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January 5, 2012

MEMO TO: Reid Miner, Kirsten Vice

FROM: Brad Upton

COPY: Steve Stratton

SUBJECT: Review of December 21 Amendments to Western Climate Initiative "Harmonized" Essential Requirements for Canadian Jurisdictions

The Western Climate Initiative (WCI) published its *Final Essential Requirements for Mandatory Reporting* (ERs) of greenhouse gases on July 16, 2009, and on June 1, 2010, proposed *Harmonized Reporting Requirements* for both U.S. states and Canadian provinces in response to the USEPA Mandatory GHG Reporting Rule (published in the Federal Register October 30, 2009). The harmonized requirements for Canadian jurisdictions were finalized on December 17, 2010, and were summarized in an NCASI memorandum dated January 6, 2011 (attached). On December 21, 2011, WCI published *2011 Amendments for Harmonization of Reporting in Canadian Jurisdictions*. WCI has not published amendments to its ERs for U.S. jurisdictions, which were last updated on November 15, 2010.

The 2011 amendments to the Canadian ERs include minor changes to various sections and broader updates to sections related to petroleum and natural gas. WCI states that the amendments are primarily in response to revisions of the USEPA GHG rule, which were finalized on December 17, 2010, and to input on technical issues from various WCI Partner Jurisdictions. No changes were made to the general provisions of the ERs, nor to Section WCI.210, Pulp and Paper Manufacturing. Aspects of the amendments to Section WCI.20, General Stationary Combustion, that are of significance to the forest products industry are summarized in this memorandum.

Although WCI did not publish amendments to Section WCI.210, the December 21 amendments contain a list of errata changes that include a note which is now placed at the top of Sections WCI.40 (Electricity Generation) and WCI.210:
"Note: CO_2, CH_4, and N_2O emissions from spent/pulping liquor combusted to produce electricity in the process of pulp and paper manufacturing should be reported under WCI.210, starting with the 2011 reporting year…" The inclusion of this note clarifies that emissions from recovery furnaces should not be reported as emissions from electrical generation units.

Stationary Combustion Sources

The amended ERs include a note in Section WCI.22 which clarifies that emissions from spent pulping liquor combusted in the process of pulp and paper manufacturing should be reported under WCI.210 starting with the 2011 reporting year. This is similar to the note added to Sections WCI.40 and WCI.210, mentioned above, and clarifies that recovery furnaces are not considered to be electrical generation units.

Also clarified, in Section WCI.23, is that there is no requirement to report emissions from combustion of fuels that are not listed in WCI Tables 20-1 through 20-7 nor in USEPA Tables C-1 or C-2, as long as the sum of emissions from these fuels does not exceed 0.5% of total facility emissions. If the sum of emissions from these fuels exceeds 0.5% of total facility emissions, emissions from one or more of the fuels must be reported, as needed, until the sum of emissions from the remaining unlisted fuels does not exceed 0.5% of total facility emissions.

As outlined in detail in the attached January 2011 NCASI memorandum, the WCI ERs and the USEPA rule both provide four levels of CO_2 calculation methodologies, with the WCI ERs typically prescribing use of higher methodologies with more extensive monitoring requirements than the USEPA rule, especially for facilities that are subject to verification requirements. Some WCI partner jurisdictions use the verification requirement threshold as a trigger for mandated reporting. Only significant changes to the WCI methods, reflective of the December 2011 amendments, are presented herein.

WCI Methodology 2, based on use of default emission factors and HHV from fuel testing, now includes a provision for optional use of a site-specific emission factor for solid biomass fuels (and municipal solid waste - MSW), determined through measurements, when biogenic CO_2 emissions are calculated based on steam generation rates via Equation 20-3. The site-specific emission factor must be updated no less often than every third year.

