

The sustainability of bioenergy: Some questions in search of answers

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Outline

What is current context: food crops?

Unintended consequences: do they matter?

C&I and certification?

What is current context: forestry?

How can we be proactive?

Approach

“One person’s view of sport” by highlighting questions

Why bioenergy?

- Energy security (home-grown crops)
- International policy (Middle East)
- Farm income (better price for farmers)
- Rural development (new industry)
- Subsidize forestry sector (co-generation)
- New forestry product (diversify market)
- **GHG reduction (renewable C)**

See some of the policy reasons for bioenergy in Canada in two Canadian publications:

• Klein, K.K. & LeRoy, D.G. (2007) *The Biofuels frenzy: What's in it for Canadian agriculture?* Green Paper prepared for the Alberta Institute of Agrologists, and presented at the Alberta Institute of Agrology Annual Conference, Banff, AB, 28 March 2007. Paper discusses the pros and cons of agricultural bioenergy in Canada. http://www.aic.ca/whatsnew_docs/Klein%20Final%20%234.pdf
[The lead author confirms that pp. 41 and 42 are blank, were included by mistake, and that they have no further recommendations at this time; lead author confirms that paper may be freely distributed; information on the lead author can be found at <http://research.uleth.ca/econbio/participants.htm>]

• Forge, Frédéric. 2007. *Biofuels - An Energy, Environmental or Agricultural Policy?* PRB 06-37E, Library of Parliament, Science and Technology Division, Ottawa, Canada, 8 February 2007. <http://www.parl.gc.ca/information/library/PRBpubs/prb0637-e.pdf>

Energy security and international policies are often included in US rationale

• “Reducing dependence on oil imported from unstable and often hostile regions is a paramount foreign policy imperative.” from *Brazil-U.S. Ethanol Pact: Benefits Greatly Outweigh Costs* by Richard G. Lugar, 04.09.2007, <http://www.nationalinterest.org/Article.aspx?id=13996>

In Canada, about 6% of energy is produced from wood by the forestry sector for purely economic reasons, as the forestry sector looks for cost savings in a highly competitive market.

Is bioenergy renewable?

- Global GHG issues are immediate (Kyoto)
- C renewal rate for agricultural crops
 - 1 year
 - annual, perennial
- C renewal rate for forests
 - “forest estate” perspective
 - lumpers
 - immediate
 - “forest site” perspective
 - splitters
 - over full rotation

Is bioenergy “renewable”? The **temporal scale** over which bioenergy is “renewable” has to be considered, because GHGs need to be reduced in the short-term, not at some long-term, future date (hence the urgency inherent in timelines in the Kyoto Treaty).

The C renewal rate for **agricultural** crops is usually **one year**, regardless of whether the crops are annual or perennial. (Perennial crops have the advantage that living root systems act as a C sink, and C in roots will be transferred to soil; although then subject to decomposition processes, some of this C will enter permanent soil sinks.)

However, what is the C renewal rate for forest biomass? There are two schools of thought: (i) **estate perspective**: the C in forest biomass converted to CO₂ through energy conversion today is taken up elsewhere in the world today by other forests so, at a global level, the C is instantly renewable; and (ii) **site perspective**: the C taken up elsewhere in the global forest estate would be taken up anyway, so is irrelevant; it is the time taken to replace the biomass on the site from which it came that is relevant.

There is not universal agreement on approaches. If the **site perspective** is correct, then forest biomass is not fully renewable for a full rotation, which means that forest bioenergy cannot be the **short-term** solution to reducing atmospheric CO₂ concentrations - although it is part of the **long-term** solution. Care must therefore be taken in defining the perspective in which forest biomass is considered renewable.

What is energy balance?

(LCA: energy to produce 1 megajoule)

Gasoline, petrodiesel	1.1 to 1.4 mj
Tar sands oil	~2 mj
Grain ethanol	0.8 mj
Biodiesel	0.3 mj
Cellulosic ethanol	0.1 mj
Wood	0.05 mj

0.046 tonnes GHG/MWH for wood (including 780 km trucking) cf. 1.02 for coal (for cogeneration in northern Alberta) = ~5% (Stennes & McBeath 2006)

LCA (lifecycle analyses) show that grain ethanol does not result in much of a net energy (~ C) saving – about 20%; savings are much greater with biodiesels; once cellulosic ethanol production is commercial, savings will be even greater again. Savings with wood are very dependent on the different technologies used for conversion. (Note that some papers report that LCA for corn grain ethanol is actually negative, and it takes more energy to produce it than it actually contains. However, some of these were based on old technologies; it is essential that LCAs are based on the current or latest technologies.)

Wald, M. 2007. *Is ethanol for the long haul?* Sci. Am. 296 (1): 42-49. Megajoules of fossil energy to produce one megajoule of biofuel: gasoline 1.19, corn kernel ethanol 0.77, cellulose ethanol 0.10.

For **biodiesel energy conversion**, “for every unit of fossil fuel used to make biodiesel, **3.2 units of energy** are gained in energy output. That’s a 320% increase and includes soybean planting, harvesting, fuel production and transportation.” Summary at <http://www.renewableenergyaccess.com/rea/news/story?id=34304> and full USDA report at http://www.biodiesel.org/resources/reportsdatabase/reports/gen/19980501_gen-339.pdf

What’s the energy balance for biodiesel? Energy balance is the ratio of how much energy a fuel produces compared to how much energy it takes to make the fuel. For **biodiesel**, the energy balance is **between 3 and 4**, meaning that up to four times -- 400% -- more energy is produced when it is burned than is used to make it (the extra energy comes from the sun). For **ethanol**, the energy balance is about **1.3**, and for **gasoline** and **petrodiesel** it’s between **0.7 and 0.9**. (If the energy balance for fossil fuels was > 1.0, we wouldn’t be running out of them.) <http://www.cwbiodiesel.com/faq.html>

See also

•For **wood** bioenergy “calculator”, see IEA Task 29 <http://www.aboutbioenergy.info/>

•<http://svc237.bne113v.server-web.com/calculators/treecarbonhow.htm>

“The tree carbon calculator uses general allometric relationships to estimate above-ground biomass of the tree. The biomass of the tree roots is then estimated using a root:shoot ratio. These two values are then summed to give the total tree biomass and converted to carbon assuming that 50% of the tree biomass is comprised of carbon.”

Also contains other useful information on trees and C

[An Australian site, with Australian species, but a model for how sites could be constructed elsewhere]

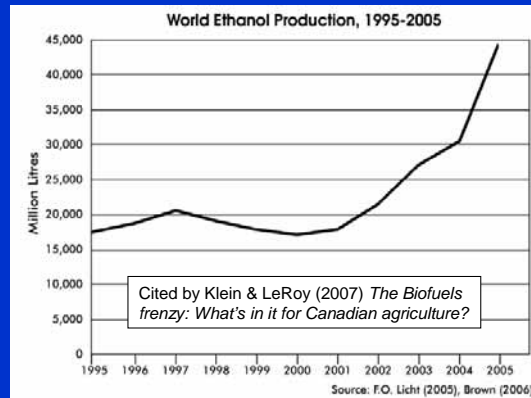
•See also <http://www.unece.org/trade/timber/mis/energy/guide.htm>,

•for **wood** (tables and calculations), see Oak Ridge National Laboratory: http://bioenergy.ornl.gov/papers/misc/energy_conv.html

•for conversion efficiencies of **fuels in tropics**, see http://www.rwedp.org/d_technology.html

Where are we going in agriculture?

