

# B.C. WOOD STOVE EXCHANGE PROGRAM EVALUATION REPORT (2015–2019)



Prepared for the B.C. Ministry of  
Environment and Climate Change  
Strategy

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## **Disclaimer**

This report has been reviewed by staff of the B.C. Ministry of Environment and Climate Change Strategy, and the Ministry supplied the consultant authors with data and information on the Wood Stove Exchange Program. However, the conclusions and recommendations expressed herein represent the views of the consultant authors and these views may or may not be supported by the Ministry of Environment and Climate Change Strategy.

## **Acknowledgements**

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## Executive Summary

Residential wood stoves in B.C. contribute emissions of fine particulate matter, a pollutant that is linked with serious health impacts. The British Columbia Wood Stove Exchange Program (WESP) aims to facilitate the removal of old uncertified residential wood stoves, and to improve wood-burning practices among users of residential wood stoves across the province. This report provides a five-year program evaluation and recommendations based on input from key stakeholders across B.C. and comparison to similar programs in other jurisdictions.

Since 2015, the program has transferred over \$1.2 million to communities across the province to deliver local wood stove exchange programs. This resulted in the decommissioning of 2,746 uncertified wood stoves in 22 communities. Within these communities, educational and outreach efforts were also funded to encourage clean burning practices through workshops, community events, media articles and interviews, house visits, and the distribution of educational materials.

Using a local program delivery approach, the program is successful in supporting communities to meet their own needs. Communities have been able to choose for themselves which appliances are eligible for exchange in their local area: some allow EPA-certified wood stove appliances to be eligible, while others only allow an electric appliance option for exchange. This local approach offered flexibility and largely worked well for communities.

In addition to these successes, there is room to improve the program to better support communities with air quality exceedances, slackening rates of exchanges, accessibility to low-income residents and First Nations, and addressing poor burning practices regardless of the type of wood stove in use. There is also an opportunity to combine climate change mitigation efforts at the provincial and local scales.

Twelve recommendations are provided below to build off of WSEP's current strengths and effectiveness.

1. Update the rebate structure to target red-zone communities and increase incentives per exchange.
2. Provide support for data-gathering within communities.
3. Provide tiered incentives to support low-income participation.
4. Align air quality goals with provincial climate goals (CleanBC).
5. Execute strategies provided in the First Nations evaluation report.
6. Provide further emphasis on clean burning practices.
7. Create an online survey for participants.
8. Develop engaging materials for improved province-wide messaging.
9. Conduct a province-wide wood-burning survey.
10. Support peer-to-peer learning for program coordinators.
11. Include outdoor wood boiler exchange for an alternative heating appliance.
12. Refine annual reporting structure.

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# 1. Introduction

## 1.1 The Issue/Context

Residential wood stoves provide a reliable source of heat for many residents throughout British Columbia (B.C.). However, the smoke generated from residential wood stoves produces fine particulate matter (PM<sub>2.5</sub>) and other air pollutants. Fine particulate matter is a pollutant with microscopic particles that, when inhaled, can cause serious health problems for people's lungs and hearts. Older wood stoves have been found to emit higher levels of toxins and particulates, such as polyaromatic compounds, benzene, aldehydes, carbon monoxide, nitrogen oxides, and respirable particulate matter.<sup>1</sup>

A recent study in B.C. found that the risk of heart attacks in people aged 65 and older was significantly increased based on rising concentrations of PM<sub>2.5</sub> caused by wood burning.<sup>2</sup> Health Canada estimates that in Canada 14,600 premature deaths per year are attributed to air pollution from PM<sub>2.5</sub>, nitrogen dioxide, and ozone.<sup>3</sup> Particulate matter exposure has been linked to health problems through many scientific studies. These health problems include: premature death in people with lung and heart disease, nonfatal heart attacks, aggravated asthma, decreased lung function, and increased respiratory symptoms.<sup>4</sup> Vulnerable populations, such as children, older adults, and people with pre-existing conditions, are most likely to be impacted by particulate matter exposure.

According to Environment and Climate Change Canada, in 2016, approximately 16% of PM<sub>2.5</sub> emissions (not include dust and fire emissions) in B.C. originated from residential wood burning in populated regions, in comparison to 45% from industrial emissions and 18% from mobile emissions.<sup>5</sup> The amount of PM<sub>2.5</sub> attributed to wood stoves will vary locally, and local studies are required to ascertain this.

The amount of PM<sub>2.5</sub> and other pollutants that emit from a wood stove depends on the age and design of the wood stove, as well as burning practices used. Fires that burn dry and well-seasoned wood release less smoke and PM<sub>2.5</sub> than fires that burn wet, unseasoned wood. Older, uncertified stoves can emit significantly more PM<sub>2.5</sub> as compared to those certified by the US EPA. The relative PM<sub>2.5</sub> emissions for heating appliances are summarized in Figure 1.

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<sup>1</sup> Characterization of Organic Compounds from Selected Residential Wood Stoves and Fuels. (2000). Environment Canada.

<sup>2</sup> Weichenthal S, Kulka R, Lavigne E, van Rijswijk D, Brauer M, Villeneuve PJ, Stieb D, Joseph L, Burnett RT. (2017). Biomass Burning as a Source of Ambient Fine Particulate Air Pollution and Acute Myocardial Infarction. *Epidemiology*, 28(3), 329-337. doi: 10.1097/EDE.0000000000000636. PMID: 28177951; PMCID: PMC5389593.

<sup>3</sup> [Health impacts of air pollution in Canada: estimates of morbidity and premature mortality outcomes](#), 2019 report. Health Canada.

<sup>4</sup> <https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>

<sup>5</sup> Environment and Climate Change Canada. (2016). [Air Pollutant Emission Inventory](#). Online Data Search. August 25, 2016.

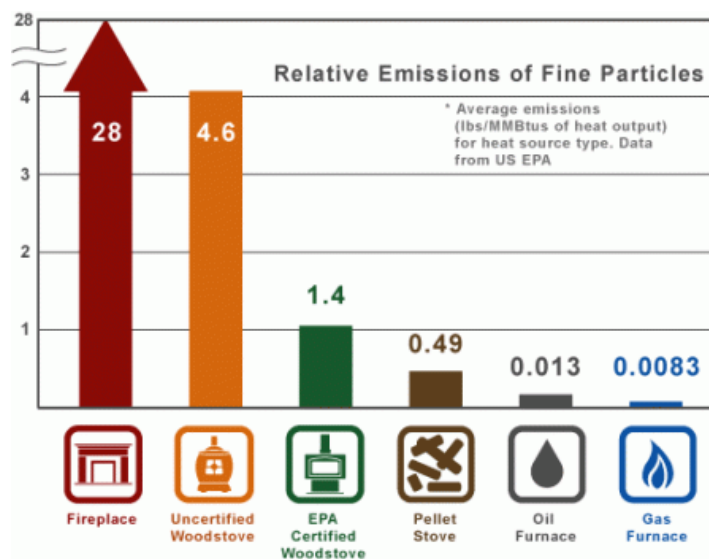


Figure 1: Relative Emissions of Fina Particles (Source: U.S. EPA [Burn Wise Energy Efficiency](#)).

### 1.1.1 Red-Zone Communities

Annual reports by the provincial government analyze air quality monitoring data for communities and broader air zones to determine whether they remain within the Canadian Ambient Air Quality Standards (CAAQS) for a number of pollutants, including PM<sub>2.5</sub>. If a local airshed exceeds or approaches these standards, they receive escalating colour coding from “green” to “red” management levels based on monitoring results.<sup>6</sup> Residents who live in areas with “red” management levels (red-zone communities described throughout this report) are at a greater risk of experiencing health problems caused by air pollution, as they are exposed to pollutant levels above health-based standards established under the *Canadian Environmental Protection Act* (CEPA). These communities are expected to work with the province towards lowering their PM<sub>2.5</sub> emissions to achieve the CAAQS.

## 1.2 B.C. Wood Stove Exchange Program

The B.C. Wood Stove Exchange Program (WSEP) was launched by the Government of B.C. in autumn 2008, following the B.C. Air Action Plan, which sought to dispose of smoky uncertified residential wood stoves. Since its launch, WSEP has facilitated the removal of 9,000 uncertified wood stoves for newer, US Environmental Protection Agency (EPA) or Canadian Standards Association (CSA) certified models or alternative heating appliances. The initial aspirational long-term goal for the program was to eliminate the use of all non-certified wood stoves by 2020, but the program was not funded at a level commensurate with achieving this goal. There is no recent provincewide data about the estimated number of remaining uncertified appliances, nor whether these are used for primary or back-up heating purposes. The most recent data source, a province-wide survey conducted in 2011, indicated 68% of respondents reported the use of certified stoves (referring to the 1988 US EPA standards applicable at that time), and 10% of respondents said they used wood as the primary source of heat in their homes.<sup>7</sup>

<sup>6</sup> For more information, see: [Air Zone Management Response for British Columbia](#) (March 2019). Ministry of Environment and Climate Change Strategy.

<sup>7</sup> Mustel Group (2012). [Inventory of Wood-burning Appliance Use in British Columbia](#).

There are two key objectives identified in WSEP that hold to this day:

1. Improving community air quality by providing incentives to change out old smoky wood stoves with cleaner or non-wood burning options.
2. Providing education on clean burning techniques through Burn it Smart workshops, brochures, websites, and social media.

The sale of wood stoves and outdoor wood boilers (OWB) in B.C. is governed by the *Solid Fuel Burning Domestic Appliance Regulation* that requires new stoves and OWBs to meet US EPA or CSA standards. Additionally, local governments may implement local bylaws that govern the installation and operation of wood stoves. WSEP is offered within this regulatory context—providing incentives and education that reduce emissions from wood stoves that are permitted to operate under current regulations.

