

PUGET SOUND CLEAN AIR AGENCY
RESIDENTIAL WOOD SMOKE REDUCTION INITIATIVE:
BURN BAN FINANCIAL ASSISTANCE *EX ANTE*
PROGRAM ASSESSMENT

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INTRODUCTION

Household wood combustion is a major contributor to ambient fine particle levels in the United States. Roughly one-half to two-thirds of the residential wood combustion in the United States occurs in wood stoves as opposed to fireplaces¹. Particulate matter (PM) is formed during combustion reactions in wood stoves, with PM, measuring a diameter of 2.5 micrometers (μm) or less ($\text{PM}_{2.5}$), being the primary form of particulate emissions from residential wood stoves. $\text{PM}_{2.5}$ is associated with increased incidence of asthma attacks² and other upper respiratory problems³ as well as increased acute and chronic mortality rates⁴ due to long-term exposure. The United States Environmental Protection Agency (EPA) monitors air quality in the U.S. and has issued National Ambient Air Quality Standards (NAAQS) –annual standards for air quality that must be maintained by states in order to provide public health protection.

In 2009, the EPA classified parts of Pierce County, Washington as a “nonattainment area” due to unhealthy levels of fine particle pollution during the three year period from 2006-2008. An area is designated as nonattainment if it too frequently exceeds either the daily or annual $\text{PM}_{2.5}$ standard, or if relevant information indicates that it contributes to violations in a nearby area. Pierce County’s nonattainment status will remain in effect until the three-year average and 24-hour levels of PM can be shown to remain below required standards⁵. The Puget Sound Clean Air Agency (PSCAA) is a regional air quality regulatory agency with a mission to conduct outreach and administer programs that will help bring Pierce County back into attainment. This evaluation is an analysis of program alternatives that the PSCAA can use to reduce wood smoke particulate emissions in the nonattainment area (also called the Smoke Reduction Zone) in Pierce County, Washington without increasing the cost burden on low-income and low-wage earning households.

RESEARCH OBJECTIVES AND METHODS

The objectives of this evaluation are first to identify potential burn ban assistance program models and then to evaluate the financial viability of each alternative. To accomplish these objectives, a number of research methods were utilized. First, the research team compiled lists of key individuals and organizations to interview in the Pierce County region regarding existing air quality, weatherization and utility programs and potential funding sources for these programs. The team then conducted phone and in person interviews with roughly 20 of these individuals over a six-

¹ P. M. Fine, G.R. Cass, and B.R.T Simoneit “Chemical Characterization of Fine Particle Emissions from the Wood Stove Combustion of Prevalent United States Tree Species” *Environmental Engineering Science* (2004) 24 (6), pp 705 - 721

² J.C. Slaughter, T. Lumley, L. Sheppard, J.Q. Koenig, G.G. Shapiro “Effects of ambient air pollution on symptom severity and medication use in children with asthma” *Annals of Allergy, Asthma, & Immunology*, 91 (4) (2003), pp. 346–353.

³ D.H. Jaffe, M.E. Singer, A.A. Rimm “Air pollution and emergency department visits for asthma among Ohio Medicaid recipients, 1991–1996” *Environmental Research*, 91 (1) (2003), pp. 21–28.

⁴ F. Laden, J. Schwartz, F.E. Speizer, D.W. Dockery “Reduction in fine particulate air pollution and mortality: extended follow-up of the Harvard Six Cities Study” *American Journal of Respiratory and Critical Care Medicine*, 173 (6) (2006), pp. 667–672.

⁵ These standards were established as part of the federal Clean Air Act of 1990 and include a maximum 3-year average ($15 \mu\text{g m}^{-3}$) as well as a 24-hour standard ($35 \mu\text{g m}^{-3}$). USEPA National Ambient Air Quality Standards for Particulate Matter: Final Rule *Federal Register*. 71(200) USEPA (2006) pp. 61143–61233

week time frame (See Appendix A for a complete list of interviewees). A set of questions was developed to compile information from these individual's perspectives on program aims, costs, key challenges, and other relevant information. Following this, a *Summary of Funding Research* was produced. Next, these preliminary findings were discussed with PSCAA staff to get feedback and provide strategic direction for analysis of program alternatives. In the final phase of this evaluation, two program alternatives were designed and financial models developed to analyze each alternative's financial feasibility and associated fine particle emission reductions. This report provides financial analyses of the program alternatives and recommends steps to move forward with program development.

BACKGROUND

During certain times of the fall and winter, the Tacoma-Pierce County nonattainment area does not meet the federal health standard for the maximum level of fine particle pollution allowed in a 24-hour period. More than half (53 percent) of the fine particle pollution measured at the Tacoma South L Street monitor during the fall and wintertime is from wood smoke, with another 25 percent from diesel and gasoline vehicles⁶. Of the 53 percent of fine particle pollution from wood smoke, uncertified wood stoves are estimated to contribute just over half of this pollution, with certified wood stoves contributing more than a quarter, fireplaces a little less than a quarter and pellet stoves less than 1 percent.

The highest pollution levels occur at night and early in the morning when more people are home and using their wood stoves and fireplaces⁷. The Tacoma-Pierce County nonattainment area lies approximately 20 miles south of Seattle, Washington. It covers most of the greater Tacoma area and surrounding Pierce County. An outline of the nonattainment area and the approximate location of the monitoring sites in the area can be found in Appendix B.

*BURN BANS*⁸

During the times that the air does not meet federal health standards, the PSCAA issues a burn ban for the communities that reside within the nonattainment area. A burn ban is a mandatory, yet temporary, order that restricts the use of wood stoves and fireplaces, as well as outdoor burning. There are two types of burn ban stages that can be issued – Stage 1 and Stage 2 – as illustrated in Figure 1. During a Stage 1 burn ban, no burning is allowed in fireplaces and uncertified wood stoves, unless it is the household's only adequate source of heat and they have an approved exemption from the agency⁹. This includes the use of manufactured logs such as Duraflame® or Java-Logs®. Households can use pellet stoves, EPA-certified wood stoves and natural gas or propane

⁶ Tacoma-Pierce County Clean Air Task Force Report and Recommendations, Dec. 2011

⁷ Tacoma-Pierce County Clean Air Task Force Report and Recommendations, Dec. 2011

⁸ Puget Sound Clean Air Agency website: <http://www.pscleanair.org/airq/burnban/default.aspx> accessed 3/4/13.

