IEA Bioenergy

Task 38

Climate Change Effects of Biomass and Bioenergy Systems

Annette Cowie,
Miguel Brandão and others
IEA Bioenergy Task 38

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- "Climate change effects of biomass and bioenergy systems"
- Leader:
  Annette Cowie, NSW DPI, Australia
- Participating countries:
  - Australia, Finland, France, Germany, Sweden, USA
- **Goal**: Understanding the climate effects of bioenergy

- What is the best use of biomass resources?
- How can land be used to provide energy and meet other needs?
- Where does bioenergy fit in a low-carbon energy future?

Energy
Volume 20, Issue 11, 1995, Pages 1131-1140

Biomass fuels and forest-management strategies: How do we calculate the greenhouse-gas emissic benefits?

Gregg Marland†, Bernhard Schlamadinger§

Biomass and Bioenergy
Volume 10, Issues 5–6, 1996, Pages 275-300

The role of forest and bioenergy strategies in the global carbon cycle

Bernhard Schlamadinger*, †, Gregg Marland*

Biomass and Bioenergy
Volume 13, Issue 6, 1997, Pages 359-375

Towards a standard methodology for gre balances of bioenergy systems in compa fossil energy systems

B. Schlamadinger*, M. Apps†, F. Bohlin‡, L. Gustavsson§, G. Jungr

Energy Policy
Volume 28, Issue 13, November 2000, Pages 935–946

Project-based greenhouse-gas accounting: guiding principles with a focus on baselines and additionality ☆

Leif Gustavsson[a], Timo Karjalainen[b], Gregg Marland[c], Ilkka Savolainen[d], Bernard Schlamadinger
Mike Apps[f]

Stock changes or fluxes? Resolving terminological confusion in the debate on land-use change and forestry

Annette Cowie[1,2]*, Kim Pingoud[3,4], Bernhard Schlamadinger[5]

Energy- and greenhouse gas-based LCA of biofuel and bioenergy systems: Key issues, ranges and recommendations

Francesco Cherubini[a,*], Neil D. Bird[a], Annette Cowie[b], Gerfried Jungmeier[a], Bernhard Schlamadinger[c,1], Susanne Woess-Gallasch[a]

Task 38 : Workshops

Task 38 holds regular workshops in participating countries, often in conjunction with other IEA bioenergy tasks.

Växjö, Sweden January 2017
Forest Modelling Workshop

Southeastern USA April 2016
Bioenergy in the Southeastern United States

Berlin, Germany October 2015
Joint Meeting Task 38 – Task 43: Climate Change Effects of Bioenergy

Berlin, Germany October 2015
Quantifying Climate Change Eff

Växjö, Sweden May 2015
Climate Change Effects of Biom

Helsinki, Finland December 20
Forest-based Bioenergy

Copenhagen, Denmark May 2014
Forests, Bioenergy and Climate Change Mitigation

Hunter Valley, Australia November 2013
Building the Future – Biomass for the Environment, Economy and Society

Vienna, Austria, November 2012
Impact of Timing of GHG emissions

Vienna, Austria, November 2012
Linking Policy, Science and Industry

Argonne, USA, April 2012
How to present the timing of emissio

Campinas, Brazil, September 2011
Quantifying and managing land use

Brussels, Belgium, March 2010
Greenhouse gas emissions from bioenergy systems: impacts of timing, issues of responsibility

Workshop statement

"Forests, bioenergy and climate change mitigation"

This statement is an outcome of the workshop on "Forests, bioenergy and climate change mitigation", held May 19-20, 2014 in Copenhagen[1] , which had the following objectives:

