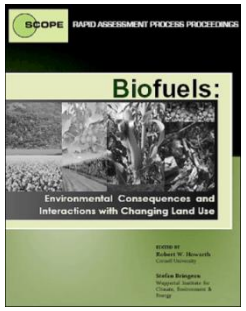
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BIOENERGY TECHNOLOGIES OFFICE

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP



SCIENTIFIC COMMITTEE ON PROBLEMS OF THE ENVIRONMENT
of the
INTERNATIONAL COUNCIL FOR SCIENCE (ICSU-SCOPE)

FAPESP
SAO PAULO RESEARCH FOUNDATION

SCOPE #2

GBEP
Global Bioenergy Partnership

2015 Project Peer Review
International Sustainability
WBS 4.2.1.31
and
IEA Bioenergy Task 38 Support
WBS 6.4.0.6

March 25, 2015

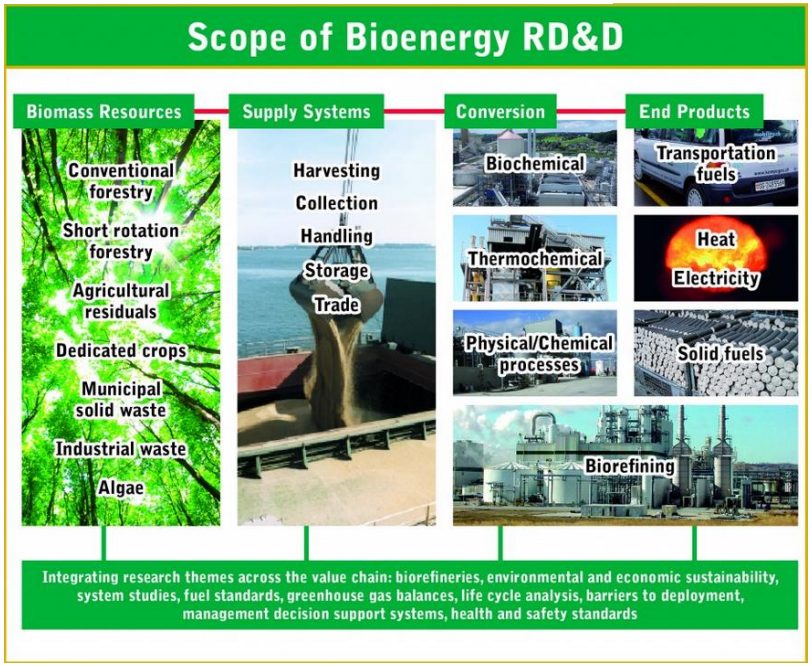
Analysis and Sustainability

Helena Chum
National Renewable Energy Laboratory

and many BETO and
global collaborators

iea International Energy Agency
Working together to ensure reliable, affordable and clean energy

IEA Bioenergy



This presentation does not contain any proprietary, confidential, or otherwise restricted information

Bioenergy Global Partners and Their Connections

Complex Global Environment

GBEP
Global Bioenergy Partnership

- ★ GBEP partner
- ☆ GBEP observer
- ★ GBEP services

The United Nations System

Funds and Programmes[1]
- ★ **UNCTAD** United Nations Conference on Trade and Development
- ★ **ITC** International Trade Centre (UNCTAD/WTO)
- ★ **UNDP** United Nations Development Programme
- ★ **UNEP** United Nations Environment Programme

Departments and Offices
- ★ **DESA** Department of Economic and Social Affairs

Specialized Agencies[1,5]
- ★ **FAO** Food and Agriculture Organization of the United Nations
- ☆ **ICAO** International Civil Aviation Organization
- ☆ **IFAD** International Fund for Agricultural Development
- **ILO** International Labour Organization
- **IMF** International Monetary Fund
- **IMO** International Maritime Organization
- **UNESCO** United Nations Educational, Scientific and Cultural Organization
- ★ **UNIDO** United Nations Industrial Development Organization
- **WHO** World Health Organization
- **WIPO** World Intellectual Property Organization
- **WMO** World Meteorological Organization
- ★ **World Bank Group**

International Resource Panel

UNITED NATIONS SYSTEM-WIDE EARTHWATCH

FAPESP SÃO PAULO RESEARCH FOUNDATION

SCOPE

SCIENTIFIC COMMITTEE ON PROBLEMS OF THE ENVIRONMENT of the INTERNATIONAL COUNCIL FOR SCIENCE (ICSU-SCOPE)

ipcc INTERGOVERNMENTAL PANEL ON climate change (WMO, UNEP)

A Unique Partnership: United Nations, THE WORLD BANK

U.S.-Brazil Strategic Energy Dialogue (SED) and MOU on Advanced Biofuels Cooperation

☆ UNITED NATIONS DECADE OF SUSTAINABLE ENERGY FOR ALL 2014-2024

★ IRENA International Renewable Energy Agency

Sustainable Bioenergy High-Impact Opportunity

CLEAN ENERGY MINISTERIAL
Accelerating the Transition to Clean Energy Technologies

☆ Bioenergy Working Group

IEA International Low-Carbon Energy Technology Platform: **Bioenergy how2guide**

REN21 Renewable Energy Policy Network for the 21st Century

OECD BETTER POLICIES FOR BETTER LIVES

★ iea International Energy Agency

★ IEA Bioenergy

Working together to ensure reliable, affordable and clean energy

Broader than energy focus

Energy focus

Goals

1. **Provide technical expertise and BETO input** on analysis, sustainability, systems integration (biomass production, conversion, and product use) to multilateral high-impact activities of the U.S. government
    - UN/IPCC and OECD/IEA Bioenergy Agreement
    - UN-related scientific assessments (e.g., SCOPE) and bilateral agreements

    Outcomes: High-impact publications; improved understanding of U.S. systems

2. **Analyze and synthesize key global bioenergy activities** to identify opportunities and challenges to a sustainable U.S. bioeconomy
    - Multilateral high impact: IRENA, SE4ALL, Clean Energy Ministerial, IEA
    - Multi-stakeholder groups building capacity in developing countries, eg GBEP
    - Voluntary standards organizations RSB, ISO, etc.

    Outcomes: Identify gaps, barriers, and needed areas for BETO bioenergy and sustainability publications to facilitate upcoming assessments

- **The Office goal:** U.S. domestic bioenergy and bioproduct industry expands as barriers to trade are decreased and opportunities for partnerships with other countries increase.

Quad Chart Overview

Timeline

Start Date	FY2009
End Date	FY2016
% Complete	75%

Budget

	Total Costs FY10–FY12	FY13 Costs	FY14 Costs	Total Planned Funding (FY15–Project End Date)
International Sustainability	$422K	$216K	$197K	$400K
IEA Task 38	$13.7K	$38K	$9.7K	$40K
Cost Share Estimated*	$200K	$150K	$600K	$600K

*Estimated from IPCC, IEA Bioenergy, and SCOPE activities over time.

About 1.2$ (partners) : 1$(BETO)

Barriers

- **St-A.** Scientific Consensus on Bioenergy Sustainability
- **St-B.** Consistent and Science-Based Message on Bioenergy Sustainability
- **St-F.** Systems Approach to Bioenergy Sustainability
- **Mm-A**: Lack of Understanding of Environmental/ Energy Tradeoffs
- **Polarized** views on large scale bioenergy benefits to climate change mitigation and potential

Partners

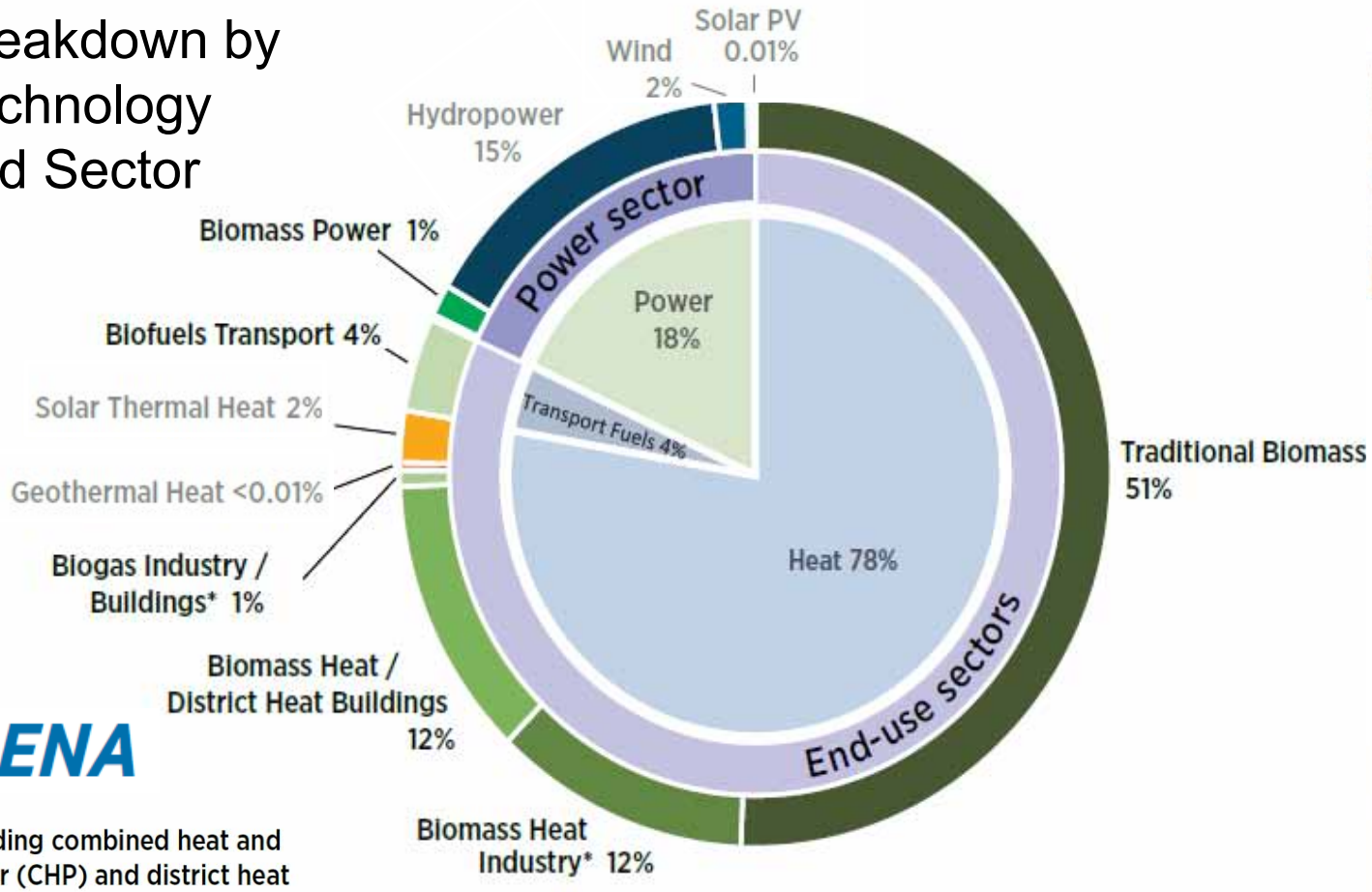
- Co-authors of IPCC 5th Assessment Report
- SCOPE Bioenergy and Sustainability: Bridging the Gaps, FAPESP, Scientific Advisory Committee and authors
- IEA Bioenergy Task 38 members
- Other DOE Labs: ORNL, ANL, INL, PNNL
- Other agencies: USDA, EPA (Cincinnati Lab)
- Other Brazil/US SED, UNEP, IRENA, IEA
- Stakeholder groups: Roundtable for Sustainable Biomaterials (RSB), Global BioEnergy Partnership (GBEP), REN21

Context: Challenges/Objectives

- Biofuels can offer multiple benefits but some environmental impacts, such as climate change, are more uncertain as they are context and biomass system dependent
  - Methodologies evolving, data gaps in many areas
  - Climate change (CC) impacts of biomass and bioenergy systems, other than GHG emissions, can be positive or negative depending on the specific location.
- Bioenergy (biomass use) benefits, including on climate, need to be defined and verifiable; voluntary standards, certification, multiple systems, impact industry and trade
- Expansion of U.S. bioenergy goals (RFS2 and others)
  - Expected to contribute greatly to doubling the share of renewable energy globally by 2030 in the UN SE4All initiative
  - Sustainability frameworks for the expansion. IPCC AR5 models identified large-scale bioenergy for negative emissions with more uncertain mitigation potential; efficient small- to medium-scale bioenergy and use of residues and wastes favored. AR5 feeds UNFCCC, COP 21 Paris meeting, 11/2015