WCI Methodology 3, based on fuel carbon content testing, now allows the optional use of Equation 20-3 for calculating biogenic CO_2 emissions from combustion of solid biomass fuels in units that generate steam. Calculating emissions via Equation 20-3 entails use of either default CO_2 emission factors or optional use of site-specific emission factors. Therefore, the amended Methodology 3 now allows use of default emission factors for calculating biogenic CO_2 emissions from combustion of listed solid biomass fuels in units that generate steam, without the requirement to adjust the emission factor every three years based on source testing. Methodology 3 also allows use of "measured emission factor[s] for biomass solid fuels… adjusted no less often than every third year" via Equation 20-5.

The amended WCI ERs mandate re-calibration of fuel oil and gas flow meters once every three years (or at the minimum frequency specified by the manufacturer) rather than annually (as was previously required).

The amended WCI ERs also provide enhanced flexibility (relative to the December 2010 ERs) with regard to methods for determining fuel HHV and carbon content. The ERs now allow use of methods "published by a consensus-based standards organization if such a method exists," and “[use of] industry standard methods, noting where such methods are used and what methods are used” if no appropriate method is published by a consensus-based standards organization. The amended ERs include examples of specific test procedures that may be used in WCI.25(c)(1-4) and WCI.25(d)(1-3). The amended ERs include a list of example consensus based standards organizations in WCI.27.

The December 2010 ERs included two sets of emission factors for wood/wood residuals and two sets of emission factors for spent pulping liquor: one set from Environment Canada, which have been documented as erroneous[1]; and one set drawn from the USEPA GHG reporting rule. The December 2011 amended ERs have replaced these with a single set of factors for each category of biomass fuel. The CO_2 emission factors were drawn from a report prepared for the British Columbia Ministry of Environment[2]. The CH_4 and N_2O emission factors for “wood waste” were drawn from the USEPA GHG reporting rule (and are equivalent to the 1996 IPCC[3] Tier 1 factors for wood and wood residuals). The CH_4 and N_2O emission factors for spent pulping liquor were drawn from the 2006 IPCC Guidelines for National GHG Inventories[4], Tier 1 factors for manufacturing industries and combustion.

Attachment

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1 NCASI documented these errors in 2004 via email and written comments between Environment Canada, NCASI, and FPAC

2 A Review of Biomass Emissions Factors. 2011. Clarity Works Ltd. Prepared for BC Ministry of Environment.

3 Intergovernmental Panel on Climate Change (IPCC). 1997. *1996 IPCC guidelines for national greenhouse gas inventories: Reference Manual (Vol. 3).* IPCC National Greenhouse Gas Inventories Programme.

4 Intergovernmental Panel on Climate Change (IPCC). 2006. *2006 IPCC guidelines for national greenhouse gas inventories, Vol. 2: Energy, Chapter 2: Stationary Combustion, Table 2.3*. IPCC National Greenhouse Gas Inventories Programme.

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January 6, 2011 [REVISED January 5, 2012]

MEMO TO: Reid Miner, Kirsten Vice

FROM: Brad Upton

COPY: Steve Stratton

SUBJECT: Review of Updated Western Climate Initiative "Harmonized" Essential Requirements for Mandatory GHG Reporting

This memorandum conveys updated information on The Western Climate Initiative's (WCI) efforts to harmonize its greenhouse gas (GHG) reporting requirements with those of the United States Environmental Protection Agency's (USEPA) Mandatory GHG Reporting Rule, and follows a memorandum on this topic from November 3, 2010. WCI published its Final Essential Requirements for Mandatory Reporting (ERs) on July 16, 2009, and on June 1, 2010, proposed "Harmonized Reporting Requirements" for both US states and Canadian provinces in response to the USEPA Mandatory GHG Reporting Rule (published in the Federal Register October 30, 2009).

WCI's approach to harmonizing its ERs and the USEPA rule for US jurisdictions, last updated and described as "final" on November 15, 2010, takes the form of a "redline" markup of the October 30, 2009, USEPA rule showing proposed changes to the USEPA program "that are needed to support a cap and trade program" (www.westernclimateinitiative.org). It is noteworthy that the USEPA rule has undergone significant revision since the original publication in the October 30, 2009, Federal Register that forms the basis of the WCI ER harmonization markup. [NCASI Corporate Correspondents Memorandum 10-042 outlines some of the changes that were published in the Federal Register on December 17, 2010.]

