EHS

Environmental Metrics Reporting and Management Guideline

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Executive Summary

This guideline was designed to facilitate accurate and consistent recording and reporting of environmental metrics at all Novelis locations. This reference has been prepared to provide assistance for this process. For reporting of Environmental Events, please refer to Novelis Environmental Event Management Guideline.
The accuracy of environmental data is contingent upon a common definition of terms related to environmental metrics reporting and recordkeeping. A listing of important terms and definitions are included in the guideline for all variables that are to be reported into the Performance Data Management (PDM) Data Warehouse including: Air Emissions, Electricity Grid Mix, Material Flows, Transportation, Waste, Water, Energy Sources, Registrations, and General Data.

Another critical facet of accurate data is the ability to produce the highest level of Data Quality. Data entered into the PDM system should be derived from the best achievable data quality:

- **Calculated -** Any data based on measured values that have been modified to reflect calculations by process engineers
- **Estimated -** Any secondary data or theoretical calculation
- **Measured -** Any primary data that reflects actual measurements (direct sampling) performed during the subject time period
- **Not Applicable -** Data quality is not relevant to the parameter being reported
- **Not Available -** Should only be used when no information is available as to the quality of data.

Environmental metric charts are available through the PDM system. The charts can be obtained for Novelis, Inc., Business Group, Business Unit or Site levels. The following environmental metric charts are available:

- **GHG Emissions Efficiency**
  - Total GHG emission efficiency (emissions in total tonnes of CO2 equivalents divided by the plant production in tonnes)
  - Plant Production = Recycle, Cold Metal – Cast Secondary, Hot Rolling, Cold Rolling, Coating, Hot Metal Reduction, Cold Metal – Cast Primary, and Alumina

- **Energy Efficiency**
  - Total energy efficiency (energy in Gigajoules divided by the plant production in tonnes)
  - Plant Production = Recycle, Cold Metal – Cast Secondary, Hot Rolling, Cold Rolling, Coating, Hot Metal Reduction, Cold Metal – Cast Primary, and Alumina

- **Landfill Waste (Absolute)**
  - Landfill Waste (Absolute) = Total landfilled waste (including site contribution and contribution of salt cake generated from offsite dross processing)

- **Water Efficiency**
  - Water efficiency = Total water consumed (cubic meters) divided by total plant production
  - Plant Production = Recycle, Cold Metal – Cast Secondary, Hot Rolling, Cold Rolling, Coating, Hot Metal Reduction, Cold Metal – Cast Primary, and Alumina

The environmental metrics data that is reported in the PDM Data Warehouse must be utilized in the management review process established at the various levels in the Novelis organization. It is expected that each site will review trends in these metrics at least quarterly to identify out of control situations and assure root cause analysis and permanent corrective actions are implemented. This guideline also contains an appendix that details the process for managing the sustainability data that is communicated to the external public.

1.0 Purpose, Scope, and Application

1.1 Purpose

The purpose of the Novelis Environmental Metrics Reporting and Management Guideline is to promote uniformity in the management of the critical environmental metrics. This includes the consistent and accurate classification, quantification, reporting and analysis of these metrics.

1.2 Scope

The Novelis Environmental Metrics Reporting Guideline covers the definitions, reporting deadlines/procedures and management review requirements necessary to maintain consistent environmental reporting and recordkeeping to allow for statistical analysis and management at all levels in the organization. It also covers the management and calculation of external environmental sustainability indicators.

1.3 Application

The Novelis Environmental Metrics Reporting Guideline applies to all Novelis sites. There are however some variables discussed in this guideline that are not applicable to all sites.

2.0 Definitions

2.1 Air Emissions (Annual)

Air emissions for each operating site must quantify air emissions on an annual basis. R&D sites and offices are not required to report air emissions. Data must be reported in April for the preceding fiscal year. Unless specified otherwise, air emissions should be reported as stack or point source emissions. Fugitive emissions should not be included in the estimate unless specifically identified in this guideline. Please note that actual stack testing data is the preferred source for quantifying air emissions. If they are not available, internationally recognized emissions factors such as USEPA AP-42 (or other internally recognized factor) should be used to estimate air emissions. Appendix 2A, 2B and 2C also has some process specific emissions factors that can be used in this estimation process.

Note: All air emissions will be reported for the previous fiscal year. Note: Sites may be required by local legislation to report on a calendar year basis also.

2.1.1 Particulate Matter

Include the total quantity of organic or inorganic Particulate Matter, mist or dust air emissions for the entire plant. Only include sources of stack emissions. Do not include fugitive emissions that escape from processes and are emitted through building openings. Data based on stack test results are preferred. Estimates are acceptable if measured data is not available. The most significant source of PM is scrap melting furnaces, flux boxes, holders, shredders, dross coolers, dryers, and decoaters. This variable must be reported in metric tonnes.

2.1.2 Hydrogen Chloride

Report the total quantity of hydrogen chloride air emissions from all plant processes onsite. Typically HCl emissions are associated with furnace and flux box operations where chlorine or other reactive fluxing is performed. In addition, HCl is generated during scrap or used can delaquerering operations. Report stack emissions only, not fugitive emissions that fail to be captured by the ventilation system and escape into the building. Appendix 2A contains some critical emissions factors that can be used for estimating HCl emissions. Please note that site specific emission factors are preferred and should be used in lieu of the factors contained in Appendix 2A when available. This variable must be reported as HCl in metric tonnes.

2.1.3 NOx

Include the total quantity of NOx air emissions for the entire plant. Only include sources of stack emissions. Do not include fugitive emissions that escape from processes and are emitted through building openings. Data based on stack test results are preferred. Estimates are acceptable if measured data is not available. The most significant source of NOx is various natural gas or fuel oil combustion sources (i.e. building heaters, melting/holding furnaces, soaking pits, gas fired annealing furnaces, etc.). Appendix 2B contains a Novelis approved method for estimating NOx emissions from combustion sources. This variable must be reported as NO_2 in metric tonnes.

2.1.4 SO_2

Include the total quantity of SO_2 air emissions for the entire plant. Only include sources of stack emissions. Do not include fugitive emissions that escape from processes and are emitted through building openings. The most significant source of SO_2 would be through the combustion of petroleum-based fuels such as heavy oil (#6 / Bunker C). Data based on historical stack test results are preferred. Estimates are acceptable if measured data is not available. This variable must be reported in metric tonnes.

2.1.5 VOC

Include the total quantity of VOC air emissions for the entire plant. VOC is any pollutant that can contribute to ozone formation in the lower atmosphere. It is typically measured via EPA Method 25A for US Facilities. Only include sources of stack emissions. Do not include fugitive emissions that escape from processes and are emitted through building openings. Data based on stack test results are preferred. Estimates are acceptable if measured data is not available. Typically sources of VOC are cold rolling operations, melt furnaces that process oily/coated scrap, and scrap decoating operations. Appendix 2C contains a Novelis approved method for estimating cold mill VOC emissions. This variable must be reported in terms of propane (equivalent to 1/3 of carbon equivalents) in metric tonnes.

2.1.6 MEK

Report the total quantity of MEK air emissions from all plant processes onsite. This should only include stack emissions not fugitive emissions that fail to be captured by the ventilation system and escape into the building, or are lost through volatilization from open containers. The major source of MEK is coating/painting processes onsite. This variable must be reported in metric tonnes.

2.1.7 Toluene

Report the total quantity of toluene air emissions from all plant processes onsite. Report stack emissions only, not fugitive emissions that fail to be captured by the ventilation system and escape into the building, or are lost through volatilization from open containers. The major source of toluene emissions is any coating/paint processes onsite. This variable must be reported in metric tonnes.

2.2 Direct Energy Sources (Quarterly)

2.2.1 Direct Energy Sources - Biomass

Report the total amount in tonnes of the biomass energy source consumed by the site for the reporting period, as applicable. The data should come from invoicing records.

2.2.2 Direct Energy Sources – Coal

Report the total amount in kilograms of each energy source consumed by the site for the reporting period, as applicable. The data should come from invoicing records.

2.2.2.1 Anthracite (86-98% Carbon)
2.2.2.2 Bituminous (45-86% Carbon)
2.2.2.3 Sub-bituminous (35-45% Carbon)
2.2.2.4 Lignite (25-35% Carbon)
2.2.2.5 Petroleum Coke

2.2.3 Direct Energy Sources – Natural Gas

2.2.3.1 Natural Gas

Report the total amount of natural gas consumed (cubic meters) by the site for the reporting period. This data should come from invoice / accounting records or a meter of “billing” quality, where possible.

2.2.3.2 Liquid Natural Gas (LNG)

Report the total amount of liquid natural gas consumed (kilograms) by the site for the reporting period. This data should come from invoice / accounting records or a meter of “billing” quality, where possible.

2.2.3.3 Methane

Report the total amount of methane consumed (cubic meters) by the site for the reporting period. This data should come from invoice / accounting records or a meter of “billing” quality, where possible.

2.2.3.4 Propane

Report the total amount of propane consumed (liters) by the site for the reporting period. This data should come from invoice / accounting records.

2.2.3.5 Butane

Report the total amount of butane consumed (liters) by the site for the reporting period. This data should come from invoice / accounting records.

