National Round Table on the Environment and the Economy
Table ronde nationale sur l'environnement et l'économie

What Are the Implications of Calculating Greenhouse Gas Emissions on a Life-Cycle Basis for the Design of Domestic Emissions Trading Systems?

Domestic Greenhouse Gas Emissions Trading
Technical Paper Series

Droits d'échange d'émission nationaux des gaz à effet de serre
Série de documents techniques

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Prepared for:

Multistakeholder Expert Group on Domestic Emissions Trading

National Round Table on the Environment and the Economy

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At the heart of the NRTEE's work is a commitment to improve the quality of economic and environmental policy development by providing decision makers with the information they need to make reasoned choices on a sustainable future for Canada. The agency seeks to carry out its mandate by:

- advising decision makers and opinion leaders on the best way to integrate environmental and economic considerations into decision making;
- actively seeking input from stakeholders with a vested interest in any particular issue and providing a neutral meeting ground where they can work to resolve issues and overcome barriers to sustainable development;
- analyzing environmental and economic facts to identify changes that will enhance sustainability in Canada; and
- using the products of research, analysis and national consultation to come to a conclusion on the state of the debate on the environment and the economy.

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Introduction

This is one of a series of papers prepared for the National Round Table on the Environment and the Economy (NRTEE) that looks at issues relevant to the design of a variety of potential domestic emissions trading systems for greenhouse gases (GHGs).[1]

For emissions trading to work, it is clearly critical to be able to measure, monitor and verify total GHG emissions and/or the GHG emission reductions associated with a specific action. This requires agreement on the use of equipment that can directly measure emissions (e.g., continuous emission monitors) or agreement on the methodologies used to calculate emissions from other well-documented data (e.g., fuel use).

Emissions trading also, however, requires agreement on basic principles for determining how responsibility for GHG emissions should be allocated among different sources. At this time, there is a broad international agreement that an emissions source is responsible for all GHG emissions that are a direct result of its activities. For example, with regard to fossil fuel combustion, it is the source that actually combusts the fossil fuel that is responsible for the resulting GHG emissions.

This mechanism for allocating responsibility has been enshrined in the international guidelines for preparing GHG inventories developed by the Intergovernmental Panel on Climate Change and is reflected in the reporting frameworks established under the United Nations Framework Convention on Climate Change (UNFCCC). It also underpins the binding emission reduction commitments negotiated among industrialized countries in the Kyoto Protocol to the UNFCCC.

Despite this broad international consensus, however, it is often argued that this system of allocating responsibility for GHG emissions is problematic from an equity perspective. In Canada, the example most often used to illustrate this point concerns the export of Canadian natural gas to the United States.

The production of natural gas is an energy-intensive process, and Canada is currently responsible for all GHG emissions associated with the production of gas exported for use elsewhere. As a result, increased exports to the United States will increase Canada's total GHG emissions under current accounting procedures.[2] At the same time, however, the United States can use this natural gas to substitute for more GHG-intensive fuels (e.g., natural gas can replace coal in electricity generation). As a result, such exports could decrease GHG emissions in the United States under current accounting procedures.

This has led some to argue that the current method of allocating responsibility for GHG emissions is unfair.[3] The argument states that Canada is being penalized because its GHG emissions have increased even though there has been no increase in the demand for final goods and services within Canada. In effect, the argument states that GHG emission reductions in the United States are being "subsidized" by GHG emission increases in Canada. While it is true that the current international consensus requires Canada to take responsibility for these emissions, Canadian companies are also being paid to provide this natural gas. In a carbon-constrained world, it

1 The authors would like to thank Marlo Raynolds of the Pembina Institute for his helpful comments on an earlier draft of this paper.

2 More than 50% of Canada's natural gas production was exported to the United States in 1995. It has been estimated that 31% of the growth in Canada's GHG emissions between 1990 and 1995 was a result of increased natural gas exports to the United States (National Air Issues Coordinating Committee, *Review of Canada's National Action Program on Climate Change*, November 1996).

