




Agriculture and
Agri-Food Canada

Agriculture et
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Canada



Sustainable Biomass Supply Chains for Biorefineries – IEA Task 42 Update

Maria Wellisch, Agriculture and Agri-Food Canada

Fourth International Forest Biorefinery Symposium

February 3, 2014

Montréal, QC

Our Vision

Driving innovation and ingenuity
to build a world leading agricultural and food economy
for the benefit of all Canadians.

Our Mission

Agriculture and Agri-Food Canada provides leadership
in the growth and development of a competitive, innovative
and sustainable Canadian agriculture and agri-food sector.

Overview

1. IEA Bioenergy Task 42 Biorefineries

2. Sustainable Biorefineries

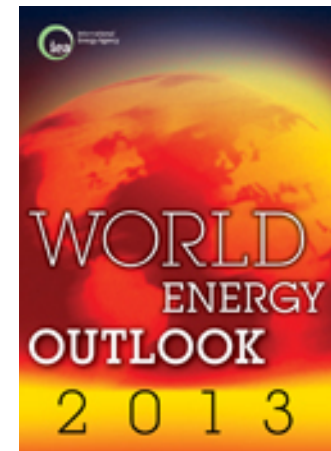
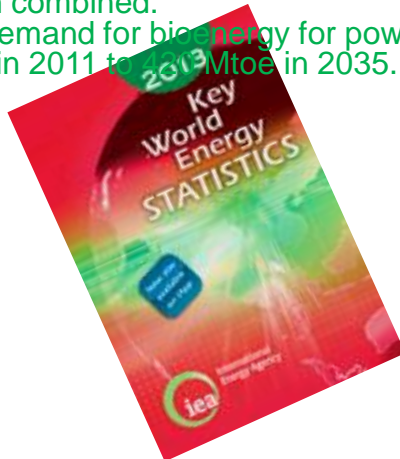
- LEEAFF Framework
- Inter-task Project: Mobilizing Sustainable Biomass Supply Chains

3. How to Get Involved

- Update Country Profile
- Next Task Meeting: Dec 4-5, 2014 in Toronto-Guelph, ON

IEA (International Energy Agency)

- Autonomous organisation which works to ensure reliable, affordable and clean energy.
 - Main areas of focus are: energy security, economic development, environmental awareness, and engagement worldwide.
-
- Power generation from renewables increases by over 7,000 TWh from 2011 to 2035, making up almost half of the increase in total generation.
 - Renewables become the second-largest source of electricity before 2015 and approach coal as the primary source by 2035, with continued growth of hydropower and bioenergy, plus rapid expansion of wind and solar PV.
 - Almost two-thirds of the increase in power generation from renewables is in non-OECD countries.
 - The increase in China is more than that in the European Union, United States and Japan combined.
 - The demand for bioenergy for power generation and heat increases from 136 Mtoe in 2011 to 435 Mtoe in 2035.