WCI released draft revised ERs for use in Canadian jurisdictions "to ensure harmonized quantification methods throughout the US and Canadian WCI jurisdictions" on September 8, 2010, and finalized the harmonized ERs on December 17, 2010 (www.westernclimateinitiative.org). It appears that several Canadian provinces are basing their mandatory GHG reporting programs on the WCI ERs.

Although differing in format, the two sets of harmonized reporting requirements–redline markup of USEPA rule for US WCI jurisdictions and stand alone report for Canadian WCI jurisdictions–

appear to be equivalent. However, they are not equivalent to the requirements of the USEPA mandatory GHG reporting rule, which is also ultimately anticipated to influence reporting requirements in a Canadian context and regional cap and trade programs throughout North America. In general, the ERs require more extensive monitoring and QA/QC measures than does the USEPA rule. An overview of the significant differences between the December 17, 2010, USEPA Mandatory GHG Reporting Rule and WCI Essential Requirements is provided herein. For convenience, quotations attributed to the WCI ERs are drawn from the December 17, 2010, Final Essential Requirements of Mandatory Reporting Amended for Canadian Harmonization. At this time it is not known if WCI will further modify its harmonizing ERs to reflect the revisions to the USEPA GHG rule which were finalized on December 17, 2010.

General Provisions

The WCI ERs require facility-wide GHG emissions reporting. The reporting threshold is 10,000 metric tons CO_2 eq. Biogenic CO_2 from stationary combustion sources must be included in the threshold determination, with two exceptions: if a WCI partner jurisdiction has made a determination that any biomass fuels are "carbon neutral" the CO_2 emissions from combustion of those fuels may be excluded from the threshold determination; and before a WCI jurisdiction has made a determination regarding biomass fuel carbon neutrality a maximum of 15,000 metric tons of CO_2 emissions from combustion of "pure solid biomass fuel" may be excluded from the threshold determination. The USEPA rule includes a 25,000 metric ton CO_2 eq reporting threshold, and biogenic CO_2 is excluded from the threshold determination.

The WCI program requires facilities with emissions of 25,000 tons CO_2 eq or greater to obtain annual emissions verification from a third party. The biogenic CO_2 exclusion conditions specified for the reporting threshold also apply to this verification threshold. Carbon dioxide emissions from combustion of biomass fuels that the WCI partner jurisdiction has deemed carbon neutral may be excluded from the scope of the verification program; however, a WCI partner jurisdiction may elect to require that biogenic CO_2 be included in the scope of verification. The verification requirements are intended to ensure sufficiently accurate and complete emissions reporting to support an anticipated cap and trade program. WCI recommends that carbon neutral biomass be excluded from any eventual cap and trade program. The USEPA rule does not require third party verification of emission reports, instead requiring that additional data sufficient for USEPA to perform any verification be reported. For example, the USEPA rule requires unit-specific reporting of emissions and of data used to calculate the emissions, whereas the WCI ERs require reporting of aggregated emissions by source category only.

The WCI ERs allow use of simplified emission calculation methods for *de minimis* sources, described as those that collectively emit no more than 3% of a facility's total emissions but not exceeding 20,000 metric tons CO_2 eq. The USEPA rule does not include a *de minimis* provision, rather it requires calculation and reporting of all emissions from sources that are specifically addressed by the rule.

Stationary Combustion Sources

The WCI ERs and the USEPA rule both provide four similar levels of CO_2 calculation methodologies. The WCI ERs refer to them as Methodologies, while the USEPA rule refers to them as Tiers. The WCI ERs typically prescribe use of higher methodologies with more extensive monitoring requirements for facilities that are subject to verification requirements (facilities subject to the verification requirements must adhere to more stringent monitoring methods when developing emission inventories). Some WCI partner jurisdictions use the verification requirement threshold as a trigger for mandated reporting.