2.2.4 Direct Energy Sources – Petroleum

2.2.4.1 Heavy Fuel Oil (Number 4 or 6)

Report the total amount of heavy fuel oil consumed (kilograms) by the site for the reporting period. This data should come from invoice / accounting records or a “billing” quality meter.

2.2.4.2 Diesel and Number 2 Fuel Oil

Report the total amount of diesel (Gasoil) and No. 2 fuel oil consumed (liters) by the site for the reporting period. This data should come from invoice / accounting records or a “billing” quality meter.

2.2.4.3 Kerosene

Report the total amount of kerosene consumed (liters) by the site for the reporting period. This data should come from invoice / accounting records or a “billing” quality meter.

2.2.4.4 Gasoline

Report the total amount of gasoline consumed (liters) by the site for the reporting period. This data should come from invoice / accounting records or a “billing” quality meter.

2.2.4.5 Direct Energy Sources - Wood

Report the total amount in tonnes of the wood energy source consumed by the site for the reporting period, as applicable.

Note: Direct Energy data such as biomass, coal, natural gas, petroleum and wood is managed by the PDM Data Warehouse to calculate GHG emissions. The GHG emissions associated with the direct energy consumption is calculated by using standard factors such as the fuel’s calorific value. If the site decides that the generic calorific factor in PDM is no longer acceptable, a site/regional specific value can be entered into PDM. The site/regional specific value can be entered for each type of fuel in the data input field labeled as “CV”. If you enter data into the CV field, PDM will use that factor in calculating the GHG emissions. Therefore it is critical that the sites/regional specific calorific value entered by the site is accurate.

2.3 Electricity Grid Mix (Quarterly)

Note: Electricity Grid Mix information should be received from your local Electrical Utility Company. If you are only able to obtain information on a yearly basis, please enter the yearly figures into each quarter. NOTE: All percent figures should be entered in decimal form (i.e. 100% should be entered as 1; 25% would be 0.25).

2.3.1 Coal

Coal is normally used in a pulverized form to fuel a conventional boiler, generating steam, which is then used to produce electricity. Three types of coal are used for electrical generation. They vary in energy content per unit of weight.

2.3.1.1 Bituminous coal (45 – 86% Carbon)
2.3.1.2 Sub-bituminous coal (35 – 45% Carbon)
2.3.1.3 Lignite (25 – 35% Carbon)

2.3.2 Natural Gas

Natural gas is extracted from the earth, processed, and burned to produce electricity. Gaseous fuels, when available, are ideal for steam generation because of the ease of control and the presence of little or no solid residue. Natural gas is perhaps the closest to an ideal fuel because it is practically free from non-combustible gas or solid residue.

2.3.3 Other

2.3.3.1 Grid Mix Nuclear Power

Nuclear energy is derived from the splitting or "fissioning" of uranium atoms.

2.3.3.2 Hydropower

Hydroelectric power plants transform the energy of falling water into electrical energy through the use of water wheels or hydraulic turbines. Small hydroelectric facilities may either use a small dam or river flows to harness the energy of the moving water.

2.3.3.3 Biomass

Biomass fuels are residues produced from logging, mill operations and the manufacture of wood, pulp, paper, and fiberboard, agricultural field and orchard crops, livestock and poultry growing operations, food processing, and demolition (urban wood waste).

2.3.3.4 Renewable

Geothermal electricity is produced using heat from deep within the earth (often evidenced by the presence of hot springs or geysers). This heat is captured and used to turn an electric generation turbine.

Solar electricity can be generated in two ways. One way involves focusing the heat of the sun on a central point that heats up. This heat is then used to produce steam, which turns an electricity turbine. Another way to harness solar power for electricity is using photovoltaic cells such as those seen on rooftops.

Wind energy is derived from the movement of air caused by the uneven heating of the earth's surface by the sun. Power from the wind is captured using wind turbines – blades that turn as the wind blows – to generate electricity.

2.3.4 Petroleum

Refined Petroleum Products are the various products created from refining petroleum. The main ones used for electricity generation plants are heavy fuel oil, light fuel oil (Gasoil) and diesel fuel.

2.3.4.1 Heavy Fuel Oil

Heavy Fuel Oil is a petroleum-based fuel which contains the undistilled residue from distillation of crude oil. It is also known as Bunker Fuel Oil or No. 6 Fuel Oil. The emission of carbon dioxide, sulfur and nitrogen oxides during combustion is much

greater. Hence it pollutes more than distillate or gaseous fuels, but less than solid fuels such as coal.

2.3.4.2 Diesel

Diesel (or Gasoil) is the fuel of choice for emergency and standby electrical power due to its fuel efficiency and cost.

2.4 Indirect Energy Sources (Quarterly)

2.4.1 Indirect Energy Sources – Input

2.4.1.1 Electricity in from Novelis

Report the total electricity in kWh supplied from Novelis generating station to facility. This data should come from invoice / accounting records or a “billing” quality meter.

2.4.1.2 Electricity in from Third Party

Report the total electricity in kWh supplied from third party electricity provider to facility. This value can be calculated from supply data and converted to kWh.

2.4.1.3 Steam in from Third Party

Report the total steam in kWh equivalents supplied from third party to facility. This value can be calculated from supply data and converted to kWh.

2.4.1.4 Steam in from Novelis

Report the total steam in kWh equivalents supplied from Novelis to facility. This value can be calculated from supply data and converted to kWh.

2.4.1.5 Hot Water in from Third Party

Report the total hot water in kWh equivalents supplied from third party to facility. This value can be calculated from supply data and converted to kWh.

2.4.1.6 Hot Water in from Novelis

Report the total hot water in kWh equivalents supplied from Novelis to facility. This value can be calculated from supply data and converted to kWh.

2.4.2 Indirect Energy Sources – Output

2.4.2.1 Electricity out to Third Parties

Report the total electricity in kWh supplied to third parties from Novelis generating capacity. This data should come from invoice / accounting records or a “billing” quality meter.

2.4.2.2 Electricity out to Novelis

Report the total electricity in kWh supplied by Novelis generating capacity to other Novelis facilities. This data should come from invoice / accounting records or a “billing” quality meter.

2.4.2.3 Steam out to Third Parties

Report the total steam in kWh supplied to third parties from Novelis generating capacity. This value can be calculated from supply data and converted to kWh.

2.4.2.4 Steam out to Novelis

Report the total steam in kWh supplied by Novelis generating capacity to other Novelis facilities. This value can be calculated from supply data and converted to kWh.

2.4.2.5 Hot Water out to Third Parties

Report the total hot water in kWh equivalents supplied to third parties from onsite generating capacity. This value can be calculated from supply data and converted to kWh.

2.4.2.6 Hot Water out to Novelis

Report the total hot water in kWh equivalents supplied to other Novelis facilities from onsite generating capacity. This value can be calculated from supply data and converted to kWh.

2.5 Material Flows (Quarterly)

2.5.1 Total Production Tonnes

Include only the good production (tonnes) that are shipped offsite to internal and external customers of the plant.

2.5.2 Hot Rolling Production

Include only the total good hot band production (tonnes) from hot rolling operations such as a Reversing/Tandem Mill combination. Only include the production from the entire hot rolling process. Do not include the production of the reversing mill and tandem mill separately. Do not report pass tonnes.

2.5.3 Cold Rolling Production

Include only the total good production (tonnes) from the plant's cold mill operations. This production figure should include all gauges of sheet. (Do not calculate this as pass tonnes.)

2.5.4 Cold Rolling Pass Tonnes

Include the total cold mill production in pass tonnes. This figure includes the total quantity of metal that was physically rolled on each cold mill in the plant. In other words if you produced 1,000,000 kg of good production on a cold mill using a 3-pass operating schedule you should report 3,000,000 kg (3,000 tonnes). This should be a sum of the pass tonnes from all cold rolling mills in the plant.

2.5.5 Coil Coating Production

Include only the good production (tonnes) from the plant's coil coating operations such as a process which applies organic lacquers as can end coatings, waxes or other relevant coatings. Production from pretreatment, annealing, cleaning and relube operations should not be included in this figure.

2.5.6 Recycling Production

Include only the total good production (tonnes) from the plant's induction melters, side well melters and any other furnace type not associated with a DC Casting operation. Include only the good molten metal and sow produced from all furnaces that are not directly part of the plant's DC casting centers.

2.5.7 Cold Metal – Cast Secondary

Include only the good ingot production (tonnes) from all DC casting operations (melter and/or holder connected with troughs feeding a DC Casting operation) situated at a secondary aluminum plant. It does not include production from the plant's induction melters, side well melters and any other furnace type not associated with DC casting.

Note: Cold Metal – Cast Secondary can also be referred to as Remelt production.

2.5.8 Cold Metal – Cast Primary

Include only the good ingot production (tonnes) from all DC casting operations (holder connected with troughs feeding a DC Casting operation) situated at primary aluminum smelter operations. It does not include production from the plant's induction melters, side well melters and other furnace types not directly connected to a DC casting.

Note: Cold Metal – Cast Primary is sometimes referred to as the Cast House production.

