

NONATTAINMENT CONSUMER RESEARCH

**A Summary of Frequent and
Occasional Wood Burner
Demographics**

September 20, 2012



BCRA 

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SUMMARY OF AUDIENCES

During the campaign strategy development phase, three core audiences were identified for nonattainment outreach efforts. Each is critical to the success of the two overarching campaign messages - enhanced enforcement of burn bans and removal of uncertified wood stoves. The audiences are summarized as **Frequent Wood Burners (FWB)**, **Occasional Wood Burners (OWB)**, and **Stove Owners Who Do Not Use Them (DNU)**.

BCRA analyzed the findings of previous research efforts and modeled current data available through the United States Census and American Community Survey to better clarify the geographic and demographic characteristics of specifically FWB and OWB for the purposes of qualitative study and message development. There was general consensus that the DNU audience is difficult to pinpoint, both geographically and psychographically, and was therefore not studied under this effort. Messaging for the DNU audience would primarily be focused on removal of uncertified devices, burn ban enforcement and clean burning practices.

The following audience profiles characteristics were drawn from census-tract level analysis.

Audience	Region	Age	Income	Education
FWB	Eastern NAA	35-65	\$68,000 (median)	90% HS Grad or Higher
OWB Supplmts	Western NAA	35-65	All levels evenly	97% HS Grad or Higher
OWB Ambience	Western NAA	45-65	50% over \$70,000 ann.	99% HS Grad or Higher

RESEARCH APPROACH

Defining the target markets for nonattainment communication and community outreach was completed in three phases and used a variety of data sources and previous studies. The research team included staff from Puget Sound Clean Air Agency (PSCAA) as well as analysts at design and strategy consulting firm BCRA.

The team began by identifying the major wood burner types, then used relevant characteristics of each type to identify where each audience was most densely saturated in the nonattainment area (NAA). Finally the demographic qualities of target geographies were aligned to build an audience profile on which to base the first year's campaign efforts.

On July 18, 2012, PSCAA and BCRA held a Strategy Charette to plan and discuss the key tactics, audience types, and marketing vehicles appropriate for the first year of the campaign. During the workshop, participants from City of Tacoma, Washington State Department of Ecology, Tacoma-Pierce County Health Department, Pierce County, and PSCAA staff collaborated to abstractly outline audiences. Their insights were most often based on past experience and speculation.

Following the charette, BCRA began a geographic targeting exercise using primarily Geographic Information Systems (GIS) technology. Using GIS, BCRA modeled a series of data sets from the 2010 United States Census and American Community Survey (ACS). The ACS is a nationwide survey designed to provide communities with reliable and timely demographic, social, economic and housing data every year. Survey data was obtained directly from the U.S. Census Bureau. The intended outcome of the GIS modeling was to identify geographic priorities for targeting each audience type.

Once geographic priorities were set and confirmed by PSCAA, BCRA extracted demographic data from the target regions. Once again, this data was obtained from the U.S. Census Bureau. Wherever possible, BCRA utilized the projected data sets for 2011. Demographic information was taken at the census tract level to avoid hyperlocal analysis that could potentially produce greater uncertainty and make alignment with future marketing strategies a challenge.

On several occasions, it was not possible to geographically model certain audience types because data sets were not available. In those situations, BCRA turned attention to previous studies made available by PSCAA and their agency partners. Numerous studies, each offering varying results, were reviewed by BCRA's research team. Relevant findings are summarized in this report.

PART I: AUDIENCE PROFILES

Frequent Wood Burners

For research purposes, frequent wood burners (FWB) in the NAA are defined as those who use a wood stove or fireplace insert as their *primary heat source*. Secondary or supplemental heat sources may or may not be available to them. Motivating factors for using wood are detailed in the demographics and focus group portions of this document.

Because FWBs rely primarily on wood burning devices to heat their homes, and because open-hearth fireplaces are inefficient heat devices, use of fireplaces was included in research on OWBs. This premise allowed us to closely target and identify users who burned frequently (4+ times per week) during the heating season, with heating as the primary motivation.

Using data sets from the American Community Survey, Pierce County Assessor, and Puget Sound Energy, the highest density of FWBs were identified at the census tract level.

The following is a summary of the findings and conclusions that were drawn from each.

Geographic Identification

Map Title: Primary Fuel Source = Wood

Helps identify location of Frequent Wood Burners

In order to understand the location of residents in the NAA who burn wood as their primary source of heat, information was drawn directly from the 2010 ACS. Data from the 2008 Pierce County Assessor survey, which shows exact locations of wood stoves in the NAA, was then overlaid on the primary heat source = wood map. Using both data sets, it was possible to identify areas of both identified wood stoves and people who answered “wood” as their primary source of heat in the ACS survey.

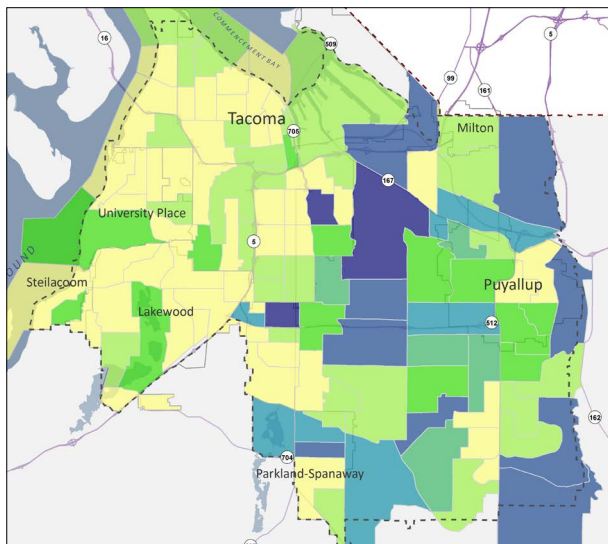


Figure 1: Frequent Wood Burner Census Tracts

The figure 1 map below shows the location of FWBs. Darker areas represent census tracts with the highest densities.

Census tracts with both a large density of presumed stoves and a high concentration of households identifying wood as their primary heating fuel were considered for future analysis under the FWB profile.

Objective: Identify higher concentrations of people who burn wood for primary heat

Data Source: ACS

Conclusion: Higher concentrations in the Eastern portion of the NAA

Limitations: Needs to be paired with additional data to be useful.

Location of wood stoves (presumed) in the NAA

Identify location of Frequent Wood Burners

One of the foundational components of the study is understanding where wood stoves exist throughout the NAA. Data for this depiction [Figure 2] was obtained from the Pierce County Assessor by way of PSCAA. Approximately 80% of the points are wood stoves. The remaining 20% are likely gas stoves.

There are higher densities of presumed stoves in the southeast portion of the NAA, as well as a pocket in the University Place area. This is better visualized in the heat map [Figure 3].

Combined Wood Stoves & Primary Heating Fuel

Identifies density of Frequent Wood Burners

BCRA paired the findings of the American Community Survey data on wood as a primary fuel for home heating with presumed wood stoves in the NAA. A priority of census tracts emerged. The highest concentration of presumed FWBs [Figure 4] rose to the top, primarily on the eastern half of the NAA.

Darker colors identify census tracts with higher concentrations of FWBs as a share of the total population in that region.

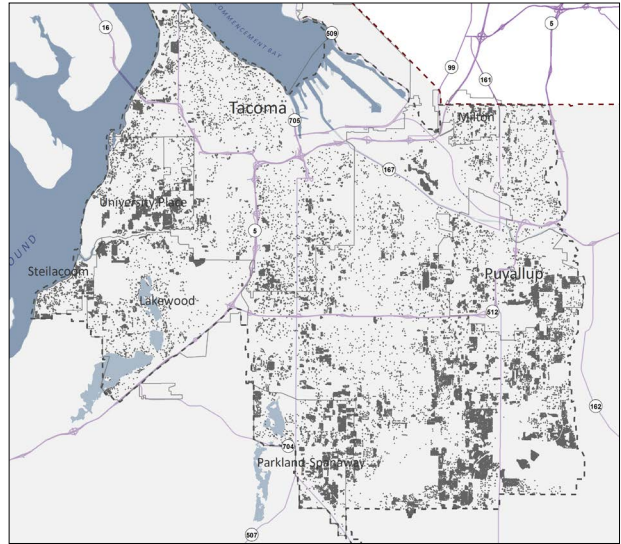


Figure 2: Locations of wood stoves in NAA

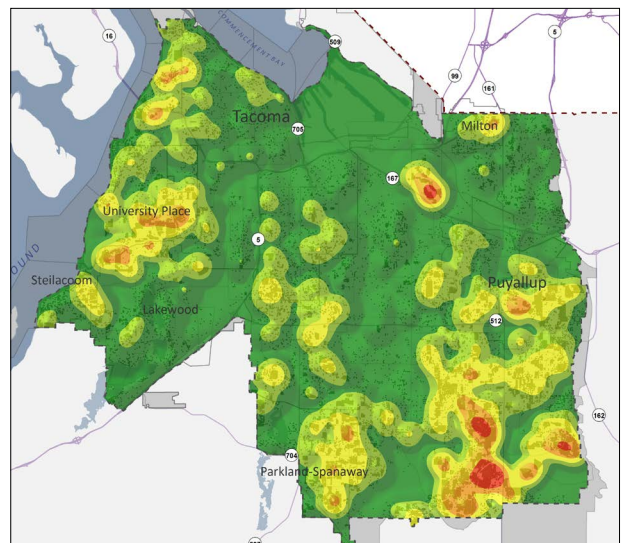


Figure 3: Visualization of higher densities of wood stoves in NAA

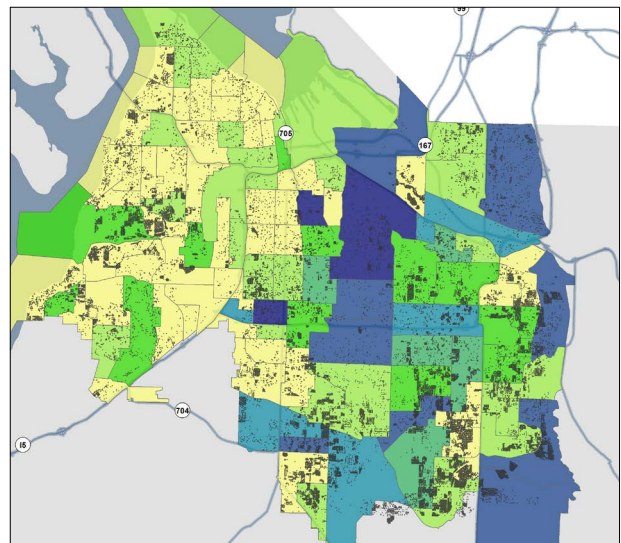


Figure 4: Combined wood stoves and primary heating fuel wood

Locating Gas Utility Consuming Households

Helps validate Frequent Wood Burners Geographies

Understanding that identifying the location of presumed wood stoves likely includes a percentage of residents whose stove is actually gas, we used data gathered from the largest local natural gas provider, Puget Sound Energy, to identify the largest concentrations of gas customers within the NAA [Figures 3 and 4]. Then, with the stove overlay data from the 2010 Pierce County Assessor, we were able to confidently identify which tracts within the NAA have the highest number of gas stove users. Those tracts were therefore ruled out for further demographic study under the FWB audience profile, for year 1.

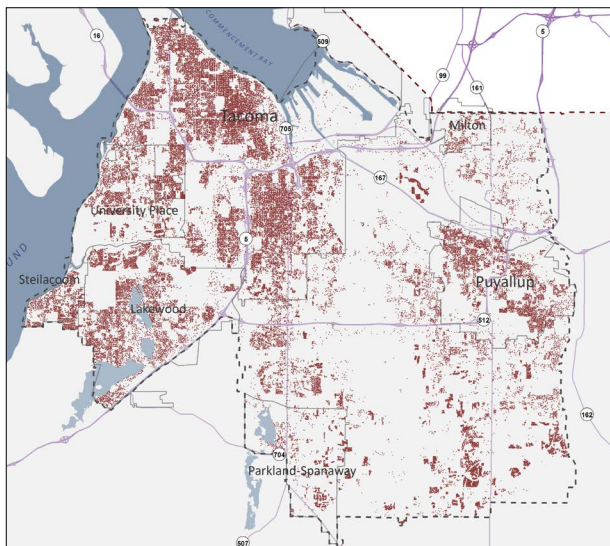


Figure 5: Location of gas customers within NAA

Objective: Locate gas customers in NAA

Data Source: Puget Sound Energy

Conclusion: Higher concentrations in the Western portion of the NAA where gas is more readily available as an option

Limitations: Inverse data only data available from PSE, so conclusions need to be drawn about where customers are actually located.

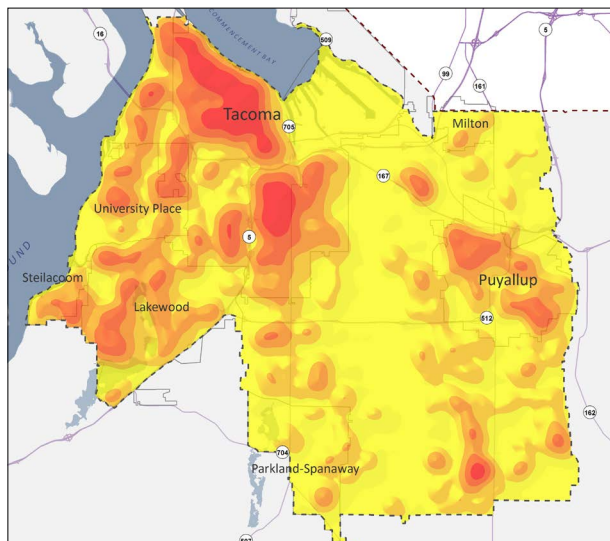


Figure 6: Visualization of higher densities of gas customers in NAA

Objective: Identify higher concentrations of gas customers

Data Source: PSE

Conclusion: Higher concentrations in the Western portion of the NAA where gas is more readily available as an option

Limitations: Inverse data only data available from PSE, so conclusions need to be drawn about where customers are actually located.

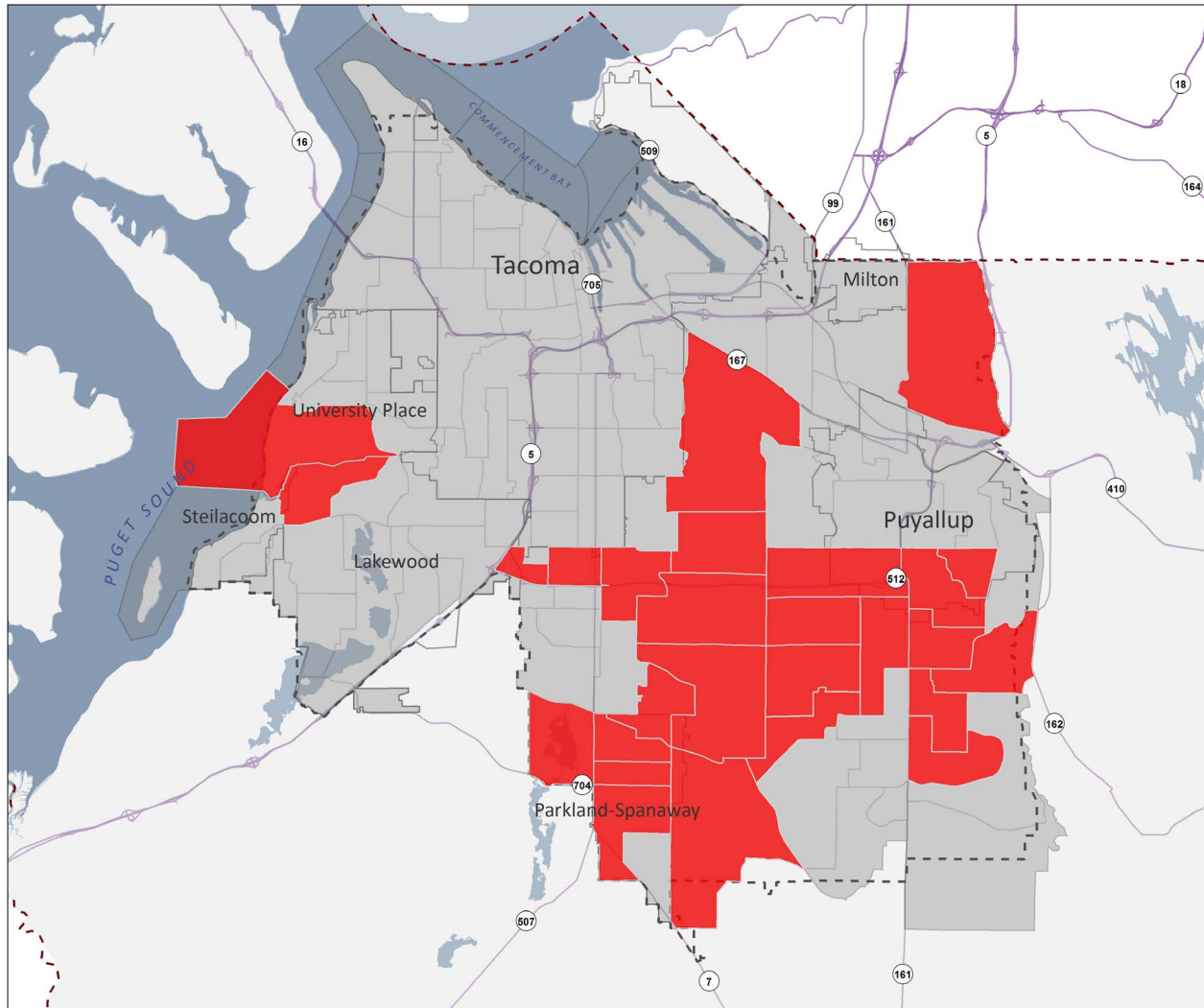


Figure 7: Frequent Wood Burner Audience Geographic Audience Identification (red)

Frequent Wood Burner Geographic Audience Identification (Year One)

Identifies Frequent Wood Burners in NAA

A combination of all previous maps yields an identification of key tracts within the NAA from which to draw further demographic data for year 1 consumer research [Figure 7]. Identified census tracts appear in bold red.

Demographic Characteristics of FWB Tracts

Once audience geographies have been located, demographic characteristics are an important next step to take to create a hypothetical aggregate. The goal of research for this effort was to understand what subsets exist within the overall Pierce County population and form characteristics of a typical member of each audience.

Age

Average (mean) ages in the FWB identified tracts within the NAA varied from 36 years to 50 years old. Taking averages from all FWB identified tracts, we identified the median age as 42 years with subsequent age breakdowns:

- 20-29: 20%
- 30-39: 18%
- 40-49: 21%
- 50-59: 19%
- 60-69: 13%
- 70+: 10%

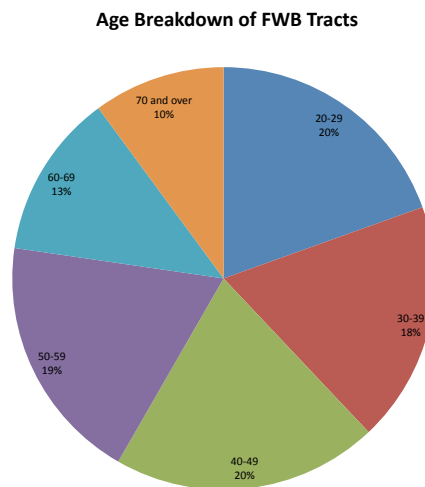


Figure 8: Age Breakdown of FWB Tracts within the NAA

To engage the largest percentage of the target FWB audience, it is of particular interest to engage people in the 35-65 age range.

Ethnicity

Caucasians comprise 75% of the population in the FWB tracts. The next largest population is Hispanic, at 9%. High densities of Caucasians appear in Edgewood, South Hill, and generally in the eastern portion of the NAA. Larger African-American densities are seen in Parkland and Midland tracts. University Place and Midland offer the largest Asian densities, and the highest population of Native Americans appears in the Waller tract.

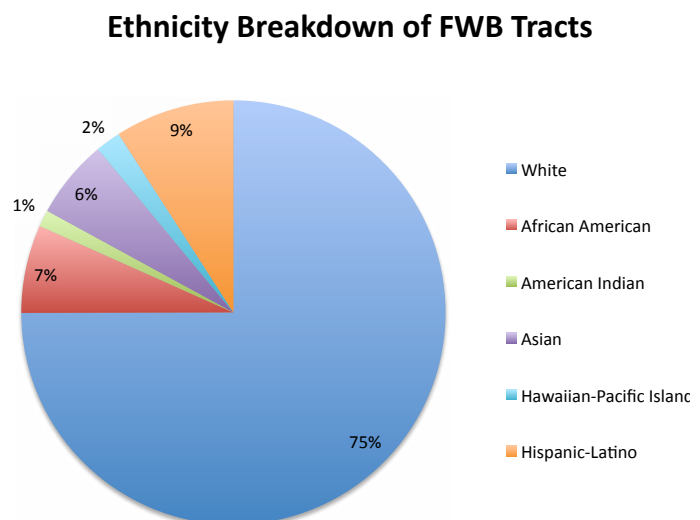


Figure 9: Ethnicity Breakdown of FWB Tracts within the NAA

Median Income

The median household income for the FWB tracts in the non-attainment area is \$62,968. Highest median income occurs in a South Hill tract (\$87,794), and lowest occurs in Parkland (\$33,000k).

Education Level

The majority average for education levels falls under “high school or GED” followed closely by “some college, no degree.” A closer look reveals lowest (less than 9th grade) levels of education in the Parkland area (10%), which also corresponds with lower incomes and multiple ethnicities. Midland follows with 8% under the 9th grade level.

Average Education of Residents in FWB Tracts

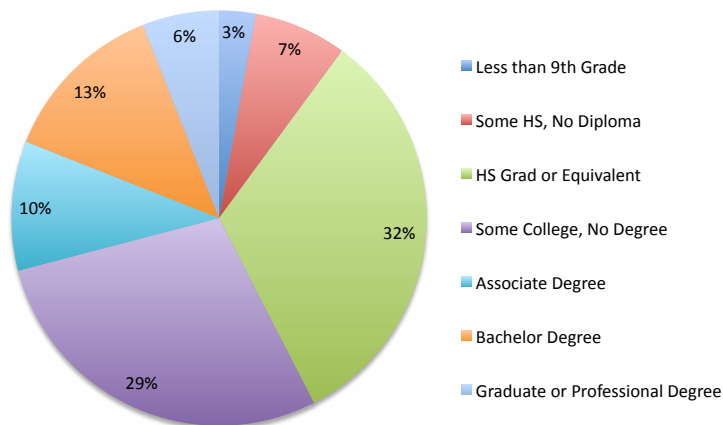


Figure 10: Average Education Levels of Residents in FWB Tracts within the NAA

Household Size

Average household size in the FWB tracts is 2-3, and 68% of households are between 1-3 people.

Household Size of FWB Tracts by Percentage

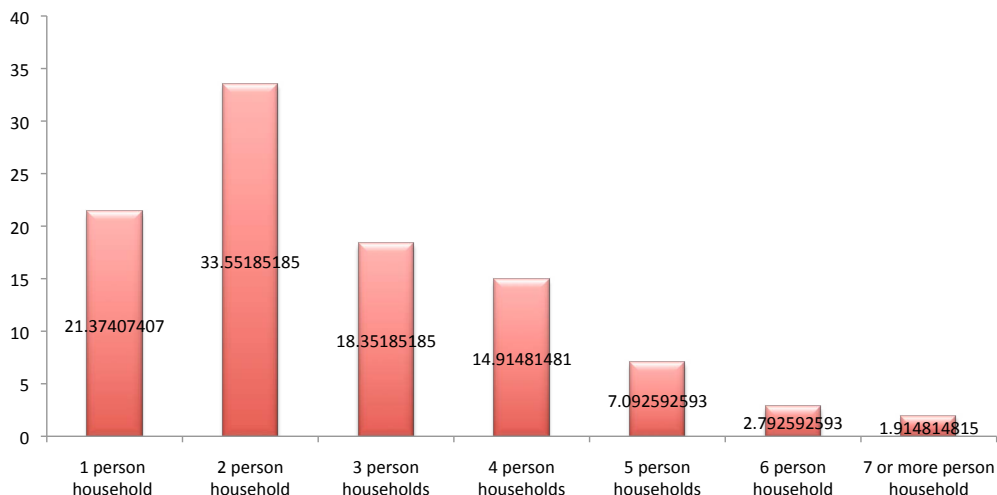


Figure 11: Household Size of FWB Tracts within NAA, by Percentage

Homeowners vs. Renters

Homeowners on average make up 68% of the FWB tracts, while renters comprise 32%. Highest percentages of homeowners are in areas of South Hill (95%), University Place (85%), and Frederickson (84%).

Highest percentages of renters come from Parkland (88%), the South Hill/512 interchange area (64%) and Midland (56%).

Homeowners vs. Renters in FWB Tracts

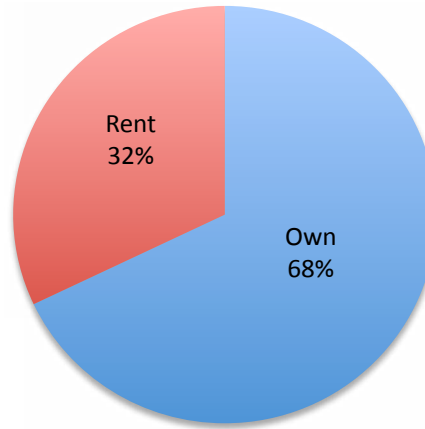


Figure 12: Percentages of Homeowners vs. Renters in FWB Tracts in NAA

Languages

In the FWB identified tracts, 88% speak only english at home.

Primary Language Spoken in Identified FWB Tracts

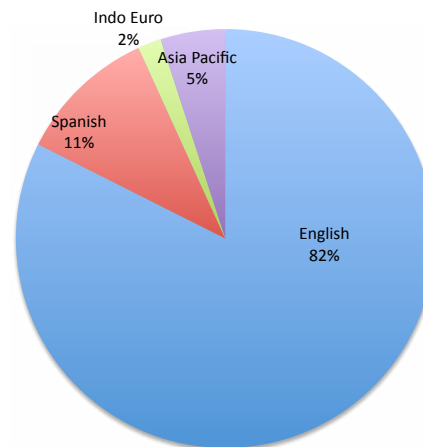


Figure 13: Percentages of the Primary Language Spoken at Home in FWB Tracts within NAA

Occasional Wood Burners

For research purposes, occasional wood burners (OWB) in the NAA are defined as those who burn wood occasionally in a wood stove, fireplace insert or open hearth fireplace during the heating season. Motivating factors for using wood are detailed in the demographics and focus group portions of this document. The OWB audience has two specific segments that should be considered during messaging:

Those who wish to supplement their primary source of heat

Those who burn wood for the ambience

As opposed to a frequent wood burner (FWB), who is defined as using a wood stove or fireplace insert as their primary source of heat, both OWB audience segments are inclusive of potential use of open-hearth fireplaces. With a large number of estimated fireplaces within the NAA, this definition dramatically increases both the number and geographical target areas of OWBs in the NAA.

Unfortunately, clearly targeting each segment using trusted data sets was a challenge during the profiling exercise. Limited geographic data sets were available, at a smaller level than zip codes, to be used to filter wood burning behavior. Many data sources offering insights into the OWB audience did not include enough respondents to allow BCRA to draw confident conclusions at a micro-market level.

However, a collection of past studies helped the research team hone in on geographies where OWBs are more likely to reside in higher proportions than FWBs. The following is a summary of those data points and the conclusions that were drawn from each.

Density of wood stoves and all primary home heating fuel sources, except wood and gas *Helps identify Occasional Wood Burners and Stove Owners Who Don't Use Them*

In order to understand where devices that are either not being used or are lightly used in the NAA, we need to understand which areas of the NAA are most densely populated with residents who use something other than gas or wood as their primary heating fuel.

Figure 14 shows where wood stoves exist. Accounting for potential inaccuracies in identifying whether a stove is actually wood or gas, 80% of this data is likely to be wood burning stoves, with the remaining percentages being gas. The map also identifies census tracts and the proportion of households in that tract who identified utilizing a fuel other than wood or gas as their primary heating fuel in the ACS.

Census tracts with a large density of presumed stoves and a high concentration of households identifying something other than wood/gas as their primary heating fuel were identified as potential OWB tracts. In summary, these tracts tell us which regions of the NAA tend to have more households with wood burning devices either not being used or used lightly.

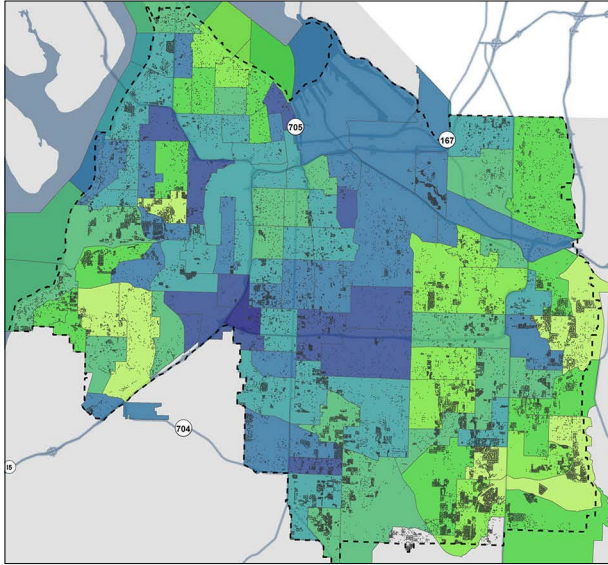


Figure 14: Wood stoves and primary heating other than wood and gas

Objective: Identify higher concentrations of people who burn wood for occasionally
Data Source: ACS, Pierce Cty Assessor

Conclusion: Higher concentrations in the western portion of the NAA

Limitations: Margin of error high regarding wood stove vs. gas stove identification

Map of “Fireplaces”

Helps identify Occasional Wood Burners

It is assumed, for research purposes that a resident does not use a fireplace as a primary heat source, due to low efficiencies and in some cases negative productivity ([California Energy Commission, 2012](#)). With that in mind, the occasional wood burner may look to their fireplace to create a desired indoor atmosphere or to potentially supplement their primary source of heat during colder than average temperatures.

Based on the density of fireplaces shown in this map [Figure 15], messages and imagery more geared toward an occasional fireplace wood burner should be deployed in higher density pockets of the NAA. This includes urban areas like Tacoma and Lakewood.

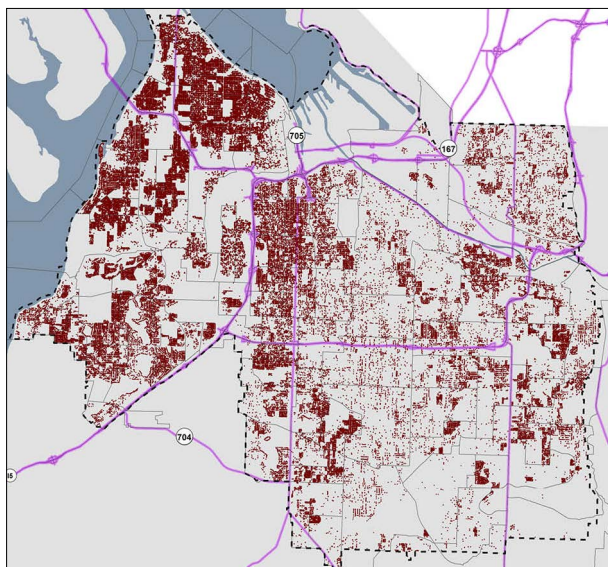


Figure 15: Locations of fireplaces within NAA

Objective: Identify location of people who potentially burn wood for ambience.

Data Source: Pierce Cty Assessor

Conclusion: Higher concentrations in the western portion of the NAA

Limitations: Assumptions must be made about whether a fireplace is actually in use.

Supplemental Heat Wood Burners

Supplemental heat wood burners are defined as those people relying on wood as a supplement to their main source of home heating. Specific situations/circumstances can vary, but may include the following possibilities:

- Burn during extreme cold outdoor temperatures
- Existing primary home heating system is inadequate during late fall to early spring
- Resident may use in a space disconnected from primary heating system (i.e. garage, shop)

BCRA reviewed the demographic characteristics of respondents who answered the question “Would you say this [fireplace without insert]/[fireplace with insert]/[wood stove] is used mainly as a primary heating source, supplemental heating source or for pleasure/aesthetics?” The following charts outline the key demographic findings relevant to the upcoming Pierce County NAA campaign.

An overwhelming difference in uses exists among device types for supplemental heat. The primary supplemental heat wood burning device is a fireplace with insert or wood stove.

DEVICE AND USE TYPE			
Use Type	Fireplace w/o Insert	Fireplace w/ Insert	Wood Stove
Primary	12 (6.4%)	22 (20.0%)	48 (36.1%)
Supplement	67 (35.6%)	67 (60.9%)	71 (53.4%)
Ambience	109 (58.0%)	21 (19.1%)	14 (10.5%)
Total Respondents	188	110	133

Figure 16: Supplemental Heat Wood Burner Device and Use Type

Age of Wood Burning Device Respondents for Supplemental Heat

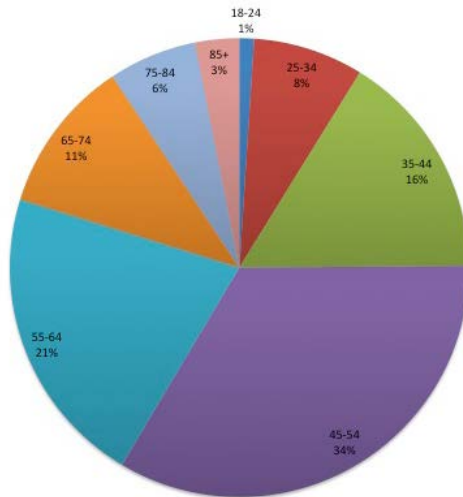


Figure 17

Nearly **three of four** people who use their wood burning device for supplemental heat are between 35 and 65 years old.

Education of Wood Burning Device Respondents for Supplemental Heat

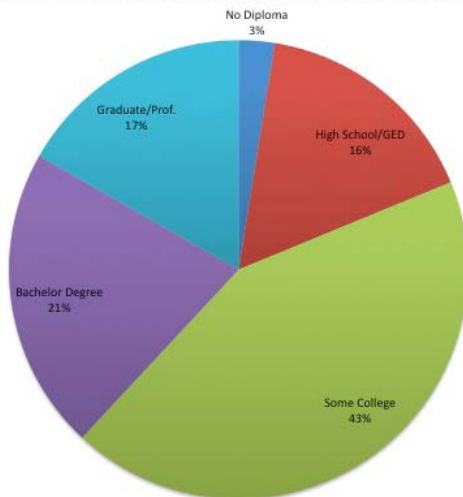


Figure 18

Supplemental heat OWBs are well educated, with at least 97% graduating from high school. This is well above the 87.6% national average.

(National Center for Education Statistics, 2012)

Income of Wood Burning Device Respondents for Supplemental Heat

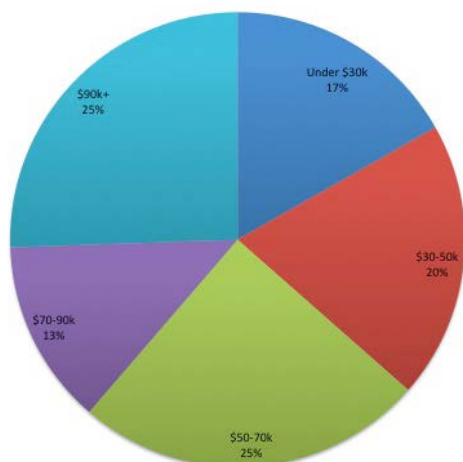


Figure 19

There does not appear to be a direct correlation between income and the OWB Supplemental Heat audience.

Ambience Wood Burners

The second segment of OWBs are those who burn wood for the ambience it provides in the home. Anecdotally, it is believed that during the holidays, when guests are over, and for weekend pleasure are some of the popular times when this audience burns wood.

BCRA reviewed the demographic characteristics of respondents who answered the question “Would you say this [fireplace without insert]/[fireplace with insert]/[wood stove] is used mainly as a primary heating source, supplemental heating source or for pleasure/aesthetics?” The following charts outline the key demographic findings relevant to the upcoming Pierce County NAA campaign.

An overwhelming difference in usage exists among device types for ambience. The primary ambience wood burning device is a fireplace without insert.

DEVICE AND USE TYPE			
Use Type	Fireplace w/o Insert	Fireplace w/ Insert	Wood Stove
Primary	12 (6.4%)	22 (20.0%)	48 (36.1%)
Supplement	67 (35.6%)	67 (60.9%)	71 (53.4%)
Ambience	109 (58.0%)	21 (19.1%)	14 (10.5%)
Total Respondents	188	110	133

Figure 20

Age of Wood Burning Device Respondents for Ambience

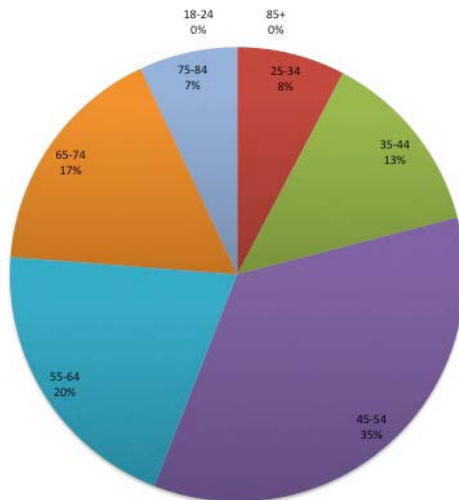


Figure 21

*Nearly **three of four** people who use their wood burning device for ambience are between 45 and 65 years old.*

Education of Wood Burning Device Respondents for Ambience

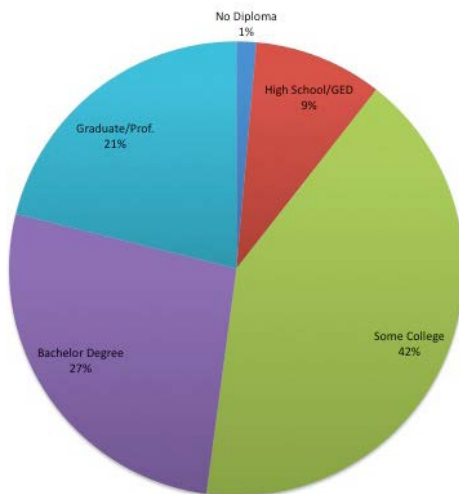


Figure 22

99% of people who use their wood burning device for ambience have at least graduated high school. This is well above the 87.6% national average.

(National Center for Education Statistics, 2012)

Income of Wood Burning Device Respondents for Supplemental Heat

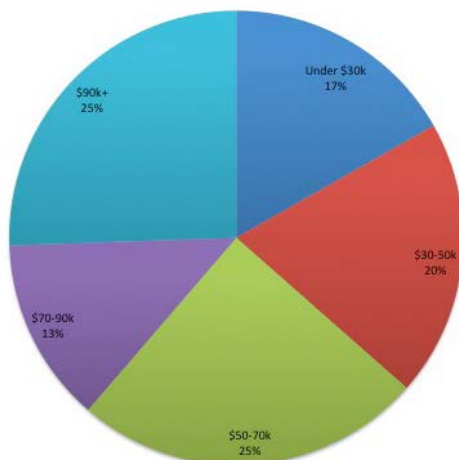


Figure 23

More than 50% of households who burn wood for ambience make more than \$70,000 per year.

Review of WSRP Leads & Participants Database

Helps understand the type of occasional wood burner among interested participants

Over the course of the past few years, PSCAA and its agency partners, through administration of the Wood Stove Removal Program (WSRP), have built and managed a database with over 2,700 prospects of successful participants.

BCRA reviewed records of those who responded to a question concerning the frequency of which they use their wood burning device. Responses ranged from “I never use my device” to “I use my device daily.” The research team was interested in people who responded with something in between (i.e. “a few times per month”).

The aggregated responses show a high propensity for OWBs in Lakewood (51%) and University Place (60%), supporting a general geographic focus on the western half of the NAA. We recommend additional analysis of participants to further break down the specific zip codes of Tacoma to better understand how the regions along Pacific Avenue south of Interstate 5 may vary from North Tacoma and towards Tacoma Narrows Bridge.

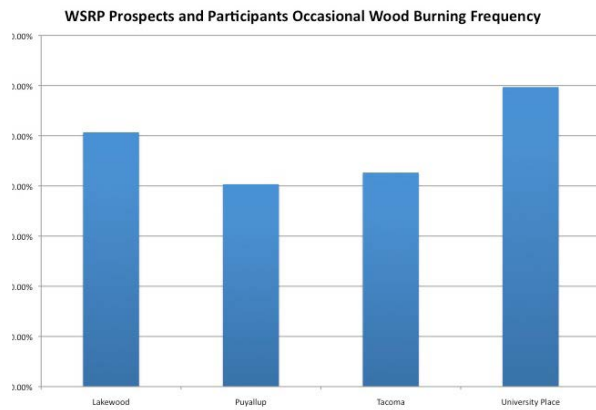


Figure 24

Exit Survey of 2011 WSRP Participants

Helps identify characteristics of participants who burn in the NAA

At the completion of a work order from the WSRP in 2011, participants were asked to supply some information to aid in future planning. BCRA was especially interested in comparing the respondent demographic qualities based on the quantity of wood they burned each year. Regardless of the quantity of wood, it was extremely apparent that **the age of a wood burner is most often over 45 years old and trending towards over 65 years old**. An overwhelming 95% of participants own their home, and over 80% burn wood to save money.

OWB Audience Profile Summary

While additional studies are recommended to better pinpoint demographic characteristics of both types of OWBs, the data that was available and modeled suggests the geographic priorities for messaging this audience type.

In particular, a higher concentration of OWBs exist in the western portion of the NAA. The demographic aspects of this audience that could be targeted for messaging include age and education. Both supplemental and ambience burners tend to be middle aged and well educated.

Owns a Stove, But Does Not Use (DNU)

The data sets used to arrive at the OWB audience profile - locations of stove within the NAA coupled with residents who provided any other primary heating fuels besides gas or wood - are the same data sets that would, in theory, pinpoint the DNU audience. However, in the absence of any hard data on whether those residents actually use their stove or not, it is impossible to further refine or narrow both the geographies and psychographics of this audience beyond this point.

It was determined that the best strategy for approaching the DNU audience was through a combination of targeting this audience under the OWB profile, and through specific outreach under the PSCAA bounty program. For year one purposes, messaging targeting OWBs who burn for ambience will cover the DNU audience, and will primarily focus on removal of uncertified stoves, secondarily on burn ban compliance and lastly on cleaner burning practices.

FOCUS GROUPS

A Discussion with Frequent and Occasional Wood Burners

September 20, 2012



Research Approach

To understand the psychographic aspects of the target audience, BCRA conducted two focus groups - one with self-identified frequent wood burners (FWBs) and the other with occasional wood burners (OWBs.) Both focus groups were moderated by Derek Lunde of BCRA and lasted 90 minutes. Participants were compensated with dinner, a gift bag from PSCAA, and a \$75 gift card to Fred Meyer.

Occasional Wood Burner Focus Group - 7 attendees

Monday, August 27, 2012, 5:30-7:00 PM

University Place Public Library

- June (University Place): 65-74, burns 2 days a week, burns for supplemental heat.
- Gilbert (Central Tacoma) 55-64. Burns 3 days a week for supplemental heat.
- Beth (Fircrest). 45-54. Renter. Burns 1 day a week for ambiance.
- Kristina (Parkland/Midland/Spanaway). 35-44. Burns once a week for supplemental heat.
- Emily (Central Tacoma). Burns 7 days a week for primary heat.
- Al (North/West Tacoma). 65-74. Burns 3x week for supplemental heat.
- Carrie (Central Tacoma). 35-44. Burns 2x week for supplemental heat.

Frequent Wood Burner Focus Group - 8 attendees

Tuesday, August 28, 2012, 5:30-7:00 PM

Puyallup Public Library

- Tammy (South Hill). 35-44. Burns 7 days a week for primary heat.
- Linda (Edgewood). 55-64. Burns 6 days a week.
- Richard (Parkland/512/Midland). 20-34. Burns 7 days a week.
- Catherine (Puyallup). 35-44. Burn 4 days a week.
- Mitch (South Hill) 45-54. Burns wood 7 days a week for primary heat.
- Jerry (Summit/Frederickson). 55-64. Burns 7 days a week for primary heat.
- Jeff (Edgewood). 45-54. Burns 7 days a week for primary heat.
- Annelise (South Hill). 55-64. Burns 5 days a week.

Each focus group utilized the same moderator's guide, which was approved by PSCAA prior to the start of the study. Participants were asked to sign a consent form in order to participate. Each focus group was both audio and video recorded to ensure the integrity of each participants' statements was retained during transcription and interpretation.

The key components of each study included background in wood burning, awareness of burn bans, perspectives on wood burning, motivations/behaviors of wood burning, evaluating heating alternatives and messaging reactions.

Overall, the studies were both extremely effective and enlightening. Most participants were willing to share information and were curious how the information will be used. In addition, most participants indicated interest in being contacted to take part in future studies related to the campaign.

Occasional Wood Burner Focus Group Highlights

- All participants agreed that wood heat is a *different* kind of heat. The feeling is something that cannot be replicated by other, cleaner-burning technologies (including gas inserts).
 - While pellet stoves may offer a close comparison to wood in terms of heat quality, participants did not feel comfortable with having to buy pellets from limited sources. In addition, there was general agreement that pellet stoves don't function during power outages.
- Most tended to begin burning at 7:00 PM. One participant noted that they choose not to add additional fuel to their stove after 7:00 PM because they indicated having a highly-efficient device.
- A large majority of participants were aware of burn bans, and yet there appeared to be some uncertainty over the differences between burn ban stages. A couple of participants exhibited heightened interest in the science of burn bans and what triggers them being called, and many expressed that "you can just tell" when a burn ban is likely to be called.
 - One indicated they did not know the difference between stages and simply opted to stop burning at the sign of any burn ban.
- Most participants believed learning when a burn ban is in effect is straightforward, and they tend to rely on the newspaper and major local news networks for that information. It's most commonplace to look for burn ban information in the weather forecast. A fire station was also believed to be a place to find that information.
- Most will respect a burn ban, despite the common belief that burn ban enforcement is somewhat of a myth.
 - One mentioned they will continue burning during a burn ban if they are cold because there is an impression that while there may be enforcers out there, they look the other way.
- One participant felt that increased enforcement of burn bans would motivate them to burn more due to the appearance of too much governmental interference in personal choices. Another indicated that awareness of increased enforcement would encourage them to pursue a permit (or other source of documentation) that would allow them to continue burning.
- Many participants perceived their burning practices to be highly efficient/clean and that many ambience burners are likely not well educated in clean-burning practices. They feel that additional emphasis on clean-burning education should be the higher priority.
- Most were not clear on what distinguishes a certified device from an uncertified one. Participants noted that some changes to certification were made in the 1990s, but those standards likely changed over time, and they aren't sure what's considered certified anymore.
- Regarding wood smoke's impact on overall air quality, many believed that perception is due to the inexperienced wood burner who needs education. Some found it hard to believe that wood smoke is a higher contributor to pollution in Pierce County than pollution from automobiles, and increased population density. One had the opinion there

are really not that many wood burners in Pierce County at all.

- The positive benefits to burning wood, according to participants included memories of growing up, cooking, being prepared during power outtages, enhanced home comfort and longer-term heat retention over other sources.
- The majority of participants indicated their wood comes from free sources; however, those participants who obtained wood from free sources tended to voice their opinion of being more experienced wood burners.
- It was a general consensus that people learn more about clean burning through word-of-mouth than any other source.
- All agreed wood is a “dirty” source of heat. Examples participants used to illustrate this included dirt, bugs, moss/debris, occasional smoke in home, ash and wood remnants.
- Perceived negative impacts to burning wood include:
 - Clothes can smell smoky if fire isn’t managed well.
 - Occasional effects on their kids or other family members with asthma.
 - Burning yourself when loading more wood.
 - Bad smoke from people who aren’t educated on what can and can’t be burned.
 - It’s a dirty heat.
- Pellet stoves are not an alternative that these participants would consider, due especially to the heightened cost to heat the home. Storing pellets is perceived to be more challenging, and the cost of pellets is perceived to be noticeably high compared to wood. One participant indicated that there was not enough room in her house for the clearance area that a pellet stove requires, and that she needed a small device that could fit into her existing fireplace.
- It did not appear that concern for neighbors influences burning behavior. One participant noted that they would likely change their action only if they felt their neighbors were likely to report them.
- Many respondents question the validity of data and/or the proportion of wood smoke to the rest of the contributions to air pollution. Questions and concerns raised about the scale of the problem include:
 - Wood burners probably make up 1% of the total primary heat sources.
 - The smoke I put out is very clean compared to others I see.
 - Is the problem being unnecessarily put on urban areas?
 - Where is the highest concentration of wood burners? This focus group drew participants mainly from more urban areas of Tacoma. General consensus within the group is that the majority of the burners are rural, suburban or live close to the Cascade Mountains.
- None of the respondents indicated they would be interested in giving up their stove in favor of a \$200 or \$350 cash payment.
- A majority of participants indicated interest in upgrading to a certified device if financial assistance existed to offset some of the cost.

Response to Messages

The three core messages discussed and the reaction from participants follows:

1: There are health and environmental impacts associated with wood burning...

This was not a compelling message for this group. While participants acknowledged there are some health impacts to wood burning, they also had the perception that wood smoke really isn't that big of a deal. Though there is some proactive consideration for their neighbors, the message doesn't appear to be compelling enough to get them to take an action. If anything, it might be a good secondary message on why burn ban compliance is important.

2: Act now and we'll pay you for your uncertified device...

It was clear that Message 2 "We'll Pay You..." was the one most likely to compel action from participants of this focus group. They appreciated the direct connection to economic benefits. Many of the participants recognized this message (or program) from the previous efforts PSCAA and its partners have undertaken. For some of those people, the message lost a bit of credibility, as they had tried to take advantage of the program but funds ran out too quickly. Despite these feelings, this appeared to be the strongest, most actionable message.

3: Remove your uncertified device before it's against the law...

For most, this appeared to be too "government in your face" and was a turn-off. Many questioned the authority of whomever would be tasked with enforcement. It also led to statements like, "are they going to regulate my refrigerator next?" Interestingly, this one appeared to draw the most reaction from the group. While it may have made participants feel uneasy, they did respond with passionate, engaged responses.

Creative Examples, Key Comments and Outcomes

- The creative samples that offered easy-to-consume clean burning practices received good praise from participants.
- Visually, participants were turned-off by dramatic imagery of affected children and did not respond to text heavy pieces.
- Many preferred pieces with a more sophisticated visual look, suggesting better credibility. This may affect how someone perceives the "accuracy" of what is being reported.
- Showing the science and connecting that to personal health must be very clear to understand and not so extreme that it is considered a hyperbole.

Frequent Wood Burner Focus Group Highlights

- Most participants agreed wood offers a different type of heat than other methods can provide. One indicated “wood heat gets right in your bones to warm you up.”
- Many indicated they begin the early heating season using another heating method (electric and gas primarily) and switch to wood when they either notice their utility costs escalating or when it becomes cold “to a point” where it’s time to go to wood.
- It appeared the majority of participants were unaware of the difference between burn ban stages. Many, however, felt they could anticipate when burn bans would be imposed due to the stagnation in the air.
- Burn ban enforcement seemed to be a non-factor in a person’s decision when to burn wood. Most indicated observing burn bans when they are in action, but did not believe enforcement actually happens. Most could not cite who conducts enforcement, and one believed it only happened in urban environments.
 - One participant had previously been reported by a neighbor.
 - Enforcement was believed to be done by Pierce County and the Health Department.
 - “They have guns they can point up at your chimneys, and that’s coming soon.”
- Participants suggested they would heed a burn ban, understanding the reasons why it’s in place. One said they would only reduce their burning during burn ban because wood is their only source of heat, but they understand why it’s in place.
- Many indicated having methods of looking up burn bans:
 - Television and radio weather reports are a common method.
 - Email subscription was mentioned (and was believed to be a beneficial method).
 - Bookmarked website.
 - One noted they did not realize burn bans are something that needed to be looked up.
- The group suggested interest in text message sign ups and “checking online” for burn bans.
- If burn ban enforcement were increased and appeared more credible, participants noted they are even more likely to obey it.
- Many were aware that certified stoves existed. The main difference, according to participants, of a certified stove over an uncertified one is the efficiency of the device and the amount of particulate matter they release.
 - “The catalytic converter re-burns the smoke before it leaves the stove and destroys some of the particulate matter, so there is less pollution than just burning and letting the smoke go up the chimney.”
- Participants said the positive benefits of burning wood included utility bill savings, cooking as a dual purpose, for emergencies, ambience, and the difference kind of heat produced.
 - One participant noted they invited elderly neighbors to their home to stay warm during a power outage. It was their way of “providing for their neighborhood.”
- Negative impacts included the work required to keep wood properly seasoned, the collection of dirt and dust, and the insects that get inside the house from the wood itself.
- Many indicated getting their wood from free sources.

- There was no noticeable affect that neighbors had on the burning practices of the participant. One reminded us of her burn ban violation that came as a result of a neighbor. She mentioned she would still burn wood when she's cold.
- Participants found it hard to believe that wood smoke was more of a pollution factor than automobiles and industry. One mentioned that may be the case in some neighborhoods, but not from a regional perspective.
 - "I think it's funny that they want me to burn oil instead of wood. My wood stove chimney is cleaner than my oil chimney."
- Most do not check their chimneys for smoke volume and opacity. If they did, it was as part of another routine (i.e. driving to/from the home). Participants followed that up with comments that if you burn hot it won't require additional observation.
- Things preventing the change to a different source of heat included:
 - Usage during power outage.
 - Cost of fuel, including perception of high price, low competition for pellets.
 - Free wood sources.
 - High cost to switch to completely different system (gas, in particular).
 - Perceived need for home weatherization in tandem with change to different source.
- Asthma was common in some participants homes, yet they perceived no affect from wood smoke on them or their family members.
- Participants felt that clean burning practices should be highlighted.

Response to Messages

The three core messages discussed and the reaction from participants follows:

1: There are health and environmental impacts associated with wood burning...

Most agreed with this statement, however, there was not enough discussion surrounding it to warrant substantial pursuit of the message as a primary driver. The subject changed quickly to tax incentives and economic motivators. The group was not very clear in their responses on whether health-related messages would affect them or not.

2: Act now and we'll pay you for your uncertified device...

This was noticeably more motivational. Participants noted they would be in favor of it, though some mentioned a similar program being offered that did not have the funding to follow through. One mentioned they did not qualify due to their zip code. The economic incentives approach is favored, but only if it can be followed through. Cash for Clunkers was mentioned here. One participant mentioned using this program and it worked very well for them.

3: Remove your uncertified device before it's against the law...

Participants questioned the methodology of this and how enforcers would check to see if you have an uncertified device. They believed it would be hard to enforce and, therefore, less compelling. However, they did mention that it is compelling to move from an uncertified device to a certified one both to remain legal and to reduce the consumption of wood.

Creative Examples Key Comments and Outcomes

- The creative samples that offered easy to consume clean-burning practices received positive praise from participants.
- Visually, participants did not respond to text-heavy pieces.
- Some responded favorably to pieces that were localized to their community.
- Be careful to not make it feel as though a different method of heat is clearly preferred over wood. One cited that it appeared gas was heavily favored over wood, and that it felt like paid promotion for the gas company.
- Comparison to cigarette smoke felt like a significant hyperbole. "Wood smoke may be that harmful if you stick your head in the stove."

SURVEY

Wood Burner Perspectives & Activities

September 20, 2012



Research Approach

In order to provide clarity to many findings in the focus group, BCRA conducted a survey of WSRP prospects provided by PSCAA. The 24-question survey was sent to 1070 email addresses. 189 people began the survey, and 165 completed it, an 87.3% completion rate. It took, on average, four minutes and 31 seconds to complete the survey.

Of interest, 88% completed the survey from a desktop computer, and 7% completed it from a mobile device. 86% of respondents were between the ages of 35 and 74. The survey was incentivized with the opportunity to enter a drawing for a \$75 Fred Meyer gift card, and was open for four days in total, from September 2-5, 2012.

Survey Findings

Wood Burning Background

Most respondents in the NAA have a fireplace insert or wood stove in their home. Additionally, electricity is the most common primary heat source. Three out of four respondents burn wood for *supplemental heating*, which supports key focus group findings.

Survey findings suggest that *economic reasons* are the largest driver on whether someone chooses to burn wood. Over half of respondents obtain their wood from free sources, and 99% pay less than \$150-\$250 per cord. This is of particular interest when paired with other survey findings related to the quantity of wood burned. 70% of respondents burn less than two cords per year, with only 5% burning more than four cords per year.

The belief that wood burning heats a home more effectively is a key secondary motivator, which supported focus group comments. Many expressed that “wood heat just feels better,” and “wood heat takes the humidity and chill out of the air.” 51% of survey respondents agreed when asked if wood heats their home more effectively than other heating methods.

Burn Bans

When asked if survey respondents comply with burn bans, 82% answered “always.” Only two people surveyed indicated a lack of awareness of burn bans, and two people never comply with burn bans. The vast majority feel that burn bans are either not enforced at all, or that there is some level of enforcement. Many indicated that higher levels of burn ban enforcement would make them more likely to comply with burn bans, but since a large percent indicated that they always comply with burn bans, either question may reflect a response bias.

Health and Air Quality

Only one in four people agree that wood smoke is a primary source of air pollution in Pierce County. However, nearly three in four people believe wood smoke impacts air quality moderately to heavily. Almost half of the individuals surveyed indicated concern for their neighbors influences their burning habits.

This supports comments from focus group participants that indicate people in the NAA agree that wood smoke *contributes* to air pollution, but it's not the primary source.

Removal/Replacement

Money is clearly the largest motivator when it comes to removal and/or replacement. A staggering 87% of survey respondents indicated that they would be interested in changing to a non-wood burning device if financial assistance was available to them. 68% indicated that the amount of financial assistance available was the most important factor when considering replacement of their uncertified device.

On a write-in question, "What would motivate you to remove/replace your uncertified device," most of those surveyed indicated financial reasons as their biggest motivator.