The WCI ERs allow Methodology 1 for determining CO_2 emissions using default emission factor and default higher heating value (HHV) for facilities subject to verification requirements only from combustion of natural gas (HHV between 36.3 and 40.98 GJ/m^3) in units with a rated heat input capacity ≤250 MMBtu/hr (264 GJ/hr), certain biomass fuels that are "exempted from verification requirements by the jurisdiction, unless … specifically addressed under the provisions for another source category (e.g., spent pulping liquor…)" burned in units of any size, and fuels listed in WCI Table 20-1a (which includes distillate fuel oils and 14 other fuels such as propane, LPG, and gasoline, but not other fuels often burned in boilers such as residual oil and coal) burned in units of any size. The USEPA rule allows Tier 1 for any fuel for which default emission factors and HHV are provided in Table C-1 (which includes commonly used fuels such as residual oil and coal) when the fuel is burned in units <250 MMBtu/hr, and for listed biomass fuels and natural gas for which billing meters expressing quantities in therms or MMBtu are used to quantify fuel use, burned in units of any size. WCI Methodology 1 is not allowed for a fuel in which HHV is routinely obtained at the frequency required for Methodology 2.

The WCI ERs allow Methodology 2 using default emission factor and HHV from fuel testing for facilities subject to verification requirements for any fuel for which Methodology 1 is also allowed, and require use of Methodology 2 (or a higher method) for combustion of natural gas (HHV between 36.3 and 40.98 GJ/m^3) in units with a rated heat input capacity >250 MMBtu/hr (264 GJ/hr). Note that the ERs do not allow use of Methodology 1 or 2 for small combustion units that burn coal or residual fuel (or any other fuel not listed in Table 20-1a except natural gas or certain forms of biomass) at facilities subject to verification requirements. The USEPA rule allows Tier 2 for any fuel for which a default emission factor is provided when the fuel is burned in units <250 MMBtu/hr, and for natural gas and distillate fuel oil in units of any size.

The WCI ERs require use of Methodology 3 based on fuel carbon content testing for all fuels other than natural gas (HHV between 36.3 and 40.98 GJ/m^3), biomass ("exempted from verification requirements" and/or "not subject to a compliance obligation under the cap-and-trade program"), and fuels listed in WCI Table 20-1a, regardless of unit size (unless Methodology 4 is required). This implies that small units burning fuels such as residual oil, petroleum coke, or non-listed fuels, must base CO_2 emission calculations on fuel-specific carbon content data. However, if a fuel is not listed in WCI Tables 20-1 through 20-7 or in USEPA Tables C-1 or C-2, reporting emissions from combustion of the fuel is not required as long as total emissions from such fuels do not exceed 0.5% of total facility emissions. Furthermore, if a WCI jurisdiction determines that a biomass fuel is not exempted from verification requirements necessary for the WCI cap and trade program, CO_2 emissions from its combustion would fall under Methodology 3 requirements. The USEPA rule requires use of Tier 3 only for units >250 MMBtu/hr, and only requires reporting of emissions from combustion of those non-listed fuels that contribute at least 10% of a unit's annual fuel input. USEPA never requires Tier 3 for natural gas, distillate fuel oil, or listed biomass fuels.

The WCI ERs require use of Methodology 4, which requires continuous emission monitoring systems (CEMS), for estimating CO_2 emissions from any unit equipped with a CEMS required by regulation that includes both a stack gas volumetric flow monitor and a CO_2 concentration monitor. The USEPA rule only requires use of CEMS-based Tier 4 for units burning solid fossil fuel or municipal solid waste as a primary fuel, subject to other requirements.

