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Working together for clean air

A carrot and a nudge: large scale approaches to residential wood smoke in the Tacoma (former) PM nonattainment area

Phil Swartzendruber, Ph.D.

Clear the Air, Paths to Attainment
Sept 26-28, 2016
Fairbanks, AK

Ewe! Where is this coming from?

2006 revision of Daily PM2.5 standard brings area into nonattainment

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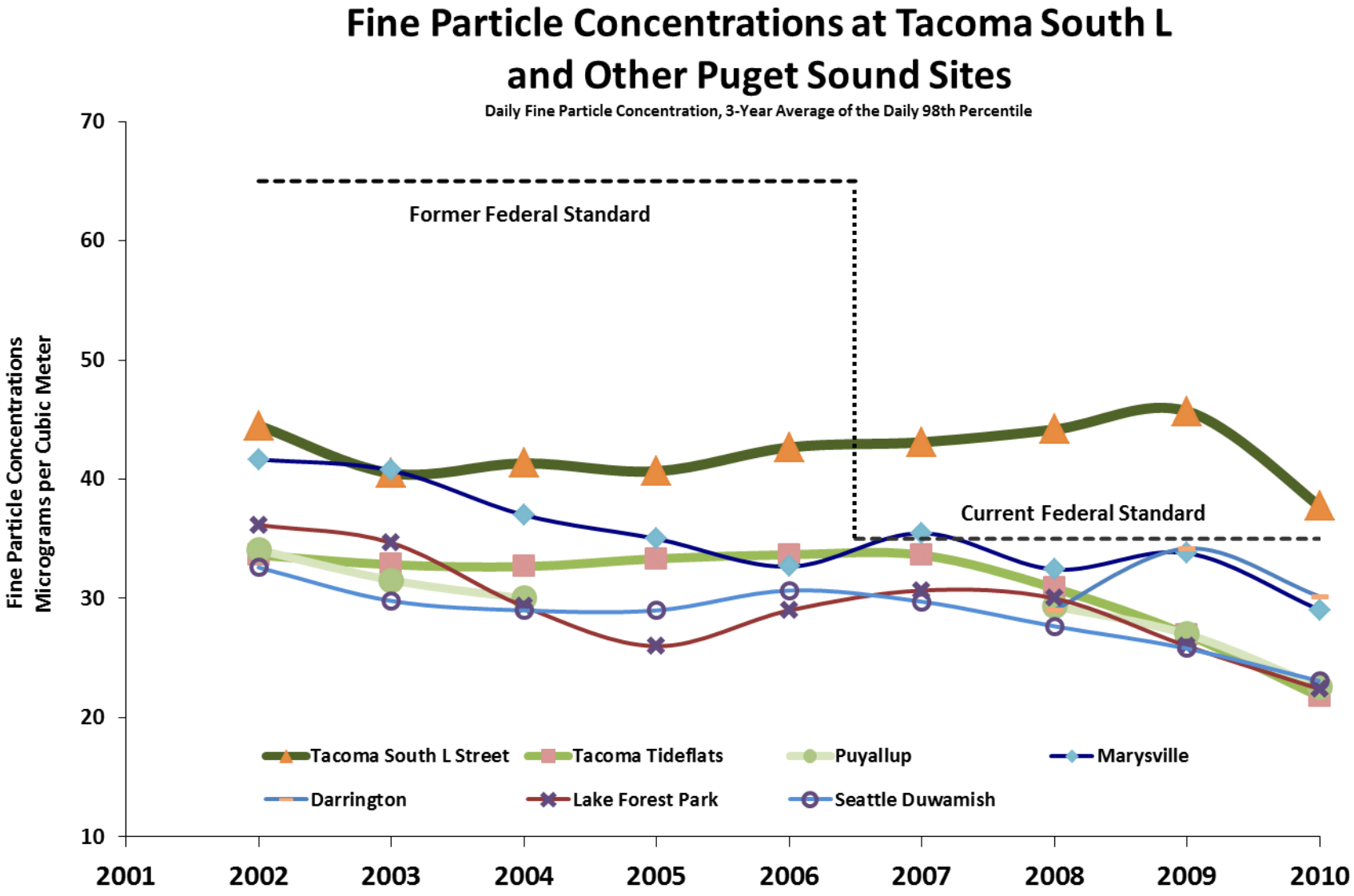

Designation occurs in 2009

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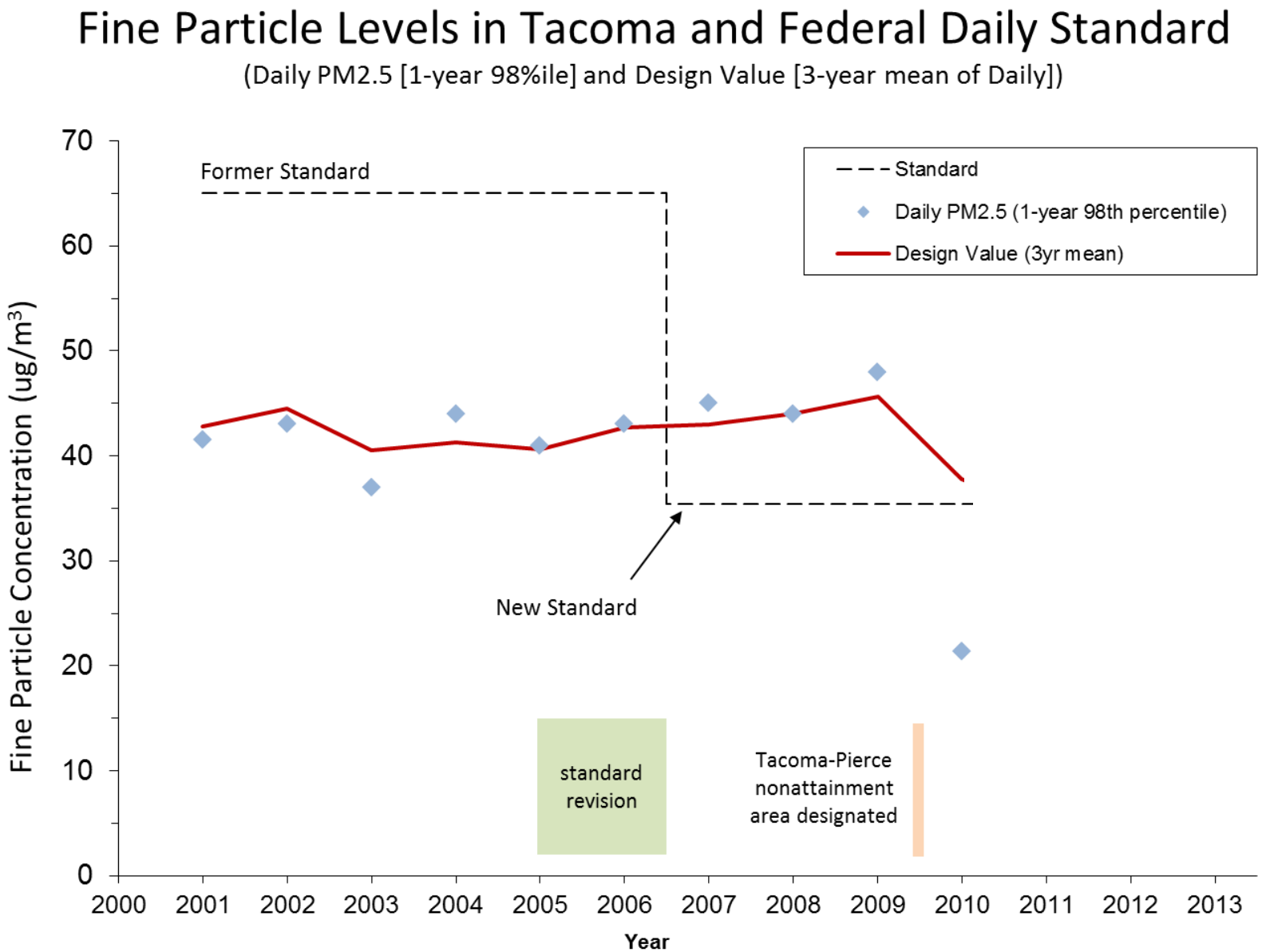

Where is the nonattainment (aka Smoke Reduction Zone) ?