⁹ From Puget Sound Clean Air Agency's Solid Fuel Burning Device Limitation Exemption Application 2012-13. "Adequate source of heat" means a heating system designed to maintain seventy degrees Fahrenheit at a point three feet above the floor in each normally inhabited room. If any part of the heating system has been disconnected, damaged, or is otherwise nonfunctional, the Agency shall base the assessment of the adequacy of the design on the system's capability prior to the disconnection, damage, improper maintenance, malfunction, or occurrence that rendered the system nonfunctional.

fireplaces¹⁰. During a Stage 2 burn ban, no burning is allowed in any fireplace, pellet stove or wood stove (certified or not), unless it is the household’s only adequate source of heat and they have an approved exemption from the Agency. Households can use natural gas or propane fireplaces. Regardless of the stage, no visible smoke is allowed and all outdoor burning is prohibited during a burn ban, even in areas where otherwise permitted by law.

FIGURE 1: PUGET SOUND CLEAN AIR AGENCY’S BURN BAN STAGES¹¹

KNOW THE DIFFERENCE IN STAGES



Use of fireplaces and uncertified wood stoves and inserts prohibited. Pellet stoves, EPA certified wood stoves and inserts are allowed. Outdoor burning prohibited.



All wood burning prohibited, including pellet stoves. Outdoor burning prohibited.

NO Fireplaces
Uncertified Wood Stoves
Uncertified Wood Inserts
Outdoor Burning

OK Certified Wood Stoves
Certified Wood Inserts
Pellet Stoves & Inserts

**ALL
WOOD BURNING
PROHIBITED**

The agency estimates the number of burn ban days each year to be approximately fifteen Stage 1 days and three to five Stage 2 days (see Table 1). Non-compliance with the burn bans can result in a \$1,000 violation fee for each occurrence. Historically, the Pierce County area has experienced between 3 and 26 burn ban days per year¹².

TABLE 1 ANNUAL BURN BAN DAYS IN PIERCE COUNTY, 2009-2013

Year	Stage 1 burn ban days	Stage 2 burn ban days	All burn ban days
2013 (year to date)	6	3	9
2012	18	0	18
2011	10	5	15
2010	3	0	3
2009	11	15	26

Source: Puget Sound Clean Air Agency

¹⁰ The State of Washington has strict laws about wood stoves and other wood burning devices. Most states use federal Environmental Protection Agency (EPA) emission standards for fine particles to determine which wood burning devices can be sold. To be sold in Washington, all wood burning devices must meet both EPA’s standards *and* Washington’s stricter standards. http://www.ecy.wa.gov/programs/air/indoor_woodsmoke/wood_smoke_page.htm

¹¹ PSCAA website: <http://www.airsafepiercecounty.org/burn-bans>, accessed 4/26/13.

¹² PSCAA website: <http://www.pscleanair.org/airq/burnban/historicalrecord.aspx>, accessed 3/4/13.

NO OTHER ADEQUATE SOURCE OF HEAT

On burn ban days (particularly Stage 2 days), residents in the nonattainment area are prohibited from using a wood stove to heat their home unless it is the household's only adequate source of heat. During burn bans, field inspectors canvas the area for visible smoke and issue Notices of Violation (NOV) to properties that violate the burn ban. In certain cases, a household can qualify for an exemption by completing a [Solid Fuel Burning Device Limitation Exemption Application](#) and certifying that it is not within the household's ability to comply with the burn ban. The exemption was designed to identify those homes that have no other way, besides wood burning, to sufficiently heat their homes. The exemption is based on: a) whether the wood-burning device is the only source of heat available in the home; or b) whether an alternative type of heating appliance (gas/oil furnace or electric baseboard/heat pump) is available but not able to heat the home adequately as designed. If the exemption application is approved, the Notice of Violation is closed. During the 2012-2013 heating year, the agency received over 200 exemption requests and approximately 50% have been approved. The exemption is not automatically given if the appliance is broken or if the homeowner cannot afford the alternative energy source heating costs, however homeowners that qualify may be referred to low income assistance programs to help with the heating costs.

PSCAA'S WOOD STOVE REPLACEMENT PROGRAM

In 2007 the PSCAA began implementing marketing and outreach programs to educate the residents on air quality issues associated with wood smoke and offering incentives to switch to cleaner, more efficient heating devices. Through these programs, the agency has replaced over 1,500 uncertified wood stoves – approximately six percent of the estimated 24,000 uncertified wood stoves in the area. In 2012, new regulations were enacted that require that all uncertified wood-burning devices in the Tacoma-Pierce County nonattainment area to be removed or rendered inoperable by September 30, 2015. Although the regulations do not go into effect until January 1, 2015, the PSCAA enacted a wood stove replacement program designed to assist residents in replacing old, uncertified wood stoves with cleaner, more efficient heating devices¹³. The program was originally funded from a \$1.5 million grant from Washington State's Department of Ecology and is being used in three ways to help remove, recycle or replace a portion of the 24,000 uncertified devices in the Tacoma-Pierce County nonattainment area¹⁴.

1. **Wood stove buy-back program** –Households receive up to \$350 by turning in their old, uncertified wood stove (\$200 if the agency picks up the stove).
2. **No-cost replacement program** – Low-income households (defined as having household income up to 150% of the federal poverty level or \$35,325 for a family of four) with a wood stove manufactured before 1995 can receive a replacement device for no cost.
3. **Replacement lottery (full cost award and point-of sale discounts)** –Two lotteries were held for non-low-income households and ten grand prizes (free replacements) were awarded. All other non-low-income households that entered the lottery received \$1,000 and \$1,500 point-of-sale discounts to use when replacing old stoves/inserts with cleaner heating devices.

