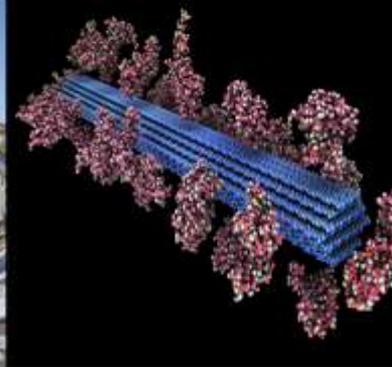




U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



Sustainability Practices for Integrated Biorefineries

GBEP Bioenergy Week
Medan, Indonesia
May 25-29 , 2015

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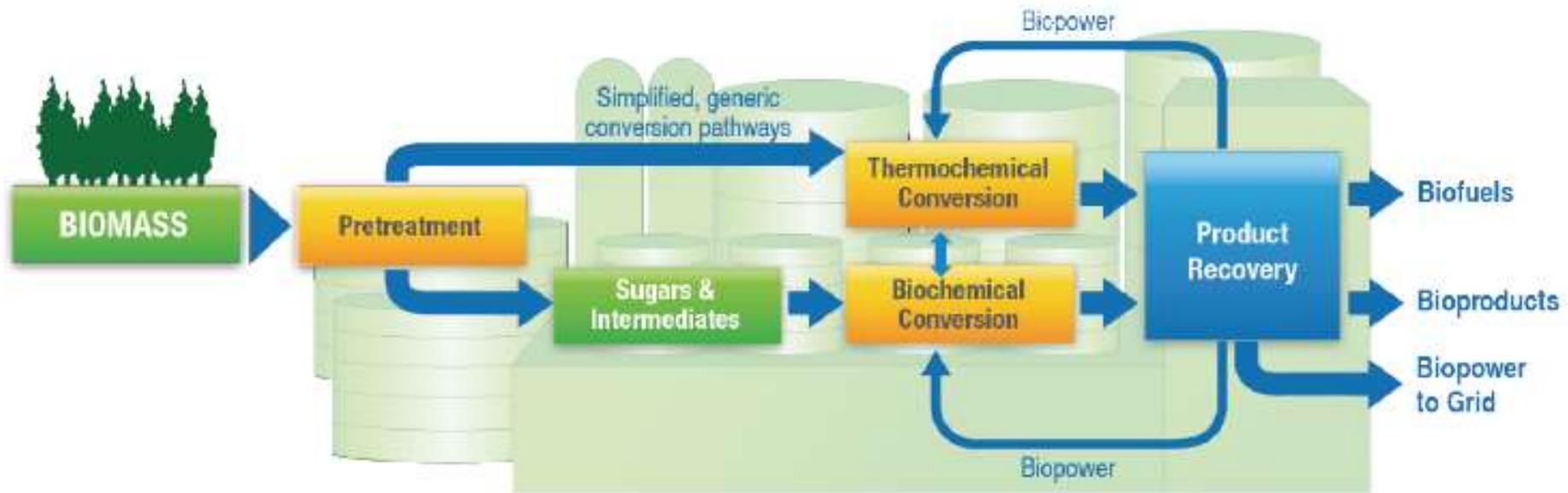
Overview

- **Integrated Biorefineries**
 - Dimensions of sustainability practices
 - Historical examples
- **Across the supply chain to multiple products**
 - Palm Oil Example
 - Best practice integration of heat, power, and efficient use of palm
 - Continuous improvement
 - Best practice – small scale anaerobic digestion CDM audited projects
- **Country-wide best practices**
 - Communication to the UNFCCC on the inventory of GHG emissions (non Annex I parties)
 - Relevance to Bioenergy

Key Challenge for Innovation Involves Lowering Risks

De-risking technologies is central to R&D through demonstration that addresses greater integration and scale: **NEW PROCESSES**

- BETO is focusing on advancing renewable gasoline, diesel, and jet fuels technologies.
- Technical, construction, operational and financial/market risks.



Key Challenges			
Biomass	Pretreatment	Conversion	Product
<ul style="list-style-type: none"> • Reliable supply • Consistent quality • Affordable delivery 	<ul style="list-style-type: none"> • Biomass feeding, sizing and moisture • Solids handling • Construction materials 	<ul style="list-style-type: none"> • Products Yields • Construction materials • Catalysts • Fermentation organisms 	<ul style="list-style-type: none"> • Separations • Catalytic upgrading • Recycle loops

Demonstration and Market Transformation Activities



Pioneer Scale:

