

Bioenergy's role in energy planning for the future - according to an environmental NGO

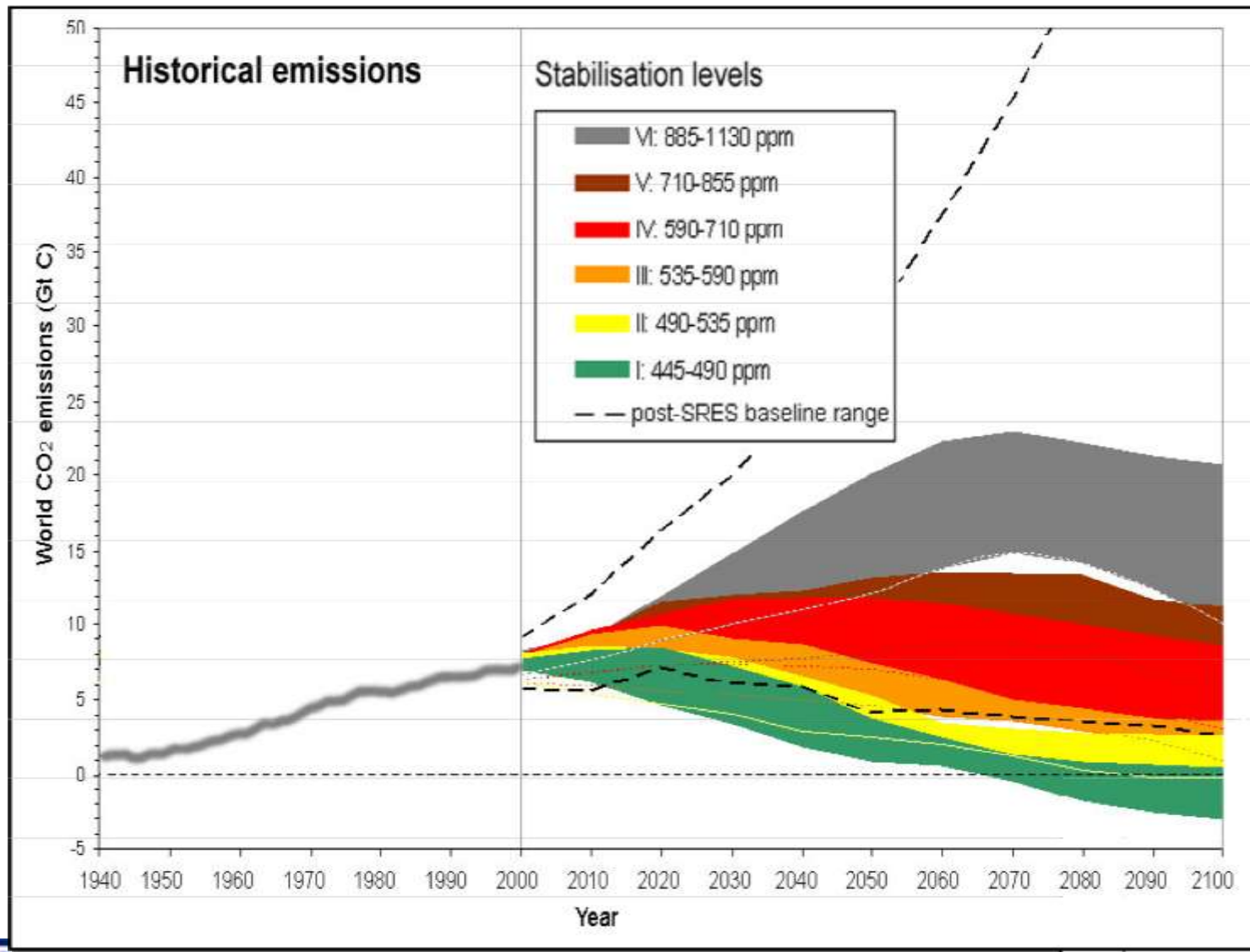


marius.holm@bellona.no

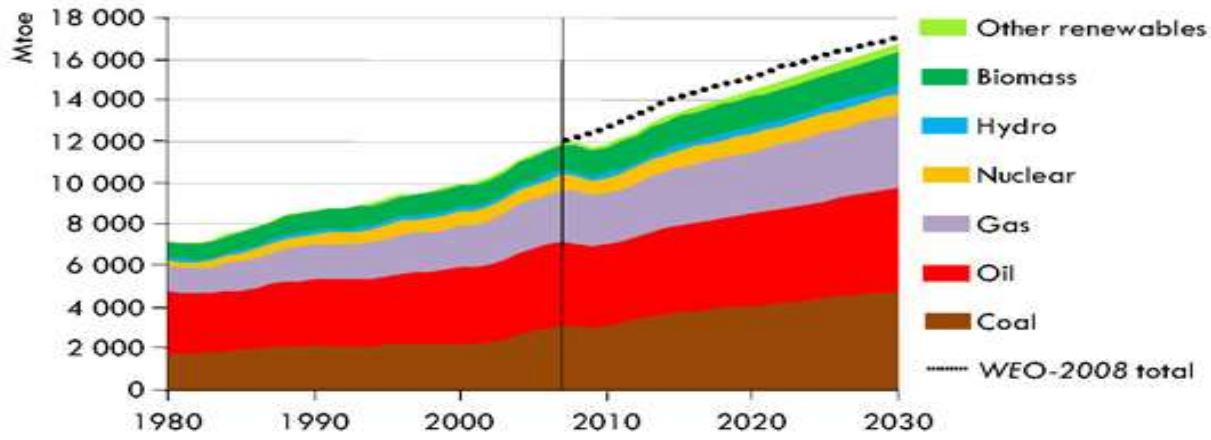
Outline – the role of bioenergy:

- Where to use it – comparative advantages vs other renewables
- Carbon accounts
- Sustainability issues
- Future sources

