SKEENA REGION
BEEHIVE BURNER PHASE-OUT

Background

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A. Introduction

This report is intended to provide background information for the general public and particularly for those who will be actively involved in the upcoming public consultation process regarding the elimination of Tier 1 beehive burners in Skeena Region. The report does not include the actual burner phase-out plans which are to be submitted by the burner operators. The public consultation process, anticipated to begin in March and be completed by May 15, 1998, will involve stakeholders such as local municipal governments, health officers, medical practitioners, environmental groups, sawmill operators, local residents and others. Information gathered through the public consultation process will be compiled and submitted to the provincial Cabinet for its decision(s) to be made by June 30, 1998 regarding any further extensions for the use of the beehive burners.

B. BC Environment's Role

(1) Mandate

The Pollution Prevention Program is mandated under the Waste Management Act (WMA) to prevent pollution and to regulate waste discharges to the environment through permits, approvals, regulations and other legal means.

"Environment" is defined as: "the air, land, water and all other external conditions or influences under which humans, animals and plants live or are developed".

"Pollution" is defined as: "the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment".

"Air contaminant" is defined as a substance that is emitted into the air and that

(a) injures or is capable of injuring the health or safety of a person,

(b) injures or is capable of injuring property or any life form,

(c) interferes or is capable of interfering with visibility,

(d) interferes or is capable of interfering with the normal conduct of business,

(e) causes or is capable of causing material physical discomfort to a person, or

(f) damages or is capable of damaging the environment.

Each operating beehive and silo burner in Skeena region is authorized to discharge emissions to the atmosphere under a waste management permit issued by the Regional Waste Manager (RWM). Tier 1 burners are additionally authorized under the Wood Residue Burner and Incinerator Regulation which specifies the phase-out dates. Permits specify discharge limits,

monitoring and reporting requirements as well as a variety of other requirements. Section 10 of the WMA outlines the powers of the RWM with respect to permitting. These powers include things like the ability to:

- "require the permittee to repair, alter, remove, improve or add to works or to construct new works..."
- "require the permittee to monitor..."
- "require the permittee to conduct studies and to report information..."
- "require the permittee to recycle certain wastes, and to recover certain reusable resources, including energy potential from wastes."

All "decisions" of the RWM are appealable by an affected party to the Environmental Appeal Board. Prior to 1997 the first level of appeal was to the Deputy Director of Waste Management. Requirements imposed through Regulations are not appealable and can only be amended through Cabinet.

(2) Relevant Policies

Ministry policies are not enforceable but serve as guidelines for legal requirements that are incorporated into permits, approvals, orders and other enforceable instruments. Following are some policies that are applicable to the beehive/silo burner phase-out initiative:

- Precautionary Principle: Where there are threats of serious or irreversible damage, the lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation.
- Discharger Pays: Otherwise referred to as the Polluter Pays Principle, this requires that those who release polluting substances into the environment pay the full associated environmental and social costs including costs of treatment, monitoring and remediation.
- 5 R's of Pollution Prevention: To the maximum extent practically achievable, with respect to "waste" discharges, Reduce, Reuse, Recycle, Recover (energy), Residual management (in an environmentally safe manner).
- Use Best Available Practices: A best available practice is a technology or method of operation which achieves operational or production goals with the least impact on the environment.
- Maximize Net Environmental, Social, Health and Economic Benefits: All costs and benefits of implementing guidelines and standards will be considered with the objective of maximizing net environmental, social, health and economic benefits. (a fairly recent addition, signed by the Deputy Minister Oct. 27, 1997)

(3) Tier 1/Tier 2

In December 1993, BC Environment finalized and began implementation of its Wood Residue Management Policy for beehive burner phase-out based on the following tiered approach:

Tier 1 Burners to be phased out in the short term (Dec 31, 1995);

Tier 2 Burners to be phased out in the period 1996 to 2005.

Tier 1:
1. Burners within 5 km of a population of 500 or more, within one km of schools, hospitals and extended care facilities, or within a population based smoke sensitive area (Ministry of Forests designation), AND one or more of the following conditions;
2. Burners in areas with ambient PM10 results significantly greater than 50 ug/m3 (preferably one hour averages);
3. Burners in non-compliance with permit, if the technology is not capable of achieving consistent compliance;
4. Burners in visibility sensitive areas (Ministry of Forests designation), AND where opacity/visibility concerns as defined by RWM exist.

Tier 2:
All other beehive and unmodified silo burners.

(4) Wood Residue Burner and Incinerator Regulation

This regulation first came into effect Dec. 7, 1995 and required the shut-down of 80 Tier 1 burners in B.C. (8 in Skeena region) by various specified dates over the next 2 years. The regulation also allows for the construction and operation of wood residue incinerators without a permit under the WMA, provided the incinerator emission rate is less than 120 mg/m3, discharge smoke opacity is less than 15% and the specified monitoring requirements are followed.

By the Dec 31, 1997 deadline, 44 of the 80 burners (5 in Skeena region) were shut-down while 34 Tier 1 burners (3 in Skeena region) were still in operation. Cabinet amended the regulation on December 18, 1997 to allow mills to continue to operate their burners for up to one more year with a provision for further extension under certain conditions. The amended regulation was sent out before Christmas to all Tier 1 burner operators along with a letter from the Minister and attached guidelines for the required phase-out plans. Copies of the amended regulation, the minister's letter and the guidelines are available from BC Environment upon request. Following are the key points in the amended regulation:

- the 3 Tier 1 burners in Skeena region at Northwood (NW) and Houston Forest Products (HFP) in Houston and at Pacific Inland Resources (PIR) in Smithers are to be phased out by December 31, 1998
- draft phase-out plans to comply with the Dec 31/98 deadline are to be submitted to the Ministry by Feb 28/98 with completion, submission and approval (by Ministry) of a final phase-out plan by March 31, 1998
- the amended regulation makes provision for application to the Minister for a further extension: "On application to the minister by a burner facility operator... the Lieutenant Governor in Council may consider extending the date... where circumstances warrant."

Some relevant highlights from the Minister's letter:

- "In November 1997, a consultation panel toured the province to receive input on the Bridges report and the phase-out of the burners. Three major themes emerged: public health was a major concern; the need to protect jobs and economic prosperity; and, the desire to see wood residue put to value-added uses, particularly co-generation."
- "In response to public health concerns, the government remains committed to phasing out beehive burners. However, community sustainability is also a priority, and every effort will be made to ensure that employment is not impacted and that the potential for future value-added opportunities is maximized."
- "Burners in communities with recorded air quality problems will be subject to particular scrutiny to ensure their early closure. These communities are Prince George, Quesnel and the Bulkley Valley."
- "Community review of phase-out plans will be required."
- "Burners seeking further extensions will be required to meet stringent performance standards to reduce air pollution."
- "The government will also be looking at ways to support value-added projects."

Any application to the minister for a further extension (beyond Dec 31/98) would require Cabinet approval and must include the following additional information in the phase-out plan according to the Guidelines attached to the Minister's letter:

- evidence to show why the Dec 31/98 phase-out deadline is not a financially viable option
- a detailed outline of and demonstrated commitment to an alternative plan
- an estimate of the benefits and social costs of the alternative plan
- a description of a detailed public consultation process to review the phase-out plan with the local community during the period April 1 to May 15, 1998
- a summary of equipment and operational improvements that have been or will be implemented to improve the short-term operation of the burner
- a proposal for ambient particulate (PM10) monitoring that would be undertaken by the burner facility operator in the community to determine the acceptability of local air quality

In the case of a request for extension, the Guidelines further specify that "the content of the plan must be verified by an independent financial management consultant or other qualified third party, at the burner facility operator's expense, who has full access to the firm's financial and production records."

Cabinet rejection or approval of any extension request(s) is scheduled for completion by June 30, 1998 after full consideration of the results of the public consultation process.

Three additional sets of guidelines developed jointly by BC Environment headquarters and regional staff were sent out to all the Tier 1 mills in the province along with a covering letter from the Assistant Deputy Minister on February 9, 1998. These guidelines are entitled:

- Guidelines for Consultation to Review Beehive and Unmodified Silo Burner Phase-out Plans

- Guidelines for Monitoring Plans for Beehive and Unmodified Silo Burners - Data Collection, Assessment and Application (and attachment: Checklist for Ambient Monitoring Proposal)
- Operating Guidelines for Beehive and Unmodified Silo Wood Residue Burners

Copies of the above Guidelines are available from the Smithers BC Environment office upon request.

C. Regulatory History

(1) Pertaining to Beehive/Silo Burners

The original Pollution Control Objectives for the Forest Products Industry dated November 1971 recommended that unmodified beehive burners be eliminated by Jan 1/75 and that modified beehive burners (referred to as "interim operating facilities") be upgraded to improve their burning efficiency or that they be replaced with multiple-chambered incinerators within a specified period of time (which was never specified prior to the 90s).

The "unmodified beehive burners" were phased out by the early 80s except for a few in remote locations. The modified beehive burners were upgraded during the 80s somewhat, with the major improvement being the addition of PLCs or programmable logic controllers that control the air supply systems and dome dampers.

In the late 80s, primarily due to increased public awareness and concern about environmental protection issues and the public demand for tougher enforcement, BC Environment adopted a more rigorous approach to permit compliance assessment. It did not take long for Ministry staff to realize that most beehive burners were not capable of achieving consistent compliance with permit discharge opacity limits under the current normal operating conditions. In a memo to the Assistant Deputy Minister dated May 27/89, Skeena region requested the Ministry consider adoption of a policy that would require the major sawmills in B.C. to eliminate their woodwaste burners by 1993. A draft letter, attached to this memo, for the Executive Committee's approval, required mills to retain an engineering consultant to study the options available to them to replace their burners and to provide a report to the Regional Waste Manager (RWM) by the end of 1989.

In response, Victoria requested that the Smithers office hold on to the letters for the time being and indicated that it would coordinate the development of a provincial approach to burner phase-out. A memo from the Executive Director of Environmental Protection, dated Nov 27/90 to regional directors indicates that a draft discussion paper from an interministry smoke management task force recommends phase-out of woodwaste burners by 1995 and that Ministry policy will be formulated once the paper is endorsed by Cabinet. The task force was mandated to review issues around smoke derived from various sources including beehive burners. An August 91 memo from Victoria to the Skeena Regional Director indicates the Cabinet Committee was in the process of reviewing the Smoke Management Discussion Paper at that time.

About mid 91 BC Environment's Kootenay Region issued a (regional) policy on smoke management which included an expiry date of 1995 for beehive burners. This action as well as similar previously attempted action in Skeena Region caused the sawmill industry to express their concerns about lack of a "level playing field" and unfair competitive disadvantages developing in one region over another.

In spring 92, the Interministry Clean Air Policy Steering Committee released a public discussion paper, "Smoke Management for the 90's", which summarized the direction for BC's improved smoke management for sources such as woodstoves, agricultural landclearing, forestry slashburning and beehive burners. This paper identified that smoke from sawmill burners contributes to frequent episodes of air pollution for BC communities, limits visibility and leads to potential health problems. It proposed January 1/96 as the phase-out date for burners in smoke sensitive areas.

In Feb 93 a government-industry task force was established at the request of industry to look at alternative means of dealing with sawmill wood residue other than in beehive burners and to review methods of implementing the policy framework.

Following the announcement of the formation of the Task Force, on Feb 23/93 the Skeena RWM held a meeting in Smithers for all mill operators and other interested parties. With approximately 25 sawmill operators present, the RWM announced the proposed provincial policy with respect to beehive/silo burners and indicated that the Skeena region intended to eliminate essentially all of its burners by the end of 95. Some exceptions were noted for remote areas where no significant air quality concerns existed.

