POLLUTION PROBE
CLEAN AIR. CLEAN WATER.

LOW CARBON FUEL STANDARDS FOR CANADA

Toronto, Ontario

June 3 and 4, 2008

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To: Participants who attended Pollution Probe's *National Conference on Low Carbon Fuel Standards for Canada*

On behalf of Pollution Probe, I wish to express to you my sincere thanks for attending and actively participating in this timely and important conference. As currently proposed, the Low Carbon Fuel Standard is a multifaceted transportation energy and technology policy framework with potentially transformative implications for energy industries and vehicle manufacturers. Your expertise and engagement during the conference was instrumental in addressing and characterizing the scope of the low carbon fuel standard, and helping to make sense of how to approach its development in a Canadian context. I sincerely hope these proceedings reflect the comments and advice generously exchanged, as well as the excellent discussions that occurred, during the breakout groups and plenary sessions.

We look forward to continuing the dialogues initiated at this conference, and working with you to develop solutions for reducing greenhouse gas emissions from the transportation and energy sectors in Canada.

Sincerely,

Bob Oliver
Executive Director
Pollution Probe

Table of Contents

About the Organizers

POLLUTION PROBE is a non-profit charitable organization that works in partnership with all sectors of society to protect health by promoting clean air and clean water. Pollution Probe was established in 1969 following a gathering of 240 students and professors at the University of Toronto campus to discuss a series of disquieting pesticide-related stories that had appeared in the media. Early issues tackled by Pollution Probe included urging the Canadian government to ban DDT for almost all uses and campaigning for the clean-up of the Don River in Toronto. We encouraged curbside recycling in 140 Ontario communities and supported the development of the Blue Box programme. Pollution Probe has published several books, including Profit from Pollution Prevention, The Canadian Green Consumer Guide (of which more than 225,000 copies were sold across Canada) and Additive Alert!

In the 1990s, Pollution Probe focused its programmes on issues related to air pollution, water pollution, climate change and human health, including a major project to remove human sources of mercury from the environment. Pollution Probe's scope has since expanded to include new concerns, such as the unique risks that environmental contaminants pose to children, the health risks related to exposures within indoor environments, and the development of innovative tools for promoting responsible environmental behaviour.

Since 1993, as part of our ongoing commitment to improving air quality, Pollution Probe has held an annual Clean Air Campaign during the month of June to raise awareness of the inter-relationships among vehicle emissions, smog, climate change and human respiratory problems. The Clean Air Campaign helped the Ontario Ministry of the Environment develop a mandatory vehicle emissions testing programme, called Drive Clean.

Pollution Probe offers innovative and practical solutions to environmental issues pertaining to air and water pollution. In defining environmental problems and advocating practical solutions, we draw upon sound science and technology, mobilize scientists and other experts, and build partnerships with industry, governments and communities.

For information on Pollution Probe's programme areas and publications, please visit **www.pollutionprobe.org**.

Acknowledgements

Sponsors

Pollution Probe expresses its sincere appreciation to the supporters of our work on Low Carbon Fuel Standards. Their generous contributions enabled Pollution Probe to conduct the *National Conference on Low Carbon Fuel Standards for Canada* and prepare this report.

The supporters are:

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Writers and Organizers

The National Conference on Low Carbon Fuel Standards for Canada and this report would not have been possible without the hard work of the project team. Bob Oliver and Ken Ogilvie from Pollution Probe contributed their expertise to the development of the agenda, the securing of key stakeholders and resources necessary to make the conference a success, and the writing of the final conference report. Barry Bower and Bill Greenizan from the Ontario Ministry of Energy also provided their expertise in the development of the agenda. In addition, Barry Bower wrote the background document circulated prior to the conference, as well as sections of this report. Special thanks to Dr. Quentin Chiotti for serving as master of ceremonies throughout the conference. Rebecca Spring acted as the project manager, BoAnne Tran provided layout and logistical support for the conference, and Taskin Shirazi helped to ensure that the conference ran smoothly from start to finish.

Finally, Pollution Probe would like to thank Jon McKechnie, Luc Charron, Yimin Zhang, and Beau Standish for their important contribution to this report by taking notes and summarizing discussions during the LCFS conference.

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Conference Report

INTRODUCTION

On June 3–4, 2008, Pollution Probe hosted a *National Conference on Low Carbon Fuel Standards for Canada*. This conference constituted Pollution Probe's initial work on the issue of low carbon fuel standards and how they can be applicable in a Canadian context, particularly as province-led measures.

The State of California is implementing a Low Carbon Fuel Standards (LCFS) aimed at reducing the lifecycle carbon intensity of transportation fuels by 10 per cent by 2020. The Governments of British Columbia and Ontario have both signed memoranda of understanding with California to coordinate policies on LCFS.

LCFS can have far-ranging implications for stakeholders in the traditional fuel supply chain (e.g., petroleum producers), as well as non-traditional, emerging and potential transportation energy suppliers (e.g., synthetic fuels, biofuels, electricity and natural gas suppliers). Transportation equipment and vehicle manufacturers, agriculture and forestry sector companies, consumer groups and environmental organizations have an important stake in how LCFS are developed.

Pollution Probe hosted the national conference to facilitate the exchange of information and perspectives among experts, government, industry stakeholders and non-governmental organizations, relating to the design and implementation of LCFS in Canada. This report is intended to serve as a point of reference for Ontario's forthcoming consultations on the development of its LCFS, as well as for other jurisdictions developing low carbon fuel policies.

This report is designed to capture the essence of the presentations and discussions that occurred during the two-day National Conference on Low Carbon Fuel Standards for Canada, held in June 2008 in Toronto, Ontario.

The conference was attended by more than ninety key stakeholders, representing the conventional fuels and unconventional fuels industry, the automotive industry, academia, the government of Canada, the provincial governments of Ontario, Alberta, Saskatchewan and British Columbia, and noted experts from the United States and United Kingdom.

The structure of this report follows the conference agenda, addressing topics in the following sequence:

1. Low Carbon Fuel Standards (standard definition and regional interpretations)
2. International Issues and Programs (examples of transportation fuel policies in other countries)
3. Petroleum Producing and Refining (perspectives of the conventional fuel industry)
4. Lifecycle Analysis (the tools of measuring the carbon intensity of fuel)
5. Alternative and Renewable Fuels (prospects for alternative transportation energy sources)
6. Vehicle Technologies for Low-Carbon Fuels (vehicle technologies for low-carbon fuel options)
7. Compliance Issues (design issues relating to compliance)
8. Technology Pathways (considerations for compliance through fuel-technology options)

Opening Remarks

Bob Oliver
Pollution Probe

Bob Oliver opened the conference by welcoming the participants and reviewing the conference objective for the next two days.

Objective: To educate and inform participants, and to identify and discuss key issues and implications related to designing and implementing an effective and efficient low carbon fuel standard in a Canadian context.

Bob noted that the conference is Pollution Probe's first investigative step into this interesting and relevant policy issue. He reviewed the agenda and the process to be followed for the conference. He stated that proceedings will be prepared that capture the essence of the discussions, but no attribution of comments would be made, other than for speakers and panellists. Finally, he advised that the conference agenda and presentations would be posted on the Pollution Probe website soon after the completion of the conference (see page 70 for URL).

Bob thanked the sponsors and Pollution Probe staff, particularly Rebecca Spring for coordinating the conference and BoAnne Tran and Taskin Shirazi for managing logistics, as well as Barry Bower and Ken Ogilvie who played key roles in conceptualizing the conference and developing the agenda.

Bob introduced the Keynote Speaker, Rick Jennings, Assistant Deputy Minister, Energy Supply, Ontario Ministry of Energy.

KEYNOTE

Rick Jennings
Ontario Ministry of Energy

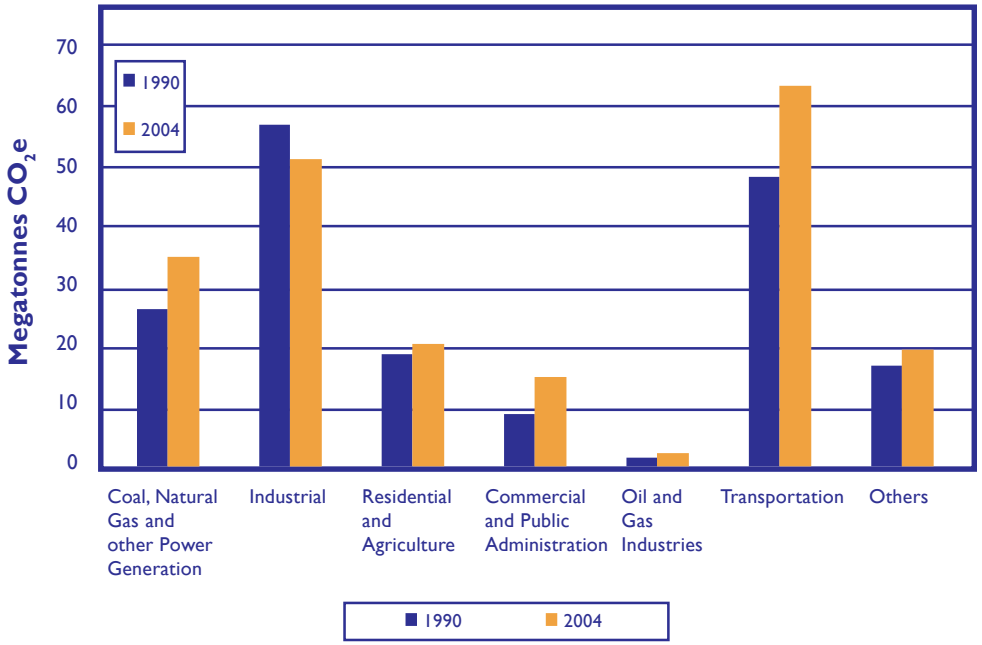
Rick Jennings opened by describing where the LCFS fits into the overall government Go Green initiative. He noted that the Ontario government is determined to act aggressively to reduce greenhouse gas (GHG) emissions that contribute to global climate change.

Rick presented slides on Ontario's GHG emissions, comparing 1990 and 2004 data. Figure 1, indicates that there was a 25 per cent increase in emissions between 1990 and 2004, particularly in the electricity sector (with increased coal use) and the transportation sector. Industrial GHG sector emissions declined, despite increased economic output.

The Ontario government has adopted GHG reduction targets, including a six per cent reduction from the 1990 level by 2014, and a 15 per cent reduction by 2020. Compared to business-as-usual (BAU projections, there will be a 61 megatonne (Mt) gap to fill by 2014 and a 99 Mt gap by 2020. This is illustrated in Figure 2.

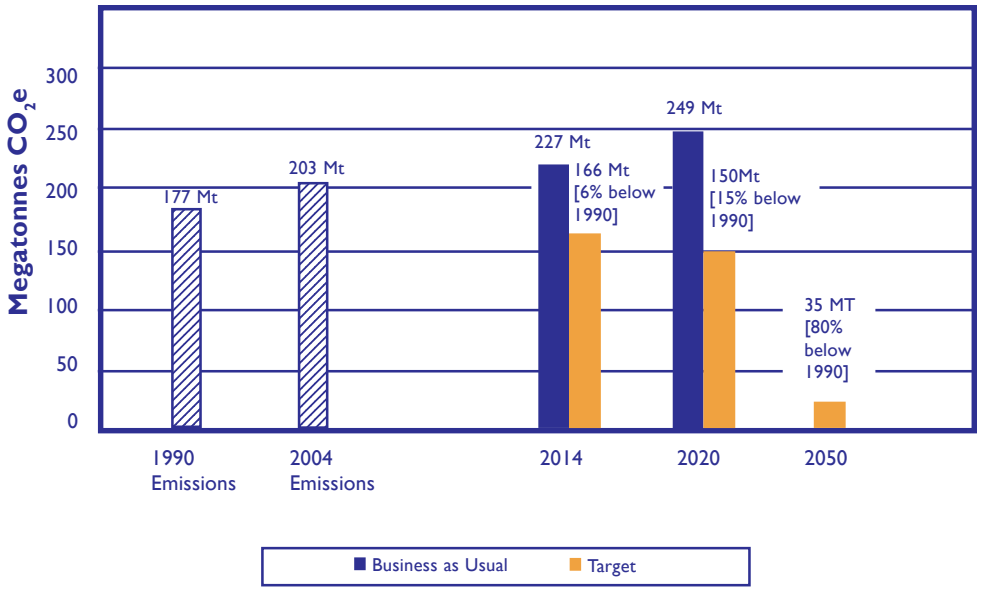
Rick profiled the government's Go Green Initiative. Of relevance to the LCFS is the New Generation Jobs Fund ($650 million to support

Figure 1: Ontario's Greenhouse Gas Emissions by Sector — 1990 and 2004



Source: National Conference on LCFS for Canada. Rick Jennings.

Figure 2: Ontario's Greenhouse Gas Emissions Targets



Source: National Conference on LCFS for Canada. Rick Jennings.

strategic investments, including alternative fuels and technologies), the Renewable Fuels Standard (all gasoline sold in Ontario to contain an average of five per cent ethanol by January 1, 2007) and the commitment to establish two E85 fuel stations (initially for the government fleet, but eventually for other fleets). He noted that the transportation sector is one of the most difficult and costly sectors in which to reduce GHGs, but given its large amount of emissions and the fast growth of emissions, it has to be part of the solution. He stated that Pollution Probe's National Conference on LCFS is the start of the Ontario government's LCFS consultation process and invited preliminary views by conference participants.

The commitment to develop a LCFS was made in May 2007 when the Governor of California visited the province. Ontario and California signed a Memorandum of Understanding (MOU) committing to coordinate policies in this area. Rick made it clear however, that Ontario's policy will reflect provincial circumstances. He noted that agreement will be required on important matters, such as life cycle costs and GHG performance of fuels. Many issues will need to be resolved, including which fuels will fall under the standard, what compliance pathways will be used, and so on. These may vary from jurisdiction to jurisdiction. The LCFS will thus have to be flexible to be effective. In this regard, markets will be allowed to determine which technologies are employed to meet the standard. Fuels will likely evolve to take advantage of local sources (e.g., wood for cellulosic ethanol, and clean electricity after coal is phased out). Ontario will have more of an incentive than many jurisdictions to go towards electric vehicles. He also emphasized that the standard will be influenced by the Ontario auto sector. Fuels must be compatible with new technologies and greener vehicles that will increasingly be manufactured in Ontario.

Rick noted that the global nature of the LCFS is important. There is little sense in reducing emissions in Ontario if it only serves to increase emissions elsewhere. Designing an LCFS that will result in real emission reductions is a challenge that will draw upon the help of participants in Pollution Probe's National Conference on LCFS, and others. Rick highlighted the LCFS Discussion Paper that was prepared by Ministry of Energy staff and sent out for use in the conference. It identifies a number of issues that will be considered in designing an Ontario standard. These need to be resolved before the LCFS is finalized.

In closing, Rick reviewed the consultation process and timelines that Ontario will follow for the standard. Pollution Probe's National Conference on LCFS is the start of the process. It will be followed by one-on-one consultations with stakeholders and supplemented by consultant studies to inform the government on key issues. A White paper is anticipated by the end of 2008, with the final standard expected by the end of 2009. Key Ministry of Energy staff were introduced, with Rick noting that Bruce Orr is leading the consultation process. He can be contacted at bruce.orr@ontario.ca or (416) 325-7044.

OVERVIEW OF LOW CARBON FUEL STANDARDS

Daniel Sperling
University of California, Davis

Daniel Sperling opened by making the point that a lot of vehicles are being produced around the world. This will continue into the future, so that eventually we will have billions of them on the road. The Intergovernmental Panel on Climate Change (IPCC) curves show that business-as-usual (BAU) projections will result in increasing GHG emissions. Even to stabilize these emissions will require a dramatic reduction from BAU.

Transportation has three legs: vehicles, fuels and vehicle use. There is a great deal of policy action with respect to vehicles (e.g., fuel efficiency standards), but much less effective policy intervention on fuels. As far as usage is concerned, California is only starting to focus on this area. Transportation is a large part of overall GHG emissions and we haven't been very effective at moving people towards alternatives to vehicles. Thus, we need to do something about fuel uses and alternative fuels in vehicles. But there are many barriers to increasing the use of alternative fuels.

The California Global Warming Solutions Act is a short and fairly simple law, but it implies a major transformation of the economy over the longer term. It requires getting back to 1990 levels of GHG emissions by 2020. It has some early action items, and the LCFS is the most important of them. It is moving faster than most of the other action items. The California Air Resources Board (CARB) adopted the LCFS in June 2007. It is now in the rulemaking process. The final rules will be adopted in November or December 2008, and the standard will take effect in January 2010.

Daniel emphasized that the LCFS process has not been an academic exercise. A huge amount of time has been spent working with the oil industry and environmental groups, as well as many others. The background papers produced reflect their input.

What is an LCFS and what does it include? The California definition (which is not adopted yet, although it is expected to be) includes all possible road-based transportation fuels (e.g., gasoline and diesel). It excludes aviation and marine fuels only because California doesn't have jurisdiction over them; otherwise, they would be included. The key to the LCFS is the use of a life cycle basis for policy. This is a 'first' and a harbinger for future policies in other areas. It makes an adjustment for vehicle drive train efficiency on the basis that some fuels enable more efficient automotive operation compared to conventional gasoline-powered vehicles, thus generating less GHG emissions per unit of energy over the fuel-vehicle lifecycle. The LCFS calls for at least a 10 per cent reduction in the carbon intensity of transportation fuels delivered to market by 2020. There is some discussion in California about whether to include upstream refinery emissions in the LCFS or to keep these emissions in a separate cap and trade program.

Daniel believes the LCFS is the best policy approach for introducing alternative fuels and reducing GHG emissions from fuel use in the transportation sector. Other approaches have not worked well (e.g., subsidies, biofuels directives). Governments aren't good at picking winners and losers. The US Energy Independence and Security Act, which requires 36 billion gallons by 2022 and will support both corn-based and cellulosic ethanol as well as biodiesel, is simpler than an LCFS, but it has an awkward treatment of GHGs. It also ignores non-biofuel options and has a very weak effect in terms of inducing innovation. Setting prescriptive rules and standards without flexible compliance pathways lowers the motivation to innovate. Elasticity on both the supply and demand side of the transportation fuel market is not very sensitive to price, so carbon taxes or cap and trade systems are probably not sufficient. These tools are likely to be much more effective in the electricity sector than the transportation sector. For example, a $25 per ton carbon price could be very effective in the electricity sector because there are lots of low carbon options, such as wind, nuclear, solar and water, but for gasoline, a tax of $25 per ton translates into about a 20–22 cents per gallon price increase, which wouldn't have much effect on reducing demand and GHG emissions.

The LCFS is starting to get attention in other jurisdictions. The European Union is looking at translating its biofuels directive into more of an LCFS-type program, and similar thinking is going on in the United Kingdom and Germany.

What are the key attributes that make an LCFS so important and effective? First, it creates a durable framework for introducing low carbon fuels. California is not just setting a target for 2010 or 2020; it is putting in place a framework that can be tightened over time. Everyone included in the standard will know the framework and make investments with this understanding. Second, the LCFS stimulates innovation. We are entering a whole new world with this issue. It's no longer just about putting in place off-the-shelf technology. We need innovation to deal with climate change. Finally, the LCFS is not picking winners and losers; it's putting in place a performance standard and making it more flexible by introducing trading.

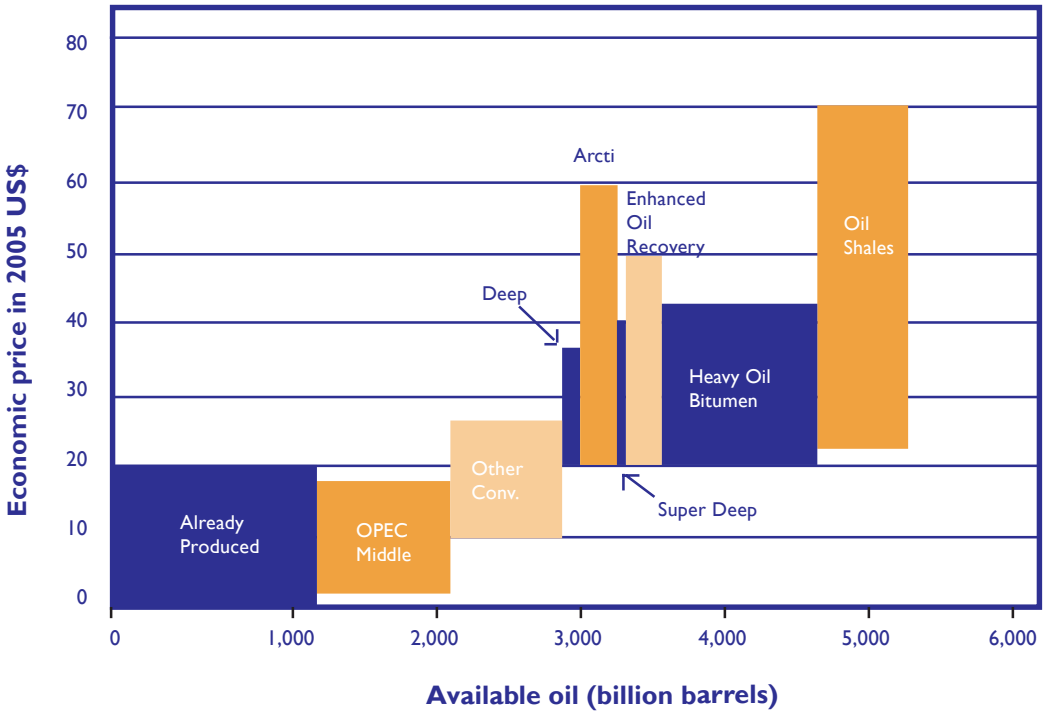
Daniel noted that California is aware that it is not an island; it has to be part of a bigger system. The basic rules and structures have to be similar across jurisdictions so that opportunities for trading exist in the broader market, and so that 'shuffling' of high carbon fuel to other jurisdictions is avoided. He also noted that, for the most part, the LCFS will be consistent with oil security strategies, but there is one place in which they could potentially be in conflict. That is in the area of unconventional fuels, such as oil derived from oil sands, oil shale and coal, as well as some biofuels (see Figure 3). There is plenty of fossil fuels out there, but as we move up the supply chain there's much more carbon intensity. One of the key questions is how to handle high carbon fuels. Daniel argues that, even here, LCFS is the right tool to use. It puts a durable framework in place to handle the issue of the carbon

emissions associated with these fuels and also provides an incentive to improve the efficiency of their production. One of the attractions of the LCFS is that it combines both regulatory and market instruments into one policy (i.e., it sets rules, but relies on market forces to achieve the goals).