The implication of the the two degree target



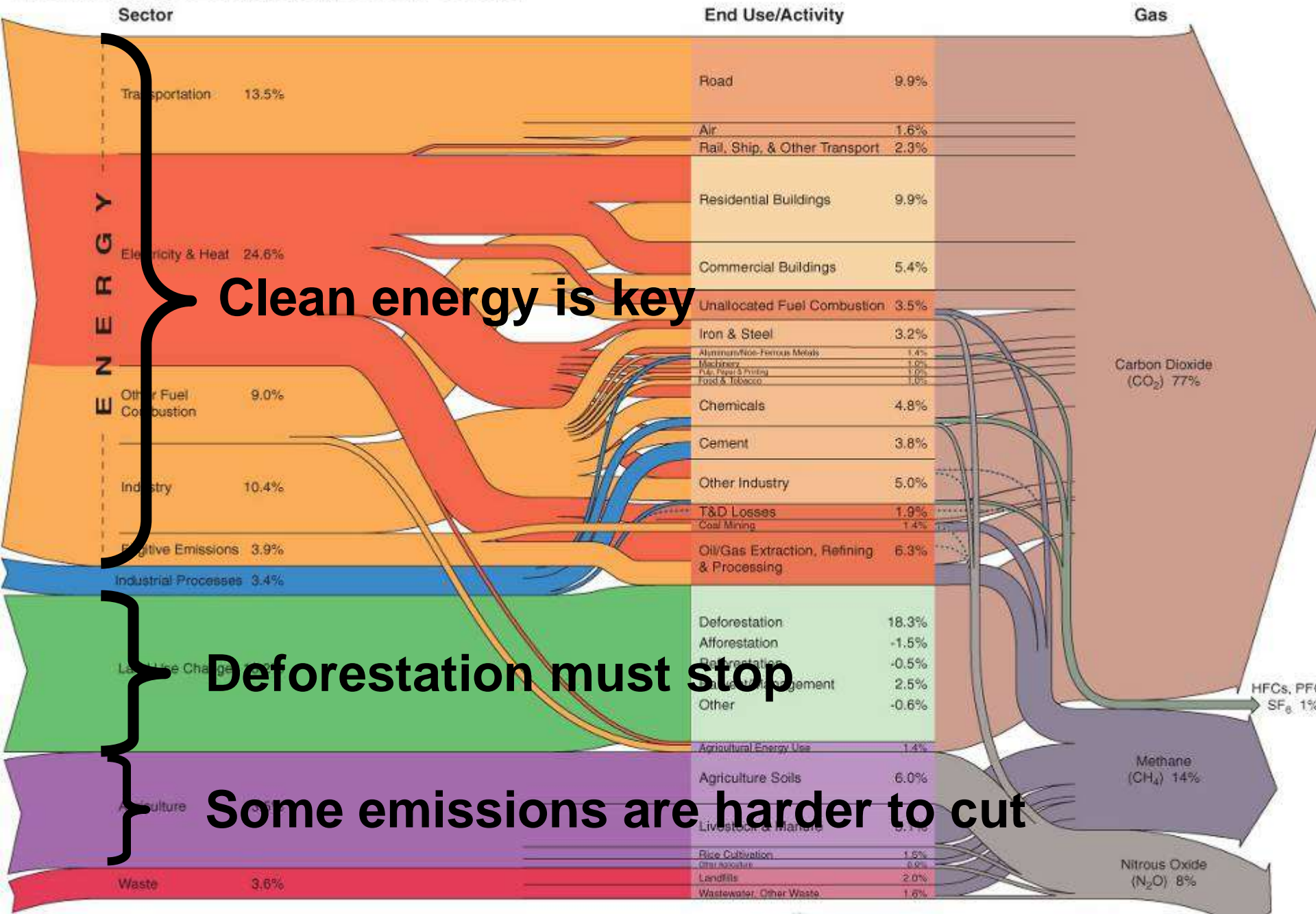
Energy demand



Global demand grows by 40% between 2007 and 2030, with coal use rising most in absolute terms

© OECD/IEA - 2009

World GHG Emissions Flow Chart



Clean energy is key

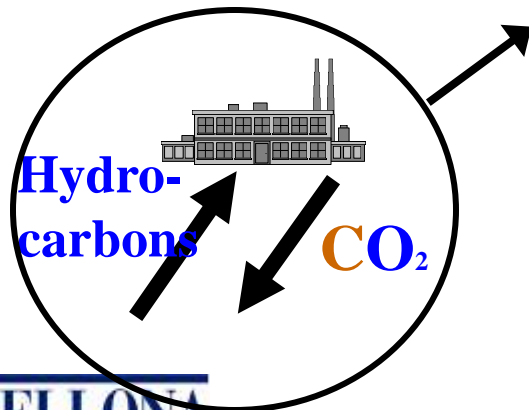
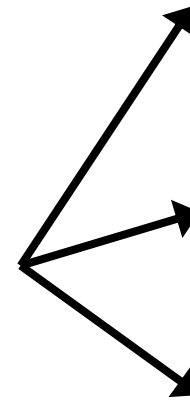
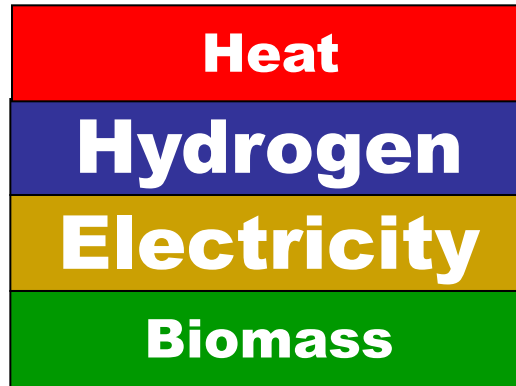
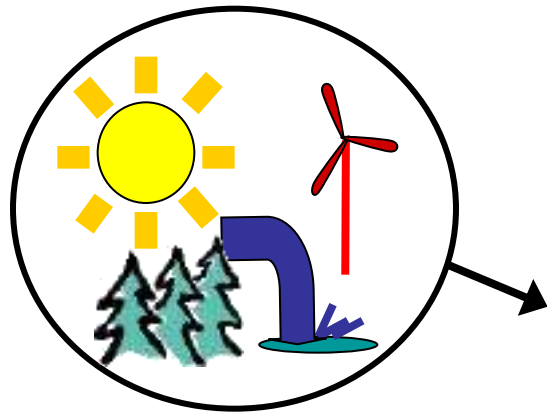
Deforestation must stop

Some emissions are harder to cut

Steps towards clean energy chains

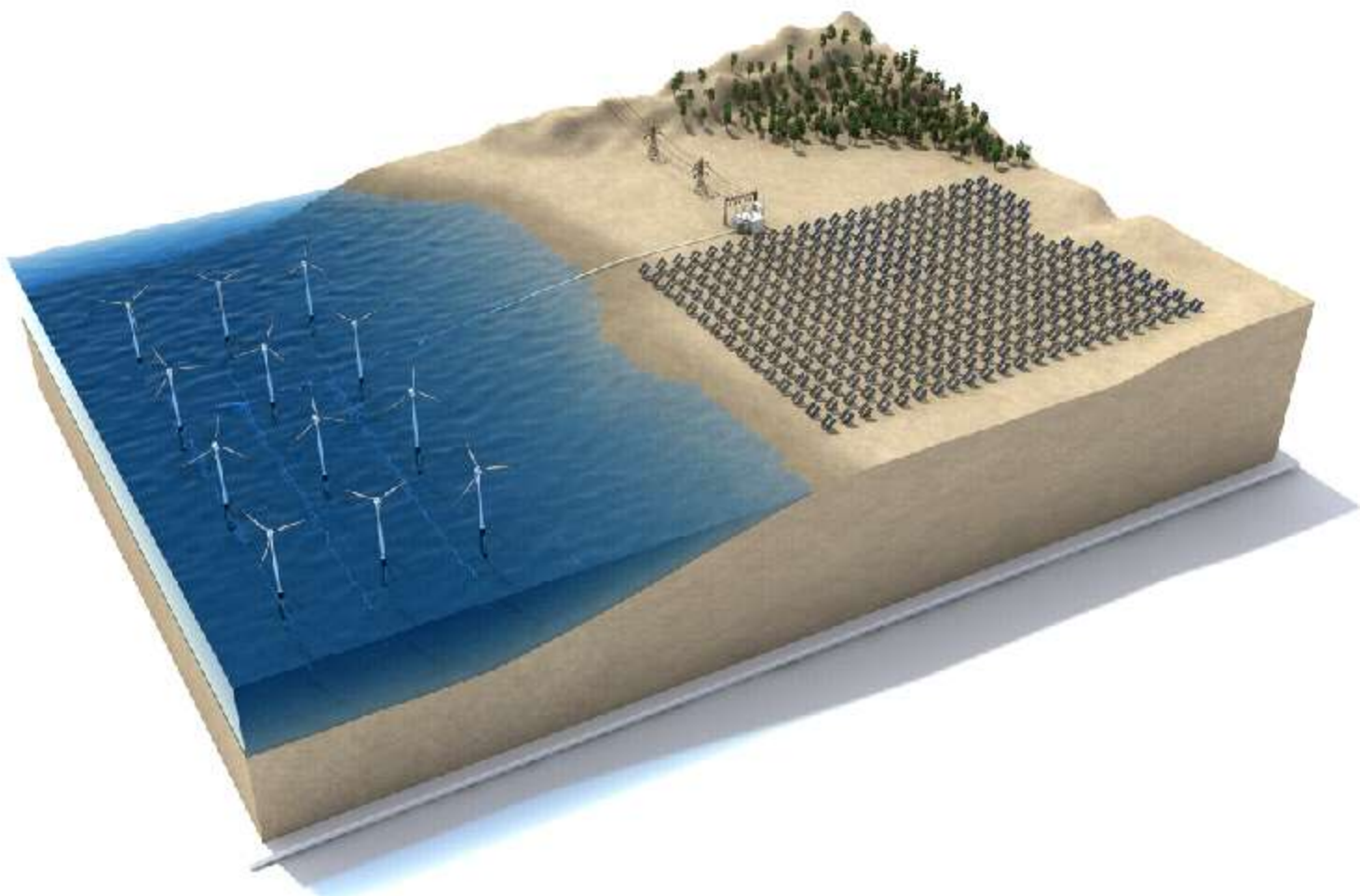
- Introduce *clean* energy carriers
- Increase *energy efficiency*
- Enhance *renewable energy* production
- Carbon capture and storage (**CCS**)

