Georgia Basin/ Puget Sound
Industrial and Energy Sector Air Emissions Outlook

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Table of Contents

Executive Summary

The *Georgia Basin / Puget Sound International Airshed Strategy* is a multi-agency, international co-operative effort to address shared air quality management concerns. The emphasis of the Georgia Basin / Puget Sound International Airshed Strategy is co-operation and information sharing between Canadian and American agencies regarding potential and actual transboundary air pollution issues. These include impacts to human and environmental health specific to this region. This strategy also aims to prevent future deterioration of air quality.

The **Industrial and Energy Sector Air Emissions Outlook** report provides an overview of the major industrial sectors that are significant air emission emitters in the region. The report reviews the current industrial facilities and provides a forecast of what might be expected in these sectors by 2020. Technology trends related to process changes and energy use and energy conservation are also discussed. Table ES-1 presents the projections of additional output capacity by industrial sector.

This report focuses on five industrial sectors – electrical power generation, petroleum refining, cement plants, pulp and paper mills, and primary aluminum smelters – the key sectors that emit air pollutants. These five industrial sectors represent roughly 66 percent of all point source emissions on Vancouver Island, 48 percent of all point sources in the Lower Fraser Valley, and 95 percent of all point sources in Island/Skagit/Whatcom Counties in Washington State.

Electric Power Generation

British Columbia and the US Pacific Northwest are unique in that the majority of electric power generated to serve the population is hydro-electric power. From the perspective of air emissions, only thermal generating plants are of interest – hydroelectric, nuclear and wind generating facilities are not air polluters. Only the coal-fired, oil-fired, natural gas, and municipal solid waste / biomass plants produce combustion gases that exit from their stacks.

The region will need new sources of electricity, either from new generation projects within the region, or from electricity purchased outside the region. Combined cycle gas turbines (CCGT) are the most likely technology for new electric generation.

In the Georgia Basin region, the power generation issues are the future status of BC Hydro's Burrard Thermal Plant – will it be retained or closed down – and new generation capacity for Vancouver Island. The projection is that new generation capacity will be built on Vancouver Island, mostly likely combined cycle gas turbine (CCGT) facilities.

In the Puget Sound region, new electric generation capacity can be expected – again the most likely are CCGT facilities. The BP Cogeneration facility (CCGT with steam sales to the refinery) at Cherry Point is a strong candidate; the future of the Sumas 2 project is very uncertain, given the recent application for transmission access denied by Canada's National Energy Board.

Table ES-1 Additions to Industry Sector Capacity by 2020

	Georgia Basin	Puget Sound	Description
Industry Sector			
Electric Power Generation MWs			
Existing	1205	919	Burrard Thermal Plant maintained in its present role.
2004 to 2010	250	750	New generation capacity on Vancouver Island (likely CCGT). New generation capacity in Puget Sound Region (BP Cogeneration Project most likely to proceed).
2010 to 2020	750	250	Further CCGT capacity on Vancouver Island. Additional CCGT capacity to Puget Sound area.
Oil Refineries Barrels per Day			
Existing	52,000	624,500	Georgia Basin (Vancouver) served by refined products shipped via the Trans Mountain pipeline from Edmonton area refineries.
2004 to 2020	None	50,000	No new oil refineries in Airshed. Allowance for modest addition to existing capacity at Puget Sound refineries—no significant additional emissions expected.
Cement Plants Tonnes per Year			
Existing	2,400,000	1,005,000	
2004 to 2020	None	None	No new plants in Airshed. Additional demand for cement in region expected to be met by imports.
Pulp and Paper Mills Tonnes per day			
Existing	9,020	3,060	
2004 to2020	None	None	No new pulp mill capacity in Airshed. Allowable cut from forests on the BC coast expected to decline. Harvesting of timber from Federal Forests in Washington State continues to be unlikely.
Aluminum Plants Tons per year			
Existing	None	307,000	Existing plant operating well below capacity.
2004 to 2020	None	None	Aluminum production uneconomical at forecast electricity price.

Oil Refineries

The six oil refineries serving the West Coast of British Columbia and the Pacific Northwest of the U.S. are all located in the Georgia Basin/Puget Sound Region with tide water access. Five of the six refineries are in Washington, on Puget Sound and the Georgia Strait, principally near Ferndale and Anacortes relatively close to the Canada/US border.

No new refineries are expected to be built in the region; however, the existing ones will undergo modifications to meet new regulations related to sulfur levels in fuels. As demand for products

increases, refineries may undergo modifications to achieve modest increases in capacities; no significant emission increases are expected to result from these modifications.

Cement Plants

There are four cement plants operating in the Georgia Basin-Puget Sound region, two in the Seattle area and two on the south arm of the Fraser River in the Vancouver area.

Demand for cement will continue to grow in North America and in the Georgia Basin Puget Sound region. However, the current trend is expected to be more new capacity built in Asia to serve both domestic and export demands. New cement capacity in the Airshed is unlikely: energy costs and the environmental concerns around siting new plants in major urban areas suggest that additional demand in the Airshed will be served by imports.

Pulp and Paper Mills

Pulp and paper production is an important industrial activity in the Georgia Basin Puget Sound Region. There are ten pulp and paper mills located on tide water in the Region. The pulp mills are major point sources of air emissions – from natural gas, oil, and hog fuel boilers, chemical recovery boilers, fuel handling systems, and lime kilns.

Pulp mills depend on a regular flow of wood chips from sawmills as furnish for the pulp digesters and paper machines. Based on its recent reviews of timber supplies, the B.C. Ministry of Forests expects the downward trend in allowable cut to continue for the next fifty years.

Washington State and Oregon have been at the centre of controversy over the protection of old growth forest lands for both wildlife conservation and esthetics. The northern spotted owl was listed as a threatened species under the US Endangered Species Act in 1990, prompting 2.4 million acres of old growth forest land in Washington to be off limits to harvesting. Harvesting in Federal Forest lands is not likely in the foreseeable future.

In the Georgia Basin Puget Sound region, there are no surplus wood chips to support new pulp mills, or any major expansions of existing mills.

Aluminum Smelters

The Intalco Works smelter west of Ferndale on the Strait of Georgia is the only aluminum smelter currently operating in the region. The facility has operated at reduced capacity recently – at about 90,000 tons per year (about 30% of maximum capacity), with only one of the three pot lines operating. With aluminum market recovery uncertain, and electricity prices hovering near a critical point (US$35 per MWh) for aluminum plant profitability, the future for aluminum production in the region is very uncertain.

Georgia Basin/Puget Sound
Industrial and Energy Sector Air Emissions Outlook

1.0 Introduction

The Georgia Basin / Puget Sound area is located in the western transboundary coastal region of Canada and the United States of America (USA), and consists of the Georgia Basin in Canada and Puget Sound in the USA. Seattle and Vancouver are the largest communities, although the provincial capital of British Columbia (Victoria) and the state capital of Washington (Olympia) are also included in the basin.

The *Georgia Basin / Puget Sound International Airshed Strategy* is a multi-agency, international co-operative effort to address shared air quality management concerns. These include impacts to human and environmental health specific to this region. This strategy also aims to prevent future deterioration of air quality.

Government agencies in both countries with a responsibility for air quality are interested in ensuring that the region's air quality is protected for present and future generations. It is for this

reason that various governments, along with First Nations/Tribal agencies and non-governmental organizations, are working to develop the Georgia Basin / Puget Sound International Airshed Strategy[1]. The emphasis of the Georgia Basin / Puget Sound International Airshed Strategy is co-operation and information sharing between Canadian and American agencies regarding potential and actual transboundary air pollution issues.

The region's population has grown to over seven million people, mainly in the Greater Seattle and Greater Vancouver areas. The population increase has been significant in recent years, growing from about six million in 1991, and is expected to be as much as fifty per cent larger (at nine million) by 2020. This growth has important implications for regional environmental health due to greater demand for employment, goods and services, land for housing, business and transportation expansion, and related impacts on recreation space and associated environmental resources.
Some of the main causes of air pollution in this area include combustion from automobiles, truck and bus engines, wood stoves, open burning of yard and wood waste, industrial combustion sources, and power plants.

