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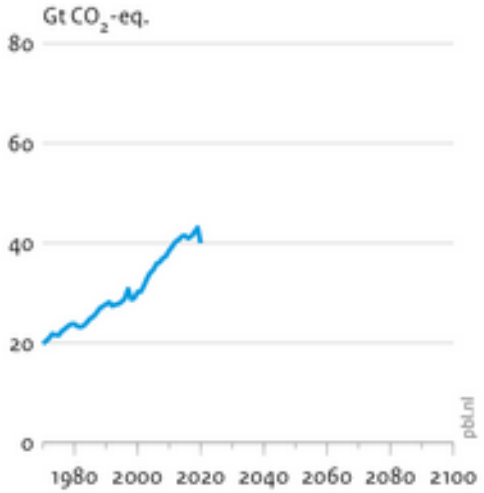
Untying the Knot: Explorations to Meet Climate and Sustainability Goals

Detlef van Vuuren

Clear environmental degradation



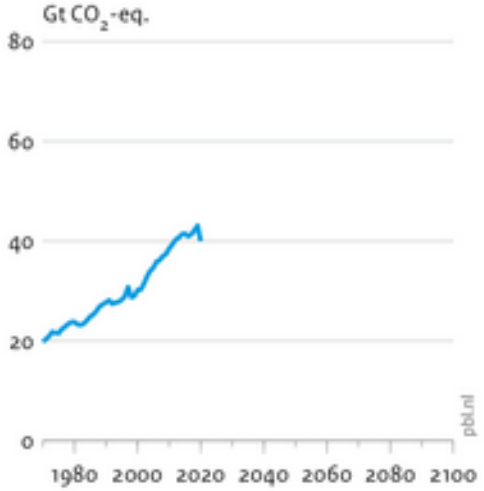
But also international promises to do better…

Paris-agreement

The universal agreement's main aim is to keep a global temperature rise this century **well below 2 degrees Celsius** and to drive efforts to limit the temperature increase even further to **1.5 degrees Celsius** above pre-industrial levels

Convention on Biological Diversity

Aichi targets: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society and reduce the direct pressures on biodiversity and promote sustainable use…



The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action **to end poverty, protect the planet**, and ensure that by 2030 all people enjoy peace and prosperity.

Sustainable development goals (SDGs)

What would it take to achieve this comprehensive set of development and environmental goals**….. simultaneously?**

Rationale and relevance

Sustainable development goals (SDGs)

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Rationale and relevance

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Sustainable development goals (SDGs)

Sustainable development goals (SDGs)