On Mar 9/93 the Skeena RWM sent out a standard letter to all burner permittees requesting the submissions of reports by Dec 31/93 on wood residue management options. Firm dates for implementation were required to be submitted to the RWM. Permittees were advised that the target shutdown date was Jan 1/96 and that future permit amendments may include a clause with an expiry date of Dec 31/95. This letter went out to all burner operators province-wide in Mar/93.

On Mar 31/93, the Houston Forest Products (HFP) permit was amended by the Smithers office to include an expiry date of Dec 31/95 and phase-out plan reporting dates of Jan 31/94 and Jan 31/95. The HFP permit was the first to be amended this way simply because it was at that time up for amendment concerning another issue. Over the next 4 months there was a series of correspondence between BC Environment Smithers staff and HFP concerning the burner phase-out issue and on Aug 12/93, HFP made a request to appeal the RWM's decision regarding the expiry date, essentially arguing that such a decision was premature.

On Dec 17/93, in response to continuing concerns raised by RWMs, Minister Moe Sihota announced that "operators of beehive burners... have until March 31, 1994 to provide the BC government with plans for phasing out these burners". Mr. Sihota indicated that he had accepted the recommendations of the joint government/industry task force report (released in late Nov 93) with its two-tiered approach to the elimination of burners: Tier 1 phase-out by Jan1/96 and Tier

2 phase-out in the period 1996 - 2005. He accepted the definitions provided for Tier 1 and Tier2, but left the responsibility with his RWMs to identify which burners belonged in which Tier.

In Jan 94, the RWM sent to each burner operator a letter with an attached permit amendment for the 10 Tier 1 operations in Skeena Region which specified a burner shut down date of Dec 31/95 and a requirement for submission of a phase-out plan by Mar 31/94. Out of the 10 that received these permit amendments, 4 operations submitted acceptable burner shut down plans (Veenstra, Repap Smithers, Pine Creek Sawmills/Alpine Cedar Prod. and Kitwanga Lumber), 4 operations appealed the RWM's decision (HFP, NW, Repap-Carnaby and Repap-New Hazelton) and one operation submitted an acceptable plan to upgrade its burner to qualify for reclassification to a Tier 2 (Decker Lake Forest Products). PIR decided 13 months after their permit was amended that they too wished to appeal, however, they were not granted leave to appeal, neither by the Director, nor by the Environmental Appeal Board, because it was well beyond the 21 day limit for filing notice of appeal.

HFP's appeal was the first in the province to be heard on Jan 13/94 and the Director, Dr. McTaggart Cowan, ruled in favour of the RWM's decision. HFP appealed this decision to the next level, the Environmental Appeal Board. With respect to the 2 Repap appeals, the Director's decisions were handed down on Mar 13/95 upholding the RWM's decisions concerning burner phase-out requirements. Repap's lawyers informed the RWM and the Director of the company's decision to proceed to the next level of appeal on Mar 15/95.

A number of other operations throughout the province also appealed the expiry dates in their permits. Grounds typically included arguments such as the following (summarized and simplified) excerpts from the Repap case:

- that the Director's requirement that the Repap burners cease operating by January 1, 1996 is unreasonable in the circumstances
- that the Director has exceeded his jurisdiction in amending the permits, particularly that such amendments are not necessary for the protection of the environment
- that the policy which formed the basis for the action of the Director with respect to the classification of the beehive burners, is not justifed
- that the Director acted unlawfully in directing the Regional Waste Manager (RWM), Skeena Region, to take the action which he did in amending the permits
- there is insufficient evidence that the operations of the Repap burners are causing harm to the environment
- the only economically viable alternative to the operation of the Repap burners is to dispose of the wood waste by means of an electrical generation facility
- the decision of the BC Cabinet on electrical generation policy has not been issued
- there is insufficient evidence that the ceasing of operations of the Repap burners is necessary for the protection of the environment
- results of testing from air monitoring stations in the area in question do not indicate an impact on the environment as a result of the operation of the burners
- there is no scientific basis for the Tier 1 and Tier 2 designations

- there is no objective or reasonable grounds for the establishment of the policy relevant to the protection of the environment
- both the RWM and the Director failed to exercise any independent judgement in amending the permits and in considering the appeal, respectively
- the RWM, in amending the permit, and the Director in considering the appeal, both allowed their judgement to be improperly fettered.

On Sep 27/95 the Environmental Appeal Board announced its decision to overturn the RWM's and Director's decisions concerning the requirement to shut down burners by dates specified in the amended permits. "The decisions made by the Regional Waste Managers and by the Deputy Director in the permit amendments under appeal were fettered of the implementation by a province-wide policy and accordingly are void." RWMs were directed to take into full consideration site and case specific factors for each operation and "engage in any negotiations necessary in order to improve the operation of the beehive burners in question." The Board indicated that phase-out decisions had to be solidly based on site-specific environmental protection objectives rather than broad-based policy.

In many cases throughout the province the necessary ambient air quality data simply did not exist and to commence studies at each location and resume negotiations with each burner operator in BC would require more time and resources than the Ministry had at its disposal. In consideration of this and the likelihood of further appeals of future decisions of the RWM, the Ministry decided to draft a regulation to require burner phase-out. The regulation was approved by Cabinet Dec 7/95 and was most recently amended on Dec 18/97. The Regulation is summarized in Section B 4 of this report.

(2) Other Smoke Management Regulatory Initiatives

As noted previously in this section, the 1992 Ministry report, "Smoke Management for the 90's", addressed smoke emissions from a variety of sources. While the above discussion has primarily focused on the regulatory history of beehive burner phase-out, it is important to note that the Ministry fully recognizes that there are other significant sources of smoke such as silviculture related slash burning, woodstoves, burning of landclearing debris associated with agricultural and subdivision development activities, backyard trash burning, grass burning and so on.

In the period 1988 through 1990, BC Environment staff from the Smithers office focused much attention on the issue of smoke emissions and the health effects of woodsmoke in general. At that time B.C. was in many respects far behind other neighboring jurisdictions like Washington, Oregon and even some municipalities in Alaska and the Yukon. Information was obtained from environmental regulators and health effects researchers in these jurisdictions and passed on to headquarters staff, the BC Lung Association, local physicians, Smithers Town Council and local residents through public information meetings, articles submitted to local newspapers, pamphlets distributed by mail and so on. As woodstove and backyard burning emissions were exempt under the Waste Management Act, presentations were made by BC Environment staff to Smithers Council requesting development of appropriate bylaws modeled after neighboring jurisdictions and endorsement of an airshed management plan involving voluntary curtailment of woodstove use and open burning bans as needed to prevent poor air quality episodes. The public

education campaign was picked up by the BC Lung Association, EACH (local environmental group) and a group of Smithers physicians that formed an environmental committee.

Most of the other sources of wood smoke (i.e. other than beehive burners) are being dealt with through new legislation and ongoing public education efforts. For example, the Open Burning Smoke Control Regulation came into force in April 93 and a Woodstove Regulation, governing emissions limits for all new stoves and fireplace inserts sold in BC, came into force in August 94. BC Environment's air quality meteorologist, Doug Johnson, has been part of the Town of Smithers Environmental Services (Air Quality) Committee since early 92 and assisted in the drafting of a comprehensive bylaw pertaining to "backyard burning" which came into force in 1997. Significant Ministry resources have been applied in recent years towards education and enforcement in these new areas of legislation and more work is still needed.

Furthermore, an ambient air quality monitoring network consisting of state of the art TEOMs and associated meteorological stations has been developed in Skeena region which gives BC Environment continuous and instantaneous air quality information for a good number of communities in the region. This information is updated daily and available to the public through the Ministry's Air Quality Hotline and the Internet. The information is also used by Ministry staff in decision making with respect to imposing burning bans, requesting voluntary curtailment of woodstove use, issuance of public health advisories and the like.

D. Current Status of Wood Residue Burners in Skeena Region

For the 3 remaining Tier 1 burners and the 7 operating Tier 2 burners in Skeena region, a brief description of each operation, updated to February 98, is provided as an appendix to this report. The following information is provided for each operation:

- Company name and address
- Mill location
- Size of operation (i.e., lumber production rate)
- Total number of employees
- Hours of operation and number of shifts
- Total quantity of wood residue generated
- Breakdown of wood residue types
- Disposal/utilisation methods
- Size and type of wood residue burner
- Equipment and modifications associated with burner

E. Burners Eliminated in Recent Years

Beehive burners have remained in operation much longer than the provincial government had originally envisioned, however, BC Environment has been working with the sawmilling industry for many years towards the elimination of beehive burners on a prioritized basis, thereby also achieving better utilization of the wood fibre resource. Phase-out priority has been based on factors such as proximity to local residents, air quality information, nuisance concerns (e.g.

flyash complaints), opportunities for alternatives, permit compliance problems and so on. Real progress has been made over the years, for example, in the 70's as many as 8 burners were operating in the Smithers area; 5 were operating in the 80's and only one burner is operating today. Operation of the remaining burner today at the PIR mill is far more sophisticated than that of its predecessors with a computer controlling its underfire air, overfire air and dome damper systems, a 24 hour/day continuous fuel feed system, a temperature activated automatic supplementary fuel addition system that meters in additional fuel if the burner temperature drops below the set point 800 °F, a video monitoring system and so on. The 24 hour/day fuel feed eliminates smoke problems typically associated with daily startups, shutdowns and shift changes when the burner formerly was not able to maintain a high enough temperature to burn cleanly.

To provide some further insight into how and why burners have been phased out in recent years in the Skeena region, the following are some brief examples:

- West Fraser shut down its beehive burner in Terrace in 1982 after installing a hogger and has hauled the hog fuel since then to its pulpmill in Kitimat for its power boiler. SCI's mill in Terrace was required by BC Environment to shut down its burner in 1988 due to unacceptable smoke and flyash impacts on nearby businesses and residents. A hogger was installed at the mill and wood residue trucked to the pulpmill in Prince Rupert as hogfuel for the power boiler. Unfortunately, due to economic and other factors, there continues to be a surplus of hogfuel in the Terrace-Kitimat-Prince Rupert triangle and a mountain of hogfuel continues to grow at the SCI pulpmill at a rate of several hundred tonnes per day creating other environmental concerns such as toxic leachate and risk of spontaneous combustion.
- When relocating/rebuilding its operations at the Westar millsite in South Hazelton, Isolite-Stege was not permitted to build a beehive or silo burner due to the site's close proximity to the residential area. The company (now known as Kispiox Forest Products) spent $3.2 million a few years ago installing a Volcano Energy System to burn its wood residues and produce heat for its lumber dry kilns and space heating needs and generate 750 kW of electricity as well.
- SCI Smithers was charged by BC Environment in 1990 for permit opacity violations. Although SCI won the court case on a technicality (definition of opacity), the company did not wish to risk future prosecution and decided to stop using their beehive burner since that time. SCI hauled the wood residues to their on-site landfill for several years until they became quite concerned about longterm environmental liabilities associated with a wood residue landfill (spontaneous combustion and toxic leachate contaminating groundwater and surface waters). Since 1993 the company has been trucking the wood residue at an annual cost of about $400,000 to Carnaby for disposal in the #1 burner at this millsite.
- Kyah Forest Products operated a very smoky burner on the Moricetown reserve for a number of years. Despite the jurisdictional questions and limitations associated with an operation on Indian reserve land, BC Environment pressed the matter with the (federal) Department of Indian and Northern Affairs, the Kyah mill manager and the Moricetown Band. Northwood negotiated a joint venture partnership with the Moricetown Band for a new finger jointing mill and willingly complied with the Ministry's request to put in a low emissions wood residue burner with energy recovery. Kyahwood now successfully operates a 2-stage gasifier system which also provides space heating for the mill and office buildings.