¹³ Article 13: Solid Fuel Burning Device Standards, Section 13.07, <http://www.pscleanair.org/regulated/reg1/1-13.pdf>

¹⁴ Air Safe Pierce County website, accessed 4/18/13. <http://www.airsafepiercecounty.org/wood-stove-program>

Replacement devices include electric ductless heat pumps, whole house electric heat pumps, gas inserts and gas furnaces. Washington State-certified wood stoves, inserts and pellet stoves are available as replacement options for low- income households. The wood smoke replacement program runs through June 30, 2013. As of 4/23/13, there were approximately \$673,000 in funds remaining. The PSCAA expects to conclude the current program with about \$450,000 to carry-over to the next cycle of the program¹⁵.

TABLE 2: SUMMARY OF PSCAA'S 2012/2013 WOOD STOVE REPLACEMENT PROGRAM

Program	Number of households participating as of 4/23/13	Number of households participating as of 6/18/13
Wood stove buy back	138	198
No-cost replacement - low income	150	178
Point of sale discount (or full cost award lottery) - non low income	86	116
TOTALS:	374	492

Source: Puget Sound Clean Air Agency

OTHER ASSISTANCE PROGRAMS AVAILABLE

Once a household has been identified as eligible for financial assistance, there are a number of existing programs established to help address their needs, particularly for households qualifying as low-income (defined as 150% of federal poverty level). These programs include home repair programs, energy assistance programs, weatherization programs and wood stove replacement programs. The majority of these programs are targeted to low-income households. A complete list of programs can be found in Appendix C.

ASSESSMENT OF BURN BAN FINANCIAL ASSISTANCE ALTERNATIVES

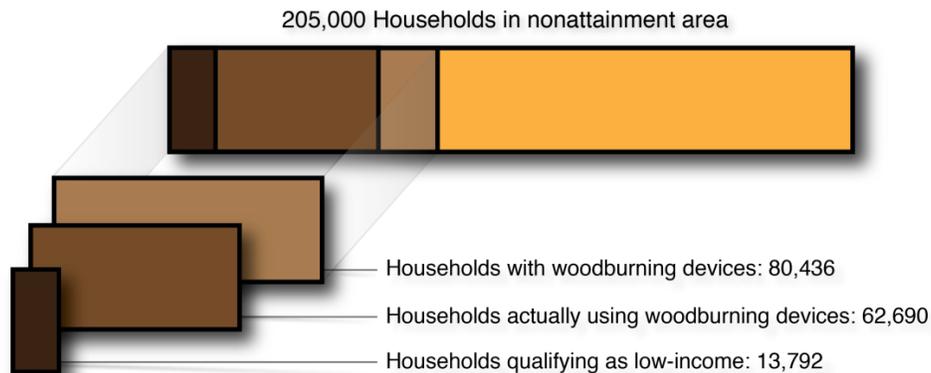
The objective of a burn ban financial assistance program is to provide support to low-income households that do not have the financial means to comply with the burn ban either because they cannot afford an alternative source of heat or their alternative source of heat is not working as designed. In addition, some households that do comply with the burn ban are economically disadvantaged and either live without heat on the burn ban days or are forced to reduce expenditures on another primary need such as food. The potential burn ban financial assistance programs assessed in this evaluation are short-term (two to three year) programs designed to assist the economically disadvantaged. They are designed to be used in partnership with federal and state weatherization programs and utility-backed bill assistance programs. In this way, a portfolio of solutions is available to help households on burn ban days as well as facilitate their compliance with the upcoming deadline mandating replacement of all uncertified wood stoves by September 2015.

¹⁵ Update on Puget Sound Clean Air Agency's wood stove replacement program provided by Amy Warren, project manager, on 4/23/13 and 6/18/13.

TARGET MARKETS

Based on a 2010 Occupied Household Census estimate for the nonattainment area, PSCAA estimates that there are approximately 205,000 households in the area including 80,436 households with a wood burning device in their home, as illustrated in Figure 2. While it is difficult to estimate the exact number of households that actually use their wood burning device on a regular basis, a 2007 survey indicated that 78 percent (62,690 households) have used their device as least once over a twelve month period¹⁶. Of the households that reported having used their wood- burning device, an estimated 13,792 (22%) would fall into the low-income target market for the burn ban assistance program. Low income is defined as annual household income that falls below 150% of the federal poverty guidelines – or less than \$35,325 for a family of four¹⁷. Some of these low income households may burn wood for financial reasons (to save money on heating bills or furnace in disrepair) however it is not known how frequently they use their wood burning device or how many households comply with the burn bans.

FIGURE 2: HOUSEHOLDS IN NONATTAINMENT AREA



The remaining households with wood burning devices fall into three categories and would not be eligible for burn ban financial assistance.

1. Low-wage earning households with income above the designated 150% federal poverty level but below 200% (annual household income between \$35,325 and \$47,100 for a family of four). These households do not qualify for low-income assistance, however many cannot afford to replace their wood-burning device with a cleaner alternative or repair an alternative heating source device that is not working.
2. Households that economically can afford alternative heat sources, but choose wood to save money or for ambiance.
3. Households that only have wood for heat and either violate the burn ban or go without heat (these households are exempt from burn ban if they meet the “no other adequate source of

¹⁶ National Research Center, *Puget Sound Clean Air Agency Indoor Wood-Burning Emission Inventory Survey of King, Kitsap, Pierce, and Snohomish Counties*, 2007

¹⁷ Federal Register, Annual update of the HHS Poverty Guidelines, January 24, 2013, <https://www.federalregister.gov/articles/2013/01/24/2013-01422/annual-update-of-the-hhs-poverty-guidelines#t-1>.

heat” exemption criteria and may be eligible for low-income weatherization and energy assistance programs).

Of the 62,690 households that have and use a wood-burning device in their home, the number of households that fall into the “low-wage earning household” category – between 150 and 200% of the federal poverty level – are estimated to be 5,642, with approximately 1,907 of these having used a wood-burning device over the last year¹⁸. This assessment focuses on the low-income and low-wage target groups.

CRITERIA FOR BURN BAN FINANCIAL ASSISTANCE PROGRAMS

There are a number of alternatives that the PSCAA can consider to incentivize households in the Tacoma-Pierce County nonattainment area to discontinue use of wood-burning devices on burn ban days. These options include direct subsidies to households, utility supplied incentives and rebates, weatherization programs, wood stove replacement programs and need-based assistance programs. The alternatives were considered based on the following key criteria:

1. The program must have the ability to assist the economically disadvantaged.
2. The program must be able to be implemented during the 2013-2014 heating season.
3. The program must have short term emission reduction benefits, but ultimately must lead to long term changes in behavior and permanent reductions in fine particulates.