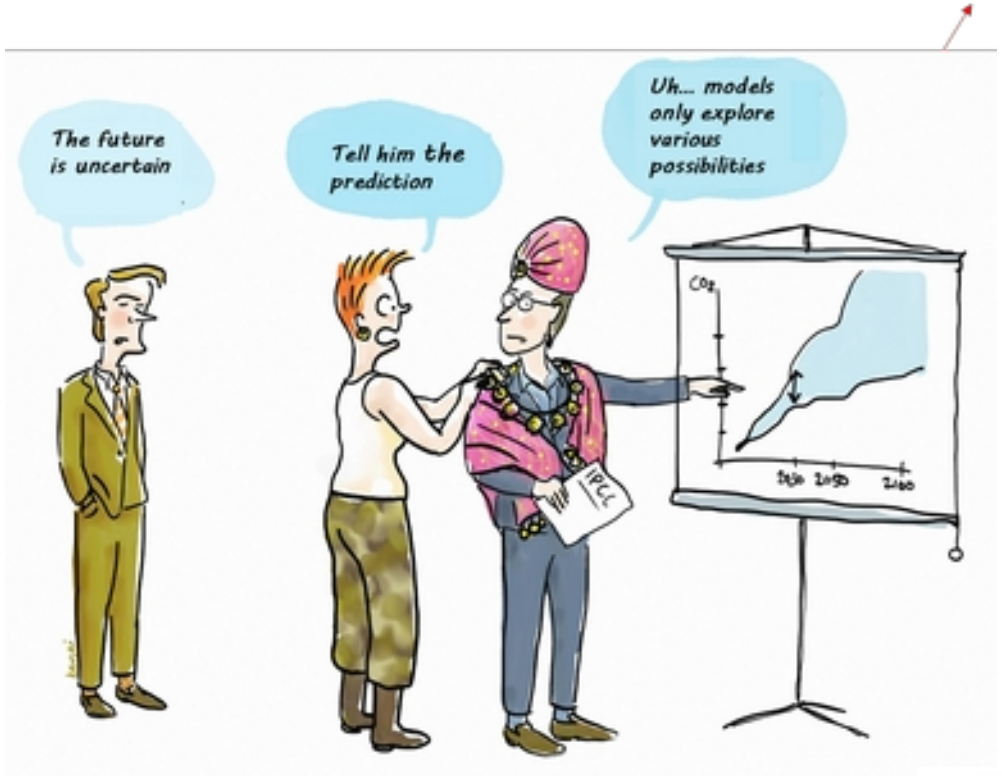
Human development and equity

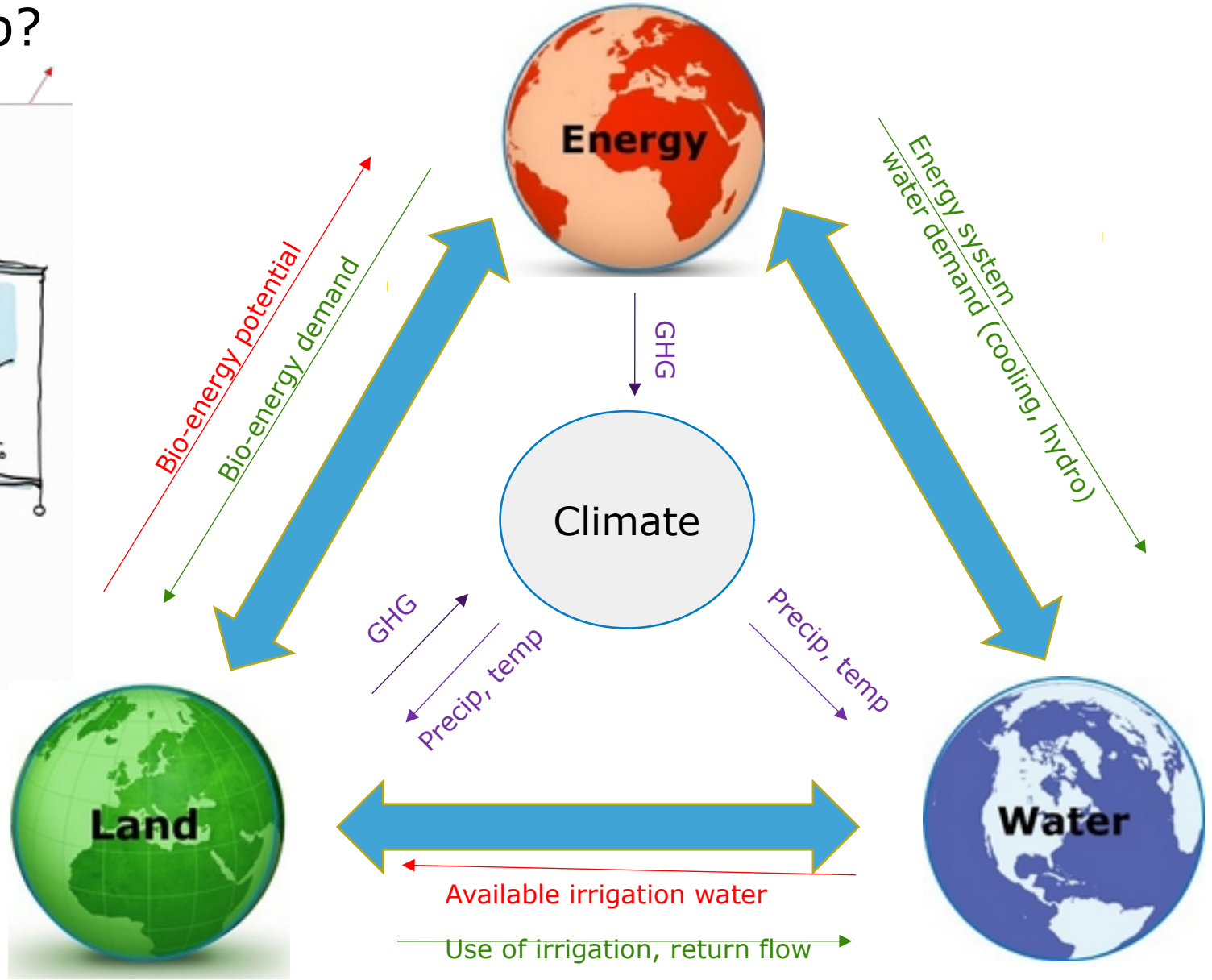
Good governance & infrastructure

Efficient and sustainable resource use

Protecting natural environment

How will this further develop?





How will this further develop?

