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### **Bioethanol Fuels**

June 6, 2006 4:00p.m – 6:00 p.m. (EDT)

Moderated by Dr. Ann Dale

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This e-Dialogue were part of research undertaken by an independent expert working party, as part of their project on biotechnology, sustainable development and the economy. As such, neither the opinions expressed nor the information provided in this on-line conversation are in any way associated with the Canadian Biotechnology Advisory Committee (CBAC) or the advice it offers to government.

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**Ann Dale**    **Posted: Tue Jun 06, 2006 11:46 am**

Welcome to our second private e-Dialogue on Biotechnology, Sustainable Development and the Future of Canada's Economy, focusing on the specific issue of biofuels policy, using three potential scenarios.

The working party is now nearing completion of its report to the Federal Government, and we are interested in obtaining your unique perspectives on some of our thinking, by bringing together this interdisciplinary group of policy makers, young scholars and practitioners. Thank you for giving us your time to discuss this critical public policy direction, une mille fois merci.

Perhaps while Art is preparing his comments, why don't we go through introductions and general comments?

The background paper presents three different scenarios, Art, do you want to make some introductory remarks?

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**Arthur J Hanson**    **Posted: Tue Jun 06, 2006 12:03 pm**

Thanks Ann. I will be on-line with Ann acting as moderator, but I hope that she may also intervene with comments as a member of our working party. Stuart Lee will also be present in his role as a Secretariat Member. Stuart may also play a

"devil's advocate" role on some of the points I or others raise. We have lots of discussion in our group. Always friendly, but not always in consensus!

We have focused on bioethanol for this e-dialogue because it is very topical and also gives us a good, real world case to discuss.

We want your views on how we should be assessing this biotech approach, and we will see how these views stack up against what we are preparing in our report. I hope your views will shape some of our thinking.

I am ready to go right into the substance of the discussion. Who wants to be first?

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**Lenore Newman**    **Posted: Tue Jun 06, 2006 12:03 pm**

Good afternoon everyone.

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**Levi Waldron**    **Posted: Tue Jun 06, 2006 12:05 pm**

Good afternoon. I'm a post-doctoral student, working with Ann and Lenore. I'm looking forward to this discussion.

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**Ann Dale**    **Posted: Tue Jun 06, 2006 12:09 pm**    **Moderator**

Welcome Lenore and Levi, decided to move outside, it is a very beautiful sunny day here outside of Ottawa and one of the benefits of this technology, is our ability to work virtually, independent of place, and not tied to a desk necessarily. I see Rodney has now joined us, Art, you have a question?

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**Rodney McDonald**    **Posted: Tue Jun 06, 2006 12:07 pm**

Good afternoon, I'm a sustainability consultant based in Winnipeg. Thank you for the opportunity to participate in this discussion. Art, Has the Advisory Committee developed (or do you plan to develop) a set of decision making principles for Canada to help decision-makers and the public make good, sound, sustainable decisions about biotechnology?

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**Mark LR Hall**    **Posted: Tue Jun 06, 2006 12:08 pm**

Hello everyone. Thank you for allowing me to participate today, I excited about it. As a background, I am a Registered Professional Forester from BC. I am a graduate of the Royal Roads Environment & Management MSc program (2004), which is where I first met Ann. Since then we touch base now and again talking mostly about writing and art! I hope I can bring some perspective on the topic from a small rural Forester from BC!

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**Stuart Lee** Posted: Tue Jun 06, 2006 12:09 pm

Hi all - it is good to be back in e dialogue space again.

Perhaps I will start off by mentioning that a headline I read today warned us (perhaps with a bit of hyperbole) that oil prices could go as high as \$150 a barrel, if Iran's threat of disrupting the oil supply were carried out.

This would certainly make bio-ethanol economic, but would it be a good SD choice?

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**Ann Dale** Posted: Tue Jun 06, 2006 12:10 pm Moderator

Welcome, Mark, i am sure you will, and also Stuart.

***Mark LR Hall wrote:***

*Hello everyone. Thank you for allowing me to participate today, I excited about it. As a background, I am a Registered Professional Forester from BC. I am a graduate of the Royal Roads Environment & Management MSc program (2004), which is where I first met Ann. Since then we touch base now and again talking mostly about writing and art! I hope I can bring some perspective on the topic from a small rural Forester from BC!*

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**Arthur J Hanson** Posted: Tue Jun 06, 2006 12:11 pm

I am looking forward to getting views from a forester. One of the most difficult areas is the business of pulp and paper. We are having real problems figuring out the role of P&P. The mills already are bio-refineries, but their future role seems unclear, for bio-fuels or other bio-products.

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**Rodney McDonald** Posted: Tue Jun 06, 2006 12:12 pm

**Mark LR Hall wrote:**

*Hello everyone. Thank you for allowing me to participate today, I excited about it. As a background, I am a Registered Professional Forester from BC. I am a graduate of the Royal Roads Environment & Management MSc program (2004), which is where I first met Ann. Since then we touch base now and again talking mostly about writing and art! I hope I can bring some perspective on the topic from a small rural Forester from BC!*

I too am a graduate of the RRU MEM program (2005).

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**Justin Trudeau**    **Posted: Tue Jun 06, 2006 12:12 pm**

Hi guys, Justin Trudeau here, looking forward to chatting with all of you...

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**Arthur J Hanson**    **Posted: Tue Jun 06, 2006 12:12 pm**

Stuart, I guess it depends upon the criteria that we use, and whether we think of sustainable development and security as being linked.

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**Nancy Averill**    **Posted: Tue Jun 06, 2006 12:13 pm**

Hi All. I am Nancy Averill, Director of Research at the Public Policy Forum in Ottawa but also have experience with the National Round Table on the Environment and the Economy. I own a farm near Minnedosa and am interested in market opportunities but my kids tell me that the ethanol blend makes the car run rough. Any solutions? :)

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**Lenore Newman**    **Posted: Tue Jun 06, 2006 12:13 pm**

I am also interested in Stuart's concern of whether bioethanol would be sustainable. It seems to me there is a big difference between fuel made from waste and fuel made from a crop such as corn that requires heavy use of petrochemical fertilizers to grow in our climate.

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**Ann Dale**    **Posted: Tue Jun 06, 2006 12:14 pm**    **Moderator**

We have a question from Stuart about the sustainability of bioethanol and Rodney has also asked Art a question about whether or not the working party

has developed a set of principles to guide Canadians? Comments, anyone, let's rock and roll.