Based on discussions with key stakeholders, two program alternatives were selected for additional analysis. The first program is working in partnership with regional utility partners to develop an on-bill utility credit program designed to give the 13,792 low-income households that own a wood-burning device a one-time credit on their utility bill to offset the additional cost of using a non-wood source of heat on burn ban days. The second program alternative does not address the burn ban day problem per se but instead addresses how low-wage earning households could replace an uncertified wood-burning device with a cleaner, more efficient alternative to comply with the September 30, 2015 mandate banning the use of non-certified wood burning devices. New devices range from between \$3,000 to \$5,000 to purchase and install and are prohibitively expensive to many low-wage earning households. Specifically, this program aims to increase the income-qualifying range of the PSCAA’s existing wood stove replacement program from a maximum 150% of federal poverty level upward to 200% in order to assist the 1,907 low-wage earning households in switching from uncertified wood stoves to alternative heating source devices. These two programs are analyzed in more detail in the following section.

¹⁸ Estimates for the number of low-income and working poor households provided by Erik Saganic, Air Quality Specialist, Puget Sound Clean Air Agency on 4/13/13.

FINANCIAL FEASIBILITY EVALUATION

To assess the financial feasibility of the burn ban financial assistance programs, a series of [Excel-based financial models](#) were developed for an on-bill utility credit program, a wood stove replacement program for low-wage households and a wood stove replacement loan program. Key inputs to the models are based on data provided in the 2010 Occupied Household Census, home heating cost information calculated by PSCAA, and particulate estimates also provided by PSCAA. The models use these data inputs to estimate the annual cost and emission impacts of two potential assistance programs over a two and a half year period (2013-2015).

1) ON-BILL UTILITY CREDIT PROGRAM

DESCRIPTION OF PROGRAM

A potential solution to reduce fine particulate matter during burn ban days is to incentivize the 13,792 low-income households that use a wood-burning device to instead use an alternative heating source (electricity, natural gas) during burn ban days. One way to accomplish this is to implement an on-bill utility credit program in coordination with local utility companies. In an on-bill credit scenario, a household would apply for an annual subsidy and if approved (based on income and proof of wood-burning device), would receive a credit on their utility bill equal to the estimated cost of using the alternative heating source on the burn ban days.

FINANCIAL ANALYSIS MODEL

This analysis uses the target population of 13,792 households that live in the nonattainment area, have used a wood burning device and are under the federal poverty threshold. These households have not necessarily violated the burn ban ordinance, but would benefit from a financial incentive allowing them to use an alternative heat source on burn ban days. This model uses a range of burn ban days per year to project the costs and emissions impacts of an on-bill credit program. For the *Low Annual Burn Ban Day Scenario*, six burn ban days are used, and 14 and 23 days per year are used for the *Average* and *High Annual Burn Ban day Scenarios*, respectively.

In the past, the participation rate for low-income household assistance programs in the Pierce County region has been surprising low. PSCAA estimates that participation in their wood smoke replacement program has hovered around five percent and local utility Tacoma Power has indicated that only 93 low-income households participated in the Tacoma Power Aid program in 2012¹⁹. Based on the historical participation rates of similar programs, this financial analysis assumes that only ten percent of eligible households will apply for and receive the subsidy each year (1,379 households in the first year). A 10 percent reduction of eligible households in the second year is built into the model to reflect households' receiving certified stoves through other programs. The administrative costs to run such a program are estimated at 30 percent of the total

¹⁹ Tacoma Power Aid is a low-income household assistance program that provides a \$150 credit on the utility bill of qualifying households. 93 households participated in the program during the November 1, 2011 – May 30, 2012 heating season. So far, 81 households have participated in the November 1, 2012 – May 30, 2013 heating season. Data provided by Francis Artis, Tacoma Power Customer Solutions Supervisor in an email dated 5/17/13.

cost based on historical costs estimates for similar programs. These assumptions are summarized in Table 3.

Table 3: Assumptions for Burn Ban On-Bill Utility Credit Program Model

INPUTS		
Number of Households <150% of the federal poverty line in the NAA:		13,792
Cost per burn ban day times the number of households per heat source, at 100%		\$ 96,869
Program coverage (share of qualified homes)		10%
Cost per burn ban day times the number of households per heat source, at program coverage		\$ 9,687
Program reduction as households get new devices in Year 2		10%
Administrative costs (% of total costs)		30%

SUMMARY OF RESULTS

Based on the model, the following summary results emerge. As expected, the annual program cost is highly dependent on the number of burn ban days per year. With a daily cost of roughly \$9,700, if 10 percent of the eligible households receive assistance, the annual program cost ranges from \$71,780 in a year with a low number of burn ban days to \$275,157 for a year with a high number of burn ban days – a very wide range (see Table 4). In a “low year,” each household receives \$42 in financial assistance, in an average year \$98, and in a high year \$162. Particularly in the high year scenario, this amount will impact household budgets as it amounts to roughly 0.4% of household income for households at 150% of the federal poverty line (\$35,325 for a family of 4).

TABLE 4: ON-BILL UTILITY CREDIT PROGRAM FINANCIAL FEASIBILITY PROGRAM SUMMARY

PROGRAM SUMMARY - UTILITY ON-BILL CREDIT			
	Low	Historic	High
Number of burn ban days per year	6	14	23
Total households participating	2,620	2,620	2,620
Average annual cost	\$ 71,780	\$ 167,487	\$ 275,157
Total cost of program (2 years)	\$ 143,560	\$ 334,974	\$ 550,314
Average subsidy per household	\$ 42	\$ 98	\$ 162
Maximum possible average daily particulate reduction at 10% participation rate (µg/m³)	0.73		

To understand the result of higher participation, a sensitivity analysis was performed to outline a variety of participation scenarios. One scenario used different program coverage rates to estimate the number of households needed to participate in the financial assistance program to achieve a particulate emissions reduction (assuming they burned wood previous to the program) in compliance with EPA air quality standards. According to PSCAA, the Pierce County region would need to reduce about 7.5ug/m³ to be below the standard. Our financial model indicates that 97% of income -eligible households must participate to reach this daily reduction and assumes that they all burned wood on burn ban days previous to the program. Although particulates reduction was not

an explicit program aim, such a number provides indicative evidence of participation rates needed to achieve the secondary benefit of improved air quality.