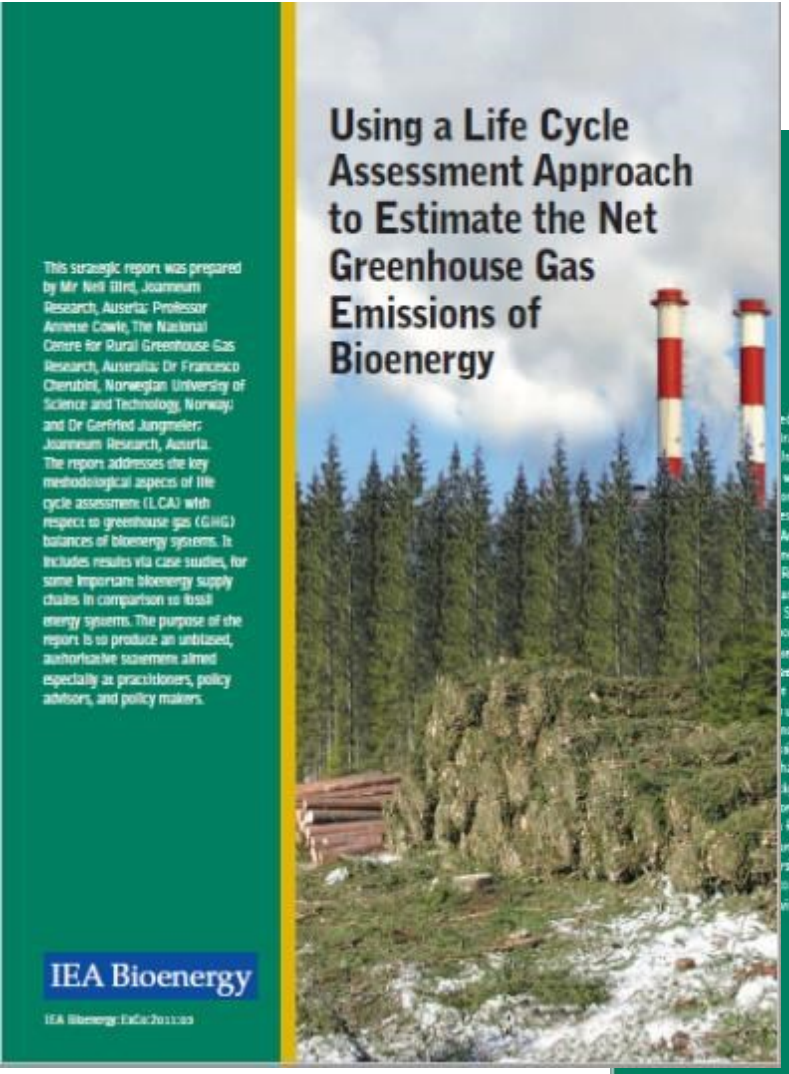
Dubrovnik Statement

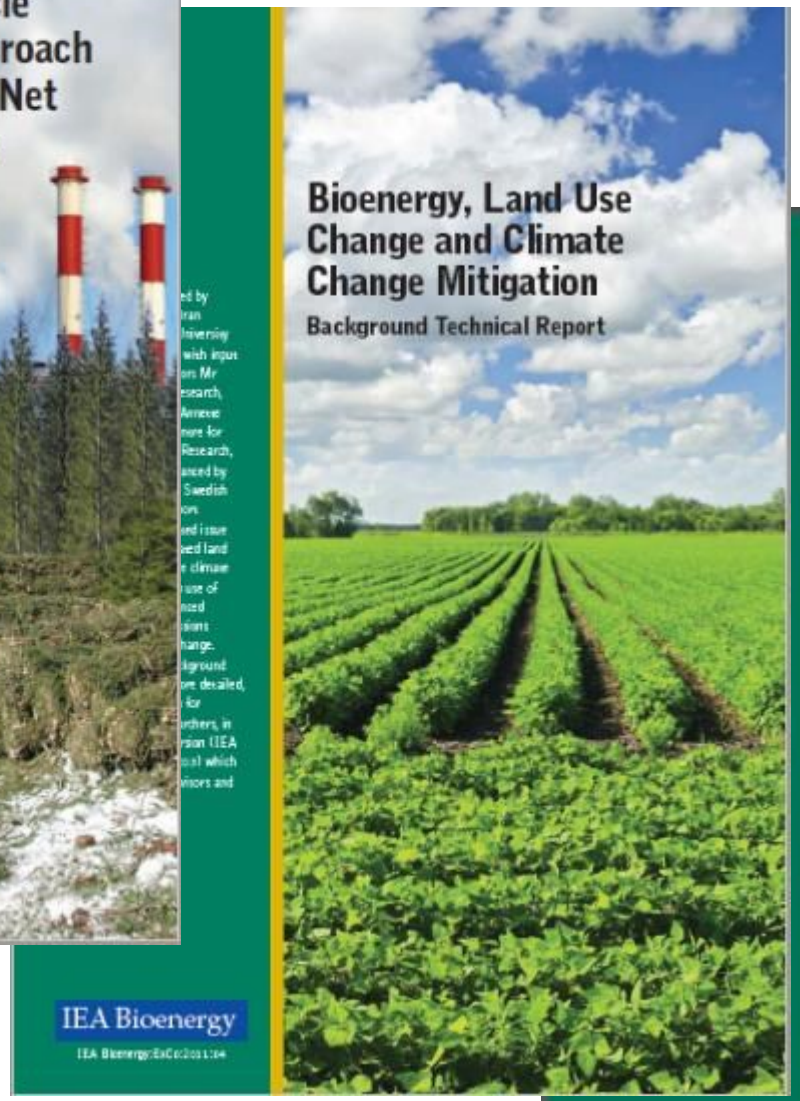
A STATEMENT RESULTING FROM A
JOINT IEA BIOENERGY MEETING

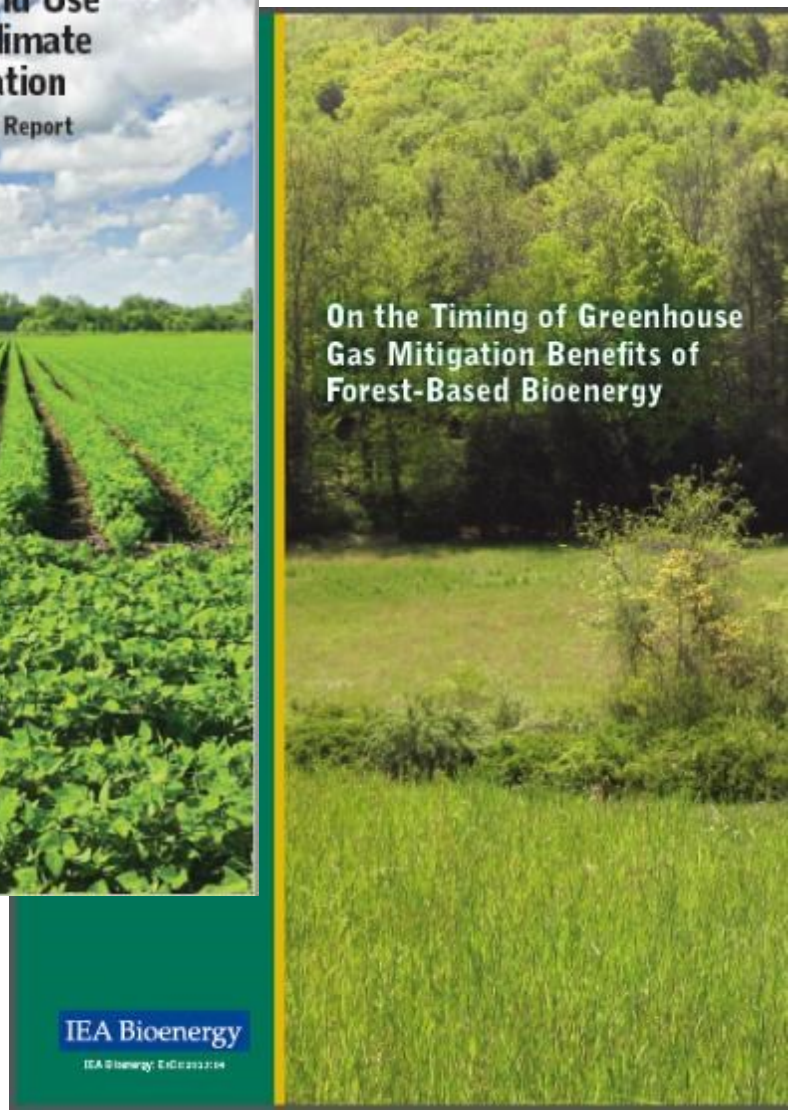
Task 29, Task 38 and Task 40 Expert Consultation on the sustainability of bioenergy held in Dubrovnik, 25 – 26 October, 2007, and Task 38 workshop on direct and indirect land use change held in Helsinki 30 March-1 April 2009