3 The issue has been raised internationally by Canada with regard to natural gas exports. It has also been raised by Scandinavian countries in the context of electricity exports and imports. In the Scandinavian case, it is argued that a country can reduce its GHG emissions simply by substituting imported electricity for domestically produced electricity. This is a real issue in Scandinavia because of the interconnectedness of the electricity grid. Under current accounting practices, it is the exporting country that bears responsibility for the emissions associated with the production of that electricity. These concerns, however, have not been enough to alter the current international consensus on this issue.

may be possible for Canadian natural gas producers to charge a premium for taking on responsibility for the GHG emissions associated with the production of natural gas for export.[4]

Beyond these equity concerns, however, it may also be the case that internationally agreed mechanisms to assign responsibility for GHG emissions are problematic from an environmental perspective. This is because the current method of allocating responsibilities for GHG emissions provides no incentive to minimize the GHG emissions generated through the full life cycle of a product or service. For example, under the current system, an organization can reduce GHG emissions that are its responsibility (e.g., emissions from fossil fuel combustion) by switching to an alternative energy source that produces fewer emissions on-site. If the production of the alternative energy source is more GHG-intensive, however, total GHG emissions may increase even though emissions that are the responsibility of the organization taking the action may decline. Under such a scenario the environment loses.

One way to address these concerns is to use an alternative method for allocating responsibility for GHG emissions. This paper looks at one such method: allocating responsibility for GHG emissions on a life-cycle basis. It describes the concept and rationale behind addressing GHG emissions on a life-cycle basis; examines the extent to which life-cycle accounting can be applied to GHG emissions; and discusses the potential application of life-cycle accounting within the domestic GHG emissions trading system options being examined by the NRTEE.

What Are Life-Cycle GHG Emissions?

It is now broadly accepted that if one wants to understand the full environmental impact of a good or service, one must examine all the environmental impacts generated by the good or service throughout its life. In other words, if one wants to understand the full environmental impact of a product, one needs to examine the environmental impacts associated with:

- extracting the raw materials required to make the product;
- manufacturing the product;
- transporting the product from its manufacturing site to its end-use destination;
- using the product; and
- disposing or recycling of the product.

Life-cycle thinking is important because it is often possible to take actions to reduce the environmental impact of a product at one stage in its life while increasing the environmental impact of the product at another stage in its life. For example, electric vehicles produce no emissions from vehicle use. However, depending on the sources of electricity and the type of battery technology, the upstream (production-related) emissions can be significantly higher than is the case with conventional gasoline vehicles. As a result, the electric vehicle may simply shift the environmental impact elsewhere. It is only by taking life-cycle considerations into account that one can understand what actions will produce the largest net benefit for the environment.

Application of the life-cycle emissions concept would change the allocation of responsibility for GHG emissions. Instead of assigning responsibility for GHG emissions generated at different points in the life of a product or service to different organizations, the life-cycle emissions concept would assign total

4 The ability to charge such a premium will depend on policies taken in the United States to address climate change as well as on actions taken by Canadian competitors in the U.S. market.

responsibility for the GHG emissions generated throughout the life of a product or service to one organization. That organization could be the producer, distributor or user of the product or service.

Such an approach to allocating responsibility for GHG emissions could be attractive for a number of reasons. For example:

- making consumers or distributors of goods and services responsible for the full life-cycle GHG impact of their purchasing decisions might encourage them to make decisions that represent the lowest possible GHG emission impact; and
- making producers and distributors of goods and services responsible for the full life-cycle GHG impact of their goods or services might encourage them to find ways to work with consumers to lower the environmental impacts associated with the use of the goods or services.

Can the Life-Cycle Emissions Concept Be Used to Assign Responsibility for GHG Emissions Associated with Fossil Fuels?

Under the current international consensus, users of fossil fuels are considered responsible for the GHG emissions produced as a result of their direct use of such fuels. This use can also represent disposal, since the fossil fuel is combusted during use in most cases.[5] It also, however, is possible for users of fossil fuels to calculate and be held accountable for the GHG emissions associated with the production and distribution of the fossil fuel energy sources they use.

For example, under current accounting practices, electricity generators are required to take full responsibility for the GHG emissions generated by the production and distribution of electricity. Because electric utilities know both the amount of electricity and the total GHG emissions they have generated, they can calculate the carbon intensity of the electricity they produce and distribute.