- CGED Forest Products operated a very smoky beehive burner at the former Westar site on Indian reserve land adjacent to Kitwanga. Despite the same jurisdictional issues, BC Environment had meetings with mill and band managers as well as Indian and Northern Affairs staff to attempt to work out a resolution. The burner (and the mill) has been shut down due to operational problems.
- Abfam Enterprises Ltd operates a sawmill and beehive burner at Pt. Clements (Q.C.I.) and in partnership with another company, under the name of North Island Power Corp. (NIPC), has successfully negotiated a 20 year wood residue fired 5MW electric power generation contract with BC Hydro. Through a series of meetings with MacMillan Bloedel (MB) and amendment of their permit, BC Environment persuaded MB to work out a 20 year wood residue supply agreement with NIPC that will provide 45,000 tons/year of fibre from its coastal log sort operations (formerly open burned and landfilled) for the power plant. The low emissions NIPC power project will replace BC Hydro's high cost diesel generating facilities at Masset.
- Alpine Cedar Products shut down its beehive burner at the Pine Creek Sawmill site on Tatlow road, Smithers, on Dec 31/95 as required by the Regulation. The blocky dry pine waste is hauled at an estimated annual cost of $60,000 to PIR where it provides good quality supplementary fuel for its beehive burner.
- Veenstra Sawmills Ltd. (VSL) stopped using its beehive burner on Tatlow Road as of Dec 31/95 as required by the Regulation. VSL waste is now trucked along with SCI Smithers waste to Carnaby's #1 burner at an estimated annual cost of $50,000.
- Kitwanga Lumber shut down its beehive burner by Oct 31/96 in compliance with the Regulation and is trucking its wood residue to the #1 burner at Carnaby at an estimated annual cost of $270,000.
- SCI shut down its silo burner at its whole log chipper operation in New Hazelton by Oct 31/96 in compliance with the Regulation and now trucks the wood residue to the Carnaby #1 burner at an estimated annual cost of $735,000.

Both beehive burners at Carnaby experienced intermittent permit compliance problems, historically, due to periodic insufficient fuel supply. In 1995, BC Environment indicated that it was willing to grant SCI a Tier 2 classification (only reason it was Tier 1 was permit compliance problems) for its Carnaby operations if the company would upgrade its burner facilities to convert to a communal burner arrangement which could accommodate wood residue from other area Tier 1 mills (thereby enabling these burners to shut down) and to ensure 100% compliance henceforth with its permit opacity limits. SCI spent about $600,000 in 1996 in modifications to the burner and its conveyor system to allow for trucks to unload at its #1 burner. The #2 (sawdust) burner at Carnaby has not been operating since Feb/97 as all of the sawdust now goes to Kitimat to feed Eurocan's new sawdust digester.

In addition, several other beehive burners have been eliminated in the past decade or so due to enforcement pressures and as other opportunities for utilization of wood residues became available. For example, planer mill burners at several operations were eliminated because these burners were frequently in violation of their permit opacity limits and the planer waste could be better utilized as supplementary fuel in other burners, raw material for panelboard

manufacturing, or fuel in energy recovery systems for heating lumber dry kilns such as the Volcano systems installed at Houston Forest Products and Babine Forest Products.

F. Air Quality Issues

This section has been extracted from a 37 page report completed by BC Environment air quality meteorologist, Doug Johnson. The full report is available on the Internet at http://www.env.gov.bc.ca/ske/skeair/index.html#AQhp or can be requested from the Smithers office of BC Environment.

(1) Executive Summary

Combustion of wood residue and other fuels generates an air contaminant known as particulate matter. This contaminant may be transported through the atmosphere to populated areas where it may be inhaled into the human respiratory system. This atmospheric contaminant is known as inhalable particulate.

Air quality monitoring data indicate both Smithers and Houston experience inhalable particulate-related air quality impacts. This has occurred, with varying severity, during every year monitored to date. Compared with other industrial sources permitted by BC Environment, beehive burners are the largest single source of particulate emissions in the Bulkley Valley.

In the Bulkley Valley air quality has generally been improving over the past 3-4 years. The improvements are greatest in Smithers, compared to Houston. It would appear that new regulatory initiatives, such as those in place for new woodstoves and open burning, combined with public information campaigns, have resulted in improved air quality.

In spite of the improvements observed in recent years, air pollution is still occurring in the Bulkley Valley. Further work needs to be done to reduce particulate emissions in the airshed if we want to get these measures of impacts down to zero. Of the management options presented in *Smoke Management for the '90s* (BC Environment, 1991), beehive burner phase out in smoke sensitive airsheds, such as the Bulkley Valley, remains the last significant option for particulate emission reductions and air quality management.

(2) Contributing Sources

Emissions (sources) and meteorology (dispersal of emissions) are two critical variables that determine local air quality. While forces beyond human control determine meteorology, this is not the case for emissions from anthropogenic (human) sources. Thus, we are masters of our air quality. Quantified in this section are Skeena Region particulate emissions. Meteorological processes are discussed. Subsequent sections present air quality trends, i.e., the impacts of particulate sources on Bulkley Valley air quality.

(a) Meteorological Processes

The Bulkley Valley is located 250 kilometres inland from the west coast of North America. Stable air masses commonly characterise meteorological conditions. In winter, this is in the form of continental polar air masses, typified by cold, dry, air with clear skies and low wind speeds. Clear skies, combined with long winter nights, calm winds, and bright (snow) surfaces to reflect daytime sunlight, promote an intense climatological process known as radiative cooling.

Radiative cooling is a process whereby ground surfaces lose energy (heat) by longwave radiation at a rate greater than the overlaying atmosphere. Thus, over time, the ground surface is progressively colder than the overlaying atmosphere. Such conditions are termed *temperature inversions*: i.e., the atmospheric temperature profile is inverted. Temperature increasing with height is opposite to the 'normal' atmospheric lapse profile (temperature decreasing with height). Skiers on Hudson Bay Mountain near Smithers will recognise this phenomenon in winter whereby the mountain temperatures are much warmer than valley bottom temperatures. These processes can operate at other times of the year, however, they tend to be less intense than in winter.

The net result of atmospheric temperature inversions from an air quality perspective is a very stable atmosphere characterised by little mixing. Such atmospheres have very limited capacity to disperse (transport) emissions such as smoke coming from a beehive burner or residential chimney. Thus, any emissions into a stable atmosphere tend to remain trapped close to their source height. Over time (hours to days), this can lead to degraded air quality as compounds continue to be emitted into the atmosphere but are not transported away. If the resulting build-up of emissions results in environmental impacts (including human health impacts), *air pollution* is said to occur and the emitted air contaminants thus become classified as *air pollutants*.

When the air begins to mix, (e.g.,) from thermal turbulence generated by morning solar heating or mechanical turbulence as a regional wind picks up, the temperature inversion is broken, pollutants aloft are well-mixed through this previously-stable lower layer, and any pollutants aloft are drawn down to ground level. This is termed *fumigation* and can result in short-lived, but extremely high, concentrations of air pollutants.

It is only when the regional air mass as a whole is changed that built-up pollutants are removed. Such conditions are marked by the passage of a frontal system which defines the boundaries between air masses[1]. Fronts are often associated with precipitation. When in the form of rain, such precipitation can act as a very efficient scrubber, thereby removing aerosol pollutants, such as particulates, from the atmosphere.

These meteorological conditions are typical of any central interior community in British Columbia. They are contrasted by coastal communities, such as Prince Rupert, that are largely under maritime polar air masses for much of the winter. Maritime polar air masses are characterised by cool and damp air that is unstable. Such unstable (windy) and relatively warm

[1]Occasionally, air mass changes can have the opposite effect of bringing in pollutants from other areas.

environments tend to have excellent dispersion characteristics: air quality problems, such as the wood smoke ones experienced by the interior communities, tend to be much less frequent or intense in such environments.

Houston, Smithers, and the Hazeltons are located in the Bulkley Valley. As such, local topography can have significant influences on local meteorology and climatology. The surfaces of mountain and hillside slopes cool radiatively in the same manner as the surfaces described in the paragraphs above. The cold air overlying these surfaces is dense (heavy) and will drain down slope as a fluid (just as water does in a mountain stream). Thus, cold air accumulates and can build up in valley bottoms. This acts to intensify any radiative temperature inversion set up in the valley. In addition, any smoke at mountain slope elevation (e.g., smoke from an open burn) can be drawn down into the valley with the air under such conditions.

Mountainous terrain also can act to detach valley air from regional air masses. For example, cold air can collect in the valley through the processes of radiative cooling and cold air drainage. When a warm front comes in from the coast, the frontal surface can be detached from the valley bottom (forced up by mountains) resulting in stable cold air remaining trapped in the valley with unstable warm coastal air aloft. Thus, the inversion conditions can be maintained (even intensified) even though the regional air mass has changed. This is known as an *advection inversion.*

(b) Particulate Sources

Particulate emissions may be classified into three types of sources: natural, industrial, and domestic. Natural sources may include wind-blown dust, wildfires (e.g., forest fires), volcanic eruptions, sea salt spray, etc. Industrial sources are typically ones that are regulated by government in the form of an air emissions permit or whose emissions are controlled by regulation. These would include open burning of land clearing debris, beehive burner and other sawmill emissions, and other ‘smokestack-type’ sources. Domestic sources tend to be smaller and emitted by individuals. Examples would include wood burning appliances and automobiles (both tailpipe and road dust). The domestic category would also include industrial (though not permitted) transportation such as rail and trucking.

(3) Potential Environmental Impacts

(a) Beehive Burners and Combustion

Freshly cut wood contains between 45% and 55% water by weight. The remainder consists of a wide variety of hydrocarbons and other organic compounds. Combustion is the exothermic process whereby the hydrocarbon is oxidised, e.g.,

$$CH_4 + 2O_2 = CO_2 + 2H_2O$$

or

Methane + Oxygen = Carbon Dioxide + Water

As impurities are added and/or the hydrocarbon becomes more complex, the chance of more

complex by-products may result. Some of these by-products are atmospheric contaminants[2]. For example, adding sulphur to the hydrocarbon results in the formation of sulphur oxides (SO_2, SO_4). If combustion is inefficient due to impurities or an inadequate oxygen supply, potentially harmful by-products result. These are generally known as products of incomplete combustion (PIC). If these potentially harmful by-products impact the environment, they are termed air pollutants[3].

The efficiency of wood combustion depends on moisture content, temperature, and oxygen supply. Wet wood burns poorly because the pre-ignition phase is prolonged, lowering the combustion temperature. A fire which is starved of air also burns poorly, increasing the production of PIC. Many of the pollutants contained in wood smoke are strongly associated with chronic respiratory impacts such as increased airway resistance and decreased vital capacity. Most researchers believe that these impacts far outweigh all other possible human health impacts. Common PIC and their potential human health impacts are summarised below.

- **Acrolein** - irritation of the eyes and respiratory tract.
- **Carbon Monoxide** (CO) - angina in people with heart disease, lethal at very high concentrations.
- **Formaldehyde** (HCHO) - headaches, respiratory tract irritation, probably carcinogenic.
- **Nitrogen Oxides** (NO_x) - bronchial congestion, lung edema (fluid congestion), fibrotic changes in the lungs.
- **Particulate** - fine particulate, i.e., particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometres (PM_{10}), penetrates to the lung's alveolar region and may affect lung function. It can also interact with visible light causing a haze which limits visual range. As humans are acutely most sensitive to fine particulate compared to other contaminants, the inhalable particulate portion of the PIC is an appropriate one on which to focus combustion-related air quality management strategies. As such, a more detailed discussion regarding the characteristics and impacts of fine particulate is presented below.
- **Polynuclear Aromatic Hydrocarbons** (PAHs) - PAHs are among the most harmful of the products of incomplete combustion. Certain PAHs (e.g., Benzo(a)Pyrene) are probable human carcinogens and are classified as air toxics. Exposure to such PAHs is associated with a small, but not insignificant, cancer risk.
- **Volatile Organic Compounds** (VOCs) - respiratory irritation and illness, some (e.g., benzene) are carcinogenic.