Other issues arise with respect to the LCFS; for example, ecological and social sustainability (e.g., importing fuel from countries in which people and land are exploited). We do need to address sustainability concerns, but it's not obvious how to do it, especially in ways that don't make the LCFS too onerous (and thus scare away capital and investment). The support of environmental groups and the oil industry (or at least their acquiescence) is essential.

Daniel commented on the land use change issue, while noting that other speakers at the conference would address this in more detail. With respect to life cycle analysis models, he said that we know what data we need and the methodologies to analyse the data are established. The most important issue is the default values that will be set for such things as how the fuel is grown and how it is harvested. He said the easiest thing is just to accept the default values, but if a fuel supplier can do better, it can provide evidence and documentation for alternative values.

Figure 3: Unconventional Oil: Where Energy Security and Climate Strategies Conflict. Can LCFS Help?



Source: National Conference on LCFS for Canada. Daniel Sperling.

Other issues include how to measure electricity use (e.g., different vehicles being charged in different places), vehicle efficiency adjustment factors, how to treat gasoline and diesel fairly (California will probably keep them separate), and whether or not to include home heating oil (which is being considered now by the NESCAUM region: The Northeast States for Coordinated Air Use Management).

The overarching messages that Daniel left for the audience were:

- he believes in the LCFS
- it provides a durable regulatory and policy framework to guide the transition to low carbon fuel alternatives (noting the LCFS is just a foundation, and that other policies are needed for electricity and gaseous fuels, which have their own market barriers that must be addressed)
- LCFS can co-exist with carbon cap and trade systems
- It is important to have consistency across political jurisdictions

In conclusion, Daniel stated that LCFS is hugely important. Yes, there's some uncertainty. Yes, there's complexity. Yes, more research is needed (especially on land use effects). But, he believes LCFS is the most important policy measure in transportation fuels, perhaps ever (because all others have performed so poorly or failed completely). It's in all of our interests to work together to make the LCFS a success!

Questions and Answers

Q. The drive train efficiency adjustment seems to be a mix of two legs of the transportation stool (i.e., vehicle efficiency and low carbon fuel). Is this appropriate?

A. It does mix them, but you have to do it; otherwise, you will provide essentially no incentive for such things as electricity.

Q. But doesn't electricity have its own life cycle?

A. Yes, but you want to create an incentive on the supply side. Two major parties are involved: vehicle makers and fuel suppliers. Policies exist on the vehicle side to provide incentives for electric vehicle use, for example, but you also want to provide incentives on the fuel side to supply low carbon fuels for the fuel efficient vehicles.

Q. What do the LCFS principles related to cooperation among jurisdictions really mean?

A. A globally meaningful LCFS has to assume compatibility between Canada, the United States, Brazil, and so on.

Q. There is no compatibility among jurisdictions in the agricultural sector, so what does it mean in the fuel sector?

A. It means developing common units and methodologies for measurement of GHGs. The fuels must be accounted for properly; the same reasoning applies for corn-based and cellulosic ethanol. We've

got to agree on protocols for measurement methods.

Q. When you take a regulatory requirement and add trading to it, you change it into a pricing system. Is this recognized by the people who are behind the LCFS in California? Is that the intent?

A. Different people see the LCFS how they want to see it. There is tension in California between those who want to use the market and those who prefer rules and regulations (and believe that they provide certainty relative to market instruments). It's a philosophical view of the world. Can you trust the market? Many people are starting to appreciate that there will be a mix of market and regulatory instruments in California's overall plan to address climate change. But, for example, the environmental justice movement in California is adamantly opposed to cap and trade systems because they've seen some bad experiences in the past (while overlooking the good experiences).

Q. What kind of price is going to underlie the LCFS? How many dollars per tonne do we need to drive the transformative change that the standard is really aimed at?

A. The LCFS is a forcing mechanism. This is a case in which pure market mechanisms (at least in the realm of political acceptability) are not going to result in much change, so you need something that forces an outcome. All market failures have to be dealt with somehow, and the LCFS is a mechanism for dealing with most of them.

Q. Given that the complexity of the LCFS has become more evident since it was first announced in 2007, what sort of message is CARB getting now from the Governor's Office? Is there any tension between CARB and the Governor?

A. There has been very strong support from the Governor. He sees the LCFS as perhaps even a centrepiece of his legacy on climate change and on environmental innovation in general. There has been no tension at all between CARB and the Governor.

Q. The devil is in the details. For example, conventional oil has become more unconventional in its production. How can you use a single number to deal with this?

A. The LCFS is a performance standard with a single metric for each jurisdiction. One of the questions is: Does everyone have to have the same target? I don't believe this has to be the case. The important thing is to get the durable framework in place. Then we can worry about the exact target and tighten it up over time. The framework has to be put in place and the rules have to be worked out to make sure everyone knows how to work in the system and is comfortable with it. I think this can be done even in regions in which it's going to be hard to reduce the carbon content of the fuel. We may have to make some accommodations, but we need to get the methods correct and to get agreement on the data protocols. Perhaps we can have different targets in different areas.

LCFS — REGIONAL ISSUES AND IMPLICATIONS

Barry Bower
Consultant

Barry Bower recently retired from the Ontario Ministry of Energy. He was the lead author of the Low Carbon Fuel Standard discussion paper prepared by the Ministry of Energy staff and distributed by Pollution Probe in advance to the conference participants (see page 83). Barry presented some of the main points covered in the paper. The following is a brief summary of his presentation.

Barry opened by noting that, as with all policies and programs, a lot will depend on how the LCFS is implemented. In particular, unintentional consequences that could threaten people and the economy should be avoided, if possible. The goals of a good LCFS are to: 1) achieve real GHG emission reductions; 2) avoid shuffling of fuels, and 3) understand and mitigate unintended consequences.

The point was made that not all jurisdictions will arrive at the same answers in designing an LCFS. In part, that is because the reasons for having a standard are complex and go well beyond just the need to reduce GHG emissions. All sectors need to reduce emissions, and if reductions don't happen in other sectors, it's unlikely that significant reductions will occur in the transportation sector (in which the cost per tonne of GHG emission reductions is relatively high). On the other hand, emissions from the transportation sector are large and growing fast, so it has to be part of the solution.

The details of an LCFS can be quite different between jurisdictions. For example, California is considering prohibiting the flow of credits to transportation from other sectors. Moreover, California is looking at establishing a separate baseline for diesel, which will make it harder for dieselization of the passenger vehicle fleet to contribute to compliance. But while dieselization can contribute to reducing GHG emissions, it doesn't contribute significantly to the "off-oil" objective (i.e., reduced dependence on imported oil). To California, and more broadly, the United States, the LCFS is largely an off-oil program. But this is not the main driver for Canada and Ontario, which is a net exporter of oil; thus, in itself, off-oil is not a major policy goal. Reducing GHG emissions is the motivation in Canada.

Barry added that California is a significant producer of oil and has ready access to offshore oil. Ontario, on the other hand, is landlocked and faces high costs if it imports oil from offshore. But Ontario does have good pipeline access to western Canadian oil. Hence, the province will increasingly rely on crude from western Canadian oil sands. The LCFS policy will have to take this into account. In general, Ontario will seek to develop and use resources that it has access to in abundance. Since Ontario's auto sector is a significant part of the North American industry, the implications for vehicle technology development and manufacturing investment should also be considered. Also, Ontario has quite different weather than California and relies to a significant extent on the use of oil for space heating purposes. A key

question for Ontario is: Why not include heating oil in the LCFS as it is made in the same refineries as transportations fuels (i.e., gasoline and diesel)?

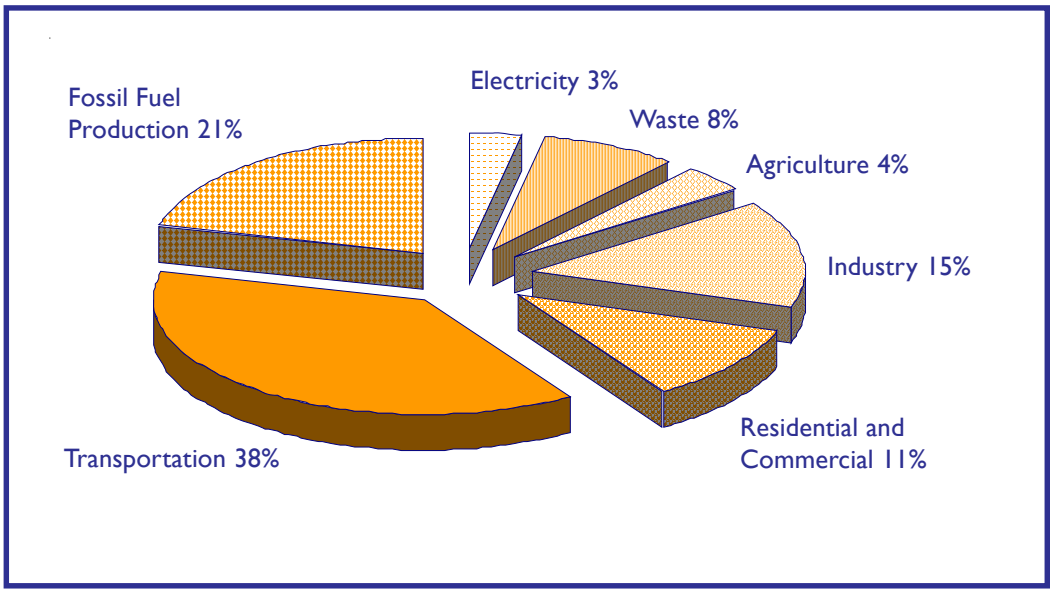
A final point made by Barry was that the Ontario agricultural sector can't generate as much crop-based ethanol as, say, the prairie provinces, but Ontario does have access to wood, so cellulosic ethanol will be of more interest in the future due to more abundant access to this resource.

Paul Wieringa
British Columbia Ministry of Energy, Mines and Petroleum Resources

Paul Wieringa opened by noting that British Columbia's GHG emissions have increased since 1990. It is estimated that a 33 per cent reduction will be required to meet British Columbia's 2020 GHG target. He showed slides of where GHGs are currently coming from and noted that the province is aiming for net zero GHG emissions from electricity generation by 2016. Figure 4 was presented to conference participants. He also mentioned other areas in which reductions would occur, such as in waste management, agriculture and residential energy use (e.g., green building code; Live Smart BC). With respect to transportation, there are five areas of action: tailpipe GHG standards for vehicles, the LCFS and renewable fuels standard (RFS), a hydrogen highway, public transit and green communities.

Paul noted that some decisions have already been taken for the LCFS. For example, it won't include emissions from the electricity sector or upstream oil and gas. He also mentioned the British Columbia carbon tax of $10 per tonne that

Figure 4: British Columbia's Greenhouse Gas Emission Sources



Source: National Conference on LCFS for Canada. Paul Wieringa.

came into effect on July 1, 2008 (with $5 per tonne increases to occur at specified future dates). The tax has been estimated to increase prices for liquid fuels (2–3 per cent) and natural gas (approximately 10 per cent), as well as coal (which will be much higher, depending on contracting details).

British Columbia's new legislative framework, which was recently passed, includes the RFS (i.e., five per cent ethanol content in gasoline by 2010, as well as five per cent diesel), and an LCFS Act. British Columbia is starting to draft regulations for the RFS and is targeting completion by the end of 2008. The regulations will allow 'notional transfers' (legal terminology analogous to credits and trading) and will deal with compliance by using automatic administrative penalties.

The LCFS will only include transportation fuels and is being modelled on the California approach. Heating fuels, for example, are not in the Act, but will be included in the RFS. The LCFS will use default values for fuel components, or companies can come forward with actual data and request valuation of GHG emissions intensity on this basis. The point of regulation will be at the wholesale market level. British Columbia will consult on the LCFS this Fall and is working towards the same dates as California for the LCFS to come into effect.

While the British Columbia LCFS is trying to harmonize as much as possible with the California standard, there may be several differences, due to British Columbia's different fuel mixture, electricity generation 'stack' (i.e., the distribution of energy supply, from baseload power sources to marginal sources to meet demand in peak periods), and the fact that British Columbia's crude oil supply mostly comes from Alberta and the oil sands. British Columbia will also use a different pathway model than California (i.e., the GHGenius model versus California's use of the GREET model).

One issue that will have to be addressed by British Columbia is the declining carbon intensity of the oil sands. Thus, for example, there is the question of what start date should be used to deal with this? There is also the issue of validating what is occurring in the oil sands. Paul stated that Canada should be doing research on this and that validation has to be worked into the methodology and accounting for GHG emissions. Paul left the conference participants with a key message: Canada needs to have lots of debate about default values (e.g., maximums, minimums, averages and means). In electricity, for example, will we use marginal GHG emission rates, or just the average in the supply stack?

Paul went on to talk about other issues, such as the large amount of fallow agricultural land in British Columbia (due to low and falling prices), forest sustainability, and food production. He noted some differences between California and British Columbia, such as the fact that California forestry is mostly on private land, whereas British Columbia's forestry is mostly crown land. Paul also mentioned issues related to incenting new technology (e.g., waste utilization and renewable diesel).

Questions and Answers

Q. There appears to be at least three different LCFS's, and potentially three sets of rules, for California, British Columbia and Ontario (and many more later on as other states and provinces establish their own LCFS'). Are there connections between these systems? And, on a broader basis, is the LCFS the right direction for national energy policy?

A. Paul referred to the Western Climate Initiative and emissions trading. He believes there's going to be trading in some sectors, but there may be a different system and price signal for the transportation sector. As mentioned, British Columbia does have the authority to make notional transfers among fuels suppliers. If this measure is set up in other jurisdictions, then at some point there will likely be trading between them. He emphasized, however, that the priority is to set up the LCFS framework and then see how it plays out.

Barry responded that you don't necessarily have to have trading of products with trading of credits/notional transfers. This is rather difficult to arrange at the provincial level and is not something Ontario has dealt with in any depth to date. He invited stakeholders to share their ideas on this at future consultations. The question is: How can Canada have some measure of harmony on LCFS' throughout the country, and throughout the continent?

Q. The figure of 30 per cent fallow agricultural land in British Columbia was challenged and the issue of waste residues and the mountain pine beetle was raised. A question was asked about how local sources of transportation fuels would be handled. The question was asked: What gets weighted more heavily, the use of local resources or the use of good science?

A. Paul replied that British Columbia is coming out with a bioenergy strategy to deal with the pine beetle that will address what the related wood residue can be used for. He noted that the greatest competition for this resource is not for liquid fuels; rather, it is for electricity generation.

Barry responded that Ontario's agricultural sector is not as big as in many other jurisdictions. He mentioned that there's lower hanging fruit in Ontario than agricultural wastes for ethanol production; for example, wood waste/residue. He said that science is important in setting the LCFS, but noted that there multiple provincial goals and a variety of programs have to be considered. The question arises: If the LCFS is going to result in more expensive fuels, what else are we going to do to mitigate the harm to the economy? He suggested that Ontario-based resources will be used to the extent possible, but without erecting barriers against the use of renewable fuels from other sectors and regions.

Q. A conference participant asked for an elaboration on the issue of dieselization.

A. Paul noted that BC legislation does not explicitly say that there has to be a different standard for diesel and gasoline. Daniel added that the fact that diesel and gasoline are kept as separate standards in California does not mean that diesel for light duty vehicles cannot qualify for credit. That is a separate decision. First, a standard for gasoline will be set. Later, the use of diesel might get credit towards meeting the gasoline standard. The thinking in California right now is not to do it.

International Programs and Issues

Ken Ogilvie, Executive Director Emeritus, Pollution Probe chaired an international panel on LCFS and related policies. The panel included: Paul Argyropoulos, Senior Policy Advisor, Office of Transportation and Air Quality, US Environmental Protection Agency; Sonia Yeh, Research Engineer, Institute of Transportation Studies, University of California, David; and Philip Watson, Senior Consultant, E4Tech (UK) Ltd.

US GOVERNMENT POLICIES

Paul Argyropoulos
US Environmental Protection Agency

Paul presented a broad overview of the policy landscape for the existing program that the US EPA is operating under as part of the Energy Policy Act of 2005. He also gave an overview of the new renewable fuel provisions that fall under the authority of the Energy Independence and Security Act of 2007 (EISA). He reflected on some of the key requirements of the 2007 Act and wrapped up with a summary of next steps and ongoing activities that are planned by the EPA. The main areas covered in Paul's presentation are as follows.

Under the Final Energy Policy Act (2005), the Final Renewable Fuel Standard (RFS) was signed in 2007. It established new renewable fuel requirements for obligated parties. The rulemaking was set forth in April 2007 and published in May. The program was officially started in September 2007. It requires the obligated parties to ultimately blend (for gasoline only) specific volumes of renewable fuels into their product and to sell fuels with a certain percentage of renewable fuels. Flexibility is allowed to bank and trade Renewable Identification Numbers (RINs), which are essentially 'credits,' with corn ethanol assigned an RIN of 1. Other biofuels have RIN values based on their volumetric energy content in relation to corn ethanol. For example, biodiesel (alkyl esters) has an RIN of 1.5 and cellulosic biomass ethanol has an RIN of 2.5. Fuel producers can comply with the renewable fuel requirements by blending fuels as well as trading and purchasing credits on the open market. RINs are becoming valuable; since the December 2007 signing of EISA, which increases the RFS volumes (to new "RFS 2" levels as explained below), prices increased from 0.25 cents per gallon to more than 5 cents per gallon.

Some highlights of RFS 2 include:

- EISA modifies the existing Energy Policy Act RFS Program. Under EISA RFS 2, volumes of renewable fuel must increase to 36 billion gallons per year by 2022. New renewable fuel categories and eligibility requirements are established, new waivers and paper credit provisions are provided for, and new obligated parties are included. The final

RFS 2 rule is required by December 19, 2008, and will become effective in early 2009. It will build on the foundation of RFS 1. EPA is currently working through what the new standard will really mean, and in this regard a number of new studies and reports are being produced. Several challenging new provisions include, land use effect, lifecycle analysis and facility definitions.

- The standard will be extended to diesel fuel, in addition to gasoline, and non-road fuel, in addition to highway fuel. Jet fuel and heating oil aren't covered, but renewable fuel sold into these markets can generate RINs. The standard eliminates some old categories, such as waste-derived ethanol, and definitions include new elements, such as lifecycle GHG reduction thresholds and an existing cropland criterion (i.e., renewable fuels must now be produced from renewable biomass harvested from land "cleared or cultivated" prior to the enactment of EISA). Extensive stakeholder consultation and interaction will be needed for these additions.
- Under RFS 2, each fuel category will be required to meet mandated GHG performance thresholds (i.e., reductions compared to the baseline petroleum fuel produced). The four categories include: conventional biofuel (ethanol derived from corn starch), advanced biofuel (essentially anything but corn starch ethanol), biomass-based diesel, and cellulosic biofuel. The baseline fuel for comparison is gasoline and diesel fuel in 2005.
- EPA is doing a lot of work on lifecycle assessment and lifecycle modelling. For example, a consistent modeling framework is being built that captures both domestic and international agricultural sector changes and GHG impacts. Country-specific GHG emissions factors associated with land use change and agricultural practices are being developed. EPA is also updating the petroleum baseline and will be updating biofuel lifecycle GHG factors for all four categories of biofuel.
- Given the aggressive targets that have been put forth in RFS 2, there is a need to have appropriate waiver authorities. Anyone subject to the requirements can petition for waiver or relaxation of the standards based on claims of severe harm to the economy or environment, or inadequate biofuel supply.

Paul closed his presentation by giving an overview of tasks that still remain to be done in the rulemaking process. Many studies and analyses will be done, both before the final rules are set and on an ongoing basis to deal with complex issues related to the standard. For example, analysis will be done on co-pollutant inventories and air quality and other benefits; water and soil impacts; macroeconomic impacts; energy security; agricultural sector impacts, and GHG lifecycle modeling. The studies are being done under the authorities given in Sections 204 and 209 of the EISA.

Comments, Questions and Answers

Q. It looks like the requirements of RFS 2 support all of the investment that's been made to date, but it appears that no reference is made to the biodiversity impacts of fuels imported from outside the United States, and nothing within the United States itself.

A. Paul replied that the EPA is looking at biodiversity in the biofuels strategy. A group has been put together to provide advice to the administrator on issues such as this. The advice given last year was to look across the full lifecycle of fuels and review the legal authorities that the EPA has to address biodiversity and other issues related to the standard. Biodiversity impacts won't necessarily be part of the EPA's rulemaking, but it is one of many potential impacts that will have to be evaluated and understood. EPA will be looking at international land use issues from a GHG perspective and establishing lifecycle thresholds. International biodiversity aspects won't be part of the rulemaking, but they will be part of the international dialogue.