- Europe & Brazil ahead of North America
- 2006-07 a “tipping point” for North America:
 - 5% liquid biofuels in Canada = 18% of crops (5% in gasoline by 2010; 2% in diesel and heating oil by 2012)
 - 12% ethanol & 6% biodiesel in US = *all* corn & soy
 - US targets = 3x to 5x US corn production



Graph from: Klein & LeRoy (2007) *The Biofuels frenzy: What's in it for Canadian agriculture?* Green Paper prepared for the Alberta Institute of Agrologists, and presented at the Alberta Institute of Agrology Annual Conference, Banff, AB, 28 March 2007

Achim Steiner, Executive Director, UN Environment Program (UNEP)

*“A new breed of "prospectors" have set off a rush to claim their stakes in the **green gold [rush]** of biodiesel and ethanol...*

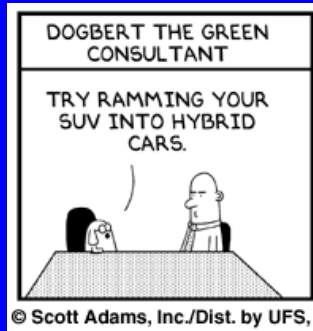
*“[We] need to remember the **law of unintended consequences**...”*

*“The path to sustainable development is paved with **well-intentioned but failed projects**...”*

Baltimore Sun, February 13, 2007, <http://www.uneptie.org/energy/act/bio/op-ed.htm>

Op-ed by Achim Steiner, Executive Director, **United Nations Environment Program** (UNEP): “2006 was the year when “climate change” and “biofuels” became part of the common lexicon... A new breed of “prospectors” have set off a rush to claim their stakes in the green gold of biodiesel and ethanol... Biofuels have the potential to meet 50 percent or more of the world’s energy demand over the next century in a sustainable and cost-effective manner. Or not. ... U.S. presidential candidates ... need to remember the law of unintended consequences. The path to sustainable development is paved with well-intentioned but failed projects... ”. Baltimore Sun, February 13, 2007. <http://www.uneptie.org/energy/act/bio/op-ed.htm>

Who pays for unintended consequences?



Of course, we could dispense with the need for some biofuels if we changed our lifestyles - or if others changed them for us!

What is effect on grain prices?

(Increases March 2006 to March 2007)

Corn ¹	86%
Soybeans ¹	32%
Oats ¹	39%
Feed barley ²	54%
Feed wheat ²	59%

From Klein & LeRoy (2007) *The Biofuels frenzy: What's in it for Canadian agriculture?*

1. Chicago Board of Trade; 2. Winnipeg Commodity Exchange

From Klein, K.K. & LeRoy, D.G. (2007) *The Biofuels frenzy: What's in it for Canadian agriculture?* Green Paper prepared for the Alberta Institute of Agrologists, and presented at the Alberta Institute of Agrology Annual Conference, Banff, AB, 28 March 2007. Paper discusses the pros and cons of agricultural bioenergy in Canada. http://www.aic.ca/whatsnew_docs/Klein%20Final%20%234.pdf

What is effect on food prices?

(Increases over past year)

Eggs	125%
Chicken breasts	90%
Corn	53%
Butter	24%
Bacon	17%
Beef	16%

Source: U.S. Department of Labor and Stephens Inc. report of May 15, 2007

Table from:

Corn Gobbled Up for Ethanol Leaves Consumers Paying More, by Kim Souza, *The Morning News*, Arkansas; Friday, May 18, 2007, 10:46 PM CDT in *Business*, at <http://www.nwaonline.net/articles/2007/05/19/business/051907food.txt>

A new study by economists and agricultural experts at Iowa State University on the impact of higher corn prices estimates that corn-based ethanol production could add as much as **\$14 billion per year** to the price of food that Americans pay. Rising food prices garnered the attention of Richard Bernstein, the chief investment strategist for Merrill Lynch, who recently said in an investors note that "rising food prices were leading to agflation." The term **agflation** relates to an increase in food prices that occur as a result of increased demand from human consumption and use as alternative energy source -- as with corn for ethanol. The **Producer Price Index** -- a major indicator for inflationary pressure being felt in an economy -- index for farm products registered a PPI of **141.0** in April compared to **111.3** a year earlier. The PPI data suggests an **annual food price increase of 29.7 percent**. Through the first four months of this year, total consumer inflation is rising at an annual rate of 4.8 percent, almost double the 2.5 percent increase for all of 2006. The acceleration has occurred in large part because of higher costs for food and energy, the U.S. Labor Department said Tuesday.

Commodity Food Price Jumps From a Year Ago.

Eggs up 125 percent
Chicken breasts up 89.5 percent
Corn up 53.1 percent
Butter up 23.8 percent
Bacon up 16.7 percent
Beef up 15.8 percent

Source: **U.S. Department of Labor and Stephens Inc.** report of **May 15, 2007**.

See also:

• *Appetite for ethanol spurs food price inflation*, Wednesday, April 11, 2007, globeandmail.com
<https://secure.globeadvisor.com/servlet/ArticleNews/story/gam/20070411/RFOOD11> "...the **IMF** is forecasting that food price inflation is likely to remain high in 2007 and beyond. "Recent high price levels are likely to be sustained," the IMF said. The **world price of food rose 10 per cent in 2006**, driven mainly by surging prices of corn, wheat and soybean oil. The boom is producing some strange anomalies. **Iowa, the largest corn-producing state, could eventually become a net importer of corn as it struggles to feed its crop of ethanol plants.** The USDA also said the 2006 corn crop will sell for an average \$3.10 (U.S.) a bushel at the farm gate, the highest price in a decade. **Farmers expect to plant 15 per cent more corn this year, making a record crop possible.**"

• *Fears over food price inflation*, by Jenny Wiggins in London, Financial Times, London; Published: May 23 2007
http://www.ft.com/cms/s/7f8bccb8-0960-11dc-a349-000b5df10621.Authorised=false.html?_i_location=http%3A%2F%2Fwww.ft.com%2Fcms%2Fs%2F7f8bccb8-0960-11dc-a349-000b5df10621.html&_i_referer=http%3A%2F%2Fwww.google.ca%2Fsearch%3Fq%3Dinflation+corn+europe+food
"Retail **food prices** are heading for their **biggest annual increase in as much as 30 years**, raising fears that the world faces an unprecedented period of food price inflation. Prices have soared as the **expanding biofuels** industry, climate change and the growing **prosperity of nations such as India and China** push up the costs of farm commodities including wheat, corn, milk and oils."

• *Biodiesel and Ethanol - Crop prices soar, push food costs up globally*, by Patrick Barta, The Wall Street Journal
<http://dissidentnews.wordpress.com/2007/05/02/biodiesel-and-ethanol-crop-prices-soar-push-food-costs-up-globally/>

• *Biofuel Boom Sparks Beer Price Fight: Trouble Brews in Germany as Biofuel Boom Jacks Up Price of Beer*, by Kirsten Grieshaber, Associated Press Writer, Wednesday May 30, 11:52 am ET
http://biz.yahoo.com/ap/070530/germany_beer_to_biofuel.html?v=1

But note that not all observers believe that agflation will be long-term:

Where are we going in agriculture?