(b) Sources of Inhalable Particulate

The entire domain of particulate matter in the atmosphere is known as total suspended particulate. Total suspended particulate (TSP) is a general term for airborne particles such as

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[2] A solid, gas, or liquid that is emitted into the atmosphere that has the potential of causing an environmental impact (pollution of the air, water, or ground).

[3] "pollution" means the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment (*Waste Management Act*, 1996).

smoke, fume, dust, flyash, and pollen. Suspended particles may be solid or liquid, organic or inorganic. Fine particulates are rained out and washed out of the atmosphere; course particulates undergo sedimentation. Most environmental scientists are concerned with the subset of the total suspended particulate, fine particles 10 µm or smaller in diameter (PM_{10}), due to their potential impacts on visibility and human health. Sometimes PM_{10} is subdivided into a coarse fraction (2.5 to 10 micrometres) and a fine fraction (less than 2.5 micrometres, otherwise known as $PM_{2.5}$).

Fine particulates remain suspended in the atmosphere (as opposed to undergoing direct sedimentation) and, as they are efficient scatterers of light, appear as a haze. PM_{10} is invisible to the naked eye and small enough to be breathed into our lungs. As such, *inhalable particulate* can affect lung function: hence the focus on this air contaminant by environmental scientists and regulatory agencies.

Incomplete combustion is a significant source of particulate matter. Anthropogenic (human) sources include wood-burning stoves, beehive burners, automobile exhaust, road dust, and the open burning of land clearing debris. Natural sources include windblown dust, sea salt, forest fire smoke, and volcanic ash.

(c) Potential Health Impacts of Inhalable Particulate

PM_{10}

In 1993 the Provincial Health Officer, John Millar, noted that particulate matter health impacts appeared to be greater than those associated with any other outdoor air pollutant. In that year Dr. Millar's office released a report summarising the health risks associated with airborne particulate (Vedal, 1993). The British Columbia Ministry of Health subsequently characterised airborne small particulate from combustion sources as being the single greatest air pollution problem in British Columbia (Ministry of Health, 1994). Exposure to inhalable particulate matter can have the following effects (Vedal, 1993; Vedal, 1995):

- decrease in levels of pulmonary lung function in children and adults with obstructive airways disease;
- increase in daily prevalence of respiratory symptoms in children and adults;
- increase in functional limitations as reflected by school absenteeism and restricted activity days;
- increase in physician and emergency room visits for asthma and other respiratory conditions;
- increase in hospitalisations for respiratory and probably cardiac conditions;
- increase in cardiac and respiratory mortality on days after those with high particulate levels.

Senior citizens and people who already have lung or heart problems are most at risk of dying prematurely, but normal healthy adults and children can also be affected (BC Environment, 1995; Ministry of Health, 1994).

Vedal (1995) notes that for each 10 μg m^{-3} increment exposure above a base level of 20 μg m^{-3} there is a linear increase in health impacts. The greater the exposure increments, the greater the risk of impacts. This is known as a 'dose accumulation' form of air pollution impact assessment. Specifically, each 10 μg m^{-3} increment of PM_{10} over 20 μg m^{-3} has the following impacts:

- 1.0% increase in total mortality;
- 3.4% increase in respiratory mortality;
- 1.4% increase in cardiac mortality;
- 0.8% increase in respiratory hospitalisation;
- 0.6% increase in cardiac hospitalisation;
- 0.7% increase in asthma hospitalisations;
- 3.4% increase in asthma emergency visits;
- 2.3% increase in chronic obstructive pulmonary disease emergency visits;
- 9.5% increase in respiratory reduced activity days;
- 4.9% increase in minimal reduced activity days;
- 4.1% increase in school absenteeism;
- 3.0% increase in lower respiratory illness;
- 0.7% increase in upper respiratory illness;
- 1.2% increase in cough.

PM_{10} Size Distribution

Because of their weight, particles larger than 10 micrometres settle to the ground quickly. If inhaled, they tend to collect in the throat and nose, and are eliminated from the body by sneezing, coughing, nose blowing (collectively known as the upper respiratory system), or through the digestive system. Particles greater than 2.5 μm in diameter are formed primarily by mechanical processes such as construction, demolition, unpaved road dust, wind erosion, etc. (Wolff, 1996). They contain materials common to the earth's crust and the ocean, reflecting the fact that natural sources are contributors to the coarse fraction. Industrial activities that involve grinding or pulverising, such as mining, quarrying and cement manufacturing, are also important. These particles don't stay in the air long, settling to the ground within a matter of a few hours to a few days (BC Environment, 1995).

Particles less than 2.5 μm in diameter are formed primarily by combustion or secondary chemical reactions in the atmosphere (Brook *et al.*, 1997; Wolff, 1996). Fine particles contain a higher proportion of potentially harmful chemical species, such as acids, heavy metals, and PAHs, compared to particles greater than 2.5 μm in diameter (Brook *et al.*, 1997). Fine particulate matter ($PM_{2.5}$) can remain suspended in the atmosphere for days to weeks. When inhaled fine particles can penetrate deep into the lung's alveolar region. Here fine particles can affect pulmonary lung function as this is where oxygen enters the bloodstream. Lung function may be

impaired temporarily or permanently. Fine particulate matter may contribute to the development of chronic bronchitis and may be a predisposing factor to acute bacterial and viral bronchitis, especially in sensitive individuals. It also may aggravate bronchial asthma, the late stages of chronic bronchitis, pulmonary emphysema, and existing cardiovascular disease. Exposure also can have effects on mucociliary clearance and other host defence mechanisms and can promote morphological alteration of lung tissue. Recent studies such as Schwartz *et al,* (1996) have suggested that it is exposure to very fine particles ($PM_{2.5}$) that is specifically responsible for observed associations of particulate matter with daily mortality. The US EPA has indicated that it is the very smallest particles ($PM_{2.5}$) that have the worst effects on health (Walsh, 1995, in Acid News, 1996).

(d) Other Environmental Impacts

Another environmental impact of fine particulate matter includes visibility degradation. As particulate matter (especially fine particulate matter) accumulate in the atmosphere, the particles act to scatter and absorb light. The net effect is that these particulates can obscure the view, making it difficult for residents and tourists alike to "enjoy the scenery". An entire region may experience a reduction in visibility due to large sources of particulate such as forest fires or open burning. Thus, visibility is degraded obscuring vistas resulting in what is largely an aesthetic, yet highly visible, environmental impact.

Visibility degradation can take on a much more serious nature when it interferes with the navigation of vehicular traffic on highways and around airports. This occurs when nearby smoke sources obscure pilots' and drivers' vision. Aircraft navigation can be impacted by open burning of land clearing debris when large volumes of smoke obscure the landscape from pilots using visual navigation. These environmental impacts are serious from a road and air safety perspective.

The soiling effect of particulate matter is another environmental impact. When particulates fall out of the atmosphere they can accumulate on people's cars, laundry drying outside, and in their homes. Thus, elevated levels of atmospheric particulate can have a 'nuisance impact' on the environment.

(4) Air Quality Monitoring Programme

At the beginning of the decade, BC Environment Skeena Region identified inhalable particulate as an emerging air quality issue. Consequently, an inhalable particulate sampling programme was initiated in Smithers. A sampling network was developed and upgraded as resources became available. Meanwhile, BC Environment Air Resources Branch initiated emissions inventory work. These efforts formed the precursor to BC Environment policy initiatives related to managing the inhalable particulate air quality issue.

When, in 1993 the Provincial Health Officer noted that particulate matter health impacts appeared to be greater than for any other outdoor air pollutant, he further identified a need for increased monitoring of airborne particulate in the province's population centres. As authorised

by Section 10 (Permits) of the *Waste Management Act*, the Regional Waste Manager may require permittees to monitor the environment that will be affected by waste discharges and require permittees to conduct related studies. With the establishment of an air quality objective for PM_{10}, this has included having inhalable particulate monitoring and assessment programmes undertaken by Skeena Region air emission permittees.

(5) Air Quality Assessment

The first aspect in any air quality assessment is to determine the representativeness of data both in terms of physical siting and data collected. Most communities have only a single monitoring site. Therefore, air quality monitors are sited to estimate a representative exposure. However, the atmosphere is a dynamic fluid; air quality therefore varies over space and time. There will be locations in any community that experience poorer air quality than recorded at the monitoring station. Likewise other sites will have better air quality. Monitoring stations sited to provide a representative estimate of community exposure to air contaminants.

Monitoring programmes should strive for at least 85% data capture. When data capture is less than 75%, such data may be considered not representative of the environment sampled with respect to trends or statistical summary measures.

There are three types of assessment that may be conducted using data derived from a programme that samples the concentrations of atmospheric contaminants. Comparing the relevant air quality objective with a given air quality monitoring data set can yield statistics representative of the *frequency* of objective exceedence (how often the objective is not met). However, this method does not characterise exceedence magnitudes (total exposure to contaminants at polluted levels) . This ‘dose accumulation’ approach (noted above, as the exposure increment recommended by Vedal, 1995) is a measure of the *intensity* of impacts occurring in a community. However, it must be emphasised that, while an excellent tool for air quality assessment, the exposure increment is not a formal provincial “standard” like an air quality objective. The third type of assessment includes descriptive statistics such as mean concentrations and tests of significant differences.

(a) Air Quality Objective Definition

British Columbia's ambient air quality ‘standards’ are in the form of objectives and guidelines and are comprised of two or three levels (A, B, and C). Canadian objectives are also defined for two or three levels (Desirable, Acceptable, Tolerable). Air quality objectives are designed to prevent air pollution, as defined as the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment (*Waste Management Act*, 1996). Objective levels are defined in more detail in the following sub-sections.

(b) British Columbia's and Canada's Air Quality Assessment Criteria

Level A **(Maximum Desirable)**

Designed to provide **long term protection for all environments**. This level is reasonable for polluted areas to aim for and to achieve. This level represents a conservative approach of *protecting the most sensitive receptor*, thereby providing a wide margin of safety to protect other less sensitive receptors.

Level B **(Maximum Acceptable)**

Intended to be the **acceptable interim objective**. This level provides adequate protection against adverse effects on human health and comfort, vegetation, animals, soil, water, materials, and visibility.

Level C **(Maximum Tolerable)**

Defines the ***"immediate"*** **ambient objective**. Due to a diminishing margin of safety, appropriate action is immediately required to protect the health of the general population when concentrations of air contaminants exceed this level.

With respect to air quality assessment work, new sources, in general, should be designed such that their emissions would not result in any Level A air quality objective exceedences. For existing situations, BC Environment in general would work to progressively improve (reduce) emissions in an airshed with the goal of meeting the Level A air quality objective.

Note that many of British Columbia's air quality impact criteria were developed in the 1970s. In 1995 British Columbia proclaimed an interim air quality objective for fine particulate: 50 $\mu g\ m^{-3}$ (24 hour average concentration). This is intended to be equivalent to a Maximum Acceptable level in the national air quality objective system. A Maximum Desirable equivalent level has not been proclaimed. In Skeena Region, BC Environment has identified an annual air quality objective of 20 $\mu g\ m^{-3}$ (Johnson, 1992, 1994) to complement the 50 $\mu g\ m^{-3}$ daily objective.

(c) Summary

In summary, air quality can be characterised by measure of central tendency (average and range of concentrations and how they change over time) or in terms of their impacts. Air quality impacts can be measured in terms of frequency or magnitude. Frequency statistics for inhalable particulate may be expressed as the number of daily exceedences of the 50 $\mu g\ m^{-3}$ air quality objective. Such measures should be expressed as percent of days sampled if comparisons are to be made between stations or years, as the number of samples will change for any given sampling site or period.