Context: Aggressive Goals for Global Bioenergy Expansion – 1

Breakdown by Technology and Sector

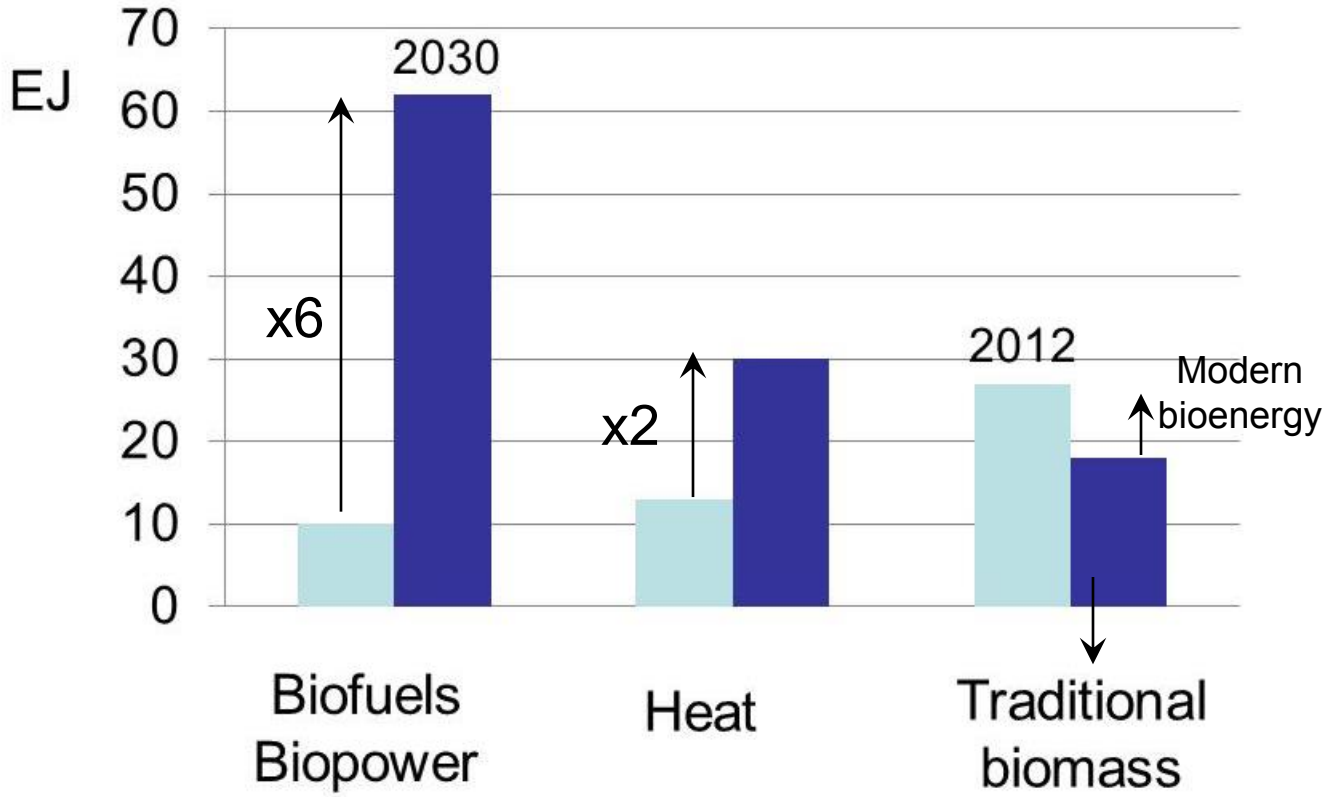


Household Bioenergy

"Double the share of renewable energy, double efficiency improvement rate, and give universal access to modern energy by 2030." **SE4ALL:** Sustainable Energy for All: http://www.se4all.org.

Context: Aggressive Goals for Global Bioenergy Expansion – 2

United Nations Decade of Sustainable Energy for All: 2014-2024



IRENA (2014), REmap 2030: A Renewable Energy Roadmap, Summary of Findings, June 2014. IRENA, Abu Dhabi. www.irena.org/remap

Numerous Initiatives for Multilateral Action in Energy/bioenergy and Broader Context

A Unique Partnership: United Nations THE WORLD BANK

UNEP United Nations Environment Programme environment for development

UNITED NATIONS DECADE OF SUSTAINABLE ENERGY FOR ALL 2014-2024

Sustainable Bioenergy High-Impact Opportunity

Food and Agriculture Organization of the United Nations

IRENA International Renewable Energy Agency

CLEAN ENERGY MINISTERIAL

Accelerating the Transition to Clean Energy Technologies

Bioenergy Working Group

Multiple frameworks for positive sustainable bioenergy implementation. Developing countries perspective

GBEP Global Bioenergy Partnership

OECD BETTER POLICIES FOR BETTER LIVES

iea International Energy Agency

Working together to ensure reliable, affordable and clean energy

IEA International Low-Carbon Energy Technology Platform: **Bioenergy how2guide**

Integrative:
- Feedstocks for energy markets
- Sustainable international bioenergy trade
- Climate change effects
- Commercializing liquid biofuels
- Integrated biorefineries

IEA Bioenergy

Technical: Combustion, gasification, pyrolysis, waste management, biogas

Large Scale ← Bioenergy → Small Scale

1 – Project Overview

Challenge	2009-2012	2013-2015
1. Overall Benefits and Impacts	• Benchmarking U.S. and Brazilian ethanol • Bioenergy in IPCC SRREN (Special Report on Renewable Energy Sources and Climate Change Mitigation) update from 2007 preparing for the Assessment Report (AR5)	• Benchmarking expanded environmental impacts • Bioenergy in IPCC AR5: agriculture, forestry, other land use; energy systems; and transport chapters. Large-scale bioenergy favored for providing negative emissions (models) but emissions uncertainties high.
2. Bioenergy Systems Climate Impacts and Methodologies	• IEA Bioenergy Task 38, timing impacts on GHG of bioenergy systems; issues on the methodologies used • IEA Inter-Task: Role of Sustainability Requirements in International Bioenergy Markets	• IEA Bioenergy Task 38 & 39 compare tools used to estimate GHG mitigation; trade impacts • IEA Bioenergy Task 38 & AR5: Albedo impacts on boreal and temperate zone managed forest use; indirect albedo? • Inter-Task Project: “Mobilizing Sustainable Bioenergy Supply Chains” pasture intensification sugarcane in Brazil

1 – Project Overview (cont.)

Challenge	2009-2012	2013-2015
3. Bioenergy Benefits Verification	With ORNL/ANL • Roundtable on Sustainable Biofuels participation to develop science-based credible standards • GBEP input on "GBEP Sustainability Indicators" • Brazil bilateral support to bioenergy sustainability dissemination	• RSB (now Biomaterials) development as an independent entity; board participation to implement protective but practical standards; continuous learning and delegate annual meetings • GBEP technical input to U.S. presentations to the Capacity Building activity and GBEP Steering Committee (with ORNL/ANL)
4. Expansion of Bioenergy and Sustainability Together		• SCOPE Bioenergy and Sustainability: Bridging the Gaps. NREL Leadership, with ORNL, ANL, INL • Synthesis of UN-related IRENA, SE4ALL, Clean Energy Ministerial, IEA, FAO and gaps

2 – Approach (Technical)

- Develop meta analysis in specific areas in the context of technology development and deployment
- Provide a systemic view including from multiple feedstocks, conversion pathways, product(s) and uses

Critical success factors:

- Sustainability assessments become common best practices for bioenergy and biorefineries projects and eventually use landscape/watershed designs
  - Enabler: Share sustainability lessons from IBR and other projects to decrease the risk of U.S. and global deployment
  - Enabler: continued collection sustainability data of established commercial projects and incorporation into decision-making to decreased investment risk
- Increased market stability (eg, regulatory certainty) to foster continued private investment

Top challenges:

- Existing polarization based on field-specific projections of bioenergy potential needs sufficient sustainability data for multiple contexts, including agriculture adaptation to climate change (adaptation and mitigation together)
- Foster increased resource efficiency in the U.S. bioeconomy

Risks/mitigation of risks:

- U.S. perspective may not be directly presented at key multilateral discussions

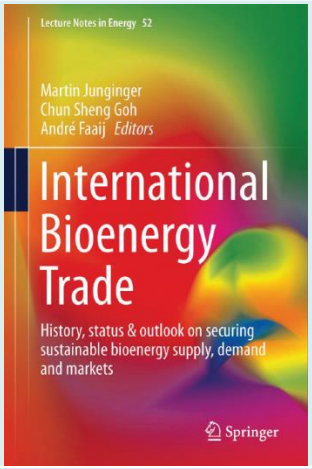
2 – Approach (Management)

- Management approach:
  - The selection of activities provides science-based information to globally important expert peer reviewed assessments
  - Prioritization and selection of activities in consultation with DOE/BETO and EERE International, including Go/No-Go activities
  - Use of milestones for monitoring progress
  - Teleconferences (or Skype), planned activity meetings, emails
- Informs the program on areas where expanded rigorous independent studies are needed to feed the upcoming high-level assessments
- Top challenges:
  - Multi-country efforts require extensive travel and coordination of efforts
  - More difficult to control timing of outputs; many are volunteer efforts of collaborators
  - Small projects subdivided into many subprojects

3 – Technical Accomplishments/ Progress/Results

Challenge	NREL & INL participated in the first IEA Bioenergy Strategic inter-task project peer reviewed multi-chapter book.

1. Overall Benefits



POPULAR CONTENT WITHIN THIS PUBLICATION (by downloads, 2/28)

Synthesis and Recommendations
Junginger, Martin; Goh, Chun Sheng; Faaij, André

Development of Bioenergy Trade in Four Different Settings – The Role of Potential and Policies
Thrän, Daniela; Hennig, Christiane; Thiffault, Evelyne Show all authors (5)

Developments in International Liquid Biofuel Trade
Lamers, Patrick; Rosillo-Calle, Frank; Pelkmans, Luc Show all authors (4)

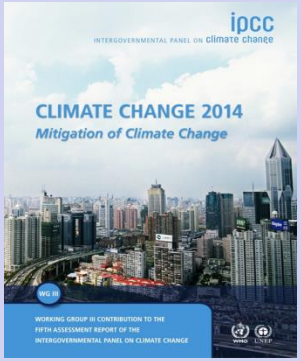
Medium and Long-Term Perspectives of International Bioenergy Trade
Kranzl, Lukas; Daioglou, Vassilis; Faaij, Andre Show all authors (7)

The Role of Sustainability Requirements in International Bioenergy Markets
Pelkmans, Luc; Goovaerts, Liesbet; Goh, Chun Sheng; Junginger, Martin; Dam, Jinke; Stupak, Inge; Smith, C. Tattersall; Chum, Helena; Englund, Oskar; Berndes, Göran; Cowie, Annette; Thiffault, Evelyne; Fritsche, Uwe; Thrän, Daniela Hide authors

NREL

2. Climate Change Benefits

Chum Invited for the Plenary Berlin Approval Session



2014 Top 15 Most Downloaded Papers

GCB Bioenergy (2014), doi: 10.1111/gcbb.12205

REVIEW

Bioenergy and climate change mitigation: an assessment

FELIX CREUTZIG[1], N. H. RAVINDRANATH[2], GÖRAN BERNDES[3], SIMON BOLWIG[4], RYAN BRIGHT[5], FRANCESCO CHERUBINI[5], HELENA CHUM[6], ESTEVE CORBERA[7], MARK DELUCCHI[8], ANDRE FAAIJ[9], JOSEPH FARGIONE[10], HELMUT HABERL[11,12], GARVIN HEATH[6], OSWALDO LUCON[13], RICHARD PLEVIN[14], ALEXANDER POPP[15], CARMENZA ROBLEDO-ABAD[16], STEVEN ROSE[17], PETE SMITH[18], ANDERS STROMMAN[5], SANGWON SUH[19] and OMAR MASERA[20]

SRREN reached 177 citations

3 – Technical Accomplishments/ Progress/Results (cont.)

Challenge

3. Benefits verification, sustainability standards

RSB ROUNDTABLE ON SUSTAINABLE BIOMATERIALS

Page 10

b. Board of Directors

The Board of Directors is responsible for the management of the RSB and represents the Association towards third parties. RSB Board of Directors as of 31 December 2013 are listed below. In addition, Alwin Kopse (former Head of the RSB Secretariat) acted as Secretary to the Board during 2013.

1. Barbara Bramble – National Wildlife Federation (Chair)
2. Khoo Hock Aun – Cosmo Biofuels (Vice-Chair)
3. Maarten van Dijk – SkyNRG (Treasurer)
4. Willemijn van der Werf – Lanzatech
5. Arturo Barrit – Associated Labor Unions – Trade Unions Congress of the Philippines (ALU-TUCP)
⇨ *6. Helena Chum – National Renewable Energy Laboratory (USA)*
7. Michael Rogers – (Legal Counsel)

Chum Previous: Chair, delegate Government Chamber

NRDC Compares Certification Systems

- key attributes,
- economic performance,
- environmental performance, and
- social performance

and subcategories within each.

35 subcategories total

☑ sufficiently protective,
⊖ less protective, or
⊗ insufficient.

NRDC found that each certification system had strengths and weaknesses.

The RSB was most protective.