2.5.9 Hot Metal Reduction

Report the production (tonnes) of good hot metal produced on the pot lines associated with all smelting operations that is either shipped offsite or is further processed into saleable ingots onsite in DC Casting operations.

2.5.10 Alumina

Report the production (tonnes) of all good alumina production from bauxite ore-refining process. The various grades of alumina should be reported separately.

2.5.10.1 Alumina for Electrolyses
2.5.10.2 Alumina Calcined
2.5.10.3 Alumina Specialities
2.5.10.4 Alumina White / Brown Fused

2.6 Transportation (Quarterly)

2.6.1 Average Distance to Customer

The data should reflect the calculated average distance in kilometers, per mode of transport, that is traveled to deliver product to the internal and/or external customer offsite (not part of production facility).

Example:

Customer #1	Customer #2	Customer #3
50 kilometers	75 kilometers	100 kilometers
20 shipments	10 shipments	30 shipments

$$= \frac{(50\ km * 20\ shipments) + (75\ km * 10\ shipments) + (100\ km * 30\ shipments)}{60\ (Total\ \#\ Shipments)} = 79\ kilometers$$

2.6.1.1 Air Cargo
2.6.1.2 Barge
2.6.1.3 Coaster
2.6.1.4 Train
2.6.1.5 Ferry
2.6.1.6 Heavy Truck (28 Tonnes)
2.6.1.7 Heavy Truck (18 Tonnes)
2.6.1.8 Ocean Vessel

2.6.2 Total Tonnes Shipped

Include total tonnes of good product shipped, per mode of transport, to the internal or external customer offsite (not part of production facility). The sum of production shipped via all modes of transport should equal the data reported as Total Production (listed as a material flow in Section 2.5.1)

2.6.2.1 Air Cargo
2.6.2.2 Barge
2.6.2.3 Coaster
2.6.2.4 Diesel Train
2.6.2.5 Ferry
2.6.2.6 Heavy Truck (28 Tonnes)
2.6.2.7 Heavy Truck (18 Tonnes)
2.6.2.8 Ocean Vessel

2.7 Waste (Quarterly)

Depending on your local jurisdiction's solid waste definitions, some materials will be reported in different manners from site to site. In particular there are significant differences in how used oils, oily wastes, dross and scrap metals are classified in the local regulations. In some regions in Novelis these materials are not defined as wastes. However, Novelis external sustainability reporting needs require that all wastes be appropriately accounted for even if a waste does not meet a local jurisdiction's solid waste definition. Appendix 2D provides a reference for waste classifications for each region. For items listed in the Table as "Not a Waste", refer to the footnote for proper PDM reporting requirements.. Note: Waste generated from large construction projects or remediation projects are to be included in the PDM entries and must be noted in the PDM comments field of the appropriate waste.

2.7.1 Hazardous

2.7.1.1 Hazardous Waste Incinerated

List the total quantity (kilograms) of all hazardous waste (as defined by your local government jurisdiction) incinerated by the plant. You should include the quantity of all hazardous waste incinerated onsite or offsite. Incineration is defined as the destruction of wastes that have a low BTU content. A low BTU content waste is defined as a waste that requires additional fuel to effectively destroy. This is not a self-sustaining process. This estimate should be all inclusive. Therefore the estimate of Total Hazardous Waste Incinerated should include the quantity of any incinerated Specific Material (Section 2.5.3) that is classified as hazardous waste by local government regulations.

2.7.1.2 Hazardous Waste Recycled

List the quantity (kilograms) of all hazardous waste (as defined by your local government jurisdiction) recycled by the plant. You should include the quantity of all hazardous waste recycled onsite or offsite. Please note that the processing of high BTU content materials which allow for a self sustaining process is an alternative fuel and should be included in this figure (as a recycling activity). This estimate should be all inclusive. Therefore the estimate of Total Hazardous Waste Recycled should include the quantity of any recycled Specific Material (Section 2.5.3) that is classified as hazardous waste by local government regulations.

2.7.1.3 Hazardous Waste Landfilled

Please note that this figure must include the quantity (kilograms) of all relevant hazardous wastes (as defined by your local government jurisdiction) that were landfilled. This figure should include all hazardous industrial wastes that are landfilled onsite and offsite. The estimate should be all inclusive. Therefore the estimate of Total Hazardous Waste Landfilled should include the quantity of any landfilled Specific Material (Section 2.5.3) that is classified as hazardous waste by local government regulations.

2.7.2 Non-Hazardous

2.7.2.1 Non-Hazardous Waste Incinerated

List the quantity (kilograms) of all non hazardous waste (as defined by your local government jurisdiction) incinerated by the plant. You should include the quantity of all waste incinerated onsite or offsite. Incineration is defined as the destruction of wastes that have a low BTU content. A low BTU content waste is defined as a waste that requires additional fuel to effectively destroy. This is not a self-sustaining process. This estimate should be all inclusive. Therefore the estimate of Total Non-Hazardous Waste Incinerated should include the quantity of any incinerated Specific Material (Section 2.5.3) that is classified as non-hazardous waste by local government regulations.

2.7.2.2 Non-Hazardous Waste Recycled

List the quantity (kilograms) of all non-hazardous waste (as defined by your local government jurisdiction) recycled by the plant. You should include the quantity of

all non-hazardous waste recycled onsite or offsite. The processing of high BTU content materials which allow for a self sustaining process is an alternative fuel and should be included in this figure (as a recycling activity). This estimate should be all inclusive. Therefore the estimate of Total Non-Hazardous Waste Recycled should include the quantity of any recycled Specific Material (Section 2.5.3) that is classified as non-hazardous waste by local government regulations (also report any materials defined in Appendix 2D as "Not a Waste" if indicated that reporting is required in the appropriate footnote.)

2.7.2.3 Non-Hazardous Waste Landfilled

Please note that this figure must include the quantity (kilograms) of all relevant non-hazardous wastes (as defined by your local government jurisdiction) disposed of in onsite and offsite landfills. This figure should include all industrial wastes and general trash items that are landfilled**.** This estimate should be all inclusive. Therefore the estimate of Total Non-Hazardous Waste Landfilled should include the quantity of any landfilled Specific Material (Section 2.5.3) that is classified as non-hazardous waste by local government regulations.

2.7.3 Specific Materials

2.7.3.1 Dross

Report the total quantity (kilograms) of dross generated by all primary and secondary aluminum processes such as Recycling furnaces, DC Casting Centers, and flux boxes and shipped offsite during the quarter. If any facilities recycle dross onsite during a quarter, the amount of dross recycled must be reported in the PDM comment field (not as shipped). Dross is defined as the metallic oxide and salt slag that collects on the surface of molten metal during refining operations. This should include all gray (i.e. holder and round top melter dross) and black drosses (i.e. side well furnace dross) of varying aluminum content. The generation of salt cake from dross and scrap recycling operations (rotary salt furnaces) should not be included in this figure.

2.7.3.2 Recycle Baghouse Dust

Insert the quantity (kilograms) of baghouse dust waste generated. The amount of "baghouse dust reported should equal the waste generated from the cyclones, spark arrestors and filter baghouses associated with all melting furnaces, holding furnaces, filter boxes, shredders, and decoaters/delaquerers. This figure should include the total waste generated (including the dust collected from the process as well as acid scrubbing reagents injected into the baghouse for acid gas control).

2.7.3.3 Hot Mill Used Emulsion

Insert the quantity (kilograms) of all hot mill (both reversing and tandem mill designs) used oil emulsion generated by the process. You should report the total quantity of used emulsion <u>as generated (prior to any treatment)</u> by the process. Do not report the quantity of the treated waste oil concentrate or used oil fuel produced from the treatment of the used emulsion. Please report the actual quantity of used oil emulsion generated by the actual process in its original form and concentration.

2.7.3.4 Cold Mill Used Oil

Report the total quantity (kilograms) of cold mill used roll coolant generated at the plant. The quantity of oil reported should not include the amount of oil sent to a VDU process for recycling, only the amount of oil or VDU bottoms removed from the cold rolling process.

2.7.3.5 Cold Mill Filter Media

Report the total quantity (kilograms) of waste cold mill filter media. The definition of cold mill filter media includes the media itself as well as any filter papers utilized in the process. The amount of the wastes such as roll grindings from the reconditioning of hot or cold mill rolls should not be included in this figure. This

would include all types of cold mill oil filter media including DE/FE and ActiCel/wood pulp filter medias.

2.7.3.6 Coating Line Related Waste Paint/Solvent

Report the total quantity (kilograms) of the used paint waste, coating wastes and all clean up solvents used in all coating line processes. The amount of gloves and rags used and disposed of in the waste paint/solvent should be included as well.

2.7.3.7 Spent Pot Lining (Primary)

Report the total quantity (kilograms) of spent pot lining (carbon cathode material within each pot in a potline) that is generated and shipped offsite for management.

2.8 Water (Quarterly)

2.8.1 Water-Input (Quarterly)

2.8.1.1 Groundwater

Report the quantity (cubic meters) of water used from a source of water such as an onsite groundwater well.

2.8.1.2 Surface Water

Report the quantity (cubic meters) of water used from an untreated (with the exception of crude filtration) source of water such as a river or lake.

2.8.1.3 Sea Water

Report the quantity (cubic meters) of sea or ocean water used onsite.