This report provides an overview of the major industrial sectors that are significant air emission emitters in the region. The report reviews the current industrial facilities and provides a forecast of what might be expected in these sectors by 2020.

[1] Partners include: Environment Canada (Pacific-Yukon Region), Environmental Protection Agency (EPA Region 10), B.C. Ministry of Water, Land and Air Protection, Washington State Department f Ecology, Fraser Valley Regional District, Greater Vancouver Regional District, Lower Fraser Valley Air Quality Advisory Committee, Northwest Air Pollution Authority, Puget Sound Clean Air Agency, Coast Salish Sea Initiative, Sto:lo Tribal Council, Swinomish Tribe, and Tsawassen First Nation.

2.0 Industrial Sectors

In the nomenclature of air emissions, emissions from industrial facilities are known as point source emissions – the other main categories are area sources (e.g. residential heating), and mobile sources (automobiles, trucks, etc.). Table 2-1, Table 2-2 and Table 2-3 presents emission inventory data from Vancouver Island, Lower Fraser Valley, and the northern portion Puget Sound (Island, Skagit and Whatcom Counties). The inventory data are not a consistent set, but from three different sources and for three different years.

Table 2-1 Emission Inventory Data – Vancouver Island

Source	**CO** Tonnes	**NOx** Tonnes	**SOx** Tonnes	**VOC** Tonnes	**PM** Tonnes
Vancouver Island					
Point Sources	43,920	8.768	4,982	3,221	16,220
• Paper	29,259	4,388	4,369	1,702	9,580
• Refined Petroleum	51	147	80	28	308
• Non-Metallic Mineral	-	-	3	-	30
• Power Generation	255	29	49	25	107
Area Sources	42,310	1,752	260	21,044	11,057
Mobile Sources Point	146,733	42,108	9,172	16,611	2,948
Total	232,963	52,628	14,414	40,876	30,225

Source: British Columbia 1995 Inventory of Emissions. See www.env.gov.bc.ca for complete inventory information

Table 2-2
Emissions Inventory Data – Lower Fraser Valley

Source	**CO** Tonnes	**NOx** Tonnes	**SOx** Tonnes	**VOC** Tonnes	**PM** Tonnes
Greater Vancouver Regional District and Fraser Valley Regional District					
Point Sources	3,965	5,865	1,694	4,426	7,843
• Paper	179	154	9	50	371
• Refined Petroleum	225	390	1,324	463	358
• Non-Metallic Mineral	1,271	3,757	206	63	2,115
• Power Generation	123	235	26	72	99
Area Sources	9,871	4,665	203	35,576	5,301
Mobile Sources Point	353,323	71,970	6,864	31,899	3,167
Total	367,159	82,500	8,761	71,901	16,311

Source: *2000 Emission Inventory for the Lower Fraser Valley Airshed*, Greater Vancouver Regional District, Policy and Planning Department, October 2002.

Table 2-3
Emissions Inventory Data, 2002 – Island, Skagit and Whatcom Counties, Washington State

Source	CO Tons	NOx Tons	SOx Tons	VOC Tons	PM Tons
Island, Skagit and Whatcom Counties					
Point Sources	19,063	8,183	15,266	3,209	1,573
• Refined Petroleum	2,715	6,829	13,008	3,029	1,070
• Aluminum Plants	15,969	65	354	1,924	11

Source: Northwest Air Pollution Authority (2002) *Air Operating Permit and Other Large Source Emission Inventory for Northwest Air Pollution Authority* – see www.nwair.org

This report focuses on five industrial sectors – electrical power generation, petroleum refining, cement plants, pulp and paper mills and primary aluminum smelters. The key ingredient to industrial air emissions is the energy consumption in these industrial sectors. Each industry sector uses large amounts of primary energy in their production processes – and the result is significant air emissions that need to be controlled and reduced.

Heavy industrial facilities are major point sources in any airshed, and the data in Tables 2-1, 2-2 and 2-3 illustrates this point. On Vancouver Island, pulp and paper mills dominate the point source emissions data, producing 67% of the CO, 50% of NOx, 88% of SOx, 53% of VOC, and 59% of particulates. In the Lower Fraser Valley, oil refining emits 78% of the SOx, and the cement plants (non-metallic mineral) produce 64% of the NOx emissions. In Island/ Skagit/ Whatcom counties the four oil refineries and one aluminum plant dominate all the point source common air contaminant (CAC) categories. In summary, the five industrial sectors represent roughly 66 percent of all point source emissions on Vancouver Island, 48 percent of all point sources in the Lower Fraser Valley, and 95 percent of all point sources in Island/ Skagit/ Whatcom Counties.

Future air emissions from these industrial sectors will depend on three key factors:

- The prospects for growth in these industrial sectors – general population increases and economics growth that creates additional demand for industrial products. Alternatively, output can decline and facilities close if prices and economics lead to other more profitable production locations outside the study area.

- Technology trends related to process changes and energy use and energy conservation can also result in new facilities or modifications to existing facilities.

- Regulatory changes that result in reduced air emissions.

Each industrial sector is discussed in this report, with existing facilities identified, and leading candidates for new facilities or modifications noted. The study does not predict which possible new individual facilities will become new point sources in the airshed; however, estimates of the changes in industrial output and related energy use are presented.

3.0 Electric Power Generation

The main electric utility companies serving the study area are BC Hydro, Bonneville Power Administration, Puget Sound Energy, Snohomish County Public Utility District, Seattle City Light and Tacoma Light. As well, a number of municipal electric and water utilities serve smaller communities and rural areas within the study area.

British Columbia and the US Pacific Northwest are unique in that the majority of electric power generated to serve the population is hydro-electric power. In British Columbia, BC Hydro has 11,500 megawatts of generating capacity of which 87 percent is hydroelectric, primarily on the Peace and Columbia Rivers; in the US, the Bonneville Power Administration has 19,800 megawatts of capacity of which about 70 percent is hydro-electric, primarily on the Columbia River and its major tributaries. Both BC Hydro and Bonneville purchase electric power from independent power producers (IPP) to supplement their own generation sources.

Bonneville is a major wholesale supply to the electric utilities in Washington State and sells power directly to the primary aluminum smelters. Puget Sound Energy, Seattle City Light and Tacoma Power are distribution utilities that generate a portion of their own power, purchasing the remainder from Bonneville and third-party generation suppliers (independent power producers).

From the perspective of air emissions, only thermal generating plants are of interest – hydroelectric, nuclear and wind generating facilities are not air polluters. Only the coal-fired, oil-fired, natural gas and municipal solid waste/biomass plants produce combustion gases that exit from their stacks.

3.1 Existing Thermal Generation Facilities

Most of the electric power consumed in the Basin is from hydroelectric generation; the limited thermal electric generation facilities in the study are listed in Table 3-1.

Table 3-1
Existing Thermal Electric Generating Facilities in the Study Area

Facility/Plant	Location/ Owner	Capacity (MW)	Type of Use	Description
British Columbia				
Island Cogeneration	Campbell River	245	Base Load	Combined cycle gas turbine (CCGT) located at Norske Canada pulp mill, supplies steam to mill, electric power output sold to BC Hydro
Burrard Thermal	Vancouver/ BC Hydro	960	Peaking	Older plant, built 1960. Natural-gas fired steam generation, high heat rate, runs to meet peak demand or when natural gas prices are favorable compared to electricity prices.