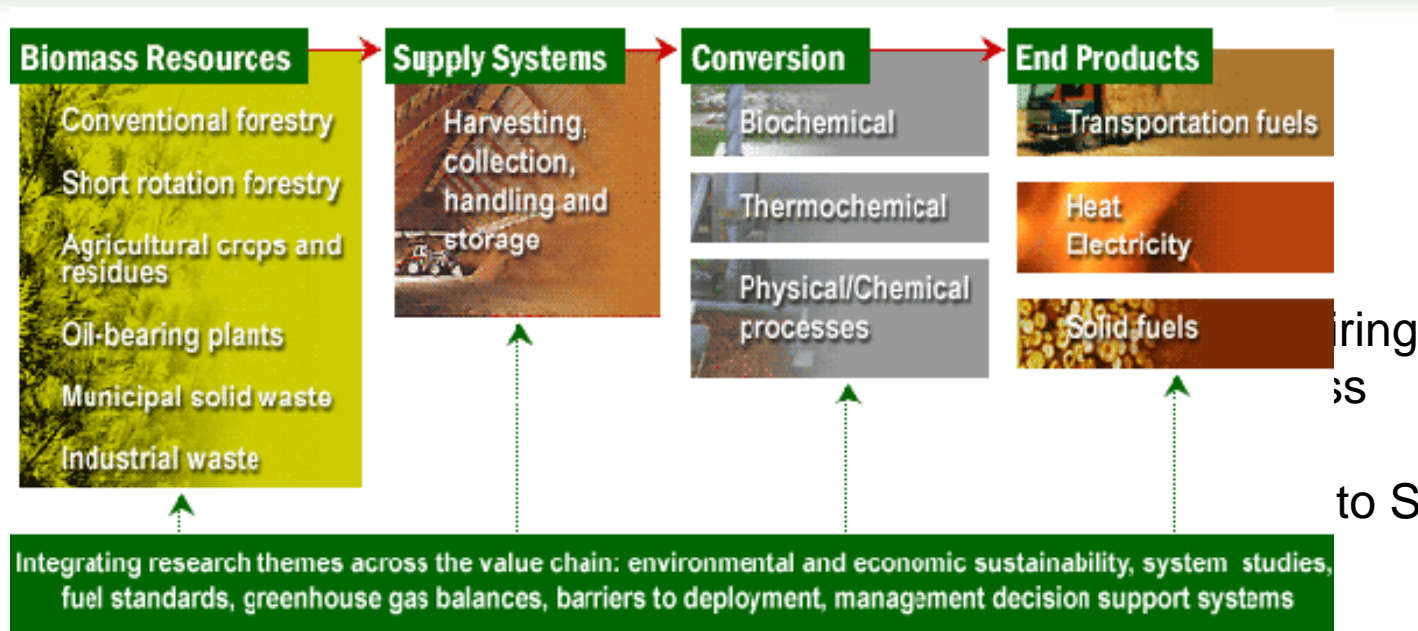


Consumption of biofuels increases to meet 8% of road-transport fuel demand in 2035. The United States, Brazil, European Union and China make up more than 80% of all biofuels demand. Advanced biofuels, helping to address sustainability concerns about conventional biofuels, gain market share after 2020, reaching 20% of biofuels supply in 2035.

IEA Bioenergy

International Collaboration

- IEA Bioenergy aims to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost competitive bioenergy systems and technologies.
- Bioenergy Implementing Agreement
 - Natural Resources Canada
 - Task 39 Commercializing Liquid Biofuels (Co-Lead: Dr. Jack Saddler)
 - Task 42 Biorefineries (Maria Wellisch – AAFC)
 - Task 43 Biomass Feedstocks for Energy Markets (Dr. Tat Smith)
- Bioenergy Reports: <http://www.ieabioenergy.com/iea-publications/>