CONCLUSIONS

As part of its attainment plan, the Tacoma-Pierce County nonattainment area strives to reduce particulate emissions to about 7.5ug/m³ per day. However, if 10% of the 13,792 households who use a wood burning device participate in this program then this program alone will not achieve the desired goal. The 7.5ug/m³ goal is reached only when the program reaches 97 percent coverage – holding all other factors constant (i.e. concurrent wood smoke reduction programs) and with the highly unlikely assumption that all 13,792 households are using their wood burning devices on burn ban days.

Therefore, although the proposed burn ban financial assistance program has the potential to reduce fine particle emissions, for a number of reasons this may not be the most effective approach. First, relatively little is known about the target households and their behaviors, therefore reaching program participation targets might be costly and potentially distributed to households that are ineligible for the subsidy. In addition, it remains unclear how many of these households are already doing “the right thing”, i.e. not burning on burn ban days and how many are burning. The incentive here is mixed if the program aims to pay people who are currently in violation, or pay people who are already in compliance. Also, enforcement may be difficult and it will be a challenge to verify that households receiving the money actually switch to an alternative source of heat on burn ban days. Another challenge will be coordinating with the local utilities (Puget Sound Energy, Tacoma Power and local municipal utilities) to launch this program within the short time frame necessary. Finally, this program is expensive and may not be the best use of funds to achieve the stated goals in the long term. High administrative costs, especially for proof of income and evidence of an uncertified stove in the household place a high burden on the administrating agency.

Finally, if households begin to rely on the burn ban assistance money, it may be difficult to change behaviors and comply with the September 2015 mandate to remove all uncertified wood stoves. Given these findings, it is worth exploring alternatives that could produce equivalent benefits with a lower life cycle cost.

2) WOOD STOVE REPLACEMENT PROGRAM FOR LOW-WAGE EARNING HOUSEHOLDS

DESCRIPTION OF PROGRAM

This program model was elected for analysis as it addresses the long-term challenge of how to initiate structural change in wood burning behavior for households that cannot afford the upfront capital (even with the current program’s incentive) to purchase a certified woodstove or repair a non-working alternative fuel device, but do not qualify for financial assistance. As such, this is not a burn ban program at all, but addresses how to transition to cleaner, more efficient sources of heat amongst this “gap group” of low-wage earning households.

It is estimated that approximately 1,907 households in the nonattainment area may use a wood-burning device as a source of heat but do not have the financial means to switch to an alternative

during burn ban days. These households do not qualify for low-income assistance programs (their income is above the 150% federal poverty line designation) and therefore do not have the financial means to comply with the state mandate to stop using uncertified stoves by September 30, 2015. This group falls into two categories: 1) households who have an alternative heating device in their home that is broken or in need of repair; and 2) households that use wood as a source of heat and do not have a cost-effective alternative. Under this program scenario, both groups would receive a grant equal to a 100% reimbursement of the cost to switch to more efficient alternatives either through the repair of an existing non-wood device or the replacement of an uncertified wood-burning device. In either case, this program would require the removal of the wood burning device from the home.

FINANCIAL ANALYSIS MODEL

PSCAA’s existing Wood Smoke Replacement program, aimed at low-income households below 150% of the federal poverty line, currently experiences an estimated five percent participation rate. This analysis assumes that participation in the program for the low-wage earning group (between 150 and 200% of the federal poverty line) will increase from five percent during in the first year (2013) to 25% participation in 2015 (the year that all uncertified stoves must be converted or replaced) for a 40% total participation rate (or 764 households). It is further assumed that approximately 60% of participating households will choose to replace their device at an average cost of \$5,000 and the other 40% participating will repair an existing non-wood heating device (and remove the wood heating device from the house). Table 5 summarizes these assumptions.

TABLE 5: ASSUMPTIONS FOR LOW-WAGE EARNING WOOD STOVE REPLACEMENT PROGRAM MODEL

INPUTS				
Total Number of HHds	1,907	(150% < X < 200% of federal poverty line)		
	2013	2014	2015	2016
Participation Rates	5%	10%	25%	0%
Administrative Costs (% of total costs)	20%	20%	20%	20%
Woodstove Replacement Costs				
	Average Cost	Percentage of Hhlds	Amount of grant	Percentage paid by grant
Replacement devices	\$ 5,000	60%	\$ 5,000	100%
Repaired devices	\$ 3,000	40%	\$ 3,000	100%

SUMMARY OF RESULTS

With 40% of low-wage earning households participating, the total cost over the three year program is \$3.8 million with an average cost of \$5,040 per household as summarized in Table 6. By reducing the number of uncertified wood stoves in the area by 764, the resulting reduction in emissions is 17.88 tons of fine particulate or a 0.43 ug/m³ reduction to the 24-hour standard²⁰.

²⁰ Fine particulate reduction estimates provided by Erik Saganic, PSCAA Air Resources Specialist on 4/18/13. Every 100 uncertified stoves and inserts replaced with a non-wood source of heat results in 2.34 tons of fine particulate per year reduced or 0.056ug/m³ reduction to the violating 24-hour standard concentration.

TABLE 6: SUMMARY OF RESULTS FOR LOW-WAGE EARNING WOOD STOVE REPLACEMENT PROGRAM

PROGRAM SUMMARY	
Total households:	764
Percentage of qualified households:	40%
Total cost of program	\$ 3,850,560
Average cost per household:	\$ 5,040
PARTICULATE REDUCTION SUMMARY	
Tons of fine particulate reduced	17.88
ug/m3 reduction to 24-hour standard	0.43

CONCLUSIONS

While accomplishing the long-term goal of changing wood-burning behaviors and permanently reducing fine particle emissions through the removal of uncertified wood stoves, this program only reduces daily emissions by 0.43 ug/m³ – not nearly enough to move the region out of nonattainment status. However, looking at it through a public health cost-effectiveness lens provides another perspective. Although this reduction may seem minor, the resulting public health cost savings far exceed the upfront capital investment. In a 2012 health benefit analysis, the EPA estimated that a reduction of one ton of PM_{2.5} results in \$280,000 in health benefits²¹. These health benefits exceed the \$215,385 per ton cost of the low-wage earning household program. In addition, this program targets a population that is currently not served by either weatherization programs or current woodstove replacement programs. The proposed low-wage earning households program is similar to PSCAA’s current Wood Stove Replacement Program and would be fairly straightforward to set up. If used in conjunction with the other programs, this program could assist households in the nonattainment area without current access to funds to help them comply with the current burn ban policy or the imminent woodstove prohibition.

