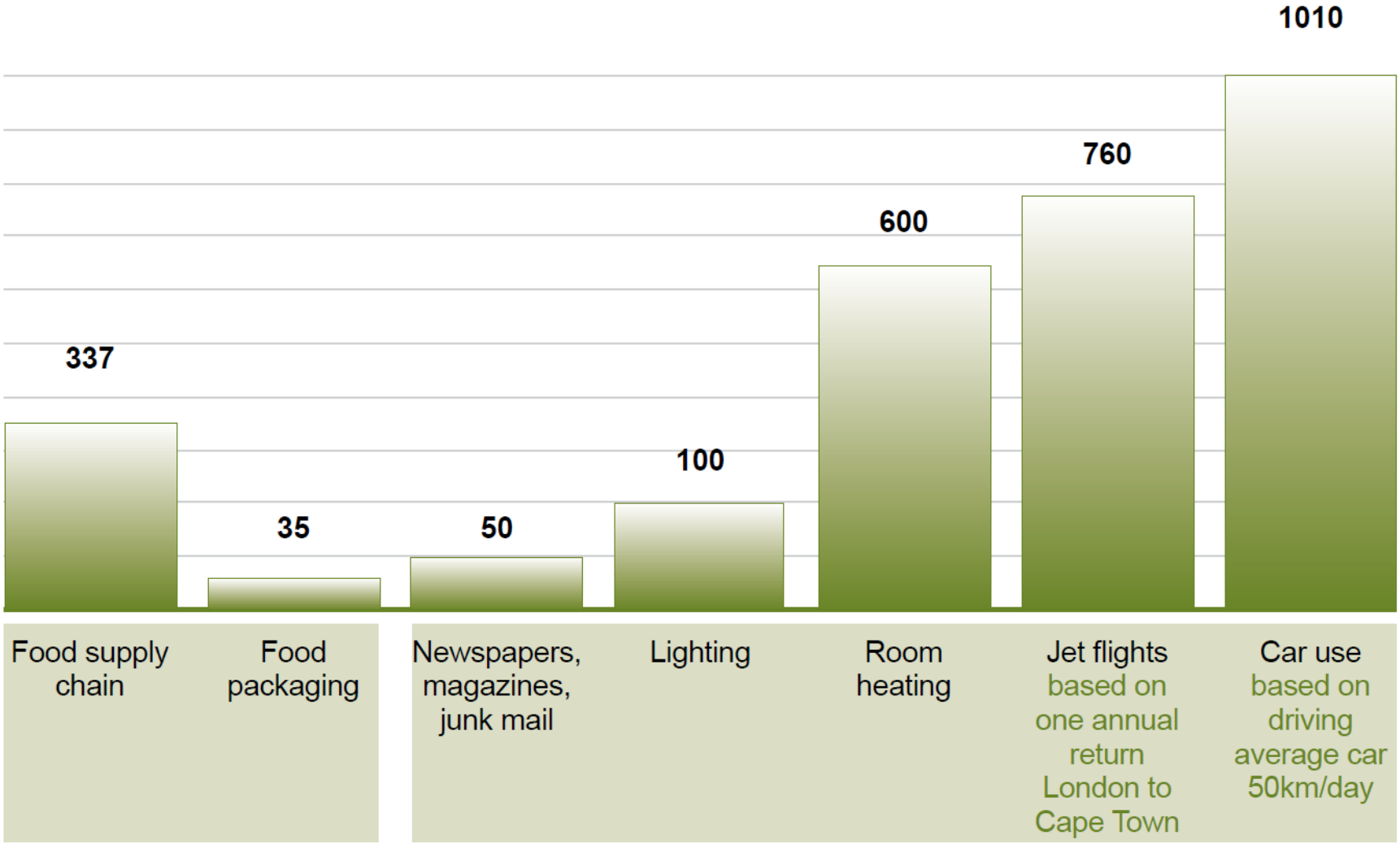
- Agriculture, including forestry, emits ~ 32 % of global GHG:
- 25 % CO_2 , largely from deforestation
- 50 % CH_4, rice and enteric fermentation
- > 75 % N_2O, largely from fertilizers

Overall food-related contribution to GHG emissions

- EU : 31% all EU consumption related GHGs
- UK estimates: around 19% (probably an underestimate)
- World agriculture contribution – 17 - 32% total global emissions
- Huge uncertainty / variability between countries