POET-DSM

INEOS

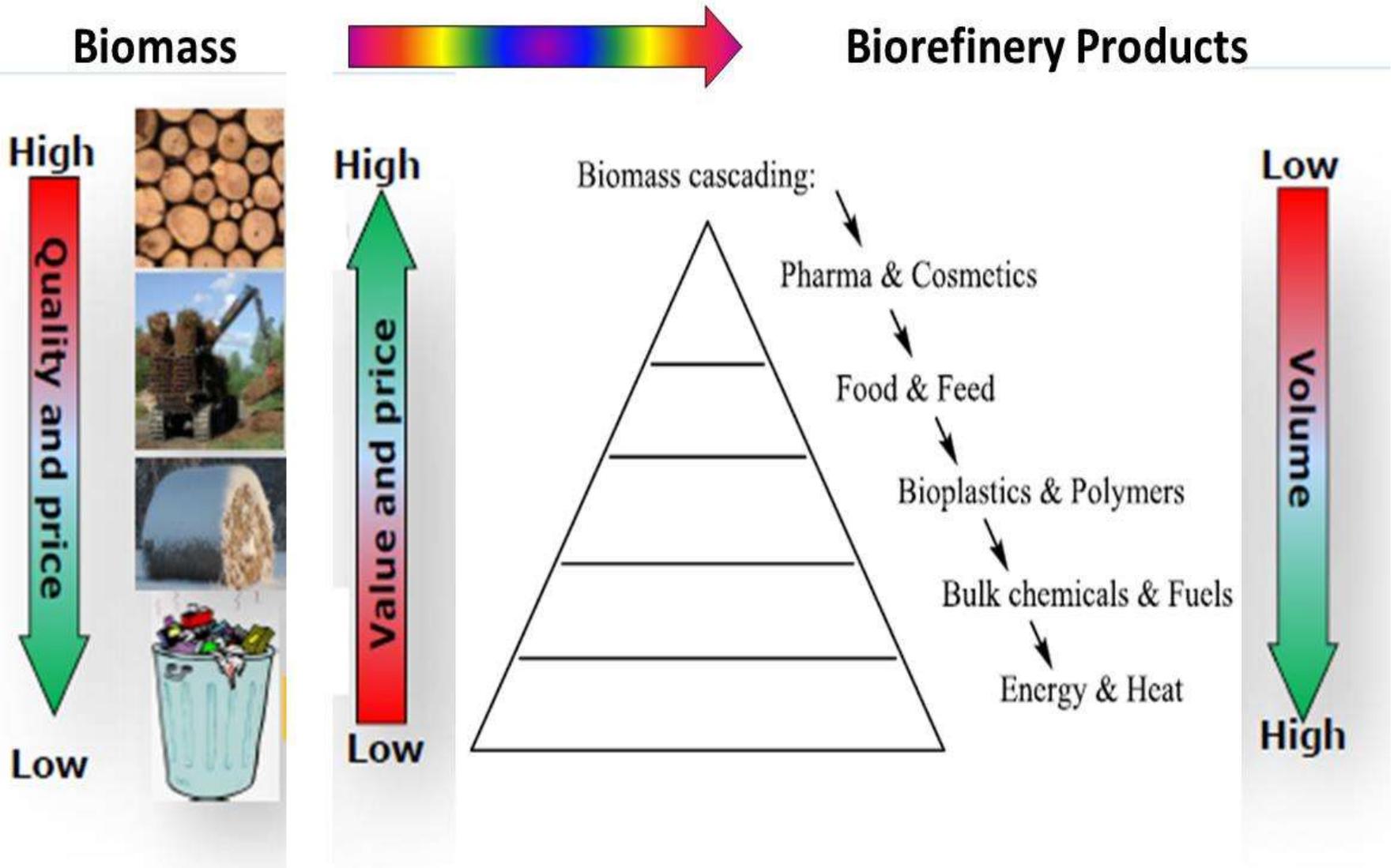
Abengoa

Pilot Scale:

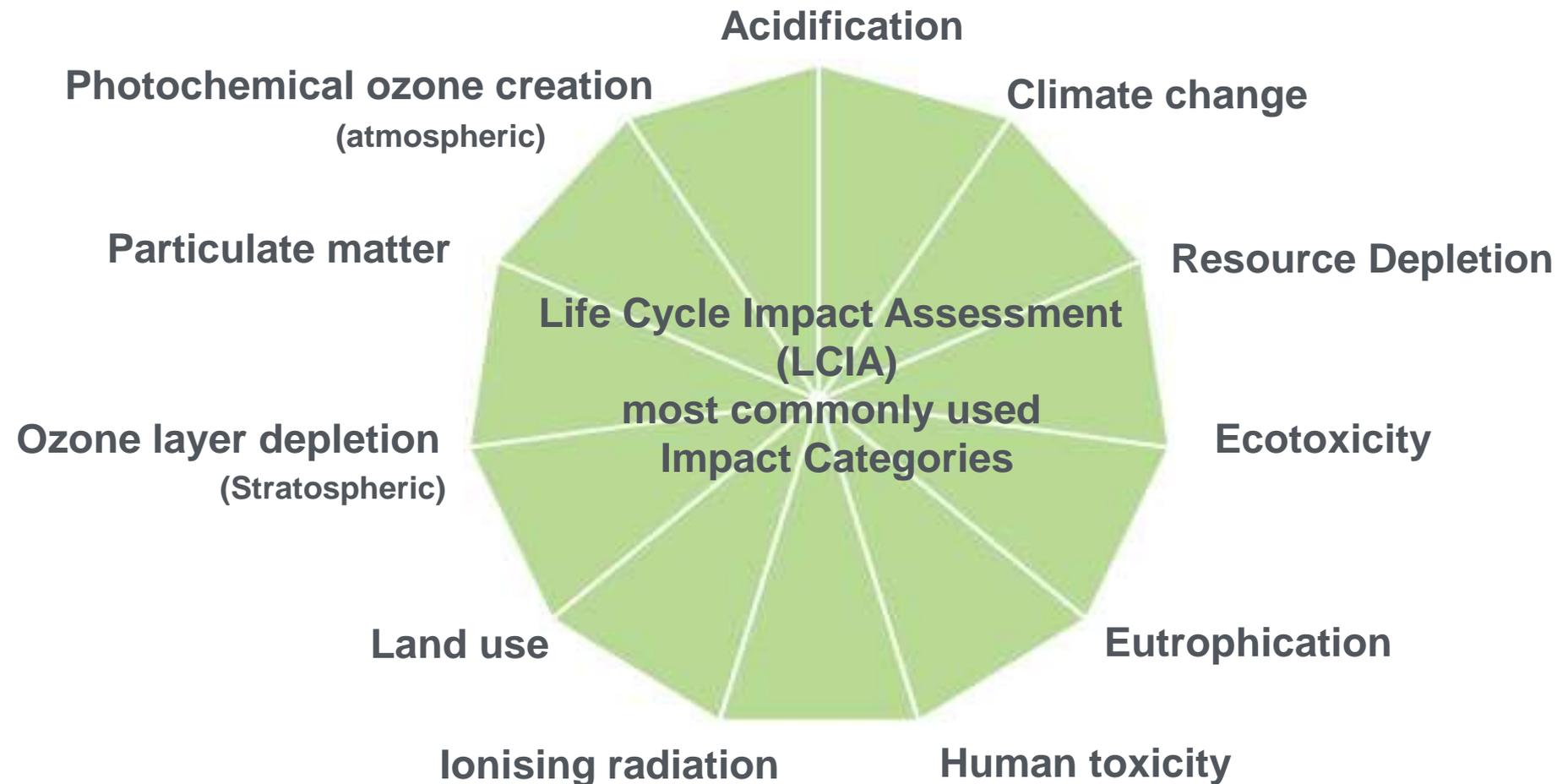
Alpena

<http://www.energy.gov/eere/bioenergy/integrated-biorefineries>

Biorefineries – Many Types

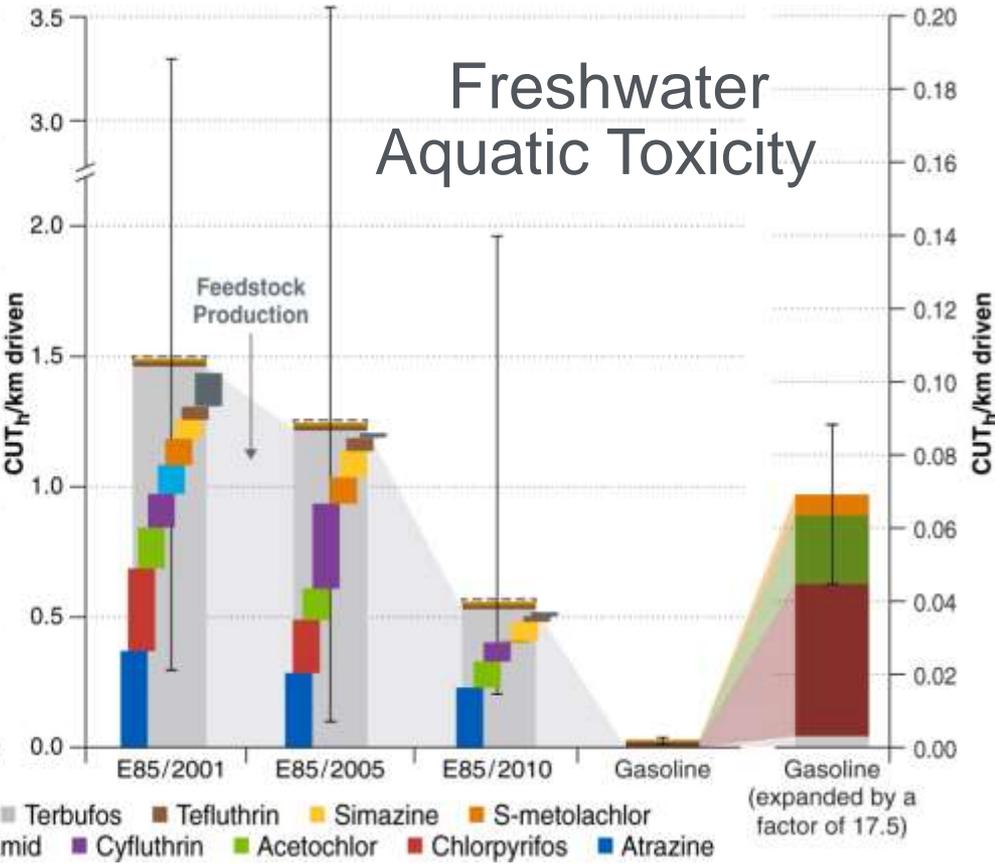
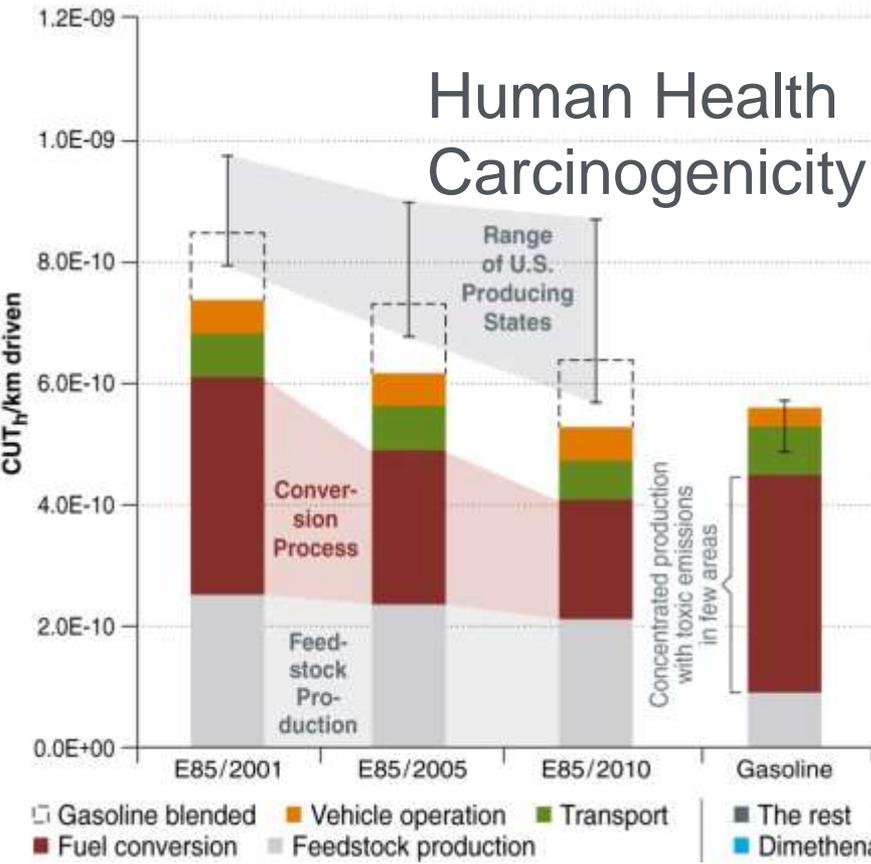


Sustainability practices dimensions from LCA assessments



Environmental Impact of Biofuels, Edited by Marco Aurélio dos Santos Bernardes,
ISBN 978-953-307-479-5, 280 pages, <http://www.intechopen.com/books/how-to-link/environmental-impact-of-biofuels>