2.8.1.4 Water from Public Net

Report the quantity (cubic meters) of water used from a treated (including filtration and disinfection) source of water such as a public/municipal water supply.

2.9 Water (Annually)

2.9.1 Water- Discharge (Annually) Identify planned and unplanned water discharges by destination. Do not include storm-water discharges. If the facility does not have a meter to measure water discharges, this figure needs to be estimated by subtracting the approximate volume consumed on-site from the volume withdrawn (or other valid estimating means). Report the total volume of water discharged in cubic meters per year. Report by destination below:

2.9.1.1 Groundwater

Water discharged beneath the earth's surface.

2.9.1.2 Surface Water

Water discharged to the atmosphere.

2.9.1.3 Water discharged to off-site treatment facilities

Water that is discharged to an offsite third party facility for subsequent treatment. Include water that is discharged to a sewer system or trucked.

2.9.2 Water/Wastewater- Recycle/Reused(Annually) – Definition: Recycled water is worked water that is treated before it is used in a task. Reused water is worked water that is used in a task without treatment beforehand.

2.9.2.1 Recycled Water Used in the Same Process

Report water recycled back in the same or a higher use process. An example of recycled water includes cooling water cooled by a cooling tower prior recirculation back into the cooling loop. Recycled cooling water volumes can be estimated by; multiplying the average recirculation flow rate (i.e. from cooling tower pumps) by the hours of operations (less input water); or multiplying cooling water input

volume by the cooling tower cycles of concentration. Report the total volume of water recycled in cubic meters per year.

2.9.2.2 Recycled/Reused Water used in a Different Process

Report water recycled/reused in a different process. An example includes reverse osmosis concentrate water reused in an air pollution control scrubber. Grey water (i.e., collected rainwater and wastewater generated by household processes such as washing dishes, laundry, and bathing) is included. Report the total volume of water recycled in cubic meters per year.

2.10 Registrations (Annual)

Update your site's registration status as status changes. The information required is your registration status, date of last registration and next registration.

- **2.10.1 Environment**
- **2.10.2 Quality**
- **2.10.3 Safety**

2.11 General Data

2.11.1 Net Sales (annual)

Report the net sales in millions of US dollars for good product that provided revenue for the facility in the calendar year. Facilities should use data from their Accounting department.

2.11.2 Number of Employees (annual)

Report total number of full-time and part-time employees at the end of the reporting year.

3.0 Data Quality

It is important to have an understanding of the data quality related to some of the environmental performance indicators. Obviously we are encouraging everyone to provide the highest data quality possible. However where actual data is not available, estimates are acceptable. It is always better to insert an estimate than to leave the field blank. Use the data quality indicator definitions below when identifying the data quality.

3.1 Calculated

Any data based on measured values that have been modified to reflect calculations by process engineers

3.2 Estimated

Any secondary data or theoretical calculation

3.3 Measured

Any primary data that reflects actual measurements (direct sampling) performed during the subject time period

3.4 Not Applicable

Data quality is not relevant to the parameter being reported

3.5 Not Available

Should only be used when no information is available as to the quality of data.
Note: Historical data (Pre-2005) may have Not Available as the Data Quality due to being imported into the PDM system.

Data is collected and reported by each site on a quarterly or annual basis depending on type. Depending on the site, there may be one or more people responsible for data collection (i.e. environmental resource, energy manager, transportation manager). Where data is significantly different from subsequent quarters, the sites are required to insert comments explaining the variance. Once data is entered and saved by the site, PDM automatically locks the data to assure data integrity.

The site has 15 days after the end of the quarter to enter the required data into PDM. Once all data is submitted, the Novelis Inc Data Validator reviews the data to assure data is complete and accurate. If inconsistencies are identified, the plant is notified and a validation process is initiated. Once the data is deemed accurate by the Data Validator, a quarterly performance report is developed and distributed to the various operational leaders.

Data Collection Process – Quality Assurance

Each site is required to validate their data. Plants have access to absolute and specific GHG emissions data for their site through the PDM Database. Once the site deems it accurate, the data is saved and locked by the site. A second data validation is performed quarterly by the Novelis Inc Data Validator. PDM has several standard reports that will facilitate this validation. In addition, the Data Validator performs a query of all data reported each quarter and reviews it for variation between historical data (i.e. prior quarter and same quarter from prior year). Uncertainties identified by the Data Validator are identified and reported back to the site. The site is responsible for correcting errors or identifying explanations for the variations. A conversion tool is included in PDM to assure sites are converting units correctly.

An annual audit is performed at each site to assure the representative responsible for reporting GHG metrics is providing accurate data and fully understands the Novelis environmental metrics reporting requirements.

Data Collection System Security

All data input into PDM is backed up daily so data is not lost due to IT failures. PDM is maintained on an internal Novelis server and is accessible only through the internal intranet. Access to PDM is controlled by access control software whereby reader, writer, super user rights are controlled depending on reporting responsibility. These access rights are controlled by the Novelis Inc PDM Data Coordinator. Once data is entered into PDM and saved as final data by the site, the data is locked. The rights to unlock data are controlled by the Novelis Inc PDM Data Coordinator. Based on PDM's access control features, the GHG data reported is considered secure and well controlled.

Internal Auditing

Auditing of the Environmental metrics reporting system is performed once per year at all sites. At a minimum, the audit covers the review of the sites knowledge of the reporting definitions as well as the data collection process and calculation method to assure data is accurately and consistently reported. Calibration of key measurement devices and meters are also checked if the site considers those meters related to a significant aspect.

The audits are performed in accordance with the Novelis EHS Auditing Guideline which is a controlled document. Auditors are trained to assure competency. Findings from the audit must be corrected using the sites ISO 14001 certified corrective action process.

Corrective Action

Any findings identified at the site level are identified as corrective actions and managed in accordance with the site's corrective action process as defined in their ISO 14001 Management System.

4.0 Environmental Metrics Reports

A number of standard reports are automatically generated by the Novelis Performance Data Management (PDM) Data Warehouse for use by the plants so they can analyze their site's past performance. These Crystal Reports can be accessed by going to the Novelis PDM Intranet Site and clicking on the Reports Button. The reports available include:

4.1 GHG Emissions Efficiency

- Total GHG emission efficiency (emissions in total tonnes of CO2 equivalents divided by the plant production in tonnes)
- Plant Production = Recycle, Cold Metal – Cast Secondary, Hot Rolling, Cold Rolling, Coating, Hot Metal Reduction, Cold Metal – Cast Primary, and Alumina

4.2 Energy Efficiency

- Total energy efficiency (energy in Gigajoules divided by the plant production in tonnes)
- Plant Production = Recycle, Cold Metal – Cast Secondary, Hot Rolling, Cold Rolling, Coating, Hot Metal Reduction, Cold Metal – Cast Primary, and Alumina

4.3 Landfill Waste (Absolute)

- Landfill Waste Absolute = Total landfilled waste in kTonnes(including site contribution and contribution of salt cake generated from offsite processing)

4.4 Water Efficiency

- Water efficiency = Total water consumed (cubic meters) divided by total plant production
- Plant Production = Recycle, Cold Metal – Cast Secondary, Hot Rolling, Cold Rolling, Coating, Hot Metal Reduction, Cold Metal – Cast Primary, and Alumina

5.0 Management Review Process Requirements

The environmental metrics data that is reported in the PDM Data Warehouse must be utilized in the management review process established at the various levels in the Novelis organization. It is expected that each site will review trends in these metrics at least quarterly to identify out of control situations and assure root cause analysis and permanent corrective actions are implemented.

Appendix 2A
HCl Emission Factors

Process-specific HCl emissions factors generated from actual stack testing data should be used where possible. Local regional factors should be used where process-specific data is not available. If the site does not have any HCl emissions factors available, the below factors can be used.

Can Decoating Processes

- Uncontrolled emissions from a can decoating process will emit approximately 1.35 kg/tonne (2.7 lb/ton) of HCl.
- Therefore an estimate of HCl emissions can be calculated if you know your pollution control's HCl removal efficiency.
- A well designed acid gas dry or wet scrubbing baghouse should achieve approximately 85% removal. Therefore overall can decoating HCl emissions can be estimated using the below equation:

HCl Emissions (kg/year) = 1.35 kg/tonne x .85 x Prod. Rate (tonne/year)

Remelt Molten Metal Fluxing

1) Chlorine Gas Fluxing

Based on past stack testing performed, approximately 8% of the chlorine gas utilized for fluxing operations is converted into HCl. Therefore the below equation can be utilized for estimating HCl from chlorine gas fluxing in a typical Holding Furnace operation.

HCl Emissions (kg/year) = Chlorine Used (kg/year) (.08)

2) Rotary Flux Injection Utilizing Magnesium Chloride Solid Salt Flux

75% of MgCl salt flux is elemental chlorine. Based on past stack test approximately 6% of this chlorine is converted into HCl when injected utilizing good furnace practices. Therefore the HCl emissions for rotary salt injection systems can be estimated utilizing the below equation.