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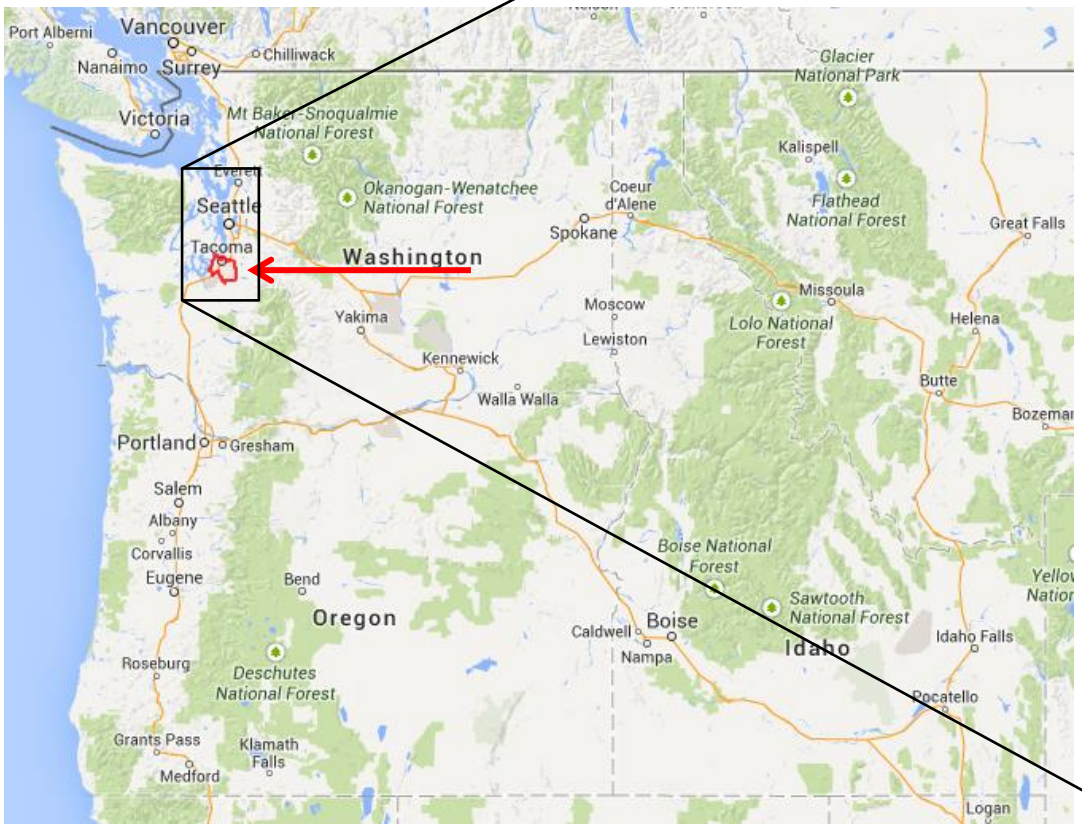

The Tacoma-Pierce County Non-Attainment Area

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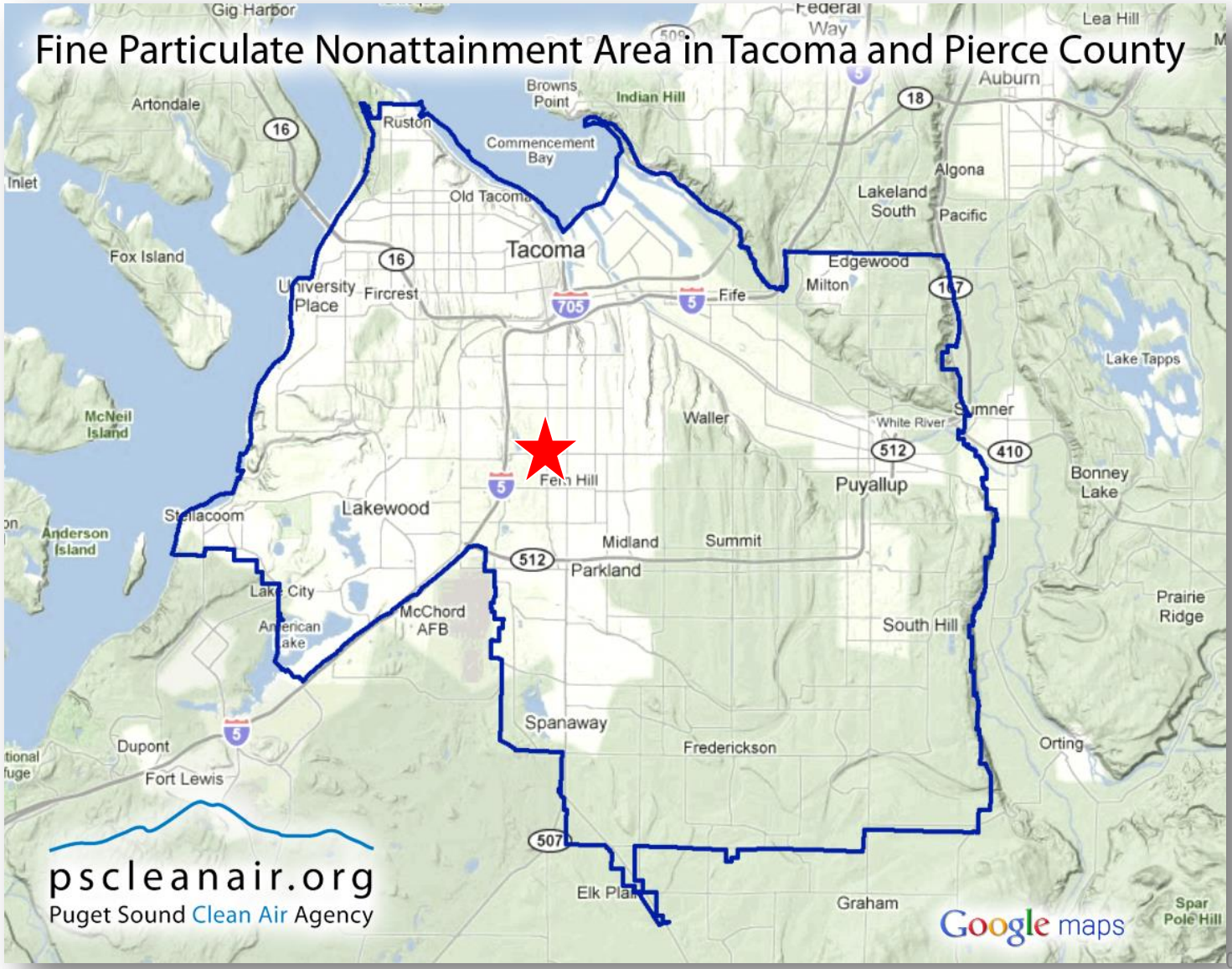

