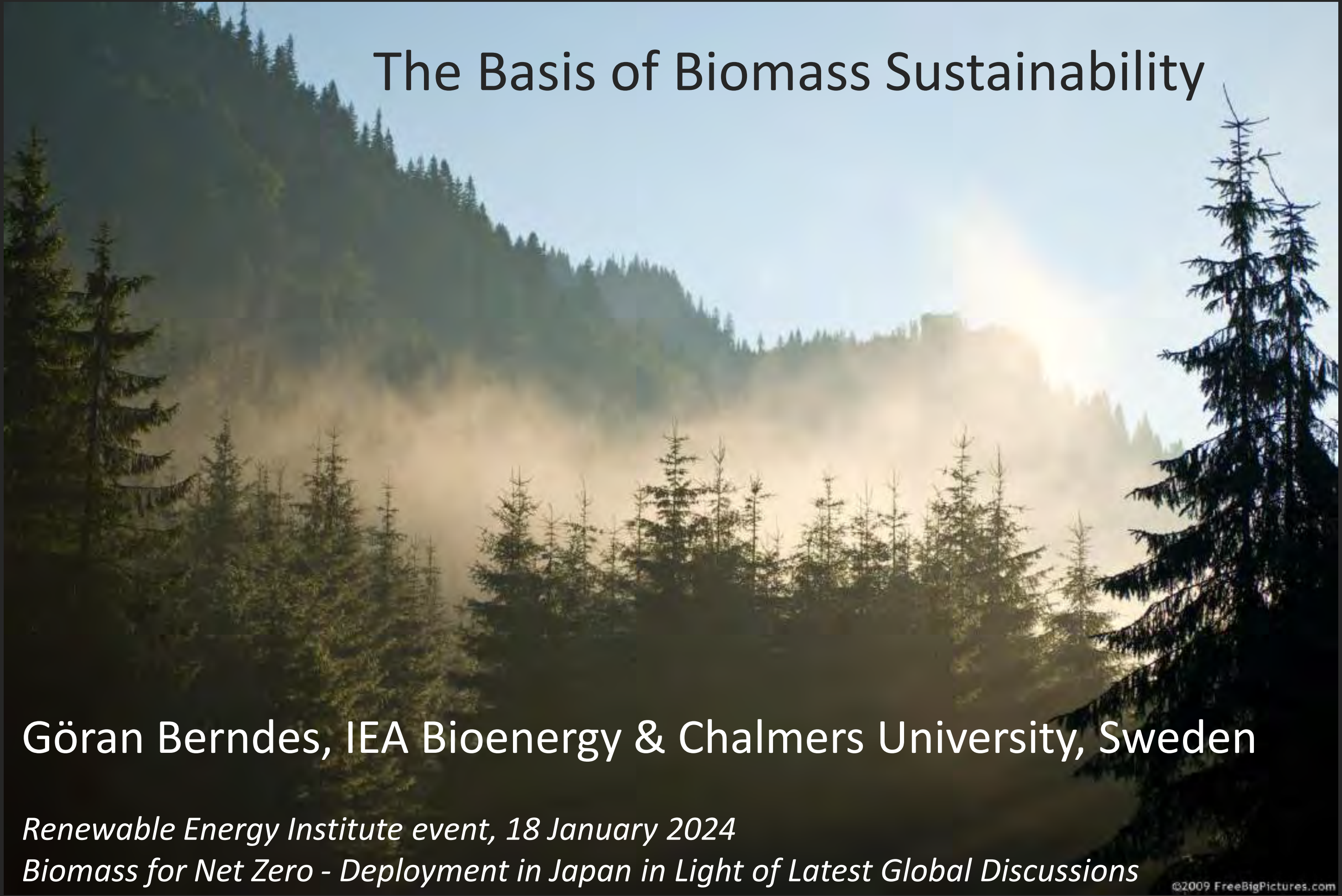
The Basis of Biomass Sustainability
Göran Berndes, IEA Bioenergy & Chalmers University, Sweden
Renewable Energy Institute event, 18 January 2024
Biomass for Net Zero - Deployment in Japan in Light of Latest Global Discussions
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Not today…

- Bioenergy relevant in all sectors
- Multiple bioenergy-SDG linkages
- Synergies & tradeoffs
- Governance is important

