

# A Smoke Management Framework for British Columbia

A Cross-government Approach to Reduce Human Exposure  
to Smoke from Biomass Burning



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Province of British Columbia



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## Foreword

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The 2008 Air Action Plan identifies “smoke management” as a priority for reducing air pollution in B.C. Action 27 of the Plan calls for the development of a “province-wide smoke management plan.” This B.C. Smoke Management Framework partially fulfils that commitment by describing the current government-wide approach for managing all sources of biomass smoke in B.C. It is intended to be updated regularly as measures to address smoke pollution in B.C. develop.

## Acknowledgements

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These individuals, listed alphabetically, contributed to its development:

- Rebecca Freedman Ministry of Environment
- Chris Jenkins Ministry of Environment
- Markus Kellerhals Ministry of Environment
- Bob Konkin Ministry of Environment
- Glen Okrainetz Ministry of Environment
- Steve Sakiyama Ministry of Environment
- Tony Wakelin Ministry of Environment
- Jacquay Foyle Ministry of Agriculture
- Lyle Gawalko Ministry of Forests, Lands and Natural Resource Operations
- Janice Larson Ministry of Energy and Mines.

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- RDOS Air Quality Program for “Residential Wood Burning” and “Chipping of Agricultural Debris”
- Wildsight Program for “Outdoor Wood Boiler” and “Old Stove Exchanged for Cleaner Burning Stove.”

## Contact

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Please address inquiries about this document to: [BCAirQuality@gov.bc.ca](mailto:BCAirQuality@gov.bc.ca)



Tyaughton Lake Wildfire

## Purpose

The B.C. Smoke Management Framework outlines and describes a cross-government approach to reduce human exposure to smoke from biomass burning (e.g. wood smoke). Biomass smoke is a significant contributor to air pollution including fine particulate matter, which has known human health effects. This framework does not introduce any new policy or regulatory requirements; rather it compiles and unifies existing smoke management measures into one cohesive framework.

## Principles for Smoke Management in B.C.

To meet the objectives of the Smoke Management Framework, the following general principles will be applied:

- **Flexibility** – A range of tools and approaches are used for smoke management.
- **Innovation** – New tools and approaches are developed to minimize smoke effects.
- **Scientific basis** – Smoke management draws on the findings of relevant disciplines including health and environmental sciences, waste management, forestry, and agriculture.
- **Cost effectiveness** – Programs to manage the effects of smoke do not impose undue costs on society, government, industry, or other stakeholders.
- **Equity** – Programs to manage the effects of smoke do not unfairly target certain sectors.
- **Inclusiveness** – The views of stakeholders are taken into account.

- **Transparency** – Policies and decisions are made in a transparent fashion.

## Objectives for Smoke Management in B.C.

The overall goal of smoke management in B.C. is to reduce health risks by minimizing human exposure to smoke from biomass burning.

Human exposure to biomass smoke is minimized by:

- reducing emissions of smoke from biomass burning
- ensuring that emissions of smoke from biomass burning occur in times and places where dispersion is good so that high concentrations of smoke are not transported to populated areas
- warning citizens of high levels of smoke and other pollution, and advising appropriate actions to minimize exposure.

In achieving these objectives, smoke management in B.C. takes into account these considerations:

- The use of fire needs to remain available as a resource management tool.
- Lifecycle impacts of biomass burning and of alternatives to biomass burning should be evaluated.
- Where possible, residual or waste biomass is used as feedstock for products or for bioenergy.
- The best use is made of B.C. biomass resources.
- Open-air burning of wood and other biomass is minimized. However, it is recognized that burning may be required as a component of ecosystem restoration projects for forest management purposes or as a component of fuel hazard reduction to reduce wildfire risks and support public safety.
- Use of alternatives to open burning, where available, is essential.
- Use of good burning practices is required.
- Best practices to maintain air quality and best technology for biomass use are employed.
- High polluting sources (such as beehive burners) are phased out.

# Biomass Smoke in B.C.

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## What is in Biomass Smoke

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When biomass burns, the main products are carbon dioxide, water vapour, and mineral ash. However, biomass burning also produces smoke consisting of a mix of pollutants. Important contaminants in smoke include both fine and coarse particulate matter ( $PM_{2.5}$  and  $PM_{10}$  respectively), carbon monoxide (CO), nitrogen oxides ( $NO_x$ ), and volatile organic compounds (VOC). Biomass burning can also release small amounts of toxins such as benzene, acrolein, polycyclic aromatic hydrocarbons (PAHs), formaldehyde, and dioxins and furans.

Smoke and the pollutants it contains are signs of inefficient combustion. Efficient combustion produces very little smoke, while inefficient combustion can convert a significant fraction of the total fuel into smoke pollutants.

## Biomass Burning in B.C.

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Biomass burning in B.C. takes place for many different reasons, including:

- disposal of debris from land clearing
- disposal of debris from agriculture and domestic gardening
- disposal of post harvest forest debris to abate fire hazards (pile burning)
- controlled (also called prescribed) fires for habitat restoration, wildfire threat reduction (associated with Community Wildfire Protection Plans) and forestry planting site preparation
- production of bioenergy to power industrial processes or to generate electricity
- home heating with wood-burning appliances.

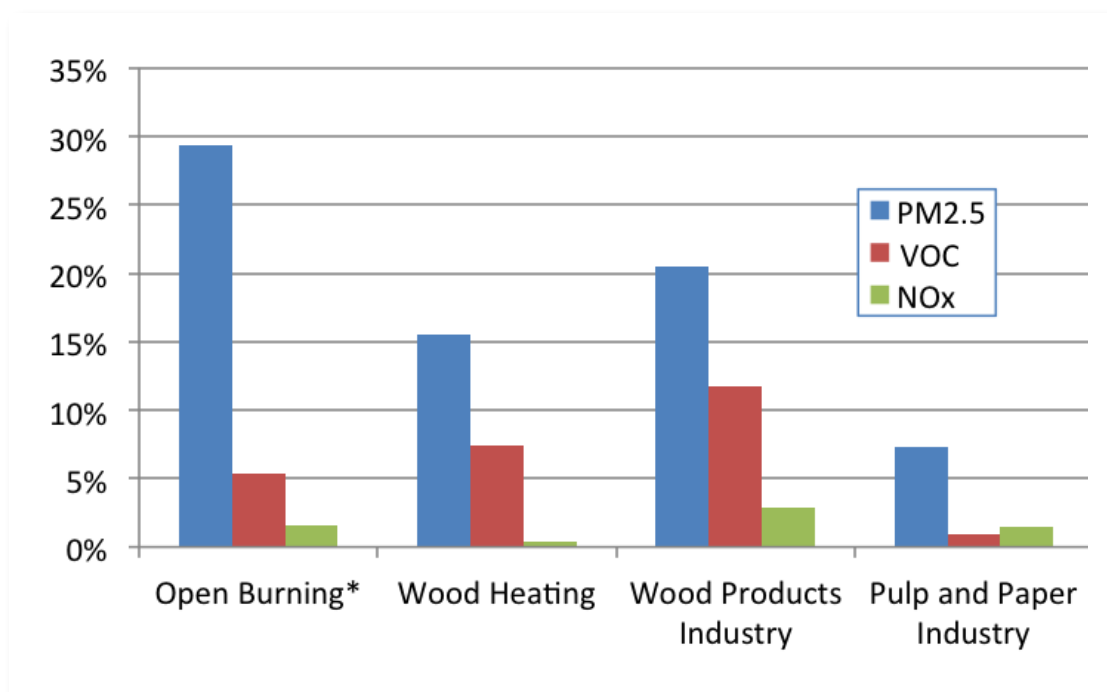
Biomass burning also occurs naturally in forest fires and this type of smoke release is unavoidable. For these types of events, the best action is to limit public smoke exposure by providing air quality advisories.

## Prevalence of Biomass Smoke in B.C.

Biomass burning is a significant contributor to pollutant emissions. Figure 1 shows emissions in B.C. of  $PM_{2.5}$ , VOC and  $NO_x$  from several biomass related sectors. The inventory categories in Figure 1 are:

1. controlled burning, which includes habitat restoration, wildfire threat reduction (associated with Community Wildfire Protection Plans), forestry planting site preparation, and pile-burning of post harvest forest debris
2. wood heating, which includes all residential wood combustion for aesthetic or heating purposes
3. the wood products industry
4. the pulp and paper industry.

**Figure 1:** Percentage Contribution to Provincial Emissions



\*Open burning includes pile burning of forestry, agricultural, and land-clearing debris and controlled burns for ecosystem restoration, fuel reduction, and ecosystem health.

Biomass is the predominant fuel in all four categories and, therefore, is a primary contributor to  $PM_{2.5}$  emissions in B.C. It is also a significant contributor to VOC emissions and a minor but not insignificant contributor to  $NO_x$  emissions.

A large contribution to emissions may not on its own indicate a risk to health, as the extent to which pollutants build up in the local atmosphere depends on where and when they are emitted. Pollutants emitted in remote areas distant from communities are less likely to cause



human exposure. Likewise, pollutants emitted during periods of good atmospheric dispersion are less likely to cause human exposure than pollutants emitted in stagnant<sup>1</sup> air conditions.

For example, controlled burns are planned to occur during times of good atmospheric dispersion conditions to minimize smoke transmission to urban areas. Therefore, although these burns may be relatively large emitters of smoke, the risk of population exposure is minimized. Conversely, wood smoke from home heating, released during times of poor ventilation conditions, may have a significant effect on local air quality.