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**Arthur J Hanson** Posted: Tue Jun 06, 2006 12:15 pm

Junstin and Nancy--hello to you both. I am interested in whether you share common views--urban and rural. Nancy and I have talked on numerous occasions about her family's farm in Manitoba. Perhaps she could describe some of the thinking on the farm, since it is in MB's bio-ethanol country.

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**Mark LR Hall** Posted: Tue Jun 06, 2006 12:17 pm

Yes the forest industry role is unclear at this time, mainly due to the economic hardship created by the soft wood dispute. The impacts on biotech fuel production of the P&P sector will be much like that of sugar in Brazil...switching between which ever is more profitable. This may good or a bad thing.

**Arthur J Hanson wrote:**

*I am looking forward to getting views from a forester. One of the most difficult areas is the business of pulp and paper. We are having real problems figuring out the role of P&P. The mills already are biorefineries, but their future role seems unclear, for biofiels or other bioproducts.*

**Arthur J Hanson** Posted: Tue Jun 06, 2006 12:17 pm

Lenore, We want to see life cycle analysis done as part of any significant effort for bi-ofuels. At the moment it is quite confusing to read US studies, some of which claim net energy gain from bio-ethanol, others not. Clearly IOGEN has the lead on this with use of wastes and they claim very good net energy gain.

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**Nancy Averill** Posted: Tue Jun 06, 2006 12:18 pm

Hi Art: I certainly could not speak for all the thinking 'on the farm' but certainly farmers have an interest in markets that are sustainable but it would be curious if we found these in non-food production.

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**Stuart Lee** Posted: Tue Jun 06, 2006 12:19 pm

Hi Lenore -- I agree, to a point, with you. For now, the fuel-grade ethanol will come from grain or sugar, so we need to keep this in mind for the near term, but over time, cellulosic ethanol could become more dominant - which then brings up

the question - how much fibrous material can we harvest from our crop and forest land without compromising the soil?

...and Art -- I hadn't heard "security" mentioned as part of SD considerations before, but you have a good point, especially considering the weekend's developments!

**Lenore Newman wrote:**

*I am also interested in Stuart's concern of whether bioethanol would be sustainable. It seems to me there is a big difference between fuel made from waste and fuel made from a crop such as corn that requires heavy use of petrochemical fertilizers to grow in our climate.*

**Justin Trudeau**    **Posted: Tue Jun 06, 2006 12:19 pm**

My own perspective is that ideally we wouldn't start growing bioethanol so much as converting our present waste: garbage or cellulose from forestry or agriculture. Of course, I'm only marginally aware of technology that can do this.

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**Arthur J Hanson**    **Posted: Tue Jun 06, 2006 12:19 pm**

Stuart: How about you taking the lead on principles, since you have been deeply involved in their development for our working party. My general comment is that we need principles and values guiding our overall effort and that these need to cover the three legs of the SD stool, social economic and environment.

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**Levi Waldron**    **Posted: Tue Jun 06, 2006 12:20 pm**

I got the impression from the background document that the potential environmental benefits of using ethanol vs. oil are uncertain or unknown, and the social impacts seemed speculative. Most of the discussion was about economic viability of implementing ethanol usage, and trade barriers. What is the primary motivation for our interest in ethanol? Do we have reliable life cycle analysis of environmental and social impacts, for the various ethanol production scenarios? This seems to me important, if we are interested in it partially or primarily for the sake of sustainable development.

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**Ann Dale**    **Posted: Tue Jun 06, 2006 12:21 pm**    **Moderator**

I am also concerned about the ethics of converting food crops to fuel crops when so many of the world's children are suffering from malnutrition now?

**Lenore Newman wrote:**

*I am also interested in Stuart's concern of whether bioethanol would be sustainable. It seems to me there is a big difference between fuel made from waste and fuel made from a crop such as corn that requires heavy use of petrochemical fertilizers to grow in our climate.*

**Arthur J Hanson** Posted: Tue Jun 06, 2006 12:21 pm

Justin, we are taking that point--start with wastes as our desired approach. This is close to the third scenario, and certainly different than the first scenario that I laid out.

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**Arthur J Hanson**

The ethics of food are very complex, and it also gets into conversion of grains into animal food. Something like 40% of China's grain now goes to animals, then to humans. So we have this new kid called bio-ethanol. Where will it fit in Africa, when Europe starts looking to source bio-fuels from developing countries?

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**Tracy James**

Hi everyone - I'm Tracy, also an alumni of RRU (and of McGill - hi Justin). Thanks for the opportunity to participate. The bar we set for biofuels (meeting the 3 legs of the stool) will be interesting when juxtaposed against the same set of rules for other carbon-based fuels; probably fair to say that if anyone were trying to newly introduce oil or coal to the economy now, they might have a hard time!

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**Mark LR Hall**

One criteria I think that should be applied in Canada, is whether the feedstock is primary source or secondary product. For example, to be sustainable we should only be using excess wood residue created from lumber and P&P.

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**Author: Tracy James**

Mark - how far away are we from making wood waste into bio-fuel a viable economic option?

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## **Mark LR Hall**

There is a good paper by McCloy and O'Connor called Wood-Ethanol Opportunities and Barriers (1999) that was prepared for the National Climate Change Process. There are 5 main technologies for whitewood process. Technology around pre-treatment of softwood is still lacking and finding a use for lignin (co product) is unproven.

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## Ann Dale

Art, referring as well to Justin's comments, this is the critical link that has to be made between biotechnology and sustainable development, for example, we made an industry out of bottled water, when it would be more sustainable to protect water at source, rather than industrialize, what would we call it, the bads and create a less sustainable industry?

### **Arthur J Hanson wrote:**

*The ethics of food are very complex, and it also gets into conversion of grains into animal food. Something like 40% of China's grain now goes to animals, then to humans. So we have this new kid called bioethanol. Where will it fit in Africa, when Europe starts looking to source biofuels from developing countries?*

## Arthur J Hanson

Well, bottled water industry has made water a more valuable commodity than hydrocarbon fuel, even at a \$100 a barrel. But in the process, by and large they have created what I consider a highly marketed, unsustainable product, that is often not all that hygenic by comparison to municipal water.

My point is simply the power of marketing. And that power is now being unleashed on the public (see the ads for E85 vehicles)

The concern we have is the best ways to build good public literacy on this subject as well as accurate info. I find it difficult for example, to get the full info on subsidies for Manitoba bio-ethanol.