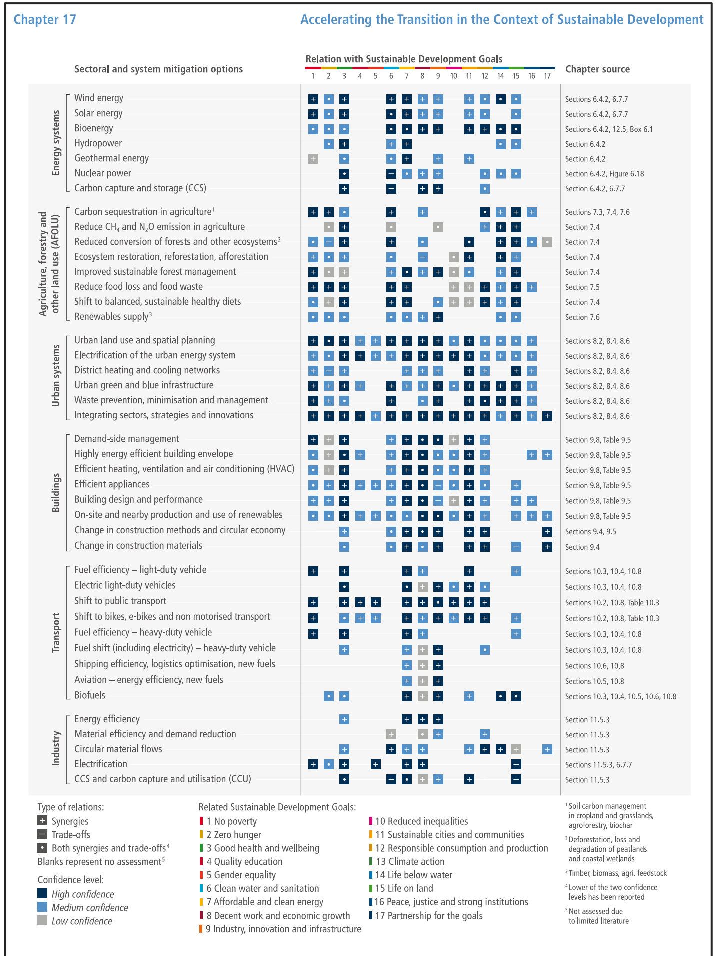
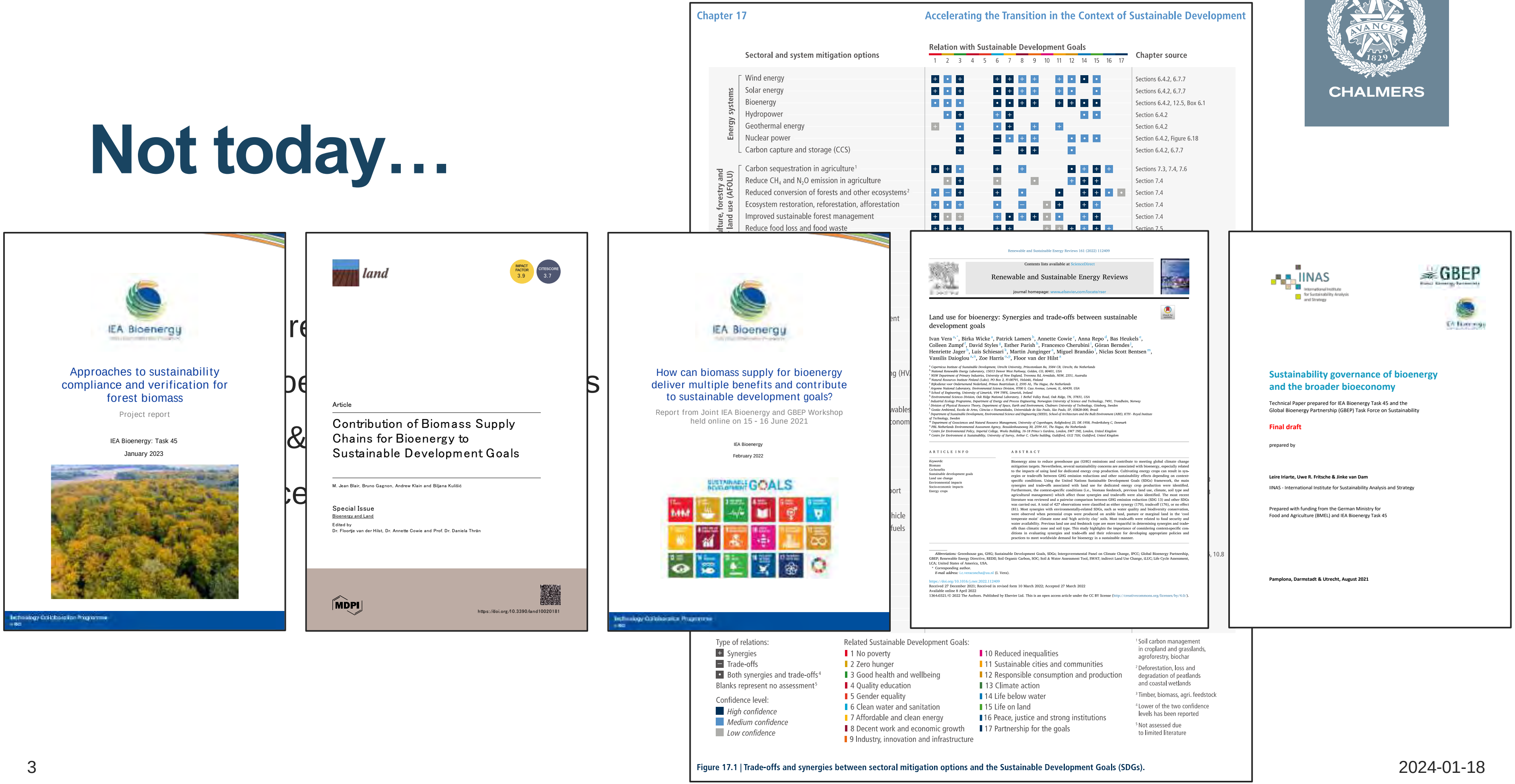


Figure 17.1 | Trade-offs and synergies between sectoral mitigation options and the Sustainable Development Goals (SDGs).

Not today…


Chapter 17
Accelerating the Transition in the Context of Sustainable Development
Sectoral and system mitigation options
Relation with Sustainable Development Goals
Chapter source
Figure 17.1 | Trade-offs and synergies between sectoral mitigation options and the Sustainable Development Goals (SDGs).
IEA Bioenergy
Approaches to sustainability compliance and verification for forest biomass
Project report
IEA Bioenergy: Task 45
January 2023
land
Article
Contribution of Biomass Supply Chains for Bioenergy to Sustainable Development Goals
M. Jean Blair, Bruno Gagnon, Andrew Klain and Biljana Kulišić
Special Issue
Bioenergy and Land
MDPI
How can biomass supply for bioenergy deliver multiple benefits and contribute to sustainable development goals?
Report from Joint IEA Bioenergy and GBEP Workshop held online on 15 - 16 June 2021
IEA Bioenergy
February 2022
Renewable and Sustainable Energy Reviews
Land use for bioenergy: Synergies and trade-offs between sustainable development goals
IINAS
GBEP
Sustainability governance of bioenergy and the broader bioeconomy
Final draft
Leire Iriarte, Uwe R. Fritsche & Jinke van Dam
Pamplona, Darmstadt & Utrecht, August 2021