IEA Bioenergy
Tasks

38 Climate Change Effects of Biomass and Bioenergy Systems

39 Commercialising Conventional and Advanced Liquid Biofuels from Biomass

40 Sustainable International Bioenergy Trade: Securing Supply and Demand

42 Biorefining – Sustainable Processing of Biomass into a Spectrum of Marketable Biobased Products and Bioenergy

43 Biomass Feedstocks for Energy Markets

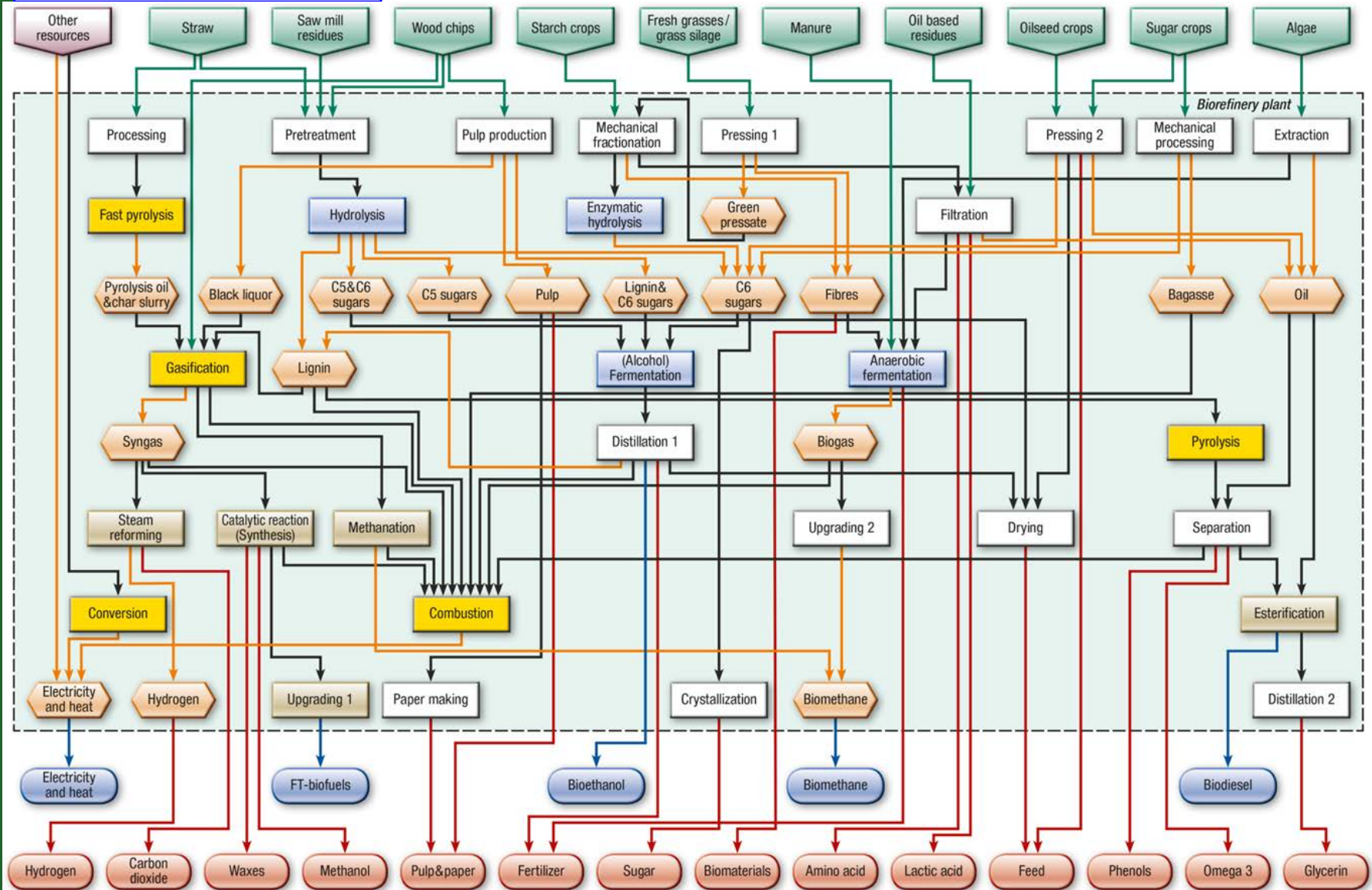
Task 42 Biorefineries

- **Definition:** Sustainable processing of biomass into a spectrum of marketable products and energy.
- **Goal:** To contribute to the development and implementation of sustainable biorefineries – as part of highly efficient, zero waste value chains – synergistically producing bio-based Food and Non-food Products as base for a global BioEconomy.
- Led by Dr. Rene van Ree (Wageningen, NL)
- 11 Member countries
- Complement the other IEA Bioenergy Tasks
 - Larger systems vs specific technologies
 - Non-energy products: other bioproducts that make the biorefinery concept financially viable; co-existence with food
- <http://www.iea-bioenergy.task42-biorefineries.com/en/ieabiorefinery.htm>



NEW

Task 42 Biorefining



Benefits of International Dialogue

- Opportunity to learn about biorefinery development in other countries
- What types of biorefineries are developing, what scale, what enabling conditions (including policies)
- What challenges to development and how are different countries responding
- Share Canada's emerging biorefineries



Canadian Biorefineries List (pilot, demo, commercial)

- Lignol Innovations Ltd
- Bio-economy Technology Centre
- Enerkem – pilot
- Greenfield Ethanol – pilot
- Enerkem – demo
- Domtar P&P with demo facility (CelluForce)
- Highmark Renewables
- Ensyn
- Permolex
- Greenfield Ethanol
- Alberta Pacific Forest Industries
- Enerkem Edmonton
- Vanerco

Forest, MSW,
Agriculture (crop, manure)