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## Stuart Lee

Hi Levi -- life cycle analyses do not quite abound, but almost do. it is an approach that is certainly under development, and, as I am sure you can appreciate, very sensitive to scale issues and local practices - a change in the fuel source for the fermenters, for example, can make a big difference in the LCA outcome. But to answer your question, my reading of the literature shows that, Dr. Pimmenthal aside, most analysts think that grain-based EtOH shows a modest net energy gain, while analyses of cellulosic processes all show clear energy gains.

but, the policy directives that seem to be driving hte development of the industry right now do not seem focussed on sustainability or LCA, to my reading -- Art would you agree?

### **Levi Waldron wrote:**

*I got the impression from the background document that the potential environmental benefits of using ethanol vs. oil are uncertain or unknown, and the social impacts seemed speculative. Most of the discussion was about economic viability of implementing ethanol usage, and trade barriers. What is the primary motivation for our interest in ethanol? Do we have reliable life cycle analysis of environmental and social impacts, for the various ethanol production scenarios? This seems to me important, if we are interested in it partially or primarily for the sake of sustainable development.*

### **Arthur J Hanson**

My problem with existing life cycle analyses is that they tend to be good on some of the short-term energetics stocks and flows, but do not do anything really on biodiversity, and they are quite hopeless on social dimensions. I should also point out that they do not really take into account really long-term (50 years to 300 years) perspectives on sustainability (e.g. soil fertility and biodiversity). This is where people like David Pimentel come in, and their work gets trashed. Part of the problem is most of the numbers are highly speculative. So what do we do. Apply the precautionary principle? Give up on the new technology? Better ecological science? All of the above?

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### **Lenore Newman**

From the statistics I have seen it is clear that we could never make enough bio-fuel to support our current levels of fuel consumption- but maybe this is a good thing as we will still have to push forward with efficiency and other technologies. Maybe bio-fuels will prove to be most valuable as a transition fuel as they are compatible with our current system?

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### **Justin Trudeau**

I understand, but compared to the alternative of keeping gung ho on fossil fuel I'd rather take a chance on bio fuels.

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### **Rodney C. McDonald**

Lenore, you touch on the need to also consider the larger picture, in this case the mix of new fuels and the efficiency of fuels. From this perspective, it is also necessary to talk about how we use fuels and energy. For transport, for example, this begs discussion of how our communities are planned (can you walk to the

store) the availability of public transit, and finally the efficiency of the vehicles we drive.

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### **Lenore Newman**

Rodney, this is an interesting point. I could imagine one group wanting to make biodiesel out of old cooking oil and another group wanting to burn it for electricity, and a bidding war erupt over the resource. It seems government subsidies could have a real effect on how we use such resources.

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### **Stuart Lee**

According to the estimates that I've read this would, however, give us only a small fraction of the available woody debris, and not yield a commercial - scale meaningful amount of fuel. But I do think we need to be careful on what we consider 'waste' in the forest.

...also, with respect to forestry, Mark, what do you think of the gasification process, which seems to me to be a better source of more valuable compounds?

***Mark LR Hall wrote:***

*One criteria I think that should be applied in Canada, is whether the feedstock is primary source or secondary product. For example, to be sustainable we should only be using excess wood residue created from lumber and P&P.*

### **Mark LR Hall**

I think that is why combined processes are where the technology needs go. We can't and shouldn't be practicing high utilization from the forest rather efficient use at the sawmills. Gasification from what I understand can utilize tree bark that the other processes cannot.

### **Rodney McDonald**

**Posted: Tue Jun 06, 2006 12:32 pm**

What happens when there is no longer enough excess waste product to make the bio-ethanol infrastructure economically viable. Will we be faced with the tough decision with new plant material: food or fuel?

***Mark LR Hall wrote:***

*One criteria I think that should be applied in Canada, is whether the feedstock is primary source or secondary product. For example, to be sustainable we should only be using excess wood residue created from lumber and P&P.*

## Stuart Lee

Rodney, this is an interesting point. I could imagine one group wanting to make bio-diesel out of old cooking oil and another group wanting to burn it for electricity, and a bidding war erupt over the resource.

...and this could be a second income stream for restaurants, lowering meal prices, or giving the wait staff better wages!

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## Tracy James

And as someone mentioned earlier, there will have to be flexibility in infrastructure (regular fuel, bio-fuels, etc) to allow for the price of various fuels to rise & fall, as consumers will follow their wallets...

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## Arthur J Hanson

And I would like to tie this useful observation back to water supply. Should be using that as a criterion for how go about this--both water quality (e.g. improvement of the waste stream from P&P) and water quality (large volume used in bioconversion from corn or other plant crops to bio-ethanol)?

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## Justin Trudeau

That's not going to be a huge problem, in Europe they seem to have at least six different types (not grades) of fuels in each station.

### ***Tracy James wrote:***

*And as someone mentioned earlier, there will have to be flexibility in infrastructure (regular fuel, bio-fuels, etc) to allow for the price of various fuels to rise & fall, as consumers will follow their wallets...*

## Arthur J Hanson

This raises the possibility that flex-fuel vehicles are handy. Brazilians have done this. Could we combine bio-ethanol with hydrogen fuelled vehicles or hybrids? logen has suggested this for hydrogen power.

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## Justin Trudeau

Let's not get into Hydrogen cars, but the possibilities of combining bio-fuels with hybrids or even just much more fuel-efficient cars has real potential.

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### **Mark LR Hall**

Yes, the concept of attacking the problem at multiple fronts with multiple technologies may be a good strategy for SD.

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### **Tracy James**

This raises lots of opportunities for tax-shifting scenarios, which has a different ring than 'subsidies'.

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### **Stuart Lee**

I agree entirely, Rodney. Regardless of how they are produced, we are using too much fuel. One tidbit that does not get widely shared is that engine efficiency drops quite drastically with increasing EtOH content, requiring more fuel per km.

#### ***Rodney McDonald wrote:***

Lenore, you touch on the need to also consider the larger picture, in this case the mix of new fuels and the efficiency of fuels. From this perspective, it is also necessary to talk about how we use fuels and energy. For transport, for example, this begs discussion of how our communities are planned (can you walk to the store) the availability of public transit, and finally the efficiency of the vehicles we drive.

### **Levi Waldron**

Could someone give a succinct idea of what decision we are contributing to in this discussion? I'm not sure we're on track in relation to the decision at hand. There are three scenarios outlined in the document, but they don't seem mutually exclusive:

1. Conventional and incremental
2. Lead the Way
3. Be a Free Trader

At least, 2 and 3 are not mutually exclusive to each other but one differs from both of them. I think I could comment on some differences between these alternatives in terms of sustainable development.