Biomass smoke is a significant contributor to total PM<sub>2.5</sub> concentrations in a number of communities where it has been investigated. For example:

- In Golden, the “wood smoke” and “winter heating” fractions of PM<sub>2.5</sub> (both attributed to biomass burning) together account for 60% of measured PM<sub>2.5</sub>.<sup>2</sup>
- An airshed modelling study in Quesnel determined that the “residential” sector (including wood stoves and backyard burning) contributes up to 62% of PM<sub>2.5</sub>.<sup>3</sup>
- In Williams Lake, wood heating was the top PM<sub>2.5</sub> contributor at 7 out of 15 sites investigated.<sup>4</sup>
- In Prince George, wood burning sources contribute 12 to 26% of total PM<sub>2.5</sub>.<sup>5,6</sup>
- Even in the lower Fraser valley, where there are many other sources of PM<sub>2.5</sub>, biomass burning is estimated to contribute 7-9% of measured PM<sub>2.5</sub> concentrations.<sup>7</sup>
- Wood smoke pollution is a frequent cause of winter air quality advisories.

Smoke from forest fires is a variable contributor to average PM<sub>2.5</sub> emissions in B.C. During active forest fire seasons, forest fires may contribute a significant proportion of annual provincial PM<sub>2.5</sub> emissions. In other years they are a small source<sup>8</sup>.

Because forest fire emissions are episodic and can be intense, they have been observed to cause extremely high concentrations of PM<sub>2.5</sub> and other smoke pollutants. Examples include extremely high PM<sub>2.5</sub> levels in Kelowna and Kamloops during the 2003 Kelowna fires and in Williams Lake and Kelowna in 2010. During the 2003 fires, 24-hour average PM<sub>2.5</sub> concentrations reached 200 µg/m<sup>3</sup> in Kelowna and 140 µg/m<sup>3</sup> in Kamloops<sup>9</sup>, well above the provincial objective level of 25 µg/m<sup>3</sup>.

Forest fires cannot be eliminated, so the only way to limit public smoke exposure during these events is to provide air quality advisories. In the summer of 2010, smoke from the many wildfires was so problematic that air quality advisories were issued in several areas of the

<sup>1</sup> “Stagnant” air conditions occur when normal mixing is reduced by light winds, temperature inversions and recirculation of polluted air.

<sup>2</sup> See: [www.bcairquality.ca/reports/golden\\_pmf.html](http://www.bcairquality.ca/reports/golden_pmf.html)

<sup>3</sup> See: [www.bcairquality.ca/reports/Source\\_Apportionment.html](http://www.bcairquality.ca/reports/Source_Apportionment.html)

<sup>4</sup> See: [www.bcairquality.ca/reports/fine\\_part\\_source\\_apport.html](http://www.bcairquality.ca/reports/fine_part_source_apport.html)

<sup>5</sup> See: [www.pgairquality.com/uploads/files/pdf/123110153%20Final%20PG%20AIR\\_MOE\\_08-Oct-2010.pdf](http://www.pgairquality.com/uploads/files/pdf/123110153%20Final%20PG%20AIR_MOE_08-Oct-2010.pdf)

<sup>6</sup> See: [www.pgairquality.com/uploads/files/pdf/PG\\_PM25SourceApportionment\\_FinalReport.pdf](http://www.pgairquality.com/uploads/files/pdf/PG_PM25SourceApportionment_FinalReport.pdf)

<sup>7</sup> Environment Canada presentation to LFVAQCC, Roxanne Vingarzan, 2010

<sup>8</sup> See: Provincial Emission Summaries, Environment Canada at: [www.ec.gc.ca/inrp-npri/default.asp](http://www.ec.gc.ca/inrp-npri/default.asp)

<sup>9</sup> Moore, David, et al., (2005). Population Health Effects of Air Quality Changes Due to Forest Fires in British Columbia in 2003: Estimates from Physician-visit Billing Data, CJP 107, pp 105-108.

province. Preliminary data indicate maximum twenty-four hour concentrations of 260 and 180 mg/m<sup>3</sup> in Williams Lake and Kamloops respectively during this period.

In addition to their episodic effects, forest fires contribute significantly to annual mean concentrations of PM. For instance, in the western U.S.A., biomass burning accounts for roughly 30% of annual average PM<sub>2.5</sub><sup>10</sup> at sites not adjacent to large man-made emission sources (referred to as background levels).

Much of this is likely from forest fires. Under unfavourable conditions, or with very large fires, it is possible for air quality to be affected hundreds or even thousands of kilometres from the fire location<sup>11</sup>.

In addition to the elevated levels of PM<sub>2.5</sub> associated with forest fire emissions, significant increases in episodic<sup>12</sup> and average<sup>13</sup> ozone levels have also been observed. Forest fires have even been found to cause significant increases in CO<sup>14</sup>, VOC<sup>14</sup>, NO<sup>12</sup>, and mercury<sup>15</sup>.

## Health Effects of Biomass Smoke

Burning wood and other biomass creates smoke that contains a large number of air pollutants that can affect people's health. (See *Smoke Pollutants and their Health Effects*.) The main air pollutants emitted in biomass burning are particulate matter, especially fine particulate matter (PM<sub>2.5</sub>) and carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), and volatile organic compounds (VOC). In addition, wood smoke contains smaller quantities of other health-damaging compounds such as benzene, acrolein, formaldehyde, and polycyclic aromatic hydrocarbons (PAH).

There is an extensive body of literature on the health effects of individual smoke constituents. Epidemiological and laboratory studies have also investigated the health effects from all of the constituents of smoke when in combination. A recent review of wood smoke health effects<sup>16</sup> concludes that "there is a considerable and growing body of epidemiological and toxicological evidence that both acute and chronic exposures to wood smoke in developed country populations, as well as in the developing world, are associated with adverse health impacts".

PM<sub>2.5</sub> is widely used as the main metric to characterize exposure to wood smoke. Extensive literature on the health effects of fine PM supports this. The review article also concludes that current evidence is not sufficient to determine that wood smoke PM is either more or less toxic than PM<sub>2.5</sub> in general. However, given the importance of wood smoke as a contributor to

<sup>10</sup> Park, R.J., et al., (2007). Fire and biofuel contributions to annual mean aerosol mass concentrations in the United States. *Atmospheric Environment* 41, pp. 7389–7400.

<sup>11</sup> Jaffe, D., et al., (2004). Long-range transport of Siberian biomass burning emissions and impact on surface ozone in western North America. *Geophysical Research Letters*, Vol. 31.

<sup>12</sup> Cheng, L., et al., (1997). Forest fire enhanced photochemical air pollution: A case study. *Atmospheric Environment* 31.

<sup>13</sup> Jaffe, D., et al., (2008). Influence of Fire on O<sub>3</sub> concentrations in the Western U.S., *Environmental Science and Technology* 42.

<sup>14</sup> Wotawa, G. and Trainer, M., (2000). The Influence of Canadian Forest Fires on Pollutant Concentrations in the United States. *Science* 288, pp. 324–328.

<sup>15</sup> Sigler, J. M., et al., Emission and long-range transport of gaseous mercury from a large-scale Canadian boreal forest fire. *Environ. Sci. Technol.* 2003, 37, 4343–4347.

<sup>16</sup> Naeher, L.P., et al., (2007). Woodsmoke Health Effects: A Review. *Inhalation Toxicology* 19, pp 67–106.

## ***Smoke Pollutants and their Health Effects***

**Fine Particulate Matter (PM<sub>2.5</sub>)** – PM<sub>2.5</sub> causes effects in the respiratory and cardiovascular systems. Outcomes observed from PM<sub>2.5</sub> exposure range from subtle changes in lung and heart function to more serious outcomes such as triggering asthma, bronchitis, chronic obstructive pulmonary disease, ischemic heart disease (coronary artery disease), myocardial infarction (heart attack), atherosclerosis (plaque build-up in the arteries), increased emergency room visits, and even premature death. An exhaustive EPA review<sup>1</sup> concludes that there is a causal relationship between PM<sub>2.5</sub> and cardiovascular effects and mortality, plus a likely causal relationship between PM<sub>2.5</sub> and respiratory effects.

**Nitrogen Oxides (NO<sub>x</sub>)** – Nitrogen oxides are mostly emitted as nitrogen monoxide (NO), but are transformed in the atmosphere to nitrogen dioxide (NO<sub>2</sub>). NO<sub>2</sub> directly affects respiratory health, causing increased airway responsiveness, which in turn can trigger respiratory symptoms, particularly in asthmatics. Epidemiological studies show an association between NO<sub>2</sub> and increased respiratory hospital admissions and respiratory emergency room visits<sup>2</sup>. NO<sub>x</sub> is a precursor to the formation of secondary PM<sub>2.5</sub> and ozone.

**Volatile Organic Compounds (VOC)** – VOCs are a huge class of compounds with some quite toxic components and some relatively benign. Many VOCs contribute to ozone formation. Some also contribute to secondary PM formation.

**Ozone (O<sub>3</sub>)** – Ozone is not directly emitted by biomass burning. Rather, it is a secondary pollutant that forms in the atmosphere from reactions between precursor pollutants NO<sub>x</sub> and VOC, both of which are emitted from biomass burning. Ozone is a respiratory irritant. It has been shown to cause airway irritation, reduced lung function, and to exacerbate asthma. These respiratory effects result in increased hospital admissions and premature mortality<sup>3</sup>. Also, long term ozone exposure may cause permanent lung damage.

**Carbon Monoxide (CO)** – High levels of CO cause hypoxia by binding to haemoglobin in place of oxygen. Environmentally relevant CO concentrations also cause cardiovascular effects, primarily increased hospital admissions among those with underlying conditions. A recent EPA review<sup>4</sup> concludes that “a causal relationship is likely to exist between relevant short-term exposures to CO and cardiovascular morbidity.”

**Benzene** – Benzene is a known carcinogen, although the individual cancer risk is very low at levels typically measured in the environment.