3) ADDITIONAL PROGRAM CONSIDERATION – WOOD STOVE REPLACEMENT LOAN

The Washington State legislature is currently reviewing a proposal to provide funding for wood stove replacement in the Tacoma-Pierce County region and, if approved, could be used to fund the Wood Stove Replacement program for the low-wage earning households outlined above. But while this program is a promising first step in reducing particulate emissions in the short- and long-term, additional financial assistance may be needed to help all residents fully comply with the September 30, 2015 mandate to remove all uncertified wood stoves from the nonattainment area.

²¹ Fann, Baker and Fulcher, *Characterizing the PM_{2.5}-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S. (2012)*. <http://www.epa.gov/airquality/benmap/sabpt.html>, accessed 5/21/13.

One possible solution for long term wood stove compliance and the permanent reduction of PM_{2.5} emissions is the development of a low-interest rate wood stove replacement loan program with a local financial partner – possibly Craft3, a non-profit community development financial institution, headquartered in Ilwaco, Washington. Craft3’s mission is to strengthen economic, ecological and family resilience in Pacific Northwest communities. As part of this mission, it currently administers two loan programs to assist homeowners with energy efficiency upgrades and septic system replacement²².

HOME ENERGY EFFICIENCY LOANS

In partnership with the City of Seattle’s Community Power Works and Clean Energy Works Oregon, Craft3 offers loans for home energy efficiency retrofits. The Home Energy Efficiency Loan allows homeowners to finance 100% of their residential energy efficiency upgrade with repayment through the homeowner’s monthly utility bill. The Seattle program offers fixed interest rates from 3.49% to 4.49% (depending on income qualification) and the average loan size is \$12,500²³.

CLEAN WATER LOANS

Craft3 offers loans to help property owners in certain Washington counties repair or replace their failing septic systems. The average loan is \$20,000 and it can cover up to 100% of the costs of designing, permitting, installing, and maintaining a new septic system. Interest rates for this program are tiered based on the property owner’s income²⁴.

CONSIDERATIONS FOR A WOOD STOVE REPLACEMENT LOAN PROGRAM

Craft3 has indicated a willingness to discuss developing a consumer loan program to encourage the replacement of uncertified wood stoves. This program could be structured similar to the existing Home Energy Efficiency and Clean Water loan programs; however a viable loan program would need additional time to establish. Therefore, a likely target date for launch of this program would be prior to the 2014-2015 heating season, or in conjunction with the September 30, 2015 compliance deadline as an option to assist homeowners with the replacement of their uncertified wood stove. While this alternative will not assist the PSCAA with reaching its short-term emission reduction goals, it could help with the long-term goal of eliminating uncertified wood stoves in the region.

A few key elements of a successful partnering financial institution include an understanding of the target market, the credit profile of the borrowers, the amount of the loans and the source of funding:

Target market: Up to 21,000 households.

Of the 62,690 households in the nonattainment area that have used their wood burning device, approximately 21,000 use an uncertified wood burning device²⁵. The program would aim to help

²² Craft3 website, <http://www.craft3.org/About>, accessed 5/3/13.

²³ Craft3 website, <http://www.craft3.org/Borrow/CPW>, accessed 5/3/13.

²⁴ Craft3 website, <http://www.craft3.org/Borrow/CleanWater>, accessed 5/3/13.

²⁵ Estimates for the number of households with an uncertified wood stove in the home provided by Erik Saganic, Air Quality Specialist, Puget Sound Clean Air Agency on 12/21/12.

all households in any income range access funds to replace an uncertified wood stove with a cleaner, more efficient alternative.

Amount of loan: \$3,000 - \$10,000

The amount of the loan will depend on the type of device the homeowner chooses as a replacement and if weatherization assistance is also included in the loan. Lower loan amounts are not as attractive to financial institutions due to the administrative costs necessary to set up each loan however might be feasible if the loans were streamlined, simple, and turnkey. Variables that affect a financial institution's ability to lend at lower loan amounts include whether there is a reserve set aside for loan losses, the cost of program operation, the credit risk profile of the potential borrowers and how strong enforcement/regulation is (i.e. how strongly will the September 2015 mandate be enforced)²⁶.

Funding for loan program: dependent on type of financial institution

For a lender that is not a depository institution (e.g. Craft3), the full amount of loan capital would be needed upfront. For other financial institutions (e.g. Puget Sound Cooperative Credit Union), the establishment of a loan loss reserve fund may be required. Loan loss reserve funds keep a percentage of outstanding loans, generally 5 – 10 percent, in a separate account to cover anticipated loan losses. When interest payments on a loan have not been made for a reasonable period, usually 90 days, a financial institution may draw upon the reserve to cover the expected loss. Considering the small loan amounts and credit risk profile of the households, the additional transaction cost may require an operating subsidy for the lender as well.

MOVING FORWARD: RECOMMENDATIONS AND CONCLUSIONS

Given the short time frame and limited resources with which to develop a program to address Pierce County's current air quality problems, pushing forward a program will be a challenge. Yet, there is a strong desire by all key stakeholders to implement a program to overcome the hurdles and many of the critical elements are already in place. PSCAA has developed expertise and proven mechanisms for achieving success in improving air quality in the region. Local utilities, particularly Tacoma Power and Puget Sound Energy, have expressed a willingness to investigate the feasibility of providing an on-bill utility credit program for low income residents on burn ban days. Utilities also have resource limits for implementing such programs. Other key stakeholders such as Pierce County's extensive community services network and the community development funding institution Craft3 are all aware of the program needs and have expressed interest in moving forward with discussions.