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**Arthur J Hanson**

Thanks Levi, I drew up the three scenarios in order to give some perspective on clearly different but all plausible outcomes. We could, of course, have a mix of the three.

What I am after are the ways in which we might actually address these choices in an informed way:

values and principles

criteria for assessment, especially environment, social, economics, etc.

possible evolution over time

very important considerations that might not be covered in the above

Can we focus our discussion around these points?

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**Mark LR Hall**

Yes i think it does argue for diversity...on a number of fronts/levels. I also think it means not to ignore the elephant in the room. We want to facilitate a shift but what happens in 10yrs when the use of ethanol is skyrocketing out of control?

***Ann Dale wrote:***

*Mark, a very interesting perspective, does this argue for a diversity of approaches?*

**Peter Levesque**

Hello Ann and friends,

I read the brief with interest. I am wondering whether you have looked at incentives, beyond the crude financial ones, for changes in behaviour. I think the case of Brazil is very interesting but you only talk about direct return on investment. There are clearly powerful cultural and geo-political reasons for adopting the path they did.

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**Arthur J Hanson**

We are having some real difficulties in our report on the issue of subsidies. Obviously this is a technology that will not get off the ground without them. The USA is well into it, goaded by strong agri-industry and others. Europe will be too. But should we follow suit? And if so, for how long? What conditions? For example in the US it probably means conservation lands will be turned into bio-fuel cropland. And for how long? Should there be sunset clauses as Manitoba appears to be doing. And should subsidies be applied in a transparent way? The bio-fuel industry says, treat us like the tar sands and we will be happy.

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### **Lenore Newman**

It seems to me that subsidies will be a necessary evil as oil and coal and tar sands are so heavily subsidized. At the same time if subsidies are too narrow they might encourage a technology that is not in the long run the best option-maybe in a developing industry such as this one subsidies need to be broad to encompass all competing innovations (For example growing algae in clear tubes to capture contaminants and then making fuel out of the biomass is a form of bio-fuel, but doesn't fit the image of a farm full of corn).

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### **Peter Levesque**

Vehicles that use "alternate fuels" are nothing new. I have a 1938 Ariel motorcycle that runs on almost anything I put in it from cooking oil to kerosene. The technology has been around for a long time - the desire to mass produce has been driven by other reasons than capability.

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### **Arthur J Hanson**

For the times, Brazil probably did the right thing when viewed in terms of their socio-economic setting. But the ramifications of where Brazil might go from here in terms of unsustainably produced ethanol for export are quite worrisome. But there are important lessons to be learned by the USA and Canada in relation to their 30 years of experience.

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**Ann Dale**

Art, one of the things I have argued for, and this may seem heretical, is 'get the prices right', eliminate all subsidies, but we know what that means, the vested interests for maintaining the status quo crowd out the new innovations?

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**Peter Levesque**

Arthur, Is there something to be learned form the open source software movement that could be adopted in this case? Or is scale too much of an issue?

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**Stuart Lee**

Hi Peter:

i am wondering how you envisage an open source model working? To me, this is something that applies to intellectual property, as opposed to commodities... perhaps it could contribute to the sharing of the technology with developing nations, or just in general?

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**Arthur J Hanson**

Peter, Your point about open source software is an interesting one. I don't know but I would be interested in hearing what others think. I also want to hear about views on knowledge networks. We feel that a dedicated knowledge networked is needed on biotechnology and SD. Perhaps open source software would link with this idea?

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**Peter Levesque**

Arthur, Knowledge networks are crucial. The stumbling block is always around issues of control or emerging intellectual property. The Creative Commons agreement is one way to deal this. I have also experimented with knowledge collectives and exploitation agreements, etc. Private property is always an issue in collective enterprise.

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**Nancy Averill**      **Posted: Tue Jun 06, 2006 12:50 pm**

Hi All: I wanted to comment on Levi's point about our dialogue. What is our notion of scale? I see ethanol production and use as a pilot project which should be encouraged but, we have to keep in mind, at the end of the day, that it can only

make a small contribution to the overall challenges of our life style dependence on personal vehicles.

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### **Arthur J Hanson**

Nancy, the point on pilot effort is important. We think that much more experience with bio-refineries is needed on a variety of scales. The reason being that these have to become much more cost efficient, and are the breaking point for the new technology. If they don't work well, or contribute to rural benefits, it all falls apart.

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### **Ann Dale**

Peter, as a knowledge management expert, could you expand on this comment a little? What are the barriers to entry of the new?

***Peter Levesque wrote:***

*Vehicles that use "alternate fuels" are nothing new. I have a 1938 Ariel motorcycle that runs on almost anything I put in it from cooking oil to kerosene. The technology has been around for a long time - the desire to mass produce has been driven by other reasons than capability.*

### **Mark LR Hall**

Do we, or should, we facilitate a shift in energy supply focusing only on supply side dynamics? From a SD point of view does the overall issue also need to address the demand side. We are accelerating our use of energy and we will continue to do so regardless of what source we can facilitate a shift to, with or without incentives. Is this right to facilitate the shift and ignore the fact that we are facilitating a culture that is consuming at an increasing rate.

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### **Levi Waldron**

Any new fuel (including the tar sands) will require some enormous initial investments to build the economies of scale needed to make it efficient and competitive. I can't see why a domestic ethanol crop would be less deserving of such support in terms of social and environmental considerations than tar sands development, and I suspect this would be a hard case to make. The oil sands' advantage is in their vast quantities and potential to make money.

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**Nancy Averill**

**Posted: Tue Jun 06, 2006 12:54 pm**

Let's talk about values and principles? What can we learn from other jurisdictions and what is unique to Canada?

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**Stuart Lee**

Hi Nancy -- in other jurisdictions, say Queensland, Australia, they have a code that is supposed to govern the ethics/principles of biotechnology development, and this code commits government funding to projects that support SD, and protect the environment.

So, if people consider bio-fuels to be a biotechnology development, that is one code from another jurisdiction that could apply... does anyone else have any comments?

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**Ann Dale**

As well, Jim MacNeill refers to ecologically damaging and economically perverse subsidies, and how do we again make the link between innovative biotechnology, bio-fuels and sustainable development, a very difficult question?

***Lenore Newman wrote***

It seems to me that subsidies will be a necessary evil as oil and coal and tar sands are so heavily subsidized. At the same time if subsidies are too narrow they might encourage a technology that is not in the long run the best option-- maybe in a developing industry such as this one subsidies need to be broad to encompass all competing innovations (For example growing algae in clear tubes to capture contaminants and then making fuel out of the biomass is a form of bio-fuel, but doesn't fit the image of a farm full of corn).