EU average personal energy consumption

MJ / person / week

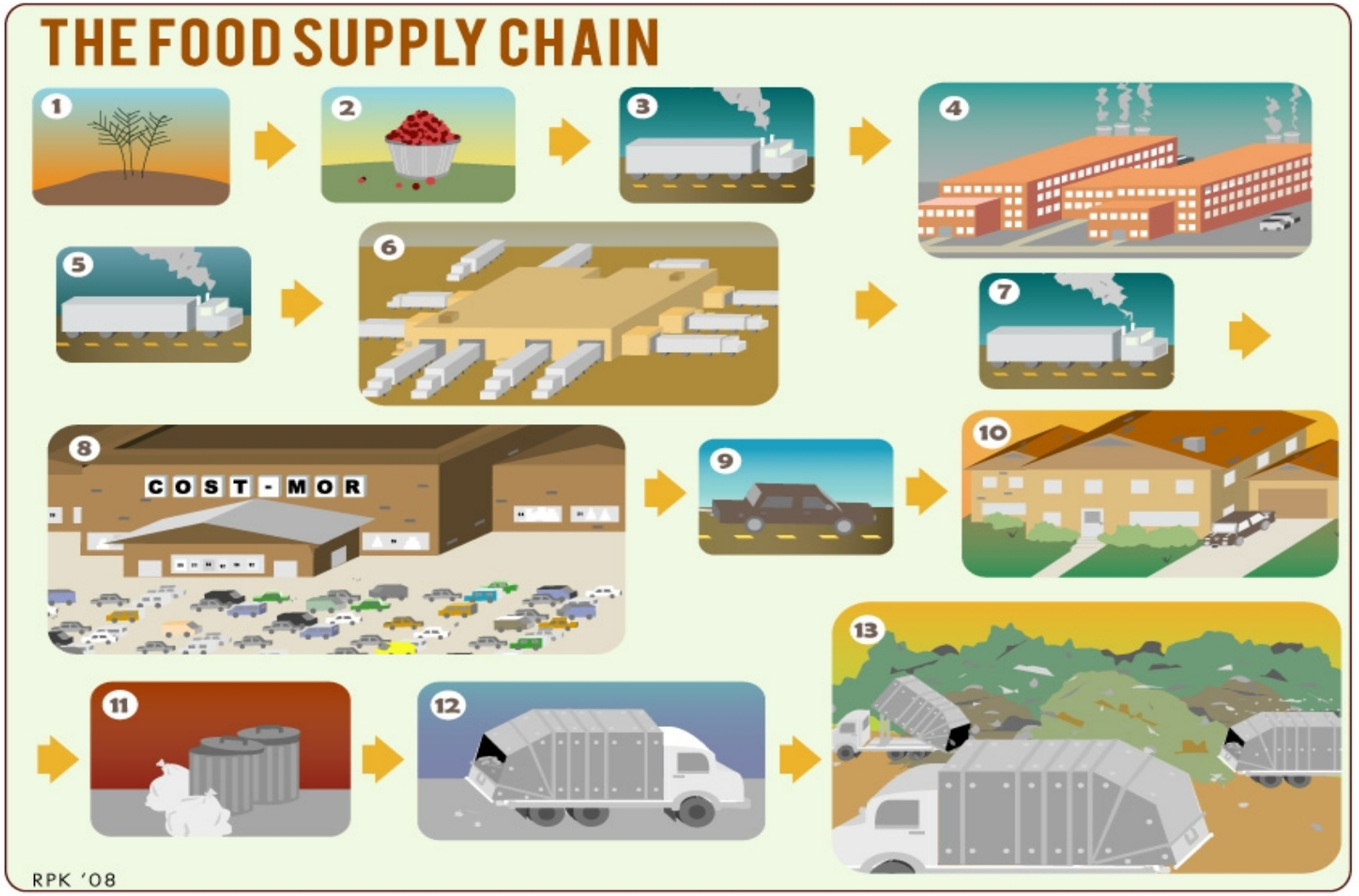


Facing the dangers from climate change…

…there are only three options:

- Mitigation, meaning measures to reduce the pace & magnitude of the changes in global climate being caused by human activities.
- Adaptation, meaning measures to reduce the adverse impacts on human well-being resulting from the changes in climate that do occur.
- Suffering the adverse impacts that are not avoided by either mitigation or adaptation.

The food system has a major impact on climate change at every stage of production