Q. How is "wise rulemaking" relating to possible environmental impacts of biofuel production reconciled against mandated volumes? Is grandfathering actions under RFS 1 wise?

A. Paul pointed out that the EPA has to follow its Congressional mandate, but will be doing as many evaluations as practicable within the confines of the timelines that have been set. Beyond these timelines, there will still be issues to deal with. Studies are being (or will be) done under Sections 204 and 209 of the EISA on how these issues might be addressed in the future.

Q. Why does the RFS 2 program have nothing in it related to natural gas, biomethane and hydrogen, among other fuels? Why were these eliminated in the process of shaping this program?

A. Paul noted that any fuel produced from a renewable feedstock (as defined in the EISA) can be counted towards meeting the obligation. If the fuel is not from a renewable feedstock, it can still produce it, but it won't count towards the RFS since the program is solely based on renewable fuels. Other alternative fuels may be addressed in future measures.

IMPLEMENTING CALIFORNIA'S LCFS: TECHNICAL AND POLICY CHALLENGES

Sonia Yeh
University of California, Davis

Sonia presented the technical and policy challenges to implementing California's LCFS. She talked about her analysis and described various scenarios for achieving the targets. She also discussed how to handle the related sustainability issues that have become more important as work on the standards have progressed.

Sonia opened by restating the California LCFS goal of reducing by 10 per cent the carbon intensity of California's fuel supply by 2020 and pointing out that the California Air Resources Board (CARB) has proposed to set two separate standards for transportation fuels:

- **Gasoline standard:** all fuels used for light-duty vehicles, except diesel and biodiesel and the gasoline and ethanol used by medium and heavy-duty vehicles; and,
- **Diesel standard:** all fuels used for medium and heavy-duty vehicles, except gasoline, ethanol, and light-duty diesel and biodiesel fuels.

Sonia noted that the LCFS is still evolving in response to further analysis and to comments received during the extensive public consultation process that is underway. Incorporating diesel in the standard, for example, is controversial. Originally proposed in the University of California report to recognize the inherent superior fuel efficiency of diesel engines compared to gasoline engines, the standard has run into opposition from environmental groups due to concerns that increasing adoption of light-duty diesel engines might lead to increases in harmful air emissions, including fine particles, air toxics and ozone. Industry groups, on the other hand, argue that ignoring the use of a Diesel Efficiency Adjustment Factor violates the principle of "fuel neutral." To deal with these concerns, CARB is proposing separate standards for gasoline and diesel as a way of reducing the incentive to introduce diesel light-duty vehicles to meet the standard while requiring the regulated entities to reduce the GHG intensity of diesel.

Sonia noted that Pavley AB1493 provides a strong incentive for light-duty diesel vehicles, even if they can't get credit for higher fuel efficiency under the LCFS, because they will still get credit under Pavley.

Sonia noted that there are three compliance options for meeting the LCFS:

- Lowering the carbon intensity of current fuels;
- Using low carbon fuels (e.g., blending low carbon biofuels into finished fuels, or buying low carbon fuels, such as electricity, natural gas and hydrogen); and,
- Purchasing credits from other "obligated parties."

Sonia focused her presentation on the second option, but noted that for the first option, default values that represent the average fuel carbon intensity of the blend stock would be determined by CARB; and for the

third option, there would be lots of interaction between the LCFS and the use of credits in AB32 (i.e., California's economy-wide Cap-and-Trade program).

The second option relates to using low carbon fuels. It proposes using "vehicle fuel efficiency adjusted average fuel carbon intensity" emission numbers for a range of fuel types, and variations within them. For example, there are several different types of ethanol and biodiesel, depending on the feedstock and process used to make them and after adjusting carbon intensity numbers for vehicle efficiency, numbers varying accordingly (see Figure 5). Sonia emphasized that credit should be given to fairly recognize fuels that support higher drivetrain efficiency in vehicles, such as electricity for electric vehicles, which can be a less carbon intense option.

Sonia next reviewed some work she is doing on scenarios for bioresource availability in the Western Governors' Association Region. Her general conclusion is that United States biofuels could, by 2015, provide between 5–10 per cent of the region's projected transportation fuel demand with a fuel price between $2.20 and $3.00 per gasoline gallon equivalent, excluding local distribution costs and taxes. A diverse resource base would provide this fuel, with significant contributions from municipal solid waste, agricultural residue, herbaceous energy crops, forest thinning, corn and tallow resources. She noted that there are still major uncertainties in her estimates, such as the economic performance of different conversion technologies, the adequacy of the supporting feedstock and biofuel delivery infrastructure, and the overall sustainability of many of the biomass resources being considered. She then presented a supply curve for all biofuels using California's resources. The curve showed municipal solid waste as the largest single resource.

Sonia stated that the conclusions of her (and her colleagues') resource assessment for California are not hugely affected by food versus fuel and land use change (LUC) considerations. Corn is not a significant biofuel resource in California and energy crops are not estimated to be commercially attractive until 2015–2020. The Renewable Portfolio Standard (RPS) in California may, however, compete for biomass, especially for electricity generation. The RPS is resource-neutral, but the California Bioenergy Action Plan calls for 20 per cent of electricity generated to be from biomass in 2010 and 2020.

Sonia presented a table on California-based biofuel CO_2e reduction potentials, which shows that there is more than enough potential to meet the California LCFS (which will require about 16 million tonnes of CO_2e per year by 2020 — about 10 million tonnes per year to satisfy the gasoline standard and five million tonnes per year for the diesel standard).

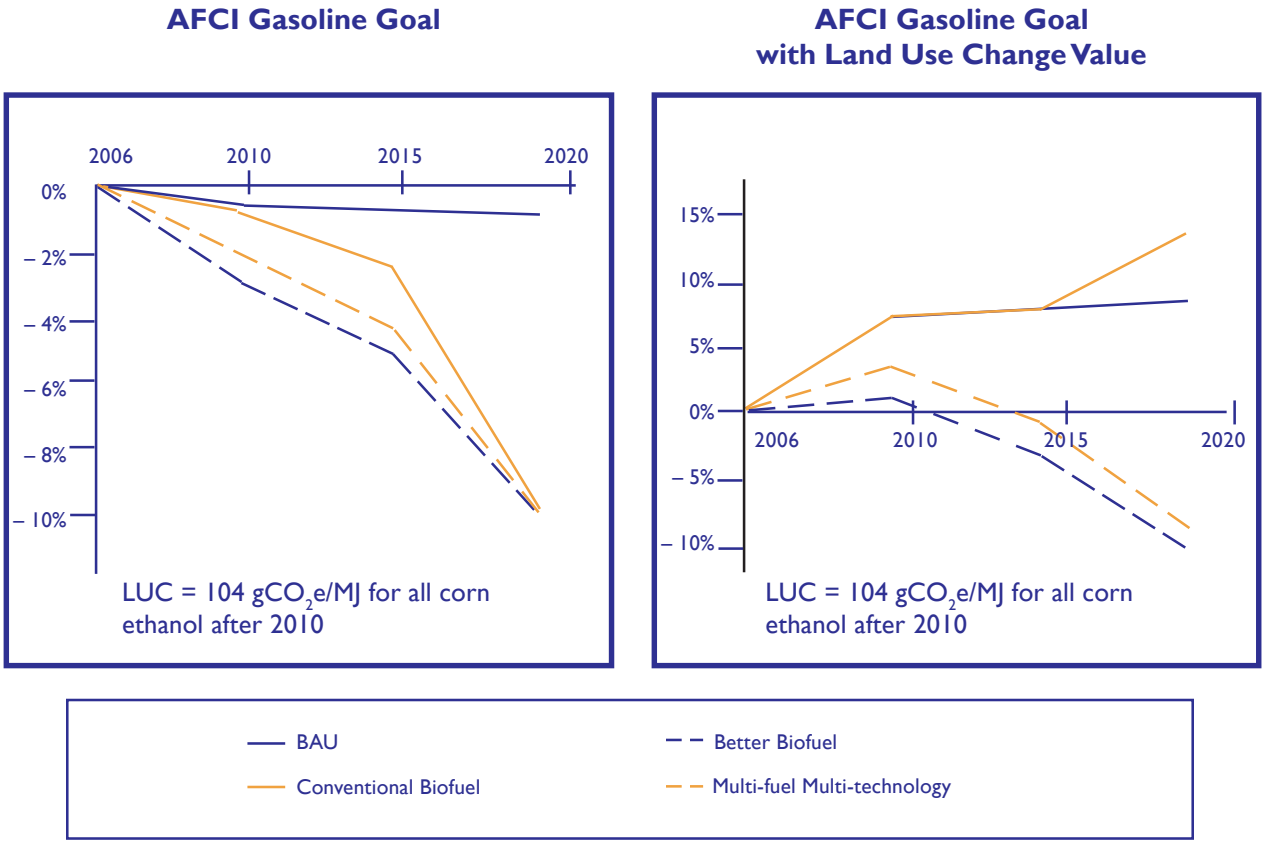
Sonia went on to show three possible pathways to achieve the LCFS 10 per cent reduction goal (please refer to the presentation, available at http://www.pollutionprobe.org/Happening/

pdfs/lowcarbonfuelwkshp/agenda.pdf), noting that the Pavley AB1493 requirement for more fuel efficient vehicles will significantly reduce California's total projected fuel demand by 2020. She observed that the standard won't be met if only corn ethanol is used, and further noted that the compliance trajectory scenarios do not yet include indirect land use change (LUC) values. With LUC, corn ethanol is actually projected to increase carbon intensity after 2010 (see Figure 5).

Sonia also shared her preferred list of basic principles of sustainability for feedstock production, which include:

- Achieve sustainable GHG reductions;
- Avoid large-scale environmental degradation;
- Do not threaten food supply and food price stability; and,
- Lead to continuous technology innovation that improves energy efficiency, reduces energy use and minimizes environmental footprint.

Figure 5: Carbon Intensity Reduction Goals With & Without LUC
(Numbers are Preliminary)



Source: National Conference on LCFS for Canada. Sonia Yeh.

In this context, Sonia observed that in many instances greenhouse gas emissions and ecological impacts are highly correlated. Her opinion was that if the sustainability criteria can be integrated into default values, it would go a long way towards addressing the sustainability issues. She then reviewed currently proposed solutions to address sustainability issues associated with the LCFS and renewable transportation fuels. She noted some inadequacies in them in terms of addressing "indirect, market-mediated effects at macro levels" as well as "some issues only associated with large-scale implementation." She proposed a potential solution to the large-scale, aggregate effects issue and suggested that combining methods for estimating direct and indirect greenhouse gas impacts would make for a complete "lifecycle" inventory analysis. She went on to argue that the sustainability criteria provide a consistent framework for measurement and comparison, but they don't equate to "impact," so they would have to be combined with Environmental Impact Analysis to address site-specific and time-dependent impacts that are hard to generalize or extrapolate to the entire fuel chain.

Comments, Questions and Answers

Q. How is food price stability represented as a sustainability factor? Is price stability a sustainability principle or a wish?

A. Sonia noted that she is not an expert on this issue, but observed that there is still an open debate going on, at least in the United States, about whether and how much corn ethanol contributes to the food and fuel issue. It's very controversial, but if it is serious, there's agreement that it needs to be addressed; however, there's no clear answer yet on how to do it. Sonia ventured the view that if we're able to address multi-sustainability issues, which she believes we will, then perhaps that will lessen the food versus fuel controversy.

EUROPEAN POLICIES

Philip Watson
E4Tech

E4tech is a European sustainable energy consulting firm based in the United Kingdom and Switzerland. It focuses on four key areas of sustainable energy: fuel cells and hydrogen; sustainable buildings; distributed energy systems; and, biomass and waste-to-energy.

Philip presented an overview of biofuels and low carbon fuel policies in Europe in terms of historic policy drivers, current status and future directions.

With respect to historic policy drivers, Philip reviewed the evolution of European policies since World War I, when oil became a key strategic fuel. Economic drivers also entered the picture; for example, when France's economy wasn't doing well and policies were put in place to reduce expensive oil imports. Thus, energy security, through the diversification of energy sources, as well as economic factors (especially the diesel trade balance deficit), were key policy drivers. By the late 1980s/early 1990s, agricultural concerns had become another important policy driver. Finally, by the late 1990s, greenhouse gas reductions were added to the list.

Currently, European Union policies have emerged to provide a framework for member countries to support biofuels development. A Biofuels Directive was introduced in 2003 that set indicative targets for EU countries to meet in 2005 (two per cent biofuels market share) and 2010 (5.75 per cent biofuels market share). An Energy Taxation Directive was also introduced in 2003 that allows EU countries to reduce excise tax on biofuels used for transport fuels. Without the Directive, the tax reduction would be prevented by "State Aid" legislation.

As a result of the two Directives, most EU countries now have biofuel support policies in place, either as sales obligations (similar to the US RFS) or as tax incentives. In the past three years, there has been a trend in member country policies away from tax incentives and towards sales obligations. The result has been a rapid expansion in the production of biofuels, including both biodiesel and ethanol.

With respect to future directions, a range of issues are shaping low carbon fuel policy development in Europe. These include:

- Greenhouse gas emissions reductions (which can be highly variable for different biofuels — e.g., more savings from waste-derived biofuels, but less from corn ethanol);
- Direct land use changes due to biofuels production (hence the need to find ways to incorporate this into the assessment of greenhouse gas emissions reductions);
- Indirect land use changes (Philip noted the imminent release of a UK study on this issue, as well as a key EU study that is underway);
- Sustainably sourced biofuel feedstocks;
- Promotion of technological innovation (e.g., using the LCFS); and,

- Regulating the lifecycle greenhouse gas emissions of all fuels (including the trajectory of fossil fuel lifecycle emissions).

Philip noted that the framework provided by EU policies is evolving towards an integrated approach that is closely linked to the policy objectives. The following new EU Directives have been proposed:

Renewable Energy Directive:
- Sets a mandatory target of 10 per cent by 2020 for every country in the EU;
- All biofuels will be required to achieve a minimum 35 per cent greenhouse gas emissions reductions (still under negotiation);
- By default, it is assumed that biofuels do not cause any land use change;
- Countries may reward biofuels on the basis of their greenhouse gas emissions reductions (i.e., if more than 35 per cent is saved, the biofuel may qualify for support);
- Basic sustainability criteria are incorporated (e.g., must not destroy areas of high carbon stock or high biodiversity); and,
- A provision for countries to provide additional incentives for advanced biofuels (not much detail on this yet).

Fuel Quality Directive:
- Requires a 10 per cent reduction in lifecycle greenhouse gas emissions of all transport fuels between 2011–2020 (very similar to an LCFS); and,
- Same greenhouse gas emissions reductions and sustainability criteria as for the Renewable Energy Directive.

Philip noted that some individual EU countries have also been considering emerging issues when implementing the new biofuels policies, including minimum sustainability criteria, minimum greenhouse gas emissions reductions/performance, and support for biofuels based on their links to overall greenhouse gas emissions reductions. Germany has been the most active country in this regard.

Philip also provided an introduction to the UK Renewable Transport Fuel Obligation (RTFO), which requires suppliers of fossil fuels to ensure that a specified percentage of the volume of the road fuels they supply in the UK is composed of renewable fuels.

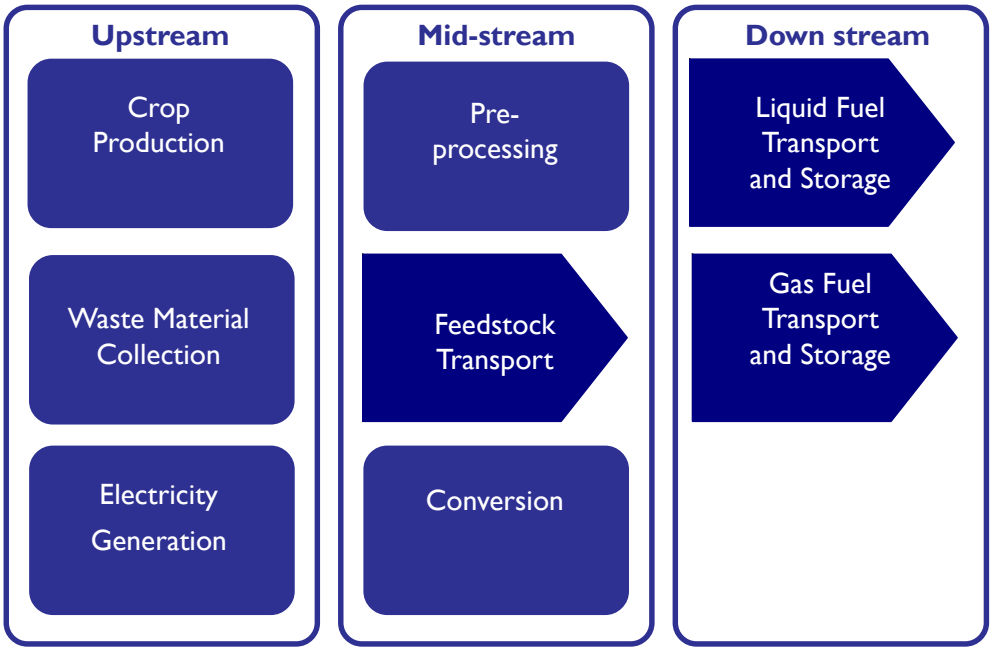
The following obligations have been set:
- 2008/09: 2.5 per cent
- 2009/10: 3.9 per cent
- 2010/11: 5.3 per cent
- Intention to continue increases beyond 2011

Fuel suppliers can comply with the RTFO by meeting their percentage production requirement, by purchasing Renewable Transport Fuel Certificates (RTFCs), or "buying out" of their obligation at a price of £0.30 per litre (i.e., about 0.60 ¢ per litre). Philip noted that the RTFCs can be banked and traded among suppliers, but there's no interaction between them and other schemes (e.g., the EU's Emissions Trading System). Fuels suppliers are required to submit monthly reports on the carbon content and sustainability of the biofuels supplied.

Philip also noted that the RTFO was never intended to address broader sustainability issues — it is constrained to feedstock production only. A "Meta-Standard" approach is taken to assessing sustainability performance. This approach sets out principles, criteria and indicators against which the broader sustainability issues are judged. Compliance with the environmental and social aspects of the Meta-Standard is tested separately and can be achieved by auditing feedstock production directly against the Meta-Standard, or through compliance with an existing agri-environmental standard that is cross-compliant with the RTFO Meta-Standard. The second test is expected to be the one used by most fuel suppliers. Fuel suppliers are not obliged to supply sustainably sourced biofuels; however, companies will be "named and shamed" if they do not meet indicative targets.

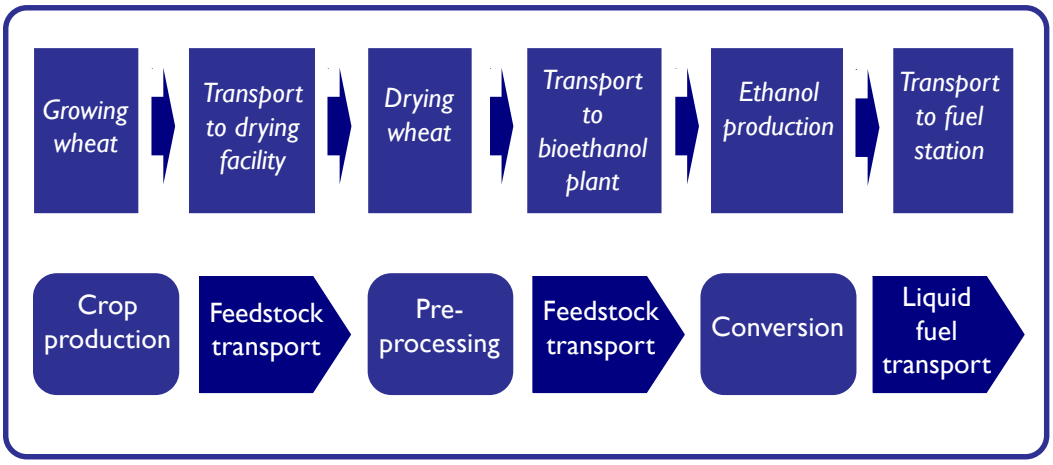
Philip presented a model in which modules that contain pre-defined calculations can be used to describe any fuel chain, from upstream to mid-stream to downstream (see Figure 6). Each step in a fuel chain is mapped to a module (see Figure 7). Default fuel chains, which set out the steps that occur during biofuel production, are specified for every fuel chain likely to enter the UK market (i.e., 76 unique fuel chains for feedstocks and conversions).

Figure 6: Pre-defined Modules to Describe any Fuel Chain



Source: National Conference on LCFS for Canada. Philip Watson.

Figure 7: Mapping Each Step in the Fuel Chain to a Defined Module



Source: National Conference on LCFS for Canada. Philip Watson.

Individual default values have been established for every single data point needed to calculate a biofuel's carbon intensity (i.e., nearly 4,000 values). Companies can use a combination of single default values and actual data, except where there is a strong correlation between two data points (e.g., crop yield and the nitrogen fertiliser application rate) to discourage potential gaming. Fuel chain default values are also set so companies can select a default value based on actual data on the fuel type, feedstock type and country of feedstock origin.

Philip showed how companies can either rely on default values or collect information about their biofuels and how they were produced. The more information they collect, the less they have to rely on default values.

Finally, Philip talked about the extensive stakeholder input that was used to help develop the carbon and sustainability aspects of the RTFO. He praised the valuable input from the stakeholders.