	⊖	⊗
RSB	1	0
FSC	1	1
RSPO	4	0
Bonsucro	4	1
CSBP	4	3
RTRS	5	3
ISCC	18	2

Sustainability certification systems

- Roundtable on Sustainable Biomaterials (RSB)
- Council on Sustainable Biomass Production (CSBP) (not active)
- International Sustainability & Carbon Certification (ISCC)
- Roundtable on Sustainable Palm Oil (RSPO)
- Roundtable on Responsible Soy (RTRS)
- Bonsucro
- Forest Stewardship Council (FSC)

http://www.nrdc.org/energy/files/biofuels-sustainability-certification-

ISEAL Alliance membership matters

2012-3 FSC BONSUCRO Sustainable Agriculture Network RSB RSPO

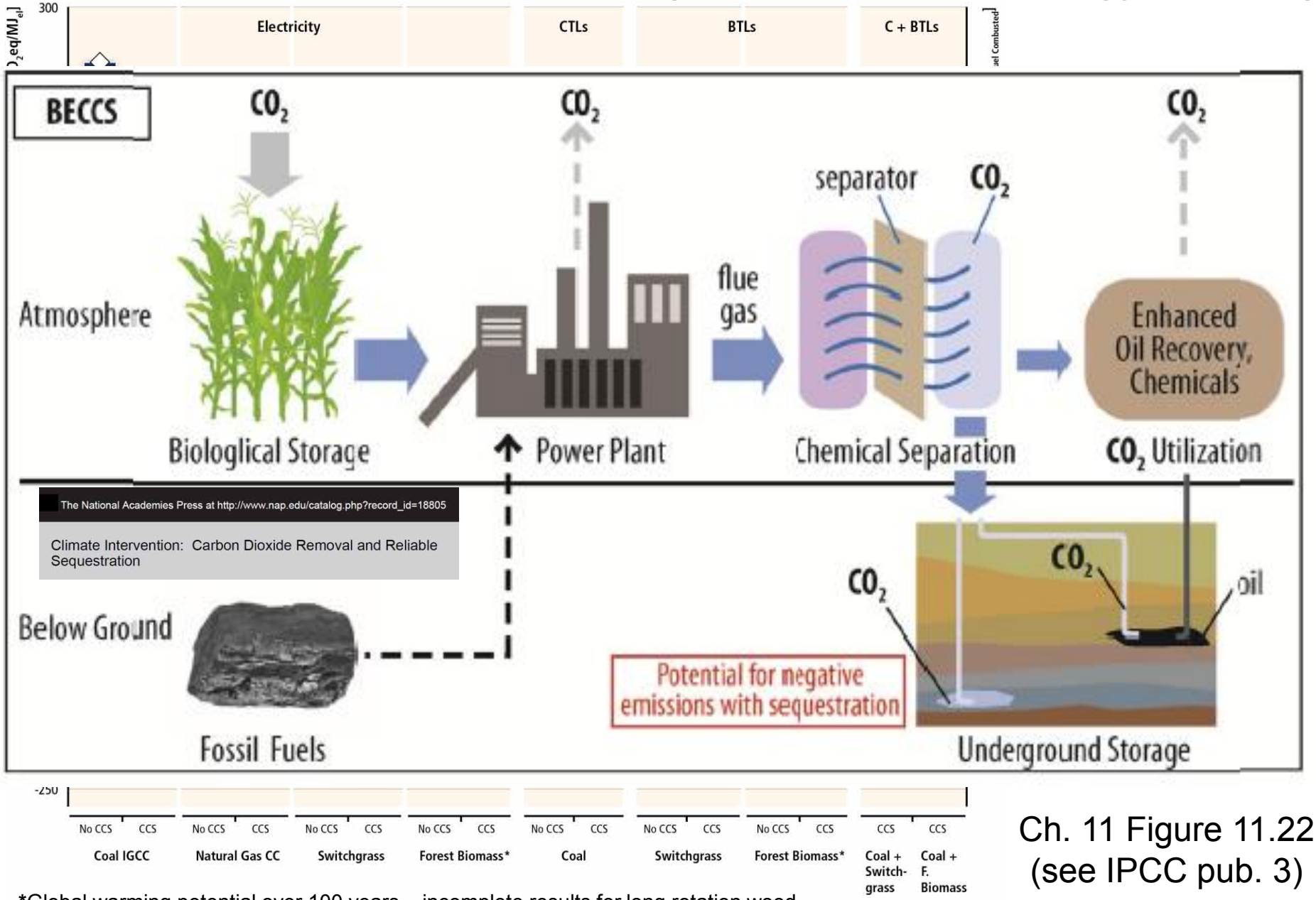
2013-4 FSC BONSUCRO SAN RSB

Affiliate 2012-3: ISCC

http://www.isealalliance.org/

Associate member 2013-4: RSPO
ISCC just an ISEAL subscriber

3 – Technical Accomplishments (AR5 and IEA Bioenergy Task 38)

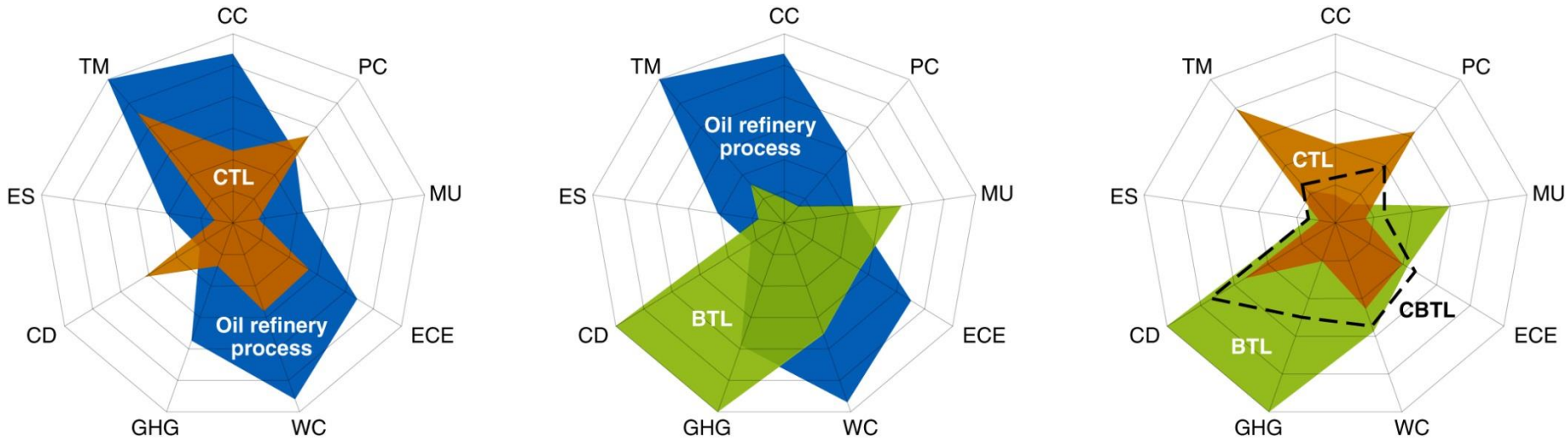


Ch. 11 Figure 11.22
(see IPCC pub. 3)

*Global warming potential over 100 years – incomplete results for long rotation wood.

3 – Technical Accomplishments (SCOPE)

More Sustainability Dimensions: Example Coal/Biomass to Liquids – Stage of Maturity

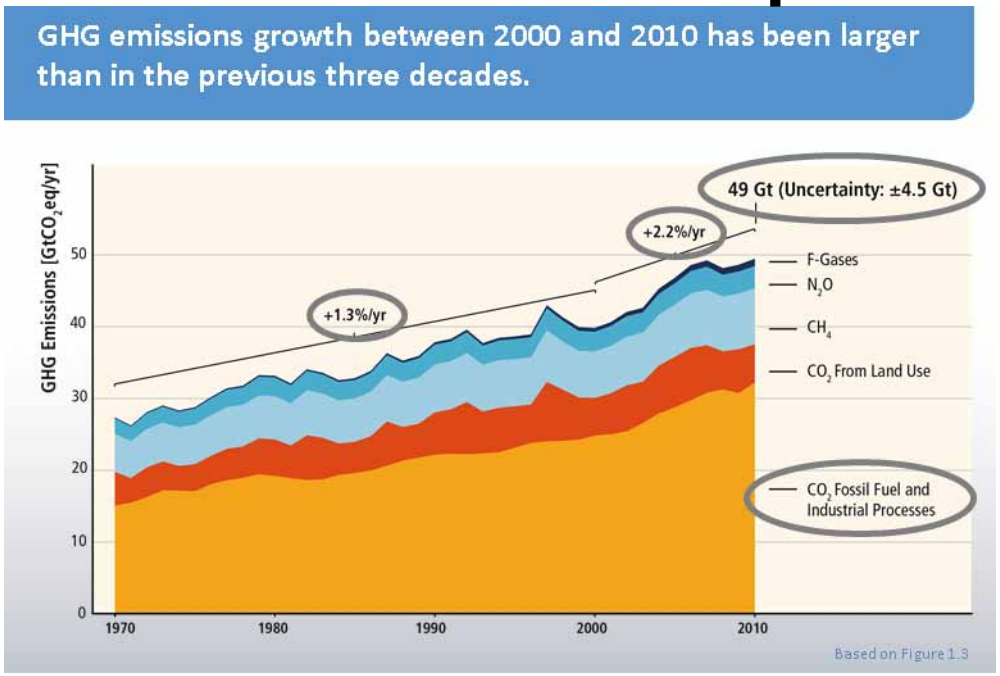


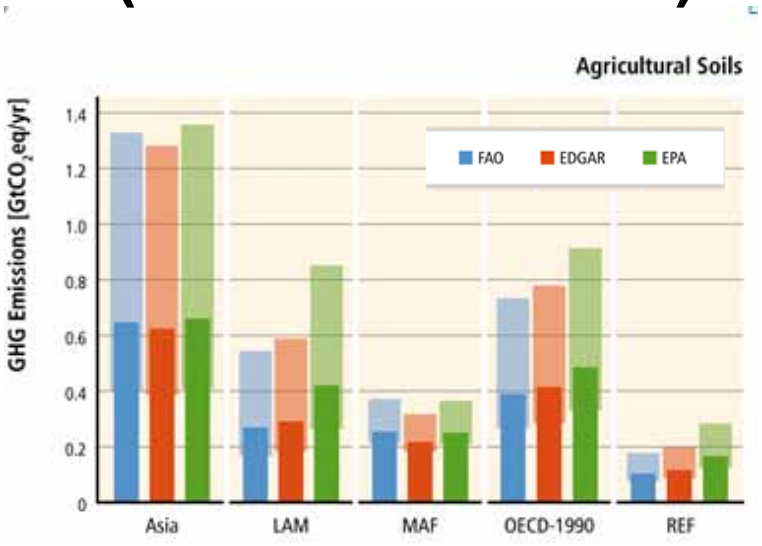
PC – Production Costs MU – Material Utilization ECE – Energy Conversion Efficiency WC – Water Consumption
GHG – GHG Emissions CD – Community Development ES – Energy Security TM – Technical Maturity CC – Capital Costs

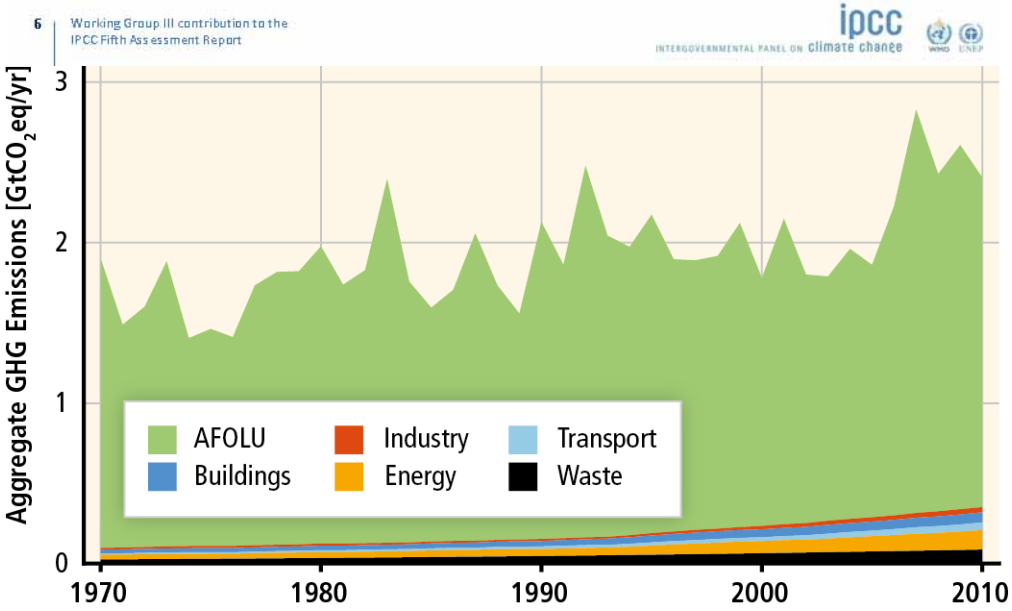
Figure based on Yang et al., 2013

Chum et al., SCOPE Chapter 12, 93 pp. (Figure 12.8). April 14, 2015 release date: 729 page e-book; will be available from FAPESP and linked to from BETO KDF site: https://www.bioenergykdf.net/

3 – Technical Accomplishments (Context of AR5)







Significant efforts of many countries, largely reducing deforestation or increasing afforestation resulted in NET AFOLU emissions decreasing with time.