Since 2008, the B.C. Ministry of Environment and Climate Change Strategy (ENV) has transferred over \$3 million to communities across the province to deliver local wood stove exchange programs. The program uses a local delivery model where communities lead local exchange programs that adhere to requirements linked to the grant funding. Communities must apply for funding each year. Applications need to meet a number of criteria, including demonstrating the need for the program, outlining goals and a work plan for the year. The program also needs to identify a coordinator and local partners that will assist with program delivery.

WSEP provides funding for wood stove exchange incentives, delivering education, advertising, and, where necessary, supporting staff salaries to deliver the program. Wood stove exchange incentives are \$250 per certified wood stove or electric fireplace insert and \$400 per gas, propane, electric appliance, or certified pellet-fueled appliance in 2020. Since 2018, WSEP has been offering \$100 higher incentives for red-zone communities (for a total of \$500) per exchange for an electric, natural gas, propane, or pellet appliance.

For a full outline of the WSEP governance and administration, as well as how local programs are delivered, see the 2015 WSEP evaluation report.<sup>8</sup>

There have been two program evaluations conducted since WSEP's inception: a 2015 general program evaluation,<sup>8</sup> and a 2017 evaluation of First Nations accessibility.<sup>9</sup> The results of how the program has shifted based on the 2015 evaluation recommendations are summarized in section 3.2 of this report.

### 1.3 Evaluation Purpose, Scope, and Approach

The 2015 evaluation reviewed the impact of the B.C. WSEP from 2008 to 2014. The evaluation included an analysis to understand what impact the program has had on how British Columbians use wood as a heat source, and made recommendations on how the program could be improved in future years.

For this 2020 evaluation, the ENV requested targeted feedback on the following nine topics:

1. Program effectiveness related to reducing fine-particulate levels (PM<sub>2.5</sub>) in communities, with a focus on “red” management level (red-zone) communities.
2. Identification of potential changes to the overall rebate scheme.
3. Reflection on First Nations participation in WSEP and methods for gaining support.
4. Accessibility of the program for low-income wood burners.
5. Reflection on types of replacement appliances funded by the program.

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<sup>8</sup> [BC Wood Stove Exchange Program Program Evaluation](#) (2008 to 2014) Final Report. (2015). Prepared for Ministry of Environment by Pinna Sustainability

<sup>9</sup> [First Nations Participation in the Wood Stove Exchange Program](#): Strategies for improved implementation of the Wood Stove Exchange Program in First Nation communities. (2017). Prepared for Ministry of Environment by Pinna Sustainability.

6. Reflection on the current exchange structure including consideration of increasing the program incentives for non-wood-burning change-outs (i.e., gas or propane stove, electric, heat pump).
7. Recommendations on incorporating outdoor wood boilers (OWBs) into the WSEP.
8. Analysis of successful examples of wood stove exchange programs from other jurisdictions.
9. Methods of gaining support and interest in WSEP from local governments and local and regional retailers who are not currently participating the program.

The framework used to evaluate the topics listed above included the following:

**Conduct interviews and online surveys:** Interviews were completed with stakeholders and program coordinators from across the province. These included air quality experts, public health experts, senior staff, representatives from the non-profit sector, and program administrators. Two online surveys were conducted, one for stakeholders and one for program coordinators, to gain a wider range of feedback. Four program coordinators from other jurisdictions, in the US and in Ottawa also completed the interview (summarized in section 3.3). All interview and survey questions are provided in Appendix B.

**Review annual reports:** Program coordinators submit a standard annual report to ENV at the end of each year. To gain a more nuanced understanding, nine 2019 annual reports from a selection of communities were analyzed to get a sense of educational offerings and exchange amounts, as well as local program participation. These nine communities represent each economic region of the province, and include every participating red-zone community.

**Literature review and web search:** To supplement this review, recent articles (since 2015) were reviewed in relation to wood stoves, air quality, and health in B.C., nationally, and internationally.



## 2. Program Documentation

### 2.1 Summary of Local Program Results

#### 2.1.1 Location and Year of Local Programs Delivered

Between 2015 and 2020, 22 local communities and regions have participated, varying from as little as one year to the full six years. Figure 2 lists all of the programs that were delivered, and summarizes the years that each location participated. There has been a slight drop in participation over this five-year period. In comparison between 2008 and 2014, 25 local communities and regions participated in the WSEP.

	2015	2016	2017	2018	2019	2020 (proposed)
Regional District of Nanaimo	■	■	■	■	■	■
Central Kootenay	■	■	■	■	■	■
Port Alberni	■	■	■	■	■	■
Fraser Valley	■	■	■	■	■	
Cowichan Valley	■	■	■	■	■	■
Metro Vancouver	■	■	■	■	■	■
Prince George	■	■	■	■	■	
Skeena	■					
Central Okanagan	■	■	■	■	■	■
Campbell River	■	■				
Kootenay Boundary	■	■	■		■	■
Sunshine Coast	■	■	■	■		
Golden		■	■	■	■	
Vanderhoof				■	■	■
Comox Valley		■	■	■	■	■
Sea to Sky	■	■		■	■	
Valemount						■
Nuxalk (Bella Coola)	■					
Strathcona Regional District			■		■	
Bulkley Valley and Lakes District		■	■	■	■	■
Kamloops				■	■	■
Qathet Regional District					■	■

Figure 2: Summary of communities and regions participating in WSEP by year (2015–2020).

### 2.1.2 Number of Wood Stoves Exchanged

During this evaluation period (2015–2019) a total of 2,746 uncertified wood stoves have been decommissioned under WSEP, not including exchanges that occurred in 2020 (funding has been provided to communities for a proposed 629 exchanges in 2020). The number of exchanges per year is displayed in Figure 3.

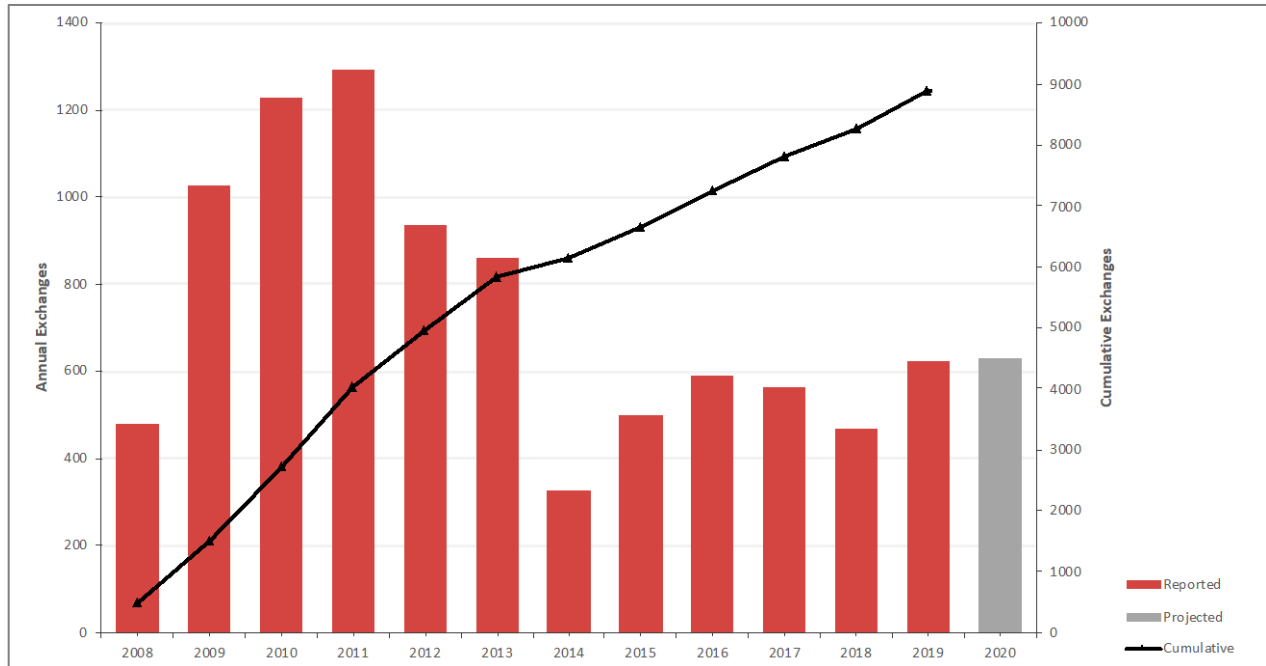


Figure 3: Annual and cumulative wood stove exchanges under the B.C. WSEP (2008–2020)

During the first five full years of the program (2009–2013) WSEP exchanged 5,347 wood stoves, in comparison to the 2,746 wood stoves exchanged during this five-year evaluation period. The average number of wood stoves exchanged between 2009 and 2013 was just over 1,000 annually, while the average number of wood stoves exchanged between 2015 and 2019 was just over 500 annually, a decrease of nearly 50%. Program funds allocated to exchange incentives were not always expended. The reason for this decrease of wood stove exchanges is due to a decline in program funding. This may also reflect that the “low-hanging fruit” had already exchanged wood stoves during previous years of the program.

## 2.2 B.C. WSEP Funding, Allocation, and Resource Inputs

From 2015 to 2020, the program has allocated a total budget to communities of over \$1.2 million. On an annual basis, these funds are allocated to specific items for each community, and the total amount provided varies by community and by year. Table 1 summarizes how program funds were allocated for the 2015 to 2020 program years. The overall budget is significantly less in comparison to the 2008 to 2013 five-year period, which is reflected in the reduced number of wood stoves exchanged. The budget allocation is similar to that of the previous evaluation, except there was a 3% reduction in staff salaries for local programs, and a 3% increase in education spending.