**Nancy Averill**

I agree with Ann and we have a dismal record with agricultural subsidies. Arguments can always be made for 'sustainability' especially if there is a market to protect. Once they become part of the market viability equation, they are there forever. What are positive 'incentives' could be used to support research and innovation?

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## **Rodney McDonald**

On the topic of subsidies. Subsidies for the supply side of the energy equation vastly outweigh subsidies for the demand (i.e., demand reduction) side of the equation in Canada. Every business understands that remaining competitive advantage of efficiency. Per capita, only the US uses more energy than Canada. If we continue to provide subsidies for the supply side and provide comparatively little incentive for efficiency, will this erode Canada's competitiveness?

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## **Mark LR Hall**

Values - Criteria for feedstock should be surplus and waste utilization and minimal primary production.

Principles - Energy policy should be nationally led

Criteria - Net energy balance, distribution of benefits, feedstock source and demand side economics.

Evolution - R&D must facilitate continuous technology evolution and technology shifts must be sensitive and responsive

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## **Peter Levesque**

Ann, my work is around knowledge exchange not knowledge management - very subtle but important differences in power and relationships.

Arthur, I think that value and principles are the hardest part of this equation. Although I am over generalizing, we value the "new" much more than the established, and we value "more" rather than better. There is rhetoric to suggest to the contrary but I am not buying it. All the indicators point to the continuation of growing consumption until collapse.

In my work with physicians, they do not change practice, despite knowledge of new evidence, unless they are forced to by regulation or structural changes or through unseen "market" adjustments brought on often by the pharmaceutical companies. It is depressing but real.

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## **Lenore Newman**

I think it is important to ensure that we are looking at both urban and rural feed stocks. It seems to me that a large city produces masses of food waste that could be collected in green bins and turned into fuel. I know some cities have been

making compost out of some of this feedstock, but perhaps fuel is also a good use, and many urban areas do not compost and are struggling to landfill this material. On a similar note, could one make ethanol out of sewage, or only methane?

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### **Stuart Lee**

Ann, I think this argues for, first and foremost, a reduction in energy use, facilitated by the built and planned environment, and then also a variety of energy supply approaches.

#### ***Ann Dale wrote:***

*Mark, a very interesting perspective, does this argue for a diversity of approaches?*

#### ***Mark LR Hall wrote:***

*Do we, or should, we facilitate a shift in energy supply focusing only on supply side dynamics? From a SD point of view does the overall issue also need to address the demand side. We are accelerating our use of energy and we will continue to do so regardless of what source we can facilitate a shift to, with or without incentives. Is this right to facilitate the shift and ignore the fact that we are facilitating a culture that is consuming at an increasing rate?*

### **Arthur J Hanson**

On the several comments on incentives and subsidies...We consider this to be a very central point for the future. We see a strong possibility that enshrining a rather limited value crop-oriented approach such as corn for bio-fuel, or grain (i.e. scenario 1) will lock us in, a bit in the fashion of some coal burning fuel generating plants. Our dilemma is that we do feel a strong need to experiment with bio-based products, but believe Canada should embrace most strongly only those products of high SD potential. Cellulosic ethanol appears to be an example.

Question is--do you think we should mainly just continue or expand the research on such initiatives, or should we also subsidize as we appear to be doing through recent announcements a new source of farm income?

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### **Ann Dale**

Sweden, for example, has just committed to a carbon free economy, are they doing this for altruistic reasons only, I doubt it, being the pessimist I am about aggregate human motivation.

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## Arthur J Hanson

I bet that Sweden will be an importer of bio-fuels.

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## Ann Dale

This is a key question.

### ***Nancy Averill wrote:***

*I agree with Ann and we have a dismal record with agricultural subsidies. Arguments can always be made for 'sustainability' especially if there is a market to protect. Once they become part of the market viability equation, they are there forever. What are positive 'incentives' could be used to support research and innovation?*

## Peter Levesque

The challenge with incentives for research and innovation are not for doing research and being innovative it is for exploitation and control of outputs. We have a great record in Canada of dealing with "what?" and "so what?" questions but are terrible with "now what?" unless there is a dollar figure attached to it. The vast majority of research goes underused, under-exploited.

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## Nancy Averill

Art: New sources of farm income are always enticing but, again, what are the principles that would guide us to subsidies that were truly sustainable?

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## Ann Dale

Another supplemental question, how does diversity of approaches, and adaptive management fit into this equation, Art?

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## Mark LR Hall

Question is--do you think we should mainly just continue or expand the research on such initiatives, or should we also subsidize as we appear to be doing through recent announcements a new source of farm income?

I think the technology around cellulosic feedstock is still too young for incentives that facilitate full scale production shifts. From what I understand, effective and economic pre treatment steps of whitewood digestion are still uncertain. Maybe what is needed is cooperative (government and Industry) R&D that will provide answer to questions. Answers we can then try to make decisions about National or regional policies that may or may not include incentives. In summary, we need to invest in learning more about what will work, what will not and what the trade off and benefits are. But...how long can we afford to study and improve the technology until we are comfortable?

**Arthur J Hanson wrote:**

*On the several comments on incentives and subsidies...We consider this to be a very central point for the future. We see a strong possibility that enshrining a rather limited value crop-oriented approach such as corn for bio-fuel, or grain (i.e. scenario 1) will lock us in, a bit in the fashion of some coal burning fuel generating plants. Our dilemma is that we do feel a strong need to experiment with bio-based products, but believe Canada should embrace most strongly only those products of high SD potential. Cellulosic ethanol appears to be an example.*

**Arthur J Hanson**

Mark - Cellulosic ethanol clearly seems to have a very important place, especially over the longer term. We think that one aspect of our recommendations will be focused on what criteria we need to apply in relation to the research side. We think it is necessary to keep asking the question along the whole chain from basic research to pre-commercialization--how will this product/process help us towards SD and in a better way than alternatives. Do you agree?

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**Rodney McDonald**

The ecological "system" is designed for the compost to return to the earth and feed new growth. If we use this material for fuel rather than compost, to recharge our soils, will we then need more petrochemical-based fertilizers?