Example



A pulp, off-gas, electricity & heat biorefinery for the production of kraft pulp, biomethanol, electricity and heat from wood chips [Alpac Forest Products Inc., Canada]



*A sugars, lignin and syngas biorefinery for bioethanol,
power and heat from renewable biomass and MSW
[INEOS New Planet Bioenergy, USA]*



A whey biorefinery for ethanol and protein-based food products from milk [Edgumbe Milk Processing Plant, Fonterra Cooperative Group, New Zealand]



*An oil production and refinery pilot-plant for Omega-3,
fuels, chemicals from microalgae
[Wageningen UR, the Netherlands]*



Task 42 Mtg in Berlin (Jan 22-23, 2014)

- Triennium Workplan 2013-2015
 - ☐ Assessment market deployment potential of integrated Biorefineries
 - ☐ Support industrial/SME stakeholders finding their position in the BbE
 - ☐ Optimal sustainable biomass valorisation using market pull approach
 - ☐ Policy advice
 - ☐ Knowledge dissemination
 - ☐ Training
- Inter-task collaboration
 - Task 39 Biofuels (Jack Saddler, Jim MacMillan)
 - Intertask project on Mobilizing Sustainable Biomass Feedstock Chain (Task 43 lead)

Overview

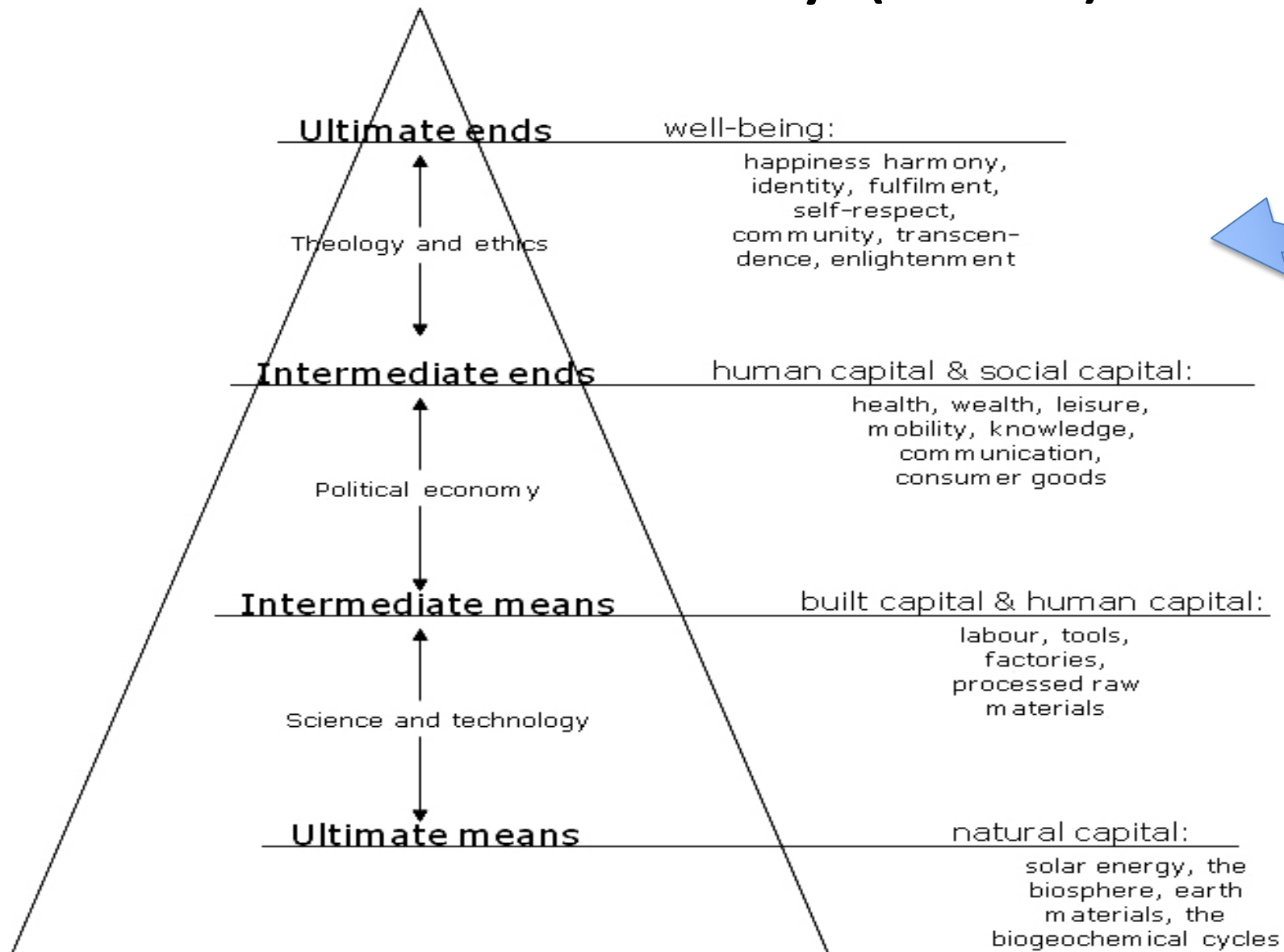
- IEA Bioenergy Task 42 Biorefineries
- **Sustainable Biorefineries**
 - ❖ **LEEAFF Framework**
 - ❖ **Inter-task Project: Mobilizing Sustainable Biomass Supply Chains**
- How to Get Involved
 - Update Country Profile
 - Next Task Meeting: Dec 4-5, 2014 in Toronto-Guelph, ON