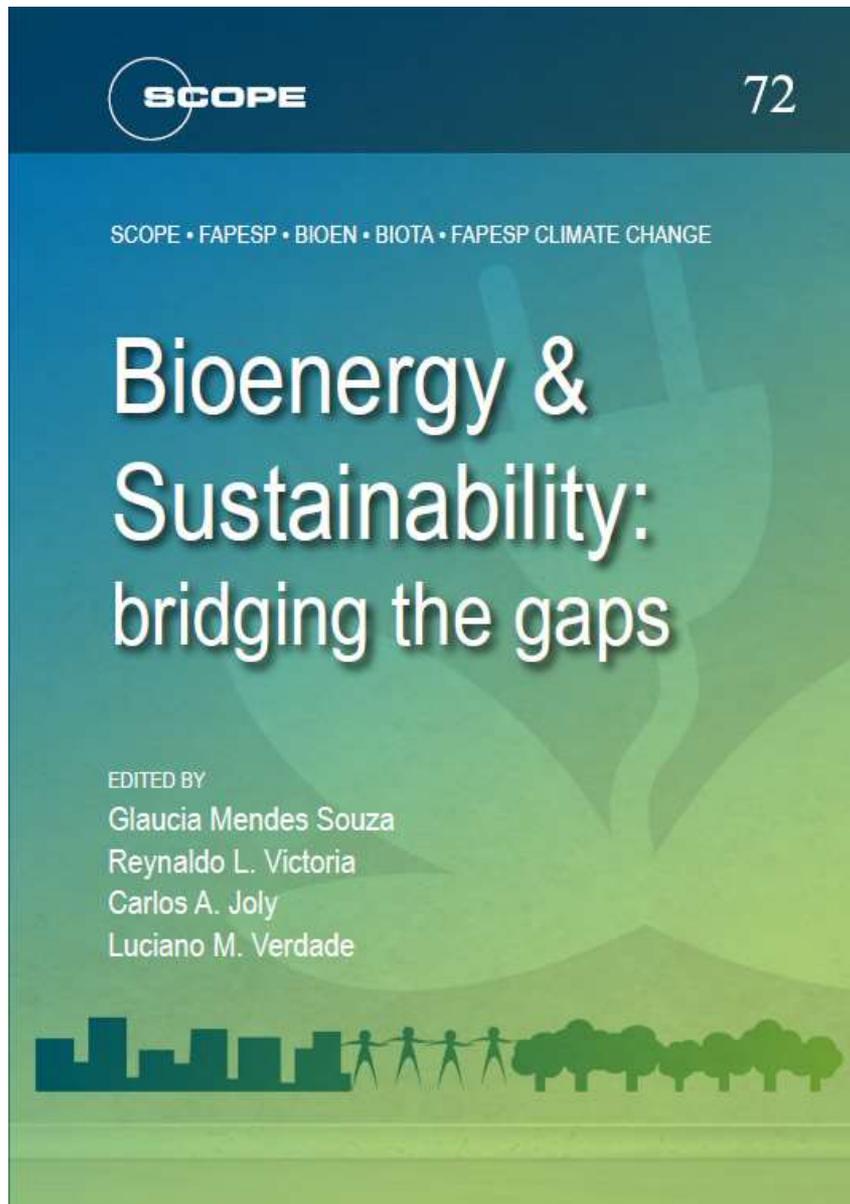
Lifecycle Assessment Benchmarks Corn Ethanol



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., Conversion Technologies to Biofuels and their use, Chapter 12, in Souza, G. M., Victoria, R., Joly, C., & Verdade, L. (Eds.). (2015). Bioenergy & Sustainability: Bridging the gaps (Vol. 72, p. 779). Paris: SCOPE. ISBN 978-2-9545557-0-6; http://bioenfapesp.org/scopebioenergy/images/chapters/bioen-scope_chapter12.pdf
 Yang, Y. *Journal of Cleaner Production* (53), pp. 149-157 (2014).

New Assessment



SCOPE = Scientific Committee for Problems on the Environment

Land Use, Feedstocks, Technologies and Impacts, Key Findings, Conclusions and Policy Recommendations

- 136 contributors from 81 institutions in 24 countries
- 779 pages

April 14, 2015

<http://bioenfapesp.org/scopebioenergy/>

Across the supply chain to multiple products example

Palm oil mill (POM)



Fresh Fruit Bunch (FFB)