The solution: a collaboration

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- Clean Air Task Force (stakeholder group) with independent facilitator
- Puget Sound Clean Air Agency sponsored, with major help from WA State Department of Ecology
- open to public, accepted comments at every meeting
- met 12 times over 8 months

Clean Air Task Force

The solution: a collaboration

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Clean Air Task Force membership included representatives from:

- citizen wood burners
- business
- realtors
- Hearth/Stove retailors
- Respiratory health professional (UW)
- the Port of Tacoma
- Joint Base Lewis-McChord
- Electric and gas utilities
- regulators

Clean Air Task Force

The solution: a collaboration

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Clean Air Task Force discussion progressed through:

1. **Background science on air pollution, health, and Tacoma data**
2. **Relevant Regulations**
3. **Brainstorming solutions**
4. **Narrowing and revising solutions**
5. **Making final recommendations**

Clean Air Task Force

About the Nonattainment are (now, Smoke Reduction Zone)

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- About 200 square miles
- About 220,000 urban, suburban and rural households
  - Median income = $51,000
  - Poverty rate = 12%
  - ~25,000 households (17%) are at 150% of federal poverty level
- 10 cities and towns plus many unincorporated communities (most of the county's urban growth area)
- About 24,000 uncertified wood stoves (2007 inventory)
  - ~21,000 of those are being used
  - ~3,500 wood is "Primary" source of heat (Census, 2005-2009 ACS)
  - ~600 wood is sole source of heat (Assessor records)

Where, when, how, why ?????
Exceedances only occur in the winter…

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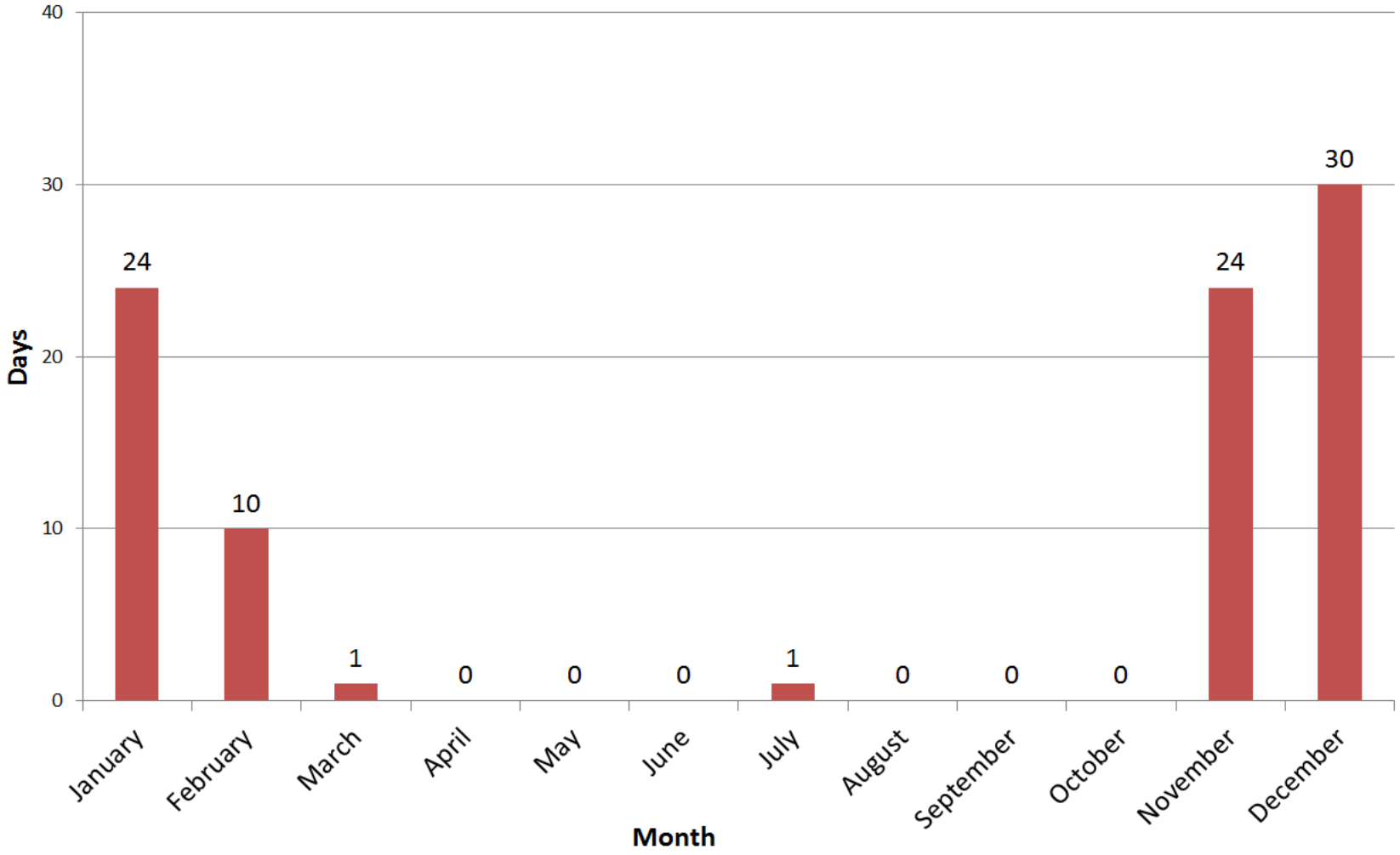
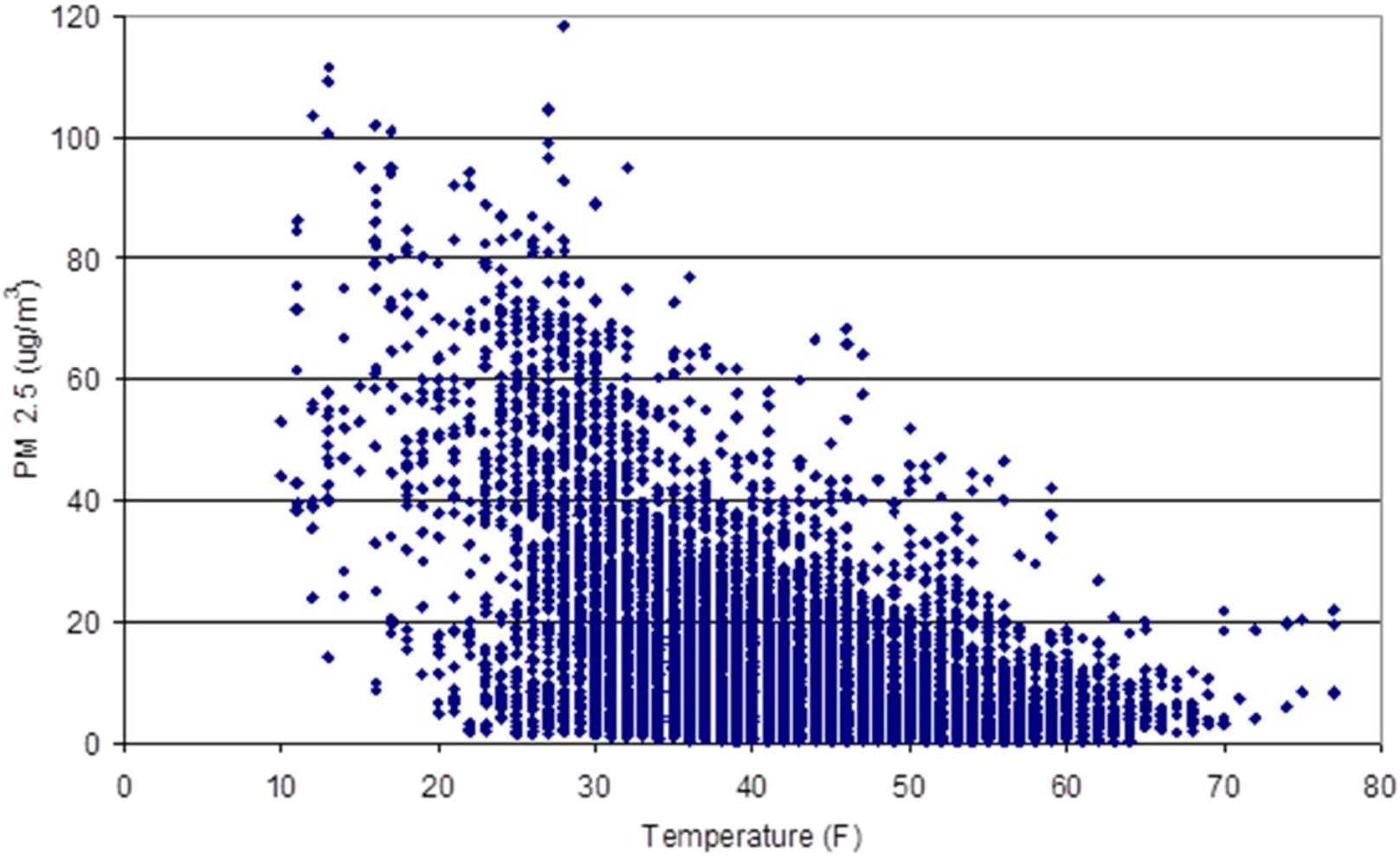
Number of days per month over the Federal Standard since 2002