Philip concluded by summarizing lessons learned (so far) from the UK RTFO scheme:

- Stakeholder engagement should include all communities of interest and should occur throughout the policy development process (which should also give them a decision-making role);
- Existing schemes should be leveraged as much as possible (e.g., using the Meta-Standard approach to sustainability issues): and,
- Reporting on lifecycle greenhouse gas emissions should be simplified by prescribing calculations and by defining (conservative) high-level default values.

Comments, Questions and Answers

Q. Did you encounter any World Trade Organization (WTO) challenges to the RFTO under Technical Barriers to Trade (TBT) rules?

A. Yes, but for now, the RTFO is just a reporting scheme. A challenge to it under TBT rules isn't considered likely, and I believe that it can be defended, but the use of sustainability criteria is expected to be challenged. The prevailing view in the United Kingdom seems to be that using these criteria can be defended.

Q. In the stakeholder outreach, how did you deal with the media and the public on sustainability issues?

A. The consultations were focused on stakeholders and didn't try to reach the media and the public.

Petroleum Production and Refining Perspective

The Petroleum Production and Refining Panel was moderated by Doug Wright, the Managing Director of the Ontario Centre of Excellence for Earth and Environmental Technologies. The panel consisted of Cathy Reheis-Boyd, Chief Operating Officer and Chief of Staff of the Western States Petroleum Association (WSPA), Rick Hyndman, Senior Policy Advisor, Canadian Association of Petroleum Producers (CAPP) and Faith Goodman, Ontario Vice President of the Canadian Petroleum Products Institute (CPPI).

Mr. Wright described his organization as being engaged in promoting and supporting research, development and technology innovation in all areas that could contribute both to the environment and to the province's economy. The Centre is currently working in a number of areas which could potentially contribute to LCFS goals in Canada including biofuels and biofuel blends, electric engines and hydrogen. He noted that several speakers had emphasized that the policy was intended to be technology and innovation forcing and that this implied a role for the Centre.

UPSTREAM/DOWNSTREAM OIL

Cathy Reheis-Boyd
Western States Petroleum Associaton

WSPA is an association representing refiners in six western states: Washington, Oregon, California, Arizona, Nevada and Hawaii.

Cathy described the California LCFS target as complex and difficult, aggressive and transforming. The costs of meeting the target would be dramatic and this made it important to inform consumers about what was in store. Extensive consultation, she said, would be vital.

Cathy placed the LCFS in context. California's GHG emissions are 394 Mt out of a US total of 5,923 Mt and global emissions of 26,900 Mt. But growth rates in North America, at about 1–1.2 per cent a year are much lower than the 2.6–3.4 per cent a year in China and India. In California, the LCFS is part of a much broader climate change initiative known as AB32 which aims to reduce total emissions to 2000 levels by 2010, 1990 levels by 2020 (a 25 per cent reduction) and by 80 per cent by 2050. The transportation sector accounts for 38 per cent of California's GHG emissions. These emissions are targeted by both the LCFS and a plan to reduce GHG

emissions from vehicles. It is also important that the LCFS and other measures under AB32 be coordinated with federal actions such as the Energy Independence and Security Act (EISA).

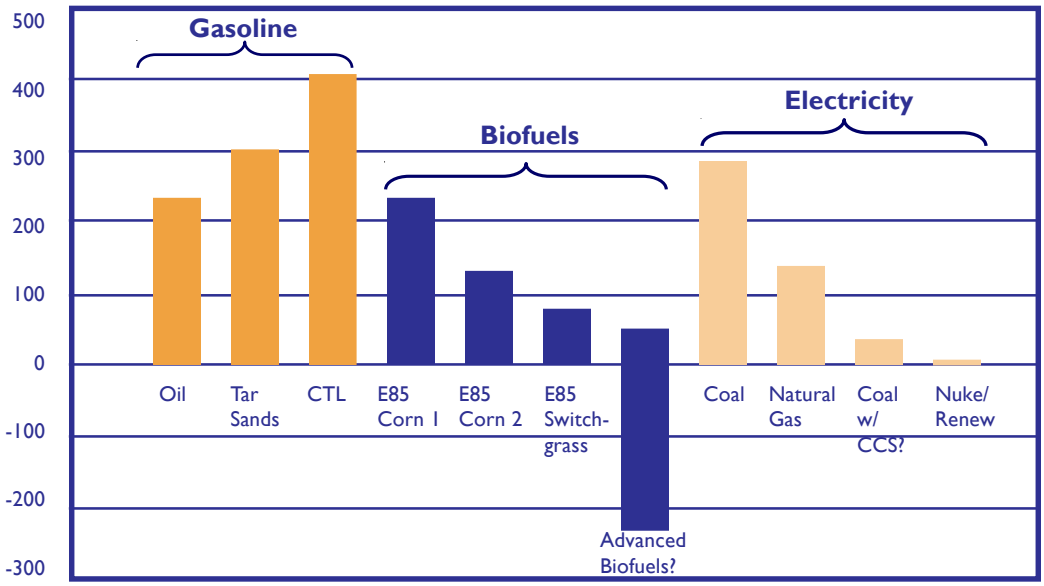
While the initial target of the LCFS is a 10 per cent reduction in the carbon intensity of transportation fuels by 2020, this is really only the first step. The ultimate target is an 80 per cent reduction economy-wide by 2050. It is important to keep this long term target in mind to avoid making short term investments to meet the 2020 target which may not be appropriate for meeting the longer term goal.

Transportation accounts for about 40 per cent of California's emissions but will also have to deal with emissions from the source side. How these emissions will be dealt with is important. The current thinking in California is leaning toward a system which relies about 60 per cent on command-and-control measures and 40 per cent on market mechanisms.

The oil refiners, blenders and importers are the obligated parties under the LCFS. However, cooperation between the fuels and auto sectors is essential because the vehicle and the fuel have to be compatible.

Originally, it was anticipated that corn-based ethanol was going to be a major compliance pathway in the short term. Because of land use change, this no longer seems feasible (see Figure 8). The lack of short term

Figure 8: Representative Lifecycle GHG Emissions (gCO_2e/mile)
Uncertaintes are not shown, actual results may vary



Source: A.E. Farrell. Energy & Resources Group. UC Berkeley

compliance mechanisms leads WSPA to favour a back-end-loaded compliance schedule to allow the industry to develop and deploy new pathways.

California is developing lifecycle analyses for six fuel pathways: ULSD, corn ethanol, CARBOB, CARFG, natural gas and electricity. Cathy anticipates that this work will not be complete before California's policy is due to be finalized. This implies that the policy will continue to evolve even after it is formally adopted.

WSPA believes that a successful LCFS would not only reduce greenhouse gas emissions but also drive innovation, strengthen the economy and ensure reliable fuel supplies. If not done properly, however, all of these goals could be frustrated. Cathy presented a list of the characteristics of a successful policy. It would be the product of a transparent and technically sound rule-making process; it would be fuel and process neutral (which would drive innovation and would also avoid mandating specific fuels or technologies); it would be back-end loaded; it would avoid exporting emissions to other jurisdictions; it would include regular reviews; it would rely on markets and it should promote the development of transformative technologies.

WSPA recommends that, initially at least, the scope of the LCFS should be confined to gasoline only with diesel to be brought in later. This would partially compensate for the loss of corn-based ethanol as a practical compliance pathway.

WSPA was successful in convincing CARB to treat all conventional crudes equally. They tried to get oil sands included but have not been successful to date. WSPA sees oil sands as a vital energy resource that must be accommodated in some fashion.

WSPA is concerned about what it sees as a lack of coordination between climate change and energy policies, which runs the risk of creating an energy crisis, particularly in transportation fuels. California does not use very much Canadian crude oil but the USA as a whole does. That makes it important because other jurisdictions are watching what California does. WSPA also believes that carbon capture and storage could play an important role and Cathy described the opposition to it in California as a lack of understanding.

THE POLICY CONTEXT AND ROLE OF LCFS IN MANAGING GHG EMISSIONS

Rick Hyndman
Canadian Association of Petroleum Producers

The Canadian Association of Petroleum Producers (CAPP) is an association representing 140 members who explore for, develop and produce crude oil, natural gas and natural gas liquids.

Rick, an economist, asserted that LCFS policy development needed more of an economic focus. He began by placing the LCFS in the broader context of the climate change challenge. Until now, we have been consuming energy without regard to carbon dioxide emissions and not putting a cost on those emissions. Now we are faced with the prospect of incurring costs to reduce GHG emissions without necessarily gaining any other benefits. The costs of reducing emissions will rise as ever deeper cuts are required. The economist's view as to how to implement such a policy is to put a price on carbon dioxide.

CAPP wants policy makers to recognize that we will have to undertake costly actions to achieve the targets set for 2050 and we will need technologies that either do not exist today or which are currently uneconomic. We should therefore begin with measures which are available today and send a clear signal that the policy cost of emissions will escalate over time as deeper cuts are required. The core policy should therefore be to set a price on emissions. However, we cannot simply rely on market pull to achieve the necessary reductions. We need technology push. Alberta does this by allowing payments to a technology fund as an alternative compliance mechanism. The money is pumped back into technology development and deployment.

Emission pricing can be accomplished in two different ways: via emission levies or via cap-and-trade, which, in a dynamic system, is also essentially a pricing mechanism because, over time, it implicitly sets a price through limiting quantities.

Oil sands derived crude is more carbon intensive than some other crudes, but that difference is small relative to combustion emissions from vehicle usage. If we seek to manage emissions on a lifecycle basis, then we should manage them in the jurisdiction in which they arise. The exception to this would be the situation where one jurisdiction is not doing enough to curb its emissions relative to others. In the case of Alberta, for example, it was the first jurisdiction in North America to implement a broad mandatory policy of emission control. Thus there is little basis for other jurisdictions to penalize Alberta's crude exports through an LCFS.

The best approach for a general reduction in emissions is a broadly based pricing regime. Reducing emissions from fuels is likely to be more expensive than in other sectors. No politically acceptable carbon price is likely to have the necessary impact on transportation emissions. So policy must be focused on

developing specific transformative technologies. This approach necessitates the picking of "winners". Inevitably, the process will also pick some losers. CAPP offers three alternative ways of doing this:

1. Mandating a market share for specific transformative technologies;
2. Offering a $/tonne incentive for specified technologies;
3. Engaging in a bid process allowing the government to choose volumes and/or costs on the basis of the bids that are received.

Rick added that, because technology development is a high risk venture, incentives would need to be set at levels that would exceed the costs of the new technology in order to induce innovators to take the necessary risks.

WORKING TOWARDS A CLEANER AND MORE PROSPEROUS ONTARIO

Faith Goodman
Canadian Petroleum Products Institute

The Canadian Petroleum Products Institute (CPPI) is an association representing major companies involved in the refining, distribution and/or marketing of petroleum products.

Faith placed the LCFS in the context of Ontario's Green Plan, which also contains a cap-and-trade component, and said that the task was to balance the need for a greener Ontario with the need for a robust economy and a competitive industry in order to ensure that the plan is sustainable. Clarity and certainty of policy objectives will be critical in achieving this.

The Ontario fuel market is integrated with global markets and is dependent on imports of both crude oil and refined products. Therefore, any environmental policy should be tested for its impact on the market, on consumers and on the Ontario economy as a whole. A degree of harmonization with other jurisdictions should also be pursued wherever it makes sense. Recognize also that Ontario's reliance on imported fuels and limited import options also constrains our fuel options.

One of the major challenges facing the refining sector with respect to the LCFS is that the only existing compliance mechanism is corn-based

ethanol, which is only capable of delivering an eight per cent reduction even if land use change is ignored. We therefore need technology-forcing solutions and a high degree of collaboration among all stakeholders.

CPPI believes that Ontario has three separate policies which interact with one another: the Renewable Fuels Standard, the LCFS and cap-and-trade. The RFS guarantees a market for ethanol but does not cap emissions and is threatened by the emerging land use debate. The LCFS guarantees a market for alternative fuels but, depending on the design, will result in unknown costs and complex regulations. Cap-and-trade caps total emissions. It could be an effective mechanism if there were price certainty, but the demand signal would be weak in the transportation sector and it would create price risk for the Ontario refining industry.

CPPI has developed a set of principles which it believes are necessary for the development of a successful LCFS policy:

- Actions must *measurably* reduce GHG emissions (based on sound science and mitigation of incidental consequences);
- Actions must maintain Ontario's economic growth and competitiveness;
- Policy should be designed with performance-based objectives that allow time for new technologies to be developed and deployed;
- Policy should foster ongoing stakeholder consultation.

A second set of principles deals with "best practices":

- Level playing field: no discrimination between or among sectors;
- Preserve North American competitiveness: reward performance and avoid shuffling;
- Cost certainty ad stable access to viable compliance options;
- Provisions for periodic review and "course corrections";
- No duplication of regulatory burden;
- Transparency and ease of administration;
- Cost efficiency by allowing markets to work.

Respondant: Brent Stuart Suncor Energy Inc

Brent Stuart of Suncor Energy Inc provided his thoughts on what he had taken from the session. He noted that a wealth of policy recommendations had been made which would prove invaluable to policy-makers. There was unanimity on a common theme: the need for collaboration. He also noted that it was very apparent that there was considerable overlap among various climate change initiatives, including renewable fuels standards, renewable portfolio standards, low carbon fuels standards and cap and trade programs.

He said that there was broad agreement that the LCFS would be a major challenge, not least because it requires the necessary technologies to be developed within a very short timeframe. He said that the approach used by petroleum associations in the past would probably not work in this case and a more collaborative approach would be necessary.

Comments, Questions and Answers

Q: You talk of reliance on market forces but also urge a focus on research into transformational technologies because market forces will be unable to deliver them. Explain.

A: (Hyndman) If the goal is to reduce overall emissions at the lowest cost, then a carbon pricing regime is the most efficient. However, there is a problem ensuring adequate funding for research and development. The market for carbon credits depends on government policy and this creates a moral hazard. If the development costs for a particular technology are, say $50 per tonne, then the developer will require a much higher return — $200 per tonne or more — to offset the risk that the research may not be successful. This is all the more true because of the tight timeframes being proposed. Price signals will not drive the necessary research and development, hence the need for a technology push.

Q: inaudible

A : (Hyndman) You could select a particular technology such as cellulosic ethanol. It is important to focus on transformative technologies and avoid those which can deliver only marginal improvements.

A: (Reheis-Boyd) In California, there is a strategy under consideration that is known as "a little bit of a lot". Under this strategy, serious investments would be made in promising technologies such as cellulosic ethanol. Start with these technologies to see if they can be made viable. Cathy warned against implementing something so extreme that there is no way of complying by reformulating existing fuels. That would be picking winners and losers.

Comment: There will be a number of transformative technologies moving towards the goal of renewable, carbon-free and pollution-free fuels. Natural gas is on one of these pathways. It is already only one carbon atom away from pure hydrogen and it pollutes very little. It can lead to bio-methane and, eventually to hydrogen. It deserves a higher profile. Plug-in hybrids might be another path if the electricity is generated with hydrogen.

Respondent: (Goodman) CPPI is in full agreement. There will be no single solution, so all viable pathways should be on the table: biofuels, hybrids, natural gas, propane, gasoline and diesel. Any fuel that is carbon-free and low-pollution should be considered, and there should be no discrimination. CPPI is committed to working with stakeholders to find such pathways.

Q: The LCFS uses a fossil fuel baseline to set the targets. What confidence do we have in the accuracy of this baseline?

A: (Hyndman) The upstream baseline will be dealt with in the discussion on lifecycle analysis. The real problem, however, is not the upstream, but the combustion of the resulting fuels. What is needed is an alternative, non-fossil fuel.

Q: Support for research and development funding is a good thing but do you support the idea of a low carbon fuel standard which does not pick winners but has constantly tightening standards resulting in an 80 per cent reduction in emissions by 2050?

A: (Hyndman) The LCFS is nothing more than a very complex intensity target based on an emission pricing system. It is not clear that this is the best way for the government to ensure that the critical technologies emerge.

Q: Do you think the administrative burden is too high? Technical support is high, but we also need an intensity target.

A: (Goodman) The LCFS is a good environmental policy but we do not know enough about it. Right now, the Ontario government is considering the fuel by itself rather than the vehicle/fuel system. As a result, our only compliance option is corn-based ethanol. That is why we need to work with stakeholders and adhere to the principles laid out in the CPPI presentation.

Comment: We never know enough before we are forced to make major decisions.

Respondent: (Hyndman) Would you favour an LCFS if the end result was corn-based ethanol or palm oil-based biodiesel?

Respondent: Absolutely not. It must be sustainable. The recently announced federal support for corn-based ethanol is a massive waste of taxpayers' money.

Life-Cycle Analysis

The lifecycle panel was moderated by Hadi Dowlatabadi of the University of British Columbia, and was comprised of Heather MacLean of the University of Toronto and Michael O'Hare of the University of California, Berkeley.

LESSONS LEARNED FROM LIFE-CYCLE ASSESSMENT OF TRANSPORTATION FUELS

Heather MacLean
University of Toronto

Heather MacLean described the uncertainties in lifecycle analysis, particularly with respect to biofuels and oil sands. Historically, lifecycle analysis (LCA) has been used as a decision tool by governments and other stakeholders. The LCFS and similar initiatives will be the first policies with binding targets based on LCA. This means that it is important to have a straightforward, transparent framework that can be used broadly.

With respect to transportation fuels, there are two components that existing models have considered: "well-to-tank" relating to the fuel and "tank-to-wheel" relating to the vehicle. There are a number of models that deal with this, including GREET (Argonne National Laboratory), GHGenius (Natural Resources Canada), and LEM (UC Davis). These models differ in what is included. Most do not consider emissions associated with the construction of production facilities but with operations. Others include emissions associated with vehicle manufacture. Boundary issues such as these present a significant challenge.

With respect to biofuels there are the first generation fuels such as ethanol from corn and biodiesel via a trans-esterification process using oilseeds. There are other processes not yet at commercial sales such as those to produce lingo-cellulosic ethanol and many others. Some of these technologies show great promise.

Before recent papers on the impacts of land use change, most models showed that corn-based ethanol delivers significant reductions in petroleum use but relatively modest GHG reductions of around 13 per cent. Recent studies have found that, once land use change emissions are factored in, particularly indirect land use change, corn-based ethanol may have higher emissions than gasoline. There is, as yet, no certainty, but these increases could range from marginal to significant. Cellulosic ethanol has the potential to deliver large reductions in greenhouse gas emissions but these will not be known until the technology is commercialized.

In order to properly compare lifecycle emissions and dispel the confusion that has arisen because of the wide variance in results among studies, several issues have to be resolved. Results will vary due to boundary conditions, that is, what is included and what is not. Issues surrounding

land use change have to be resolved. The source of process heat also has a big impact (e.g., some ethanol production facilities burn coal to generate process heat). Nitrous oxide emissions from agricultural activities also play a large role because nitrous oxide has such a large global warming potential — over 300 times more powerful than carbon dioxide. Emissions associated with enzyme and chemical production have been largely ignored by many of the studies even though these can be very significant.

Another issue is the accuracy of our baseline estimates for gasoline and diesel. This is important because it is against the performance of these fossil fuels that alternative fuels will be measured.

The production of most alternative fuels involves the production of various co-products. How these products are accounted for can have a significant impact on the LCA emissions performance of the fuel. Second generation fuels will also need to be modeled more accurately and updated as the processes evolve.

Professor MacLean has recently collaborated on a study with Donald O'Connor of (S&T)2. They examined 37 different models with particular emphasis on GREET and GHGenius. They looked at conventional ethanol and biodiesel pathways. The sensitivity analysis showed that the issues that had the largest impact on the results were nitrous oxide emissions, land use emissions and co-product allocations. In the case of canola-based biodiesel, it was determined that more needed to be understood about the energy inputs.

In comparing results between GHGenius and GREET, it was found that the overall LCA GHG emissions were very similar, but that total emissions for different elements of the LCA models varied significantly. These results were for conventional fuels that have been in use for many years, so even larger discrepancies can be expected for emerging technologies. Heather noted, however, that the sources of these discrepancies can be explained, so what is needed is a common set of assumptions, allocations and boundary conditions for LCA.

In the context of next-generation ethanol processes, there is considerable uncertainty at every stage of the various ligno-cellulosic technologies. The co-product credit associated with the use of lignin as a fuel for electricity generation can be very large depending on the type of generation that is being displaced. In the United States, with its heavy dependence on coal for power generation, the burning of lignin results in cellulosic ethanol having *negative* lifecycle GHG emissions, according to some models.

Heather has also worked on lifecycle analysis of oil sands production. They have undertaken a comprehensive survey of the available literature on the subject. Both GREET and GHGenius have oil sands pathways but these have relied on data from Syncrude and Suncor — both surface mining operations. They do not cover in-situ production. The same variables are important as is the case with biofuels — choice of process fuel, co-product allocation etc. While there are large differences between operations, the studies are

not directly comparable because they were conducted at different times using different sets of assumptions. Further, the differences are small relative to the overall lifecycle emissions of the final products, which are dominated by combustion emissions.

GREET and GHGenius both deal with oil sands pathways but GHGenius is more complete and has been more recently updated.

INDIRECT LAND USE CHANGE AND ITS IMPLICATIONS FOR BIOFUELS

Michael O'Hare
University of California, Berkely

Michael O'Hare said that the LCFS should be placed in the context of broader climate change policy.

He said that the original concept of an LCFS envisaged starting with a "brown" fuel such as gasoline and mixing it with a "green" fuel to make the blend progressively better over time. Ethanol seemed to be an answer, starting with corn-based ethanol, but there would be a variety of different options. The question of how green ethanol really is became important, hence the emphasis on lifecycle assessment. However, LCA should not be used to determine the exact carbon intensity of individual fuels. Rather, it should be used to compare the relative impacts of different courses of action.