Exposure increments represent the intensity of air pollution impacts. For inhalable particulate they are calculated by counting the number of daily 10 $\mu g\ m^{-3}$ increments above 20 $\mu g\ m^{-3}$. These must be normalised to account for differences in the number of samples collected between

sampling periods and between stations. BC Environment Skeena Region normalise this statistic to a 365 day-year equivalents.

An assessment for the communities of Smithers and Houston using these measures is presented in the following sections. Time periods for which data collection is below 75% of the number of possible samples should not be considered as representative of that location or time period. Summaries are grouped in one year sample periods which run from July to June. 1997-98 summaries are current to January 1998.

(6) Houston Data Summary

History

In February 1993 a high volume sampler was deployed at Silverthorne School. It was operated by BC Environment and subsequently taken over by Northwood Pulp and Timber and Houston Forest Products as part of their air emissions permits. Houston Forest Products appealed this requirement to the Environmental Appeal Board. The Board agreed that there exists sufficient legislated authority for BC Environment to require industry to share the costs of monitoring environmental impacts of their waste emissions. Furthermore, such monitoring should be continuous. As a result, each of the two Houston permittees were required to contribute one-third of the costs to install a new continuous, real-time, inhalable particulate and meteorological monitoring station. This cost sharing formula will continue as long as the mills are emitting waste into the common airshed (Environmental Appeal Board, 1994). The new monitoring station is located a few hundred metres from the Silverthorne school site in the Houston Firehall. It began operation in October 1995. While it may appear obvious, the Board’s decision firmly links the concept that beehive burner emissions may impact nearby communities and burner operators are responsible for the fate of their emissions.

Figure 1. **Houston Air Quality Trends.**
High volume samples are midnight -to-midnight (February 1993-September 1994); TEOM readings are maximum daily average. Running annual mean is based on midnight-to-midnight daily averages. Numbers on the chart are annual means; these are significantly different than 20 μg m^{-3} if bolded (note: they are not the same as the 1 January running annual mean).

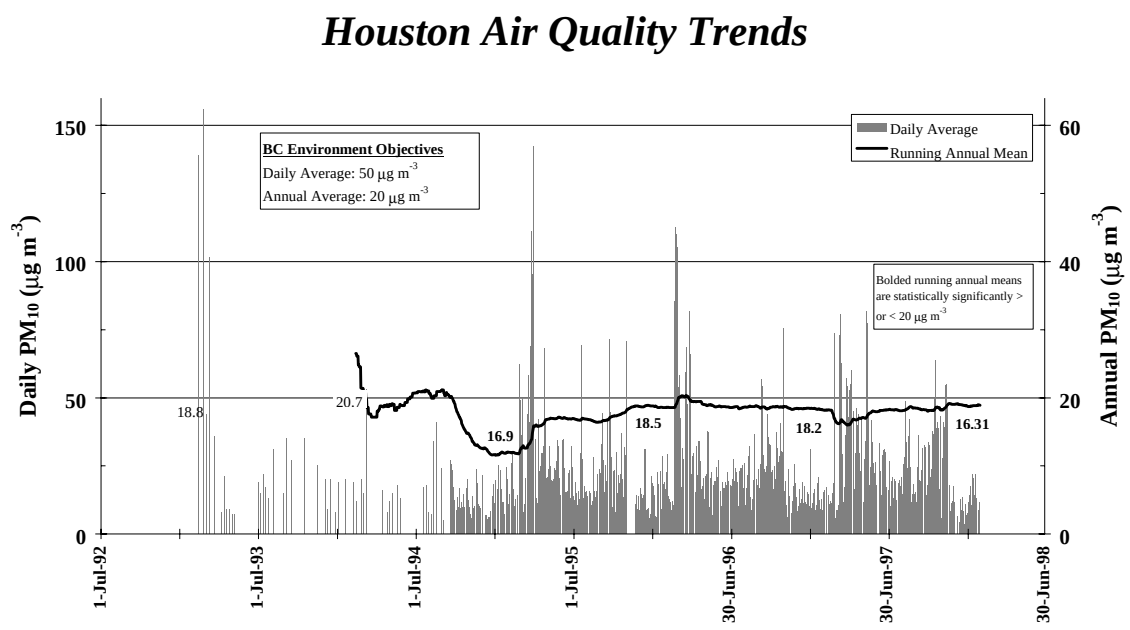


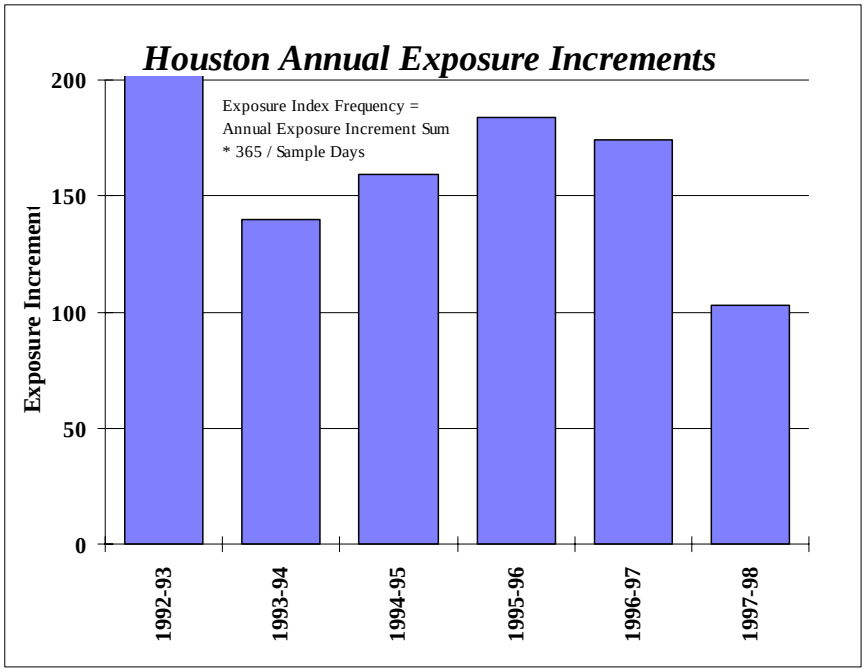
Table 1. **Measures of Houston Inhalable Particulate Impacts**

Absolute Days refers to the number of exceedences of the BC Environment Interim air quality objective (50 μg m^{-3} averaged over 24 hours).

Measures of Houston PM_{10} Impacts

	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Days > 50 μg m^{-3}	7	2	7	18	16	2
Percent	38.9%	5.9%	2.5%	5.2%	4.4%	1.0%
Exposure Increments	831	140	159	184	174	103
Sample Days	18	34	278	343	360	205
Total Days	365	365	365	366	365	365
Data Capture	30%	57%	81%	94%	99%	56%

Figure 2. **Houston Exposure Increments.**
Increments are normalised to a 365-day year to account for differences in the number of samples collected between sampling periods and to ensure representative comparisons between stations.



(7) Smithers Data Summary

History

In July 1990 Skeena Region's first inhalable particulate sampling programme was initiated with a high volume sampler at St. Joseph's school. This programme was subsequently upgraded with the support of Environment Canada and the British Columbia Lung Association to a continuous, real-time, sampler. It is currently operated with the support of local industry.

Figure 3.

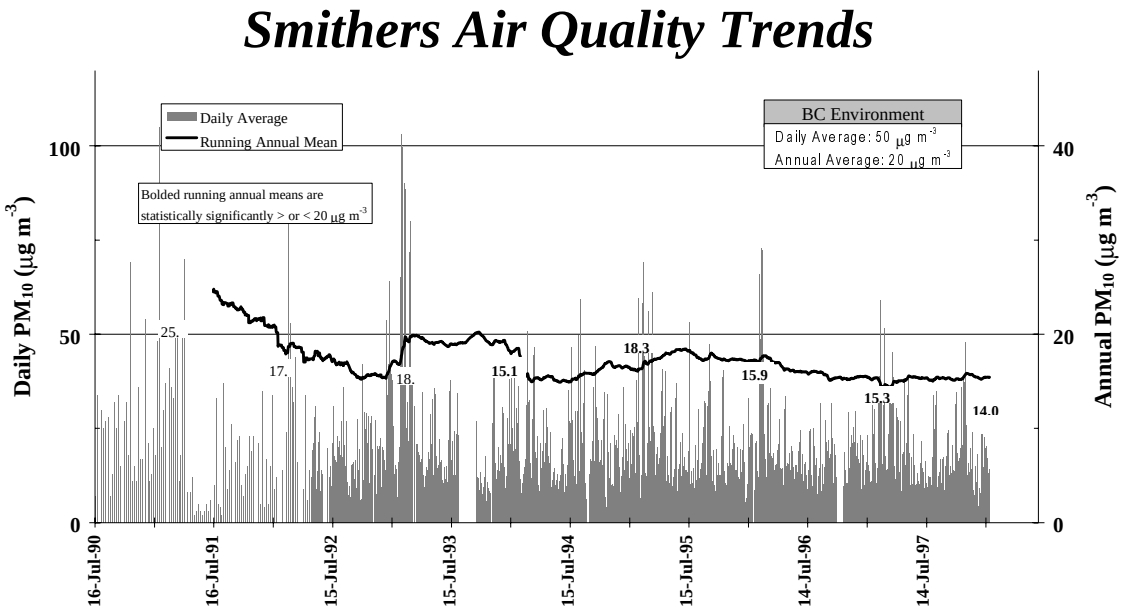
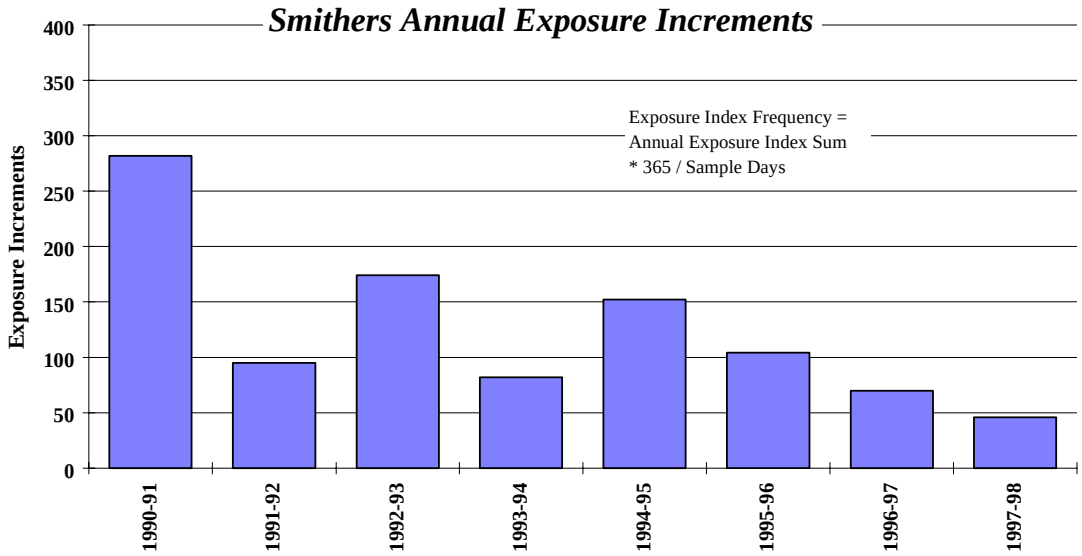


Table 2. Measures of Smithers Inhalable Particulate Impacts.