However, before moving forward several important elements need to be considered. First, the primary agency tasked with selecting and running a new program is PSCAA. PSCAA has been highly successful in developing creative and strategic programs to reduce air pollution in the region, but has limited additional capacity at present to design and run new programs. As such, further

²⁶ Information on loan requirements provided by Desiree Sideroff, VP, Craft3, in an email dated 5/22/13.

scrutiny must be given as to which agency or organization would run either of the alternatives described in the pages above. Technical skills such as community engagement, marketing, financial management, and air quality analysis are all needed to run such a program. It remains unclear at present whether or not the Washington State legislature will include funds for additional wood stove removal and replacement in its next capital budget. The programs described above will each require capital of varying degrees.

Understanding the strengths, weaknesses and ultimate viability of the two programs described above will rely on careful understanding of how these alternatives contribute to reaching PSCAA's larger goals and objectives. If providing financial assistance to low income households is a major priority, along with the anticipated emissions reductions if households indeed don't burn, the on-bill utility credit program may be a good use of state resources. More thorough understanding of households in this group and their potential compliance with the burn ban is needed. Specifically, outreach to non-English speakers and senior citizens will be critical. It may be the case that longer term structural change is a priority rather than the immediate impacts of a two year financial subsidy. In this case using funds to increase coverage of a wood stove replacement program may be a more viable model.

Based on this ex-ante assessment of program alternatives for providing financial assistance to reduce fine air particulates in the Pierce County nonattainment area, the following recommendations emerge.

First, although the burn ban subsidy associated with the *On-Bill Utility Credit Program* would provide financial relief to some households, limited knowledge of households' potential compliance – even with the subsidy – diminish the anticipated effectiveness of the program in reducing burning on those days. There are more than two years remaining until non-certified wood smoke burning becomes illegal in all cases. As such, this program provides temporary relief to households but will not ultimately address the non-certified wood stove removal challenge when households can burn wood at little to no cost. Research on behavioral change and household energy use suggests that policies aimed at changing habits are less effective than those aimed at changing the household infrastructure (i.e. certified stove, energy efficient appliances, etc.)²⁷. For these reasons, the burn ban subsidy may not be the most effective program to achieve the agency's stated goals.

More promising is the proposed *Low Wage Household Wood Stove Replacement program*. This program can help to accomplish the long-term goal of changing wood-burning behaviors and permanently reduce fine particulate emissions through the removal of uncertified wood stoves. This not only helps to reduce PM_{2.5} emissions on burn ban days, but also permanently eliminates the source of emissions from the nonattainment area. In addition, this program targets low-wage earning households, a population that is currently underserved by existing weatherization and

27 Charlie Wilson and Hadi Dowlatabadi "Models of Decision Making and Residential Energy Use" Annual Review of Environment and Resources. (2007) Vol. 32: 169-203.

assistance programs. However, due to the limited funds available for this program and low anticipated participation, this program is only expected to reduce daily emissions by 0.43 ug/m³ – beneficial from a health perspective, but not nearly enough to move the region out of nonattainment. Therefore, the Low Wage Household Wood Stove Replacement Program must be used in conjunction with other weatherization and assistance programs in order for the PSCAA to meet its emission reduction target.

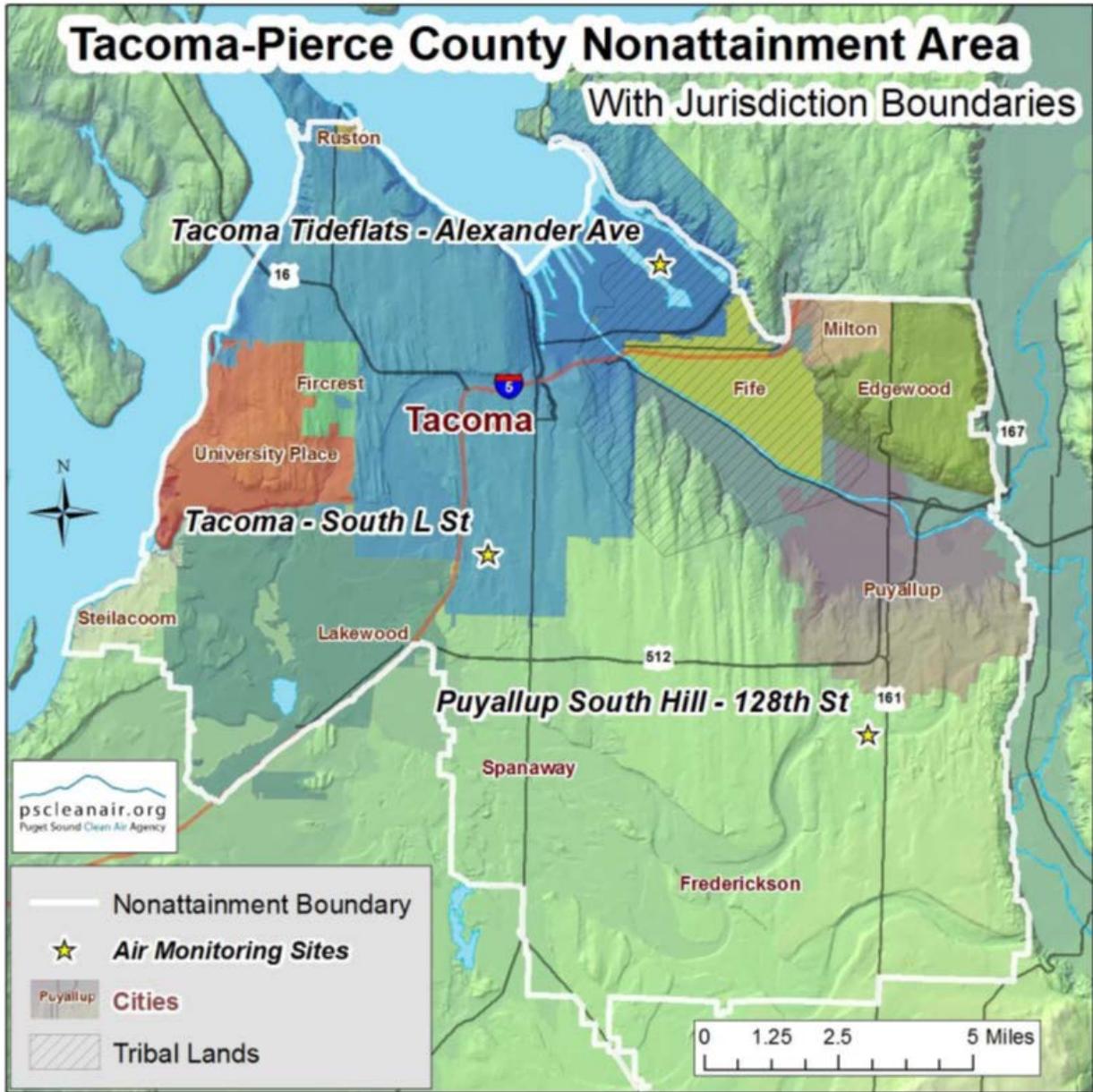
It is also recommended that consideration be given to a *Wood Stove Replacement Loan program*. This program could follow the Low Wage Household Wood Stove Replacement program to assist all Tacoma-Pierce County homeowners with the replacement of uncertified wood stoves as the September 30, 2015 deadline draws near. Ultimately, it is these long term solutions – ones that change behaviors both structurally and behaviorally – that will help bring Pierce County back into attainment.