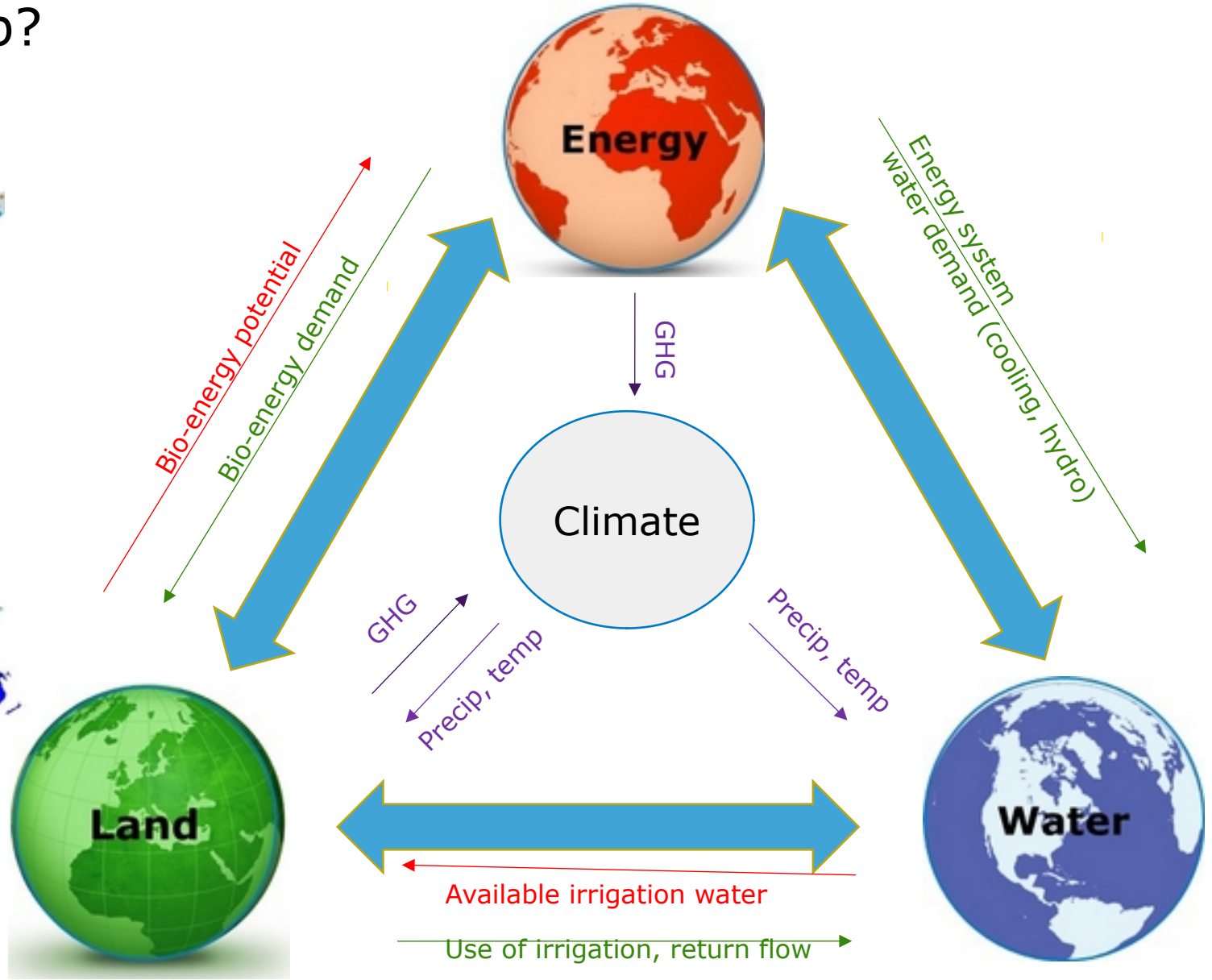
Scenario 1: Sustainable Development

Low consumption,
Low population growth

Scenario 2: Middle Of the road

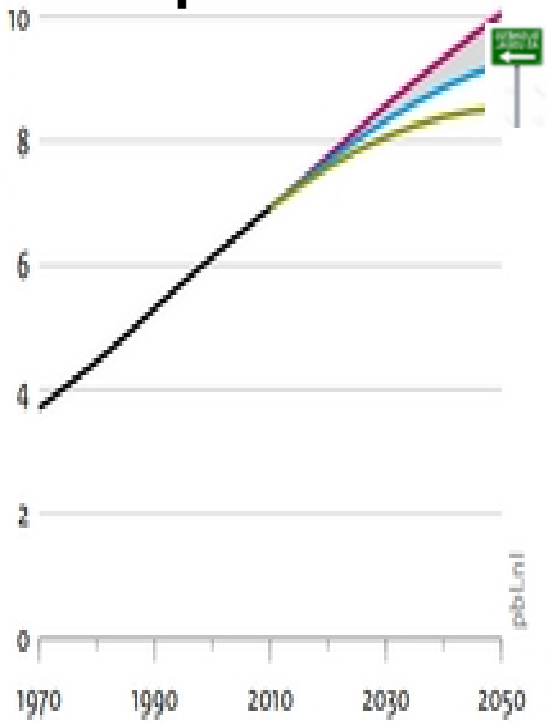
Scenario 3: Increasing competition

High population growth, domestic resource use



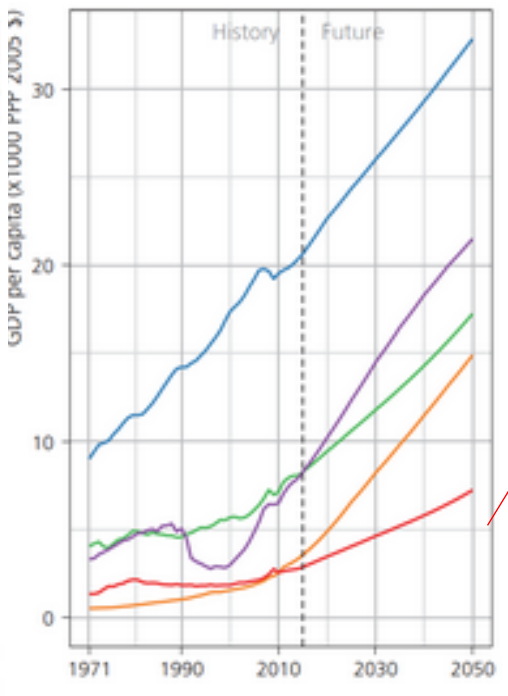
How will this further develop?

Population

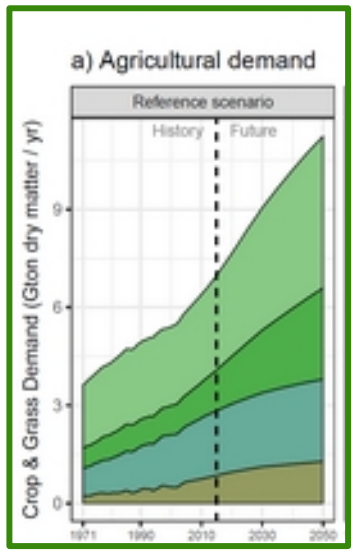


Population increases to 9-10 billion

Income



People become more wealthy



- 35% more people
- Shift to meat-intensive diets
- 60% increase in demand
- Most of increase from higher yields

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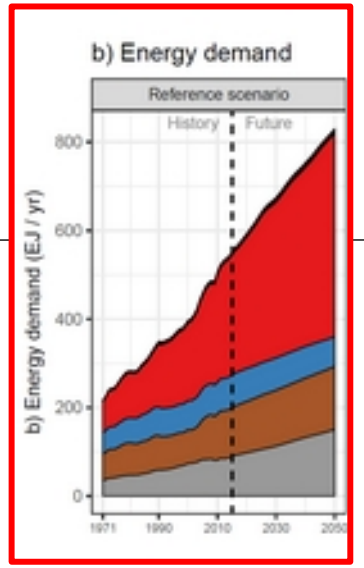
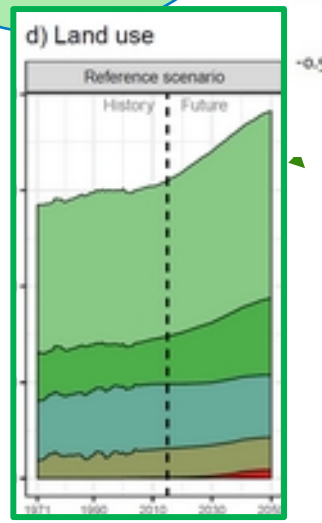


Households

Industry

Transport

Food Demand + prod



Energy

Land

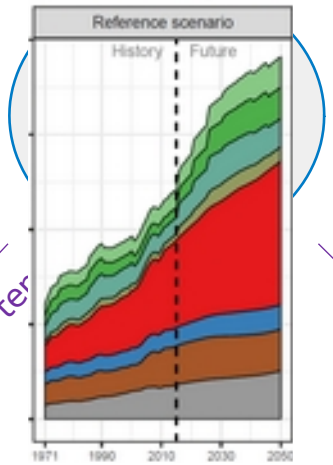
Water

Bio-energy potential

Bio-energy demand

GHG

Energy system water demand (cooling, hydro)