IEA Brochure - New Triennium

- Biorefinery definition: sustainable processing of biomass into a spectrum of marketable products and energy.
 - Can we make it “standard” to address the 3 pillars of sustainability in biorefinery descriptions, data collection, etc. to show biorefineries are part of the solution?

(Vienna Task 42 Meeting, Nov 2012)

Herman Daly (1973)



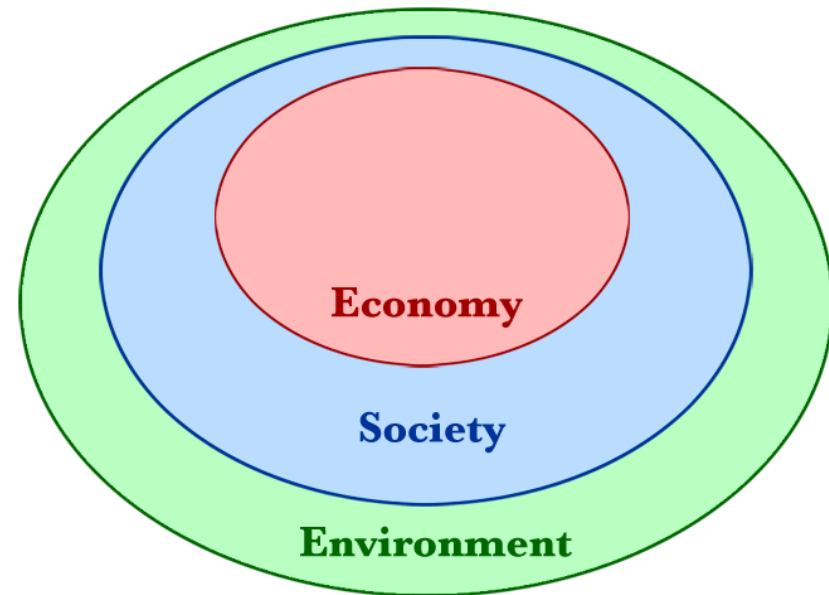
Biorefinery as a Contributor to Sustainable Development

- System (sum of technologies) that convert bio-based natural resources into useful products and energy
 - generating economic activity
 - In order to achieve human well-being
- Activities carried out in such a way that they can be repeated or modified
 - Not destroying or exhausting resources

Feedstock – Process – Transportation – Products – End of Life

Challenge: How to Demonstrate

- Sustainable development frameworks
 - Triple bottom line
 - Many indicators
 - Different measurement protocols
 - Data not collated at the right level
 - Etc.
- Emerging Technologies
 - Data not available
 - Available but not optimized
 - Business sensitive, not available to the public



➤ *Nevertheless, it is important for emerging biorefineries to communicate their sustainability attributes*

Many Sustainability Schemes - Common Trends

- Science-based
 - Developed through consensus
 - 3 broad dimensions are addressed (Environmental, Social, Economic)
 - Lifecycle basis (especially for GHG)
 - Many years and resources to develop.
- At high level, there is general agreement on the key parameters.