- Europe ahead of North America
- 2006-07 a “tipping point” for North America:
 - 5% liquid biofuels in Canada = 18% of crops
 - 5% in gasoline by 2010; 2% in diesel and heating oil by 2012
 - 12% ethanol & 6% biodiesel in US = *all* corn & soy
 - US targets = 3x to 5x US corn production
- Global demand → increases in crop prices:
 - **Corn**: 75,000+ people in “tortilla riots” in Mexico
 - **Oil palm**: deforestation in Malaysia & wetlands in Indonesia = large C release
 - **Soy**: 100,000 ha/yr deforestation in Bolivia (& indigenous peoples); paved road in Amazon to export soy → illegal deforestation
 - **Knock-on effect**: crop conversion → price inflation for non-biofuel crops

North America **cannot grow enough food crops** for ethanol and biodiesel

•5% content in gasoline and 5% content in diesel will require **18%** of Canada’s harvest of crops appropriate for biofuel production (Environment Canada, 2006. *Renewable Energy*. Accessed at http://www2.nrcan.gc.ca/es/ener2000/online/html/chap3f_e.cfm on 22 Jan. 2007 * web address no longer working *)

•dedicating all corn and soybeans to biofuels in the US would replace only **12% of gasoline** and **6% of diesel** consumption (Hill, J., Nelson, E., Tilman, D., Polasky, S. and Tiffany, D. 2006. *Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels*. Proceeding of the National of Academy of Sciences, doi:10.1073/pnas.0604600103)

•US target is **35 billion gallons** of renewable and alternative fuels by 2017, enough to replace 15% of gasoline consumption; the National Corn Growers Association (US) estimates that the nation’s corn crop could produce a maximum of **15 billion gallons** of ethanol (McKinney, M. 2007. Ethanol demand will outpace corn supply. Minneapolis-St. Paul Star Tribune, January 25, 2007, http://www.timesrecordnews.com/trn/local_news/article/0.1891.TRN_5784_5304560.00.html ; and Nelson, S. 2007. ANALYSIS - Corn Alone can’t Meet Bush Green Fuel Goal. 25/1/2007, Reuters News Service, http://www.autonewsservice.org/alternative_fuels/02_01_07/reuters_012507.htm

Corn

•**corn prices have doubled** over the last year (see also

<http://select.nytimes.com/gst/abstract.html?res=FB0E16FA3E5B0C728CDDAB0894DF404482>)

•**tortilla price up 60%** in one year: **Tortilla Riots** in Mexico (see also http://www.sun-sentinel.com/news/local/caribbean/sfl-htortillas11feb11_0.3669196.story?coll=sfla-news-caribbean; http://www.sun-sentinel.com/news/local/caribbean/sfl-htortillas11feb11_0.3669196.story?coll=sfla-news-caribbean)

Oil palm

•the largest cause of tropical deforestation is now conversion of forest to oil palm plantations for biodiesel: there will be environmental conflicts or trade-offs – “green” fuel vs. protection of tropical forests (Sprott, E. and Bambrough, K. 2006. *Investment implications of an abrupt climate change*. Sprott Asset Management Inc., Toronto, Ontario. <http://www.sprott.com/pdf/climate.pdf>; largely an issue in Malaysia and Indonesia

•Annual C emissions from **peat** and **forest fires** for palm oil plantation establishment = five times the total annual emission cuts which the Kyoto Protocol aims to make by 2012, from 1990 levels; Indonesia holds 60% of all tropical peat (=50 billion tonnes of carbon, = 7-8 years of global fossil fuel emissions); one tonne of palm oil grown on peat is linked to the release of ~20 tonnes of carbon dioxide released from that peat (Wetlands International); from <http://www.biofuelwatch.org.uk/files/pressrelease2006-11-10.pdf>

•see also

<http://www.taipetimes.com/News/editorials/archives/2007/02/03/2003347535/print>

<http://www.sciencedaily.com/releases/2007/03/070308121818.htm>

http://www.mg.co.za/articlePage.aspx?articleid=302353&area=/insight/insight_economy_business/

<http://www.energywire.net/2007/01/biodiesel-asias-alternative-fuel-16663.php>

<http://www.commondreams.org/headlines07/0322-01.htm>

www.biofuelswatch

Are liquid biofuels sustainable?

- **Local protest:** biodiesel plant using palm oil cancelled in UK
- **Global protest:** increasing number of petitions against developed countries
- **UN** grappling with *unintended consequences* and *sustainability* (social, ecological, economic)

Biodiesel plant cancelled in the UK:

• Npower, one of the UK's top three gas and electricity suppliers, announced its decision to drop plans to use palm oil to fuel its Littlebrook power station in Kent, southeastern England, in November 2006 because of environmental pressure over use of palm oil from SE Asia; <http://dte.gn.apc.org/71oil.htm>

UN report:

- See next slide

**Sustainable Bioenergy:
A Framework for Decision Makers**

UNITED NATIONS

Widening Access

ENVIRONMENTAL SUSTAINABILITY

Food Security

Overcoming Challenges

RURAL DEVELOPMENT

UN-Energy

UN report (April 2007)

*“Bioenergy requires a **multidisciplinary and global approach** if it is to play the key role expected by... the energy, agricultural and environment sectors”*

See April 2007 UN report “**Sustainable bioenergy: A framework for decision makers**” at <http://esa.un.org/un-energy/pdf/susdev.Biofuels.FAO.pdf> and MSNBC news item on it at <http://www.msnbc.msn.com/id/18551000/>

What does UN Report say about Sustainable Bioenergy?

Along with knowledge generation, compilation, & transfer (North to South):

- C&I to be mainstreamed into projects and programs
- Establish internationally agreed standards and certification models

See April 2007 UN report “**Sustainable bioenergy: A framework for decision makers**” at <http://esa.un.org/un-energy/pdf/susdev.Biofuels.FAO.pdf> and MSNBC news item on it at <http://www.msnbc.msn.com/id/18551000/>

Are C&I the answer?

- Dutch government's **Cramer Commission**
(reported July 2006; refinements to C&I late 2006; 1st step 2007, 2nd step 2011)
 - “to formulate a set of **sustainability criteria** for the production and conversion of biomass for energy, fuels and chemistry”
 - “**no distinction**... between imported biomass and biomass that is produced in the Netherlands”
 - “An **internationally** watertight monitoring and registration system will be needed”
 - C&I “must **integrate** into ... **policy** frameworks at the national, European & global level”

General principles in Cramer Commission (2006) *Criteria for sustainable biomass production*, 14 July 2006, the Netherlands. http://www.forum-ue.de/bioenergy/txtpdf/project_group_netherlands_criteria_for_biomass_production_102006bonn.pdf , and follow-up comments in press in April 2007 at http://news.yahoo.com/s/ap/20070426/ap_on_sc/good_biofuels_vs_bad_2

Cramer C&I the new “standard”?

6 themes, each with C&I

(#2-6 range from “insight” to “no negative” between 2007 & 2011)

1. **lifecycle GHG balance** (>30% reduction from fossil fuel reference for 2007; 50% for 2011)
2. **Competition** with food, local energy supply, medicines and building materials
3. **Biodiversity**
4. **Economic prosperity**
5. **Social well-being**
6. **Environment**

Cramer Commission (2006) *Criteria for sustainable biomass production*, 14 July 2006, the Netherlands.

http://www.forum-ue.de/bioenergy/txtpdf/project_group_netherlands_criteria_for_biomass_production_102006bonn.pdf

6 themes in Cramer Commission (2006) *Criteria for sustainable biomass production*, 14 July 2006, the Netherlands. http://www.forum-ue.de/bioenergy/txtpdf/project_group_netherlands_criteria_for_biomass_production_102006bonn.pdf, and follow-up comments in press in April 2007 at http://news.yahoo.com/s/ap/20070426/ap_on_sc/good_biofuels_vs_bad_2

Cramer Environment Indicator?