Washington				
Centralia Coal-Fired Plant	Centralia (near Tacoma)	1,340	Base Load	Coal from adjacent mine, built in 1971, owned by TransAlta. This facility is cleaner than in the past, but is still a major source of emissions[2].
Fredrickson Plant	Tacoma	249 (upgrade to 275 planned)	Base Load	CCGT, project started up in 2003, owned 50/50 by EPCOR Power and Puget Sound Energy
Encogen Northwest	Bellingham	125	Base Load	CCGT located adjacent to Georgia Pacific
March Point Cogen	Anacortes March Point Cogeneration Co.	120	Base Load	CCGT located adjacent to Puget Sound Refining and Tesoro Northwest refineries
Sumas Cogen	Sumas Calpine Corp	120	Base Load	CCGT located in Sumas
Tacoma Steam Plant	Tacoma	35	Base Load	Wood, coal, RDF power plant
Tenaska Washington Partners	Ferndale Tenaska Washington Partners, LP	270	Base Load	CCGT located adjacent to ConocoPhillips Co. refinery
Fredonia Station	Burlington	335	Peaking	Four combustion turbine units, owned by Puget Sound Energy
Whitehorn Station	Ferndale	246	Peaking	Three combustion turbine units, owned by Puget Sound Energy

There are other major thermal generation plants in Washington State that are not in the Basin, located south of the study area between Tacoma and the Columbia River (Washington-Oregon Border). Specifically:

- Big Hanaford – 248 MW natural gas-fired CCGT power plant, located adjacent to Centralia coal-fired plant, base loaded plant, built in 2002, owned by TransAlta.
- Chehalis – 540 MW natural gas-fired CCGT power plant, located in Lewis county (120 miles south of Seattle), built in 1997.

[2] For purposes of comparison, the SO_2 emissions from the Centralia plant in 2002 were 19,036 tons while the total SO_2 emissions from the five refineries in the U.S. portion of the study area were13,019 tons. In other words, the Centralia power plant emitted about 1.46 times the SO_2 emissions of all the refineries combined.

3.2 Electric Generation Technology Trends

Combined cycle gas turbines (CCGT) have been the leading technology for power generation for the last fifteen years. By adding a steam turbine using the hot exhaust gases from gas turbines, the CCGT configuration has increased unit fuel conversion efficiencies to about 50 percent from 35 percent. High fuel efficiency, coupled with relatively simple siting requirements and shorter construction schedules have made CCGT the technology of choice.

The risk associated with CCGT is the fuel price risk. Natural gas prices have been volatile in the past five years – natural gas prices have doubled during that time, with periods of volatility and significantly higher prices. The other main electric power generation technology is coal-fired steam plants – the attraction of coal plants being more predictable, lower cost coal as fuel.

The prediction by the US Energy Information Agency[3] is that CCGT will continue to be the cost-effective technology for new power generation, with coal-fired plants also gaining a significant share of new generation after 2015. No new nuclear plants are forecast. Renewable power sources, particularly wind power, are forecast to increase significantly, but wind power is still a minor contributor in the national total.

The Georgia Basin/Puget Sound Region has slightly different options for new generation. Natural gas-fired CCGT are the primary candidate for new generation, and owing to limited local coal resources, coal-fired plants are unlikely. Vancouver Island has coal reserves near Campbell River and an existing coal mine (Quinsam Coal); however there are no current plans for coal-fired facilities. Renewable power generation is a strong candidate for new generation in British Columbia and Washington – specifically small hydro, biomass and wind in B.C., and wind in Washington State.

3.3 Supply/ Demand Balance and Potential Generation Projects

Future projects of electricity supply and demand balances are available for British Columbia and the Pacific Northwest states (including Washington State). BC Hydro has submitted its 2004 Integrated Electricity Plan (IEP) to the BC Utilities Commission. The IEP is available on the BC Hydro website (www.bchydro.com). The Northwest Power Planning and Conservation Council is responsible for power planning in Idaho, Montana, Oregon and Washington, essentially the region served by power generated by the Bonneville Power Administration (BPA) system. The Council is preparing its Fifth Power Plan for presentation in 2004. The Fifth Power Plan is in draft form and available on the Council's website (www.nwppc.org).

BC Hydro forecasts increases in demand for electric energy of 1.1 percent per year from 2003 to 2014 and 1.3 percent over the period 2003 to 2025. Their forecast predicts an increase in electric generation capacity needed of 1.9 percent per year from 2003 to 2014 and 1.7 percent per year from 2003 to 2024[4]. These estimates are after Power Smart, BC Hydro's demand side

[3] *Annual Energy Outlook 2004 with Projections to 2025 (www.eia.doe.gov/oiaf/aeo/electricity.html)*
[4] BC Hydro (2004) *2004 Integrated Electricity Plan, Part 2: Demand-Supply Outlook (www.bchydro.com).*

management program, has been factored into the projections. Electricity demand in the Georgia Basin is forecast to increase relatively slowly over the period to 2024.

The Northwest Power and Conservation Planning Council forecasts growth in electricity of 0.64 percent per year from 2000 to 2015, and 0.95 percent per year from 2016 to 2025. The slower demand growth in the 2000 to 2015 period reflects the reduced electricity use by the aluminum industry.

To summarize, the Georgia Basin/Puget Sound Region faces a growing demand for electricity in the next twenty years. New generation capacity will be needed to serve the region – either within the airshed, or outside the airshed and wheeling to industries and power distribution utilities in the airshed.

British Columbia

The keys of the future thermal power generation in the Georgia Basin (B.C.) are the Burrard Thermal Plant and new generation for Vancouver Island.

Burrard Thermal Plant

The future of the Burrard Thermal Plant is under review. BC Hydro is studying the options for Burrard Thermal[5], including:

- Close the plant, and decommission the facility entirely. The reason why this option might be chosen is to eliminate air emissions from this facility.

- Maintain the status quo. That is, maintain Burrard as a peak generation resource, located in BC Hydro's major load centre (Vancouver area). The air emission consequences are limited with this option since the Plant will operate only occasionally. Burrard has been retrofitted with SCRs in the last ten years to reduce NOx emissions.

- Repower the site with up to 1400 MW of CCGT. This option has been discussed in an earlier review of Burrard, but is an unlikely outcome given the public opposition by residents of the Lower Fraser Valley to air emissions from the Sumas 2 project.

Vancouver Island

Vancouver Island is currently served in part by on-island generation resources, but primarily by submarine transmission cables that transmit power to Vancouver Island from the mainland of B.C. The oldest of the submarine transmission circuits are facing the end of their service life. The initial BC Hydro strategy for Vancouver Island generation was to build CCGT in cogeneration configurations with pulp mills – at Campbell River, Port Alberni and possibly Crofton. The Island Cogeneration Project at Campbell River is a result of this strategy. The next

[5] BC Hydro (2004) *Integrated Electricity Plan, Part 7: Action Plan*

stage was the proposed Georgia Strait Crossing Gas Pipeline (GSX) and a 265 MW CCGT plant at Duke point south of Naniamo, with a further 730 MW plant at the Duke Point site later.

The current situation is that Vancouver Island needs additional firm power generation by 2007, and BC Hydro, after B.C. Utilities Commission turned down its GSX/ Duke Point CCGT proposal, has issued a "generation call" for 150 to 300 MW of firm power to be available by 2007. Eleven bidders have been qualified to submit tenders in August 2004; nine of the eleven are proposing natural gas based projects[6].

The options for new firm power supply to Vancouver Island are:

- Build the natural gas pipeline crossing and a CCGT at Duke Point. Expectations with respect to the future price of natural gas are a key factor in whether this option will be selected.

- A combination of smaller projects, meeting a minimum total of 150 MW, including biomass, wind, smaller-scale CCGT proposals, and energy conservation/load reduction program.

- Fuel switching by pulp mills, substituting coal, biomass, shredded tires, etc. for natural gas. This would free-up existing supplies of natural gas, which would be utilized in residential and commercial markets, and reduce electricity load on the Island.

- Replace the aging submarine cables and serve the Island's peak power demand from the mainland.

The decisions with respect to new electric generation will play out over the next year or so. However, from an air emission perspective, the most likely outcome is approximately 1000 MW of new CCGT (or equivalent) installed on Vancouver Island in the next twenty years, the first 250 MW installed by 2007.