Budget Item	Budget Allocation 2015-2020	Budget Allocation 2020
Incentives for wood stoves exchanged	73%	\$ 226,800 (76%)
Staff salaries for local programs	8%	\$ 19,000 (6%)
Advertising for local programs	5%	\$ 16,300 (5%)
BC Lung program administration	5%	\$ 15,000 (5%)
Education	7%	\$ 15,400 (5%)
Other	3%	\$ 7,500 (3%)
<b>Total Budget</b>	<b>\$1,201,579</b>	<b>\$300,000</b>

Table 1: Allocation of budget to local programs by percent (2015–2020) and current budget allocation (2020).

### 3. Program Evaluation

#### 3.1 Program Effectiveness

This section outlines WSEP effectiveness based on program documentation, interviews and surveys from program coordinators and stakeholders from across the province, and document review. There was a particular focus on the impact of the program in red-zone communities. The results of this analysis are outlined below related to the following topics: removal of older model uncertified wood stoves, effect on air quality, effect on clean burning practices, support given by communities, and program efficiency.

##### 3.1.1 Removal of Older Model Uncertified Wood Stoves in Red-Zone Communities

In the past five years, there has been 913 wood stove exchanges in red-zone communities. Since 2018, the program has offered an additional \$100 incentive per wood stove exchange in red-zone communities (from uncertified wood stove to certified pellet-fueled appliance, natural gas or propane-fueled appliance or electric heat pump). Table 2 below displays the number of annual wood stove exchanges in participating red-zone communities.

	2015	2016	2017	2018	2019
<b>Vanderhoof</b>				4	6
<b>Bulkley Valley and Lakes District</b>		4	12	18	10
<b>Comox Valley</b>		29	38	31	59
<b>Cowichan Valley</b>	90	92	87	106	94
<b>Port Alberni</b>	39	30	45	12	14
<b>Total: number</b>					
<b>(% of total annual exchanges)</b>	129 (26%)	155 (26%)	182 (32%)	171 (36%)	183 (29%)

Table 2: Annual wood stove exchanges in red-zone communities (2015–2019).

The percentage of total wood stove exchanges within red-zone communities has ranged between 26% and 36% over the last five years. New red-zone communities have continued to join WSEP: the Comox Valley and Bulkley Valley and Lakes Districts joined in 2016, the District of Vanderhoof joined in 2018, and the Village of Valemount joined in 2020. Cowichan Valley and the Comox Valley Regional Districts have seen increases in number of exchanges from 2017 to 2019, while the City of Port Alberni exchanges have decreased in recent years.

### 3.1.2 Public Surveys in Red-Zone Communities

Since 2015, public surveys in two red-zone communities, Port Alberni (2017)<sup>10</sup> and the Town of Smithers (2016),<sup>11</sup> found similar results, reporting that up to 40% of wood stoves used in the community may be uncertified. The Town of Smithers found that slightly less than half of all respondents reported being aware of the provincial wood stove exchange program, and only a small fraction has yet participated. Results from another red-zone community, Vanderhoof (2017),<sup>12</sup> found that at least 13% of wood-burning appliances in the community are likely uncertified. Results from all three surveys suggest that significant work is needed to upgrade or replace uncertified wood stoves within these communities. Results from each survey also indicated that more education can be done in the communities about clean burning techniques.

### 3.1.3 Impact on Air Quality

Local levels of PM<sub>2.5</sub> depend on many factors, including industrial activity, open burning, geography, and wind and weather patterns. As a result, a detailed monitoring study is required to evaluate the effectiveness of WSEP for reducing PM<sub>2.5</sub> levels in each local delivery area.

In communities where these detailed studies have not been conducted, other factors are considered for evaluating the impact on air quality. The ambient PM<sub>2.5</sub> level in the Cowichan Valley has improved from the “red” to “yellow” management level in Duncan, based on the 2015 to 2017 air zone report.<sup>13</sup> During the 2015 to 2017 reporting period, Port Alberni did not exceed the threshold for PM<sub>2.5</sub> and shifted from a management level of “red” to “orange”. These improvements have continued to be observed in the updated 2016 to 2018 air zone report.<sup>14</sup>

While the 2017 to 2019 air zone reports are not yet released, calculations using the 2017 to 2019 air quality data and CAAQS achievement determination methodology indicate that the communities of Courtenay, Port Alberni, Cowichan Valley, and Smithers will be below the CAAQS levels for PM<sub>2.5</sub> in the 2017 to 2019 reporting period.<sup>15</sup>

Since 2015, there has been one study that has measured the effectiveness of WSEP on air quality in four communities in B.C. (Burns Lake, Houston, Smithers, and Telkwa). This study found that the wood stove exchanges were effective in lowering the contribution of residential wood combustion to air pollution<sup>16</sup> and that these reductions in wood smoke were observed in communities with the most stoves exchanged relative to population size. The same study also found that wood smoke remains a major PM<sub>2.5</sub> source in these communities, and to achieve substantial air quality improvements, there is a need to exchange a large number of non-certified stoves.<sup>17</sup>

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<sup>10</sup> [Understanding Woodstove Usage: Maximizing the Environmental Benefit of Public Education](#). (2017). Prepared for the Alberni Air Quality Society and the Port Alberni Air Quality Council and Ministry of Environment by ECollaborate Now

<sup>11</sup> [Residential Wood-Burning Appliances in Smithers: Door to Door Survey Results](#). (2016). Prepared for The Town of Smithers and BC Ministry of Environment by Jesse Hiemstra & Co.

<sup>12</sup> [Residential Wood-Burning Appliances: District of Vanderhoof Door to Door Survey Results](#). (2017). Prepared for The District of Vanderhoof and BC Ministry of Environment and Climate Change Strategy by Evan Morrow.

<sup>13</sup> [Georgia Strait Air Zone Report](#) (2016-2018). Ministry of Environment and Climate Change Strategy.

<sup>14</sup> [Air Zone Management Response for British Columbia](#) (March 2019). Ministry of Environment and Climate Change Strategy.

<sup>15</sup> Personal communication from M. Kellerhals, ENV staff, 2021.

<sup>16</sup> Sbihi, H. [Air quality impacts of Bulkley Valley and Lakes District woodstove exchange program](#) (2017). 14<sup>th</sup> annual air quality and health workshop.

<sup>17</sup> Allen, R., Yuchi, W., Millar, G., Karlen, B., Leckie, S., and Brauer, M. (2014). Air Quality Impacts of a Wood Stove Exchange Program in British Columbia, Canada (2014). ISEE Conference Abstracts 2014(1):2531. DOI: 10.1289/isee.2014.P3-786

There was also a study in New Hampshire, USA, that evaluated the PM<sub>2.5</sub> levels before and after a wood stove exchange program from the City of Keene. Keene is located in a valley that experiences temperature inversions that contribute to the accumulation of smoke in winter, much like some of the red-zone communities in British Columbia. Keene exchanged 86 older model wood stoves for 63 newer models, 15 pellet stoves, and 8 gas appliances. Based on air quality and weather data, the researchers found a significant reduction in PM<sub>2.5</sub> on calm winter nights. The researchers determined the wood stove exchange program had improved air quality on nights that are most likely to violate national air quality standards. These two studies showcase the importance of programs like WSEP in improving air quality in communities, especially ones that experience temperature inversions.

In addition to the above studies, Hong et al. created an algorithm that helps to determine how much PM<sub>2.5</sub> may be coming from residential wood stoves within a local airshed, based on PM<sub>2.5</sub> concentrations and temperature data.<sup>18</sup> Hong et al. looked at 23 communities and determined the number of smoky days caused by residential wood stoves. This may be a useful tool for future evaluation of the WSEP (see recommendations).

### 3.1.4 Education Achievement on Good Burning Practices

Based on the 2019 annual reports, the educational events and components are summarized below that occurred in nine communities, representing each economic region in the province.

- Number of education events held: from four to zero per community.
- Number of participants in events (workshops, community events): from thousands to two per community.
- Number of media items (articles, interviews, PSA): from 35 to zero per community.
- Number of telephone inquiries and house visits: from 200 to 15 and 32 to zero per community, respectively.
- Number of educational resources distributed (moisture meters, DVDs, printed materials): from 500 to zero per community.

Based on interviews and survey results conducted as part of this evaluation, many WSEP program coordinator respondents believed their educational efforts were having an impact on those who participate in the program, and, to a lesser extent, the wider community. Education outreach occurred through a variety of methods including: Burn it Smart workshops, outreach at local events, social media, information pamphlets, and newspaper articles and advertisements.

Overall, person-to-person interactions were seen as most impactful, while social media was playing a role to reach and engage with a wider audience. One regional district has created their own online portal for clean burning practices on their website.

One program coordinator noted their community was finding success through a partnership with a local fire department:

“We have partnered with our fire department so that they include our safe and efficient wood burning brochure in their engagement with residents. They have been doing door-to-door campaigns (pre-COVID-19) in key neighbourhoods and distributing this information directly to residents. This level of engagement

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<sup>18</sup> Hong, K.Y., et al., Systematic identification and prioritization of communities impacted by residential woodsmoke in British Columbia, Canada, Environmental Pollution (2016), <http://dx.doi.org/10.1016/j.envpol.2016.10.056>

would not have been possible without tapping into an existing program with the fire department and has amplified our reach greatly.”

Another community was finding its success through advertising in a free monthly magazine and through partnerships with local retailers.

### 3.1.5 Support from Communities

Although ENV provides the primary funding for the program, additional resources are often allocated to local programs by local governments, retailers, and/or other organizations. WSEP encourages different kinds of support and contributions from participating local governments. Some local governments developed clean air bylaws or building bylaws to reduce particulate-matter emissions from wood-burning sources, while some support the program by providing extra funding or educational workshops.