Messaging

1. "Reduce environmental and health impacts from smoke. Remove your uncertified wood-burning device and observe burn bans."
 - Most indicated being "neutral" (34%) or "a bit motivated" (31%).
 - Responses reinforce comments generated during focus group discussions.
2. "Act now and we'll pay you up to \$1,500 cash to replace your old, uncertified device with a cleaner, more efficient one."
 - 80% found this either a bit or highly motivating.
 - Financial incentives are the largest motivator to take part in a removal or replacement program.
3. "Remove your device before it's against the law. Beginning Fall 2015 it will be illegal to own an uncertified wood stove."
 - 46% found this message to be motivating, either "a bit," or "highly."
 - 32% were turned off, either "a bit," or "highly."
 - Findings suggest this message tends to be polarizing and should be saved for a later outreach effort.

Conclusions

Findings in the survey and focus groups clearly indicate that most people within the NAA burn wood in their homes for supplemental heat, and they do so primarily for financially-motivated reasons. Many focus group comments expressed frustration with the cost of other methods or the presumption that prices for those methods are set by arbitrary means that the general public has no say in.

There appears to be a strong “it’s not me, it’s everybody else” attitude when it comes to wood burning, particularly with FWBs. This is backed up by statements in focus groups such as “what you guys really need to do is educate people on how to burn cleanly.” Survey results indicate a propensity to care on some level for both air quality and being good neighbors. Messaging for burn ban enforcement therefore should be positive, and seek to get people within the NAA to sign up for burn ban alerts, raise awareness of enhanced enforcement efforts, and drive people towards the website for further information on clean burning practices.

Many statements in focus groups reflected an attitude that, unless a law is enacted making burning wood illegal, efforts to get people to stop using wood to heat their homes altogether would fail. The economics of wood burning to those in the middle income, target audience range cannot be ignored; wood is free-to-cheap and plentiful in the Pacific Northwest. The team heard statements to the effect of “why should I turn on my electric furnace and pay those high bills during winter when I can get wood for free?”

Though three in four people feel that wood smoke has a moderate-to-high impact on outdoor air quality, it does not appear in research findings that air quality as a motivator is influential as an incentive for the removal program. Indeed, research findings point again towards economics, with many survey respondents and focus group participants indicating that they would participate in the program if they were offered financial assistance. However, many focus group participants indicated that while they would not part with their wood burning device, they would happily swap it for a certified wood stove, if funding were available, as it would burn less wood while having other positive benefits. Our recommendations, therefore, are for PSCAA to provide more financial assistance within the NAA to those wishing to swap their uncertified stove for a certified device.

Messaging towards this effort should 1. Raise awareness of the existence of the WSRP program within the NAA, 2. Clearly and easily communicate the methodologies and process of the WSRP program and 3. Create excitement and demonstrate personal benefits to the consumer of acting on the WSRP program.

Recommendations for Further Study

Observations from National Research Center 2007 Study

Suggests opportunity for additional study of occasional wood burning behavior

In 2007, PSCAA commissioned a study of wood burning behavior in all four counties under its jurisdiction. In particular, the study asked owners of either a fireplace (with or without an insert) or wood stove (whether they use that device as a primary heating source, supplemental source or for ambience reasons). While the study effectively addressed the questions needed by the research team for the NAA, it did not include a sufficient number of responses to draw statistically relevant conclusions.

However, there are several observations worth noting from this study. First, there is a higher propensity of “ambience” respondents in zip codes on the western side of State Route 7. Second, the highest rates of primary heat or supplemental heat respondents were located in zip codes on the eastern side of State Route 7.

While the results of this subset of data are not considered statistically valid, they do inform and reinforce perspectives that other data sources suggest about where OWBs are located. **BCRA suggests that PSCAA conduct a study similar to the 2007 NRC report, but with a significant enough N-value to draw statistically relevant conclusions in the NAA.** The results of that study can inform decisions for the following year’s campaign.

While a geographically targeted analysis of OWBs was not possible from this study, a segmentation of key question responses uncovered a number of demographic qualities of OWBs throughout King, Snohomish, Pierce, and Kitsap counties. For the purposes of understanding the make up of OWBs, BCRA developed crosstabs of certain data sets of this study to uncover characteristics of the two OWB segments outlined in pages 12-19 of this document.

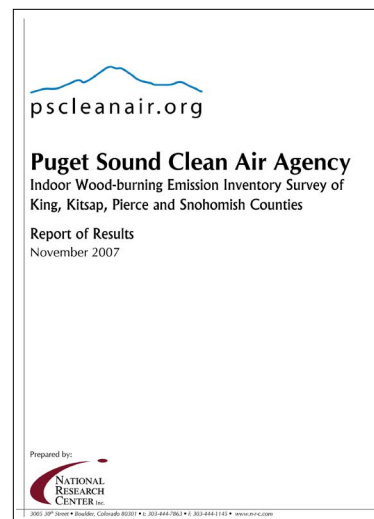


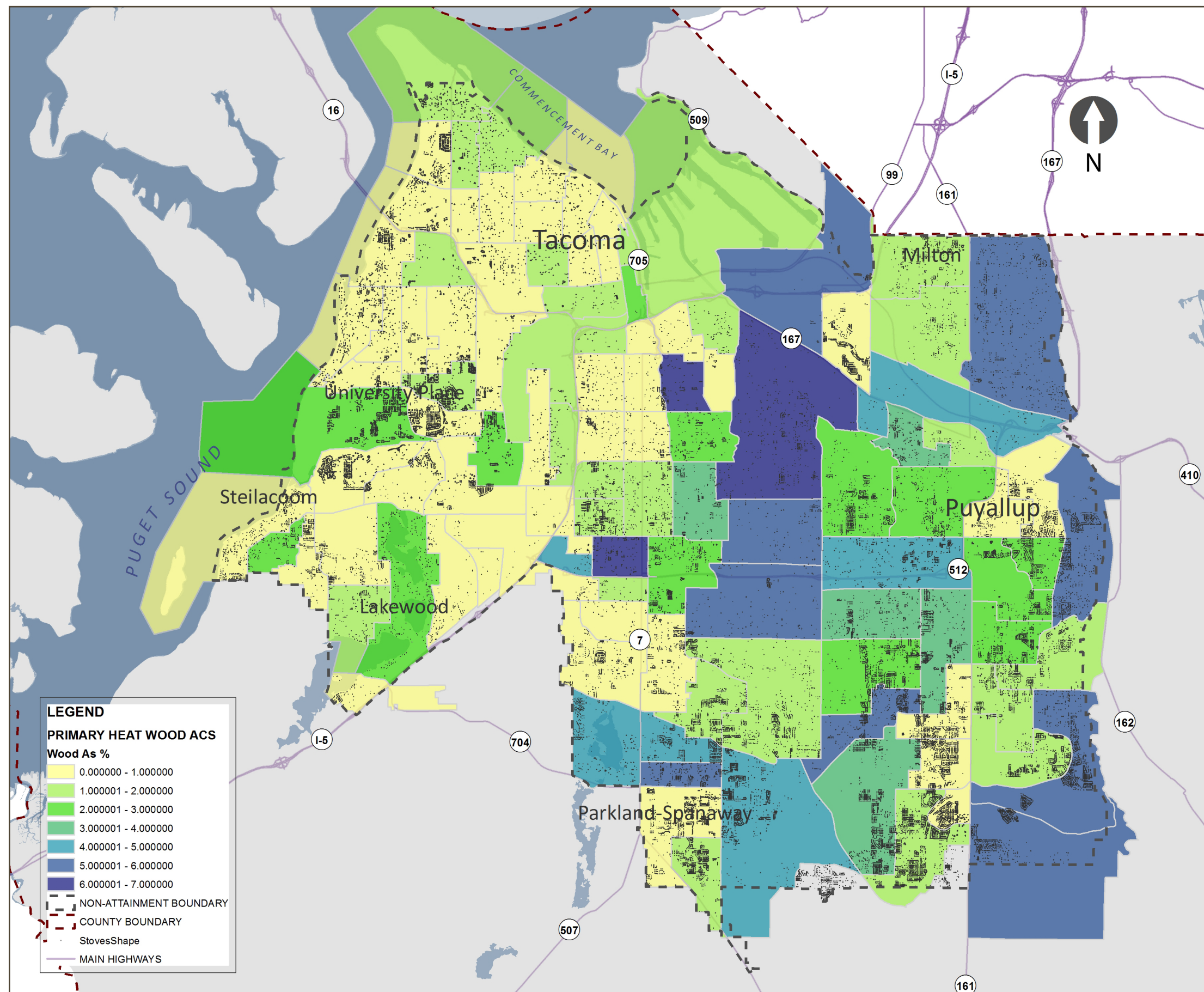
Figure 16

APPENDIX

MAPS

DATA SOURCES

September 20, 2012



FREQUENT WOOD BURNERS

NONATTAINMENT AREA

Data Layers:

1. Survey respondents, in percentages, who answered “wood” as their primary source of heating on the 2010 ACS survey.
2. Black dots are placed where wood stoves are located according to the Pierce County Assessor.*

Conclusions: Putting the two data layers together allows us to draw our target audience demographic, “frequent wood burners,” from several key geographical locations within the nonattainment area.

*The Pierce County Assessor makes no designation between a wood-burning stove and a gas stove.


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Puget Sound Clean Air Agency

1904 Third Avenue, Suite 105
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800.552.3565

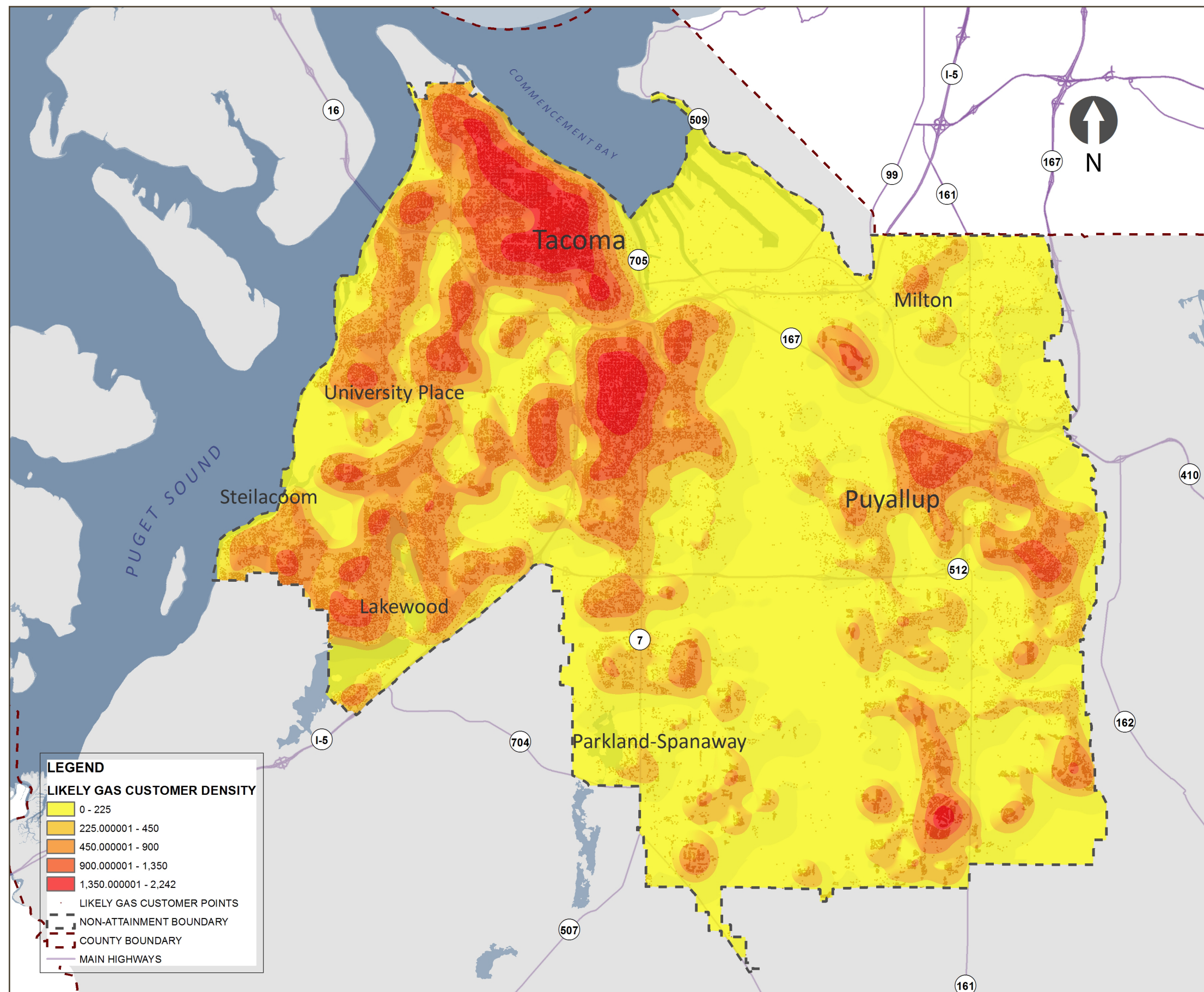
MAP POWERED BY

BCRA 

2106 Pacific Avenue, Suite 300
Tacoma, WA 98402
253.627.4367

Date: August 15, 2012
Data Source: American Communities Survey,
Pierce County Assessor

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bcradesign.com



LIKELY GAS CUSTOMERS

NONATTAINMENT AREA

Data Layers:

1. Gas customers per census tract, derived from inverse customer data from Puget Sound Energy. Darker areas represent higher concentrations of gas customers.
2. Red dots are placed where wood stoves are located according to the Pierce County Assessor.*

Conclusions: Putting the two data layers together allows us to validate assumptions regarding pockets of “frequent wood burners” by comparing larger areas of gas customers with known stoves in a “rule out” scenario.

*The Pierce County Assessor makes no designation between a wood-burning stove and a gas stove.


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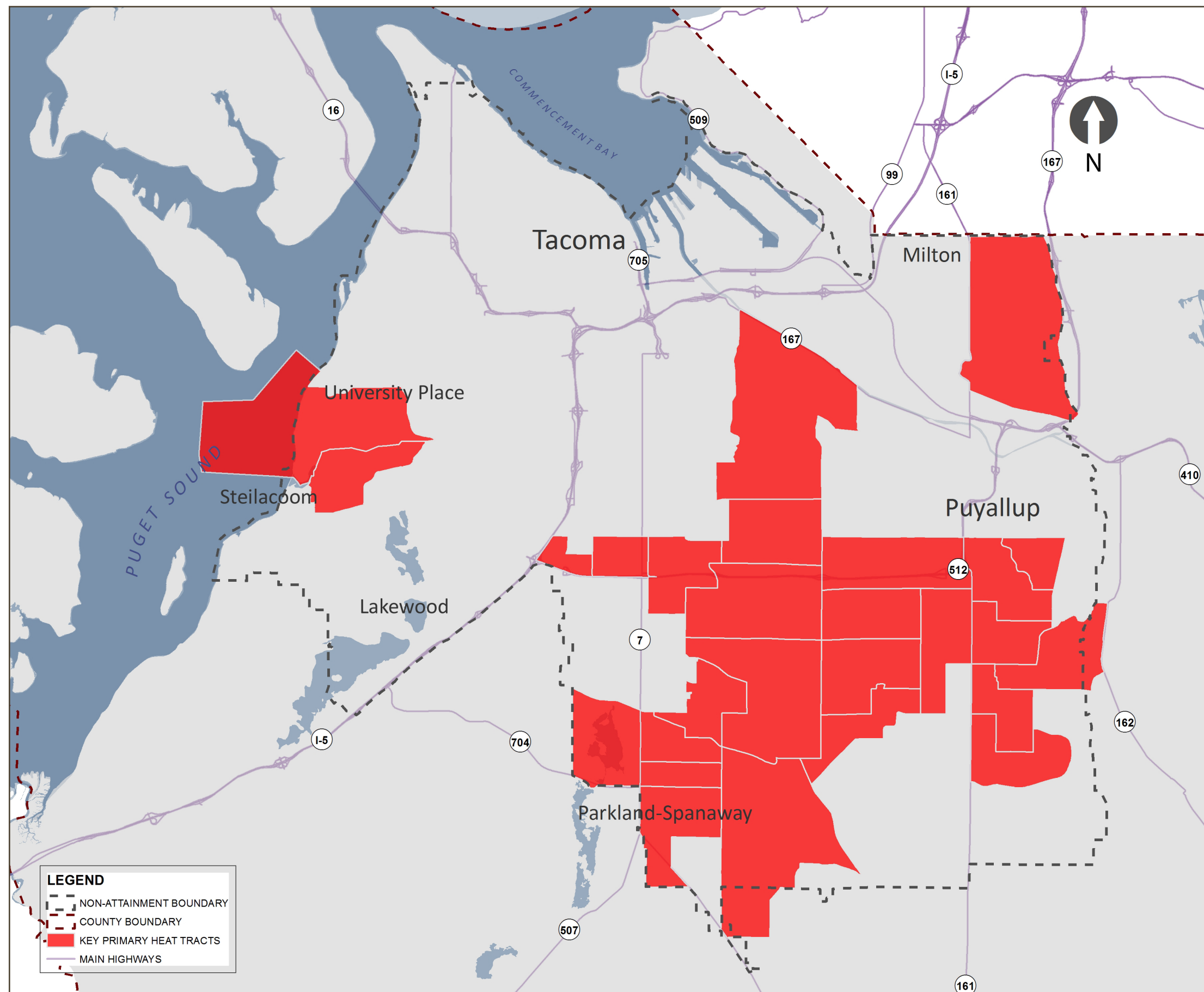
BCRA 

2106 Pacific Avenue, Suite 300
Tacoma, WA 98402
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Date: August 15, 2012

Data Source: Puget Sound Energy, Pierce County Assessor

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FREQUENT WOOD BURNERS

TARGET AUDIENCE GEOGRAPHIES

Drawing conclusions from the Frequent Wood Burners, Frequent Wood Burner Validation, and Gas Customer Inverse maps, key tracts within the nonattainment area are highlighted from which to pull demographic data and center communications targeted to the Frequent Wood Burner audience.


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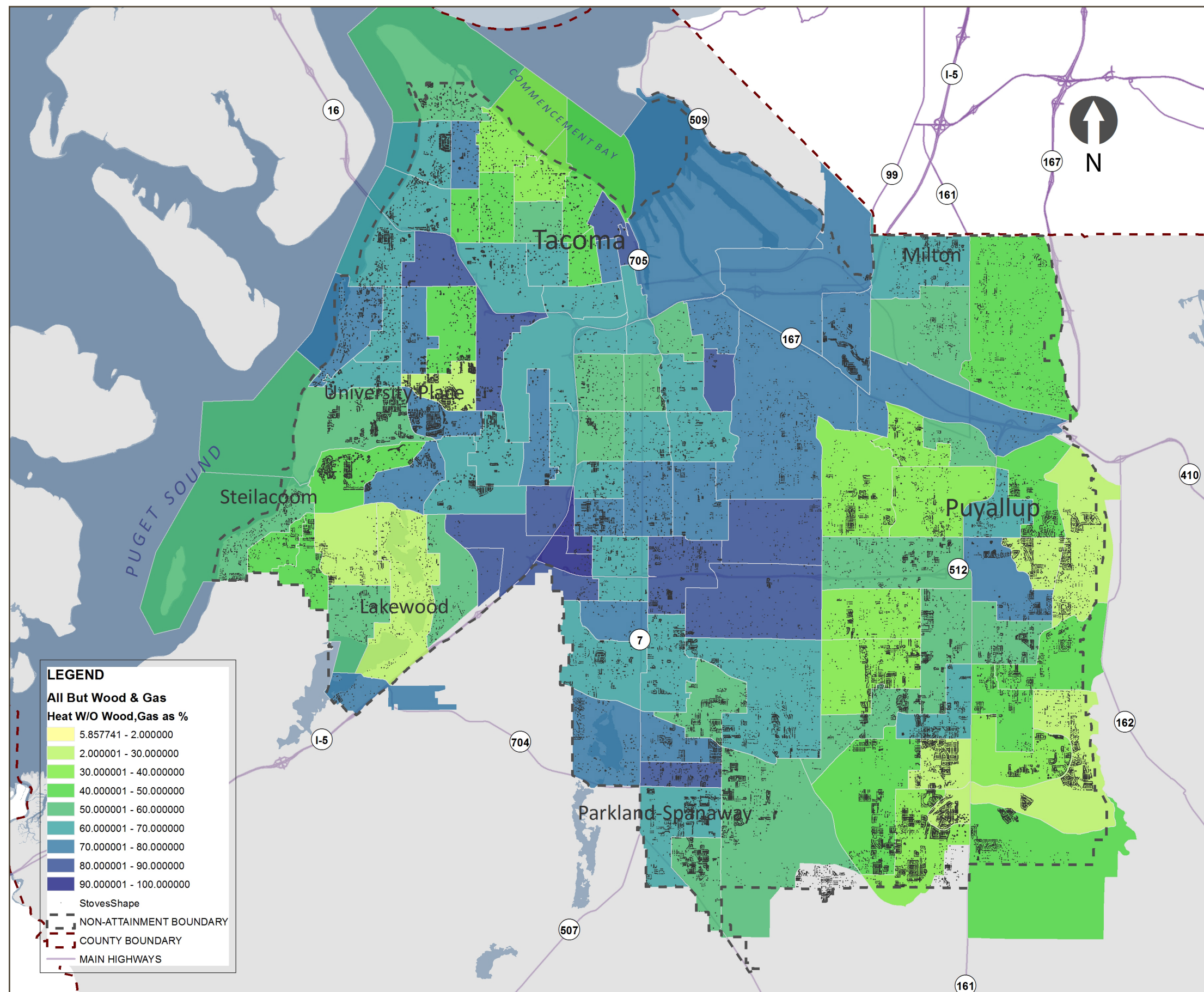
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DEVICES AND HIGH INCIDENCE OF NON-WOOD/GAS PRIMARY HEATING SOURCE

NONATTAINMENT AREA

Data Layers:

1. Survey respondents, in percentages, who answered anything besides “wood” or “natural gas” as their primary source of heating on the 2010 ACS survey.
2. Black dots are placed where wood stoves are located according to the Pierce County Assessor.

Conclusions: Putting the two data layers together allows us to better identify our target audience demographic, “occasional wood burners,” from key locations within the nonattainment area. This is not a true inverse of the “Frequent Wood Burner” map, and some areas appear to have higher densities of both frequent and occasional wood burners.


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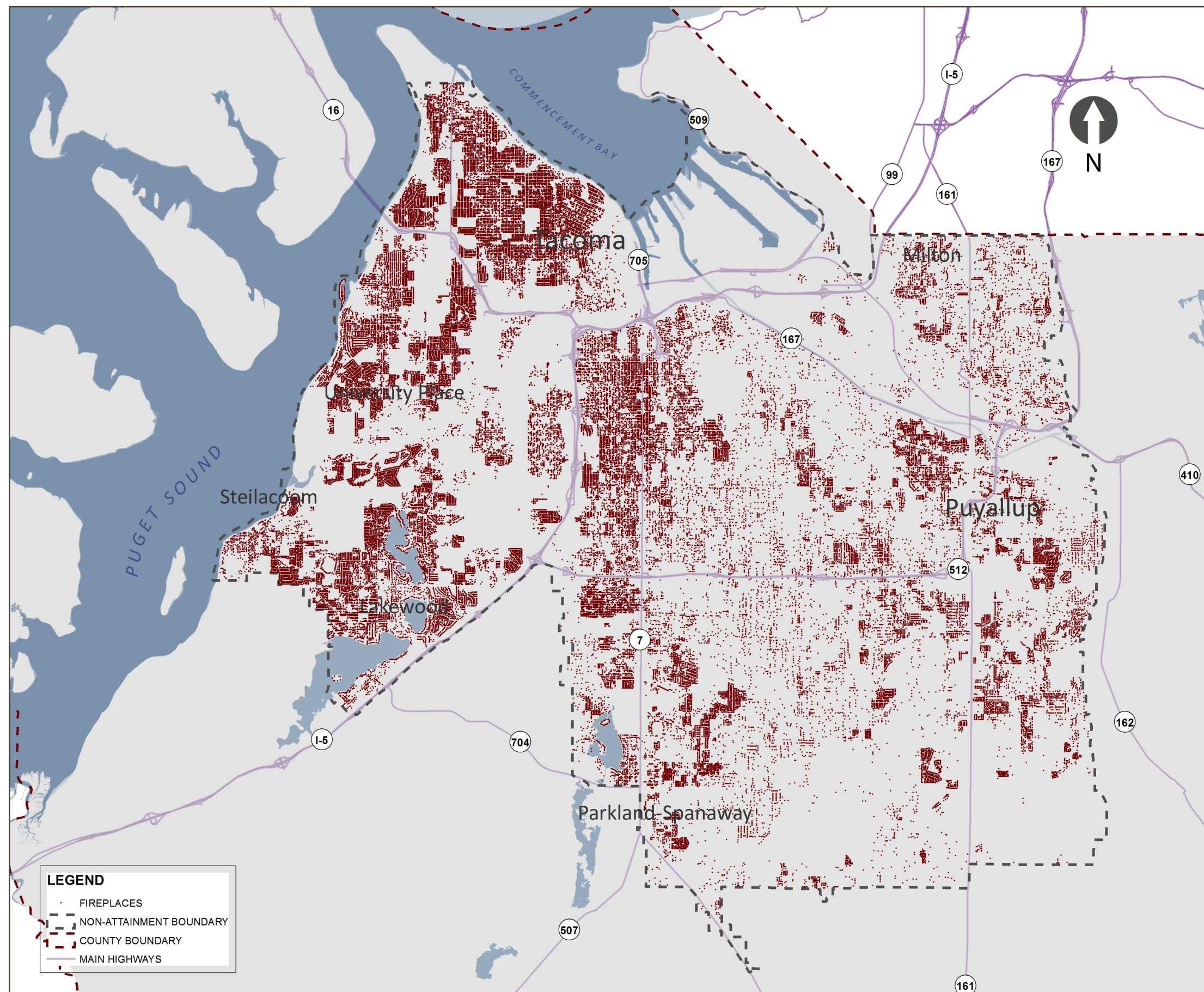
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Date: August 15, 2012
Data Source: American Communities Survey,
Pierce County Assessor

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FIREPLACES

NONATTAINMENT AREA

Map demonstrating densities of fireplaces within the nonattainment area. It is believed most fireplace users are occasional wood burners. This map helps us draw conclusions for targeting of key messaging regarding enforcement of burn bans.


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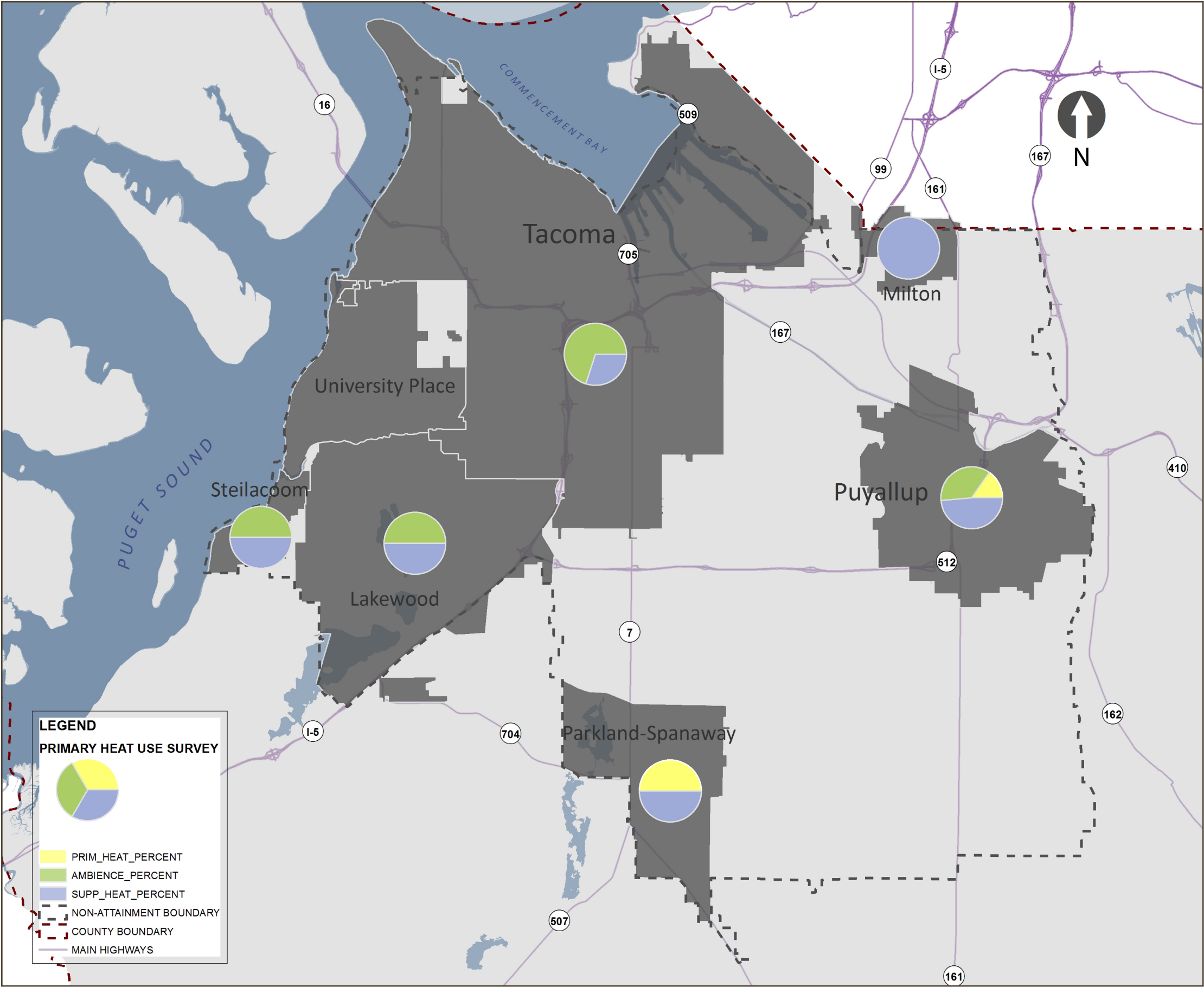
MAP POWERED BY

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[253.627.4367](tel:253.627.4367)

Date: August 15, 2012
Data Source: Pierce County Assessor

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REASON FOR BURNING

BY REGION OF NAA

Map indicates the share of respondents, per city in the non-attainment area, who burn wood for their primary source of heat, for ambiance or as a supplemental heat source.

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MAP POWERED BY

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Tacoma, WA 98402
[253.627.4367](tel:253.627.4367)

Date: August 15, 2012
Data Source: National Research Center Indoor
Wood-Burning Emission Inventory Survey, 2002

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THE American Community Survey

This booklet shows the
content of the
American Community Survey
questionnaire.

Please complete this form and return it as soon as possible after receiving it in the mail.

This form asks for information about the people who are living or staying at the address on the mailing label and about the house, apartment, or mobile home located at the address on the mailing label.



If you need help or have questions about completing this form, please call **1-800-354-7271**. The telephone call is free.

Telephone Device for the Deaf (TDD):

Call 1-800-582-8330. The telephone call is free.

¿NECESITA AYUDA? Si usted habla español y necesita ayuda para completar su cuestionario, llame sin cargo alguno al **1-877-833-5625**. Usted también puede pedir un cuestionario en español o completar su entrevista por teléfono con un entrevistador que habla español.

For more information about the American Community Survey, visit our web site at: <http://www.census.gov/acs/www/>

Start Here

➔ **Please print today's date.**

Month	Day	Year
<input type="text"/>	<input type="text"/>	<input type="text"/>

➔ **Please print the name and telephone number of the person who is filling out this form.** We may contact you if there is a question.

Last Name		
<input type="text"/>		
First Name		MI
<input type="text"/>		<input type="text"/>

Area Code	+	Number
<input type="text"/>		<input type="text"/>

➔ **How many people are living or staying at this address?**

- **INCLUDE** everyone who is living or staying here for more than 2 months.
- **INCLUDE** yourself if you are living here for more than 2 months.
- **INCLUDE** anyone else staying here who does not have another place to stay, even if they are here for 2 months or less.
- **DO NOT INCLUDE** anyone who is living somewhere else for more than 2 months, such as a college student living away or someone in the Armed Forces on deployment.

Number of people

➔ **Fill out pages 2, 3, and 4 for everyone, including yourself, who is living or staying at this address for more than 2 months. Then complete the rest of the form.**



Person 1

(Person 1 is the person living or staying here in whose name this house or apartment is owned, being bought, or rented. If there is no such person, start with the name of any adult living or staying here.)

1 What is Person 1's name?

Last Name (Please print)

First Name

MI

2 How is this person related to Person 1?

☒ Person 1

3 What is Person 1's sex? Mark (X) ONE box.

☐ Male ☐ Female

4 What is Person 1's age and what is Person 1's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age (in years)

Month

Day

Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this survey, Hispanic origins are not races.

5 Is Person 1 of Hispanic, Latino, or Spanish origin?

- ☐ No, not of Hispanic, Latino, or Spanish origin
- ☐ Yes, Mexican, Mexican Am., Chicano
- ☐ Yes, Puerto Rican
- ☐ Yes, Cuban
- ☐ Yes, another Hispanic, Latino, or Spanish origin – Print origin, for example, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on. ↘

6 What is Person 1's race? Mark (X) one or more boxes.

- ☐ White
- ☐ Black, African Am., or Negro
- ☐ American Indian or Alaska Native — Print name of enrolled or principal tribe. ↘

- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Other Asian – Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on. ↘
- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese
- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro
- ☐ Samoan
- ☐ Other Pacific Islander – Print race, for example, Fijian, Tongan, and so on. ↘

☐ Some other race – Print race. ↘

Person 2

1 What is Person 2's name?

Last Name (Please print)

First Name

MI

2 How is this person related to Person 1? Mark (X) ONE box.

- ☐ Husband or wife
- ☐ Biological son or daughter
- ☐ Adopted son or daughter
- ☐ Stepson or stepdaughter
- ☐ Brother or sister
- ☐ Father or mother
- ☐ Grandchild
- ☐ Parent-in-law
- ☐ Son-in-law or daughter-in-law
- ☐ Other relative
- ☐ Roomer or boarder
- ☐ Housemate or roommate
- ☐ Unmarried partner
- ☐ Foster child
- ☐ Other nonrelative

3 What is Person 2's sex? Mark (X) ONE box.

☐ Male ☐ Female

4 What is Person 2's age and what is Person 2's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age (in years)

Month

Day

Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this survey, Hispanic origins are not races.

5 Is Person 2 of Hispanic, Latino, or Spanish origin?

- ☐ No, not of Hispanic, Latino, or Spanish origin
- ☐ Yes, Mexican, Mexican Am., Chicano
- ☐ Yes, Puerto Rican
- ☐ Yes, Cuban
- ☐ Yes, another Hispanic, Latino, or Spanish origin – Print origin, for example, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on. ↘

6 What is Person 2's race? Mark (X) one or more boxes.

- ☐ White
- ☐ Black, African Am., or Negro
- ☐ American Indian or Alaska Native — Print name of enrolled or principal tribe. ↘

- ☐ Asian Indian
- ☐ Chinese
- ☐ Filipino
- ☐ Other Asian – Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on. ↘
- ☐ Japanese
- ☐ Korean
- ☐ Vietnamese
- ☐ Native Hawaiian
- ☐ Guamanian or Chamorro
- ☐ Samoan
- ☐ Other Pacific Islander – Print race, for example, Fijian, Tongan, and so on. ↘

☐ Some other race – Print race. ↘

Person 3

1

What is Person 3's name?

Last Name (Please print)

First Name

MI

2

How is this person related to Person 1? Mark (X) ONE box.

☐ Husband or wife

☐ Biological son or daughter

☐ Adopted son or daughter

☐ Stepson or stepdaughter

☐ Brother or sister

☐ Father or mother

☐ Grandchild

☐ Parent-in-law

☐ Son-in-law or daughter-in-law

☐ Other relative

☐ Roomer or boarder

☐ Housemate or roommate

☐ Unmarried partner

☐ Foster child

☐ Other nonrelative

3

What is Person 3's sex? Mark (X) ONE box.

☐ Male

☐ Female

4

What is Person 3's age and what is Person 3's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age (in years)

Month

Day

Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this survey, Hispanic origins are not races.

5

Is Person 3 of Hispanic, Latino, or Spanish origin?

☐ No, not of Hispanic, Latino, or Spanish origin

☐ Yes, Mexican, Mexican Am., Chicano

☐ Yes, Puerto Rican

☐ Yes, Cuban

☐ Yes, another Hispanic, Latino, or Spanish origin – Print origin, for example, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.

6

What is Person 3's race? Mark (X) one or more boxes.

☐ White

☐ Black, African Am., or Negro

☐ American Indian or Alaska Native – Print name of enrolled or principal tribe.

☐ Asian Indian

☐ Chinese

☐ Filipino

☐ Other Asian – Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on.

☐ Japanese

☐ Korean

☐ Vietnamese

☐ Native Hawaiian

☐ Guamanian or Chamorro

☐ Samoan

☐ Other Pacific Islander – Print race, for example, Fijian, Tongan, and so on.

☐ Some other race – Print race.

Person 4

1

What is Person 4's name?

Last Name (Please print)

First Name

MI

2

How is this person related to Person 1? Mark (X) ONE box.

☐ Husband or wife

☐ Biological son or daughter

☐ Adopted son or daughter

☐ Stepson or stepdaughter

☐ Brother or sister

☐ Father or mother

☐ Grandchild

☐ Parent-in-law

☐ Son-in-law or daughter-in-law

☐ Other relative

☐ Roomer or boarder

☐ Housemate or roommate

☐ Unmarried partner

☐ Foster child

☐ Other nonrelative

3

What is Person 4's sex? Mark (X) ONE box.

☐ Male

☐ Female

4

What is Person 4's age and what is Person 4's date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age (in years)

Month

Day

Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this survey, Hispanic origins are not races.

5

Is Person 4 of Hispanic, Latino, or Spanish origin?

☐ No, not of Hispanic, Latino, or Spanish origin

☐ Yes, Mexican, Mexican Am., Chicano

☐ Yes, Puerto Rican

☐ Yes, Cuban

☐ Yes, another Hispanic, Latino, or Spanish origin – Print origin, for example, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.

6

What is Person 4's race? Mark (X) one or more boxes.

☐ White

☐ Black, African Am., or Negro

☐ American Indian or Alaska Native – Print name of enrolled or principal tribe.

☐ Asian Indian

☐ Chinese

☐ Filipino

☐ Other Asian – Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on.

☐ Japanese

☐ Korean

☐ Vietnamese

☐ Native Hawaiian

☐ Guamanian or Chamorro

☐ Samoan

☐ Other Pacific Islander – Print race, for example, Fijian, Tongan, and so on.

☐ Some other race – Print race.



Person 5

1

What is Person 5’s name?

Last Name (Please print)

First Name

MI

2

How is this person related to Person 1? Mark (X) ONE box.

☐ Husband or wife

☐ Biological son or daughter

☐ Adopted son or daughter

☐ Stepson or stepdaughter

☐ Brother or sister

☐ Father or mother

☐ Grandchild

☐ Parent-in-law

☐ Son-in-law or daughter-in-law

☐ Other relative

☐ Roomer or boarder

☐ Housemate or roommate

☐ Unmarried partner

☐ Foster child

☐ Other nonrelative

3

What is Person 5’s sex? Mark (X) ONE box.

☐ Male

☐ Female

4

What is Person 5’s age and what is Person 5’s date of birth? Please report babies as age 0 when the child is less than 1 year old. Print numbers in boxes.

Age (in years)

Month

Day

Year of birth

→ NOTE: Please answer BOTH Question 5 about Hispanic origin and Question 6 about race. For this survey, Hispanic origins are not races.

5

Is Person 5 of Hispanic, Latino, or Spanish origin?

☐ No, not of Hispanic, Latino, or Spanish origin

☐ Yes, Mexican, Mexican Am., Chicano

☐ Yes, Puerto Rican

☐ Yes, Cuban

☐ Yes, another Hispanic, Latino, or Spanish origin – Print origin, for example, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.

6

What is Person 5’s race? Mark (X) one or more boxes.

☐ White

☐ Black, African Am., or Negro

☐ American Indian or Alaska Native — Print name of enrolled or principal tribe.

☐ Asian Indian

☐ Chinese

☐ Filipino

☐ Other Asian – Print race, for example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on.

☐ Japanese

☐ Korean

☐ Vietnamese

☐ Native Hawaiian

☐ Guamanian or Chamorro

☐ Samoan

☐ Other Pacific Islander – Print race, for example, Fijian, Tongan, and so on.

☐ Some other race – Print race.

→ If there are more than five people living or staying here, print their names in the spaces for Person 6 through Person 12. We may call you for more information about them.

Person 6

Last Name (Please print)

First Name

MI

Sex

☐ Male

☐ Female

Age (in years)

Person 7

Last Name (Please print)

First Name

MI

Sex

☐ Male

☐ Female

Age (in years)

Person 8

Last Name (Please print)

First Name

MI

Sex

☐ Male

☐ Female

Age (in years)

Person 9

Last Name (Please print)

First Name

MI

Sex

☐ Male

☐ Female

Age (in years)

Person 10

Last Name (Please print)

First Name

MI

Sex

☐ Male

☐ Female

Age (in years)

Person 11

Last Name (Please print)

First Name

MI

Sex

☐ Male

☐ Female

Age (in years)

Person 12

Last Name (Please print)

First Name

MI

Sex

☐ Male

☐ Female

Age (in years)

4

Housing

➔ Please answer the following questions about the house, apartment, or mobile home at the address on the mailing label.

- 1 Which best describes this building?
Include all apartments, flats, etc., even if vacant.
- ☐ A mobile home
 - ☐ A one-family house detached from any other house
 - ☐ A one-family house attached to one or more houses
 - ☐ A building with 2 apartments
 - ☐ A building with 3 or 4 apartments
 - ☐ A building with 5 to 9 apartments
 - ☐ A building with 10 to 19 apartments
 - ☐ A building with 20 to 49 apartments
 - ☐ A building with 50 or more apartments
 - ☐ Boat, RV, van, etc.

- 2 About when was this building first built?
- ☐ 2000 or later – Specify year →
-
- ☐ 1990 to 1999
- ☐ 1980 to 1989
- ☐ 1970 to 1979
- ☐ 1960 to 1969
- ☐ 1950 to 1959
- ☐ 1940 to 1949
- ☐ 1939 or earlier

- 3 When did PERSON 1 (listed on page 2) move into this house, apartment, or mobile home?
- Month Year
-
-

A Answer questions 4 – 6 if this is a HOUSE OR A MOBILE HOME; otherwise, SKIP to question 7a.

- 4 How many acres is this house or mobile home on?
- ☐ Less than 1 acre → SKIP to question 6
 - ☐ 1 to 9.9 acres
 - ☐ 10 or more acres

- 5 IN THE PAST 12 MONTHS, what were the actual sales of all agricultural products from this property?
- ☐ None
 - ☐ \$1 to \$999
 - ☐ \$1,000 to \$2,499
 - ☐ \$2,500 to \$4,999
 - ☐ \$5,000 to \$9,999
 - ☐ \$10,000 or more

- 6 Is there a business (such as a store or barber shop) or a medical office on this property?
- ☐ Yes
 - ☐ No

- 7 a. How many separate rooms are in this house, apartment, or mobile home?
Rooms must be separated by built-in archways or walls that extend out at least 6 inches and go from floor to ceiling.
- INCLUDE bedrooms, kitchens, etc.
 - EXCLUDE bathrooms, porches, balconies, foyers, halls, or unfinished basements.
- Number of rooms
-
- b. How many of these rooms are bedrooms?
Count as bedrooms those rooms you would list if this house, apartment, or mobile home were for sale or rent. If this is an efficiency/studio apartment, print "0".
- Number of bedrooms
-

- 8 Does this house, apartment, or mobile home have –
- | | Yes | No |
|---|--------------------------|--------------------------|
| a. hot and cold running water? | <input type="checkbox"/> | <input type="checkbox"/> |
| b. a flush toilet? | <input type="checkbox"/> | <input type="checkbox"/> |
| c. a bathtub or shower? | <input type="checkbox"/> | <input type="checkbox"/> |
| d. a sink with a faucet? | <input type="checkbox"/> | <input type="checkbox"/> |
| e. a stove or range? | <input type="checkbox"/> | <input type="checkbox"/> |
| f. a refrigerator? | <input type="checkbox"/> | <input type="checkbox"/> |
| g. telephone service from which you can both make and receive calls? Include cell phones. | <input type="checkbox"/> | <input type="checkbox"/> |

- 9 How many automobiles, vans, and trucks of one-ton capacity or less are kept at home for use by members of this household?
- ☐ None
 - ☐ 1
 - ☐ 2
 - ☐ 3
 - ☐ 4
 - ☐ 5
 - ☐ 6 or more

- 10 Which FUEL is used MOST for heating this house, apartment, or mobile home?
- ☐ Gas: from underground pipes serving the neighborhood
 - ☐ Gas: bottled, tank, or LP
 - ☐ Electricity
 - ☐ Fuel oil, kerosene, etc.
 - ☐ Coal or coke
 - ☐ Wood
 - ☐ Solar energy
 - ☐ Other fuel
 - ☐ No fuel used



☐ Included in rent or condominium fee

☐ No charge or these fuels not used

☐ Yes
☐ No

☐ None

19

☐ Yes, insurance included in mortgage payment

☐ No, insurance paid separately or no insurance

20

☐ No regular payment required

D

Answer question 21 if this is a MOBILE HOME. Otherwise, SKIP to **E**.

21

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E

Answer questions about PERSON 1 on the next page if you listed at least one person on page 2. Otherwise, SKIP to page 28 for the mailing instructions.

Person 1

➔ Please copy the name of Person 1 from page 2, then continue answering questions below.

Last Name

First Name MI

7 Where was this person born?

☐ In the United States – Print name of state.

☐ Outside the United States – Print name of foreign country, or Puerto Rico, Guam, etc.

8 Is this person a citizen of the United States?

☐ Yes, born in the United States → SKIP to 10a

☐ Yes, born in Puerto Rico, Guam, the U.S. Virgin Islands, or Northern Marianas

☐ Yes, born abroad of U.S. citizen parent or parents

☐ Yes, U.S. citizen by naturalization – Print year of naturalization

☐ No, not a U.S. citizen

9 When did this person come to live in the United States? Print numbers in boxes.

Year

10 a. At any time IN THE LAST 3 MONTHS, has this person attended school or college? Include only nursery or preschool, kindergarten, elementary school, home school, and schooling which leads to a high school diploma or a college degree.

☐ No, has not attended in the last 3 months → SKIP to question 11

☐ Yes, public school, public college

☐ Yes, private school, private college, home school

b. What grade or level was this person attending? Mark (X) ONE box.

☐ Nursery school, preschool

☐ Kindergarten

☐ Grade 1 through 12 – Specify grade 1 – 12

☐ College undergraduate years (freshman to senior)

☐ Graduate or professional school beyond a bachelor's degree (for example: MA or PhD program, or medical or law school)

11 What is the highest degree or level of school this person has COMPLETED? Mark (X) ONE box. If currently enrolled, mark the previous grade or highest degree received.

NO SCHOOLING COMPLETED

☐ No schooling completed

NURSERY OR PRESCHOOL THROUGH GRADE 12

☐ Nursery school

☐ Kindergarten

☐ Grade 1 through 11 – Specify grade 1 – 11

☐ 12th grade – NO DIPLOMA

HIGH SCHOOL GRADUATE

☐ Regular high school diploma

☐ GED or alternative credential

COLLEGE OR SOME COLLEGE

☐ Some college credit, but less than 1 year of college credit

☐ 1 or more years of college credit, no degree

☐ Associate's degree (for example: AA, AS)

☐ Bachelor's degree (for example: BA, BS)

AFTER BACHELOR'S DEGREE

☐ Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)

☐ Professional degree beyond a bachelor's degree (for example: MD, DDS, DVM, LLB, JD)

☐ Doctorate degree (for example: PhD, EdD)

F Answer question 12 if this person has a bachelor's degree or higher. Otherwise, SKIP to question 13.

12 This question focuses on this person's BACHELOR'S DEGREE. Please print below the specific major(s) of any BACHELOR'S DEGREES this person has received. (For example: chemical engineering, elementary teacher education, organizational psychology)

13 What is this person's ancestry or ethnic origin?

(For example: Italian, Jamaican, African Am., Cambodian, Cape Verdean, Norwegian, Dominican, French Canadian, Haitian, Korean, Lebanese, Polish, Nigerian, Mexican, Taiwanese, Ukrainian, and so on.)

14 a. Does this person speak a language other than English at home?

☐ Yes

☐ No → SKIP to question 15a

b. What is this language?

For example: Korean, Italian, Spanish, Vietnamese

c. How well does this person speak English?

☐ Very well

☐ Well

☐ Not well

☐ Not at all

15 a. Did this person live in this house or apartment 1 year ago?

☐ Person is under 1 year old → SKIP to question 16

☐ Yes, this house → SKIP to question 16

☐ No, outside the United States and Puerto Rico – Print name of foreign country, or U.S. Virgin Islands, Guam, etc., below; then SKIP to question 16

☐ No, different house in the United States or Puerto Rico

b. Where did this person live 1 year ago?

Address (Number and street name)

Name of city, town, or post office

Name of U.S. county or municipio in Puerto Rico

Name of U.S. state or Puerto Rico

ZIP Code

Person 1 (continued)

16 Is this person **CURRENTLY** covered by any of the following types of health insurance or health coverage plans? Mark "Yes" or "No" for EACH type of coverage in items a – h.

- | | Yes | No |
|---|--------------------------|--------------------------|
| a. Insurance through a current or former employer or union (of this person or another family member) | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Insurance purchased directly from an insurance company, (by this person or another family member) | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Medicare, for people 65 and older, or people with certain disabilities | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Medicaid, Medical Assistance, or any kind of government-assistance plan for those with low incomes or a disability | <input type="checkbox"/> | <input type="checkbox"/> |
| e. TRICARE or other military health care | <input type="checkbox"/> | <input type="checkbox"/> |
| f. VA (including those who have ever used or enrolled for VA health care) | <input type="checkbox"/> | <input type="checkbox"/> |
| g. Indian Health Service | <input type="checkbox"/> | <input type="checkbox"/> |
| h. Any other type of health insurance or health coverage plan – <i>Specify</i> | <input type="checkbox"/> | <input type="checkbox"/> |

17 a. Is this person deaf or does he/she have serious difficulty hearing?

- ☐ Yes
☐ No

b. Is this person blind or does he/she have serious difficulty seeing even when wearing glasses?

- ☐ Yes
☐ No

G Answer question 18a – c if this person is 5 years old or over. Otherwise, SKIP to the questions for Person 2 on page 12.

18 a. Because of a physical, mental, or emotional condition, does this person have serious difficulty concentrating, remembering, or making decisions?

- ☐ Yes
☐ No

b. Does this person have serious difficulty walking or climbing stairs?

- ☐ Yes
☐ No

c. Does this person have difficulty dressing or bathing?

- ☐ Yes
☐ No

H Answer question 19 if this person is 15 years old or over. Otherwise, SKIP to the questions for Person 2 on page 12.

19 Because of a physical, mental, or emotional condition, does this person have difficulty doing errands alone such as visiting a doctor's office or shopping?

- ☐ Yes
☐ No

20 What is this person's marital status?

- ☐ Now married
☐ Widowed
☐ Divorced
☐ Separated
☐ Never married → SKIP to **I**

21 In the PAST 12 MONTHS did this person get –

- | | Yes | No |
|--------------|--------------------------|--------------------------|
| a. Married? | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Widowed? | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Divorced? | <input type="checkbox"/> | <input type="checkbox"/> |

22 How many times has this person been married?

- ☐ Once
☐ Two times
☐ Three or more times

23 In what year did this person last get married?

Year

I Answer question 24 if this person is female and 15 – 50 years old. Otherwise, SKIP to question 25a.

24 Has this person given birth to any children in the past 12 months?

- ☐ Yes
☐ No

25 a. Does this person have any of his/her own grandchildren under the age of 18 living in this house or apartment?

- ☐ Yes
☐ No → SKIP to question 26

b. Is this grandparent currently responsible for most of the basic needs of any grandchild(ren) under the age of 18 who live(s) in this house or apartment?

- ☐ Yes
☐ No → SKIP to question 26

c. How long has this grandparent been responsible for the(se) grandchild(ren)?

If the grandparent is financially responsible for more than one grandchild, answer the question for the grandchild for whom the grandparent has been responsible for the longest period of time.

- ☐ Less than 6 months
☐ 6 to 11 months
☐ 1 or 2 years
☐ 3 or 4 years
☐ 5 or more years

26 Has this person ever served on active duty in the U.S. Armed Forces, military Reserves, or National Guard? Active duty does not include training for the Reserves or National Guard, but DOES include activation, for example, for the Persian Gulf War.

- ☐ Yes, now on active duty
☐ Yes, on active duty during the last 12 months, but not now
☐ Yes, on active duty in the past, but not during the last 12 months
☐ No, training for Reserves or National Guard only → SKIP to question 28a
☐ No, never served in the military → SKIP to question 29a

27 When did this person serve on active duty in the U.S. Armed Forces? Mark (X) a box for EACH period in which this person served, even if just for part of the period.

- ☐ September 2001 or later
☐ August 1990 to August 2001 (including Persian Gulf War)
☐ September 1980 to July 1990
☐ May 1975 to August 1980
☐ Vietnam era (August 1964 to April 1975)
☐ March 1961 to July 1964
☐ February 1955 to February 1961
☐ Korean War (July 1950 to January 1955)
☐ January 1947 to June 1950
☐ World War II (December 1941 to December 1946)
☐ November 1941 or earlier

28 a. Does this person have a VA service-connected disability rating?

- ☐ Yes (such as 0%, 10%, 20%, ... , 100%)
☐ No → SKIP to question 29a

b. What is this person's service-connected disability rating?

- ☐ 0 percent
☐ 10 or 20 percent
☐ 30 or 40 percent
☐ 50 or 60 percent
☐ 70 percent or higher



Person 1 (continued)

29 a. LAST WEEK, did this person work for pay at a job (or business)?

- ☐ Yes → SKIP to question 30
☐ No – Did not work (or retired)

b. LAST WEEK, did this person do ANY work for pay, even for as little as one hour?

- ☐ Yes
☐ No → SKIP to question 35a

30 At what location did this person work LAST WEEK? *If this person worked at more than one location, print where he or she worked most last week.*

a. Address (Number and street name)

If the exact address is not known, give a description of the location such as the building name or the nearest street or intersection.

b. Name of city, town, or post office

c. Is the work location inside the limits of that city or town?

- ☐ Yes
☐ No, outside the city/town limits

d. Name of county

e. Name of U.S. state or foreign country

f. ZIP Code

31 How did this person usually get to work LAST WEEK? *If this person usually used more than one method of transportation during the trip, mark (X) the box of the one used for most of the distance.*

- | | |
|---|--|
| <input type="checkbox"/> Car, truck, or van | <input type="checkbox"/> Motorcycle |
| <input type="checkbox"/> Bus or trolley bus | <input type="checkbox"/> Bicycle |
| <input type="checkbox"/> Streetcar or trolley car | <input type="checkbox"/> Walked |
| <input type="checkbox"/> Subway or elevated | <input type="checkbox"/> Worked at home → SKIP to question 39a |
| <input type="checkbox"/> Railroad | <input type="checkbox"/> Other method |
| <input type="checkbox"/> Ferryboat | |
| <input type="checkbox"/> Taxicab | |

J Answer question 32 if you marked "Car, truck, or van" in question 31. Otherwise, SKIP to question 33.

32 How many people, including this person, usually rode to work in the car, truck, or van LAST WEEK?

Person(s)

33 What time did this person usually leave home to go to work LAST WEEK?

Hour

Minute

☐ a.m.

☐ p.m.

34 How many minutes did it usually take this person to get from home to work LAST WEEK?

Minutes

K Answer questions 35 – 38 if this person did NOT work last week. Otherwise, SKIP to question 39a.

35 a. LAST WEEK, was this person on layoff from a job?

- ☒ Yes → SKIP to question 35c
☐ No

b. LAST WEEK, was this person TEMPORARILY absent from a job or business?

- ☐ Yes, on vacation, temporary illness, maternity leave, other family/personal reasons, bad weather, etc. → SKIP to question 38
☐ No → SKIP to question 36

c. Has this person been informed that he or she will be recalled to work within the next 6 months OR been given a date to return to work?

- ☐ Yes → SKIP to question 37
☐ No

36 During the LAST 4 WEEKS, has this person been ACTIVELY looking for work?

- ☐ Yes
☐ No → SKIP to question 38

37 LAST WEEK, could this person have started a job if offered one, or returned to work if recalled?

- ☐ Yes, could have gone to work
☐ No, because of own temporary illness
☐ No, because of all other reasons (in school, etc.)

38 When did this person last work, even for a few days?

- ☐ Within the past 12 months
☒ 1 to 5 years ago → SKIP to **L**
☐ Over 5 years ago or never worked → SKIP to question 47

39 a. During the PAST 12 MONTHS (52 weeks), did this person work 50 or more weeks? Count paid time off as work.

- ☐ Yes → SKIP to question 40
☐ No

b. How many weeks DID this person work, even for a few hours, including paid vacation, paid sick leave, and military service?

- ☐ 50 to 52 weeks
☐ 48 to 49 weeks
☐ 40 to 47 weeks
☐ 27 to 39 weeks
☐ 14 to 26 weeks
☐ 13 weeks or less

40 During the PAST 12 MONTHS, in the WEEKS WORKED, how many hours did this person usually work each WEEK?

Usual hours worked each WEEK

Person 1 (continued)

L Answer questions 41 – 46 if this person worked in the past 5 years. Otherwise, SKIP to question 47.

41 – 46 CURRENT OR MOST RECENT JOB ACTIVITY. Describe clearly this person's chief job activity or business last week. If this person had more than one job, describe the one at which this person worked the most hours. If this person had no job or business last week, give information for his/her last job or business.

45 What kind of work was this person doing?
(For example: registered nurse, personnel manager, supervisor of order department, secretary, accountant)

46 **What were this person's most important activities or duties?** (For example: patient care, directing hiring policies, supervising order clerks, typing and filing, reconciling financial records)

47 INCOME IN THE PAST 12 MONTHS

Mark (X) the "Yes" box for each type of income this person received, and give your best estimate of the TOTAL AMOUNT during the PAST 12 MONTHS. (NOTE: The "past 12 months" is the period from today's date one year ago up through today.)

Mark (X) the "No" box to show types of income NOT received.

If net income was a loss, mark the "Loss" box to the right of the dollar amount.