Puget Sound

The Puget Sound region will need new electricity sources over the next twenty years, either new generation capacity built within the region or power purchases from outside the area. For example, Puget Sound Energy has recently issued Requests for Proposals (RFP) for up to 355 MW of new generation (all Sources), 150 MW of wind generation and 40 MW of energy conservation.

The potential sources of new thermal generation in the Puget Sound region include CCGT plants, CCGT plants with cogeneration, wood/biomass generation facilities, and energy conservation/ wind/renewable energy sources.

CCGT Plants

[6] www.bchydro.com

Sumas Energy 2 (SE2) is a proposed 660 MW CCGT to be located at Sumas, Whatcom County, adjacent to the Canada/ US border. This project has been licensed by the Washington Energy Facility Site Evaluation Council (EFSEC)[7]. The project has been extremely controversial with respect to the air emissions impacts in British Columbia, particularly in Abbotsford (near Sumas). SE2 applied to Canada's National Energy Board (NEB) for a transmission line interconnection to BC Hydro's system in Canada, and the NEB heard the application in 2003. Recently, the NEB denied the transmission interconnection, leaving the project's future very uncertain.

SE2 is the only licensed and permitted CCGT project in the Puget Sound region. A project that is a strong candidate, however, is a second phase to the existing Fredrickson Plant near Tacoma. The second phase would add another module (245 MW) on the same site.

Other EFSEC licensed and permitted CCGT projects in Washington State include: Northwest Regional Power Facility (838 MW) at Creston, Lincoln County (Eastern Washington); Satsop Combustion Turbine Project (Phase I – 650 MW, Phase II – 650 MW) al Elma, Grays Harbor County, and Wallula Power Project (1300 MW), near Wallula, Walla Walla County (eastern Washington). None other these projects are under construction.

BP Cherry Point Cogeneration Project

This project is currently under review by EFSEC. The Project is 720 MW of CCGT generation with cogeneration, that is, steam sales to the adjacent BP oil refinery at Cherry Point, near Blaine, Whatcom County. BP proposes to purchase 85 MW of electric power and 510,000 pounds per hour of steam, and the remainder the electric power generation will be sold to third parties. TransCanada Power is the proponent for this project. This project would be able to offset air emissions because combustion in refinery boilers would decrease.

Darrington Cogeneration Facility

The project is a nominal 20 MW, wood-fired cogeneration facility to be located adjacent to the Hampton Lumber mill in Darrington, Washington, ninety miles northeast of Seattle. The project proposes to construct a cogeneration power plant utilizing biomass fuel in the form of wood residue to generate electricity and provide process steam to the nearby Hampton Lumber sawmill[8].

The cogeneration facility will be located approximately 40 km west of North Cascades National Park (NP) which is a Class I air quality area. The U.S. Clean Air Act states that one of its purposes is to 'preserve, protect, and enhance air quality in national parks, national wilderness areas … and other areas of special national or regional natural, recreational, scenic, or historic value'. Allowable ambient air quality deterioration is most stringent in Class I areas (national parks, national wilderness areas as defined in the Act). Any project within 100 kilometers of a Class I area must

[7] See www.efsec.wa.gov

[8] Emissions from Darrington project are predicted as follows: NOx – 242 tons per year, VOC – 40 tons per year, Particulate – 35 tons per year, and SO_2 – 29 tons per year.

undertake an impact analysis for visibility and an analysis to show that the project increment would not exceed the allowable. A Prevention of Significant Deterioration (PSD) review is ongoing. In a first-of its-kind determination in this region, the U.S. Forest Service recently issued an "Adverse Impact" letter. The letter[9] expressed concern about impacts resulting from the air pollution emissions from the proposed facility. Approval of the PSD permit will likely be delayed until these issues are resolved.

3.4 Future Electric Thermal Generation

Table 3-3 projects new thermal power generation capacity in the Georgia Basin – Puget Sound Airshed. The numbers are indicative and represent a worse case scenario from an air emission perspective.

Table 3-3
New Thermal Power Generation Capacity in Airshed

Thermal Electric Generation Capacity (MW)	Georgia Basin	Puget Sound
Existing	1205*	919
New Generation**		
2004 to 2010	250	750
2010 to 2020	750	250

* 960 MW is peaking only (Burrard Thermal Plant)
** CCGT

Renewable energy, particularly small hydro and wind generation projects, will be important non-polluting sources of new electric generation for the Georgia Basin Puget Sound region.

[9] "Based on our review of the permit application, we find that the proposed emissions from Darrington will significantly impact visibility and exacerbate acid deposition at North Cascades NP", letter dated February 26, 2004 from Y. Robert Iwamoto, Acting Forest Supervisor.

4.0 Petroleum Refining

The oil refineries serving the West Coast of British Columbia and the Pacific Northwest of the U.S. are all located in the Georgia Basin/Puget Sound Region with tide water access. In B.C., refineries were built on Burrard Inlet in Burnaby, and in Washington, on Puget Sound and the Georgia Strait, principally near Ferndale and Anacortes relatively close to the Canada/US border.

In 1953, an oil pipeline was built from Edmonton to the Vancouver area (Trans-Mountain Pipeline), with a lateral to Ferndale/Anacortes area. Four refineries were built in Burnaby to serve the B.C. market – Chevron, Shell, Petro-Canada and Texaco. Today, only the Chevron refinery is operating, the others closed and converted to tank farm operations.

Easy shipping access to the Ferndale/ Anacortes area led to refinery projects in the 1950s and 1960s. However, with the discovery of crude oil at Prudhoe Bay in Alaska in 1968 and the building of the Trans-Alaska oil pipeline, Washington State's close proximity led to further refinery development in the Ferndale/ Anacortes area, and Alaskan crude has become the primary feedstock for these facilities.

4.1 Existing Refineries

There are six oil refineries in the Georgia Basin/ Puget Sound region – one in B.C. and five in Washington State. Table 4-1 lists the refineries operating in the region.

Table 4-1
Oil Refineries in the Airshed

Refinery Name	Location	Capacity (Barrels Per Day)	Description
British Columbia			
Chevron Canada Limited	Burnaby	52,000	Refinery is located on the south side of Burrard Inlet. Chevron is integrated refining and marketing company and the leading marketer of transportation fuels in B.C.
Washington			
BP West Coast Products, LLC [Formerly ARCO]	Ferndale (Cherry Point)	225,000	Refinery constructed in 1971 and is located about eight miles south of the international border along the Strait of Georgia. The facility was owned by ARCO until it was purchased by BP.
ConocoPhillips [Formerly Tosco]	Ferndale	100,000	Built in 1954, refinery is located on the Georgia Strait, 90 miles north of Seattle and 20 miles south of the international border. Mobil Oil operated the refinery for many years and more recently it was operated by Tosco.

Shell Oil Products U.S. [Formerly Texaco and Equilon Enterprises, LLC]	Anacortes (March Point, Fidalgo Bay)	140,800	Refinery was constructed in 1957, and owned and operated by Texaco until 1998 when Equilon Enterprises (a joint venture owned by Shell and Texaco) begun operating the facility. In 2002, Equilon begun doing business as Shell Oil Products U.S.
Tesoro West Coast [Formerly Shell]	Anacortes	115,000	Facility is located on March Point west of Anacortes, immediately north of the Shell Oil Products refinery. The refinery was originally constructed in 1955 and was operated by Shell Oil.
U.S. Oil & Refining Co	Tacoma	43,500	Refinery was built on the Tacoma tide flats in 1957.

4.2 Technology Trends in Oil Refining

The trend in oil refining is to larger facilities with greater capacity – economics of scale in the industry favour larger refineries. The B.C. market illustrates this point – three refineries have been closed in the Vancouver-area in the last fifteen years, only the Chevron Canada refinery continues to operate. Larger refineries in the Edmonton area (Imperial Oil – Strathcona Refinery, Petro-Canada – Edmonton Refinery, and Shell Canada – Scotford Refinery) now supply refined petroleum products to the tank farms in the Vancouver area, via the Trans-Mountain pipeline. The air emissions related to this refining capacity are no longer in the Georgia Basin airshed.