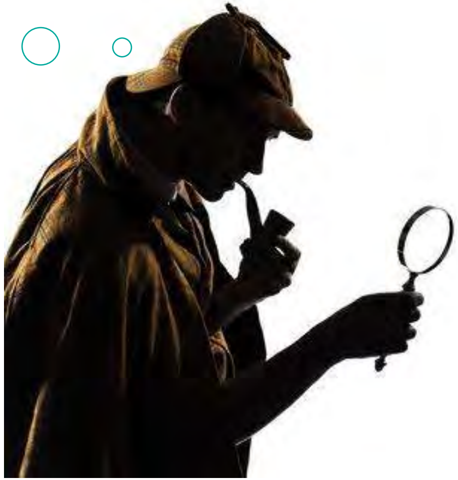
Today…

Biomass, carbon cycle, and climate

Beneficial land use change

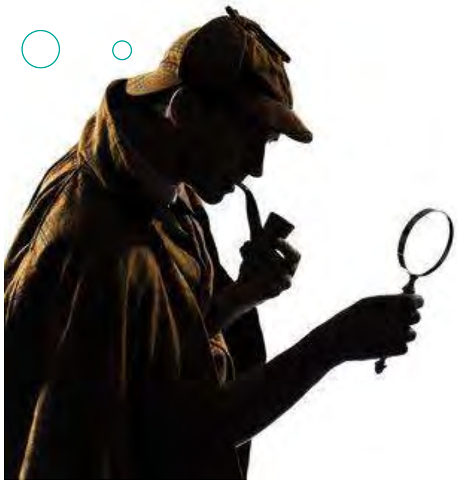
Biomass, carbon cycle, and climate

I don't see any difference… both cars emit CO_2 that warms the world…



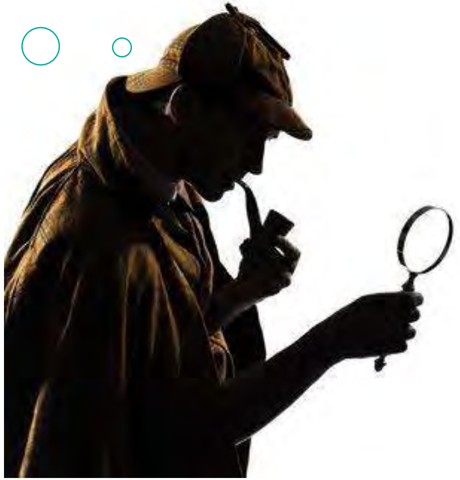
Biomass, carbon cycle, and climate

Besides for supply chain emissions biofuel use does not contribute to climate change since the emitted CO_2 was previously removed from the atmosphere…



Biomass, carbon cycle, and climate

~~Biofuel use causes huge CO2 emissions because of the carbon opportunity cost…~~



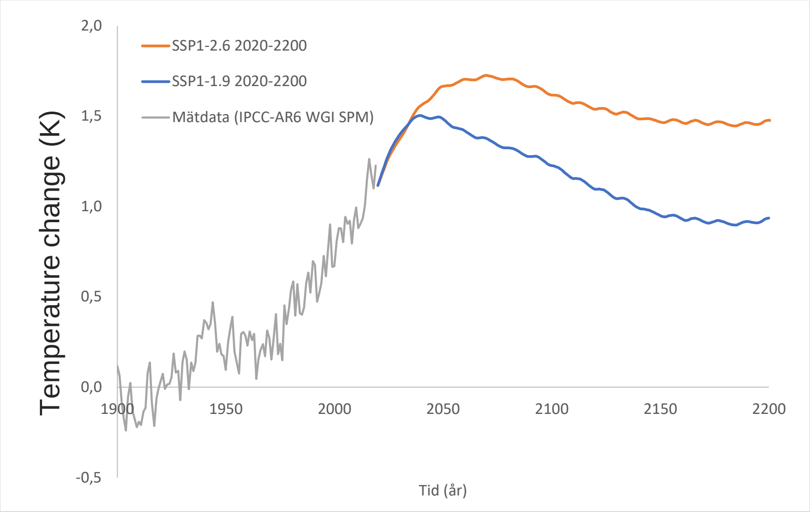
Illustration

The next few slides show how the use of fossil fuels and bio-based fuels affects the global average temperature

Focus is on the fossil/biogenic carbon in the fuels

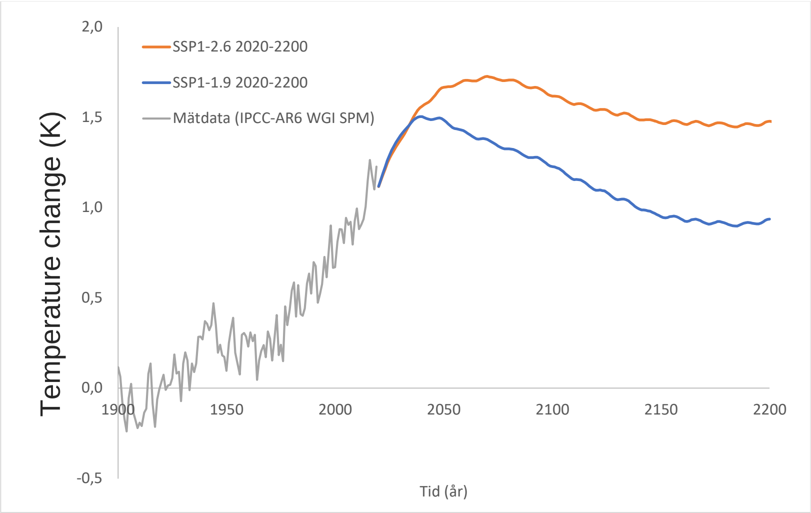
The diagram below shows how the global average temperature changes over time in the IPCC scenarios SSP1-1.9 and SSP1-2.6 that were used for climate modelling and research associated with the sixth IPCC assessment report.