Prepared by Annette Cowie, Neil Bird and Susanne Woess-Gallasch

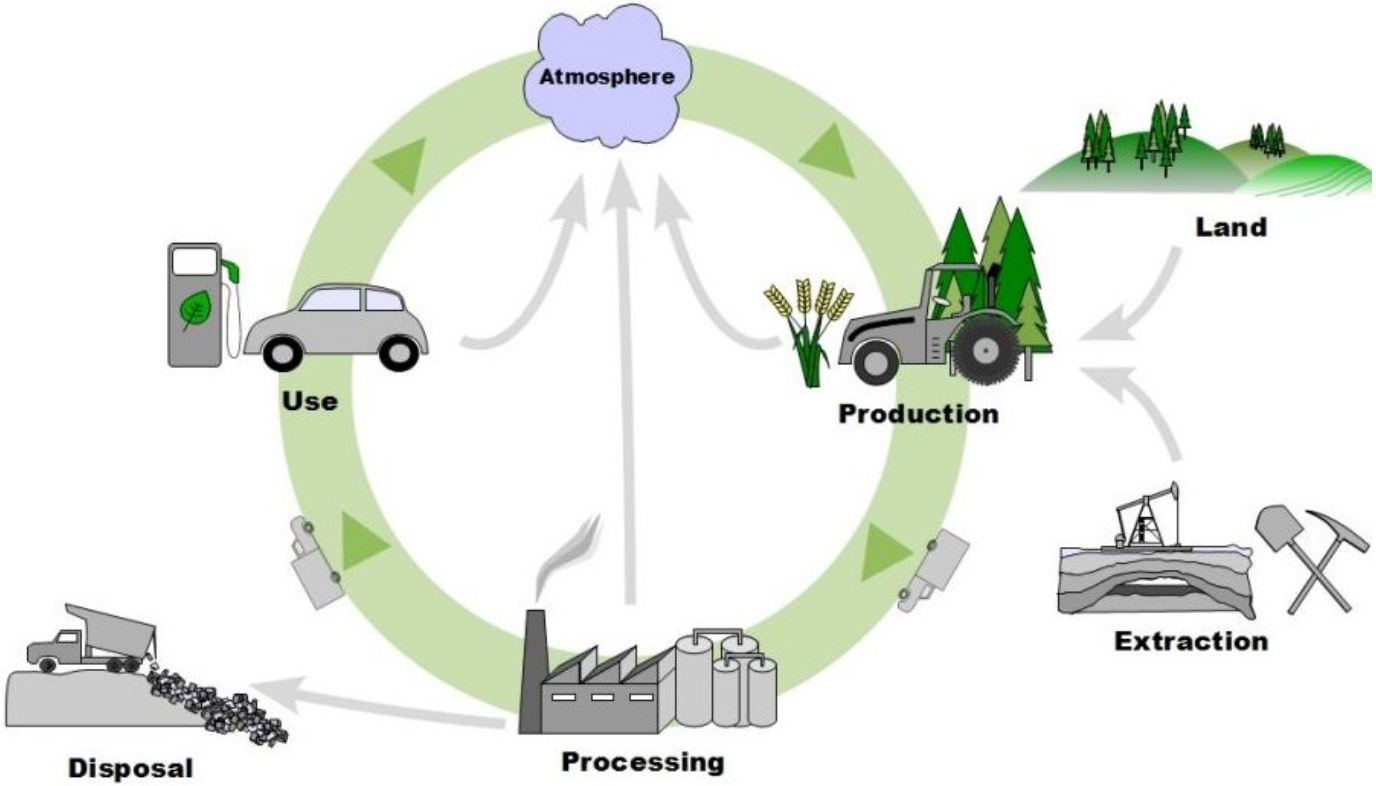
SUSTAINABILITY OF BIOENERGY


Using a Life Cycle Assessment Approach to Estimate the Net Greenhouse Gas Emissions of Bioenergy
This strategic report was prepared by Mr Neil Hird, Joanneum Research, Austria; Professor Annette Cowie, The National Centre for Rural Greenhouse Gas Research, Australia; Dr Francesco Cherubini, Norwegian University of Science and Technology, Norway; and Dr Gerfried Jungmeier, Joanneum Research, Austria.
The report addresses the key methodological aspects of life cycle assessment (LCA) with respect to greenhouse gas (GHG) balances of bioenergy systems. It includes results via case studies, for some important bioenergy supply chains in comparison to fossil energy systems. The purpose of the report is to produce an unbiased, authoritative statement aimed especially at practitioners, policy advisors, and policy makers.
IEA Bioenergy


Bioenergy, Land Use Change and Climate Change Mitigation
Background Technical Report
IEA Bioenergy


On the Timing of Greenhouse Gas Mitigation Benefits of Forest-Based Bioenergy
IEA Bioenergy

Life cycle approach



- Production chain emissions
- Non-CO_2 GHGs
- C stock change in biomass or soil (direct effects, may involve dLUC)
- C stock change in biomass or soil thru iLUC
- Albedo and other biophysical effects on climate

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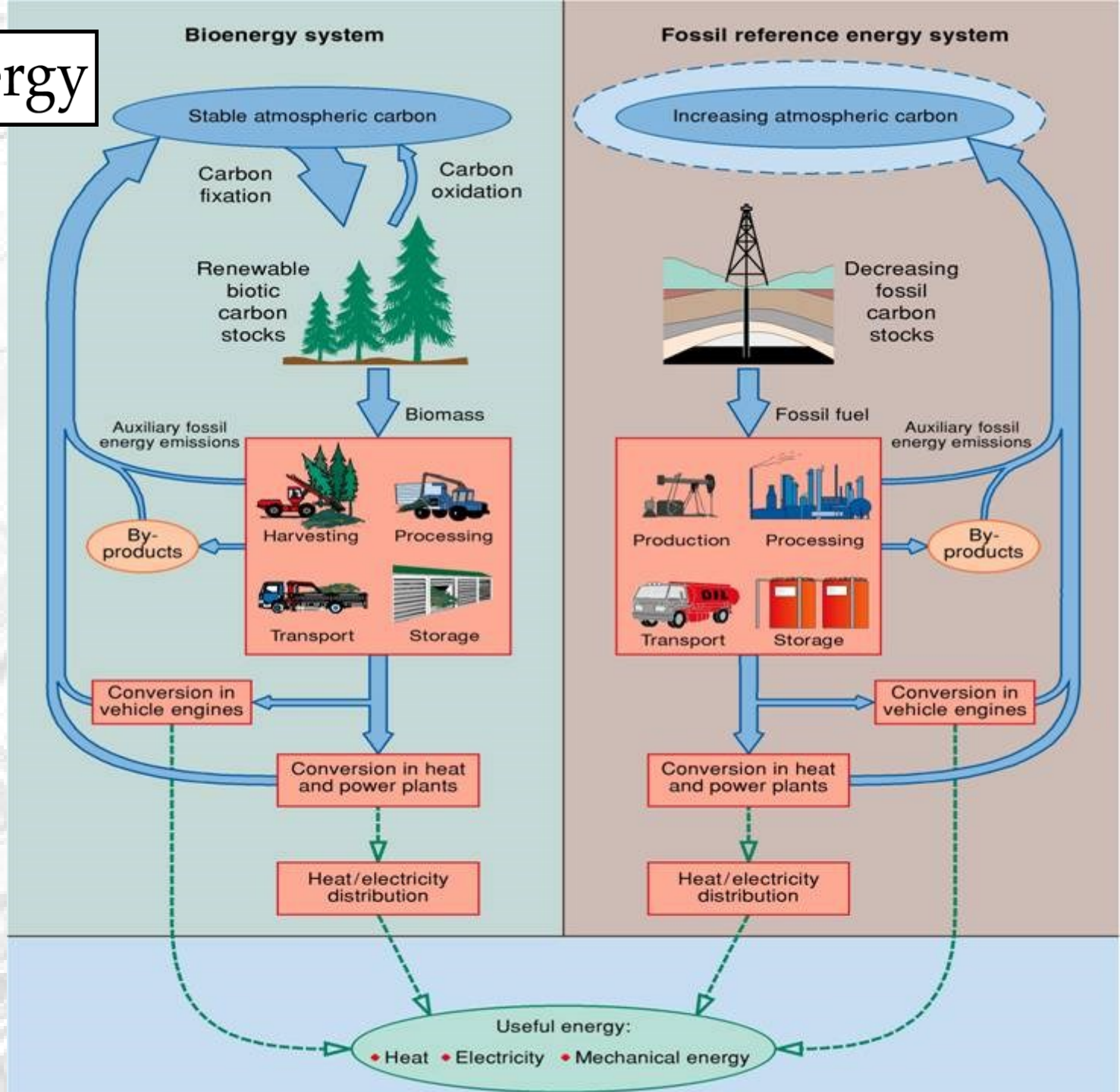
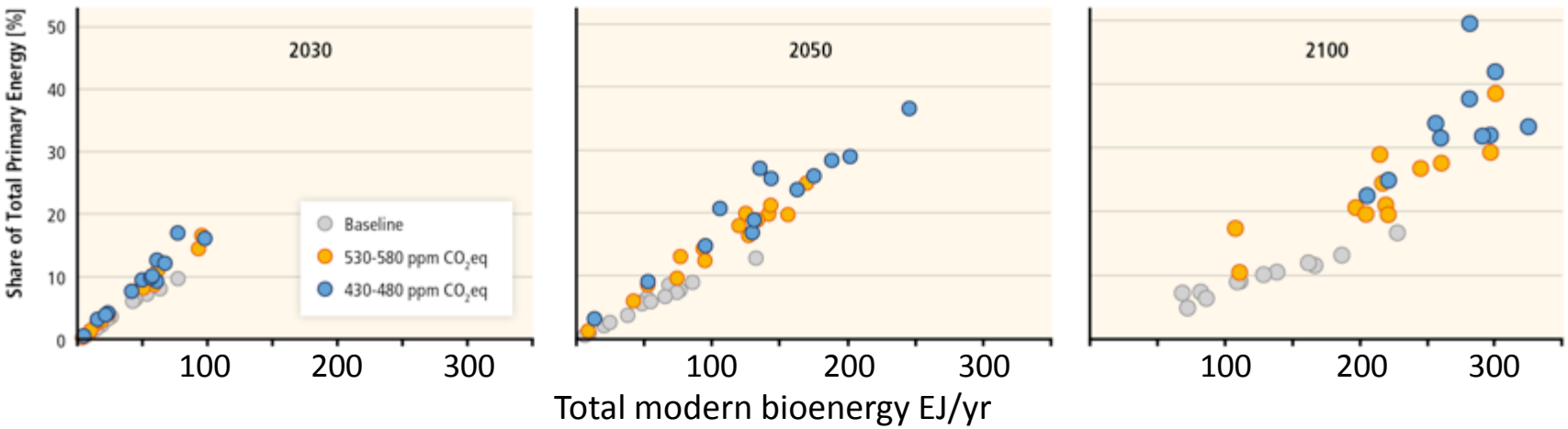
Task 38



