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Lifecycle analysis of GHG intensity in BC's energy sources

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Issue

The government of British Columbia (BC) has enjoyed broad public support for tackling climate change – leading to a suite of complementary policies introduced since 2007. However, the efficacy of these policies is only as good as the accuracy of greenhouse gas (GHG) intensities assumed for different energy options available here. These same GHG intensities form the basis of policy designs promoting some fuels while inhibiting others through credits, subsidies, renewable fuel mandates and carbon taxes. These, in turn, are leading the conscientious consumers of BC to develop GHG reduction strategies that, in the light of more accurate information, may be revealed to involve even higher impacts on the environment than not having acted at all.

Environmentally conscious end users make decisions that are, at best, as good as the information and signals they receive about the emissions intensity of their energy choices. Where there is fuel flexibility, as in transportation, this can lead to on-going misdirection of subsidies to (or mandates for) energy forms, e.g., ethanol, whose use is just as GHG intensive as gasoline. In the case of capital decisions, e.g., to provide heating, it can lead to the selection of the wrong energy form (e.g., electricity) in the belief that an electric boiler is far less GHG intensive than a gas boiler. We need accurate information on the full environmental impacts of our energy resources upstream of the consumer in order to provide the correct market and regulatory signals to BC consumers.

Background

BC has an ambitious GHG reduction target and a suite of complementary policies for its achievement. However, we have failed to provide consumers and decision-makers in BC with accurate information on the emissions associated with our energy choices. This is a matter of evolving information, i.e., we continuously learn more about how our activities contribute to climate change forcing. It is also a matter of incomplete reporting standards, i.e., the ISO and other standards for how we assess and account for environmental impacts lag behind scientific knowledge.

BC is ahead of other jurisdictions in terms of our GHG accounting practices. We use ISO and World Resources Institute standards for GHG accounting. However, these systems do not

reflect the available science and do not reflect the lifecycle impacts of different energy sources. This inadequacy is not of significant concern in other jurisdictions. Nowhere else is there as ambitious a reduction target on as short a timeline. Because of this, we need to lead others in adopting more comprehensive emission accounting so that decisions made in our province are as well informed as possible and that we are not locked into the misguided technologies and options simply because we moved before we knew what to do. Hence, the proposal here to develop the next generation of GHG accounting practices in BC. This will lead to better policies and help consumers make better decisions to reduce emissions. It will also create knowledge and practice suitable for export to other jurisdictions.

The case for transportation fuels

Road transportation activities currently generate ~22% of the emissions in BC.[1] We can reduce these emissions through promotion of more efficient technologies and fuels with lower *lifecycle* GHG intensity. Yet fossil fuel taxes are only based on the CO_2 generated from combustion – ignoring all upstream emissions.[i] Upstream of consumers, fossil fuels have to be extracted, refined and transported to the point of sale. For conventional oil, this represents an additional 12% of GHG emissions on top of the GHGs released from combustion of gasoline or diesel. In the case of oil-sands derived fuels, the upstream emissions are closer to 30% – or 2.5x higher. Current provincial policies do not reflect these factors. Surely our carbon taxes should reflect the lifecycle impacts of fuel, and the carbon tax for oil-sands derived fuels should reflect the greater impact of that resource on the environment. Similarly, the drive to promote "renewable" transportation fuels may not reflect the full lifecycle of emissions.

Biofuels, such as corn-based ethanol, are assumed to be carbon neutral because the atmosphere will recapture CO_2 released from their combustion to grow more corn. However, this is an overly simplistic estimate for any fuel. The production of ethanol from corn is a highly energy intensive process with significant cultivation and process emissions – so much so that the overall difference in GHG intensity between corn ethanol and gasoline is a wash.[ii] Consequently, while the province has a mandate that 5% of liquid transportation fuels sold in BC be renewable, this mandate and the associated tax credits are not having an overall impact on emissions in the transportation sector. Currently, corn rotation with soy, and advanced ethanol plants provide an overall reduction of 30% in GHG intensity[iii] compared to gasoline. But food-based fuels have many drawbacks in a world failing to feed its population, beyond not offering large GHG savings. Until the advent of cellulosic ethanol, we are subsidizing an industry that is contributing to food shortfalls and not measurably reducing GHGs.