**Lenore Newman wrote:**

*I think it is important to ensure that we are looking at both urban and rural feedstocks. It seems to me that a large city produces masses of food waste that could be collected in green bins and turned into fuel. I know some cities have been making compost out of some of this feedstock, but perhaps fuel is also a good use, and many urban areas do not compost and are struggling to landfill this material. On a similar note, could one make ethanol out of sewage, or only methane?*

## **Nancy Averill**

Rodney: Interesting point. Farmers have been encouraged to give up summer fallow, to quit burning stubble and to embrace zero tillage which has them shifting back and forth on natural re-energizing of the soil. Does anyone know what the long-term impacts of harvesting off all the biomass would be?

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## **Arthur J Hanson**

Peter, your points on values also raise the issue of mandated commitments-- government specifying fuel content. This stimulates but also skews the markets. We believe that mandates can be a good way to change course, but they also can create new problems. And therefore I wonder whether we should place more emphasis on choice and flexibility as part of our values discussion.

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## **Peter Levesque**

Arthur, I agree with you on all points here. There is a necessary culture change needed and this is a tremendously difficult thing to do. The challenge with choice is the power imbalance that precedent and default positions have over alternatives. In my opinion, even with choice there are few true alternatives. The key is what people feel is important as a reward - the literature on rewards for compensation is interesting - the outliers are all corporate.

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## **Stuart Lee**

Art -- all this discussion about energy and subsidies brings up our trading and energy relationship with the US, primarily, but also overseas markets.

We know the US is providing subsidies on bio-ethanol on the order of \$0.50 per gallon -- how do you see their energy policy affecting our economic choices/opportunities?

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## **Arthur J Hanson**

This is where well done life cycle analysis would be valuable. I think we have time to work this out, given the limited scale of bio-fuel applications. But it take both will, mandate and money to get the right answers.

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## Tracy James

That might tie back to Nancy's earlier comment about using pilot projects wisely -  
- test a variety of options, at a variety of scales, with a variety of partners, and  
see what works.

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## Stuart Lee

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feed new growth. If we use this material for fuel rather than compost, to recharge  
our soils, will we then need more petrochemical-based fertilizers?

I am not sure we capture it for soil regeneration right now! so that shifts the  
question to one of : what is better, fuel use or landfill?

...or -- should we do neither and adopt composting?

### **Lenore Newman wrote:**

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been making compost out of some of this feedstock, but perhaps fuel is also a  
good use, and many urban areas do not compost and are struggling to landfill  
this material. On a similar note, could one make ethanol out of sewage, or only  
methane?*

## Mark LR Hall

I agree, choice and flexibility are important. To bring in Ann' question about  
adaptive management I think fits here. For adaptation to be effective there must  
be flexibility and choice driven by a number of diverse mechanisms. To  
accomplish this there must be clear vision and goal for the future, at the National  
level. Everyone must know where we want to be heading, as Canadians. Let the  
people find their way.

### **Arthur J Hanson wrote:**

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We believe that mandates can be a good way to change course, but they also  
can create new problems. And therefore I wonder whether we should place more  
emphasis on choice and flexibility as part of our values discussion.*

## **Ann Dale**

Can we start drilling down to the basic question, what criteria would you want to apply in order to be satisfied that Canada is on a sustainable track for its bio-fuels (and I would expand this to bio-products) policy? Mark, do you want to reiterate your earlier points?

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## **Arthur J Hanson**

We can be copy cats, we can buy their subsidized product, we can produce a better product, or...? One question that will certainly emerge is whether we should be thinking of North American markets for bio-fuels? If so, what is Canada's comparative advantage? I doubt that it would be in bio-fuel crops, but perhaps wastes.

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## **Justin Trudeau**

After all, Art, we are the largest per capita producers of solid waste in the world.

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## **Arthur J Hanson**

Justin, I keep coming back to choices between forest sources and agriculture wastes. We do not appear to be doing so much for the former, in part because we are not there yet with cellulosic ethanol. But we have huge amounts of waste already in pulp mills. And we face major problems with the dead wood arising from insect pests. In addition, there is a lot of food processing and municipal wastes.

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## **Mark LR Hall**

I do agree Art. I do believe the foundation for the future will lie in cellulosic feedstock. The criteria for the research side must be closely linked to the reality of the forestry industry. A close partnership between industry and the universities will be key. I do believe the forest companies may be best suited to own and operate the refineries as they can be integrated into the lumber and P&P stream effectively. Many already do this with cogen. We must pay particular attention to criteria that involve trade-off decision-making as this is where the danger lies in elements such as excess utilization from the forest or conversion of forestland to hybrid poplar...that sort of thing.

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## Stuart Lee

...but the use of wastes is not easy from a technical perspective. At the most recent conference I attended on the subject, speakers were very concerned with the uniformity of the feedstock - because different material respond to the same treatment in different manners...

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## Nancy Averill

My understanding is that ethanol does not travel well or cheaply. Could this lead to local economies--like Minnedosa--having a comparative advantage in cheap fuel as an attraction to other industries?

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## Peter Levesque

buy local - burn local?

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## Rodney McDonald

Adopt composting. Whatever we take from the land needs to be returned in a manner that continues to give new life.

### ***Stuart Lee wrote:***

### ***Rodney McDonald wrote:***

### ***Lenore Newman wrote:***

*I think it is important to ensure that we are looking at both urban and rural feed stocks. It seems to me that a large city produces masses of food waste that could be collected in green bins and turned into fuel. I know some cities have been making compost out of some of this feedstock, but perhaps fuel is also a good use, and many urban areas do not compost and are struggling to landfill this material. On a similar note, could one make ethanol out of sewage, or only methane?*

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*I am not sure we capture it for soil regeneration right now! so that shifts the question to one of : what is better, fuel use or landfill?*

*...or -- should we do neither and adopt composting?*

## Ann Dale

The speed of these dialogues is getting to me, I must be getting older, Art, i don't think you responded to this question, not to put you on the spot, but also can you draw your experiences in China here? What about solid wastes, as Justin indicated?

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## Arthur J Hanson

I think the Chinese will be well ahead of us. They are already the 3rd largest in the world, and we are about 12th or 15th. They have mandated 10% ethanol in some provinces for fuels, and they are running out of production capacity. What should we do? Compete in the ethanol export market with Brazil? Export more grain for them to produce ethanol? Import some of our ethanol from them in the future? Believe it or not, I think all of the above are possibilities 5 years from now. Point here is really that we have to include our positioning in global markets as one part of this.

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## Ann Dale

Art, is this fair, as long as it is not based on further co modification of nature?