Measures of Smithers PM_{10} Impacts								
	1990-91	**1991-92**	**1992-93**	**1993-94**	**1994-95**	**1995-96**	**1996-97**	**1997-98**
Days > 50 µg m^{-3}	6	3	14	1	11	8	2	0
Percent	10.5%	3.7%	4.2%	0.3%	3.1%	2.2%	0.6%	0.0%
Exposure Index	282	95	174	82	152	104	70	46
Sample Days	57	81	330	297	350	356	343	343
Total Days	365	366	365	365	365	366	365	365
Data Capture	95%	75%	90%	81%	96%	97%	94%	59%

Figure 4. **Smithers Exposure Increments.**
Increments are normalised to a 365-day year to account for differences in the number of samples collected between sampling periods and to ensure representative comparisons between stations.



(8) Discussion

We have the ability to improve air quality in our communities by changing the quantity of particulate matter emitted into the atmosphere. While this is very hard to do with respect to natural sources; domestic and industrial sources can be improved by a combination of education, regulation, and technology. These strategies have been applied in the Bulkley Valley in an effort to improve air quality. They are summarised below chronologically.

BC Environment has undertaken a number of educational initiatives, as have local and provincial interest groups. These groups include the British Columbia Lung Association, the Physician's Environmental Concerns Committee (PECC), Environmental Action for Our Children's Heritage (E.A.C.H.), Ministry of Forests, and the Town of Smithers Environmental Services Committee (Air Quality). Initiatives have included public presentations, production of educational videos (BC Environment, no date; E.A.C.H., no date), leaflet drops, newspaper advertisements, etc. Smithers was the focus of much of the education initiatives.

In 1992, BC Environment Skeena Region implemented the *Smithers Air Quality Management Plan* for particulate matter (Johnson, 1992). The plan included an incremental response to deteriorating air quality conditions, including voluntary wood stove and fireplace use restrictions and health-related advisories.

In 1993, the British Columbia government enacted the *Open Burning Smoke Control Regulation*, which had the effect of imposing a code of practice (enacted in 1994) on much of the open

burning conducted in the province. The code is designed to ensure that smoke emissions are minimised and impacts on human populations are prevented.

In 1994, the British Columbia government enacted the *Solid Fuel Burning Domestic Appliance Regulation* which regulates wood burning stove and fireplace emissions from new appliances. In effect, this requires new wood burning appliances to use state of the art emissions control technology. Particulate emissions are much lower compared to old airtight wood burning stoves. Also in 1994, the *Low Sulphur Diesel Regulation* was passed by the provincial government to reduce emissions of particulates and their precursor gases from on-road diesel vehicles.

In 1995, the *Smithers Air Quality Management Plan* was expanded to include the Bulkley Valley (Johnson, 1994), to incorporate the new continuous, real-time, inhalable particulate monitor in Houston. Health advisories were revised in consultation with the Ministry of Health Skeena Health Unit. The plan now includes guidelines for when BC Environment would implement the provisions of the *Open Burning Smoke Control Regulation* to effectively ban open burning of land clearing debris during air pollution events.

Also in 1995, the province enacted the *Wood Residue Burner and Incinerator Regulation* (BC Environment, 1995). This, effectively, gave notice to the sawmill industry of the government's intention to follow-up on it's proposed management strategy to phase out beehive burners (BC Environment, 1991), particularly in smoke sensitive airsheds. As of January 1998, approximately one half of the province's beehive burners have shut down, including a silo burner in New Hazelton.

In 1997, the town of Smithers effectively banned backyard burning.

It may be hypothesised that monitoring programmes themselves act to reduce emissions. The early days of the Smithers sampling programme saw a very public debate in the news media regarding assessments of the initial data. The debate focused on particulate sources and what could be done to improve emissions. Now, the continuous, real-time, technology gives people information they need to act locally to improve emissions during periods of poor air quality, whether it be a voluntary curtailment of wood stove use, walking or biking instead of driving, or increased vigilance by industry with respect to the performance of permitted or regulated particulate sources. BC Environment itself places higher priority on enforcement and compliance initiatives during periods of poor air quality.

(9) Conclusions

Many trends are observed in the air quality data collected in the Bulkley Valley, particularly when one assesses the past 3-4 years. The number of daily air pollution episodes is declining, as indicated by the decreasing number of exceedences of the BC Environment interim air quality objective for inhalable particulate. The intensity of daily air pollution episodes is also declining, as indicated by the decreasing number of exposure increments. The mean annual inhalable particulate concentration is declining. The improvements are greatest in Smithers, compared to Houston. In Smithers, the frequency distribution of daily inhalable particulate observations

indicates a shift to reduced exposures. Similarly, the difference in means between monitoring years is progressively greater over time. These latter two trends are not evident in the Houston data.

It would appear that new regulatory initiatives, such as those in place for new woodstoves and open burning, combined with public information campaigns, have resulted in improved air quality. (It should be noted, however, that it could be meteorological conditions driving the observed improvements).

In spite of the improvements observed in recent years, exposure increments and interim air quality objective exceedences are still occurring in both Houston and Smithers, every year, regardless of meteorological conditions and emission reduction and management strategies. This indicates that further work needs to be done to reduce particulate emissions in the airshed if we want to get these measures of impacts down to zero. Of the management options presented in *Smoke Management for the '90s* (BC Environment, 1991), beehive burner phase out in smoke sensitive airsheds remains the last significant policy option to be implemented for particulate emission reductions and air quality management.

G. Alternatives Explored for Remaining Burners

(1) "Cogen" or Wood-fired Electrical Power Production

The Smithers office of BC Environment has been actively working for more than 10 years towards the Ministry objectives of elimination of beehive burners and better utilisation of surplus wood residues. Numerous "good-looking" proposals have been brought forward, mostly in the area of electrical power production, but very few have materialised. Most projects proposed were deemed to be "uneconomic". The sawmilling industry also has studied independent power production opportunities, however, unless an operation had its own on-site demand for the energy it could produce (e.g. pulpmill with its power boilers), the projects were "uneconomic". Typically, a sawmill operation can only utilize about 1/3 of the electrical energy it would produce from its wood residue and without the ability to sell the surplus power into the electrical grid at a reasonable price, the power projects become infeasible (from a normal business perspective). Many factors are involved here including such things as: natural gas prices, government policies with respect to electrical energy pricing, power wheeling and greenhouse gas emissions, changing electrical energy demand forecasts, power export restrictions and so on.

To illustrate, Northwood had a feasibility study done in 1981 by H.A. Simons Ltd. of Vancouver and found it had sufficient surplus wood residue going to its beehive burner to fuel a 30 MW (net) electrical generation facility at its Houston mill. The entire mill complex could only utilise 5 MW, leaving 25 MW to sell or give away. Northwood's chief engineer advised Ministry staff that if BC Hydro would have at that time paid Northwood for its surplus electrical energy at 1/3 the rate BC Hydro was charging the mill for electrical energy, the project would have been viable with a 7 year payback period. A power plant like this would have eliminated Northwood's 2 (at that time) beehive burners and provided at least a dozen permanent jobs.

As an indication of changes that have taken place at the Northwood mill over the past 17 years, a recent engineering assessment indicates that a wood-fired power plant today would be sized at 14 MW (net) with only 7 MW of surplus electrical energy. This is a reflection of a reduction in wood residue volumes produced, an increase in utilisation of wood residue for other purposes (like panelboard manufacture and pulpmill chips) and an increase in electrical power (2MW) requirements for the mill. Despite the fact that the mill underwent a substantial production expansion since 1981, the quantity of surplus wood residue has decreased by more than 50%.

In April 1990, BC Hydro (BCH) sponsored a workshop in Vancouver entitled: Independent Power Production in the 90's - a Workshop for Private Power Producers. Some remarks made at this workshop by Jack Davis, Minister of Energy, Mines and Petroleum Resources (EMPR) at that time include:

- the current government is intent on privatisation as much as possible; future new electrical generation capacity will be brought on line largely by independent power producers (IPP)
- until recently, the most BCH offered for independent power production was 2 cents/kWh: a total disincentive for independent power development
- a process has been developed through the Williams Lake experience which allows making application for an environmental premium of up to 15% to be paid by BCH, passed on to B.C. government through reduced dividends, for cases where an IPP proposal would eliminate a long standing serious environmental problem, e.g. air pollution

Some public remarks at the workshop from Larry Bell, Chairman and CEO of BCH at that time:

- global warming and the use of fossil fuels for thermal generation is a very key issue we will have to face - no problem with using fossil fuels as backup for woodwaste or municipal solid waste or (pulpmill) spent liquor fired generating facilities but use of fossil fuels on their own for power production is questionable
- BCH would be delighted to set up a smaller scale woodwaste power generation project with a sawmill as a test - if successful it could serve as a model for other sawmills throughout B.C.
- BCH was very pleased with the Williams Lake project (NW Energy's 55 MW wood residue fired power plant commissioned in 93); the solid support from the community and the constant telephone calls from the Mayor is what made the difference here.

A government news release in September 91 from the Ministry of EMPR seemed to confirm the new direction that was broadcast by BCH at the IPP Workshop in April 90. Following are some relevant quotations from the news release:

- "A new program of BC Hydro power purchases which will give an economic boost to generating electricity from forest woodwaste, cut back pollution from existing woodwaste burners, and create quality jobs in B.C. was announced today by Energy and Mines Minister Jack Weisgerber and Environment Minister Dave Mercier."
- "This means that less woodwaste will just 'go up in smoke,'" said Weisgerber. "Instead, it will be used efficiently and add to B.C.'s electricity supply."
- "Strict emission controls on the energy from woodwaste plants will put a stop to air pollution from beehive burners in a number of B.C. communities," added Mercier. "The smoke from

beehive burners contributes to respiratory ailments, visual blight and fall-out of dirt and soot."

- "Hydro will issue a 'woodwaste-only' proposal call later this year to identify the projects which are most competitive and which help the areas of the province most affected by woodwaste burning. After a commercial review by Hydro and an environmental and regulatory review by government, contracts for about 110 MW of power - enough for about 70,000 households - will be signed with the successful companies."
- "Under the program, BCH will give environmental credits on top of its normal power purchase price to qualifying independent producers using woodwaste as their sole fuel to generate electricity."

With positive signals like this from government, sawmill companies and independent power producers got busy conducting studies and preparing proposals. The Houston area was considered to be a very favourable candidate for such a project because out of all locations in the province, it probably produced the largest volume of surplus wood residue in one small area.

In March 1990, the Ministry of Regional and Economic Development, in cooperation with the Regional District of Bulkley Nechako, released a comprehensive study report prepared by Sandwell, Swan, Wooster Inc. entitled, "Nechako Wood Residues: A Resource Opportunity". The study examined a wide range of alternatives for wood residues that were currently being incinerated in beehive burners. The study recommended further development work on several value-added applications including bio-oil extraction, carbon production, press-board production and electrical energy production. A copy of the executive summary is included as an appendix to this report.

A Beehive Burner Committee was formed by the Regional District of Bulkley Nechako (RDBN) in 1993 with representatives from all of the major mills in the area, municipalities, COFI, BC Environment and RDBN. Regular meetings were held during 1993 and 94 to examine the technical and policy issues surrounding beehive burner phase-out and wood residue utilisation opportunities and to develop strategies to implement viable alternatives. Guests from other companies and agencies were often asked to attend, e.g. people from BCH, BC Utilities Commission, Independent Power Producers' Association and other power companies.