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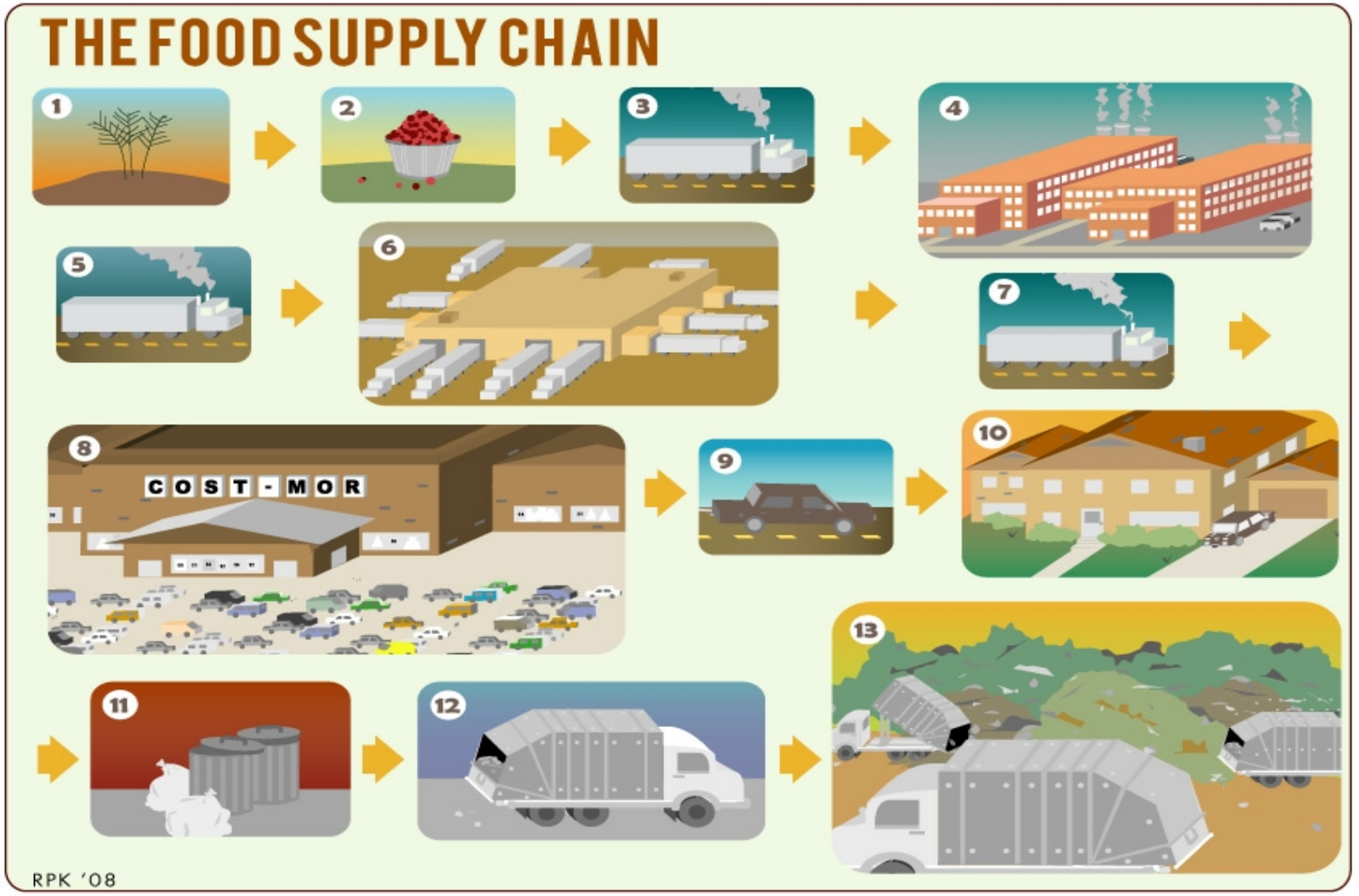


Means of achieving carbon neutral food: on the farm

- Reduce methane production from ruminants
  - Feeding strategies
  - GM
  - Fewer animals
- Reduce emissions of N_2O
  - Reduce fertiliser use
  - Better timing of fertiliser
  - GM N-fixing crops
- Reduce emissions of CO_2
  - Reduce cultivations
  - Reduce cultivated area