### ***Arthur J Hanson wrote:***

*Justin, I keep coming back to choices between forest sources and agriculture wastes. We do not appear to be doing so much for the former, in part because we are not there yet with cellulosic ethanol. But we have huge amounts of waste already in pulp mills. And we face major problems with the dead wood arising from insect pests. In addition, there is a lot of food processing and municipal wastes.*

## Arthur J Hanson

Nature is commodifying the forest by the over wintering of beetles that kill the forest! Question is how we should respond in a sustainable way.

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## Mark LR Hall

On the social side of the SD equation, the pine beetle infestation in BC has created a glut of both lumber and chips. We currently do not have the diversity to respond to the fibre supply. With a cap on lumber in the US market at 34% the

options are limited for the raw material. It is expected that communities in the central interior will literally collapse once the initial salvage harvesting is over....not good for the social leg. These places will have lost a lot of natural capital in a short period of time. They will have no means to maintain social well being. Can bio-fuels help bridge that gap?

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### **Levi Waldron**

Having a crack at the first of your questions:

values and principles  
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Global warming - should be a top consideration, particularly since Canada has enough oil reserves in the tar sands to very seriously contribute to it.

conservation vs. production - there are choices to be made between sources of fuel, but also between production and conservation. Enabling energy conservation has clear sustainable development benefits and should be also be at the forefront of energy policy initiatives.

Importing fuels (bio-fuels or oil) - problematic for a number of reasons. Energy self-sufficiency is preferable.

food supply - will affordability of food or soil sustainability be significantly impacted by large-scale bio-fuel production? It shouldn't be.

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### **Lenore Newman**

Looking at Levi's comments, I would add that bio-fuel development should add to Canada's green areas- ie. instead of clearing forest to grow feedstock we should grow it on roof tops and brown-fields and reclaim damaged scrubland if possible. This might also help to offset the reality that Canada is going to exploit every drop of oil sand- I can't imagine a scenario in which we leave any of our oil in the ground, so we need to offset that carbon.

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### **Arthur J Hanson**

I would like to add a new dimension of high relevance to both oil sands and bio-fuels--water resource limitations. We need to consider this as a key factor in our decision-making. Problem is the difficulty of limited information, especially in relation to changing climate conditions.

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## **Nancy Averill**

Levi: would we also address the question of scale? Are we to produce ethanol for export or for our own use? The scale we choose will have an impact on food production trade-offs. Levi: I would also add something about trying the wisdom of sustaining our fuel-dependent culture.

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## **Levi Waldron**

Yes, scale seems to be a critical question. It would help to have some specific scenarios:

- how could we produce enough biofuels to blend 5% into our fuels
- how could we produce enough to replace our use of conventional oil in automobiles?
- how could we produce enough to export x% of how much fossil fuels we export?

Explicitly laying out what might be involved in achieving these ends would help to understand the choices better.

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## **Arthur J Hanson**

Scale is also important for farm communities to capture benefits. This raises a dilemma. Big refineries will be efficient and also possibly the ones able to produce the greatest range of products. But they may well be located away from some of their supply sources. Smaller refineries might be owned by farmer groups, and provide jobs in local rural areas.

On scale to export, that to me is still pretty scary, but I am sure we will see pressures for it within half a decade, and depending on market conditions and success of the trade in Canada.

One important matter not so far discussed is criteria for sustainability certification either for import or export of products.

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## **Mark LR Hall**

Yes it going fast for me too!

Some earlier points about criteria for assessing the SD track.

Feedstock should focus mostly on secondary feedstock use. i.e, excess whitewood from milling and pulp process. this also includes primary pulp and paper effluent because it has cellulose in it.

Criteria must focus on demand side dynamics...the over consumption problem.

Criteria should evaluate diversity in approaches, flexibility and responsive/sensitive to major shifts.

I think there is more...I will need to sift them out.

***Ann Dale wrote:***

*Can we start drilling down to the basic question, what criteria would you want to apply in order to be satisfied that Canada is on a sustainable track for its biofuels (and I would expand this to bio-products) policy? Mark, do you want to reiterate your earlier points?*

**Ann Dale**

Good to hear, you are not nearly as old as I, and aging every day working with the indefatigable Dr. Hanson, his energy level is amazing!

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**Arthur J Hanson**

Can you be more specific on the demand side. I would agree very much about that. Where I have problems is dealing with both the innovation agenda (tech driven) and the demand side (conservation, reduced consumption driven). I think we need criteria that can simultaneously deal with both...Or is that asking too much?

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**Stuart Lee**

Art, could the key point linking the two be efficiency? i think I understand your challenge, as the innovation agenda is all about creating more, developing new markets, new products, etc -- which could be opposed to the idea of conservation, and it's implied reduction in consumption. But new things that reduce consumption could be the link, no?

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**Rodney McDonald**

Art: Rather than using the terminology conservation and reducing consumption, I think it preferable to talk about increasing efficiency. There are many process and technological innovations (to contribute to economic development) that increase efficiency. I work in the area of buildings. There are simple things we

can do today, such as changing building design (which require the intellectual development of building designers - a social capital benefit) and applying efficient heating and lighting technologies to increase the efficiency of new building design by a minimum of 50%, compared to current conventional construction (at no increase in capital cost if done well).

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### **Mark LR Hall**

I know what you mean. Yes I do have this fuzzy feeling there is criteria to track both simultaneously. On supply side, criteria need to be focused on net energy for production and realized emission reductions. On the demand side we need to track per unit consumptions at the per person or household level to track individual behaviour as it relates to making sustainable lifestyle choices.

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### **Arthur J Hanson**

very helpful, Levi, but not only quantitative, but in a sustainable fashion and at a reasonable cost.

-how could we produce enough to export x% of how much fossil fuels we export?

Explicitly laying out what might be involved in achieving these ends would help to understand the choices better.

***Levi Waldron wrote:***

***Nancy Averill wrote:***

*Levi: would we also address the question of scale? Are we to produce ethanol for export or for our own use? The scale we choose will have an impact on food production trade-offs.*

Yes, scale seems to be a critical question. It would help to have some specific scenarios:

-how could we produce enough biofuels to blend 5% into our fuels

-how could we produce enough to replace our use of conventional oil in automobiles?

### **Mark LR Hall**

In BC, four major centers have been identified for facilities as it relates to proximity to the facilities generating the majority of the province's supply of wood residue. They will benefit the big centers but economically the argument can be accepted.

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**Mark LR Hall**

Is efficiency a stand alone criteria or a factor of the demand side of the equation? People can make choices about efficiency when they buy products and how they use them.

