31 August 2015

Mr. Bob Hamilton, Deputy Minister
Natural Resources Canada
580 Booth Street
21st Floor Room B5-1
Ottawa, ON
K1A 0E4

Bob.Hamilton@NRCan-RNCan.gc.ca

Information Request: IR0208

Dear Mr. Hamilton:

As you are likely aware, the Parliamentary Budget Officer (PBO) provides independent analysis to the Senate and to the House of Commons about the nation's finances and the economy, the estimates of the government, and the cost of programs, legislation, and policies. In carrying out its mandate, the PBO often requires access to information held by government departments. When such information is needed, the PBO makes a request to the department holding the information.

The PBO is currently undertaking an analysis pursuant to section 79.2(a) of the *Parliament of Canada Act*, which mandates the PBO to "provide independent analysis to the Senate and to the House of Commons about the state of the nation's finances, the estimates of the government and trends in the national economy."

In pursuing this work, the PBO would ask that, in accordance with the *Communications Policy of the Government of Canada*, you provide access to the following information:

> The PBO is undertaking a study concerning greenhouse gas emissions, with the goal of outlining potential reductions. We would like to get clarifications from Natural Resources Canada concerning a few industries where some information is available but is scattered and not always clear.
>
> We would welcome the opportunity to either discuss these issues at a meeting, or receive written responses. We would also welcome hearing from your experts on a background basis; that is, where we use the information to confirm or learn about issues, without necessarily making a reference to NRCAN on that issue
>
> Our questions concern the following industries:

Cement

- There is substantial possibility to reduce emissions from cement production though (1) improved energy efficiency; (2) using alternative fuels; (3) substitute out clinker; and (4) carbon capture and storage (CCS). All of these would likely make cement more expensive. (1) and (2) are somewhat predictable since the difference in cost between current fuel sources and non-greenhouse-gas alternatives is available. (3) is limited since only a fraction of clinker can be eliminated (about 20%, we believe). (4) is perhaps the most difficult, but the only way to eliminate the remaining half of current emissions that are process-related. We note that a US Department of Energy estimate suggests that the implicit cost of CCS is about $26 per ton of CO2 for a new coal-burning electricity plant. There is a CCS demonstration project in Saskatchewan (Boundary Dam) that applies CCS for enhanced oil recovery. Use of CO2 in enhanced oil recovery is considered a mature technology given that it has been widely used.

- Is the cost in Saskatchewan similar to the US DOE estimate, and would this be applicable to CCS in cement production?

Iron and Steel

- The main source of CO2 emissions from Iron and Steel is in the production of iron from iron ore. In particular, blast furnace (BF) technologies generate considerable CO2 emissions when processing iron ore into pig iron. A newer technology that has been applied to process iron ore is direct reduction (DR). It uses a reducing agent such as natural gas and has no CO2 emissions in making high grade iron pellets. Its use world-wide has grown at a very rapid rate since the 1990's. In combination with electric arc furnaces (EAF), this has the potential to eliminate much of the CO2 emissions from steel production.

- Are there limits concerning how far DR can go in eliminating BF for processing iron ore? Related to this is a question concerning the cost of DR as it is deployed ever more widely. Is it possible for DR to eliminate all BF in iron production with only a modest increase in the cost of steel? Since India is a major user of the DR technique, we expect that the answer to this latter question is yes.

Buildings

- Buildings are an important source of CO2 emissions during the winter when natural gas or fuel oil is used to heat buildings. In regions that use coal or natural gas to produce electricity, air conditioning and any other building-related electricity uses also contribute to emissions. Better insulation as well as higher quality doors and windows, and more efficient lighting (LEDs) can significantly lower energy use for a house or building (though LEDs provide no additional saving in commercial buildings). For new structures, the cost of meeting high energy efficiency standards is estimated to be around 5% of the construction cost (with variation around that depending on a number of factors). The payback period is considered to be around 8 years, so the annual return on that investment is about 12% (we are not certain if this includes the opportunity cost of the 5% investment). Liquidity-constrained builders and principal-agent problems might be causing those gains to go unrealised. For existing buildings, the issue is less clear since the age of a structure matters for what can be done, and also past government programs that provided incentives for retrofitting had substantial uptake.

- Is the estimate of 5% additional cost and 8 year payback for building "green" buildings consistent with NRCAN's own analysis? Is there any analysis of cost and potential uptake for renewed programs for building retrofits?

Transportation

- Improvements in the internal combustion engine and more widespread use of hybrid technologies are estimated, on their own, to be able to reduce emissions from vehicles by up to 40%. This would be at moderate costs above today's implemented technology (ranging from CO2 cost equivalents of $30 to $100 per tonne).