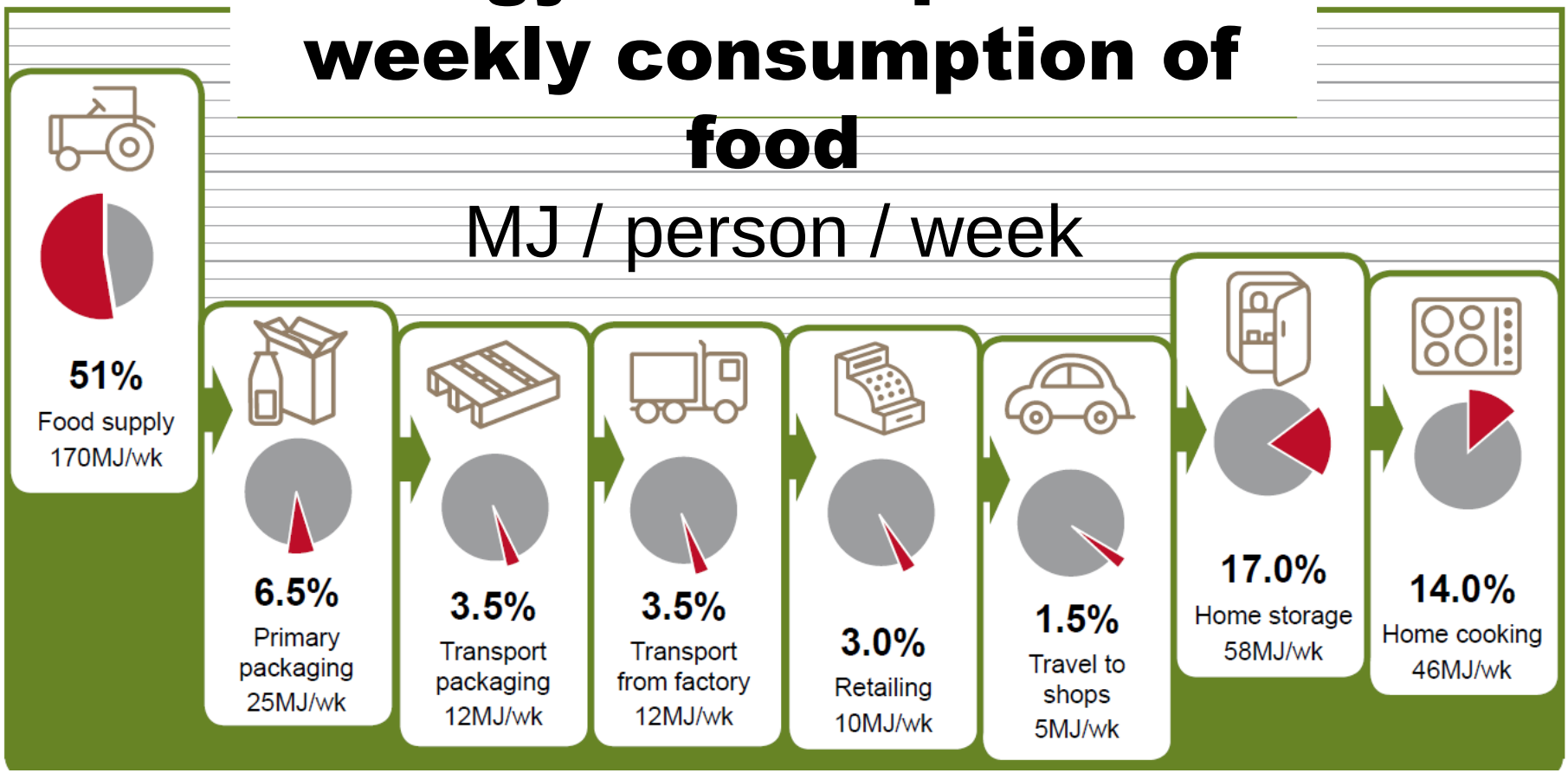
incpen

Table for one

the energy cost to feed one person

Energy for one person's weekly consumption of food

MJ / person / week



Reduce energy: Eco-friendly cooking

- Think before using electrical equipment.
  Could you do that by hand?
- Think before you cook yourself a snack.
  Could you eat something raw?
- Think before you put 3 or 4 pans on the cooker for your dinner.
  Could you cook everything together?

Study conducted for the International Congress

SAVE FOOD!