The WCI ERs do not allow use of "company records," as defined in the USEPA rule, for determining fuel consumption except in units that combust a combination of fossil and biomass fuels. In all other scenarios for any fuels via any of the four calculation methodologies, fuel consumption must be measured directly. However, use of recorded fuel purchase or sales invoices to determine fuel consumption is allowed, and fuel consumption in units that burn solid biomass fuels and produce steam can be back-calculated based on steam generation rates (however, if emissions are calculated from steam generation via Methodology 3 the emission factor must be adjusted "not less frequently than every third year, through a stack test measurement of CO_2…"–this would apply only to biomass that is not excepted from verification requirements). The WCI ERs do not specifically address methods for determining consumption of self-generated (as opposed to purchased) biomass fuels that are burned in units that do not produce steam. The USEPA rule allows use of company records, which are broadly defined, for determining fuel consumption in calculations based on Tiers 1 and 2 for all fuels, and on Tier 3 for solid fuels (biomass consumption in stationary combustion units can always be determined from company records).

For units that burn a mixture of biomass and fossil fuels (not including waste-derived fuels) and do not use CEMS, the WCI ERs allow the mass of biomass combusted to be determined using company records (which are not defined by WCI) or, for premixed fuels, determined based on best available information. Emissions are calculated using Methodology 1, 2, or 3 as applicable. Note that the WCI ERs apparently do not allow use of company records to determine mass of biomass fuel combusted in units that burn only biomass.

If CEMS are used to quantify CO_2 emissions from a unit burning a combination of biomass and fossil fuels (or fuel mixtures) the WCI ERs require use of Methodology 1, 2, or 3 to determine annual fossil fuel CO_2 emissions. Biomass fuel CO_2 emissions are then determined by subtracting fossil CO_2 from total CO_2 emissions. This method was included in the October 2009 USEPA rule, and was problematic for facilities with units that burn predominately fossil fuels with a small percentage of biomass fuels. It should be noted that on December 17, 2010, however, USEPA revised its rule to allow biomass CO_2 from units that burn a combination of fossil and biomass fuels and that are equipped with CEMs to estimate the biogenic CO_2 portion using Tier 1 methods or based on annual heat input from the biomass fuel obtained, where feasible, from electronic emissions reports or best available information.

Under the WCI ERs, for units that burn fuels or fuel mixtures that contain both fossil and biomass carbon in which the biomass fraction cannot be documented or for which a CO_2 emission factor for biomass fuel is not provided, the facility is to use radiocarbon dating (ASTM Method D6866) to determine the biogenic portion of CO_2, but may opt to not separate biogenic CO_2 from the total for fuels that contain less than 5% biomass by weight or for waste-derived fuels that are less than 30% by weight of total fuels combusted in the year for which emissions are to be reported.* The December 17, 2010, amended USEPA rule allows use of the default factors to describe the biogenic portion of carbon in tire-derived fuels.

Methane (CH_4) and nitrous oxide (N_2O) emissions cannot be determined by facilities subject to verification using the Methodology 1 analogue (using default HHV) except for natural gas (HHV between 36.3 and 40.98 GJ/m^3) combustion and combustion of biomass for which fuel consumption is calculated based on steam generation rates. Other fuels require methods based on fuel-specific HHV testing or, for coal, fuel-specific CH_4 and N_2O emission factors provided by the fuel vendor or measured directly. These requirements differ from those of the USEPA rule, which allows use of default fuel HHV and CH_4/N_2O emission factors whenever a default fuel HHV is used for determining CO_2 emissions (e.g., Tier 1) or when fuel-specific carbon analysis is required for determining CO_2 emissions (e.g., Tier 3). The WCI ERs do not require reporting CH_4 or N_2O emissions for fuels not listed in WCI Tables 20-2 through 20-4 and 20-6.

The WCI ERs require sampling and analysis of each shipment of coal and certain liquid fuels. In the December 17, 2010, amended USEPA rule the definition of fuel lot was expanded such that less frequent sampling would be required in cases where multiple shipments are received from the same fuel supply source, in addition to provision of other sampling and analysis options.

The WCI ERs include lists of approved analytical methods for use in determining fuel HHV and carbon content. The December 17, 2010, USEPA rule amendments allow "a method published by a consensus-based standards organization if such a method exists, or … [an] industry standard practice…" (the USEPA rule no longer includes a list of approved analytical methods).