“Top-up” funding to increase the incentives was provided by some local governments. Central Kootenay Boundary Regional District, for example, offers a \$100 top-up for residents, while the Cowichan Valley Regional District provides a \$500 top-up when exchanging an uncertified wood stove for a heat pump.

The program encourages public participation. Local organizations, retailers, and manufacturers of applicable appliances provide in-kind or cash support to operate the program. Most communities that participate in the program have dedicated volunteer resources. The number of volunteers and total volunteer hours reported range widely across communities. A review of 2019 year-end reports from each region shows reported numbers of volunteers by local program vary from zero up to 26, and total volunteer hours vary from zero up to 411 hours in one year.

In most cases, communities also involve civil servants, such as municipal or regional district staff, in their local program (e.g., Prince George and Comox Valley). In addition, several communities have invited local elected officials (mayors, councillors, regional district directors) to participate through organizing volunteers for community events, offering meeting room space, and mentorship (e.g., Central Kootenay).

A total of 77 retailers were reported to have been involved with local programs from the nine communities summarized across the participating regions in 2019.

### 3.1.6 Program Efficiency

The program continues to be quite efficient, costing approximately \$328 per wood stove exchanged over the period of 2015 to 2019, which is lower than the previous cost per wood stove of \$370 prior to 2015. However, as noted above, the program reach is slowing and increased resources per exchange are likely needed to increase the number of annual exchanges. Budget for the educational component of WSEP has been increased since the last evaluation, from 5% to 7% of the overall budget.

## 3.2 Review of 2015 Recommendations

The table below reviews each recommendation from the 2015 B.C. WSEP evaluation report and summarizes how ENV has addressed each one.

Recommendation	How it was addressed
<p><b>1. Increase the program's emphasis on improving burning practices.</b></p>	<ul style="list-style-type: none"> <li>• ENV has invested in educational programs to serve all communities including:                             <ul style="list-style-type: none"> <li>○ Two educational videos on clean burning.</li> <li>○ Support for online training course development.</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Plans to include these resources when communities apply for WSEP to provide standardized online training.</li> </ul>
<p><b>2. Actively communicate a non-wood-burning appliance option.</b></p>	<ul style="list-style-type: none"> <li>• This information is communicated through ENV’s website and communication materials, including annual press releases.</li> <li>• Ongoing communication between ENV staff, BC Lung Association, and local coordinators.</li> </ul>
<p><b>3. Focus additional resources where air quality standards or objectives are being exceeded.</b></p>	<ul style="list-style-type: none"> <li>• An additional \$100 incentive per wood stove exchanged is available for communities where air quality standards or objectives are being exceeded.</li> </ul>
<p><b>4. Commit stable funding for three or more years.</b></p>	<ul style="list-style-type: none"> <li>• Program funding is on an annual basis, however there has been consistent funding provided throughout this evaluation period, without gaps or hiatuses.</li> </ul>
<p><b>5. Conduct a province-wide education campaign.</b></p>	<ul style="list-style-type: none"> <li>• There has not been a province-wide education campaign, although ENV has invested in education materials to provide to communities (as described in Recommendation #1).</li> </ul>
<p><b>6. Align program and provincial legislation for wood stoves with new EPA emissions standards.</b></p>	<ul style="list-style-type: none"> <li>• This recommendation has been completed through the <i>Solid Fuel Burning Domestic Appliance Regulation</i>.</li> </ul>
<p><b>7. Link burning education to the wood stove exchange incentive.</b></p>	<ul style="list-style-type: none"> <li>• ENV is considering utilizing the recent education materials (described in Recommendation #1) to be a program requirement for WSEP participation.</li> </ul>
<p><b>8. Measure effectiveness of various outreach materials (e.g., burn kit contents).</b></p>	<ul style="list-style-type: none"> <li>• The effectiveness of outreach materials is currently measured based on annual reporting and discussions with program coordinators.</li> </ul>
<p><b>9. Shift resources provided for education toward home visits.</b></p>	<ul style="list-style-type: none"> <li>• A few communities shifted resources towards home visits and felt they had success, however they reported that it was a resource-intensive process.</li> <li>• This recommendation was not possible in 2020 due to the COVID-19 pandemic.</li> </ul>
<p><b>10. Provide option to increase incentives or buy-back of stoves for lower-income households.</b></p>	<ul style="list-style-type: none"> <li>• This recommendation was not completed provincially.</li> </ul>
<p><b>11. Collaborate with a First Nations community to develop a targeted program.</b></p>	<ul style="list-style-type: none"> <li>• The 2017 First Nations Participation in the Wood Stove Exchange Program report was commissioned to offer guidance on how to move forward.</li> </ul>
<p><b>12. Communicate progress with key stakeholders and the public annually.</b></p>	<ul style="list-style-type: none"> <li>• This currently occurs through the website, an annual news release, and BC Lung Association reports.</li> </ul>



<b>13. Broaden the use of online and social media for education and advertising.</b>	<ul style="list-style-type: none"> <li>This has occurred at the community level, but ENV's Air Program does not have a social media presence.</li> </ul>
<b>14. Create an information template to engage retailers.</b>	<ul style="list-style-type: none"> <li>Program guideline agreement for retailers, distributors &amp; manufacturers is distributed annually.</li> </ul>
<b>15. Limit funds directed to advertising.</b>	<ul style="list-style-type: none"> <li>Complete.</li> </ul>
<b>16. Include air source heat pumps in the eligible appliances for rebates.</b>	<ul style="list-style-type: none"> <li>Complete.</li> </ul>
<b>17. Streamline year-end reporting for local program coordinators.</b>	<ul style="list-style-type: none"> <li>Complete, the annual report was reduced in length following the 2015 evaluation.</li> </ul>
<b>18. Obtain regulatory commitment from participating communities.</b>	<ul style="list-style-type: none"> <li>The existence or progression of a bylaw is one of the criteria for participating in WSEP.</li> </ul>
<b>19. Engage and/or regulate the firewood industry.</b>	<ul style="list-style-type: none"> <li>This recommendation was not completed. With respect to regulation, ENV does not have jurisdiction over the fire wood industry.</li> </ul>
<b>20. Consider provincial regulation to support the goal to eliminate all non-certified wood stoves in BC.</b>	<ul style="list-style-type: none"> <li>The <i>Solid Fuel Burning Domestic Appliance Regulation</i> works towards eliminating wood stoves through attrition. As old stoves reach the end of their life the regulation ensures that replacement appliances sold in B.C. are emissions certified.</li> </ul>

### 3.3 Lessons Learned from Other Jurisdictions

Four different wood stove exchange program coordinators in Canada and the US were interviewed from the following programs:

- Hearth, Patio & Barbecue Association of Canada's (HPBA) program in Ottawa.
- Puget Sound Clean Air Agency's program in Washington state.
- Northern Sierra Air Quality Management District's program in California.
- Washington County's program in Oregon.

The following table outlines the different jurisdictions' wood stove exchange programs, and summarizes notable successes and lessons learned.

	<b>HPBA</b>	<b>Puget Sound Clean Air Agency</b>	<b>Northern Sierra Air Quality Management District</b>	<b>Washington County</b>
<b>Location</b>	Ottawa, Canada	Washington, US	California, US	Oregon, US
<b>Population served</b>	~990,000	~820,000	~110,000	~602,000
<b>Motivation</b>	Improving air quality and supporting the hearth industry by	Measured high particulate matter in wintertime.	Greenhouse gas mitigation.	Measured high particulate matter measured in wintertime, paired with

	replacing non-certified wood stoves.			a local survey showcasing prevalence of wood stoves for residential heating.
<b>Incentive</b>	25% of the cost of stove up to \$750	\$1,500 (not reliant on income)	\$1,000 (med-high income) \$5,000 (low-income)	\$1,500 (high-income) \$2,500 (med-income) \$3,500–\$5,000 (low-income)
<b>Exchanges</b>	Unknown	(2012–2018) removed over 5,000 wood stoves	115 in first year of program	134 exchanges in 2017; 156 in 2018; and 103 in 2019
<b>Of Note</b>	<p>This program is run by a retail association and funded by the City of Ottawa.</p> <p>The program was motivated by co-benefits of emissions reductions from old wood stoves, and supporting small and family-owned local hearth retailers.</p>	<p>Targeted approach focused on counties that exceed air quality guidelines.</p> <p>Coupled with regulatory aspect: EPA wood stove was no longer legal to use effective October 2015 in a previous iteration of the program.</p>	<p>Funded by greenhouse gas reduction initiative.</p> <p>Does not have enough funding to meet the demand for wood stove exchanges.</p>	<p>Measuring downward trend of PM<sub>2.5</sub> each year.</p> <p>Successful low-income accessibility: 67% of applicants are below the median family income level.</p> <p>Significant number of heat pumps installed.</p>

There is much to learn for B.C.'s WSEP based on the examples summarized above. First, each US program is finding success through directly supporting low-income participants. The rebate model used in Oregon has been particularly successful, with 67% of applicants below the median family income level. This is an approach that could support the B.C. WSEP in implementing a program to properly support low-income residents.

Second, each example provides a higher incentive per wood stove exchange ranging from \$750 (in Ottawa) to the full cost of the exchange for low-income residents (in two US examples). This is providing a significantly higher motivation for exchange for participants in comparison the \$250 to \$500 provided in the B.C. WSEP. Finally, a targeted approach for areas that exceed national standards (such as in the US examples) allows for more resources in areas that need it most, leading to more exchanges in targeted airsheds.