HCl Emissions (kg/year) = Total Salt Flux Used (kg/year) x .75 x .06

3) In Line Flux Box Emissions

The use of chlorine gas in Flux Boxes creates HCl. Based on past stack testing, typical flux box operations utilizing chlorine gas will generate approximately .04 kg HCl per tonne of molten metal processed. Therefore the equation below can be utilized to estimate HCl emissions from a flux box.

HCl Emissions (kg/year) = .04 kg/tonne x Production Rate (tonne/year)

Appendix 2B
NO_x/SO_x Emissions Estimation Methodology for External Combustion Sources

Process-specific NO_x/SO_x emissions factors generated from actual stack testing data should be used where possible. Local regional factors should be used where process-specific data is not available. If the site does not have any NO_x/SO_x emissions factors available, the below USEPA factors can be used.

The U.S. Environmental Protection Agency has established emissions factors and emissions estimation methods for various types of External Combustion Sources utilizing a number of different types of fuel (Fuel oil, natural gas, etc).

Below is an Internet link that you can refer to for guidance on how to estimate your NOx and SO_2 emissions.

http://www.epa.gov/ttn/chief/ap42/ch01/

For information on NOx related to the combustion of natural gas in various types of furnace operations, please refer to Section 1.4 and Table 1.4 -1 in AP 42.

For information on SO_x related to the combustion of natural gas in various types of furnace operations, please refer to Section 1.4 and Table 1.4 -2 in AP 42.

Appendix 2C
Cold Mill VOC Emission Estimation Methodology

Process-specific VOC emissions factors generated from actual stack testing data should be used where possible. Local regional emissions factors should be used where process-specific data is not available. If the site does not have any VOC emission factors available, the below estimation method can be used.

The best method to estimate VOC emissions from Cold Rolling is to perform a cold mill oil mass balance.

If you can account for all oil inputs and outputs (with the exception of the air emissions) from the cold mill, you should be able to estimate the quantity of VOC air emissions (difference between the inputs and outputs).

Typical oil inputs into the cold mill include:
- Purchased base oil (do not consider the amount of reclaimed oil from the VDU)
- Purchased additive

Typical outputs include:
- Used oil removed from the mill (not including used oil sent to VDU and returned to process)
- VDU bottoms
- Cold Mill Filter Media Waste (typically contains approximately 35% oil)
- Residual oil on coils

Therefore the quantity of VOC from Cold Rolling can be estimated using the below equation:

Cold Mill VOCs (tonne/year) = Inputs (tonne/year) – Outputs (tonne/year)

- Or -

Cold Mill VOCs (tonne/year) =
Purchased Base Oil (tonne/year) + Purchased Additive (tonne/year) –
Used Oil Removed From Process (tonne/year) – VDU Bottoms (tonne/year) –
(Cold Mill Filter Media (tonne/year) x 0.35) – Residual Oil on Coils (tonne/year)

Appendix 2D
Waste and Determination

	United States			Ontario Canada			Italy		
	Non Hazardous	Hazardous	Not a Waste	Non Hazardous	Hazardous	Not a Waste	Non Hazardous	Hazardous	Not a Waste
Dross			X[1]		X			X	
Recycle Baghouse Dust	X			X					
Hot Mill Used Emulsion			X[1]	X					
Cold Mill Used Oil			X[1]	X				X	
Cold Mill Filter Media	X			X				X	
Coating Line Related Waste Paint/Solvent		X			X			X	
Scrap Metal			X[1]			X[2]			X[2]
Spent Pot Lining		X			X				

1 Not Considered a Waste if Material is Recycled or Reclaimed in USA. For PDM, report all dross, cold mill used oil, and scrap metal that is recycled or reclaimed as “non-hazardous recycled.”
2 For PDM, report all scrap metals that is recycled or reclaimed as “non-hazardous recycled”. Scrap metal includes plant generated scrap aluminum that is shipped off-site for recycling.

Appendix 2D
Waste Determination

	Germany Europe			United Kingdom Europe			Switzerland Europe		
	Non Hazardous	Hazardous	Not a Waste	Non Hazardous	Hazardous	Not a Waste	Non Hazardous	Hazardous	Not a Waste
Dross	X	X[1]			X		X	X[1]	
Recycle Baghouse Dust		X		X[2]	X[2]			X	
Hot Mill Used Emulsion		X			X			X	
Cold Mill Used Oil		X			X			X	
Cold Mill Filter Media		X			X			X	
Coating Line Related Waste Paint/Solvent	X[3]	X[3]		X[3]	X[3]			X[3]	
Scrap Metal	X[4]			X[4]			X[4]		
Spent Pot Lining	X	X[5]			X		X	X[5]	

1 Dross will normally be classified as non-hazardous. But if the gas formation rate upon addition of water exceeds 1 l / (kg h) it is hazardous.
2 Baghouse dust may be non-hazardous or hazardous depending upon its composition e.g. if lime injection is used, the waste is definitely hazardous.
3 Organic solvents / solvent-based paints are hazardous. Water based paints may be non-hazardous if they do not contain hazardous materials.
4 Scrap metal will normally be classed as non-hazardous unless it is contaminated by other hazardous substances.
5 Spent pot lining will normally be classed as non-hazardous unless it is contaminated by other hazardous substances.

Appendix 2D
Waste Determination

	Brazil South America			Korea Asia			Malaysia Asia		
	Non Hazardous	Hazardous	Not a Waste	Non Hazardous	Hazardous	Not a Waste	Non Hazardous	Hazardous	Not a Waste
Dross	X			X				X	
Recycle Baghouse Dust		X		X[1]			-	-	-
Hot Mill Used Emulsion		X				X[2]	-	-	-
Cold Mill Used Oil		X			X			X	
Cold Mill Filter Media		X			X			X	
Coating Line Related Waste Paint/Solvent		X			X			X	
Scrap Metal	X					X[3]			X[3]
Spent Pot Lining		X		-	-	-	-	-	-

1 If Recycle Baghouse Dust exceeds limits for heavy metals (Pb, CN, Cd, Hg, Cr, Cu), PCBs, or Oil (5% above) etc. using specified analysis method, The waste is considered hazardous. It is hazardous waste at Ulsan and non-hazardous waste at Yeongju.

2 Hot mill coolant is not a waste, it is waste water because oil density is 5% below. But oil & waters were segregated by oil separator. Oil is Hazardous waste by Korean law.

3 For PDM, report all scrap metals in Korea and Malaysia that is recycled or reclaimed as “non-hazardous recycled”. Scrap metal includes plant generated scrap aluminum that is shipped off-site for recycling.

Appendix 2E
Environmental Metrics Reporting Frequencies and Deadlines

Variable ID	Reporting Frequency	Reporting Deadline
Electricity Grid Mix	Quarterly	15 days after end of quarter
Transportation	Quarterly	15 days after end of quarter
Direct Energy Sources	Quarterly	15 days after end of quarter
Indirect Energy Sources	Quarterly	15 days after end of quarter
Waste	Quarterly	15 days after end of quarter
Water Consumption	Quarterly	15 days after end of quarter
Material Flows	Quarterly	15 days after end of quarter
Water Recycling and Discharge	Annual	4 weeks (28 days) after end of fiscal year
Air Emissions	Annual	4 weeks (28 days) after end of fiscal year
Registration Status	Annual	4 weeks (28 days) after end of fiscal year
General Data	Annual	4 weeks (28 days) after end of fiscal year

Appendix 2F
Management Plan for External Sustainability Reporting

1) Scope

Novelis collects various data for the reporting of environmental sustainability performance to external parties and shareholders. The purpose of this management plan is to document how environmental sustainability data is gathered and results calculated for reporting to external parties. Reported data includes emissions of greenhouse gases (GHGs), energy usage, wastes recycled, incinerated and landfilled, water usage and air emissions. Novelis has developed this Management Plan to:

- Define boundary conditions for our reporting of environmental sustainability data,
- Develop definitions for consistent reporting of data,
- Define types of data to be reported,
- Assure that accurate and consistent data is maintained.

The information contained in this document describes the various facets of the Novelis Environmental Sustainability Management Plan and is supplemented by other Novelis referenced documents.

2) Boundary Conditions

Organizational Boundary

The organizational boundary includes all Novelis divisions, subsidiaries and legal entities in the countries in which we are present. Novelis generally follows the Operation Control approach[1] when setting organizational boundaries (however Novelis only accounts for the portion of the operations based on the volume of product sold by Novelis). A company has operational control over an operation if the former or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation. Novelis incorporates our joint venture facilities as follows:

- Novelis reports *50%* of the Alunorf joint venture in Germany where we have 50% of plant output.
- Novelis reports *55%* of the Logan joint venture in the USA, where we own 40% of outstanding common shares, but receive 55% of plant output due to equipment investments (It should be noted that for Logan, the percentage of output depends on current year output levels and may vary with time). For FY2007 through FY2010, Logan's output was reported at *64%*. For FY2011 and beyond, Logan's output was reported as *55%*. In addition, Logan does not report energy and waste associated with the Novelis JV partner wholly owned recycle center located on the facility.
- In Korea, Novelis holds a 99% equity interest in the Ulsan and Yeongju plants and Novelis reports *100%* of operational data.
- In the Aluminum Company of Malaysia Berhad(Alcom), Novelis holds a 59% equity interest and Novelis markets 100% of the plant's output. As such, Novelis reports *100%* of Alcom operational data.