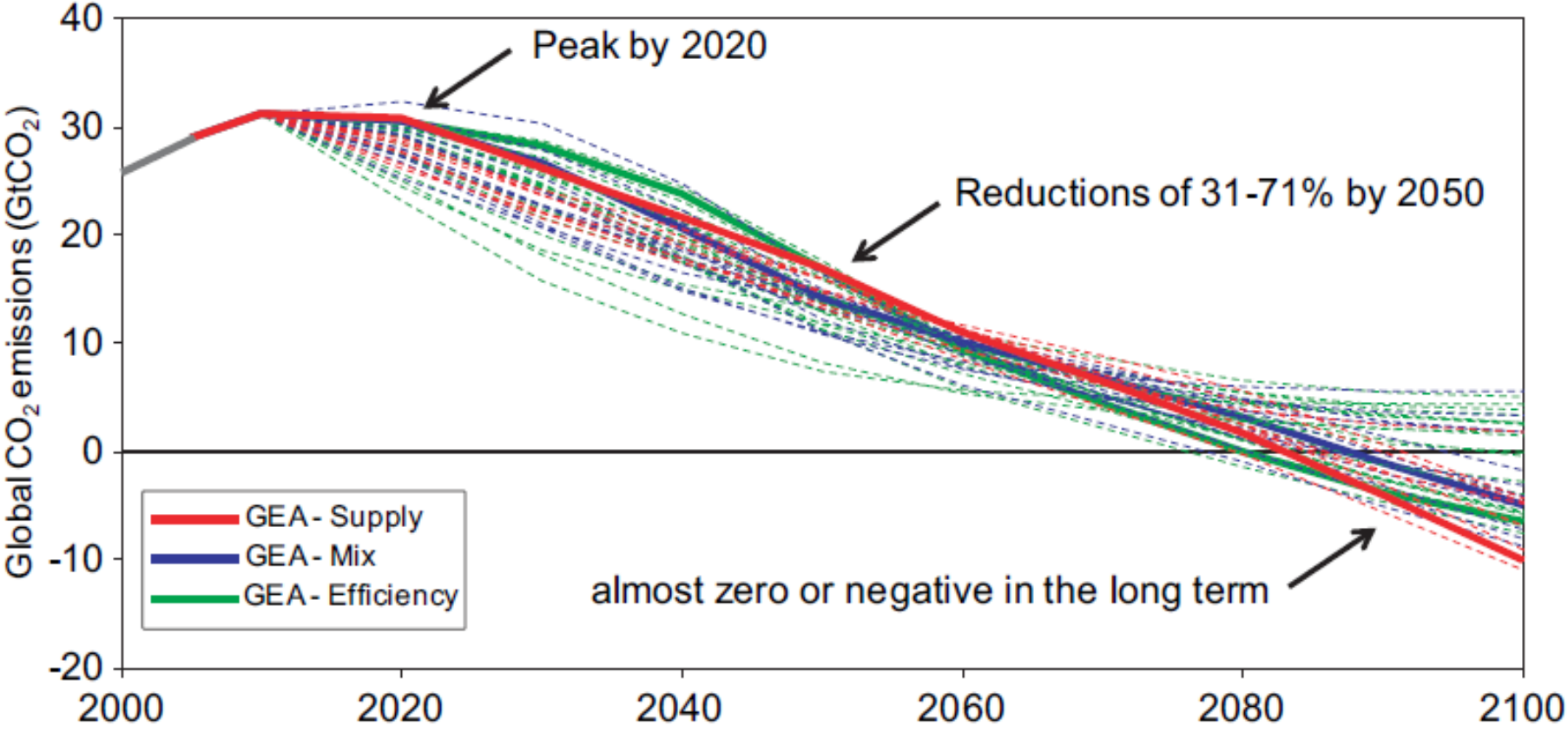
Bioenergy for climate change mitigation

Integrated assessment modelling indicates a big role for bioenergy in order to meet the temperature target of the Paris Agreement.