These IPCC scenarios are used in this illustration of the temperature impacts of using fossil fuels and bioenergy.



QUESTION:

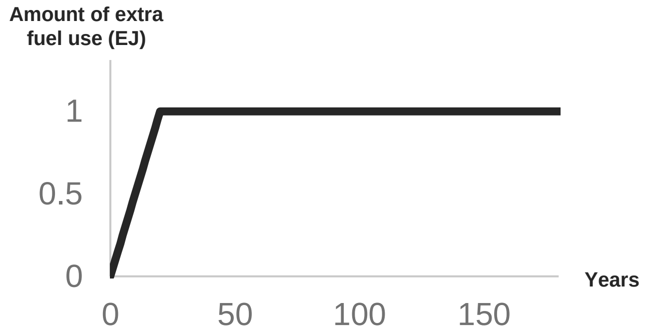
How will the global average temperature deviate from the development that is shown in the diagram, when some extra fuels are used?



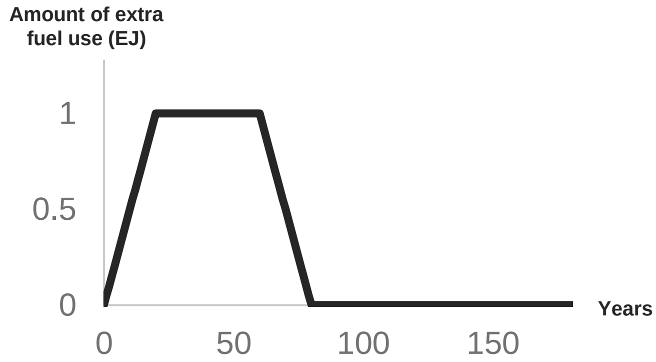
TWO SCENARIOS, SHOWN BELOW

The extra fuel is either coal, fossil gas, or bio-based fuels obtained from forests managed for production of (primarily) sawtimber and pulpwood.

More fuel use “forever”



More fuel use “for a while”

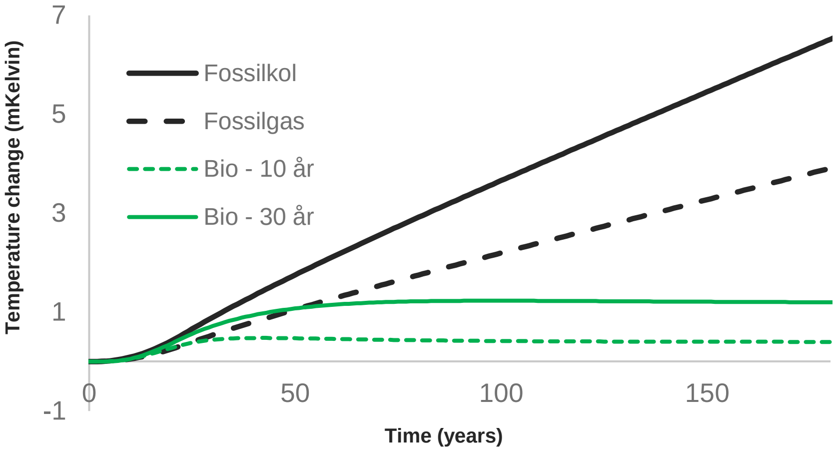


The bio-based fuels are produced from:

- forest residues that would decompose in the forest within 10 or 30 years if not used for energy
- wood that would otherwise be used for producing other products with 10- or 30-year residence time in society

No other changes in the forest sector besides this increased forest biomass use for energy

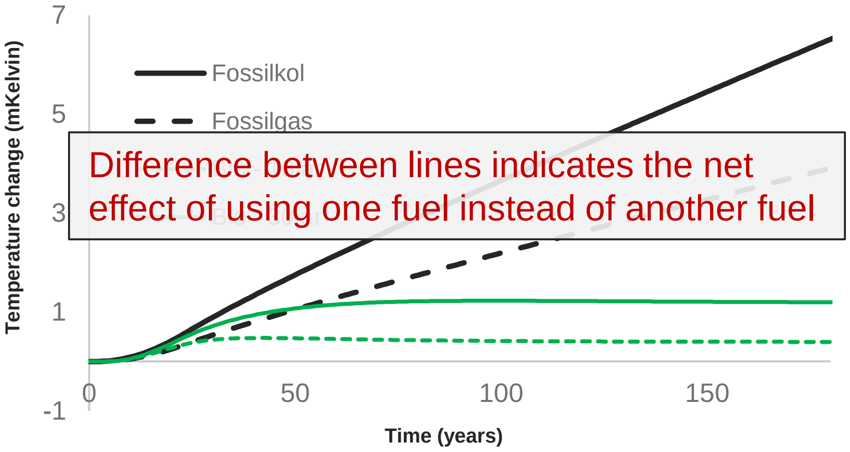
Temperature impact of using more fuel "forever"



For fossil fuels, there is a temperature increase that is linearly related to the cumulative CO_2 emissions from chimneys and exhaust pipes

This is not the case for biobased fuels. Instead, the temperature impact stabilises at a level that is determined by what type of biomass is used

Temperature impact of using more fuel “forever”