But measurement uncertainties are the largest in AFOLU.

AFOLU = Agriculture, Forestry and Other Land Use

3 – Technical Accomplishments (Research Issues Addressed by IEA Bioenergy Task 38)

IEA Bioenergy

Climate change effects of bioenergy and biomass systems.

Barrier: Polarized views on large-scale bioenergy benefits to climate change mitigation and potential.

Current regulatory ALCA using ISO standards do not take into account:

- Timing of emissions and removals (sinks)
  - Implement dynamic LCA methodologies under development elsewhere?
- Reference system for LCA
  - Counterfactuals used in woody based systems vary from comparisons with pristine environment to continued use
- Other CC forcings (albedo global or local)
  - Global under investigation; possible to add to models
  - Local effects indirectly enhance mitigation for perennial grasses based on initial model studies; models not verified

PNAS | March 15, 2011 | vol. 108 | no. 11 | 4307–4312

Direct climate effects of perennial bioenergy crops in the United States

Matei Georgescu[a,1], David B. Lobell[b], and Christopher B. Field[c]

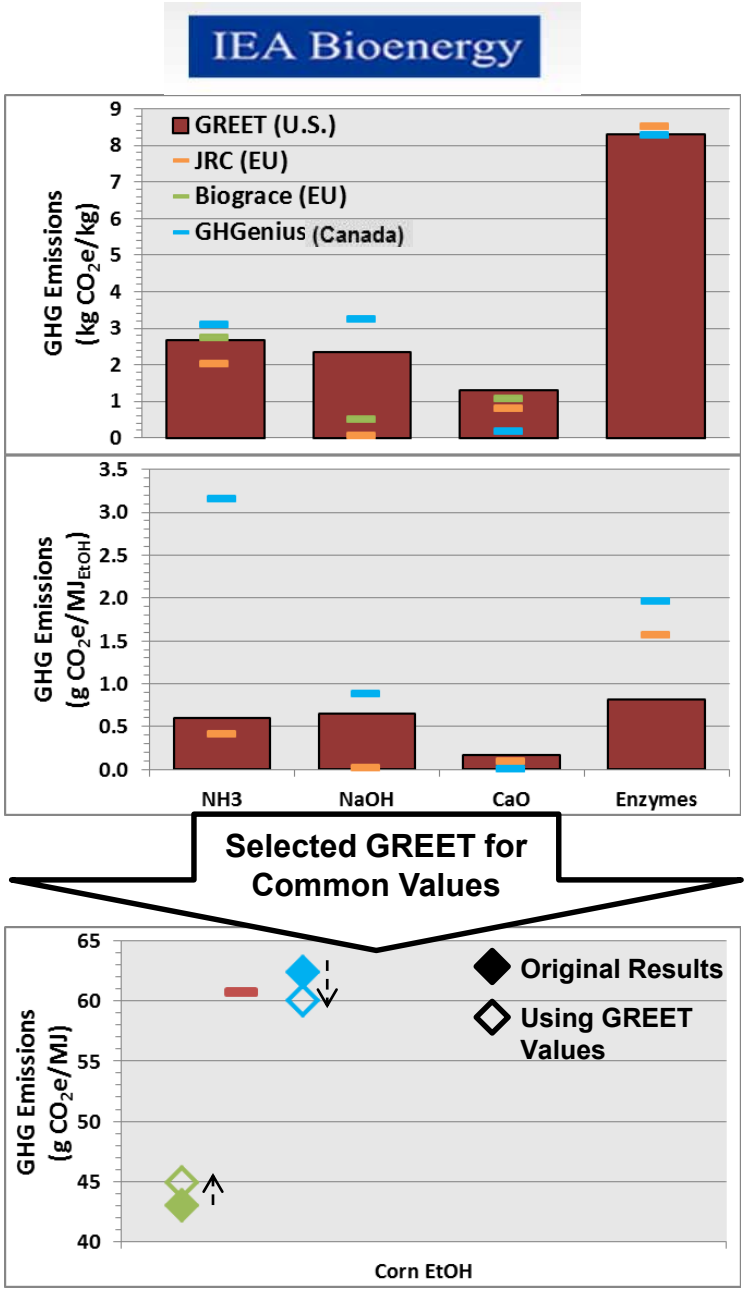
[a]School of Mathematical and Statistical Sciences and Center for Environmental Fluid Dynamics, Arizona State University, Tempe, AZ 85287; [b]Department of Environmental Earth System Science and Program on Food Security and the Environment, Stanford University, Stanford, CA 94305; and [c]Department of Global Ecology, Carnegie Institution for Science, Stanford, CA 94305

Edited by Robert E. Dickinson, University of Texas, Austin, TX 78712, and approved January 28, 2011 (received for review June 20, 2010)

3 – Technical Accomplishments (NREL Work in Progress, Warner)

Quantitative Comparison of Biofuel Lifecycle Assessment (ALCA) Tools

- Problem:
  - Multiple biofuel LCA tools exist, each with differing purposes, methods, and data sources
  - Major structural differences are a barrier to consistent biofuel LCA comparison
- Goal:
  - Understand the differences between models and improve international sustainability metric comparisons
- Approach:
  - Collect and examine differences in data
  - Use a meta-model to apply common assumptions across modeling system
  - Examine the impacts of common assumptions
  - Identify what is difficult to harmonize
- Current Insights From **DRAFT** Results:
  - Data vintage plays a major role in differences between the results from each model
  - Applying common assumptions align results
  - Results that appear consistent may hide differences in underlying assumptions



3 – Technical Accomplishments (Expanding Sustainable Bioenergy)

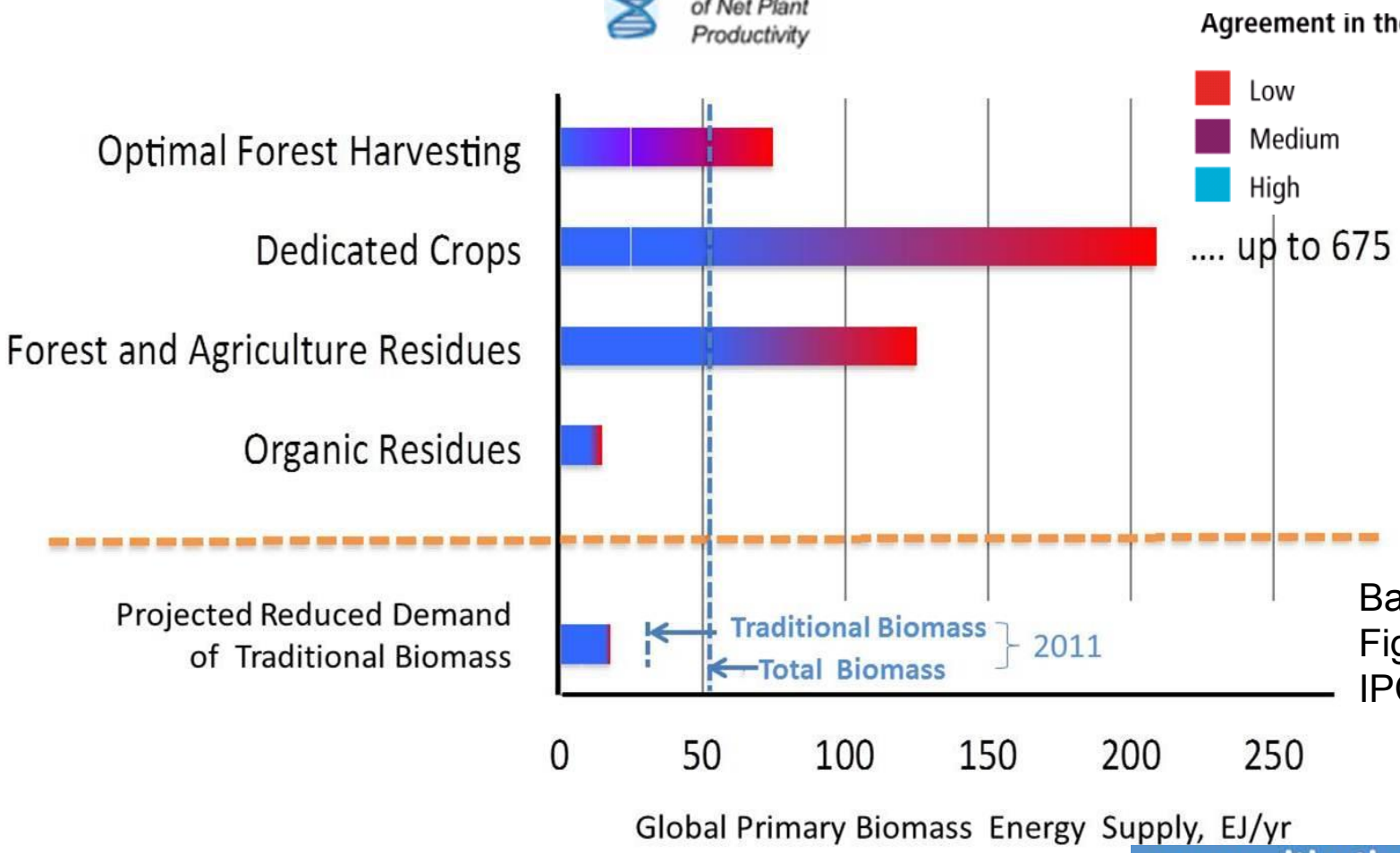
Range of values for dedicated bioenergy crops by field of expertise

UNEP International Resource Panel — *Resource Productivity, Industrial Metabolism*

Ecologists

Human Appropriation of Net Plant Productivity

Integrated Assessment Models: ***Economic dynamics at longer time scales with global aggregation of spatially explicit data, and equilibrium effects (100 to 300 EJ).***



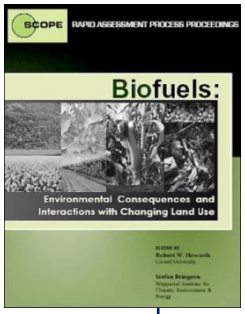
Based on Figure 11.20 IPCC ref 3

Barrier: Polarized views on bioenergy potential

www.mitigation2014.org

Working Group III contribution to the IPCC Fifth Assessment Report

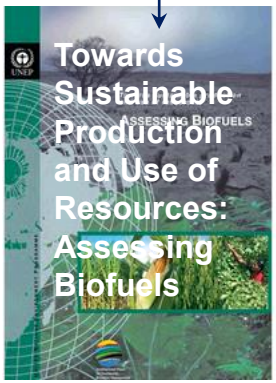
3 – Technical Accomplishments (Top Challenge Resource Productive Bioeconomy)

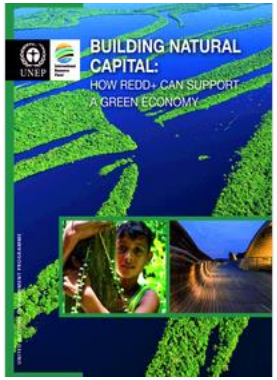


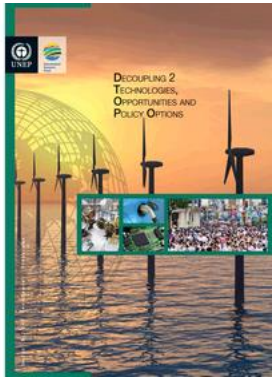
Based on SCOPE 1

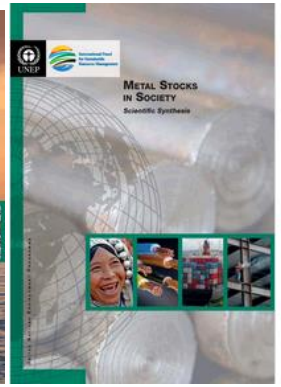
UNEP International Resource Panel

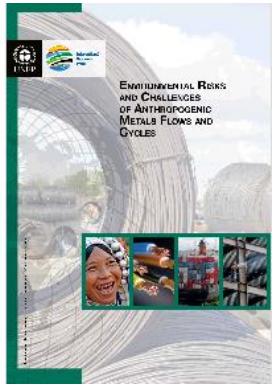
UNEP's Resource Efficiency/ Sustainable Consumption and Production