Diesel and its "renewable" substitutes are a particularly interesting option. Diesel engines are by design 10-25% more energy efficient than gasoline. Biodiesel produced from used cooking oil or slaughterhouse fats is arguably the lowest GHG intensity renewable liquid fuel available. However, biodiesel from these feed-stocks is only suitable for warm weather conditions. Canola biodiesel is also highly effective with overall GHG reductions (when substituted for fossil diesel) of 60 to 80%.[iv] However, we need to be very careful of the climate impact emissions associated with land-clearing in order to grow plants used as feedstock to biofuels. For example, the clearing of forests to develop tropical palm oil plantations, a competing feedstock for biodiesel, generates GHG emissions to such an extent that the overall impacts of consuming palm-oil biodiesel increases net GHG emissions compared to fossil diesel.

Clearly, mandated renewable fuel requirements and the carbon tax need to reflect the full lifecycle impacts of various fuels on the climate system. Doing otherwise, would force BC consumers to adopt solutions that are as harmful to the environment and society as just doing nothing. If we want to make a positive impact with biofuels, we also need concurrent policies for

the protection of forests and advanced agricultural practices, which do not strain water resources, rely on fertilizers (a major source of N_2O, a powerful greenhouse gas) or harm food production.[v]

The case for electricity

Reported emissions associated with use of electricity in BC have been remarkably low. However the figures usually bandied about reflect emissions associated with only some of the activities leading to their power generation when what consumers need are all emissions associated with their electricity consumption. The corrected GHG intensity for electricity therefore needs to include a number of factors currently not reported:

- BC Hydro reports on only a subset of emissions associated with generation and delivery of electricity. All such emissions, from business travel, emergency repair trucks owned by contractors, and biomass burned to keep water-ways clear need to be included;

- BC Hydro does not report on the emissions associated with electricity that it imports to meet domestic demand while using its own hydro supply to satisfy more lucrative markets. If electricity sold by BC Hydro is sold as a low carbon product, the carbon intensity of electricity delivered in BC has to reflect the gross imported power.

While BC has significant hydro resources, much of this is exported at high prices to the US. The shortfall in supply is imported from thermal power plants using coal and gas, as well as wind turbines in Alberta and Northwest USA. The GHG emissions associated with the fossil plants ranges from 450 - 900 tCO_{2e}/GWH. Taking account of the imports needed to meet BC energy demand almost quadruples the carbon intensity of electricity supplied to consumers here from the reported 24 to 84 tCO_{2e}/GWH.[vi]

Furthermore, BC Hydro operations involve the combustion of significant amounts of woody debris in order to come into compliance with the Water License.[2] Even though it can be argued that the CO_2 from this process is recycled by nature, the carbon monoxide and black carbon emissions from this process are significant in terms of their impact on climate. This fact has not been reflected in the 2008 inventory for BC. However, the burning in pyres by BC Hydro of ~ 300 kilotons of woody debris—required under the terms of the Water License—generates the equivalent of ~ 0.4 $MtCO_{2e}$/y of additional impact on the climate system.[vii] This raises the overall GHG intensity of electricity delivered to BC customers close to 140 tCO_{2e}/GWH.

The case for gas

According to the 2008 BC GHG inventory, natural gas combustion accounts for about 1/3 of the total emissions of GHGs in the province. Upstream emissions associated with the production and delivery of natural gas are between five and 10% of the total energy delivered to consumers. Therefore, the emissions factors (and carbon tax) for the use of conventional natural gas are only off by about 5%, hence only 190 tCO_{2e}/GWH. In the absence of carbon capture and sequestration, GHG emissions associated with BC shale gas extraction and cleanup will add another 10% upstream of consumers or 210 tCO_{2e}/GWH.[viii, ix]

Many consumers do not consider renewable gas as a near term option in BC. Just as we have embraced wind and solar “green” electricity, we can generate bio-methane (and producer gas) from waste streams available to us today with improvements in local air and water quality. The introduction of bio-methane into the natural gas network will reduce its GHG intensity significantly. Both FortisBC (formerly known as Terasen Gas) and Bullfrog will be offering “Green Gas” in BC in 2011.