For income received jointly, report the appropriate share for each person – or, if that's not possible, report the whole amount for only one person and mark the "No" box for the other person.

a. Wages, salary, commissions, bonuses, or tips from all jobs. Report amount before deductions for taxes, bonds, dues, or other items.

☐ Yes → \$.00

☐ No

TOTAL AMOUNT for past
12 months

b. Self-employment income from own nonfarm businesses or farm businesses, including proprietorships and partnerships. *Report NET income after business expenses.*

<input type="checkbox"/>	Yes →	\$.00	<input type="checkbox"/>
<input type="checkbox"/>	No	TOTAL AMOUNT for past 12 months	Loss <input type="checkbox"/>

c. Interest, dividends, net rental income, royalty income, or income from estates and trusts. *Report even small amounts credited to an account.*

☐ Yes → TOTAL AMOUNT for past 12 months Loss

☐ No

d. Social Security or Railroad Retirement.

☐ Yes →

☐ No

\$.00
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TOTAL AMOUNT for past
12 months

e. Supplemental Security Income (SSI).

☐ Yes →

☐ No

\$.00
----	--	--	--	--	-----

TOTAL AMOUNT for past
12 months

f. Any public assistance or welfare payments from the state or local welfare office.

☐ Yes →

☐ No

\$.00
----	--	--	--	--	--	-----

TOTAL AMOUNT for past
12 months

g. Retirement, survivor, or disability pensions.
Do NOT include Social Security.

☐ Yes → \$

☐ No

TOTAL AMOUNT for past
12 months

h. Any other sources of income received regularly such as Veterans' (VA) payments, unemployment compensation, child support or alimony. Do NOT include lump sum payments such as money from an inheritance or the sale of a home.

☐ Yes →

☐ No

TOTAL AMOUNT for past 12 months

42 For whom did this person work?

If now on active duty in the Armed Forces, mark (X) this box → ☐

Name of company, business, or other employer

43 What kind of business or industry was this?
Describe the activity at the location where employed.
(For example: hospital, newspaper publishing, mail order house, auto engine manufacturing, bank)

44 Is this mainly – Mark (X) ONE box.

- ☐ manufacturing?
- ☐ wholesale trade?
- ☐ retail trade?
- ☐ other (agriculture, construction, service, government, etc.)?

48 What was this person's total income during the PAST 12 MONTHS? Add entries in questions 47a to 47h; subtract any losses. If net income was a loss, enter the amount and mark (X) the "Loss" box next to the dollar amount.

☐ None OR

\$.00
----	--	--	--	--	--	-----

☐ Loss

TOTAL AMOUNT for past
12 months

➔ Continue with the questions for Person 2 on the next page. If only 1 person is listed on page 2, SKIP to page 28 for mailing instructions.



Person 2

The balance of the questionnaire has questions for Person 2, Person 3, Person 4, and Person 5. The questions are the same as the questions for Person 1.

INFORMATIONAL COPY



INFORMATIONAL COPY



Mailing Instructions

➔ Please make sure you have...

- listed all names and answered the questions on pages 2, 3, and 4
- answered all Housing questions
- answered all Person questions for each person.

➔ Then...

- put the completed questionnaire into the postage-paid return envelope. If the envelope has been misplaced, please mail the questionnaire to:
U.S. Census Bureau
P.O. Box 5240
Jeffersonville, IN 47199-5240
- make sure the barcode above your address shows in the window of the return envelope.

Thank you for participating in the American Community Survey.

INFORMATIONAL COPY

For Census Bureau Use

POP <input type="text"/>	EDIT <input type="text"/>	PHONE <input type="text"/>
EDIT CLERK <input type="text"/>	TELEPHONE CLERK <input type="text"/>	

JIC1 <input type="text"/>	JIC2 <input type="text"/>
JIC3 <input type="text"/>	JIC4 <input type="text"/>

The Census Bureau estimates that, for the average household, this form will take 38 minutes to complete, including the time for reviewing the instructions and answers. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to: Paperwork Project 0607-0810, U.S. Census Bureau, 4600 Silver Hill Road, AMSD – 3K138, Washington, D.C. 20233. You may e-mail comments to Paperwork@census.gov; use "Paperwork Project 0607-0810" as the subject. Please **DO NOT RETURN** your questionnaire to this address. Use the enclosed preaddressed envelope to return your completed questionnaire.

Respondents are not required to respond to any information collection unless it displays a valid approval number from the Office of Management and Budget. This 8-digit number appears in the bottom right on the front cover of this form.





Tacoma-Pierce County Air Quality Briefing



Erik Saganic

BCRA

July 2012

To be covered today...

- **Puget Sound Clean Air Agency**

- Who we are
- What we do

- **Air Quality Standards**



- **Tacoma-Pierce County & Wood Smoke**

- **Clean Air Task Force**

PSCAA Overview

- **Four - county Jurisdiction**
- **Agency organization**
 - **Compliance (Industrial Monitoring)**
 - **Air Monitoring**
 - **Planning and Analysis**
 - **Communication**
- **Governed by Board of Directors**
- **Extremely collaborative**
 - **State, federal, local**



Who Oversees Your Air Quality?

- National Level – Environmental Protection Agency (EPA)



- State Level – Washington State Department of Ecology



- County Level – Puget Sound Clean Air Agency





Photo courtesy:
northtacoma.net



Photo courtesy: The News Tribune



Many Different Types of Pollutants

- **Fine Particles**
- **Ozone (Smog)**
- **Sulfur Dioxide**
- **Nitrogen Dioxide**
- **Carbon Monoxide**
- **Lead**
- **Air Toxics (like benzene)**

What are fine particles?

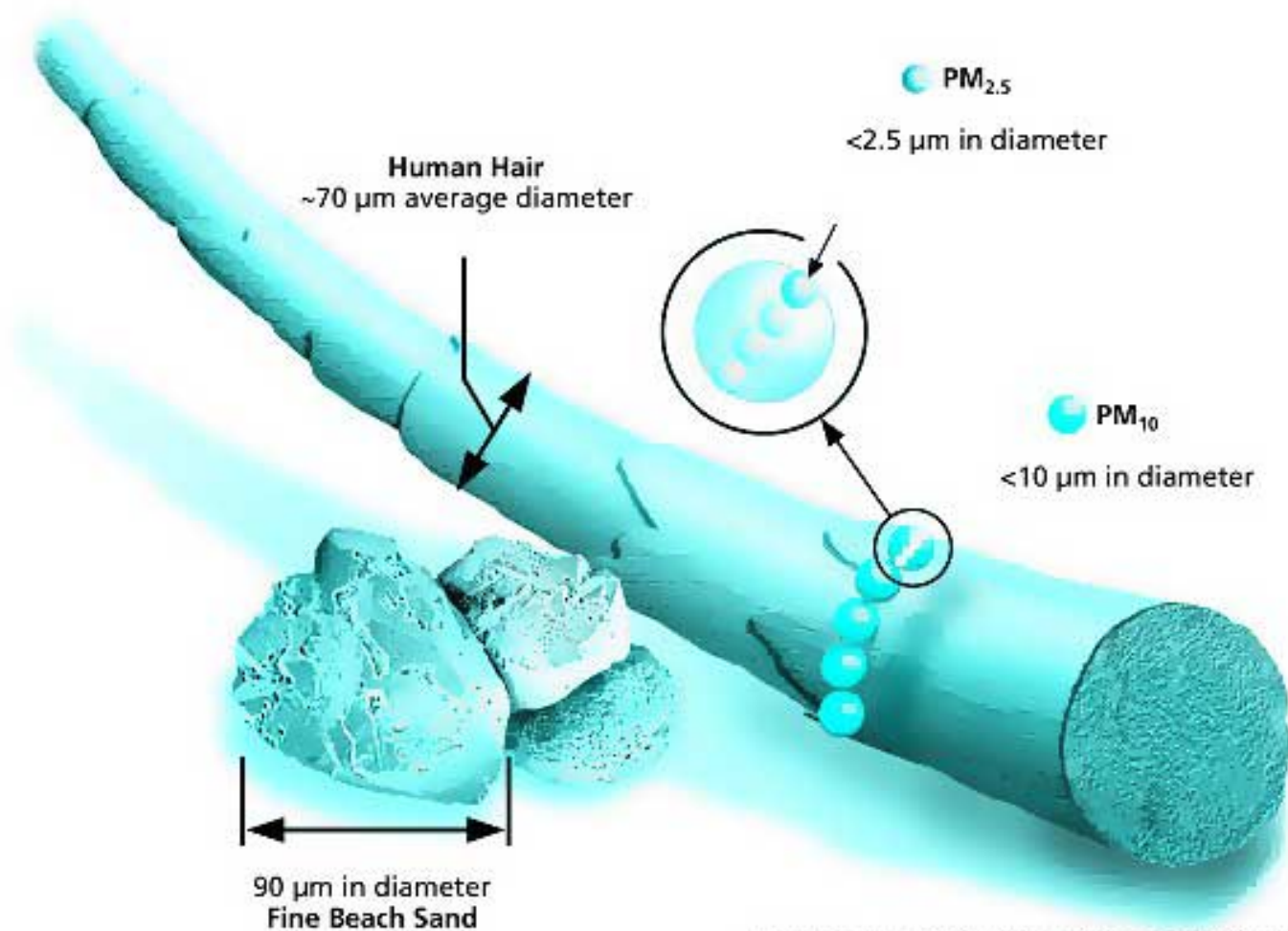
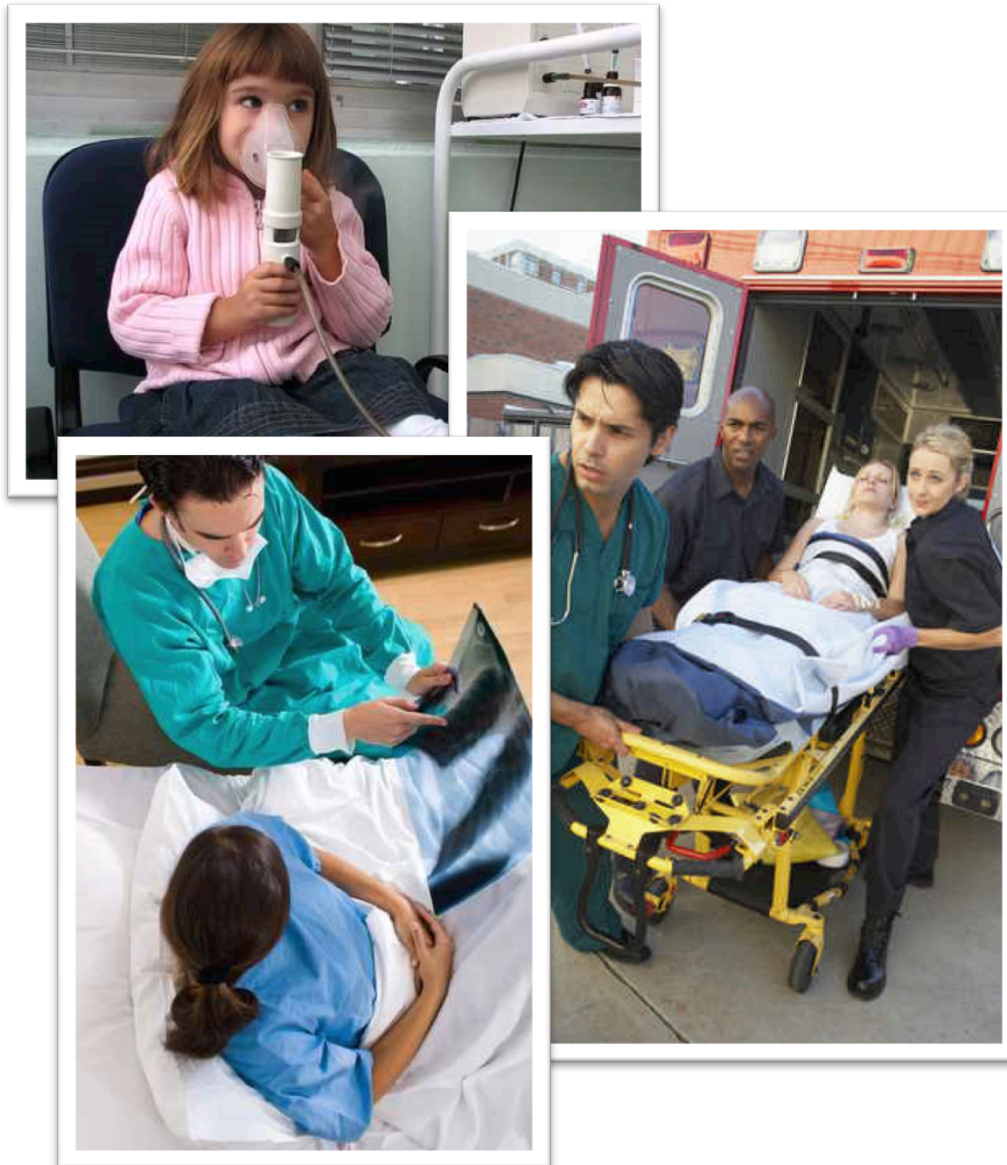


Image courtesy of EPA, Office of Research and Development

Who is affected? Why now?

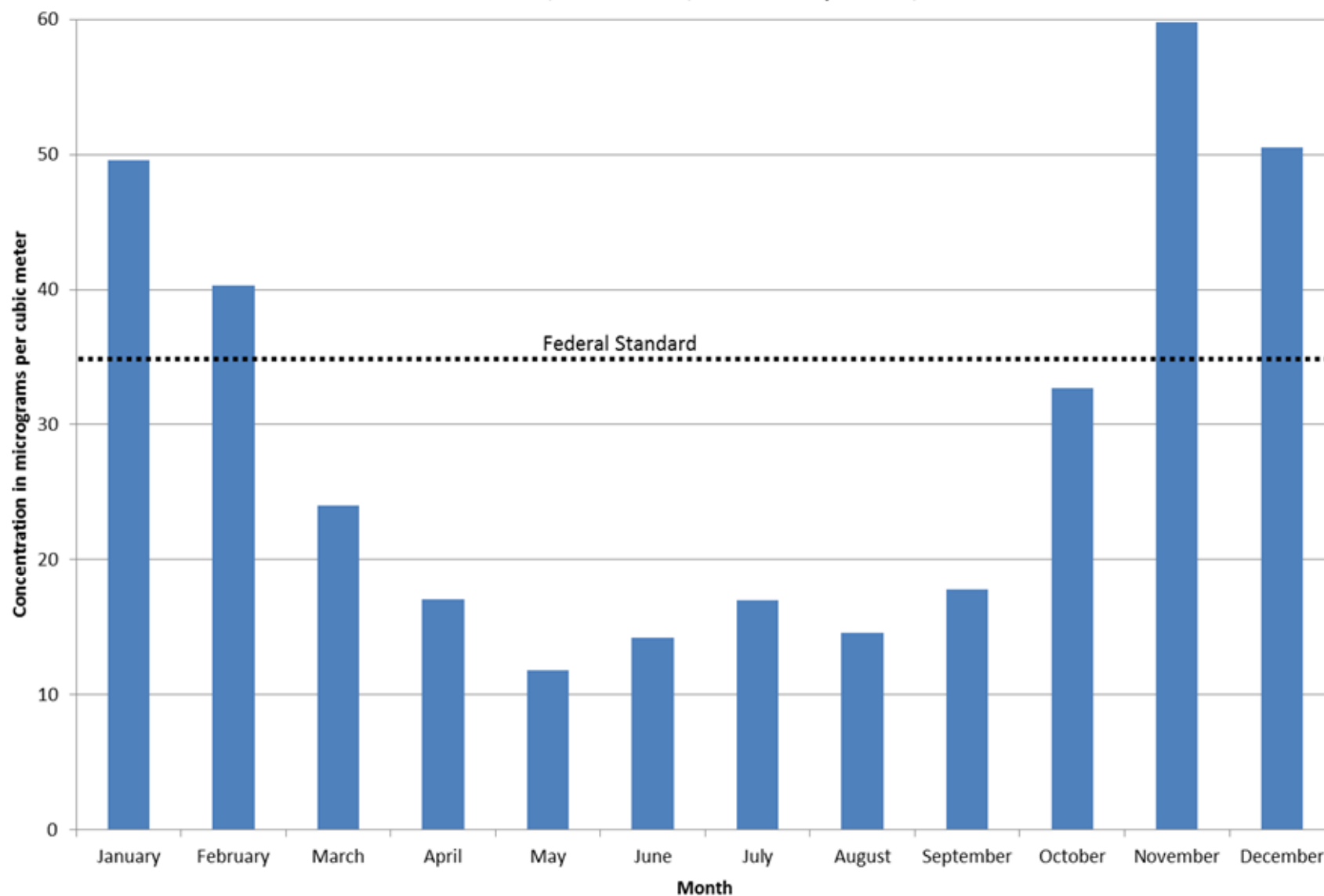


Many health effects

- Asthma aggravation
- Reduced lung function
- Heart attacks
- Strokes
- Premature death

**Parts of Pierce County
don't meet standard**

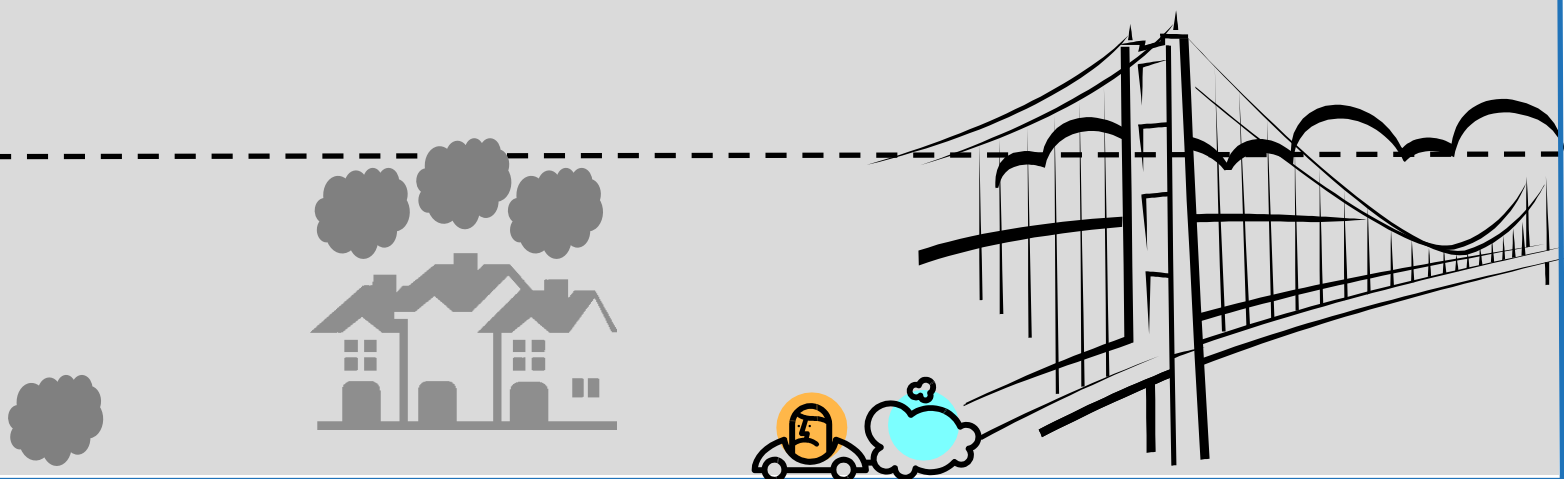
When is fine particle pollution highest?



When highest? Normal ventilation – most days

3,000 ft

300 ft



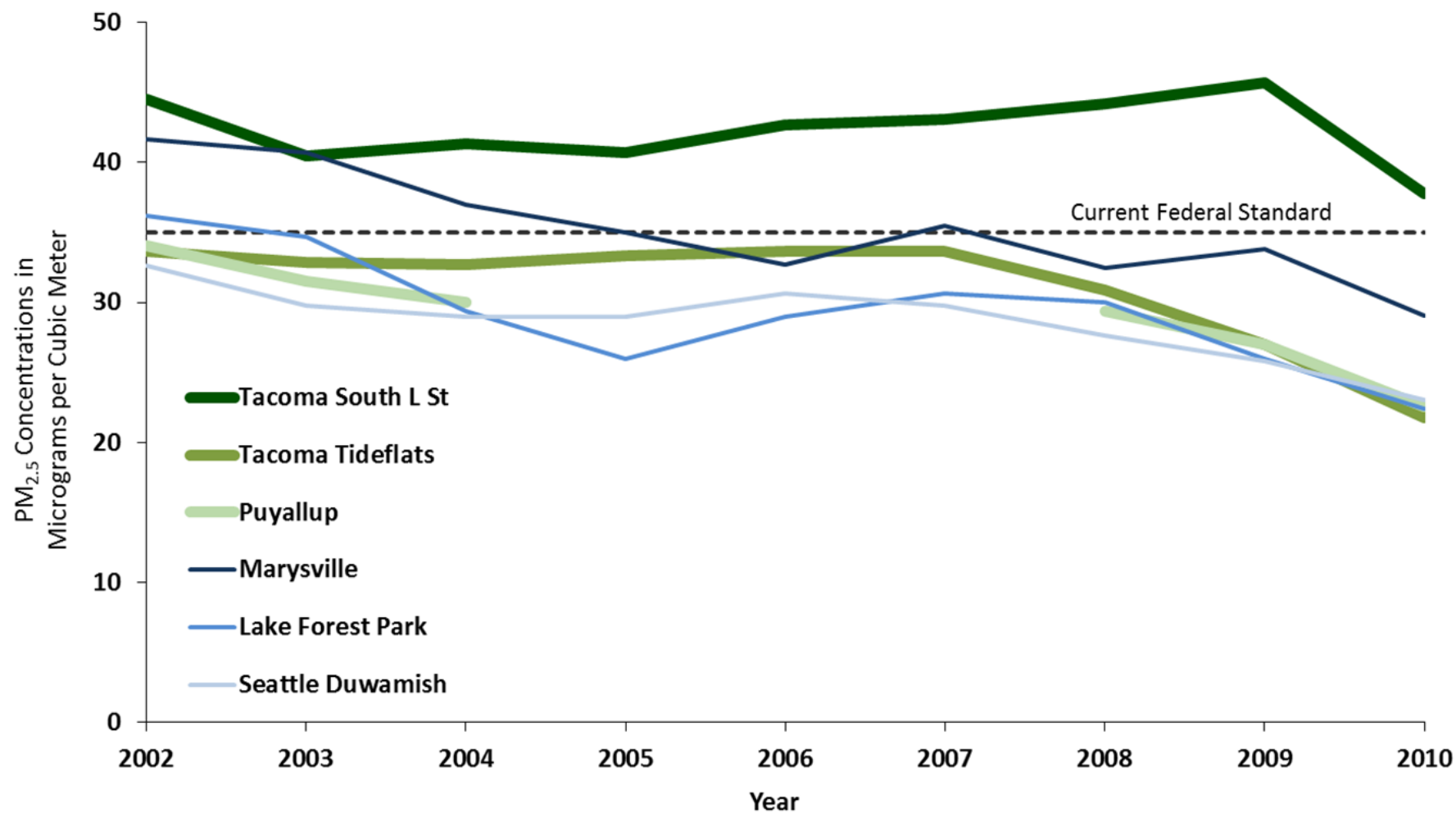
When highest? Ventilation during an inversion

3,000 ft

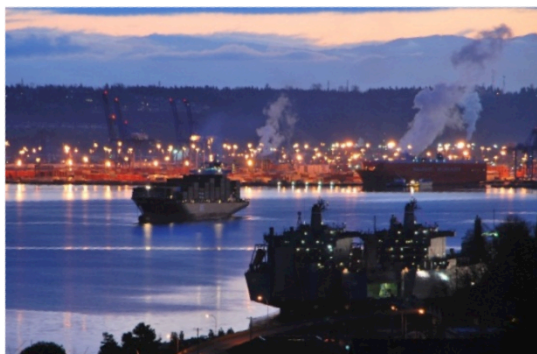
300 ft inversion "lid"



Where are Fine Particles Highest?

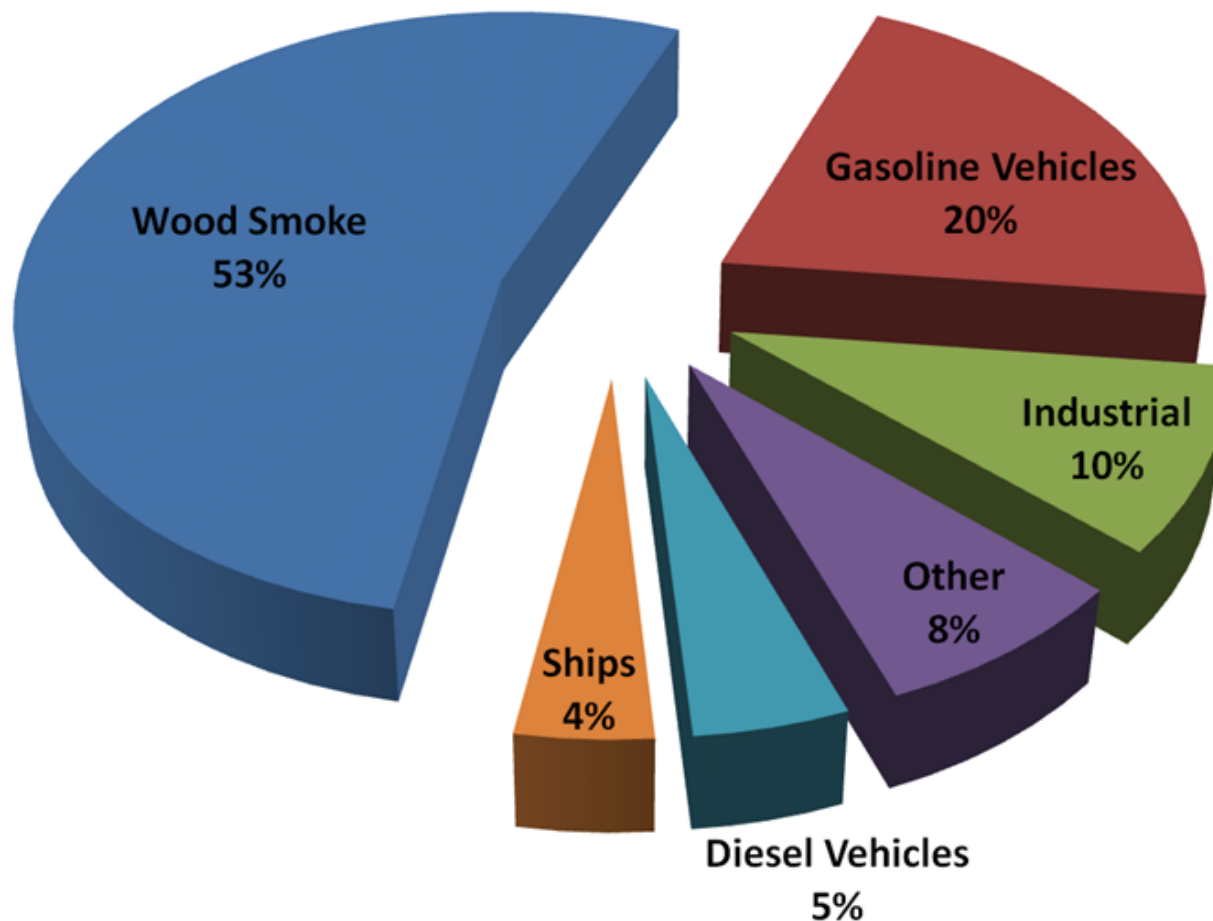


What creates fine particle pollution?



Where do fine particles come from?

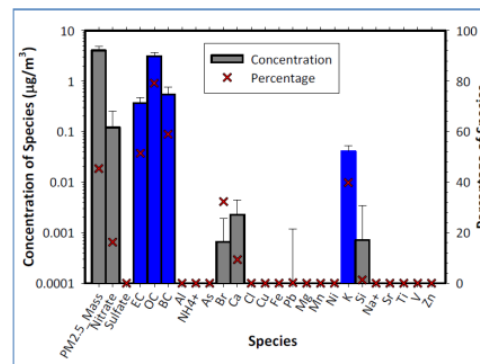
Sources of wintertime (Dec, Jan, Feb) fine particle pollution in
South End Tacoma/Pierce County, with the timeframe of Jan 2006- May 2009



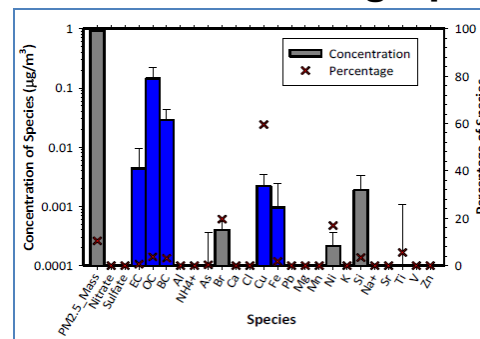
** Adapted from Ogulei 2010*

What is the pie chart based on?

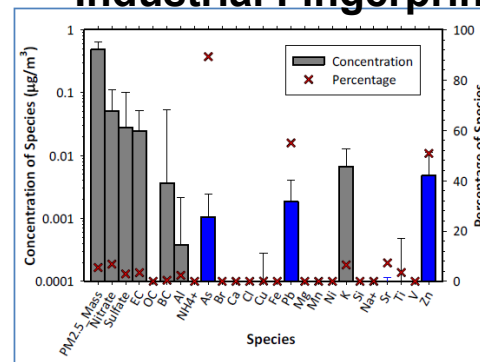
Wood Smoke Fingerprint



Gas Vehicle Fingerprint

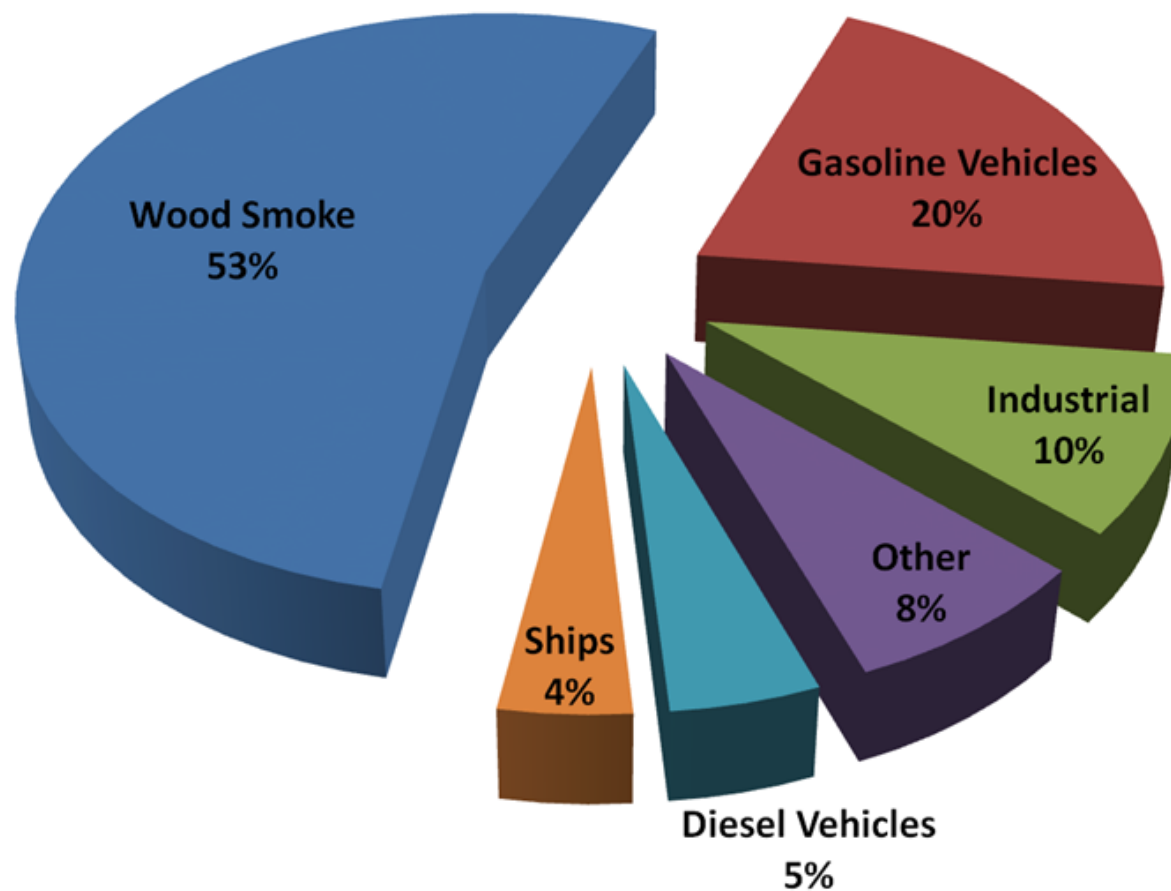


Industrial Fingerprint



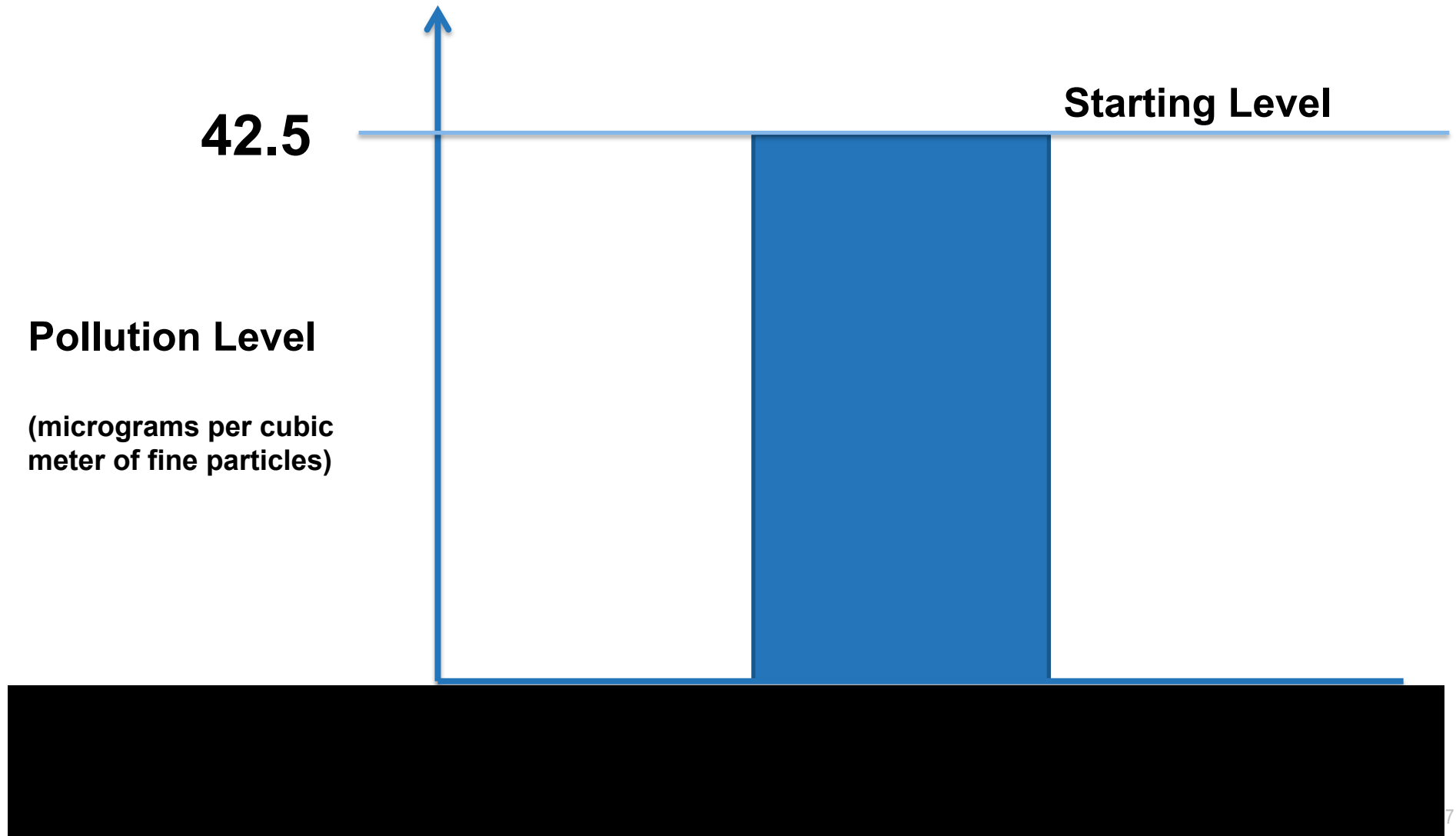
Where do fine particles come from? What's being done to reduce them?

Sources of wintertime (Dec, Jan, Feb) fine particle pollution in
South End Tacoma/Pierce County, with the timeframe of Jan 2006- May 2009

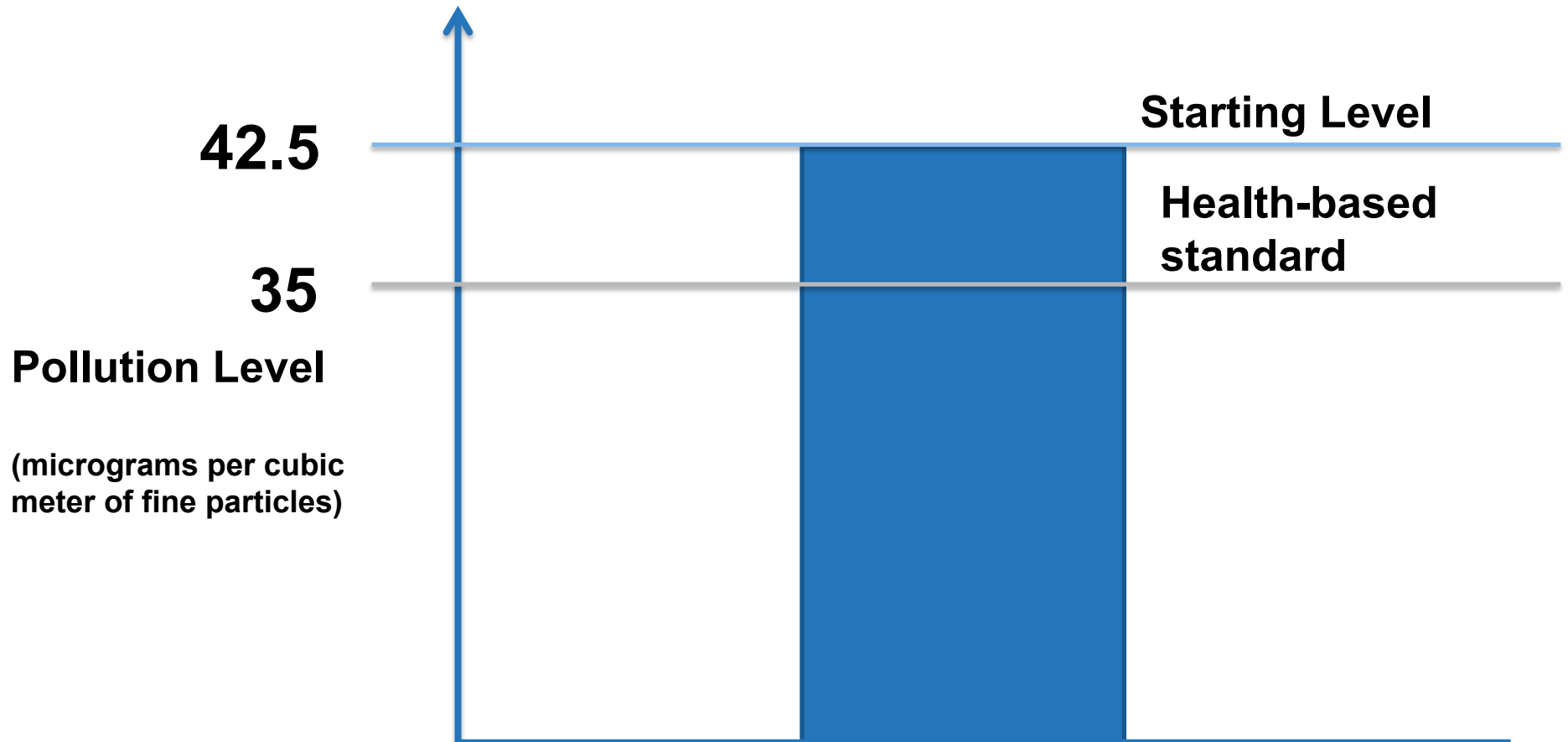


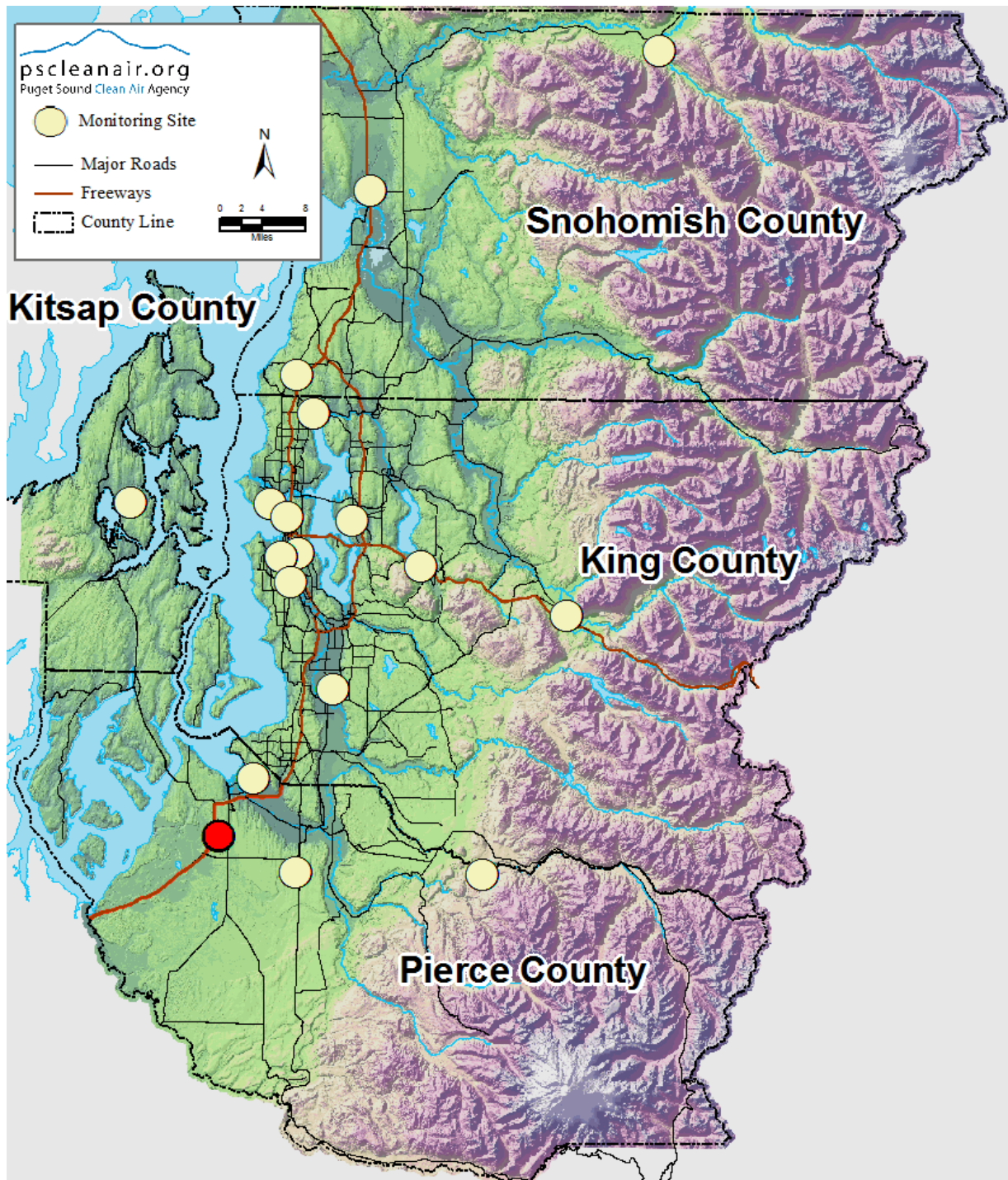
** Adapted from Ogulei 2010*

How far do we have to go to healthier air?



How far do we have to go to healthier air?





Where is the area we're concerned about for fine particle pollution?

Based on:

- 1) Emission data
- 2) Air quality data
- 3) Population density
- 4) Traffic/commuting
- 5) Growth rates
- 6) Weather
- 7) Topography
- 8) Jurisdictional boundaries
- 9) Control of sources



What are wood burning devices? How do they differ?



Who is part of the solution?

- **Clean Air Task Force (Community Advisory Group)**
- **Puget Sound Clean Air Agency**
- **Washington State Department of Ecology**
- **Public Comments**



Proposed Solutions:

- **Burn Bans**

- Already have burn ban program that limits burning during certain periods
- More enforcement

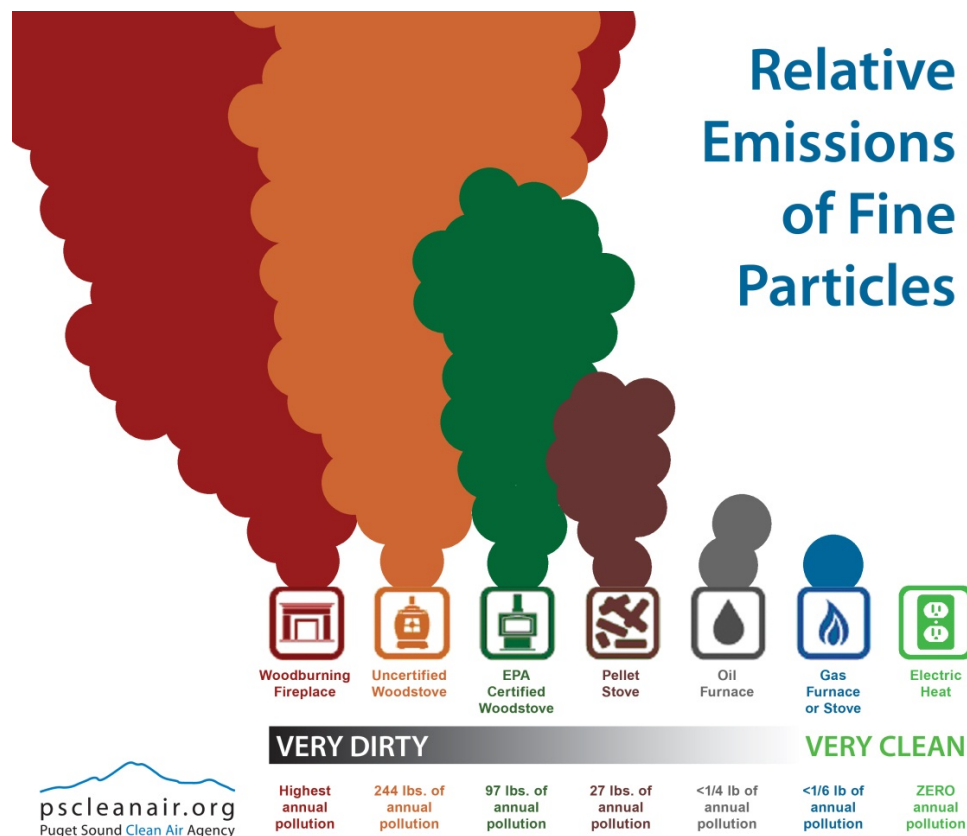
- **Removing Uncertified Stoves and Inserts**

What we've been doing

- **Promote change to a cleaner form of heat**
- **Call and enforce Burn Bans**
- **Complaint response**
- **Public education**
- **Discourage installations of wood-burning devices in new developments**

Woodstove change-out programs

- Tacoma – Pierce County
 - ~4 years, ~1200 woodstoves replaced



Burn Bans

- **New trigger levels passed in 2012 Legislature**
 - **Stage 1 – Met. conditions predicted to cause $\text{PM}_{2.5}$ levels $> 30 \mu\text{g}/\text{m}^3$ within 72 hours – No fireplaces or uncertified stoves**
 - ▲ **Formerly $35 \mu\text{g}/\text{m}^3$**
 - **Stage 2 – $25 \mu\text{g}/\text{m}^3$ $\text{PM}_{2.5}$ – No wood burning (pellet, certified, or uncertified) – unless only source of heat**

Complaint Response Program

- **Affected person completes complaint form**
- **Agency informs neighbor about complaint**
 - Sends brochure about health effects
 - Asks for written response—what will they do to address complaint?
 - Informs that will send copy of response to complainant
- **Agency sends complaint response to complainant**
- **Upon subsequent complaints, agency sends inspector to location to check for violations**
- **If violations, take enforcement action; if none, close case**



Our Mission and Vision

“We work together for clean air and climate protection through education, incentives and enforcement”

The actions of the agency, its partners and the people of the Puget Sound region have resulted in clean, healthy air for all to breathe:

- Essentially no outdoor burning.
- Remaining indoor burning uses only the cleanest alternatives.
- All diesel engines that are retrofit candidates have been replaced or retrofitted.
- Differential risks of breathing poor air – based on race, language or incomes levels are diminishing.
- We are meeting or exceeding green house gas reduction targets established by the state and continue to make progress toward climate stabilization.

Public Education

- Health effects of wood smoke
- Legal restrictions on wood-burning activities
- Clean burning practices
 - Media releases during burn bans
 - Brochures, DVDs
 - Web site
 - Links to health sites



Thanks for your attention....

Questions?

ErikS@pscleanair.org

206-689-4003

Challenges to promoting cleaner heat...



Nonattainment

- Informal is “early action” group
- Formal process is State Implementation Plan
 - 3 years
 - Technical component
 - Stakeholder component
- EPA Headquarters interested in a potential alternative approach – more flexibility...

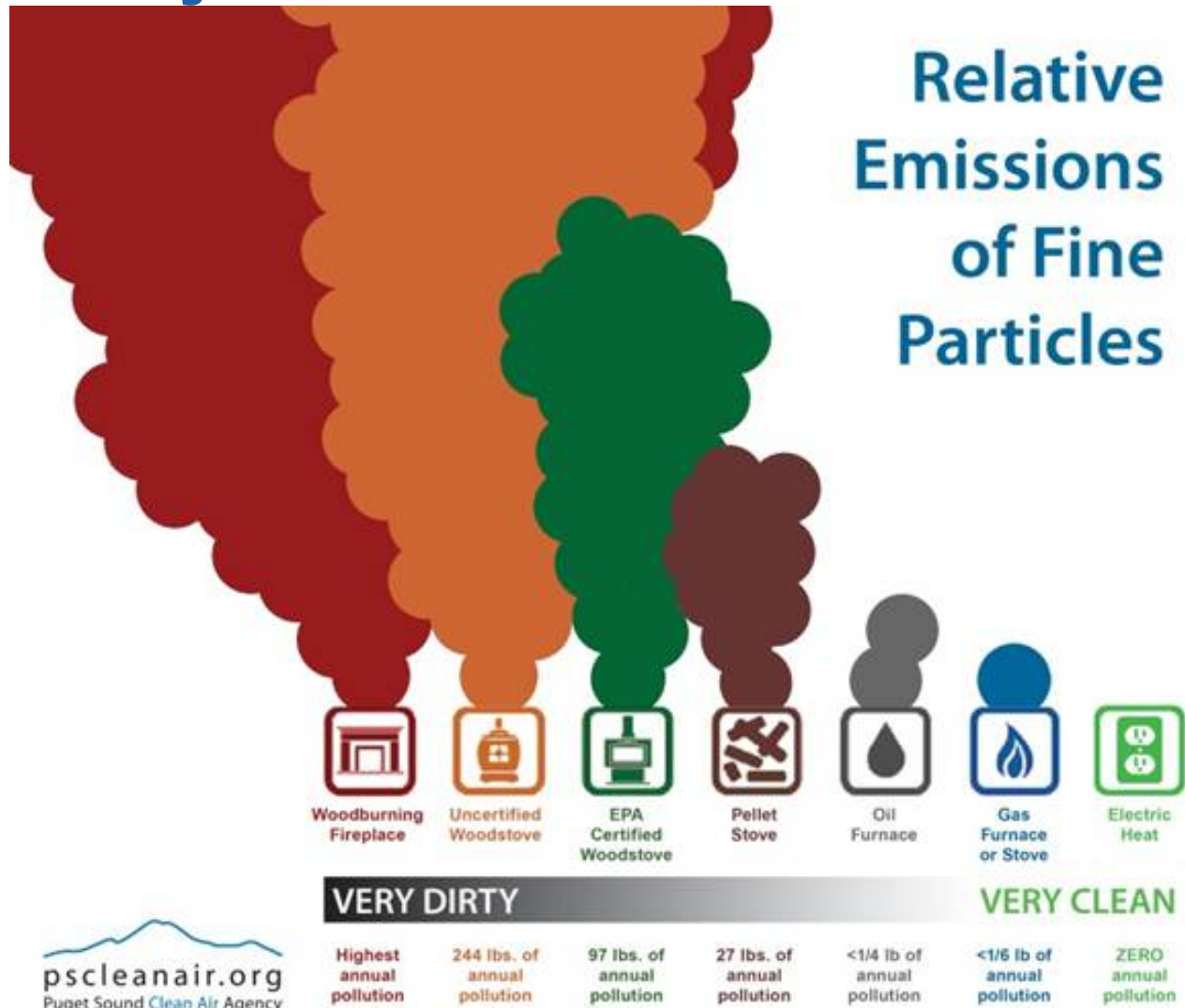
Why now?

- **Public health impacts/societal cost**
- **“Stigma” of unhealthy air**
- **Implications for major existing and new industry/economic development**

What needs to happen? When?

- **We must design, submit, and implement a plan with solutions that work for our communities**
 - **Must achieve cleaner air that meets the standard**
 - **Can't rely only on education, outreach, and voluntary programs (must have enforceable standards or rules)**
 - **Must address multiple sources of fine particle pollution**
- **Clean Air Task Force submits recommendations to Clean Air Agency by December 2011**
- **Washington Department of Ecology submits plan to EPA by December 2012**
- **We reach healthier fine particle levels 2014 - ? (latest 2019)**

What are wood burning devices? How do they differ?



What draft solutions are currently being discussed?

- **Enhancing enforcement of wintertime burn bans**
 - **Focuses on those contributing most to the problem, when problem is worst**
 - **Requires sustained presence – doesn't fundamentally address fine particle pollution source**
 - **Education and outreach in addition to enforcement**
 - **Exemptions for those who most need them**

What draft solutions are currently being discussed? (contd.)

- **Removing older, more polluting uncertified wood stoves from households**
 - **One-time removal results in permanent emission reduction**
 - **Requirement at date certain (under discussion)**
 - **Many of these devices in the area (estimate >24,000
- we've replaced 1,200 with incentive programs)**
 - **Help those who need it most**
- **2nd variation identical, but removes uncertified wood stoves at time of sale**

How can I learn more, and offer my input? What will be done with my input? What's next?

- **Various ways to provide input tonight**
- **www.CleanAirPierceCounty.org; 1(855)360-0660**
- **Sign up for updates**
- **Next steps...**
 - **Task Force wraps up by December**
 - **Input provided to Task Force**
 - **Future opportunities – informal and formal - to comment on draft plan in 2012**

EXTRA SLIDES

Consequences of Nonattainment

- Reality of having unhealthy air
- Negative image associated with this finding
- Strictest control measures required on new big businesses or major modifications to existing
- Other existing businesses may be required to install new air pollution control equipment
- Possible loss of transportation funding
- Wood stove and fireplace restrictions

What's Been Done So Far

- Industrial and business emissions reduced over last several decades
- Wood smoke reduced
 - Voluntary, subsidized wood stove trade-out program
 - Over 1,200 old wood stoves replaced in 4 years
- Diesel emissions reduced
 - All school bus fleets in Pierce county retrofitted (40% emission reduction)
 - Retrofitted Tacoma maintenance vehicles (25% reduction)
 - Retrofitted Port cargo-handling equipment (40% reduction)

What's Happening Now?

- **May-December 2011:** Tacoma-Pierce County Clean Air Task Force developed three key pollution-reduction recommendations (*next slide*).
- **January-February 2012:** Puget Sound Clean Air Agency board of directors reviewed, heard public comment, then adopted Task Force recommendations
- **March 2012:** Changes made to Washington State's wood smoke law
 - Clarifying "prohibit" authority for uncertified wood stoves
 - Modifying levels when burn bans are called
 - Fireplaces included as potential contingency measure

What's Happening Now? (cont.)

- **September-October 2012:** Puget Sound Clean Air Agency Board of Directors to consider and accept public comment on new local wood stove rule
- **October 2012:**
 - Launch of voluntary, incentivized wood stove removal/replacement program.
 - Start of enhanced burn ban enforcement.

Strategies for clean air/attainment

- **1) Implement a range of strategies to reduce fine particle pollution for gasoline vehicles, diesel vehicles, ships, and industry (non-wood smoke sources).**
 - Clean Car Standards
 - Federal diesel rules
 - International Maritime Organization (IMO) Emission Control Area
 - Northwest Ports Strategy
 - PSRC regional transportation plan
 - Industrial source controls

Strategies for clean air/attainment (cont.)

- **2) Enhancing enforcement of fall/wintertime burn bans**
 - Focuses on those who contribute the most to the problem, when the problem is worst
 - Requires sustained presence – doesn't address fine particle pollution source on a long-term or "permanent" basis
 - Education and outreach in addition to enforcement
 - Exemptions for those who most need them

Strategies for clean air/attainment (cont.)