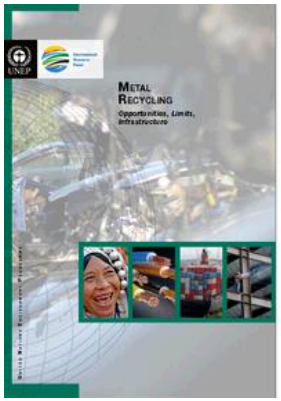


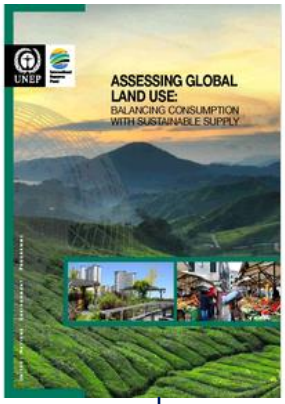


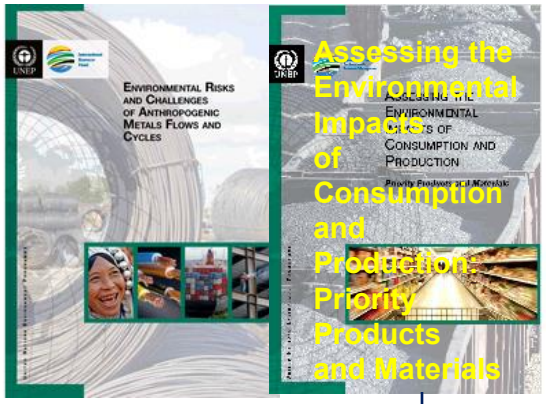


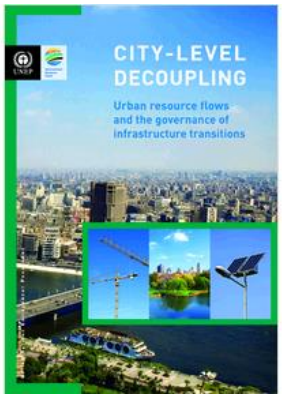


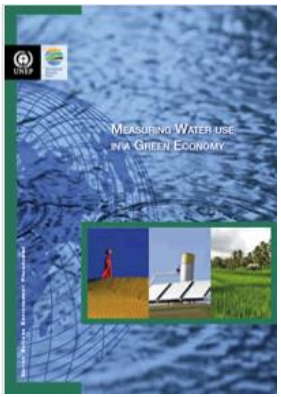












Still largely based on SCOPE 1

Resource Productivity, Industrial Metabolism

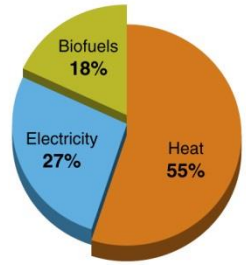
Economic Input-Output Life Cycle Assessment across all supply chains ↔

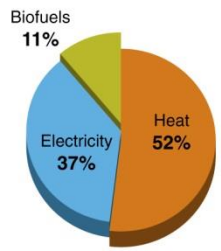
Emerging approaches, challenges and opportunities in life cycle assessment
Stefanie Hellweg and Llorenç Milà i Canals
Science **344**, 1109 (2014);
DOI: 10.1126/science.1248361

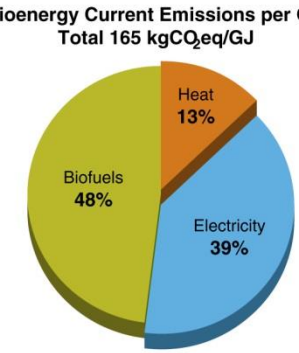
http://www.unep.org/resourcepanel/new/

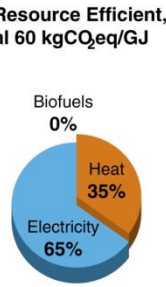
3 – Technical Accomplishments (Bioenergy Productivity)

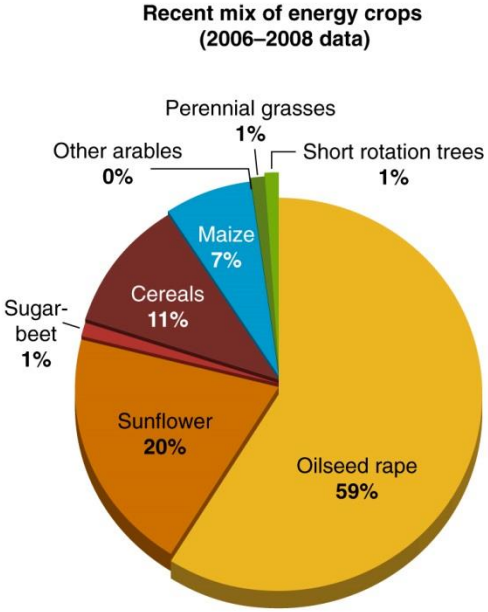
"Considering Resource Efficiency and GHG Mitigation"–European Environmental Agency

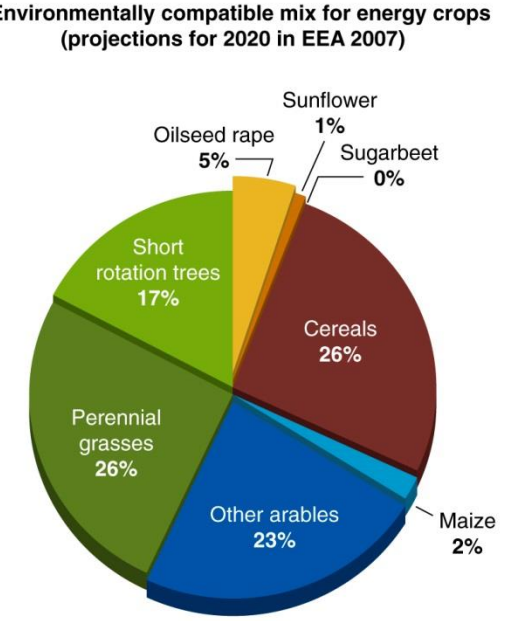


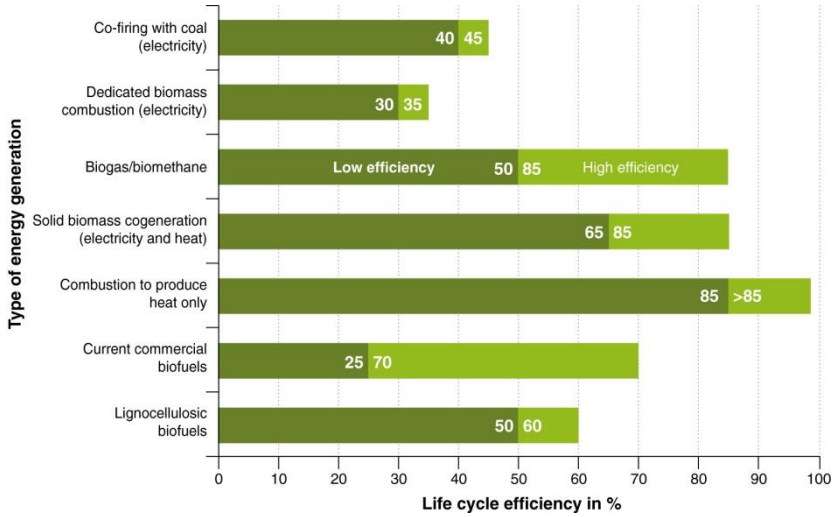












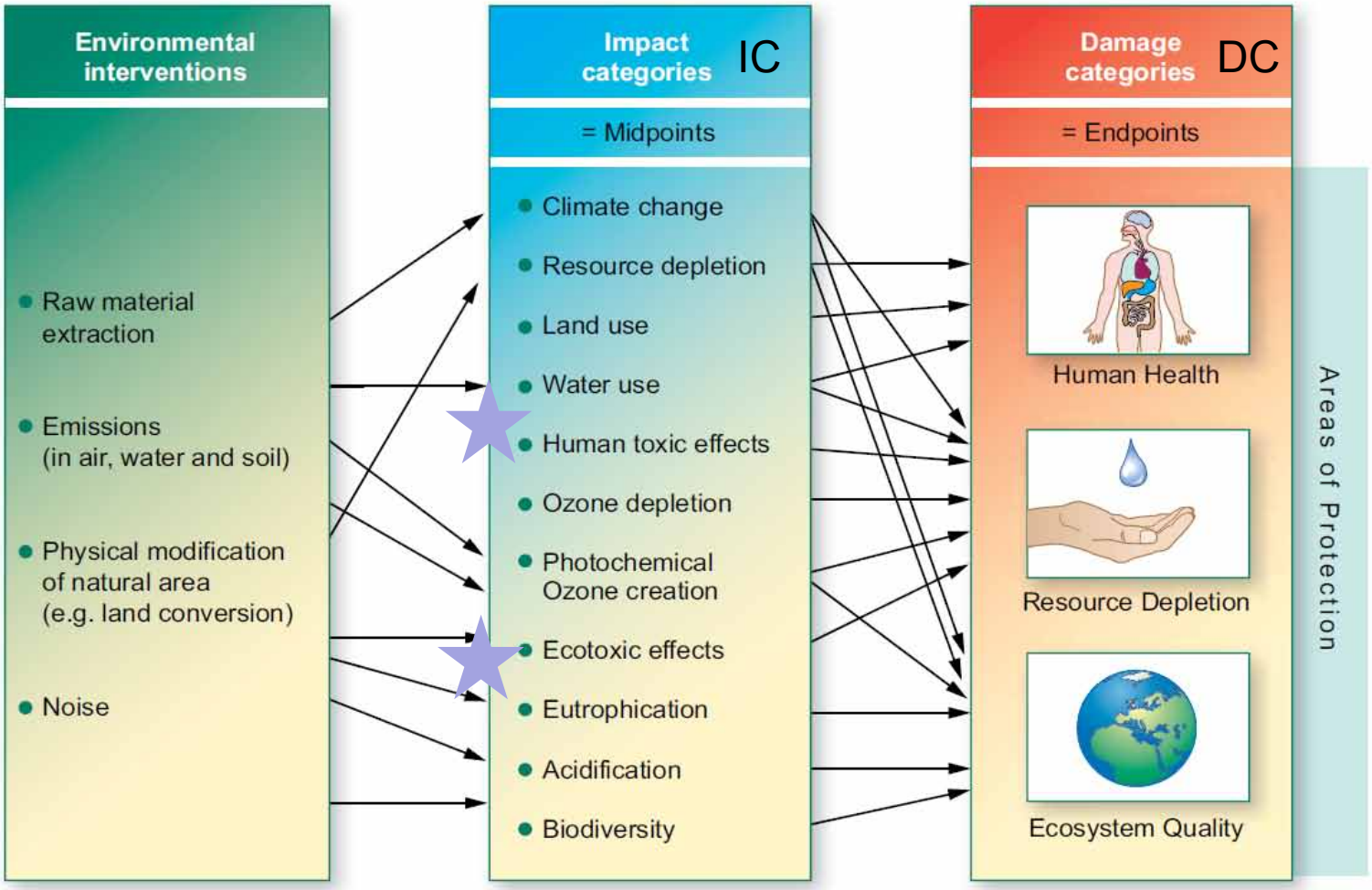
A modeling study: Petersen et al., *Biomass and Bioenergy* (65), pp. 170-182 (2014)

Chum et al., SCOPE Chapter 12, 93 pp. April 14, 2015 release date

3 – Technical Accomplishments (Benchmarking Additional Life Cycle Impact Categories)

U.S. practices up to this point

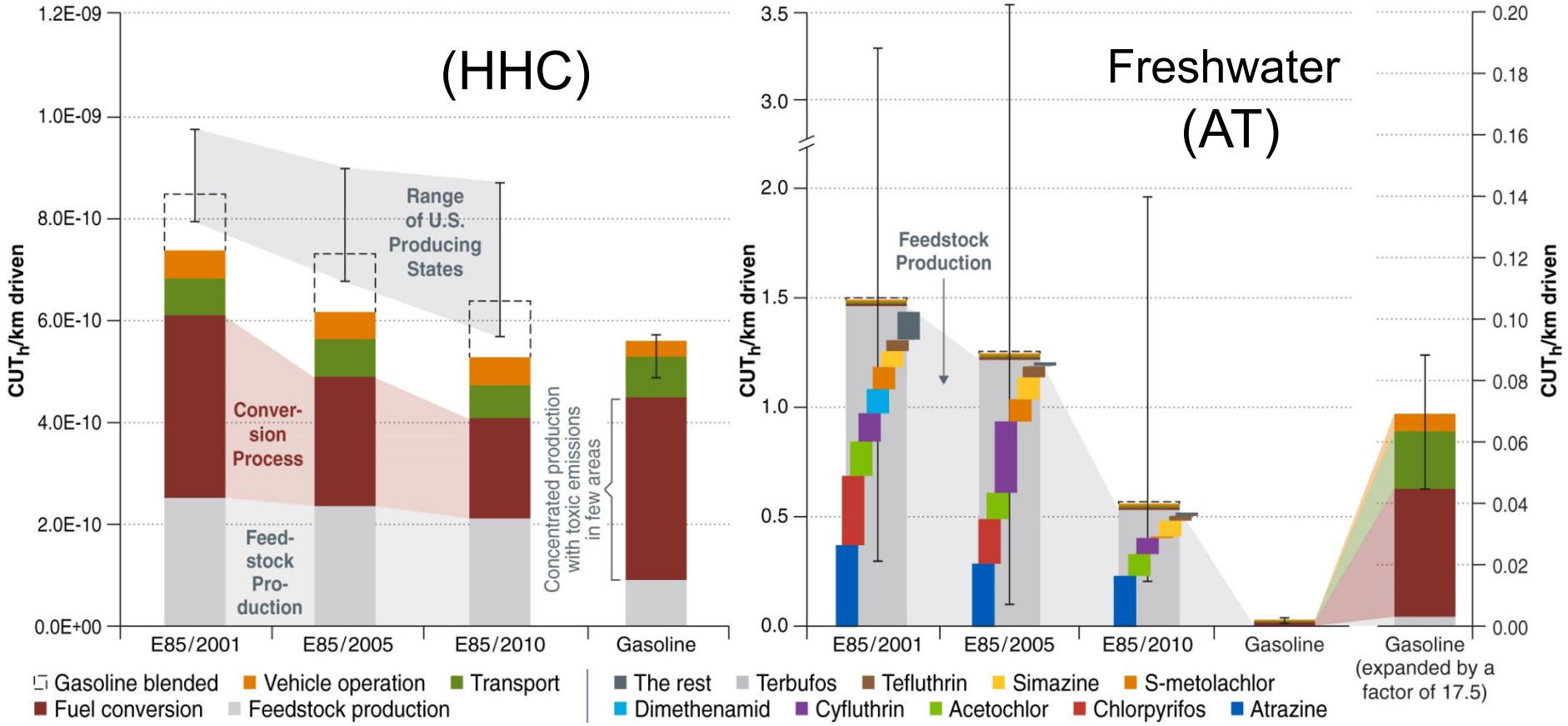
IC contributions converted to 3 DC by assigning values (some countries)