- Does NRCAN have its own estimates that confirm or are different from these CO2 cost equivalents.

Chemicals

- About half of Canada's emissions from industrial chemical production come processes such as making ammonia (the other half is in burning fuels to generate heat – which could be substituted out). The main way to eliminate CO2 from ammonia production will be to capture it and store it (CCS).

- Would the costs of CCS outlined for coal-based electricity generation be applicable to ammonia production?

We would appreciate that you provide access to this information by 18 September 2015. If we do not hear back from you by that date, we may consider your non-response a deemed refusal and, accordingly, report it to our named committees as instructed.

Attached is a reply form. It too should be filled out and returned by 18 September 2015, whether or not you provide access to the requested information. The details contained in the reply form will assist us in preparing the PBO annual report.

Your response letter will be posted on the PBO website and, therefore, it should not be marked "confidential". Could you please attach the requested information separately. If this information is confidential, please clearly mark it as such, either on the electronic spreadsheet or the hard copy version.

Should you or your staff have any questions about this information request, the analyst responsible, Philip Bagnoli can be contacted directly at Philip.Bagnoli@parl.gc.ca, 613-286-2687.

I want to thank you for your assistance in this matter. Providing timely and effective analysis to the Senate and House of Commons is the PBO's primary objective. The degree to which this is possible depends, to a large extent, on free and timely access to quality information held by government departments. In doing so, you are assisting us in better serving the Senate, the House of Commons, and their members.

Yours sincerely,

Jean-Denis Fréchette
Parliamentary Budget Officer

c.c.: Mr. Douglas Nevison, Assistant Secretary to the Cabinet,
Privy Council Office, Liaison Secretariat for Macroeconomic Policy
Stéphane McNicholl, Manager, PAU, Ministerial and Public Affairs Division
Natural Resources Canada

Attachment: Reply form for IR0208

Reply Form / Formulaire de réponse

31 August 2015 / 31 août 2015

Natural Resources Canada / Ressources naturelles Canada

1. Information request No.: / N° de la demande d'information :	IR0208
2. Response required by: / Réponse demandée d'ici le :	18 September 2015 / 18 septembre 2015
3. Contact: / Personne-ressource :	Philip Bagnoli, Philip.Bagnoli@parl.gc.ca, 613-286-2687
4. Information requested: /	The PBO is undertaking a study concerning greenhouse gas emissions, with the goal of outlining potential reductions. We would like to get clarifications from Natural Resources Canada concerning a few industries where some information is available but is scattered and not always clear. We would welcome the opportunity to either discuss these issues at a meeting, or receive written responses. We would also welcome hearing from your experts on a background basis; that is, where we use the information to confirm or learn about issues, without necessarily making a reference to NRCAN on that issue. Our questions concern the following industries: **Cement** There is substantial possibility to reduce emissions from cement production though (1) improved energy efficiency; (2) using alternative fuels; (3) substitute out clinker; and (4) carbon capture and storage (CCS). All of these would likely make cement more expensive. (1) and (2) are somewhat predictable since the difference in cost between current fuel sources and non-greenhouse-gas alternatives is available. (3) is limited since only a fraction of clinker can be eliminated (about 20%, we believe). (4) is perhaps the most difficult, but the only way to eliminate the remaining half of current emissions that are process-related. We note that a US Department of Energy estimate suggests that the implicit cost of CCS is about $26 per ton of CO2 for a new coal-burning electricity plant. There is a CCS demonstration project in Saskatchewan (Boundary Dam) that applies CCS for enhanced oil recovery. Use of CO2 in enhanced oil recovery is considered a mature technology given that it has been widely used. Is the cost in Saskatchewan similar to the US DOE estimate, and would this be applicable to CCS in cement production? **Iron and Steel** The main source of CO2 emissions from Iron and Steel is in the production of iron from iron ore. In particular, blast furnace (BF) technologies generate considerable CO2 emissions when processing iron ore into pig iron. A newer technology that has been applied to process iron ore is direct reduction (DR). It uses a reducing agent such as natural gas and has no CO2 emissions in making high grade iron pellets. Its use world-wide has grown at a very rapid rate since the 1990's. In combination with electric arc furnaces (EAF), this has the potential to eliminate much of the CO2 emissions from steel production. Are there limits concerning how far DR can go in eliminating BF for processing iron ore? Related to this is a question concerning the cost of DR as it is deployed ever more widely. Is it possible for DR to eliminate all BF in iron production with only a modest increase in the