- **3) Requiring removal of older, more polluting “uncertified” wood stoves from households**
 - One-time removal results in permanent emission reduction
 - Requirement at date certain (likely Sept. 2015)
 - Many of these devices in the area (estimate more than 24,000 in nonattainment area)
 - Direct help to those who need it most

Reminder of what is not affected

- No new rules on certified wood stoves
- Still two stages for burn bans – certified stoves allowed during Stage 1 burn ban
- Per legislative direction, no changes:
 - If burning wood is only adequate source of heat, home is exempt from burn bans or any new wood stove rules (*but not exempt from clean-burning rules*)

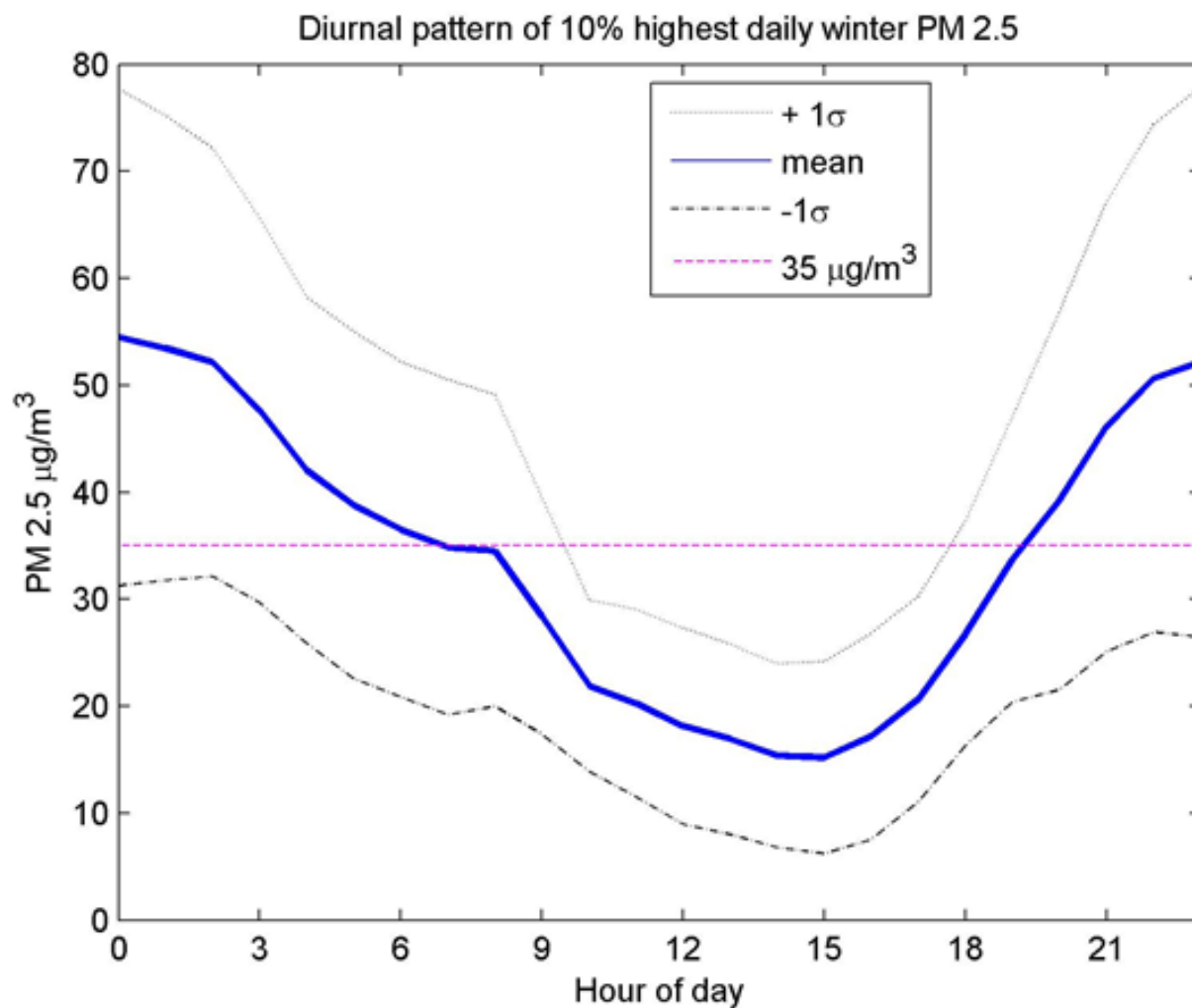
What's next for the attainment process?

- The state's formal pollution reduction plan to reach attainment is finalized
 - **Fall 2012:** Dept. of Ecology conducts formal public review and public comment process on State Implementation Plan (SIP)
 - **Dec. 2012:** Dept. of Ecology submits attainment strategy (SIP) to US EPA for approval
- 2014: Must demonstrate at least substantial progress to cleaner air
- 2019 or before: Must “attain” federal standard for fine particle pollution

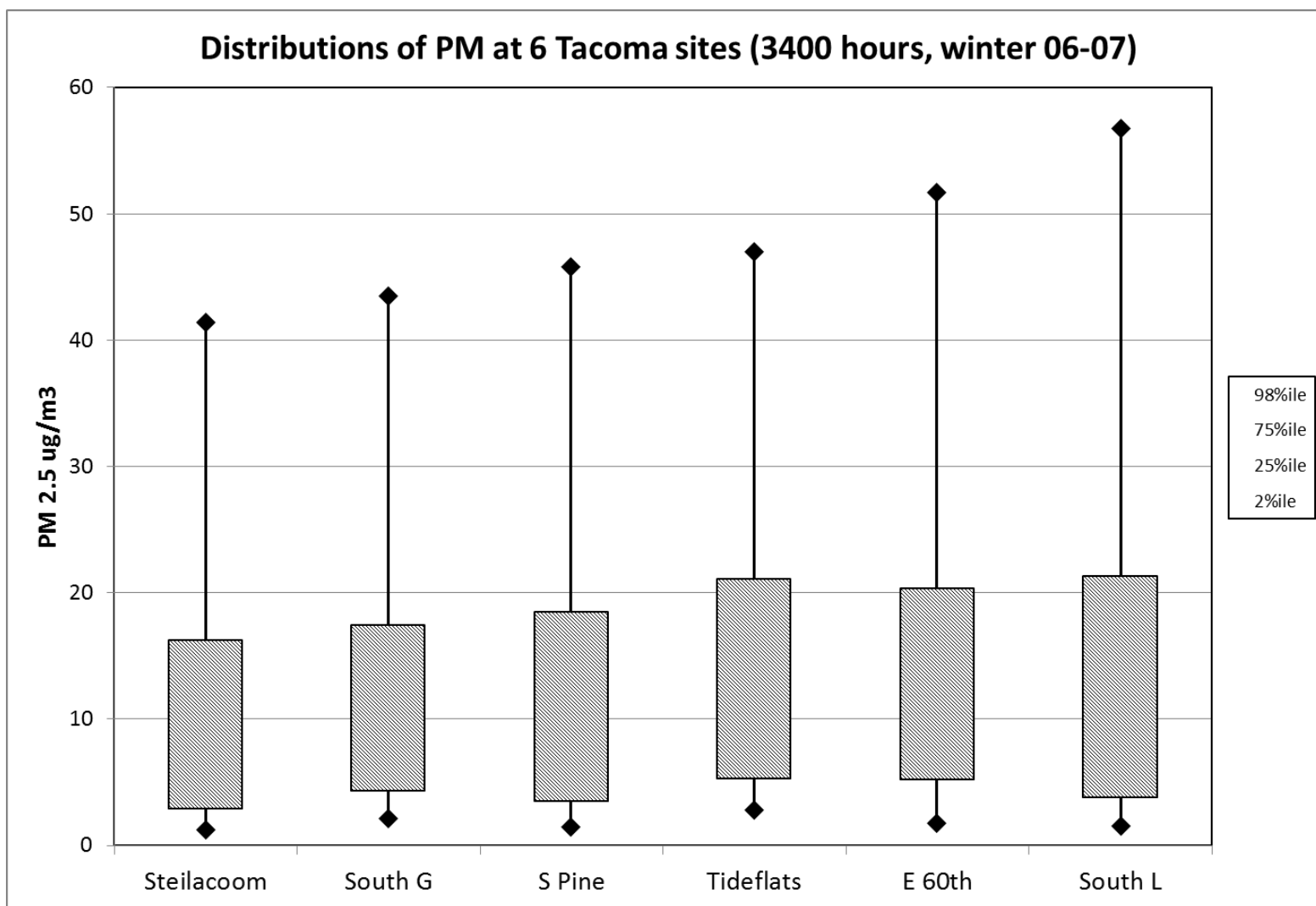
Be part of the solution

- If you have an old wood stove, sign up to take advantage of money to remove or replace.
 - www.pscleanair.org/woodstove OR 253-798-7369
- If you burn wood, be in the know about burn bans – sign up for alerts and obey the bans.
 - www.pscleanair.org/signup
- Be air aware. Know when air quality is bad, especially if you have health concerns.
 - www.pscleanair.org
- Learn more
 - www.cleanairpiercecounty.org
- Help spread the word. Tell your friends and neighbors.

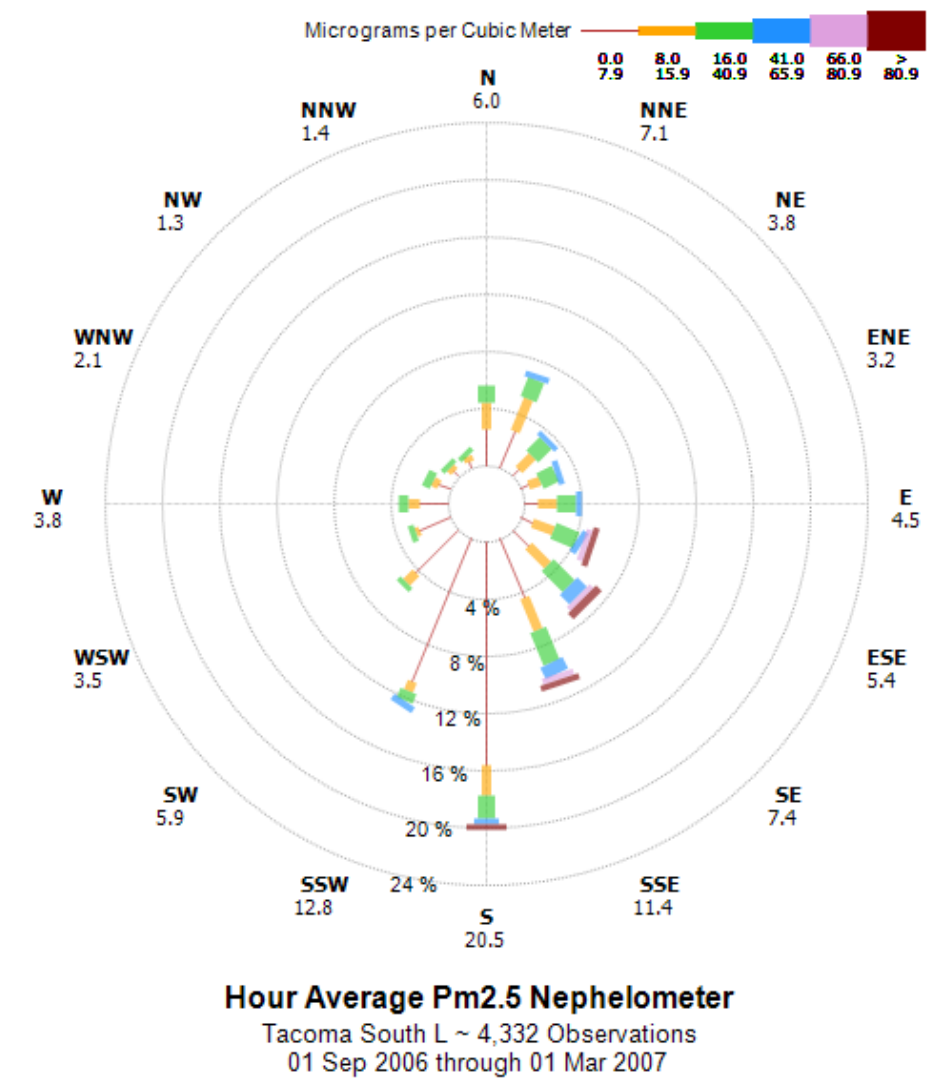
Daytime/Nighttime Pattern



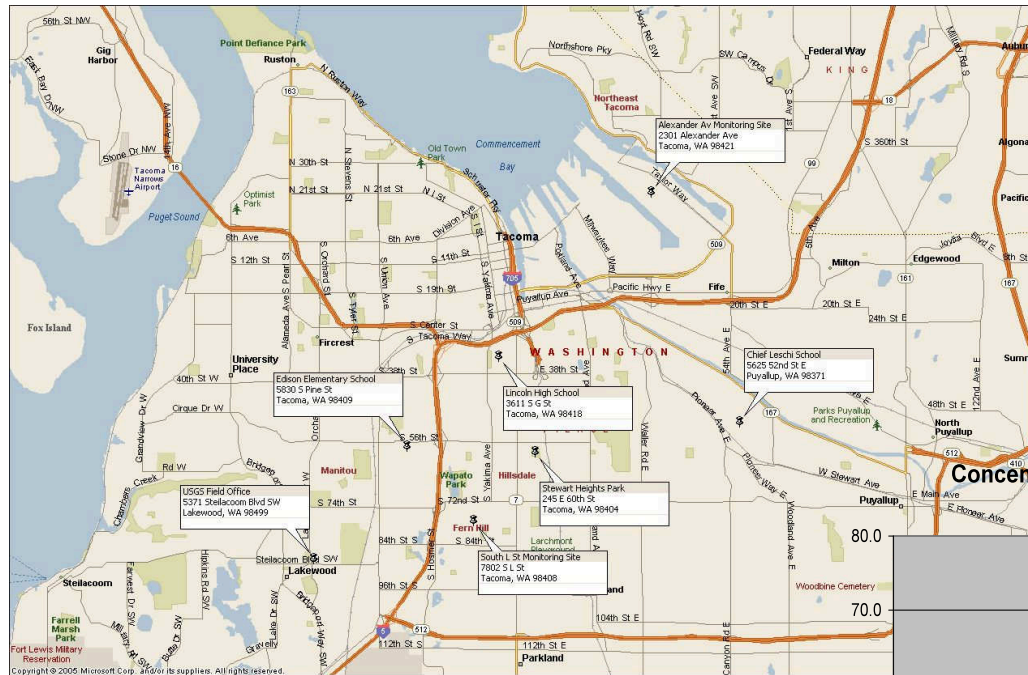
Temporary Monitoring Study



Wind direction when fine particle pollution levels high

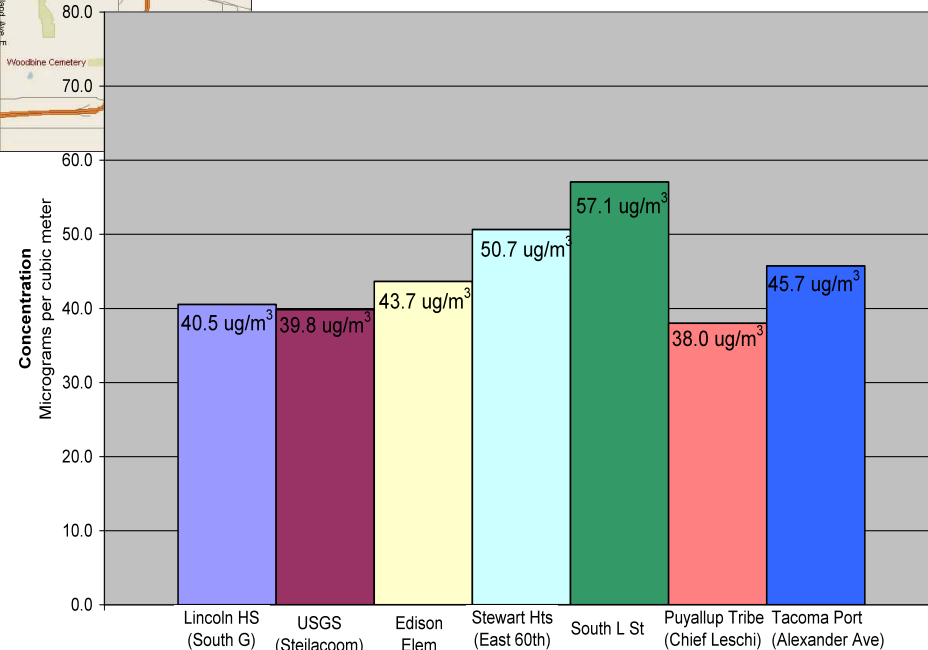


Seasonal study results

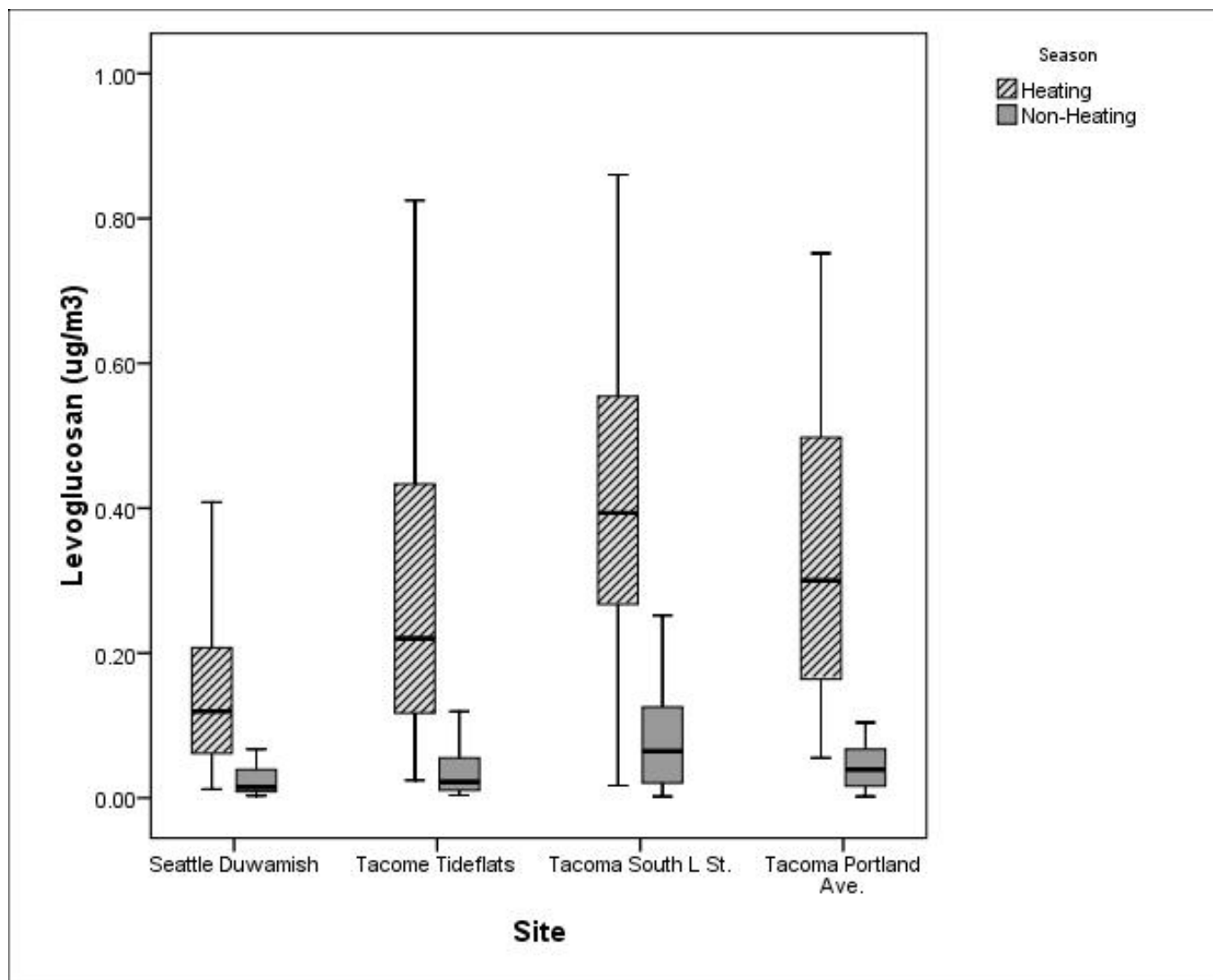


PM_{2.5} daily concentrations, 98th percentile
Sept 2006 - Feb 2007

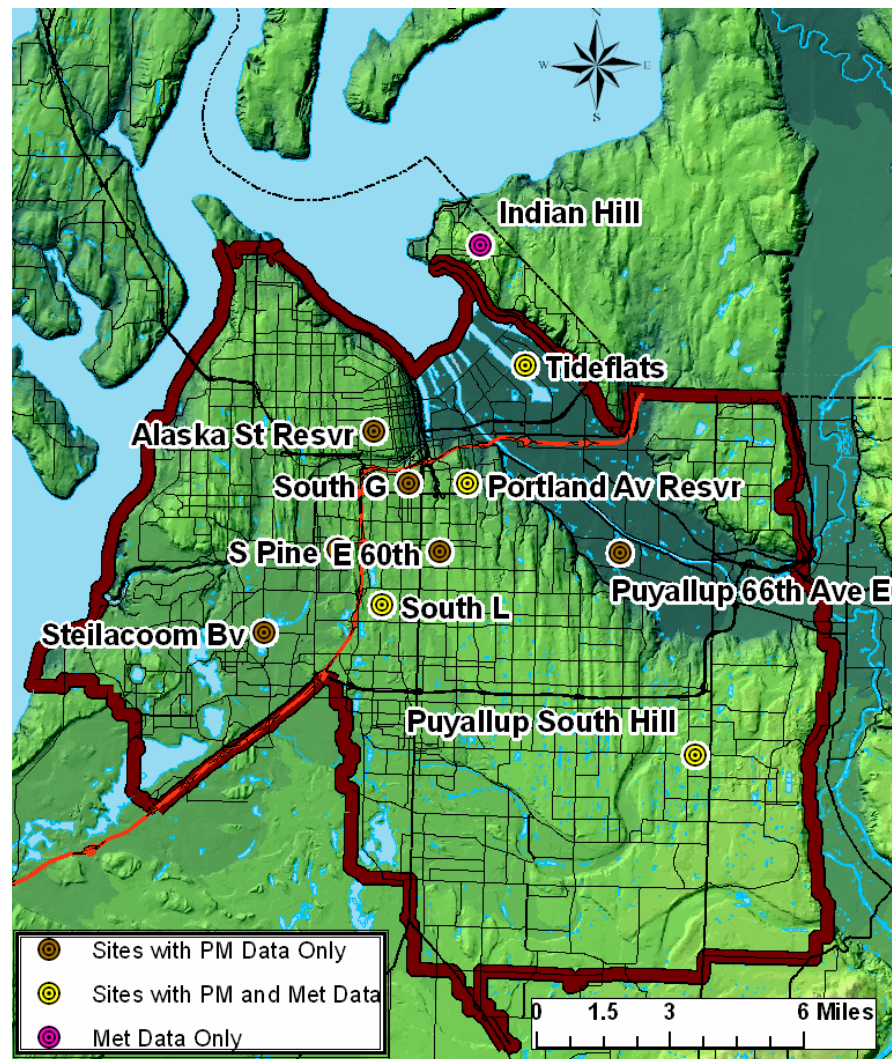
Concentrations exceed the daily federal standard and local health goal



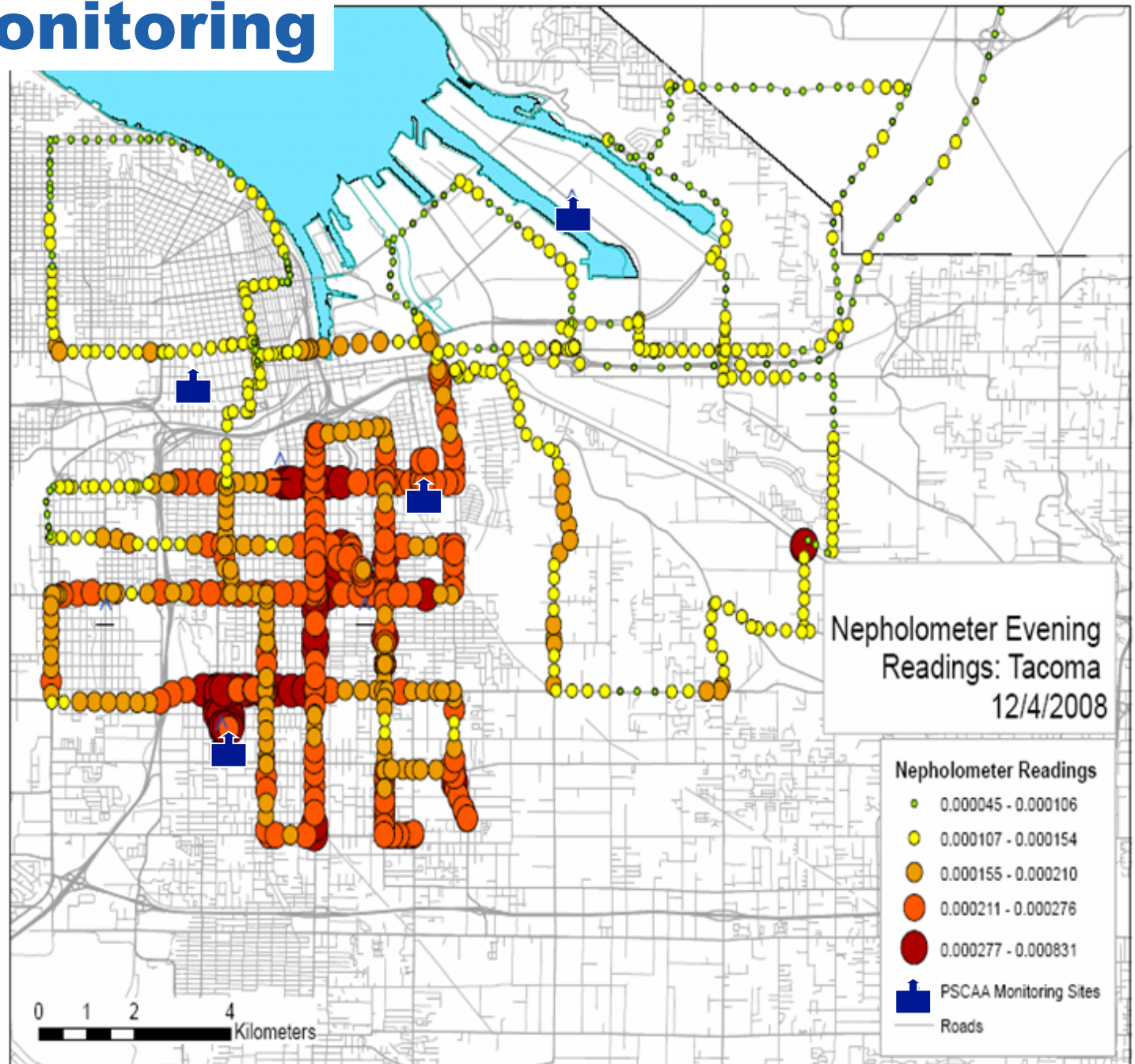
Wood Smoke Tracer Results



Monitoring sites



Mobile Monitoring

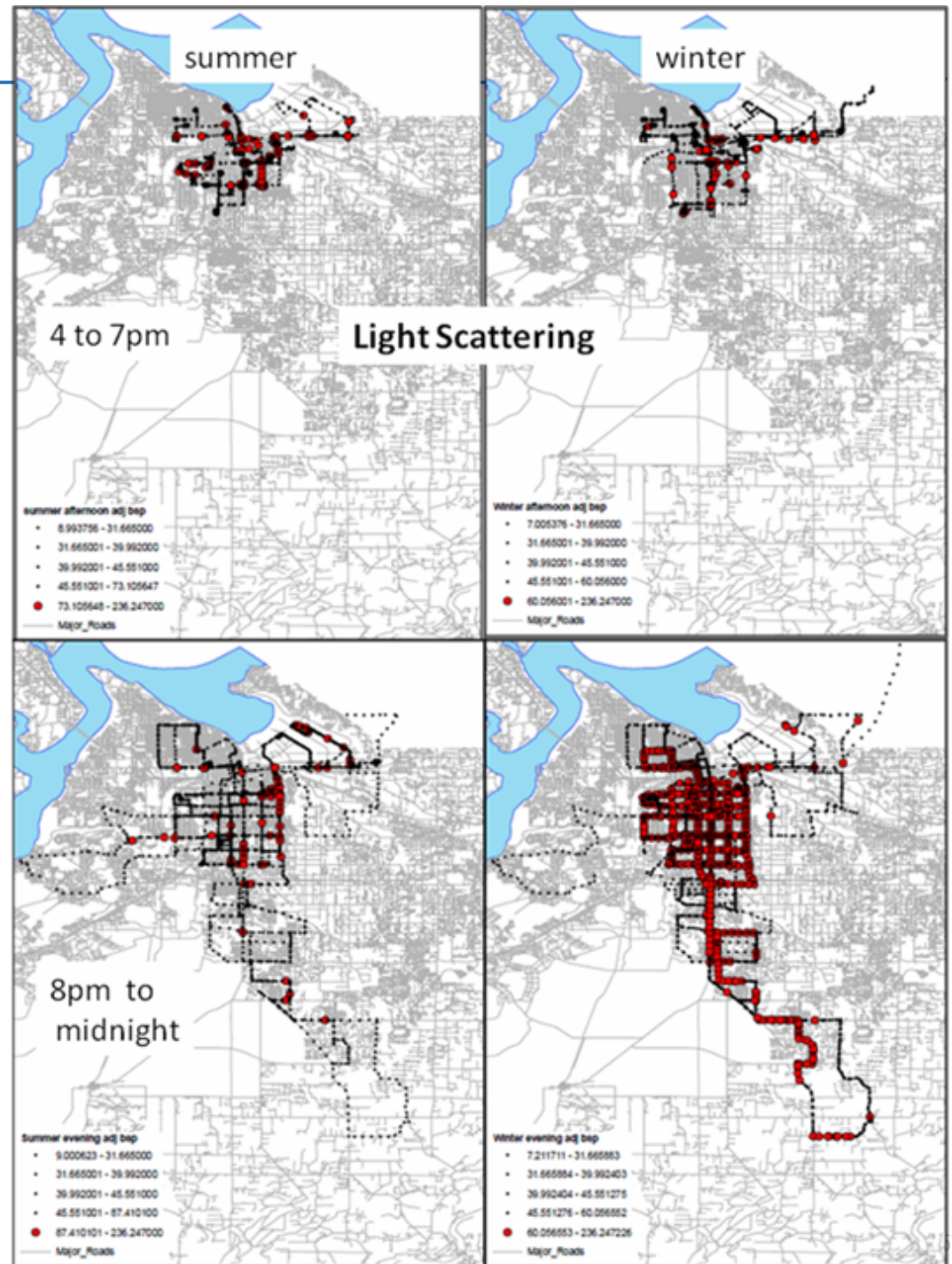


Mobile Monitoring

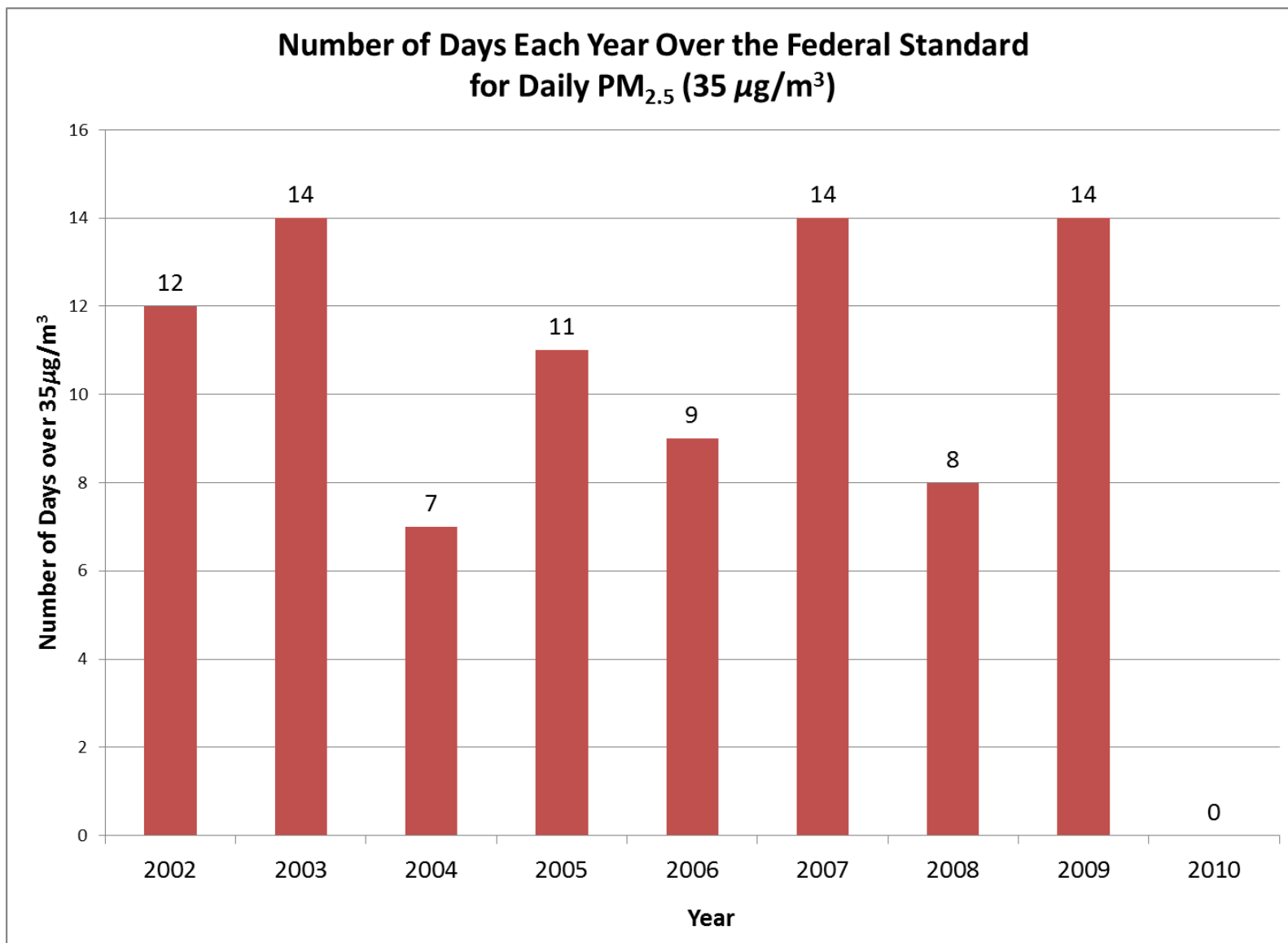
Tacoma winter evenings have highest pollution

Found in residential neighborhoods

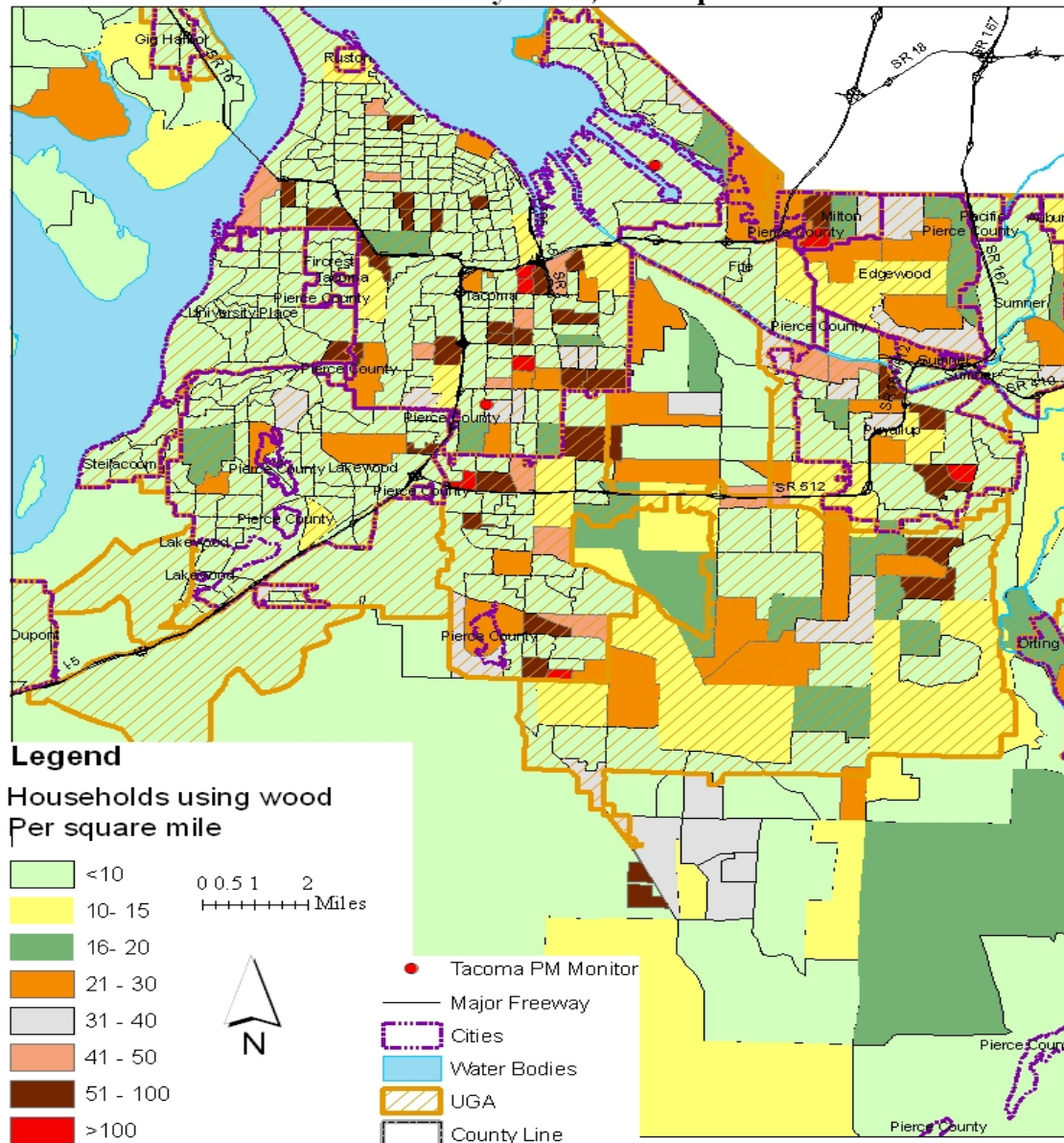
Mobile source contribution is light



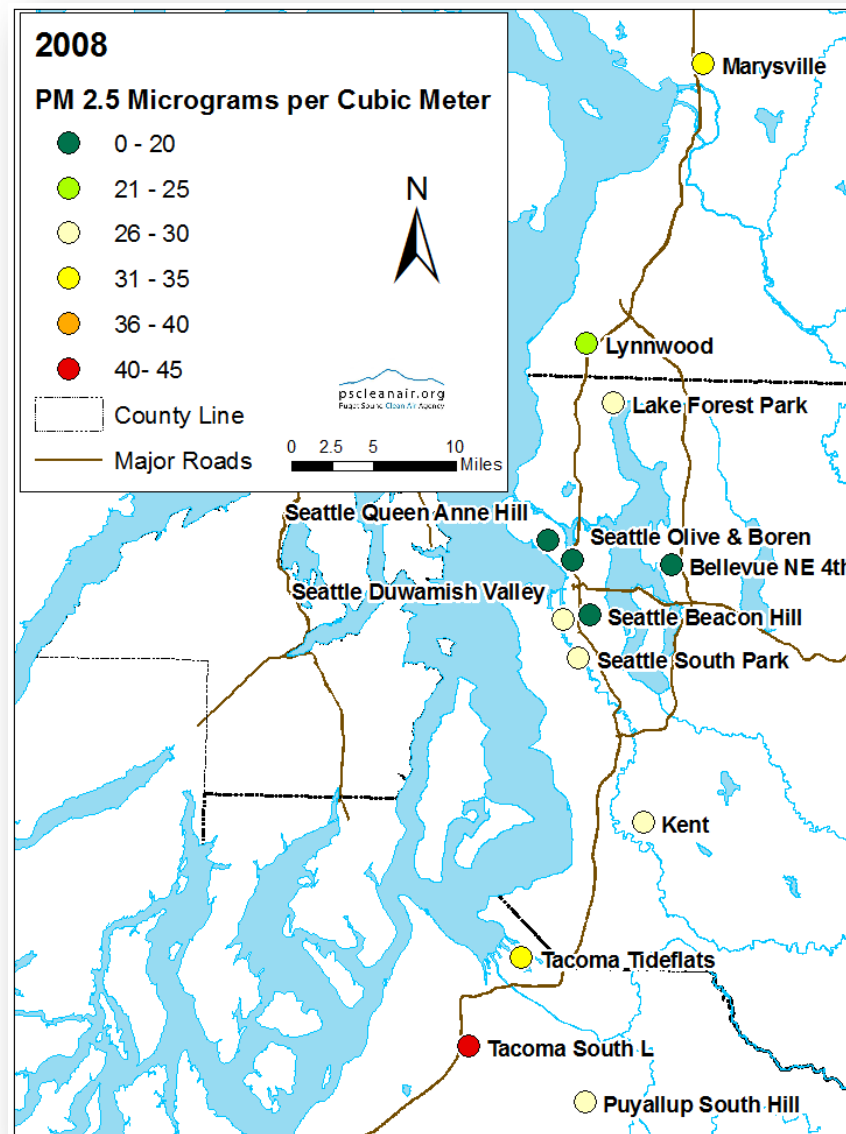
Days over standard at South L



Pierce County Tacoma Area Households Using Wood for Primary Heat, Per Square Mile

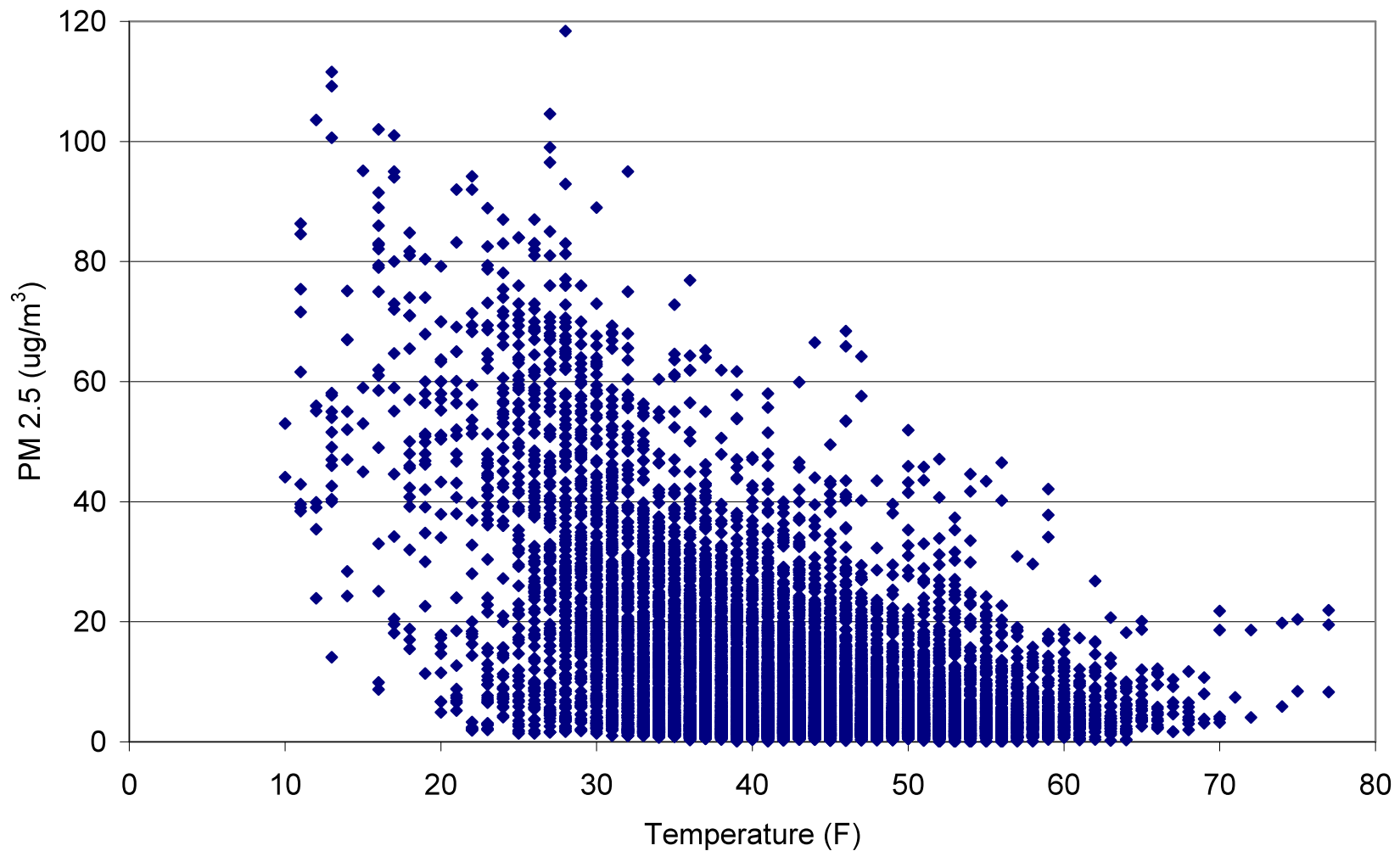


Air quality at South End Tacoma monitor doesn't meet standard

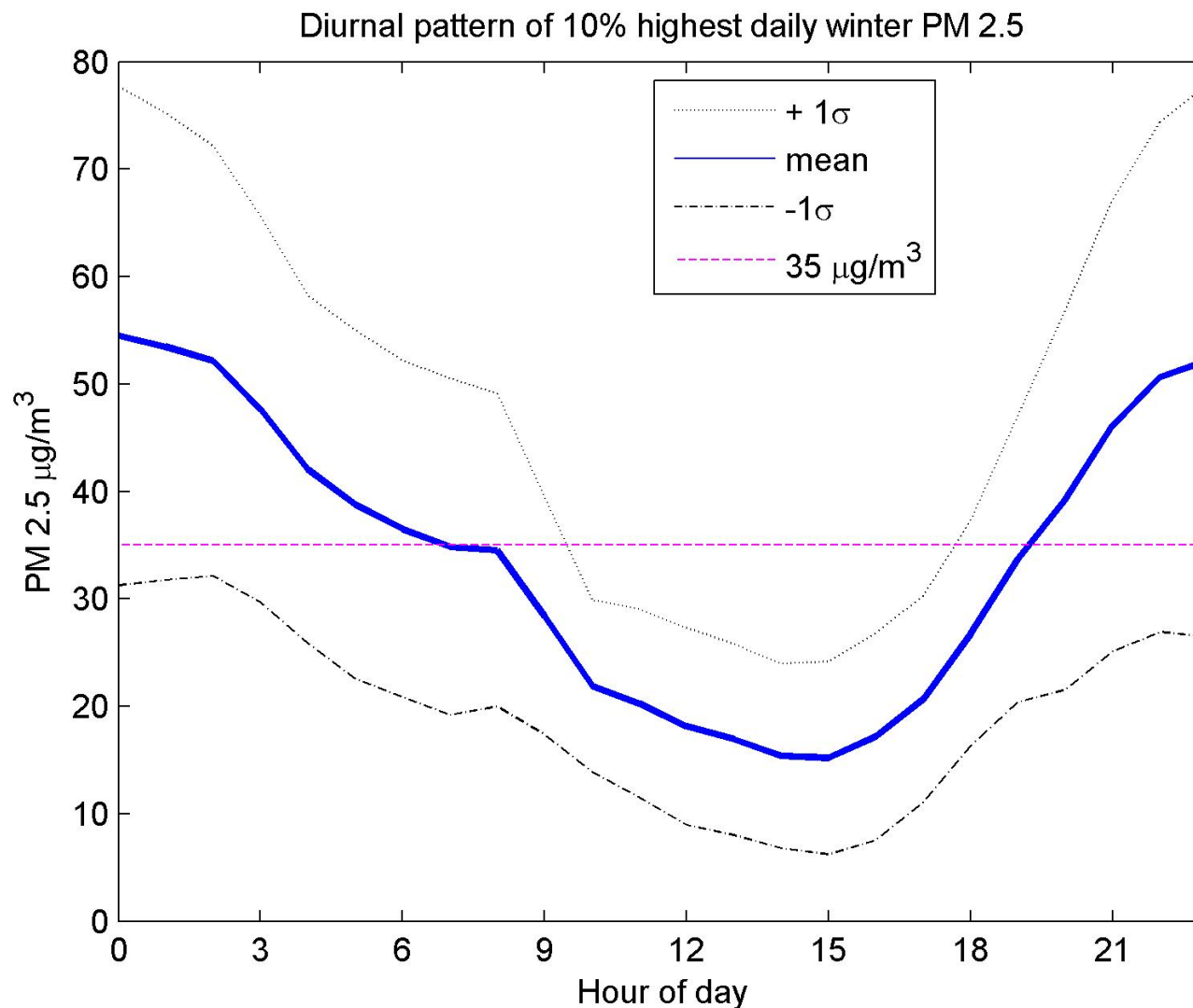


Strong relationship between PM and temperature

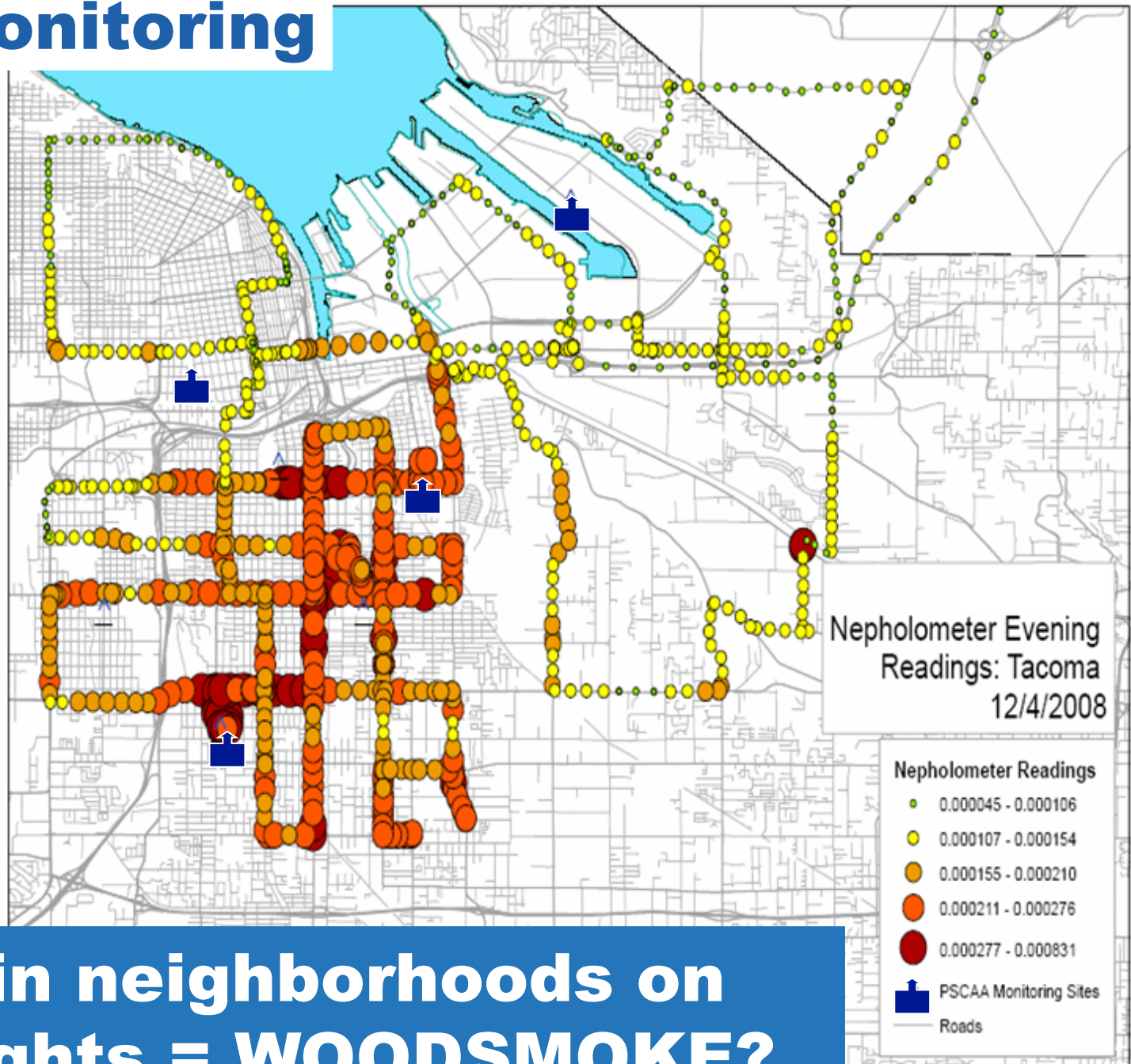
Tacoma South L, fall-winter hourly PM 2.5



- Exceedances driven by nighttime increase.
- Many nights have strong linear increase for 6+ hrs

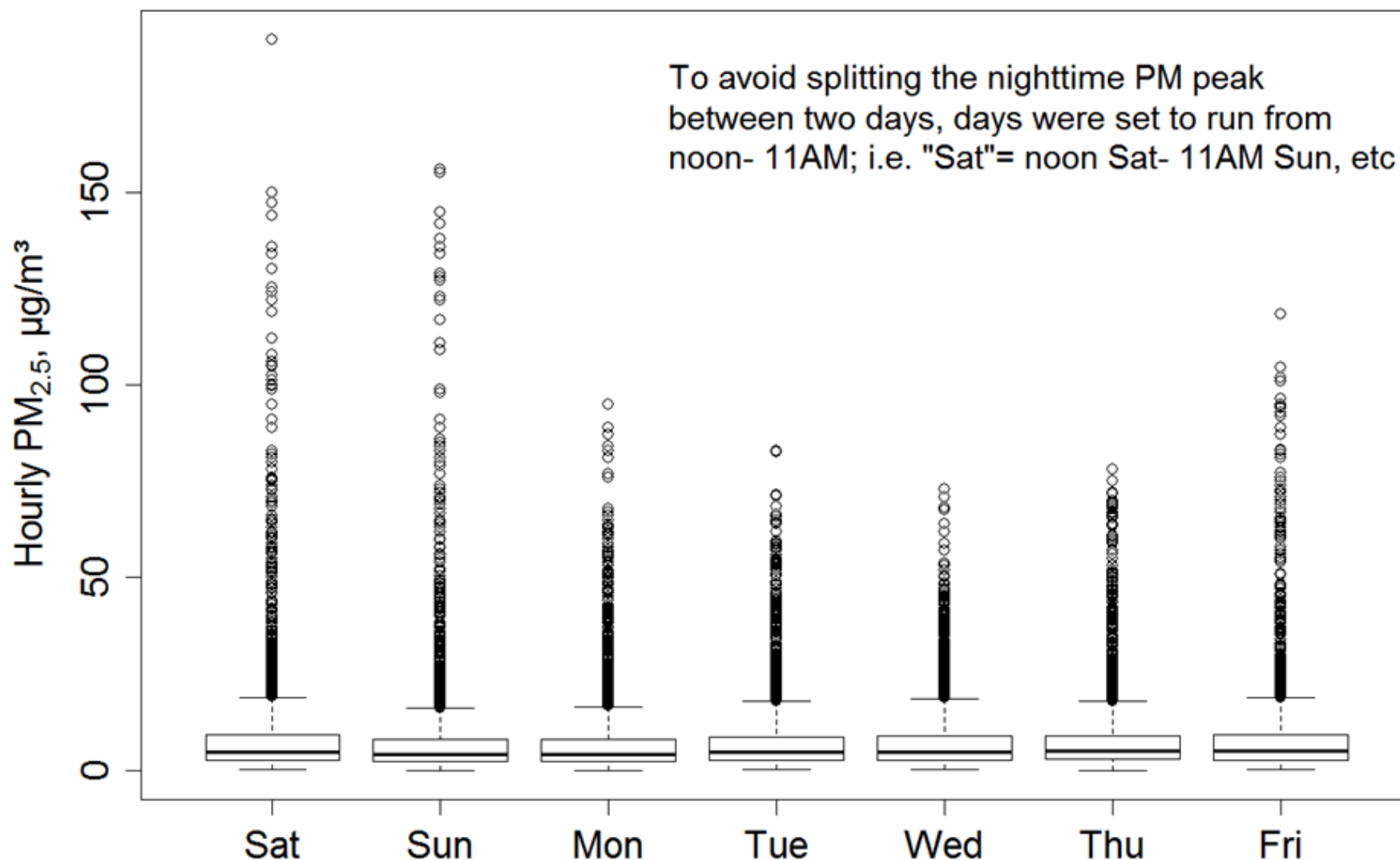


Mobile Monitoring

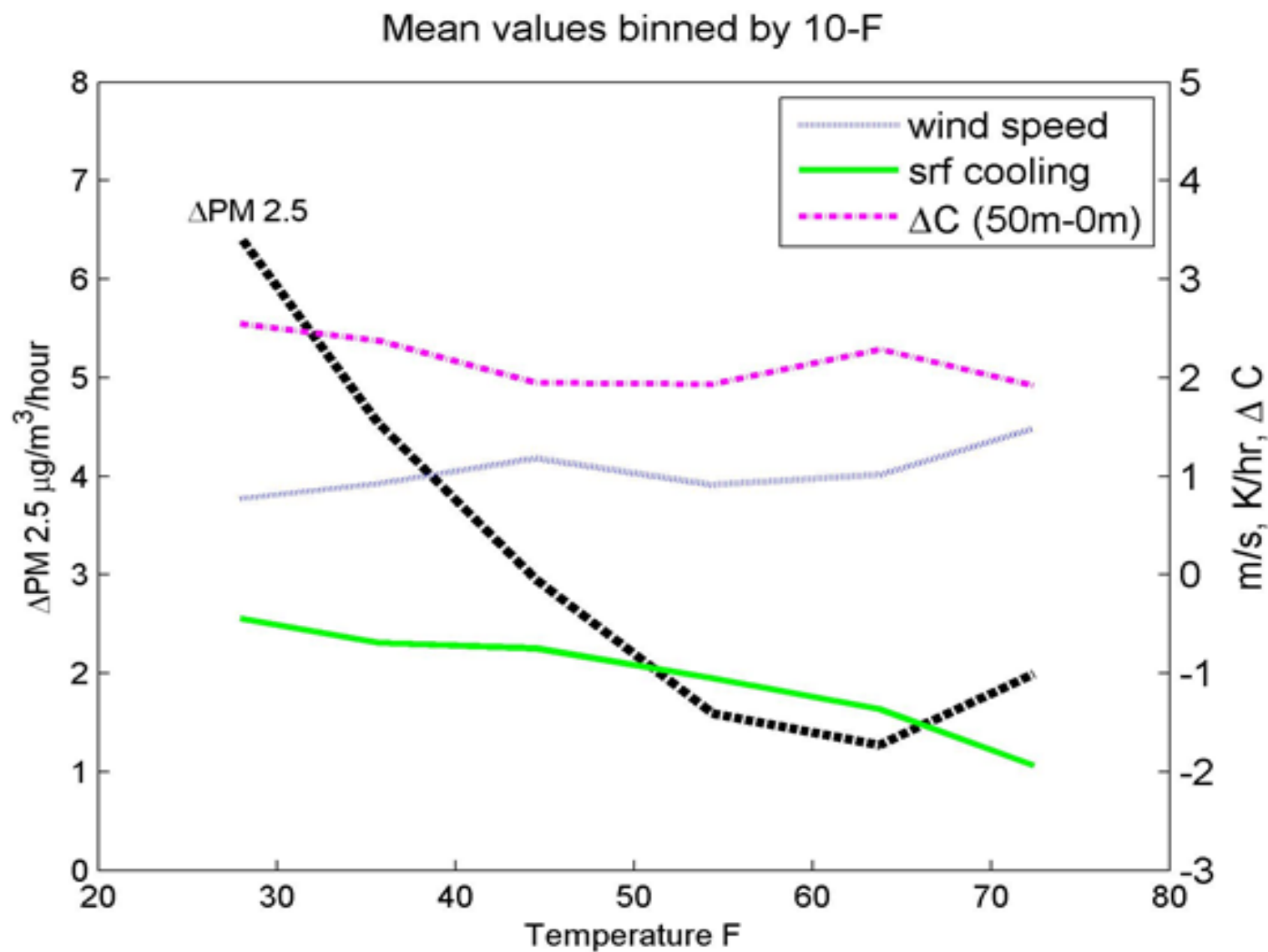


High PM in neighborhoods on winter nights = WOODSMOKE?