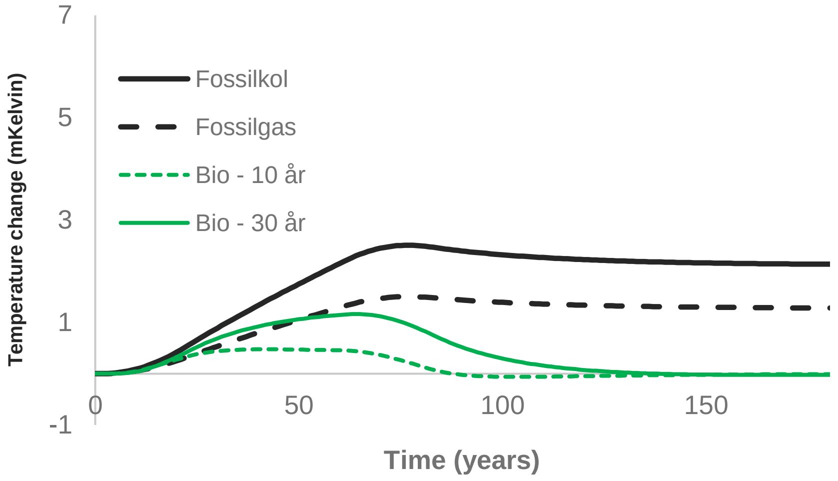


Difference between lines indicates the net effect of using one fuel instead of another fuel

For fossil fuels, there is a temperature increase that is linearly related to the cumulative CO2 emissions from chimneys and exhaust pipes

This is not the case for biobased fuels. Instead, the temperature impact stabilises at a level that is determined by what type of biomass is used

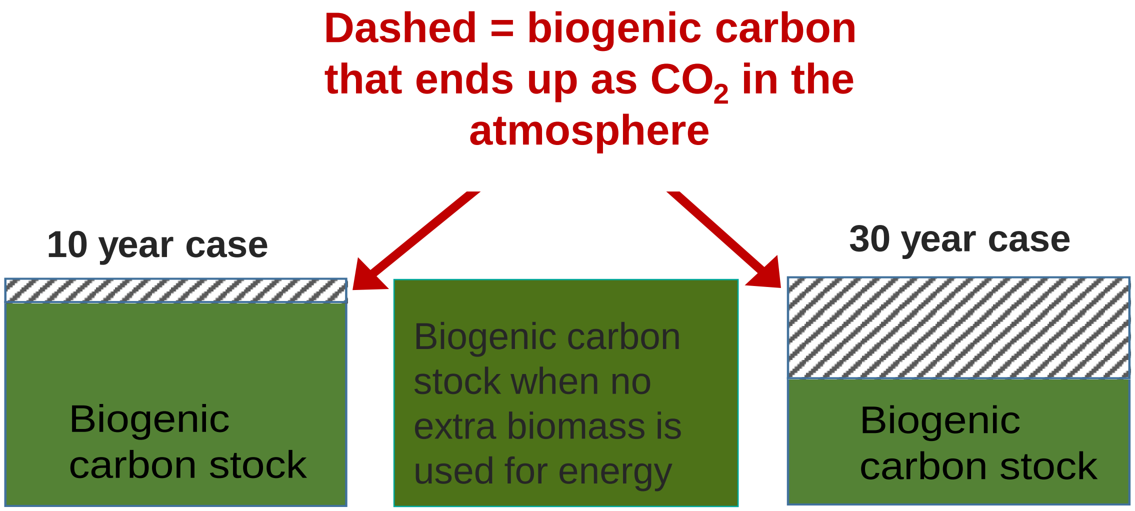
Temperature impact of using more fuel "for a while"



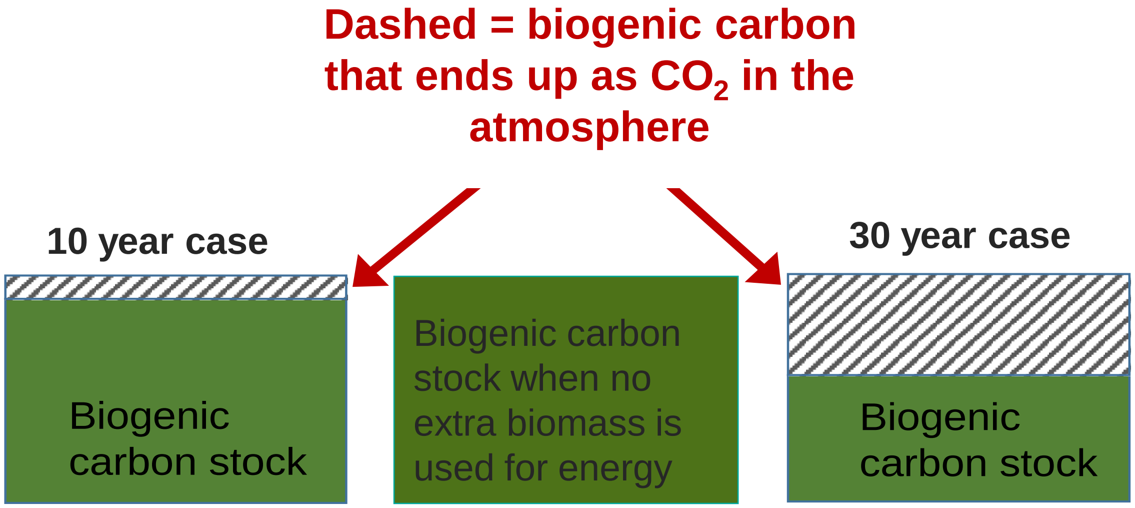
The temperature impact from fossil fuel use remains a long time after the fuel use has ended

For biobased fuels, the temperature impact declines towards zero after the fuel use has ended