### 3.4 Key Issues

The following section outlines key issues identified for B.C.'s WSEP and is based on program documentation, interviews and surveys from program coordinators and stakeholders from across the province. The topics include: potential change to the overall rebate scheme, accessibility of the program for First Nations, accessibility of the program for low-income residents, replacement of wood stoves versus non-wood-burning options, perspectives on incorporating outdoor wood boilers, perspectives on non-participating local governments, and, finally, public awareness and educational components.

### 3.4.1 Potential Changes to the Overall Rebate Scheme

The current exchange structure provides incentives for removing an uncertified EPA wood stove based on the appliance that will be installed: \$250 for an EPA-approved wood stove, \$400 for a natural gas, propane, or electric heating appliance, and \$500 for a cleaner-burning appliance (pellet, gas, propane, or electric) in a red-zone community.

Based on the interviews and survey, many respondents did not believe the current incentives were enough to encourage those who were not already going to exchange their wood stoves. For those respondents, the current incentives were not seen as enough in comparison to the total cost of the unit, and therefore could not motivate an exchange in residents who were not already going to exchange for another reason (convenience, renovations, etc.)

In regions where a local top-up was provided, respondents believed the top-up increased the number of exchanges and contributed to their program's success. Additional incentives were encouraged by many program coordinators and stakeholders, especially for older stoves in hot-spot areas where air quality is poor.

Numerous respondents spoke about the consideration of the incentive for propane and gas appliances contradicting the goals of reducing greenhouse gas emissions set out in B.C.'s *Climate Change Accountability Act*. Many believed that there was an opportunity to achieve co-benefits of improving air quality in communities and reducing greenhouse gas emissions by providing additional incentives for heat pumps and other electric options.

### 3.4.2 Accessibility of the Program for First Nations

First Nations participation in WSEP is currently low. Many program coordinators reported that First Nations within their region were able to participate in the program, however, there was not a targeted approach. Several communities noted that they had engaged with local First Nations when they were developing strategies to improve air quality.

Two communities with targeted First Nations engagement reported having in-person engagement on their program in 2019, and online engagement in 2020. Several respondents recommended a more targeted approach to engage with local First Nations communities, including culturally appropriate educational material.

### 3.4.3 Accessibility of the Program for Low-Income Residents

Many wood stove exchange programs have a component to support low-income residents' participation. This is done to support those who cannot afford to exchange their wood stoves at the general level of incentive offered. It is also done because wood stoves are an affordable method to heat your home, so low-income residents may be more likely to heat their home using wood burning. If the goal is to change-out all uncertified wood stoves within communities, those who cannot afford to do so must be supported.

The majority of those interviewed do not believe the current program is accessible for low-income residents, citing that the incentives provided are a small amount in comparison to the cost of a replacement appliance. Most incentives were perceived to be taken by mid-to-high-income families, although the income of participants in WSEP is not tracked by any community. There was no reported targeted approach by communities to support this group through WSEP, there was however much interest expressed to provide greater support. As one survey respondent noted, "We must always be cognizant of the affordability of heating a space. Lower-income residents are still relying on wood appliances for heat and comfort."

### 3.4.4 Replacement of Wood Stoves versus Non-Wood-Burning Options

Overall, the majority of wood stoves were exchanged for wood stoves (63%), or natural gas or propane units (31%), while a small amount were exchanged for certified pellet stoves (2%), electric heat pumps (1%), and electric inserts (<1%). Overall, there has been a shift toward non-wood stove replacements over time, and by 2019, non-wood stove replacements overtook certified wood stoves as the majority of exchanges.

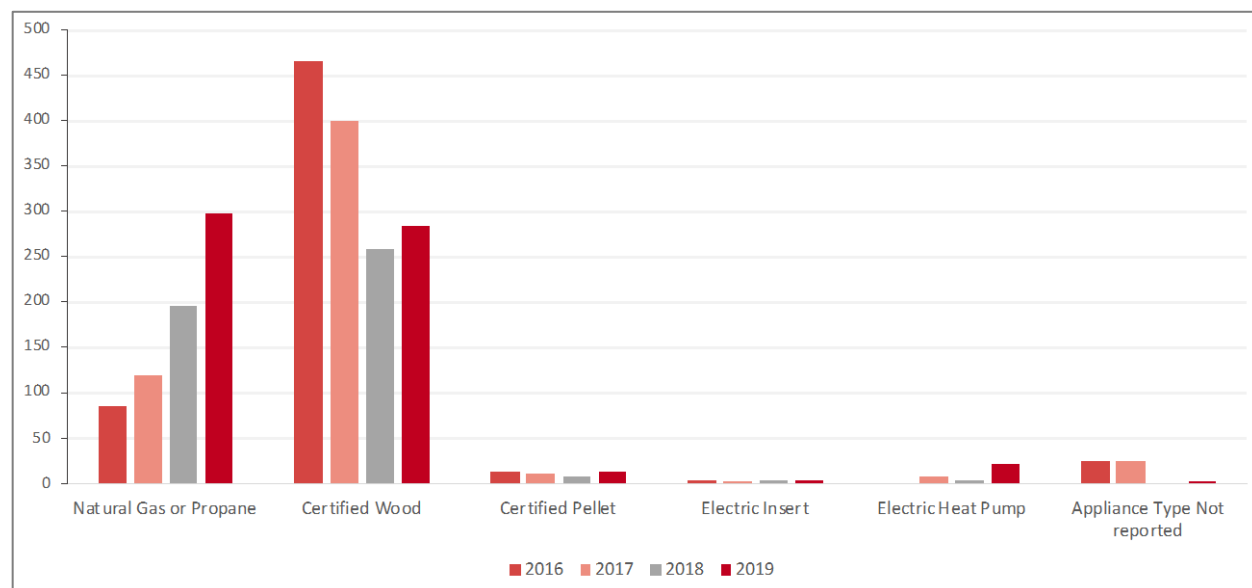


Figure 4: Annual wood stove exchanges by appliance type (note: 2015 annual reports did not collect information on appliance types).

WSEP is structured to allow each community that participates to decide what appliances are eligible. The wood stoves can be exchanged for EPA-certified wood stoves; however, each community can decide not to allow for wood stove replacement at all. Or, for example, to align with climate goals, communities can choose to only allow wood stoves to be replaced with electric heat pumps or inserts.

Many respondents noted advantages to the current approach’s flexibility that allowed for communities to match their own values and priorities when choosing which appliances are applicable for their local exchanges. Most respondents agreed that allowing EPA-approved wood stoves contributed to the success of the program. Respondents felt many people would not participate in the program if the option to replace with a wood stove was not offered. In rural areas where power can be unreliable in winter, wood stoves are an important back-up source of heat for some residents. As one stakeholder noted, “I personally like giving people a choice. Any reduction in PM<sub>2.5</sub> will improve population health. Other measures such as local bylaws, requirements to upgrade or remove wood-burning appliances with home sale, etc., all complement collective efforts to reduce PM<sub>2.5</sub>.”

There were also disadvantages noted regarding WSEP allowing wood stoves to be exchanged for EPA-approved models. A few respondents did not want to see wood stoves allowed for exchanges, and supported only non-wood stove appliance options. Respondents also pointed out that wood stoves require a lot of education on clean burning techniques. Further, one program coordinator noted that storing dry wood can be especially difficult in coastal damp climates, meaning residents are more likely to burn wet wood which produces more smoke.

### 3.4.5 Perspectives on Incorporating Outdoor Wood Boilers

Domestic outdoor wood boilers (OWBs) generate smoke that can significantly contribute to reductions in air quality.<sup>19</sup> The *Solid Fuel Burning Domestic Appliance Regulation* requires that all OWBs must meet PM<sub>2.5</sub> emissions standards from the US EPA or equivalent standards from the CSA to be legally sold in B.C. It also requires a 40-metre setback from adjacent property lines.

Many respondents spoke to the concerns about OWBs in their communities, and the complaints that come along with them in terms of smell and smoke. Respondents felt it would be beneficial to the program to add OWBs as eligible appliances to exchange, as replacing an old, smoky OWB with a certified boiler would offer improvements. As one respondent noted, “We would strongly support the addition of wood boilers. We see them as huge polluters, and get complaints from the neighbours of boiler owners. They are very popular in our region.” Another respondent requested an incentive for the disposal of OWBs, as these appliances are banned within their community.

Several respondents believed OWBs needed to be banned altogether. They had concerns about residents using OWBs as garbage incinerators, which would have further impacts on air quality.

### 3.4.7 Non-Participating Local Governments

One regional district was interviewed that has no current or past involvement with WSEP. Capacity to handle the administration of the program was the main reason as to why they are not participating; they did not have enough capacity in-house to support the program, and no non-profit was offered to support the process. They suggested that hearing from other communities who have successfully implemented the program would be helpful for them to get started and to understand how other communities found the resources to facilitate participating in the program.

### 3.4.8 Public Awareness and Educational Components

With respect to the effectiveness of WSEP in raising awareness of the impacts of wood stoves, many stakeholders were not sure whether the program had an impact on public perspective, with some pointing to larger events such as wildfire smoke raising awareness within their communities. As one respondent stated, “The public's awareness of air quality issues is only marginally influenced by the program as there have been larger, more publicized issues in recent years including a mine application, and a focus on local air quality due to naturally dusty conditions and wildfires.”

Several respondents did not believe their program was having an impact on the wider community, with awareness around good burning practices appearing to be poor. There was a desire for province-wide messaging and education to be provided online to increase public awareness of wood smoke as a health issue, and awareness of clean burning practices.

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<sup>19</sup> [Assessment of Outdoor Wood-fired Boilers; Northeast States for Coordinated Air Use Management](#). (2006). Northeast States for Coordinated Air Use Management.