Oil refiners are also 'lightening' the product slate, i.e., making process equipment changes in refineries to produce more higher-valued gasoline and less lower-valued heavy oil and asphalt. The Puget Sound refineries are an example of this strategy. For example, Table 4-2 lists the modification projects approved at these refineries in the last four years; many of these modifications will change the product slate to high-valued lighter products.

4.3 New Regulations

In 2000, the U.S. EPA issued regulations ("Tier 2 standards") establishing lower sulfur requirements for all gasoline and established stricter tailpipe emissions standards for all passenger vehicles, including sport utility vehicles, minivans, vans and pick-up trucks. The gasoline sulfur control program begins phasing-in in 2004. In general, refiners must meet a refinery average sulfur standard of 30 ppm for gasoline beginning in 2005 and a per gallon cap standard of 80 ppm beginning in 2006. Canadian regulations are in-step with the EPA regulations.

The current legal limit for sulfur in diesel fuel for on road use is 500 ppm – highway diesel in northwest Washington runs about 350 ppm sulfur, in British Columbia 200 ppm. New EPA rules will impose a limit of 15 ppm (ultra low sulfur diesel). The new low-sulfur fuel must be available at retail stations by September 1, 2006, with a phase-in period from 2006 to 2009. Again, Canadian regulations are identical, except that there is no phase-in period allowed. Ultra low sulfur diesel is necessary to utilize pollution control technology planned for model year 2007

heavy-duty trucks and buses. Vehicle manufacturers will be allowed a phase-in period from 2007 to 2010. EPA expects the new technology to reduce nation-wide heavy-duty vehicle particulate emissions by 110,000 tons per year and NOx emission by 2.6 million tons per year.

The ConocoPhillips refinery in Ferndale is currently producing ultra low sulfur diesel. This has allowed the Department of Ecology and local air pollution agencies to implement a program to retrofit school buses with particulate filters or, if low sulfur diesel is not available in an area, oxidation catalysts[10].

The BP refinery recently announced that it would be spending more than $110 million to construct new Clean Gasoline Facilities at the refinery. The new equipment will allow the refinery to produce gasoline that contains less sulfur and benzene – the fuel is expected to exceed all current and impending gasoline quality regulations. The new fuel will lower NOx emissions from automobiles, reducing emissions by 620 tons per year…the equivalent of removing 40,000 cars off I-5 every day"[11]. BP expects to complete construction of the Clean Gasoline Facilities by June 2004.

Table 4-2 lists equipment modification projects approved in the last four years for the Georgia Basin Puget Sound refineries[12]. The modifications are related to changing the product slate and meeting new regulations limiting sulfur levels allowable in gasoline and diesel fuel.

Table 4-2
Georgia Basin/ Puget Sound Refinery Modifications

Refinery Name	Construction Permits/PSD Approvals
Chevron (Burnaby Refinery)	-Low Sulfur Gasoline Modifications -On-going program with GVRD re: reduction in SOx emissions
BP West Coast Products, LLC	-Hydrocracker Second Stage -Fractionator Reboiler—low NOx burners. -Isomerization Project—Clean gasoline project.
ConocoPhillips	-Refinery upgrade and Clean Fuels Project—replace old cracking unit with new fluidized bed unit
Shell Oil Products U.S.	-Heater modification project—add low NOx burners in H_2S Reboiler Heater and Fractionation Reboiler Heater. -HTU#2 modifications to produce ultra low sulfur diesel.
Tesoro West Coast	-Catalytic Cracking Unit Modification Project—this project will result in incremental increases in particulate and NOx. -Low Sulfur Gasoline Project—involves modification of the cat gasoline splitter, a Reboiler Heater, catalytic reformer and amine treatment system. -Butadiene Hydrogenation Unit—construction of new unit to reduce sulfuric acid use. -Residuum Oil Supercrital Extraction Unit.

[10]Oxidation catalysts achieve a 30% reduction in soot emissions; particulate filters reduce soot emissions by 90% when used in combination with oxidation catalysts. Some retrofits are funded by the Washington State Legislature, some by EPA's Clean School Bus USA program. For more information: cleanschoolbususa@epa.gov or (734) 214-4780

[11] www.pscleanair.org/news/2003/03_19bp.shtml

[12] NWAPA approval orders.

The utilization of low sulfur gasoline and low-sulfur diesel fuel will result in a significant reduction in tailpipe emissions by automobiles and trucks. The air emission impact of refinery modification to produce of these low sulfur fuels can be increased emissions[13] or decreased emissions. Still, the norm is that air emissions regulators require improved air emissions as a condition when permitting refinery equipment modification and changes associated with low sulfur fuel production. A reasonable expectation is that low sulfur fuels will be produced without incremental air emission increases at the refineries.

4.3 Oil Refining – Future Projections

U.S demand for crude oil and refined petroleum products are forecast to increase steadily in the next 25 years[14]. Crude oil demand is forecast to increases from 19.8 million barrels per day in 2002 to 28.3 million barrels per day by 2025. Crude oil imports will meet 70 percent of demand by 2025, up from 53 percent in 2002.

Alaskan crude oil production is expected to continue at about 900,000 barrels per day (down from the initial 2 million barrels per day) through 2016, and decline to 510,000 barrels per day by 2025.

New refinery capacity in the US is expected, but is likely to be at existing refineries. Nearly all the additional capacity is expected on the Gulf Coast. Future refinery utilization rates are expected to be high – 90 percent and higher, as refinery capacity will be tight throughout the U.S.

4.4 Future Oil Refinery Capacity in the Region

Table 4-3 projects oil refinery capacity in the Georgia Basin – Puget Sound Airshed. The numbers are indicative and represent a worse case scenario from an air emission perspective. No new refineries are expected in the Region.

Table 4-3
Oil Refinery Capacity Projection

Oil Refineries Capacity	Georgia Basin Barrels per day	Puget Sound Barrels per day
Existing Capacity	52,000	624,500
New Capacity by 2020	None, any addition demand for refined petroleum products will be delivered from Edmonton via	An additional 50,000 barrels per day from existing refineries.

[13] Refinery modifications related to new low sulfur gasoline production can result in higher refinery air emissions. For example, Chrevon's Burnaby refinery sought and received minor increases to its air emissions permit in 2003 as a result of its plant modification related to low sulfur gasoline production. The GVRD, as a condition of the permit air emissions increases, sought a joint program with Chevron of future SOx emission reductions at the refinery. Also see www.chevron.ca (community – Burnaby Neighbourhood News).
[14] *Annul Energy Outlook 2004 with projections to 2025: Market Trends – Oil and Natural Gas*, see www.eia.doe.gov/oiaf/aeo/gas.html.

	pipeline.	

5.0 Cement Plants

There are four cement plants operating in the Georgia Basin-Puget Sound region, two in the Seattle area and two on the south arm of the Fraser River in the Vancouver area. Water access is very important for cement plants since the key input materials – limestone and coal are delivered by barge. The primary source of limestone for all the cement plants in the region are quarries on Texada Island in the Georgia Strait between Vancouver Island and the B.C. Sunshine Coast. Other plants that previously operated in the Region are now closed[15]. The cement plants are owned and operated by large multi-national companies with production throughout North America and worldwide. These companies are vertically integrated, with manufacturing and sales operations in construction materials - concrete supply, building materials, and lime and gyproc production – to compliment their cement manufacturing.

5.1 Existing Cement Plants

The four cement plants in the Georgia Basin/ Puget Sound region are listed in Table 5-1.

Table 5-1
Existing Cement Plants in the Airshed

Facility	Location	Output Tonnes* per Year	Description
British Columbia			
Lafarge Canada – Richmond Plant	Richmond	1,300,000	Original built in 1956; facility was rebuilt, expanded and converted from the wet process to the dry process in 2001. Plant fuel is coal, with natural gas available as a back-up
Lehigh Northwest Cement Limited (formerly Tilbury Cement)	Delta	1,100,000	Modern dry process facility. Plant uses coal as its primary fuel
Washington State			
Lafarge North America – Seattle Plant (formerly Holnam Cement)	Seattle	380,000	Wet process plant; uses coal as its fuel.
Ash Grove Cement Company – Seattle Plant	Seattle	725,000	Dry process plant, coal is its fuel. Limestone from quarry at Blubber Bay, Texada Island.