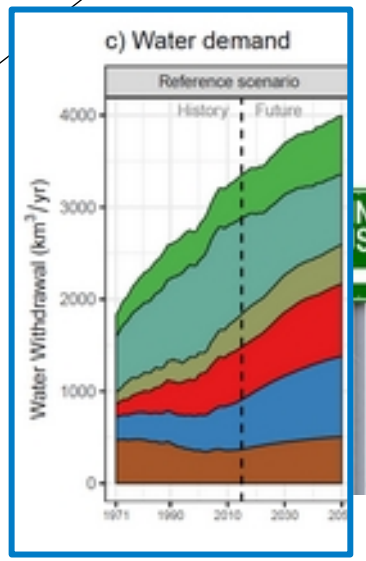
GHG

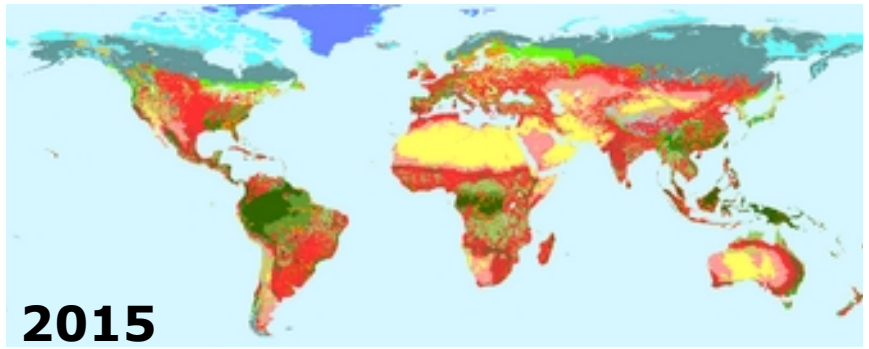
Precip, ter

Precip, temp

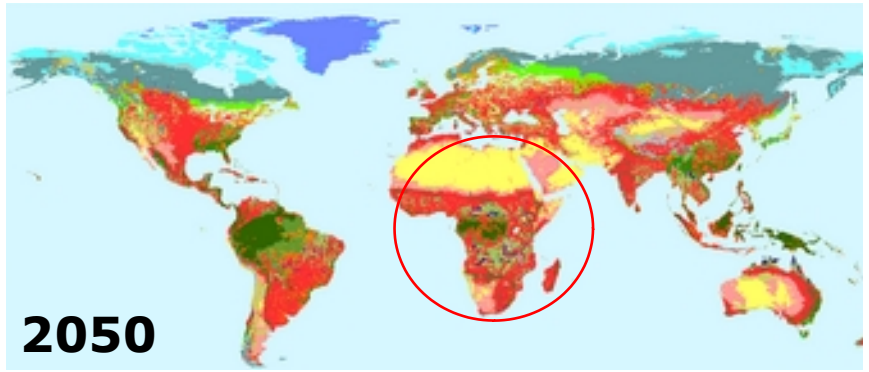
Available irrigation water

Use of irrigation, return flow



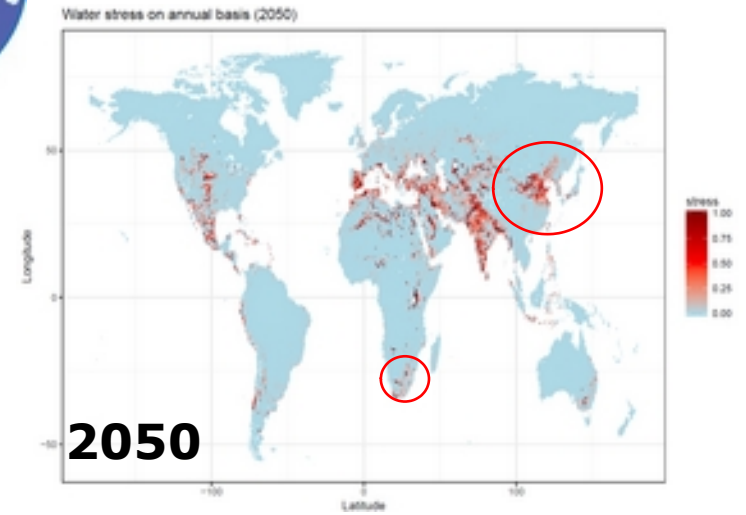

2015

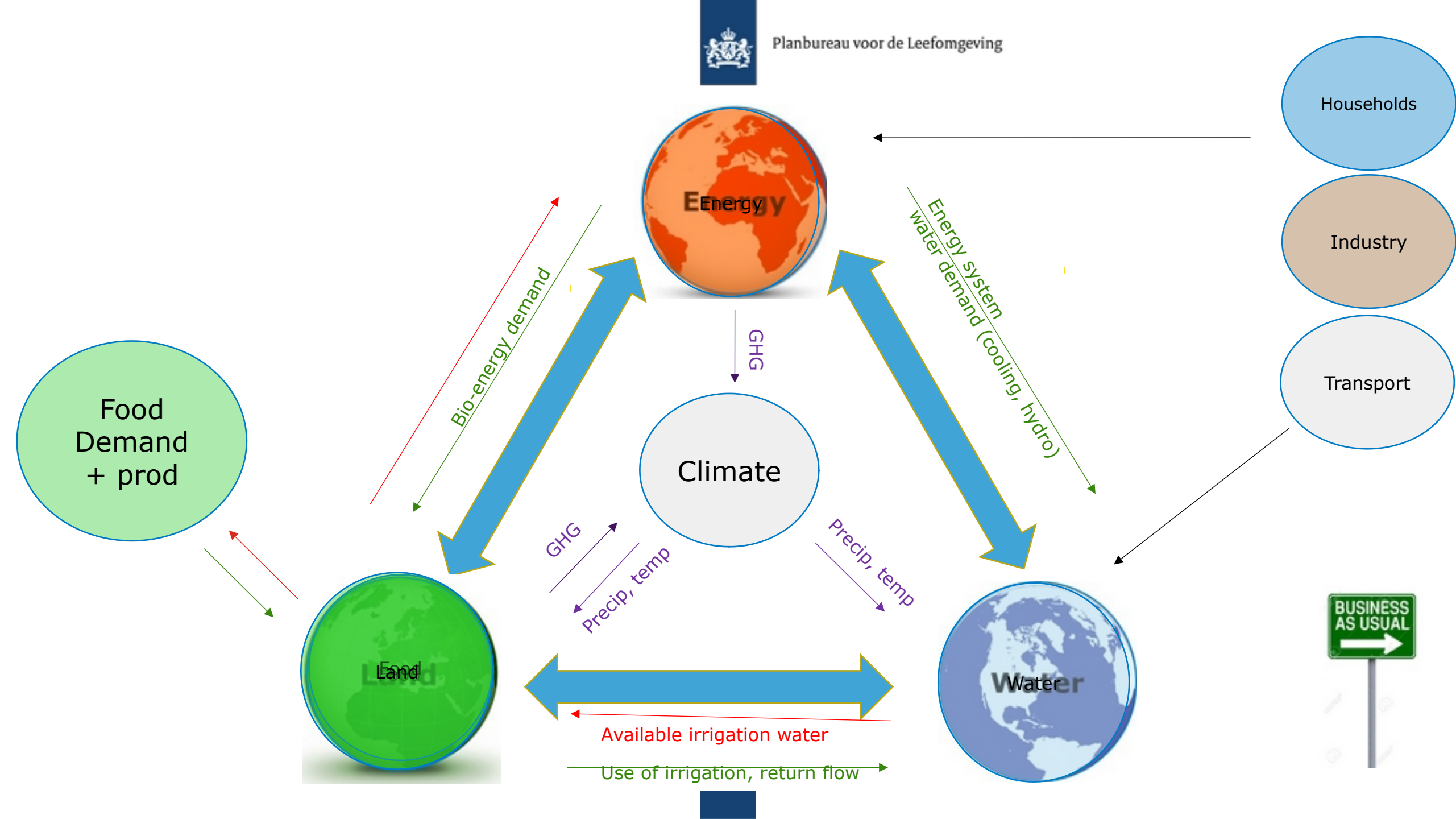

Land


2050


Water


Water stress on annual basis (2015)
2015
Latitude
Longitude
stress


Water stress on annual basis (2050)