**Acrolein** – Acrolein has a strong acrid odour. It is a respiratory and eye irritant.

**Formaldehyde** – Formaldehyde has a pungent odour. It is an irritant to the nose, eyes, and throat. Long term exposure may cause asthma symptoms. Occupational exposure to formaldehyde has been observed to cause cancer of the nasal cavity; however this occurs at levels far above normal environmental concentrations.

**Polycyclic Aromatic Hydrocarbons (PAHs)** – Long term exposure to low levels of some PAHs have caused cancer in animals. Several PAHs are classified as probable human carcinogens by the International Agency for Research on Cancer and by the U.S. EPA.

<sup>1</sup> U.S. EPA. Integrated Science Assessment for Particulate Matter - Final Report. 2009.

<sup>2</sup> U.S. EPA. Integrated Science Assessment for Oxides of Nitrogen – Health Criteria (Final Report). 2008.

<sup>3</sup> U.S. EPA. Provisional Assessment of Recent Studies on Health and Ecological Effects of Ozone Exposure. 2009.

<sup>4</sup> U.S. EPA. Integrated Science Assessment for Carbon Monoxide (Final Report). 2010.

ambient PM<sub>2.5</sub> concentrations in many locations, “strategies to reduce wood smoke emissions may be an effective means of lowering particle exposures.”

A study in B.C. investigating effects of the 2003 Kelowna fires on hospital admissions in Kamloops and Kelowna<sup>17</sup> found significantly elevated rates of respiratory hospital admissions in Kelowna during the period of exposure. In Kamloops, where the exposure was lower, no such effect was observed.

A modelling study attempted to quantify the economic cost of health effects from a forest fire in Alberta that exposed Edmonton, Red Deer, and surrounding communities to high levels of pollution for several days<sup>18</sup>. The study found a health cost from the fires in the range of two to three million dollars, similar in cost to damaged and destroyed buildings and other infrastructure. The health cost is notable as the duration of exposure was only a few days.

In assessing the potential health effects of smoke emissions from different sources, “intake fraction” is a useful concept. The intake fraction is simply the fraction of pollutant emissions actually inhaled by the exposed population.

In general, sources that emit in close proximity to communities have a higher intake fraction than sources that emit at large distances from communities. Sources that emit from elevated stacks also tend to have lower intake fractions versus sources at ground level.

In the context of biomass burning, emissions from burning that occurs during good atmospheric dispersion conditions generally have a lower intake fraction than emissions from burning that occurs under stable conditions. A study in Metro Vancouver found that emissions from residential wood heating have a high intake fraction<sup>19</sup>, consistent with the fact that these emissions take place in the midst of the community.

## Other Effects of Smoke

In addition to its effects on health, smoke reduces visibility. Visibility degradation can range from a regional haze that obscures distant views to dense smoke that causes immediate safety concerns. People express concerns about visibility degradation because of smoke even when smoke pollutant levels are well below provincial or national objectives.

At moderate levels of reduced visibility, scenic views are obscured by a haze of smoke particles. This can affect tourism, as visitors who travel to scenic locations and experience views compromised by pollution are less likely to return or recommend the trip to others.<sup>20</sup> An example of this occurred in the Canadian Rockies in 2003 when smoke from forest fires in Alberta and B.C. obscured mountain vistas for residents of and visitors to the mountain parks<sup>21</sup>. Smoke from burning can also travel in a well-defined plume, reducing visual air quality in a

<sup>17</sup> Moore, D., et al. (2006). Population Health Effects of Air Quality Changes Due to Forest Fires in British Columbia in 2003: Estimates from Physician-visit Billing Data. *Canadian Journal of Public Health*.

<sup>18</sup> Rittmaster, R., et al. (2006). Economic Analysis of Health Effects from Forest Fires. *Can. J. For. Res.* Vol. 36. (and subsequent erratum)

<sup>19</sup> Ries F.J., et al. (2009). Intake fraction of urban wood smoke. *Environ Sci. Technol.* 43(13):4701-6.

<sup>20</sup> McNeill, R. and Roberge, A. (2000) The Impact of Visual Air Quality on Tourism Revenues in Greater Vancouver and the Lower Fraser Valley, GBEI report number EC/GB-00-028

<sup>21</sup> See “Cleaner air expected in 2004”, *Canmore Leader* (Dec. 30, 2003) at: [www.canmoreleader.com/ArticleDisplay.aspx?archive=true&e=1990328](http://www.canmoreleader.com/ArticleDisplay.aspx?archive=true&e=1990328)

phenomenon known as “plume blight”. High levels of smoke can degrade visibility to such an extent that transportation is affected because of safety concerns. In extreme smoke events, roads and highways may be closed<sup>22</sup> or aircraft diverted.



Two Plumes from Separate Open Burns about to Merge

Smoke from biomass burning is usually associated with a distinctive smell. Reactions to the smell of smoke vary dramatically, depending on the concentration of smoke, the type of biomass fuel being burned, and the preferences of the observer. While some observers enjoy a light smell of wood smoke, others find the smell irritating or worse. Since exposure is involuntary, the odour from biomass smoke can be a nuisance to those who find it unpleasant.

## Smoke and Climate

The main source of carbon dioxide that contributes to climate change is derived from fossil fuels – largely from the combustion of oil and gas. Burning biomass such as wood or agricultural waste need not contribute to the build-up of the greenhouse gas carbon dioxide (CO<sub>2</sub>) in the atmosphere if the biomass is sustainably harvested. Assuming a sustainable harvest, the CO<sub>2</sub> released into the atmosphere by burning is taken up by new plant growth in roughly equal proportion. For this reason, biomass burning can be viewed as “climate-neutral” (i.e. not contributing to global warming). In fact, biomass burning is only climate-neutral if the combustion is also efficient and complete. Inefficient combustion leads to the release of particles and trace gases that contribute to global warming (in addition to being air pollutants). Collectively, these substances are known as short-lived climate forcers (SLCFs), distinguishing them from CO<sub>2</sub> which has a much longer atmospheric life-span. Among the SLCFs released by wood combustion are methane, CO, VOC and black carbon (soot) particles.

<sup>22</sup> See “Smoke from stubble fires engulfs Winnipeg” CBC News (Sept. 6, 2007) at: [www.cbc.ca/canada/manitoba/story/2007/09/06/stubble-smoke.html](http://www.cbc.ca/canada/manitoba/story/2007/09/06/stubble-smoke.html)



Most efforts to reduce air pollution from biomass burning also reduce SLCFs. Thus there are air-quality and climate benefits to encouraging clean, efficient biomass burning. If biomass is burnt cleanly for energy and the resulting energy is used to displace energy from fossil fuels then there can be a net climate benefit by avoiding CO<sub>2</sub> emissions.

## Smoke and Energy Efficiency

When biomass is combusted for energy (e.g. wood heaters, industrial boilers) it is desirable to get as much energy as possible from the biomass. Since the majority of smoke pollutants are in fact products of incomplete combustion, they represent wasted energy when they are emitted.

For example, CO in biomass smoke represents biomass carbon that has not been fully combusted (oxidized) to CO<sub>2</sub>. Incomplete combustion that transforms the carbon in biomass to CO rather than CO<sub>2</sub>, releases less than one third of the energy of complete combustion.

Generally, energy-efficient combustion of biomass leads to low emission of air pollutants and SLCFs. Thus, there is often a financial incentive in the form of higher energy efficiency to encourage cleaner biomass combustion.



Outdoor Wood-burning Boiler

## Sources of Biomass Smoke

Following are the four main sources of biomass smoke, as discussed in greater detail in “Strategies for Addressing Biomass Smoke Sources.”

1. **Forest Fires** – Forest fires are short-term sources of emissions. While active, they can produce enormous amounts of pollution. Although many of these emissions occur in areas far from population centres, they can also occur immediately adjacent to or even inside communities. Emissions from forest fires are concentrated in the summer months. This category includes:
  - natural or human-caused wildfire
  - controlled burns for ecosystem management
  - controlled burns for wildfire threat reduction near communities.



Seedling After a Fire



Large B.C. Wildfire

**2. Open Burning** – Open burning is typically used to dispose of waste biomass. It takes place both in remote forestry locations and in communities. It occurs particularly in the spring and fall when the wildfire hazard is low enough to permit burning. It generally has very high air pollutant emissions per unit of fuel as the burning is usually inefficient. This category includes:

- open burning of post harvest forest debris to abate fire hazards
- open burning of agricultural residues
- open burning of residues from land clearing for development
- open burning at landfills
- backyard biomass burning
- recreational burning: bonfires, campfires, beach fires.



Open Burning in the Skeena Region



Open Burn Piles

**3. Residential Wood Burning** – Wood provides about 10% of B.C.'s space heating requirements while accounting for approximately 97% of air pollution from space heating. Residential wood burning emissions occur primarily in the cool months. Generally, they emit at roof level in communities, so have a high potential for exposure. This category includes:

- comfort heating – largely with woodstoves, but also pellet appliances, furnaces, and boilers
- aesthetic wood burning in fireplaces.



Residential Wood Burning



Beehive Burner

**4. Industrial Biomass Burning** – Wood and other biomass is burned in many industries to power various industrial processes. Typically, biomass is burned in boilers with emission controls, so the emissions per unit of fuel are relatively low. However, facility emissions can still be significant when large volumes of fuel are combusted. Industrial sources typically contribute emissions fairly evenly throughout the year. Locations range from remote to within or at the edge of communities. This category includes:

- bio-energy for industrial applications (e.g. heat for lumber kilns) – mostly waste wood
- biomass combustion for agricultural heating
- biomass electricity generation – largely waste wood
- burning of wood residue in beehive burners.