The temperature impact is determined by the change in carbon storage in soils and vegetation, and in biobased products, which depends on what type of biomass is used to produce the fuels

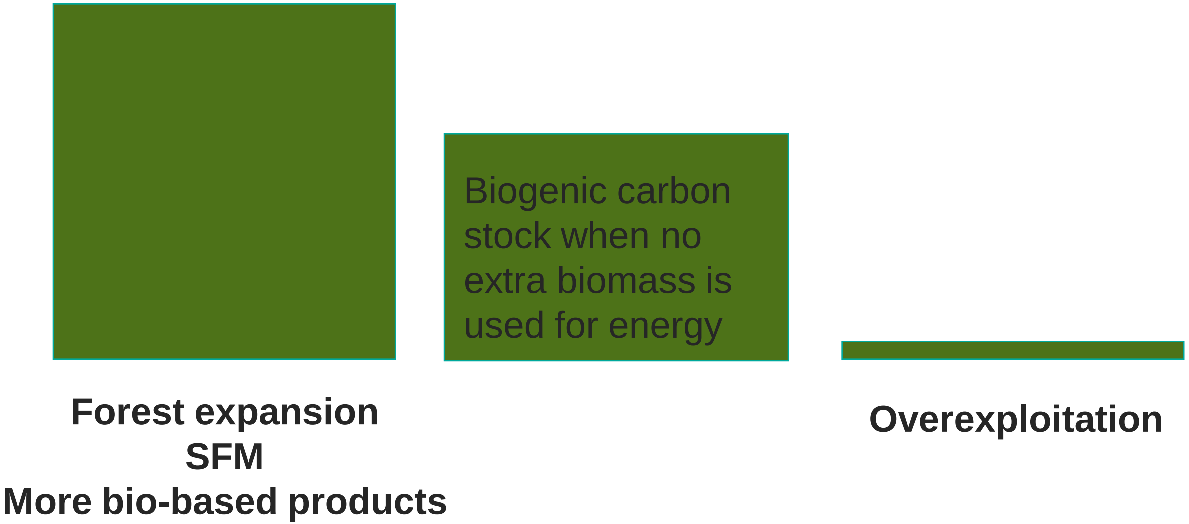


We assumed that there were no other changes in the forest sector besides the increased forest biomass use for energy



We assumed that there were no other changes in the forest sector besides the increased forest biomass use for energy

But the forest sector may change also in other ways



Biomass, carbon cycle, and climate

- Bioenergy’s supply-chain emissions can be reduced a lot but **biogenic carbon balance will remain critical determinant of the climate benefit**
- **Carbon storage** in vegetation, soils and bio-based products **can both increase and decrease** when the land sectors change to provide more biomass for energy
- Much confusion around biomass, carbon cycle, and climate: important to explain matters and **dispel misconceptions**

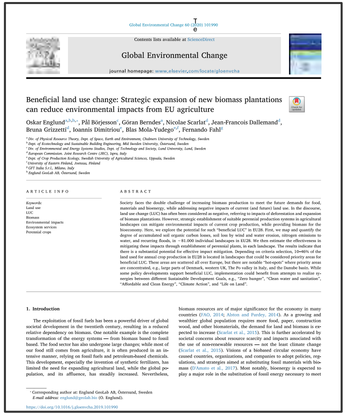
If there is still time…

Biomass, carbon cycle, and climate

Beneficial land use change

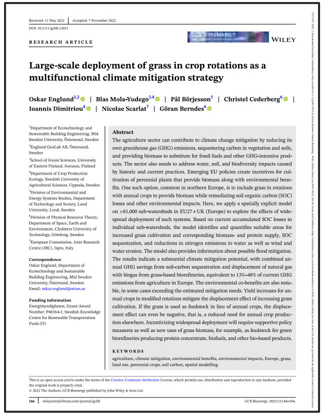
CHALMERS

Beneficial land use change


Global Environmental Change

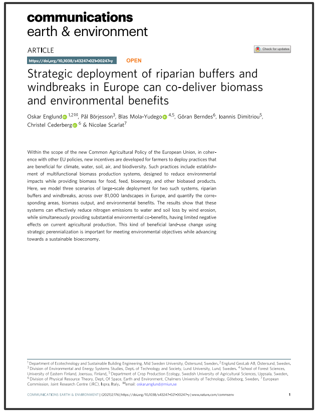
Beneficial land use change: Strategic expansion of new biomass plantations can reduce environmental impacts from EU agriculture

Oskar Englund, Pål Börjesson, Göran Berndes, Nicolae Scarlat, Jean-Francois Dallemand, Bruna Grizzetti, Ioannis Dimitriou, Blas Mola-Yudego, Fernando Fahl


RESEARCH ARTICLE

Large-scale deployment of grass in crop rotations as a multifunctional climate mitigation strategy

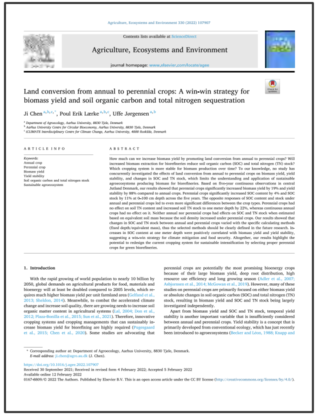
Oskar Englund | Blas Mola-Yudego | Pål Börjesson | Christel Cederberg | Ioannis Dimitriou | Nicolae Scarlat | Göran Berndes


communications earth & environment

ARTICLE

Strategic deployment of riparian buffers and windbreaks in Europe can co-deliver biomass and environmental benefits

Oskar Englund, Pål Börjesson, Blas Mola-Yudego, Göran Berndes, Ioannis Dimitriou, Christel Cederberg & Nicolae Scarlat