When we embark on a given course of action, a number of different things happen. Some things have money prices, set by markets on the basis of people's willingness to exchange. Others are externalities that do not have natural market values. Some things we can see. Well-to-wheel analyses deal with these things. Other things are less visible, such as the impact of agriculture on soil carbon or the effects of land use change.

If we use land to grow fuel that could be used to grow food (even if it is not currently being so used) we will cause land use change effects. One reason is that the elasticity of demand for food is low. If food prices rise, we can react in a number of different ways. We may eat less or eat less meat. We may increase agricultural productivity. We may convert new land to agricultural production (direct land use change). We may cause land use change elsewhere (indirect land use change). All of these things will occur by way of price signals in markets. Michael provided an example of how this might occur. Higher corn prices resulting from biofuel demand induce North American farmers to switch from a corn-corn-soy cycle to corn-corn-corn. This results in an increase in the price of soy beans causing farmers in South America to clear land for increased soy production. It is not necessary that the land being converted to fuel crops to have been previously used for food. The clearing of the land has impacts. The carbon in all the standing vegetation will move into the atmosphere either by decay or by burning. This "puff" of carbon dioxide must be charged to the biofuel being produced. This process is described in a paper by Tim

Searchinger et al.[1] Searchinger suggested that the puff should be amortized over a period of 30 years. The numbers are very large. If they are even close to being right, then mixing crop-based biofuels into gasoline in an effort to comply with an LCFS will, in fact, make things worse.

Similarly, a Renewable Fuels Standard (RFS) requiring the use of ethanol, could be contributing to global warming in an effort to help farmers.

It is important to note that it does not matter and, in fact, cannot be known where the land use change will occur. It will happen all around the world in a number of places and cannot be directly attributed to a specific feedstock. For this reason, German rules which require biofuel feedstocks not to be grown on previously uncultivated land are inconsequential.

Much of the criticism of land use change models centres on the contention that other factors are far more significant than biofuels. Thus food price increases, blamed for creating the incentive to clear more land for agriculture, are caused by a range of factors (such as meat consumption). The land use change related to the paving over of farm land is, according to this argument, far more significant than that caused by biofuels production. In Professor O'Hare's view, this misses the point.

Increased land use for food production and the paving over of land will indeed result in increased GHG emissions. But what we are concerned with is the incremental effects of growing additional crops for purposes other than food.

There are many unanswered questions. Over what period should the puff of carbon dioxide be amortized? Does the release of a tonne of carbon dioxide today have the same social value as a release (or a decrease in the release) of a tonne twenty years from now? What happens if the land is re-forested after the project winds down? Will this matter if the damage from climate change has already occurred?

Professor O'Hare said that most previous studies had ignored the timing of emissions. Searchinger, for example, dealt only with total emissions regardless of when they occur. In land use change, there is a large up-front puff of emissions followed by a long period of savings that accrue over the life of the project. Professor O'Hare suggested that if, at some future time, climate change caused a calamity, such as the melting of the Greenland ice cap or the interruption of the Gulf Stream, then we might be relatively indifferent about what happens afterwards, since the world would be facing a problem of a different order of magnitude. Under that scenario, the impact of the initial puff would be far more significant than any savings that might occur later. Such a calamity, if it occurred at all, could occur at any point, so Professor O'Hare suggested that for purposes of analysis, we use a straight line discounting (or, as he put it, de-rating) schedule. The effect

[1] Searchinger, Tim, Ralf Heimlich and Richard Houghton. 2007. Factoring Greenhouse Gases from Land Conversion into Biofuel Calculations.

of this is to magnify the importance of the initial puff because the subsequent savings become increasingly less valuable.

Most critics of the land use change concept claim that the data used are inaccurate. Even if this is so, the errors are relatively small. If future savings are de-rated as Professor O'Hare suggests, then the impact of land use change is approximately double that suggested by Searchinger. This implies that, in order for land use change not to be an issue, any errors in Searchinger's analysis would have to be much larger.

The conclusion is that ethanol from corn is worse than gasoline and Renewable Fuels policies should be protected from it. The benefits of crop–based cellulosic ethanol are dubious. Fuel from waste has potential but there is probably only enough waste to replace about eight per cent of the fuel supply. That leaves other sources such as algae.

Biofuels have become a vehicle to justify a wide range of policy goals but they need to be sustainable. Greenhouse gas emissions are not the only drawback. Large monoculture plantations limit bio-diversity and may not be sustainable for those reasons. In lifecycle analysis, much attention has been paid to fine-tuning the emissions from various fuels. This may not be relevant if the details are swamped by the size of the land use change associated with their production. A study was conducted that treated Searchinger's data as inherently uncertain and superimposed probability distributions around his numbers. The results still showed a penalty for land use change that was so large that, unless there is a fundamental flaw in the concept, the details do not matter.

Respondant: Marlo Raynolds Pembina Institute

There are four requirements for a useful lifecycle analysis:

1. The selection of boundary conditions must be consistent across fuels;
2. There must be a standard approach to the allocation of emissions to co-products;
3. There must be recognition that, even for the best understood processes there is an uncertainty of at least 10 per cent in quantifying emissions; and
4. Land use change must be calculated and applied to fossil fuels just as it is to biofuels.

Comments, Questions and Answers

Comment: The data shown in Heather MacLean's presentation are calculated on the basis of the higher heating value while California uses the lower heating value. The numbers are therefore not comparable unless a conversion is made.

Comment: The issue is: how much new land do we need versus how much productivity gain? Globally, there are huge differences in productivity between countries, partly as a result of lower levels of fertilizer application in some countries. Many countries cannot afford more fertilizer because of low prices resulting from high US subsidies. If productivity were to be increased worldwide there would be no need for more land.

Respondent: (O'Hare) It is not what could happen that matters but what will happen.

Comment: Corn, when grown in an environmentally sensitive way (i.e., by no-till methods), accumulates carbon in the soil, unlike mature forests. Consideration of indirect land use change is totally irrelevant and demoralizing for farmers who have experienced large increases in energy costs but only modest increases in crop prices. Productivity is growing fast and should double by 2030. It would be wrong to draw inferences from a single model based on doubtful assumptions that does not validate current science, undermines farmers' economics and erodes good debate. Indirect land use change should be outside the boundary. In Ontario, land use change is a result of paving over farmland, not biofuels.

Respondent: (O'Hare) There are certainly deplorable things being done but these do not change the fact that biofuels cause land use change. The models apply regardless of increases in productivity, though such increases affect the rate of land use change. It should also be noted that the increased productivity comes at the expense of higher nitrous oxide emissions.

Comment: With more efficient application, yields can be increased using less fertilizer.

Q: How can we be sure that there are not alternative uses for waste? If there are, then those alternative users will need to find new feedstocks.

A: (O'Hare) We can assume that anything that goes into landfill is waste. Materials such as corn stover and forest slash can be removed up to a certain level without causing environmental damage. This too is waste.

Comment: There is certainly big potential for yield increases and this could free up land for corn production for ethanol. However, there are alternative strategies. You could allow the land to revert to forest.

Respondent: (O'Hare) Yes, that is the point. Land use change occurs if you could use the land otherwise.

Q: Is it possible that future GHG emissions savings may have a higher social value than current ones?

A: (O'Hare) I am not aware of any theory to that effect, but would be receptive to one.

Comment: (Dowlatabadi) The question is very complex. It is affected by, among other things, as the length of time the carbon dioxide molecule remains in the atmosphere and the concentration in the atmosphere. The radiative forcing of carbon dioxide changes with concentration so that the impact of a release twenty years from now would be lower, even in the absence of a calamity.

Summary: (Hadi Dowlatabadi) There are three "legs" to be dealt with in the transportation sector: fuels, vehicles and usage. The LCFS is one of many concrete steps that need to be taken. We need to tackle all of these things simultaneously. We also need to remember that nothing is free. Wind power also causes climate change; small hydro has ecological impacts. Only conservation is truly free.

Alternative and Renewable Fuels in Canada

Rick Whittaker
Sustainable Development Technology Canada

Rick Whittaker began by providing a brief overview of Sustainable Development Technology Canada (SDTC)'s role in fostering the development and demonstration of alternative and renewable fuels in Canada. By forging unconventional partnerships and investing in promising but unproven technologies, SDTC creates an atmosphere that supports sustainable development technologies from conception to market.

Rick highlighted the two funds that are operated by SDTC to promote various technologies on the path to market: the SD Tech Fund and the NextGen Biofuels Fund. The SD Tech Fund was created in response to the high risk associated with developing unproven technologies, widgets and processes that may eventually enable superior environmental and economical performance. Consequently, it funds projects that conventional investors are not interested in touching, and often SDTC funds enable the proving of a new technology, making it more economically attractive to industry and investors.

The NextGen Biofuels Fund was implemented to complement the federal government's renewable fuel standard and also as a policy response to promote alternative fuels that are net energy positive. Similarly to the SD Tech Fund, the NextGen Fund provides support to projects and new technologies which possess risk profiles that classical funding sources do not agree with. Rick provided an example of an alternative fuels project that might qualify for this fund — a project investigating how a fuel (e.g., cellulosic ethanol) can be produced and be net energy and environment positive from a water use and land use point of view.

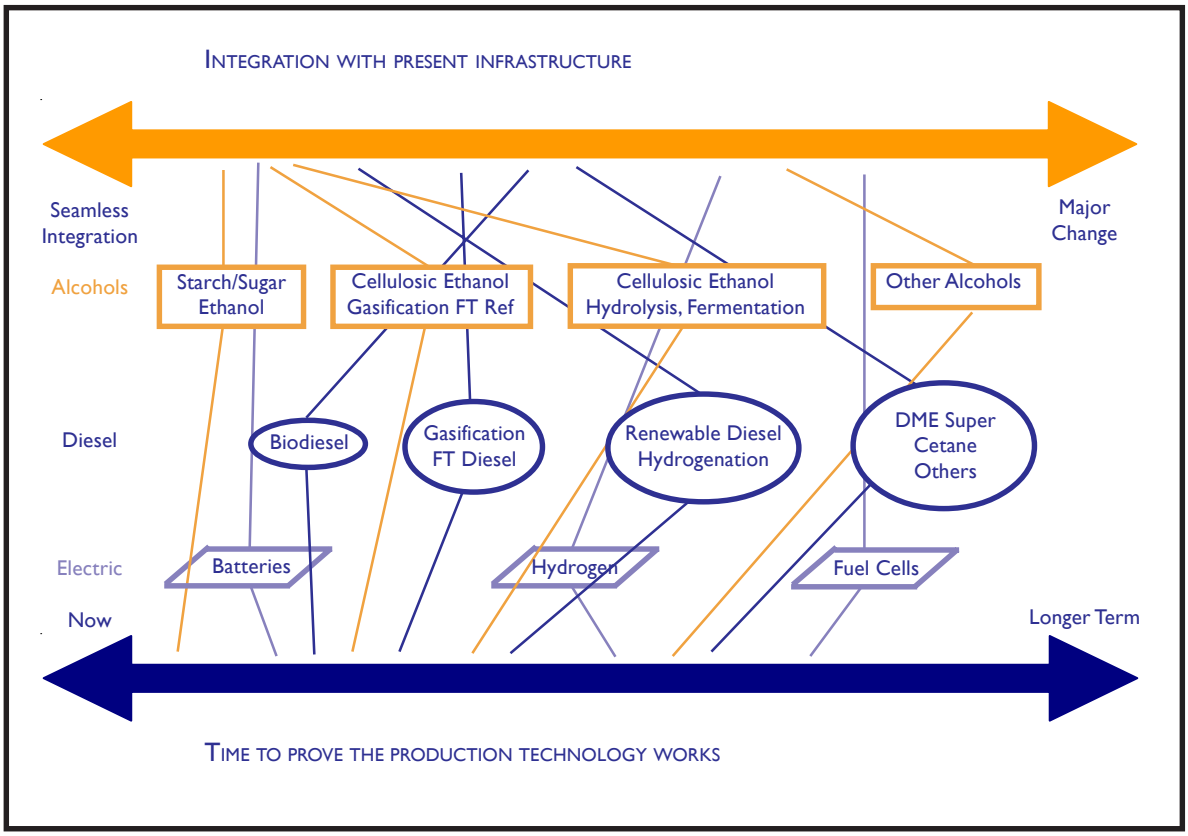
Rick noted that policy and regulations, such as an LCFS, can influence investment in, and development of, new technologies by acting as a general guideline that SDTC can break down into actionable plans.

The panel on alternative and renewable fuels in Canada had representatives from most of the alternative fuels in Canada: natural gas and propane; hydrogen; ethanol; biodiesel; dimethyl-ether (DME) and super cetane; and electricity. Before summarizing each, Rick pointed out that broad categories like natural gas, hydrogen, ethanol and electricity have subcategories that add complexity when determining: whether the fuel in question is actually an improvement in carbon intensity compared to conventional fuels; how much capital is required to alter infrastructure to accommodate the fuel; and whether vehicles must be altered to

accommodate the fuel. Discussing higher level categories in general terms is fine, but Rick cautioned that what is really needed is to delve down deeper into more specific categories when talking about solutions.

In determining the potential of new technologies, SDTC gauges the fuel's or technology's integration with existing infrastructure (i.e., can it be integrated seamlessly or will it require changes in the method of distribution, the processing of the fuel, and/or the vehicle) and the amount of time needed to prove the production technology works and make it attractive to industry and investors. Using this grid, SDTC can determine which technologies are limited by technology (e.g., certain ethanols) and which are limited by infrastructure (e.g., hydrogen), and can construct a sequencing plan for moving forward with SDTC's investments. Figure 9, illustrates the integration of low-carbon fuels in the existing transportation infrastructure in Canada. Rick noted that

Figure 9: Integration of Low-carbon Fuels in the Existing Transportation Infrastructure in Canada



Source: National Conference on LCFS for Canada. Sustainable Development Technology Canada.

technologies that ranked well on both seamless integration and length of time to prove the production technology works include ethanol, batteries and biodiesel, all of which are in some stage of demonstration within the vehicle market.

Noting that the panelists would examine specific fuels and technologies, Rick briefly introduced the general categories of transportation fuels in Canada.

- **Natural Gas and Propane Vehicles**: In addition to low carbon emissions, NGV's and PV's have clean air benefits (i.e., reduce NOx emissions by 87 per cent and VOC emissions by 89 per cent). Commercially, they have few infrastructure barriers and consequently are already in use in fleet vehicles and heavy duty applications (public transit, forklifts and class 6–8 trucks). However, privately they encounter infrastructure limitations and consequently the technology is not broadly used in light-duty vehicles.

- **Hydrogen Vehicles**: There are currently three uses for hydrogen in vehicles: mixed with compressed natural gas (HCNG) in buses (most prevalent in British Columbia); compressed hydrogen gas in modified internal combustion engines for light-duty vehicles; and fuel cell demonstrations in industrial vehicles. Because of infrastructure barriers and the developmental stage of fuel cells, they are not being used in consumer vehicles to-date.

- **Ethanol**: Multiple production techniques are being demonstrated using cellulosic feedstocks, which are moving up to the commercial level. In response to a question from the audience, Rick pointed out that commercial developers are proposing and building plants to manufacture ethanol.

While second generation ethanols (e.g., cellulosic and waste-derived processes) are in the development stages, Rick pointed out that attempts are being made to improve the energy efficiency, water consumption and land use aspects of first generation ethanol (i.e., sugar and starch based processes). The "1.5 generation ethanols", as Rick calls them, are those produced using improved processes, such as crop rotation, growing on arid land and using low-water crops.

- **Biodiesel**: There is already enough production of biodiesel (in B10 and B25 form) that it makes commercial sense to industry and investors. One condition for the fuel and production technology is that seamless integration (a condition of the federal RFS) has yet to be proven. Finally, in developing biodiesel commercially, Rick noted that trucking, light-duty, marine and rail transport should all be considered.

- **DME**: research is developing for DME and there are indications that, despite the benefits of using a diverse feedstock, DME fuel will require changes to vehicles' engines. Consequently the technology is looking at a much longer time to market.

- **Electricity**: Through the development of plug-in hybrids, electricity is becoming a transportation fuel that must be recognized in a low carbon fuel standard. Rick noted that an Ontario LCFS must consider: how to deal with electric vehicles; where the boundary assessment should be set in lifecycle analysis; and whether they should be included in baselines.

There are other transportation options than alternative and renewable fuels and technologies. Rick noted that energy efficiency can attain environmental gains in concert with fuel improvements. Public transportation (i.e., commuter trains, urban rapid transit, subways, and high occupancy vehicle lanes), higher urban parking charges, permits for access to urban core, lighter weight vehicles, and lower power vehicles are all methods for reducing GHG emissions from the transportation sector. In order to recognize environmental improvements outside of fuels in vehicles, Rick suggested that there be some debate about how to account for intermodal shifts (i.e., moving single occupancy vehicle commuters to public transit) in an LCFS.

Rick concluded his presentation with key considerations that he hoped would be discussed by the alternative and renewable fuels panel, such as:

- Inclusions and exclusions in an LCFS
  - On modes (i.e., air, rail, marine, heavy industrial, etc)
  - On fuels (i.e., transportation, stationary)
- Intermodal shifts
- Cross-sectoral impacts
  - For example, considering upstream electricity emissions related to plug-in hybrids.

Comments, Questions and Answers

Q. Other than soy, what can be used as feedstock for biodiesel?

A. Fatty acid methyl esters, animal waste, animal grease and tallow. Waste greases are the logical starting point for biodiesel since the input costs are negative (you get paid to take these materials off renderers' hands). There is also development in using non-food-based mustard strains as feedstock for biodiesel. These mustard strains grow on arid, non-commercial lands, contain 44 per cent oil, and produce a natural methyl bromide (pesticide) replacement as a by-product.

Q. How does lower energy intensity affect the performance of ethanol? Is this something investors/consumers should be concerned with?

A. Ethanol is approximately a third less energy intensive than conventional gasoline. However, the impact of this fact might be negligible, depending on the mix of fuel. E5 (i.e., five per cent ethanol blended into gasoline) fuel loses one kilometre on 100 km, so a regular 500 km tank may only lose 5 km when running on E5. This loss is unlikely to be noticed by the public, although it may be a concern for fleet managers. When considering higher mixes of ethanol (i.e., E85 or E100), however, the loss in distance will become much greater and will

become a concern for the driving public as well as fleet managers.

Q. Can specified risk material (i.e., material containing pathogens) be used as a feedstock for biodiesel?

A. I believe specified risk material can be used as a feedstock, as long as the process deals with the pathogens (through gasification or high temperatures) and ensures that there is no release of pathogens.

Q. I am not familiar with the processing of fuels — is there a threshold scale for biodiesel plants?

A. There may be for plants that contain individual processes, but most biodiesel plants are constructed using modular design, which allows the plants to be upscaled as large as necessary.

Q. I haven't heard anything about algae-based biodiesel — has this process been given up on, or is production simply too far ahead in the future to talk about right now?

A. Thank you for bringing this up. Growing algae as a feedstock for biodiesel hasn't done well historically in Canada because it is grown in pools and been subjected to long, cold winters. However, the introduction of photo-bioreactors is allowing Canada to begin producing algae in large enough quantities to use as a feedstock. The process still needs to be improved; however, photo-bioreactors should be automated to allow for continuous production, and algae strains should be studied and developed to allow them to draw CO2 and contaminants out of combustion flue gases.

Comment: I would just like to make a clarification. Biodiesel can also be made out of canola — it is a huge feedstock in Canada and it will use a continuous process that will eliminate some efficiency questions that come from other ethanol/biodiesel processes.

NATURAL GAS

Joanna Underwood
Energy Vision

The founder and former president of INFORM, a national environmental research organization, Joanna Underwood is currently the founder and President of Energy Vision, a national non-profit organization, created to promote the swiftest possible transformation in the United States to a sustainable transportation future.

Having researched non-petroleum alternatives for transportation fuels since the mid-80's (initially with a concern for air quality pollutants, and later for greenhouse gases), Joanna asserted that natural gas has appeared to perform the best in aiding the transition of transportation fuels away from oil. Natural gas can act as a step between oil to hydrogen, by promoting and building the infrastructure capable of dealing with a compressed, rather than liquid, gas.

There are applications of natural gas capable vehicles right now in commercial, heavy duty vehicles, such as transit buses, school buses and garbage vehicles. In fact, a Canadian company — Westport Innovations — has built the cleanest heavy-duty engine available, but for some reason, North America is not picking up on the potential natural gas holds as a transitioning fuel. The biggest demand for these engines is coming from China, India and Europe.

While natural gas can aid in the transition to hydrogen, it can also transition to biomethane, which is a promising, sustainable fuel that processes waste that would otherwise contribute to climate change.

Natural gas may not be the total solution to greening all personal vehicles in North America, but urban fleets can certainly benefit and improve their emissions by transitioning to it. By doing this they are also preparing for future improvements in compressed gas.

RENEWABLE DIESEL

Neville Fernandes
Neste Oil

Neville Fernandes is the Business Manager at Neste Oil's North American headquarters in Houston, Texas and is also in charge of launching NExBTL renewable diesel technology in North America. Neste Oil Corporation is a refining and marketing company concentrating on low-emission, high-quality traffic fuels.

Neste Oil's latest venture has been in renewable fuels, specifically renewable diesel. To clarify: a non-ester renewable diesel is very different from an ester-based biodiesel. While they use the same feedstock, they are treated differently.