When Does Pollution Occur?

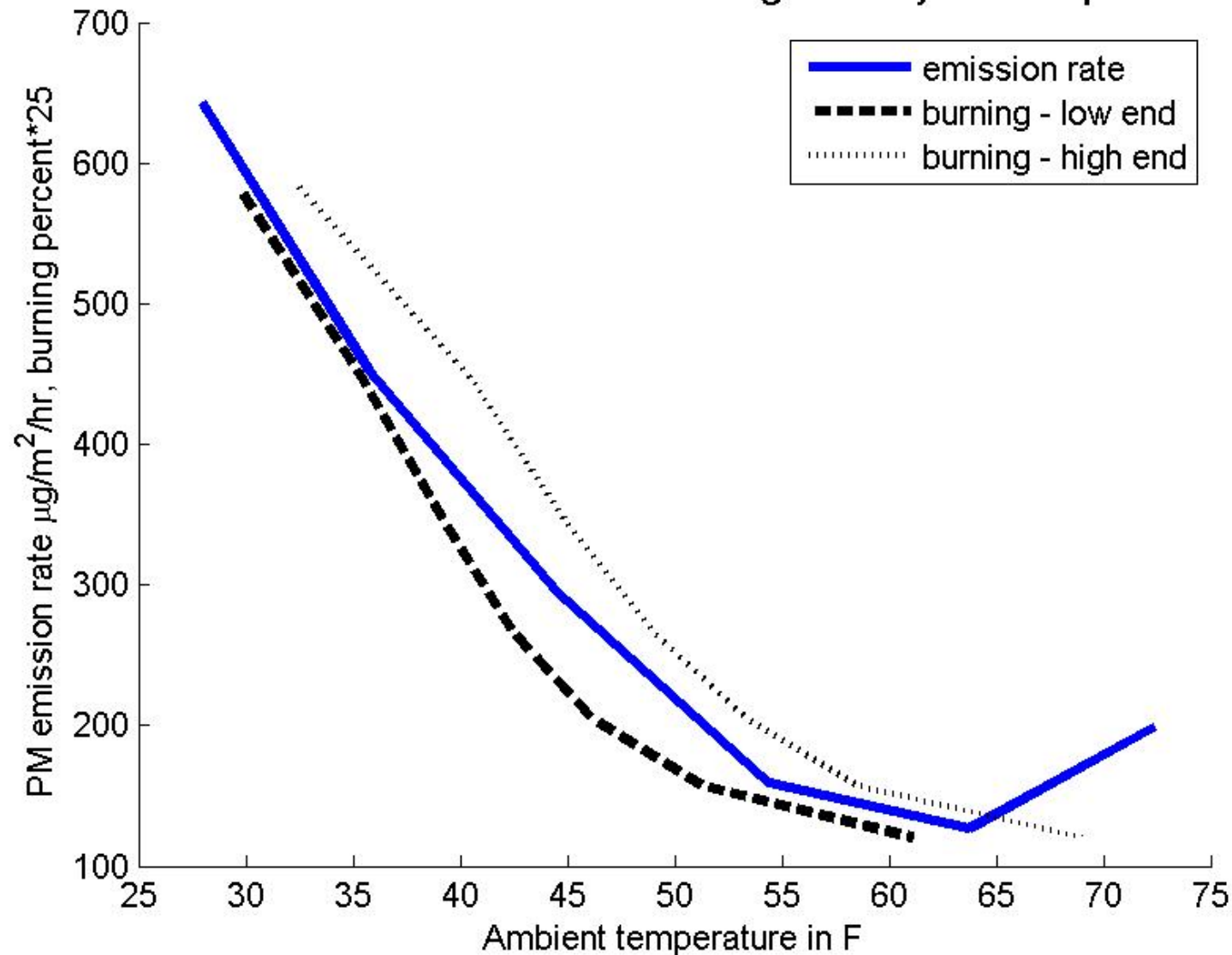


Is it driven by meteorology?



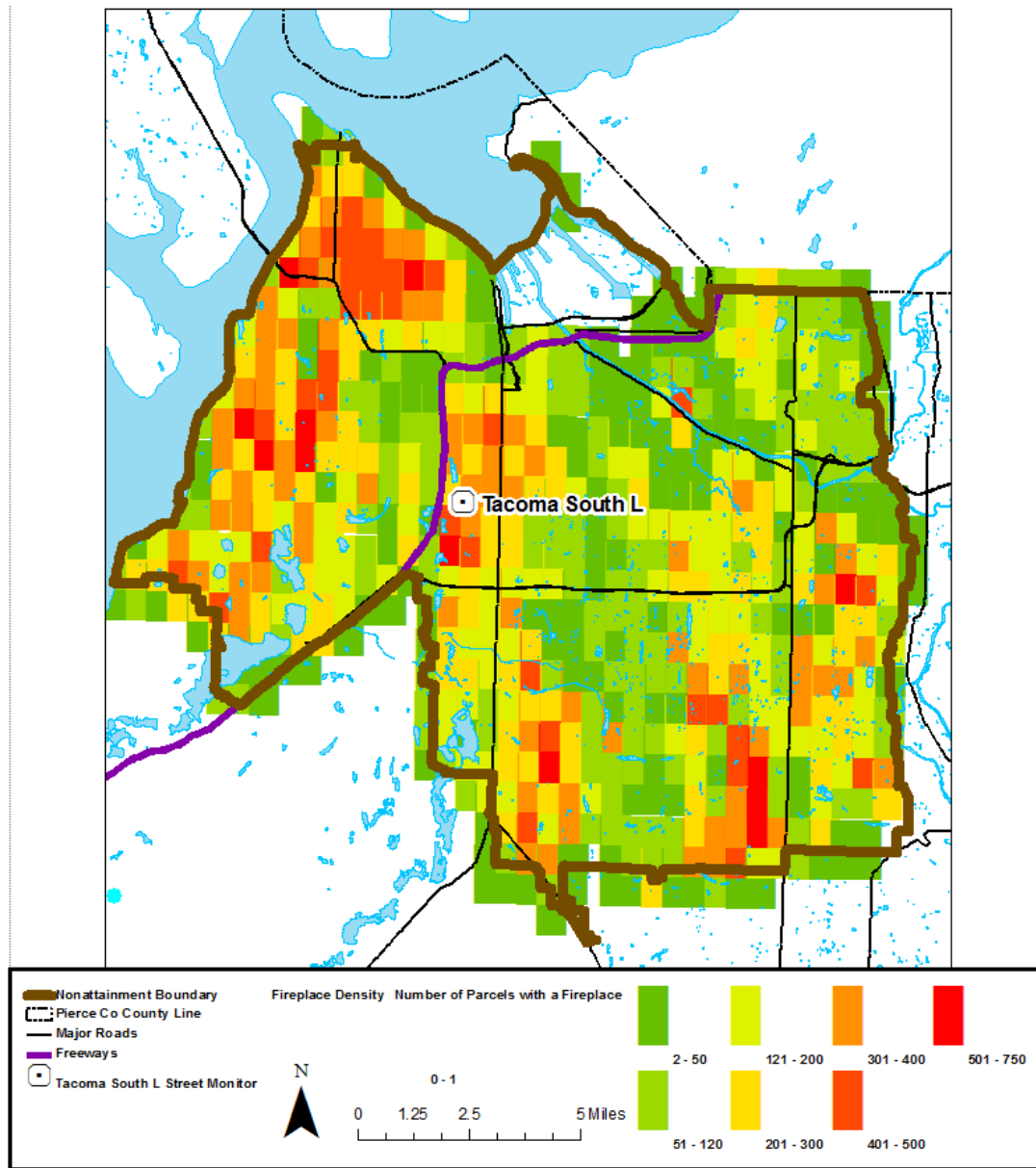
Home Heating Activity Rates

Calculated emissions and burning activity vs temperature

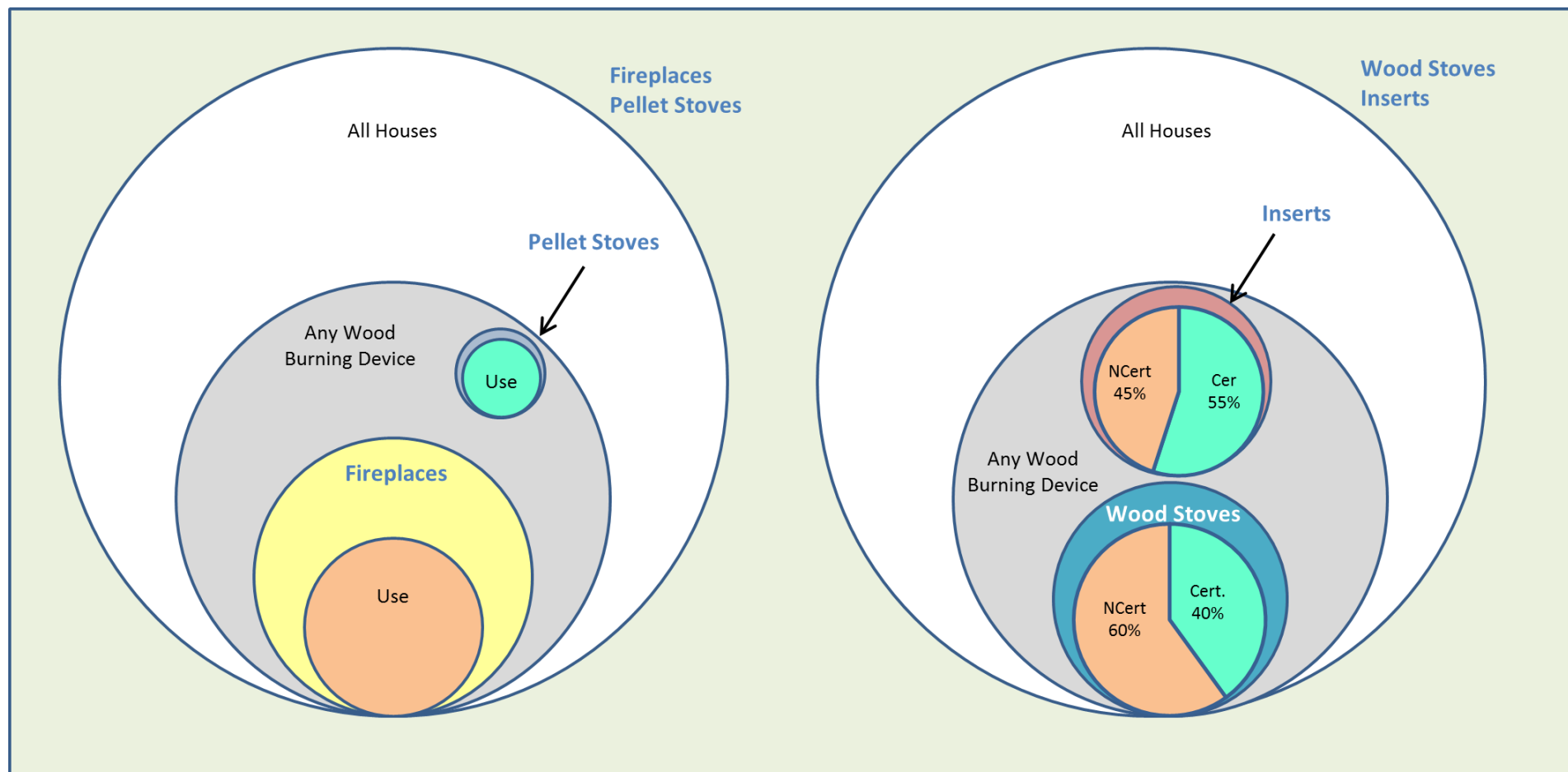


Where is the Sources?

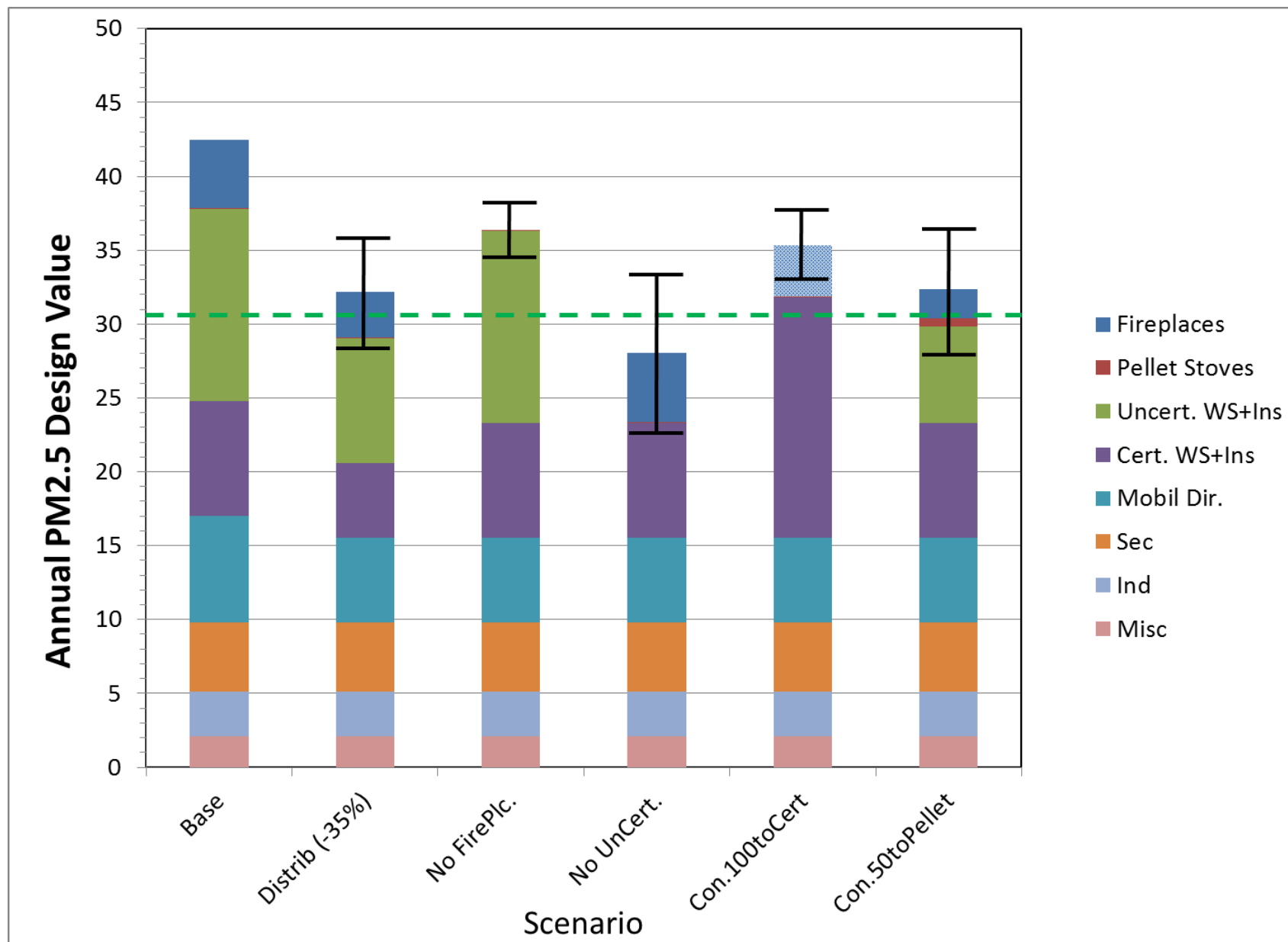
- Fireplace Density Map



Breakdown of Types of Fireplaces (area proportional)

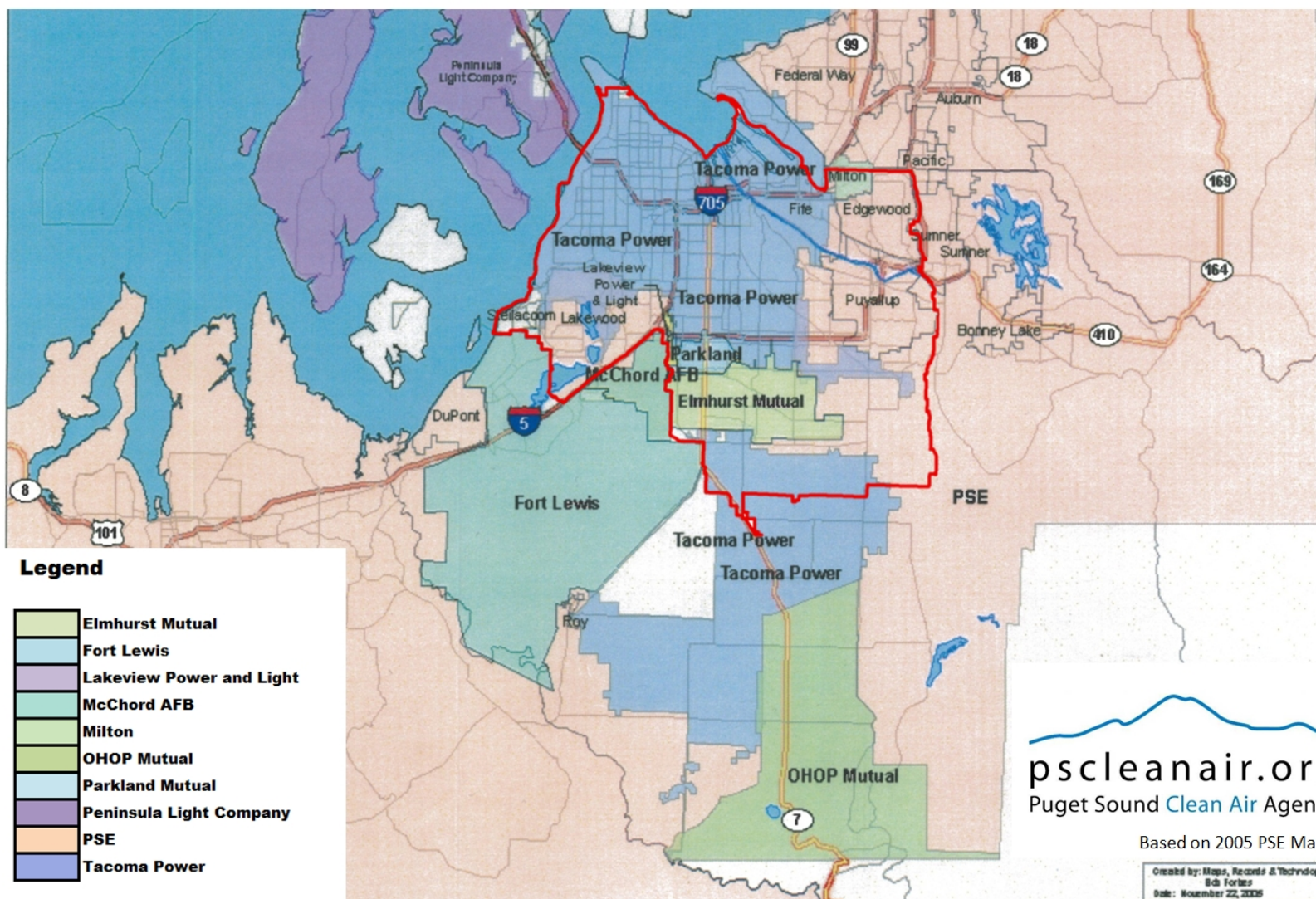


How to Lower Emissions

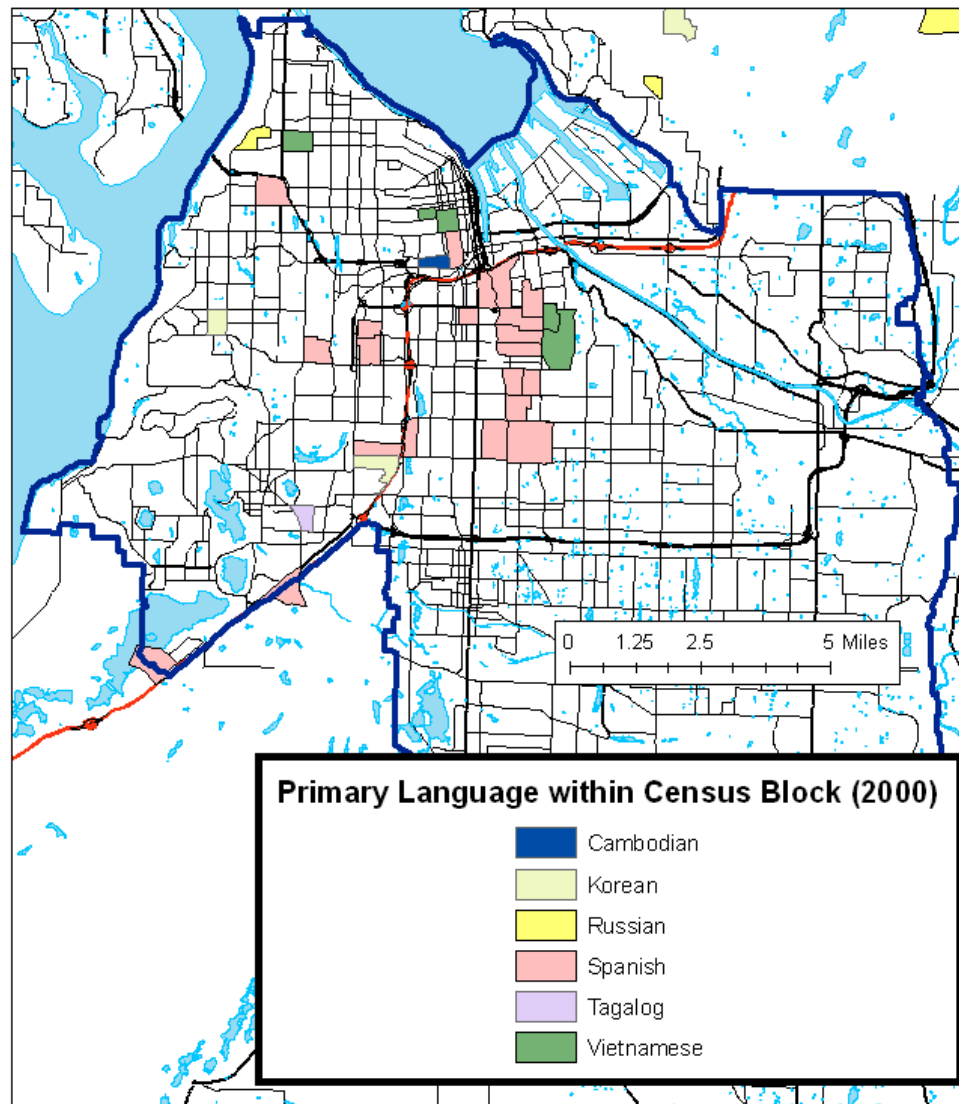


Who is potentially burdened?

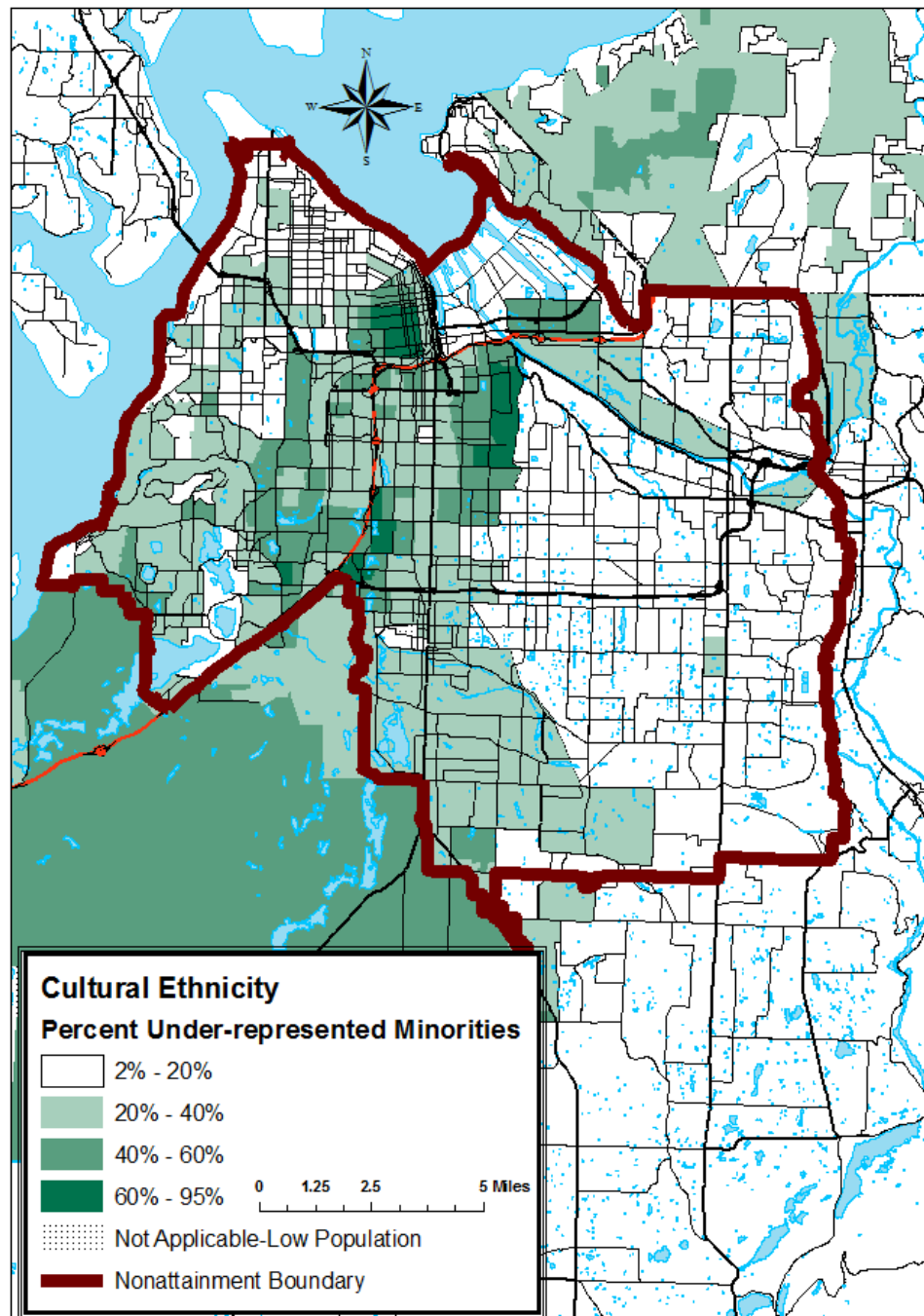
Nonattainment Area Electric Utilities



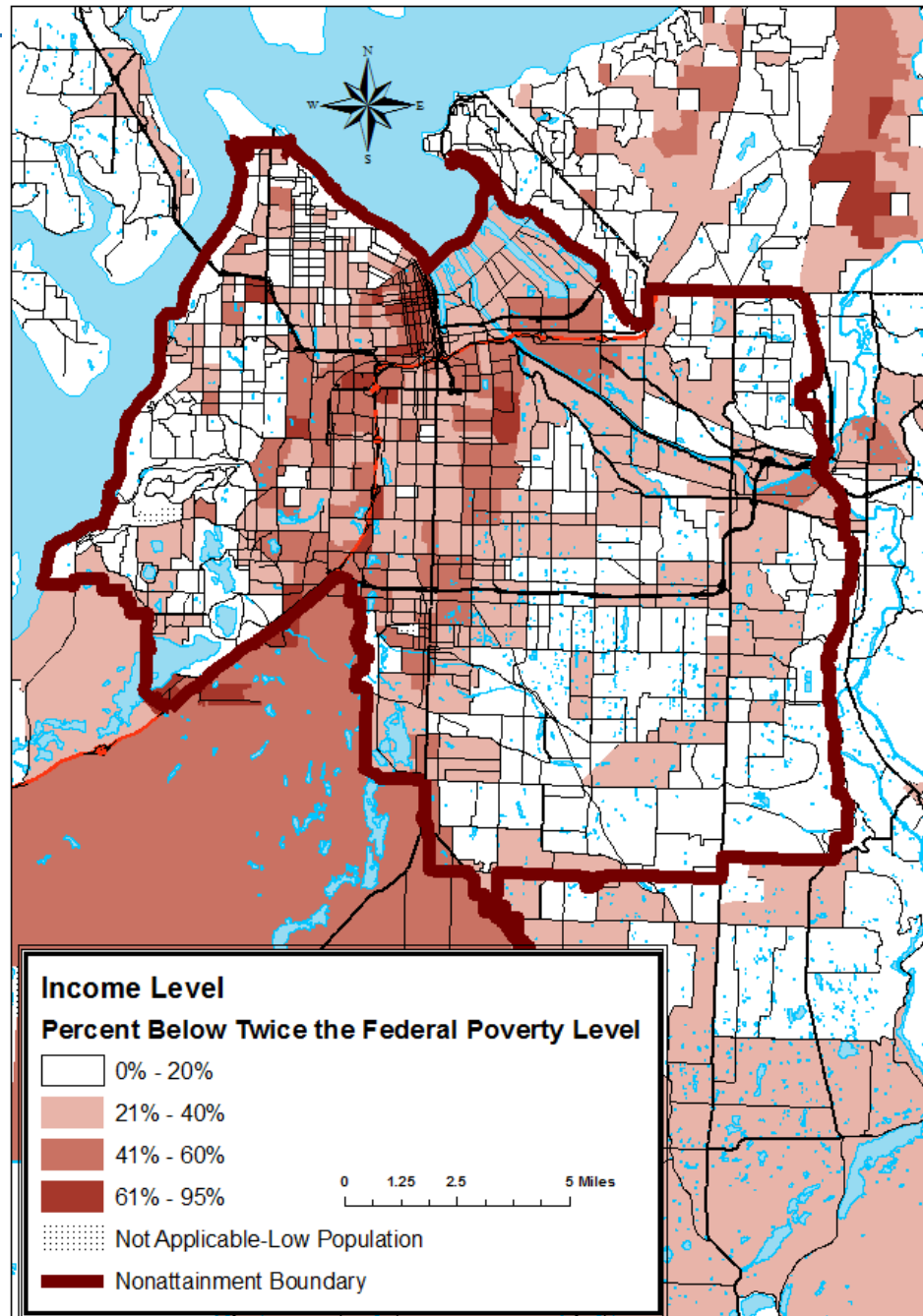
**Primary Language of Non-English Speakers
(18 years or older, 2000, In Census Blocks where > 10%
Speak English "Not Well" or "Not at All")**



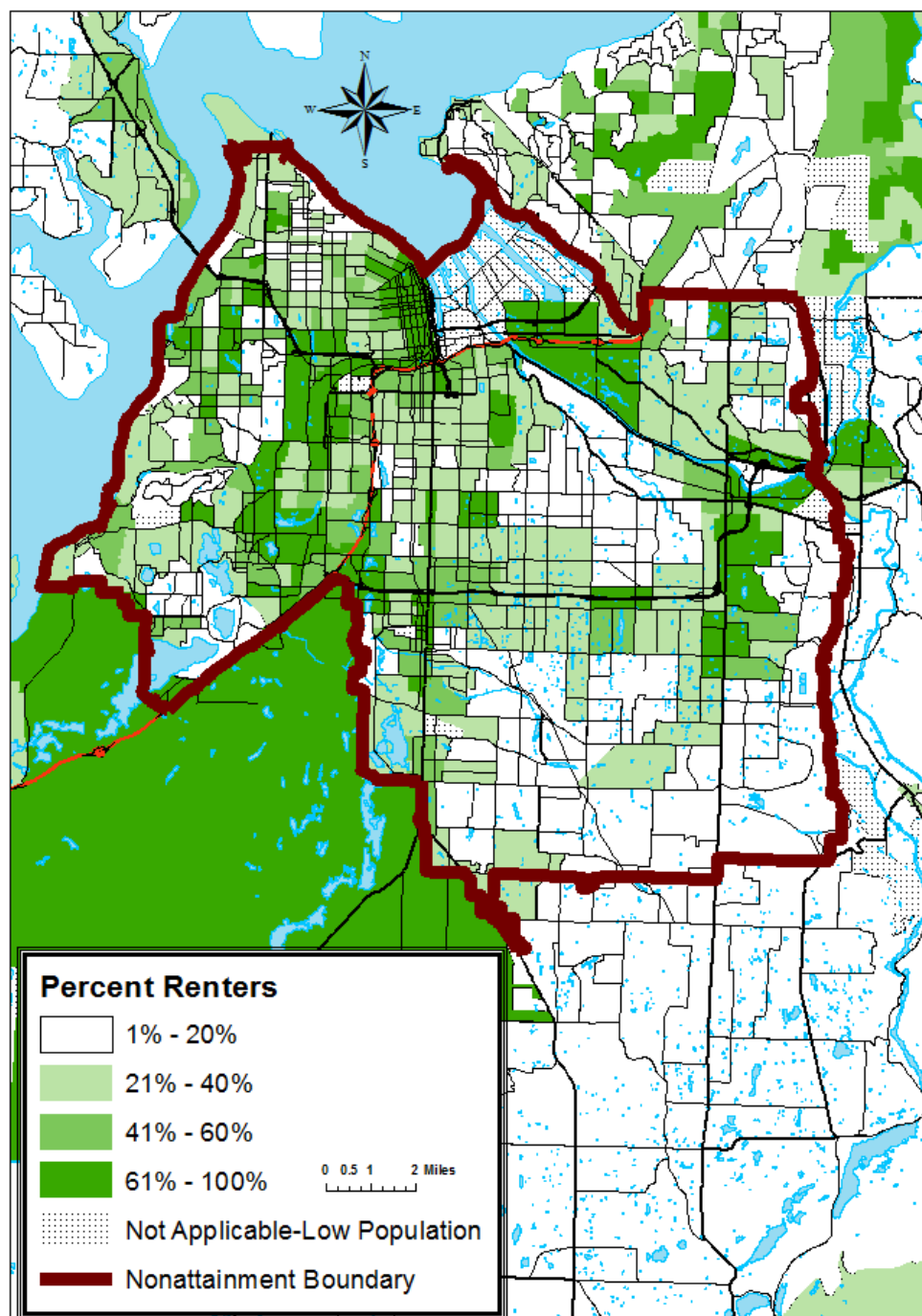
Race



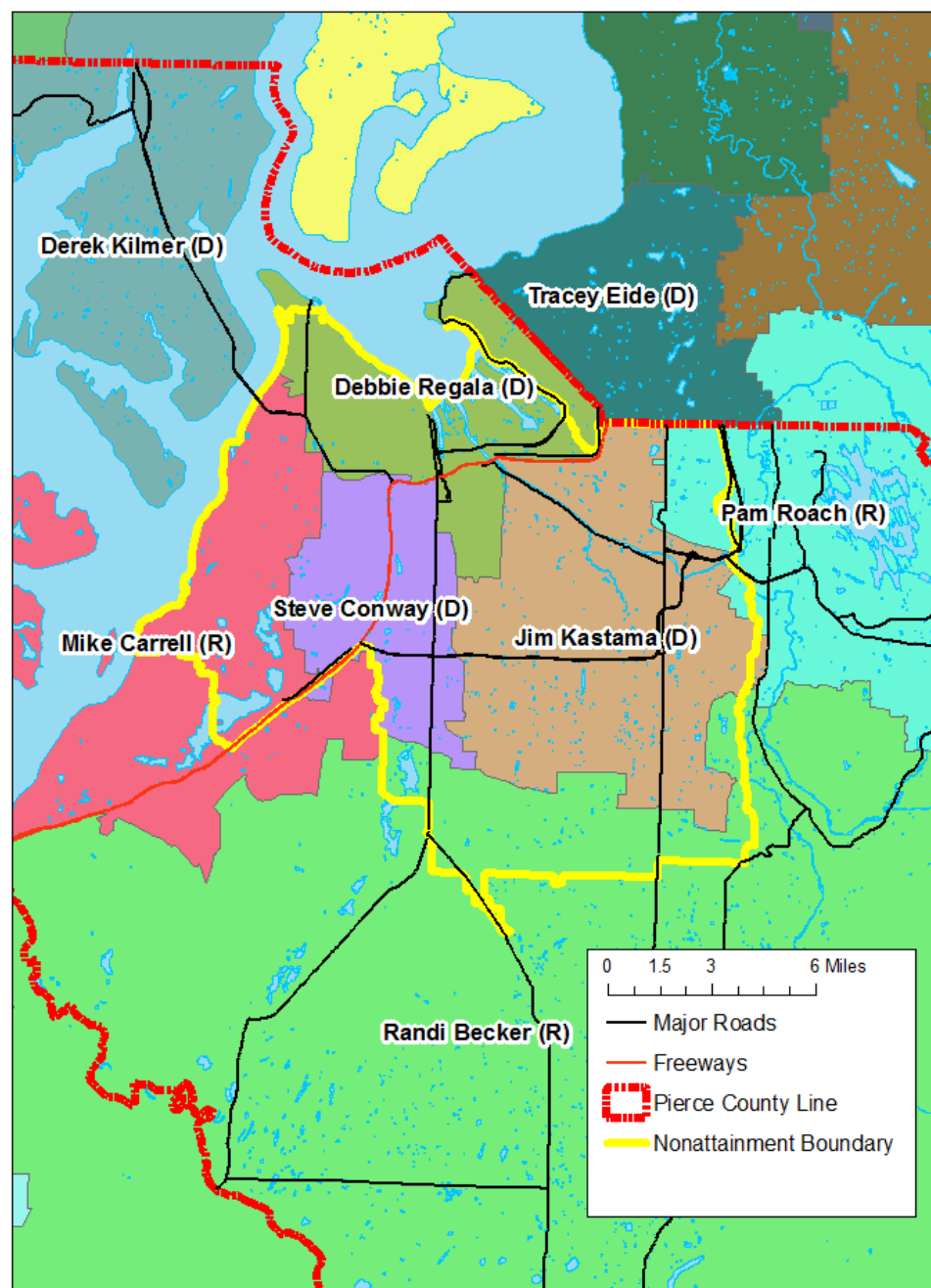
Income



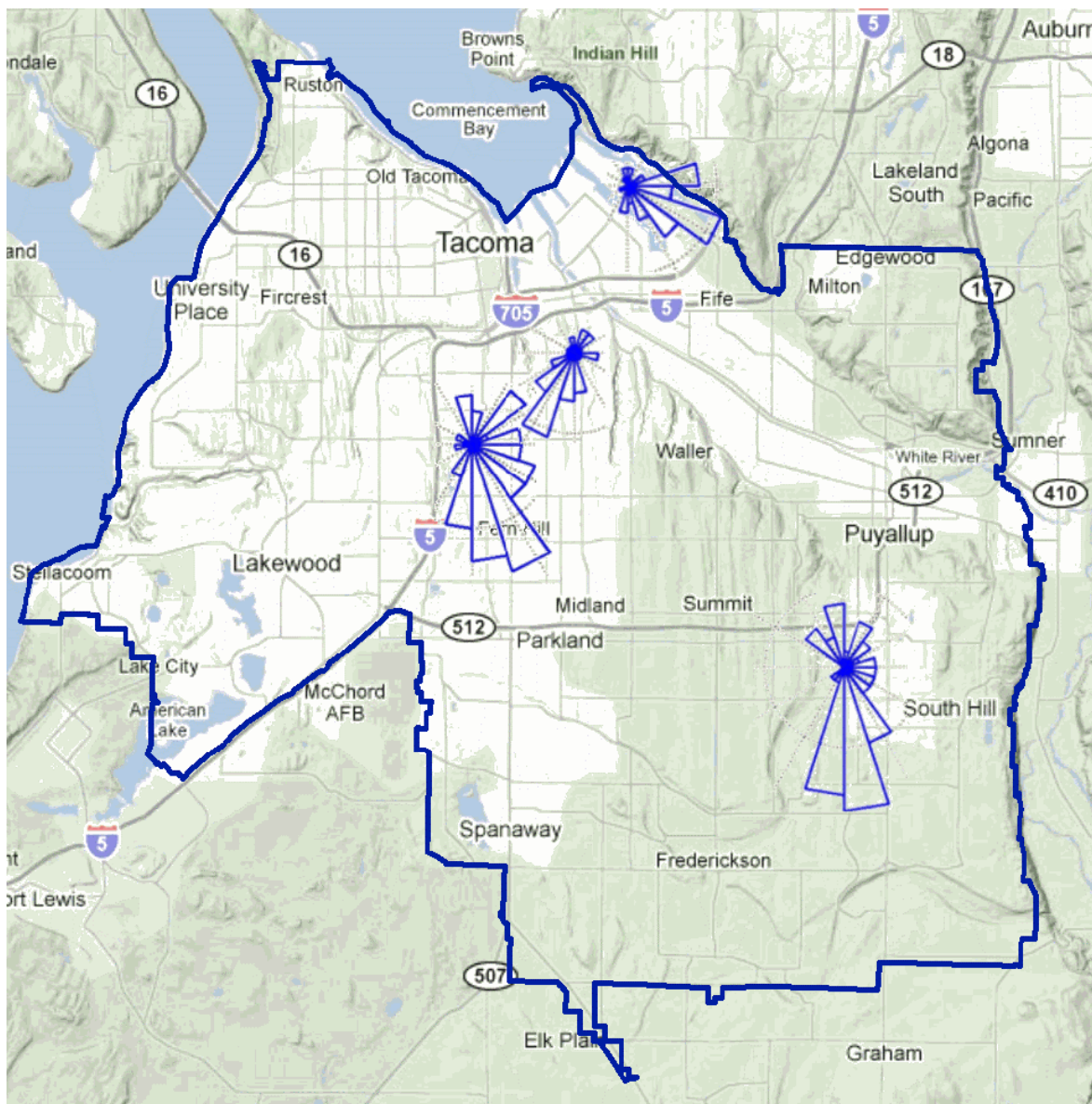
Renters

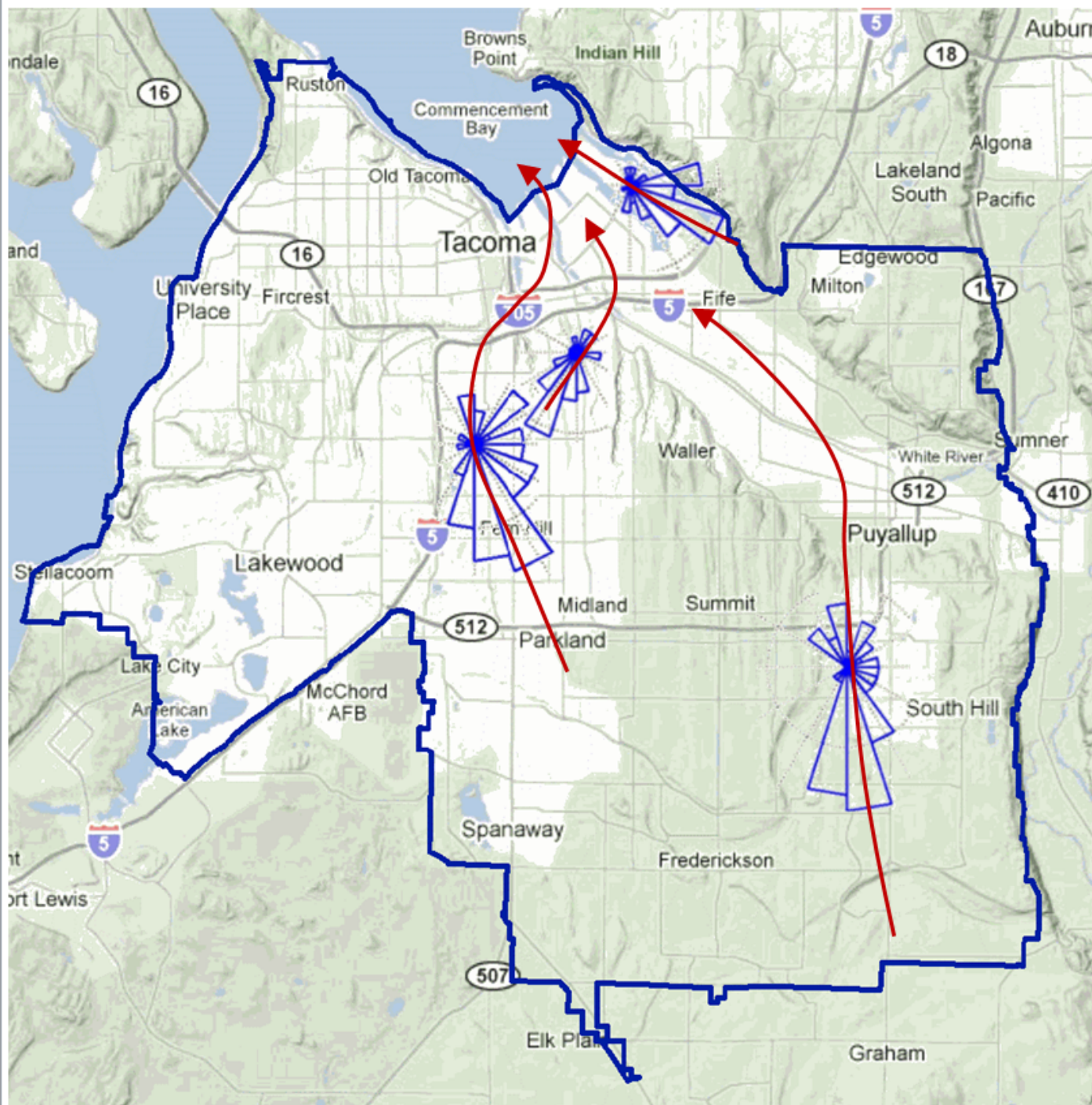


State Senators in the Nonattainment Area



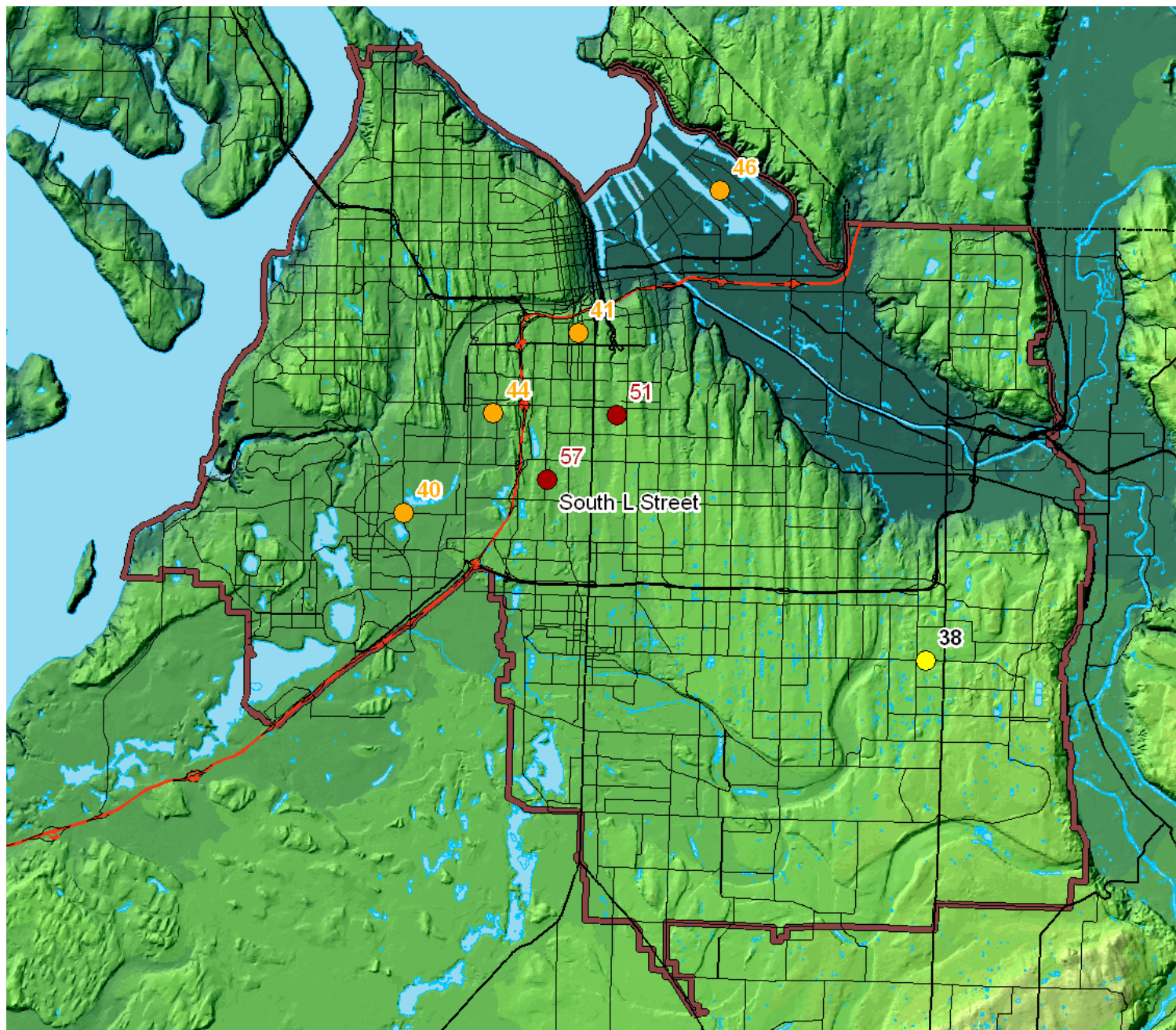
Pollution Roses



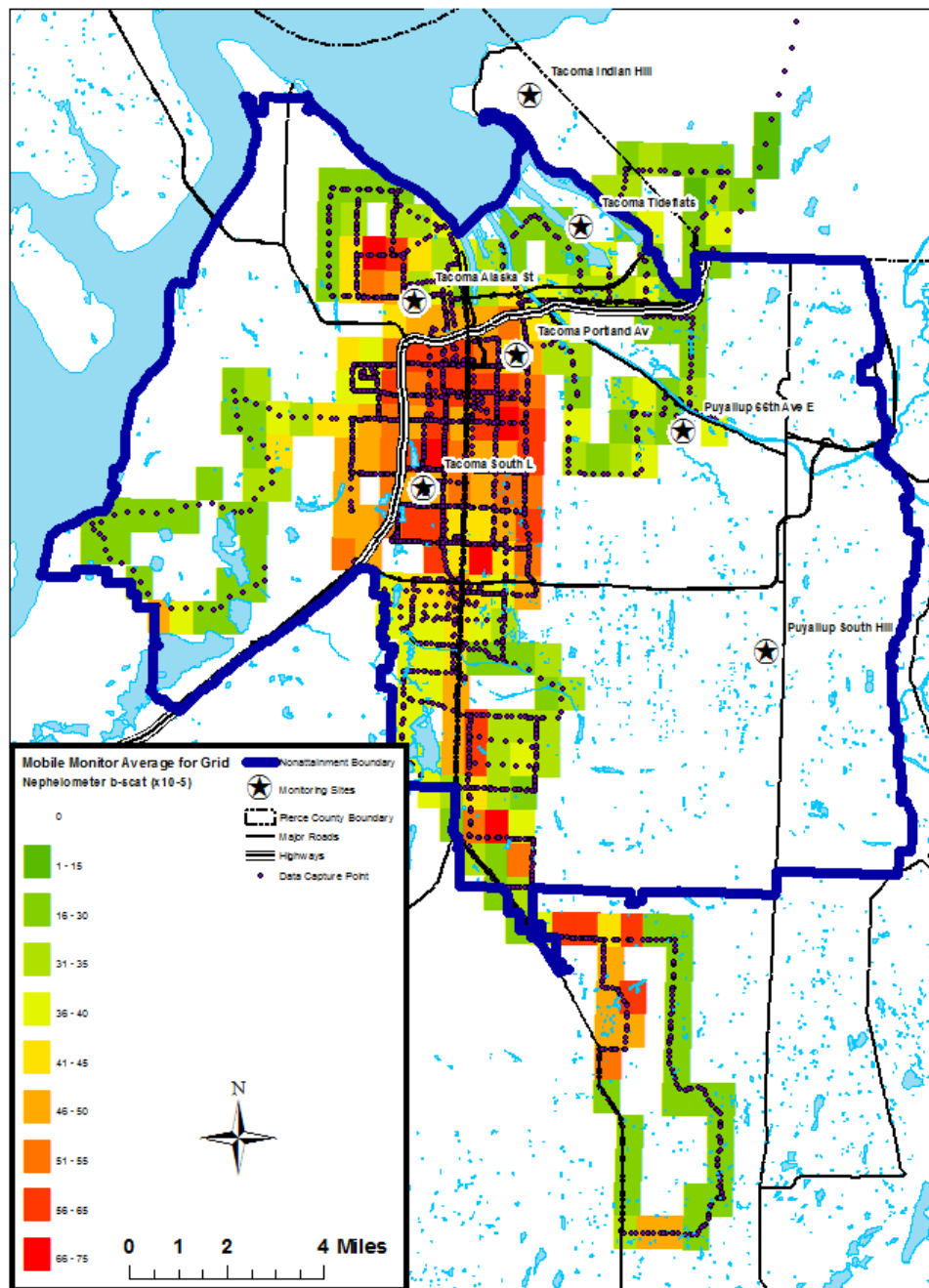


Temporary Monitoring Study 2007 – 98th Percentiles

pscleanair.org
Puget Sound Clean Air Agency



Mobile Monitoring Data Averaged for Each Grid Block 10 Winter Evenings, 9PM-1AM, Dec 2008 - Feb 2009



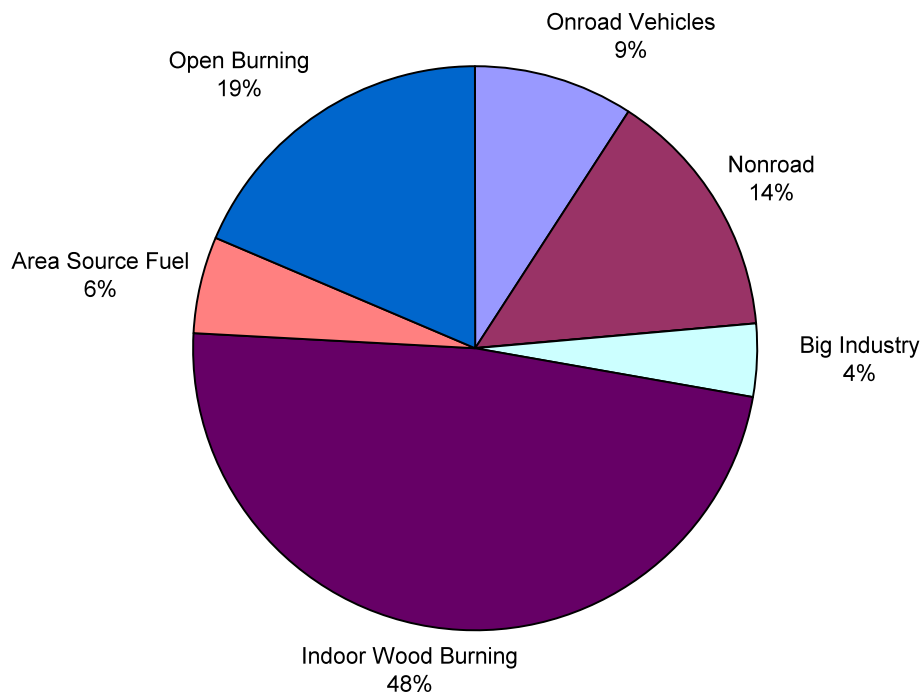
Wood smoke: Why all the fuss?