## 4. Recommendations

Since its inception and as of 2019, WSEP has facilitated the exchange of just under 9,000 wood stoves throughout B.C. and supported communities to provide education around clean burning techniques. Using a local program delivery approach, the program is successful in supporting communities to meet their own needs. Communities are able to choose for themselves which appliances are eligible for exchange in their local area: some choose to allow EPA-certified wood stove appliances to be eligible, while others only allow an electric appliance option for exchange. Communities have flexibility with the eligible appliances they allow, and are able to allow for wood replacements in rural areas, but limit appliances within city limits, for example. This approach has offered flexibility and has largely worked well for communities.

As the majority of exchanges over the last five years have been for newer model wood stoves (63%), and based on the results of recent air quality studies displaying improvements in air quality related to wood stove exchange programs, it is recommended that WSEP continue to allow wood stoves to be exchanged with the program, at each community's discretion.

The local approach has also worked insofar as some communities continue to successfully use social media to get the word out about clean burning techniques and the program in general. There is room for improvement in some aspects of the program that are outlined below.

### **1. Update the rebate structure to target red-zone communities and increase incentives per exchange.**

Many stakeholders and program coordinators believe the incentives currently provided are insufficient to motivate residents to exchange their wood stoves. Indeed, some communities have not been able to fully distribute funds for exchanges over recent years due to the reduced participation of residents, and as a result, these communities carry over additional funds for distribution in the following year. The average number of wood stoves exchanged between 2009 and 2013 was just over 1,000 annually, while the average number of wood stoves exchanged between 2015 and 2019 was just over 500 annually, a decrease of nearly 50%. The expenditures for the program have similarly decreased during this time from \$2 million to \$1.2 million.

It is recommended that the rebate structure be updated to take a targeted approach and provide increased incentives for red-zone communities. The additional funding provided to red-zone communities for wood stove exchanges has provided a good starting point, however additional resources and support are needed. The \$500 offered per exchange still does not reach the lowest incentive provided in programs in other jurisdictions. For reference, Ottawa offers an incentive of up to \$750 per wood stove (or 25% of the total cost of appliance), while the US programs interviewed provided at least \$1,000 USD per exchange.

Communities in the US that exceed national air quality standards have been given significantly more resources and provide higher incentives per exchange, such as in Washington state. As the 2015 evaluation states:

Communities in the US that are exceeding national standards have been provided more significant resources. The increased resources are accompanied by stronger requirements, including not allowing new appliances to be wood burning (with some exceptions for areas without natural gas service), and regulations requiring the removal of uncertified appliances by a specific date. For

example, in the Tacoma-Pierce non-attainment area, Washington State provided \$1.5 million in funding for a two-year period, with three options for removing old smoky stoves: \$350 bounty for removal, free replacement for low-income households, and \$1,000 to \$1,500 incentives for non-low-income replacements. A new regulation was also passed requiring all uncertified stoves be removed by September 2015. Outside of the targeted area, wood stove exchange incentives are provided at a lower level of \$350 per exchange (page 30).

This approach could be mirrored in B.C. in red-zone communities that have data collected to ascertain that the smoke is coming from residential wood stoves. Based on examples from other jurisdictions, the incentives provided for red-zone communities should be at least \$750 to \$1,000.

Further, it is recommended that the program continues to be offered to communities across the province at a lower incentive per exchange. This lower incentive per exchange should be increased from the current rate at minimum based on inflation since WSEP's inception.<sup>20</sup>

Increasing the incentives could result in a lower number of exchanges if the total program budget is not increased. As the overall program expenditures have dropped when the number of exchanges dropped, there is room for an increase in incentives to provide further exchanges within the current budget to a degree. However, if increasing the incentives leads to exceeding the annual budget, focusing higher rebates in communities with air quality exceedances and/or focusing on urban areas would allocate limited resources where they are needed most.

Targeting red-zone communities could be done a number of ways. For example, ENV could weight annual program applications based on historic and current air quality data, as well as how the communities have taken action on improving their own air quality (to determine how committed they will be to the program's local success).

## **2. Provide support for data gathering within communities.**

To facilitate a targeted approach that reaches areas with elevated PM<sub>2.5</sub> levels, support should be provided for data gathering within communities to determine where hot-spot areas are located. ENV can provide support in a few ways:

- Review the method defined by Hong et al. (as described in section 3.1) and, if appropriate, assist participating communities with identifying when elevated PM<sub>2.5</sub> levels are coming from residential wood stoves.
- Review the methodology used in the Comox Valley to identify hot-spot areas, as described in the Mobile Monitoring Air Quality Study,<sup>21</sup> and if appropriate, assist participating communities with undertaking a similar study. This can support additional incentives or education to targeted areas.
- The province can set up a mobile monitoring project in partnership with an academic institution that has the necessary equipment and make it available to red-zone communities. Upon completion, those red-zone communities can get higher rebates for targeted areas.

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<sup>20</sup> According to the Bank of Canada, the \$400 rebate should be increased to ~\$500, and the \$250 rebate should be increased to ~\$310 based on inflation between 2008 and 2021 (<https://www.bankofcanada.ca/rates/related/inflation-calculator/>)

<sup>21</sup> Wagstaff, M. (2018). Monitoring residential woodsmoke in British Columbia communities. (Master's thesis). Vancouver: University of British Columbia. <https://open.library.ubc.ca/ciRcle/collections/ubctheses/24/items/1.0371217>



Note that the Comox Valley began offering higher incentives to targeted areas for the 2020/2021 winter season (during the COVID-19 pandemic), but has had minimal success with their approach to date. They have completed three rebates when they had 21 to offer at these rates. They largely attribute this to minimal in-person interactions for the exchange, and plan to increase this when it is safe again.

### 3. Provide tiered incentives to support low-income participation.

The accessibility of WSEP for low-income households is important in terms of supporting those who cannot afford it to transition to cleaner forms of heating, as well as in terms of meeting the goals of exchanging all non-certified wood stoves. Wood burning is seen as an affordable method of providing heat in comparison to other heating methods, and is posited to be more likely to be a primary source of heat for low-income residents. If we are to transition away from non-certified wood stoves, supporting low-income residents is an important program component for success.

Many respondents believed the program should provide additional incentives for low-income households. This approach was met with success in the US examples described above. Each program offered the full cost of the wood stove, up to \$5,000 USD. The wood stove exchange program in Oregon offers vouchers for low-income households, allowing upfront costs to be held by the retailer. This has been successful, with 67% of applicants being below the median family income level.

ENV should align the requirements and process of the energy efficiency guidelines for medium- and low-income support for heat pumps from the forthcoming CleanBC rebates under the CleanBC Better Homes: Income-Qualified Rebate Program.

### 4. Align air quality goals with provincial climate goals (CleanBC).

For every wood stove that is exchanged for an electric appliance, there are not only zero PM<sub>2.5</sub> and other air pollutants emitted, but there are also no longer any greenhouse gases emitted. There are potential co-benefits when exchanging wood stoves to help meet greenhouse gas emissions reductions as set out in CleanBC. The wood stove exchange program in California receives funding through greenhouse gas emissions mitigation efforts.

Heat pumps are the ideal solution to both air quality and greenhouse gas concerns where there is a reliable electricity supply, while propane and natural gas appliances emit greenhouse gases, moving us further away from the provincial goals set out in CleanBC.

Heat pumps require additional up-front investment as they are much more expensive than a wood stove or propane or gas appliance. For example, the average cost of installed heat pumps ranges from \$7,000

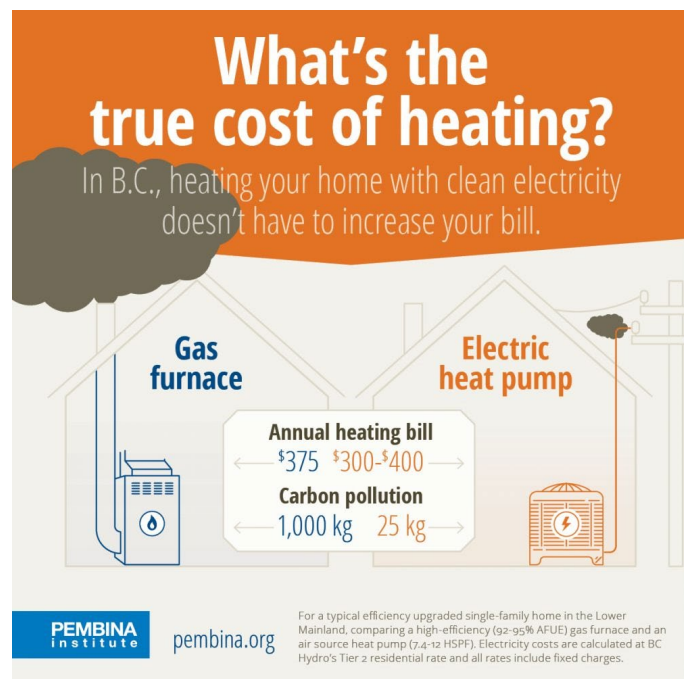


Figure 5: What's the true cost of heating? (Source: Pembina.)



to \$16,000<sup>22</sup> in comparison with an installed natural gas furnace, which ranges from \$3,500 to \$7,500.<sup>23</sup> A comparison between the annual cost of a heat pump and a natural gas furnace is displayed in Figure 5.

Heat pumps are only recently gaining momentum as a primary heat source. Based on municipal, regional, and provincial climate plans, governments are aiming to have these as the primary heat source for residents in new and existing homes in the next one to two decades. In rural locations, however, relying on electric heating systems can be problematic if electricity goes out frequently and this should be taken into account.