When calculating the contribution of a specific environmental sustainability indicator for a joint venture facility, Novelis multiplies the contribution factor identified above in red italics by the value of the specific indicator for that site.

Leased sites, where Novelis holds no equity, have been excluded from this inventory.

Definition of Reporting Scopes

When defining energy usage and GHG emissions, Novelis uses the concept of three scopes[2]. The three scopes are as follows:

- **Scope 1: Direct energy usage/GHG emissions -** Direct energy uses and GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment.
- **Scope 2: Electricity indirect energy usage/GHG emissions -** Scope 2 accounts for energy usage and GHG emissions from the generation of purchased electricity consumed by the company. Purchased

[1] The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, World Resources Institute and World Business Council for Sustainable Development, March 2004

[2] The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, World Resources Institute and World Business Council for Sustainable Development, March 2004

electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

- **Scope 3: Other indirect GHG emissions -** Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Reporting of environmental sustainability metric by Scope is further explained in the following sections of the report.

Reporting Period and Baseline Years

Novelis reports all sustainability data in fiscal year format. The Novelis fiscal year begins on April 1 and ends on March 31. In establishing progress towards environmental sustainability goals, Novelis has designated the average of Fiscal Year 2007 through Fiscal Year 2009 as a baseline period.

Structural Change Adjustments - Novelis will adjust the base year sustainability metrics if structural changes occur within the company or a significant amount of change occurs due to outsourcing. Both increases and decreases in the structure will be considered a change. A change in operational control would also trigger a change. The Novelis Inc EHS Team is responsible for tracking structural change. This is performed to assure that the company can track progress in meeting all long term objectives and targets in a meaningful way. This assessment is performed on a continuous basis with physical change to the structure in PDM and associated recalculation of the baseline year performed once per year.

Methodology Changes Adjustments - Novelis will adjust the base year emissions if changes in calculation methodologies or emission factors occur. Also, discovery of errors will trigger an adjustment of the base year.

Materiality Exemptions

For reporting purposes, Novelis considers that any facility indicator that contributes less than 0.01% to the overall sustainability indicator total to be non-material and that facilities indicator may be exempt from reporting. Specific site exemptions are discussed in further sections.

Facilities List

The following table contains a list of Novelis facilities and whether they report a specific sustainability metric. Facilities designated as inactive have either been closed or sold but are part of the Novelis baseline.

				Sustainability Metric Reported?		
FACILITY LIST	Facility Type	Active	Inactive	GHG and Energy	Waste	Water
ALCOM SHEET AND FOIL	MFG	x		x	x	x
BEREA	MFG	x		x	x	x
BUCKHEAD OFFICE	Office	x				
BURNABY	MFG	x		x	x	x
CHANGZHOU	MFG	x				
FAIRMONT	MFG	x		x	x	x
FLORIANOPOLIS	Collection	x				x
GÖTTINGEN	MFG	x		x	x	x
GREENSBORO	MFG	x		x	x	x
KENNESAW	Office	x		x	x	x
KINGSTON	MFG	x		x	x	x
LATCHFORD	MFG	x		x	x	x
LOGAN ALUMINUM	MFG	x		x	x	x
LUEDENSCHEID	MFG	x		x	x	x
NACHTERSTEDT	MFG	x		x	x	x
NGTC	R&D	x		x		
NORF	MFG	x		x	x	x
NOVELIS PAE	MFG	x		x		x
OHLE	MFG	x		x	x	x
OSWEGO	MFG	x		x	x	x
OURO PRETO	MFG	x		x	x	x
PIEVE	MFG	x		x	x	x
PINDA	MFG	x		x	x	x
PRESIDENTE PRUDENTE	Collection	x				x
RECIFE	Collection	x				x
SALVADOR	Collection	x				x
SAO PAULO COLLECTION CENTER	Collection	x				x
SEOUL OFFICES	Office	x				
SIERRE	MFG	x		x	x	x
TERRE HAUTE	MFG	x		x	x	x
TORONTO	MFG	x		x	x	x
ULSAN	MFG	x		x	x	x
UTINGA PLANT	MFG	x		x	x	x
WARREN	MFG	x		x	x	x
YEONGJU	MFG	x		x	x	x
ARATU	MFG		x	x	x	x
BERLIN	MFG		x	x	x	x
BRESSO	MFG		x	x	x	x
BRIDGNORTH	MFG		x	x	x	x
D.C. ITALY	R&D		x	x	x	x
DUDELANGE	MFG		x	x	x	x
LOUISVILLE	MFG		x	x	x	x
LUCE AND MARKET CENTRES	R&D		x			
ROGERSTONE	MFG		x	x	x	x
RUGLES	MFG		x	x	x	x
SAGUENAY	MFG		x	x	x	x

Intensity Metrics
Intensity measures are used for external reporting of water and energy sustainability indicators. The divisor for the intensity metric is the volume of flat rolled product (FRP) sales (as provided by the Novelis corporate finance department). FRP sales are defined as tonnes of rolled products shipped by Novelis facilities to a third party. FRP sales do not include intersegment rolled products and non-rolled products.

Quantification Method
Environmental sustainability measures are managed in the Novelis Performance Data Management (PDM) warehouse. The plants enter prime data into PDM on a predetermined frequency (quarterly/annually). Utilizing calculations and emissions factors included into PDM, the database automatically converts the prime data into calculated emissions and provides standard performance graphs for specific energy and GHG emissions (normalized to a production metric).

Emissions Factors and Other Constants
Novelis uses the emission factor methodology for their direct emission calculations. The emission factors used for combustion and mobile sources are from the WRI/WBCSD GHG Protocol. Emission factors from IAI are used for process emissions if no site specific emission factors are available.

The emission factors use the following order of preference:

1. Emission factor from site, based on required legal factors, supplier, or local information
2. Novelis default emission factors that originate from the GHG Protocol, central laboratories, or industrial sector protocols

Novelis uses the following order of preference for indirect emissions:

1. Actual EF/grid mix transmitted by the supplier/subcontractor of energy if site has a direct supply agreement and is documented to be accurate
2. Where local supplier/subcontractor data is not available or considered inaccurate, local average EF and grid mix published for the region, state, country (eGrid) is used
3. Novelis default EF calculated based on the technical parameters of the purchased electricity

Emission factors are reviewed at the Novelis Corporation level annually for reliability, completeness, consistency, and appropriateness.

The inventory of calculations and emissions factors used in the Novelis PDM can be found in the PDM GHG Calculations Summary (Appendix 2G) attached to this manual. The various emissions factors are reviewed annually to assure they are kept up to date.

3) External Environmental Sustainability Indicators and Targets

Energy
Novelis measures and records the energy usage for Scope 1 (direct energy sources), Scope 2 (indirect energy sources) and Scope 3 (transportation energy only). For external energy reporting, only Scope 1 and Scope 2 energy usage is considered. Refer to the Novelis Environmental Metrics Reporting and Management Guideline for the collection, calculation, and reporting of energy data. Energy is reported as an intensity metric with the units of GJ energy per ktonne of FRP sales.

Notes: In South America, Novelis owns hydro generation facilities. Electrical energy generated at these facilities and used at the Ouro Preto plant is counted for energy totals. Also, the Norf facility generates hotwater that is used by the local community. The energy content of this water is not reflected as a reduction on of overall energy usage.

Novelis has established a target of reducing energy usage by 39% per ton of sales by 2020 (from FY2007-FY2009 average).

GHGs
Novelis measures the quantity of emissions of GHGs from Scope 1 (direct energy sources), Scope 2 (indirect energy sources, PFC emissions) and Scope 3 (transportation of Novelis products and purchases of primary aluminum). Refer to the Novelis Environmental Metrics Reporting and Management Guideline for the collection,

calculation, and reporting of GHG emissions resulting from energy and transportation. GHG emissions are reported as absolute tonnes of CO_{2e}.

GHG List - Novelis reports emissions for CO_{2e} (fuels combustion, VOC destruction), CH_4 (fuels combustion), and N_2O (fuels combustion). PFCs are currently and been historically been emitted by the Novelis South American smelters in Ouro Preto and Aratu (closed).

Since Novelis is not in the business of gas transport, CH_4 emissions from natural gas leaks is nonexistent. Novelis has performed an assessment of the significance of global warming impacts associated with the release associated with refrigerant systems (HFCs/CO2), fire suppression systems (CO2/FM200) and emissions associated with VOC release and destruction and have found them to be insignificant sources.

GHG emission factors have been developed from a variety of sources primarily including: the International Aluminum Institute (IAI), World Resources Institute (WRI), World Business Council for Sustainable Development (WBCSD), and US Environmental Protection Agency (USEPA). Novelis follows 1996 IPCC guidelines for stationary and mobile sources. The IPCC guidelines are consistent with the USEPA Climate Leaders methodologies. Process-specific alumina production, anode production and aluminum smelter emissions (South America only) are calculated based on emission factors and calculation methods identified in the International Aluminum Institute's (IAI), "The Aluminum Sector Greenhouse Gas Protocol". All GHG emission factors are defined in the PDM GHG and Energy Calculation guide.