Criteria: No negative effects on local environment

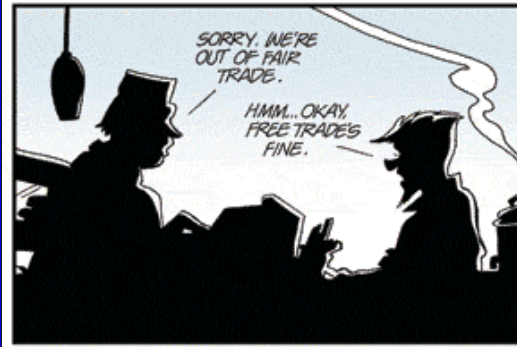
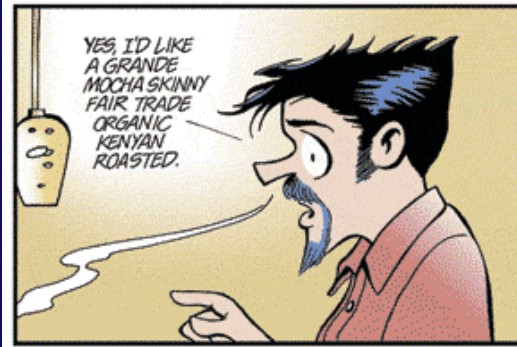
Indicators (*that could also relate to forestry*):

- Local guidelines and legislation
- Erosion
- Steep soils, marginal or vulnerable soils
- Nutrient balance

Focusing just on **impacts on environment through biomass removals**, from **Cramer Commission (2006)** *Criteria for sustainable biomass production*, 14 July 2006, the Netherlands. http://www.forum-ue.de/bioenergy/txtpdf/project_group_netherlands_criteria_for_biomass_production_102006bonn.pdf , and follow-up comments in press in April 2007 at http://news.yahoo.com/s/ap/20070426/ap_on_sc/good_biofuels_vs_bad_2

(There are other environmental indicators)

Are N. Am. consumers familiar with certification?



If North Americans have become used to certified coffee (e.g., Fair Trade), then are they ready to respond to certified bioenergy and biofuels?

Are consumers ready for certified bioenergy?



- See Canada's **Ecologo** (Environment Canada) for "**Electricity – Renewable Low-impact** (favoured by FPAC) <http://www.environmentalchoice.com/English/ECP%20Footer/About%20the%20Program/Criteria/Electricity%20Products/Electricity%20Generators> and specific criteria in *Environmental Choice Program Certification Criteria Document CCD-003* at http://www.environmentalchoice.com/images/ECP%20PDFs/CCD_003.pdf
- The **Pembina Institute** also has an interesting report on bioproducts and this contains information on labelling [*do search in it for "Ecologo"; some interesting comments in it re: biomass labeling, etc.*] http://www.pembina.org/pdf/publications/Bioproducts_Mkt_Dev.pdf

For some general reports, see also

- Lewandowski and Faaij (2005) *Steps towards the development of a certification system for sustainable bioenergy-trade*. Biomass & Bioenergy 30: 83-104. The authors call for, amongst other things, care in formulating government policies that are consistent across a wide range of topics, and do not work against each other.
- Dufey, A. 2006. *Biofuels production, trade and sustainable development: emerging issues*. Sustainable Markets Discussion Paper Number 2, International Institute for Environment and Development, London, September 2006. 57 pp. <http://www.iied.org/pubs/pdf/full/15504IIED.pdf>. Major report, funded by Netherlands Ministry of Foreign Affairs (DGIS) and Royal Danish Ministry of Foreign Affairs (Danida); Swedish International Development Cooperation Agency (Sida) financed production of the paper.
- Dufey, A. 2007. *International trade in biofuels: Good for development? And good for environment?* International Institute for Environment and Development (IIED) Report, London, Jan. 2007. 4 pp. <http://www.iied.org/pubs/display.php?o=11068IIED> [*looks like synopsis of Dufey 2006*]; calls for integrated certification policies, and points out that **current agricultural and forestry certification systems are a good starting point**; concerned about proliferation of schemes in North (see **Green Labelling** below) that do not take into account conditions in producer countries, and place an unfair burden on them; this relates directly back to CREM (2006) above, with interviews with producing countries in South
- **CREM (2006)** *Dutch import of biomass: Producing countries' point of view on the sustainability of biomass exports*, CREM Report No. 06.885, Amsterdam, Oct. 2006. (<http://www.crem.nl/>) for C&I and case studies, plus strong recommendations for policy and action. http://www.bothends.org/strategic/061211_Dutch%20import%20of%20biomass.pdf
- van Dama, J. et al. 2006. *Overview of recent developments in sustainable biomass certification (DRAFT)*. Paper written within the frame of IEA Bioenergy Task 40, 22 December 2006. Deliverable for Task 40. The final version will be submitted mid-January 2006 to a special issue of Biomass and Bioenergy. (M.Junginger@chem.uu.nl) <http://www.bioenergytrade.org/downloads/ieatask40certificationpaperdraftforcomments22..pdf> *Overview of recent developments in sustainable biomass certification – Annexes (DRAFT)* <http://www.bioenergytrade.org/downloads/ieatask40certificationpaperannexesdraftforcomm.pdf>
- Van Den Berg, J. & Rademakers, L. (2007) *An in-depth look at Brazil's "Social Fuel Seal"*, 23 March 2007, Biopact web page <http://biopact.com/2007/03/in-depth-look-at-brazils-social-fuel.html>; sort of a certification system, but certainly designed to protect small farmers; Brazil's attempt to not repeat mistakes with ethanol when promoting biodiesel

For some specific programs, see:

- **GreenLabelsPurchase**: A number of "green electricity" labels can be found through <http://www.greenlabelspurchase.net/en-Green-Electricity.html>. [*The conditions to be met are not always clear; some do not seem onerous. How effective are these groups? Where does marketing end, and idealistic certification begin?*] These include: Guarantee of Origin, RECS, Green Electricity Label, ok-Power www.energie-vision.de, TÜV Mark EE, TÜV Mark UE01/02, Norppa, Electricity Disclosure, EUGENE, 100% Energia Verde, Austrian Eco-Label,
- **EUGENE**: European Green Electricity Network <http://www.eugenestandard.org/index.cfm>, and see more on it at the WWF page at



We are used to certification in forestry, but usually for overseas markets. It should be possible to modify current systems for biomass harvesting; there is no need to invent a new system.

Summary so far...

- Agricultural biofuels are not a panacea
- Unintended consequences (& Canada is not immune)
- Calls for C&I and certification
- Dutch have implemented C&I process
- Are North American public open to the concept of global certification?

Where are we going in forestry?

- **Sweden and Finland: 20%** from forests
- **Canada: 6%** from forests (wood waste)
 - half of this generated BC
 - cf. **76%** potential for Canada (Wetezel et al. 2006)
 - **30%** potential for BC (cf. total BC energy; Ralevic & Layzell)
- Why so little in Canada?
 - **Hydro:** QC, MB and BC have 3 cheapest electricity prices in North America
 - **Economics:** wood is high volume/mass and low value = tough market to compete in...