2050
Latitude
Longitude
stress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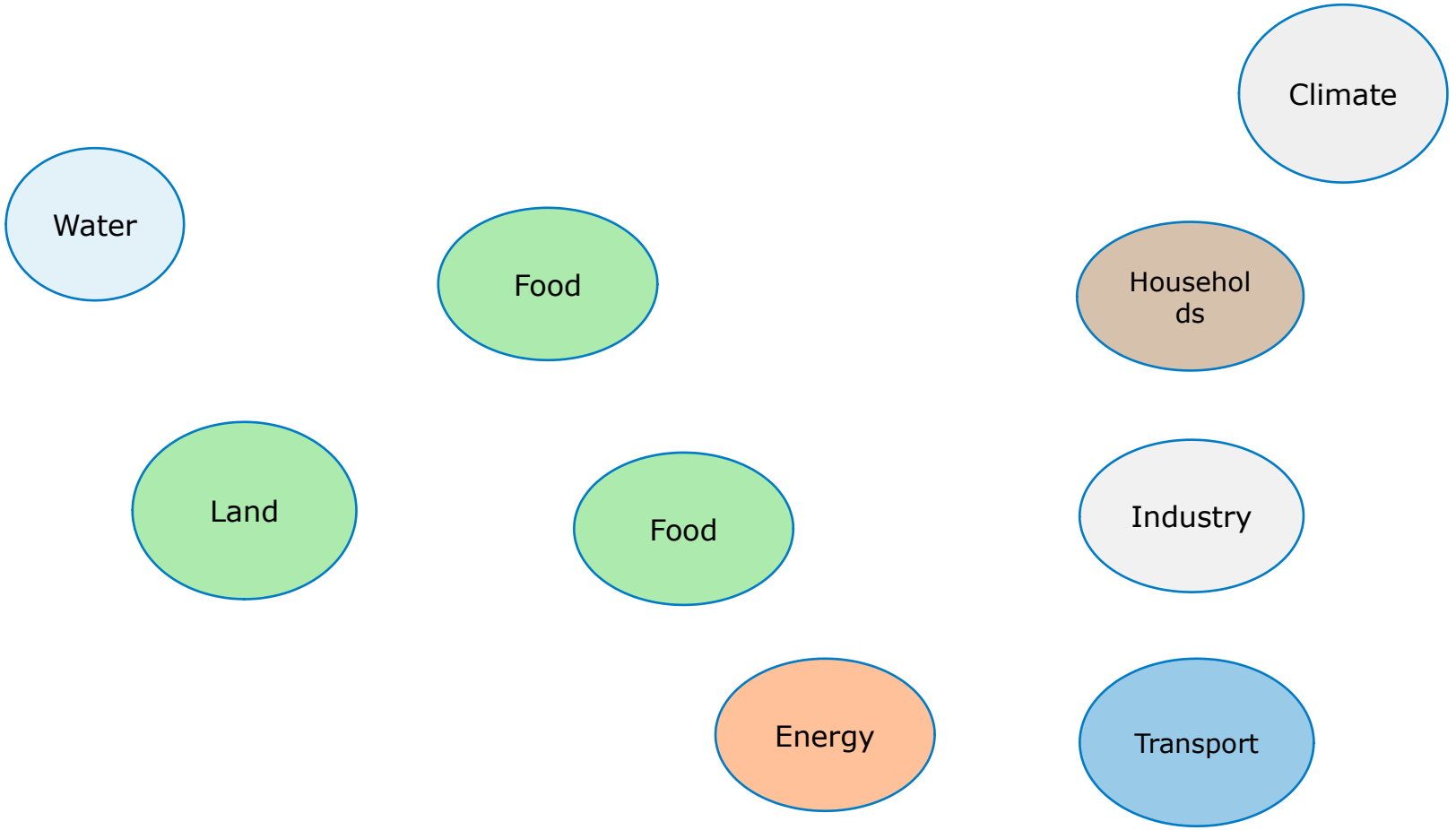
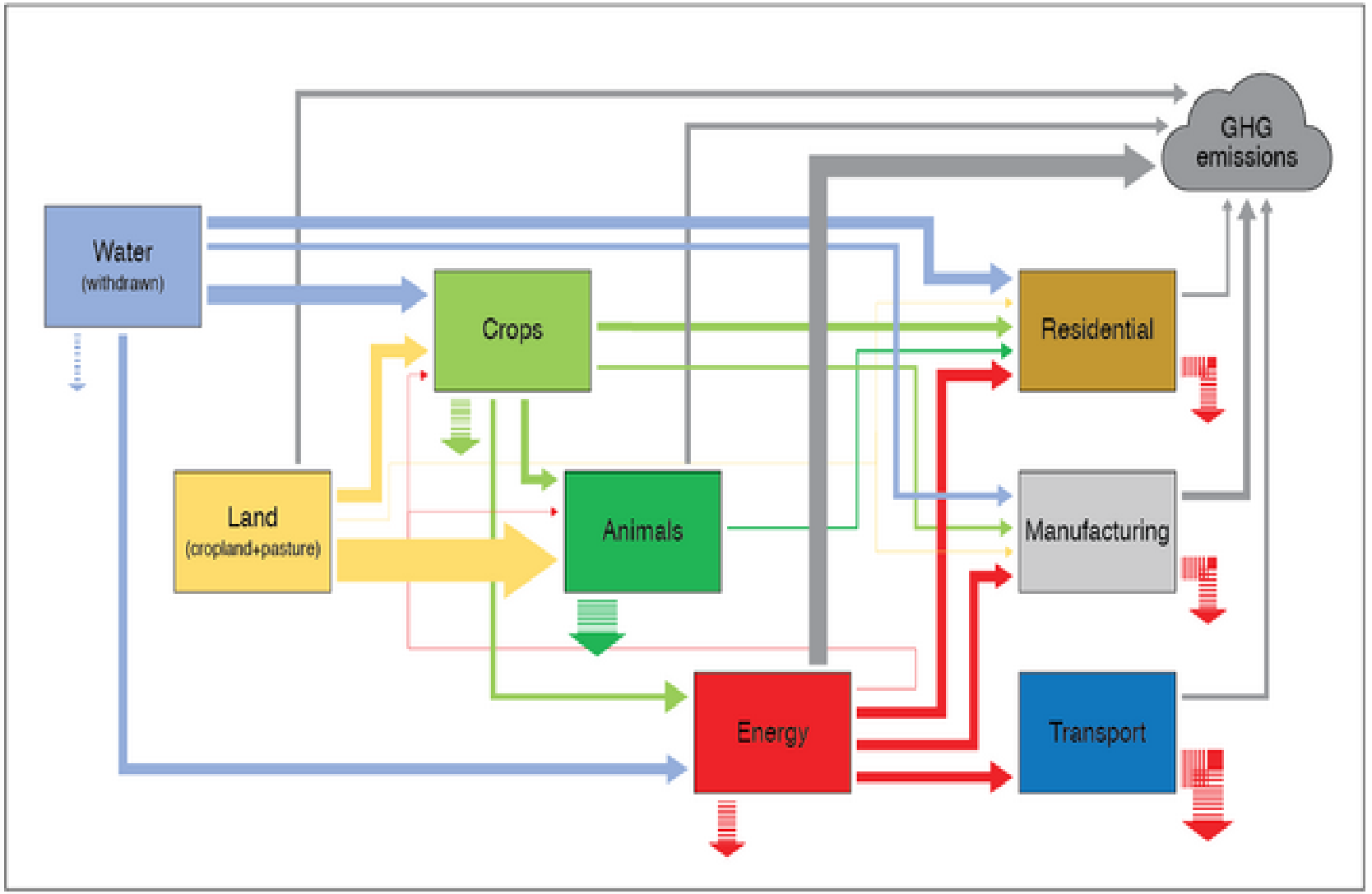
Households
Industry
Transport
Energy
Energy system
water demand (cooling, hydro)
Bio-energy demand
GHG
Food
Demand
+ prod
Climate
GHG
Precip, temp
Precip, temp
Land
Water
BUSINESS
AS USUAL
Available irrigation water
Use of irrigation, return flow