Developments in 2013

"Guidance"

- ISO 13065 Sustainability Criteria for Bioenergy (5th Plenary in Stockholm - Sept 2013)
 - 3 Dimensions of sustainability
 - Environmental: Lifecycle GHG, Air, Soil, Biodiversity, Water, Waste, Energy
 - Scorecard: e.g. economic operator has a soil management plan (Y or N)
 - What to include vis-à-vis sustainability , but does not indicate direction
 - Started in 2009: long time to reach consensus (science and policy)
- OECD Recommendation of the Council on Assessing the Sustainability of Bio-Based Products (released Fall 2013)
 - <http://webnet.oecd.org/OECDACTS/Instruments/ShowInstrumentView.aspx?InstrumentID=283&InstrumentPID=298&Lang=en&Book=>
 - Council Recommendation (quasi mandatory)
 - 3 dimensions of sustainability
 - Consensus among relevant stakeholders
 - Product end of life considerations

(Berlin Task Mtg, Jan 2014)

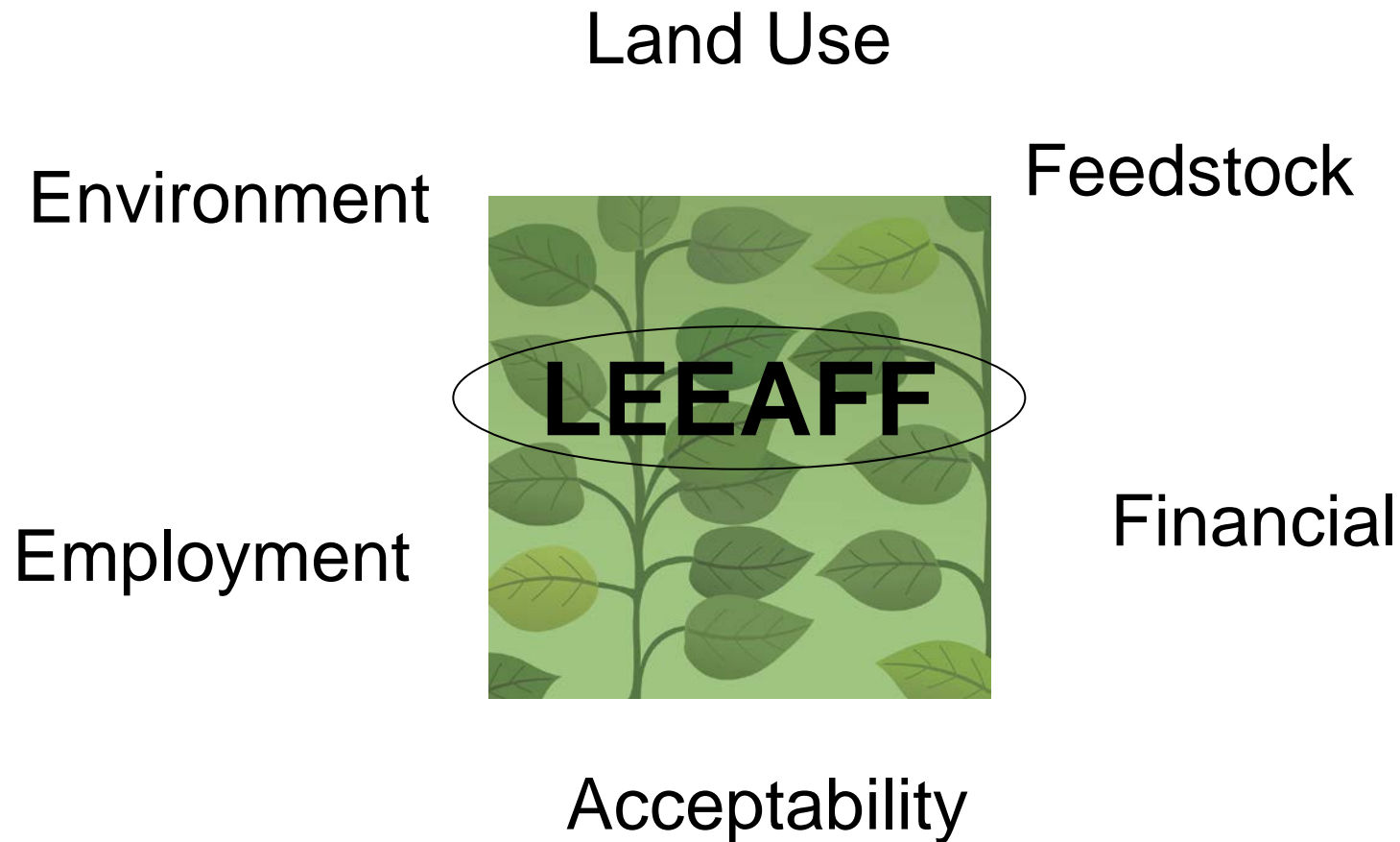
Developments in 2013

“Evaluation Tools”

- EU Prosuite <http://www.prosuite.org/>
 - integrative approach and evaluation tool to assess the sustainability of new technologies
 - 5 mutually exclusive impact categories that represent the environmental, economic and social dimensions of sustainability
 - HUMAN HEALTH
 - SOCIAL WELL BEING
 - PROSPERITY
 - NATURAL ENVIRONMENT
 - EXHAUSTIBLE RESOURCES

(Berlin Task Mtg, Jan 2014)

LEEAF: Sustainability Framework



Acronym that exemplifies renewability and key information requirements.

LEEAF Dimension	Economic	Environmental	Social
Land Use and Use of other natural resources (water, soil)		X	X (access to resources)
Environmental Benefits and Impacts		X	X (health)
Employment	X		X