Tacoma South L Street
Daily Federal Standard = 35 Micrograms per Cubic Meter

Temperature drops, PM2.5 goes up…

Tacoma South L, fall-winter hourly PM2.5



On worst winter nights, diurnal pattern matches burning habits…

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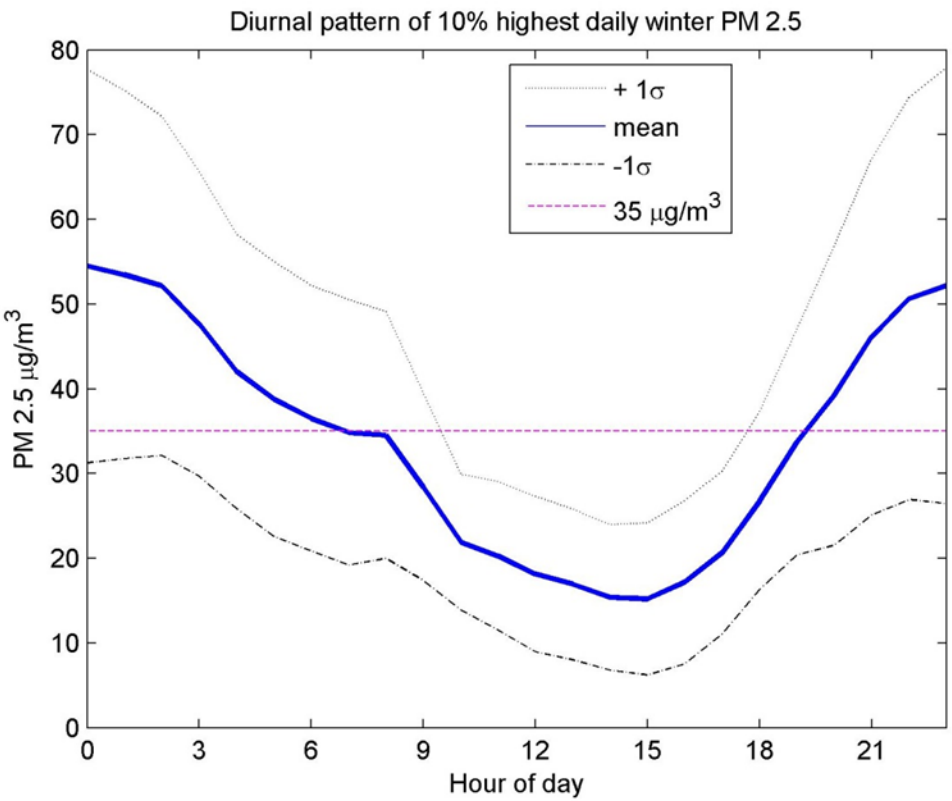
- diurnal pattern
- stagnation at ***night***
- rapid increase in evening when burning occurs
- dissipates after midnight
- venting during the day
- typically clear with high pressure ridge



Emissions Inventory highlights residential wood burning as largest PM2.5 source…

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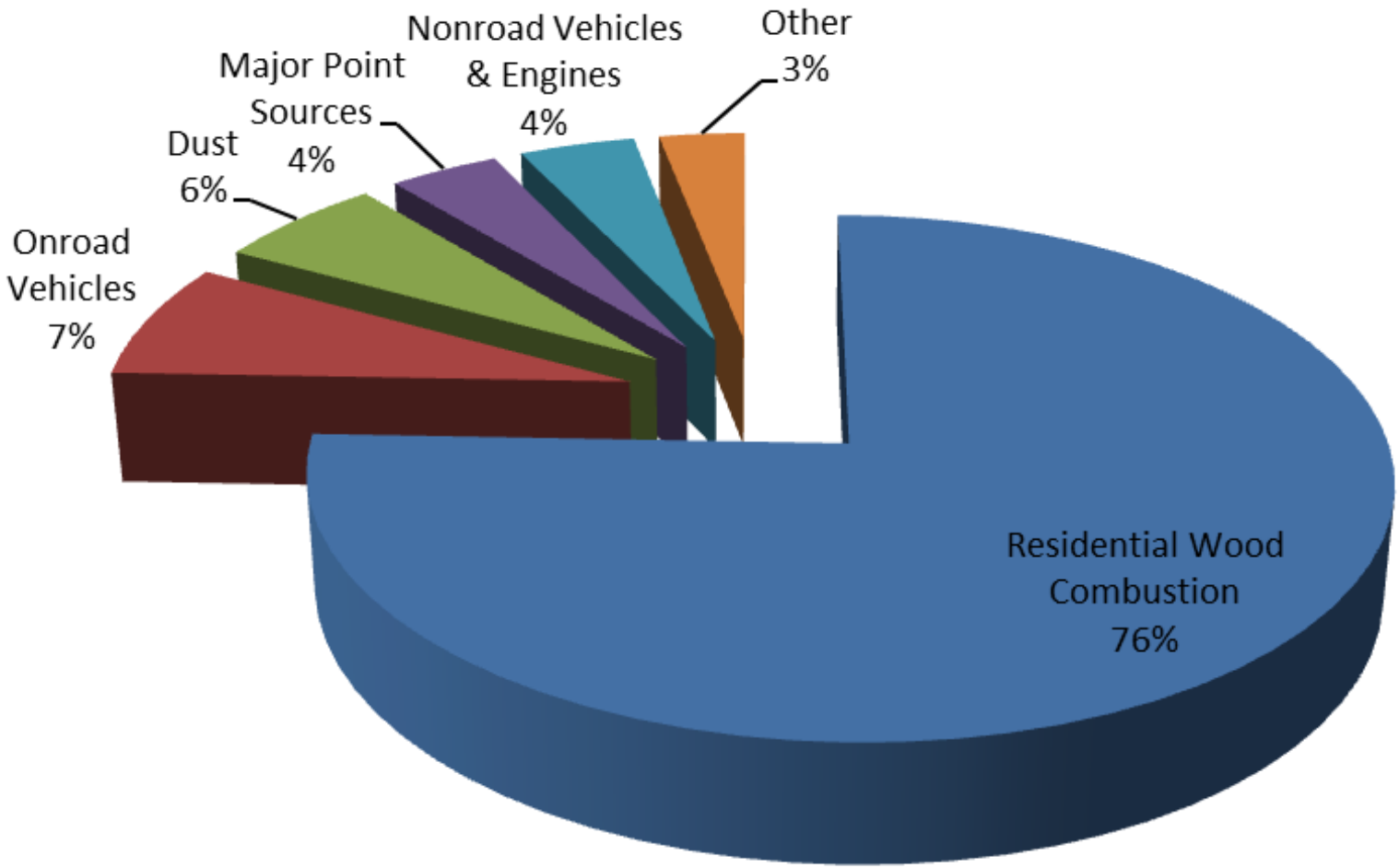