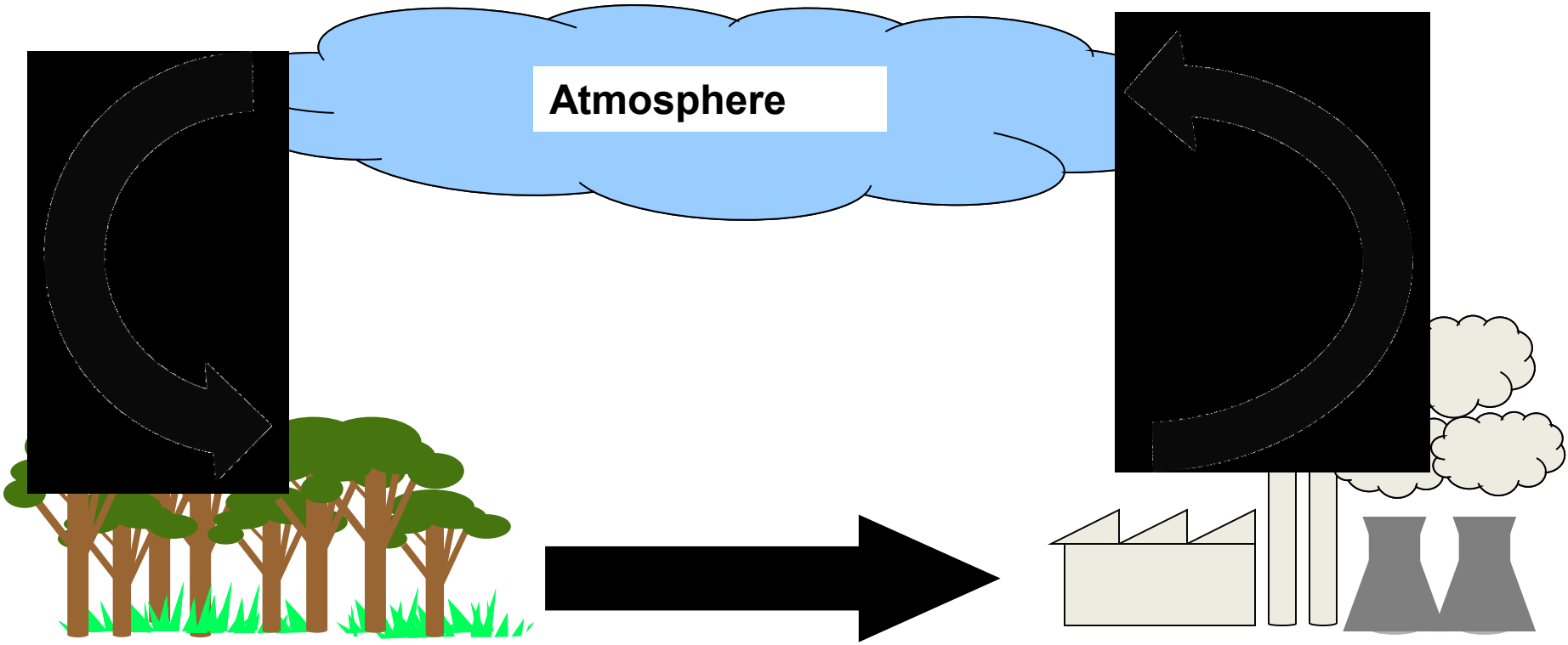


Source: IPCC AR5

Negative emissions required to meet 2° C target – role for BECCS



Global Energy Assessment 2012



Bioenergy – “carbon neutral”

Manomet Center for Conservation Sciences JUNE 2010 NCI-2010-03

NATURAL CAPITAL INITIATIVE AT MANOMET REPORT

BIOMASS SUSTAINABILITY AND CARBON POLICY STUDY

CONTACT IN

Manomet C

Bioenergy

a carbon accounting time bomb

BirdLife INTERNATIONAL · EUROPEAN ENVIRONMENTAL BUREAU · TRANSPORT & ENVIRONMENT

Biomass better than coal? War over carbon accounting erupts

In Washington, the Environment Working Group has released a study that claims the impacts of the American Clean Energy and Security Act (ACESA)—which has already passed the House of Representatives—would require the equivalent of cutting between 18 and 30 million acres by 2025, and up to 50 million acres by 2030.

"From Maine to Washington state, from Ohio to Florida," the EWG report says, "electric utilities have been embracing "biomass power" as a way to reduce dependence on coal and other fossil fuels and to meet ambitious goals for limiting greenhouse

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CLIMATE CHANGE

Fixing a Critical Climate Accounting Error

Timothy D. Searchinger,[1*] Steven P. Hamburg,[2*] Jerry Melillo,[3] William Chame
Petr Havlik,[5] Daniel M. Kammen,[6] Gene E. Likens,[7] Ruben N. Lubowski,[2] Micha
Michael Oppenheimer,[1] G. Philip Robertson,[8] William H. Schlesinger,[7] G. Davi

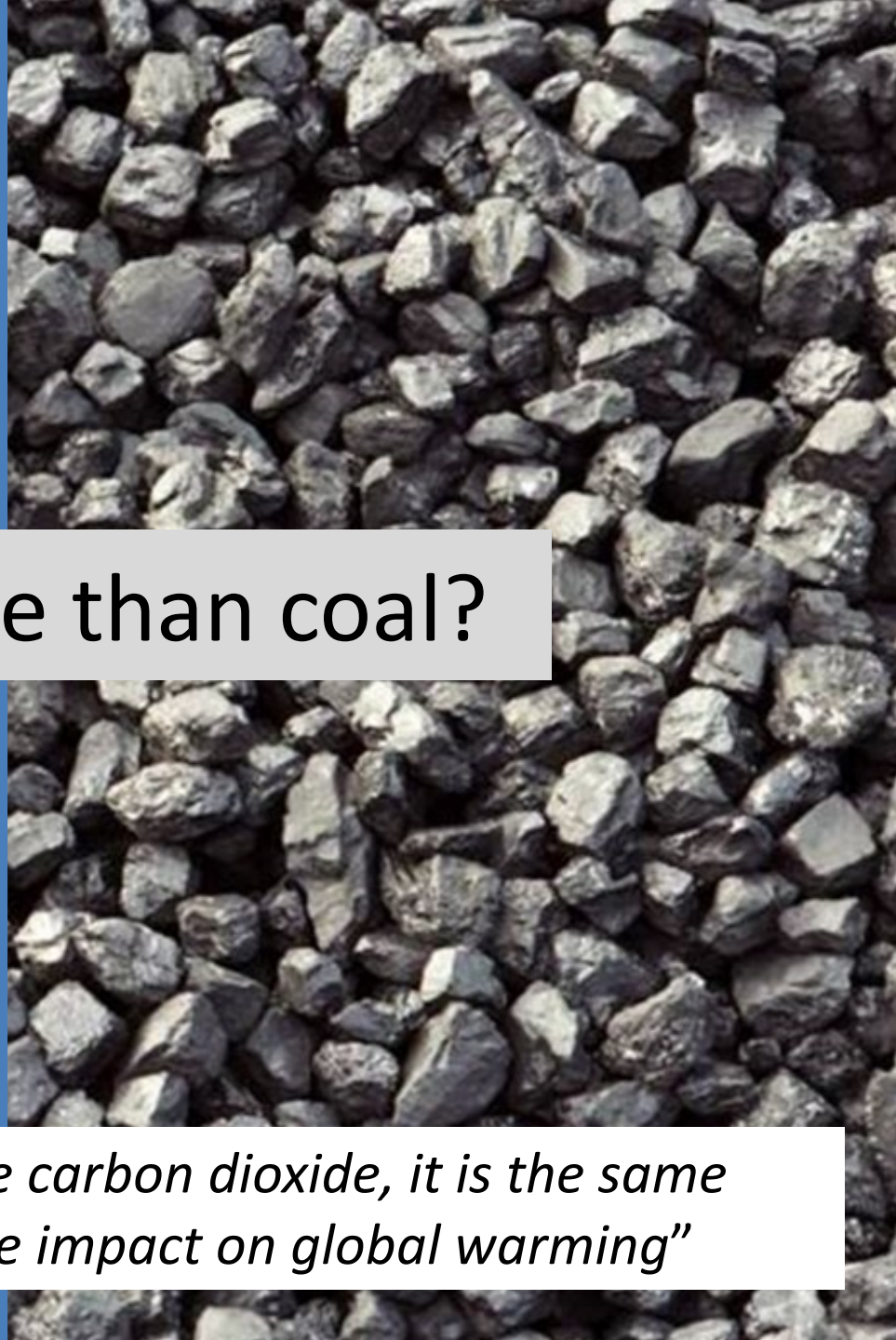
Rules for applying the Kyoto Protocol and national cap-and-trade laws contain a but fixable, carbon accounting flaw in assessing bioenergy.

The accounting now used for assessing compliance with carbon limits in the

not count changes in emis
use when biomass for energ

“Carbon debt” some papers:

- Holtsmark, B. (2012). “Harvesting in boreal forests and the biofuel carbon debt.” Climatic Change 112(2): 415-428.
- Hudiburg, T. W., Law B. E., Wirth C. and Luyssaert S. (2011). “Regional carbon dioxide implications of forest bioenergy production.” Nature Clim. Change 1(8): 419-42
- Lamers P., Junginger M., (2013) " The ‘debt’ is in the detail: a synthesis of recent temporal forest carbon analyses on woody biomass for energy." Biofuels, Bioproducts, and Biorefining, in press.
- McKechnie, J., S. Colombo, J. Chen, W. Mabee and H. L. MacLean (2011). “Forest bioenergy or forest carbon? Assessing trade-offs in greenhouse gas mitigation with wood-based fuels.” Environmental Science and Technology 45(2): 789-795.
- Schulze, E.-D., C. Körner, B. E. Law, H. Haberl and S. Luyssaert (2012). “Large-scale bioenergy from additional harvest of forest biomass is neither sustainable nor greenhouse gas neutral.” GCB Bioenergy: 4(6): 611-616.
- Searchinger, T et al (2009). “Fixing a critical climate accounting error.” Science 326(5952): 527-528.
- Walker, T et al (2010). Massachussets Biomass Sustainability and Carbon Policy Study. Manomet Center for Conservation Sciences.
- Zanchi, G., N. Pena and D. N. Bird (2010). The upfront carbon debt of bioenergy. Graz, Austria, Joanneum Research.