Nordic countries currently lead the world in use of wood for energy:

•**Sweden:** wood and wood byproducts account for 85% of bioenergy produced, and 14% of total energy consumption (SVEBIO. *Factsheets on Bioenergy in Sweden*. Accessed at <http://www.svebio.se/?p=774&m=614> on 22 Jan. 2007; now likely 20%)

•**Finland:** it is the main (20%) renewable energy source = 10% of electricity production (FinBioenergy. *Bioenergy in Finland*. Accessed at <http://www.finbioenergy.fi/default.asp?init=true&initID=398;14347> on 22 Jan. 2007; FinnFacts. *Finland uses the most bioenergy in Europe*. Accessed at <http://www.finnfacts.com/english/main/actualities/bioene.html> on 22 Jan. 2007.)

Canada:

•6% of Canada's primary energy supply is already derived almost exclusively from forests (Environment Canada. 2006. *Renewable Energy*. Accessed at http://www2.nrcan.gc.ca/es/ener2000/online/html/chap3f_e.cfm on 22 Jan. 2007.)

•Forest-derived biomass could generate up to 76% of Canada's annual energy consumption (Wetzel, S., L. Duchesne, and M. LaPorte (eds) 2006. *Bioproducts from Canadian forests: New Partnerships in the Bioeconomy*. Springer, Dordrecht, The Netherlands.)

•The forest products industry produces 57% of their energy needs from industrial byproducts such as bark, wood shavings and sawdust (FPAC Dec. 2005. *Canada's Forest Industry Achieves Incredible 44% Efficiency In Reducing Greenhouse Gas Emissions*. Accessed at http://www.fpac.ca/en/media_centre/press_releases/2005/2005-12-07_KyotoProgress.php on 22 Jan. 2007.)

BC:

•Biomass inventory (Ralevic, P. & Layzell, D.B. 2006. *An Inventory of the Bioenergy Potential of British Columbia*, BIOCAP Canada Foundation, from http://www.biocap.ca/images/pdfs/BC_Inventory_Final-06Nov15.pdf)

•11.9 million t (i.e., Mt) of (dry) biomass/yr from slash = 191 PJ/yr = **21%** of current fossil fuel demand of 920 PJ/yr (assuming 70% of the slash is removed)

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• 8.6 Mt (dry)/yr of WTH MPB-killed wood that is non-recoverable for traditional wood products = 138.6 PJ/yr = **15%** of current fossil fuel demand

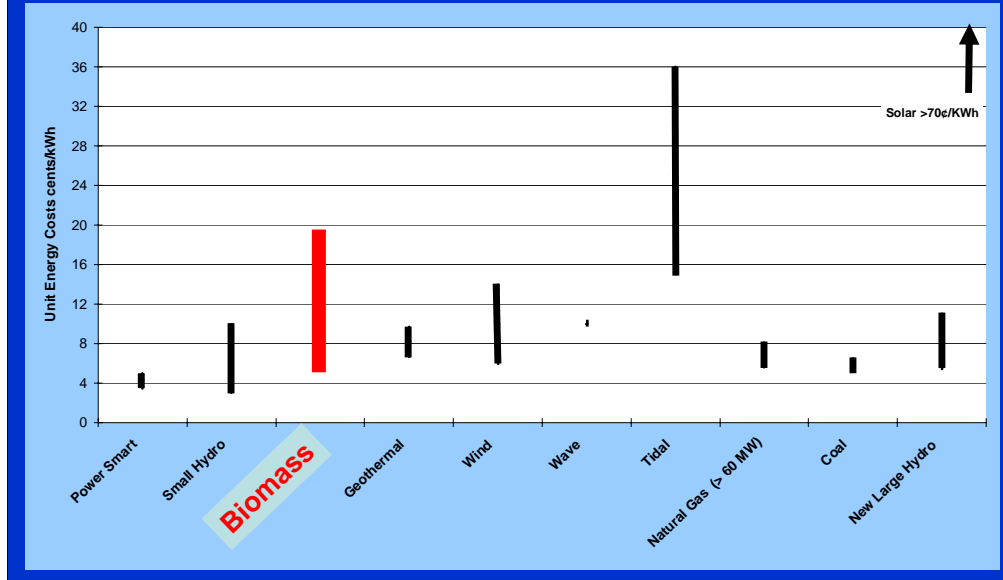
= total of 22.9 Mt (dry)/yr = **40%** of current fossil fuel demand

[* but what is meant by "current fossil fuel demand"? *]

•General information about bioenergy in BC: <http://www.for.gov.bc.ca/hts/bioenergy/>

Levelized Unit Energy Costs

(BC Hydro, 2003)



Levelized Unit Energy Costs (from BC Hydro 2003)

2 points with this slide;

Cost of conventionals: The obvious leaders are natural gas, coal and new large hydro 5 to 8 cent per kWh range.

Cost of alternatives: Compare 'conventionals' to new sources such as wind (6 to 14 cents a kWh) and biomass (6 to 19 cents a kWh) in BC; close to conventionals, but a greater ranging in prices and capacity; therefore not close conventionals.

Interestingly power smart or demand side initiatives fair quite well at 4 cents kWh. When I started working on this research in 2004 it was thought that demand side would not be large enough to be a realistic alternative but recently there appears to be more strategies to make it an option as a huge part of the BC energy plan includes strategies around conservation especially with commercial users and pricing.

Where are we going in forestry?

- “1st generation” (ethanol, biodiesel) → “2nd generation”:
 - syngas
 - cellulosic ethanol (Iogen, Lignol, UBC)
 - bio-oil (pyrolysis)
- Cellulosic ethanol from stover (→ loss of SOM?) & perennial grasses; forests = huge feedstock supply
- Technological advances in forestry, notably:

John Deere 1490D Slash Bundler



One bundle contains
1 MWh of energy

- John Deere **slash bailer**, with slash “pulp logs” being handled using traditional forestry equipment, therefore **little added equipment cost or training for contractors/companies**; 1 MWh energy per 8’ bundle

http://www.deere.com/en_GB/forestry/forestry_equipment/energy_wood_harvester/1490d.html)

- **Efficient technology for producing forest chips ... Bundling technology revolutionized the transportation of uncomminuted biomass and opened the way to centralized comminution at the plant. Several large CHP plants e.g. Alholms Kraft installed a stationary crusher that, in turn, made it possible to process stump and root wood. By 2004, some 24 residue balers were in operation in Finland. The new technology was found especially attractive with respect to the flexible process control of large-scale procurement of forest chips. ...**. From

http://www.bioenergynoe.org/?_id=146&showArticle=76; final report available at www.tekes.fi/english/programmes/woodenergy

Stumps for biomass

6000 ha/year pulled in Finland; Sweden now doing operational trials



“Build and they will come”

Once committed to bioenergy, can we end up with “unintended consequences”, as with food crops?

- Finland currently harvests **stumps** from **6,000 ha/yr**, cf. logging residues from final fellings from 25,000 ha/yr (15 Dec. 2006 presentation; http://www.metla.fi/tapahtumat/2006/metsanuudistaminen/Laitila_Juha-2006-12-15.pdf);
- Stump lifting for bioenergy **began in 2000** (http://www.metla.fi/tapahtumat/2006/metsanuudistaminen/Strandstrom_Markus-2006-12-15.pdf)
- Finland: **Stumps – an unutilised reserve**; Wood EnergyTechnology Programme Newsletter on results 4/2004 <http://www.tekes.fi/eng/publications/kannoteng11.pdf>
- Stumps recently started being harvested at **experimental** level in Sweden (Anna Furness-Lindén; anna.furness-linden@skogforsk.se; www.nordgen.org/nsfp/doc/temadagar/Anna_Furness-Linden.ppt)
- This is now taking place more operationally (Egnell & Olsson, pers. comm., April 2007)

Advanced BioRefinery Inc. (ABRI), Ottawa

Portable (flat bed trucks) 50 Dry Ton Per Day (DTPD)
conversion plant



Breakthrough in development of **portable conversion plants** that can be taken to the forest, rather than transporting biomass to a conversion plant (e.g., portable pyrolysis by Advanced BioRefinery Inc. (ABRI) in Ontario <http://advbiorefineryinc.ca/>)

What about BC?