at Interpack2011
Düsseldorf, Germany

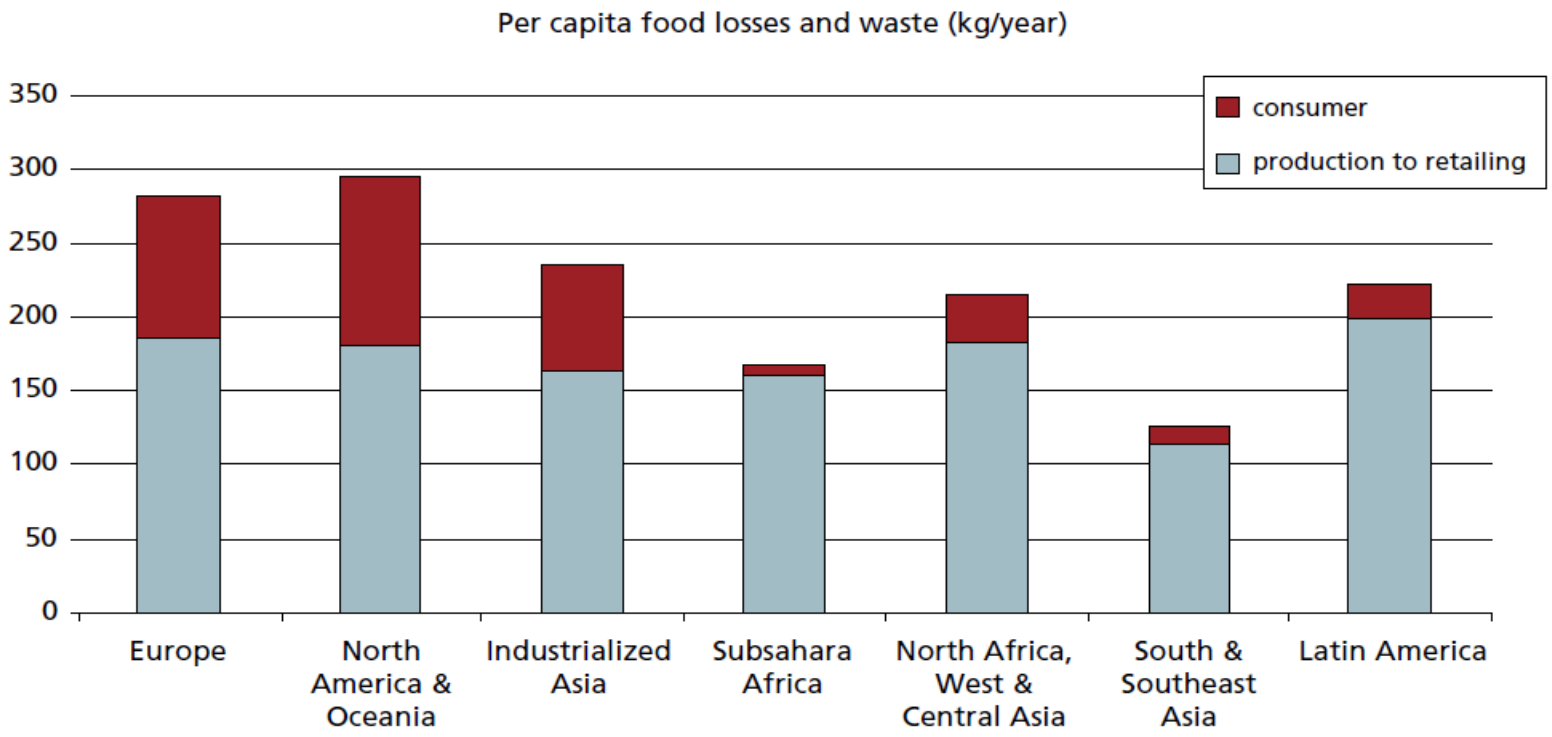
GLOBAL FOOD LOSSES AND FOOD WASTE

EXTENT, CAUSES AND PREVENTION

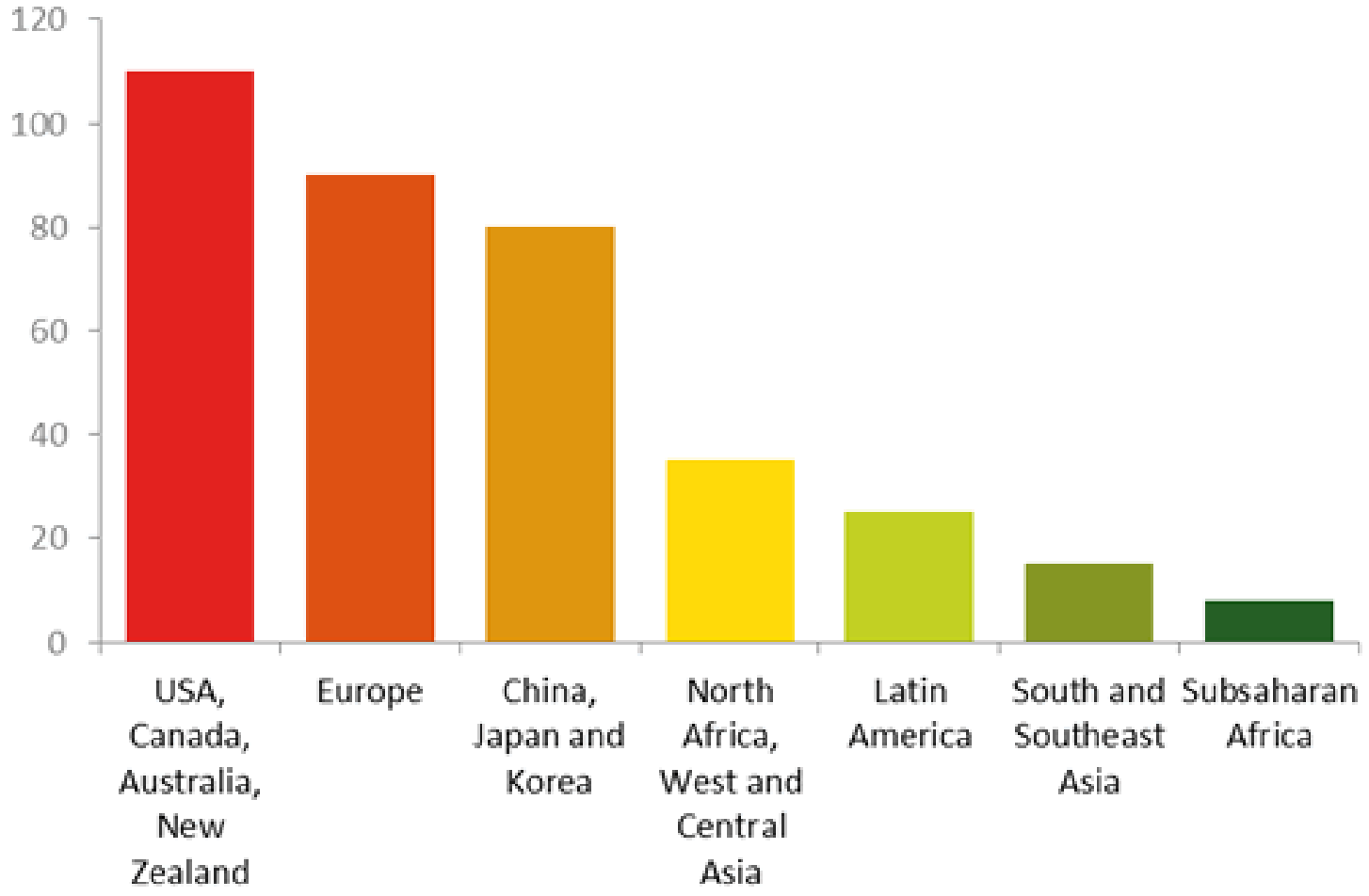
FAO
FIAT PANIS


Food Wastage
Food Loss
Food waste
Agricultural production and harvest
Processing
Distribution & retail
Restaurants & catering
Domestic consumption

Per capita food losses and waste, at consumption and pre-consumptions stages, in different regions



Annual food waste by region (kg/person)



Note: Figures are consumer waste per capita based on data from 2007 in the FAO report 'Global Food Losses and Food Waste'. Globally consumer food waste amounts to roughly 350 Mt each year which equates to about 50 kg per person or 10% of total food supply.

Source: Gustavsson et al (2011), FAO

Shrink That Footprint

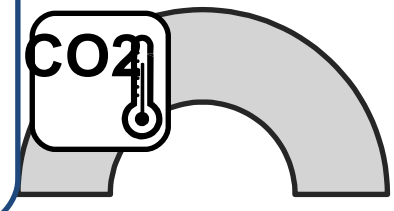
Estimated/assumed waste % for each commodity group in each step of the FSC

Europe incl. Russia

	Agricultural production	Postharvest handling and storage	Processing and packaging	Distribution: Supermarket Retail	Consumption
Cereals	2%	4%	0.5%, 10%	2%	25%
Roots & Tubers	20%	9%	15%	7%	17%
Oilseeds & Pulses	10%	1%	5%	1%	4%
Fruit & Vegetables	20%	5%	2%	10%	19%
Meat	3.1%	0.7%	5%	4%	11%
Fish & Seafood	9.4%	0.5%	6%	9%	11%
Milk	3.5%	0.5%	1.2%	0.5%	7%

Footprint of food wastage (1.3 Gt/year)

3.3 Gt CO2eq/year
=
3rd largest emitter,
if food wastage was
a country

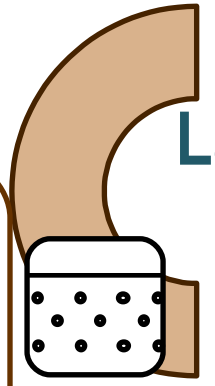


Carbon

Water

305 km3/year
=
3 times lake
Geneva

Land



Biodiversity

1.5 billion ha
used to grow food
that is wasted
=
30% of agricultural
land

66% of endangered/
vulnerable species
threatened by food
production

FAO, 2013. Food Wastage Footprint: Impacts on Natural Resources

Food waste can and must be reduced

The food supply chains need to be strengthened by

- *Encouraging* small farmers to organize and to diversify and upscale their production and marketing.
- *Investments in infrastructure*, transportation, food industries and packaging industries

Food waste can and must be reduced

Change of consumer behaviour

The causes of food losses and waste in medium/high-income countries mainly relate to consumer behaviour as well as to a lack of coordination between different actors in the supply chain.

Food waste in industrialized countries can be reduced by raising awareness among food industries, retailers and consumers.

At the consumer level, insufficient purchase planning and expiring ‘best-before-dates’ also cause large amounts of waste, in combination with the careless attitude of those consumers who can afford to waste food.

There is a need to find good and beneficial use for safe food that is presently thrown away.


How to reduce food waste
Plan ahead
Buy what you need
Store correctly
Cook the right amount
Eat it all or store leftovers for later
Recycle what you can't eat

Reduce food miles

The number of miles a food travels from where it is grown or manufactured to where it is eaten is often measured in terms of **food miles**.