In the years that followed there were numerous other studies done, meetings held (both technical and political), firm proposals prepared and submitted to government for review, power wheeling policies developed and legal challenges heard between B.C. and the U.S. with respect to import/export of electrical energy, the Columbia River Treaty negotiations and so on. After years of delay, in January 95, BCH finally announced its request for proposals (RFP) for 200 - 300 MW of new generating capacity and Houston-based project proposals were submitted by NW Energy and Inland Pacific Energy Corp. by the Mar 15/95 deadline. BCH announced its short list of 10 proposals, out of the 48 applications submitted, on Aug 30/95 and neither of the Houston projects was included. A third power project proposal by Destec-Powergen, joint venture, for a hybrid gas/wood plant for Houston was still in the works. This project was not part of the BCH RFP and was being handled by Powerex, the export arm of BCH. Destec/Powergen and Powerex had a signed MOU for 50 MW with the Sacramento Municipal Utilities District in California but their project was delayed for years because power wheeling

and export policies were being developed and also because of the legal challenges between American and B.C. utilities over free trade issues. The legal challenge was finally settled in the fall of 97, in theory opening the U.S. market to the export of BC electricity, however, power wheeling prices are still "prohibitive" in B.C.

In March 97, Dr. Mark Jaccard, of Simon Fraser University and former chair of the B.C. Utilities Commission, was charged with the mandate to (again) lead a Task Force to bring forward to government a package of electricity market reform proposals. The 55 page report was submitted in Jan 98 and contains some progressive recommendations with respect to environmental issues. The market reform package submitted to Cabinet, if adopted, would encourage the development of wood waste power projects and would improve the economics of "cogeneration" projects by industrial and large commercial customers because of access to the spot market for load balancing. "Wood waste projects will now have access to the market. Investment in new incineration technologies has been mandated by the Ministry of Environment, Lands and Parks and desired by many forest communities because of local air quality concerns," says Jaccard.

Dr. Jaccard defines environmentally desirable technologies (EDTs): "An EDT is defined as an electricity generation technology that has no net greenhouse gas emissions, no net impact on local or regional air quality, only minor impacts on watersheds or landscapes, and no contribution to toxic waste buildup. EDTs include biomass (wood waste), small hydro, expansion of generation capability at existing large hydro facilities with no reservoir expansion, cogeneration retrofits to existing combusion of natural gas (and other fossil fuels), landfill gas generators, solar, wind, geothermal and tidal." With respect to EDTs, Dr. Jaccard recommends:

- A minimum percentage of electricity sold by any retailer of electricity in B.C., including BCH and West Kootenay Power must be derived from EDTs. In this proposal, this requirement is set at the following levels:

  1998 - 2004 - 5 %
  2005 - 2009 - 10%
  2010 - 2014 - 15%

- Retailers of electricity who do not have EDT generation facilities can purchase EDT credits from producers or those retailers having excess credits.

According to Jaccard's report, the rate impact of this program for B.C. residential customers is estimated to be about 0.1 cent/kWh over the next decade, about $1 per month per residential customer.

Based on what is happening with other electrical utilities around North America, it is only a matter of time before total access to the North American power grid will be available to anyone who wants to buy/sell electricity. The industry is going in the same direction as did the telecommunications business a few years ago. With increasing pressure globally to reduce green house gas emissions, utilities that have much of their electrical generation capacity based on combustion of fossil fuels will be seeking alternatives like bio-mass to provide them with the necessary green house gas credits. Companies like Ontario Hydro and Edmonton Power have in

the past year inquired with forest companies in B.C. about purchasing wood-fired power from B.C. The forest companies themselves would like to generate power at the sawmill sites and transmit the energy via the BCH grid to their pulpmills (e.g. NW to Prince George and HFP to Kitimat) where they could displace power currently purchased from BCH. Unfortunately, BCH wheeling policies presently are not conducive to such arrangements.

A B.C. based power company, Houston Power Corporation (HPC), is at this time still prepared to proceed on short notice with construction and operation of a wood residue fired electrical power generation facility in Houston which would supply electrical energy to the 2 large mills in Houston and sell the surplus energy into the BC Hydro grid. Financing is apparently not a problem. The company has not been able to date to negotiate a favourable contract with BC Hydro.

(2) Riverside Carbon Products, Charcoal Plant

In spring of 96, Synchem International of Alabama, USA, (now Southern Ventures Inc. or SVI) approached BC Environment and local sawmills with a proposal to build 2 charcoal plants to take all of the surplus wood residues from Houston through Kitwanga and produce charcoal and electricity. The first plant would be built in Houston and utilise wood residues from NW, HFP and Corwood Timber Products in Houston while the second plant, to be built at Carnaby, would utilise wood residues from mills in Smithers through Kitwanga. Synchem would provide for the transportation of the wood residues to its plants. While the Carnaby plant was put on hold due to financial uncertainties associated with SCI operations, the proponent continues to work on the Houston project, although the original schedule has slipped considerably.

Riverside Carbon Products Inc., the Canadian subsidiary of SVI, planned to begin construction on the Houston plant in May 97 and have it fully operational by the end of 97. This plant, a first of its kind, would make 50,000 tonnes/yr of charcoal and 8 - 10 MW of electricity from over 200,000 bone-dry tonnes/yr of wood residue. The furnaces that would be used in this plant were designed by SVI to achieve maximum conversion of hogfuel into charcoal with minimal emissions of particulates (permit limit is 10 mg/m3, compared with 120 mg/m3 limit by regulation for a wood residue incinerator). Non-condensable gases and oils created during this pyrolysis process would be used to provide energy for the furnaces and fuel for the power boilers and wood residue dryers. Waste Management permits were issued in Jan 97 and wood residue supply agreements with NW and HFP were signed in May 97. The company has an option to purchase 30 acres of land directly opposite the NW mill for construction of the facility which would cost $20 million and provide 23 jobs.

The hold up with this project is the financing. SVI, being a relatively small company, can not finance the project on its own. The company recently reported the following to BC Environment: "Financial institutions have indicated a willingness to provide up to 75% of the $20 million needed to construct the Houston plant.... it has taken longer than anticipated to raise the necessary funds. Every effort is now being made to secure firm markets for charcoal, in both North America and Europe. Discussions are underway with several companies that are expected to lead to the formation of one or more new joint venture companies to construct and operate the Houston charcoal plant.... It is now anticipated that markets, financing and operating partnerships

will be finalized within the next few months and that construction of this unique value-added facility will start next spring (98)."

As of Feb 25/98, BC Environment has been advised by Northwood and Houston Forest Products that they do not see much hope for the charcoal project proceeding within an acceptable time frame. As such, Northwood has advised SVI that the wood residue supply agreement and the option to purchase land from Northwood is now null and void and the mill is free of all its obligations with respect to SVI. The mills wish to be able to freely pursue any other value-added opportunities that may develop. It is our understanding that SVI continues to pursue secure markets and financing and that the company intends to build charcoal plants eventually, if not in B.C., then in Ontario. Northwood and Houston Forest Products have indicated that if SVI is able to secure financing and firm customers, they are willing to reactivate their wood residue supply agreements at any time.

(3) Incinerators

The fall-back plans of most major mills has been some form of multiple chambered incineration with emissions scrubbers installed to meet the 120 mg/m3 limit stated in the regulation. It would cost Northwood (NW) approximately $20 million for 2 incinerator units from Salton Fabrication Ltd., each equipped with an electrostatic precipitator (ESP) for fine particulate removal. This assumes NW would be able to get rid of all of its white wood fraction (shavings and sawdust) to the panelboard plant and to pulpmills. To upgrade the system to replace NW's aging existing power boiler (permit limit of 230 mg/m3 total particulate emissions) and recover energy to heat the lumber dry kilns would cost another $500K and to upgrade even further to produce electricity (14 MW) would cost an additional $15 million ($35 million total).

HFP was quoted $8 - $10million for straight incineration with an ESP and no energy recovery. Alternatively, HFP could spend $6.75 million for modifications to their existing Volcano energy system which is used to heat the lumber dry kilns and the mill. The modifications would allow the Volcano system to burn "brown wood residue" (bark) rather than the planer shavings it presently burns. An additional $2.5 -$3 million would be required for new infrastructure like a waste conveyor system and storage bins, etc.

PIR, Smithers has indicated that an incinerator without energy recovery that would meet the Ministry's emission standard of 120mg/m3 would cost them about $8 million.

By copy of letters sent to Weldwood (HFP) and Northwood, the District of Houston Council has advised the Ministry: "We do not believe it to be in the best interest of our community to support incineration of wood waste and we will oppose this option if it is proposed to the province as an alternative to the beehive burners."

(4) Other Options

Many other applications have been developed and implemented throughout the province which utilise sawmill wood residues. Examples include woodstove pellets and presto logs for (relatively clean) home heating, bark mulch for landscaping, hog fuel for nursery bedding and

horse tracks, trail surfacing and the like, sawdust and shavings for animal bedding, sawdust for mushroom bedding and for hydroseeding "turf", hog fuel for composting with municipal sewage sludge and so on. Many of these options are available in certain areas and for relatively small quantities of wood residue. Market niches are being developed for some of these applications and a large mill's supply of wood residue could overwhelm such markets instantaneously. Composting of wood residue produces a very high quality soil conditioner, however, large quantities of high-nitrogen fertilizer (municipal sewage sludge or manure from large scale feedlot style farming operations) are required for this process. Such nutrient sources are not available in the Bulkley Valley. Free and ready access to sawmill wood residue is provided, however, to farmers and anyone else who wants it for bedding material, soil conditioner or for composting with manure.

Even with a fairly large volume application for export markets, such as medium density fibreboard (MDF) production, economic viability is very sensitive to market demand. West Fraser built an MDF plant in Quesnel a couple of years ago and had indicated earlier that it was considering a second MDF plant for the Bulkley Valley area if market indications were favourable. An oversupply of MDF and other external economic factors have resulted in poor prices and now the Quesnel plant is apparently losing $3 million per month but can't shut down because it has commited to taking wood residues from other mills in the surrounding area.

Landfilling of wood residue as an alternative to beehive burners is not acceptable for the volumes generated at the 3 Tier 1 mills in the Bulkley Valley. Large areas of land are required and there is significant risk to the environment due to generation of toxic leachates and the potential for spontaneous combustion. Operators are being encouraged to minimize quantities of waste going to existing landfills.

Various companies in B.C. have in recent years explored the technologies of wood residue based methanol, ethanol or bio-oil production and have concluded that such projects could not compete with similar production facilities based on natural gas feedstock (at current gas prices). West Fraser in particular has spent over $600K in the last few years researching ethanol and bio-oil production from wood residue.

Having said this, Pyrovac International Inc. has spent the last 16 years developing a "clean" Pyrocycling (TM) process capable of utilising wood residue to produce high quality charcoal, bio-oils and combustible wood gases. Pyrovac employs 25 full-time technical staff at a research and development center in Quebec, associated with Laval University, which is recognized internationally for its work in the area of vacuum pyrolysis. Pyrovac is presently constructing its first full-scale wood residue based pyrolisis plant in Quebec at a capital cost of $40 million. The 150,000 tonne/year plant, consisting of three 50,000 t/y units, is scheduled for start up in June 98. The company apparently has a firm market for its products, is capable of arranging financing to 80% of capital costs and is interested in expanding operations into B.C. Local engineer and businessman, Hans Duerichen, recently toured Pyrovac's Quebec facilities and was positively impressed.

(5) G.E. Bridges Study

In June 97 G.E. Bridges and Associates were commissioned by the Government and the Council of Forest Industries (COFI) to do a study of opportunities for the use of wood residue and the phase-out of beehive and unmodified silo burners. The 72 page "Wood Residue Opportunities Strategy" was completed on Oct 29/97. It showed that few value-added uses of wood residue are currently viable and pointed to some of the policy options to improve their viability. The study also noted the problems created by the current downswing in forest products' markets and recommended steps which might be taken to promote value-added uses and accelerate the phase-out of beehive burners. Copies of the executive summary of this report are available from the Smithers BC Environment office upon request.

The 3 Tier 1 sawmill companies in Skeena region will be expected to outline for the public consultation process their proposed alternative(s) to existing beehive burners in their phase-out plans.