Emissions Source Identification Procedure - Novelis has identified stationary and mobile combustion sources, indirect emissions, emissions from process specific operations and fugitive emissions. Site reconnaissance and visual inspections have been done at all Novelis Corp facilities to identify all emission sources at the sites. A review of energy usage records and invoices was also completed to assure completeness of the initial source inventory.

The responsibility for maintaining and identifying emissions is the responsibility of each site. Additionally GHG metrics reporting is audited each year as part of the Novelis EHS Comprehensive Audit Program. This audit program will facilitate the identification of new sources to assure the source inventory is maintained properly.

Novelis has established a target of reducing GHG emissions by 50% by 2020 (from FY2007-FY2009 average).

Water Usage

Novelis has developed external sustainability targets for water usage intensity. Water usage is defined as the volume of water intake at a facility. As described above, to obtain water usage intensity, water intake is divided by the ktonnes of FRP sales. Refer to the Novelis Environmental Metrics Reporting and Management Guideline for the collection, calculation, and reporting of water data. Water is reported as an intensity metric with the units of cubic meters of water intake per ktonne of FRP sales. For external reporting, Novelis considers Scope 1 sources only and does not consider water usage from Scope 2 and Scope 3 sources.

Novelis has established a target of reducing water usage by 25% per ton of sales by 2020 (from FY2007-FY2009 baseline average).

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Waste to Landfill

Novelis has developed external sustainability targets for waste to landfill. Novelis does not consider wastes as landfilled if those wastes are land applied in such a way that they are considered a raw material for the application (i.e. – road base subgrade material, ingredient to concrete.) Novelis records all wastes to landfill. Wastes that are not considered reoccurring but are one time wastes (i.e. – remediation wastes and large construction projects) are reported externally towards goal attainment. Volumes of these type wastes are recorded in PDM. Refer to the Novelis Environmental Metrics Reporting and Management Guideline for the collection, calculation, and reporting of waste to landfill data. Waste to landfill is reported as absolute in units of ktonne. For external reporting, Novelis considers Scope 1 sources only and does not consider waste to landfill from Scope 2 and Scope 3 sources. Novelis does estimate and include landfill wastes generated from the off-site recycling of dross.

Novelis has established a target of reaching zero landfill by 2020 (from FY2007-FY2009 average).

Appendix 2G

PDM Greenhouse Gas and Energy Calculation Guide

Note - Refer to the following link for emission factor reference sources and calculations:
##########################

A. Indirect GHG Emissions and Energy Consumption from Electricity Generation

GHG Calculation:

$$Emissions\ of\ CO_2e\ (tonne) = \sum PE * (EF / 1000)$$

Where

PE = Electricity Consumption (kWh)
EF = Emission factor (tCO_2 /MWh)
1000 = Conversion Factor (1 MWh = 1000 kWh)

Energy Calculation:

$$Energy\ Consumption\ (GJ) = \sum PE * (3.6 / 1000)$$

Where

PE = Electricity Consumption (kWh)
3.6 = Conversion Factor (3.6 MJ = 1 kWh)
1000 = Conversion Factor (1000 MJ = 1 GJ)

Electricity Emission Factors (includes all 6 GHG Emissions)

Region	Country/ Subregion	t CO2e/ MWh (2003-2008)	t CO2e/ MWh (2009-2010)	t CO2e/ MWh 2011	t CO2e/ MWh (2012-FY2014)	t CO2e/ MWh (FY2015-current)
Asia	China	0.8572	0.7943	0.751	0.772	0.77
	India	0.948	0.9505	0.9744	0.9184	0.8624
	Malaysia	*	0.672	0.6576	0.7286	0.6896
	South Korea	**	0.4691	0.4622	0.5352	0.5472
Europe	France	0.0872	0.0853	0.0872		0.061
	Germany	0.4554	0.4062	0.4406	0.4636	0.477
	Italy	0.4564	0.4054	0.4049	0.4079	0.402
	Luxembourg	0.3343	0.3278	0.3247	0.4117	0.387
	Switzerland	0.0243	0.0257	0.028	0.027	0.03
	United Kingdom	0.4688	0.5066	0.4989	0.4589	0.441
North America	British Columbia	0.024	0.02	0.0200	0.0113	0.0140
	Ontario	0.222	0.18	0.1700	0.0980	0.0930
	Quebec	0.008	0.006	0.0020	0.0020	0.0020
	NPCC Upstate NY (Oswego)	0.3737	0.3287	0.3114	0.2269	0.2487
	RFC West (Warren, Terre Haute, Fairmont)	0.7093	0.7012	0.7075	0.6933	0.6855
	SERC South (Greensboro)	0.6796	0.6794	0.6819	0.6043	0.6173
	SERC Tennessee Valley (Logan, Berea)	0.6816	0.6888	0.7026	0.6190	0.6333
South America	Brazil	0.0856	0.0818	0.0894	0.0874	0.0684

*0.631 (2004), 0.614 (2005), 0.661 (2006), 0.684 (2007), 0.672 (2008)
**0.4363 (2005), 0.4420 (2006), 0.4633 (2007), 0.4691 (2008)

Source (refer to calculations worksheet for the most current reference.)
United States: eGRID
Canada National Inventory Report - Greenhouse gas sources and sinks in Canada
Source CO2 factors: International Energy Agency Data Services. "CO2 Emissions from Fuel Combustion (#### Edition)"
Source International CH4/N2O factors: International Electricity Emission Factors by Country,
Source Malaysia: Study on Grid Connected Electricity Baselines in Malaysia,
Source South Korea: Korea Energy Management Corporations,

Exceptions:
Saguenay buys direct from Alcan Power Plant or City of Jonquiere: 100% Hydropower.
Sierre uses 100% Hydropower.
Nachterstedt and Latchford enter their own site-specific value.

B. Indirect GHG Emissions and Energy Consumption from Steam and Hot Water Generation

GHG Calculation:

$$Emissions\ of\ CO_2e\ (tonne) = \sum PE * EF$$

Where

PE = Steam/Hot Water Consumption (kWh)
EF = Emission factor for steam or hot water used (tonne CO2/kWh) = 0.00023

Note:
PDM calculation assumes Natural Gas fuel and a boiler efficiency of 80% to convert the quantity of steam or hot water reported in kWh to tonne of CO_2. The calculation that was used to derive the emissions factor is below:

$$EF = ((0.0018\ tCO_2/m^3\ gas) / (0.035\ GJ/m^3\ gas) / .80) * (0.0036\ GJ/kWh)$$
$$= 0.00023\ tonne\ CO_2\ per\ kWh\ steam/hot\ water$$

Energy Calculation:

$$Energy\ Consumption\ (GJ) = \sum PE * (3.6 / 1000)$$

Where

PE = Steam/Hot Water Consumption (kWh)
3.6 = Conversion Factor (3.6 MJ = 1 kWh)
1000 = Conversion Factor (1000 MJ = 1 GJ)

C. Direct GHG Emissions and Energy Consumption from Stationary & Mobile Combustion

GHG Calculation:

$$Emissions\ of\ CO_2e\ (tonne) = \sum (Fuel_i\ consumption\ \ x\ \ Fuel_i\ EF)$$

Where:

$Fuel_i\ consumption$: total fuel quantity purchased expressed in physical unit (kg or m3 or liters)

$Fuel_i\ EF$: CO2 emission factor expressed in tCO2e/physical unit of fuel.

Default Factors used in GHG Calculation:

Type	Default Factor	Factor Units
Heavy Fuel Oil (Number 4 or 6)	3.2×10^{-3}	tonne/kilogram
Diesel and Number 2 Fuel Oil	2.7×10^{-3}	tonne/liter
Kerosene	2.6×10^{-3}	tonne/liter
Gasoline	2.4×10^{-3}	tonne/liter
Natural Gas	1.8×10^{-3}	tonne/cubic meter
Liquid Natural Gas	3.1×10^{-3}	tonne/kilogram
Methane	2.8×10^{-3}	tonne/kilogram
Propane	1.6×10^{-3}	tonne/liter
Butane	1.8×10^{-3}	tonne/liter
Anthracite (86-98% carbon)	2.9×10^{-3}	tonne/kilogram
Bituminous (45-86% carbon)	2.6×10^{-3}	tonne/kilogram
Sub bituminous (35-45% carbon)	1.9×10^{-3}	tonne/kilogram
Lignite (25-35% carbon)	1.5×10^{-3}	tonne/kilogram
Petroleum Coke	3.1×10^{-3}	tonne/kilogram
Wood	0	
Biomass	0	

Source: WRI/WBCSD GHG Protocol stationary combustion calculation tool. When calculating default factors, the following global warming potentials were used: CH4 = 21 kg CO2e/GJ, N2O = 310 kg CO2e/GJ.

Energy Calculation:

$$Energy\ Consumption\ (GJ) = \sum (Fuel_i\ consumption\ \ x\ \ Fuel_i\ EF)$$

Where:

$Fuel_i\ consumption$ = total fuel quantity purchased over the period expressed in physical unit (kg or m3 or liters)

$Fuel_i\ EF$ = Energy emission factor expressed in GJ/physical unit of fuel.