Palm oil

waste water and waste



POME



EFB

waste as energy source



mesocarp fibre

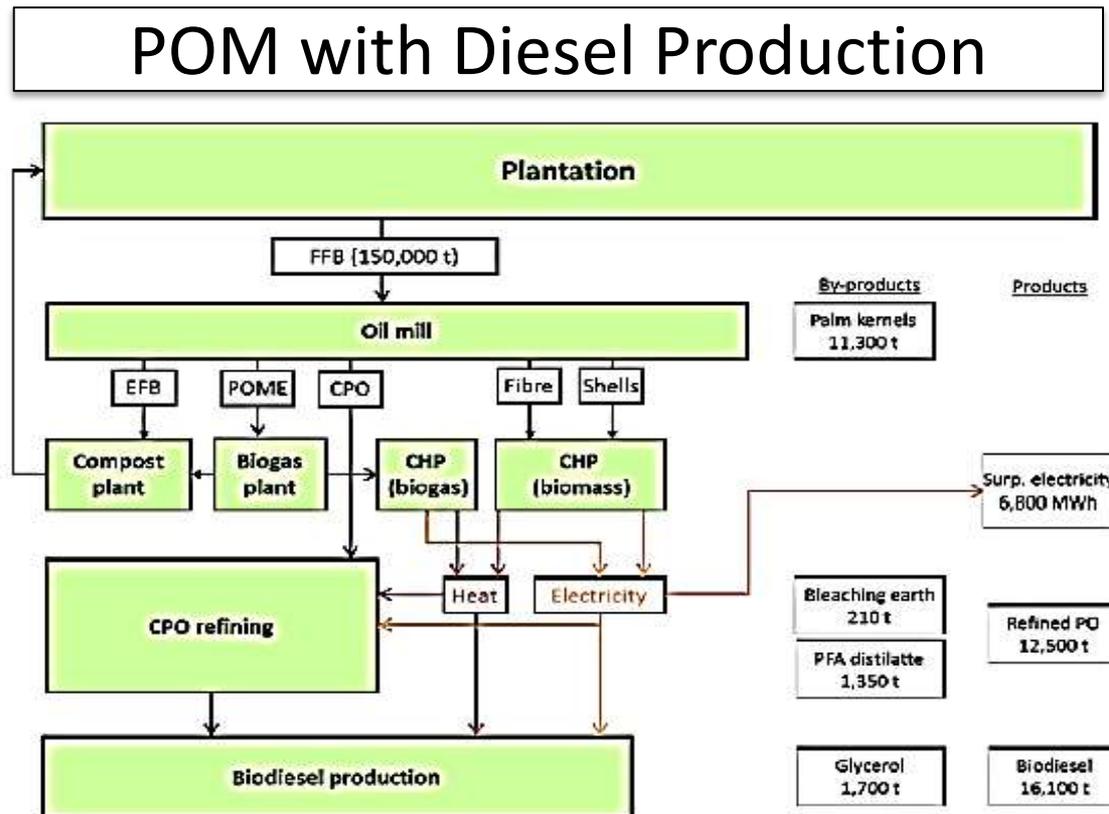


shell

From Hans Langeveld et al.

Palm Oil Mill - Example of Best Practice – continuous improvement

integration of heat, power, and efficient use of the palm plant



Ongoing IEA
Bioenergy Intertask
Hans Langeveld,
Heinz Stichnothe.

Can more heat energy be used in these applications?

Or others specific to the location?

Co-digestion opportunities?

http://www.ieabioenergytask43.org/wp-content/uploads/2014/07/Mobilising-feedstocks-biogas-case-Progress-May-2014_v11.pdf

Biofuel cropping systems: carbon, land, and food / Hans Langeveld, John Dixon and H. van Keulen, London: Routledge, 2014.

Multiple technological options available

- Pelletizing, briquetting feedstock
- Advanced combustion technologies
- Advanced anaerobic digestion and integration
- Fast pyrolysis technologies producing liquid fuel for heating, electricity generation, and possibly upgrading in FCC petroleum refining units to regular petroleum products (e.g., Ensyn Corp. and partners including Felda, Petrobras/NREL,* and others)

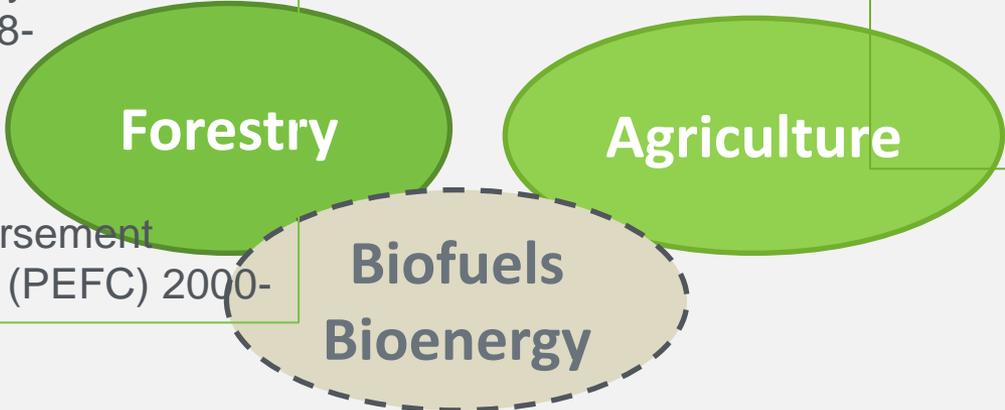


http://www.energy.gov/sites/prod/files/2015/04/f21/thermochemical_conversion_chum_242303.pdf

Sustainability Certification Standards

*Forest Stewardship Council (FSC) 1994-
Sustainable Forestry Initiative (SFI) 1998-
Program for the Endorsement of Forest Certification (PEFC) 2000-

*Sustainable Agriculture Network (SAN)/Rain Forest Alliance (RA) 2010-
Global Good Agricultural Practice (Global GAP) 2000-