[15] Columbia Cement operated in Bellingham for many years. This wet process, two kiln, coal-burning plant was the source of many citizen complaints. The plant was shut down in the late 1980s. The source of limestone was a quarry near Glacier in Whatcom County. A cement plant operated in the town of Concrete (Skagit County) until the 1950s when the facility was closed. Extensive limestone deposits remain and there was an effort to site a new plant there in the late 1970s. However, the proposal never got beyond the exploratory stage.

* One metric tonne equals 1.102 (short) tons

Cement plant emissions from the plants in the Georgia Basin Puget Sound region have been relatively stable over the last few years[16].

Table 5-2
Georgia Basin/Puget Sound Cement Plant Emissions (Tons/Year)

Plant	Year	SO_2	CO	NOx	PM_{10}
Lafarge -- Richmond	2000	3	405	836	267
Lehigh – Richmond	2000	222	905	3198	780
Lafarge – Seattle	2000	532	254	2743	114
	2001	658	253	2438	72
	2002	771	264	2251	78
Ash Grove – Seattle	2000	106	1477	1282	51
	2001	129	1138	1198	46
	2002	188	1414	1213	50

Source: Puget Sound Clean Air Agency Emission Inventory, and detailed 2000 LFV Point Source Emission Inventory (data in tonnes converted to tons).

5.2 Technology Trends in Cement Plants

The two production techniques are the 'wet' process and the 'dry' process. Effectively, the difference is in how the limestone is handled into the rotary kiln. With the wet process, the feed to the kiln is wet slurry, which flows down the kiln's incline as the kiln rotates. With the dry process, the kiln feed is in the form of a powered-like material. The dry process is more energy efficient since there is no need to evaporate slurry water. The dry process is the current approach for new facilities. Cement plants practice heat recovery to pre-heat the kiln feedstock from the cooling of the clinker.

Two federal standards applicable to U.S. cement plants were adopted in 1999[17]. EPA promulgated final hazardous air pollutant emissions standards for cement kilns burning hazardous wastes. These so-called Maximum Achievable Control Technology (MACT) standards limit emissions from both new and existing cement plants. Pollutants regulated under the MACT rules are dioxins and furans; mercury; total chlorine; semi-volatile metals, including lead and cadmium; low-volatility metals, including arsenic, beryllium and chromium; particulate matter; carbon monoxide; and hydrocarbons. National Standards for Hazardous Air Pollutants (NSPS) rules for the Portland cement manufacturing industry were also promulgated. Complying with these rules will result in lower cement plant emissions in the future[18].

[16] Puget Sound Clean Air Agency Emission Inventory, personal communication, John Anderson.
[17] National Emission Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry. Emission limits for existing and new non-hazardous waste kilns are 0.15 KG/Mg dry feed; opacity limits are 20%. For complete emission limits, see: http://www.epa.gov/ozone/title6/noness/64fr31772.pdf For a summary of the rule, see: http://www.epa.gov/airprogm/oar/oaqps/takingtoxics/sum4.html
[18] Nation-wide, EPA expects the MACT rule to reduce dioxins/furans by 36%, particulate by 24% and hydrocarbons by 38%. See: "Fact Sheet Final Air Toxics Rule for Portland Cement Manufacturing Plants", http://www.epa.gov/ttn/oarpg/t3/fact_sheets/portf_fs.pdf.

The cement plants located in the Vancouver area operate under air emissions permits issued by the Greater Vancouver Regional District. The guideline the GVRD uses for permitting is 'best available technology'. Still, there are no required, statutory standards, and the actual permit limits are site specific.

5.3 Cement Plants – Future Projections

The cement industry is a continental industry in North America, and the trends in the industry are driven by U.S. demand. Over the past decade, U.S. demand has exceeded domestic supply[19]. In 2001, U.S. cement consumption was 114 million metric tonnes, compared to domestic U.S. production of 89 million metric tonnes. Canada exported about 5 million metric tonnes to the U.S. in 2001.

Demand for cement will continue to growth in North America and in the Georgia Basin Puget Sound region. However, the current trend is expected to be new capacity built in Asia to serve both domestic and export demands. New cement capacity in the region is unlikely; energy costs and the environmental concerns around siting in a major urban area suggests additional demand in the region will be served by imports.

5.4 Future Cement Capacity in the Region

Table 5-3 projects cement plant capacity in the Georgia Basin – Puget Sound Airshed.

Table 5-3
Cement Plant Capacity Projection

Cement Plant Capacity	**Georgia Basin** Tonne*s per Year	**Puget Sound** Tonnes* per Year
Existing Capacity	2,400,000	1,005,000
New Capacity by 2020	None, addition demand likely to be imported	None, additional demand likely to be imported.

* One metric tonne equals 1.102 (short) tons

[19] M. Jacott et al. (2003) *Energy Use in the Cement Industry in North America: Emissions, Waste Generation and Pollution Controls, 1991-2001*, presentation to 2nd Symposium on Assessing Environmental Effects of Trade, April 4, 2004.

6.0 Pulp and Paper

Pulp and paper production is an important industrial activity in the Georgia Basin Puget Sound Region. There are ten pulp and paper mills located on tide water in the Region and a much larger number of sawmills that provide the initial break down of logs into lumber, pulp chips, and hog fuel. Traditionally, sawmills where a major source of air emissions, owing to the burning of bark and mill wastes in Beehive burners. There are no remaining operating Beehive burners in the Region. Washington State has banned Beehive burners and incinerators; and although B.C. still permits waste burners at sawmills in smaller communities (Tier II permits), there are no Beehive burners or incinerators operating in the B.C. portion of the Region.

The pulp mills are, however, major point sources of air emissions – from power (hog fuel) boilers, chemical recovery boilers, fuel handling systems, and lime kilns. Table 6-1 lists the pulp and paper mills in the Region.

Table 6-1
Pulp and Paper Mills in the Airshed

Facility	Location	Output	Energy Facilities	Description
British Columbia				
Norske Canada/ Elk Fall Mill	Campbell River	2200 MT/day	Electricity – 170 MW purchased, 25 MW self-generation.	Kraft pulp mill (1027 MT/day capacity) and mechanical pulp mill (1500 MT/day capacity). Facility produces newsprint and specialty paper (80%), market pulp (20%).
Pope and Talbot/ Harmac mill	Nanaimo	1165 MT/day	Electricity – 30% purchased, 70% self-generated (30 MW)	Kraft pulp mill (1165 MT/day capacity). Facility produces bleached and unbleached market pulp.
Norske Canada/ Crofton mill	Crofton	2000 MT/day	Electricity – 75% purchased, 25% self-generated	Kraft pulp mill (1100 MT/day capacity), mechanical and recycle capacity. Facility produces newsprint and specialty paper (60%), market pulp (40%).
Norske Canada/ Powell River Div.	Powell River	1250 MT/day	Electricity – 36% purchased, self-generated 64% (40 MW hydro)	Mechanical (ground wood) pulp mill (1300 MT/day capacity) Facility produces newsprint and other specialty ground wood papers.
Howe Sound Pulp and Paper Ltd. Partnership Port Mellon mill	Port Mellon	1625 MT/day	Electricity – 100% self-generation, plus sales to BC Hydro (225 MW)	Kraft pulp mill (1100 MT/day capacity), mechanical mill 550 MT/day capacity). Facility produces bleached kraft market pulp and newsprint.
Western Pulp Limited Partnership Woodfiber Mill	Squamish	780 MT/day	Electricity – 75% purchased, self-generated 25%	Kraft pulp mill (780 MT/day capacity) Facility produces bleached and unbleached kraft market pulp.