Analysis

Countless businesses, organizations, and households are struggling to make investments they hope will reduce their impact on the climate system. By giving them inaccurate information (and associated carbon taxes, subsidies and mandates) we misdirect investments intended to help the province meet its long-term climate objectives.

Most decision-makers, including the PCT, are under the illusion that electricity in BC is almost carbon neutral and endlessly available at very low cost. This is leading them to choose electricity as their fuel of choice for: boilers, home heating, etc. and advocacy for electric vehicles. Electricity is too valuable a commodity and far too short in supply to proceed in this way.[X]

In order to plan an economically viable solution to the GHG emissions of the province, we need to send strong signals about the future trends in electricity prices into the future. A simple declaration cannot render BC electricity self-sufficient and carbon neutral by 2016.[3] Electricity prices would need to rise by many cents per kWh to meet rising demand. They would also have to rise by at least one third of a cent per kWh in order to offset ongoing GHG emissions. Finally, any electricity consumed in BC at 8 to 10 cents/kWh is a lost opportunity to export that electricity to higher price markets (e.g., California) at 15 to 25 cents/kWh.

Would BC consumers choose electricity over gas if they were informed of the large price hikes ahead? Would they choose to invest in heat pumps instead of resistive heating (thereby slashing their energy demand by two-thirds) by investing in higher capital costs initially? Would they choose to invest in more efficient appliances and buildings? There can be little doubt that the dual challenge of self-sufficiency and climate change should be changing the pattern of energy use in BC. What we are missing are the correct signals for consumers to make informed decisions about how to get there.

Similarly, what transportation technologies and fuels should consumers be using? Diesels are most efficient and biodiesel can offer significant lifecycle GHG reductions. Alas, there is no canola based biodiesel plant in North America but surely, there should be no subsidies for corn-ethanol and no required renewable fuel standard until such time that these fuels offer real environmental benefits. If the programs are simply a ploy to support farmers, let us call it a farm support program, rather than mislabel it as a climate change mitigation effort. There may be many end-users who would gladly pay more for a made-in-Canada fuel that would support our farmers. We need transparency in policy intent both to inform decisions for production and consumption.

Recommendations

BC has been at the forefront of policies for GHG mitigation. We also need to be at the forefront of GHG policy design by using full lifecycle analysis and improving GHG reporting and accounting conventions to account for these emissions (see previous briefing notes – The Challenges of BC's "Carbon Neutral Government" Mandate [BN11-30] and Expanding the Scope of BC's "Carbon Neutral Government" Mandate [BN11-31]). Specifically, BC should:

- Use available scientific methods and information to calculate full lifecycle environmental impacts on all fuels in BC.
- Base carbon taxes on the lifecycle impacts of fuels, not their immediate combustion.
- Base renewable fuel mandates on the basis of their lifecycle impacts.

- Base technology subsidies on their lifecycle impacts on energy service delivery.
- BC Utility Commission should provide price trajectories for gas and electricity over longer time horizons. In particular, there should be clear guidance on how making BC Hydro self-sufficient and carbon neutral by 2016 will impact electricity prices.

Conclusion

BC is a world leader in promoting GHG management through meaningful targets and timetables and in launching a suite of complementary policies to achieve these goals. BC now needs to be a leader in how we assess the GHG impacts of various fuels, how we take account of their full lifecycle impacts and how we use these as the basis of regulations and policies. Provision of clear signals about the GHG intensity of different fuels is the key to a successful long-term transition to a more sustainable economy.

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Endnotes

[1] Road transportation is 15.4 $MtCO_{2e}$ in a total inventory of 69 $MtCO_{2e}$ (BC Ministry of Environment, 2010).

[2] The multi-stakeholder Water Use License under which BC Hydro operates, stipulates that reservoirs and rivers used for power generation be navigable and free from woody debris. This has led BC Hydro to collect and burn the woody debris in open pyres.

[3] Two-thirds of this target is to be achieved through energy conservation, the rest through new GHG-neutral generation.

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