Clean energy chains require clean energy carriers



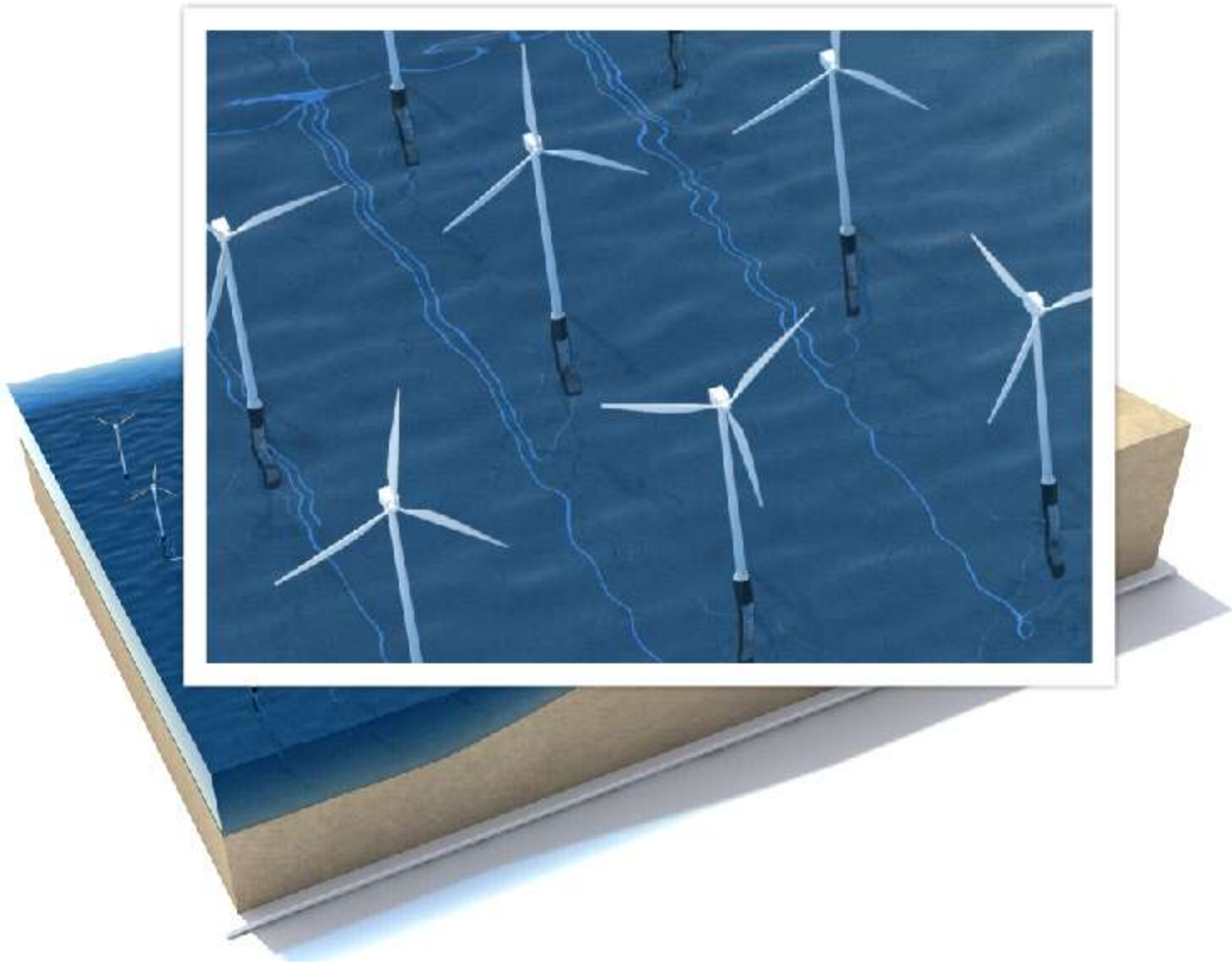
THE BELLONA SCENARIO

BELLONA



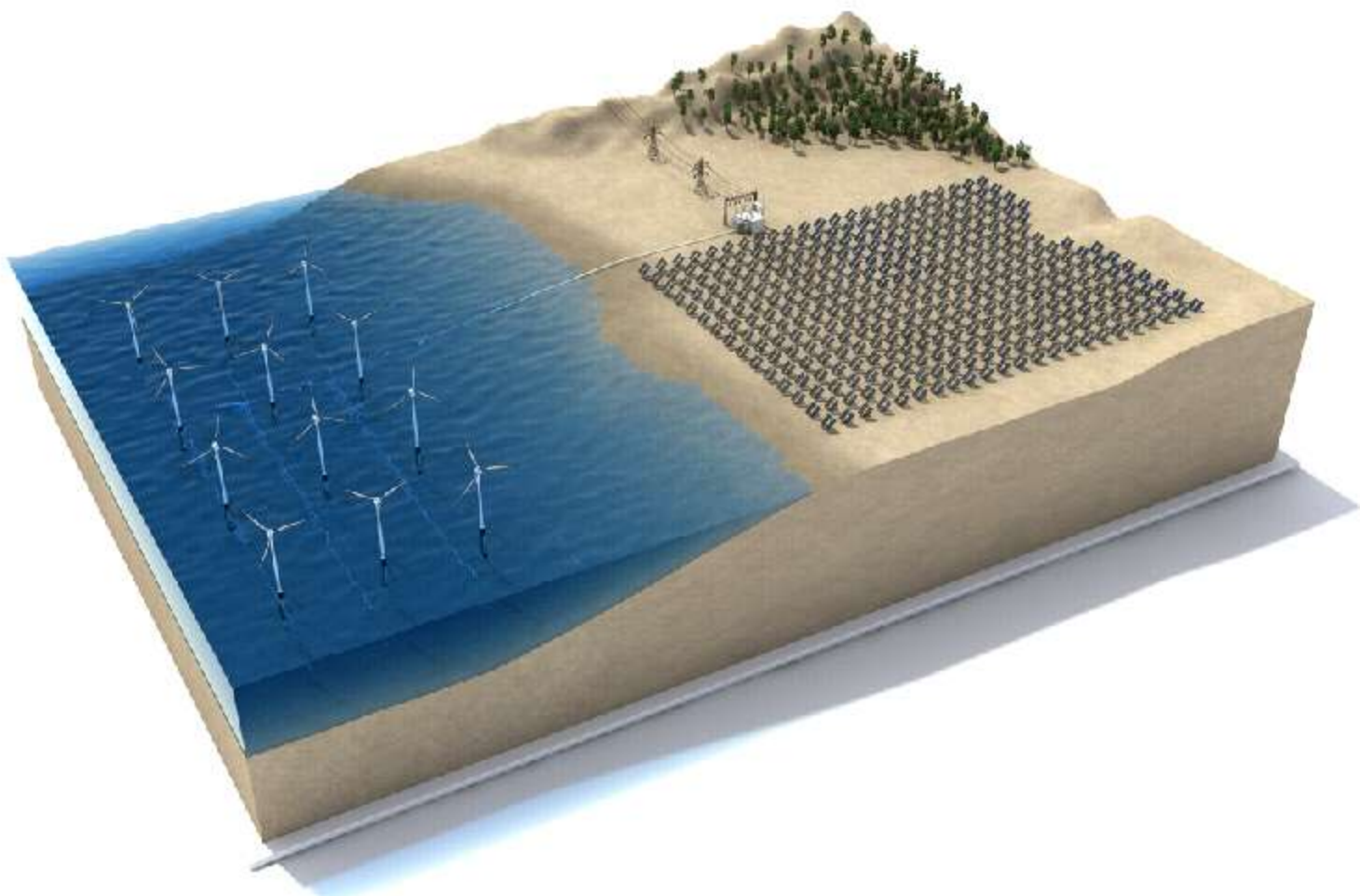
THE BELLONA SCENARIO

BELLONA



THE BELLONA SCENARIO

BELLONA



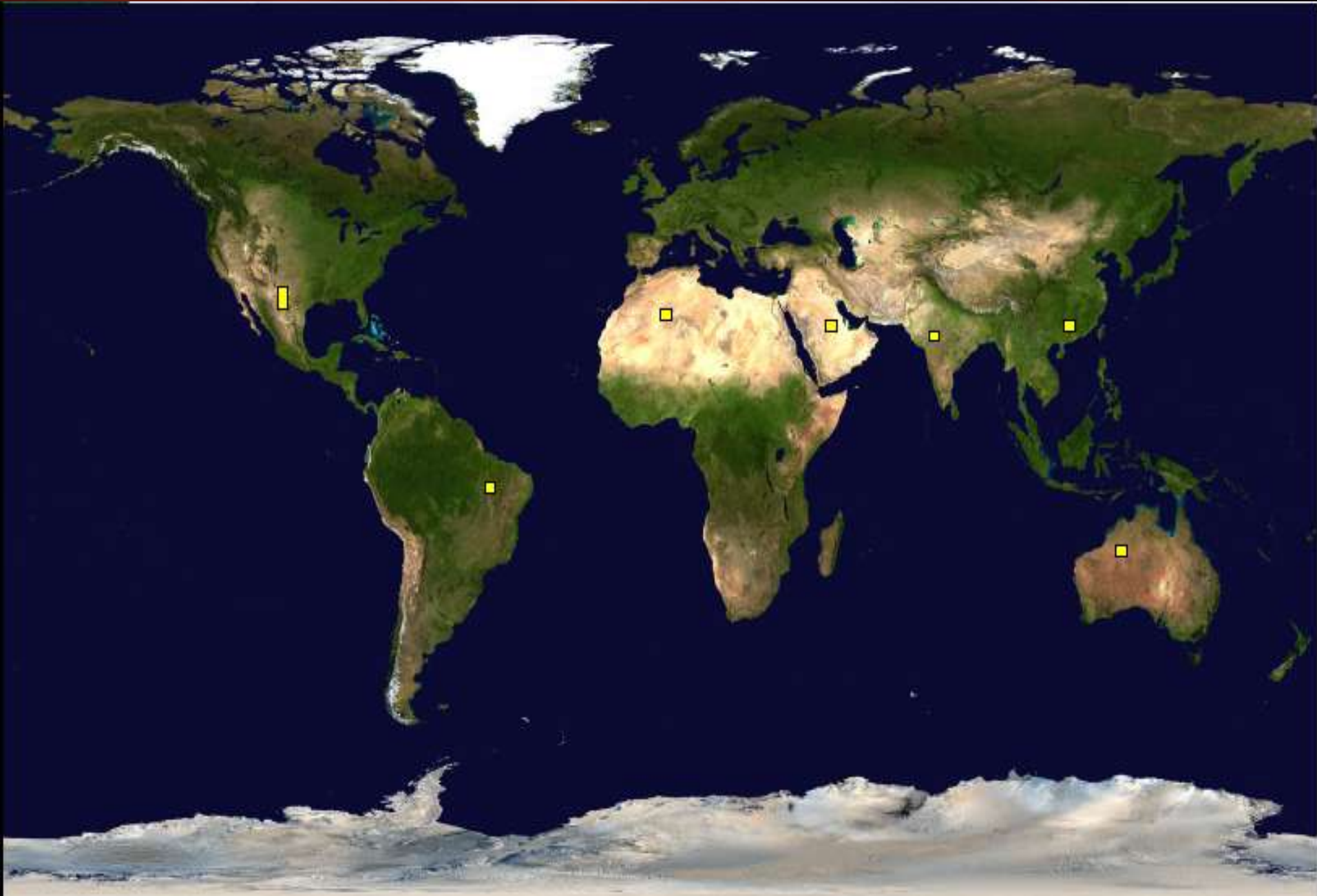
THE BELLONA SCENARIO

BELLONA