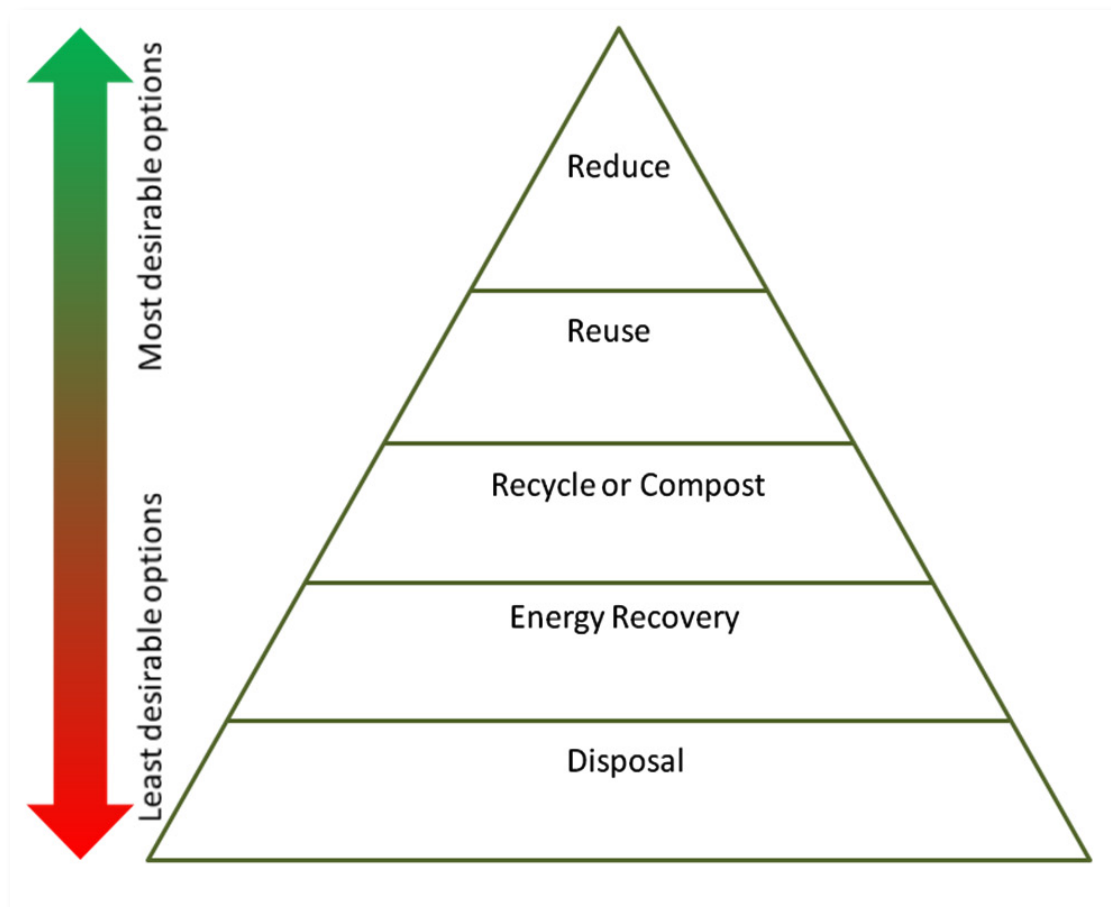
## Hierarchy of Biomass Management

A hierarchy of biomass management recognizes that there are multiple options for dealing with residual biomass (i.e. biomass left over after activities such as logging, wood processing, crop harvesting, etc.). These produce various benefits to society as well as various potentials for negative health effects caused by air pollution. The costs and benefits of the different options are weighed and the options are ranked from most to least desirable. This is a general ranking that could vary in specific cases.

The following general hierarchy is applicable to all forms of biomass:

1. Sufficient biomass is left in place (or re-used) to meet ecosystem/agricultural requirements.
2. Biomass is converted into useful products such as agricultural products, forest industry products, biofuels, and bioenergy.
3. Biomass is burned according to the applicable regulatory framework.

**Figure 2:** A waste management hierarchy applicable to dealing with waste biomass.



Often, smoke management issues involve disposal of residual biomass – a waste management problem. In this context, a general waste management hierarchy (Figure 2) applies. The B.C. Ministry of Agriculture recognizes this hierarchy for dealing with agricultural waste. Waste management options ranked from most desirable to least desirable are:

1. salvaging
2. recycling
3. land filling
4. burning

Examples to illustrate the categories in Figure 2 include:

- **Reduce** – Reducing waste biomass could be done by changing harvest practices or increasing use of the harvested biomass. Also, leaving some waste biomass on the landscape may be ecologically desirable in agriculture or forestry.
- **Re-use** – Some biomass products, especially in agriculture, can be re-used for their original purpose. An example is the re-use of fence posts.
- **Recycle or Compost** – Residual biomass can be recycled by diverting it into the manufacture of useful products such as engineered wood products, pellets, chips and syngas. Compost can be another recycled product of waste biomass.
- **Energy Recovery** – Waste biomass is burned for energy to power industrial processes, to generate electricity, or to heat buildings. The desirability of energy recovery from biomass is highest for options that include advanced emissions controls.
- **Disposal** – Waste biomass may be land-filled, incinerated, or open-burned. The relative desirability of these options depends on location and other factors.

# Strategies for Addressing Biomass Smoke Sources

## 1. Forests

### 1.1 Wildfire

Wildfire suppression is conducted to protect public safety, property, critical infrastructure, timber and other forest assets. Wildfire prevention, reduction of hazardous forest fuels and rapid wildfire suppression will also reduce smoke impacts. Tools to predict smoke transport, real-time pollutant monitoring, and air quality advisories can help to warn citizens of wildfire smoke exposure. Air quality advisories are issued when air pollutants are predicted to exceed provincial standards. The advisories contain information on measures to reduce pollutant exposure.

One way to reduce the effects of smoke from wildfires is to proactively reduce forest fuels (e.g. by controlled burns, thinning and/or chipping of the vegetation, or selective harvesting) so that wildfire intensity may be reduced and fires quickly controlled and extinguished.

#### ***The BlueSky Wildfire Smoke Forecasting System***

Smoke from wildfires can affect huge areas resulting in a range of effects that include nuisance, safety concerns, and risks to human health. The ability to forecast smoke affected areas is beneficial to a wide variety of public and agency interests.

Since 2007, a number of B.C. and Alberta government agencies have worked in partnership to create a wildfire smoke forecasting system for B.C. and Alberta, based on a system used in the U.S.A. called BlueSky. In August, 2010 such a system became reality and operated through the remainder of an intense fire season.

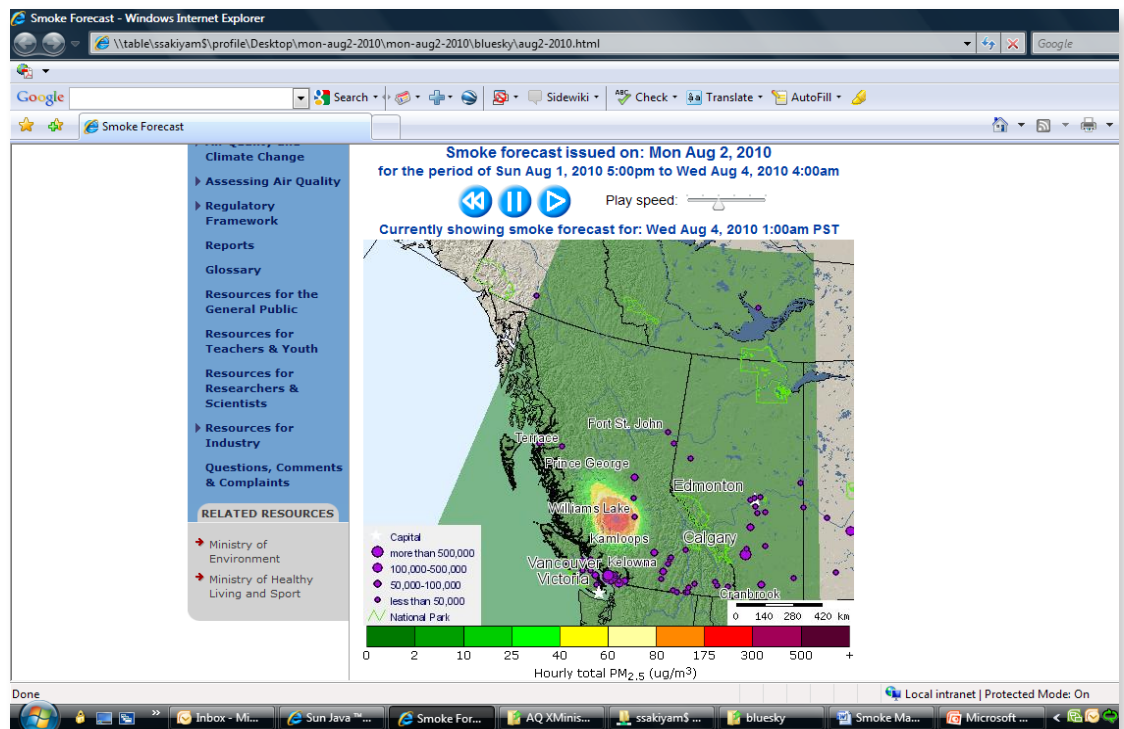
The system relies on meteorology as forecast by a computer model. The model predicts winds and other variables every 4 km over B.C. and Alberta for every hour, 48 hours into the future. A system developed by the Canadian Forest Service is used to determine wildfire locations through satellite detection of hotspots and fuel consumption estimates based on forest inventories. Finally, a transport and dispersion model is used to estimate the resulting smoke ( $PM_{2.5}$  concentrations) at ground level.

The meteorology, wildfire location and emissions, and smoke transport and dispersion are all linked together through the BlueSky framework. All data links and processing is done at the University of British Columbia, and animations of hourly smoke forecasts of  $PM_{2.5}$  for the next 48 hours are displayed on the B.C. government [website at www.bcairquality.com/bluesky/](http://www.bcairquality.com/bluesky/).