Climate
Water
Food
Household
ds
Land
Food
Industry
Energy
Transport

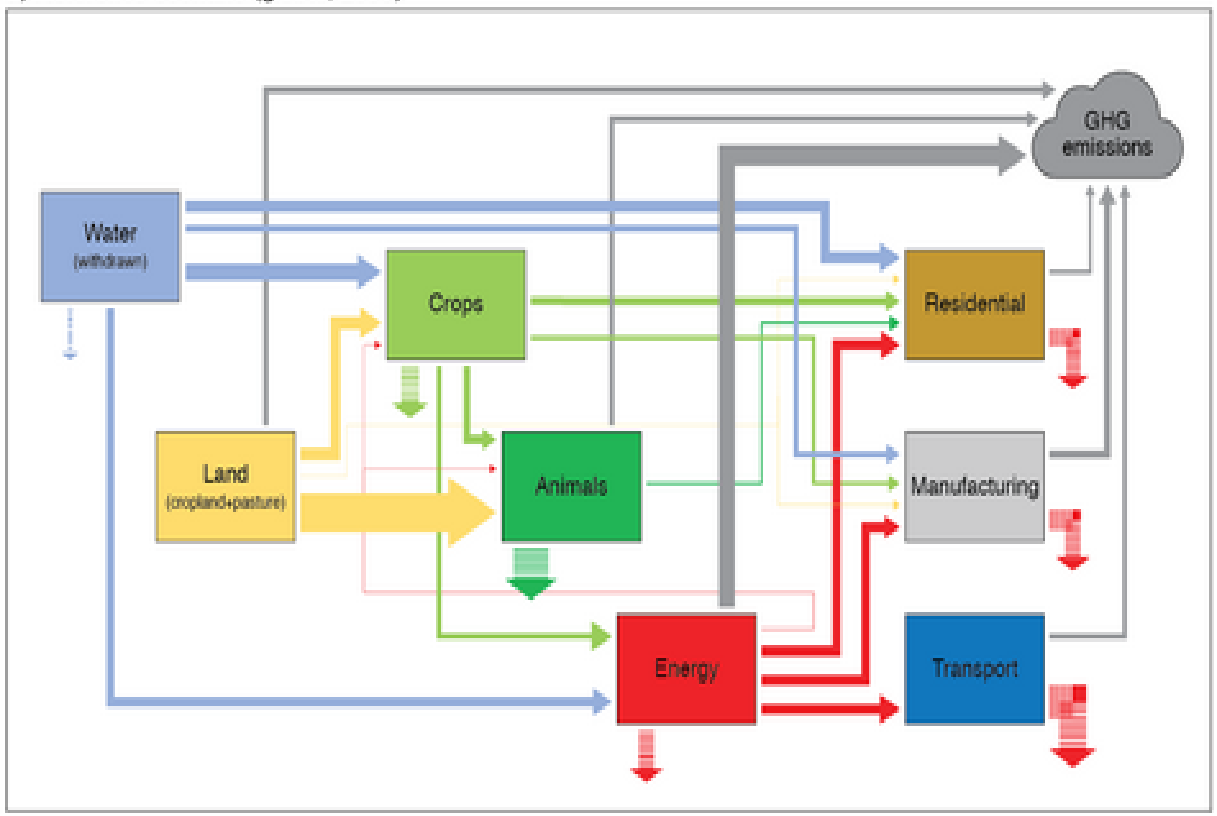
a) Reference scenario (global; 2050)