Agriculture, Ecosystems and Environment

Land conversion from annual to perennial crops: A win-win strategy for biomass yield and soil organic carbon and total nitrogen sequestration

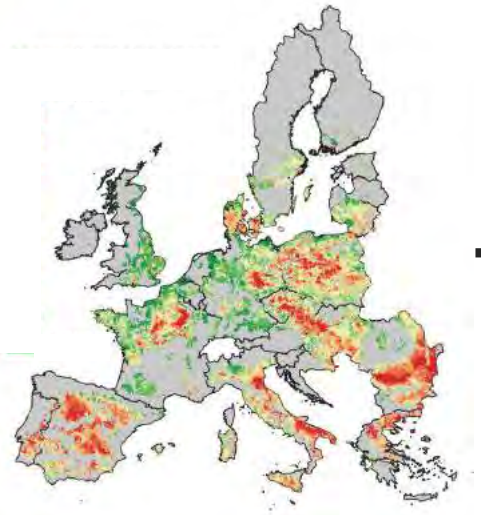
Ji Chen, Poul Erik Lærke, Uffe Jørgensen


Original Article

Biofpr

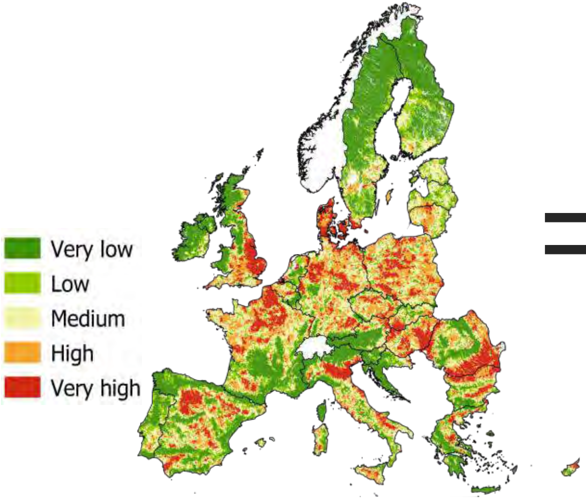
Towards multifunctional landscapes coupling low carbon feed and bioenergy production with restorative agriculture: Economic deployment potential of grass-based biorefineries