Dedicated emphasis since 2007

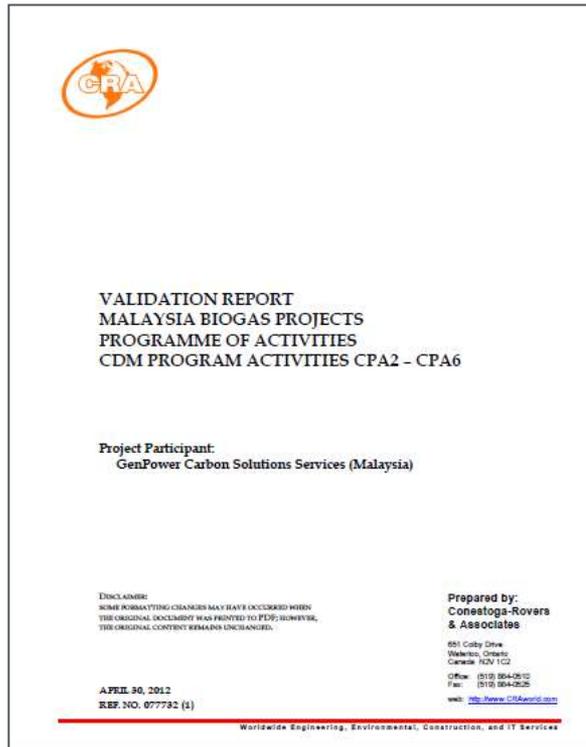
***ISEAL ALLIANCE Member**

*Roundtable on Sustainable Biomaterials
*Bonsucro
*Roundtable on Sustainable Palm Oils (Associate member)

Sectors covered

Agriculture	Carbon and climate	Fishing	Forestry
Manufacturing and textiles	Mining and minerals	Water	Emerging sectors

Best Practice: Small scale anaerobic digester validated CDM projects



VALIDATION REPORT SUMMARY

Project Title	<p>Malaysia Biogas Projects</p> <ul style="list-style-type: none"> CPA-02: SYNNG Biogas Project in Taiping, Perak, located in Peninsular Malaysia CPA-03: Pontian Fico Biogas Project, Kinabatangan, Sabah located in East Malaysia CPA-04: Ayer Item Biogas Project at Ayer Item, Johor located in Peninsular Malaysia CPA-05: Wealth Houses Biogas Project at Bruit, Sarawak located in East Malaysia CPA-06: Yee Lee Biogas Project at Bidor, Perak located in located in Peninsular Malaysia
Project Participant(s)	GenPower Carbon Solutions Services (Malaysia)
Summary of Project Activity and Findings	<p>GenPower Carbon Solutions Services (Malaysia) (Project Participant) commissioned Conestoga-Rovers & Associates Limited (CRA) to complete an independent third party validation of GHG emission offsets associated with the addition of five new CDM Program Activities (CPAs) for the existing Programme of Activities (PoA), as follows:</p> <ul style="list-style-type: none"> CDM Validation of SYNNG Biogas Project in Taiping, Perak, located in Peninsular Malaysia CDM Validation of the Pontian Fico Biogas Project, Kinabatangan, Sabah located in East Malaysia CDM Validation of the Ayer Item Biogas Project at Ayer Item, Johor located in Peninsular Malaysia CDM Validation of the Wealth Houses Biogas Project at Bruit, Sarawak located in East Malaysia CDM Validation of the Yee Lee Biogas Project at Bidor, Perak located in located in Peninsular Malaysia <p>The proposed CDM CPAs are part of an exiting PoA for a series of small-scale biogas projects developed by the Project Participant to reduce greenhouse gas (GHG) emissions associated with Palm Oil Mill Effluent (POME) treatment systems. The GHG reductions result from capturing of the biogas (i.e., methane) generated from the treatment systems (using a biogas recovery system), rather than allowing the</p>

emissions to release to atmosphere. The goal of the PoA is to promote biogas utilization and renewable energy production in the palm oil industry within Malaysia. The Project Participant states in the PoA-DD that most common and least costly practice for treatment of POME are open ponds or lagoon systems. It is the anaerobic decay of the organic matter in the POME that results in the methane generation/releases.

The Project Participant utilized the CDM methodology entitled: "Methane recovery in wastewater treatment", Version 16 (AMS IIIH) for all proposed CDM CPAs. CPA-03 was also assessed by CRA's Project Team versus the Approved Small-Scale Methodology AMS IA "Electricity generation by user" Version 14. CPA-06 was also assessed by CRA's Project Team versus the Approved Small-Scale Methodology AMS LF "Renewable electricity generation for captive use and mini-grid" Version 02.

The scope of this validation is such that CRA, as an independent third party recognized as a Designated Operational Entity (DOE) by the UNFCCC is responsible for reviewing the PDDs including the monitoring plan, baseline assessment, and any supporting documentation. CRA utilized a risk based analysis against the relevant requirements of both the interpretation from the CDM as applicable. CRA also assessed each CPA against the eligibility criteria presented in the existing PoA-DD.

As part of the validation process, CRA reviewed the completeness, conservativeness, and accuracy of the underlying evidence for the assumptions and claims made, and data sources used. The results of this investigation were then, together with the results of the review of other areas, combined to form the necessary input for the validation report and opinion.

The validation report and associated appendices document a total of 59 findings for the four proposed CPAs which include:

- Twenty-seven (27) Corrective Action Requests (CARs)
- Thirty-one (31) Clarification Requests (CLs)
- One (1) Forward Action Request (FAR)

Upon review of the documentation and explanations provided by the Project Participant, all findings were closed out in a clear and transparent manner.