## Measures and Resources

- Proactive fuel hazard reduction, particularly near communities.
- Proactive wildfire management planning to reduce wildfire impacts.
- BlueSky system to predict locations where smoke exposure may occur.
- Air quality advisory system to inform citizens when pollutant levels exceed provincial objectives.

The *The B.C. Wildland Fire Management Strategy* (<http://bcwildfire.ca/Prevention/PrescribedFire/docs/BCWFMS.pdf>) provides a framework for the proactive management of wildfires to reduce wildfire effects by using proactive fuel hazard reduction, controlled burning, planning, and public education.



BlueSky Forecasting System Showing Smoke Dispersion (Screenshot)

## 1.2 Controlled Burns

Controlled burning of forests or rangelands (as opposed to residue) occurs for a variety of reasons. These include reducing fire hazard, maintaining forest and ecosystem health, and fighting wildfire. Whenever possible and feasible, controlled burns are conducted to minimize smoke transport to populated areas. Planning for the burn focuses on reducing smoke exposure by conducting burns in times of good venting when air currents are blowing away from populated areas. Burns are planned to be brief and of low intensity to reduce the amount of biomass consumed.

Coordinating burning through local smoke management plans can time burns to ensure that air quality is not compromised by excessive burning. Informing the public of burn times, location, and prevailing weather conditions, combined with real-time pollutant monitoring, can help citizens to minimize their exposure to this source of pollution.

## Measures and Resources

- Detailed planning to reduce fuel load and minimize the duration, location and intensity of smoke emissions.
- Weather information to predict where smoke exposure may occur and to help choose appropriate times to burn.
- Air quality advisory system to inform citizens when pollutant levels exceed provincial objectives.

### 1.3 Community Wildfire Protection Program

As urban development and infrastructure expand into wildland areas (the wildland-urban interface), the need for proactive fuel management to reduce wildfire threats to communities has increased. Since 2004, Community Wildfire Protection Plans have been developed or are underway for local governments and First Nations communities. Communities are actively completing fuel reduction projects. These projects generate biomass, the disposal of which should be guided by the general principles in the waste management hierarchy of Figure 2.

## Measures and Resources

- Harvesting all marketable timber generated by fuel reduction projects.
- Using alternative slash disposal methods (i.e. use as biofuels and or/chip and grind post-harvest slash and residue where possible).
- Piled burning of debris if there are no other options for disposal and burning is recommended/supported by a professional designate or official. (Requirements for burning debris piles under the Open Burning Smoke Control Regulation (OBSCR) may be relaxed if burning is planned to minimize smoke duration and effects).

The Union of BC Municipalities administers the Strategic Wildfire Prevention Program (under which the Community Wildfire Protection Program is run) in partnership with the Ministry of Forests, Lands and Natural Resource Operations and the First Nations Emergency Services Society. More information is available at [ground.hpr.for.gov.bc.ca](http://ground.hpr.for.gov.bc.ca) or [www.ubcm.ca/EN/main/funding/community-safety/strategic-wildfire-prevention.html](http://www.ubcm.ca/EN/main/funding/community-safety/strategic-wildfire-prevention.html).



Controlled Burn



## 2. Open Burning

### 2.1 Open Burning of Post-harvest Forest Debris

Forestry slash remaining after an area has been logged is generally piled and burned to prepare the site for replanting and to abate fire hazards as required under the *Wildfire Act* and Regulation. These burns must comply with the *Environmental Management Act* and the OBSCR.

While many sites are far from populated areas, smoke from large-scale open burns can drift into communities if the weather, venting, topography, or pile quality is not optimal. Community forests, woodlots and some timber supply areas may be located near communities where minimizing impacts from open burning is critical.

Residues are also generated at primary wood-processing facilities such as log sorts and forwarding facilities. These residues are sometimes open burned if there are no other feasible alternative uses or disposal options. These activities fall under the permitting system, though they may be incorporated into the OBSCR, as proposed in the 2010 *intentions paper* ([www.env.gov.bc.ca/epd/codes/open\\_burning/index.htm](http://www.env.gov.bc.ca/epd/codes/open_burning/index.htm)).

In some cases, and when recommended by a professional designate or official, burning is used to manage diseased trees.



Open Burn Piles

#### Measures and Resources

- The Open Burning Smoke Control Regulation (OBSCR) permits open burning that follows certain conditions such as setback distances from residences, schools, hospitals, and care facilities, and favourable venting conditions, limited smoke release period, and number of burns per year.
- The OBSCR is being revised to tighten the standards governing open burning. (See the 2010 *intentions paper* ([www.env.gov.bc.ca/epd/codes/open\\_burning/index.htm](http://www.env.gov.bc.ca/epd/codes/open_burning/index.htm))).

- Allowances are made for the necessary burn activities to manage diseased trees provided that plans for this cover how the effects of smoke will be mitigated.
- Local fire departments, municipalities, and improvement districts or regional districts may have specific bylaws on open burning that affect forestry activities within local jurisdictions. Where these are more stringent, they apply over provincial regulations.
- Best management practices have been developed and are promoted to ensure that smoke emissions are minimized. An example guide is the [Woody Debris Management Info Flip \(http://fire.feric.ca/36512008/FinalReport/WoodyDebrisManagementStrategies-InfoFlip.pdf\)](http://fire.feric.ca/36512008/FinalReport/WoodyDebrisManagementStrategies-InfoFlip.pdf).
- The Woody Debris Management Program encourages the development of new techniques and technologies to manage and utilize woody debris from logging or land development without compromising air quality. Funding opportunities and a showcase of projects previously funded under this program are available at: <http://fire.feric.ca/>.
- Smoke management plans have been developed in several forest districts to coordinate burn times and locations among many of the operating forestry companies. Formalization of the smoke management planning process is being proposed in an updated OBSCR. See the [intentions paper \(www.env.gov.bc.ca/epd/codes/open\\_burning/index.htm\)](http://www.env.gov.bc.ca/epd/codes/open_burning/index.htm).
- To support the objectives of the [Clean Energy Act, \(www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/00\\_10022\\_01\)](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_10022_01), the B.C. Ministry of Forests, Lands and Natural Resource Operations has prepared new tenures that allow for the transfer of post-harvest woody debris to a secondary tenure holder so that the debris may be used for alternative biofuel initiatives rather than being burned. New opportunities that arise from the [BC Bioenergy Strategy \(www.energyplan.gov.bc.ca/bioenergy\)](http://www.energyplan.gov.bc.ca/bioenergy) also provide for incentives and innovation to utilize this valuable resource.
- An inventory of facilities in each region that accept vegetation debris for disposal from personal and business sources is available at: [www.bcairquality.ca/topics/rcbc-alternatives.html](http://www.bcairquality.ca/topics/rcbc-alternatives.html).

## 2.2 Open Burning of Agricultural Residues

Agricultural residues may be disposed of by open burning. Some agricultural material (weeds, crops, stubble, leaves, foliage) is exempted under the **Environmental Management Act**. This means that individuals are not required to follow the Open Burning Smoke Control Regulation (OBSCR) to open-burn these materials, though they must comply with applicable local bylaws.

Other materials do fall under the OBSCR, including debris from orchard, vineyard, or crop replanting and piled burning of removed trees/debris from agricultural development or ecosystem management (squaring up land, expanding cropping area on agricultural land, or removal and burning from ditch lines). In some cases, and when recommended by a professional designate or official, burning is used to manage diseased agricultural vegetation.

Wherever possible, debris should be diverted from burning and disposed of in other ways. Otherwise, burns should be conducted to minimize the smoke produced following best management practices. The burning of banned materials, including plastics, treated woods, fence posts, support structures, pots, plastic wraps, pesticide bags, and manure, is illegal in B.C.

## Measures and Resources

- Agricultural burning of crops, weeds, foliage, or stubble does not require a waste discharge approval or permit and is typically exempt from the OBSCR. Still, farmers are encouraged to follow best management practices to reduce smoke. Land clearing debris on agricultural land does fall under the OBSCR.
- The OBSCR is currently being revised to tighten the standards governing open burning. (See 2010 *intentions paper* ([www.env.gov.bc.ca/epd/codes/open\\_burning/index.htm](http://www.env.gov.bc.ca/epd/codes/open_burning/index.htm)).
- Allowances are made for the necessary burn activities to manage agricultural diseased vegetation, provided that plans document how smoke effects will be mitigated.
- Treated woody materials specific to agriculture, such as wooden plant pots, fence posts, and posts for holding up plants are banned from open burning under the OBSCR.
- Materials specific to agriculture such as stumps and ripped-out orchards/trees are discouraged from open burning and fall under the OBSCR rules.
- Local fire departments, municipalities, and improvement districts or regional districts may have specific bylaws on open burning that affect agricultural activities within local jurisdictions. Where these are more stringent, they apply over provincial regulations. Check with your local fire department or municipality for any local burn bans for fire control or smoke and nuisance control.
- *The Farm Practices Protection Act* protects farmers from liability in nuisance-related cases when they meet certain regulatory conditions and are not in contravention of the *Environmental Management Act*.
- The voluntary *Environmental Farm Plan* (<http://www.agf.gov.bc.ca/resmgmt/EnviroFarmPlanning/index.htm>) (EFP) program allows farmers to participate in an all- farm environmental assessment and to take advantage of tools and techniques to manage their environmental risks. This program provides farmers with an opportunity to learn about acceptable burning practices and allows them to follow beneficial management practices with options to reduce burning and to reduce smoke when burning is necessary.
- The EFP program suggests beneficial management practices (BMPs) for burning and gives funding incentives for burning substitutions such as mulching. See the *BC Environmental Farm Plan Program information and BMP list at: [www.ardcorp.ca/index.php?page\\_id=14](http://www.ardcorp.ca/index.php?page_id=14)*.
- Local Governments and the B.C. Ministry of Agriculture regularly publish fact sheets and hold information sessions to promote beneficial environmental management practices that often include smoke management. The B.C. Ministry of Agriculture's Strengthening Farming program publishes *fact sheets* (<http://www.agf.gov.bc.ca/resmgmt/fppa/refguide/intro.htm>) as part of their farm practice reference guide, including fact sheets on *burning* ([http://www.agf.gov.bc.ca/resmgmt/fppa/refguide/activity/870218-28\\_Burning.pdf](http://www.agf.gov.bc.ca/resmgmt/fppa/refguide/activity/870218-28_Burning.pdf)) and *wood waste handling and disposal* ([http://www.agf.gov.bc.ca/resmgmt/fppa/refguide/activity/870218-61\\_Woodwaste.pdf](http://www.agf.gov.bc.ca/resmgmt/fppa/refguide/activity/870218-61_Woodwaste.pdf)).