- New **BC Energy Plan** (27 Feb. 2007)
 - zero net GHG emissions from all new projects
 - BC to be self-sufficient in electricity by 2016
- **Call for Proposals** by BC Hydro (with EMPR, MOFR, forestry & energy sectors; projects by end of 2007)
- Specific **Bioenergy Strategy** TBA (soon!)
- Will P&P and lumber give way to bioenergy? (Craig Campbell, PWC, 10 May 2007)


Are we ready?

Low-hanging fruit = “underutilized wood residue”



BC has a lot of biomass available already, without having to harvest slash

Photo from <http://www.photopix.de/images/uploads/klarsreuti-0069-20051027.jpg>



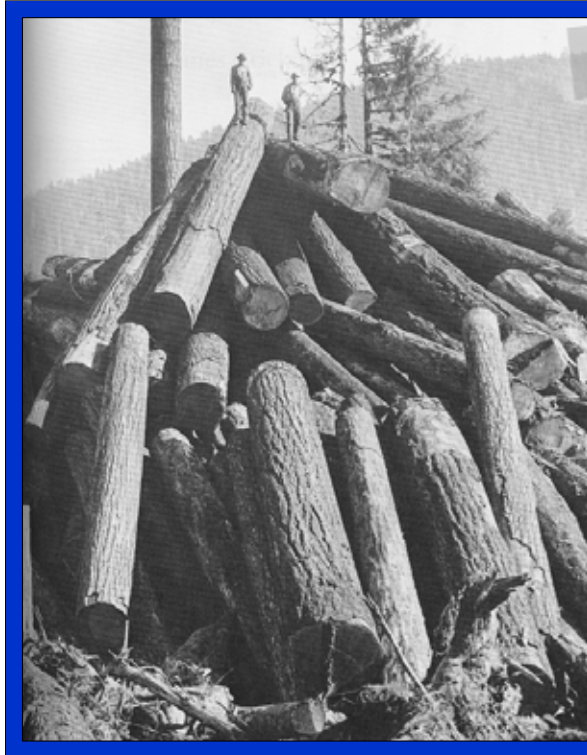
Sawmill residue
1.2 x 10⁶ BDt burned
in beehives = good
use of resource

Courtesy of Alec McBeath

In the not-to-distant past this was the fate of quite a bit of the residuals from processing timber.

Creating a lot of energy here – none captured.

So there is energy to be saved. There are both environmental and financial costs that could be avoided.



Roadside logging residue

- 7×10^6 BDt in Central Interior
- *Maritimes*: opposition to full-length to roadside
- *Quebec*: documentary highlighted slash piles; public concern
- *Ontario*: public input to biorefining; boreal controversy
- *Even though*

Issue with roadside slash piles is that, even though it has been done in BC for years, (i) it is no longer done in Maritimes, and there is currently controversy about going back to it (see Salenius in June 2007 For. Chron., and Salenius and Mahendrapa in Atlantic Forestry Review); (ii) QC did this for years, until a documentary highlighted it, putting pressure on government to change; (iii) boreal controversy in ON could merge with biomass removals, and gain impetus.

Will negative public reaction to global agricultural biofuels debate draw their attention to forestry?

MPB-killed wood



- 400 x 10⁶ to 1 billion BDt non-recoverable for timber
- MPB is limited resource
- Stop gap: “see us over the hump”?

Stagnant stand 20 years after MPB in SE BC (Courtesy of Alec McBeath)

Regeneration Delays

Stagnant stand 20 years after MPB outbreak that occurred in the SE corner of the province. Very little regeneration this stand and it would be difficult to do any management activities here.

fire risk is once again quite high when a stand is in this condition.

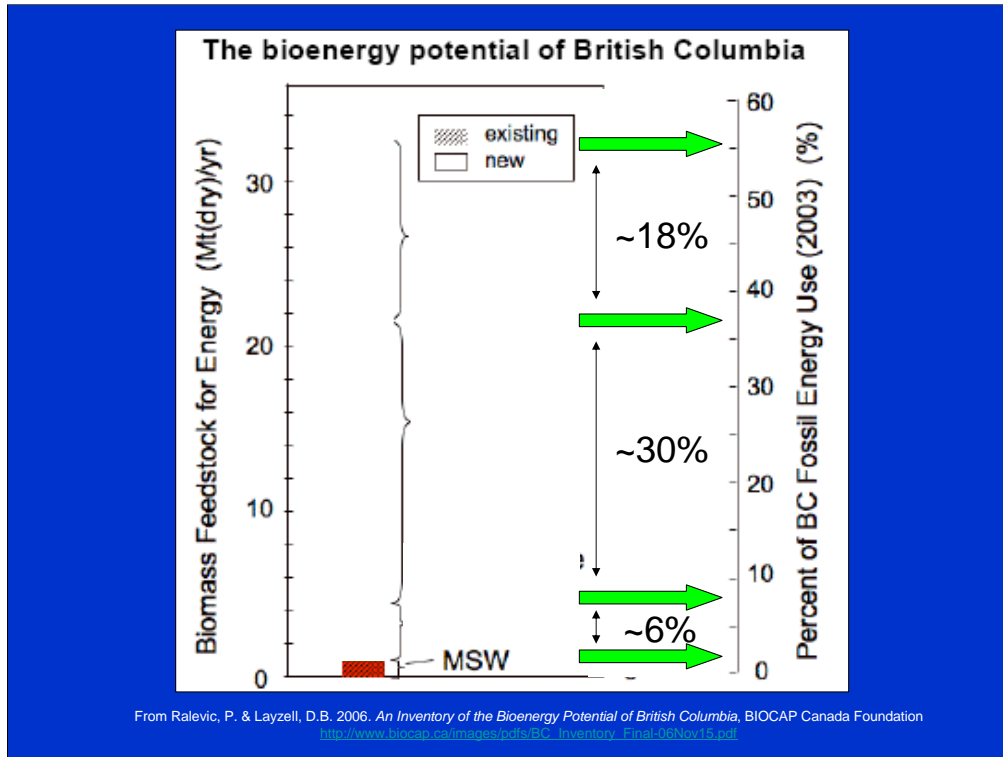


Figure reproduced from:

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[* but what is meant by "current fossil fuel demand"? *]

•General information about bioenergy in BC: <http://www.for.gov.bc.ca/hts/bioenergy/>

NB: Does NOT take into account site productivity, therefore must be an overestimate, for slash. (See Nordic guidelines for slash removal, and EU environmentally-sensitive biomass inventory.)