	cost of steel? Since India is a major user of the DR technique, we expect that the answer to this latter question is yes. **Buildings** Buildings are an important source of CO2 emissions during the winter when natural gas or fuel oil is used to heat buildings. In regions that use coal or natural gas to produce electricity, air conditioning and any other building-related electricity uses also contribute to emissions. Better insulation as well as higher quality doors and windows, and more efficient lighting (LEDs) can significantly lower energy use for a house or building (though LEDs provide no additional saving in commercial buildings). For new structures, the cost of meeting high energy efficiency standards is estimated to be around 5% of the construction cost (with variation around that depending on a number of factors). The payback period is considered to be around 8 years, so the annual return on that investment is about 12% (we are not certain if this includes the opportunity cost of the 5% investment). Liquidity-constrained builders and principal-agent problems might be causing those gains to go unrealised. For existing buildings, the issue is less clear since the age of a structure matters for what can be done, and also past government programs that provided incentives for retrofitting had substantial uptake. Is the estimate of 5% additional cost and 8 year payback for building "green" buildings consistent with NRCAN's own analysis? Is there any analysis of cost and potential uptake for renewed programs for building retrofits? **Transportation** Improvements in the internal combustion engine and more widespread use of hybrid technologies are estimated, on their own, to be able to reduce emissions from vehicles by up to 40%. This would be at moderate costs above today's implemented technology (ranging from CO2 cost equivalents of $30 to $100 per tonne). Does NRCAN have its own estimates that confirm or are different from these CO2 cost equivalents. **Chemicals** About half of Canada's emissions from industrial chemical production come processes such as making ammonia (the other half is in burning fuels to generate heat – which could be substituted out). The main way to eliminate CO2 from ammonia production will be to capture it and store it (CCS). Would the costs of CCS outlined for coal-based electricity generation be applicable to ammonia production?
Information demandée :	Le DPB entreprend une étude des émissions de gaz à effet de serre dans le but d'établir les possibilités de réduire ces dernières. Nous aimerions obtenir de Ressources naturelles Canada (RNCan) des clarifications au sujet de quelques industries pour lesquelles des renseignements sont disponibles, mais de façon éparse, et pas nécessairement claire. Nous serions heureux de discuter de ces questions lors d'une rencontre, ou bien d'y recevoir des réponses écrites. Nous serions également heureux d'entendre vos experts se prononcer sur le contexte de ces questions, information que nous utiliserons pour confirmer ou approfondir ces dernières, sans nécessairement citer expressément RNCan sur le sujet. Nos questions portent sur les industries suivantes : **Ciment** Il existe d'importantes possibilités de réduire les émissions liées à la production de ciment par 1) l'amélioration de l'efficacité énergétique; 2) le recours à des combustibles de remplacement; 3) le remplacement du clinker par un substitut et 4) le captage et le stockage du carbone (CSC). Toutes ces solutions auraient probablement pour conséquence de rendre le ciment plus coûteux. Dans les cas 1) et 2), l'augmentation du coût peut être plus ou moins évaluée, puisque la différence de coût entre les carburants actuels et leurs substituts n'émettant pas de gaz à effet de serre est connue. La 3) est d'une portée limitée, car seule une partie du clinker (environ 20 % croyons-nous) pourrait être remplacée. La 4) est probablement la plus difficile à mettre en œuvre, mais elle constitue le

seul moyen d'éliminer la moitié restante des émissions qui sont liées au processus lui-même. Nous avons constaté que le Département américain de l'énergie estime que le coût implicite du CSC est à environ 26 $ par tonne de CO2 pour une nouvelle centrale électrique au charbon. Il existe un projet pilote de CSC en Saskatchewan (à Boundary Dam) dans lequel le CSC est appliqué à la récupération assistée du pétrole. L'emploi du CO2 dans la récupération assisté du pétrole est considéré comme une technologie qui a fait ses preuves puisqu'elle est largement utilisée.

Le coût du projet pilote en Saskatchewan est-il similaire à l'estimation du Département américain de l'énergie, et serait-il applicable au CSC dans le contexte de la production de ciment?

Fer et acier

La principale source d'émissions de CO2, pour le fer et l'acier, est la production de fer à partir de minerai de fer. Les hauts fourneaux (HF), en particulier, produisent énormément de CO2 lors de la transformation du minerai de fer en fonte brute. Une technologie plus récente de traitement du minerai de fer est la réduction directe (RD) qui consiste à recourir à un agent réducteur tel que le gaz naturel pour produire sans émissions de CO2 des boulettes ayant une teneur élevée en fer. Cette technologie a été rapidement adoptée dans le monde entier depuis les années 1990 et, combinée à l'emploi de fours électriques à arc (FEA), elle pourrait permettre d'éliminer une grande partie des émissions de CO2 liées à la production d'acier.