Wood worse than coal?

”Whatever the source of the carbon dioxide, it is the same molecule and has the same impact on global warming”

10. We acknowledge support from the key project of the Chinese Academy of Sciences (grant KZCX2-YW-341).

Bioenergy: Counting on Incentives

THE SUGGESTION BY T. D. SEARCHINGER *et al.* ("Fixing a critical climate accounting error," Policy Forum, 23 October 2009, p. 527) to account for CO_2 by "tracing the actual flows of carbon" appears to promote an approach to carbon accounting in which emissions and removals from a forest are determined on the basis of gross atmospheric fluxes between the forest, or forest products, and the atmosphere. This contrasts with the current "stock-change" approach, in which the annual removals or emissions from a country's forest are assumed to be equal to the net change in carbon stocks in biomass and soils of the forest estate.

We share the concern of the authors that a "critical climate accounting error" exists within the Kyoto protocol and could under-

GLOBAL CHANGE BIOLOGY BIOENERGY

GCB Bioenergy (2012) 4, 617–619, doi: 10.1111/j.1757-1707.2012.01190.x

LETTER

A comment to "Large-scale bioenergy from additional harvest of forest biomass is neither sustainable nor greenhouse gas neutral": Important insights beyond greenhouse gas accounting

RYAN M. BRIGHT*, FRANCESCO CHERUBINI*, RASMUS ASTRUP†, NEIL BIRD‡,

opinion & comment

CORRESPONDENCE:

Policy institutions and forest carbon

management options. Indeed, the value of their paper is that it shows the sensitivity of results to the choice of system boundary and modelling assumptions. The obvious conclusion to be drawn from their study is that current GHG accounting approaches need revision. We suggest that such revisions should be guided by comprehensive assessments that include full life-cycle emissions, compare equivalent scenarios and reflect market dynamics, in order to analyse the potential impacts of policy institutions. ❐

IEA Bioenergy

Response to Chatham House report "Woody Biomass for Power and Heat: Impacts on the Global Climate"

Annette Cowie, Principal Research Scientist Climate, NSW Department of Primary Industries, Australia; Adjunct Professor, University of New England; Leader of Task 38 of the IEA Bioenergy TCP

Göran Berndes, Associate Professor, Department of Energy and Environment, Chalmers University of Technology, Sweden; previous leader of Task 43 of the IEA Bioenergy TCP

Martin Junginger, Professor Bio-Based Economy, Utrecht University, the Netherlands; Leader of Task 40 of the IEA Bioenergy TCP

Fabiano Ximenes, Research Scientist, NSW Department of Industry - Lands, Australia

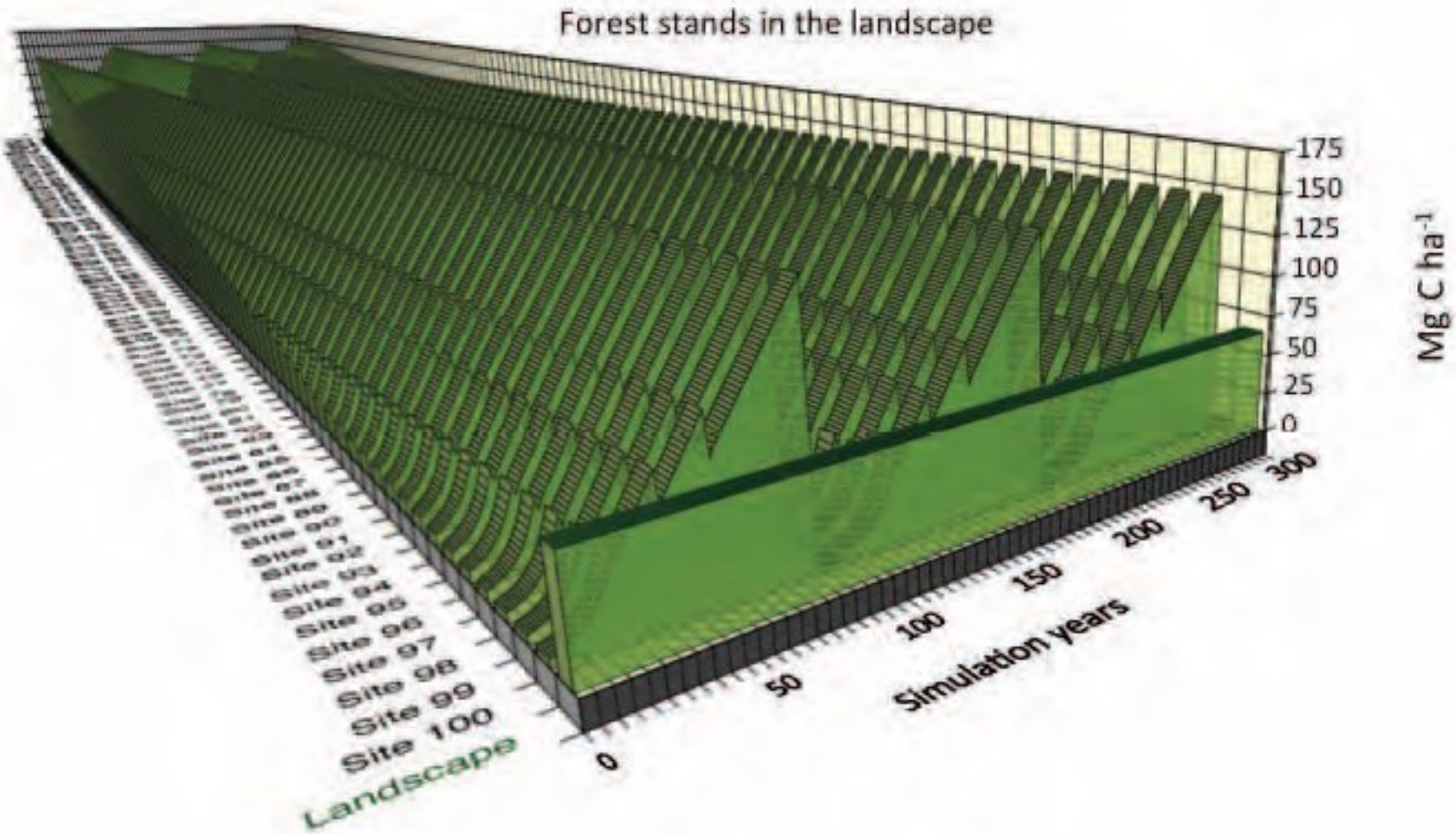
Current debate

- Spatial scale:
  chip pile/ stand/ forest estate

- Counterfactual:
  reference land use, energy system

- Relevant time frame:
  tipping points/GHG targets/ temperature stabilisation/fast vs slow carbon pools

Spatial scale?



Berndes et al 2011

Reference land use

- Timber without residue harvest?
- Conservation forest?