- Major contributor to PM_{2.5}
- Health effects of PM_{2.5}
- Stricter federal standard
 - *Nonattainment in Pierce County*
- More stringent local health goal



Emission inventory

2005 Distribution of Wintertime PM_{2.5} Emissions



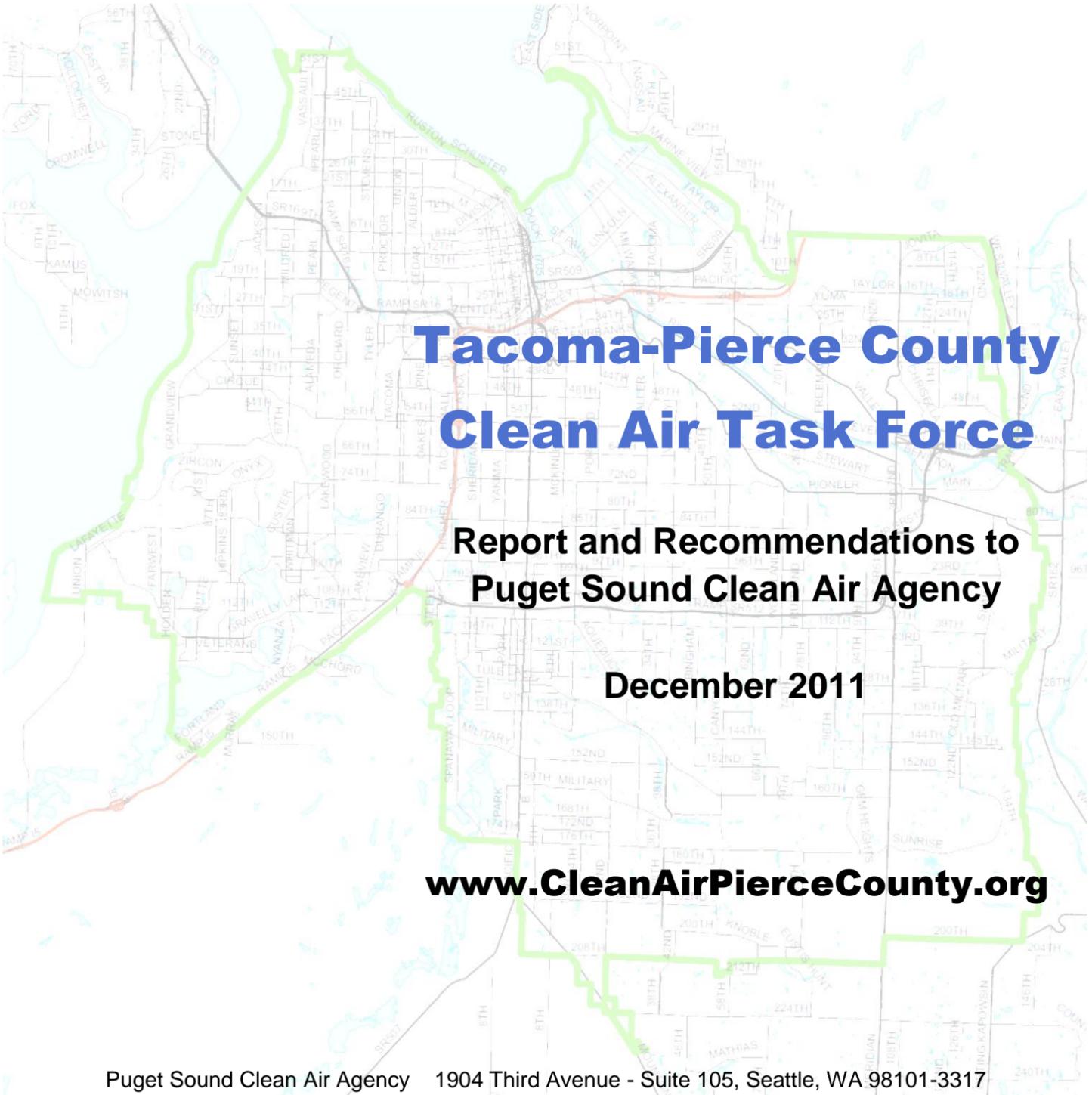
2005 Air Emission Inventory for King, Kitsap, Pierce, and Snohomish Counties

March 2008

Puget Sound Clean Air Agency

Indoor Wood-burning Emission Inventory Survey of
King, Kitsap, Pierce and Snohomish Counties

Report of Results
November 2007



**Tacoma-Pierce County
Clean Air Task Force**

**Report and Recommendations to
Puget Sound Clean Air Agency**



December 2011

www.CleanAirPierceCounty.org

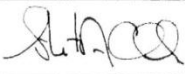
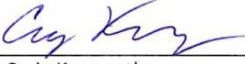
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Earl Brydson	Julio Quan
	
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Abbreviations

Clean Air Agency: Puget Sound Clean Air Agency

Ecology: Washington State Department of Ecology

EPA: United States Environmental Protection Agency

HOV: high occupancy vehicle

PSCAA: Puget Sound Clean Air Agency

RACT: reasonably available control technology

SIP: State Implementation Plan

Executive Summary

The following provides a summary of the Tacoma–Pierce County Clean Air Task Force final report. The task force was created in early 2011 to help the Puget Sound Clean Air Agency (Clean Air Agency) address a local fall and winter air quality problem. The task force was asked to recommend community-based solutions to help the area meet federal air quality standards for fine particles. The Task Force learned that much of the typical pollution sources, such as industry and vehicles, are already operating under pollution control rules or are adopting tighter controls, and that about one-third of the needed pollution reductions will come from those sources.

With wood smoke making up 50 percent of the particle pollution, the Task Force recommended two key solutions to reduce those emissions. One solution focuses on reducing spikes of pollution during weather inversions. The other focuses on reducing pollution from older more polluting uncertified wood burning devices. The task force recognized that the problem will not be solved by addressing only wood smoke, but it cannot be solved if wood smoke is not addressed.

Type of Pollution and Area of Concern

In 2009, the U.S. Environmental Protection Agency (EPA) classified parts of Tacoma and Pierce County as a “nonattainment area” for fine particle pollution (or PM_{2.5}) under the federal Clean Air Act. During certain times of the fall and winter, the area does not meet the federal health standard for the maximum level of this pollutant allowed in a 24-hour period. Fine particle pollution comes mainly from combustion (burning) of fuels. Sources include wood smoke (from wood stoves, fireplaces, and burning of yard waste and land clearing), exhaust from motors (from cars, trucks, buses, ships, etc.), and industrial operations.

The levels of pollution are documented by one of the Clean Air Agency’s air monitoring stations, which is located in the South End of Tacoma at South L Street. While not as high as the South End monitor, fine particle pollution levels are also elevated at other Pierce County monitoring sites. The violations occur in the late fall and winter months, usually on days of meteorological “inversion,” when a layer of cold air is trapped close to ground level, and pollutant levels build up rapidly.

Pollution Sources

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 vehicles. Other fine particle pollution sources in fall and winter months are: industrial (10 percent), sea salt (5 percent), ships (4 percent), dust (2 percent), and fireworks (1 percent). 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 fireplaces.

Implications of Nonattainment

Not attaining federal air quality standards impacts health and potentially impacts regional economic development. The fine particle pollution in the air poses a serious health risk to people who live and work in the nonattainment area. Fine particles can easily enter the lungs and travel into the circulatory system, affecting the heart and lungs. All residents are affected, although children, older adults, and people with respiratory and cardiac illnesses are especially at risk.

Effects on economic development include stricter requirements on large industries seeking to expand and on new large businesses interested in moving to the area. Some large businesses could be required to install additional emission control equipment, which would be costly. Tourism can also be affected by the perception that the area has “dirty” air.

There are also consequences for failing to act. If the state does not create a plan for improving air quality that is approved by the EPA, the Clean Air Act requires EPA to impose its own plan on the area. Their plan would not necessarily clean up the problem in the way the local community might prefer. Not acting also would endanger federal transportation funding for the region, and grant funding for air quality monitoring, planning, and control programs.

To respond to the nonattainment designation and to show how the area will achieve cleaner air, the state Department of Ecology (Ecology) must develop a State Implementation Plan (SIP) and submit it to the EPA for approval by December 2012. The area is required to get into attainment by the end of 2014 but can seek a series of extensions if it can show substantial progress in reducing pollution. (All communities must be in attainment by 2019.)

Scale of the Challenge

The fine particle levels at the Tacoma South L Street (violating) monitor need to drop by at least 9 micrograms per cubic meter on peak fall/winter days, from an average of 42.5 to between 32 and 34 micrograms per cubic meter (a little over 20 percent), in order to reach attainment.

Clean Air Task Force and Its Work to Develop Recommended Solutions

The Clean Air Task Force was asked to identify, evaluate and recommend community-based solutions to bring the area back into compliance with federal air quality standards. The 22 members were community leaders, elected officials and residents (see list on page ii). The task force met a total of 11 times between May and December 2011. After developing an understanding of the air quality issues and requirements of the nonattainment designation, the task force worked to identify possible solutions to reduce fine particle pollution in the nonattainment area and to assess which solutions would be the best fit for the community and region. The task force also learned about the solutions that other cities and counties across the country are using to reduce fine particle pollution. To evaluate the possible solutions, the task force used criteria the federal Clean Air Act requires and developed additional criteria to reflect the community’s values and interests.

The task force brainstormed potential solutions, producing a list of more than 60 possibilities. The Clean Air Agency staff reviewed the solutions for their potential to reduce the level of fine particle pollution in

the area, and grouped them into four categories: (1) major reduction potential solutions (to reduce fine particle pollution by 0.5 micrograms per cubic meter or more); (2) supplemental solutions (which would not achieve much reduction alone but could boost the impact of one or more major solutions); (3) low reduction potential solutions; and (4) public education and outreach.

Because wood smoke accounts for more than half of the fine particle pollution in the fall and winter months, the solutions focused mainly on wood smoke. Reductions in pollution are also needed from the other sources of fine particle pollution (vehicles, ships, etc.).

Evaluation of potential solutions. The evaluation process yielded four solution packages that could produce adequate reductions in fine particle pollution in the nonattainment area: (1) removal or decommissioning of uncertified wood stoves and inserts at the time a home is sold; (2) enhanced burn ban enforcement; (3) removal of uncertified wood stoves and inserts at “date certain” in a future year; and (4) reductions from non-wood smoke sources, such as gas and diesel engines, ships and industry. The task force and agency staff reviewed each in detail. The task force used several steps to review, discuss, and evaluate each of the potential solutions, including: a presentation by agency staff on each proposed solution; review and discussion of the key assumptions about how solutions would be implemented and the results of technical modeling; review and discussion of the staff’s assessment of the evaluation criteria they were asked to rate; the task force’s assessment of evaluation criteria related to community values and impacts; additional review and discussion after the staff revised each solution based on the evaluations; and development of recommendations.

The agency staff and task force worked together to further develop the elements of three of the four solutions: enhanced burn ban enforcement, date certain removal, and reductions from non-wood smoke sources. The task force decided not to move forward with the time of sale removal or decommissioning of uncertified wood stoves/inserts solution because of several concerns (described in this report).

Public Outreach and Input

The task force allowed for public comment at each of its meetings. In addition, the Clean Air Agency conducted significant public outreach in Pierce County on fine particle nonattainment. There were two primary purposes: to raise general awareness and to gather public input on the draft solutions the task force was considering. Because of the likely impacts from future implementation of wood smoke reduction programs, special emphasis was given to reaching members of the community who burn wood for heat. Public outreach was conducted throughout the task force process, but was ramped up during October and November 2011. Activities included: mailing a post card to all 220,000 households in the non-attainment area; two public open houses with a total of 200 people attending; an online survey; a direct mailing; print and online advertising; and outreach throughout the year to approximately 30 community groups. As a result of these efforts, the Agency received more than 600 comments.

Overall, the majority of respondents indicated full or qualified support for the proposed solutions while expressing concerns about the possible impacts on some community members. Four major themes emerged: (1) strong concerns about the economic impacts of the potential solutions, particularly for

low- and fixed -income families; (2) a large proportion of people expressed concerns about the impacts of wood smoke on their health and in their neighborhoods; (3) a smaller number expressed disbelief that wood smoke is a significant source of pollution; and (4) a small number expressed concern that efforts to address wood smoke are intrusive and a waste of taxpayer money.

Recommended Solutions and Principle Statements

No single solution would enable the nonattainment area to reduce fine particle pollution sufficiently to achieve the federal air quality standard. The task force is recommending a combination of strategies to improve air quality in a timely manner and to help the area reach attainment. The three main strategies recommended by the task force are:

1. Enhanced enforcement of burn bans
2. Establishment of a date certain for removal of uncertified wood stoves and inserts
3. Implementation of the range of strategies to reduce fine particle pollution for gasoline vehicles, diesel vehicles, industries and ships.

The Clean Air Act allows education and voluntary measures to account for only up to 6 percent of the total emission reduction needed to achieve attainment because these measures are not considered enforceable and are difficult to measure. However, the task force firmly believes that the recommended solutions will not be successful without considerable public education, community outreach, and public involvement. Local communities must first understand the nature of the problem and then take ownership of the actions needed to improve air quality. Education and outreach are needed to help residents understand the causes and impacts of fine particle pollution, to encourage residents to take informed actions, and to overcome the skepticism many members of the public may have about why these steps are needed. Outreach and education must include efforts to reach individuals who may not receive information from traditional civic or community organizations.

The task force also expressed concern that the solutions being recommended could create an economic burden on residents in the nonattainment area. As a result, they are proposing that the solutions be implemented in a manner that will provide assistance to low-income residents.

The following provides several overarching principles the task force wants to see used in implementing the solutions described below.

Overarching Principle Statement

- All residents and communities in the nonattainment area should contribute to the solution. We are all in this together.

Common Principles for Implementing All Solutions

- Education efforts are a key component to ensure effective implementation.
- Outreach should be broad-based and include groups that are less likely to receive notice or support.
- Individual strategies should be consistent and complement other strategies.

The task force recommendations regarding reduction of wood smoke pollution include a combination of suggested program design features and statements of principle to guide the future implementation of these solutions.

Recommended Solution 1: Enhanced Burn Ban Enforcement

Goal: Ensure that those who are contributing the most to the fine particle pollution during periods of the poorest air quality reduce their emissions. The task force felt that this potential solution would be effective because it would focus action during the days of the year when fine particle pollution in the nonattainment area exceeds the federal 24-hour air quality standard. The solution also builds on an existing regulation (issuance and enforcement of burn bans) that is familiar to many residents.

Proposed Key Features of Enhanced Burn Ban Enforcement: The task force is recommending a number of changes to the way in which burn bans are currently called and enforced in the nonattainment area. The changes include the following: revise the emission thresholds for calling burn bans; increase enforcement presence during burn bans; enforce violations based on visible emissions (in addition to smoke density); add more evening enforcement, as practical; maintain a two-stage burn ban; provide exemptions and/or assistance to low-income residents and households for whom wood burning is their only adequate source of heat; create a registration program for wood burning devices to make the program more effective; and expand outreach and education efforts.

Statements of Principle to Guide Implementation of Enhanced Burn Ban Enforcement:

- Enhanced enforcement should be combined with a robust community outreach initiative to enable neighbors to talk with neighbors about the importance of obeying burn bans and burning cleanly when the community is not in a burn ban.
- Assistance should be provided for low-income households who may be affected by this requirement. Enforcement of burn bans should respect the challenges faced by low-income burners and provide alternatives (e.g., financial assistance or exemptions), even if these residents have other sources of heat available.
- Enhanced enforcement should be phased in to allow those who receive a first notice of violation to reduce or eliminate the initial fine if they engage in educational opportunities about proper burning practices and the importance of burn bans, or move to a cleaner source of heat. The initial fine should be meaningful enough to provide sufficient incentive to participate in education activities and to discourage subsequent burning during burn bans.
- Enhanced enforcement should continue to accommodate households for whom a wood burning device is their only adequate source of heat, while ensuring that the exemption is used only for those who qualify. Exemptions from burn ban enforcement do not exempt people from burning cleanly nor from other standards.
- Decisions about who provides enforcement should be based first on who would be most effective, while respecting the need to consider any capacity challenges of local governments.
- When implementing a registration program, consider that the goal is to enhance effectiveness of enforcement staff and minimize unnecessary interactions with exempted households.

- Revisions to the Stage 1 and/or Stage 2 “trigger” levels (when burn bans are called) should be considered, as they may enable burn bans to more effectively keep fine particle pollution below the federal daily standard during inversions, and better protect public health.
- Both forecast and monitored data should be utilized to call burn bans (as they are both currently used).

Based on the program design features described above, it is estimated that enhanced enforcement of burn bans could achieve a reduction in fine particle pollution of about 1.4 micrograms per cubic meter by 2014 (nearly 20 percent of the minimum reduction needed); and a reduction of 6.8 micrograms per cubic meter by 2019 (approximately 70 percent of the minimum reduction needed).

Recommended Solution 2: Date Certain Removal of Uncertified Wood Stoves and Inserts

Goal: Removal of the older, more polluting wood stoves and inserts from the nonattainment area. Wood stoves and inserts manufactured prior to 1988 produce more pollution and are less efficient than more modern devices. The older stoves and inserts made prior to 1988 are called uncertified devices. Since wood burning devices can last for 40 years, there are still a considerable number of older uncertified wood stoves and inserts in use. The task force felt that establishing one clear date when all residents will need to remove their uncertified wood stove or insert would be effective in reducing fine particle pollution in the long run.

Proposed Key Features of Date Certain Removal: The task force is recommending that all uncertified wood stoves and inserts be removed by the end of August 2015; that a combination of incentives, fines, education and regulations be used to encourage residents to remove uncertified devices; that a registration system be created for owners of wood burning devices; and that a “medium” level of confirmation be created to confirm removal of uncertified devices (e.g. including higher fines for using an uncertified device during a burn ban, or technology like GPS-marked photos to confirm removal). The goal on confirmation is to achieve enough emission reductions in a way that creates the minimal amount of intrusion in homes as possible.

Statements of Principle to Guide Implementation of Date Certain Removal of Uncertified Wood Stoves and Inserts:

- Households should have a range of options if they choose to replace their uncertified device (including certified device, pellet stove, or other type of heat), but incentives could vary depending on the device they use.
- Assistance should be provided for low-income households who may be affected by this requirement. The assistance could take several forms, including, but not limited to, financial assistance for installing a new heating device, home weatherization, and/or providing additional time for low-income households to meet this requirement.
- The solution should accommodate households for whom a wood burning device is their only adequate source of heat.
- Date certain removal should allow time for transitions, yet begin soon enough that the date is meaningful. Timing of implementation should be equitable, be publically acceptable, and allow time to find funding.

- A medium level of confirmation is the preference. But if that is not sufficient to achieve EPA approval or program effectiveness, a more active form of confirmation should be used. If more rigorous methods of confirmation are needed, they should be equitable and as nonintrusive as possible.
- The purpose of the registration program is to confirm widespread removal of uncertified devices.
- Recognizing the current challenges in local, state, and federal budgets, funds should be prioritized according to the task force's ranking, where possible. The task force provided the following rankings for use of resources: 1st assistance to low-income households; 2nd assistance to households with no other adequate source of heat; 3rd incentive payments for early adopters; and tied for 4th incentive payments of cleaner heat and assistance to all households for removal of stoves/inserts.

It is estimated that date certain removal of uncertified wood burning stoves and inserts could achieve a reduction in fine particle pollution of about 0.7 micrograms per cubic meter by 2014 (less than 10 percent of the minimum reduction needed); and a reduction of 2.5 micrograms per cubic meter by 2019 (more than 25 percent of the minimum reduction needed).

The task force concluded that this solution would improve air quality over time and address one of the underlying causes of fine particle pollution. The task force expressed concern about the level of public and political acceptance of this solution, acknowledging that there are some in the community who will be opposed to limitations on their options for heating their home, or who object to the potential cost to replace the uncertified device with another stove, insert or other heating device. At the same time, the group recognized that this solution is needed to get to attainment.

Recommended Solution 3: Other Pollution Sources

Approximately one-quarter to one-third of the emission reductions needed to meet the fine particle pollution standard by 2019 will be accomplished from new federal regulations and local initiatives related to non-wood smoke sources of pollution (vehicles, ships, etc.). Most of these regulations and initiatives are in the process of being implemented.

Nationally, the focus for reducing fine particle pollution related to gasoline vehicles has been on creating cleaner standards for both engines and fuels. The State of Washington has adopted the California Clean Car Standards for vehicles, the most stringent automobile standards in the country. These standards will help to reduce fine particle pollution. Local governments have adopted several programs to reduce fine particle pollution related to gasoline engines, including installing electric vehicle charging stations, using electric and biodiesel vehicles, and adopting anti-idling programs. The regional transportation plan adopted by the Puget Sound Regional Council has several policy goals that will help reduce fine particle pollution even further. A number of planned transportation capital investments will also help, such as high occupancy vehicle (HOV) lane extensions, ramp metering, Sound Transit Sounder rail improvements, and investments in alternative means of travel. In addition, the task force suggested continued education efforts that encourage individual car and truck owners to take actions to reduce pollution emissions (e.g. anti-idling initiatives).

New federal standards for diesel engines and fuel also will help to reduce emissions. In addition, several local jurisdictions have adopted programs to reduce emissions from diesel engines and equipment.

Among the industrial sources of fine particle pollution in the nonattainment area, there are six that have been identified by Ecology and the Clean Air Agency as the largest industrial emitters of fine particle pollution. Collectively, these six sources contribute more than 90 percent of the industrial fine particle pollution from industrial sources in the nonattainment area. The federal Clean Air Act establishes a requirement for working with industries to reduce their levels of pollution called Reasonably Available Control Technology (RACT). Engineering staff at Ecology and the Clean Air Agency are reviewing the existing pollution controls and operations at these six industrial sources to determine if they already meet RACT. A preliminary analysis indicates that most, if not all, of the sources do.

For ocean-going ships, new international standards require use of lower sulfur fuel, beginning in 2012 and moving to much stricter levels by 2015. These cleaner fuels will reduce the fine particle pollution from ships. The Port of Tacoma and its tenant, Totem Ocean Trailer Express (TOTE), have also installed shore power facilities and retrofitted ships so that ships can use shore power instead of operating diesel engines to create power when at berth.

Together the anticipated reductions from emission sources other than wood smoke are estimated to achieve approximately one-quarter to one-third of the reductions needed (2 to 3 micrograms) to reach the federal 24-hour air quality standard by 2019. Most of the emission reductions from these other sources of fine particle pollution will come from changes in federal standards for more efficient engines and cleaner fuels. Continued efforts to reduce emissions from these sources will contribute to the overall plan to achieve attainment.

Making Progress Toward Clean Air

The task force was mindful of the need to meet the federal Clean Air standard, but also to reduce overall levels of pollution in the nonattainment area. Since high levels of fine particle pollution have been demonstrated to have impacts on human health, the task force wanted the recommendations to first and foremost, meet the federal standard. While acknowledging that the Clean Air Agency board of directors previously set a more aggressive regional health goal for the area, the Task Force chose to focus solutions on reaching the federal standard of attainment. The combined effects of the proposed solutions suggest that attainment could potentially be achieved by 2017 assuming the programs were fully supported over the time frame. By 2019, it is estimated that the nonattainment area would achieve fine particle pollution reductions over the federal 24-hour standard, leaving room should reductions not occur as rapidly as projected or should the standard be lowered (it is up for review in 2012).

Contingency Measures

The State Implementation Plan submitted by Ecology to EPA must identify not only the solutions the nonattainment area will use to meet the air quality standards, but also potential additional measures in case the area is not making sufficient progress toward its target date. These additional solutions are

called contingency measures. The task force is recommending that the following contingency measures be considered for inclusion in the Plan:

- That cleaner technologies be required for use of fireplaces, such as cost-effective catalysts, starters, or filter technology that has been shown to work (this technology has not yet been demonstrated successfully).
- A requirement that in the nonattainment area only the cleanest burning devices (equivalent to emissions produced by a pellet stove) be allowed. (The task force acknowledged that because the EPA is currently revising its emission testing protocol for stoves, this measure may not be available at the time the SIP is submitted, but could be added at a later date.)
- That the time of sale of a home be used as an opportunity to confirm the removal of uncertified wood stoves or inserts (in addition to the “date certain” removal of uncertified devices).
- For households that have an uncertified wood stove or insert as their only adequate source of heat, only those that are income qualified would receive assistance or be exempted from the requirement to remove their device.

Task Force Consensus on Recommendations

The task force reached consensus on the recommendations with one exception. This exception was on the recommendation that a system of registration be created for all wood stove and insert owners in the nonattainment area. Three members did not support the recommendation for the registration system, because of concerns about the level of response to a voluntary program, about resentment that it might create, about possible confusion as to whether a stove is certified or uncertified and about what registration means, and about whether the program might become more regulatory over time.

Next Steps

With this report the task force is transmitting its recommendations to the Puget Sound Clean Air Agency. The Agency’s board of directors will review the report and make recommendations to the State Department of Ecology. Ecology will conduct further analysis and prepare a State Implementation Plan (SIP). There will be opportunities for public review and comment on the Plan. Because any local rules or state laws required for the solutions will need to be in place before the SIP is submitted to the EPA, the Clean Air Agency will seek state legislation in 2012 to clarify its existing authority for implementing the recommended solutions.

Ecology must submit the SIP to the EPA by December 2012 for their review and approval. At the same time, the Clean Air Agency will be developing plans and implementing actions to improve air quality in the nonattainment area.

I. The Air Quality Problem

The Tacoma–Pierce County Clean Air Task Force was created in early 2011 to help the Puget Sound Clean Air Agency (Clean Air Agency) address a local air quality problem. In 2009, the U.S. Environmental Protection Agency (EPA) classified parts of Tacoma and Pierce County as a “nonattainment area” for fine particle pollution (or PM_{2.5}) under the federal Clean Air Act. During certain times of the fall and winter, the area does not meet the federal health standard for the maximum level of this pollutant.

The pollution comes from a variety of sources. But with half of the emissions coming from indoor wood burning (see Figure 4, below), it is a different challenge from past air pollution issues. To be sustainable, solutions must include finding a way to achieve both clean air and warm homes for the citizens of Pierce County.

A. Fine Particle Pollution

Definition. Dust, soot, and smoke are all “particulate matter.” Fine particles in the air measure 2.5 micrometers in diameter or smaller – commonly referred to as PM_{2.5}. This is a fraction of the diameter of a human hair. In the Pierce County nonattainment area, fine particle pollution comes mainly from combustion (burning) of fuels, such as wood and fossil fuels. Sources include wood smoke (from wood stoves, fireplaces, and burning of yard waste and land clearing), exhaust from motors (from cars, trucks, buses, ships, etc.), and some industrial operations. Less significant contributions come from sea spray, wind-blown dust, and fireworks.

Effect on health and environment. This kind of air pollution affects everyone. The impact on human health can be serious. Fine particles can easily enter the lungs and travel into the circulatory system, affecting the heart and lungs. Children, older adults, and people with respiratory and cardiac illnesses are especially at risk. Breathing fine particle pollution can cause coughing, wheezing and decreased lung function, even in otherwise healthy children and adults. Exposure to fine particle pollution has been linked to respiratory disease, asthma attacks, decreased heart and lung function, heart attacks, strokes, and premature death. Studies have found that even short-term exposures to fine particles can cause health problems. See Appendix F for a summary of health effects studies and references.

Certain types of fine particles are considered toxic. For example, both diesel exhaust and wood smoke contain chemicals known to cause cancer.¹ Each year millions of dollars are spent treating illnesses and health conditions stemming from fine particle pollution that are preventable.²

Nonattainment designation. The federal EPA, under the authority of the federal Clean Air Act, sets standards and regulations for air quality in communities across the nation. The EPA has set two standards for fine particle pollution. One standard is the 24-hour particle standard (calculated by taking the three-year average of the 98th percentile of the 24-hour air quality values for each of the three years). The other EPA fine particle standard is the annual standard (calculated by taking the average air quality value for each of the four quarters of the year).

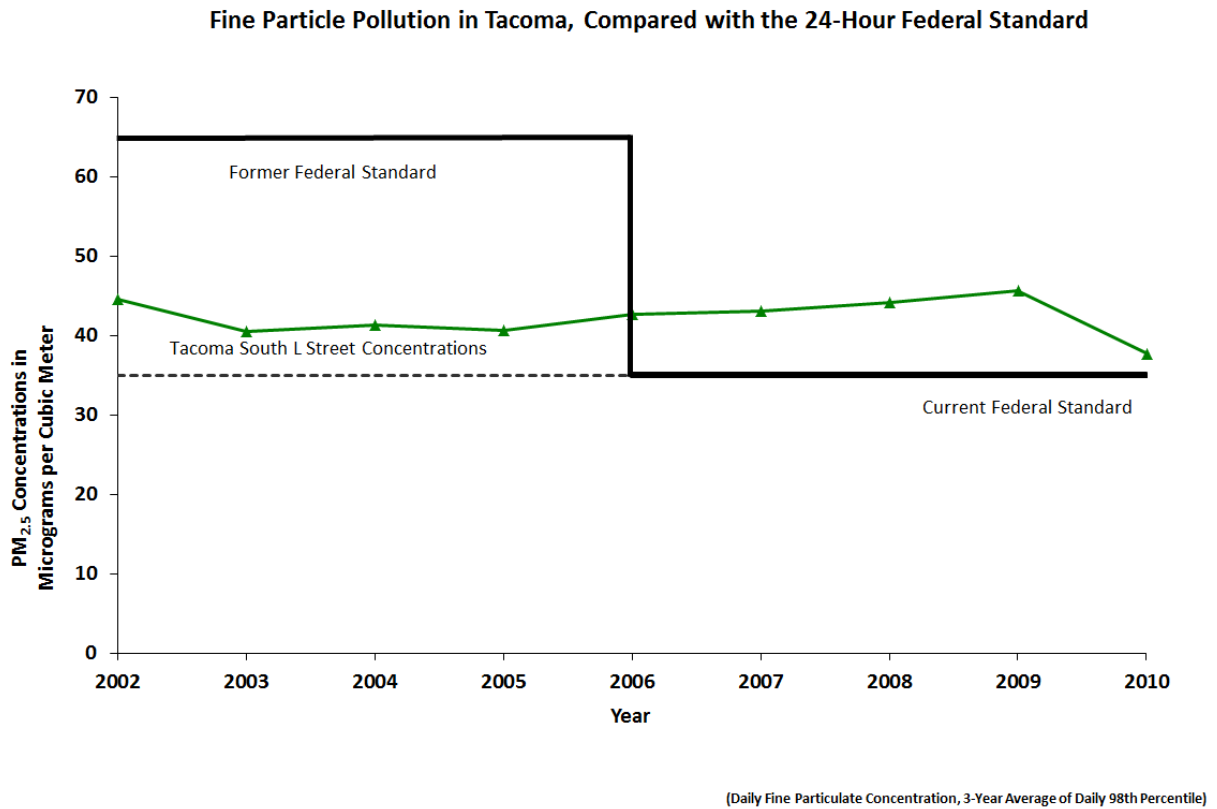
Much of Tacoma and Pierce County are currently in “nonattainment” for the 24-hour fine particle pollution standard (does not meet the standard of 35 micrograms per cubic meter). The EPA designated this area (called “Wapato Hills–Puyallup River Valley” in some documents) as being in nonattainment as a result of three factors: a change in EPA’s protective standards in 2006, the fall and wintertime pattern of pollution in the area, and the sources of fine particle pollution in the area. The same area is in compliance with the federal annual standard. (See Figures 1 and 2 for graphic representations of how air quality in the area has compared to both the 24-hour and annual standards since 2002.) For the remainder of this report, the area will be referred to as the “nonattainment area.” (See Figures 5 and 6 for maps of the nonattainment area.)

Change in EPA protective standards. The federal Clean Air Act requires the EPA to conduct a comprehensive review of ambient air quality standards every five years to ensure they are set at levels protective of public health. As part of that review, the EPA set a stronger daily (24-hour) air pollution standard (limit) for fine particle pollution in 2006.³ This action was in response to numerous scientific and health studies that concluded that exposure to fine particle pollution, even for short periods of time, has serious health effects at lower levels than previously understood. Based on this evidence, the EPA lowered the federal 24-hour standard for fine particle pollution from 65 micrograms per cubic meter to 35 micrograms per cubic meter. The intent was to better protect human health.

Under the lower daily standard, the nonattainment area’s air quality is considered unhealthy on certain fall and winter days of the year. Between 2002 and 2010 the air quality in the nonattainment area exceeded the federal daily standard on 89 days, or an average of nearly 10 days per year.

Air Quality Monitoring and Pollution Levels

The Clean Air Agency operates a network of air monitoring stations in the Puget Sound area. There is a monitor in the South End in Tacoma at South L Street. The levels measured at this monitor are below the former federal standard but are above the current, more protective standard (see Figure 1). While not as high as the South End monitor, fine particle pollution levels are also elevated at other Pierce County monitoring sites, including the Tacoma tide flats, Puyallup South Hill, and in several areas where temporary monitors were located. These monitors also collect data from which the Clean Air Agency can estimate the annual average concentration for fine particle pollution.⁴



**Figure 1. Fine Particle Pollution at Tacoma South L Street Monitor,
Compared to Old and Current Federal 24-Hour Standards**

The level of fine particle pollution recorded at this air monitor has remained fairly stable since at least 2002.⁴

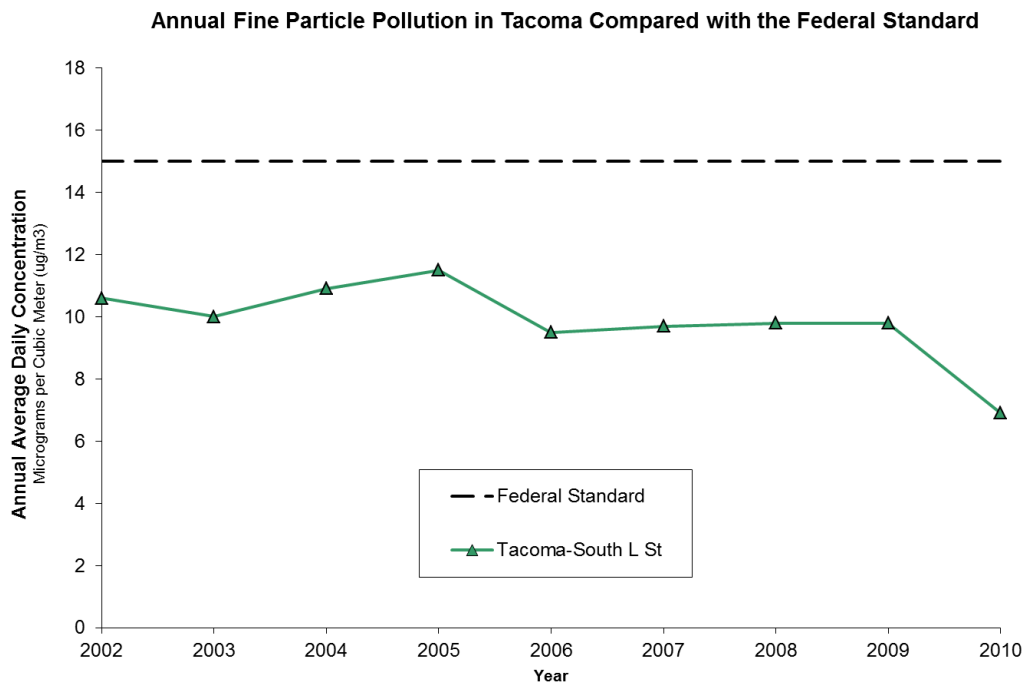


Figure 2. Annual Average Fine Particle Pollution at Tacoma South L Street Monitor

*Since the federal annual standard was announced, the L Street Monitor has remained below the standard. The annual average represents air quality throughout the year—unlike the daily standard, which represents the highest pollution days.*⁴

Fall and wintertime pollution pattern. The violations of the federal daily standard for fine particle pollution in the nonattainment area occur in the late fall and winter months (see Figure 3). Looking at fine particle pollution levels by month for a 10-year period, as recorded at the Tacoma South L Street monitor, shows that the air pollution levels exceeded the 24-hour standard for fine particle pollution on certain days in January, February, November, and December. These are most commonly days of meteorological “inversion,” when a layer of cold air is trapped close to ground level, and pollutant levels build up rapidly. The EPA finds an area to be in nonattainment of the fine particle pollution air quality standard when the monitored air pollution exceeds the 24-hour standard a specified number of times each year, using three years of data. This ensures that an area is not designated as nonattainment just because of one bad year.

When Does Air Pollution Violate the 24-Hour Federal Standard?

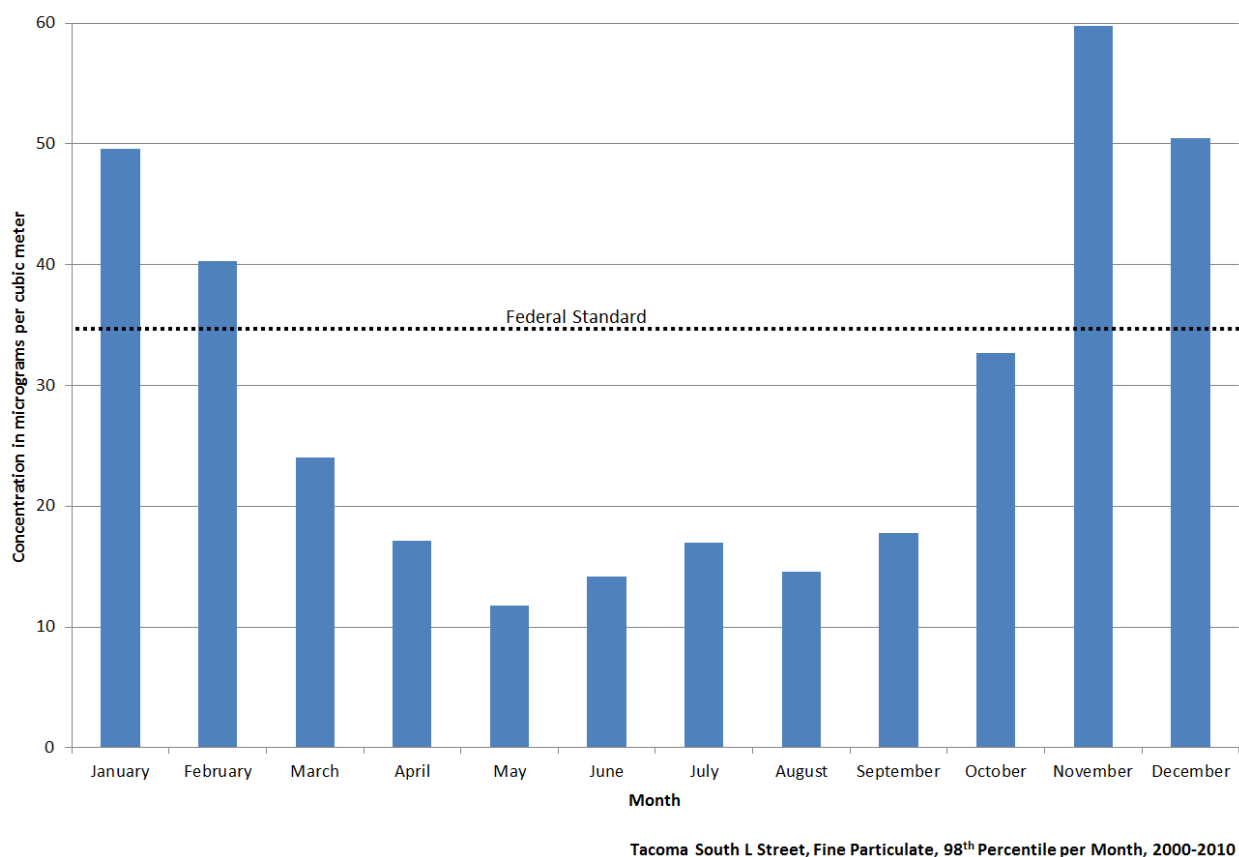


Figure 3. Tacoma South L Street Fine Particle Pollution by Month, 2000 – 2010

Air pollution levels at Tacoma South L Street monitor exceeded the standard for fine particle pollution on certain days in January, February, November, and December. These are days of meteorological “inversion,” when a layer of warm air traps a layer of cold air close to ground level, and pollutant levels build up rapidly.⁵

Sources of fine particle pollution. Analysis of data from the Tacoma South L Street monitor shows that more than half (53 percent) of the fine particle pollution during the fall and wintertime is from wood smoke, with another 25 percent from diesel and gasoline vehicles (see Figure 4 below). To identify the sources, a mathematical model is used that utilizes data about the chemical composition of samples collected from the South L Street monitor.⁶

Of the wood smoke contribution, uncertified wood stoves contribute approximately 51 percent of the fine particle pollution, while certified wood stoves contribute 27 percent, fireplaces 21 percent, and pellet stoves less than 1 percent. These estimates are based on the estimated total number of devices in the nonattainment area, the amounts of fine particle pollution that each typically emit, and the way devices are used, based on survey results.⁷

The higher pollution levels occur at night and early in the morning, when more people are home, and more wood stoves and fireplaces are in use than during the daytime hours. Evening hours are also when

colder air is trapped near the ground and winds are nearly stagnant, contributing to pollution levels rising.

During the summer months, the fine particle pollution levels are lower overall and the sources are in different proportions, with motor vehicles as the highest source.

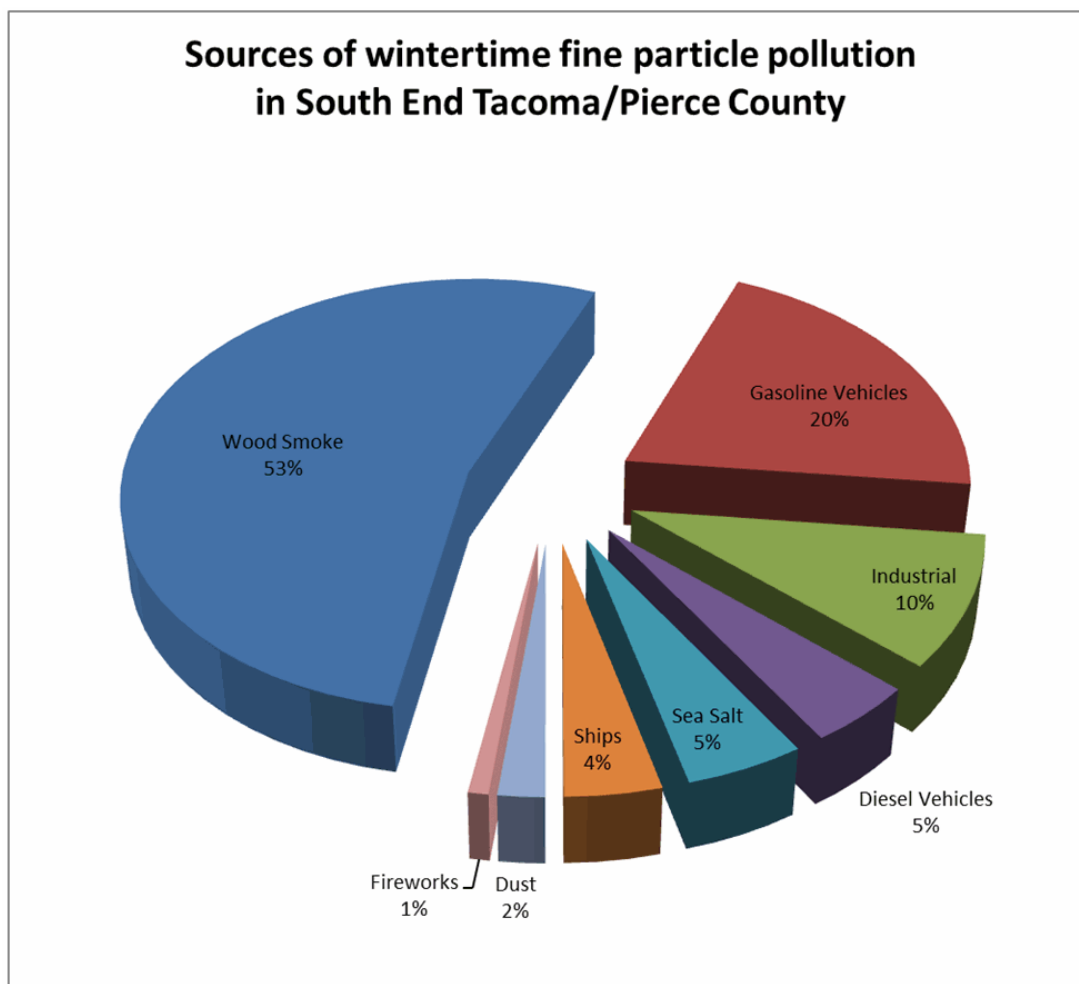


Figure 4. Sources of Fall and Wintertime Fine Particle Pollution at Tacoma South L Street Monitor

Analysis of data from the Tacoma South L Street monitor shows that more than half (53%) of the fine particle pollution during fall and winter months is from wood smoke, with another 25 percent from diesel and gasoline vehicles.

Size of problem. The fine particle levels at the Tacoma South L Street monitor need to drop by at least 9 micrograms per cubic meter on peak fall/winter days, from an average of 42.5 to between 32 and 34 micrograms per cubic meter (a little over 20 percent), in order to reach attainment. Not all emissions reductions will have an equal impact at the monitor, based on the location of the emissions and weather conditions. Reductions that take place in neighborhoods where people are living and playing will have a more immediate impact on their local air quality.

What Is the Area of Concern?

Nonattainment area. The Clean Air Act requires that a “nonattainment area” include not only the area that is violating the federal pollution standard, but also nearby areas that contribute to the violation. The Clean Air Agency and Ecology proposed a boundary to the EPA that took into account such factors as: air quality data, emissions information, population density, traffic and commuting patterns, expected growth, weather, topography, jurisdictional boundaries, and control of emissions.⁸ In 2009, the EPA approved the boundary.⁹ The nonattainment area includes most of Tacoma, including the Port of Tacoma and residential areas, and most of the Pierce County urban growth area, including the cities and towns of: Edgewood, Fife, Fircrest, Lakewood, Milton, Puyallup, Ruston, Steilacoom, and University Place. The nonattainment area also includes the unincorporated communities of Fredrickson, Midland, Parkland, South Hill, Spanaway, and Summit-Waller. Figure 5 below shows the topography and major roads in the nonattainment area; Figure 6 shows the jurisdiction boundaries. Also see Appendix A for the demographics of the area.

The nonattainment area includes most of Pierce County’s urban growth area, with two exceptions. The first exception is the areas of south and east Pierce County that have low population density or very few emission sources that contribute to this problem, such as Graham and Orting. Joint Base Lewis-McChord has a concentration of population but few fine particle emission sources. The task force learned that the analysis of fine particle pollution at the South L Street monitor does not show jet fuel to be a contributor to the air quality violations in the area. The second exception is areas for which the topography and typical weather patterns make it unlikely that their pollution affects the air quality measured at Tacoma South L Street. These areas include the far eastern portion of Pierce County (east of the Puyallup River and White River Valley).

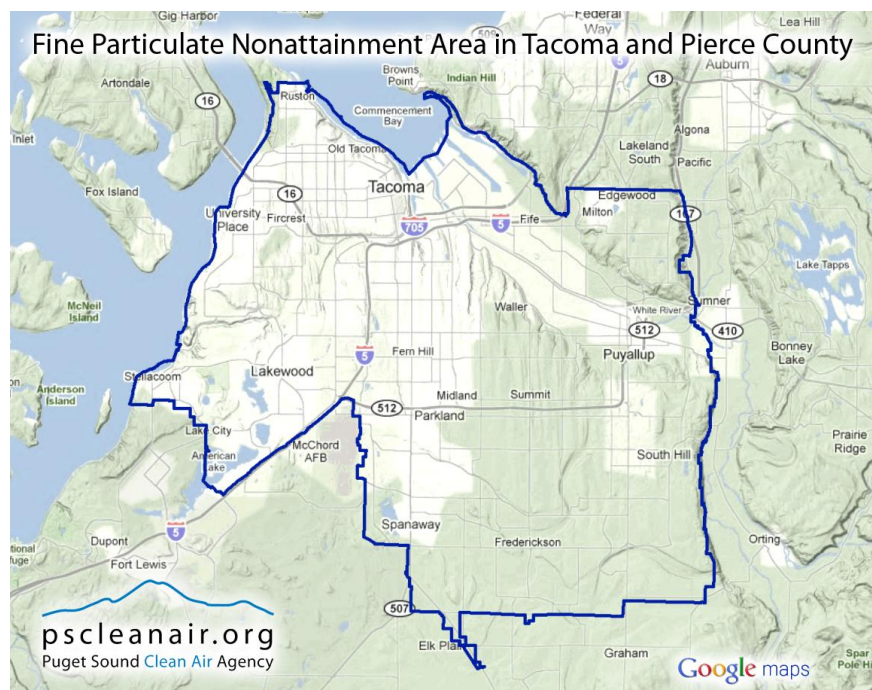


Figure 5. Map of Nonattainment Area, with Topography

The nonattainment area, showing topography, major highways, and larger communities.

Nonattainment Area with Jurisdiction Boundaries

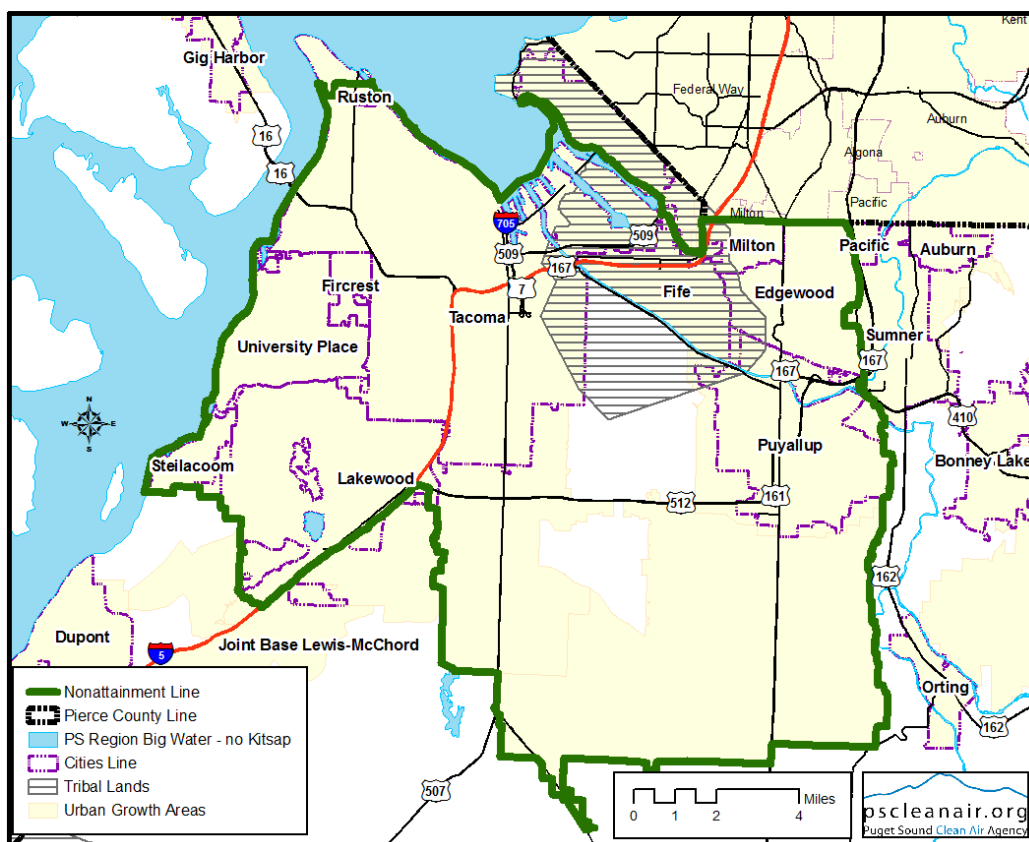


Figure 6. Map of Nonattainment Area, with Jurisdiction Boundaries

Wood burning devices in use in the nonattainment area. The Clean Air Agency provided estimates of the number of households in the nonattainment area that have wood burning devices and the number in use (see Table 1), and of the number who use wood as their primary or sole heat source (see Table 2). These estimates were based on results of a survey done by the National Research Center in 2007 and U.S. Census data.¹⁰

Table 1. Wood Burning Devices in the Nonattainment Area

Device	Estimated # Households that Have	Estimated # Households that Use
Fireplaces	30,900	21,200
Uncertified inserts and wood stoves	24,200	21,200
Certified inserts and wood stoves	20,200	17,200
Pellet stoves	3,900	2,100
<i>Total</i>	<i>79,200</i>	<i>61,700</i>

Source: National Research Center, Puget Sound Clean Air Agency Indoor Wood-Burning Emission Inventory Survey of King, Kitsap, Pierce and Snohomish Counties (2007).

Table 2. Wood Use for Heat in the Nonattainment Area

	Number of Households	Percent
Use wood as primary source of heat ¹¹	3,446	1.7%
Use wood as “only adequate” source of heat (definition in statute) ¹²	unknown	Estimate: 0.02% to 0.46%
Wood is the sole source of heat ¹³	600	0.3%

Definitions of heat sources and wood burning devices. “Non-wood heating equipment” refers to equipment used to heat a home that uses natural gas, heating oil, electricity, or another source of energy to heat a home. These sources of heat emit significantly less fine particle pollution than wood, with natural gas and clean electric heating equipment emitting less than 1 percent of the fine particle pollution of wood burning, and heating oil equipment emitting less than 2 percent of the amount emitted by wood burning.

Washington state regulations define “adequate source of heat” as “the ability to maintain seventy degrees Fahrenheit at a point three feet above the floor in all normally inhabited areas of a dwelling” (see Washington State Rule, WAC 173-433-030).

There are a limited number of homes located within the nonattainment area, less than one percent, for which a wood stove or wood-burning fireplace insert is the only, or sole, source of heat (a narrower definition than “adequate source of heat”). This figure comes from a review of the U.S. Census 2005-2009 American Community Survey, Pierce County property records and the Clean Air Agency’s wood stove replacement program database.

Even though a home may have working, non-wood heating equipment that is sufficient to heat the home—such as a gas, oil or electric furnace, or electric heaters—a wood burner might consider his or her wood stove to be the home’s “primary source of heat.” According to the 2005-2009 American Community Survey, 1.7 percent of respondents with homes in the nonattainment area consider a wood device to be their primary source of heat.

A wood stove is an appliance that is usually made of cast iron, steel, or stone. It can be free standing or made to be installed within the firebox of an existing masonry or metal fireplace.

“Uncertified” refers to older, higher polluting, less efficient, conventional wood stoves that were manufactured prior to 1988 when the EPA issued emission standards. The internal design of wood stoves and wood burning fireplace inserts changed significantly in 1988. Any wood stove or fireplace insert can last as long as 40 years, so there are still an estimated 21,200 uncertified wood stoves in operation in the nonattainment area. Because of their high emissions, uncertified wood stoves cannot be used during Stage 1 or Stage 2 burn bans (see Washington State Rule, WAC 173-433-150).

“EPA-certified” stoves and inserts are much less polluting (up to 50 percent less polluting) and are more energy efficient than older uncertified stoves. In 1988, the EPA issued standards of performance and

testing for new wood stoves.¹⁴ New stoves produced or sold in the United States after 1988 had to meet these standards. Additionally, since January 1, 1995, wood stoves offered for sale in the state of Washington must meet an emission limit that is more strict than the EPA standard.¹⁵ Certified wood stoves sold in Washington state must meet an emission standard of 4.5 grams/hour for non-catalytic stoves, and 2.5 grams/hour for catalytic stoves. Certified stoves can be used during a Stage 1 burn ban, but cannot be used during a Stage 2 burn ban (see Washington State Rule, WAC 173-433-150).¹⁶

Pellet stoves and pellet fueled inserts are similar in appearance to wood stoves; however, instead of wood, pellet stoves burn a fuel made of ground, dried wood, and/or other biomass compressed into pellets. Because they are solid-fuel burning devices, they must meet Washington state's emission standards. Because of their design, many pellet stoves are exempt from the requirement to be certified by the EPA. Pellet stoves are recognized by the EPA and Washington state as among the lowest emission solid fuel heaters and on average emit about 60 percent less than is required by the Washington standard. Pellet stoves can be used during a Stage 1 burn ban, but cannot be used during a Stage 2 burn ban.¹⁶

B. Implications of Nonattainment to Public Health and Regional Economic Development

Current effects. Not attaining federal air quality standards for fine particle pollution means that in the nonattainment area, the air quality is not as healthy as it should be. The fine particle pollution in the air at certain times of fall and winter months poses a serious health risk. A study conducted by Ecology estimates that approximately 1,100 people in Washington die every year because of fine particle pollution.²

Nonattainment can also hinder economic development and tourism in the area and wider region. When Congress wrote the federal Clean Air Act, it decided to provide an incentive to communities to clean their air, by putting stricter requirements on large industries seeking to expand and on new large businesses interested in moving to the areas with high pollution. Some large businesses could be required to install additional emission control equipment. These factors might prompt businesses to locate their operations elsewhere. Tourism also might be affected by the perception that the area has "dirty" air.

Consequences of failing to act. If the state does not create a plan for improving air quality that is submitted to the EPA by December 2012, the Clean Air Act requires EPA to impose its own plan on the area. This plan would not necessarily clean up the problem in the way the community might prefer. Not

Table 3. Timeline

2006 – Health studies cause U.S. EPA to tighten the standard for fine particle pollution

2009 – EPA designates a nonattainment area in much of Tacoma and Pierce County

Summer 2011 – Clean Air Agency convenes Clean Air Task Force

Fall 2011 – Clean Air Task Force makes recommendations to Clean Air Agency

Winter 2011/2012 – Clean Air Agency submits recommendations to Ecology

December 2012 – Ecology submits State Implementation Plan (SIP) to EPA for approval

2014 – Target for County nonattainment area to reduce fine particle pollution to meet federal standard

2019 – Final deadline to meet federal standard for fine particle pollution

acting also would endanger federal transportation funding for the region, and grant funding for air quality monitoring, planning and control programs, as well as the continued personal and societal costs from the health impacts caused by unhealthy air.¹⁷

C. Steps Needed

To respond to the nonattainment designation and show how the area will get to cleaner air, Ecology must develop a State Implementation Plan (SIP) and submit it to the EPA by December 2012 for approval. The plan must describe how the state will improve air quality to achieve the air quality standard for fine particle pollution as quickly as possible. The SIP must: (1) define what actions will be taken to control air pollution; (2) describe how these actions will lead to meeting the air quality standard; and (3) project when air quality will meet the standard.

The Puget Sound Clean Air Agency, as the regional air quality regulatory agency with jurisdiction within Pierce County, is working with Ecology to draft the SIP. The Clean Air Agency formed the Tacoma–Pierce County Clean Air Task Force to get advice and ideas from the community about proposed solutions. The goal is to develop a plan that reflects the community’s values.

The SIP for the nonattainment area must meet certain requirements in order to show that the actions included will lead to attaining the federal air quality standard. These requirements are:

- Reduce the maximum daily fine particle pollution levels recorded at the Tacoma South L Street monitor to below the federal daily standard of 35 micrograms per cubic meter measured over a 24-hour period. This requires reducing current levels by at least 9 (and possibly up to 11, depending on the results of the modeling Ecology will do to show attainment) micrograms per cubic meter on peak fall and winter days.
- Improve air quality as fast as possible. The plan should target attaining the federal air quality standard by 2014 with a possible extension of one to four years (2019) based on the severity of the problem and feasibility of implementing controls. If the target for attainment is after 2014, the area must show it will make substantial progress each year and then actually achieve those targets.
- Address all sources of fine particle pollution.
- Use primarily enforceable actions with measurable results.
- Since public education and voluntary actions are not enforceable and are difficult to measure, the Clean Air Act allows these efforts to account for only up to 6 percent of the total emission reduction needed to achieve attainment (at least 9 micrograms). The SIP may contain additional public education and voluntary actions because they will be helpful to achieve attainment, but they may not be considered by the EPA when they approve the SIP.¹⁷

Only after the air monitoring data indicate that the air quality has improved can the state petition the EPA to redesignate the area from nonattainment to attainment. The EPA can approve the redesignation if the following conditions are met:

1. Air quality monitoring data show that the area meets the federal standard.
2. Reductions in the area’s emissions are permanent and enforceable.