Acceptance			X
Financial	X		
Feedstocks (material and energy)	X	X	

LEEAF framework expands on the three fundamental pillars – economic, environmental and social - to address the questions that are most frequently raised in the development process - be it by engineers, financiers, policy makers, and the broader public.

LEE AFF *elaborated*

Environment

- Impacts
- Benefits

Land Use

- Resource use intensity
- Ownership



Feedstock

- All inputs – material and energy
- Renewable and nonrenewable

Employment

- # Direct & Indirect
- Full & Part time
- Education

Acceptability

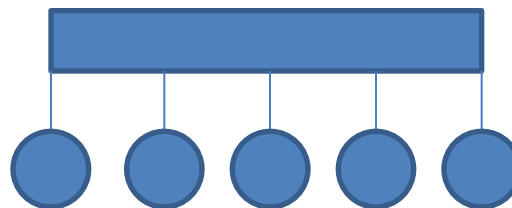
- Consumers
- Community
- Industry
- Food vs fuel

Financial

- Profitability
- Rate of return
- Size of investment
- Govt Incentives
- Taxes

Inter-task Project (2013-2015)

- Mobilizing sustainable biomass supply chains
 - Led by Dr. Tat Smith (Univ of Toronto; IEA Task 43)
 - 5 supply chain studies
 - Boreal and Temperate Forest case study - led by CAN
 - Agriculture residues – led by DEN; CAN participating
 - Biogas – Heinz Stichnothe (GER)
 - Perennials - Landscape
 - Sugar Cane
- What is a sustainable supply chain? How are the supply chains mobilizing? What are the opportunities and hurdles?
 - Interpreted at a practical, local level in different member countries
- Report published March 2015



What is a sustainable supply chain?

- 5 Case studies:
 - Interpreted at a practical, local level
 - New biomass supply chains
 - Existing supply chains – new products (beyond energy)
- Which sustainability assessment framework?
 - Starting point: Use GBEP framework
 - Other options: US NREL, AAFC, etc.