The first renewable diesel plant has just completed its first of production, and three other plants are in development. Neste Oil is the first producer of renewable diesel — at least 100 per cent (R100) diesel. It has been extensively tested in the

marketplace with automotive companies, and has been field tested by running the Helsinki bus fleet on R100 diesel. Neste Oil is also participating in Alberta's renewable diesel demonstration, running at five per cent.

There has been good feedback from the marketplace, although production has only occurred in Europe so far. Neste Oil's office in Houston is looking to site a plant in North America and also to break renewable diesel into the market.

There are many challenges to the production and marketing of renewable fuels: limited feedstocks, costly development of new feedstocks, and poor public opinion:

- *There are limited volumes of current feedstocks*. Only edible oils in large quantities and animal fats and tallow can be used as feedstocks for renewable/bio diesel. If you took all the edible oils in the world, you would only fill about 10 per cent of the world's diesel demand.
- *New feedstocks take time and money to develop.* New generation feedstocks are being developed to meet the need for diesel. Algae have been proven in the lab, but commercially it is too expensive and therefore not available yet. Non-edible oils are being developed in low volumes on arid or marginal lands, which is a great improvement to first generation feedstocks. The yields for some of these look to be quite promising: algae has the potential to produce 10, 000 gallons per acre compared to the most efficient edible oil palm oil producing 600 gallons per acre.
- *Biofuels have received a bad rap.* Biofuels have also received the brunt of the blame for high food prices recently. There are many issues with regard to rising food prices, such as increased global demand for food, high energy costs, and weather conditions. Biofuels have had some effect by putting an increased demand on edible oils, but it is certainly not the only cause.

Finally, with regard to indirect land use change, each renewable fuel should be judged individually based on its own lifecycle analysis. Neste Oil uses feedstock from sustainable plantations and publishes its major feedstock's lifecycle analysis to prove its greenhouse gas reduction of about 40–60 per cent compared to conventional diesel.

CELLULOSIC ETHANOL

Jeff Pasmore
Iogen

Jeff Passmore is Executive Vice President of Iogen Corporation, responsible for new market and business development in Canada, the United States and Europe, public and media affairs, and government relations for Iogen's cellulosic ethanol technology. He offered eight observations on both the policy and technical sides of an LCFS based on the previous day's discussions.

- *The food for fuel debate has been lacking in facts*. The way the debate has been portrayed in the media has been spectacularly irresponsible. Many other issues are driving up food prices: commodity speculators, drought in the Ukraine and Australia, high oil prices, globalization issues that have encouraged developing countries to rely on cheap food from developed countries in the past, and now that food is no longer cheap, the developing countries are having a hard time starting to grow their own food again, and yes, a small percentage (about five per cent) is attributable to biofuels.

  In fact, the existence of biofuels diversifies the amount of fuel in the marketplace and eventually will reduce the price of fuel — having impacts on sectors that rely on fuel as an input (e.g., agriculture, which requires fuel and fertilizer). In the long run, more biofuels will drive food prices down.

- *An LCFS is not a substitute for an RFS*. There are three policy objectives that accompany an RFS: energy security; new economic opportunities for agriculture; and environmental benefits. Depending on the jurisdiction, any one of these policy objectives could be primary. In the United States, it appears that energy security is the driving policy objective, whereas in Canada and Europe, environmental benefits appear to be the motivating objective.

- *Integrating and differentiating LCFS with other policies.* There shouldn't be any silos within an LCFS — fuels and vehicles have to exist within the same arena. In Brussels different objectives and policies were set for fuels and vehicles, and they were found to be in competition. The economy will deliver the cheapest greenhouse gas reduction options if the LCFS integrates all components. In some cases, vehicle options will be the cheapest, in others fuel options will be. Also, in structuring an LCFS, there needs to be differentiation among the policy objectives the government is trying to achieve. The outcomes should then incent options that will meet these objectives.

- *Compared to what?* When talking about biofuels and alternative options, let's not lose sight of what we're trying to replace — gasoline.

- *Any costs incurred to achieve the policy objective of reducing greenhouse gas emissions should be*

borne by the market. Market signals may not be high enough right now to induce greenhouse gas emission reductions, but the market is what is going to deliver on the policy objectives.

- *Mandates or volume requirements don't guarantee a market.* Only financial returns guarantee a market. Politicians and policy makers need to be aware that other policies, grants, or loan guarantees may be necessary to move new technologies into the market.

- *Policies are more effective than programs at achieving objectives.* The most effective Canadian method may be tax policies.

- *A lack of knowledge doesn't mean a lack of action.* The more you know, the more you don't know, but that doesn't mean that you don't take action. This is true for both LCFS policy and new technologies. Without first generation ethanol, there wouldn't be the much improved second generation ethanol.

RENEWABLE FUELS

Gordon Quaiattini
Canadian Renewable Fuels Association

President of the Canadian Renewable Fuels Association (CFRA), Gordon Quaiattini is a veteran political insider and government relations specialist. As President of the CRFA, Gordon is the principal advocate for the renewable fuels industry in Ottawa and the provinces, as well as the main national media industry spokesperson.

CRFA is the industry body that represents the full value chain of stakeholders who are interested in developing a robust and dynamic biofuels market in Canada. The CRFA's membership includes grain and oil seed producers, fuel producers of ethanol, biodiesel and next generation cellulosic ethanol (e.g., Iogen, Shell and Suncor), and vehicle manufacturers (e.g., Volkswagen and General Motors).

CRFA's work is evident in terms of federal and provincial mandates for the development and use of biofuels. CRFA was also instrumental in the development of governmental programs (e.g., the $500 million SDTC Next Gen biofuels fund was supported by the industry).

CRFA's role is to bring their dialogue and discussions to governments, stakeholders and Canadians so that they may debate the role biofuels will play within an energy diversity strategy in Canada.

As Jeff Passmore mentioned, the food versus fuel debate has been a challenge to CRFA's messaging. It has been intellectually dishonest and CRFA's role has been to correct the misinformation being circulated. The good news is that through extensive polling and working groups, CRFA has found out that Canadians continue to support the role that biofuels play in an energy diversity strategy.

In conclusion, CRFA believes that Canada's energy security has been exaggerated in the past — we have been portrayed as an 'energy superpower'. However, we continue to import about 50 per cent of the crude oil we refine into petroleum. Canada is dependent on imported energy and needs to be a part of the global energy security debate.

ELECTRIC DRIVE TRANSPORTATION

Al Cormier
Electric Mobility Canada

Al Cormier is the founding Executive Director of Electric Mobility Canada (EMC), which is a new Canadian organization dedicated to the promotion of electric mobility.

Electric drive transportation is growing in interest and support from a lot of areas. The momentum behind electric mobility could be seen as a return to electric mobility because at the turn of the century electricity was the driving force in transportation. Even today, more than half of the trips taken in Toronto on public transit use electric modes (e.g., subway and streetcar).

Electric Mobility Canada (EMC) is an industry association that promotes electric mobility because it is a very important solution to sustainable transportation. At one point, Al believed that public transit was the solution, but it is only an important part of the solution because people drive private cars and will continue to do so because of land use patterns that require private transport. Given the reliance of society on private transport, electric drive transportation could reduce the carbon footprint of our transportation choices.

EMC's membership includes large electric vehicle manufacturers, such as Bombardier, as well as manufacturers of small electric vehicles (e.g., electric bicycles).

As a rule, hybrid vehicles driven properly can reduce greenhouse gas emissions by roughly a third. Plug-in hybrids have the potential to reduce emissions by a half or better. All-electric transport can reduce emissions by 100 per cent from the vehicle exhaust perspective.

In Canada, we have a unique advantage because most of our electricity is produced from renewable sources — approximately two-thirds, which compares to Norway, but nowhere else. Some provinces are almost completely hydro powered (i.e., British Columbia, Manitoba, Quebec and Newfoundland) and could see

electric vehicles reduce greenhouse gas emissions from the transportation sector by 100 per cent. Even provinces that contain the lowest renewable energy mix (i.e., Alberta and Saskatchewan) could reduce transportation greenhouse gas emissions by a third. In Ontario and other provinces, with a medium mix of renewable and fossil energy, transportation greenhouse gas emissions could be reduced by 60–70 per cent with the introduction of electric mobility.

The infrastructure exists for the production, transmission and distribution of electricity for vehicles, but there is an obvious barrier to urban residents — the lack of outlets for multi-unit residential buildings (MURBs). EMC is working on addressing this barrier through the Canadian Standards Association, and ultimately through changing building codes.

EMC is also working in agreement with Natural Resources Canada, Transport Canada, Industry Canada and Environment Canada to complete a technology roadmap for the introduction of electric mobility that will identify what is needed to move forward.

There are many potential applications for electric vehicles and there should be all-electric vehicles on the market soon to satisfy urban transport needs. For further distances and higher speeds, plug-in hybrids are also approaching market readiness in the near future.

Comments, Questions and Answers

Comment: Indirect land use change needs clarification. The claim is not that growing biofuel feedstock has caused the price of food to go up. If you imagine that all the yield gains that could be attained have been attained, and that the food market settles out in the context of all the other factors (e.g., increases in diesel prices for farmers and hauling), and then the market demand changes once more due to a new factor (e.g., people consuming more meat, OR production is lost to drought OR some is used as fuel for vehicles), then production will have to be increased elsewhere to meet the existing demand.

By studying indirect land use change, we're trying to understand how that will play out around the world from a global warming perspective. This is not a model about rising prices, food availability or food security — this is about climate change.

Deforestation contributes a quarter of all current greenhouse gas emissions globally. When you start growing fuel on cropland, the demand for that food will likely be directed elsewhere and could indirectly cause further deforestation.

Algae ponds, waste, and material grown on arid lands don't compete with the food supply and consequently are not the issue.

Energy security cuts both ways. Petroleum supplies are not liable to droughts, pests or natural disasters.

We're trading one form of energy insecurity for another. It is also important to recognize that the expected impacts of climate change on productivity may further impact biofuels. We cannot develop a policy that contains no risks.

Comment: Joanna Underwood indicated that she would like to comment on some of the claims made in other panelists' opening presentations:

1. In response to the claim that tax policies drive decisions — in the United States, mandates and tax policies have a history of ending up in court. Tax incentives, grants, etc., work better for leveling the playing field and have resulted in the flourishing of natural gas.

2. In response to the claim that renewable fuel standards have three policy objectives — in the United States, mixing up agricultural policy and energy policy has caused a focus on biofuels at the cost of environmental policy. Agricultural economic stimulation should only be an objective if energy and environmental criteria are met first.

3. North America mistrusts natural gas vehicles because of the disappointing performance of early models. After 15 years this technology is strong and is being readily adopted in Europe and Asia. Canadians should take a second look at this clean technology.

Q. I think an important question was touched upon in the second point — for a renewable fuel standard, should policy objectives be kept separate and pure, or should a holistic approach be taken?

A. (Cormier) In terms of electric drive transportation, not only does it appear to have the lowest risk because the infrastructure is there, but it is one of the few, possibly the only, fuel commodity for which we can control the price in Canada. Fossil fuel prices, and possibly renewable fuel prices, are certainly not controlled by Canada.

A. (Quaiattini) When you look at where the biofuels industry is going, it's clear that we're building on a baseline of first generation technology, but when you look at where the members, investments and technology are looking, it is next generation development. CRFA is anticipating with great interest SDTC's planned investments and is looking at evolving technologies (e.g., Greenfield Ethanol has announced plans to use municipal waste as an ethanol feedstock). The notion that the biofuel industry is looking exclusively at grain-based production to exploit over the long term is probably not accurate.

When you look at the US Energy Bill of December 2007, there is a hard cap on grain-based technology development (15 out of 36 billion gallons). It's clear that the majority of that biofuel target will be met by next generation development.

On a global basis, with regard to land use change and impacts, CRFA would never advocate using marginal land or rainforest to produce biofuels. There is more than enough existing land to grow biofuels: 42 million square kilometers of arable land is available, of which only 15 million square kilometers is being used. Biofuel production currently only takes up 0.1 million square kilometers.

A. (Passmore) He clarified his earlier statement by emphasizing that his point was that an LCFS does not deliver on the same policy objectives as an RFS. The importance you place on each of the objectives will differ depending on the jurisdiction. The United States used an RFS to get off imported oil (i.e., energy security). Europe used an RFS to meet their greenhouse gas objectives (i.e., environmental improvements). The fact that there were benefits to farmers is fantastic — because of corn-based ethanol, farmers have started to be able to earn a proper living.

The nightmare scenario for an LCFS is that if you don't get the proper signals into the market that are going to drive new transformative technologies to deliver significant greenhouse gas reductions, then there will be no results.

Cellulosic ethanol is democratizing — grass grows everywhere and developing countries could grow their own energy.

Comment: An audience participant noted that the panelists' responses appear to represent the interests of their affiliation.

The electricity infrastructure, while adequate for current demand, isn't even stable in Ontario north-south. So we can't say that the infrastructure is in place. An infrastructure that is only just adequate for our current demand is in place. Electricity's economics are attractive because it doesn't have any of the taxes that go on the fossil fuels that we use for transportation. Let's put on the taxes that fossil fuels have because if we move to electricity as a transportation fuel then the government is going to come looking for taxes. So a little bit of "compared to what" is needed here.

With regard to the LCFS, yesterday it was suggested that a parallel suite of incentives would be needed to complement the LCFS. In order to have this, then we should have a frontier of progress, because we're seeing a rapid technological change that's moving way past first generation technologies very quickly. That should become the benchmark against which we calculate subsidies. So there is a maximum subsidy to the frontier and a declining subsidy to the trailing end. If you end up being a fuel whose ability to address greenhouse gas objectives is minimal (e.g., corn-based ethanol) then your initial subsidy is there, but once 1.5 and second generation fuels are developed, your subsidy declines rapidly. Does the panel have any problems with this?

A. (Passmore) He did not find issue with the suggestion of declining subsidies, on the condition that it applies to conventional fossil fuels as well.

Comment: The audience member acknowledged that there is a need for transportation fuels. There is no recognition by the fossil fuel industry that there aren't enough refineries to meet demand. So we can reduce demand, but if that is not sufficient, then we need a complementary supply — which is represented by the panelists.

A. (Quaiattini) The current funding program in place, the ecoENERGY for biofuels program, is a one-time, 1.5 billion dollar program that has hard declines in the level of incentive after the first three years of the program until the program runs out over nine years. The majority of our membership would like to see incentives based on next generation technologies, which is why we advocated for the SDTC program. It would be nice not to need this sort of support, but market forces around biofuels are not taking off and support is needed.

The funding programs should be viewed as an investment, rather than a subsidy — an investment because these funds will be returned to the Canadian economy through economic growth.

Vehicle Technologies for Low-Carbon Fuels

Mark Nantais
Canadian Vehicle Manufacturers Association

Mark spoke on the subject of vehicle technologies for low carbon fuels. He referred to these fuels in his presentation as "Green Transportation Fuels." The main thrust of his remarks was to emphasize that both vehicles and fuels operate as a system. He referred to the need for a "total systems approach."

Mark argued that the LCFS should address the "well-to-tank" part (i.e., fuel production and distribution) of the vehicle/fuel system, with a separate fuel efficiency (FE) standard applying to the "tank-to-wheels" part (i.e., gas stations and vehicles).

Mark presented slides showing pollution management as applied to the vehicle/fuels system. He reviewed progress by the auto industry in reducing vehicle emissions since the 1970s. He emphasized that new vehicles are the cleanest ones ever on the road, reducing smog-causing emissions by 99 per cent since pre-control levels prior to 1975.[2]

Mark noted that Tier 2 vehicle emission requirements are "fuel neutral" — the same requirements apply to all fuels (e.g., gasoline, diesel, natural gas, ethanol, biodiesel, and so on) and they apply for the "full useful-life" of the vehicle (i.e., a minimum of 193,000 km). The same requirements apply to all light-duty vehicles, including cars, minivans, pickups and sport utility vehicles. Heavy-duty trucks also have similar emission control requirements. Mark reviewed some of the technologies that the auto sector has applied to reduce both smog-causing and greenhouse gas emissions.

Transportation fuel quality affects emissions, fuel consumption, durability and driveability. The

[2] Pollution Probe has been unable to verify this claim in the past. The Union of Concerned Scientists claims the 99 per cent factor might be correct, but only based on comparisons of 2009 model year vehicles to those of 1965 and earlier, before early emissions controls were mandated in California (http://www.ucsusa.org/clean_vehicles/avp/automaker-vs-the-people-ucs-ad-response-to-automakers.html). Emissions standards are complex, but there no doubt that federal emissions standards have required great reductions in smog-forming emissions, probably in excess of 95 per cent.

ability to meet stringent emission requirements is becoming increasingly dependent on high fuel quality. This is what ensures optimum vehicle technology performance. Mark referred to the World-Wide Fuel Charter, noting that Canadian fuel is at the highest level of fuel quality (i.e., Category 4). The Charter makes recommendations for gasoline and diesel (currently under review). He highlighted that E10 and biodiesel blends fuel quality is critical.

Mark went on to talk about ethanol and biodiesel. He noted that manufacturers have designed vehicles to operate on up to 10 per cent (maximum) ethanol blended gasoline for the past 20 years. Many manufacturers also offer flex-fuel vehicles (E85) today. There is an opportunity to reduce greenhouse gas emissions through both E10 and E85 blends. The vehicle manufacturers have concerns, however, about ensuring the proper formulation of ethanol-gasoline fuel blends, among other issues. Overall, however, the CVMA supports strategies to enhance the availability of renewable fuels.

With respect to biodiesel, vehicle manufacturers recommend up to B5 (five per cent biodiesel) maximum for current diesel engines for both cars and trucks. The impact on vehicle emission control systems, fuel systems and engines needs to be considered (e.g., lubricity, stability, material compatibility, shelf-life, etc.). Mark noted the lack of national biodiesel blend specifications or requirements, which lead to quality issues. There are some CGSB standards, but they aren't applied consistently across the country. Significant work is underway on biodiesel specifications and standards. He emphasized that B6 to B20 biofuel specification is critical for future diesel engine design.

Mark returned to his point that fuel production and distribution greenhouse gas emissions must be addressed separately from vehicle technologies. He noted that the centrepiece of the new US Energy Independence and Security Act of 2007 is a landmark requirement to radically increase the fuel efficiency of light-duty vehicles (i.e., requires a new fleet-average fuel economy of at least 35 mpg by 2020. Technology development and product investment are already proceeding based on the new US national requirements. The cost to do this has been estimated at $100 billion by the US National Highway Traffic Safety Administration.[3] Mark characterized

[3] Pollution Probe notes that in April 2007, the National Highway Traffic Safety Administration proposed new rules for fuel economy, as directed by the Energy Independence and Security Act of 2007. The proposed standards are size-based, are applicable for the model years 2011–2015, and are estimated to result in fleet-average fuel economy of 31.6 mpg in 2015. The Administration further estimates the related compliance costs at $47 billion, and total benefits at $88 billion over the lifetime of the regulated vehicles. (http://www.nhtsa.gov/portal/nhtsa_static_file_downloader.jsp?file=/staticfiles/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_11-15_NPRM_April_21.pdf). Further rules will be proposed for 2016-2020. EISA requires that, *at minimum*, the standards must deliver a fleetwide average of 35 mpg.

compliance cost as $3–5K per vehicle in the low end, and $6–7K in the high end.

Mark stated that well-to-tank fuel production to reduce carbon emissions will require improved production efficiency, carbon sequestration and low carbon fuel development. Low carbon fuels will require new infrastructure investments and incentives. Thus, effective government policy direction is needed for a diverse energy/fuel future.

Mark presented slides on the vehicle/fuels system and talked about the diverse range of fuels that will be used in the future. He briefly reviewed Canadian renewable fuel requirements and highlighted the federal government's commitment to five per cent renewable fuel content based on the gasoline pool by 2010, and two per cent renewable content in diesel by 2012. Mark advocated a consistent national approach to renewable fuels policy versus a patchwork approach. He asserted that meaningful greenhouse gas emission reductions can only be achieved through coordinated policy. He stated that the auto sector can't handle a fragmented "boutique" fuels market.

Mark closed his presentation by summarizing the main points he made and offering the following statements:

"The Auto Industry Supports a National Renewable Fuels Strategy that provides Consistent and Appropriate Biofuel Quality for Canadians across the country.

The Auto Industry is a key stakeholder and must be part of the process."

Comments, Questions and Answers

Comment/Question: In the 1970s auto industry representatives testified (under oath) that fuel efficiency requirements would be impossibly expensive, but this didn't happen and cars became cheaper. Why would a smaller car made with fewer materials that consumes less fuel cost more ($3–5K per vehicle at minimum)?

Comment: It was argued that the auto industry is not simply giving the consumer what they want, but rather creating demand for larger, less fuel efficient vehicles. The notion that consumers can have whatever they want, or are led to want, must be challenged. The real issue is what consumers want versus what restrictions they face. A further series of comments were made to the effect that the needed improvements in fuel efficiency in fleets can't be achieved without phasing out larger vehicles, and that larger vehicles present a safety hazard to others that share the road in smaller vehicles.

A. This raises the issue of governments dictating to people what choices they can make. In an unrestricted market, the price of fuel will be the major influence on the type of vehicle people buy. Auto makers have to produce vehicles that meet consumer needs, including demands for greater utility. There's also a growing demand now for smaller vehicles due to the increase in the price of fuel.

Q: Assuming the $3–5K per car cost presented by Mark is correct, what would be the cost per tonne of CO_2 reduction?