With information about the carbon intensity of electricity production and distribution, electricity users should be able to calculate the life-cycle GHG emissions associated with their electricity use. The information needed by users, however, is not the carbon intensity of electricity generated by a specific electricity producer. As electricity markets become more competitive and more electricity producers enter the marketplace, electricity users increasingly have no idea which electricity generators are producing the electricity being used at any point in time. Accordingly, if electricity users are to calculate the life-cycle emissions associated with their electricity use, they will need to know the average carbon intensity of all electricity being distributed on the grid.[6]

It is possible for electricity distributors to provide information on the average carbon intensity of electricity distributed on the grid by month, season or year. Electricity users should be able to match this emission factor with their electricity use in the appropriate period to determine the upstream GHG emissions associated with the production and distribution of the electricity they are using. Indeed, many participants in Canada's Voluntary Challenge and Registry Program (VCR) already use this method to report such emissions in their annual submissions to the VCR. Although the reported emissions are not completely accurate for any specific electricity user

5 Implications for potential domestic emissions trading systems of the use of fossil fuels for non-energy purposes are discussed in NRTEE Issue Paper 5 *How Will Fossil Fuels Used as Feedstocks be Impacted by a Domestic Emissions Trading Program?*

6 In a competitive market, it would ultimately be possible for a user to sign a contract for electricity from a specific electricity supplier — for example, to receive 50% of electricity from renewable energy sources. In reality, such a contract would only ensure that this electricity enters the grid and influences the average carbon intensity of the grid. The user would still need to know the carbon intensity of the entire grid to calculate the actual upstream GHG emissions associated with their electricity use.

(because of the use of emission factors averaged over time), the method can accurately represent total GHG emissions associated with electricity production and distribution. To ensure that no double counting occurs, all electricity users would need to calculate life-cycle emissions over the same time period and with the same emission factors.

The following table shows Canada's GHG emissions in 1995 as presented by two different studies. The first column, consistent with the current international consensus on assigning responsibility for GHG emissions, presents Canada's GHG emissions where electricity utilities are responsible for all GHG emissions associated with electricity production and distribution. The second column presents Canada's GHG emissions from electricity production and distribution in a manner consistent with life-cycle principles — emissions are distributed among end users.

Table 1 – Canada's Greenhouse Gas Emissions in 1995 (Mt)

	No Allocation of Emissions from Electricity	Allocation of Emissions from Electricity to End Users
Residential	42.0	80.8
Commercial	27.2	52.4
Transport	165.0	162.4
Industry	189.8	224.0
Non-energy	92.0	103.7
Electricity generation	103.0	0
TOTAL	619.0	623.3

Note: Differences in total emissions represent the fact that the official estimate of Canada's GHG emissions in 1995 was adjusted slightly in the time period between the two studies.

Sources: The data in the first column are taken from Environment Canada, *Trends in Canada's Greenhouse Gas Emissions: 1990-1995*, April 1997; data in the second column are taken from National Air Issues Coordinating Committee, *1996 Review of Canada's National Action Program on Climate Change*, November 1996.

Can life-cycle principles be applied to the use of all fossil fuel energy sources? Under current accounting practices, the users of fossil fuels are responsible for the GHG emissions produced in their combustion of those fossil fuels. To incorporate a life-cycle perspective, however, fossil fuel users would also have to take on responsibility for the upstream emissions associated with the production and distribution of those fossil fuels and add those emissions to the direct emissions resulting from fossil fuel use.

Under current accounting practices, the production and transmission of oil and natural gas by Canada's petroleum industry was responsible for 104.3 Mt of Canada's GHG emissions in 1995 — 16.8% of Canada's total GHG emissions.[7] This figure includes emissions from the direct combustion of fossil fuels by the petroleum industry as well as fugitive GHG emissions associated with the production and distribution of oil and natural gas. These data can be broken down by fuel type (e.g., oil, natural gas), general production process (e.g., oil sands production, conventional oil production, heavy oil production) and even on a company by company basis. This allows the GHG intensity of these different energy products, producers and production processes to be calculated.[8]

On the other hand, it is difficult to obtain this information at a much more disaggregated level (e.g., oil well to oil well), where the GHG intensity of production can differ significantly. More importantly, it is difficult to trace oil and natural gas from production site or producer to specific end use.