Existe-t-il une limite à la mesure dans laquelle la RD pourrait éliminer le recours aux HF pour la transformation du minerai de fer? Et, liée à cette question, se pose celle du coût de la RD alors qu'elle est de plus en plus populaire dans le monde entier. Est-il possible que la RD remplace totalement les HF pour la production de fer avec seulement une faible augmentation du coût de l'acier? Étant donné que l'Inde est l'un des principaux pays à utiliser la RD, nous nous attendons à ce que la réponse à cette dernière question soit « oui ».

Immeubles

Les immeubles constituent une source importante de CO2 durant l'hiver lorsque du gaz nature ou du mazout sont utilisés pour les chauffer. Dans les régions où le charbon ou le gaz naturel sont utilisés pour produire l'électricité, la climatisation, et toute autre utilisation de l'électricité dans l'immeuble, contribue également aux émissions. Une meilleure isolation, de même que des portes et des fenêtres de meilleure qualité, et un éclairage plus efficace (DEL) peuvent considérablement réduire la consommation énergétique d'une maison ou d'un immeuble (bien que les DEL ne permettent pas d'économies additionnelles dans les immeubles commerciaux). Pour de nouvelles constructions, le coût lié aux respects de normes d'efficacité énergétique élevées est estimé à environ 5 % du coût de la construction (avec quelques variations selon un certain nombre de facteurs). La période de récupération est évaluée à environ 8 ans, de telle sorte que le rendement annuel de l'investissement est d'environ 12 % (nous ne savons pas si ce chiffre inclut le coût d'option de l'investissement de 5 %). Le manque de liquidité des constructeurs et les problèmes mandant-mandataire font que ces gains peuvent ne pas se concrétiser. Pour les immeubles existants, la question est moins simple, car l'âge de la structure entre en jeu et détermine ce qui peut être accompli, mais les programmes gouvernementaux passés qui encourageaient la rénovation ont connu une popularité considérable.

Les estimations relatives à la construction d'immeubles « verts », soit un surcoût de 5 % et une période de récupération de 8 ans, sont-elles conformes à votre propre analyse? Existe-t-il une analyse du coût et de la popularité potentielle de nouveaux programmes de rénovation d'immeubles?

Transports

L'amélioration des moteurs à combustion interne et l'utilisation plus répandue des technologies hybrides peuvent, à elles seules, selon les estimations, réduire les émissions liées aux véhicules de près de 40 %. Cela pourrait se faire à un coût légèrement plus élevé à celui des technologies en cours actuellement (pour un coût équivalent allant de 30 $ à 100 $ par tonne de C02).

Disposez-vous d'estimations confirmant ou infirmant ces chiffres en matière de coût

	équivalent par tonne de CO2? Chimie Environ la moitié des émissions de l'industrie chimique canadienne provient de processus tels que celui de production de l'ammoniaque (l'autre moitié provenant de l'utilisation de combustibles pour produire de la chaleur pour laquelle il existe des substituts). Le principal moyen d'éliminer le CO2 lié à la production d'ammoniaque est de le capter et de le stocker (CSC). Le coût estimé du CCS pour une centrale électrique au charbon serait-il applicable à la production d'ammoniaque?			
5. Information requested: / Information demandée :	☐ Provided / Communiquée	*Go to the next question. / Passez à la question suivante.*	☐ Not provided / Non communiquée	*Please provide your details below. / Fournissez vos coordonnées ci-dessous.*
6. Do you consent to the public disclosure of the information? / Consentez-vous à ce que les renseignements soient divulgués publiquement?	☐Yes / Oui		☐No / Non	

Name (Please print.):/ Nom (En caractères d'imprimerie S.V.P.) :	Click here to enter text.		
Title: / Titre :	Click here to enter text.		
Signature:		Date:	Date

Please return this completed reply form to:

Mr. Jean-Denis Fréchette
Parliamentary Budget Officer
Office of the Parliamentary Officer
50 O'Connor Street, 10th Floor
Ottawa, ON K1A 0A9

Veuillez faire parvenir le formulaire rempli à :

Monsieur Jean-Denis Fréchette
Directeur parlementaire du budget
Bureau du Directeur Parlementaire du Budget
50, rue O'Connor, 10e étage
Ottawa (Ontario) K1A 0A9