UNEP/SETAC Life Cycle Impact Assessment Midpoint-Damage Framework (based on Jolliet et al. 2004)

3 – Technical Accomplishments (SCOPE)

Lifecycle Assessment Benchmarks Corn Ethanol: Trends in Human Health Cancer (HHC) and Aquatic Ecotoxicity (AT)



Units are Comparative Toxic Units per km driven, which represent potential increase in human morbidity (or aquatic toxicity), calculated using the EPA USEtox model and TRACI 2.0.

Chum et al., SCOPE Ch. 12, April 14, 2015 release date; Yang, Y. *Journal of Cleaner Production* (53), pp. 149-157 (2014).

3 – Technical Accomplishments (SCOPE Bioenergy and Sustainability)

Organized by SCOPE, FAPESP BIOEN, BIOTA, FPMCG

- Land Use, Feedstocks, Technologies and Impacts, Key Findings, Conclusions and Policy Recommendations
- 136 contributors from 81 institutions in 24 countries

April 14, 2015 Launch

Part 1

1. Executive Summary
2. Bioenergy Numbers
3. Energy Security
4. Food Security
5. Environmental and Climate Security
6. Sustainable Development and Innovation
7. Filling the Gaps - The Much Needed Science

BETO Labs Participation

Chum, Scientific Advisory Committee member, Co-author Ch. 1, 2, 6, Lead Ch. 12, Responsible Scientific Adv. Committee for Ch. 9 and 20.

Foust/Arent, Ch. 3

Kline, co-author Ch. 9

Dale, co-author Ch. 16

Wang, co-author Ch. 17

Several NREL staff contributed to Chapter 12: Beckham, McCormick, Tao, Warner, Overend

USDA Participation

Karlen (with Muth Jr., Ex INL) Ch. 14,

Neary Ch. 18

Part 2

8. Perspectives on Bioenergy
9. Land and Bioenergy
10. Feedstocks for Biofuels and Bioenergy
11. Feedstock Supply Chains
12. Conversion Technologies for Biofuels and Their Use – 93 pages
13. Agriculture and Forestry Integration
14. Case Studies
15. Social Considerations
16. Biofuel Impacts on Biodiversity and Ecosystem Services
17. Greenhouse Gas Emissions from Bioenergy
18. Soils and Water
19. Sustainability Certification
20. Bioenergy Economics and Policies
21. Biomass Resources, Energy Access and Poverty Reduction

http://bioenfapesp.org/scopebioenergy/index.php/project-overview

729 page e-book; will be available from FAPESP and linked to BETO KDF site: https://www.bioenergykdf.net/

4 – Relevance

- Increase knowledge of the performance of current commercial biofuels on economic, environmental, and social dimensions, including process-related conversion impacts over time, benchmarking.
- Increase understanding of the emerging cellulosic bioenergy industry as it diversifies products, technology development of supply chains, multiple parallel conversion technologies, and portfolios of uses.
- Advance the understanding of climate change mitigation impacts in the context of the multiple environmental, social, and economic goals of current and advanced biofuels and bioenergy systems.
- Advance the understanding of the role of voluntary standards and certification in the expansion of the bioeconomy.
- Increase knowledge of global partners of the current commercial and developing technologies.
- Decrease barriers to international trade for U.S. biofuels and products industry.

5 – Future Work

- Complete SCOPE Bioenergy and Sustainability and participate in the launch in April 2015, Sao Paulo, Brazil. Continue with activities to disseminate its findings and complete Policy Briefs.
- Present "Sustainability Practices for Integrated Biorefineries" at the Indonesia GBEP Bioenergy Week in May 2015.
- Complete the IEA Task 38 paper on the differences between the various LCA methodologies (models and data) – meta-analysis and present at the October 2015 IEA Bioenergy Conference in Berlin; additional papers
- Continue the activities of the IEA Bioenergy Inter-task effort examining the effect of pasture intensification in the Brazilian system compared to the commercial benchmark.
- Continue dissemination of findings of the IPCC SRREN, AR5, SCOPE Bioenergy and Sustainability in national and international venues and produce peer reviewed papers
- Foster collaboration with groups with best practices in GHG inventories and carbon credits
  - Coalition on Agriculture Greenhouse Gases active on measurement and verification
  - U.S. UNFCCC GHG Inventories–U.S. National Resource Ecology Laboratory, Fort Collins

Summary

Category	Project Approach
Overview	Technical expertise of the PI, team, and BETO researchers was provided through this activity to various high-level assessments of bioenergy and sustainability. Insights from climate change and resource efficiency studies suggest that the use of systemic approaches to production, conversion, and product(s) use of biomass is needed for all its uses.
Approach	Partnering and stakeholder engagement in bioenergy and sustainability assessment is conducted for U.S. government/BETO UN- or IEA-related multilateral initiatives, which are updated periodically. The task: (1) provided a systemic view including from multiple feedstocks, conversion pathways, product(s), and uses; (2) disseminated findings; (3)identified areas for high level BETO publications as these studies continue; (4) identified U.S. bioenergy industry opportunities with global expansion efforts;
Technical Accomplishments	Project delivered (1) highly cited high-impact publications; (2) improved the understanding of the U.S. bioenergy systems; (3) confirmed the validity of BETO's approaches for sustainability assessments;
Relevance	The project: (1) increased knowledge of global partners of the U.S. current commercial and developing technologies; (2) worked to decrease barriers to international trade from U.S.; and (3) brought in the views of ongoing global sustainability activities.
Future Work	Plans include: (1) synthesize, analyze, and make recommendations to BETO on complex inter-related global multilateral activities in biomass and sustainability; (2) SCOPE Bioenergy and Sustainability launch, policy brief, findings dissemination; (3) IEA Bioenergy, RSB, and related activities.

Collaborators - 1

DOE BETO: Alison Goss Eng, Kristen Johnson, Alicia Lindauer, Zia Haq, Paul Grabowski, Gene Petersen (retired BETO)
NREL: Helena Chum, Ethan Warner, Yimin Zhang, Rich Bain (retired), Adam Bratis, Mary Biddy, Garvin Heath, Maggie Mann
ANL: Michael Wang, Maria Cristina Negri and May Wu.
ORNL: Keith Kline, Debo Oladosu, Maggie Stevens and Virginia Dale.
EERE International: Robert Sandoli
IEA Bioenergy Task 38: 2015 Annette Cowie, Miguel Brandao, and Stephen Schuck, Australia Alison Goss Eng and Kristen Johnson (USA), Sebastian Rüter and Hermann Achenbach (Germany), Regis Leal (Brazil), Roland Gerard (France), Leif Gustaffson and Matti Parika (Sweden), Kati Koponen, Kim Pingoud, Sampo Soimakallio (Finland); Francesco Cherubini, Anders H. Strømman and Ryan Bright (Norway).
IEA Bioenergy Task 38: White Paper -Annie Levasseur (Canada), (Canada); from US: Alissa Kendall Gregg Marland, Eric Marland, Richard Plevin, Michael O'Hare, Ken Skog (USDA); Matti Parikka and Lars Zetterberg (Sweden); Tuomas Helin (Finland) ; Francesco Cherubini, Anders H. Strømman and Ryan Bright (Norway); Miko Kirschbaum (New Zealand). Miguel Brandao, New Zealand, now chair of the timing portion of the white paper; Chum of the legislative portion of the white paper.
GBEP: Kristen Johnson (DOE)
IPCC 5th Assessment Report Bioenergy: Felix Creutzig (Germany), N. H. Ravindranath (India), Göran Berndes (Sweden), Simon Bolwig (Denmark), Ryan Bright, Francesco Cherubini, Esteve Corbera (Spain) , Andre Faaij (The Netherlands), Helmut Haberl (Germany), Garvin Heath (US), Oswaldo Lucon (Brazil), Omar Masera (Mexico), Richard Plevin, Alexander Popp (Germany), Carmenza Robledo-Abad (Switzerland), Steven Rose (US), Pete Smith (UK), Anders Stromman, Sangwon Suh (US).
IPCC 5th Assessment Report Transportation and Energy Systems Chapters: Ralph Sims and Thomas Bruckner, CLAs, respectively.
IEA Bioenergy Inter-Task (outside 38): Tat Smith, Göran Berndes, Hans Langeveld, Evelyne Thiffault, Niclas Scott Bentsen, Arnaldo Walter, Martin Junginger
UK-DECC: Alexandre Strapasson and Jeremy Woods (Imperial College, London).

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Additional Slides

Responses to Previous Reviewers' Comments

- "It is clearly important for the U.S. to remain participatory in international conversations; DOE has an important role in bioenergy agendas. The ongoing complex and heated disputes among international entities regarding deployment of genetically modified organisms stand as a cautionary tale with respect to inattention and/or disregard of international concerns and agendas. Unfortunately, the nature of this particular **presentation was such that it was difficult to discern the structure of activities**— many seem ad hoc— as well as their relative importance. (**In regards to this particular comment, I am not sure that the criticisms of previous reviews were addressed**.) While it may be defensible to be a bit ad hoc given the extent to which international activities can be disrupted by externalities, if investment dollars are constrained or relatively minimal, it is important to have a strategy to allocate money to the most important activities. This was not clear from the presentation; failure to clarify and justify the selection of activities may leave the Office open to criticism and lack of support from entities uncertain or less certain of the value of ongoing international engagement."

Response

The PI agrees with the reviewer. The 2015 presentation explains the inter-relationships of the activities, their formation is somewhat ad hoc. The schedule of these activities is tied to the UN or the OECD processes. The IPCC will decide in 2015 how long it will be before the next update occurs. The likely situation is that WG1 will take the usual 5-7 years. The activities of WG2 (adaptation and risk) and WG3 (mitigation) have much more frequent need to update information as demonstrated by the bioenergy activities updated to 2011 that had to be re-evaluated two years later. It is possible that these reports will be more frequent. The IEA Bioenergy Agreement runs triennium groups of activities; the U.S. selects those it wants to participate. The Strategic Inter-tasks are a very welcome opportunity too look at bioenergy in an integrated manner across the participating countries. Significant intelligence is obtained through this process by all parties. The triennium inter-task project is extremely important to BETO: "Mobilizing the supply chain." The SCOPE project could have appeared to be ad-hoc but it is an update of a UNESCO/SCOPE publication # 8 in biofuels in 2009. It feeds the UNEP International Resource Panel, the "State of the Environment," and other publications. In addition, the major environmental topics get summarized in policy briefs for policymakers see (http://www.scopenvironment.org/Unesco_scope.htm). European countries are much more numerous and much more connected with the design of sustainability for bioenergy as shown in the next transparency for Germany. They are linked to all of the majority of the multilateral activities with multiple members sponsored by the EU program or by individual countries. Prioritization directly addressed in the presentation.