The WCI ERs contain erroneous emission factors for biomass (wood/wood residuals and spent pulping liquor) from Environment Canada, in addition to emission factors from the USEPA rule.

Pulp and Paper Manufacturing

The WCI ER methods for determining emissions from pulp and paper manufacturing are equivalent to those in the USEPA rule with the following exceptions:

- The WCI ERs appear to require that emissions from electricity generation units (as specified in WCI.43) be reported separately from emissions from stationary combustion units (as specified in WCI.23). WCI defines an electricity generating unit as "any combustion device that combusts solid, liquid, or gaseous fuel for the purpose of producing electricity either for sale or for use onsite. This source category includes cogeneration (combined heat and power) units." The requirements for calculating emissions from electricity generating units do not differ from those for stationary combustion units.

*This statement was revised on January 5, 2012, to correct an error in the original memo.

- The WCI ERs do not allow use of company records to determine quantities of fossil fuels burned in pulp mill sources (e.g., recovery furnaces, lime kilns).

- The WCI ERs do not allow Methodology 1 (equivalent to USEPA Tier 1) for calculating CO_2 emissions from all types of fossil fuels combusted in pulp mill sources (e.g., combustion of residual oil, pet coke, or any fuel not listed in WCI Table 20-1a in recovery furnaces, lime kilns). Rather, WCI Methodology 3 based on fuel-specific carbon content analysis would be required for fossil fuels other than natural gas or those listed in WCI Table 20-1a.

- WCI Table 210-1 provides erroneous CO_2 emission factors for fossil fuels burned in kraft lime kilns (USEPA proposed revisions to the corresponding emission factors on August 11, 2010), and does not provide emission factors for petroleum coke burned in kraft lime kilns.

The WCI ERs require calculation and reporting of CH_4 and N_2O emissions from industrial wastewater treatment operations at pulp and paper mills as specified in WCI.203(g) (Methods for Industrial Wastewater Processing at Petroleum Refineries) "if required by [WCI partner jurisdiction] regulation." The prescribed methods require CH_4 estimation from "anaerobic wastewater treatment (such as anaerobic reactor, digester, or lagoon)" using methods that are similar to those in the USEPA GHG rule Subpart II. The WCI ERs do not provide a definition for anaerobic lagoon. The WCI ERs include inappropriate calculation methods for estimating N_2O emissions that are based on Intergovernmental Panel on Climate Change (IPCC) methods for domestic wastewater treatment operations (see attached memorandum from Upton to Vice dated May 5, 2010). The USEPA rule does not require reporting of N_2O emissions from industrial wastewater treatment operations.

Mobile Equipment

The WCI ERs require calculation and reporting of emissions from mobile equipment at facilities "used for the on-site transportation or movement of substances, materials, or products, and other mobile equipment such as tractors, mobile cranes, log transfer equipment, mining machinery, graders, backhoes, and bulldozers and other industrial equipment." The source category does not include on-road vehicles, aircraft, or marine vessels. Mobile equipment that is part of normal facility operations and is operated by contractors is included. The USEPA rule does not require reporting of emissions from mobile equipment.

Attachment

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May 5, 2010

MEMO TO: Kirsten Vice

FROM: Brad Upton

COPY: Reid Miner, Steve Stratton, Jay Unwin

SUBJECT: Review of British Columbia GHG Reporting Regulation Method for Pulp and Paper Wastewater Treatment Emissions

During an April 23 conference call with the British Columbia Ministry of the Environment (MOE) and the Council of Forest Industries (COFI) NCASI was requested to review the MOE's required method for calculating nitrous oxide (N_2O) emissions from pulp and paper industry wastewater treatment operations in light of new information that the required calculation methodology was derived from 2006 IPCC guidance.[1] This memorandum transmits the results of that review.