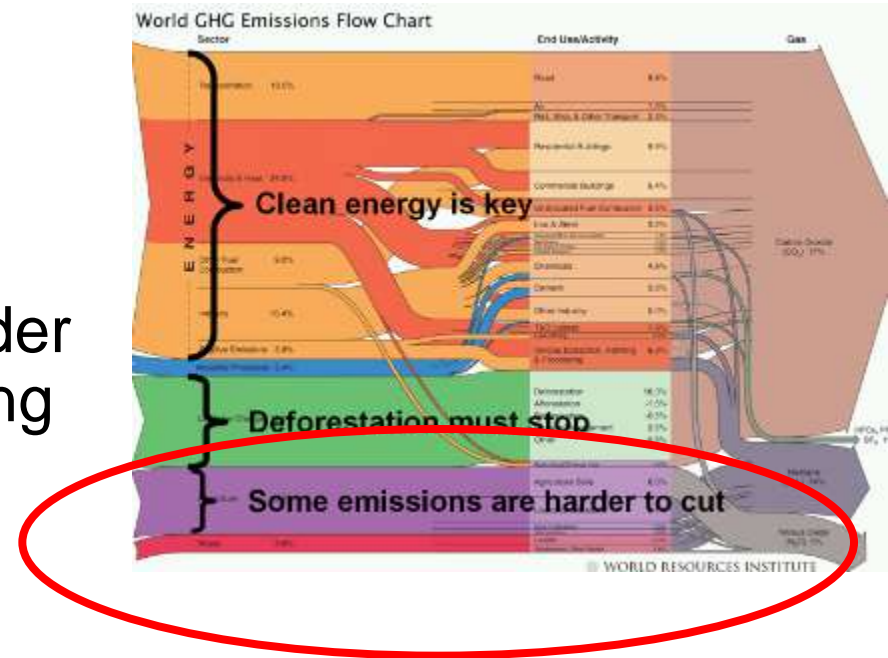
THE BELLONA SCENARIO

BELLONA



Shortcomings of Solar and Wind Power

- Intermittent power production
 - Energy users do not consider the weather before switching on their equipment
- Do not absorb CO₂
 - Non-energy GHG: Zero emissions out of reach
 - Need negative emissions in other sectors