APPENDIX A – ACKNOWLEDGEMENTS

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Neal Fann	Risk and Benefits Group	Environmental Protection Agency – Office of Air and Radiation
Graham Fitzsimons	Managing Partner	EC/R Incorporated
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Desiree Sideroff	Vice President	Craft3 (CDFI)

APPENDIX B – MAP OF TACOMA-PIERCE COUNTY NONATTAINMENT AREA



Source: Washington State Department of Ecology

APPENDIX C – PIERCE COUNTY ASSISTANCE PROGRAMS

APPLIANCE PROGRAMS

TACOMA-PIERCE COUNTY WOOD STOVE PROGRAM

1. **Recycling Buy Back** - Receive up to \$350 for the removal and recycling of eligible wood-burning devices. <http://airsafepiercecounty.org/>
2. **Low Income Wood Stove Replacement** - Free replacement for qualifying households with an uncertified device (incomes up to 150% of federal poverty level). <http://airsafepiercecounty.org/>
3. **Replacement Drawing** – Lottery for five grand prizes (full cost of replacement) and up to 250 \$1,500 point-of-sale discounts for a wood stove replacement (Note: The last drawing was held on 3/13/13). <http://airsafepiercecounty.org/>

TACOMA POWER

1. **Heat Pump Rebate** - Up to \$1,200 in rebates to install a high-efficiency heat pump system. <http://www.mytpu.org/tacomapower/conserves-energy/conserves-at/heat-pumps/Default.htm>
2. **Ductless Heat Pump Rebate** - \$800 rebate or a seven-year, zero-interest loan toward the cost of a ductless heat pump and basic installation. Income-qualified customers may be eligible for a grant that pays the entire cost. <http://www.mytpu.org/tacomapower/conserves-energy/conserves-at/ductless-heat-pumps/Default.htm>

PUGET SOUND ENERGY

1. **Ductless Heat Pump Rebate** - \$1,200 rebate to replace existing electric zonal (baseboard, cable, wall heater), electric hydronic or electric forced-air furnace with a ductless heat pump. <http://www.pse.com/savingsandenergycenter/ForHomes/Pages/Ductless-Heat-Pump-Rebate.aspx>
2. **Geothermal Heat Pump Rebate** - \$1,500 rebate to install an Energy Star geothermal heat pump. <http://www.pse.com/savingsandenergycenter/ForHomes/Pages/Geothermal-Heat-Pump-Rebate.aspx>
3. **Forced Air Furnace to Air Pump Rebate** - \$1,500 rebate to upgrade an existing electric forced-air furnace to an air-source heat pump with a 8.5 HSPF and 14 SEER or higher. <http://www.pse.com/savingsandenergycenter/ForHomes/Pages/Forced-air-Furnace-to-Air-source-Heat-Pump-Conversion-Rebate.aspx>
4. **Air Source Heat Pump Rebate** – Up to \$800 rebate for customers who do not qualify for heat pump conversion rebates can qualify for this rebate if equipment meets efficiency requirements. <http://www.pse.com/savingsandenergycenter/ForHomes/Pages/Air-source-Heat-Pump-Rebate.aspx>

WEATHERIZATION PROGRAMS

TACOMA POWER

Up to \$3,450 when homeowner insulates ceilings, floors and walls and seals heating air ducts. Tacoma Power will pay up to \$1,000 the replacement of inefficient windows. In most cases, any remaining cost can be financed with a seven-year, zero-interest loan. Qualifying low-income customers are eligible for a grant that typically covers the entire cost of new windows and insulation. <http://www.mytpu.org/tacomapower/conserves-energy/conserves-at/weatherization/Default.htm>

METROPOLITAN DEVELOPMENT COUNCIL

This program is designed for qualifying low-income residents within the city limits of Tacoma and provides access to services that will improve energy conservation, including insulation and furnace repairs. <http://mdc-tacoma.org/housing/weatherization>

USDA RURAL DEVELOPMENT - SECTION 504 REPAIR PROGRAM

Provides a grant or 1% interest rate loan program for weatherization or repair to homes of very low-income households (less than 50% of the federal poverty level). <http://www.rurdev.usda.gov/wa/sfh504lg.htm>

HEATING ASSISTANCE PROGRAMS

TACOMA POWER

1. **Discount Rate** – Provides 30% discount on all services for customers over 62 years and low income or disabled and low income. <http://www.mytpu.org/customer-service/payment-assistance.htm>
2. **Tacoma Power Aid** – Provides \$150 credit for 12 months to low income customers. <http://www.mytpu.org/customer-service/payment-assistance.htm>

LOW INCOME HOME ENERGY ASSISTANCE PROGRAM (LIHEAP)

A one-time per program-year grant to assist eligible low-income households with heating costs. Payment is made directly to the heating vendor and the amount paid is based on the household's last 12 months' heating costs.

1. **Pierce County Department of Community Connections** (Pierce County residents) <http://www.co.pierce.wa.us/index.aspx?NID=1280>
2. **Metropolitan Development Council** (Tacoma residents) <http://mdc-tacoma.org/housing/energy-assistance>