A. Depending on which scenarios you look at, the numbers range from $200–$300 per tonne. Mark referred to the work of the Transportation Sector Table several years ago, in which the studies done found the cost per tonne of carbon reduction for vehicles to be among the highest for all the transportation measures studied.

Comment (follow-up): Then $200–300 per tonne should be the dollar figure used to incent biofuels.

Comment: We already have vehicles that get 45–50 mpg, so 35 mpg by 2020 is a pitiful target, considering population growth and other factors pushing up greenhouse gas emissions. SUV drivers should pay the full cost of their space on the road, their fuel consumption, etc. Policies need to be much more ambitious.

A. There is an almost perfect correlation between the price of fuel and the type of vehicle people buy and the distance they travel. Mark noted the recent decrease in petroleum demand in response to fuel price increases as a case in point. He also noted that with respect to the 35 mpg standard, the auto sector has only two design cycles in which to do this huge effort. He observed that relative to today's average fuel efficiency, this is a higher percentage increase than any other country is proposing.

Breakout Sessions

Towards the end of the conference, participants broke out into three discussion groups to focus on specific issues relating to LCFS design and implementation. The discussions were an exercise in identifying general principles for LCFS in Canada and highlight factors requiring special consideration, rather than to produce recommendations on technical details.

Two breakout groups addressed **compliance** issues; one breakout group addressed potential **technology pathways** under an LCFS. Each group presented to plenary a summary of its discussions and the key issues identified. These summaries are presented below.

COMPLIANCE BREAKOUT GROUP I DISCUSSION

Facilitator: Ken Ogilvie, Pollution Probe
Reporter: Stephen Young, University of Waterloo
Notes taken by BoAnne Tran, Pollution Probe

The breakout group held a wide-ranging discussion about LCFS compliance issues. The focus was on compliance mechanisms and harmonization issues. Enforcement and penalties were not discussed in any depth. These notes capture the main issues raised during the discussion and as reported to the plenary by Stephen Young.

The discussion started off on the issue of potential (even likely) differences in LCFS across jurisdictions. This is a particular concern of industry from a cost of production and distribution perspective. It is also a concern of governments, given the different economic structures, interests and constraints that exist among jurisdictions. In particular, questions were asked about whether Ontario (and other jurisdictions) intended to follow the California model, which was asserted by some participants to be very restrictive.

The discussion about regional differences moved to the question of where harmonization among jurisdictions should be ensured, recognizing that some aspects of LCFS would differ among regions. Three areas of desired harmonization were quickly proposed: measurement, registry and accreditation. Coordination among jurisdictions and regions was identified as essential. A view was ventured that reporting dates should be harmonized. The point was made, however, that each region seems to begin with a different baseline; however, there could still be a common registry.

An appeal was made to leverage expertise across Canada (and internationally) to establish a strong science and knowledge foundation for LCFS. A suggestion was also made that we need a visual "puzzle map" that shows how all the LCFS fit together (including the goals and the players). This would provide a useful focus for discussions on the standard.

It was argued that clarity is needed on the overall goals for LCFS. For example:

- Reduce total GHGs?
- Reduce fuel cycle GHGs?
- Reduce transportation sector GHGs?
- Reduce petroleum sector GHGs only?

There was no attempt to reach consensus on these goals, but it was recognized that clear goal-setting is fundamentally important to the success of the LCFS.

If reducing total GHGs is the goal, a comment was made that petroleum refining is only a small fraction of Ontario's transportation GHG emissions, whereas fuel consumption is a very large source of emissions. Thus, the LCFS may only address a small part of the problem.

The discussion revealed that the compliance pathway is not apparent. Three options were identified:

- Push technology breakthroughs, but these can take decades to supply the necessary quantities of fuel (e.g., cellulosic ethanol). Existing technologies can be used, but this also takes time for investment in new infrastructure (are governments prepared to make serious financial commitments to this?);
- Go beyond the fuel cycle to facilitate compliance with the LCFS (e.g., incorporate vehicle drivetrain efficiencies, or allow use of offsets from sectors outside the fuel cycle); and,
- Use of escape clauses and off-ramps (e.g., California; UK RTFO).

An industry participant stated that there is a severe challenge in meeting the LCFS 2020 target. The 10 per cent target actually requires a 33 per cent improvement in the well-to-tank component of the fuel system by 2020. This can't be done using existing technology. The LCFS is therefore technology-forcing. That is fine, except that there has to be recognition of this in the compliance pathway in case the new technology doesn't work. Otherwise, the only way to comply is to stop production. Meeting the challenge will require more than just regulations — it will require incentives for industry to develop and try new transformative technologies.

The discussion returned to the issue of harmonization versus LCFS differences by region. With respect to harmonization, the promising areas identified included: measurement methodologies, registry systems (to ensure no double counting), setting common criteria for auditing/validation, and harmonizing reporting dates using electronic filing. With respect to potential differences, the key issues identified include: setting jurisdictional/regional objectives, opt-in requirements, establishing baselines and prescribing trading rules.

The breakout group concluded by listing some of the discussion elements they liked (but the reader should note that this was not a consensus exercise):

- Recognition that oil sands are a reality (or a necessity);
- The "elegant" escape clause in the UK feebate for non-compliance (i.e., non-compliers pay a fee to a fund that goes to parties that do comply); and,
- Simplicity and flexibility.

If LCFS targets must be set in the absence of existing technological solutions, then backloading of the targets should be considered to allow more time for technology breakthroughs. Also, five-year reviews of the LCFS should be built into the compliance regimes.

One participant suggested that perhaps a Renewable Fuel Standard approach is more direct than the LCFS approach. It is at least prescriptive, clear and simple.

COMPLIANCE BREAKOUT GROUP 2 DISCUSSION

Facilitator: Quentin Chiotti, Pollution Probe
Reporter: Bill Greenizan, Ontario Ministry of Energy
Notes taken by: Rebecca Spring, Pollution Probe

The breakout group discussed multiple facets of LCFS compliance. The group focused on default values, credit trading, program design, harmonization and other compliance issues, specifically touching on the role for government, baseline years, separate baselines, implementation and mechanisms. While solutions were suggested for many issues, the group mainly focused on identifying the questions that should be answered. These notes capture the main issues raised during the discussion and as reported by Bill Greenizan.

The discussion began by outlining top-of-mind compliance issues which group members were most concerned with, and then delved into specific issues. General issues and questions were:

- How will an LCFS interact with other climate change programs?
- Will an LCFS only encompass transportation fuels or should it include other sectors (i.e. heating fuels) in order to reduce costs by covering the broadest group possible? If so, how to prevent double counting?
- Will it be possible to trade outside of or between jurisdictions? If so, how can we ensure that credits are reliable and equitable and that real carbon emissions are reduced?
- How can Canada trade in a global market if our credits are intensity based and other countries are absolute?

Drilling down, the group started off discussing default values. The main question raised was where should default values be set? Some group members were of the opinion that default values should be set high initially, challenging industry to prove that they are lower than the default by submitting real information, which sets up a methodology for assessment. Other group members recommended starting off with an average default value, which promotes the development of a trading mechanism.

It was noted that tax-quality information would need to be submitted by industries in order to be auditable by government. Furthermore, in order for government to enforce the program, and be credible, new staff would have to be hired to review third-party audits.

Other questions which surfaced during the default value discussion include:

- Which lifecycle assessment model should be used?
- Should one or two standards be used for crude oil and oil sands products (e.g., California uses separate defaults for conventional and non-conventional oil, what should be the Canadian approach)?
- Should all refineries be held to the same default value regardless of processes? How can this be accomplished?

The questions raised in the discussion on default values led to a discussion on the program design of an Ontario-based LCFS. The question was raised whether Ontario should rethink California's decision to have two different baselines for diesel and gasoline fuels. It was suggested that Ontario shouldn't automatically separate diesel from gasoline, that California policy may have been influenced by anti-diesel mentality. In Ontario, where air emission regulations are fuel neutral, diesel may become an important compliance pathway, especially if land use change issues make biofuels less acceptable.

Group members thought that an important question to answer in designing an LCFS is who are the regulated entities and how should they comply? It was pointed out that if importers, producers, refiners and blenders are regulated, how are they expected to comply when they are not in the business of producing the alternatives like biofuel or natural gas?

The discussion progressed to baseline and compliance years. Group members asked how years and values should be chosen. It was thought that choosing a baseline year is a political rather than scientific decision, and that the baseline number is not as important as ensuring that the methodology used in calculating the baseline year (and the compliance year) is the same. This way, the policy work can focus on the difference between the baseline and target years, and identifying the pathways to bridge the gap.

Participants also asked whether Canada or Ontario could simply adopt another jurisdiction's baseline number. Some thought this was not acceptable, that an Ontario baseline should reflect an Ontario reality (e.g., fuel usage, weather, fuel sources, etc.).

The next discussion point grew from the interest in how an LCFS would interact with other climate change programs. It was noted that harmonization among the different programs (e.g., cap-and-trade, RFS, vehicle emission standards, etc.) is critical to avoiding confusion. With regards to developing vehicle fuel efficiency standards, it should be ensured that VFE standards are harmonized with the fuel goals of an LCFS.

The subject of harmonization also arose with respect to cross-jurisdictional regulations. It was expressed that Ontario should avoid the possibility of having radically different carbon intensity values for biofuels than other jurisdictions as this may hinder the ability to trade credits outside the jurisdiction. It was suggested that a consistent methodology across all jurisdictions is necessary. One group member noted that by harmonizing across regulations and jurisdictions, the cost to industry will be minimized.

Mechanisms for reaching compliance were discussed by group members. The group focused on trading, but also fee-bates, tax credits, penalties and carbon taxes. Trading was seen as an efficiency mechanism, a lower cost way to comply with regulations. Possible barriers to trading were identified, specifically regime

differences for credits outside your jurisdiction. It was noted that in order to trade among jurisdictions with different default values and exchange rate would have to be applied, which means that the methodology for calculating carbon intensity values must be well understood. Trading also requires a jurisdiction to identify what is possible in-house and what must be relied on outside of the jurisdiction to come under compliance. Finally, group members suggested that Canada or Ontario rethink California's separation of AB32 and LCFS — compliance may be simplified by allowing the two-way transfer of credits.

Mechanisms for compliance were further discussed under the focus question of 'if compliance is not met, how is the organization dealt with?' If the non-complying company is to be penalized, other questions must be raised, specifically:

- What is the penalty?
- How is it calculated?
- How is it written up in the legislation?
- How can it be implemented?

Furthermore, with regards to harmonization:

- What mechanisms can work with the LCFS?
- Are there other policy measures we can use to meet the LCFS 10 per cent target (i.e., BC's carbon tax or the federal vehicle efficiency incentive)?

Other compliance issues were discussed briefly by the group. It was noted that if an LCFS shifts vehicles away from fossil fuels towards natural gas or electricity there may need to be consideration for special meters to breakout what is used for heating or transportation purposes within a household in order to properly separate credits to be used for trading or compliance. Furthermore, if this shift happens it again raises the question of how regulated entities will act given that, currently, they are not in the electricity or natural gas business.

Comments, Questions and Answers

Comment: An audience member expressed concern about validation and accounting of credits and compliance with an LCFS. Historically, governments have left this job up to third-party auditors who have not been monitored to ensure accuracy. In order to be credible, it is the government's responsibility to have lifecycle analysis auditors on hand to monitor and verify third-party auditors.

FUEL AND TECHNOLOGY PATHWAYS BREAKOUT GROUP DISCUSSION

Facilitator: Bob Oliver, Pollution Probe
Reporter: Jesse Fleming, Natural Resources Canada
Notes taken by: Taskin Shirazi, Pollution Probe

The fuel and technology pathways breakout group presented five content points and three summary points.

1. **An LCFS is part of the solution:** An LCFS should be part of a compliance package of policies that includes price. It should be an intensity-based package of policies that is complemented by things like use incentives which may be overlain by something related to price (e.g., a pricing mechanism or a carbon tax).

2. **Scope:** An LCFS is a systems-based approach and it needs systems-based incentives and solutions. We need to understand how we can encourage comprehensive and rational compliance pathways. Certain solutions will require scoping as well (i.e., niche applications and niche solutions) which will allow the low-hanging fruit of fuel or vehicle applications to be identified and acted upon.

3. **Types of compliance pathways:** there are two major points which should be acted upon: existing and new pathways;

a. ***Existing pathways:*** Existing pathways that are commercially viable should be improved. For petroleum producers, this may involve a focus on carbon capture and storage, whereas for biofuel produces, this could be to increase efficiency at refineries.
   – Policy makers should keep in mind that for conventional petroleum, approximately 30 per cent of the total emissions occur upstream, in the Well-to-Tank processes. An LCFS with a target of 10 per cent overall reduction in carbon intensity, which does not account for improvements in vehicle drivetrain efficiency, actually implies a 33 per cent efficiency reduction in the upstream production processes.

b. ***New pathways:*** This will be examined later, but should include encouraging market penetration of the fuel and will vary depending on the technology.

4. **Support:** New fuels and technology pathways will require supporting programs, policies and mechanisms in order to be successful. The support could be fiscal, political, structural or communications. It was suggested that allowing rational double crediting through complimentary programs could add support for new technologies.

5. **New compliance pathways:**
- Improved efficiency
- Blending of low carbon fuels
- Increased use of existing fuels which are not commonly used for transportation (e.g., natural gas).

- Low carbon energy carriers
- Emerging pathways (e.g., synthetics and next generation biofuels).

In summary, the fuel and technology pathways breakout group offered three summary discussion points:

1. The market success of a transportation fuel and pathway is complex. The complexities, the suite of solutions required, and the timelines required must be recognized by policy makers.

2. Policy makers must consider costs across solutions, keeping a focus on real reductions of greenhouse gas emissions. Cost and cost effectiveness must be recognized in all pathway scenarios.

3. Government policies need to provide appropriate and equitable solutions to energy technology and vehicle suppliers. All stakeholders should look to partner on mutually beneficial solutions that are win-win. If win-win is not possible, then government should ensure that the asymmetric costs and benefits are clearly and equitably distributed and that the maximum value possible is being captured.

Comments, Questions and Answers

Q. Are we talking about a 10 per cent reduction in source to tank or in total emissions?

A. This is a very important question. We are looking at 10 per cent of the total reduction of greenhouse gas emissions over the full well-to-wheel lifecycle of the fuel-vehicle system. In conventional gasoline-powered vehicles, about 70 per cent of lifecycle emissions come from fuel combustion (tank-to-wheel) and 30 per cent comes from upstream processes (well/source-to-tank). The 10 per cent LCFS target is overall, so if the policy is only looking at upstream than we will have to see a one-third reduction in emissions from upstream processes to achieve the 10 per cent overall reduction. There are other alternatives such as fuel switching that can act as a compliance mechanism, but if you are simply looking at improving efficiency, it will require a 33 per cent improvement.

Conference Agenda

Objective: *To educate and inform participants, and to identify and discuss key issues and implications related to designing and implementing an effective and efficient low carbon fuel standard in a Canadian context.*

Day 1 — Tuesday, June 3, 2008

7:45 Registration and Refreshments

8:45 **Opening Remarks** — Bob Oliver, Acting Executive Director, Pollution Probe

8:50 **Keynote Address** — Rick Jennings, Assistant Deputy Minister, Office of Energy Supply, Ontario Ministry of Energy

9:00 **Overview Presentation on LCFS** — Daniel Sperling, Board Member, California Air Resource Board; Director, Institute of Transportation Studies and Professor of Civil Engineering and Environmental Science and Policy, University of California, Davis

9:45 **LCFS — Regional Issues and Implications**
Barry Bower, Consultant, Barry Bower Consulting
Paul Wieringa, Executive Director of Energy Efficiency and Technology, BC Ministry of Energy, Mines and Petroleum Resources

10:30 Break

10:45 **International Panel**
Moderator: Ken Ogilvie, Executive Director Emeritus, Pollution Probe
Implementing California's LCFS: Technical and Policy Challenges — Sonia Yeh, Research Engineer, Institute of Transportation Studies, University of California, Davis
US Government Policies — Paul Argyropoulos, Senior Policy Advisor, Office of Transportation and Air Quality, US Environmental Protection Agency
European Policies — Philip Watson, Senior Consultant, E4tech (UK) Ltd.

11:30 **Plenary Discussion on Approaches and Issues**

12:00 Lunch

1:00 **Petroleum Production and Refining Panel**
Moderator: Doug Wright, Managing Director, Centre for Earth & Environmental Technologies, Ontario Centres of Excellence
Upstream/Downstream Oil — Cathy Reheis-Boyd, Chief Operating Officer, Chief of Staff, Western States Petroleum Association
The Policy Context and Role of LCFS in Managing GHG Emissions — Rick Hyndman, Senior Policy Advisor, Canadian Association of Petroleum Producers
Working Towards a Cleaner and More Prosperous Ontario — Faith Goodman, Vice-President Ontario Division, Canadian Petroleum Products Institute

2:00 **Plenary Discussion on Petroleum Production and Refining**
Added respondent panelist:
- Brent Stuart, Director, Government Relations, Suncor Energy Inc

2:30 Break

2:45 **Life-Cycle Assessment Panel**
Moderator: Hadi Dowlatabadi, Professor, University of British Columbia
Lessons Learned from Life-Cycle Assessment of Transportation Fuels — Heather L. MacLean, Associate Professor, Department of Civil Engineering and School of Public Policy and Governance, University of Toronto
Indirect Land Use Change and its Implications for Biofuels — Michael O'Hare, Professor of Public Policy, University of California, Berkeley

3:30 **Plenary Discussion on Life-Cycle Assessment**
Added respondent panelist:
- Marlo Raynolds, Executive Director, Pembina Institute

4:15 **Closing Remarks and Adjourn —** Bob Oliver, Acting Executive Director, Pollution Probe

A reception will follow from 4:15 to 6:00 pm at in the Essex Lounge at the Ramada Plaza Toronto Hotel.

Day 2 — Wednesday, June 4, 2008

8:00 Morning Refreshments

8:30 **Welcome and Recap from Day 1** — Bob Oliver, Acting Executive Director, Pollution Probe

8:35 **Alternative and Renewable Fuels in Canada** — Rick Whittaker, Vice President, Investments, Sustainable Development Technology Canada

8:55 **Plenary Discussion on Alternative and Renewable Fuels**
Moderator: Rick Whittaker, Vice President, Investments, Sustainable Development Technology Canada
Panelists:
- Joanna D. Underwood, Chair and President, Energy Vision
- Neville Fernandes, Renewable Diesel Business Manager, Neste Oil
- Jeff Passmore, Executive Vice President, Iogen Corporation
- Gordon Quaiattini, President, Canadian Renewable Fuels Association
- Al Cormier, Executive Director, Electric Mobility Canada

10:00 **Vehicle Technologies for Low-Carbon Fuels** — Mark Nantais, President, Canadian Vehicle Manufacturers Association

10:30 **Plenary Discussion**

10:45 Break

11:00 **UK Renewable Transport Fuel Obligation** — Philip Watson, Senior Consultant, E4tech (UK) Ltd.

11:30 **Plenary Discussion**

12:00 Lunch

1:00 **Compliance Issues and Pathways**
- Bruce Orr, Specialist, Fuel Supply, Ontario Ministry of Energy
- Fatima Abdulrasul, Senior Policy Coordinator, Ontario Ministry of Environment
- Paul Wieringa, Executive Director of Energy Efficiency and Technology, BC Ministry of Energy, Mines and Petroleum Resources

1:15 **Breakout Groups on LCFS in a Canadian Context**

2:00 **Report Back to Plenary**

3:00 **Closing Remarks and Adjourn —** Bob Oliver, Acting Executive Director, Pollution Probe

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Presentations

Please visit http://www.pollutionprobe.org//Happening/pdfs/lowcarbonfuelwkshp/agenda.pdf to view online presentations from the National Conference on Low Carbon Fuel Standards for Canada.

Conference Background Document

The Conference Background Document entitled "Low Carbon Fuel Standard: A Discussion Paper Prepared by the Ontario Ministry of Energy" is included in the following pages (1–13).

For more information on the Conference Background Report, please contact Barry Bower at barrybower@sympatico.ca or (416) 421-9088.

Low Carbon Fuel Standard

A Discussion Paper Prepared by the
Ontario Ministry of Energy

May 2008

LOW CARBON FUEL STANDARD

Introduction

In May, 2007, Ontario and British Columbia both signed memoranda of understanding (MOU) with California which, among other things, specified that they would coordinate policies on the development of a Low Carbon Fuel Standard (LCFS). An LCFS is a climate change initiative focused on reducing greenhouse gas emissions associated with transportation fuels. Both provinces want to develop their policies by encouraging and engaging the best and brightest minds to work together. This paper is intended to serve as an introduction to the LCFS. It will provide a brief history of the concept and lay out some of the issues and options. It is intended to provide the background necessary for a conference on the LCFS to be held on June 3-4, 2008. While the conference will be national in scope, Ontario intends to use the learnings as the starting point for more comprehensive consultation with stakeholders.

In California, the concept of a low carbon fuel standard has evolved continuously. On January 8, 2007, California issued a White Paper[1] announcing it intended to implement such a standard. Its purpose was to reduce the lifecycle carbon intensity of passenger vehicle fuels by a minimum of 10 per cent by 2020, with other transportation fuels to be included later along with deeper cuts. While an Executive Order[2] issued on January 18, 2007 closely followed the White Paper, it included all transportation fuels in the 2020 target. Since then, the University of California (UC), under contract to the California Air Resources Board (CARB) has published a number of technical papers, while CARB has published a concept paper outlining its current thinking. CARB recommended that aviation fuels and marine bunker be excluded.