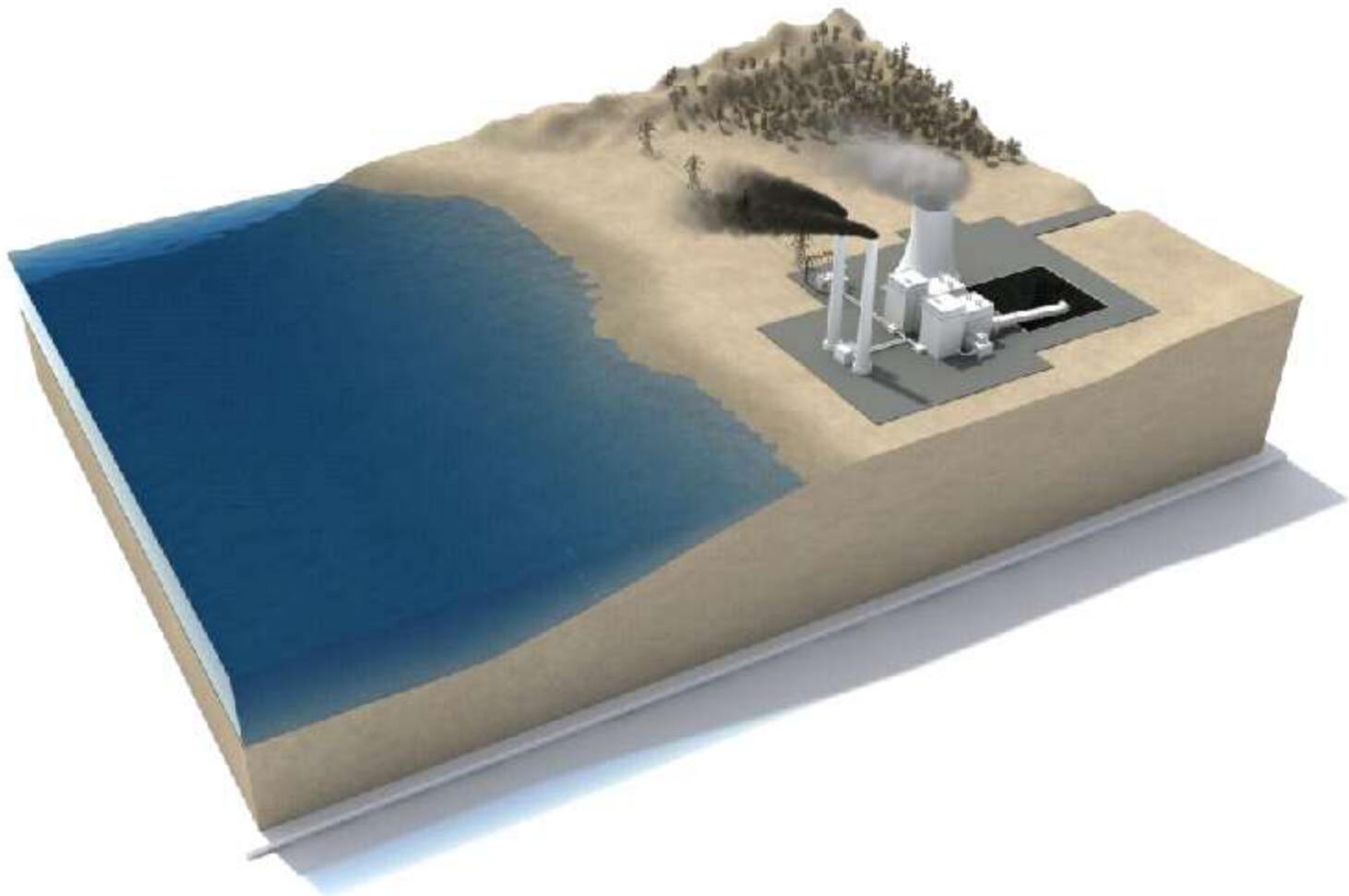
Two needs must be fulfilled:

- Base load and peak load
 - Combined heat and power
 - Energy storage (Water magazines, batteries, etc.)
- Negative CO₂ emissions
 - Biomass CHP fitted with CCS
 - Increased carbon sequestration in soils and forests