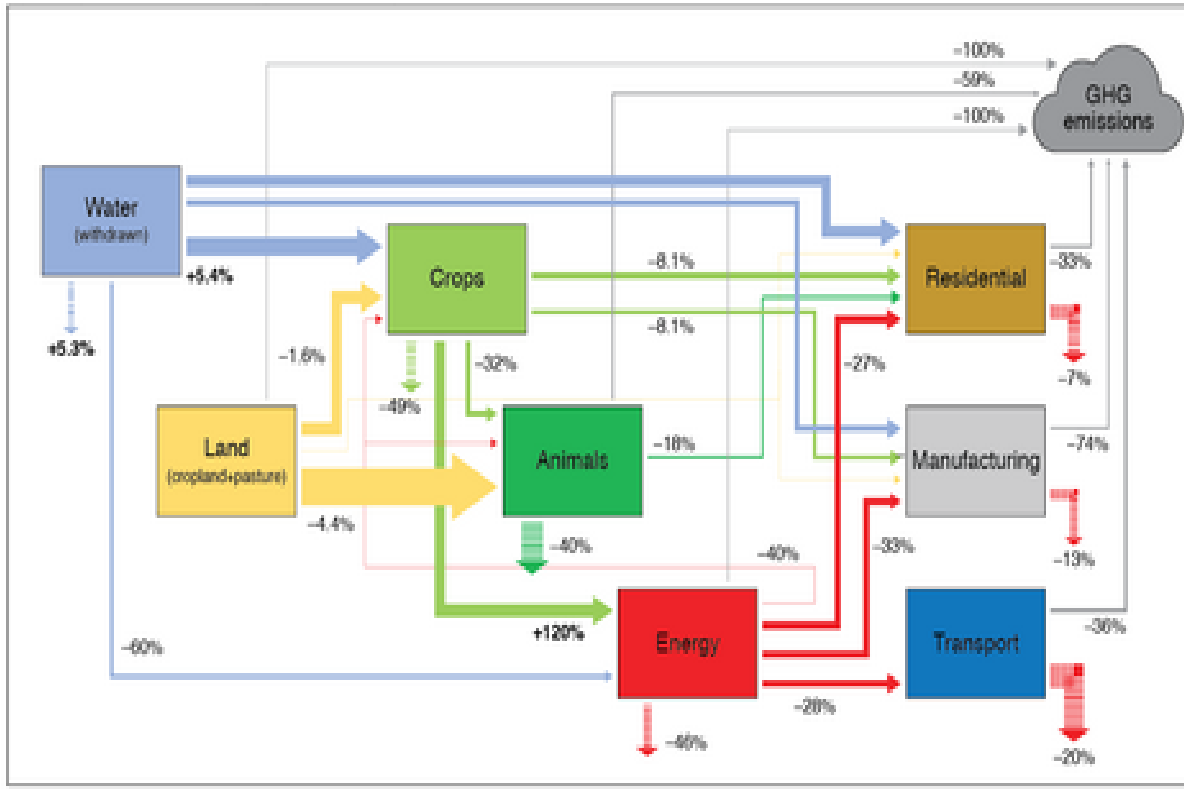
Exploration of response strategies

	Separate options	*Assumptions made in illustrative scenario*
Climate policy	Climate policy is implemented to stay within 2°C.	Climate policy is implemented to stay within 2°C.
Dietary change	Meat consumption in all regions is restricted to a 'healthy' level in all regions in 2050 (Willett diet), assuming a weekly per capita consumption of 70g beef, 70g pork and 350g of chicken and eggs[18,19].	By 2050, 44% of the people in each region follow the Willett diet and 56% still follow the conventional diet.
Waste reduction	Storage and distribution waste fractions are reduced by 86% in 2050. Household waste fractions: 98% of avoidable waste is avoided in 2050.	Storage and distribution waste fractions are reduced by 45% in 2050. Household waste fractions: 49% of avoidable waste is avoided in 2050.
Yield changes compared to baseline.	Yields are improved by 15% compared to the reference scenario, based on IIASTD[20]	Yields are improved by 7% compared to the reference scenario

a) Reference scenario (global; 2050)



b) Response scenario (global; 2050)



Model	MAgPIE					IMAGE				
Scenario	WATER	LAND	FOOD	CLIMATE	TOTAL	WATER	LAND	FOOD	CLIMATE	TOTAL
Water Withdrawal Irrigation	-26%	+10%	-24%	+31%	-25%	-28%	0%	-3%	+5%	-26%
Natural Land Area	0%	+2%	+4%	+2%	+6%	-1%	+4%	+8%	+2%	+8%
Nitrogen Surplus Agriculture	-27%	-27%	-35%	-8%	-61%	-30%	-32%	-23%	-24%	-51%
Food Price	+1%	+1%	-18%	+7%	-11%	+9%	+20%	-46%	+11%	-34%
AFOLU Emissions	-3%	-14%	-58%	-43%	-83%	0%	-27%	-45%	-30%	-53%

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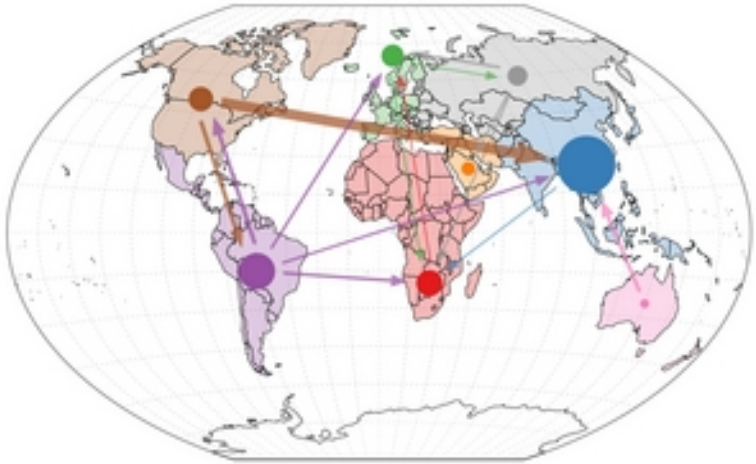
Untying the knot