<https://cdm.unfccc.int/filestorage/Y/U/S/YUSEZ7358AR2VLNGKXCF106MDTIQ9P/Malaysia%20Biogas%20Projects%20CDM-SSC-CPAs%202-6%20Validation%20Report%20Final.pdf?t=R258bm9rM3VufDAgC4BtZVPX0ueHdeBH1NDA> -- 196 pages

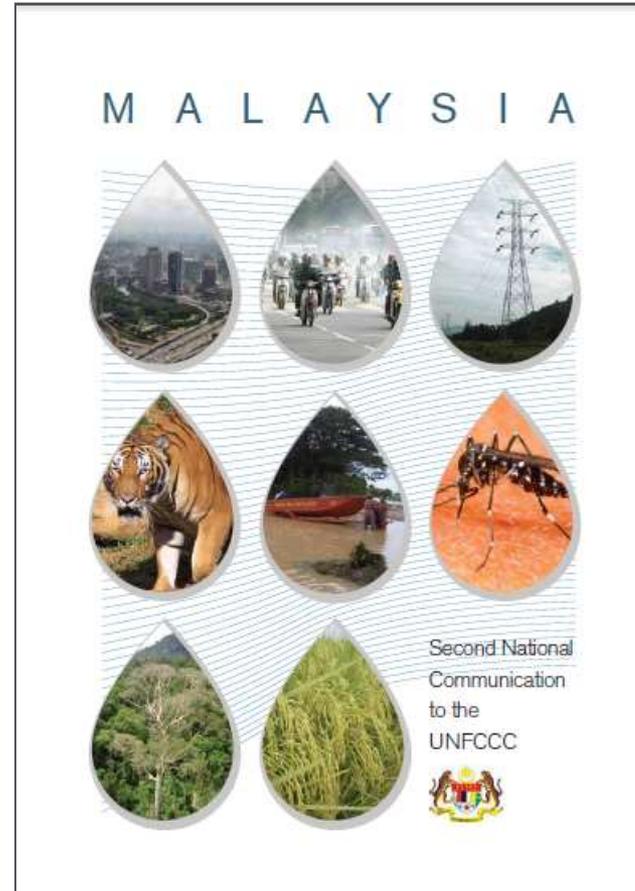
Country-wide Best Practices examples

Second national communication to the UNFCCC



IDN/COM/2 E, 2010

<http://unfccc.int/resource/docs/natc/indonc2.pdf>



MYS/COM/2 E, 2011

<http://unfccc.int/resource/docs/natc/malnc2.pdf>

Best practices offer opportunities for sharing lessons

- GHG emissions inventory tied very closely with GBEP sustainability indicators.
 - Usually done by UNFCCC/IPCC sectors and not specific to bioenergy but to overall assessment of the country.
- IPCC AR5 Lead authors for adaptation and mitigation suggest strongly that the inventories in non-Annex 1 countries be measured for more accurate data and adaptation and mitigation strategies
 - Best way to show how palm oil production and use is actually improving the countries emissions directly (not through LCA).

OPEN ACCESS

SCOP PUBLISHING
Environ. Res. Lett. 8 (2013) 015030 (9pp)

ENVIRONMENTAL RESEARCH LETTERS
doi:10.1088/1748-9326/8/1/015030

Advancing national greenhouse gas inventories for agriculture in developing countries: improving activity data, emission factors and software technology

Stephen M Ogle^{1,2}, Leandro Buendia³, Klaus Butterbach-Bahl^{4,5},
F Jay Breidt⁶, Melannie Hartman¹, Kazuyuki Yagi⁷, Rasack Nayamuth⁸,
Shannon Spencer¹, Tom Wirth⁹ and Pete Smith¹⁰

OPEN ACCESS

SCOP PUBLISHING
Environ. Res. Lett. 8 (2013) 015039 (9pp)

ENVIRONMENTAL RESEARCH LETTERS
doi:10.1088/1748-9326/8/1/015039

Methods for the quantification of GHG emissions at the landscape level for developing countries in smallholder contexts

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Carlos Eduardo Cerri⁵, Dankella Malin⁶, Mark Easter¹,
Martial Bernoux⁷, Stephen Ogle¹, Felipe Casarim⁸, Timothy Pearson⁸,
David Neil Bird⁹, Evelyn Steglich¹⁰, Madelene Ostwald¹¹,
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Sustainability

Program Manager

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Bioenergy 2015 Conference: Opportunities in a Changing Energy Landscape

On June 23–24, 2015, the U.S. Department of Energy's Bioenergy Technologies Office will host its eighth annual conference—Bioenergy Opportunities in a Changing Energy Landscape. Participants, including stakeholders from the bioenergy industry, Congress, national laboratories, academia, and the financial community, discuss critical bioenergy issues.

<https://www.bioenergykdf.net/>



What Would You Like to Do?



http://www.energy.gov/sites/prod/files/2014/03/f14/kdf_fact_sheet.pdf



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<http://www.nrel.gov/about/chum.html>



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