Example of multi-funded European research

Dr. Leire Iriarte

Research Fellow, IINAS

International Institute for Sustainability Analysis and Strategy

In Dr. Uwe Fritsche's group,/IEA Bioenergy partner.

presented at the Expert workshop for the ***How2Guide for Bioenergy***

Bangkok, **23-24 July, 2014**

research sponsored by

UNEP | IEA Bioenergy | European Environment Agency | Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety | Umwelt Bundesamt

Projects & Studies

IINAS Internationales Institut für Nachhaltigkeitsanalysen und -strategien GmbH

- Sustainability criteria for BIOMASS FUTURES www.biomassfutures.eu
- Sustainability criteria for non-food feedstocks (FP7) Crops Industry www.crops2industry.eu
- Global Assessments and Guidelines for Sustainable Liquid Biofuel Production in Developing Countries (FAO/UNEP/UNIDO) for the GEF gef
- Joint Workshop series focusing on extending the RED to forest bioenergy www.iinas.org/redex.html
- GBEP Global Bioenergy Partnership Indicators for Sustainable Bioenergy http://www.globalbioenergy.org/
- Resource-Efficient Bioenergy in EU27 (for EEA, together with Alterra)
- Possibilities of sustainable wood energy trade and impacts on developing countries (with CENBIO for BMZ/GIZ) giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
- Sustainability of certified wood bioenergy feedstock supply chains: Ecological, operational and international policy perspectives. IEA Bioenergy Task 40 + 43 (ongoing)

Final Thoughts

IINAS International Institute for Sustainability Analysis and Strategy

- **Harmonization** of schemes is needed
- **Coherent sustainability requirements** for all bioenergy (electricity, heat, transport) and biomaterials, biorefineries etc. needed
- **Bioeconomy**: **not** food (or fuelwood) vs. fuel but **land use**
- Opportunities with residues and wastes (cascading) and marginal and degraded land : **yes**, but consider trade-offs
- Address **social** effects (positive and negative)
- **Improve** indicators: C balances, maps for biodiversity and nutrient depletion risk ("**go**" areas!)
- **Integrated** agro-energy-water and forest-energy projects needed to deliver on synergy opportunities
- **Holistic vision** of sectors, risks and opportunities

Similar version presented at the workshop "Transatlantic Trade in Wood for Energy: A Dialogue on Sustainability Standards and Greenhouse Gas Emissions" Oct. 23-24, 2013 in Savannah, Georgia (USA) as part of IEA Bioenergy Intertask Studies

Previous Reviewers' Comments

- "The partnering and stakeholder engagement is the core value added of this task. The participation, dialogue, and analysis support to international and certification bodies is a complementary strength. The synthesis of the lifecycle GHG emissions, regulatory levels, and certified trade provide the basis for an important technology transfer and dissemination of U.S. progress and efforts in biofuel sustainability."

We thank the reviewers for highlighting the importance of the project.

- "This is a very high-level project that attempts to address a number of objectives that fit into BETO's goals regarding international sustainability. The work of this group appears far reaching, with international efforts ranging from partnerships with Brazil to IPCC studies. Although difficult to measure the impact of these efforts in terms of metrics, there is an obvious need to have personnel working on certification standards and representing U.S. interests through international efforts."

Thank you very much for the comments and the request to put some impact metrics. We have added some impact metrics of the work which reinforce the value of these activities for the U.S. and cooperating countries.

- "This project has a broad international objective with the main focus on collaboration, alignment, and dissemination of information. The project's value is common understanding and clarity around trade. Because the project addresses many sum-objectives, **its organization and management is somewhat unclear**; nevertheless, the progress is significant."

Thank you very much for the comments. Each of the main projects had its own organizational and management structure, usually very complex, as shown in the next two pages for the review of IPCC projects. The IEA Bioenergy tasks have two stages – one of publication of initial reports reviewed by IEA members from which peer reviewed publications are prepared. The first Intertask activity had 5 IEA task reports. Last year and this year the two major peer reviewed publications. SCOPE has had a level of review similar to the IPCC from the starting organization proposed by the Scientific Advisory Committee, reality check at the meeting in Paris (one level of papers review), re-scoping the effort based on actual authors who might be able to complete and second level internal and first level external of peer review. Revised manuscripts were submitted to a second external review and comments incorporated. Finally, the whole product together (>700 pages) was reviewed by key peer reviewers to address levels of treatment across the book of sensitive issues. The Conversion paper was written three times until I was satisfied that sustainability across the production of the biofuel and the use of the product were addressed. Of course this caused delays in milestones compared to initially planned; one was justified and one was late.

Written response was agreement with the reviewers comments

Example of IPCC review process

Scoping Mtg
Lubeck, Germany
1/2008

IPCC approves outline

Governments, organisations nominate experts

Report Structure
CLA & LA Mtg
S. Jose Campos, Brazil
1/2009, Goss Eng

Bureaux select Authors

Zero Order Draft – 6/2009
CLA & LA Review
Oslo, Norway
9/2009, Goss Eng

Authors prepare 1st - order DRAFT

12/2009

Expert Review

Reviewers Comments
CLA & LA Review
Oxford, UK
3/2010, Chum

Authors prepare 2nd - order DRAFT

6/2010

Expert and Government Review

Reviewers Comments
CLA & LA Review
Mexico City, Mexico
9/2010,Chum and Goss Eng

Authors prepare FINAL DRAFT

Pre-Final Draft
11/2010

IPCC Reviewers
CLA Meeting
Potsdam, Germany
1/2011, Chum

Final distribution and Government Review of SPM

3/2011

WG / IPCC accepts/approves Report and SPM
5/2011

IPCC WGIII Plenary
CLA Meeting
Abu Dhabi, Chum
5/2011

Publication of report

Web report: 6/2011
Print: ~9/2011

Management

SRREN Full Report CLAs
Ottmar Edenhofer (Germany),
Ramon Pichs-Madruga (Cuba),
Youba Sokona (Ethiopia/Mali),
Kristin Seyboth (Germany/USA)

Peer reviewed and internationally available scientific technical and socio-economic literature, manuscripts made available for IPCC review and selected non-peer reviewed literature produced by other relevant institutions including industry

SRREN

1070 pages

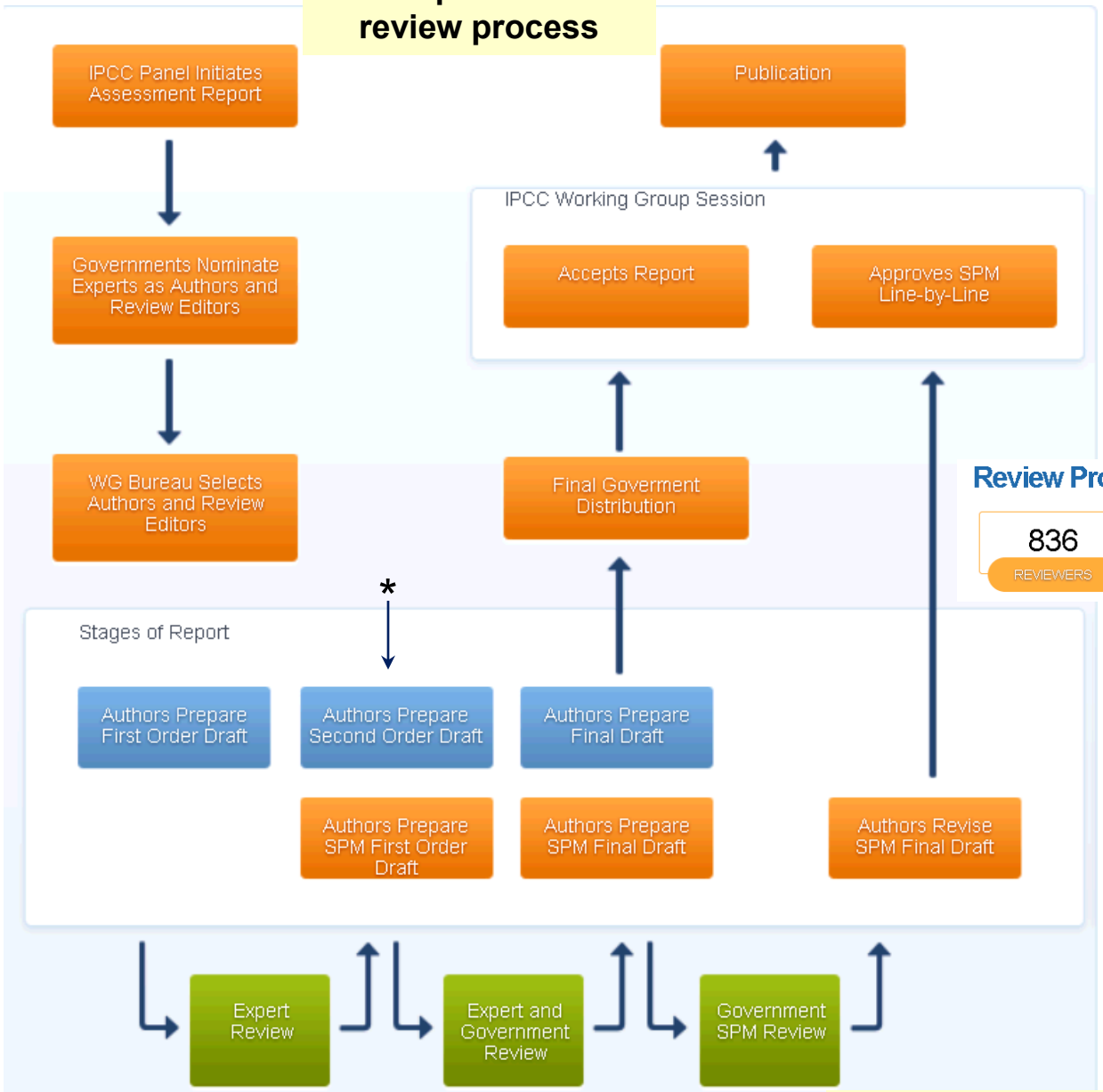
Authors
- 122 Lead
- 132 Contributing

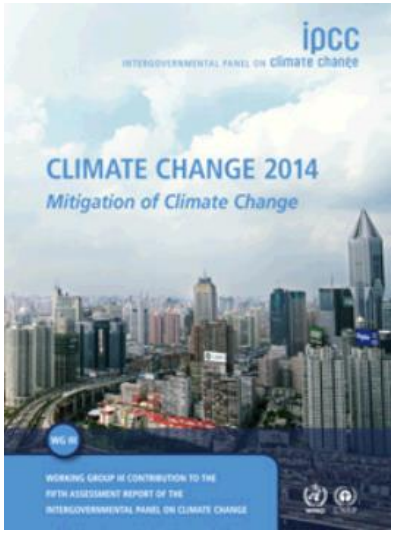
Countries: 122
Review Editors: 35

350 peer reviewers
~25,000 comments

Several additional meetings of specific groups addressing modeling and crosscutting issues

Example of IPCC review process





Review Process

836	66	37	38,296
REVIEWERS	COUNTRIES	GOVERNMENTS	COMMENTS

Working Group 3 Process

* Chum brought in to Lead from Contributing author, thus participating responding to comments. Also invited to the SPM approval on a line-by-line meeting in April 2-14, 2014 (nearly two unplanned weeks, with travel sponsored by the WMO).

Part of response To Peer Reviewer

Previous Reviewers' Comments

- "This project provides an open line of communication with the international community now making important judgments and decisions about the sustainability of bioenergy globally. For that reason, the kind of minimal presence that the project team brings to these activities is important. The efforts to participate in studies with IPCC, IEA, and United Nations Educational, Scientific, and Cultural Organization should most certainly be continued. The project's support of the U.S.-Brazil bilateral partnership is another valuable component of the work. It would good to see this project develop a more focused sense of desired outcomes for this work."

Many thanks for the comments and help in focus the reporting of these activities. Instead of talking about the accomplishments I was focusing on the problems that we were addressing at a level that was inappropriate for all reviewers. This peer review attempts to bring the focus and type of material reported at the more appropriate level.