Like users of electricity, therefore, it appears that users of fossil fuels would have to make use of average emission factors to estimate the upstream GHG emissions associated with their fossil fuel use. Such industry-wide averages can be calculated for energy products such as natural gas, heating oil, gasoline and propane. Once again, while the calculations may not accurately reflect the upstream emissions associated with the specific fuel used by each specific user, they will provide an accurate reflection of aggregate upstream emissions if all users make use of a consistent set of emission factors.

It is also likely that similar upstream conversion factors could be developed for the production of coal, which could be employed by users to get a more accurate picture of life-cycle GHG emissions associated with, for example, the consumption of coal-fired electricity.[9]

Can the Life-Cycle Emissions Concept Be Used to Assign Responsibility for GHG Emissions Associated with Other Products?

The argument for applying the life-cycle emissions concept can be extended beyond fossil fuels to other products. This is because every product includes "embodied GHG emissions" that represent all the GHG emissions released by the energy and raw materials used in the production process. Full implementation of the life-cycle emissions concept would make users of products responsible for the embodied GHG emissions associated with a product.

The applicability of the life-cycle emissions concept to non-energy products is highly dependent on the type of product being considered. It should be possible to apply this concept to basic materials (e.g., aluminum, steel, concrete) that have a small number

7 Data drawn from: Robert Hornung, *Canadian Solutions*, David Suzuki Foundation and the Pembina Institute, 1998.

8 The Canadian Association of Petroleum Producers has already collected some of these disaggregated data, and many individual oil and gas producers and pipeliners have already begun to report data on the carbon intensity of their production processes to the Voluntary Challenge and Registry Program.

9 In fact, it is only when the environmental impacts of the production of fossil fuels used to generate electricity are considered that one has a fully accurate picture of the life-cycle emissions associated with electricity generation.

of inputs and are used in the manufacture of a wide range of final products. As a result, users of these basic materials should be able to calculate and take on responsibility for the GHG emissions associated with their production. It may even be possible to develop firm-specific upstream emission factors (as opposed to industry averages) in these sectors, because there are few producers and a clear and traceable line between the users and producers of these products.

With products further down the production chain, however, it becomes increasingly difficult to apply the life-cycle emissions concept. For example, a car goes through multiple manufacturing stages and is composed of thousands of parts manufactured all over the globe; each part has embodied GHG emissions associated with its production. Applying the life-cycle emissions concept at this level becomes much more methodologically challenging. The concept is similarly difficult to apply to a broad range of other final consumer goods (e.g., televisions, homes, computers).

In summary, it appears to be impossible to apply the life-cycle emissions concept universally when allocating responsibility for GHG emissions. Consumers of many final goods and services cannot easily take on responsibility for all of the GHG emissions generated through the life of the good or service.

Nonetheless, the life-cycle emissions concept can be applied to the GHG emissions generated by a subset of all goods and services — the fossil fuels and some basic materials used in the early manufacturing stages of many consumer goods. From a GHG emissions perspective, this is far from insignificant. After all, 85% of Canada's GHG emissions are associated with the combustion of fossil fuels. As a result, the life-cycle emissions concept could be used to allocate responsibility for the vast majority of Canada's GHG emissions.

Can Canada Unilaterally Adopt the Life-Cycle Emissions Concept as a Mechanism to Allocate Responsibility for Its GHG Emissions?

As noted earlier, internationally accepted GHG emissions accounting practices do not follow the life-cycle emissions concept. Nonetheless, these practices were used to allocate responsibility for GHG emissions under the Kyoto Protocol. As a result, Canada's commitment under the Kyoto Protocol is to reduce GHG emissions to 6% below 1990 levels, on average, in the period 2008 to 2012, as determined by conventional international GHG emissions accounting practices.

Unilateral adoption of the life-cycle emissions concept in Canada would undermine the Kyoto Protocol because many fossil fuels, raw materials and other products are traded across national borders. If different accounting systems are used in different countries, it becomes unclear who is responsible for the emissions associated with those goods and services. Two examples are presented below to illustrate the point.