3. The SIP developed for the area has met the requirements of the federal Clean Air Act and has been fully approved by the EPA.
4. The EPA has fully approved a 10-year Maintenance Plan for the area, which Ecology will submit as a revision of the SIP.
5. The area meets the Clean Air Act's requirements for general SIPs and nonattainment areas.

II. Clean Air Task Force and Its Charge

The Clean Air Agency formed the Tacoma–Pierce County Clean Air Task Force in the spring of 2011. The members were community leaders, elected officials and residents (see list on page ii). Craig Kenworthy, the Executive Director of the Puget Sound Clean Air Agency, and Stu Clark, the Air Quality Program Manager of the Washington State Department of Ecology, were ex-officio nonvoting members. The members were chosen for their expertise and experience in one or more areas that are important to solving the nonattainment area’s air quality problem. Examples of some of the perspectives included are industry, public health, and people who burn wood for heat. The Clean Air Agency engaged John Howell of Cedar River Group to serve as facilitator for the task force meetings and process.

The task force’s objective was to recommend to the Clean Air Agency community-based solutions to bring the area into attainment with federal air quality standards. The solutions must reduce emissions from the main sources of fine particulate matter. The full charge to the task force is reprinted below.

Charge to Tacoma-Pierce County Clean Air Task Force

As a task force member, we ask that you actively participate in identifying and evaluating possible solutions to bring the area back into attainment with the federal air quality standard. These solutions need to reduce emissions from the main sources of fine particle pollution: wood stoves and fireplaces, mobile sources (cars, trucks, buses, ships, rail, etc.), and industrial sources. Once possible solutions are evaluated, the group will recommend to the Puget Sound Clean Air Agency those most appropriate for possible inclusion in the state’s plan.

As part of the process, all task force members are asked to:

- Address the problem and consider possible solutions
- Speak as one voice of the people or interest they represent
- Communicate with those you represent between meetings—taking information to them, and bringing their concerns and information back to the task force
- Consider the broad interests of all Pierce County residents who may be affected by poor air quality and the range of possible solutions
- Work to find consensus among the task force members in providing advice and recommendations to the Clean Air Agency

In the task force’s first two meetings, the group developed and adopted a set of ground rules to guide their discussion and decision-making process (see Appendix B). The ground rules included three guiding principles: (1) transparency in creating a thorough and open process, (2) respect for one another’s perspectives, and (3) commitment to recommending the best solutions for Pierce County. The ground rules also provided that the task force would operate by consensus, with the goal of reaching unanimous consensus, meaning that all members could support or live with the task force recommendations. If the task force could not meet unanimous consensus, the differences of opinion were to be noted and included as part of the task force’s final recommendations.

III. Task Force Process for Developing Recommended Solutions

The Tacoma–Pierce County Clean Air Task Force met a total of 11 times—monthly from May through August 2011, and twice a month from September through November, with a final meeting in December. The initial meetings focused on developing an understanding of air quality issues in the nonattainment area, the nonattainment designation by EPA, and the requirements for responding to this designation. The task force also reviewed information about what other communities facing nonattainment for fine particle pollution are doing and have done to improve their air quality and meet the federal standards.

Starting in June, the task force worked to answer three questions: What are possible solutions for reducing fine particle pollution? How do we assess what the best solutions are for our area? What solutions do we recommend? The task force’s discussions produced a list of more than 60 possible solutions and a set of evaluation criteria. The agency staff then applied initial technical modeling to the list of possible solutions in order to narrow the possibilities to those that could produce meaningful reductions of fine particle emissions. Then the task force used the evaluation criteria to identify the solutions with the best fit for the community. Based on these evaluation steps, the task force developed its recommendations. The figure below shows a graphical representation of this process.

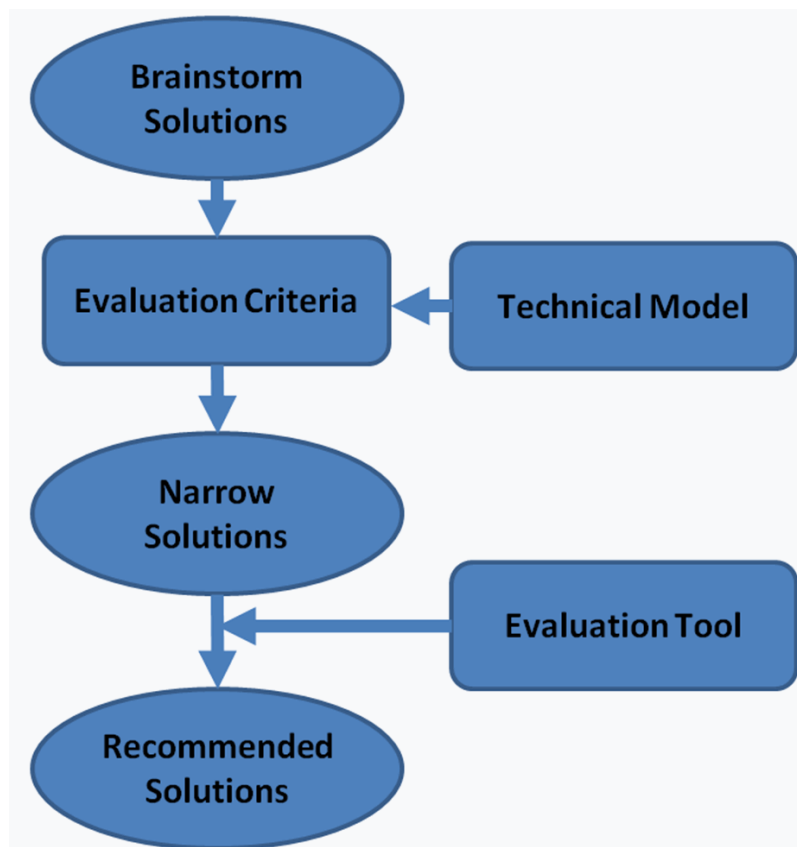


Figure 7. Process for Developing Task Force Recommendations

Note: The “Technical Model” in this graphic refers to a screening tool used by the task force. It is not the official model that will be used in the SIP.

A. Evaluation Criteria and Tools

Staff from Ecology briefed the task force on the evaluation criteria that the federal Clean Air Act requires the state to consider when developing a state implementation plan for fine particle pollution. These are that the solutions must be: reasonable, technically feasible, economically feasible, timely, and enforceable.

In addition to these criteria, the Clean Air Agency encouraged the task force to develop criteria that reflect the community's values and interests. The task force developed possible criteria at its June meeting, and revised and approved them in July. The Clean Air Agency staff recommended which criteria the agency should evaluate (those requiring technical expertise) and which criteria the task force members should evaluate (those requiring judgments from the community's perspective). Some criteria were evaluated by both the staff and the task force.

The table below lists all the evaluation criteria, the definition for each criterion, who developed the rating for each one, and what the rating method was. For the criteria that did not have a numeric measurement, the Clean Air Agency and task force agreed to rate by asking the question *How well does the solution meet each criterion?*, with the rating scale of very well (V), somewhat/mixed (S), and not well (N).

Table 4. Evaluation Criteria and Ratings Used to Assess Potential Solutions

Criterion	Definition	Who Rated	Rating Scale
Fall/Winter Day Ambient Concentration (Fine Particle Reduction)	Consider how effectively the solution will reduce fine particle pollution concentrations in the air during periods of nonattainment.	PSCAA	Micrograms per cubic meter by 2014 and 2019
Emission Reduction	Reductions in the amount of emissions emitted from the sources.	PSCAA	Tons of PM _{2.5} reduced, and percent of the reduction needed to reach attainment
Economically Feasible*	Cost is reasonable for the amount of reduction.	PSCAA	\$ per ton in cost
Implementation	Can be implemented effectively. There is a commitment to implement/enforce. There is adequate authority to implement.	PSCAA	Very well (V), somewhat/mixed (S), and not well (N)
Maintainability	Will improve air quality over time. Addresses the underlying cause of poor air quality.	PSCAA and Task Force	V, S, N
Cost and Benefit	The cost of the solution is commensurate with the air quality benefits that will be achieved.	Task Force	V, S, N
Public and Political Acceptance	There will be sufficient public and political support for the solution.	Task Force	V, S, N
Economic Well-Being of the County	Will enhance the economic development potential for Pierce County.	Task Force	V, S, N
Minimize Burden on Vulnerable	Will minimize the economic burden on individuals and households.	Task Force	V, S, N

Criterion	Definition	Who Rated	Rating Scale
Communities and Populations			
Minimize Unintended Consequences	Will minimize the likelihood of unintended consequences.	PSCAA and Task Force	V, S, N
Funding Availability	There is reasonable likelihood that funding needed to carry out the solution will be secured.	PSCAA	V, S, N
Technically Feasible/ Sound*	The solution can be put into practice. Emissions can be measured or quantified.	PSCAA	V, S, N
Timing/Timely*	How quickly the solution will produce reductions. Will enable Pierce County to meet the federal timeline, establish a basis for appropriate next steps, and reach attainment by 2014 (at the latest, 2019).	PSCAA	V, S, N
Enforceable*	Will be independently verifiable. Has defined violations. Can identify liable person. Enforceable as a practical matter.	PSCAA	V, S, N
Reasonable* (encompasses all the other criteria)	Not absurd, impractical, unenforceable, or severely disruptive socioeconomically. Focuses on significant emission reductions.	PSCAA	V, S, N (assessed based on all other criteria)

*Criterion required by the federal Clean Air Act

The task force members each used an evaluation tool to provide their ratings of each major solution. These results were rolled up into the master evaluation tool (see Appendix C).

B. Potential Solutions

At the July and August meetings, the task force learned about solutions that other cities and counties across the country are using to reduce fine particle pollution, and brainstormed possible solutions for use in the nonattainment area. This process produced a list of more than 60 potential solutions. Clean Air Agency staff organized the list by emissions source—wood smoke, vehicles, other—and public education and outreach.

The staff then reviewed the solutions in terms of their potential to reduce the level of fine particle pollution in the area, and grouped them in four categories (see Appendix D). The four categories were:

1. Major Reduction Potential Solutions – four solutions with the potential to reduce fine particle pollution by 0.5 micrograms per cubic meter or more:
 - A. Require removal of uncertified stoves by a date certain, with only non-wood burning devices allowed as replacements
 - B. Require removal of uncertified stoves by a date certain, with certified stoves allowed as replacements
 - C. Require removal or changeout of uncertified stoves at time of sale of the home
 - D. Increase capacity to enforce burn bans

2. Supplemental Solutions – 21 solutions that would not achieve very much reduction by themselves or that presented other complications when used alone, but if combined with one of the “major reduction” solutions, could help to boost the reduction of that solution.
3. Low Reduction Potential Solutions – 14 solutions that would not reduce fine particle pollution by very much or had other limitations. Task force members requested that Clean Air Agency staff evaluate the following three of these solutions:
 - L1. Explore filtering technology for wood burning devices to determine if it is effective and affordable
 - L3. Lower the threshold for calling the second stage of burn bans in the nonattainment area (from 25 micrograms to 20 micrograms)
 - L9. Develop a program to trade out polluting autos for bikes and/or fuel efficient autos

The rest of the Low Potential solutions were not taken off the table, but were not included in the evaluations.

4. Public education and outreach — 14 solutions. These were grouped separately because, while an important part of the overall solution, the federal Clean Air Act allows these efforts to account for only up to 6 percent of the total emission reduction needed to achieve attainment (at least 9 micrograms). Additional public education and voluntary actions will be necessary to achieve attainment, but may not be considered by the EPA when they approve the SIP.

C. Focusing the Solutions

The Clean Air Agency staff provided the task force with an evaluation of each of the four major reduction solutions separately and combined with supplemental solutions. In discussion, the task force members suggested some possible changes in the solution packages. The solutions the task force and agency staff reviewed were as follows:

- Time of Sale Removal or Decommissioning of Uncertified Wood Stoves and Inserts:
 - Time of sale solution
 - Time of sale solution, with inspections and incentives
 - Time of sale solution, adding decommissioning also for fireplaces, with inspections and incentives
- Enhanced Burn Ban Enforcement:
 - Enhance enforcement by adding significant personnel capacity during burn bans
 - Combined solutions for enhanced enforcement:
 - implementing a registration program
 - enforcing based on visible smoke standard, rather than illegal smoke density
 - adding enforcement personnel beyond the initial addition
 - modifying when a burn ban is called (modifying the “triggers”) to reduce the number of impaired air quality days
 - enforcing the ban more effectively during evening hours
 - increasing awareness of burn bans

- increasing education and outreach
- Date Certain Removal of Uncertified Wood Stoves and Inserts with a Variety of Options:
 - Date certain removal, and restrict replacements to non-wood sources; registration program
 - Date certain removal, and allow certified wood stoves as replacements; registration program
 - Date certain removal, and allow pellet stoves (pellet stoves are significantly lower in emissions) or a wood stove with emissions equivalent to a pellet stove as replacements; registration program

D. Evaluation of Solutions

Once the list of potential solutions had been narrowed to those that have the greatest potential to reduce fine particle emissions in the nonattainment area, the task force used several steps to review, discuss, and evaluate each of the potential solutions. The process involved the following:

- Presentation of a description of each proposed solution, including appropriate background information, as needed
- Review and discussion of the key assumptions used to conduct the evaluation of each solution, and the results of the technical modeling based on those assumptions
- Review and discussion of staff's assessment of the evaluation criteria (described earlier) they were asked to rate, and task force assessment of the evaluation criteria they were asked to rate
- Additional review and discussion of each solution after recommended revisions to the key assumptions and associated revisions to estimated modeling outcomes
- Development of recommendations

In order to conduct a thorough evaluation of each solution, a number of assumptions had to be made about how the solutions would be implemented. For example, the assumptions included estimates regarding the rate of compliance for each solution (the percentage of the public within the nonattainment area who would follow a new rule, regulation or procedure), the staffing levels needed for implementation, or the administrative and capital costs required for implementation. Those assumptions were used to inform the technical modeling carried out by the Clean Air Agency staff to estimate how much pollution reduction could be achieved by each solution and over what period of time that reduction would occur. The assumptions were also used to estimate the total cost of each solution (including an estimate of the potential costs borne by homeowners and the community).

In its September and October meetings, the task force reviewed and discussed the assumptions for each of the major solutions. A number of revisions were suggested based on the task force members' expertise or assessment of community values. Agency staff then revised the key assumptions and presented to the task force any changes in the estimated levels of pollution reduction or costs.

In addition, Clean Air Agency staff was asked to develop a tool that would allow the task force to understand how quickly a combination of solutions could achieve progress toward meeting or exceeding the federal air quality standards. Figure 8 represents the "Progress Meter" used by the task force. The

meter included three dates: 2014, which is the target established by the Clean Air Act for communities to reach attainment; 2019, which is the latest a community is allowed to achieve attainment; and 2017, a mid-term date that allowed the task force to measure estimated progress toward meeting the federal standard prior to the end-date of 2019. The meter also included two potential reduction goals: a minimum reduction of 9 micrograms per cubic meter to meet the federal daily standard and to bring the area into attainment; or a reduction of 19 micrograms per cubic meter to meet an air quality health goal established several years ago for the entire region by the Puget Sound Clean Air Agency Board. Agency staff indicated that the progress meter is a preliminary tool. Ultimately Ecology will be continuing technical analysis of recommended solutions for the SIP, so the amount of gains from individual or collective solutions could change in the final SIP.

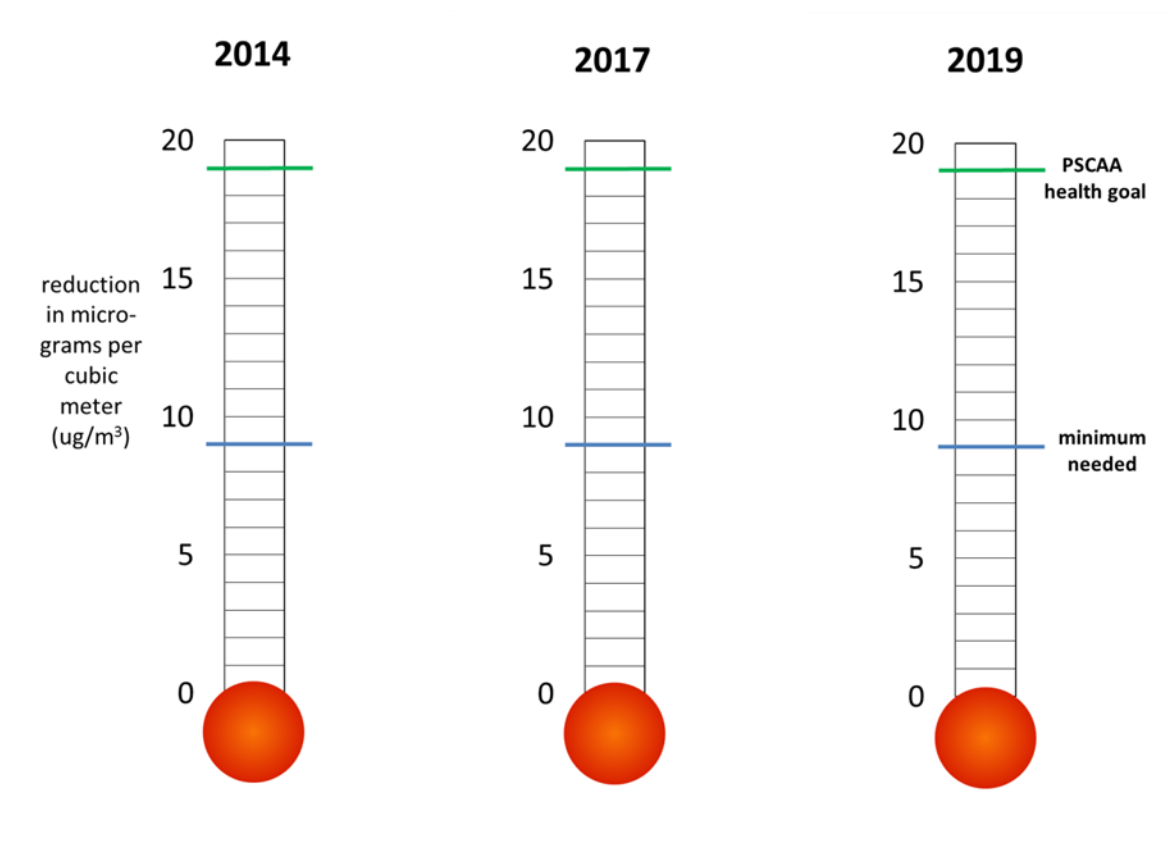


Figure 8. Example of a Progress Thermometer

The blue lines signify the minimum reduction needed to demonstrate attainment. The green line is the amount of reduction needed to reach the Agency health goal.

Time of Sale Removal or Decommissioning of Uncertified Wood Stoves and Inserts

Solution Description: This solution was based on an Oregon statewide program in which uncertified wood stoves and inserts were required to be removed, decommissioned, or changed out at the time a house is sold. The transaction of selling a home provides a point in time and an established process (an inspection prior to the closing of a sale) when uncertified stoves and inserts could be identified and

removed. The Oregon program was adopted in 2009 and effective in 2010, so there are limited data to evaluate the effectiveness of the new program.

Selected Key Assumptions:

- The rate of annual home sales in Pierce County is 2 percent to 3 percent of all homes. This is based on the Pierce County Assessor-Treasurer's reports from 2008 to 2010, and from Northwest Multiple Listing Service data provided by representatives from the Tacoma-Pierce County Association of Realtors.¹⁸
- Sixty percent of homes sold in Pierce County will comply with this requirement. The Oregon program estimated a 75 percent compliance rate, but there are not significant data yet to confirm their rate of compliance.¹⁹
- This solution would result in an annual removal rate of uncertified wood stoves and inserts of 1.2 percent to 1.8 percent.
- The cost of removing but not replacing an uncertified device was approximated to be \$350 for a freestanding wood stove and \$1,200 for an insert.

Evaluation Conclusions: The technical analysis concluded that this solution would result in the following:

- A reduction in fine particle pollution of about 0.32 micrograms per cubic meter by 2014 (less than 5 percent of the minimum reduction needed); and a reduction of 1.0 micrograms per cubic meter by 2019 (about 10 percent of the minimum reduction needed).
- A total cost *per microgram per cubic meter* for this solution was estimated to be \$3 million.

Task force members expressed several concerns about this potential solution. A primary concern was that it would be focused on one relatively small segment of the population—those individuals selling and purchasing homes—to solve a community-wide issue. Task force members felt it would be inequitable to single out those households to reduce fine particle emissions, since they represent a small portion of the total number of homes using uncertified wood stoves and inserts. This would also place a requirement on households that have an uncertified device, even if the device was not used to burn wood.

In addition, task force members expressed concern about relying on this solution in a highly uncertain and weak real estate market. There was concern that additional requirements placed upon home sales could weaken the recovery of the already soft real estate market. Finally, given the need to make substantial progress toward cleaner air, task force members said they were concerned that the current annual rate of home sales would not result in significant reduction of fine particle pollution.

Enhanced Burn Ban Enforcement

Solution Description: In order to consider modifications to the ways in which burn bans could be enforced in the nonattainment area, the task force had to understand the current law and practice regarding the use of burn bans. Washington state law allows local agencies to restrict the use of residential wood burning devices to protect public health when air pollution levels rise.¹⁶ The law stipulates the use of a two-stage burn ban. A Stage 1 burn ban is issued on the basis of weather conditions and a forecast of rising pollution levels. A Stage 1 ban is issued when a forecast estimates

that fine particle pollution will exceed 35 micrograms per cubic meter (the federal daily standard) within 48 hours. During a Stage 1 burn ban, only households with EPA certified wood burning devices or pellet stoves, or households whose wood stove or insert is their only adequate source of heat (including uncertified wood stoves or inserts), can burn.

A Stage 2 burn ban can be issued when fine particle pollution reaches certain trigger levels established in state law. A Stage 2 burn ban is issued in one of two ways: (1) if a community is already in a Stage 1 burn ban and fine particle levels are above 25 micrograms per cubic meter and are forecast not to drop below that level for at least 24 hours; or (2) if a Stage 1 burn ban has not been called but fine particle pollution levels are above 25 micrograms per cubic meter and are forecast to exceed 35 micrograms per cubic meter within 24 hours. During a Stage 2 burn ban, only households who have no other adequate source of heat can burn wood. During both a Stage 1 and Stage 2 burn ban, outdoor burning is prohibited.

During the past 10 years (2000 – 2010), 17 fall and wintertime burn bans have been issued by the Clean Air Agency for Pierce County. This represents an average of six days per year during the months of November through February. However, since the federal daily standard for fine particle pollution was strengthened in 2008 (reducing the acceptable air quality standard from 65 micrograms per cubic meter to 35 micrograms per cubic meter), it can be reasonably assumed that without further actions, the average number of burn ban days per year will increase.

The Clean Air Agency issues and enforces the burn bans. It has an enforcement staff of between eight and 12 people who operate in two-person teams, and are responsible for air quality enforcement in King, Kitsap, Pierce, and Snohomish counties. Enforcement of burn bans is currently conducted primarily during daylight hours because the light better allows inspectors to observe the opacity (density) of the smoke or visible emissions rising from chimneys. In a recent burn ban (December 2010 – January 2011), 10 notices of violation were issued in Pierce County for violation of the ban.

Enhanced enforcement of burn bans would include the following features:

- Substantially increase the number of personnel to enforce burn bans.
- Change the standard used by enforcement personnel from opacity (smoke density) to visible smoke. This will allow personnel to observe more homes and issue more notices of violation if those violations are occurring. (An opacity violation can be issued only after a home is allowed 20 minutes for start-up, when smoke is more dense, and then must be viewed for at least six minutes by an inspector trained as a certified smoke opacity reader.)
- Explore technologies that would better enable personnel to enforce burn bans during evening hours (including exploration of possible use of infrared viewers and cameras).
- Enhance community outreach and education to better inform residents about proper wood burning practices and the importance of observing burn bans.
- Increase the amount of advertising and public awareness efforts to better inform residents about the issuance of a burn ban.
- Maintain use of the two-stage burn ban, and make changes as necessary to when burn bans are called (i.e., consider changing the “triggers,” the forecasted levels of pollution, when burn bans

would take effect). This could better enable the community to use burn bans to avoid exceeding the air quality standard.

- Provide assistance for low-income households so they are not forced to spend limited resources on more expensive forms of heat during a burn ban.
- Create a registration program for owners of all certified and uncertified wood stoves and inserts. This will enable enforcement personnel to focus their efforts on those homes that are in violation of a burn ban (e.g., they would know which homes use wood stoves or inserts as their only adequate source of heat, or which homes have certified stoves or inserts that are allowed to burn during a Stage 1 burn ban).
- Establish a meaningful initial fine that could be reduced or eliminated if the resident agrees to participate in training regarding burn bans and proper wood burning practices, or to change to a cleaner source of heat.

Selected Key Assumptions:

- Three quarters of those who receive a civil penalty for violating a burn ban would not burn again during a burn ban.
- The number of inspection personnel would be ramped up over the first three years, resulting in potentially 4,000 notices of violation being issued in Year Three.

Evaluation Conclusions: The technical analysis concluded that this solution would result in the following:

- Based on the program changes described above, it is estimated that enhanced enforcement of burn bans could achieve a reduction in fine particle pollution of about 1.4 micrograms per cubic meter by 2014 (less than 20 percent of the minimum reduction needed); and a reduction of 6.8 micrograms per cubic meter by 2019 (approximately 70 percent of the minimum reduction needed).
- A total cost *per microgram per cubic meter* for this solution was estimated at \$1.2 million. This cost includes approximately \$1.3 million dollars *per year* in societal costs (including civil penalties to homeowners and program administrative costs).

For a complete list of assumptions and agency evaluation conclusions, see Appendix E.

The task force felt that this potential solution would be effective because it would focus action during the days of the year when fine particle pollution in the nonattainment area exceeds the federal air quality standards. The solution also builds on an existing regulation (issuance of burn bans) that is familiar to many residents. This solution was felt to be timely (air quality improvements could occur as soon as enforcement is increased), technically feasible, and enforceable. The task force also noted that other communities, such as Sacramento, have had success in using enhanced enforcement of burn bans to reduce wood smoke fine particle pollution (although circumstances in other communities are not directly analogous to the Tacoma and Pierce County area). The task force discussed a number of potential implementation challenges (i.e., ramping up and training the number of personnel required to enhance enforcement, securing technology to accomplish better evening enforcement, the need to include considerable public education along with enhancing enforcement of burn bans, and others), but

concluded that these challenges could be solved and that the solution could achieve results in the near-term and over time.

Date Certain Removal of Uncertified Wood Stoves and Inserts

Solution Description: Wood stoves and inserts manufactured prior to 1988 (as described earlier in this report) produce more pollution and are less efficient than more modern devices. The older stoves and inserts made prior to 1988 are called uncertified devices. Since wood burning devices can last for 40 years, there are still a considerable number of older uncertified wood stoves and inserts in use. It is estimated that there are 24,200 uncertified wood stoves and inserts in the nonattainment area, and 21,200 are estimated to be in use.⁷ This solution would set a date (or dates) when uncertified wood stoves and inserts would be required to be removed from homes in the nonattainment area.

In 2009, the Washington State Legislature provided the authority to prohibit the use of uncertified stoves and inserts in nonattainment areas if it could be demonstrated that the wood smoke was found to be part of the air pollution problem, and if there were a program to assist low-income residents in complying with the regulations.²⁰ In addition, the legislation exempted residents for whom an uncertified device is their only adequate source of heat. Given the percentage of pollution from wood smoke, the first condition can be met, and this solution presumes that the other conditions will be included in the nonattainment area.

The task force discussed several alternatives for phasing in a requirement to remove uncertified wood stoves and inserts over a several year period. However, the task force felt that establishing one clear date when all residents will have to remove their uncertified device was preferable to having multiple dates affecting multiple categories of residents. They also felt it would be important to offer a combination of “carrots and sticks” (e.g., incentives for those who remove their uncertified device before the deadline, and stiffer fines for failing to remove until after the deadline) to encourage removal in a phased fashion. The proposed date when all uncertified wood stoves and inserts would have to be removed is the end of August 2015.

This solution would include provisions to accommodate low-income households and those whose uncertified device is their only adequate source of heat. Assistance to low-income households could take several forms, including: financial payments to remove uncertified devices; providing additional time to meet the removal requirement; assistance with payment of bills for other heat sources; and/or leveraging of home weatherization programs to insulate homes to reduce all heating costs.

Although this solution is focused on the removal of uncertified devices, one of the factors affecting the estimated level of pollution reduction is the kind of heating device that could be installed after the uncertified wood stove or insert is removed. The task force felt that residents should be able to install any approved method of heating, including certified wood stoves or inserts.

The task force also discussed the level of confirmation that would be utilized to determine if and when uncertified stoves and inserts were being removed. Three levels of confirmation were considered: low, medium, and active. Low confirmation would include outreach and incentives, but would not include meaningful ways to confirm removal. This level of confirmation would not meet EPA requirements of

enforceability. The medium level of confirmation would include some ways to confirm removal. Examples are: requiring GPS-marked photos provided by homeowners to provide certainty that uncertified devices had been removed, and increased fines for burning with an uncertified stove or insert during a burn ban. The active level of confirmation would include inspections in homes to confirm removal. The task force felt that home inspections would be considered intrusive by the community

This solution could include the creation of a registration program for owners of all certified and uncertified wood stoves and inserts. The registration could be used for both the enhanced burn ban enforcement and the removal of uncertified devices. Registration would be phased in over time and would be accomplished mostly with a system of online registration. Registration of all wood burning stoves and inserts would allow the Clean Air Agency to track the progress and target efforts being made toward the removal of all uncertified wood stoves and inserts.

Selected Key Assumptions:

- The number of uncertified wood stoves and inserts that would be removed per year is estimated at 1,000.
- The compliance rate (the percentage of all owners of uncertified devices who would remove their uncertified wood stove or insert) by the deadline is estimated to be 33 percent with a “medium” level of confirmation by 2019. This allows for an exemption for adequate source of heat.
- Fifty (50) percent of those who remove their uncertified device would replace that device with a certified wood stove or insert.
- Financial assistance (\$500) would be provided to remove certified stoves, and an additional \$500 incentive would be provided for early removal.

Evaluation Conclusions: The technical analysis concluded that this solution would result in the following:

- It is estimated that date certain removal of uncertified wood burning stoves and inserts could achieve a reduction in fine particle pollution of about 0.7 micrograms per cubic meter by 2014 (less than 10 percent of the minimum reduction needed); and a reduction of 2.5 micrograms per cubic meter by 2019 (more than 25 percent of the minimum reduction needed).
- A total cost *per microgram per cubic meter* for this solution was estimated at \$5 million.

For a complete list of assumptions and agency evaluation conclusions, see Appendix E.

The task force concluded that this solution would improve air quality over time and address one of the underlying causes of fine particle pollution. This solution is technically feasible, and with a balance of “carrots and sticks,” it could begin to accomplish pollution reduction quickly. The task force did express concern about the level of public and political acceptance this solution would achieve. There are some in the community who will be opposed to limitations on their options for heating their home, or who object to the potential cost to replace the uncertified device with another stove or insert.

Reductions in Other Sources of Pollution

Solution Description: As mentioned earlier in this report, combustion from residential wood burning accounts for over half of the fine particle pollution on peak fall and winter days in the nonattainment area. However, several other sources contribute to the pollution: gasoline vehicles, industry, diesel vehicles, ships, and other miscellaneous sources. (See Figure 4 on page 15.) Each of these other sources contributes significantly less to fall/winter fine particle pollution than wood smoke: gasoline vehicles (20 percent), industrial sources (10 percent), diesel vehicles (5 percent), and ships (4 percent). Although no single source contributes more than 20 percent, there are a number of actions being undertaken to reduce fine particle pollution from these other sources.

Gasoline Vehicles

Nationally, the focus for reducing fine particle pollution related to gasoline vehicles has been on creating cleaner standards for both engines and fuels. The State of Washington has adopted the California Clean Car Standards for vehicles, the most stringent automobile standards in the country.²¹ As the old fleet of vehicles is retired from the road and the newer, cleaner vehicles replace them, the new standards will have a positive impact on reducing fine particle pollution. This trend is partially offset by the anticipated increase in population growth, which will result in more drivers on the road. In addition, local governments have adopted several programs to reduce fine particle pollution related to gasoline engines: Pierce County, the City of Tacoma, and Tacoma Public Utilities have installed 20 electric vehicle charging stations in the area, and have purchased electric vehicles, along with vehicles that use biodiesel. Anti-automobile-idling programs have been adopted for schools, Washington State Ferry loading areas and for some public fleets.

The regional transportation plan adopted by the Puget Sound Regional Council has several policy goals that will help reduce fine particle pollution:

- Focus population and economic growth in urban centers and compact communities.
- Improve efficiency through better signal coordination, active traffic management, and traveler information.
- Implement strategic capacity investments in transit, roadways, and non-motorized improvements.

In support of these policy goals there are a number of transportation capital investments planned in the nonattainment area between now and 2019. Those improvements include the following: high-occupancy vehicle (HOV) lane extensions on I-5 and SR 16; ramp metering on I-5 in the Joint Base Lewis-McCord area; Sounder (commuter rail) improvements from Tacoma to Lakewood; and selected bicycle lanes, sidewalks and trails to encourage alternative means of travel.²²

Diesel Vehicles

There are new federal standards for diesel engines and fuel. The new standards for cleaner engines apply to a wide range of diesel engines, including cars, trucks, locomotives, and marine. Cleaner diesel fuel standards have been phased in during the past several years: 2007 for on-road vehicles, 2010 for off-road vehicles, and 2012 for locomotive and marine fuel.²³ However, Tacoma Rail, the Port of Tacoma Terminal Locomotives, and the Washington State Ferries are already using fuel that meets the newer

standards. There are also several programs adopted by local jurisdictions and often implemented through the Clean Air Agency's "Diesel Solutions" program to reduce emissions from diesel vehicles and equipment, including: 93 percent of Pierce County school buses and more than 140 City, County and Port vehicles equipped with exhaust control equipment; the Port of Tacoma's and Tacoma Rail's locomotive idle-reduction program; use of biodiesel by all of the City of Tacoma, the Port of Tacoma and Tacoma Public Utilities diesel fleets; Pierce Transit's use of compressed natural gas in its entire fleet; use of "clean diesel" and hybrid buses by Sound Transit; retrofitting of 59 diesel-powered trucks with diesel oxidation catalysts by Tacoma Public Utilities; and trading out heavy-duty trucks older than 1994 for cleaner vehicles by the City of Tacoma, Port of Tacoma and Department of Ecology. The Port of Tacoma has also implemented a program that only allows drayage trucks with 1994 or newer engines to enter the Port.

Industrial Sources

Engineers and inspectors from Ecology and the Clean Air Agency have been working with Tacoma and Pierce County industries for the past 40 years to reduce pollution emissions, with significant reductions achieved. Among the current industrial sources of fine particle pollution in the nonattainment area, there are six sources that have been identified by Ecology and the Clean Air Agency as the largest industrial emitters of fine particle pollution. Collectively, these six sources contribute more than 90 percent of the industrial fine particle pollution from industrial sources in the nonattainment area. The federal Clean Air Act establishes a requirement for working with industries to reduce their levels of pollution called Reasonably Available Control Technology (RACT). The requirement stipulates that pollution control technology for industries must be available, reasonable to install, and cost effective to install and operate. Engineering staff at Ecology and the Clean Air Agency are currently conducting a review of existing pollution controls and operations at the six largest industrial sources to determine if they meet RACT. A preliminary analysis indicates that most, if not all, of the sources do.

Ships

New international standards require that ocean-going ships use lower sulfur fuel, beginning in 2012 and moving to a much stricter levels by 2015. These cleaner fuels will reduce the fine particle pollution from ships.²⁴ The Port of Tacoma and Totem Ocean Trailer Express have also installed shore power facilities and retrofitted ships so that ships can use shore power instead of operating their diesel engines to create power when at berth.

Selected Key Assumptions:

- Older cars will retire and be replaced by newer ones.²³
- Over \$5 billion in transportation-related investments that will help reduce fine particle pollution will occur by 2019.²²
- Ship emissions will decrease between 2012 and 2015 due to cleaner fuel requirements.²⁴

Evaluation Conclusions:

- The new standards for cleaner gasoline cars and newer cars on the road are estimated to achieve a reduction in fine particle pollution of 1.3 micrograms per cubic meter by 2014, and 1.5 micrograms per cubic meter by 2019.

- The federal standards for cleaner diesel engines and both diesel and marine fuels are estimated to achieve a reduction in fine particle pollution of 0.5 micrograms per cubic meter by 2014, and 0.6 micrograms per cubic meter by 2019.
- The new standards for large ship fuel are estimated to achieve a reduction in fine particle pollution of 0.4 micrograms per cubic meter by 2014, and 1.1 micrograms per cubic meter by 2019.
- Investments in regional transportation projects to improve traffic flow and provide alternative forms of transportation are estimated to achieve a reduction in fine particle pollution of 0.4 micrograms per cubic meter by 2019.

Together the anticipated reductions from emission sources other than wood smoke are estimated to achieve approximately one-quarter to one-third of the reductions needed (2 to 3 micrograms) to reach the federal air quality standard by 2019. Most of the emission reductions from these other sources of fine particle pollution will come from changes in federal standards for more efficient engines and cleaner fuels. However, while the range of local initiatives does not add a significant amount to the estimates of emission reduction in the nonattainment area, continued efforts to reduce emissions from these sources will contribute to the overall plan.

IV. Public Outreach and Input

The task force allowed for public comment at each of its meetings. In addition, the Clean Air Agency conducted significant public outreach in Pierce County on the topic of fine particle nonattainment. There were two primary purposes: to raise general awareness of the issues and to gather public input on the draft pollution-reducing strategies under consideration by the task force. Because of the likely impacts from future implementation of wood smoke reduction programs, special emphasis was given to reaching members of the community who burn wood for heat.

Public outreach was conducted throughout the task force process, but was concentrated during October and November 2011. Activities included:

- **Direct mailing** – Postcards were sent to all households within the nonattainment area (approximately 220,000 households) announcing public open houses and also requesting input online or by telephone.
- **Public open houses** – Two public meetings were held in the nonattainment area (Tacoma, October 20; Puyallup, October 24). A total of approximately 200 people attended.
- **Online survey** – Public input was invited via an online survey at www.cleanairpiercecounty.org. More than 400 comments were submitted between October 5 and November 30. Approximately 50 people responded to the postcard by phone. An additional 10 responded by U.S. mail.
- **Print and online advertising** – The public open houses and online survey were advertised in all of the major print media within the nonattainment area, in one Spanish-language weekly, on Joint Base Lewis-McChord, and on the *Tacoma News Tribune* website. Additionally, more than 4000 posters and flyers were distributed in public locations within the community.
- **Outreach to community groups** – Clean Air Agency staff and partners gave presentations and briefings throughout the year to more than 30 neighborhood coalitions, city and county councils, state and federal elected officials, and other community groups. Clean Air Agency staff also participated in community events focused on health impacts, emergency preparedness, and other relevant topics.
- **Social media** – The Clean Air Agency also used its monthly electronic newsletter, FaceBook and Twitter to promote the work of the Clean Air Task Force and to solicit public input on the draft pollution-reduction strategies being considered.

Feedback was requested on three draft pollution-reducing strategies: enhanced enforcement, removal of uncertified devices at a date certain (“date certain”), and removal of uncertified devices at the time a home is sold (“time of sale”). All comments received were categorized according to four levels of overall support for the strategy: full support, qualified support with economic concerns, qualified support with concerns about balanced implementation, and full opposition.

Overall, the majority of respondents indicated full or qualified support for all of the strategies proposed. The primary public concern about enhanced enforcement was that implementation should be balanced and reasonable. For date certain and time of sale removal, the primary concern was about economic

impacts to individual households, both due to the cost of removing uncertified devices and to ongoing heating costs.

Four major themes were common across all of the public input submitted. There were strong concerns about the economic impacts of potential pollution-reducing strategies on individual households, particularly low- and fixed-income families. A large proportion of people expressed concerns about the impacts of wood smoke on their health and in their neighborhoods. A smaller number of comments expressed disbelief that wood smoke is a significant source of pollution, as well as concern that efforts to address wood smoke are intrusive and a waste of taxpayer money.

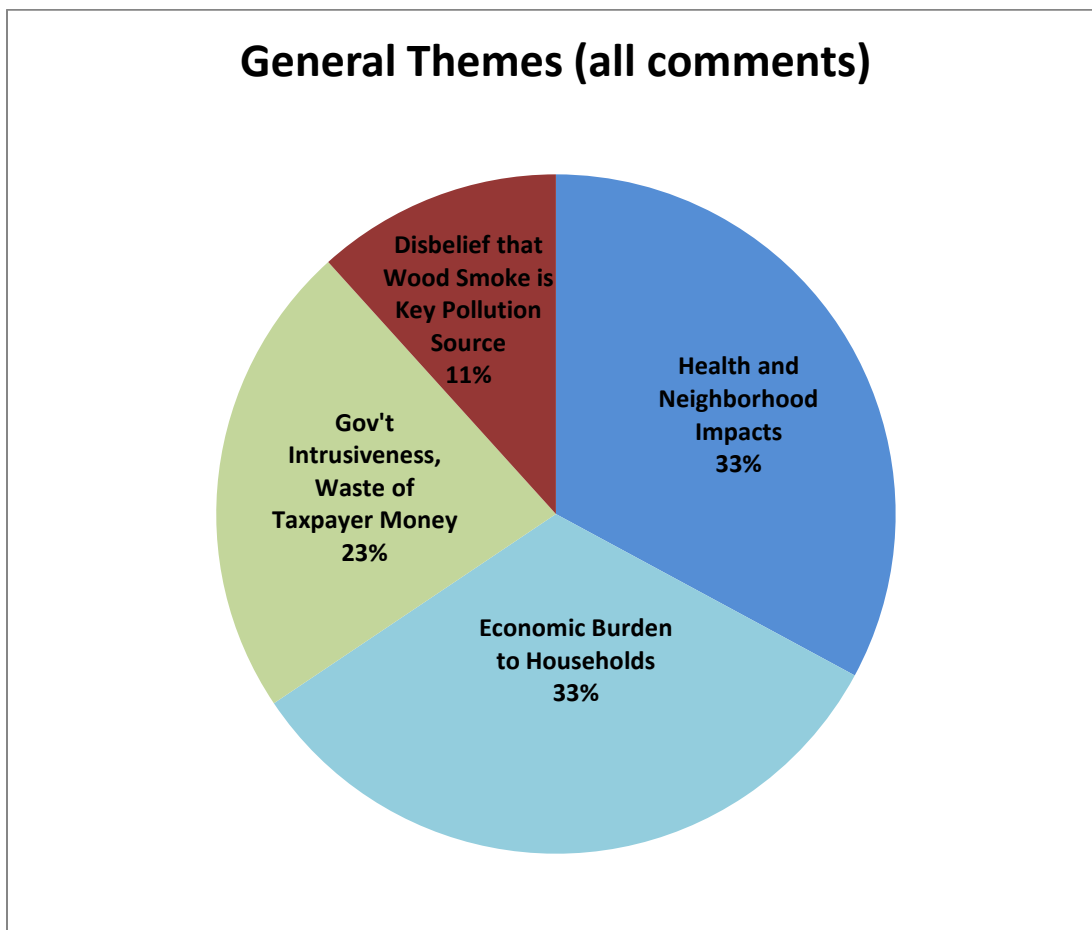


Figure 9. Overarching Themes from Combined Online, Public Open House, and Telephone Comments

Four major themes were common across all of the public input submitted. In a number of cases, individuals expressed both support for and concerns about the proposed solutions.

All public input was compiled and provided to the task force for its consideration, as well as posted online at www.cleanairpiercecounty.org. Further public outreach will be done on issues related to burn bans, health impacts of wood smoke, clean burning practices, and other topics as the state implementation plan is completed and implemented.

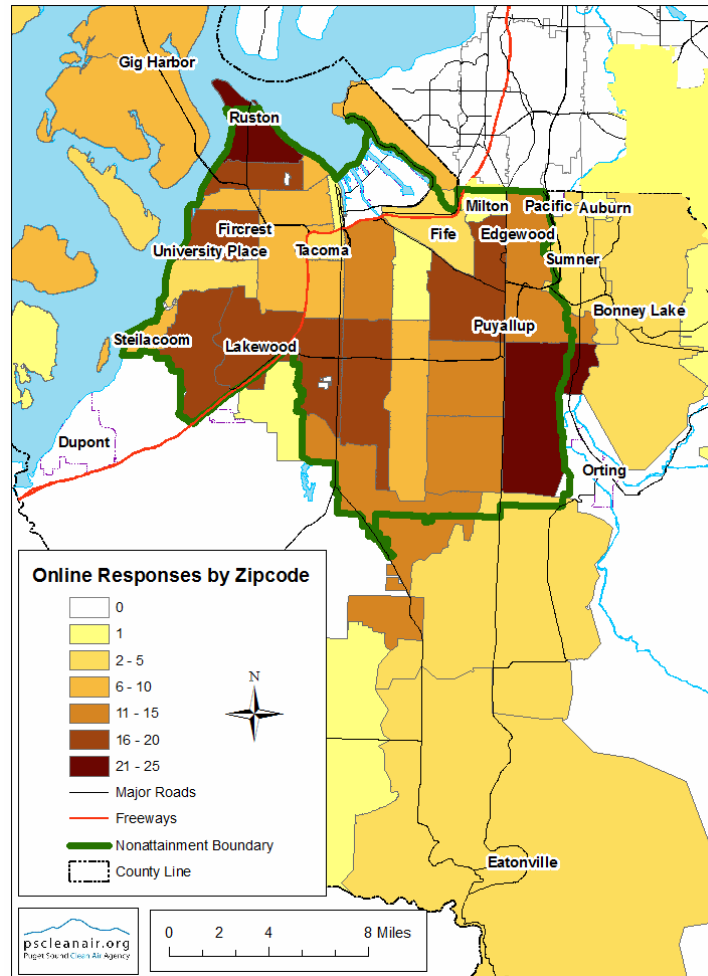


Figure 10. Location of Online Survey Respondents by ZIP Code

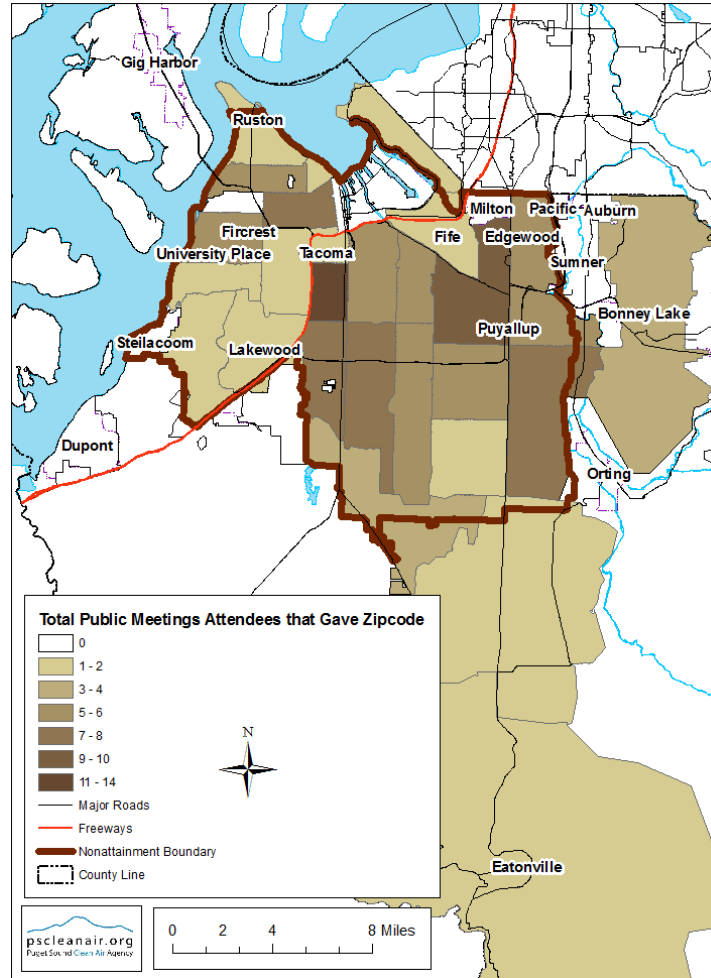


Figure 11. Location of Public Open House Attendees by ZIP Code
(Note: not all meeting attendees provided ZIP code information)

V. Recommended Solutions and Principle Statements

No single solution will enable the nonattainment area to reduce fine particle pollution sufficiently to achieve the federal air quality standard. The task force is recommending use of a combination of strategies in the nonattainment area to improve air quality in a timely manner and to help the area reach attainment. The three main strategies recommended by the task force are:

1. Enhanced enforcement of burn bans
2. Establishment of a date certain for removal of uncertified wood stoves and inserts
3. Implementation of the range of strategies to reduce fine particle pollution for gasoline vehicles, diesel vehicles, industries and ships.

As mentioned in the Evaluation Section of this report (page 27), approximately one-quarter to one-third of the emission reductions needed to meet the fine particle pollution standard by 2019 will be accomplished from new federal regulations and local initiatives related to reducing pollution from gasoline and diesel engines, ships, and industries. Since wood smoke represents more than half of the fine particle pollution on peak fall and winter days, the task force focused most of its time discussing recommendations regarding ways to reduce wood smoke.

The task force discussed numerous variables with respect to the design of the recommended solutions. However, it realized that circumstances may change as implementation plans are developed. (For example, there is uncertainty about the amount of funding to implement these solutions.) As a result, the task force recommendations include a combination of suggested program design features, and statements of principle that it suggests be used to guide the future implementation of these solutions.

As mentioned earlier in this report (see page 20), the Clean Air Act allows education and voluntary measures to account for only 6 percent of the total emission reduction needed to achieve attainment (at least 9 micrograms). Public education and voluntary outreach are not considered enforceable and are difficult to measure. However, the task force firmly believes that the two wood smoke related solutions described below will not be successful without considerable public education, community outreach and public involvement. Local communities must first understand the nature of the problem and then take ownership of the actions needed to improve air quality. Education and outreach are needed to help residents understand the causes and impacts of fine particle pollution, to encourage residents to take informed actions, and to overcome the skepticism many members of the public will have about new government regulations. Outreach and education must include efforts to reach individuals who may not receive information from traditional civic or community organizations.

Task force members also suggested that there are opportunities to work with local public health agencies, and other government and nonprofit organizations, to better inform the public about the health risks of fine particle pollution and the proposed solutions.

The task force expressed concern that the solutions being recommended could create an economic burden on residents in the nonattainment area. As a result, they are proposing that the solutions be implemented in a manner that will provide some form of assistance to low-income residents. They also raised concerns about how renters would be treated, especially in cases where the renters are low

income. The statements of principle for the task force's two major solutions include providing assistance to low-income households or helping them find alternatives. (See the first statement of principle for Enhanced Burn Ban Enforcement, and the second statement of principle for Date Certain Removal of Uncertified Wood Stoves and Inserts.) The task force members wanted to be certain that provisions for low-income households also included renters.

The task force acknowledged that the area with the highest pollution levels (near the South L Street monitor in Tacoma) is also an area where many people burn wood. Finding ways to focus resources on that area is important both to reduce health impacts on nearby residents and to solve the overall pollution problem.

Overarching Principle Statement

- All residents and communities in the nonattainment area should contribute to the solution. We are all in this together.

Common Principles for Implementing All Solutions

- Education efforts are a key component to ensure effective implementation.
- Outreach should be broad-based and include groups that are less likely to receive notice or support.
- Individual strategies should be consistent and complement other strategies.

A. Enhanced Burn Ban Enforcement

Goal: Ensure that those who are contributing the most to the fine particle pollution during periods of the poorest air quality reduce their emissions.

The task force felt that the primary value of this solution is that it would focus on those residents contributing the most to the air quality problems during the fall and winter months, and that it would focus resources on the specific times of the year when the area is out of compliance with the federal air quality standards. Task force members recommend that this targeted approach will be an effective way to reduce fine particle pollution.

The task force discussed experiences in other communities that have significantly enhanced enforcement of burn bans. Although circumstances and conditions vary from one community to the next, they felt that programs in other areas of the country, such as Sacramento, demonstrated enough success to suggest promise for enhanced burn ban enforcement in this nonattainment area.

The Clean Air Agency has been issuing burn bans for a number of years, so changes to the existing program are needed to improve fall/winter air quality. The task force considered a number of changes to make burn ban enforcement more effective. For example, as mentioned earlier, currently only eight to 12 personnel are used to enforce burn bans and other clean air regulatory requirements in King, Kitsap, Pierce, and Snohomish counties. A relatively small number of notices of violation have been issued in Pierce County during burn bans. The task force is recommending that considerably more personnel be used to enforce the burn bans in the nonattainment area.

Another change is that enforcement of a burn ban historically occurred only during daylight hours. However, data suggest that there is a large increase in the level of fine particle pollution from wood smoke in the evening hours. The task force is recommending that the Clean Air Agency explore the use of technologies that would allow for better evening enforcement of burn bans. Other recommended changes are listed below.

In addition, task force members felt strongly that use of enforcement personnel alone would not result in the change of behavior needed to alter wood burning practices. In addition to a significant increase in the use of enforcement personnel, the task force believed that community outreach and education are essential. The members suggested it would be particularly helpful to find opportunities for neighbors to talk with each other about air quality problems and the importance of complying with burn bans. They also suggested utilizing existing community-based programs, where possible, to foster this type of education and outreach effort.

The Clean Air Agency works with the local media to help notify the public when burn bans are called. However, task force members noted that many residents remain unfamiliar with the reasons for a fall/winter burn ban, and are unaware when burn bans are called. It was suggested that the Clean Air Agency do everything it can to work closely with local media outlets to publicize burn bans, and to inform the public about the causes and health impacts of fine particle pollution in the nonattainment area. (There was a specific suggestion to ask the local media to clearly indicate in news accounts when burn bans were first called.)

Key Features of Recommended Solution

- Ramp up enforcement presence during burn bans and in the fall and winter, phased in over several years.
- Enforce violations based on visible emissions, in addition to smoke density.
- Add nighttime enforcement, as practical.
- Maintain a two-stage burn ban, and consider changes to when and how the stages are called.
- Provide exemptions and/or assistance for low-income residents and households for whom the wood burning device is their only adequate source of heat.
- Include a registration program for wood burning devices.
- Enhance outreach and education efforts.

Statements of Principle to Guide Implementation of Enhanced Burn Ban Enforcement

- Enhanced enforcement should be combined with a robust community outreach initiative to enable neighbors to talk with neighbors about the importance of obeying burn bans and burning cleanly when the community is not in a burn ban.
- Assistance should be provided for low-income households who may be affected by this requirement. Enforcement of burn bans should respect the challenges faced by low-income burners and provide alternatives (e.g., financial assistance or exemptions), even if these residents have other sources of heat available.

- Enhanced enforcement should be phased in to allow those who receive a first notice of violation to reduce or eliminate the initial fine if they engage in educational opportunities about proper burning practices and the importance of burn bans, or move to a cleaner source of heat. The initial fine should be meaningful enough to provide sufficient incentive to participate in education activities and to discourage subsequent burning during burn bans.
- Enhanced enforcement should continue to accommodate households for whom a wood burning device is their only adequate source of heat, while ensuring that the exemption is used only for those who qualify. Exemptions from burn ban enforcement do not exempt people from burning cleanly nor from other standards.
- Decisions about who provides enforcement should be based first on who would be most effective, while respecting the need to consider any capacity challenges of local governments.
- When implementing a registration program, consider that the goal is to enhance effectiveness of enforcement staff and minimize unnecessary interactions with exempted households.
- Revisions to the Stage 1 and/or Stage 2 “trigger” levels should be considered, as they may enable burn bans to more effectively keep fine particle pollution below the federal daily standard during inversions, and better protect public health.
- Both forecast and monitored data should be included in the burn ban system (as they are currently) to call burn bans.

B. Date Certain Removal of Uncertified Wood Stoves and Inserts

Goal: Removal of the older, more polluting wood stoves and inserts from the nonattainment area.

This solution provides lasting emission reductions by removing one of the underlying causes of fine particle pollution from the community —uncertified wood stoves and inserts. The older uncertified wood burning stoves and inserts are more polluting than are other sources of heat. However, this recommendation represents a considerable change from current practices in the community. As mentioned earlier, it is estimated that there are 24,200 uncertified wood stoves and inserts in the nonattainment area, with an estimated 21,200 currently being used. The Clean Air Agency previously removed about 1,200 of them during a voluntary changeout program.

The task force is recommending selection of a date for removal of uncertified devices that will strike a balance between several objectives: (1) provide sufficient time for local residents to make plans to accommodate this new requirement; (2) provide sufficient time for officials to attempt to secure implementation funding; but (3) not set a date too close to 2019 when the area must meet the air quality standards. With uncertainty about the rate of compliance for this proposal, the removal date must allow sufficient time prior to 2019 to adjust the solutions as needed. The task force is also recommending that the Clean Air Agency use a combination of “carrots and sticks” to encourage early adoption of this requirement. This would allow for implementation to be phased, while still maintaining a clear date certain when all uncertified stoves and inserts would be required to be removed.

The removal program would work in concert with the enhanced burn ban enforcement. For example, uncertified wood stove/insert users who receive a notice of violation during a burn ban could receive a

higher fine if they have not removed their device by the deadline. Also, prior to the deadline, enforcement of burn bans could be used to help educate residents about the new removal requirement. This recommendation includes a proposal to create a registration system for all wood stoves and inserts. This element of the program would benefit both the enhanced burn ban enforcement and date certain removal strategies. By knowing who has an uncertified stove, the Clean Air Agency can direct incentives to those residents, provide focused enforcement of a Stage 1 burn ban, and confirm removal of the uncertified device from those homes.

The task force is also recommending that once an uncertified wood stove is removed, the homeowner should be able to replace that stove (if the owner chooses) with any other approved cleaner heating device, including a certified wood stove.

Key Features of Recommended Solution

- All uncertified wood stoves and inserts must be removed by end of August 2015.
- Use a combination of incentives, fines, education and regulations (carrots and sticks) to encourage residents to remove uncertified devices by the end of August 2015.
- Create a registration system for all owners of wood stoves and inserts (both certified and uncertified).
- Create a “medium level” of confirmation regarding removal of uncertified stoves and inserts. This could include higher fines for using an uncertified device during a burn ban, or GPS-marked photos to confirm removal. (See pages 32-33 regarding low, medium and active confirmation.)