PMF (fingerprint) results of chemical composition analysis…

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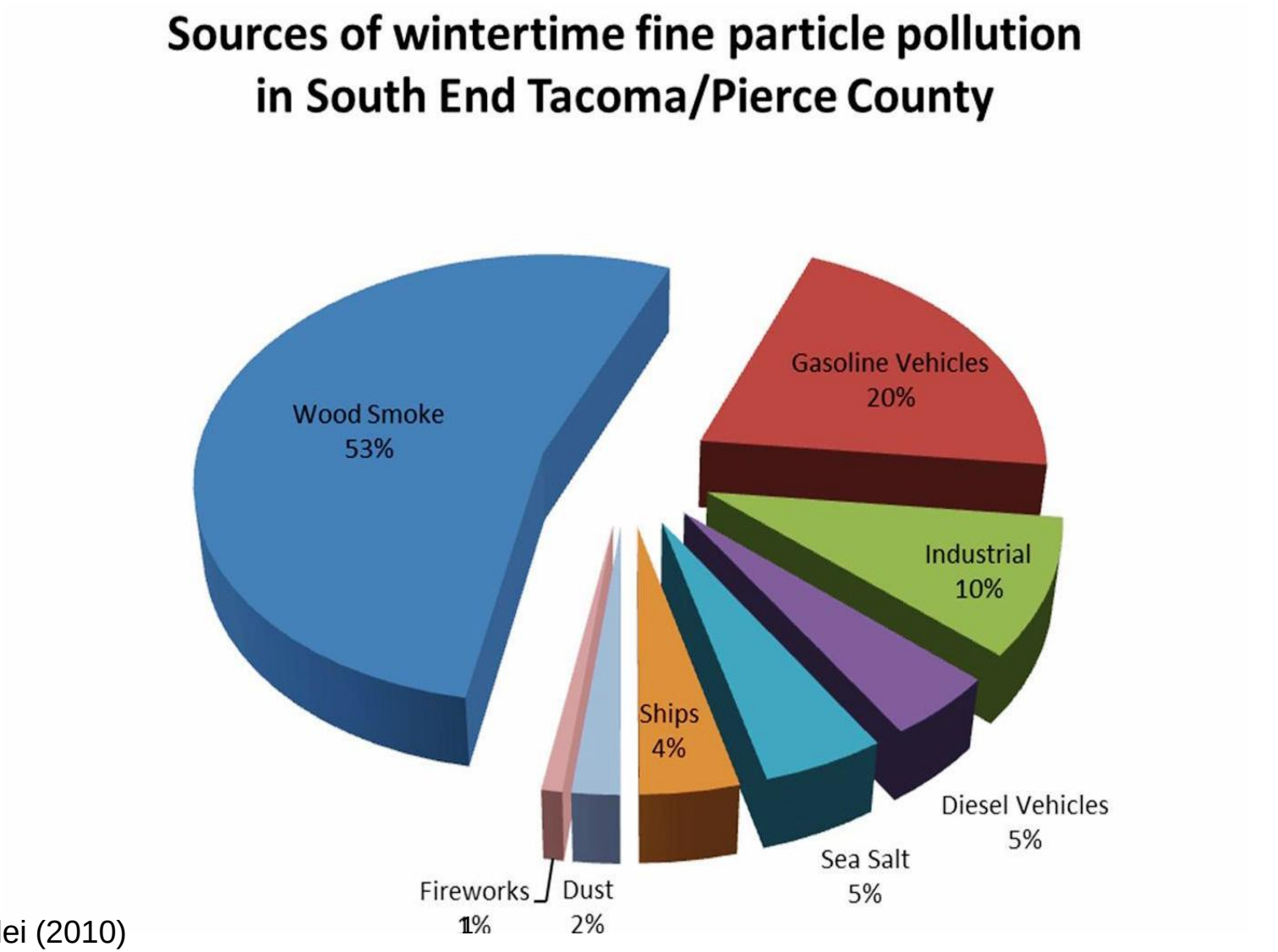

Ogulei (2010)

When highest? Normal ventilation – most days

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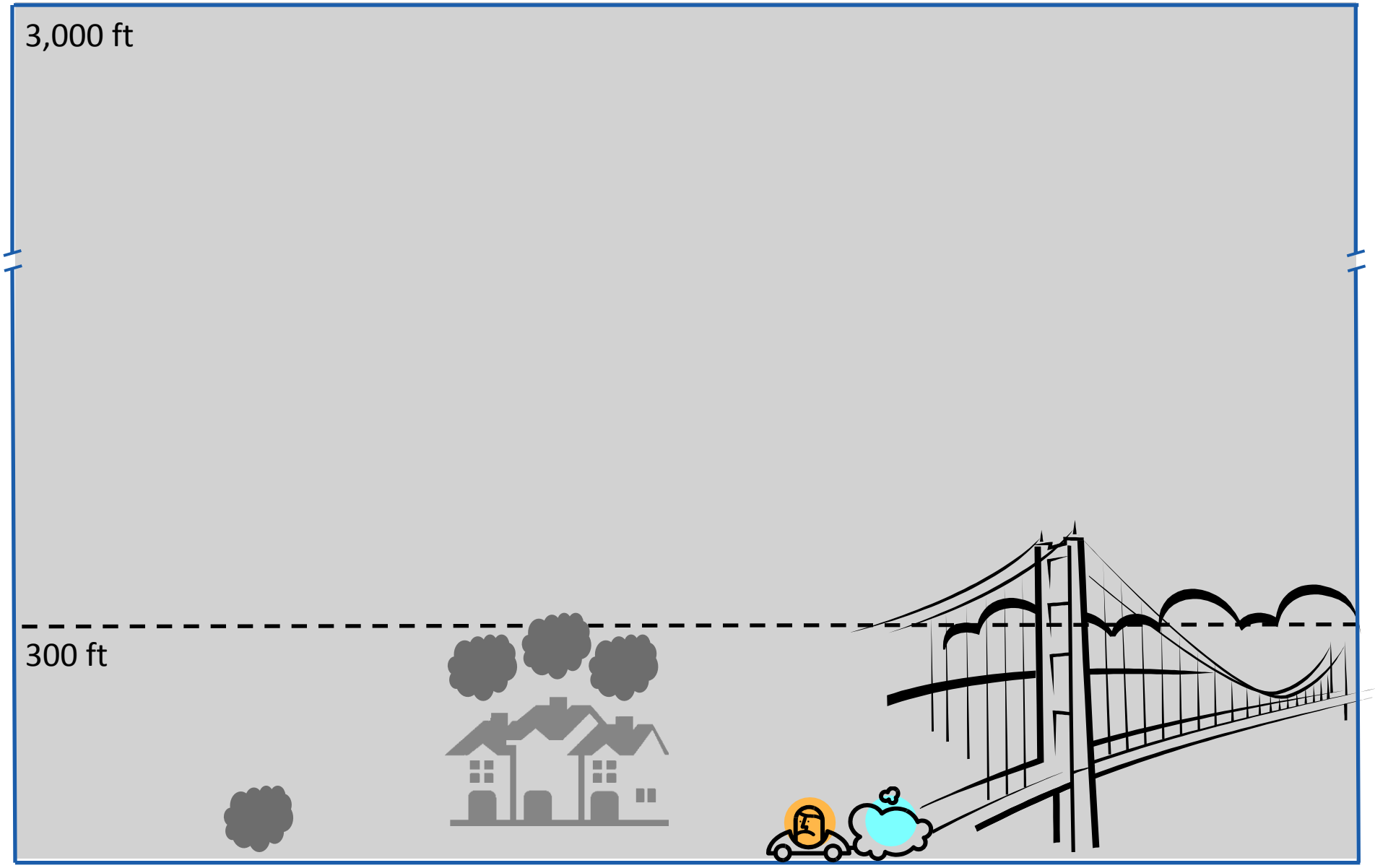