First, a significant portion of the fossil fuel and electricity consumed in Canada is imported from other countries. To make the life-cycle emissions concept work, it would be necessary to know the upstream emissions associated with the production and distribution of these energy sources. While efforts are underway to develop such data, it will be difficult to have full confidence in data obtained from other countries unless new internationally accepted inventory protocols are developed for the calculation of emissions on a life-cycle basis.[10] More importantly, however, Canada's unilateral adoption of a life-cycle emissions accounting approach would require

10 For example, the Canadian Association of Petroleum Producers is working to determine the relative carbon intensity, on a life-cycle basis, of oil produced in Canada and oil produced in competing countries such as Venezuela.

Canadian firms to take responsibility for these upstream emissions even though the Kyoto Protocol would place the responsibility with the exporting country. In this case, Canadian firms would be burdened with additional responsibilities that are irrelevant to Canada's Kyoto commitments.

Second, a significant portion of Canada's fossil fuel and electricity production is exported to other countries. Under a life-cycle emissions accounting system, energy users in the importing countries would take on responsibility for the upstream emissions associated with the production and distribution of these fuels in Canada. Under the Kyoto Protocol, however, these emissions will remain the responsibility of Canada — even though no one would be responsible for them under a domestic life-cycle emissions accounting framework. This means that if Canada were to meet an international emission reduction commitment, other emissions sources would have to reduce emissions further to compensate for these "unclaimed" emissions.

These are significant issues — issues that make the broad application of life-cycle emissions accounting a non-starter in a world where Canada is committed to meeting GHG emission reduction commitments under the Kyoto Protocol.

Nonetheless, it is possible to envision a scenario where Canada uses life-cycle accounting principles to assign responsibility for GHG emissions on a more limited scale. Canada could unilaterally adopt such principles with respect to some products (e.g., electricity, fossil fuels, some basic materials) if imports and exports were excluded from the system. In other words, the application of life-cycle principles to goods and services that release GHG emissions at all stages of their life within Canada would not have any impact on Canada's ability to comply with the Kyoto Protocol.

As a result, it is possible to envision domestic emissions trading system designs that incorporate life-cycle principles and assign responsibility for GHG emissions on a life-cycle basis. This paper will now examine these options.

Applying Life-Cycle Emissions Accounting Within a Domestic GHG Credit Trading System

Two of the potential domestic emissions trading systems being examined by the NRTEE are credit trading systems.[11] In credit trading systems, GHG emission reduction credits are created when a specific action is taken that results in GHG emissions being lower after the action is taken (action scenario) than if the action had not been taken (baseline scenario). The difference between these two scenarios is the GHG emission reduction credit. Although organizations may want to use such credits to meet voluntary objectives (NRTEE Option 1), it is likely that significant demand for such credits will only develop when they can be used to help meet a mandated standard or other regulatory objectives (NRTEE Option 8).

From an environmental perspective, life-cycle GHG emissions must be considered when taking any action to protect the climate. The environment will not benefit if an action reduces emissions at a specific time and place but produces emission increases that more than offset this decrease in other parts of the life cycle. This is one reason why most credit trading systems require that an emission reduction, if it is to be credited, pass the test of "emissions additionality."[12]

11 See NRTEE Options 1 (Voluntary Credit Trading) and 8 (Voluntary Credit Trading with Mandatory Performance Standards).

12 In many credit trading systems, it is a requirement that the emission reductions be "real." See NRTEE Issue Paper 9, *Possible Criteria for the Creation of Emissions Reductions Credits Under a Domestic Emissions Trading Credit Program.*

Can GHG emission reduction credits be calculated with a life-cycle emissions accounting methodology? The answer is clearly yes for some emission reduction activities. As noted earlier, it is possible to calculate life-cycle GHG emissions associated with the use of electricity, fossil fuels and a number of basic materials. If a user of these energy sources or materials develops both a baseline scenario and an action scenario that reflect life-cycle emissions, it is possible to calculate and seek credit for the life-cycle emission reductions associated with an action taken by the user. This is likely to be much easier to do in a credit trading system where baselines are established on a project by project basis (NRTEE Option 1) than in systems where baselines are mandated standards (NRTEE Option 8), unless those standards are developed to reflect life-cycle emissions accounting.