Several other U.S. states have expressed interest in implementing similar programs. In Canada, as noted, both British Columbia and Ontario signed memoranda of understanding with California to coordinate policies in this area. In most jurisdictions, the LCFS is part of a broader package of climate change initiatives. In Ontario, this program is known as Go Green. At the time that the MOU was signed, Ontario indicated that, while coordinating policies with California, Ontario would develop a "made-in-Ontario" policy.

[1] http://gov.ca/pdf/gov/alternativeFuels.pdf
[2] http://www.arb.ca.gov/fuels/lcfs/eos0107.pdf

Evolution of the California LCFS

- January 8, 2007. California White Paper published: 10 per cent reduction in intensity of passenger vehicle fuels by 2020. Other transportation fuels to be included later.
- January 18, 2007. Governor Schwarzenegger signs Executive Order establishing the LCFS. All transportation fuels to be included in initial target.
- May 29, 2007. UC publishes first technical paper, which includes possible compliance scenarios including heavy reliance on biofuels and dieselization of the passenger vehicle fleet.
- May 30-31, 2007. Ontario and British Columbia sign MOUs with California.
- August 1, 2007. UC publishes second technical paper, which recommends the inclusion of a non-zero estimate for land use change together with a thorough analysis of the issue. The estimate would be revised after several years.
- November 16, 2007. CARB recommends separate baseline for diesel, effectively disallowing dieselization as a compliance pathway.
- January 17, 2008. UC makes a presentation to a CARB working group which highlights the critical issue of emissions from land use change.

Several other jurisdictions are developing similar programs to reduce carbon emissions from transportation fuels. Most of these focus on renewable fuels. The U.S. Energy Independence and Security Act (EISA) of 2007[3] specifies volumes of renewable fuels that must be incorporated in the transportation fuel pool by 2022. It also specifies the performance of these fuels from a carbon emission perspective. While there is no specific target for carbon reduction, the performance requirements would reduce the carbon intensity of transportation fuels. However, the reduction would not achieve the 10 per cent LCFS target.[4] In Europe, the EU Parliament has passed legislation[5] calling for renewable content of 10 per cent in transportation fuels by 2020 (RED) and a 10 per cent reduction in the average lifecycle carbon intensity of fuels

[3] http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_bills&docid=f:h6enr.txt.pdf

[4] EISA specifies 36 billion gallons of renewable fuels by 2022 – about 15% of the transportation pool. The performance requirements average about 43% implying a GHG reduction of 6.5%. Grandfathering of existing facilities may reduce this benefit to an estimated 5%.

[5] http://ec.europa.eu/energy/res/legislation/doc/biofuels/en_final.pdf

between 2010 and 2020 (FQD)[6]. In Canada, the federal government has announced its intention to require certain percentages of renewable fuel in the transportation sector[7].

All of these policies have a common goal: to reduce the greenhouse gas emissions associated with transportation fuels. At the same time, governments have a number of other policy goals that may affect or be affected by these policies. In the United States for example, energy security issues have a high profile. While the concept of an LCFS is relatively simple – and is described in the following section – other policy objectives make implementation more complicated. A set of principles is needed to regulate how the LCFS will relate to these different policy objectives. Despite efforts at coordination, various jurisdictions will adopt different approaches to reduce the carbon footprint of transportation fuels, depending on their individual circumstances.

Possible Principles in Implementing a Low Carbon Fuel Standard

- Global reduction in GHG emissions from the transportation sector;
- No increase in other pollutants;
- Targets should be challenging but achievable;
- Targets should be technology forcing;
- Markets, to the extent feasible, should determine compliance pathways;
- Energy security should be enhanced;
- Consumers should be protected from undue price increases;
- The LCFS should benefit the economy and/or not unduly burden it;
- Other?

[6] Renewable Energy Directive and Fuel Quality Directive, respectively.

[7] http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=430AF7BE-B44F-4CFD-9313-E74EC4B28CCD

Scoping Issues

In principle, a low carbon fuel standard should apply to all transportation fuels. In practice, there are several different interpretations of how this principle should be applied. For example, The California White Paper suggested that the LCFS apply only to passenger vehicle fuels until after 2020. However, the Executive Order issued shortly thereafter covered all transportation fuels from the beginning. The California Air Resources Board (CARB), in turn, excluded marine bunker and aviation fuel from the standard. There have also been suggestions that stationary sources should be included or that reductions in carbon emissions from fuels used in stationary sources should be allowed to generate credits toward LCFS compliance.

ISSUE 1: What fuels should be included in the LCFS?

The Low Carbon Fuel Standard targets the fuel itself rather than the vehicle in which it is consumed. It is the fuel suppliers, predominantly the refiners and importers of petroleum-based fuels, who are the obligated parties. In California, the standard is expressed as an intensity target – grams of CO_2 equivalent per megajoule of contained energy. In its pure form, this principle could be described as "source-to-tank". It implies, for example, that hybrids, even though they run on a combination of gasoline and electricity, do not generate credits toward compliance because all input energy comes originally from gasoline. Plug-in hybrids (PHEVs), on the other hand, can generate credits to the extent that the electricity they consume comes from the grid.

In practice, the California LCFS diverges from a pure source-to-tank metric. Some fuels have inherent properties that enable more efficient vehicle operation. The most obvious examples of the inherent drive train efficiency of fuels are diesel and electricity relative to gasoline. California proposes to allow electricity used in vehicles to generate credits toward LCFS compliance, based on displacing fossil fuel, without being required to lower the carbon intensity of the electricity. That is, if electricity replaces gasoline and has a lower carbon intensity than gasoline, then it can contribute to meeting the LCFS. However, diesel used in transportation is required to use a separate baseline that is lower than that for gasoline. An adjustment is made to account for the better drive train efficiency. Diesel fuels cannot earn credits by displacing gasoline unless they over-comply with a requirement to reduce emissions from this lower baseline.

Some observers maintain that fuels and vehicles should be considered as a system. This would be a "source-to-wheel" metric. In this view, a coordinated "system" approach can maximize reductions in transportation emissions at minimum cost.[8]

Issue 2: How should the LCFS account for drive train efficiency differences among fuels?

Issue 3: How should vehicle and fuel targets be coordinated?

The main purpose of the Low Carbon Fuel Standard is to reduce carbon emissions from the transport sector. To be fully effective, the reductions should be considered on a lifecycle basis, that is, all the emissions associated with the fuel, including production and distribution, should be included. Furthermore, reductions should be global: a reduction in emissions from Canadian jurisdictions will not help if, as a result of our actions, emissions elsewhere increase. This phenomenon is known as "shuffling" or "rationalization" and it can have a significant influence on the lifecycle performance of many alternative fuels.

In the case of fossil fuels, the lifecycle requirement means that the emissions associated with oil production and refining need to be included. This raises some challenges.

California had originally intended to measure the carbon intensity of all crude oils entering the state either in the form of crude or as refined products. This proved to be administratively burdensome so, instead, it is proposing to develop a default baseline for "conventional" crude oils currently in use in California. Refiners can use this baseline or, if they can prove that their crude oils are less carbon intense, they can submit the appropriate data. Non-conventional crudes, such as Canada's oil sands, would be assumed to follow a higher baseline and would therefore be penalized.

Ontario has limited access to imported crude oil and receives most of its supplies from western Canada. This implies increasing reliance on oil sands crude and Ontario's refineries have been designed to accommodate this reality. If Canada were to discriminate against oil sands,

[8] See, for example, the King Review, a study commissioned by the UK government to follow up on the transport sector findings of the Stern Commission, which recommended that: "The European Commission should develop policy instruments to provide flexibility between fuel and vehicle targets, such as allowing trade of credits between targets. In the absence of flexibility between targets, EU mandates on fuels and vehicles should be balanced such that the overall costs of reducing CO_2 emissions are minimised – at present this suggests vehicle targets should be more stringent relative to fuel targets." (King Review Part II, p.46)

producers would have no difficulty in finding alternative markets. Transporting this oil to more distant markets and importing lighter oil from distant suppliers could actually increase global emissions. This would be a prime example of shuffling.

Issue 4: How should Canada deal with its increasing reliance on oil sands production?

Issue 5: Can jurisdictions in Canada effectively reduce global emissions from crude oil by lightening their own crude slates?

In California, the LCFS is part of a much broader climate change initiative commonly referred to as AB32, the number of the Assembly Bill that provides the over-arching legislation. AB32, among other things, contains requirements for large final emitters such as refineries to reduce their emissions[9]. Allowing these reductions to contribute to the LCFS targets would be double counting. As a result, while refinery emissions form part of the LCFS baseline, emissions reductions at refineries do not count towards compliance. In the case of gasoline and diesel, therefore, the California LCFS, as currently proposed, requires reductions in combustion emissions of about 14 per cent in order to achieve overall lifecycle reductions of 10 per cent including refinery and oil extraction emissions.[10]

Issue 6: How should emissions from refining be factored into an LCFS?

In California, the regulated parties are the fuel suppliers. Given that nearly all transportation fuel currently comes from fossil sources, this means predominantly refiners and importers of petroleum products. Performance is measured against a baseline of California's existing fossil fuels – either gasoline or diesel. It is expected that most compliance pathways will rely on non-fossil fuels such as biofuels and electricity. In some cases, these fuels will require different vehicle technology.

This raises the issue of how the obligated parties (the refiners and importers of transportation fuels) can ensure that the fuels they supply will be compatible with the vehicles in the fleet. It is important to note that, with the exception of dieselization of the passenger vehicle fleet, there is little that can be done with the composition of petroleum-based gasoline and diesel to reduce its carbon intensity. This is because the composition of both fuels is closely controlled to ensure their performance in and compatibility with the vehicles in which they are used as well

[9] See www.arb.ca.gov/cc/factsheets/ab32factsheet.pdf
[10] Ontario Ministry of Energy estimate

as their compliance with environmental regulations. No significant variation is likely to be acceptable to the automotive companies.[11] While some renewable fuels can be blended with petroleum-based fuels, there are limits to the amounts that can be blended without modifying the engines. Yet the fuel suppliers have no direct influence over whether and when these engine modifications will be implemented.

Issue 7: How can the LCFS be designed to incent the introduction into the market of vehicles capable of consuming lower carbon fuels?

Other Approaches

The US Energy Independence and Security Act (EISA)[12]

EISA specifies quantities of renewable fuels that must be included in the transportation pool. The Environmental Protection Agency will determine the obligation on an annual basis, but the Act requires the total to reach 36 billion gallons (136 billion litres) by 2022. Of this, 21 billion gallons must be "advanced" renewable fuels. 16 billion of the 21 billion must be cellulosic ethanol and 1 billion must be biodiesel, which is defined as Fatty Acid Methyl Ester or FAME. The remaining 15 billion gallons can come from any source.

Advanced renewable fuels must have GHG emissions at least 50 per cent lower than gasoline. Cellulosic ethanol must be 60 per cent better while "conventional" renewable fuels must be 20 per cent better than gasoline. This GHG performance is to be calculated on a lifecycle basis, taking full account of both direct and indirect land use changes. (Lifecycle analysis in general and land use change in particular will be described in a later section.)

Existing U.S. ethanol plants and those under construction (which are mostly corn-based) would be grandfathered. That is, they could contribute to the 36 billion gallon requirement but would not have to meet the 20 per cent threshold. There is currently about 13.5 billion gallons of capacity in the U.S. either in operation or under construction. Much of this is coal-fired capacity which would be unlikely to meet the 20 per cent threshold.

[11] See, for example, the World Wide Fuel Charter. www.enginemanufacturers.org/admin/library/upload/975.pdf

[12] http://www.whitehouse.gov/news/releases/2007/12/20071219-1.html

America's Climate Security Act (ACSA)[13]

In October, 2007, Senators Warner and Lieberman introduced a comprehensive climate change bill which, in many respects, resembles California's legislation. It includes both a cap-and-trade requirement for covered facilities and a transportation fuel requirement very similar to the LCFS. While this bill may not pass during the current session of Congress, officials in Washington believe that a climate change bill in some form is likely to be introduced and passed in the next session.

Renewable Fuels Directives

As discussed earlier, the European Union has a requirement for both renewable fuels (the Renewable Energy Directive) and for a low carbon fuel standard (the Fuel Quality Directive). Individual companies within the Union are developing their own programs to comply with these directives. However, there have been recent press reports that concerns about the sustainability of biofuel production may cause the European Commission to suspend these targets.[14]

Lifecycle Analysis

To ensure that the LCFS actually reduces carbon emissions on a global scale, it is necessary to look at fuels on a lifecycle basis. This is complicated and controversial. The analysis results are very dependent on the key input assumptions. For example, some researchers have found that corn-based ethanol produced in a gas-fired plant delivers very significant net greenhouse gas benefits compared to the gasoline it displaces, while others find that the resulting lifecycle greenhouse gas emissions are higher than would be the case for the fossil fuel it replaces. California is currently using a model called GREET to estimate lifecycle emissions. It looks at all the inputs that go into producing a given fuel and compares them to a similar calculation for the fossil fuel that is to be replaced. A large number of assumptions are needed to arrive at a final comparison.

The input assumptions can be varied in the GREET model and the results will vary accordingly. California is currently using assumptions that produce results showing that ethanol made in a gas-fired Midwest plant delivers a net benefit of about 23 per cent. Natural Resources Canada operates a similar model, GHGenius, which yields results closer to 40 per cent, with most of the difference being a result of the input assumptions.

[13] http://www.sourcewatch.org/index.php?title=America's_Climate_Security_Act_of_2007

[14] www.guardian.co.uk/environment/2008/apr/19/biofuels.food/print

Increasing production of biofuels may result in significant land use change in order to produce the necessary feedstocks. This land use change can, in turn, result in very significant greenhouse gas emissions. This is emerging as a major issue in lifecycle analysis. Neither GREET nor GHGenius fully takes into account changes in land use that may occur as a result of increased biofuel production. If, for example, new land is cleared to grow the necessary feedstock for biofuels production, then there will be significant one-time releases of greenhouse gases which, by some calculations, may be large enough to negate any benefits from the fuel itself for several decades. This is known as direct land use change. In other cases, existing cropland may be used to provide the biofuel feedstock, but new land must be cleared to replace the diverted food crop. This is indirect land use change.[15]

Accounting for indirect land use change is a relatively new issue and is subject to emerging analysis. While some researchers have been warning of this effect for some time, the issue did not figure prominently in LCFS policy development until relatively recently. In the United States, both California and the federal EPA are studying the issue using several different models that focus more on agricultural economics and world trade.[16]

Issue 8: How should we estimate and account for the effects of land use change in calculating the energy intensity of biofuels?

Issue 9: How do we ensure that the models used to calculate the lifecycle emissions of alternative fuels adequately reflect Canadian practices?

Certification

An important issue to deal with is the certification of biofuels, particularly when they cross borders. Jurisdictions which already have renewable fuels standards have developed measures to certify fuels as renewable. In the U.S., for example, the EPA has finalized a system of Renewable Identification Numbers (RINs) to track compliance with its standard. The RIN is a 38-character code which identifies every batch of domestically produced or imported renewable fuel. Despite this complexity, the RIN system is essentially a volume control system and has only a rudimentary capability of distinguishing between different types of renewable fuels.

[15] For a presentation on Land Use Change by the University of California, see www.arb.ca.gov/fuels/lcfs/011708UCBLUCcolor.pdf

[16] For a summary of the ongoing debate and the relevant models and studies, see www.its.berkely.edu/sustainablitycenter/Farrell_LCFS_overview_WSPA_March08.pdf

The LCFS could require a system that can discriminate among batches on the basis of carbon intensity. It may not be sufficient merely to specify what feedstock is used, because emissions will vary depending on how the feedstock is produced, how the conversion to biofuel is accomplished and what is done with any byproducts. While the question of carbon intensity can be determined for domestically produced biofuels, it is more challenging in the case of imported fuels, especially since a cargo may be made up of fuels from more than one producer. California proposes to set conservative default values but to give importers the option of supplying real data. If the default value accommodates the possibility of land use change associated with imports, it would have to be quite high. In that case, importers would have an incentive to supply real data. Third party auditing would be required to certify these data. In California, the Air Resources Board intends to modify the federal RIN system. Because it is important that there be a degree of international coordination on the certification of biofuels, CARB has also been working closely with the U.K. Department for Transport which is also developing a system of Renewable Transportation Fuel Certificates. While the U.K. program employs sustainability criteria, it does not yet deal comprehensively with indirect land use change.

The U.S. has some experience in the certification of renewable fuels and has developed the institutions necessary to fulfill this role. This is not yet the case in Canada.

Issue 10: How should Canada certify the GHG performance of alternative fuels?

Issue 11: Who should certify alternative fuels in Canada?

Co-Product Credits

The production of most biofuels also involves the production of other products. Facilities making ethanol from corn, for example, also produce Distillers Dry Grains (DDGs) which are used as animal feed. Some plants also recover the carbon dioxide emitted during the fermentation process and sell it to the bottling industry. Some of the emissions associated with biofuel production should therefore be attributed to these co-products. Various methodologies have been proposed to calculate the size of this attribution, for example:

- Volume of co-products relative to biofuel volume
- Value of co-products relative to biofuel value
- Emissions displaced by co-products.

Issue 12: What methodology should we adopt for calculating co-product credits?

Baselines

To determine how much an alternative fuel can contribute to the LCFS target, it is necessary to establish a baseline for fossil fuels as a basis for comparison. In California, baselines will be calculated for 2006, the latest year for which full data are available. California's initial estimates, based on the GREET model, were that lifecycle emissions associated with gasoline production and combustion in 2006 averaged 92 g CO_2 eq./MJ. Because of the better drive-train efficiency of the diesel cycle, the proposed baseline for diesel is 71 g CO_2 eq./MJ. British Columbia intends to use 2010 as a baseline, by which time its parallel renewable fuel requirements will be fully implemented. CARB has recently indicated that their current estimates for the intensity of both gasoline and diesel are somewhat higher.[17]

Issue 13: What is the appropriate year to use as a baseline?

Issue 14: How should the baseline for fuels be established?

Issue 15: Should there be a separate baseline for diesel?

Compliance Schedules

The California LCFS requires that carbon intensity be reduced by 10 per cent by 2020, but no decisions have yet been made as to how quickly the GHG intensity should be reduced. California envisions the LCFS as technology forcing. Since new technologies tend to take a long time to develop and to deploy, this suggests that major reductions in carbon intensity should occur late in the compliance period. On the other hand, some observers feel that the environmental imperative requires immediate action and early reductions.

While the LCFS is intended to be technology forcing, there is no guarantee that the necessary technologies will become technically and commercially feasible on any pre-determined schedule. On the other hand, technologies may emerge more quickly than anticipated allowing for faster compliance. It may therefore be desirable to include provisions for periodic review and adjustment of the compliance schedule.

[17] www.arb.ca.gov/fuels/lcfs/042308lcfs_ulsd.pdf and www.arb.ca.gov/fuels/lcfs/042308lcfs_carfg.pdf

Issue 16: How quickly should fuel suppliers be required to decrease the carbon intensity of transportation fuels?

Issue 17: What provisions should be made for periodic reviews of the LCFS?

Credit Generation

In California, obligated parties can meet their LCFS requirements a number of ways. For example, subject to certain conditions, they can bank credits or purchase them from other parties that over-comply. This raises issues as to how credits are generated. In California, credits must come from within the transport fuel sector. The LCFS can generate credits for sale outside the sector, but outside credits, for example from reducing emissions at refineries beyond required levels, are not allowed to contribute to LCFS compliance.

This approach assures that cuts will be made in the transport fuel sector, but it will probably not result in cuts at the lowest overall cost. Alternative approaches would allow a freer flow of credits in and out of the LCFS system, for example between vehicles and fuels, between fuels used in transport and in stationary sources or between transport fuels and co-products of a biorefinery.

Issue 18: How should a credit system be designed to add flexibility to LCFS compliance options?

Compliance Options

The California White Paper has several founding principles. Among the most important are:

- The standard should be technology forcing.
- The market should be free to choose the technologies used to meet the standard.

In practice, it takes so much time to develop and deploy new technologies that it is likely that only technologies that are already well advanced in development will be of useful to meet the 2020 LCFS target. Technologies that might be able to contribute by 2020 include cellulosic ethanol, various renewable diesel technologies, electric vehicles and other liquid fuels such as butanol and tert-amyl methyl ether (TAME). Technologies involving hydrogen as a fuel may not be available in quantity before 2020.

Some existing technologies may be capable of contributing to the LCFS. The University of California identified existing biofuels such as ethanol and renewable diesel, dieselization of the passenger vehicle fleet, natural gas and propane. The UC study developed a number of theoretical compliance scenarios that relied on various combinations of new and existing technologies. Some of these scenarios may no longer be viable. For example, the GHG reductions attributed to biofuels do not reflect land use change and CARB's recommended lower baseline for diesel will lower the ability to of both petroleum diesel and its substitutes to contribute.

Developing compliance options for Canada is beyond the scope of this paper. However, it is important for policy-makers to understand what various technologies can deliver.

Issue 19: What technologies are capable of contributing to the LCFS target and to what extent?

Summary

Ontario and British Columbia are both developing LCFS policies. In doing so, both provinces will rely on input from a variety of stakeholders. This paper is intended to set the stage for these consultations. It has described the concept of the LCFS and raised some of the major issues confronting policy-makers. The intention is clear: to reduce lifecycle GHG emissions associated with transportation fuels. Several principles must be kept in mind at all times – targets should be challenging but achievable; the policy should encourage the development and deployment of new technologies; the market should, to the extent practical, determine how to comply with the standard; the standard should not impose an undue burden on the economy; and, perhaps most important, the standard should achieve real reductions in global GHG emissions on a full lifecycle basis.

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