When highest? Ventilation during an inversion

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The solution: a collaboration

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Clean Air Task Force discussion progressed through:

1. Background science on air pollution, health, and Tacoma data
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Clean Air Task Force

Recommended Strategies :

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1. **Improve Efficacy of Burn Bans (but have exemptions)**

2. **Remove uncertified wood stoves (by 2015)**

3. **Continue and enhance changeout program with incentives**

Recommended Strategy #1

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- Improve Effectiveness of Burn Bans
  - Beef up enforcement: people and coverage
  - Lower the threshold for calling burn bans (triggers dropped from 35 to 30 ug/m3
  - Expand communication and outreach

Outreach Campaign

- New Burn Ban website
- Paid advertising
  - Print – Ads 2x weekly, major pubs
  - Digital – The News Tribune online
  - Outdoor – 5 at a time, 8-week/set
- Earned media
  - Print, TV, radio news, editorial
  - Government access
- Direct mail postcard
  - Targeted 80,000 pieces
- Community outreach
  - 60+ local presentations
  - 40 local publications
  - 28,000 flyers distributed locally
- Engaged partners
- Social media, text and email alerts

AVOID BURN BAN FINES.
GET FREE ALERTS
TEXT "PIERCEBURN" TO 202131
airsafepiercecounty.org
AIR

Enforcement Improvements

- Use staff of local gov. partners in on-call basis
- More patrols, was 2 or 3 teams, maxed at ~ 40 teams
- Lower thresholds for calling burn bans
- Patrol more hours at common burning times (nights and weekends)
- Developed nighttime capability (most burning is at night, day has inequality issue)
- Create “no other adequate source of heat” program (NOASH)

“No Other Adequate Source of Heat” exemption program

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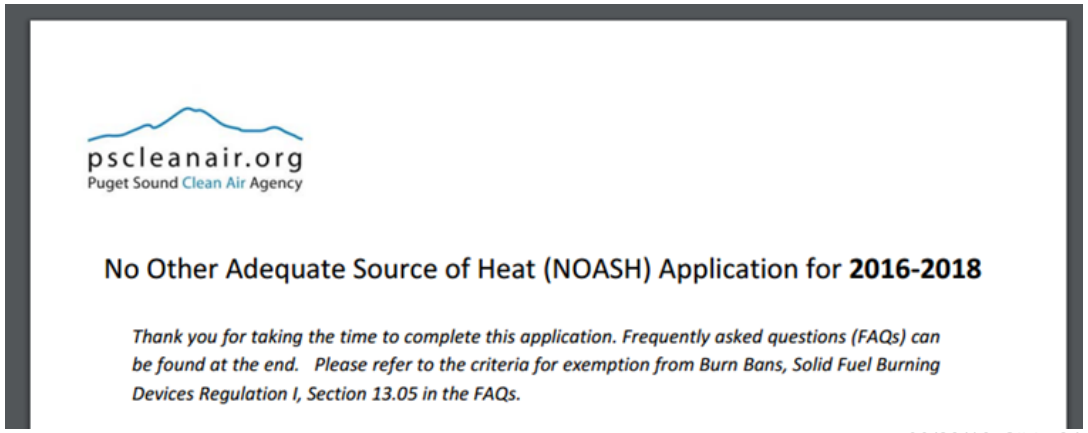
- Houses were designed with wood as primary heat
- Houses with heating systems too smallfor “adequate” warmth
- about 1-2% of all houses
- had to submit information about heating system and insulation
- compared to county records



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No Other Adequate Source of Heat (NOASH) Application for **2016-2018**

Thank you for taking the time to complete this application. Frequently asked questions (FAQs) can be found at the end. Please refer to the criteria for exemption from Burn Bans, Solid Fuel Burning Devices Regulation I, Section 13.05 in the FAQs.

How did we get 40 teams???

- "Rented" other local agency staff during burn bans
- Four cities and the county
- Developed agreements/contracts
- Required significant training on observations and documentation
- Paid them for their time

Results from 2012/13 and 2013/14 Winters

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- burn bans for ~30 days total
- ~2,700 potential violations documented with photographs (even after dark)
- ~1700 NOVs (Notice of Violations) issued
- ~1000 civil penalties issued

You might ask "How did you document smoke at night?"

Good question!

A: standard low-light photography:

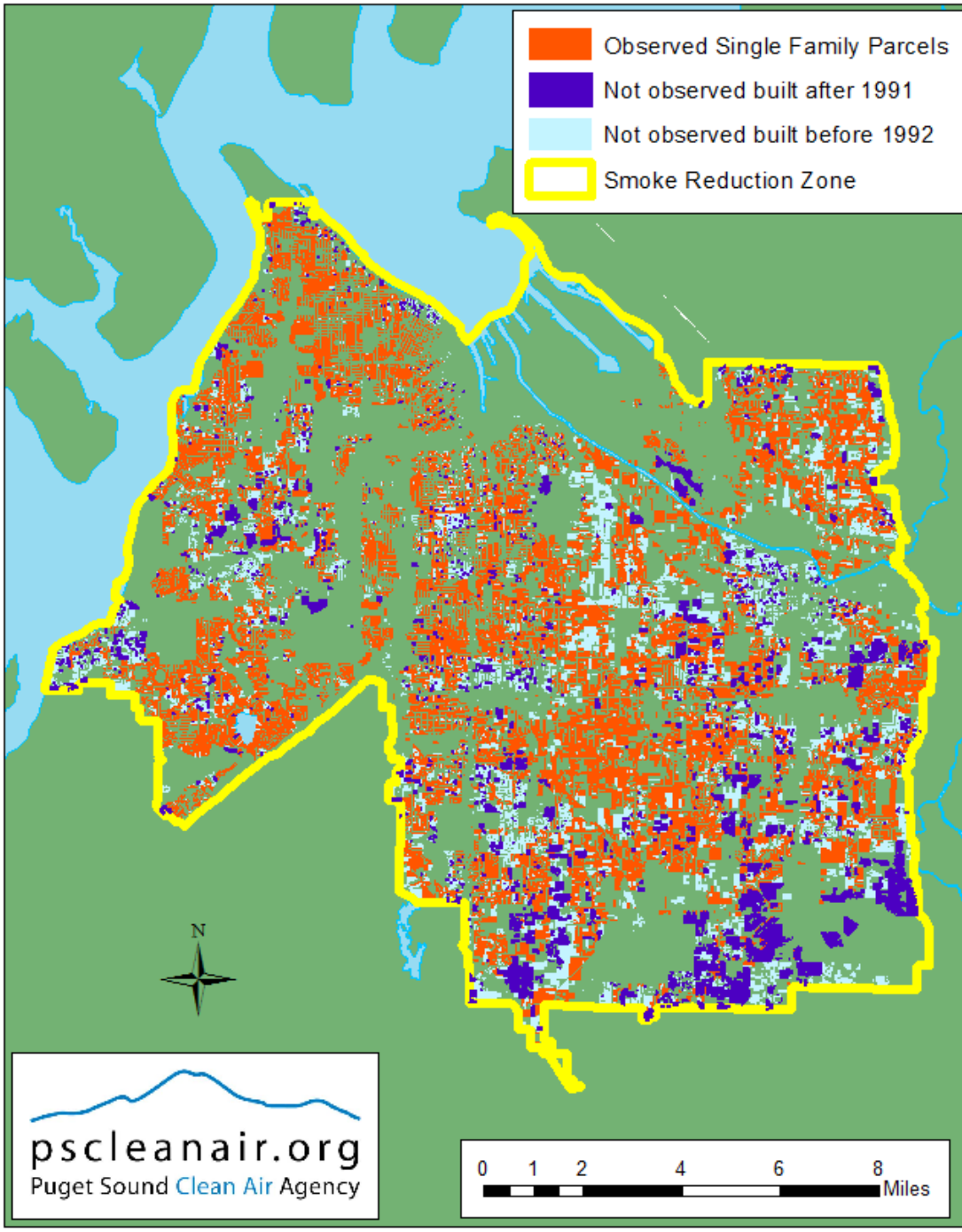
- high ISO
- "fast" lens (open aperture)
- long exposure ➡ tripod