Common Sustainability Framework

- Led by Tat Smith (Task 43)
- Ad-hoc group: leads of the case studies, sustainability experts from various IEA Tasks
- Fall 2013: Examined applicability of GBEP
 - Communication with FAO
 - Country experiences with GBEP
 - National reporting; Forestry; Developing countries
 - Data intensive; Funding ?
- Interim Conclusion (Dec 2013):
 - Not reached consensus to adopt 24 GBEP indicators
 - Use GBEP indicators as a guide
 - Individual experts are free to do more (e.g. pilot test)

Next call: Feb 5, 2014



GBEP ENVIRONMENTAL	GBEP SOCIAL	GBEP ECONOMIC
1. Lifecycle GHG emissions	9. Allocation and tenure of land for new bioenergy production	17. Productivity
2. Soil quality	10. Price and supply of a national food basket	18. Net energy balance
3. Harvest levels of wood resources	11. Change in income	19. Gross value added
4. Emissions of non-GHG air pollutants, including air toxics	12. Jobs in the bioenergy sector	20. Change in consumption of fossil fuels and traditional use of biomass
5. Water use and efficiency	13. Change in unpaid time spent by women and children collecting biomass	21. Training and requalification of the workforce
6. Water quality	14. Bioenergy used to expand access to modern energy services	22. Energy diversity
7. Biological diversity in the landscape	15. Change in mortality and burden of disease attributable to indoor smoke	23. Infrastructure and logistics for distribution of bioenergy
8. Land use and land-use change related to bioenergy feedstock production	16. Incidence of occupational injury, illness and fatalities	24. Capacity and flexibility of use of bioenergy

Boreal and temperate forests case study

Dr. Evelyne Thiffault (CFS)



Methodology:

The work is divided in two parts:

1-Comparison of forest biomass supply chains from various countries (based on information collected using online surveys from experts in various countries);

2-Specific assessments of issues related to forest biomass supply chain mobilisation (literature reviews and analyses on specific subjects).

Agriculture residues (DENMARK lead)

- Lead: Niclas Scott Bentsen (Univ of Copenhagen, Denmark)
- Facilitator: Tat Smith (Univ of Toronto Task 43)
- DEN: Wheat straw; Inbicon biorefinery
- US: Corn stover: Iowa cellulosic ethanol
- CAN: Corn stover: Ontario (Sarnia) & Quebec (Varennnes) – no existing facility
 - **Project (2013-15):** AAFC (fed govt), OFA (ag producers assn) and LCF (ag coop)
 - Awarded funding from the Program of Energy Research and Development that is operated by Natural Resources Canada
 - 1. Field trials (2014) – testing equipment for a new (lower cost) removal system
 - 2. Soil sampling protocol – soil organic carbon baseline
 - 3. Sustainability – Intertask project



Ontario Biomass Project

- Continuation of agricultural feedstock supply chain development work (for industrial, non-food purposes)
- Download reports:
<http://www.ofa.on.ca/issues/overview/biomass>
- OFA Corn Stover project
 - Corn stover - lignocellulosic sugar – BioAmber (succinic acid)



Agricultural Crop Residues CAN

- Key sustainability issues:
 - Economics – full cost of stover – price point
 - Benefits outweigh the costs
 - Environment – soil carbon and nutrients; compaction;
 - Can we remove stover, how often, where, when not
 - Social –
 - Acceptance (incl. Benefits) to Rural community
 - Non-food source of biomass for bioproducts

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Country Deliverables

- Canadian Biorefinery List
 - IEA Task 42 website – Canadian content
 - Country report (one per triennium)
- + Task projects (e.g. LEEAFF)

Contact maria.wellisch@agr.gc.ca if you want to be added to the Canadian distribution list.

Want to provide an up-to-date image of emerging Canadian biorefineries that includes sustainability.

“ready and in the game”

Task 42 Country Report - Contents

- Country specific energy consumption
- Biomass use for energy and non-energetic applications
- Biomass related (national) policy issues
- Running commercial biorefineries
- Biorefinery demonstration and pilot plants
- Major biorefinery R&D projects
- Major national stakeholders involved in the field of biorefining
- Sustainability work

Upcoming Meetings

- ❑ Task 42 Mtg: June 2014, Hamburg, GER
- ❑ 3rd European Biorefining Training School, Budapest, Hungary, 7 – 10 July 2014
- ❑ Task 42 Mtg: Dec 4-5, Toronto – Guelph, ON

From Biofuels to Bioeconomy

Canadian Renewable Fuels Summit officially becomes the Canadian Bioeconomy Summit

December 1-3, 2014



**Westin Harbour Castle
Toronto, Ontario, Canada**

<http://www.greenfuels.org/en/industry-information/summit.aspx>

Thank you,

Merci de votre attention.

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