California
Oranges
5,000 miles
West Indies
Bananas
4,000 miles
Argentina
Beef
7,000 miles
Spain
Tomatoes
1,000 miles
Central Africa
Cocoa Beans
3,000 miles
New Zealand
Lamb
11,000 miles


Food Mile Footprints
Shrink That Footprint

Reduce food miles

How many food miles has this USA pizza used?

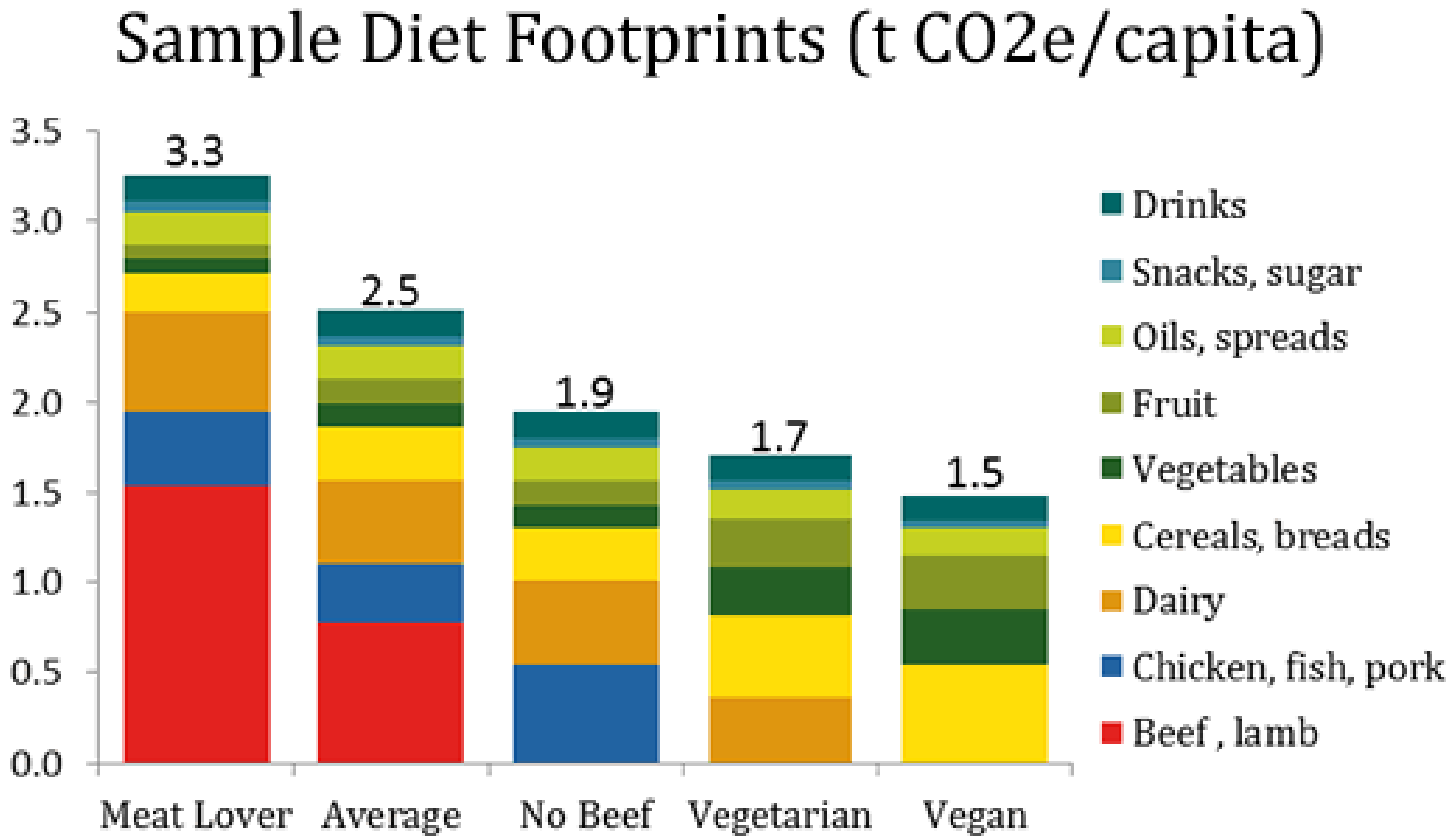
- Strong bread flour from Canada
- Mozzarella cheese from Italy
- Tinned tomatoes and tomato puree from Greece
- Pepperoni from Italy
- Chilli peppers from Spain.

Can you make this pizza using local ingredients

The features of a lower carbon food system

- *Seasonal and indigenous:*
  Fresh produce grown during its natural growing season and well adapted to local growing conditions will be less transport intensive and produce fewer overall CO2 emissions than non-indigenous foods or those imported out of season

It matters what we eat



Note: All estimates based on average food production emissions for the US. Footprints include emissions from retail losses and consumer losses. Each of the four example diets have been based on 2,600 kCal of food consumed per day, roughly the same as an average American. This equates to around 3,900 kCal of supplied food.