Washington State				
Daishawa America Co./ ex Crown Zellerbach	Port Angeles	472 T/day	Electricity – 70% purchased, 30% self-generated	Mechanical pulp mill and deinking facility. Products include telephone directory and newsprint.
Georgia-Pacific West	Bellingham	610 T/day	Electricity – 100 purchased	Sulphite pulp mill – **mill closed early 2001.** Facility currently producing 300 T/day of toilet tissue and consumer toweling from purchased pulp.
Port Townsend Paper	Port Townsend	550 T/day	Electricity – 65% purchased, 35% self-generated	Kraft pulp mill (550 T/day capacity). Facility produces specialty papers and market pulp.
Kimberly Clark Corp.	Everett	440 T/day	Electricity – 100% purchased	Sulphite pulp mill (506 T/day capacity). Plant produces toilet tissue and toweling products.
Simpson Tacoma Kraft Company	Tacoma	1300 T/ay	Electricity – 100 purchased	Kraft pulp mill (1360 T/day capacity) Facility produces linerboard (870 T/day), specialty papers (230 T/day), and market pulp (220 T/day).

Sources: 2003 Lockwood-Post's Directory of Pulp and Paper and Allied Trades; Washington State Department of Ecology (see www.ecy.wa.gov/programs/swfa/industrial)

The mills listed in Table 6-1 are all essential pulp mills; that is, at least part of the output is based in wood chips as furnish for the mill, with either chemical (kraft or sulphite) pulping or mechanical pulping of the wood chips to produce market pulp as an initial output. In addition to pulp production, most of the mills further process the pulp into various types of paper. Some of the mills purchase market pulp to supplement their own pulp production, as part of their paper manufacturing activities.

Table 4-1 does not include straight paper mills; that is, mills that produce various paper grades from purchased market pulp and from recycled paper. These paper mills are smaller facilities and do not pose the air emission issues associated with pulp mills.

There are pulp mills on Vancouver Island and in Washington State that are outside the study area, but in relatively close approximation. On Vancouver Island, there are pulp mills at Port Alberni (Norske Canada – mechanical pulp mill – 1100 MT/day capacity), Port Alice, and Gold River (closed in 1999). In Washington State, there are three pulp mills at Longview on the Columbia River, and two pulp mills at Grays Harbor on the outer coast.

Pulp and paper mills in Washington State are regulated by the Department of Ecology. The Department's rules relating to pulp and paper mills are 173-405 WAC[20] (Kraft Mills) and 173-410 WAC[21] (Sulfite Mills). In 1998, EPA adopted Maximum Achievable Control Technology (MACT) rules for pulp and paper mills[22]. The MACT Rules limit emissions of toxic pollutants including chloroform, chlorine, formaldehyde, methanol, acetaldehyde, methyl ethyl ketone, and

[20] See: http://www.ecy.wa.gov/pubs/wac173405.pdf
[21] See: http://www.ecy.wa.gov/pubs/wac173410.pdf
[22] For a summary of the MACT Rules, see: http://www.epa.gov/air/oaqps/takingtoxics/sum3.html#22

metals that are released during cooking, washing, bleaching and chemical recovery processes at these facilities. In British Columbia, pulp mill air emissions are regulated by permit by the Ministry of Water, Land and Air Protection.

6.1 Technology Trends in Pulp and Paper

The pulp and paper sector is a major energy consumer – both electricity and fossil fuels, including natural gas, fuel oil, and biomass. The industry purchases about half the energy it consumes, the other half is self-generated, primarily from pulping liquors, wood residues, and bark.

Between 1990 and 1999, Canada's pulp and paper producers have reduced the use of non-renewable fossil fuel by 30 percent per tonne of production and dropped total energy consumption by11 percent per tonne of production[23]. American pulp and paper mills have achieved similar levels of energy conservation. A state-of-the-art bleached kraft pulp mills use about 40 percent less steam and 5 percent less electricity then typical mills installed in the 1980s[24]. Although all of the pulp and paper mills in the study region have their origins before 1980, there has been a continuous upgrading of the energy utilization equipment in these mills.

For example, sources of energy use improvements include:

- Better evaporator designs, concentrating solids and improving recovery boiler performance and energy efficiency;
- Better drying designs including heat recovery from drying processes; and
- More efficient electrical equipment, systems and controls for pumps, air handling equipment, and lighting.

Pulp mils are major sources of air pollution. The air emissions of concern from pulp mills are nitrogen oxides (NOx), sulfur oxides (SOx), total reduced sulfur (TRS), and particulates. There is no simple and direct relationship between pulp mill output, energy consumption and air emissions. However, improving the energy efficiency of pulp mills has resulted in modification and additions to plant equipment, and in turn, regulators have sought improvement in mill air emission performance through the air emission permitting process.

6.2 Pulp and Paper – Future Projections

Pulp mills depend on a regular flow of wood chips from sawmills as furnish for the pulp digesters and paper machines. All sawmills depend on a steady flow of logs from the forest. The Vancouver Island pulp mills are dependent on logs harvested from the Fraser River to the North Coast of the province and the Queen Charlotte Islands. British Columbia manages its productive forest on a sustainable basis; that is, an annual allowable cut is identified and the forest industry keeps its log harvesting within this limit, and is responsible for regenerating and reforesting the areas harvested. Throughout the 1980s and early 1990s the overall annual cut on the B.C. coast

[23] See www.cppa.org/english/wood/mil-ener.htm
[24] *Energy Efficiency and the Pulp and Paper Industry* see www.aceee.org/pubs/ie962.htm

began to decline, as companies had to harvest trees in different areas, often further from mills, and the more land was set aside for parks and protected areas. The annual cut reached its peak in 1980 at 27.8 million cubic meters and by 2001 had dropped to 20.1 million cubic meters. Based on its recent reviews of timber supplies, the B.C. Ministry of Forests expects this trend to continue for the next fifty years, when the coast allowable annual cut should stabilize at about 17 million cubic meters per year[25].

The timber harvest in Western Washington has declined from 5,700 million board feet[26] in 1988 to 2,800 million board feet in 2001. Timber harvest has declined on all forest lands, regardless of tenure, whether Federal Forests, State Forests or privately owned forest. The most dramatic decline, however, has been from Federal Forests. Washington State and Oregon have been at the centre of controversy over the protection of old growth forest lands for both wildlife conservation and esthetics. The northern spotted owl was listed as a threatened species under the US Endangered Species Act in 1990, prompting 2.4 million acres of old growth forest land in Washington off limits to harvesting. Harvesting in Federal Forest lands is not likely in the foreseeable future.

The pulp and paper sector is notorious as a cyclical industry. Good prices lead to expansion and new mills, which results in over supply and downward pressure on prices – and the cycle continues. Currently, pulp and paper mills are near the bottom of the cycle – pulp and newsprint prices have been on a downward trend for the last two years or more and it is only now that there is some optimism that pulp markets are turning around and prices will trend upward[27].

In the Georgia Basin Puget Sound region, there is not surplus of timber and wood chip to support new pulp mills, or even any major expansions of existing mills. However, as the outlook for markets and prices improves, the expectation is that some 'output creep' may occur as existing mills make modest investment to add some capacity or change product mix.

Table 6-2 projects pulp and paper mill capacity in the Georgia Basin – Puget Sound Airshed. The numbers are indicative and represent a worse case scenario from an air emission perspective.

Table 6-2 Pulp and Paper Mill Output Projection

Pulp and Paper Mill – Pulp Capacity	Georgia Basin MT/day	Puget Sound MT/day*
Existing Capacity	9,020	3,060
New Capacity to 2020	None	None

* One metric ton equals 1.102 (short) tons

[25] *BC Coast Report* See www.bcforestinformation.com

[26] 1000 fbm (foot-board measure) equals 2.36 cubic meters. From Forintek Canada Corp (1997) *Conversion Factors for the Forest Products Industry in Western Canada*, Special Publication No. SP-24R.

[27] PriceWaterhouseCoopers (2003) *Global Forest and Paper Industry Survey: 2003 Edition – Survey and Results*

7.0 Aluminum Smelter Facilities

Two primary aluminum smelters have operated historically within the boundaries of the Georgia Basin-Puget Sound International Airshed, Kaiser in Tacoma and Alcoa-Intalco Works in Ferndale[28].