- Several B.C. communities have agricultural waste diversion initiatives to divert debris from landfill, burning, or improper disposal. Some turn waste into a product. For example, the Regional District of Okanagan-Similkameen provides an [agricultural plastics recycling program](http://www.rdosmaps.bc.ca/min_bylaws/ES/AQ/2010/AgPlasticsInfoSheetWEBVERSIONMar2_2010.pdf) ([http://www.rdosmaps.bc.ca/min\\_bylaws/ES/AQ/2010/AgPlasticsInfoSheetWEBVERSIONMar2\\_2010.pdf](http://www.rdosmaps.bc.ca/min_bylaws/ES/AQ/2010/AgPlasticsInfoSheetWEBVERSIONMar2_2010.pdf)) to divert plastics from being burned as well as chipping and mulching programs for woody debris to be used as mulch, compost, or another valuable product.
- To promote proper wood disposal, the Regional Districts of Okanagan-Similkameen and Summerland have removed tipping fees at the landfills for properly prepared wood waste. Specific information for the local areas can be found by calling the nearest local government office or on the local government web page.
- An [inventory](http://www.bcairquality.ca/topics/rcbc-alternatives.html) of facilities in each region that accept vegetation debris for disposal is available at: [www.bcairquality.ca/topics/rcbc-alternatives.html](http://www.bcairquality.ca/topics/rcbc-alternatives.html).
- There is some demand for agricultural residues (e.g. straw, seed hulls, pelletized agricultural fibre) as fuel for agricultural boilers. Also, as the demand for ethanol as fuel increases, the demand for agricultural fibre will increase for use as a feedstock for cellulosic ethanol production.



Chipping of Agricultural Debris

### 2.3 Open Burning of Residues from Development Land Clearing

This can range from land clearing by individual property owners on acreages to developers clearing areas for subdivisions. Generally, entire trees are removed, including the root systems which contain soil. In many cases, this debris is not left to season before it is disposed of. This results in less-than-optimal burning because of the high moisture content and the presence of large quantities of soil. Often, such debris is open-burned in close proximity to residences and other existing developments.

### Measures and Resources

- The Open Burning Smoke Control Regulation (OBSCR) permits open burning that follows certain conditions such as setback distances from residences, schools, hospitals, and care facilities, favourable venting conditions, limited smoke release period, and number of burns per year.
- The OBSCR is currently being revised to tighten the standards governing open burning. (See the 2010 [at www.env.gov.bc.ca/epd/codes/open\\_burning/pdf/obscr\\_intentions.pdf](http://www.env.gov.bc.ca/epd/codes/open_burning/pdf/obscr_intentions.pdf)).
- Local fire departments, municipalities, and improvement districts or regional districts can have specific bylaws on open burning that affect land clearing activities within local jurisdictions. Where these are more stringent, they apply over provincial regulations.
- An *inventory* of facilities in each region that accept vegetation debris for disposal is available at [www.bcairquality.ca/topics/rcbc-alternatives.html](http://www.bcairquality.ca/topics/rcbc-alternatives.html).

## 2.4 Open Burning at Landfills

Waste disposal activities are identified as part of the local governments' Solid Waste Management Plan (subject to ministerial approval) or authorized by site-specific permits. Open burning of biomass at landfills is discouraged. Alternatives such as chipping for road-base and daily cover, energy recovery, and composting are encouraged. Some landfill operators use air-curtain burners at landfills or use controlled open-burning practices infrequently at remote sites to burn residual biomass.

### Measures and Resources

- Diverting residual biomass from backyard burns to alternative uses, composting, air-curtain burners, or controlled, infrequent open burning at remote landfills meets the objectives for smoke management in B.C.

## 2.5 Backyard Biomass Burning

Backyard biomass burning ("backyard burning") is widely practised in B.C. as a means of disposal for lawn and garden waste, such as branches and leaves. These burns usually have high PM emissions per unit of fuel consumed as the fuel often has a high moisture content, which leads to incomplete combustion. These burns often happen in residential areas, so the potential for human exposure to the emissions is high. While burning of garbage is illegal in B.C., it is not unheard of for garbage to be included in backyard burns.

### Measures and Resources

- Backyard burning is typically exempt from the OBSCR.
- Backyard biomass fires are typically regulated by municipalities. Some municipalities have banned them outright, while others are much more permissive.
- The main management strategies on the part of the Ministry of Environment (MoE) have been (1) encouraging municipalities to pass bylaws controlling backyard burning; (2) providing information on the risks of backyard burning.

- MoE has published a *model bylaw on backyard burning* that municipalities can use as a tool for designing their own bylaws. See: [www.bcairquality.ca/reports/model-bylaw-backyard-burning.html](http://www.bcairquality.ca/reports/model-bylaw-backyard-burning.html).
- MOE has published a *compendium of clean air bylaws* (including open burning) that municipalities can use as a tool for designing their own bylaws. The compendium is available online at [http://www.bcairquality.ca/reports/aq\\_bylaws\\_bc.html](http://www.bcairquality.ca/reports/aq_bylaws_bc.html).
- Municipalities that have passed bylaws limiting backyard burning are often motivated by fire safety concerns as well as air pollution concerns.
- Burn bans for wildfire prevention purpose may be implemented by the Ministry of Forests, Lands and Natural Resource Operations, Wildfire Management Branch, in areas not controlled through municipal bylaws.
- The B.C. Ministry of Community, Sport, and Cultural Development's *Improvement District Manual*, available online at: [www.cscd.gov.bc.ca/lgd/gov\\_structure/improvement\\_districts/improvement\\_district\\_manual.htm](http://www.cscd.gov.bc.ca/lgd/gov_structure/improvement_districts/improvement_district_manual.htm), includes sample bylaws for improvement districts including a fire prevention bylaw that contains some provisions that target reducing pollution from open fires.
- An *inventory* of facilities in each region that accept vegetation debris for disposal is available online at: [at www.bcairquality.ca/topics/rcbc-alternatives.html](http://www.bcairquality.ca/topics/rcbc-alternatives.html).

## 2.6 Recreational Burning

Campfires and beach fires are enjoyed by many, but can be an air quality concern depending on location. Since beach fires often involve burning salt-laden wood, there are additional concerns about the possible generation of dioxins and furans.

Backyard bonfires are also popular in some areas of B.C. where they are allowed. Concerns with backyard bonfires are similar to those with backyard waste burning, although the fuel quality is usually better, fire sizes smaller, and fire duration often shorter. Backyard bonfires typically happen in summer when people spend more time outside and tend to have windows open. These two factors increase the potential for human exposure to wood smoke.

### Measures and Resources

- Campfires and bonfires are exempt from the OBCSR.
- The *Wildfire Act* and Regulation restrict campfire size to 0.5 m by 0.5 m.
- Backyard bonfires, beach fires, and campfires are typically regulated by municipalities. Some municipalities have banned them outright while others are much more permissive.
  - Some campgrounds restrict campfires out of concern for air quality in the campground and adjacent residential areas. Restrictions include total bans and time-of-day restrictions.
- Where recreational fires are regulated by local government, the bylaws often reflect a mix of air quality and fire safety concerns.
- Education campaigns including signage at parks and campgrounds help raise awareness of air quality issues stemming from campfires.

### 3. Residential Wood Burning

#### 3.1 Comfort Heating

Use of wood and other biomass fuels for home heating is widespread in rural B.C. and not uncommon in urban areas. Even the cleanest wood-burning appliances emit significantly more PM<sub>2.5</sub> and other pollutants than appliances burning other heating fuels. There exists a large potential to promote the use of cleaner burning pellet appliances and pelletized fuel from waste wood in B.C.

##### Measures and Resources

- Emissions from most new woodstoves and fireplace inserts have to meet the emission requirements of the Solid Fuel Burning Domestic Appliance Regulation (SFB DAR).
- SFB DAR Phase 1 revisions, taking place in 2010-11, require additional categories of appliances to meet emission requirements. For more information, see the 2010 *intentions paper* at: [www.env.gov.bc.ca/epd/codes/solid-fuel/index.htm](http://www.env.gov.bc.ca/epd/codes/solid-fuel/index.htm).
- The *Provincial Wood Stove Exchange Program* has provided funding (2007-11) to communities to run community-based wood stove exchange programs involving incentives for homeowners to upgrade their appliances, requirements for old stoves to be recycled, and education to change burning practices. Information about the program is available at: [www.bcairquality.ca/topics/wood-stove-exchange-program/index.html](http://www.bcairquality.ca/topics/wood-stove-exchange-program/index.html).
- The wood stove exchange program plus natural attrition will gradually replace the large existing stock of non-certified wood-burning appliances.