Sources: ERS/USDA, various LCA and EIO-LCA data

Shrink That Footprint

The features of a lower carbon food system

- *Local clustering:* The inputs to the product in question must be situated near to the site of production. For processed foods, it is important that the constituent ingredients can be and are grown or produced nearby. For livestock production a nearby source of feed and fodder will be important.
- *Journey distance:* The distance from point of production to point of retail to point of consumption should be minimised.
- *Logistical transport efficiency:* The fuel efficiency of a vehicle and the way it is managed and operated are very important. In addition loads must be consolidated and vehicles as full as possible while they are in use.

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The future of food and farming: 2030s

In the 2030s, climate change will affect food and farming more strongly, particularly small-scale producers in poor countries

Crop and pasture yields are likely to decline in many places

North-East Brazil

Maize	Rice	Wheat
-10%	-14%	-14%

Central America

Wheat	Rice	Bean
-9%	-10%	-4%

East Africa

Maize	Bean
-3%	-1.5%

New Zealand

Pasture for beef and dairy -4%

Small-scale producers with fewer assets will need most support to adapt — such as disaster relief, farm insurance and weather forecasts

Adaptation will be key

CROPS

Temperate regions will benefit more from adaption than tropical regions

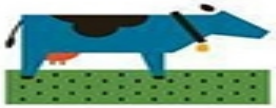
Switching to varieties tolerant to heat, drought or salinity

Optimising irrigation

Managing soil nutrients and erosion

LIVESTOCK

Key adaptations for small-scale producers include:



Matching animal numbers to changes in pastures

More farms that mix crops and livestock

Controlling the spread of pests, weeds and diseases

FISHERIES

Key adaptations for small-scale fisheries include:

Switching to more abundant species

Restoring degraded habitats and breeding sites like mangroves

Strengthening infrastructure such as ports and landing sites

SOURCES: Porter, J. R., Xie, L., Challinor, A., Cochrane, K., Howden, M., Iqbal, M. M., Lobell, D., Travasso, M. I. 2014. Food Security and Food Production Systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. http://www.ipcc-wg2.gov/
With data from ECLAC 2009, Lobell et al 2008, Margulis, et al 2010, Thornton, et al 2010, Wratt et al 2008

CGIAR
RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security
CCAFS

Strategic interventions under adaptation

- Promote and encourage highly adaptive and productive crop varieties and cultivars in drought-prone, flood-prone and rain-fed crop farming systems.
- Promote and encourage highly adaptive and productive livestock breeds.
- Promote and encourage conservation agriculture and ecologically compatible cropping systems
- Promote sustainable management of rangelands and pastures through integrated rangeland management.

Strategic interventions under adaptation

- Support community-based adaptation strategies through expanded extension services
- Develop innovative insurance schemes (low-premium micro-insurance policies) and low-interest credit facilities to insure farmers against crop failure and livestock loss due to extreme weather events.
- Promote irrigated agriculture by encouraging irrigation systems that use water sustainably.
- Promote and encourage agricultural diversification, and improved post-harvest handling and storage

Observations and conclusions

- Climate change is happening
- Food contributes to a significant proportion of global GHG emissions
- All stages in the supply chain contribute to emissions
- Agriculture most significant stage / meat and dairy most GHG intensive food
- Global food demand is moving in more GHG intensive directions

Observations and conclusions

- Maximum efficiency: accept demand as inevitable. Meet it as efficiently as possible. Minimise the damage. Tackle ethical/environmental concerns individually. More for less.
- Ecological limits: Constrain consumption within ecological limits. Integrate social environmental concerns. Focus on needs. Less is more.
- Meeting Needs rather than demand – only feasible approach?

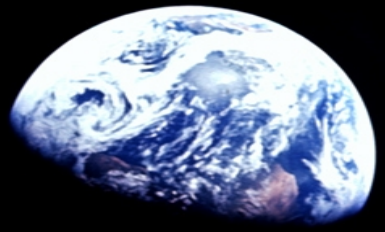
Final thougts

1. From being a problem, food sector can become a major solution in addressing climate change

2. Farming may be climate neutral, as 80% of agricultural emissions can be compensated by soil carbon sequestration through ecological/organic management

3. Market mechanisms should encourage local food supply chains and responsible consumption

We Need A Climate Literate Society



If we want to achieve sustainable development

A climate literate person:

- *understands* the essential principles of Earth's climate system,
- knows how to *assess* scientifically credible information about climate,
- *communicates* about climate and climate change in a *meaningful* way, and
- is able to make *informed* and *responsible* decisions with regard to actions that may affect climate.