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**Rodney McDonald**

I think a stand alone criteria, since it can also apply to the supply side.

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**Arthur J Hanson, PostPosted: Tue Jun 06, 2006 1:52 pm**

Efficiency needs to be thought about as both stand alone and on the demand side. Efficiency is a key matter in supply. Incentives, for example, may permit a relatively inefficient initiative to continue long past its due date! I worry that we will subsidize a bunch of refineries that will be using a process that will relatively soon be deemed energy inefficient (in terms of conversion) and yet there will be strong pressures to keep them alive.

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**Lenore Newman**

This has been a great discussion- at this point do people have closing comments?

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**Levi Waldron**

I have heard of sustainability certification with respect to forest products, but it is an interesting idea with respect to fuels. Would this be for the sake of export markets? If it is rather for assessing its worthiness of subsidy, I would think life cycle comparison with fossil fuels would be an adequate assessment.

Thanks all for the interesting discussion.

***Arthur J Hanson wrote:***

*One important matter not so far discussed is criteria for sustainability certification either for import or export of products*

**Arthur J Hanson**

Dear Participants, I have enjoyed the dialogue, and I would be very pleased to have any additional comments relating to criteria that we might apply to examining SD of bio-products and bio-fuels. You could send them to me at ajhanson@mts.net

Thanks for your participation!

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**Mark LR Hall**

Ultimately, criteria to be satisfied that Canada is on a SD track need to be at the level of Canada as a country. I would not want to for it to become an analysis of the have not problem that affects nationality in our country.

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**Rodney McDonald, PostPosted: Tue Jun 06, 2006 2:00 pm**

Thank you for the opportunity to participate. Good luck with the remainder of this work. Good night everyone.

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**Lenore Newman**

Thanks everyone for a great discussion. A copy of our conversation will sent out to you in a few days. Have a good evening!

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**Nancy Averill**

Good evening all. Talk to you soon.

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**Rodney McDonald**

This points to the need in Canada for a National Sustainable Development Strategy, which should include a national energy strategy (which itself should include a national renewable energy strategy, a national energy efficiency strategy) a national water strategy, a national climate change strategy, etc.

***Mark LR Hall wrote:***

***Lenore Newman wrote:***

*This has been a great discussion- at this point do people have closing comments?*

Ultimately, criteria to be satisfied that Canada is on a SD track need to be at the level of Canada as a country. I would not want to for it to become an analysis of the have not problem that affects nationality in our country.

**Comments from Shealagh Pope, Science Policy Advisor, Science Policy Division, S&T Division, Environment Canada: Post-Dialogue**

The question posed for the dialogue was "What criteria would you want to apply in order to be satisfied that Canada is on a sustainable track for its biofuels policy?".

My criteria would be

1) the overall environmental impact of biofuels would be less than for fossil fuels. I don't require an immediate improvement (putting the infrastructure in place to shift to biofuels (especially as we move past a 10% ethanol blend (E10), will likely have an initial negative environmental impact), but projections on a 10-year horizon should show biofuels leading. I'm looking for life-cycle analysis - not just end-of-the-tailpipe considerations which seems to be where this initiative has come from (even though we're not clear that biofuels actually represents a net positive impact vis-a-vis climate change and clear air).

If this criterion is not met, I'm not sure I'd even go looking for evidence on the other criteria.

I gather that most of the "environmental" assessments done to date have only looked at energy balances and GHG implications and have focussed almost exclusively on grain-based ethanol. So, we're not well-placed at present to answer the life-cycle question.

[I just spent three days talking about evidence-based policy, and on this 5% renewables initiative, I have a sense that the evidence base isn't there yet. However, what evidence we do have does not seem to be well marshalled in this background. Where are the data and numbers? What do we know, what don't we know? That would be useful to pull together - frame the areas of debate and consensus. Curious, and frustrating, that the government hasn't done that yet.]

2) benefit to the rural economy - that supports diversification of farming and more stable income stream - so that Canadian farms remain (become?) viable and productive. Biofuels should complement other streams we need to come from agriculture (food, fibre) not supplant them. I can't believe that we'll be further ahead if we grow our fuel in Canada but then import our food. (The transportation impacts from our food habits are probably already enormous (oranges from South Africa???), without outsourcing even more of our food supply.)

3) coincident thrust on conservation - I don't want to see only a replacement of fossil fuels and continued unsustainable development of roads, poorly planned cities and suburbs, and all the other negative environmental effects and behaviours that result from relatively cheap access to fuel. Some policy coherence would be nice.

4) consideration of co-benefits - if cellulosic bio-ethanol can be produced from switchgrass, for example, can we look at how and where we plant it to achieve protection of water courses, habitat for grassland species, and conversion of land that is marginal for crops to switchgrass which is a zero-tillage option, and, therefore, could contribute to reducing soil erosion. (Note - not sure about the water demands of this grass but since it is native to the Prairies, presumably it's adapted to typical climate conditions - though not sure "typical" applies anymore.)

5) Greater emphasis on the bio-refineries, green chemistry, green production - going beyond just making ethanol and biodiesel to redefining production (oil-based refineries not only produce transportation fuels but are the whole basis of multiple industries - plastics, fertilizers ...). The background paper makes no reference to this larger view of biorefineries.

Issues:

Energy balance for corn- and grain-based ethanol production - I gather that Agriculture recently concluded a life-cycle study that demonstrated that it takes almost as much fossil fuel to create corn- and grain-based ethanol as you get out. [I think the US has come to the same conclusion.] I also gather that bio-ethanol production uses lots of water and produces lots of wastewater (but then so do the tar sands). Since I believe that numbers are out there now, we should be factoring them into the discussion now, rather than simply saying that "fossil fuel used in their production and transportation is considerable". For corn and grain-based ethanol produced under Canadian conditions using current technologies, the energy balance does not support ethanol. Just burn the fossil fuels. So then you're left to determine if the environmental benefits (as opposed to the energy benefits) tip the scales to ethanol. Here, I think the data is not yet in for Canada.

Shift from E10 to more than 10% ethanol requires (given current technology), entirely new infrastructure. Ethanol is a solvent and dissolves the fittings used in current pipelines and refineries. So, even if people adapt and shift to E10, that doesn't actually position us, from an infrastructure point of view, for adding more ethanol to the blend. What has been the experience in Brazil - have they switched to E10 or a higher ethanol blend?

I hope this has been useful. I'm interested in the topic - from an environmental perspective but also from a policy perspective - have some inside glimpses (but

only a few) on the policy making process - and not being terribly impressed so far.