IPCC Peer Reviewed Publications

1. **F. Creutzig, N. H. Ravindranath, G. Berndes, S. Bolwig, R. Bright, F. Cherubini, H. Chum, E. Corbera, M. Delucchi, A. Faaij, J. Fargione, H. Haberl, G. Heath, O. Lucon, R. Plevin, A. Popp, C. Robledo-Abad, S. Rose, P. Smith, A. Stromman, S. Suh, O. Masera 2014. Bioenergy and climate change mitigation, Global Change Biology: Bioenergy doi: 10.1111/gcbb.12205, 29 pages. Top 15 most downloaded publication of 2014 in this journal (published7/4/2014)**

IPCC, 2014: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 1435 pp. (print citation). [Download from http://mitigation2014.org/]

2. **Chapter 7 on Energy Systems** by Coordinating Lead Authors (CLAs): T. Bruckner, I. A. Bashmakov Y. Mulugetta; Lead Authors (LAs): **H. Chum**, A. De la V. Navarro, J. Edmonds, A. Faaij, B. Fungtammasan, A. Garg, E. Hertwich, D. Honnery, D. Infield, M. Kainuma, S. Khennas, S. Kim, H. B. Nimir, K. Riahi, N. Strachan, R. Wiser, X. Zhang, pp. 511-598
3. **Chapter 11, Agriculture Forestry and Other Land Use Change** with Appendix on **Climate effects, mitigation options, potential and sustainability implications of bioenergy**. CLAs: P. Smith, M. Bustamante as Lead Authors: H. Ahammad, H. Clark, H. Dong ,E. A. Elsiddig, H. Haberl, R. Harper, J. House, M. Jafari, O. Masera, C. Mbow, N. H. Ravindranath, C. W. Rice, C. Robledo-Abad, A. Romanovskaya, F. Sperling, F. Tubiello; CAs: G. Berndes, S. Bolwig, H. Böttcher, R. Bright, F. Cherubini, **H. Chum**, E. Corbera, F. Creutzig, M. Delucchi, A. Faaij, J. Fargione, G. Hänsel, **G. Heath**, M. Herrero, H. Jacobs, O. Lucon, D. Pauly, R. Plevin, A. Popp, J. R. Porter, S. Rose, A. de S. Pinto, S. Sohi, A. Strømman, S. Suh, pp. 811-923.
4. **Chapter 8 on Transport** by CLAs: R. Sims, R. Schaeffer; LAs: F. Creutzig, X. Cruz -Núñez, M. D'Agosto, D. Dimitriu, M. J. F. Meza, L.Fulton, S. Kobayashi, Ol. Lah, A. McKinnon, P. Newman, M. Ouyang, J. J. Schauer, D. Sperling, G. Tiwar; CAs: A. A. Amekudzi, B. S. M. Cesar Borba, **H. Chum**, P.Crist, H.Hao, J. Helfrich, T. Longden, A. F.Pereira de Lucena, P. Peeters, R. Plevin, S. Plotkin, R. Sausen, pp. 599-670
5. **Summary for Policymakers** by WG3 Co-Chairs: O. Edenhofer, R. Pichs - Madruga, Y.Sokona (Mali), Writing Team: S. Agrawala, I. A. Bashmakov, G. Blanco, J. Broome, T. Bruckner, S. Brunner, M. Bustamante, L. Clarke, F. Creutzig , S. Dhakal, N. K. Dubash, P. Eickemeier, E. Farahani, M. Fischedick, M. Fleurbaey, R. Gerlagh, L.Gómez - Echeverri , S. Gupta, S. Gupta, J. Harnisch, K. Jiang, S. Kadner, S. Kartha, S. Klasen, C.Kolstad , Volker Krey, H. Kunreuthe, O. Lucon, O. Masera, J. Minx, Y. Mulugetta, A. Patt, N.H. Ravindranath, K. Riahi, J. Roy, R. Schaeffer, S.Schlömer, K. Seto , K. Seyboth, R. Sims, J. Skea, P. Smith, E. Somanathan, R. Stavins, C. von Stechow, T. Sterner, T. Sugiyama, S. Suh, K.C. Urama , D. Ürge - Vorsatz, D. Victor, D. Zhou, Ji Zou, T. Zwickel; Draft CAs: G. Baiocchi, **H. Chum**, J.Fuglestvedt, H. Haberl, E. Hertwich, E. Kriegler, J. Rogelj, H. Rogner, M. Schaeffer, S.Smith, D. van Vuuren, Ryan Wiser, pp. 1-32.

Other Peer Reviewed Publications

Bilateral Publications
Sustainability Indicators and Benchmarks of Commercial Systems

6.Chum, H. L.; Warner, E.; Seabra, J. E. A.; Macedo, I. C., A comparison of commercial ethanol production systems from Brazilian sugarcane and US corn. Biofuels, Bioproducts and Biorefining 2014, 8, (2), 205-223.

7.Chum, H. L.; Zhang, Y.; Hill, J.; Tiffany, D. G.; Morey, R. V.; Goss Eng, A.; Haq, Z., Understanding the evolution of environmental and energy performance of the US corn ethanol industry: evaluation of selected metrics. Biofuels, Bioproducts and Biorefining 2014, 8, (2), 224-240.

IEA Bioenergy

Strategic IEA Bioenergy Tasks

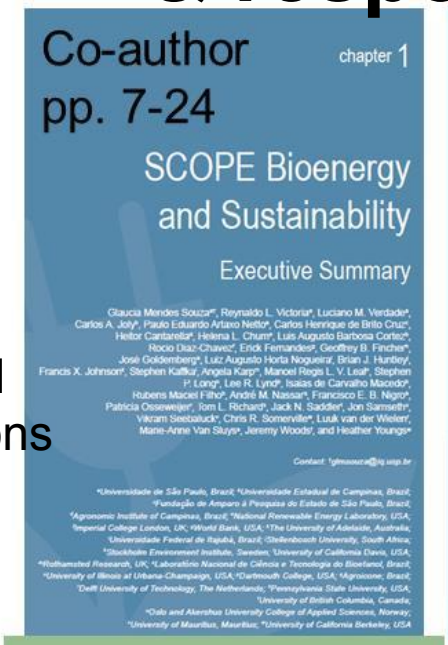
8.Pelkmans, L., L. Goovaerts, C. Goh, M. Junginger, J. van Dam, I. Stupak, C. T. Smith, H. Chum, O. Englund, G. Berndes, A. Cowie, E. Thiffault, U. Fritsche and D. Thrän (2014). The Role of Sustainability Requirements in International Bioenergy Markets. In International Bioenergy Trade: History status & outlook on securing sustainable bioenergy supply demand and markets. Series: Lecture Notes in Energy Vol. 17, Junginger M., Goh C. S., Faaij A. (Eds.) pp. 125-149, I
SBN: 978-94-007-6981-6

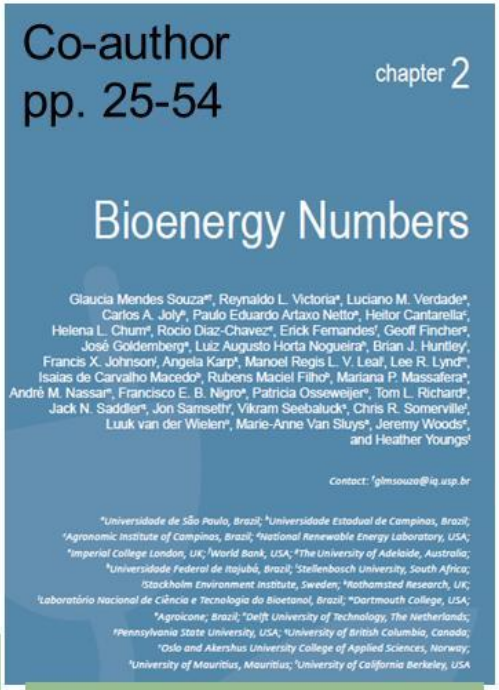
9.Inge Stupak, Ph.D.; Jamie Joudrey; C. Tattersall Smith; Luc Pelkmans; Helena Chum; Annette Cowie; Oskar Englund; Chun S Goh; Martin Junginger. "A global survey of stakeholder views and experiences for systems needed to effectively and efficiently govern sustainability of bioenergy", Wiley Interdisciplinary Reviews: Energy and Environment, In press - 2014.

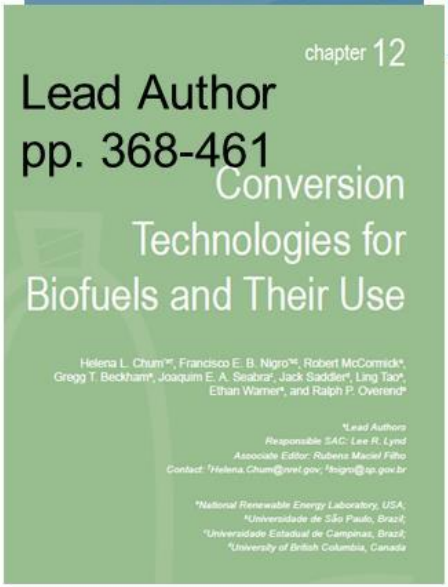
SCOPE Peer Reviewed Publications & responsible SAC member

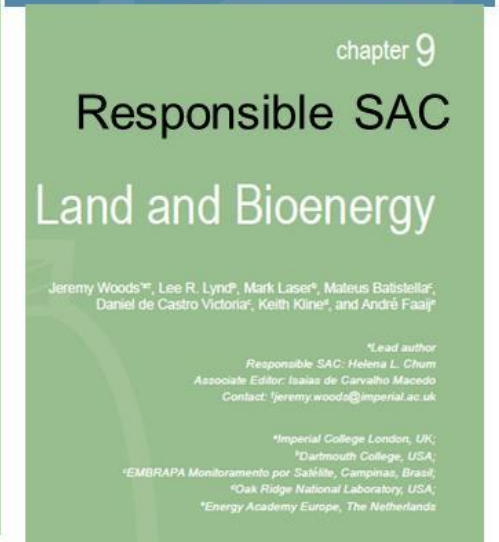
Launch April 15

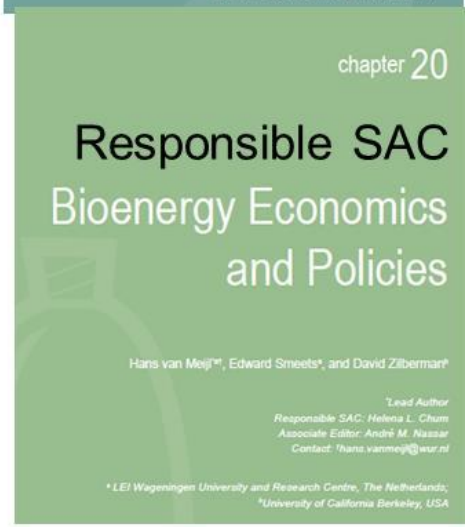
Four additional publications











Invited Presentations

The Grantham Institute, EIT Climate-KIC and Energy Futures Lab Seminar, Imperial College, London, UK, November 13, 2014,

- Chum, H. The role of the bioeconomy in climate change mitigation, https://www.youtube.com/watch?v=BKvEPPyx88w

C-AGG (Coalition on Agricultural Greenhouse Gases) Meeting, Denver, CO, July 15, 2014

- Chum, H. Implications for agricultural, forestry, and bioenergy offsets opportunities. http://c-agg.org/cm_vault/files/docs/HChum.pdf

Envisioning a Carbon Negative Economy: Workshop on Energy Supply with Negative Carbon Emissions, Denver, CO, September 4-5, 2014

- Chum, H. Climate Change 2014: Mitigation of Climate Change https://vimeo.com/107083387; https://www.biorenew.iastate.edu/files/2014/06/chumh.pdf

Colorado Renewable Energy Society – JEFFCO Chapter, Wheat Ridge, January 24, 2015

- Chum, H. Replacing Fossil Fuels - Can Biomass take over? https://www.youtube.com/channel/UCr81EUb2qVJVfmmlJMxEHVw

Invited Presentations

SCOPE Bioenergy and Sustainability: Bridging the Gaps

- H. Chum. “Integrated Biomass Conversion Systems” Plenary lecture at the 2nd Brazilian Bioenergy Science and Technology Conference (BBEST), Campos do Jordão, State of São Paulo, Brazil, October 20th-24th, 2014. (summary of conversion and use chapter and the context of bioenergy development UN/SE4ALL).

4th Meeting of the Green Chemistry School, Brazilian Chemical Industry, UFRJ, Workshop on Renewable Chemical Raw Materials, September 25, 2014, Rio de Janeiro, RJ, Brazil.

- H. Chum. Biorefineries, Sustainability Considerations, & Innovation, plenary lecture
  - http://quimicaverde.eq.ufrj.br/download/biorefineries-sustainability-considerations-and-innovation.pdf
- Case Study – RD&D to Commercialization

IEA Bioenergy

- Chum, H. and Goss Eng, A., Biomass and Bioenergy in the United States, Plenary talk at the 2013 Bioenergy Australia Conference, at Hunter Valley, Australia, November 25, 2013
- Chum, H., Warner, E., Cowie, A. Bioenergy – the evolution of sustainability schemes and certification of lifecycle GHG emissions, IEA Bioenergy Task 38 Session at the 2013 Bioenergy Australia Conference, at Hunter Valley, Australia, November 25, 2013
- Berndes, G., Cowie, A., Smith, C., Chum, H., Gustavsson, L., Pingoud, K., Kline, K. (2014). Perspectives on Quantifying the Benefits of Forest-Based Bioenergy. 22nd European Biomass Conference and Exhibition, Hamburg, Germany, 23-26 June, 2014

Honors

- "Top 125 People in the Advanced Bioeconomy" for 2015, January 2015. At number 74 , the NREL contributors: Philip Pienkos, PhD, Tom Foust, Mary Biddy, Helena Chum for NREL. Chum honored at the 2015 Annual Bioeconomy Leadership Conference for the assessments linking stage of development of technologies.

- Nominated to the BIO Rosalind Franklin Award for Leadership in Industrial Biotechnology in 2014 (see awardee and nominees): http://www.rosalindfranklinsociety.org/news/rfsbriefings/124-the-bio-rosalind-franklin-award-for-leadership-in-industrial-biotechnolog

- External Examiner of the PhD Thesis of Alexandre Strapasson, under Lecturer Jeremy Woods at the Imperial College, London, UK November 12, 2014. The Limits of Bioenergy: A complex systems approach to land use dynamics and constraints, http://hdl.handle.net/10044/1/19269

- Served as Delegate to the Roundtable on Sustainable Biomaterials and during the period of 2013-2015 also served as delegate then Chair in previous structure (2009-2011) and Member of the Board of Directors 2 years ending 6/2015. Remains as Delegate of Chamber 7.