From 2016 to 2019, only 1% of all wood stoves were exchanged for a heat pump. The current incentives only provide a fraction of the cost of purchasing and installing a heat pump. CleanBC offers additional incentives that should be actively promoted at every level of communication about the program.<sup>24</sup>

WSEP and CleanBC are working on similar goals of supporting space heating upgrades for residents. As there is alignment and potential co-benefits, it is recommended that the branches of government work together to achieve this common goal. There is the potential to cross-fertilize with energy auditors who are working to help with energy efficiency upgrades under CleanBC. Part of their assessment can include noting whether there is a wood stove, providing residents with promotional and educational pamphlets regarding wood smoke and providing a recommendation that they get the wood stove replaced.

**There are three actions recommended:**

- a. Actively promote heat pumps with additional CleanBC incentives at every communication level.
- b. Consider increasing incentives for heat pumps to align with climate goals.
- c. Connect with CleanBC to work together to achieve common goals.

**5. Execute strategies provided in the First Nations evaluation report.**

It is recommended to follow through with the strategies laid out in the First Nations Participation in the Wood Stove Exchange Program report titled “Strategies for improved implementation of the Wood Stove Exchange Program in First Nation communities”. This report provides the full context needed to work towards facilitating First Nations participation within WSEP. The next steps as stated in the report are to:

1. Deepen interagency relationships and collaboration to recruit a broader working group that will evaluate and refine emerging strategies to support the proposed pilot programs.
2. Obtain funding and resources from partner agencies to design and pilot two different approaches to WSEP delivery:
  - a) A self-directed pilot, where a community champion and a regional coordinator direct the program.
  - b) An externally run program, where there is limited administration demand on First Nation staff time (page 20).

Further, there is an opportunity to partner with BC Hydro’s Indigenous Communities Conservation Program (ICCP), which provides free energy-saving products and the training to local contractors and

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<sup>22</sup> <https://ecotrust.ca/priorities/energy/heatpumprebate/>

<sup>23</sup> <https://www.furnaceprices.ca/furnaces/furnace-prices/>

<sup>24</sup> <https://news.gov.bc.ca/releases/2020EMLI0068-002140>

installers on how to upgrade homes. The ICCP also supports heat pump installation efforts in First Nations communities. For example, the Village of Skidegate on Haida Gwaii received funding through BC Hydro rebates to replace heating devices (some of which were wood stoves) in 360 residences. Other communities are following suit, and there is room for collaboration and co-benefits.

#### **6. Further emphasis on clean burning practices.**

As was found in the 2015 evaluation, many stakeholders from across the province highlighted the need for additional education around clean burning techniques. Whether or not a wood stove is certified, the manner and substance that is burned will impact the amount of emissions released into a local airshed. Several studies were conducted and published with respect to a community-wide wood stove change-out program in Libby, Montana, between 2005 and 2008.<sup>25</sup> One study focusing on indoor PM<sub>2.5</sub> found that reductions of the pollutant were evident, but inconsistent across homes. "These findings suggest that other factors beyond the introduction of an improved wood burning device are relevant to improving indoor air quality in wood burning homes."<sup>25</sup> Focusing on education about clean burning practices was identified as important to have ongoing reductions in PM<sub>2.5</sub> following change-outs.

It is recommended that ENV utilize the online clean burning course that is currently being finalized as a requirement of participation within the WSEP program when participants are receiving a certified wood stove. This will ensure any wood burners are aware of clean burning techniques going forward. Further to this, ENV should consider whether a brief "refresher" video be sent out to all the previous year's participants that installed new certified wood stoves at the beginning of the next burning season, and ask all participating communities to repost the refresher video annually through their social media channels.

#### **7. Create a participant online survey.**

The completion of an online survey is recommended as a component of participating in WSEP, to better understand the spectrum of who is participating in the program and why. For those who exchange for a wood stove, this survey could follow the online training course described in the recommendation above. Questions could include: income level; how you found out about the program; and motivation for program participation. ENV should manage the online survey and annually review input to inform adjustments to the program on a regular basis.

#### **8. Develop engaging materials for improved province-wide messaging.**

As described in the previous recommendation, many stakeholders from across the province highlighted the need for additional education around clean burning techniques, and awareness of the health impacts of wood smoke in general. Thus, there is still a need for Recommendation 5 from the 2015 evaluation report, to conduct a province-wide education campaign. Further, the World Health Organization has identified that there is an "urgent need for education around this issue, including active outreach by air pollution, energy, and health ministries."<sup>26</sup>

ENV can learn from other jurisdictions that have had successful education efforts. As stated in the 2015 evaluation:

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<sup>25</sup> Noonan, C.W., Navidad, W., Sheppard, L., Palmer, C.P., Hooper, K., Ward, T.J., Residential indoor PM<sub>2.5</sub> in wood stove homes: follow-up of the Libby changeout program. (2012). Indoor Air.

<sup>26</sup> World Health Organization Europe (2015). [Residential heating with wood and coal: health impacts and policy options in Europe and North America.](#)

In Washington State, the Puget Sound Clean Air Agency conducted focus groups about key messages for a behaviour change campaign and determined that: messages should focus on how to get better heat with less work, messages should be delivered with credible partners, and the message of needing to store wood for six to twelve months prior to use is likely the biggest gap to good burning practices (page 31).

It is recommended that ENV develop key messages and engaging graphic material (infographics, short videos, etc.), which can be disseminated by participating communities and other organizations to improve province-wide consistency in messaging. To inform the content, focus groups could be used to identify targeted messaging appropriate to the B.C. context. There is the opportunity to include raising awareness on connecting wood stoves with climate goals, and working with partners in different agencies to support this campaign (such as health authorities, CleanBC, utilities).

Recognizing that full marketing campaigns are costly, this recommendation focuses on developing clear and consistent messages that can be distributed by many partners—avoiding the cost of a full campaign. This recommendation would require the dedication of a portion of the program budget, potentially reallocating away from exchange incentive funds. However, providing this common messaging to communities to promote their own local wood stove exchange program, as well as raise awareness of the health impacts of smoke is needed.

#### **9. Conduct a province-wide wood burning survey.**

It is recommended that a province-wide wood burning survey be conducted to gain an understanding of wood stoves and wood burning behaviour across the province. It has been ten years since the last survey was conducted in 2011.<sup>7</sup> This is an important data source to understand the percentage of uncertified stoves still in operation, the proportion of households using wood as a primary heating source, accessibility of the program to different income levels, barriers to participation in WSEP exchanges, and more.

#### **10. Support the peer-to-peer learning of program coordinators.**

As program coordinators are isolated by geography but are all working on similar issues, there is the opportunity for peer-to-peer learning. Annual gatherings or online webinars are recommended for program coordinators to discuss opportunities and challenges. Topics could include:

- Bylaw guidance
- Education messaging
- How to target incentives
- How to identify hot spots

ENV can review and build from a similar model as that used by BC Hydro for the Community Energy Managers program. Reach out to the coordinator for Community Energy Managers at BC Hydro for guidance.

Current participation in the program is based on the capacity of a local community to administer the program. There is not necessarily an alignment with capacity to deliver the program and air quality exceedances within a local area. In order to better target red-zone communities and offer more support, a mentorship program would be beneficial to connect communities who currently participate in WSEP

with ones that do not, to share how the program works in their community, and to help the non-participating community get started.

**11. Include outdoor wood boiler exchange for alternative heating appliance.**

Include outdoor wood boilers as eligible devices to exchange for non-wood burning heating appliances in all areas.

Explore the possibility of allowing communities to choose whether they would like to allow wood boilers to be exchanged for new certified OWBs, following the same protocol as all other applicable appliances. As old uncertified OWBs are a significant source of air pollution, many stakeholders believe upgrading these appliances, or more ideally replacing them with cleaner modes of heating, is an important component of improving air quality. However, as provincial regulations have specific setback requirements, allowing an exchange for a certified OWB should require a commitment at the local level to verify the exchanges are installed in compliance with local bylaws and provincial law. Furthermore, a few stakeholders interviewed mentioned that these devices were used to incinerate garbage, which has even worse impacts on air quality. There would need to be a significant educational component along with any exchange for a certified OWB.

**12. Refine annual reporting structure.**

Switch the current annual report completed by local program coordinators to an online survey platform that enables more streamlined consolidation of reporting across participating communities, particularly in relation to quantifiable responses. This will improve the ability for ENV to report annually on key program metrics, such as number and type of change-outs, number and type of education events, etc. Continue to report on these metrics annually.

## 5. Closing Considerations

As the majority of the WSEP budget is allocated to provide incentives for wood stove exchanges, the number of wood stoves exchanged, and as a result the potential for air quality improvements, is generally proportional to the budget provided for the program. Some of the recommendations above provide guidance on how to further improve the program within the existing budget. However, to significantly increase the impact of the program in terms of number of wood stoves exchanged, additional budget will be required. If no new funds are identified, ENV will need to consider the implications of reallocating funds as recommended. For the most part, recommendations support shifting more funding towards red-zone communities and/or urban areas, where reductions in  $PM_{2.5}$  have the greatest public health benefit.

## Appendix A – Acknowledgements

We would like to thank the numerous people throughout B.C. that took the time to contribute their expertise and ideas to this program review. In particular, we would like to thank the following (alphabetical by first name):

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Tony Pullman, West Fraser Timber Co.