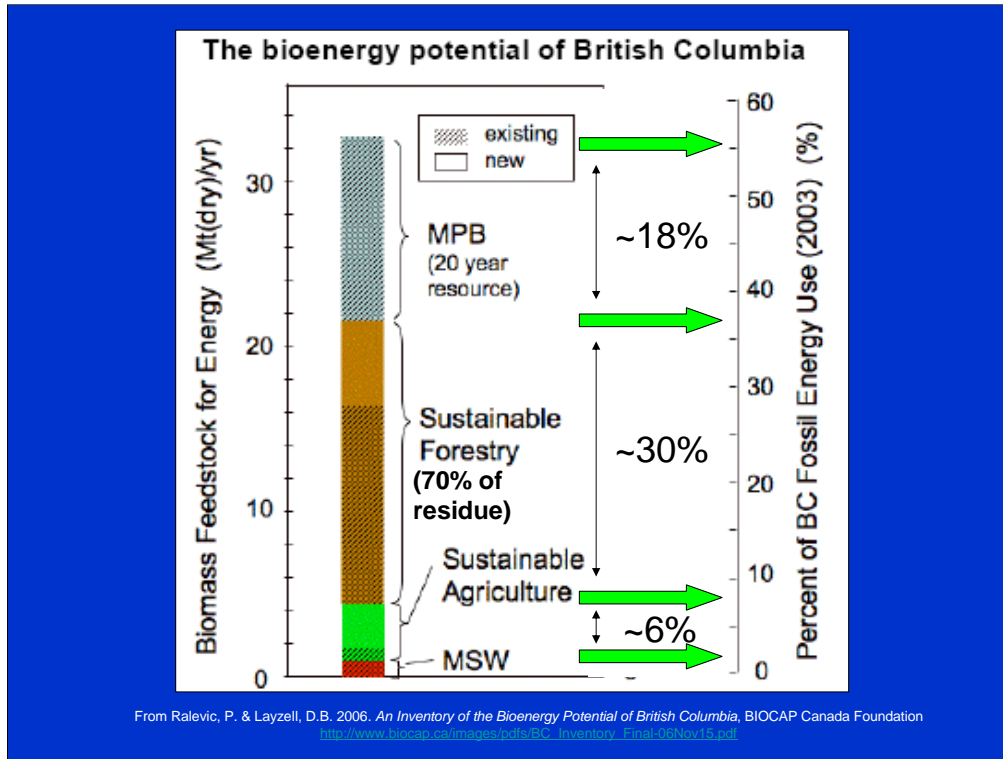
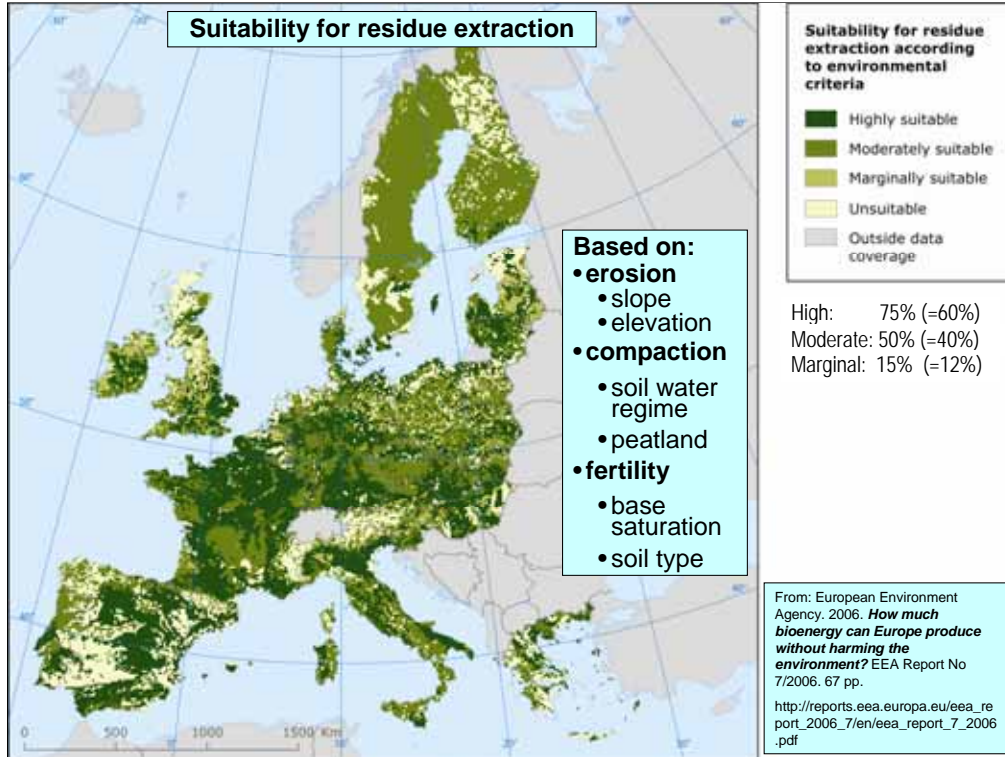


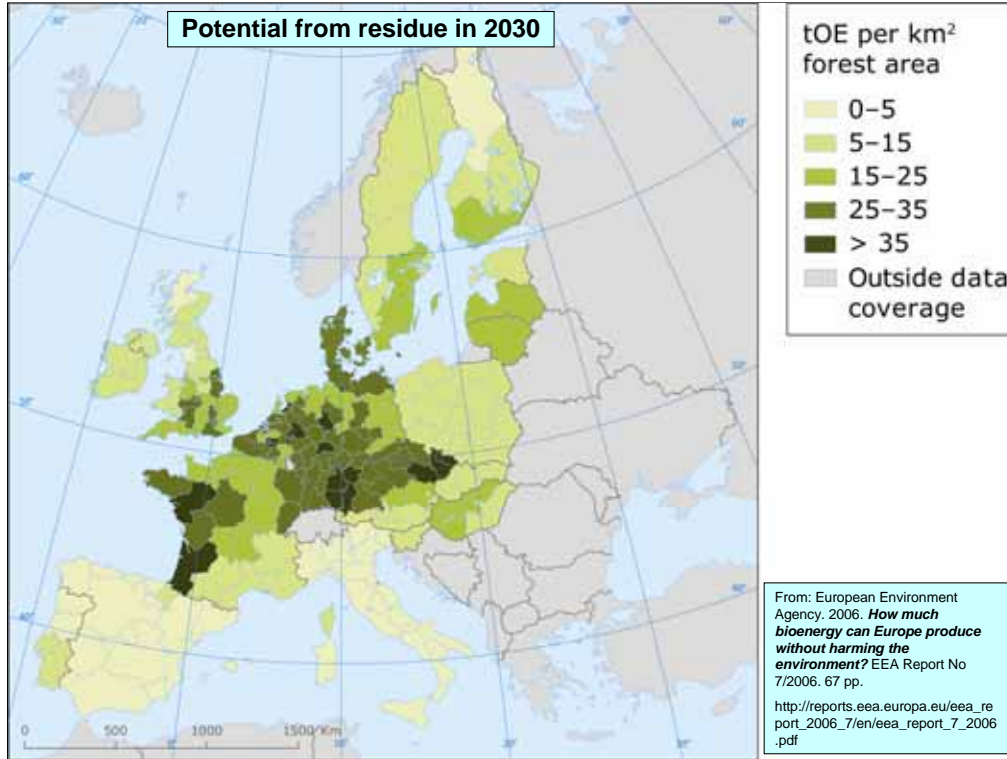
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What happens if we remove more than just logs?