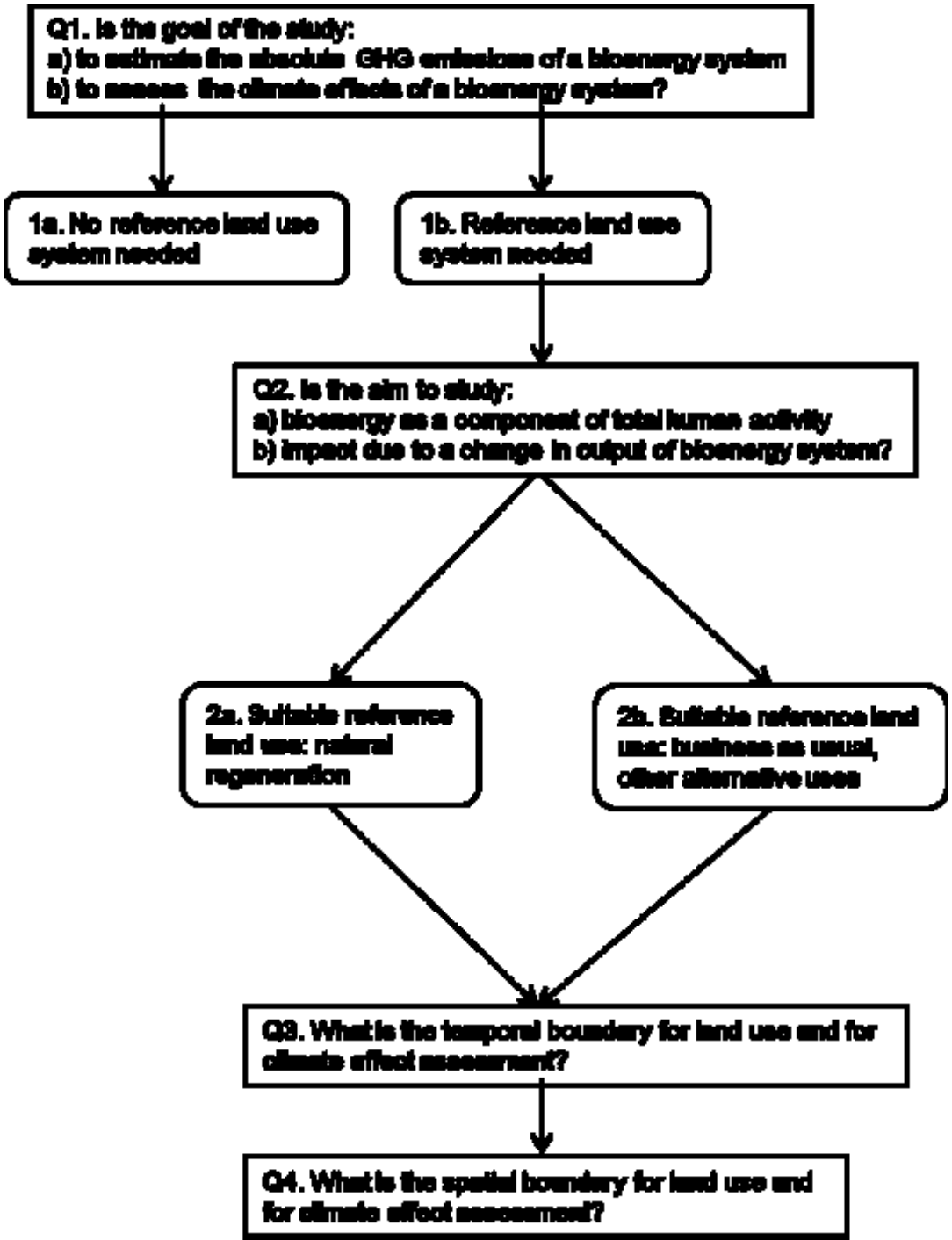
With natural disturbance?

- Purpose-grown crop?
- Grown on marginal or degraded

land?

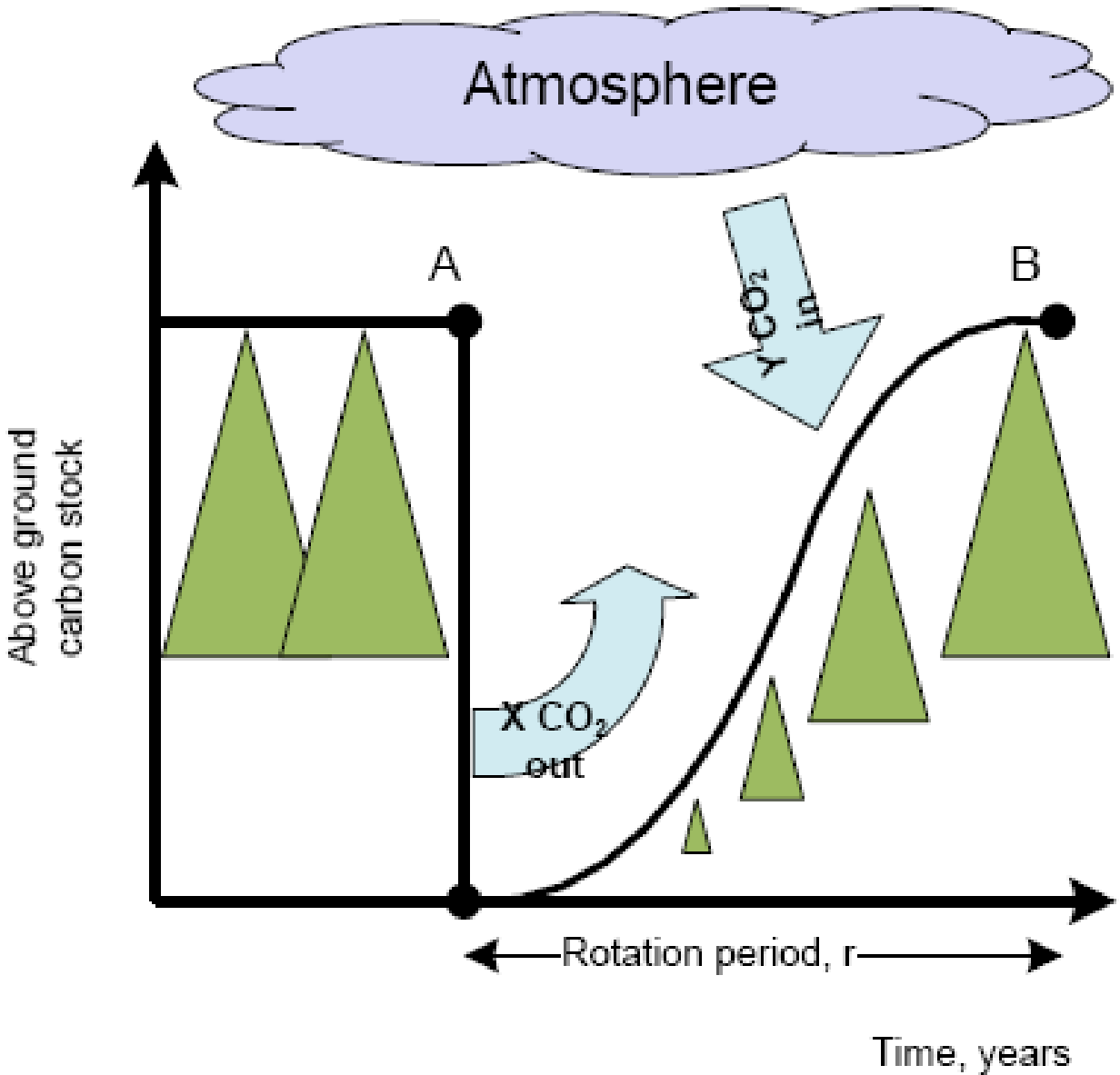
- When to start the clock?