Old Stove (right) Exchanged for Cleaner Burning Stove (left)



- Environment Canada's *model municipal bylaw* ([www.bcairquality.ca/reports/ec\\_model-bylaw-woodstoves.html](http://www.bcairquality.ca/reports/ec_model-bylaw-woodstoves.html)) and the *the compendium of clean air bylaws* ([www.bcairquality.ca/reports/aq\\_bylaws\\_bc.html](http://www.bcairquality.ca/reports/aq_bylaws_bc.html)) are resources for municipalities interested in regulating emissions from wood-burning appliances.
- Ministry of Environment regional air quality staff may be able to provide assistance to municipalities interested in regulating emissions from wood-burning appliances.
- Phase 2 SFB DAR revisions, planned for 2015, should help to reduce emissions from existing wood-burning appliances.
- Educational materials (websites, brochures, DVDs, flue pipe thermometers, moisture meters, info sessions) delivered through the Provincial Wood Stove Exchange Program, provide information on clean burning techniques.

### 3.2 Aesthetic Wood Burning in Fireplaces

Many B.C. residences have wood-burning fireplaces, though survey data show that they are used infrequently on average. Most fireplaces emit pollutants at a higher rate than woodstoves and provide little heating in return. Fireplace emission standards are under development in the U.S.A., but are not yet applied in B.C. The large existing stock of open-hearth fireplaces may be difficult to replace or retrofit with lower-emission technologies. However, some open hearths can be converted to space heaters with inserts to burn wood, pellets, or gas.

#### Measures and Resources

- Wood-burning fireplaces are generally not covered in current exchange programs, unless the open hearth is used regularly as a space heater.
- Phase 2 of SFB DAR, planned for 2015, may regulate emission standards for new factory-built fireplaces. For more information, see the 2010 *intentions paper* at: [www.env.gov.bc.ca/epd/codes/solid-fuel/index.htm](http://www.env.gov.bc.ca/epd/codes/solid-fuel/index.htm).
- Educational materials (web, brochures, DVDs, flue pipe thermometers, moisture meters, info sessions) delivered through the Provincial Wood Stove Exchange Program, provide information on clean burning techniques.



Super Stove

## 4. Industrial Biomass Burning

B.C. has a long tradition of burning biomass to power industrial processes and, more recently, to generate electricity. Wood residue is currently burned at many wood industry facilities. This provides a low-cost source of low-carbon energy to the industry and greatly reduces the amount of waste to be disposed of. Typically, PM<sub>2.5</sub> emissions from these facilities are controlled through technologies such as cyclones, electrostatic precipitators, or baghouses (filters).

Since control technologies are constantly improving, newer facilities are generally permitted at lower emissions levels than older facilities. This is consistent with the Ministry of Environment's Policy on Determining Best Achievable Technology Standards, which is intended to create a level playing field for operators participating in B.C. Hydro's call for power.

- The call for power is a result of B.C.'s Bioenergy Strategy, which directs B.C. Hydro to create opportunities for biomass-fired power generation. It is synchronized with B.C.'s new **Clean Energy Act**, which encourages new investments in independent power production while strengthening B.C. Hydro. The strategy is available online at: [www.energyplan.gov.bc.ca/bioenergy/](http://www.energyplan.gov.bc.ca/bioenergy/).

### 4.1 Bioenergy for Industrial Applications – Largely Wood Residue

A variety of industrial facilities burn biomass to generate process heat or steam, or to generate electricity using steam turbines. Biomass can also be gasified and the resulting biogas can be used as an alternative to natural gas.

Examples of bioenergy for industrial applications include waste wood combustion at pulp and paper mills for heat and electricity generation, stand-alone biomass-fired electricity plants, and waste-wood incinerators that generate heat for wood-drying kilns and dryers at pellet manufacturing facilities.

#### Measures and Resources

- Emissions of particulate and other contaminants from industrial boilers and incinerators are authorized by permits under the **Environmental Management Act**.
- Ministry policies provide internal guidance for statutory decision makers when setting discharge limits to be included in authorizations issued under the EMA.
- The following new guidelines have been developed for permitting operations using biomass as a heat source:
  - Guideline for Emissions from Biomass-fired Electrical Power Generation.
  - Authorizing Wood-fired Energy Systems and Wood Residue Incinerators.
  - Guideline for Emissions from Wood Pellet Manufacturing Facilities.
- Additional guidance can be found in these reports. Both are available at [www.env.gov.bc.ca/epd/industrial/pulp\\_paper\\_lumber/wood\\_fired.htm](http://www.env.gov.bc.ca/epd/industrial/pulp_paper_lumber/wood_fired.htm).
  - **Emissions from Wood-fired Combustion Equipment**.
  - **Emissions and Air Pollution Controls for the Biomass Pellet Manufacturing Industry**.



Biomass Heat and Hot Water Plant for Victoria's Dockside Green Neighbourhood

## 4.2 Biomass Combustion for Agricultural Heating

Biomass can provide an economical fuel source to heat greenhouses and other agricultural facilities.

### Measures and Resources

- Emissions from agricultural boilers are governed by particulate matter emission limits under the Agricultural Waste Control Regulation (AWCR). New emissions limits were set following a review of Best Achievable Technology for emissions control from small biomass boilers. The amendments (2008) set more stringent emissions limits along with registration, monitoring, reporting, and record-keeping requirements for agricultural biomass-fired boilers. The Ministry of Environment, Metro Vancouver, and the greenhouse industry collaborated to set new standards for agricultural boilers. These standards are largely based on recommendations in the report.
- Emissions from Wood-fired Combustion Equipment, available at: [www.env.gov.bc.ca/epd/industrial/pulp\\_paper\\_lumber/pdf/emissions\\_report\\_08.pdf](http://www.env.gov.bc.ca/epd/industrial/pulp_paper_lumber/pdf/emissions_report_08.pdf) and Procedures for Air Emissions Requirements has been developed for internal guidance in implementing the regulation.

### 4.3 Burning Wood Residue in Beehive Burners

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Beehive burners are used to dispose of wood waste from sawmills and other wood industries. There is no energy recovery from beehive burners; their only purpose is to dispose of wood waste. Since beehive burners typically have no emission controls other than a screen, they are large sources of pollution. The Ministry of Environment has established December 31, 2016 as the shut down date for all remaining beehive burners in B.C.

#### Measures and Resources

- Beehive burners have been gradually phased out in B.C. The Ministry of Environment revised the Wood Residue Burner and Incinerator Regulation on January 13, 2011 to require phase out of all beehive burners by December 31, 2016.

### 4.4 District Heating

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If a district heating system uses a wood-fired incinerator or boiler as a heat source, then a permit under the *Environmental Management Act* may be required in the future. Guidance for developing the permit would be obtained from the same sources as listed in Section 4.1, Bioenergy for Industrial Applications.

## Other Sources of Smoke

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Biomass burning is not the only source of smoke in B.C. Smoke also comes from transportation sources (cars, trucks, off-road vehicles, ships, etc.) and a variety of industrial sources. In general, these other sources of smoke contribute less smoke than biomass burning. They are covered by other regulations.

Emissions from transportation sources are regulated by federal and provincial statutes, including fuel quality standards (sulphur in diesel, sulphur in gasoline, benzene in gasoline, etc), new engine emission standards aligned with U.S.A.'s EPA standards, and inspection and repair (AirCare program). Industrial emissions are typically regulated under provincial permits.



# Appendix

## Regulatory Framework for Smoke in B.C.

### *Environmental Management Act (EMA)*

- The EMA ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/03053\\_00](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/03053_00)) provides a flexible authorization framework and enforcement options and uses modern environmental management tools to protect human health and the quality of water, land, and air in B.C. The EMA also enables the use of administrative penalties, informational orders, and economic instruments, such as permit fees, to support compliance.
- One of the major changes brought forward with the current EMA is the way in which the Ministry of Environment authorizes the introduction of waste into the environment. Under the **Waste Management Act**, which preceded EMA, all introductions of waste to the environment, whether from a pulp mill or a car wash, required some form of authorization, such as a permit or approval. Under sections 6(2) and 6(3) of the EMA, only introductions of waste from prescribed industries, trades, businesses, operations, and activities require authorization.
- Industries, trades, businesses, operations, and activities are prescribed in the **Waste Discharge Regulation**, available online at: [www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/50\\_320\\_2004](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/50_320_2004).
- If an industry, trade, business, activity, or operation is not prescribed by the regulation, then it does not require an authorization to introduce waste into the environment. However, the discharge must not cause pollution (EMA section 6(4)).

### *Waste Discharge Regulation (WDR)*

- In the context of section 6 of the EMA, the WDR serves two purposes:
  - It prescribes in schedule 1 the industries, trades, businesses, operations, and activities that must obtain authorization before introducing waste into the environment (sections 6(2) and 6(3)). Burning of vegetative debris, burning or incineration of waste, and burning or incineration of wood residue are included here.
  - It prescribes in schedule 2 those industries, trades, business, operations, and activities that may be exempt from sections 6(2) and 6(3) through compliance with a code of practice if an applicable code has been issued for their waste.

Those industries, trades, businesses, operations, and activities that the WDR does not prescribe in Schedules 1 or 2 do not require an authorization to introduce waste into the environment. However, they must not cause pollution as in section 6(4).

### *Wood Residue Burner and Incinerator Regulation (beehive burners)*

- The Wood Residue Burner and Incinerator Regulation (under the EMA) establishes the phase-out dates and operating conditions for specified burners and sets fees for the discharge of associated particulate matter for all burner facilities in the province. The regulation is online at: [www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/51\\_519\\_95](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/51_519_95).

### *Open Burning Smoke Control Regulation (OBSCR)*

- The OBSCR, available online at: [www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/34\\_145\\_93](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/34_145_93), governs the burning of vegetation associated with a range of activities, including land clearing and forestry-related resource management. It sets out the conditions under which the open burning of vegetation debris may be authorized. This regulation has not been substantially revised since it was enacted in 1993. A policy intentions paper for amendments was posted in 2008 and considerable feedback was received.