- Biomass

THE BELLONA SCENARIO

BELLONA



THE BELLONA SCENARIO

BELLONA



THE BELLONA SCENARIO

BELLONA



THE BELLONA SCENARIO

BELLONA

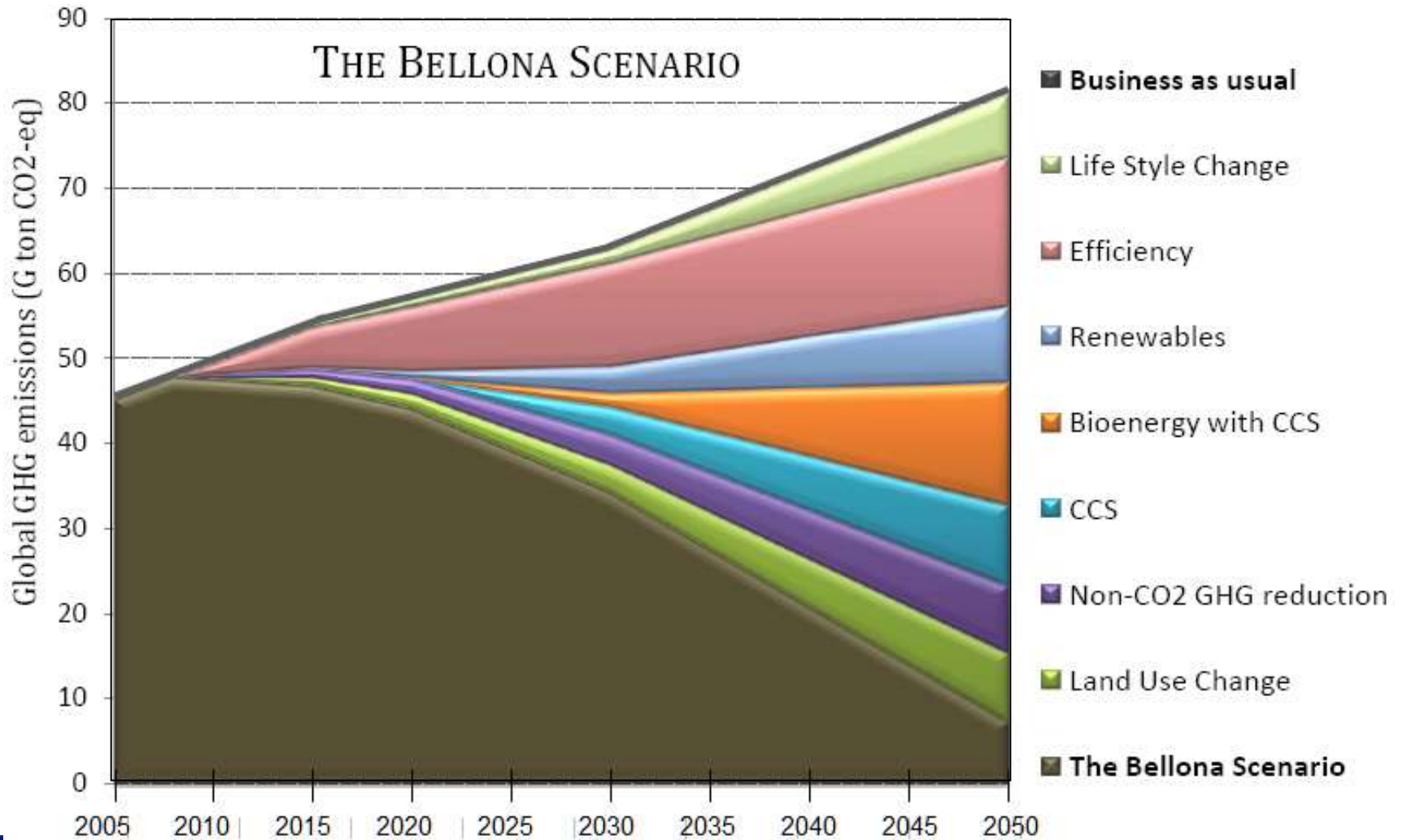


THE BELLONA SCENARIO

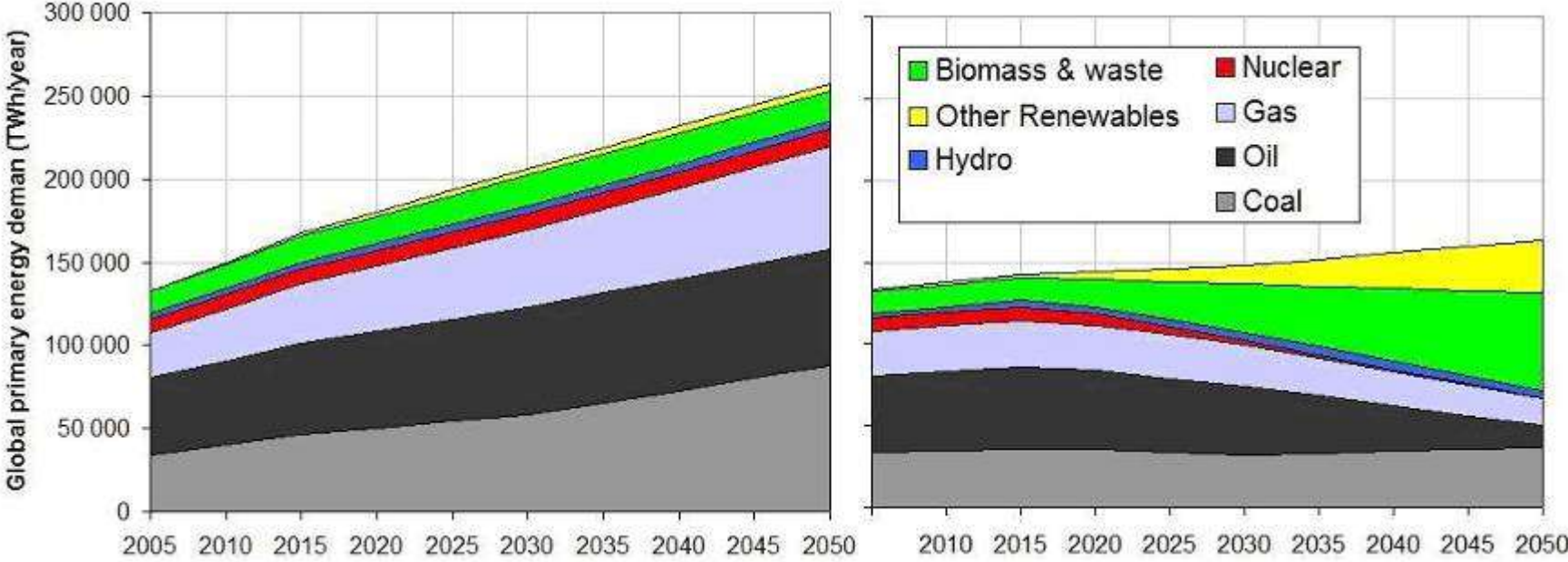
BELLONA







Biomass key energy source

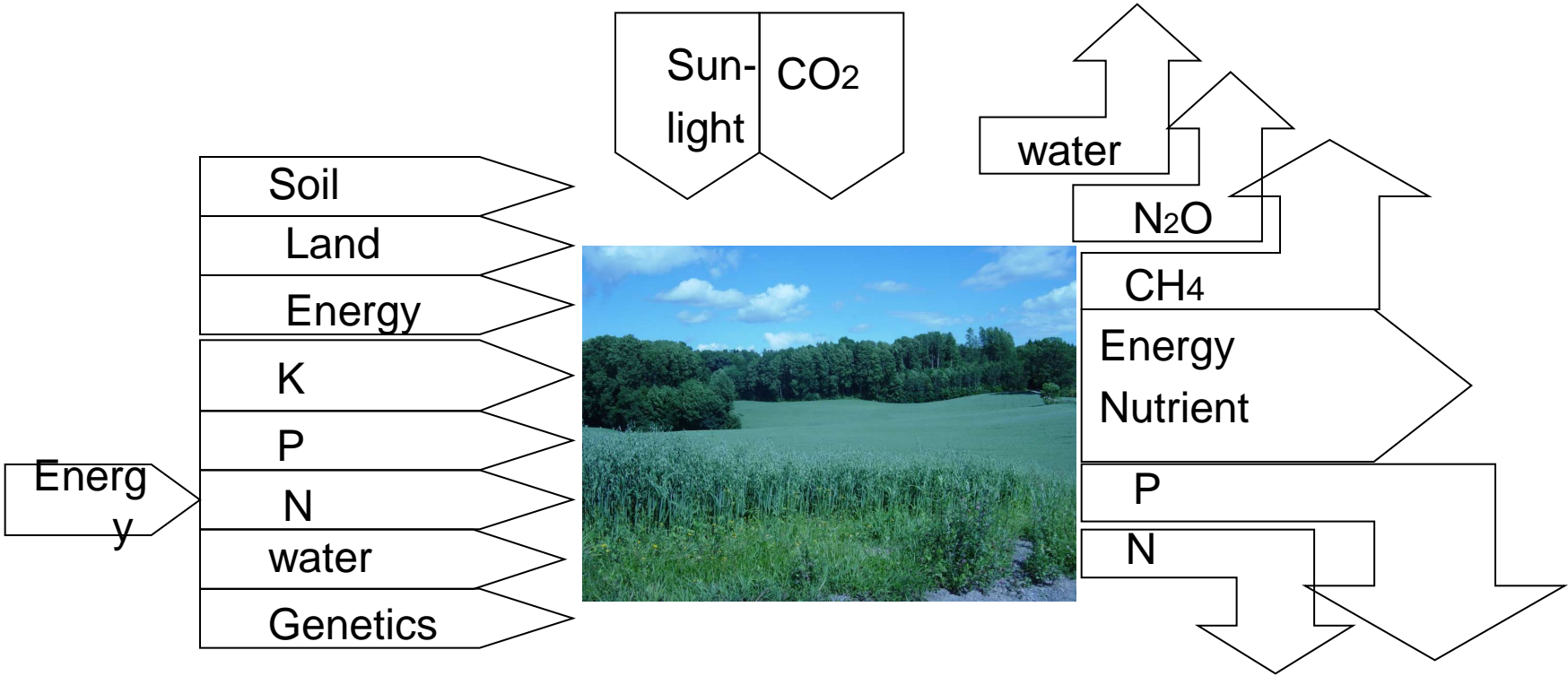


Bio energy sustainability issues



Agriculture – inputs and outputs

Sustainability challenges



COUNTDOWN

2010

Halt the loss of biodiversity

BioWood - verre enn oljesand?