Statements of Principle to Guide Implementation of Date Certain Removal of Uncertified Wood Stoves and Inserts

- Households should have a range of options if they choose to replace their uncertified device (including certified device, pellet stove, or other type of heat), but incentives could vary depending on the device they use.
- Assistance should be provided for low-income households who may be affected by this requirement. The assistance could take several forms, including but not limited to, financial assistance for installing a new heating device, home weatherization, and/or providing additional time for low-income households to meet this requirement.
- The solution should accommodate households for whom a wood burning device is their only adequate source of heat.
- Date certain removal should allow time for transitions, yet begin soon enough that the date is meaningful. Timing of implementation should be equitable, be publically acceptable, and allow time to find funding.
- Medium level of confirmation is the preference. But if that is not sufficient to achieve EPA approval or program effectiveness, a more active form of confirmation should be used. If more rigorous methods of confirmation are needed, they should be equitable and as nonintrusive as possible.

- The purpose of the registration program is to confirm widespread removal of uncertified devices.
- Recognizing the current challenges in local, state, and federal budgets, funds should be prioritized according to the task force's ranking, where possible. (See below.)

Allocation of Resources for Date Certain Removal Solution

There are a variety of ways that funds could be used to support this solution—the date certain removal of uncertified wood burning devices. But in these challenging economic times the availability of funding to support this solution is uncertain. Task force members were asked to rate several different potential uses of funds in order to recommend some priority for the future funding, when and if it becomes available. The task force was provided with a list of five possible opportunities to use funds and asked to rank them from 1 to 5, with 1 being the highest priority and 5 being the lowest priority. Members were also given the opportunity to add other potential uses for funds. The following table lists potential uses of funds and the average ranking created by the task force:

Table 5. Task Force Ranking for Potential Use of Funds

Potential Use of Funds	Average Ranking
Assistance for low-income households	1
Assistance to households with no other adequate source of heat	2
Incentive payments for early adopters	3
Incentive payments for cleaner heat	4
Assistance to all households (regardless of income) for removal of stoves/inserts	4
Other (each receiving one vote): <ul style="list-style-type: none"> • Incentives for weatherization for all households that remove stove/insert • Assistance in retrofitting a fireplace with a certified wood heater or pellet heater • Use the point of sale of a home to remove uncertified stoves/inserts 	

C. Making Progress Toward Clean Air

The task force was mindful of the need to meet the federal Clean Air standard, but also to reduce overall levels of pollution in the nonattainment area. Since high levels of fine particle pollution have been demonstrated to have impacts on human health, the task force wanted the recommendations to first and foremost meet the federal standard. Using the progress meter described earlier in this report, the task force reviewed the combined effects of the proposed solutions to understand how much progress can be made to achieve both goals. The progress meter shown in Figure 12 demonstrates that attainment could potentially be achieved by 2017 assuming the programs were fully supported over the time frame. By 2019, it is estimated that the nonattainment area would achieve fine particle pollution reductions well beyond what is required by the federal standard, and make progress toward the air quality health goal. It should be noted that there are a large number of assumptions in this estimate that have significant uncertainty. (See Appendix E.)

Figure 13 below demonstrates the proportion each solution contributes to the total reduction by 2014, 2017, and 2019. By 2014, the pie chart illustrates that the most immediate reductions come from non-wood smoke solutions. On the other hand, the 2017 and 2019 pie charts show that the wood smoke solutions make up the largest proportion of the reductions as these solutions are phased in over time.

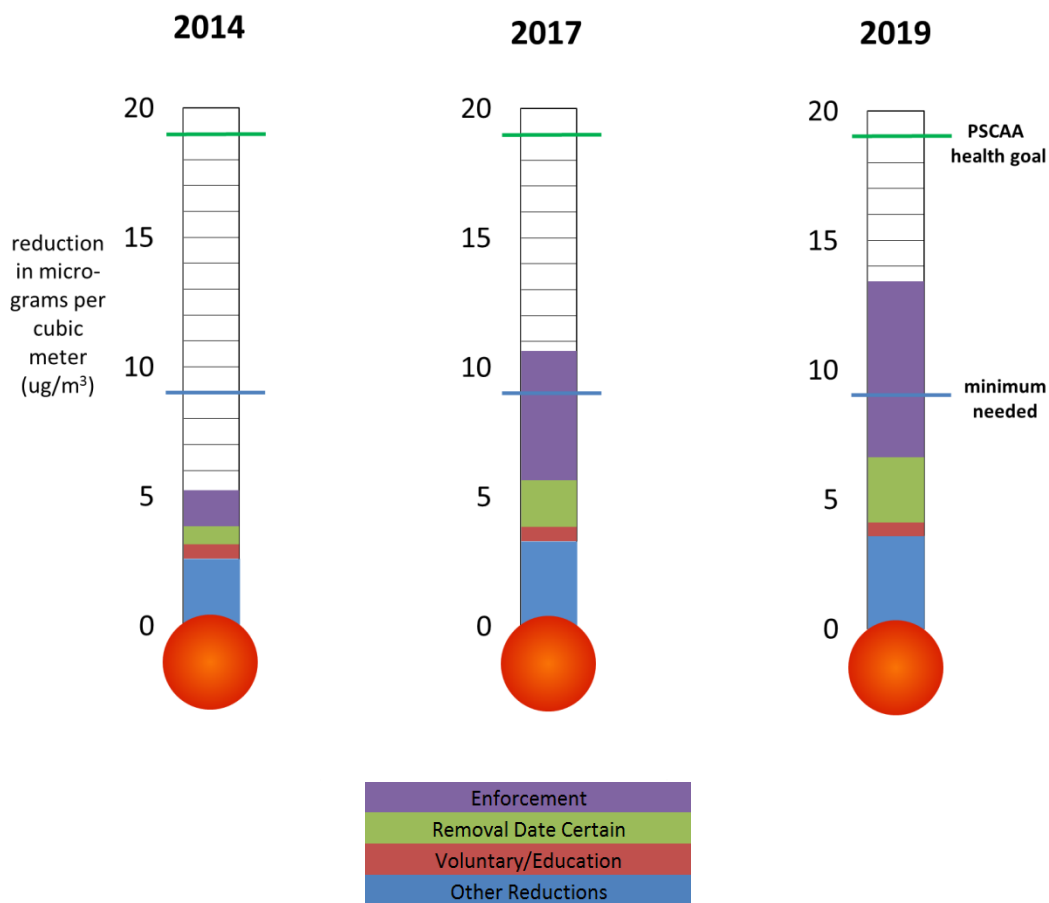
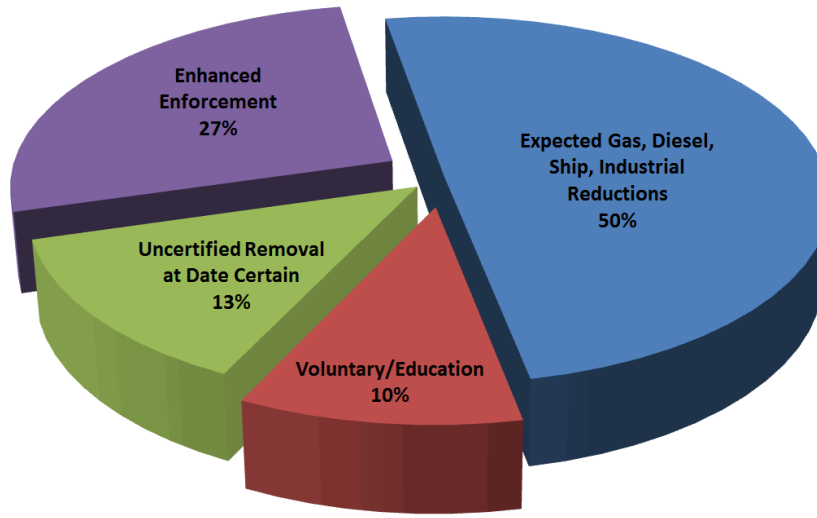


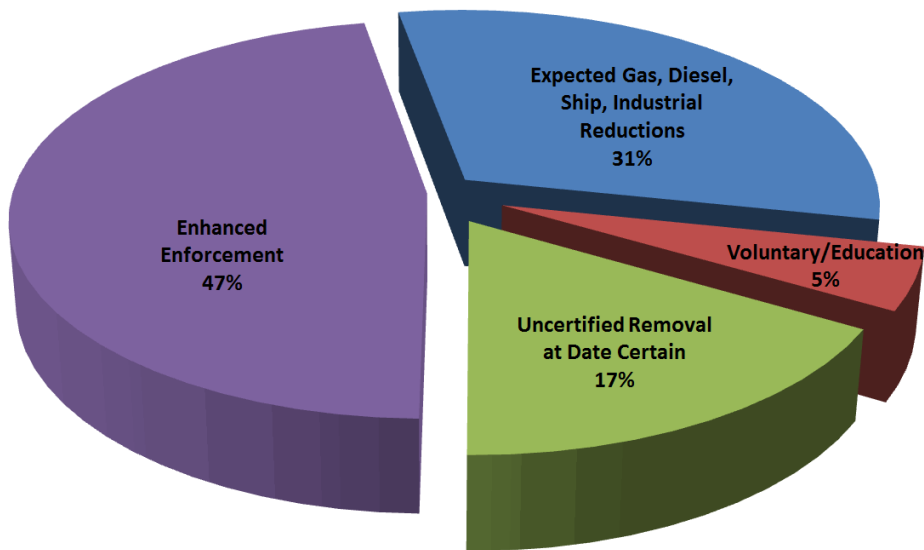
Figure 12. Progress Thermometer for Task Force Recommendations

This thermometer represents an estimated sum of the solutions proposed by the task force. Note: This is a compilation of a number of assumptions and has a significant level of uncertainty.

Solutions Contribution to Total Reduction by 2014 (Percent)



Solutions Contribution to Total Reduction by 2017 (Percent)



Solutions Contribution to Total Reduction by 2019 (Percent)

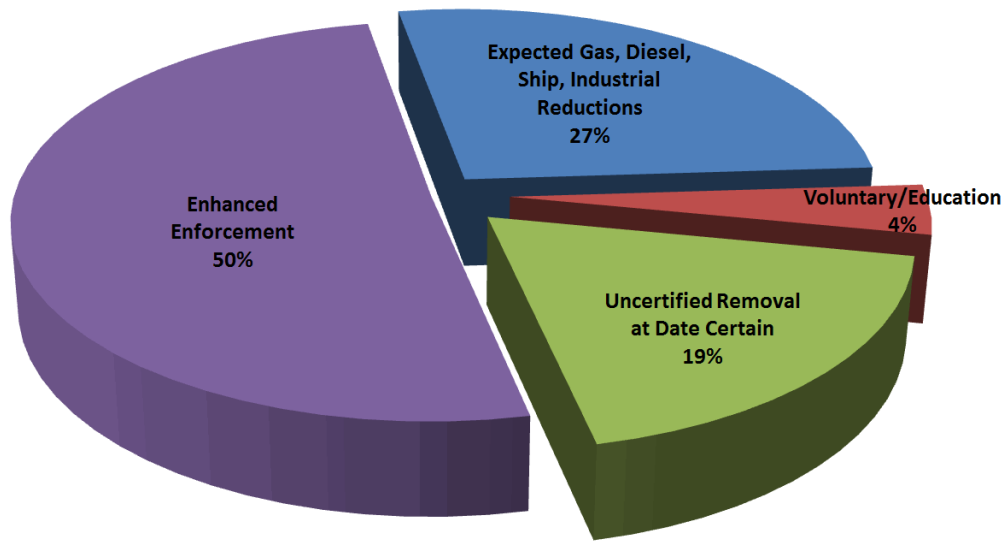


Figure 13. Proportion of Emission Reductions by Category in 2014, 2017, and 2019

The pie charts are the proportion of the reduction estimates from the thermometer above. 2014 is the target established by the Clean Air Act for communities to reach attainment; 2019 is the latest a community is allowed to achieve attainment; and 2017 is a mid-term date used by the task force to measure estimated progress toward meeting the federal standard and the PSCAA health goal. Note: This is a compilation of a number of assumptions and has a significant level of uncertainty.

D. Contingency Measures

The State Implementation Plan submitted by Ecology to EPA must identify the solutions the nonattainment area will use to meet the air quality standards, and anticipated target dates for making progress toward reaching those standards (i.e., how much improvement in air quality is expected by certain dates). If those targets are missed or if the area is not making sufficient progress toward meeting the fine particle standards, then further solutions must be adopted. These additional solutions are called contingency measures. The state's Plan must identify potential contingency measures. These measures can be heightened use of the solutions included in the Plan, or new solutions previously untried.

The task force is recommending that the following contingency measures be considered for inclusion in the Plan:

- That cleaner technologies be required for use of fireplaces, such as cost-effective catalysts, starters, or filter technology that has been shown to work (this technology has not yet been demonstrated successfully).
- A requirement that in the nonattainment area, only the cleanest burning devices (equivalent to emissions produced by a pellet stove) be allowed. (The Task Force acknowledged that because the EPA is currently revising its emission testing protocol for stoves, this measure may not be available at the time the SIP is submitted, but could be added at a later date.)
- That the time of sale of a home be used as an opportunity to confirm the removal of uncertified wood stoves or inserts (in addition to, as a backstop for "date certain").

- For households that have an uncertified wood stove or insert as their only adequate source of heat, only those that are income qualified would receive assistance or be exempted from the requirement to remove their device.

E. Task Force Consensus on Recommendations

One of the ground rules adopted by the task force during its initial meetings was that the group would attempt to reach unanimous consensus on its recommendations. Unanimous consensus was defined as all members could support or could live with the recommendations. (The term “live with” meant that a member may have some reservations about a topic but they could accept the solution being part of the task force recommendations.) The ground rule also stated that if the recommendations were not unanimous, the differences of opinion would be noted.

There is unanimous consensus on the major solutions of enhanced enforcement, removal of uncertified devices, and getting reductions from vehicles, industry, and ships. For the detailed components of those solutions, there was also unanimous consensus with one exception. The majority of task force members supported the recommendation that a system of registration be created for all wood stove and insert owners in the nonattainment area. However, three members did not support that recommendation. They did not support the registration system for the following reasons:

- Only a small portion of wood burners may respond to a voluntary program, raising questions about whether the effort is worth the cost to implement such a program.
- A registration program may create resentment (particularly among responsible wood burners) that could hinder efforts to reduce wood smoke pollution. It may be seen as government being too intrusive.
- Residents may have difficulty knowing if their stoves are certified or uncertified.
- A registration program could be confused as needing permission to use a wood burning device.
- Residents may misinterpret a registration program as providing approval for use of their device, even if it is an uncertified wood stove (i.e., once the device is registered they may feel they have the authority to use it).
- A registration program could start as voluntary and informational, but could be used over time in a more regulatory/punitive fashion.
- Registration will not result in fewer uncertified stoves and could result in impression of a new government program that would foster less self-sufficiency.

The task force discussed several ways of including fireplaces in the major solutions but did not come to consensus, other than to include fireplaces in the education about clean burning practices. Information presented to the task force included the facts that fireplaces are estimated to be 34 percent of the wood burning devices in use in the nonattainment area (see Table 1) and produce 21 percent of the wood smoke fine particle pollution. Based on this information, some task force members felt that fireplaces should be included in the major solutions.

On the other hand, the task force also learned that masonry fireplaces are exempted from Washington emission standards, although manufactured fireplaces must meet a state fireplace standard.²⁵ All

fireplaces are required to be shut down during Stage 1 and Stage 2 burn bans, so enhanced enforcement will address fireplace use during burn bans. There is currently no cost effective safe technology to assist fireplaces in burning more cleanly, although some technologies show promise. Closing off or removing fireplaces would be a considerable expense for homeowners, and some task force members were concerned that such changes would reduce the value of the home. For these reasons, other task force members felt that fireplaces should *not* be included in the solutions.

There was consensus to include a provision about fireplaces in the contingency measures.

VI. Next Steps

With this report the task force is transmitting its recommendations to the Puget Sound Clean Air Agency. The Agency's board of directors will review the task force report as part of their process for making recommendations to the State Department of Ecology. In 2012, Ecology will consider the recommendations from the Clean Air Agency, conduct further analysis, and prepare a State Implementation Plan. That plan will be submitted to the federal Environmental Protection Agency by December 2012 for their review and approval. The EPA will review the state Plan to ensure that it complies with the requirements of the Clean Air Act. During Ecology's development of the SIP, there will be opportunities for public review and comment on the Plan.

Parallel with the development and approval of the SIP, the Clean Air Agency will be developing plans and implementing actions to improve air quality in the nonattainment area. The SIP will include the timeline for the implementation of the rules.

Any local rules or state laws required to implement the solutions need to be in place before the SIP is submitted to EPA. Because of that, the Clean Air Agency will seek state legislation in 2012 to clarify its existing authority for implementing the recommended solutions.

Task force members expressed interest in being kept informed about implementation plans as they are developed, and future opportunities for public review and comment on these recommendations and on the state SIP.

Appendix A

Demographics of the Nonattainment Area

Clean Air Agency staff provided the task force with a demographic snapshot, based on census data. See the table below. With respect to population density, in general the Tacoma neighborhoods in the nonattainment area tend to have population densities in the range of 5,000 – 10,000 people per square mile. Much of the remainder of the nonattainment area has population densities in the range of 1,000 – 5,000 people per square mile.

Nonattainment Area Demographics

Category	Characteristic	Measurement
Population	Total population	533,000
Households	Total households	222,000
	Percent owner occupied households	58%
Race/Ethnicity (Note: percentages total more than 100% because Hispanic can be any race)	American Indian/Alaska Native	1%
	Asian	7%
	Black	9%
	Hispanic (any race)	10%
	White	69%
	Other race	6%
	Two or more races	8%
Language	Residents who report they do not speak English “very well” (for all of Pierce County)	12.7%
	Major languages for those who do not speak English “very well”	Korean, Khmer (Cambodian), Russian, Spanish, Vietnamese
Income	Median income	\$51,458
	Poverty rate in Pierce County	12.3%
	Nonattainment area households at 150 percent the federal poverty level	Approx. 25,000 (17%)

Sources: US Census Bureau, Census 2010 Block Group Data (2011); U.S. Census Bureau, 2005-10 American Community Survey by census tract (2010)^{10,11}

Appendix B

Ground Rules: Clean Air Task Force

Final 6/16/11

Principles that will guide our work:

- **Transparency** in creating a thorough and open process
- **Respect** for one another's perspectives
- **Commitment** to recommending the best solutions for Pierce County

1. The task force is encouraged to think creatively about potential solutions for the issues the group has been asked to address. Task force members will agree to keep an open mind to possible new ideas, and to consider the diverse interests of all Pierce County residents.
2. The task force is comprised of people with a variety of perspectives and interests. Differences of opinion are to be expected and will be respected by the task force and its members. Task force discussions will be characterized by careful deliberation and civility. Task force members will work to understand the different points of view and perspectives of other members. Questions to better understand each member's interests are encouraged.
3. The task force will operate by consensus. The goal will be to reach unanimous consensus – meaning that all members can support, or live with, the task force recommendations. If unanimous consensus cannot be reached, differences of opinion will be noted and included as part of the task force final recommendations.
4. The task force is advisory to the Puget Sound Clean Air Agency Board. The Agency has ultimate responsibility for making decisions about which actions to recommend to the State.
5. Task force members are strongly encouraged to participate in every meeting to achieve continuity in discussions from one meeting to the next. If members cannot attend a meeting, it is his/her responsibility to be informed about the topics discussed by the next meeting. An absent member may ask someone to attend a meeting on their behalf to listen to the discussion, but that person will not be able to participate in discussions or votes.
6. If a task force member cannot attend a meeting and wishes to make a statement regarding an issue that is on the agenda for that meeting, he or she may provide the facilitator with a written statement, which will be read to the full group when the issue is being considered at the meeting.
7. Meeting materials will be sent via email to task force members and posted on the Clean Air Agency project web site in advance, whenever possible. Any handouts at meetings will be emailed, or mailed, to members who were not present.
8. Meeting summaries will be prepared and distributed via email or mail to all task force members in a timely manner. If task force members have comments or concerns about the summaries, they are to notify the facilitator promptly. The facilitator will work with members to resolve those issues and make sure that the final summary reflects any revisions made. Once the task force members have had an

opportunity to review the draft summary and after any revisions are made, the summaries will be distributed to the task force and posted on the project web site.

9. Task Force members have a wide range of knowledge about air quality issues. Deliberations will need to strike a balance between creating a common base of knowledge and information and moving expeditiously to development of recommendations. It is the intent of the task force to use the limited meeting time efficiently. The facilitator may consider creation of task force sub committees to explore selected issues and report back to the full task force. Once consensus on an issue has been reached the issue will not be reopened for discussion until the full “package” of final recommendations can be reviewed and considered as a whole.
10. Any member may speak to the media or other groups or audiences regarding issues before the task force, provided s/he speaks only for her or himself. Inquiries from the media or others can be directed to the facilitator or project manager. Members are asked to let the process reach its conclusion before describing potential strategies or ideas as task force recommendations. Members agree to bring issues or concerns to the task force before raising them with others in a public fashion.
11. It is understood that task force members may need to consult with their organizations before making commitments on behalf of their respective organizations. However, each member will work hard to understand any issue or concern raised by their organization and will communicate those issues in a timely fashion to the full task force.
12. All meetings will be open to the public.
13. Meetings will start and end on time.
14. The task force does not plan to take formal public testimony. However, the task force will accept comments or questions from the public at the conclusion of meetings.
15. The facilitator will communicate with task force members between meetings to better understand issues and search for consensus on solutions.
16. Clean Air Agency staff will be responsive to the information requests from the task force. However, it may not be possible to meet all information requests. Please make information requests outside of the task force meetings to the Agency project manager or the facilitator.

Role of the Facilitator

In addition to the roles described above, the facilitator will:

- Work with the task force and Agency staff to set the agendas for meetings
- Work to resolve issues regarding process or schedule
- Open the meetings and manage the flow and timing of the topics on the agenda
- Make sure that all task force members have opportunities to participate in discussions
- Prepare draft recommendations based on task force discussions
- Occasionally make presentations, in partnership with task force members, to outside groups about the work of the task force, as requested

Appendix C Evaluation Tools

WORKSHEET FOR TASK FORCE MEMBERS' EVALUATION

Name: _____

How well does the solution meet each of the criteria below?

Rating scale: V (Very well), S (Somewhat/mixed), N (Not well)

Solution	Maintainability (V – S – N)	Cost Commensurate with Benefit (V – S – N)	Public and Political Acceptance (V – S – N)	Economic Well- Being of County (V – S – N)	Minimize Burden on Vulnerable Communities & Populations (V – S – N)	Minimize Unintended Consequences (V – S – N)

Definitions:

- *Maintainability* – Will improve air quality over time; addresses the underlying causes of poor air quality.
- *Cost commensurate with benefit*: The cost of the solution is commensurate with the air quality benefits that it will achieve.
- *Public and political acceptance*: There will be sufficient public and political support for the solution.
- *Economic well-being of County*: Will enhance the economic development potential for the county.
- *Minimize burden on vulnerable communities and populations*: Will minimize the economic burden on individuals and households.
- *Minimize unintended consequences*: Will minimize the likelihood of unintended consequences.

Example of completed evaluation form:

Clean Air Task Force Solution Evaluation Tool
(See appendix for details on ratings)

Filled Out by Task Force

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Key:

N = Does not meet criterion well

S = Meets criterion somewhat/mixed

V = Meets criterion very well

No clear consensus on how well it meets the criterion

Appendix D
Solutions Developed by Task Force:
Organized by Potential for Pollution Reduction
Ranked Brainstorming Potential Solutions
DRAFT, 9/7/11

Notes:

- Reductions potentials are preliminary.
- Solutions are categorized only by their potential to reduce fine particle pollution and are based on the technical model. Any hurdles that might impede timely implementation are not considered, for example funding availability
- There may be other air quality, public health, or other benefits, unintended consequences, or impact on other community values not accounted for here.

Major Reduction Potential (See assumptions at end of table)

Identifier	Solution	Initial Estimates of Reductions
A	<p>Required removal of uncertified stoves and replace with non-wood burning device (gas, oil, electric), weatherization, and registration program:</p> <p>Create mandatory registration program for wood burning devices (with fee based on efficiency, more efficient lower fee). Require weatherization, uncertified stoves to be removed by a certain date and, if a replacement is necessary, replace with natural gas. Include assistance for low income. Weatherization with sliding scale and high incentives for low income so it is fully paid for; higher fees for people who chose not to do changeout. For rentals, fee goes to owner, not tenant.</p>	Total reduction of 1.6 ug by end of 2014, 5.9 ug by end of 2019
B	<p>Require changeout of uncertified stove and allow replacement with certified stove, weatherization and registration program:</p> <p>Create mandatory registration program for all wood heating devices (fee based on efficiency, more efficient lower fee). Registration requires changeout of uncertified devices and</p>	Total reduction of 0.7 ug by end of 2014, 2.4 by end of 2019

	weatherization of houses by a certain date. Include assistance for low income.	
C	Require removal or changeout of uncertified stoves at time of sale: Adopt a program requiring removal, decommissioning or changeout of uncertified stoves when homes are sold	Total reduction of 0.7 ug by end of 2014, 2.2 ug by end of 2019
D	Increase enforcement capacity: Increase number of enforcement personnel to enforce burn bans (consider contracting out for private enforcement personnel).	Total reduction of 0.5 ug by end of 2014, 2 ug by end of 2019

Assumptions:

Removal and changeout solutions (A, B, and C):

50% of people do the removal or changeout by end of 2019

2,000 households per year

Start Jan 2013

Assumed 1/3 of the 2,000 per year needed weatherization creating a 5% reduction in heating requirements

Time of Sale Solution (C)

Would require legislation and so could not start until 2013

3 - 5% of houses are sold each year (low - high)

The fraction of uncertified devices in houses that are sold is the same as in all houses

Some houses will be resold, but will not be double counted

Assume 75% compliance

So, each year 2.2 - 3.7% of devices are removed (the number removed decreases each year)

Enhanced Enforcement Solutions (D)

4 Notices of Violation per Day per Field Team

No change of behavior based on Word of Mouth

No Outreach in Scenario

90% of burners that receive a notice of violation never violate a burn ban again.

10 Burn Ban Days per Year

2 Workers per Team (30 Total Teams)

Enforcement on Weekends, Weekdays, and Holidays

Supplemental Solutions for Major Solutions A, B, & C – Registration Program and Weatherization with Removal or Changeout of Uncertified Stoves, Remove or Changeout Uncertified Stoves or Fireplaces at Time of Sale of Home

Identifier	Solution	Key Information
A/B/C 1	Use incentives as a motivation to change out high emission wood burning appliances (fireplace, old technology wood stove) anytime to EPA certified /WA State approved stove, pellet stove, or natural gas/propane/electricity. Incentives could include tax incentives, cash, grants to pay some/all of costs, low interest loans.	<ul style="list-style-type: none"> Provides funding options Based on the response to previous voluntary changeout and removal programs, it does not attract enough people to have a significant reduction.
A/B/C 2	Have utilities pay for gas line extensions.	<ul style="list-style-type: none"> Provides more options for changeouts and removals Less expensive to operate than electric baseboard or oil
A/B/C 3	Explore how residents can pay the utility over time for extensions	<ul style="list-style-type: none"> This is already an option with PSE
A/B/C 4	Create a bank where pollution sources pay in and the funds are used where and as needed for sources that will make a difference (similar to offsite mitigation)	<ul style="list-style-type: none"> Likely to be small amount of money so will not make a large reduction Provides funding options for removing or changing out stoves
A/B/C 5	Allow utility rate payers to opt in (volunteer) to pay for change outs (like PSE's Warm Home Fund)	<ul style="list-style-type: none"> Likely to be small amount of money so will not make a large reduction Provides funding options for removing or changing out stoves
A/B/C 6	Offer a coupon for changeouts or removals at point of sale	<ul style="list-style-type: none"> Provides incentive
A/B/C 7	Either remove or "board up" fireplaces at time of sale or require gas/propane log retrofit, certified insert, or pellet insert.	<ul style="list-style-type: none"> Total reduction of 0.3 ug by end of 2014, 1 ug by end of 2019 Could supplement removal or changeout of uncertified stoves and inserts at time of sale

Supplemental Solutions for Major Solution D – Burn Ban Enforcement Related

Identifier	Solution	Key Information
D 1	Require registration of wood heat systems that are the only adequate source of heat prior to enforcement	<p>Registration by itself does not provide reductions, but can increase burn ban compliance if:</p> <ul style="list-style-type: none"> Used to Identify homes with only adequate source of heat Used to identify which homes have certified and which have uncertified

Identifier	Solution	Key Information
		<p>devices</p> <ul style="list-style-type: none"> Combined with enhanced enforcement and other burn ban enforcement supplemental solutions
D 2	Registration at times of purchasing new stove or change out	<p>Registration by itself does not provide reductions, but can increase burn ban compliance if:</p> <ul style="list-style-type: none"> Used to Identify homes with only adequate source of heat Used to identify which homes have certified and which have uncertified devices Combined with enhanced enforcement and other burn ban enforcement supplemental solutions
D 3	Take advantage of point of sale of homes for registration requirements	<p>Registration by itself does not provide reductions, but can increase burn ban compliance if:</p> <ul style="list-style-type: none"> Used to Identify homes with only adequate source of heat Used to identify which homes have certified and which have uncertified devices Combined with enhanced enforcement and other burn ban enforcement supplemental solutions
D 4	Change current burn ban program to a single stage burn ban equivalent to Stage 2.	Total reduction negligible with current burn ban compliance, but if combined with enhanced enforcement and other burn ban enforcement supplemental solutions makes it more effective.
D 5	Make standards during non-attainment clear and understandable – i.e., no visible smoke	Total reduction negligible with current burn ban compliance, but if combined with enhanced enforcement and other burn ban enforcement supplemental solutions makes it more effective.
D 6	Ban on wood heat as only adequate source of heat for all households, existing and new; tied to financial assistance for other energy costs and change outs/ Wood burning devices should not be only adequate source of heat in non-attainment area.	<ul style="list-style-type: none"> Total maximum reduction about 0.5 ug Would eliminate exemption in burn bans, allowing better enforcement and compliance If combined with enhanced enforcement and other burn ban enforcement supplemental solutions makes it more effective.
D 7	Improve enforcement of burn bans using infrared viewer/camera for night-	<ul style="list-style-type: none"> Total reduction negligible with current burn ban compliance

Identifier	Solution	Key Information
	time enforcement	<ul style="list-style-type: none"> Allows enforcement at times when fine particle pollution is highest If combined with enhanced enforcement and other burn ban enforcement supplemental solutions makes it more effective. Cannot distinguish what type of device is creating the heat – could be something other than a wood burning device
D 8	Reduce “rates” for other sources of heat during non-attainment periods (assumed to mean during burn bans)	Total reduction negligible with current burn ban compliance, but if combined with enhanced enforcement and other burn ban enforcement supplemental solutions makes it more effective.

Supplemental Solutions Applicable to All Major Solutions – Wood Moisture Related

Identifier	Solution	Key Information
All 1	Use/distribute/educate on moisture content devices to wood burners (requirement?).	<ul style="list-style-type: none"> Reductions due to optimum wood moisture are not quantifiable. However, general consensus is that wood in the 15 – 25% range burns more cleanly than wood with either higher or lower wood moisture. Help reduce fine particle pollution at times outside burn bans
All 2	Central wood seasoning station or swap program – provide people with efficient fuel.	<ul style="list-style-type: none"> Reductions due to optimum wood moisture are not quantifiable. However, general consensus is that wood in the 15 – 25% range burns more cleanly than wood with either higher or lower wood moisture. Help reduce fine particle pollution at times outside burn bans
All 3	Voucher for dry firewood, based on renter’s income not landlord.	<ul style="list-style-type: none"> Reductions due to optimum wood moisture are not quantifiable. However, general consensus is that wood in the 15 – 25% range burns more cleanly than wood with either higher or lower wood moisture. Help reduce fine particle pollution at times outside burn bans
All 4	License wood fuel sellers to create certified wood exchange.	<ul style="list-style-type: none"> Reductions due to optimum wood moisture are not quantifiable. However, general consensus is that

Identifier	Solution	Key Information
		<p>wood in the 15 – 25% range burns more cleanly than wood with either higher or lower wood moisture.</p> <ul style="list-style-type: none"> • Help reduce fine particle pollution at times outside burn bans
All 5	Provide free moisture checks for cordwood fuel.	<ul style="list-style-type: none"> • Reductions due to optimum wood moisture are not quantifiable. However, general consensus is that wood in the 15 – 25% range burns more cleanly than wood with either higher or lower wood moisture. • Help reduce fine particle pollution at times outside burn bans
All 6	Create home fuel storage requirements.	<ul style="list-style-type: none"> • Reductions due to optimum wood moisture are not quantifiable. However, general consensus is that wood in the 15 – 25% range burns more cleanly than wood with either higher or lower wood moisture. • Help reduce fine particle pollution at times outside burn bans
All 7	Prohibit sale or use of cordwood fuel with 20%+ moisture content using Department of Ecology approved moisture meter.	<ul style="list-style-type: none"> • Reductions due to optimum wood moisture are not quantifiable. However, general consensus is that wood in the 15 – 25% range burns more cleanly than wood with either higher or lower wood moisture. • Help reduce fine particle pollution at times outside burn bans

Low Reduction Potential

Identifier	Solution	Key Information
L 1	Explore filtering technology for wood stoves to determine if it is effective and affordable	<ul style="list-style-type: none"> • Very limited applicability of existing filter technology to wood stoves • Other non-filter technologies like catalytic combustors, natural gas firestarters, and grates may reduce emissions • Not enforceable measure
L 2	Is there a way to change utility billing to become aware of energy use?	<ul style="list-style-type: none"> • PSE currently provides comparison of usage to the previous year for both electricity and gas. • May not reduce emissions if it encourages people with non-wood

		<p>sources of heat to switch over to wood to keep usage down.</p> <ul style="list-style-type: none"> • Not enforceable
L 3	Change Second Stage burn bans for non-attainment area. Call second stage burn ban when PM _{2.5} levels have reached 20 micrograms - down from 25 – current law	Would help if there was a large buildup of fine particles throughout a burn ban, but it generally goes down during the day and back up at night.
L 4	Impede burning of non-cordwood fuels.	<ul style="list-style-type: none"> • According to PSCAA survey, for Pierce County, on average, 92% of people burn only cordwood in their fireplaces, wood stoves and inserts. • Missing key information - how much non-cordwood is burned by the remaining 8% and emission factors for non-cordwood, but reduction is likely low. • Current law prohibits burning of anything besides seasoned cordwood.
L 5	Recycling incentive for non-cordwood wood waste so it does not get burned for heat.	<ul style="list-style-type: none"> • According to PSCAA survey, for Pierce County, on average, 92% of people burn only cordwood in their fireplaces, wood stoves and inserts. • Missing key information - how much non-cordwood is burned by the remaining 8% and emission factors for non-cordwood, but reduction is likely low. • Current law prohibits burning of anything besides seasoned cordwood.
L 6	Traffic signal synchronization	Less than 0.2 ug/m3 reduction
L 7	Improving traffic flow	Less than 0.2 ug/m3 reduction
L 8	Expand commute trip reduction program to “new” communities	Less than 0.2 ug/m3 reduction
L 9	Auto trade-out program for bikes and/or fuel efficient autos	Less than 0.2 ug/m3 reduction
L 10	Complete HOV lanes on I-5	Less than 0.2 ug/m3 reduction
L 11	Light rail extension from King County to Tacoma	Less than 0.2 ug/m3 reduction
L 12	Land use policies that make it easier for people to avoid use of vehicles	Less than 0.2 ug/m3 reduction
L 13	Planning denser communities – more bike lanes and sidewalks	Less than 0.2 ug/m3 reduction
L 14	Evaluate projects in I-5 Joint Base study to determine value to this issue	Less than 0.2 ug/m3 reduction

Public Education and Outreach (some of these could be part of an enforceable solution which may allow full credit)

1. Public education on vehicle idling similar to British Columbia signs
2. Target education of people with wood burning devices at times of burn ban
3. Promote programs that have multiple public benefits – i.e., safe routes to school
4. Educate fireplace burners
5. Find opportunities to collaborate with other agencies – i.e., health
6. Better targeting of educational outreach – i.e., have doctors share the message with families with asthma attack visits to hospitals
7. More use of social media to promote good practices and burn ban
8. Mothers against dirty air campaign
9. Education re: acceptable practices on idling
10. Add fun to the mix – competition for “clean cities”. Create incentives for winners – rewards like the winning city gets free electric car plugins, Best of Western WA.
11. Help people plan ahead for winter
12. Use more aggressive media campaign during burn ban periods
13. Take advantage of point of sale of homes for registration requirements, or education.
14. Explore list from previous brainstorming re: marketing/outreach

Appendix E

Assumptions Made in Solution Analysis

Appendix: Evaluation Tool Notes

Major Solution: Increase Enforcement Capability during Burn Bans

Solution Description: Increase number of enforcement personnel to carry out burn bans (consider contracting out for private enforcement personnel).

General Assumptions:

The main assumption of this scenario that results in pollution reduction is that a major percentage of people who receive a burn ban civil penalty never burn again during a ban. The scenario to make this idea quantifiable is to increase the number of inspectors from the current 12 to 75 (likely using a subcontractor).

1. This assumes calling 10 burn bans days per year in Pierce County. This was based on the calculated average number of days over 35 micrograms per cubic meter over the last 5 years.
2. 75 Field Workers (ramped up – year 1: 25 workers, year 2: 50 workers, year 3+: 75 workers).
3. 1 Worker per Field Team.
4. 7 Hours of Enforcement on weekends and weekdays during daylight hours (daytime enforcement only).
5. 1.25 Notices of Violation (NOV) per Hour per Worker – a rate estimated from compliance staff at PSCAA.
6. 80% Rate of NOV to Civil Penalty – a rate estimated from compliance staff at PSCAA of the percentage of NOVs that result in a civil penalty.
7. 0% Word of Mouth Percent to Neighbors about Civil Penalty – Unknown and took conservative assumption. No information is available on whether anyone tells their neighbors they got an NOV or paid a fine.
8. 25% Repeat Offender Percent – This means that 25% of the people who receive a civil penalty from PSCAA continue to burn during burn bans. This percentage is highlighted as it was increased after being presented this to the task force. Initially the assumption was 10%, but there was some consensus from the Clean Air Task Force that compliance with burn bans was worse and should be lowered. PSCAA's system is not set up to track if people are repeatedly receiving notices of violation, so there is a high level of uncertainty in this assumption.
9. 25% Percent Burners during the Day – This means 25% of the people who have a wood burning device and use it will be burning during the day. This is based on recent surveys of Pierce County and Puget Sound residents. This figure puts a maximum number of burners that could be burning during the day if none were complying with the burn ban.
10. 80% Percent of All Devices Burning During Burn Ban -- This means 80% of the people do NOT comply with the burn bans, and 20% do comply. This is based on surveys in the nonattainment area on burn

ban compliance. Additionally, it factors in people simply not burning (busy, on vacation, etc.). This assumption sets another upper bound on how many devices can be enforced and are burning during a burn ban.

11. The scenario assumes enforcement based on visible emissions alone, not smoke density (opacity) as is currently done.
12. There is an exemption for income-qualified households to burn during a burn ban.
13. Assumes some form of registration program to identify only adequate source of heat burners, income-qualified households, and certified devices.
14. Higher night enforcement presence.
15. Large burn ban advertising campaign (approximately \$200,000 or 50% of the county audience is reached more than 3 times via television, radio, and online ads). Conservatively estimated only 5% additional compliance from uninformed burners – high level of uncertainty on this estimate.
16. Assumes current two-stage burn ban program (no alterations to trigger levels, fines, etc).

Cost Assumptions:

1. Cost of Field Staff per year including all costs: \$560,000.
2. Cost of Legal/Administrative Staff per year including all costs: \$220,000.
3. Cost of training for all field staff per year: \$40,000.
4. Vehicle Costs for 10 burn ban days per year: \$30,000.
5. 1 Hour to Process 1 NOV – a rate estimated from compliance staff at PSCAA, includes administrative staff time, interaction with individuals, paperwork, etc.
6. Night Enforcement Devices (infrared cameras): \$90,000.
7. Civil penalties collected: \$530,000.
8. Burn Ban Advertising: \$200,000.

Agency Evaluation of Each Criterion with Rationale:

Reduction

By 2014: 1.4 micrograms per cubic meter (about 15% of the minimum reduction needed)

By 2019: 6.8 micrograms per cubic meter (about 75% of the minimum reduction needed)

Economic Feasibility

\$1.2M per microgram per cubic meter

Maintainable:

Somewhat/Mixed = Does not improve air quality over time significantly by 2014, but does with ramp up by 2019. It does not address some of the underlying causes (such as wood is still a source of heat and the potential is there if enforcement funding ended).

Implementation:

Somewhat/Mixed = May be hard to find 75 inspectors to work 0-2 weeks on-call each fall/winter. There is, however, a commitment to enforce burn bans as the program is already established through PSCAA and adequate authority already exists in Washington State law.

Unintended Consequences:

Somewhat/Mixed = May be public backlash that endangers the burn ban program, unexpected staff time burden processing notices of violation, unexpected staff time and costs to run program, unexpected financial burden on the public.

Funding Availability:

Somewhat/Mixed = Funding could potentially be secured based on prior commitments from the legislature focusing on wood smoke. There is a lot unknown with the current budget, but funding may be plausible.

Technically Feasible/Sound:

Somewhat/Mixed = PSCAA has been enforcing burn bans in Washington for over 20 years. With increased enforcement that would curtail future burning, it is possible to estimate what the future emission reductions would be. However, night enforcement can be technically challenging. PSCAA is exploring current technologies to increase current capability.

Timing/Timely:

Very Well = Can implement before 2014 if a contractor could be lined up and trained for enforcement. A lot of knowledge and infrastructure is already established from PSCAA's experience.

Enforceable:

Very Well = Is already in Washington State law and would qualify with EPA's criteria as enforceable.

Major Solution: Date Certain Removal of Uncertified Devices

Solution Description:

1. Require uncertified stoves to be removed by a certain date.
2. Add measures to make program more equitable (e.g home weatherization with removal, incentives, subsidize for low income households an alternative source of heat for homes with no other heat source, etc).

Assumptions:

Assumptions that Effect Emissions:

1. Removal rate of 1,000 uncertified devices removed per year.
2. Expect actual compliance/disclosure rate of 33% (7,000 uncertified devices removed out of 22,000).
3. Assumes 50% of households that remove uncertified devices purchase their own certified device on their own money. This is based on PSCAA agency records of change-out programs where 50% chose a certified wood burning device when given the option to replace with another heat option, even when the incentive was smaller. Also includes 2% growth of certified devices each year with new construction.
4. Actual date certain is the end of August 2015, with first 1,000 removed before this date with incentives.
5. Assumes some form of registration of all wood stoves and inserts (not including fireplaces) to confirm removal of uncertified devices.

Assumptions that Effect Cost:

The following are just an example of potential programs that could be included based on if funds were available to implement all of these. If the compliance assumption is raised, the costs would similarly increase for most categories:

1. **Free removal for all uncertified devices.** Costs about \$4M over the life of the program.
2. **Free weatherizing to all income qualified households** as this scenario potentially removes a cheaper source of heat and makes household more reliant on utility. 12% of Pierce County is below the poverty level (2005-2009 data). Used 150% of the poverty level or 18%. Weatherization assumptions from PSE's 2010 Integrated Resource Plan. Includes percentage of single family residence estimates where weatherization is possible. Also includes cost estimates for each type (weather stripping, floor, wall, and attic insulation). Costs about \$4M over the life of the program.
3. **If only adequate source of heat, program will provide subsidy to purchase and install a new sources of heat.** About 300 devices will be replaced by other non-wood heating sources for low income residents (0.20% to 28.3% of wood device owners could be primary burners based on wood stove change-out data). Conservatively, used ratio of uncertified devices to get total from primary burners (34%). Costs of replacement devices from experience with

PSCAA's change out programs (\$2500 for certified stove, \$6500 for natural gas stove/insert, \$4500 for heat pump, \$9500 for whole house heat pump, \$4500 for propane). Costs about \$2.5M over life of program.

4. **\$500 reward if uncertified device is removed within the first year** (up to 3,000 devices). Costs no more than \$1.5M over life of program.
5. **Registration program.** Staff costs for maintaining program conservatively estimated at \$200K/yr.
6. **Expanded outreach** to ensure that the message gets out to all communities and ample efforts are made to communicate to low income and other groups regarding heat/weatherization/etc. Assumes 5% of program costs (\$280K).

Agency Evaluation of Each Criterion with Rationale:

Reduction

By 2014: 0.7 micrograms per cubic meter (less than 10% of the minimum reduction needed).
By 2019: 2.5 micrograms per cubic meter (about 25% of the minimum reduction needed).

Economic Feasibility

\$5.4M per microgram per cubic meter if all the programs above were implemented.

Maintainable:

Very Well = Will improve air quality (2.3 micrograms per cubic meter by 2014), does address some underlying causes.

Implementation:

Somewhat/Mixed = May be difficult to enforce required removals, but expected compliance set low in model. May be implementable with enough incentives. No current commitment or authority to do so.

Unintended Consequences:

Not Well = May be public backlash that endangers the burn ban program, unexpectedly low level of compliance, unexpected staff time burden processing notices of violation, unexpected staff time and costs to run program, unexpected financial burden on the public.

Funding Availability:

Somewhat/Mixed = All funding would not likely be secured by 2014, possibly beyond. This criterion is highly dependent on which program options are chosen and how it drives the costs.

Technically Feasible/Sound:

Very Well = Emission reductions would be easily measured.

Timing/Timely:

Very Well = Good reductions by 2014 and 2019.

Enforceable:

Very Well = Qualifies as an enforceable measure in EPA criteria.

Appendix F

Health Effects Studies

Puget Sound Clean Air Agency

Fine particle pollution: Information from Health Studies

The following is an overview of the findings from health studies and reviews during the past decade about the health effects of breathing fine particulate matter.

What is fine particle pollution?

Fine particles (PM_{2.5}) are tiny particles of soot, and dust suspended in the air. These particles come primarily from combustion (burning) activities. Main sources include wood smoke (from burning of wood) and vehicle exhaust (from burning of fossil fuels). Some PM_{2.5} also comes from industry and other sources. PM_{2.5} is very small, with a diameter of 2.5 micrometers -- approximately 1/30th the diameter of a human hair. This very small size allows PM_{2.5} to travel deeply into the lungs, even into the bloodstream.

How can fine particle pollution affect health?

Exposure to fine particles can affect both the lungs and the heart. This exposure has been linked to increased hospital admissions and emergency room visits, and to death from heart or lung diseases. Studies have found that even short-term exposures can cause health problems, especially in infants and young children, elderly people, and in people who have heart or lung or diseases, chronic obstructive pulmonary disease (COPD), asthma, or high blood pressure.

- ❖ **Respiratory (lung) health effects:** Many studies have linked fine particles to health problems affecting the lungs and respiratory system. The main respiratory effects include¹:
 - Inflammation of lungs and airways (also systemic and heart inflammation)
 - Reduced lung function (reduced lung capacity or more difficult breathing)
 - Asthma trigger (worsening of asthma symptoms)
 - Lung cancer (for long-term exposure to PM_{2.5}, especially fine particles from diesel engines²)
 - Increased risk of death from respiratory illnesses
- ❖ **Cardiovascular (heart) health effects:** Many health studies have stressed the association between fine particulate matter and cardiovascular health. The main cardiac health effects include:
 - Worsening of heart and vascular diseases, high blood pressure

¹ See EPA's Particulate Matter – Health web page (<http://www.epa.gov/airquality/particlepollution/health.html>).

² California Office of Environmental Health Hazard Assessment, Health Effects of Diesel Exhaust Fact Sheet, http://oehha.ca.gov/public_info/facts/dieselfacts.html.

- Altered cardiac function
 - Increased atherosclerosis (clogging of vessels)
 - Increased risk of illness and death from heart attack
 - Increased risk of illness and death from stroke
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A sampling of peer-reviewed health studies

Respiratory Health Effects:

- Fine particle pollution was linked to lung cancer and cardiopulmonary mortality in a large ongoing mortality study with about 500,000 participants. Pope, et al. Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution. *Journal of the American Medical Association*. 287, 1132-1141. March 6, 2002.
- A study of over 1,500 children in 12 southern California communities showed that exposures to elevated concentrations of fine particle pollution between the ages of 10 and 18 were associated with clinically and statistically significant reduction of lung function. Gauderman, et al. The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age. *The New England Journal of Medicine*. Volume 351:11, 1057 – 1067. September 9, 2004.
- A study of cystic fibrosis patients showed that exposures to elevated fine particle pollution levels were associated with reduced lung function and an increase in the odds of a patient having two or more exacerbations. Goss, et al. Effect of Ambient Air Pollution on Pulmonary Exacerbations and Lung Function in Cystic Fibrosis. *American Journal of Respiratory Critical Care Medicine*. Volume 169, 816-821. January 12, 2004.
- An Oakland, California cross-sectional study of more than 1,000 school children suggested an association between respiratory symptoms and traffic-related pollution. Kim, et al. Traffic-Related Air Pollution near Busy Roads. *American Journal of Respiratory and Critical Care Medicine*. Volume 170, 520-526. 2004.
- A Tacoma, Washington study showed an association between elevated fine particle pollution levels and asthma emergency room visits at six Tacoma hospitals. Asthma emergency room visits increased two to three days following elevated fine particle events. Data were collected from air quality monitors and hospitals from January 1998 to May 2002. Mar et al. Associations between asthma emergency visits and particulate matter sources, including diesel emissions from stationary generators in Tacoma, Washington. *Inhalation Toxicology*, 22(6): 445-448. 2010.

Cardiovascular Health Effects:

- A German study of 691 patients with cardiovascular disease showed a statistically significant association between transient exposure to traffic and the onset of a myocardial infarction within one hour afterward. Peters, et al. Exposure to Traffic and the Onset of Myocardial Infarction. *The New England Journal of Medicine*. Volume 351:17, 1721-1730. October 21, 2004.
- A Boston study of almost 500 older men enrolled in the Normative Aging Study showed associations between short-term exposures to fine particulate and ozone, and alterations in cardiac function (measured by heart rate variability). Park, et al. Effects of Air Pollution on Heart

Rate Variability: The VA Normative Aging Study. *Environmental Health Perspectives*. Volume 113:3, 304 – 309. March 2005. (<http://ehp.niehs.nih.gov/members/2004/7447/7447.pdf>).

- A Los Angeles study of 798 patients showed an increased carotid artery thickness with greater particulate matter concentrations. Thicker carotid arteries are considered a measure of atherosclerosis, considered a process/precursor of cardiovascular disease. Kunzli, et al. Ambient Air Pollution and Atherosclerosis in Los Angeles. *Environmental Health Perspectives*. Volume 113:2, 201-206. February 2005. (<http://ehp.niehs.nih.gov/members/2004/7523/7523.pdf>).
 - A 2007 study showed that PM_{2.5} concentrations are linked with increased risk of death from heart attack and stroke in postmenopausal women. The study of 66,000 postmenopausal women from the Women's Health Initiative (WHI) showed that, for every 10 ug/m³ increase in PM_{2.5} concentrations, the risk of dying from a stroke or heart attack went up 76%. Miller, et al. Long-term Exposure to Air Pollution and Incidence of Cardiovascular Events in Women. *The New England Journal of Medicine*. February 1, 2007 (www.nejm.org).
 - A study of six cities showed higher overall mortality rates in cities with the highest fine particle pollution when compared to cleaner cities. [Often referred to as the Harvard Study.] Dockery, et al. An Association Between Air Pollution and Mortality in Six US Cities. *New England Journal of Medicine*. 1993.
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Health reviews and studies

- In 2010 the American Heart Association updated its 2004 scientific statement “Particulate Matter Air Pollution and Cardiovascular Disease.” This statement provides a summary of studies and reached several new conclusions. These conclusions include that “exposure to PM_{2.5} over a few hours to weeks can trigger cardiovascular disease-related mortality and nonfatal events”; and that exposure over a few years can reduce life expectancy by several months to a few years. The report also finds that reduced particulate matter levels are associated with reductions in cardiovascular mortality within a time frame as short as a few years. Brook, et al. Particulate Matter Air Pollution and Cardiovascular Disease. An Update to the Scientific Statement from the American Heart Association. *Circulation, Journal of the American Heart Association*. May 10, 2010. (<http://circ.ahajournals.org>).
- EPA strengthened its daily PM_{2.5} standard in 2006 based on an extensive review that highlighted cardiac effects nationwide. (http://www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html).
- In October 2008, the California Air Resources Board adopted a concentration response of 10% increase in risk of premature death for every 10 micrograms per cubic meter increase in exposure to PM_{2.5}. Their analysis is based on a comprehensive review of epidemiological and toxicological studies. (http://www.arb.ca.gov/research/health/pm-mort/pm-mort_final.pdf).
- The Bay Area Air Quality Management District keeps an extensive list of toxicologic and epidemiologic studies that examine the association between health effects and wood smoke (a type of fine particle). (http://www.sparetheair.org/~media/STA/Files/1/Particulate%20Matter/woodburning_health_effects.ashx).

- California EPA comprehensively reviewed human and animal cancer and non-cancer studies to assess health risk from diesel particles (a type of fine particle). The California unit risk estimate for carcinogenicity is used in several studies (including local Puget Sound evaluation). A full risk assessment is included in Appendix B. *Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant*. California EPA, May 1998. (<http://www.arb.ca.gov/regact/diesltac/diesltac.htm>).
- *Health Effects of Wood Smoke* (1992, updated 1997) by the Washington State Department of Ecology offers a comprehensive look at the health risks associated with indoor wood burning. (<http://www.ecy.wa.gov/biblio/92046.html>).
- “The toxicology of inhaled wood smoke” reviews animal and human data over the last 30 years. Zelikoff, et al. *Journal of Toxicology and Environmental Health*, Part B, 101-114, 2002.

Why is it important to clean up the air?

A few recent studies show that improving air quality also results in a reduction of mortality rates:

- An eight-year follow-up of six cities showed that, as fine particle pollution levels decreased, total mortality risk also decreased. This study was a follow-up of the Harvard study, with 8,096 participants in cities with varying PM_{2.5} levels. Most mortality is attributed to cardiovascular and respiratory disease (not lung cancer). Laden, et al. Reduction in Fine Particulate Air Pollution and Mortality. *American Journal of Respiratory and Critical Care Medicine*. Volume 173, 667-672. March 2006.

See also the 2010 American Heart Association scientific statement about fine particles, summarized above.

Endnotes

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- ¹ International Agency for Research on Cancer (IARC) (2010). "Overall Evaluation of Carcinogenicity to Humans. Group 2A: Probably Carcinogenic to Humans."
- ² Washington State Department of Ecology, "Health Effects and Economic Impacts of Fine Particle Pollution in Washington," December 2009, Pub. No. 09-02-021.
- ³ US EPA, Federal Register, "PM_{2.5} and Ozone Clean Air Implementation Rule," Vol. 72, No. 79, April 25, 2007, p. 20585.
- ⁴ Values used in the figures are from EPA, which calculates using the method outlined in 40CFR50 Appendix N.
- ⁵ These values are a compilation of fine particle data from 2000-2010 at the Tacoma South L Street monitor. Federal Reference Method data were used when possible. Where data was missing, Federal Equivalent Method data were used. Next instrument of priority was the Tapered Element Oscillating Microbalance (TEOM) and lastly the nephelometer. Calculating the 98th percentile is found in 40CFR50, Appendix N.
- ⁶ Ogulei, David, Washington Dept of Ecology, 2010, Sources of Fine Particles in the Wapato Hills-Puyallup River Valley PM_{2.5} Nonattainment Area. Available at <http://www.ecy.wa.gov/pubs/1002009.pdf>.
- ⁷ National Research Center, Puget Sound Clean Air Agency Indoor Wood-Burning Emission Inventory Survey of King, Kitsap, Pierce and Snohomish Counties (2007).
- ⁸ Washington State Department of Ecology, "The State of Washington's Proposed Wapato Hills-Puyallup River Valley PM_{2.5} Nonattainment Area," February 22, 2008.
<http://www.ecy.wa.gov/programs/air/Nonattainment/ProposedWHPRVPM2.5NonattainmentArea.pdf>
- ⁹ Letter from the US EPA to Governor Gregoire of the State of Washington, dated August 18, 2008.
http://cleanairpiercecounty.org/7A_EPA_Approval_of_Nonattainment_Area_Boundary.pdf
- ¹⁰ U.S. Census Bureau, 2010 Census, Population Census Block Group Data, published 2011.
- ¹¹ U.S. Census Bureau, 2005-2009 American Community Survey, Census Block Group Data of Wood as a Primary Source of Heating Fuel, published 2010.
- ¹² Puget Sound Clean Air Agency records of self-identified primary and secondary heat sources from historical record of wood stove changeout program, 2007-2011.
- ¹³ Pierce County Tax Assessor, "2008 Pierce County parcel data," 2009.
- ¹⁴ US EPA, Federal Register, Vol. 53, p. 5873, February 26, 1988, "Subpart AAA-Standards of Performance for New Residential Wood Heaters," 40 CFR 60, subpart AAA.
- ¹⁵ Washington Administrative Code 173-433-100.
- ¹⁶ Revised Code of Washington Section [70-94-473](#) "Emission performance standards."
- ¹⁷ US EPA, Clean Air Act, [Title I, Part D – "Plan Requirements for Nonattainment Areas."](#)
- ¹⁸ Pierce County Assessor-Treasurer data: <http://www.co.pierce.wa.us/pc/abtus/ourorg/at/Reports.htm>; NWMLS data provided by Dennis Jones to PSCAA on October 3, 2011.
- ¹⁹ Based on written correspondence with Oregon Department of Environmental Quality (ODEQ).
- ²⁰ Revised Code of Washington 70-94-477.
- ²¹ Revised Code of Washington [70-120A-010](#).
- ²² Based on written correspondence with Puget Sound Regional Council.
- ²³ <http://www.epa.gov/otaq/fuels/dieselfuels/index.htm>
- ²⁴ <http://www.epa.gov/otaq/oceanvessels.htm#north-american>
- ²⁵ Washington Administrative Code 173-433-100