370-yr-old, 275-ft (84-m) Douglas-fir log (1958)

A 370-year-old and 275-foot (84-meter) arrow-straight Douglas fir was selected by the forest industry of British Columbia as its Centennial Year gift to the people of the United Kingdom. When erected as a flagpole in the Royal Botanic Gardens at Kew, London, it will be the tallest flagpole in the world. After being felled, the stem was cut to a length of 226 feet (88 meters), loaded on false bunks on top of two loaded logging trucks and delivered to a beach 25 miles (40 kilometers) away where it was dumped in the water and towed to Vancouver Harbor. Two floating cranes loaded the 36-ton log aboard a freighter where it rested on a deckload of lumber bound for the port of London. Here the big pole was dumped into the Thames river and then towed up to Kew for seasoning and dressing. It will eventually stand 214 feet (65 meters) above the ground.

Unasyuva 12(4) News of the World

Guinness Book of Records (1982) Entries

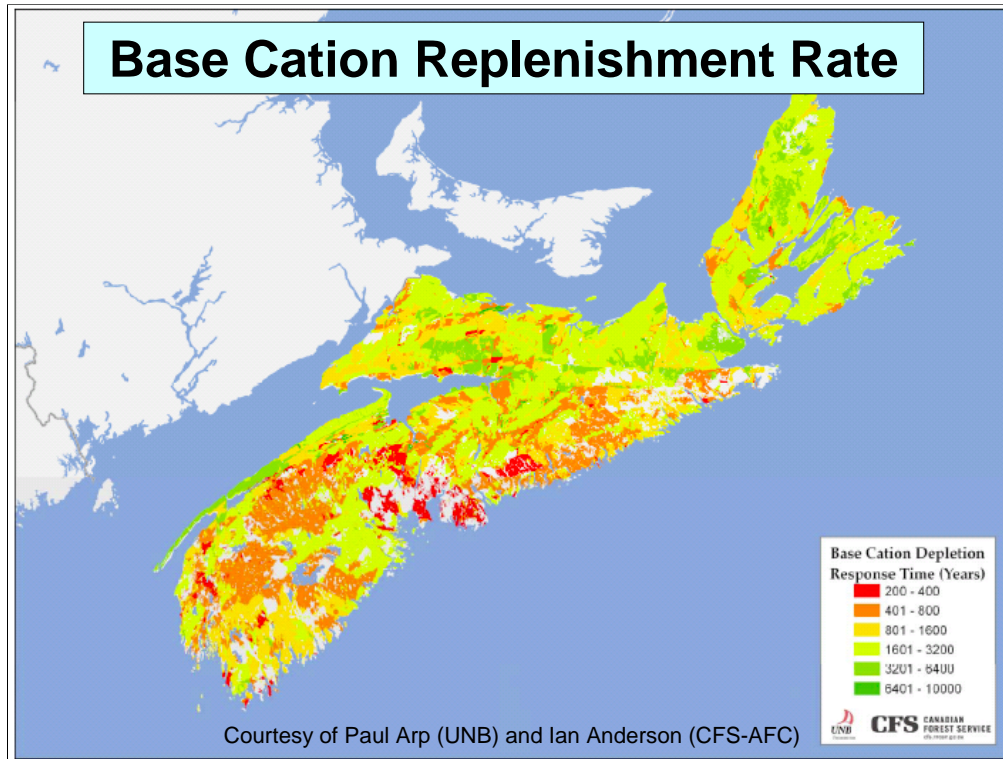
Flagstaff Tallest *Great Britain*

The tallest flagstaff in Great Britain is a 225 ft 68 m tall Douglas fir staff at Kew, Richmond upon Thames, Greater London. Cut in Canada, it was shipped across the Atlantic and towed up the River Thames on May 7 1958 to replace the old 214 ft 65 m tall staff of 1919.

Flagstaff Tallest *World*

The tallest flagstaff ever erected was outside the Oregon Building at the 1915 Panama-Pacific International Exhibition in San Francisco, California, USA. Trimmed from a Douglas fir, it stood 299 ft 7 in /91 m/ in height and weighed 45 tons 47 tons. The tallest unsupported flag pole in the world is 170 ft 51,8 m tall (plus 10 ft 3,048 m below ground) metal pole weighing 28,000 lb 12 700 kg erected in 1943 at the US Merchant Marine Academy in King's Point, New York, USA. The pole, built by Kearney-National Inc., tapers from 24 in to 5 1/2 in 61 cm to 14 cm at the jack.

<http://www.allstates-flag.com/fotw/flags/xf-supe.html>



Length of time for Ca levels to return in soil, after WTH

Ca in PNW (Oregon Coast Range)

Ca inputs (kg/ha) in young Douglas-fir stands

Wet deposition	0.90
Cloud deposition	0.60
Weathering	0.05
Total	1.55

Pool or flux	STO	WTH
Years of available Ca supply	402	54

Perakis, S.S. et al. 2006. Coupled nitrogen and calcium cycles in forests of the Oregon Coast Range. *Ecosystems* 9: 63-74.

Base cation depletion is usually thought of as an eastern Canadian/US problem. However, recent findings suggest that this is not so.

Authors measured 22 young Douglas-fir stands. Note that weathering rates are low, compared to atmospheric sources; will Ca depletion be more serious on low-Ca weathering sites further from the coast?

We have not yet seen Ca deficiencies in the field in BC yet – is this because not enough time has passed for it to become apparent? Will it become a problem in the future?

Perakis, S.S. et al. 2006. Coupled nitrogen and calcium cycles in forests of the Oregon Coast Range. *Ecosystems* 9: 63-74, Table 4.

What might we do?

- “Low hanging fruit”, but need to address thinning and slash removal questions now (cannot buy time...)
- Consolidate knowledge and make it easily accessible (provincially, nationally, globally)
 - Current WTH field trials a good starting point
 - Compile data on other relevant trials/research
 - Gap analyses and syntheses
 - Weathering rates, base cations, Ca/Al, PROFILE
 - Compile relevant spatial layers and maps
 - Address scaling questions to relate point-data to spatial units (scaling up)

What might we do?

- Concentric layers of research intensity (based on costs & need for knowledge)
 - Intensive research trials on selected, key sites
 - Extensive but less intensive “legacy” trials (establish now; only measure in future if needed)
 - Monitoring (e.g., BC Soils remote sensing study)
- Environmentally-sensitive biomass inventory
- Work towards guidelines
- Work towards C&I, certification (level playing field with agriculture)
- Adaptive management will be essential
- Where to process models fit in?

What might we do?

- Clarify terminology at outset:
 - “biofuels”, or “biomass”?
 - “logging waste”, or “slash”, “residue”?
 - “C neutral”, or “C lean”?
- Collegial collaboration (research strategies depend more on this, and serendipity, than on top-down planning)
- Inter-provincial networks and working groups, to share knowledge and minimize duplication
- Time is of the essence (can never have enough good, long-term field trials)



Are we ready?

- Guidelines for biomass removals need nutrient & site data & knowledge
 - **Denmark:** leave all slash till foliage drops
 - **Sweden:** leave most of foliage, or else need compensatory fertilization
 - **Finland:** depends on site type; greatest removal is 70% of slash or equivalent removal of nutrients on richest sites

Are we ready?

Low-hanging fruit = “underutilized wood residue”

- **Sawmill residue**
 - 1.2×10^6 BDt burned in beehives = good use of resource
- **Logging residue**
 - 7×10^6 BDt in Central Interior
 - *Quebec*: documentary highlighted slash piles; public concern
 - *Maritimes*: opposition to full-length to roadside
 - *Ontario*: public input to biorefining; boreal controversy
 - Even though presently burnt, will public approve when they find out?
- **MPB-killed wood**
 - 400×10^6 to 1 billion BDt non-recoverable for timber
 - MPB is limited resource
 - Stop gap: “see us over the hump”?