Camera specs

- "off the shelf" Nikon D5100 DSLR with f/1.8 85mm lens
- is <u>only visible light</u>
- GPS tagger adds location to .jpg file
- ISO 3200 at f/6.3, typically 1-10 seconds exposure
- tripod or window-pod
- requires training and practice for those not familiar with DSLR
- biggest problem is correct focus (auto focus doesn't work)

2013/14 Enforcement Coverage

- Used GPS to track vehicles
- 130,000 single family parcels in SRZ
- 65,000 covered (~50%) at least once
- Better coverage in fewer patrol days
- Fewer re-citation in same burn ban



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Strategy #2: Removing uncertified stoves

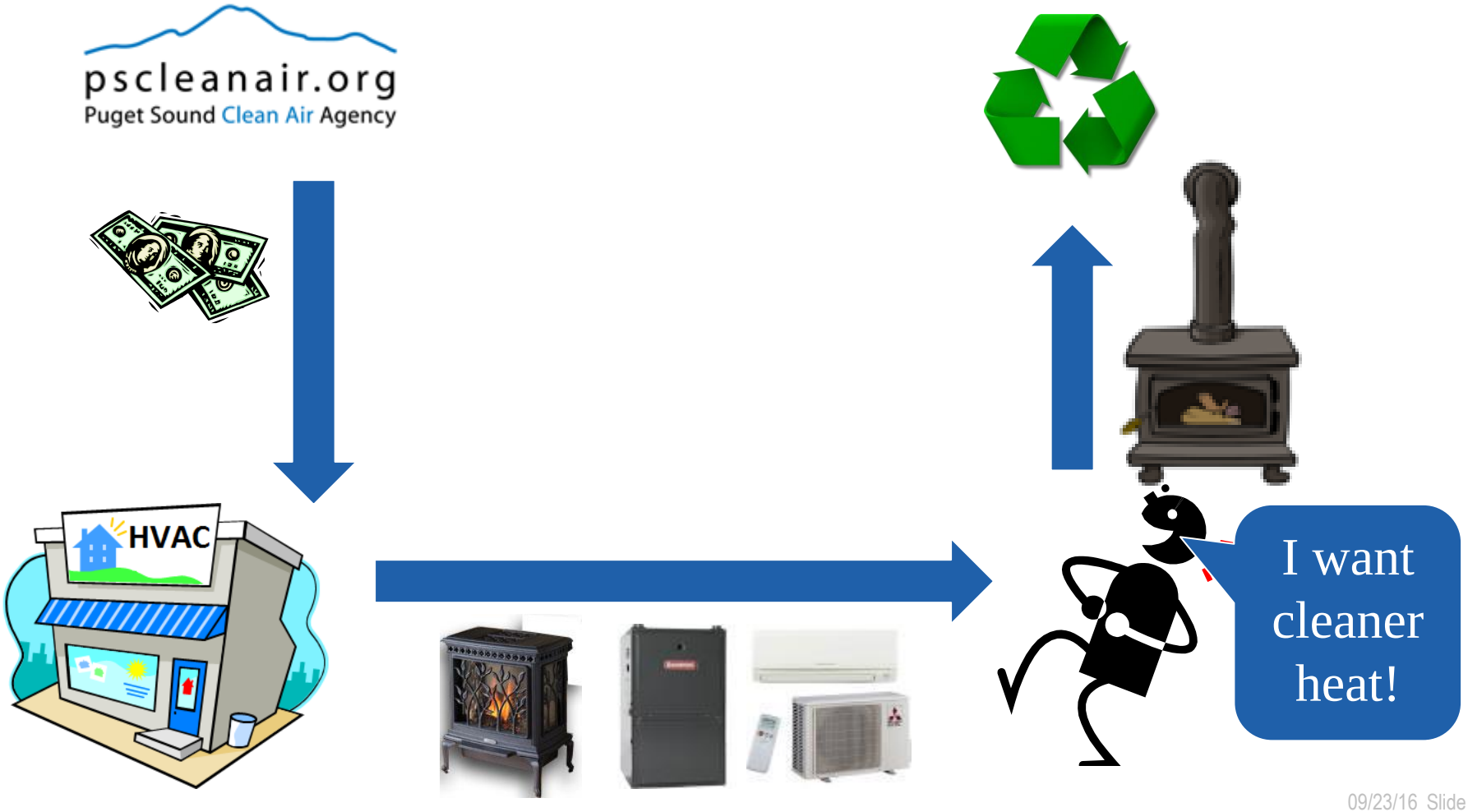
- New rule banning uncertified woodstoves as of September 2015 (along with incentives)
- Only in the nonattainment area

- Can be rendered inoperable…We prefer old stoves taken to recycler and crushed

Strategy #3: Incentives for removal or replacement of uncertified stoves

- Wood Stove Replacement Program (WSRP)
- <u>Replace</u> (with cleaner heating device)
  - Income-Qualified households = FREE
  - $1500 discount for others
  - fireplace pilot program