The adoption of life-cycle emissions accounting is particularly relevant in the case of electricity, where 100% of the GHG emissions are produced upstream from the user. Under conventional accounting methods, electricity users would not see their own GHG emissions decline if they implemented actions that reduced their demand for electricity. Instead, it would be the GHG emissions of the electric utility that would decline. A life-cycle emissions accounting approach would allow an electricity user to take on responsibility for those upstream emissions. While less significant, upstream emissions associated with production and distribution of oil and natural gas still account for approximately 15% of the total GHG emissions emitted throughout the life cycle of these fuels.

Although the adoption of life-cycle accounting principles need not pose a major methodological challenge to the calculation of GHG emission reduction credits for a subset of activities undertaken in a credit trading system, other issues need to be addressed before such principles can be adopted. Specifically, the ownership of the credit must be clear.

For example, if a firm hires an energy service company to do an energy retrofit of its facilities, that retrofit is likely to reduce the GHG emissions directly produced from the use of fossil fuels on-site for heating. Under this scenario, the firm and the energy service company must decide who owns the resulting emission reduction credit. This issue is likely to be resolved in the negotiation of the contract between the two parties.

Determining ownership of life-cycle GHG emission reductions, however, is likely to be much more complex. For example, a reduction in the use of fossil fuels on-site for heating will also reduce GHG emissions associated with the production and transmission of that fossil fuel. If either the firm or the energy service company wishes to claim these emission reductions, it will be necessary for them to ensure that these emission reductions are not claimed by the producer and distributor of the fossil fuel. Specifically, the producer and distributor of the fossil fuel will need to be clear that they will not claim these upstream emission reductions against their own requirements to control GHG emissions. Without such an understanding and if both the firm and the fossil fuel producer claim these upstream emission reductions, double counting of emission reductions will occur.

When life-cycle emissions can be credibly calculated, double counting is the main concern associated with life-cycle accounting principles in a credit trading system. It is therefore essential to clearly define ownership of life-cycle GHG emission reductions. This could be done either by establishing rules of ownership as part of the credit trading system or through negotiated agreements in the marketplace. If ownership of GHG emission reductions is clearly defined, there is no reason not to allow participants to claim life-cycle GHG emission reduction credits within a domestic credit trading system.

To sum up, it will not be possible to broadly adopt life-cycle emissions accounting principles within a domestic emission reduction credit trading system. Under a voluntary credit trading system (NRTEE Option 1), it should be possible to create life-cycle

GHG emission reduction credits in the subset of cases where calculations can be done credibly and ownership issues are clearly resolved. Under a system of mandatory standards with voluntary credit trading (NRTEE Option 8), the potential use of life-cycle emissions accounting methods would be limited to those areas where mandatory standards (baselines) can be developed that incorporate life-cycle emissions accounting principles.

Applying Life-Cycle Emissions Accounting Within a Domestic Cap and Allowance Emissions Trading System

Three of the NRTEE's potential domestic emissions trading systems for GHGs (NRTEE Options 11, 13 and 14) are cap and allowance emissions trading systems.[13] Under a cap and allowance emissions trading system, regulated limits on GHG emissions are established for a set of sources of GHG emissions, and allowances are then allocated (usually to the sources regulated) to emit a portion of the total emissions cap. At the end of the compliance period (usually a year) all sources regulated must hold allowances equal to the amount of emissions they have produced. If emissions are greater than the allowances held, the source has to purchase additional allowances to be in compliance with the regulation.

As noted earlier, it is possible to use life-cycle GHG emissions accounting methods for emissions produced throughout the life cycle of fossil fuels. NRTEE Options 11, 13 and 14 reflect current GHG emissions accounting methods. They impose the regulatory requirement to hold allowances on both producers and large consumers of these fuels. Under these systems, producers and consumers of fossil fuels have no direct incentive to limit the life-cycle GHG emissions associated with these products.

A cap and allowance emissions trading system based on life-cycle GHG emissions accounting, however, imposes responsibility for all the GHG emissions produced throughout the life cycle of the fuel on either the consumer, distributor or producer of these fuels. If the system regulated the major users of fossil fuels, these organizations would be required to hold allowances for the GHG emissions associated with their combustion of fossil fuels as well as the emissions generated by the production and distribution of those fuels.