In 2010, the B.C. government posted a second *intentions paper*, available at: [www.env.gov.bc.ca/epd/codes/open\\_burning/index.htm](http://www.env.gov.bc.ca/epd/codes/open_burning/index.htm), that addresses feedback received during the consultations to date and seeks feedback on a new approach or suite of options to regulate open burning.

### *Solid Fuel Burning Domestic Appliance Regulation (SFB DAR)*

- In 2010, the government of B.C. posted and received comments on an *intentions paper*, available at: [www.env.gov.bc.ca/epd/codes/solid-fuel/index.htm](http://www.env.gov.bc.ca/epd/codes/solid-fuel/index.htm), for amending the SFB DAR, commonly referred to as the woodstove regulation ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/44\\_302\\_94](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/44_302_94)). Consideration is being given to lower particulate matter emission standards for woodstoves and fireplace inserts covered by the regulation, expanding the scope to include both indoor central heating appliances (such as forced air furnaces), outdoor central heating appliances (known as outdoor boilers or outdoor wood-fired hydronic heaters), and cooking stoves. Delays in effective dates are being suggested to allow appliance manufacturers sufficient time to certify new appliances for sale in B.C.

### *Agricultural Waste Control Regulation (AWCR)*

- The AWCR ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/10\\_131\\_92](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_131_92)) was amended in 2008 to set more stringent emissions limits along with registration, monitoring, reporting, and record keeping requirements for agricultural biomass-fired boilers. These amendments were the result of the Ministry of Environment, Metro Vancouver, and the greenhouse industry collaborating to set new standards for agricultural boilers. Metro Vancouver also set new standards for agricultural boilers by adopting the Agricultural Boilers Emission Regulation Bylaw No. 1098 in 2008.

### **Guideline for Emissions from Biomass-fired Electrical Power Generation (internal document)**

- The Ministry of Environment produced this guideline in 2009 to provide direction for issuing permits for the B.C. Hydro call for power. For new facilities, the limits are:
  - > 25 megawatts electrical total particulate limit 20 mg/m<sup>3</sup> (at 8% oxygen).
  - For < 25 megawatts total particulate 50 mg/m<sup>3</sup>.

Further limits are stated for dioxins and furans should salt-laden wood be burned.

### **Guideline for Emissions from Wood Pellet Manufacturing Facilities (internal)**

- B.C. is the world's largest exporter of wood pellets. This industry is expected to expand rapidly over the next few years. There are several new pellet plant operations in the province that have temporary permit requirements to operate. The B.C. government

has recently completed emission guidelines for new pellet plant operations with these emissions limits:

- Dryer exhaust total particulate matter 60 mg/m<sup>3</sup> interim limit to be reviewed in two years.
- Pellet cooler exhaust total particulate matter 115 mg/m<sup>3</sup>.
- Other plant processes total particulate matter 20 mg/m<sup>3</sup>.

#### **Public Health Act (PHA)**

- The *Public Health Act* ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/00\\_08028\\_01](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_08028_01)) provides the Minister of Health Services, public health officials, regional health authorities, local governments, and others with important tools available in other jurisdictions such as up-to-date information gathering abilities, modern inspection, and ordering abilities, and other measures necessary to respond to public health emergencies.
- It includes provisions to define health impediments and enables the development of regulations to address the impediments. A health impediment is defined in the PHA as a condition, thing, or activity:
  - the cumulative effects of which, over a period of time, are likely to adversely affect public health
  - that causes significant chronic disease or disability in the population
  - that interferes with or is inconsistent with the objectives of public health initiatives regarding the prevention of injury or illness in the population, including chronic disease or disability
  - that is associated with poor health within the population.
- By prescribing a health impediment, regulations can be developed that apply to those who engage in the prescribed activity.

#### **Clean Energy Act**

- One of the objectives stated in the *Clean Energy Act* ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/00\\_10022\\_01](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_10022_01)) is to reduce waste by encouraging the use of waste heat, biogas and biomass.
- This objective, along with others encouraging the use of clean or renewable resources for energy needs, supports the hierarchy of biomass management described in this framework.

#### **Wildfire Act and Regulation**

- Numerous sections in the *Wildfire Act* ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/00\\_04031\\_01](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_04031_01)) and Regulation ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/11\\_38\\_2005](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/11_38_2005)) apply to the use and application of fire. However, neither specifically addresses smoke.
- Section 4 of the *Wildfire Act* defines the use of open fires as applied to municipalities, local governments, and private lands.

- Section 5 of the Act addresses the non-industrial use of open fires.
- Section 6 of the Act addresses the responsibilities for industrial activities that may light, fuel or use an open fire.
- Section 10 of the Act provides the authority to restrict open fires for public safety.
- Section 12 of the Act provides authority to prohibit or restrict activities and equipment that may cause or contribute to the spread of a fire.
- Section 18 of the Act provides the authority for government to use fire on crown land for a specific purpose.
- Section 1 of the Wildfire Regulation provides definitions for different categories of fires, resource management, and open fires.
- Section 2.1 of the Regulation defines prescribed municipalities.
- Section 2.2 of the Regulation defines prescribed criteria for bylaws on the lighting, fuelling or use of open fires.
- Section 2.3 of the Regulation defines prescribed circumstances respecting the lighting, fuelling or use of open fire on private managed forest land.
- Sections of the Regulation 20, 21, 22 and 23 prescribe circumstances for the lighting, fuelling or use of various types of open fires including resource management open fires.
- Section 24 provides for the requirement for a burn registration number.

#### *Farm Practices Protection (Right to Farm) Act (FPPA)*

- Under the FPPA ([www.bclaws.ca/EPLibraries/bclaws\\_new/document/ID/freeside/00\\_96131\\_01](http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_96131_01)), a farmer is not liable in nuisance to any person for any odour, noise, dust or other disturbance resulting from a farm operation that is part of a farm business, and the farmer must not be prevented by injunction or other court order from conducting that farm operation, provided that the farm operation must: be a normal farm practice, be conducted in the Agricultural Land Reserve (ALR), or on land zoned for farming, or where there is an aquaculture licence, or on Crown land designated as a farming area. Further, the farm operation must not contravene the **Public Health Act**, **Integrated Pest Management Act**, **Environmental Management Act**, the regulations of those acts, or any land use regulation.
- Under the preceding conditions, if the farm is within the ALR, aquaculture licence or Crown land areas, then the farm does not contravene certain kinds of local government bylaws, including nuisances and disturbances. However, on land zoned for farming, but outside the ALR, aquaculture licence, and Crown land, the farmer must comply with the bylaws.
- Where there is no local open burning bylaw:
  - (a) If burning only materials exempt under EMA Sec. 6(5)(e) (leaves, foliage, weeds, crops or stubble for domestic or agricultural purposes), the farmer would be protected under FPPA, provided all other pertinent FPPA conditions are met.
  - (b) If a farmer intends to burn anything else other than exempt items in (a) above, then he/she must follow the Open Burning Smoke Control Regulation and its Code

of Practice if applicable, or obtain a permit under section 14 of the EMA (if a Director considers it necessary for the protection of the environment).

- Where there is a local open burning bylaw:
  - a. If burning only materials exempt under EMA Sec. 6(5)(e) and:
    - If the local bylaw is a nuisance bylaw, and the farm is on land where the local government allows farm use (but is outside the ALR, aquaculture licence, and Crown land areas), then the nuisance bylaw likely applies to the farmer.
    - If the bylaw was created as a fire bylaw, the farmer, regardless of the farm's location in or out of the ALR, must comply with it.
  - b. If a farmer intends to burn anything other than exempt items in (a) above, then he/she must follow the OBSCR and its Code of Practice if applicable, or obtain a permit under section 14 of the EMA (if a Director considers it necessary for the protection of the environment). The farmer must also comply with the local open burning bylaw.

### Metro Vancouver Bylaws

- In 1967, the government of B.C. delegated air quality management powers to the Greater Vancouver Regional District (GVRD, now Metro Vancouver) for the district board to administer, within its jurisdiction. This extended air pollution regulatory powers first delegated to the City of Vancouver in its charter in 1948.
  - Metro Vancouver is responsible for monitoring air quality in the region, controlling industrial, commercial and some residential emissions, creating long-term plans, and conducting emission inventories.

### Other Municipalities and Bylaws

- The *Community Charter* provides the authority for municipalities and regional districts to enact bylaws that address issues not covered by provincial legislation or that are more restrictive than provincial legislation.
- Municipalities typically enact bylaws for backyard burning of vegetative debris and for installation and use of residential wood heaters. In some cases, bylaws include provisions that govern activities also covered by the OBSCR.
- The Ministry of Environment has developed a *model backyard-burning bylaw* that local governments can use as the basis of their own bylaw. It is available online at: [www.bcairquality.ca/reports/pdfs/model-bylaw-backyard-burning.pdf](http://www.bcairquality.ca/reports/pdfs/model-bylaw-backyard-burning.pdf).
- Environment Canada offers a model municipal bylaw for regulating wood burning appliances ([www.bcairquality.ca/reports/ec\\_model-bylaw-woodstoves.html](http://www.bcairquality.ca/reports/ec_model-bylaw-woodstoves.html)). It is intended to help municipalities establish a bylaw on wood-burning appliances in areas where these appliances cause significant air quality problems.
- Over 130 communities and regional districts have passed their own bylaws regulating open burning, campfires, beach fires, backyard burning, and the kinds of materials that may be burned. For more information on municipal burning bylaws, see *the Inventory of Air Quality Bylaws in British Columbia for Anti Idling, Open Burning and Wood Burning Appliances* ([www.bcairquality.ca/reports/pdfs/aq\\_bylaws\\_bc.pdf](http://www.bcairquality.ca/reports/pdfs/aq_bylaws_bc.pdf)).

## B.C. Smoke Management Framework

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