## Appendix B – Stakeholder Surveys

### Questions for Local Program Coordinators (Interview and Online Survey)

1. Please state the years the program has run in your community.
2. Please indicate the timing of the program (year-round vs. specific months per year).
3. What is the name of the organization that administers the wood stove exchange program in your community?
4. Are there any local bylaws or regulations governing the use of wood stoves in your jurisdiction?
5. Do you think this program has improved air quality in your region? If yes, how?
6. Do you feel the program achieved its objectives in your community or region? Do you have any data (qualitative or quantitative) to support this?
7. What education method(s) were used to educate people about burning practices? Which were most effective?
8. Were the materials provided by the Wood Stove Exchange Program effective during outreach activities? Do you have any recommendations for improving?
9. Were you able to meet the goals you set out to achieve with marketing/outreach efforts? If yes, how? If no, why not?
10. Do you think there is a change in the level of awareness about good burning practices in your community since the start of WSEP? Explain.
11. Do you think your program was accessible for low-income wood burners? Did you do anything to encourage participation among this group? Was it effective?
12. Are there any changes you would recommend to make the program more accessible for low-income wood burners?
13. Does your Program currently engage or work with local First Nations? Please explain.
14. Do you feel the program incentives were sufficient to encourage wood stove exchanges? If applicable, did the top-up incentives increase program uptake?
15. Do you see any advantages of the program funding replacement wood stoves vs. only replacing non-wood-burning options? Any disadvantages?
16. Do you see a need in your community to increase the incentive for non-wood-burning options? Do you think that would be effective?
17. Do you have any recommendations on incorporating outdoor wood boilers into the program with defined eligibility?
18. Has COVID-19 had an impact on the local program in 2020?
19. Did you experience any challenges related to rebate administration? Do you have any recommendations?
20. What level of human resources was required to administer this program annually?
21. What might you change about the application, administration, or reporting requirements of this program?
22. Do you have any recommendations for improving the effectiveness of the overall program?
23. Please include names and contact details of people you suggest be contacted to get other perspectives from your region (e.g., senior staff, elected officials, participating retailers).

24. Have there been any surveys in participating communities recently? What are the results of the surveys?

### Questions for General Stakeholders (Online Survey)

1. What is your organization/affiliation? [select from list]
  - a. Government (elected official)
  - b. Government (air quality expert)
  - c. Public health expert
  - d. Non-profit
  - e. Retailer
  - f. Industry
  - g. Other
2. What region do you work in? [select from list]
  - a. Vancouver Island / Coast
  - b. Mainland / Southwest
  - c. Thompson / Okanagan
  - d. Cariboo
  - e. Nechako
  - f. Northeast/Peace
3. To what extent does chimney/wood smoke in your region concern you? [select from list]
  - a. A lot
  - b. Somewhat
  - c. Not much
4. Why might chimney/wood smoke be a concern for you?
5. Which of the following statements best describes how you feel about the air quality in the area where you live?  
The air quality in the area where I live is:
  - a. Almost always good
  - b. Good most of the time, poor on occasion
  - c. Good about half of the time, poor the other half
  - d. Poor most of the time, good on occasion
  - e. Almost always poor
  - f. Don't know
6. In what ways have you been involved with the Wood Stove Exchange Program? [select from list]
7. What are, in your opinion, the main objectives of the Wood Stove Exchange Program?
8. Over the last 5 years, how successful do you think this Wood Stove Exchange Program has been in encouraging residents to turn in old wood burning appliances for new more efficient ones?
9. Over the last 5 years, how successful do you think the Program has been in improving burning practices?
10. Do you think the public's awareness of local air quality issues in your region has changed in the last five years as a result of the Wood Stove Exchange Program? If yes, how?



11. Do you support the list of eligible appliances allowed in the program (wood stoves; gas or propane heaters; electric heat pumps)? Do you have any recommendations for changes? [*\*Note: some regions do not provide incentives to install new wood stoves through the program.*]
12. Do you see any advantages of the program funding replacement wood stoves vs. only replacing non-wood-burning options? Any disadvantages?
13. Do you have any recommendations on incorporating outdoor wood boilers into the program with defined eligibility?
14. Do you support the size of the rebate under the current program? Would you recommend any changes?
15. Do you have any feedback related to educational initiatives currently supported by the program? (Either in content or format of delivery.)
16. From your perspective, do you think the program was accessible for low-income wood burners? Do you have recommendations for improvement?
17. From your perspective, do you think the program was accessible to local First Nations communities? Recommendations for improvement?
18. Has COVID-19 had an impact on the local program in 2020?
19. Do you have any recommendations for improving the effectiveness of the overall program?

### **Questions for Public Health Experts (Interview)**

1. To what extent is wood/chimney smoke in your region a concern? Why?
2. How familiar are you with the Wood Stove Exchange Program? How have you come to this knowledge?
3. Do you think the Wood Stove Exchange Program is effective at reducing wood smoke in your region? Why or why not?
4. Do you have any recommendations for improving the effectiveness of the program?
5. Do you have any comments on the list of eligible appliances allowed in the program?
6. Do you have any comments on the size of rebates under the current program?
7. Do you have any feedback related to educational initiatives currently supported by the program? (Either in content or format of delivery.)
8. Do you know of any relevant studies or research around wood smoke exposure in your region that have been published after 2015?
9. There are various ways the provincial government could respond to the wood smoke issue. Is this wood stove exchange program an effective component? Are there other things that the provincial government should do instead or in addition?

### **Questions for Air Quality Experts (Interview)**

1. To what extent is wood/chimney smoke in your region a concern? Why?

2. How familiar are you with the Wood Stove Exchange Program? How have you come to this knowledge?
3. Do you have any analysis about the effectiveness of the Wood Stove Exchange Program at reducing wood smoke in your region?
4. Do you have any recommendations for improving the effectiveness of the program?
5. Do you have any comments on the list of eligible appliances allowed in the program?
6. Do you have any comments on the rebates under the current program?
7. Do you have any feedback related to educational initiatives currently supported by the program? (Either in content or format of delivery.)
8. Do you know of any relevant studies or research around wood smoke exposure in your region that have been published after 2015?
9. There are various ways the provincial government could respond to the wood smoke issue. Is this wood stove exchange program an effective component? Are there other things that the provincial government should do instead or in addition?

### **Questions for BC Lung Association (Interview)**

1. What level of human resources is required to administer this program?
2. What would you change about the administration of this program?
3. What other partners would you suggest be engaged in reducing air emissions from wood smoke?
4. Do you have recommendations for future outreach activities?
5. How could outreach materials be improved?
6. How successful do you think this wood stove exchange program has been in encouraging residents to turn in old wood-burning appliances for new, more efficient ones?
7. Do you have any recommendations for improving the effectiveness of the program?
8. There are various ways the provincial government could respond to the wood smoke issue. Is this wood stove exchange program an effective component? Are there other things that the provincial government should do instead or in addition?
9. What would you consider in judging the effectiveness of the program?

### **Questions for Non-Participating Communities (Interview)**

1. To what extent does wood/chimney smoke in your region concern you? Why?
2. Which of the following statements best describes how you feel about the air quality in your region?  
The air quality in the region is:
  - a. Almost always good
  - b. Good most of the time, poor on occasion
  - c. Good about half of the time, poor the other half
  - d. Poor most of the time, good on occasion

- e. Almost always poor
  - f. Don't know
3. What do you already know about the Wood Stove Exchange Program? How have you come to this knowledge?
  4. Why is your community not participating in the Wood Stove Exchange Program?
  5. Are there any changes to the program that would change your community's participation?

### **Questions for Other Jurisdictions (Interview)**

1. Can you provide an overview of how your program works? [Follow-up questions to clarify details as needed.]
2. What was/were the primary driver(s) for starting your program?
3. Can you describe the main challenges you have encountered and how you have overcome them?
4. In your opinion, what are the main successes of your program?
5. How do you measure the success of your program?
6. What best practices does your program follow?
7. Do you have any support for low-income participants? How does that portion of the program work?
8. Do you have any studies that have helped informed your program design?

## Addendum – NESCAUM Report on the EPA Certification Process

March 31, 2021

Following the completion of this Woodstove Exchange Program evaluation report, the Northeast States for Coordinated Air Use Management (NESCAUM) released an *Assessment of EPA’s Residential Wood Heater Certification Program*.<sup>27</sup> The NESCAUM report provides the results of a review of the EPA’s program to test, review and certify that new wood stoves and central heaters meet the current standards (the 2015 Residential Wood Heater New Source Performance Standard). The report found many problems with the EPA’s certification process and its oversight. It stated that “the existing program provides no confidence that new residential wood heaters are performing in a manner that better protects public health than the heaters they replace, and at the level required by federal standards.” The report made several recommendations to address those problems.

As the NESCAUM report was released after the completion of this WSEP evaluation, its findings are not incorporated into this evaluation. As an addendum, it is recommended that ENV review the recommendations from the NESCAUM report and remain abreast of changes that result from the report. In particular, the report recommends that government-supported activities should apply only to appliances on the list of industry-approved wood stove models from the Alaska Department of Environmental Conservation (ADEC).

It should be noted that ENV’s rationale for supporting installation of new wood appliances as replacements for older uncertified wood appliances is based on observed PM emissions reduction between certified and uncertified appliances.<sup>28</sup> The NESCAUM report does not refute existing data showing that on average operating certified wood stoves emit significantly less than uncertified wood stoves, though it notes that emission reductions are less than expected based on the EPA test standards.

Since 2016, the WSEP has been favouring non-wood burning replacement appliances by providing larger incentives to those appliances, and in 2019 non-wood burning options became the majority of replacements. This WSEP evaluation makes several recommendations to increase the promotion and incentives for non-wood burning options. Where incentives continue to be provided for new certified wood-burning appliances, it is recommended that ENV review and if appropriate reference the ADEC industry-approved list of models referenced in the NESCAUM report.

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<sup>27</sup> Northeast States for Coordinated Air Use Management (NESCAUM). (2021). [Assessment of EPA’s Residential Wood Heater Certification Program](#).

<sup>28</sup> Characterization of Organic Compounds from Selected Residential Wood Stoves and Fuels. (2000). Environment Canada.