Making fossil fuel users responsible for the life-cycle GHG emissions associated with those fuels produces the following changes in the scope and comprehensiveness of the emissions trading system relative to those proposed in NRTEE Options 11, 13 and 14:

1. It removes fossil fuel producers, importers and distributors from the system, while the emissions produced by these sources become the responsibility of the fossil fuel users participating in the program.
2. It increases the number of sources required to participate in the program to meet any given environmental objective, because there are more users than importers and producers of fossil fuels. For example, NRTEE Options 11, 13 and 14 impose a regulatory requirement to hold allowances associated with the production and distribution of electricity on electric utilities. To cover these emissions under a system based on life-cycle principles, one would have to impose regulatory requirements to hold allowances on all users of electricity (e.g., residential, commercial).

13 See NRTEE Option Paper: *Description of Different Potential Allowance Trading Programs for Canada.*

3. It makes it more difficult to include transportation-related emissions in the emissions trading system, because it would require that a large number of small users of transportation services be regulated and required to hold allowances equal to their actual emission levels.

The most important changes, however, relate to the provision of incentives by the trading system. Under a cap and allowance emissions trading system where fossil fuel users are made responsible for all GHG emissions associated with fossil fuel production, distribution and use:

- there is little direct incentive for fossil fuel producers and importers to reduce their GHG emissions, because they are not directly regulated by the system;
- there is a clear incentive for fossil fuel users to reduce GHG emissions generated on-site (as in NRTEE Options 11, 13 and 14); and
- there is a clear incentive for fossil fuel users to reduce GHG emissions associated with fossil fuel production and distribution, because the regulation makes them responsible for these emissions.

Fossil fuel users can reduce upstream GHG emissions through consumer choice and procurement decisions. The strength of the incentive for doing so, however, depends upon how life-cycle GHG emissions are calculated. For example, if the upstream emission factors used to calculate life-cycle emissions associated with natural gas production and distribution are industry averages, there is little incentive to favour those natural gas producers whose production is less carbon intensive than their competitors in the industry. This is because any individual procurement decision will have a negligible impact on average upstream emissions in the natural gas industry. On the other hand, if life-cycle emissions are calculated on the basis of firm by firm emission factors, fossil fuel users will have a strong incentive to choose producers of natural gas with a lower carbon intensity.

If fossil fuel users are responsible for life-cycle emissions, there is little direct incentive for fossil fuel producers and importers to reduce GHG emissions. Nonetheless, they may have an indirect incentive to do so if it is clear that fossil fuel consumers are beginning to favour fossil fuel producers and importers that have a lower carbon intensity.

It is also possible to make producers responsible for the life-cycle emissions associated with the production, distribution and use of fossil fuels. This possibility is discussed in the next section.

Applying Life-Cycle Emissions Accounting Within a Domestic Carbon Content Cap and Allowance Trading System

One of the potential domestic GHG emissions trading systems examined in the NRTEE process is an upstream carbon content emissions trading system (NRTEE Option 4).[14] Under this system, fossil fuel producers and importers are regulated and required to hold allowances equivalent to the carbon content (i.e., potential GHG emissions) of all fossil fuels sold for use in Canada. Allowances to emit under the cap are then allocated (usually to fossil fuel producers and importers). To be in compliance, a fossil fuel producer or importer must hold allowances equivalent to the carbon content of all fossil fuels sold for use in Canada at the end of each year.

Of all the options being examined by the NRTEE, this is the one that most closely reflects life-cycle emissions accounting principles. Under this system, fossil fuel producers and importers are essentially assigned responsibility for all GHG emissions

14 See NRTEE Option 4, *Cap on Carbon Content of Fossil Fuels Produced and Imported.*

associated with the production, use and disposal of their product in Canada.[15] Moreover, this option imposes a life-cycle emissions perspective on the producer of fossil fuels.

Under NRTEE Option 4, fossil fuel producers and importers have a strong incentive:

- to reduce GHG emissions associated with their own use of fossil fuels because they face a regulatory requirement to hold allowances equivalent to those emissions;[16] and
- to reduce GHG emissions associated with the combustion by consumers of the fossil fuels they supply because the regulatory requirement also makes it necessary for them to have allowances to cover these emissions.