Foto: Keilen, Berit

I dag, torsdag, åpnes offisielt Hafslunds pelletsfabrikk BioWood på Averøya utenfor Kristiansund. Europas største og verdens nest største i sitt slag.



Publisert: 10.06.10 10:03, Oppdatert: 10.06.10 11:46

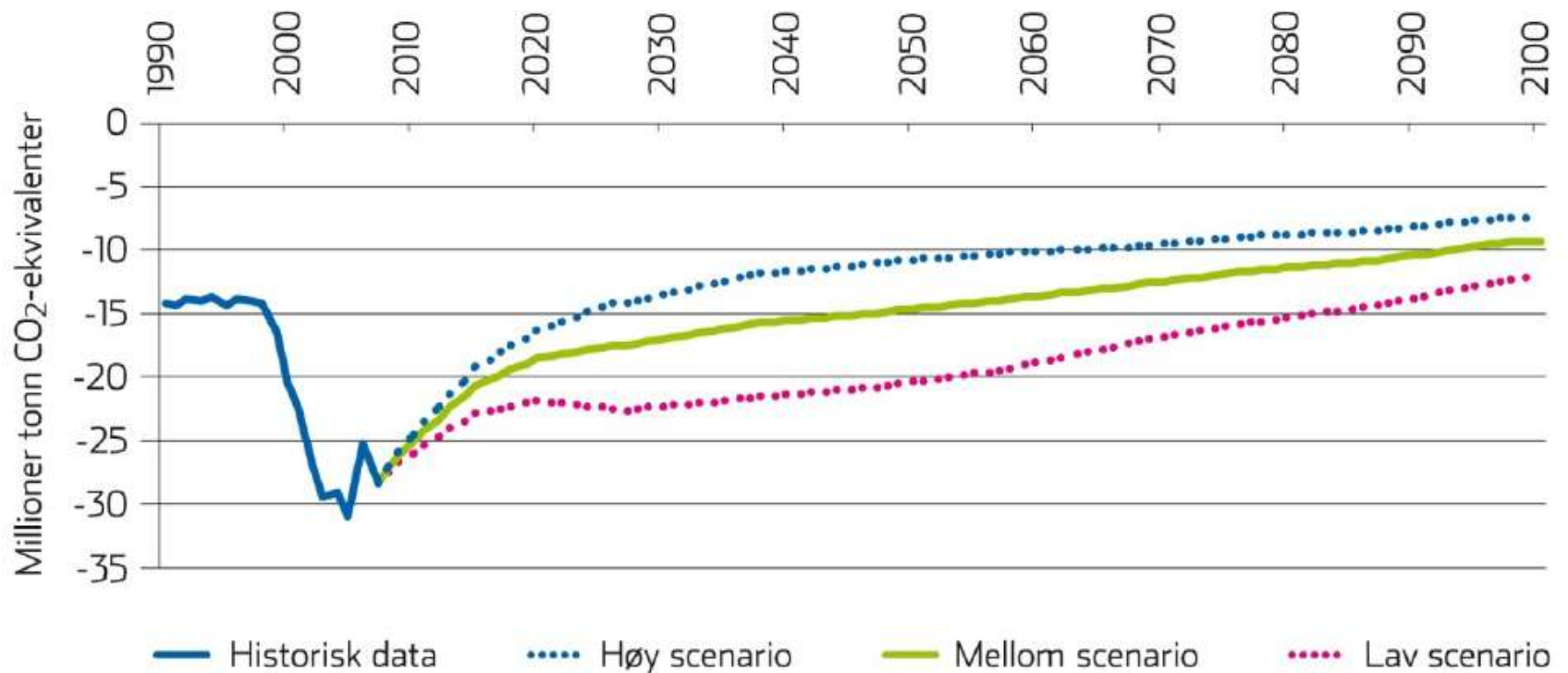
Fordi BioWood blir betraktet som et klimatiltak, har de mottatt 97 millioner kroner i investeringsstøtte fra Enova. Spørsmålet er imidlertid om BioWood heller vil øke globale