The British Columbia methods for calculating emissions from industrial wastewater processing are identical to the methods provided by WCI[2] for calculating emissions from petroleum refinery wastewater treatment operations as specified in WCI.203(g). The British Columbia methodology manual (and WCI requirements upon which it is based) indicates that the methods in WCI.203(g) are "under consideration" for application to the pulp and paper manufacturing source category. WCI.203(g) requires calculation and reporting of both CH_4 and N_2O emissions from industrial WWTP operations, using methods specified by IPCC (2006). These N_2O emission calculation methods are addressed herein.

The IPCC guidance that forms the basis of the method in the British Columbia methodology manual pertains to N_2O emissions from domestic wastewater. IPCC guidance implies that only industrial wastewater containing significant amounts of protein (e.g., "from grocery stores and butchers") would be expected to generate significant quantities of N_2O. Pulp and paper industry wastewaters are, in general, deficient in nitrogen and do not contain appreciable quantities of

[1]Intergovernmental Panel on Climate Change (IPCC). 2006. *2006 IPCC guidelines for national greenhouse gas inventories, Volume 5: Waste, Chapter 6: Wastewater treatment and discharge*. IPCC National Greenhouse Gas Inventories Programme. (http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html)
[2] Western Climate Initiative (WCI). 2009. *Final essential requirements of mandatory reporting.* (http://www.westernclimateinitiative.org/component/remository/Reporting-Committee-Documents/)

proteins. Therefore, according to the IPCC guidance used as the basis of the British Columbia methods, it is unlikely that pulp and paper industry wastewater treatment is a significant source of N_2O emissions.

IPCC further states that "N_2O emissions can occur as direct emissions from treatment plants or [as] indirect emissions from wastewater after disposal of effluent into waterways… Typically, [direct emissions from nitrification and denitrification at wastewater treatment plants] are much smaller than [indirect emissions from wastewater after discharge] and may only be of interest to … advanced centralized wastewater treatment plants with nitrification and denitrification steps." NCASI is not aware of any pulp and paper industry wastewater treatment plants designed to achieve nitrification and denitrification steps. Therefore, direct emissions from treatment plants at pulp and paper mills are expected to be insignificant.

The equations in the British Columbia methodology manual (and WCI requirements) are derived from IPCC methods designed to calculate N_2O emissions that occur from treated domestic (not industrial) wastewaters after those wastewaters have been discharged into the receiving water. Therefore, these would be indirect emissions. To our knowledge, no other greenhouse gas reporting program requires reporting of indirect emissions from discharged wastewaters.

The IPCC equations calculate N_2O emissions based on average (of quarterly determinations) nitrogen concentration in the discharged effluent using a default emissions factor developed for use with domestic wastewater. The methods do not specify whether the nitrogen concentration should pertain to total nitrogen, total kjeldahl nitrogen (TKN), or another form (e.g., ammonia, nitrate, etc.). The default emission factor for domestic wastewater is associated with "large uncertainty" and there are "insufficient field data … to improve this factor" according to IPCC.

I applied the BC method for estimating N_2O emissions to a set of arbitrary data that might be representative of a kraft pulp mill, including a TKN nitrogen content of 5.8 mg/L (as nitrogen – the median value from NCASI Technical Bulletin No. 745[3]) and an effluent flow rate of 100,000 m^3/day, using default values from the BC method. This resulting estimate was 1.6 tonne N_2O per year, or 500 tonne CO_2 eq per year.

In summary, the IPCC guidance for estimating N_2O emissions that forms the basis for the equations in the British Columbia methodology manual is designed for domestic rather than industrial wastewater, is designed to estimate indirect emissions from wastewater after discharge rather than emissions from the treatment plant, and is associated with high uncertainty. Furthermore, requiring inclusion of N_2O emission estimates from industrial wastewater treatment operations is unique among greenhouse gas reporting programs. Applying this calculation methodology to systems it was not designed to represent, such as a pulp and paper industrial wastewater treatment systems, will result in emissions estimates of questionable value.

[3] National Council for Air and Stream Improvement (NCASI). 1997. *Characterization of residual nutrients discharged with biologically-treated pulp and paper mill effluent.*