Choosing the land use reference system



Koponen et al, in prep

Carbon neutral ≠ Climate neutral?



F Cherubini NTNU

Different perspectives

- Individual operator vs national government or researcher
- Policy development vs implementation

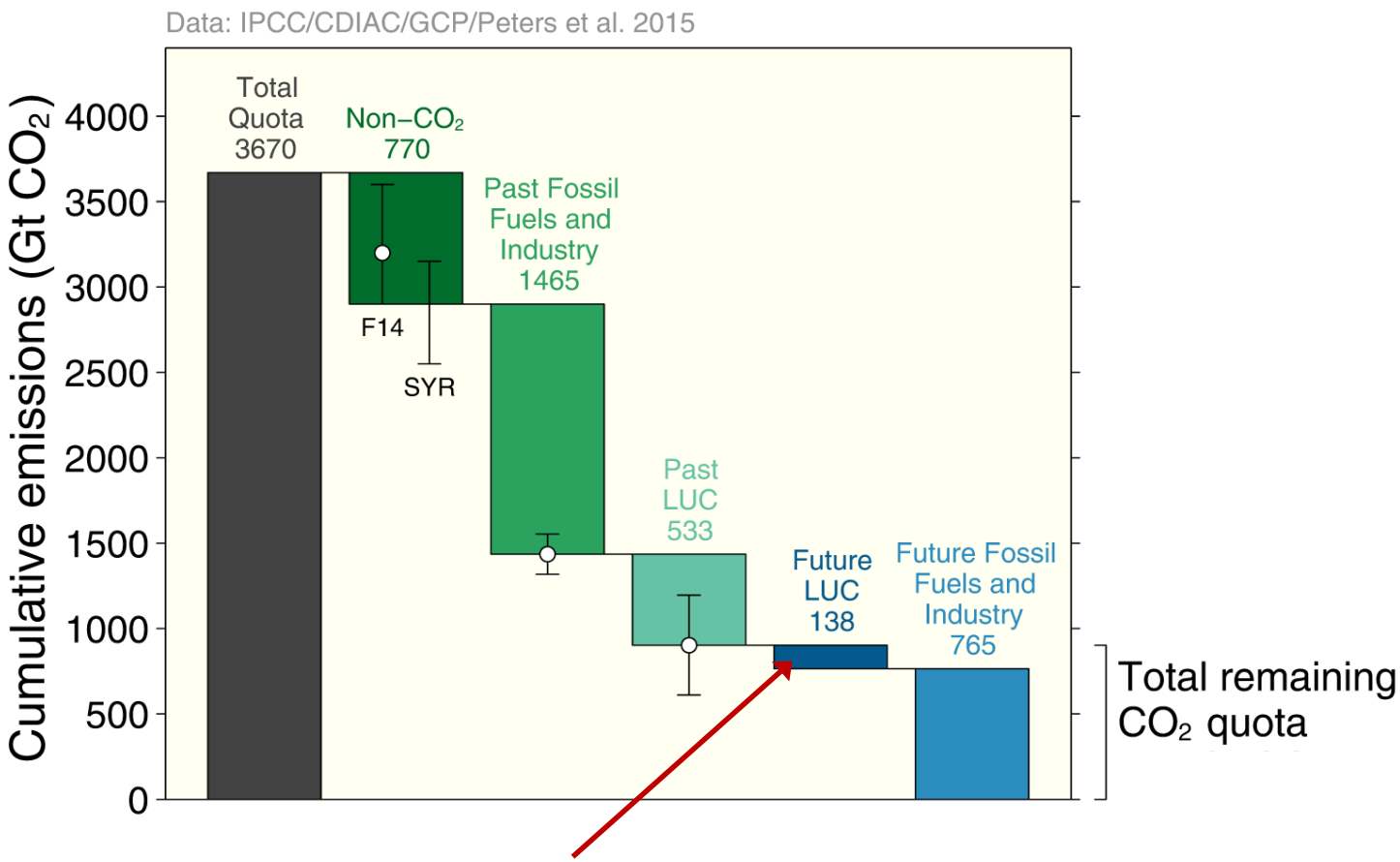
- Stand vs landscape scale
- Reference: Natural system vs managed system
- Start calculation at planting vs at harvest
- Short term vs long term
- Specific stage vs whole life cycle
- Biomass only vs integrated forest product system
- Average vs marginal reference system
- Debt vs investment

May 2017 Gothenburg workshop

Focus of discussion:

- significance of timing of carbon emissions and sequestration associated with bioenergy systems
- what insights does climate science provide concerning bioenergy in the context of temperature targets, carbon budget / emission space, timing of peak emissions and peak warming
- how bioenergy contributes to transformation pathways
- modelling and assessment of bioenergy with carbon capture and storage (BECCS)

Global carbon budget



Is it ok to use some of the quota for expanding bioenergy systems?

Gothenburg workshop: Key messages

- Most scenarios to stay below 2°C include negative emissions from BECCS, but global models do not accurately simulate large-scale bioenergy.
- Fossil CO2 emissions have an irreversible climate impact. In contrast, the climate warming effects of bioenergy are reversible except if C stock loss is permanent.
- CO_2 emissions and sequestration from bioenergy should not be considered in the global carbon budget, except when there is a long-term reduction in the biospheric carbon stock in biomass and/or soil.
- Policy should be guided by research using various analytical methods, including LCA (with different metrics), integrated assessment models, scenario analysis, energy system and economic modelling, as each gives different insights.

Task 38 upcoming activities

- LULUCF workshop Copenhagen early 2018
- Papers on:
  - Metrics for quantifying climate change effects of bioenergy
  - Contrasting ALCA and CLCA methods, to inform bioenergy policy
  - Comparing tools for GHG assessment of bioenergy
  - Algal biofuels
  - Revised standard methodology

Understanding Climate Change Effects of Forest biomass and Bioenergy Systems

7 November 2017

9:30 Welcome (Emilie Machefaux, ADEME)

9:40: Introduction to the workshop (Annette Cowie, Task 38)

10:00 Evaluation of mitigation effect from climate-change adapted forests (Denis Loustau)

10:30 Environmental balance of forest systems concerning climate change and other stakes: towards an optimization of forestry practices and territorial policies (Mathieu Fortin, Estelle Vial)

11:00 **Coffee Break**

11:30 Climate effects of different forest management regimes and wood substitution systems (Leif Gustavsson)

12h00 Tools for GHG assessment of biofuels (Patrick Lamers)

12:30 Assessing the eco-efficiency of sugarcane production using a customised LCA tool, and the implication for GHG abatement of bioenergy (Marguerite Renouf)

13:00 Lunch

14:30 Climate change effects of biochar systems (Aaron Simmons)

15:00 SOCLE project: Including Soil Organic Carbon changes in LCA to improve environmental assessments (Anthony Benoist, Cécile Bessou)

15:30 Coffee Break

15:45 Has the US bioenergy policy resulted in iLUC? (Miguel Brandão)

16:15 Quantis Guide on GHG accounting for land use change (Edith Martin)

16:45 Land use and Land Use Change in LCA (Miguel Brandão)

17:15 Discussion

18:00 Close

IEA Bioenergy Task 38

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http://task38.ieabioenergy.com/

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