While fossil fuel producers and importers have a strong incentive to reduce the GHG emissions of fossil fuel users, they have few tools to influence fossil fuel users. As a result, fossil fuel producers and importers would be forced to increase prices for their products to provide an incentive for users to reduce their demand for fossil fuels. This price signal would reflect the carbon content of the fuel being sold, much like a carbon tax.

Can fossil fuel producers and importers increase prices enough to pass responsibility for the life-cycle GHG emissions associated with fossil fuels back to fossil fuel users? The answer is no. This would only occur if the price increases generated by the emissions trading system allowed all fossil fuel producers and importers to recover the full cost of the allowances they need to comply with their obligations under the cap and allowance trading system.[17] This is unlikely to happen.

Canadian producers of crude oil and petroleum products are unlikely to command a higher price from consumers, because their products compete in a global market where a significant portion of the total supply comes from countries that would not face legally binding emission limitation commitments under the Kyoto Protocol. Canadian coal producers would face a similar situation, because they compete in both domestic and international markets with a number of countries that would not face legally binding emission limitation commitments under the Kyoto Protocol.

The situation is somewhat different for Canadian natural gas producers. These companies may be able to command a higher price for their exports to the United States, because American natural gas producers are likely to face similar obligations to reduce GHG emissions from natural gas production. Moreover, liquid natural gas from developing countries is substantially more expensive than that produced in North America. On the other hand, Canadian producers will have to compete with Mexican exports of natural gas and are likely to face increased competition from oil (because the global market will keep its price down). As a result, Canadian natural gas producers are likely to be able to recover some, but not all, of their costs through higher prices.

Would it make more sense to design an allowance emissions trading system that imposed regulatory requirements on producers and importers (NRTEE Option 4) or consumers (adjusted NRTEE Options 11, 13 and 14) to hold allowances for the life-cycle emissions implications associated with the use of fossil fuels for energy purposes?

15 NRTEE Issue Paper 5 on the treatment of feedstocks discusses a variety of options through which such a system can address fossil fuels that are not used for energy purposes.

16 According to the Canadian Association of Petroleum Producers, GHG emissions associated with oil and gas production are only one-ninth of the emissions associated with fossil fuel combustion by end users.

17 This is true for the producers of all products. If aluminum producers face a cap on GHG emissions (e.g., under NRTEE Options 11, 13 and 14), responsibility for the upstream emissions associated with the production of aluminum will not be shifted to aluminum users unless producers can increase prices to the point where they can recover the costs of the allowances they need to be in compliance with the system. The extent to which this is possible will depend on the structure of the world or regional market for specific products.

Designing a system that focuses on the producer:

- keeps the number of participants in the system manageable;
- ensures that virtually all emissions will be covered by the system;
- provides a strong direct incentive to reduce GHG emissions associated with the production of fossil fuels;
- uses a price signal to provide an indirect incentive to users of fossil fuels to reduce their GHG emissions; and
- is consistent with existing international emissions accounting rules through its treatment of imports and exports.

Designing a system that focuses on the consumer:

- vastly increases the number of potential participants — limiting the potential coverage of emissions provided by the system;
- provides a strong direct incentive to consumers of fossil fuels to reduce GHG emissions associated with their own combustion of these fuels;
- uses consumer choice in the marketplace to provide an indirect incentive to producers of fossil fuels to reduce their GHG emissions; and
- is difficult to design to be consistent with existing international emissions accounting rules (because it is hard to trace imports of fuels to specific end uses).

It would also be possible, however, to design a cap and allowance emissions trading system that imposed a regulatory requirement on the distributors of energy that made them responsible for the life-cycle emissions associated with the production, distribution and use of fossil fuels. While this is not one of the options being considered by the NRTEE, a focus on the distributor would have a number of benefits when applying a life-cycle emissions perspective:

- distributors can easily use firm by firm emission factors to calculate life-cycle emissions, because they purchase directly from producers;
- as the mid-point in the chain, distributors have clear incentives to choose less carbon-intensive producers and to help large fossil fuel users reduce their emissions;
- there are fewer distributors than there are either producers or users; and
- the system can be designed to be consistent with international emissions accounting rules, because distributors of fossil fuels can track and monitor exports and imports.