KOMMENTAR

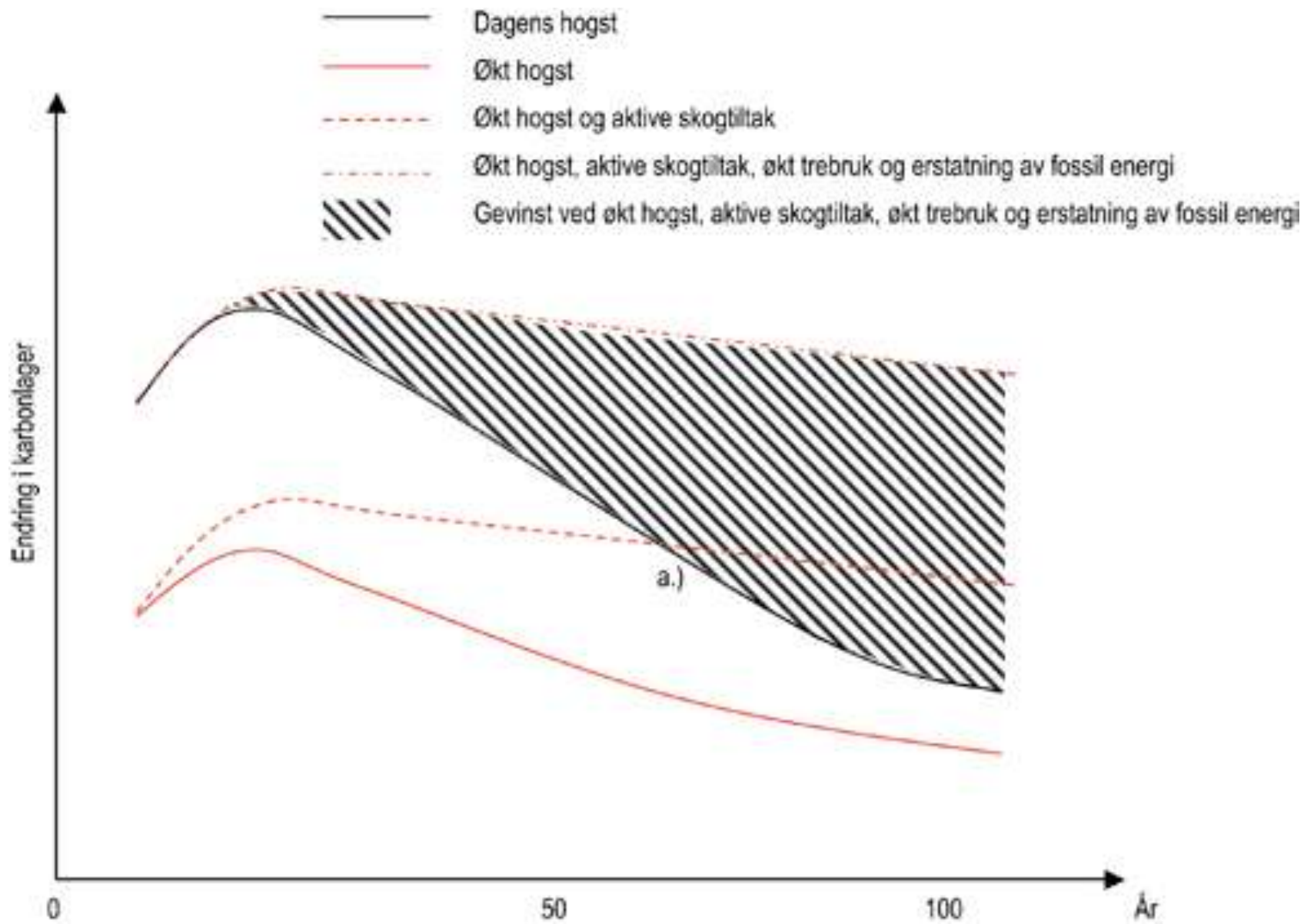
**Bjart
Holtsmark**



Født: 5. desember 1956 i Oslo.



Figur 5-4 Totalt CO₂ opptak i skog inklusiv levende biomasse, død ved, jord og bidrag fra arealforandringer under forutsetning av en 2 °C økning i temperatur fra før-industriell tid. Tre scenarier.



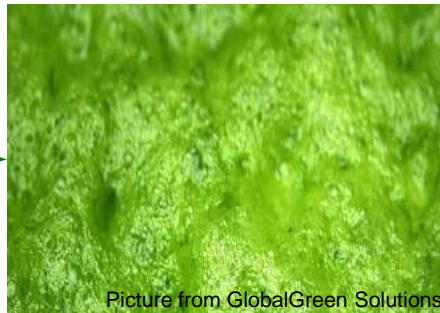


CarbonNegative – The Concept

Bio reactors



Algae biomass



Biopower plant with CCS



Fuel crops



Other biomass



Power/H₂

By-products:

- Fertilizer
- Animal feed
- Vegetable oil
- Biodiesel

CO₂ stored and removed from the atmosphere

Energy

CO₂

CO₂

Flue gas

Atmospheric CO₂

Future Generation of Bioenergy

1. High value grain carbohydrates and oil from agriculture
2. Biomass from forests and residues

3. Sustainable Industrial Photosynthesis



Algae Potential

- Assuming an output of 5 litre per sq. meter per year:
- **30,000 TWh**
10 % of global energy in 2050 could be produced on a land area equivalent to Texas (700,000 km²) or
< 0,5 % of world land area
- **COST: \$1000 / barrel**
(before industrialization)

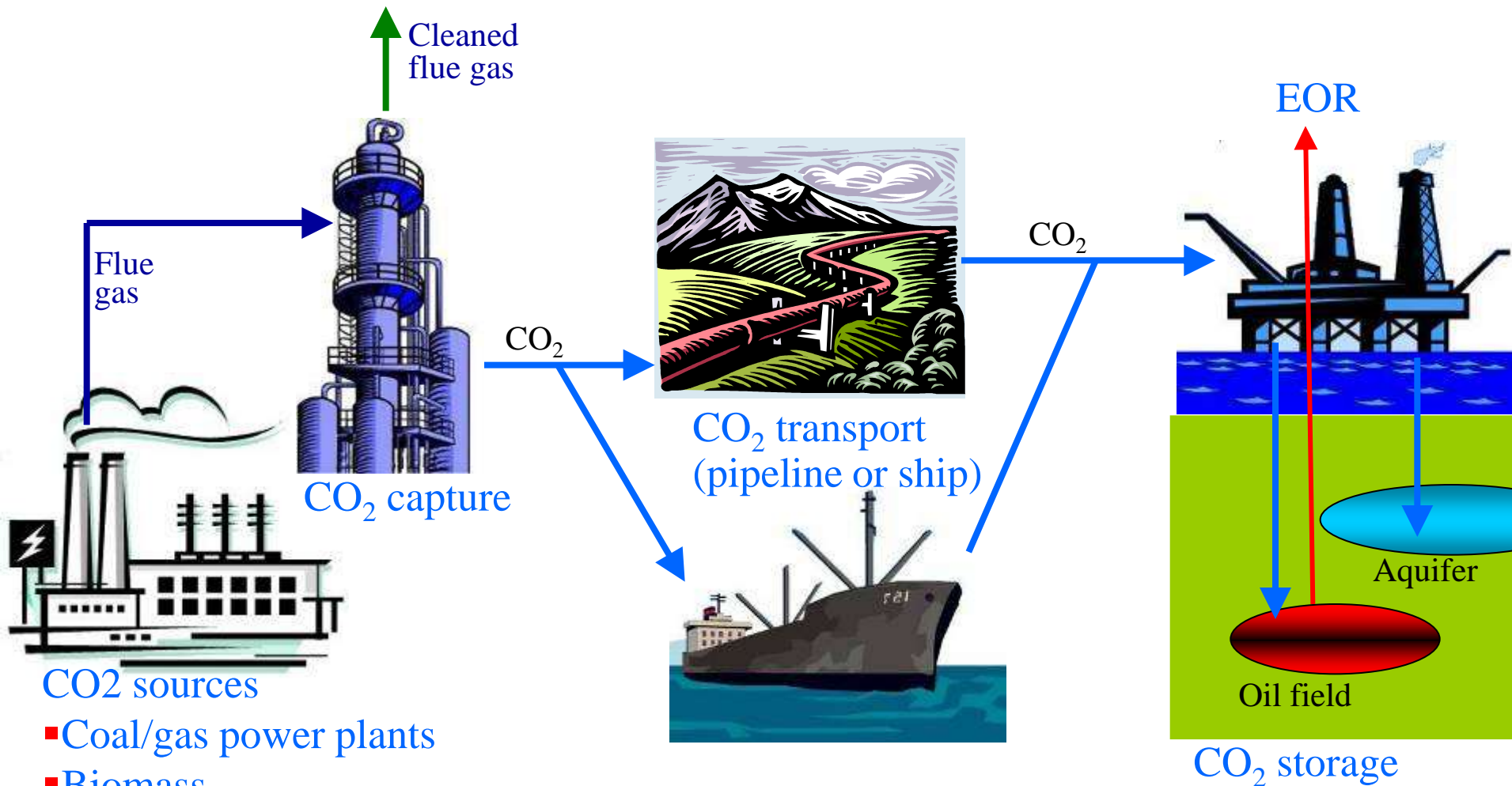


Area needed to provide 10 % of energy demand from algae

Physical Map of the World, April 2004



Biomass with CCS – Carbon Negative



CO₂ sources

- Coal/gas power plants
- Biomass
- Industry point sources







INPUT:



Sea Water



Sun



Nutritions



CO₂



Electricity



Fresh water



Food

OUTPUT:



Humid air



New
vegetation



Biomass



Biooil/
biogas

Conclusions

- Bioenergy is crucial in a renewable energy supply mix
- Bioenergy supply chains must pursue carbon neutrality
- Carbon negative bioenergy is absolutely necessary