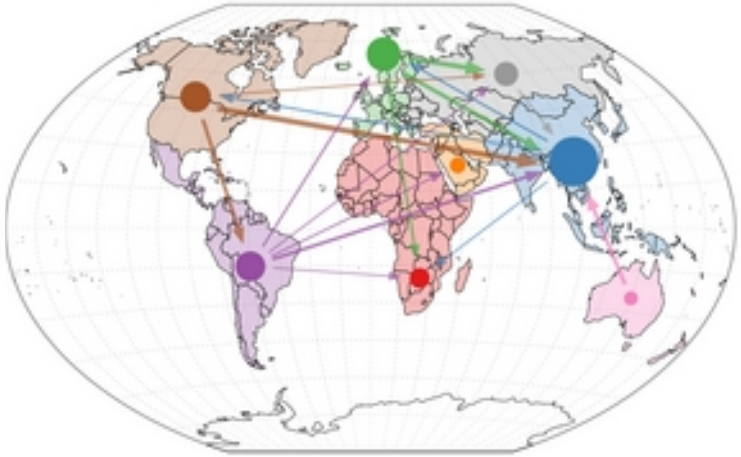
- Lot of experience on single issue scenario work regarding solutions…
- But knowledge on the connections is still developing
- Important to look at synergies and trade-offs
- Most of the nexus is local

Very different scales

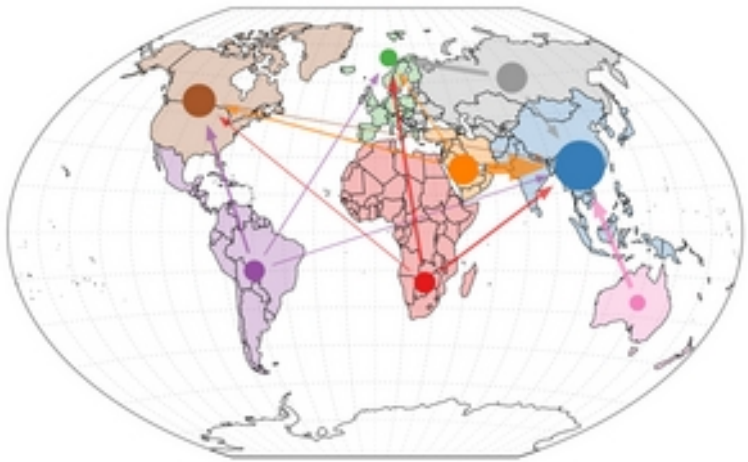
Crops



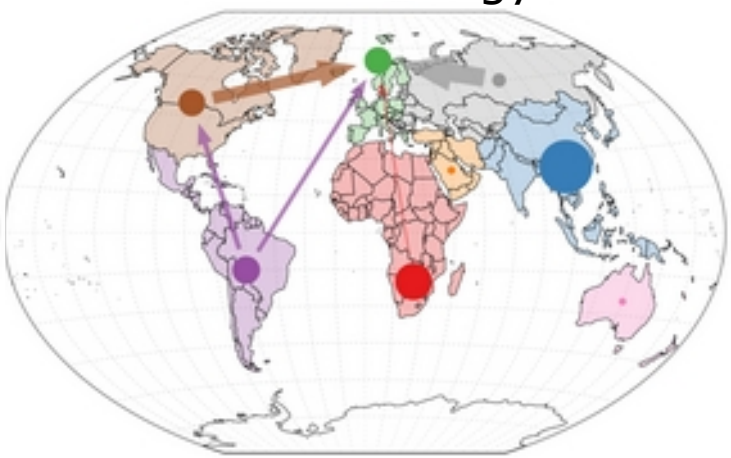
Animal products



Fossil fuel



Bio-energy



Average trade distance

Water: small

Bio-energy: 280 km

Crops: 1200 km

Animal prod: 1200 km

Natural gas: 1500 km

Coal: 2000 km

Oil: 3500 km

Reduce water scarcity

Protect biodiversity

Eridicate hunger

Meet climate goals

	Scenarios			
Measures	WATER	LAND	FOOD	CLIMATE
Environmental flow requirements	Limit water extraction,			
Biodiversity protection		Increase in protection		
Fertilizer efficiency	++	++		+
Diet change			Willett diet	
Food waste			reduction in food waste	
GHG price				Carbon price

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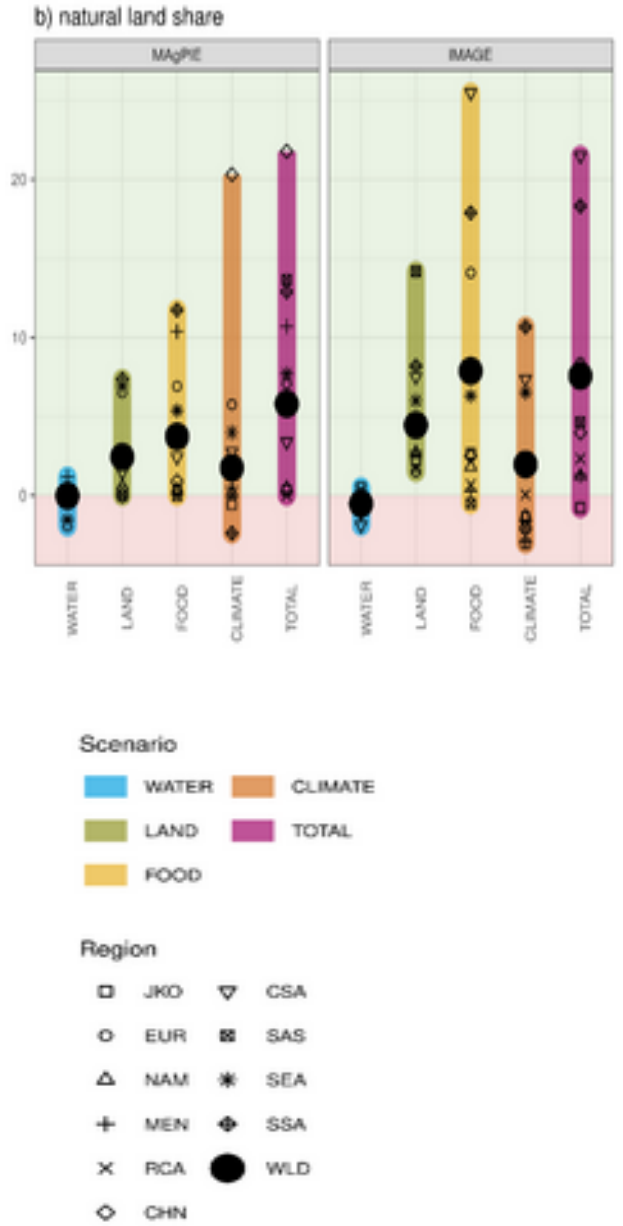

Doelman et al., in review

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