Strategic integration of perennials



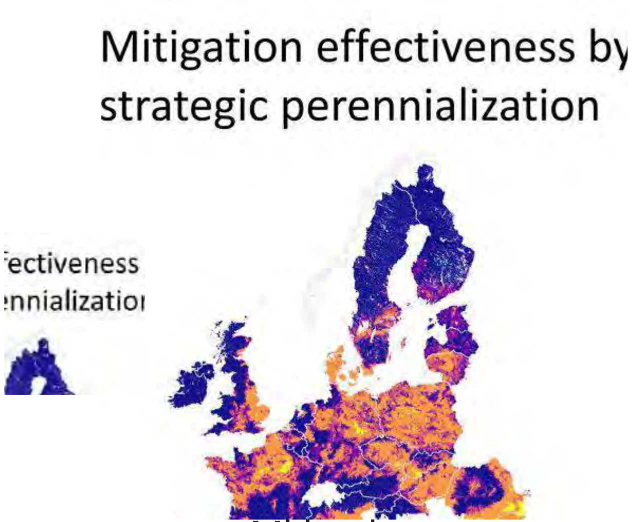
Soil carbon loss

+



Dominance of annual crops

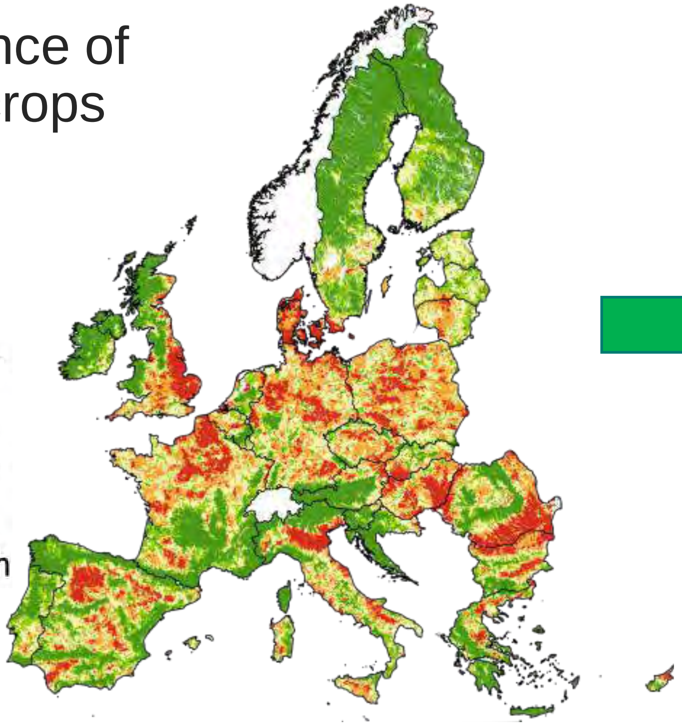
=



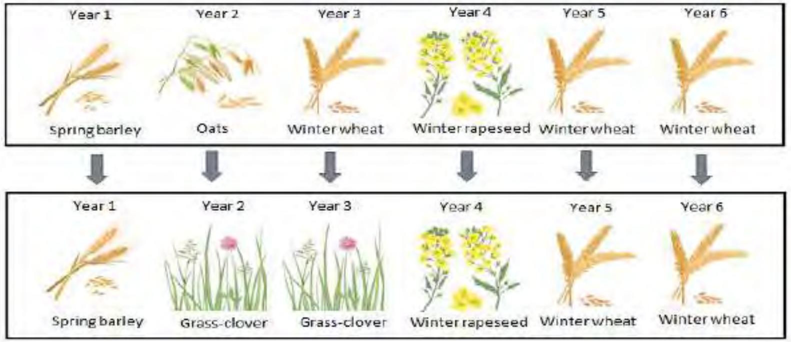
Mitigation effectiveness

Strategic integration of perennials

Dominance of annual crops

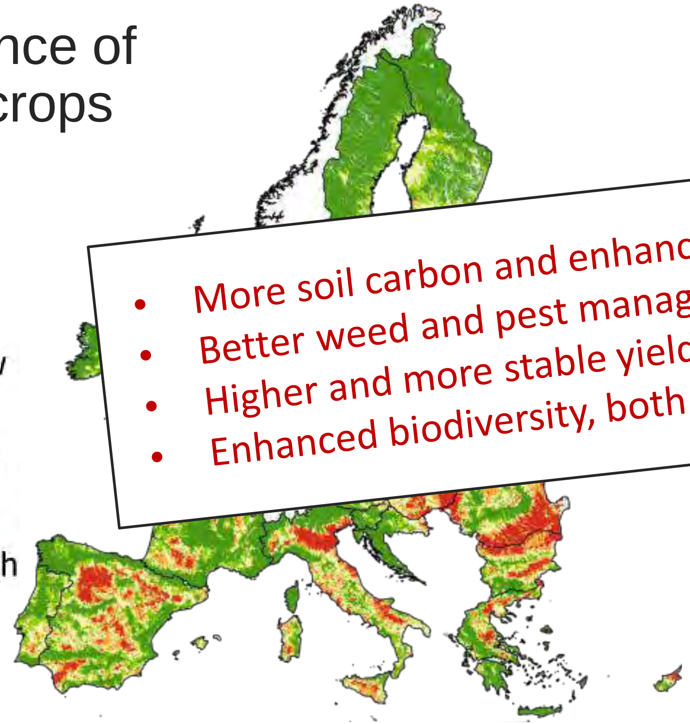


Adjusted crop rotations

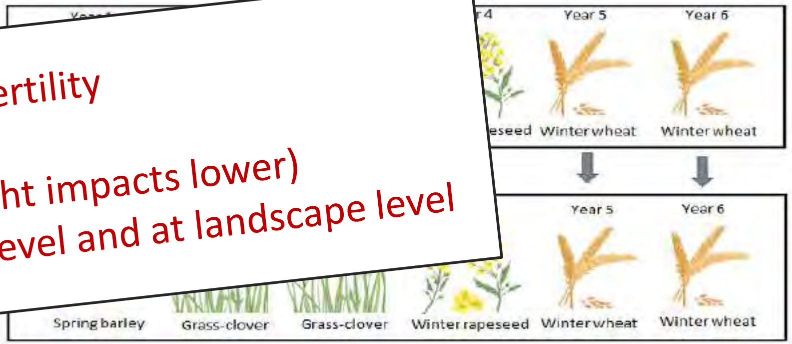


Strategic integration of perennials

Dominance of annual crops



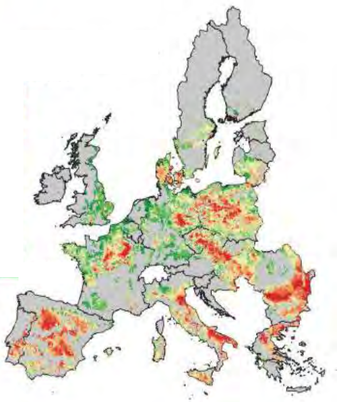
Adjusted crop rotations



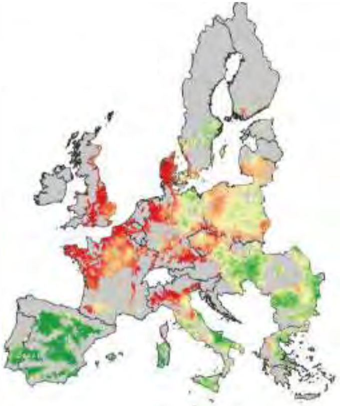
- More soil carbon and enhanced soil fertility
- Better weed and pest management
- Higher and more stable yields (drought impacts lower)
- Enhanced biodiversity, both at field level and at landscape level

Strategic integration of perennials

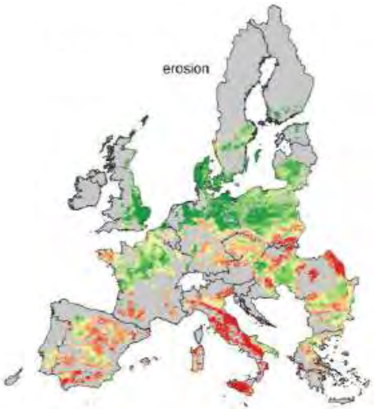
Highest impact Lowest impact



Soil carbon loss

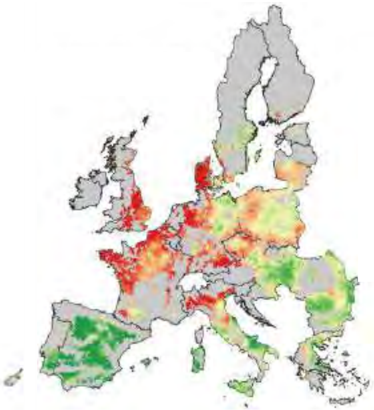


N emissions to water



Recurring floods

Water erosion



Wind erosion

The Basis of Biomass Sustainability

Thank you for listening!

Göran Berndes, IEA Bioenergy & Chalmers University, Sweden

Renewable Energy Institute event, 18 January 2024
Biomass for Net Zero - Deployment in Japan in Light of Latest Global Discussions

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On slide 3

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