FR/DJ/fr/dj

Appendix 1

BEEHIVE & SILO BURNERS IN SKEENA REGION

List of Tier 1 Burners in Skeena Region

1. Company name & address: **Pacific Inland Resources**
   Box 3130, Smithers, BC V0J 2N0
2. Mill Location: Tatlow Road, Smithers

3. Mill Lumber Production: 168,000 Mfbm/year

4. Total number of employees: 230

5. Hours of operation and number of shifts: 5 days/week
   2 8-hr shifts/day for lumber production
   1 6.5-hr shift/day for chipping

6. Total quantity of wood residue generated: 72,000 ODT (oven-dry tonnes) or 195,000 m3(dry basis)/year

7. Residue Types: Bark 111,000 m3/yr, sawdust - 33,000 m3/yr, shavings 50,000 m3/yr.

8. Disposal methods: bark burned in beehive burner, shavings and sawdust - 25% to 50% to Newpro (panelboard) plant, some burned in beehive burner and the rest shipped to Eurocan Pulp & Paper Mill in Kitimat or given to local farmers for bedding material.

9. Residue Utilization: see Item 8 above.

10. Size and type of burner: 85-ft diameter steel shelled beehive burner.

11. Equipment & Modifications: 24 hour constant feed, PLC (programmable logic controller) controlled.

1. Company name & address: **Houston Forest Products Company**
   Box 5000, Houston, BC V0J 1Z0

2. Mill Location: Km #2 of Morice River Road, Houston

3. Mill Lumber Production: 250,000 Mfbm/year

4. Total number of employees: 285

5. Hours of operation and number of shifts: 5 days/week
sawmill - two 8-hr shifts/day
planermill - one 24-hr shift/day

6. Total volume of wood residue generated: 265,340 m3/year

7. Residue Types: Bark 115,740 m3/yr, sawdust - 76,500 m3/yr, shavings - 51,850, breakage 21,250 m3/yr

8. Disposal methods: bark and breakage to beehive burner, sawdust - currently to Newpro (panelboard) plant and Eurocan Pulp & Paper Mill in Kitimat, and shavings to the Volcano Energy System.

9. Residue Utilization: see Item 8 above.

10. Size and type of burner: 90-ft diameter steel shelled beehive burner.

11. Equipment & Modifications: PLC (programmable logic controller) control with computer monitors in plant and office, re-feed system to supplement fuel with chips or dry reject lumber as required to maintain burner temperature.

1. Company name & address: **Northwood Pulp & Timber Ltd.**
Box 158, Houston, BC V0J 1Z0

2. Mill Location: Km #1 of Morice River Road, Houston

3. Mill Production: 376,000 Mfbm/year (sawmill) and 569,030 m3/yr (chips & pulp chips)

4. Total number of employees: 370

5. Hours of operation and number of shifts: 16 hours/day, 5 days/week
sawmill - 2 shifts/day, 8 hours/shift
planermill - 2 shifts/day, 8 hours/shift

6. Total volume of wood residue generated: 367,000 m3/year

7. Residue Types: Bark 140,275 m3/yr, sawdust - 114,944 m3/yr, shavings - 78,402 m3/yr, breakage 20,096 m3/yr, Chip Plant fines 13,287 m3/yr

8. Disposal methods: bark (140,275 m3/yr), sawdust (8,047 m3/yr), shavings (14,882 m3/yr), breakage (6,028 m3/yr) and Chip Plant fines (13, 287 m3/yr), or a total of 182,519 m3/yr, to beehive burner; breakage (14,067 m3/yr) and sawdust (3,448 m3/yr), or a total of 17, 515 m3/yr to landfill

9. Residue Utilization: Sawdust (103,450 m3/yr) and shavings (58,801 m3/yr), or a total of 162,251 m3/yr to Steam Plant; shavings (4,720 m3/yr) to Newpro Panelboard Plant in Smithers.

10. Size and type of burner: 90-ft diameter steel shelled beehive burner.

11. Equipment & Modifications: PLC controlled fans and top damper.

List of Tier 2 Burners in Skeena Region

1. Company name & address: **Skeena Cellulose Inc., Carnaby Lumber Operations.**
No. 10 North Boundary Road, New Hazelton, BC V0J 2R0

2. Mill Location: Carnaby Crossing

3. Mill Production: 35,063,952 fbm/year (sawmill) or 35.064 Mfbm/year

4. Total number of employees: 193

5. Hours of operation and number of shifts: 8 hours/day, 5 days/week
1 shift/day

6. Total volume of wood residue generated, excluding off-site hogfuel: 177,989 m3/year

7. Residue Types: From off-site sources (Poirier Yard, Terrace Lumber Operation, SCI Smithers, Kitwanga, Whole Log Chipper): 210,402 m3 of hogfuel/year. From Merch Deck: Bark - 138,161 m3/yr, sawdust and broken sticks- 2,103 m3/yr. From Sawmill: sawdust - 37,725 m3/yr

8. Disposal methods: off-site hogfuel, plus on-site bark, sawdust and broken sticks (total 350,666 m3/yr) to Merch deck beehive burner, burner ash and unburned residue to landfill

9. Residue Utilization: Sawmills' sawdust (37,725 m3/yr) to Eurocan Pulp & Paper Mill in Kitimat.

10. Size and type of burner: a 90-ft diameter, 90-ft high steel shelled beehive burner (Merch Deck), and a 80-ft. diameter, 80-ft high beehive burner (sawdust). The sawdust burner is currently used only for sawdust storage and extraction.

11. Equipment & Modifications: Merch deck burner is fed 5 days/week, 24 hours/day by Merch deck waste and auxiliary hog fuel (from SCI Poirier Yard, SCI Terrace Lumber Operation, Kitwanga Lumber sawmill, CGED mill (occasionally), Kispiox Forest Products (occasionally), New Hazelton Whole Log Chipper Plant, and SCI Smithers). The burner is PLC controlled.

1 Company name & address: **Abfam Enterprises Ltd.**
Address: Industrial Site, Box 233, Port Clements, BC V0T 1R0
2. Mill Location: Port Clements Industrial Site

3. Mill Production: 5 - 8 MMfbm/year (sawmill)

4. Total number of employees: 23

5. Hours of operation and number of shifts: 8 hours/day, 5 days/week
1 shift/day

6. Total volume of wood residue generated: 20,000 - 25,000 tonnes/year from sawmill, shingle mill and logyard.

7. Residue Types: sawdust, bark and cedar waste

8. Disposal methods: 15,000 - 20,000 tonnes/year to beehive burner, remaining balance to landfill.

9. Residue Utilization: Wood residue will be utilized in a 6 MW cogeneration plant that will be built soon.

10. Size and type of burner: a 65-ft diameter steel shelled beehive burner.

11. Equipment & Modifications: Lamb-Cargate burner has a 8-hour constant feed when sawmill and shingle mill are operating.

1 Company name & address: **QCI Sawmills Ltd.**
Box 346, Masset, BC V0T 1M0

2. Mill Location: Highway 16, Masset

3. Mill Production: 2,400 Mfbm/year (sawmill)

4. Total number of employees: 8

5. Hours of operation and number of shifts: 9 hours/day, 5 days/week
1 shift/day

6. Total volume of wood residue generated: 2,445 BDU/year or (2,445 x 2.7 = 6,600 m3/yr)

7. Residue Types: sawdust and shavings 50%, bark and broken wood 50%

8. Disposal methods: 90% residue to beehive burner

9. Residue Utilization: 10% to farmers

10. Size and type of burner: a 25-ft diameter silo burner.

11. Equipment & Modifications: N/A

1 Company name & address: **Decker Lake Forest Products Ltd.**
Box 250, Burns Lake, BC V0J 1E0

2. Mill Location: Palling

3. Mill Production: 25,300 Mfbm/year (lumber), 19,300 m3/year (pole)

4. Total number of employees: 72

5. Hours of operation and number of shifts: 8 hours/day, 5 days/week
1 shift/day

6. Total volume of wood residue generated: 106,000 m3/year (S-P-F sawlogs), 40,542 m3/year (pine poles)

7. Residue Types: Sawlogs: bark (11.9%), sawdust (6.9%), shavings (6.1%), and breakage (2.5%). Poles: bark (11.2%), sawdust (0.2%), and shavings (4.9%).

8. Disposal methods: 100 % residue to beehive burner (Note that the mill also hauls 1,800 cubic yard (about 1,400 m3) of log yard wastes a year (50% woodwastes, 50% dirt) to an authorized wood waste landfill within its property)

9. Residue Utilization: Up until late summer of 1997, Decker Lake Forest Products used to be able to sort lodge pole pine out of the species mix for the European market. This allowed the Company to manufacture wood stove pellets out of lodge pole pine shavings. Now because of the decline of the European market, the Company can no longer make pellets.

10. Size and type of burner: a 50-ft diameter, 60-ft high beehive burner.

11. Equipment & Modifications: N/A

1. Company name & address: **Babine Forest Products Company**
Box 4000, Burns Lake, BC V0J 1E0

2. Mill Location: 16 miles (26 km) East of Burns Lake, on Indian Reserve 19

3. Mill Production: 228 MMfbm/year (354,434.79 m3/year - lumber), 286,887.26 m3/year (chips)

4. Total number of employees: 266

5. Hours of operation and number of shifts: Planermill: 3 shifts, 24 hours/day
Sawmill: 2 shifts, 16 hours/day, 5 days/week. Maintenance operates Monday through Saturday.

6. Total volume of wood residue generated: 117,639 m3/year.

7. Residue Types: Planer shavings, bark, sawdust, fines, broken chunks, logyard wastes.

8. Disposal methods: 60,717 m3/year of residue (including some white woods) to beehive burner; 3,795 m3/year of log yard wastes to an authorized wood waste landfill within its property.

9. Residue Utilization: 53,127 m3/year of shavings to Volcano Energy System

10. Size and type of burner: a 96-ft diameter, 80-ft high beehive burner.

11. Equipment & Modifications: Programmable logic controls (PLCs) for all fans and dampers. Have a PLC interface with the Volcano Energy System to accommodate transfer of shavings to assist with maintaining (burner temperature) compliance in start-ups, cold weather, etc.. Have a waste re-entry system. Working towards being able to operate the burner system on a 24-hour basis, as required.

1 Company name & address: **Bell Pole Company, Terrace Operations.**
Box 280, Terrace, BC V8G 4A6

2. Mill Location: 5630 Highway 16 West, Terrace, BC

3. Mill Production: 10,000 m3/year (cedar poles), or about 50% of capacity

4. Total number of employees: 3

5. Hours of operation and number of shifts: 8 hours/day, 5 days/week
1 shift/day

6. Total volume of wood residue generated: 2,000 m3/year

7. Residue Types: cedar shavings/bark: 1,200 m3/year (60%), cedar blocks: 800 m3/year(40%)

8. Disposal methods: shavings and bark to silo burner

9. Residue Utilization: cedar blocks to JCJ Holdings'shake & shingle mill in Old Remo.

10. Size and type of burner: a 16-ft diameter, 40-ft high silo burner.

11. Equipment & Modifications: underfire fan, auxiliary fuel (natural gas) burner, PLC.

1. Company name & address: **Copper Mountain Cedar Products Ltd.**
   RR #4, Old Lakelse Lake Road, Terrace, BC V8G 4V2

2. Mill Location: #204 Old Lakelse Lake Road, Terrace, BC

3. Mill Production: 4,000 shingle squares per year

4. Total number of employees: 11

5. Hours of operation and number of shifts: 8 hours/day, 5 days/week
   1 shift/day

6. Total volume of wood residue generated: 800 m3/year

7. Residue Types: sawdust 60%, bark 25%, broken wood 15%

8. Disposal methods: mill residue to silo burner

9. Residue Utilization: N/A

10. Size and type of burner: a 12-ft diameter, 36-ft high silo burner.

11. Equipment & Modifications: underfire fans, overfire fans.

HL/hl