The principle toxic emissions from primary aluminum smeltering are fluorides and polycyclic organic matter. Major criteria pollutants include sulfur dioxide, particulates, and carbon monoxide. An electrolytic method (called the Hall-Heroult process) is used to obtain elemental aluminum from bauxite ore. Carbon anodes (made from delayed coke from petroleum refining) react with the bauxite to form elemental Aluminum and carbon monoxide/dioxide. A flux, called cryolite, is required in the process; the flux contains fluorine.

Primary aluminum smelters in Washington State are regulated by the Department of Ecology. The specific air regulation governing emissions from aluminum smelters is 173-415 WAC[29]. In 1997 the U. S. EPA adopted an air toxics Maximum Achievable Control Technology (MACT) rule for the Primary Aluminum Reduction Industry[30]. The MACT Rule limits hydrogen fluoride and polycyclic organic matter emissions.

The Kaiser plant in Tacoma, which once employed as many as 350 workers, was shut down in 2000 and the company filed for bankruptcy. The Port of Tacoma purchased the property and plans to develop the land for other uses.

The Intalco Works smelter was constructed in 1957. The smelter is located about ten miles south of the international border west of Ferndale on the Strait of Georgia. It is permitted to produce a maximum of 307,000 tons of aluminum per year. The facility has operated at reduced capacity recently – at about 90,000 tons per year with one of the three pot lines operating. A combination of declining aluminum prices and higher electricity prices made aluminum production in the Pacific Northwest unattractive[31]. Employment has dropped from 1,000 to 400 workers as production has decreased. Emissions have decreased along with the decreased production. Emissions in tons per year were:

Table 7-1
Criteria Pollutant Emissions from Intalco Works

Year	CO	NOx	SOx	VOC	PM
2000	34,926	61	4734	23	711
2001	5344	30	677	23	166

[28] Nine other aluminum plants, which depended historically on Bonneville Power for relatively cheap electric power, have been shut down.
[29] See: http://www.ecy.wa.gov/pubs/wac173415.pdf
[30] For a summary of the Primary Aluminum MACT rule, see: http://www.epa.gov/air/oaqps/takingtoxics/sum3.html#21
[31] Aluminum smelting is extremely electricity intensive. Electricity accounts for about 20 percent of the total cost of producing aluminum in the Pacific Northwest.

7.1 Future Aluminum Plant Capacity in the Region

Aluminum production in the Pacific Northwest was started in the 1940s in order to supply aluminum for aircraft production during WWII, and was based on inexpensive electricity from the Bonneville Power Administration (BPA). Today, BPA no longer has generation capacity at discount prices, and BPA's generation capacity is dedicated to serving the broad customer markets -- residential, commercial and industrial – of the Pacific Northwest. Electricity prices are at or above the critical point (US$35 per MWh) for aluminum plant profitability, and the future for aluminum production in the region is very uncertain [32].

Table 7-2 projects aluminum plant emissions in the Georgia Basin – Puget Sound Airshed. The numbers are indicative and represent a likely case scenario from an air emission perspective.

Table 7-2
Aluminum Plant Capacity Projection in the Airshed

Aluminum Plant Capacity	**Georgia Basin** Tons per Year	**Puget Sound** Tons per Year
Existing Capacity	None	307,000
New Capacity to 2020	None	None

The expectation is that the existing aluminum plant in the region will continue to operate at less than full capacity. However, higher aluminum prices could lead to a second or third pot line restarting at the Alcoa-Intalco Works. Still, electricity prices are trending upward making aluminum production in the region less viable in the future.

[32] *Forecasting Electricity Demand of the Region's Aluminum Plants*, Northwest Power and Conservation Planning Council, Draft Paper for the Fifth Plan (see www.nwppc.org)

8.0 Natural Gas Compressor Stations

The Duke Energy Pipeline natural gas connects with the Northwest Pipeline at the Canada/US border (Sumas), The Northwest Pipeline running south through the Puget Sound area, with compressor stations at Sumas and Mount Vernon. Terasen Gas operates a pipeline from Sumas to Vancouver and the pipeline to Vancouver Island, with compressors for the Vancouver Island in Coquitlam. Natural gas compressor stations are a significant source of air emissions, particularly NOx. Addition CCGT generation capacity, and possible another pipeline to Vancouver Island will, mean addition compressor stations, resulting in more air emissions in the region.

Northwest Pipeline received approval in 2002 from the local air permitting agency (Northwest Air Pollution Authority) to add turbine driven centrifugal compressors at both compressor stations. The new turbines must employ best available control technology and are subject to Federal New Source Performance Standards for Stationary Gas Turbines. The air pollution agency staff expects the new cleaner, more efficient turbine compressors will be used for base load and the existing reciprocating compressors will be used for peak demand. Both new and existing compressors will burn natural gas. Both compressor stations have Title 5 operating permits.

Natural gas compressors can emit significant quantities of nitrogen oxides. Emissions from the compressor stations will depend on future demand for natural gas. Demand for natural gas is expected to increase; for forecast purposes, expect the addition of two more natural gas compressor stations in the Georgia Basin – Puget Sound Airshed by 2020.

Natural Gas Compressor Station	NOx Emissions (Tons/Year)
Duke Energy – Sumas	22 (2000)
Teresen Gas – Coquitlam	180 (2000)
Northwest Pipeline – Sumas	278 (2001)
	283 (2002)
Northwest Pipeline - Mount Vernon	204 (2001)
	302 (2002)

9.0 Conclusions

The five industrial sectors – electric power generation, petroleum refining, cement plants, pulp and paper mills, and primary aluminum smelters – contribute roughly two-thirds of the point source air emissions in the Georgia Basin/Puget Sound Airshed.

Table 9-1 presents the existing output in the sectors, and projects additions, by sector, to capacity by 2020. No additions to capacity are expected for cement plants, pulp and paper mills and primary aluminum smelting. A modest increase in petroleum refining is anticipated, but no new green-field refineries are projected. The one sector where growth is expected is energy production, specifically electric power generation and related natural gas consumption. Some of the new electric power generation will be thermal power plants, most likely combined cycle gas turbines (CCGT).

From an air emissions perspective, the five industrial sectors reviewed in this study are likely to be reduced in absolute terms in the future. The one exception is air emissions from thermal electric power generation; however the air emissions increases will be relatively modest.

Table 9-1 Additions to Industry Sector Capacity by 2020

	Georgia Basin	Puget Sound	Description
Industry Sector			
Electric Power Generation MWs			
Existing	1205	919	Burrard Thermal Plant maintained in its present role.
2004 to 2010	250	750	New generation capacity on Vancouver Island (likely CCGT). New generation capacity in Puget Sound Region (BP Cogeneration Project most likely to proceed).
2010 to 2020	750	250	Further CCGT capacity on Vancouver Island. Additional CCGT capacity to Puget Sound area.
Oil Refineries Barrels per Day			
Existing	52,000	624,500	Georgia Basin (Vancouver) served by refined products shipped via the Trans Mountain pipeline from Edmonton area refineries.
2004 to 2020	None	50,000	No new oil refineries in Airshed. Allowance for modest addition to existing capacity at Puget Sound refineries—no significant additional emissions expected.
Cement Plants Tonnes per Year			
Existing	2,400,000	1,005,000	
2004 to 2020	None	None	No new plants in Airshed. Additional demand for cement in region expected to be met by imports.
Pulp and Paper Mills			

Tonnes per day			
Existing	9,020	3,060	
2004 to2020	None	None	No new pulp mill capacity in Airshed. Allowable cut from forests on the BC coast expected to decline. Harvesting of timber from Federal Forests in Washington State continues to be unlikely.
Aluminum Plants Tons per year			
Existing	None	307,000	Existing plant operating well below capacity.
2004 to 2020	None	None	Aluminum production uneconomical at forecast electricity price.