Default Values Used in Energy calculation:

Type	Default Factor	Factor Units
Heavy Fuel Oil (Number 4 or 6)	4.3×10^{-2}	GJ/kilogram
Diesel and Number 2 Fuel Oil	3.9×10^{-2}	GJ/liter
Kerosene	3.8×10^{-2}	GJ/liter
Gasoline	3.5×10^{-2}	GJ/liter
Natural Gas	3.5×10^{-2}	GJ/cubic meter
Liquid Natural Gas	5.2×10^{-2}	GJ/kilogram
Methane	5.6×10^{-2}	GJ/kilogram
Propane	2.7×10^{-2}	GJ/liter
Butane	2.9×10^{-2}	GJ/liter
Anthracite (86-98% carbon)	2.9×10^{-2}	GJ/kilogram
Bituminous (45-86% carbon)	3.0×10^{-2}	GJ/kilogram
Sub bituminous (35-45% carbon)	2.1×10^{-2}	GJ/kilogram
Lignite (25-35% carbon)	1.6×10^{-2}	GJ/kilogram
Petroleum Coke	3.3×10^{-2}	GJ/kilogram
Wood	0	
Biomass	0	

Source: WRI/WBCSD GHG Protocol stationary combustion calculation tool

D. GHG Emissions and Energy Consumption from Offsite Transport of Product

GHG Calculation:

$$Emissions\ of\ CO_2e\ (tonne) = 10^{-6} \times \sum (D_i * W_i * EF_i)$$

Where:

D_i = Average distance traveled by means of transport$_i$ (km)
W_i = Total weight of transported product by means of transport$_i$ (tonnes)
EF_i = GHG emission factor for means of transport$_i$ (g/t*km)
10^{-6} = *Conversion Factor (1,000,000 g = 1 tonne)*

Default Factors used in GHG Calculation:

Type	Default Factor	Factor Units
Air Cargo	570	grams/tonne*kilometer
Barge	35	grams/tonne*kilometer
Coaster	35	grams/tonne*kilometer
Train	20	grams/tonne*kilometer
Ferry	35	grams/tonne*kilometer
Heavy Truck (28 Tonnes)	72	grams/tonne*kilometer
Heavy Truck (18 Tonnes)	72	grams/tonne*kilometer
Ocean Vessel	10	grams/tonne*kilometer

Source: The calculation of direct and indirect GHG from mobile sources are reported in accordance with "Mobile combustion Mobile Combustion CO2 Emissions Calculation Tool. June 2003. Version 1.2 WRI-WBCSD GHG Protocol Initiative". Per the tool (see "Assumption" section on the "Introduction" tab) CH4 and N2O emissions are considered but are deemed insignificant.

Energy Calculation:

$$Energy\ Consumption\ (GJ) = \sum (D_i * W_i * EF_i)$$

Where:

D_i = Average distance traveled by means of transport$_i$ (km)
W_i = Total weight of transported product by means of transport$_i$ (tonnes)
EF_i = Energy emission factor for means of transport$_i$ (GJ/t*km)

Default Factors used in Energy Calculation:

Type	Default Value	Factor Units
Air Cargo	9.0×10^{-3}	GJ/tonne*kilometer
Barge	5.3×10^{-4}	GJ/tonne*kilometer
Coaster	5.3×10^{-4}	GJ/tonne*kilometer
Train	3.0×10^{-4}	GJ/tonne*kilometer
Ferry	5.3×10^{-4}	GJ/tonne*kilometer
Heavy Truck (28 Tonnes)	1.1×10^{-3}	GJ/tonne*kilometer
Heavy Truck (18 Tonnes)	1.1×10^{-3}	GJ/tonne*kilometer
Ocean Vessel	1.5×10^{-4}	GJ/tonne*kilometer

Source: Derived from WRI/WBCSD GHG Protocol mobile combustion calculation tool

E. Unique GHG Emissions: Søderberg Process - Anode Consumption

The formula as per IAI Aluminum Sector Greenhouse Gas Protocol Oct 2006 (pg 27):

$$E_{CO_2} = \left[(MP \times PC) - \left(CSM \times MP/1000\right) - \left[\left(BC/100\right) \times PC \times MP \times \left(\frac{S_p + Ash_p + H_p}{100} \right) \right] - \left[\left(\frac{100 - BC}{100} \right) \times PC \times MP \times \left(\frac{S_c + Ash_c}{100} \right) \right] - (MP \times CD) \right] \times 44/12$$

Where:

E_{CO2}	=	*CO2 Emissions (tonnes)*
MP	=	*Total Metal Production (tonnes)*
PC	=	*Søderberg Paste Consumption (tonnes / tonne Al)*
CSM	=	*Emissions of cyclohexane soluble matter (kg / tonne Al)*
BC	=	*Typical Binder Content in Paste (% weight)*
S_p	=	*Sulfur content in the pitch (% weight)*
Ash_p	=	*Ash content in the pitch (% weight)*
H_p	=	*Hydrogen content in the pitch (% weight)*
S_c	=	*Sulfur content in the calcined coke (% weight)*
Ash_c	=	*Ash content in the calcined coke (% weight)*
CD	=	*Carbon in skimmed dust from Soderberg Cells (tonnes carbon / tonne Al)*
$44/12$	=	*CO2 Molecular Mass : Carbon Atomic Mass (dimensionless)*

F. Unique GHG Emissions: Perfluorocarbon (PFC) Emissions

The formula as per IAI Aluminum Sector Greenhouse Gas Protocol Oct 2006 (pg 37) :

A) Method according to the Duration and Frequency of the Anode Effect (Slope Method):

$$CF_4\ (kg) = QA \times AEF \times AED \times f_{CF4}$$

$$C_2F_6\ (kg) = QA \times AEF \times AED \times f_{C2F6}$$

$$E_{CO2}\ (t) = \frac{CF_4 \times GWP_{CF4}}{1000} + \frac{C_2F_6 \times GWP_{C2F6}}{1000}$$

Where:

E_{CO2} = *CO2 Emissions (tonnes)*

QA = *Quantity of aluminum produced – Hot Metal Reduction (tonnes)*

AEF = *Anode Effect Frequency (anode effects/cell-day)*

AED = *Average Duration of the anode effects (mins)*

f_{CF4} = *Slope factor for CF_4 (kg CF_4 / tonne Al per anode effect-mins/cell-day)*

f_{C2F6} = *Slope factor for C_2F_6 (kg C_2F_6 / tonne Al per anode effect-mins/cell-day)*

GWP_{C2F6} = *Global Warming Potential constant for C_2F_6 = 9200*[3]

GWP_{CF4} = *Global Warming Potential constant for CF_4 = 6500*[4]

1000 = *Conversion Factor (1000 kgs = 1 tonne)*

[3] IPCC 1995 Factor

[4] IPCC 1995 Factor

G. GHG Emissions from Purchased Primary (Scope 3)

GHG Calculation:

$$Emissions\ of\ CO_2e\ (tonne) = \sum (W_i * EF_i)$$

Where:

W_i = Total weight of purchased primary aluminum (tonnes)

EF_i = CO2 emission factor expressed in tCO2e/tonne of primary aluminum purchased.

Default Factors used in GHG Calculation:

Scope 3 emissions related to the primary metal purchased from external suppliers by Novelis has been estimated. The CO2 eq. emission factors are based on International Aluminum Institute (IAI) detailed data and they include the different process steps of the aluminum upstream production (from bauxite mining to primary ingot casting)**.**

IAI - Global Average (China included)	*1 tonne of prime*
Process	kg of CO2eq.
Bauxite Mining	26
Alumina Refining	2,931
Anode Production	269
Electrolytic Process	2,160
Electrolytic Energy	7,780
Ingot Casting	124
Primary	**13,290**

The Global average of 13.3 Tonnes of GHG eq. for one Tonne of primary metal includes the global average electricity mix, which is not representative for what Novelis utilizes due to a different energy mix during the electrolytic process (usually each smelter has a captive power plant).

The Novelis metal group assesses the electricity power used in the production of purchased metal primary when the original source of the materials is known and can provide this information (e.g. with sheet ingot from a specific smelter to a Novelis plant). For a small population, the information is not available (e.g. aluminium ingots from LME via traders), in which case the global average is applied.

kg of CO2eq.	Hydro	Nuclear	Natural Gas	Coal	Global Average	
Global Average	**6,255**	**6,255**	**12,960**	**19,366**	**13,290**	
Novelis Mix	68%	3%	1%	15%	13%	**NOVELIS**
	4,253	188	130	2,905	1,728	**9,203**

Novelis uses an average of 9.2 Tonnes of CO2eq. for each Tonne of primary that is sourced.

H. References for T&D Line Loss, % indirect energy by source (including renewable vs non-renewable)

Source T&D line loss and % indirect (except USA and Canada for % indirect energy) IEA
http://iea.org/stats/prodresult.asp?PRODUCT=Electricity/Heat

% of indirect energy for USA and Canada

Source United States: eGRID2007 Version 1.1, January 2009

Source Canada: National Inventory Report 1990-2006, Annex 9

Exceptions:

Saguenay buys direct from Alcan Power Plant or City of Jonquiere: 100% Hydropower.

Sierre uses 100% Hydropower.