WSRP: Full cost to income qualified, $1500 to others



In 2012 added a Bounty Program…

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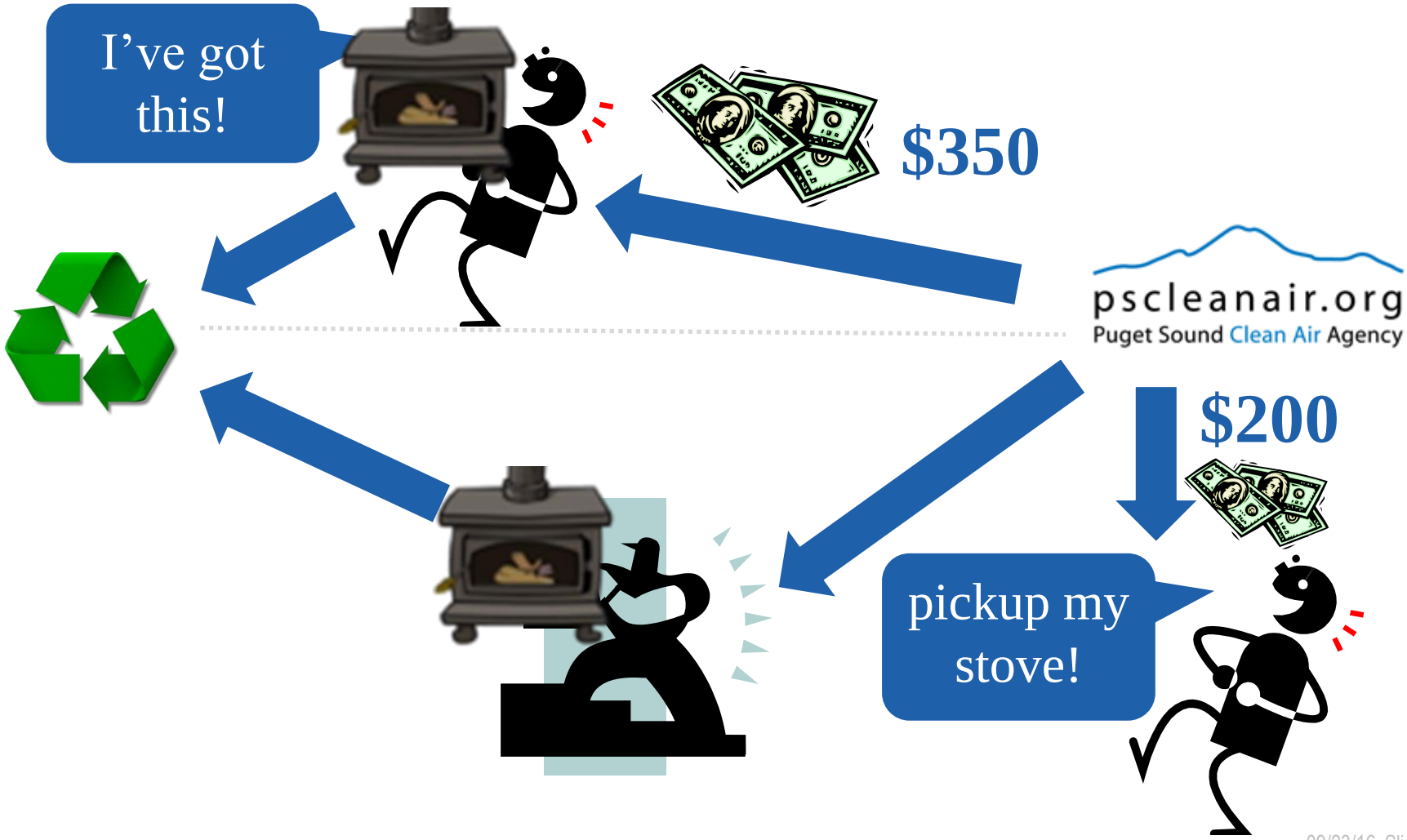
- uncertified stoves recycled for a reward
- Just scrap it!
- Don't have to replace it
- $200 reward if our contractor picks up
- $350 reward if you do heavy lifting and take to designated recycle yard

Removal (Recycling): $350 drop off, or $200 we pick up



What kinds of OLD devices are we talking about?

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Wood stoves

Free-standing, manufactured fireplaces

Wood-burning fireplace inserts

Wood-burning furnaces

Coal stoves/inserts

Fireplace retrofit
(case-by-case)

Results to date…

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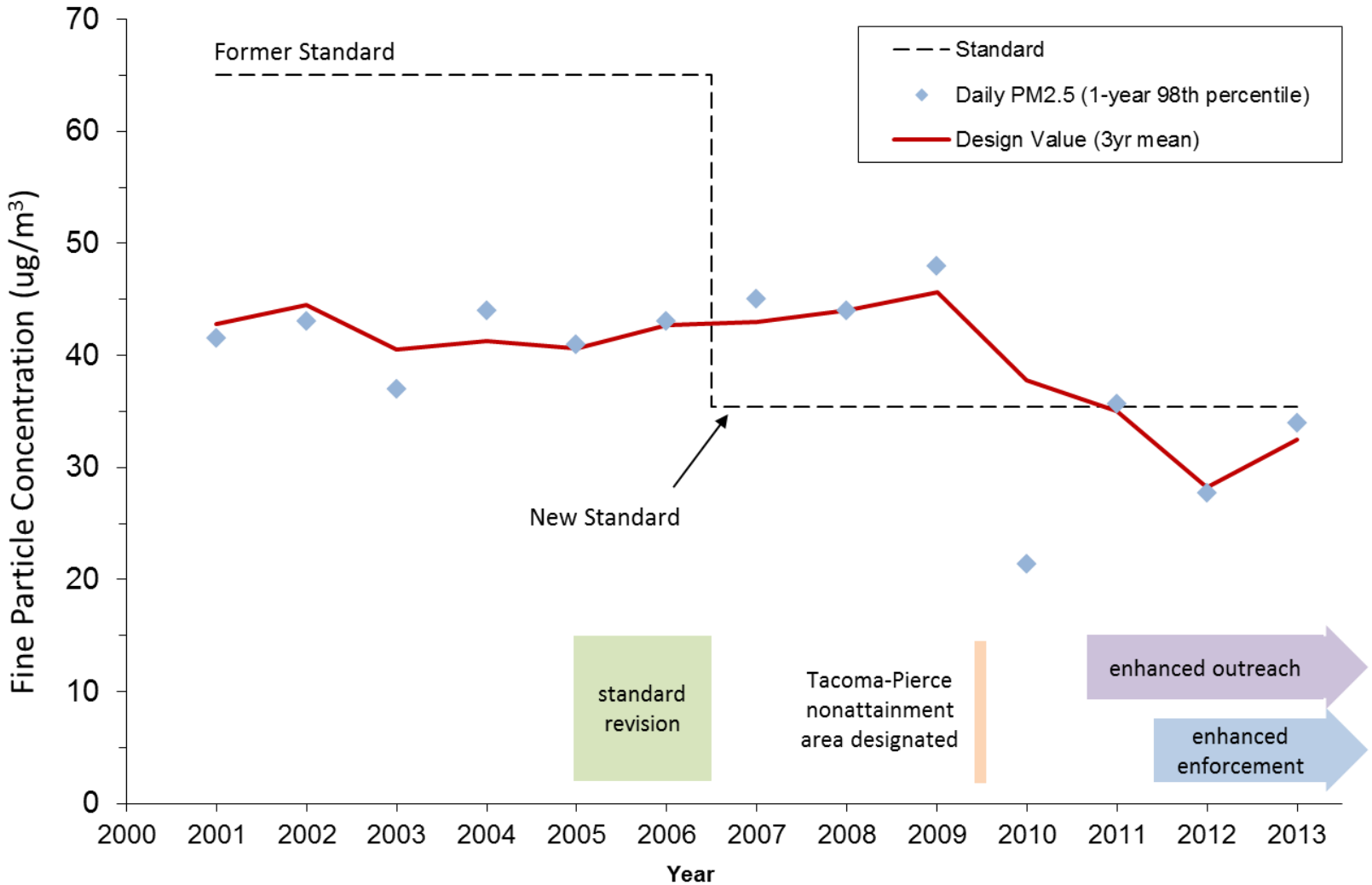
- **Over 3,000 old stoves/inserts removed!**

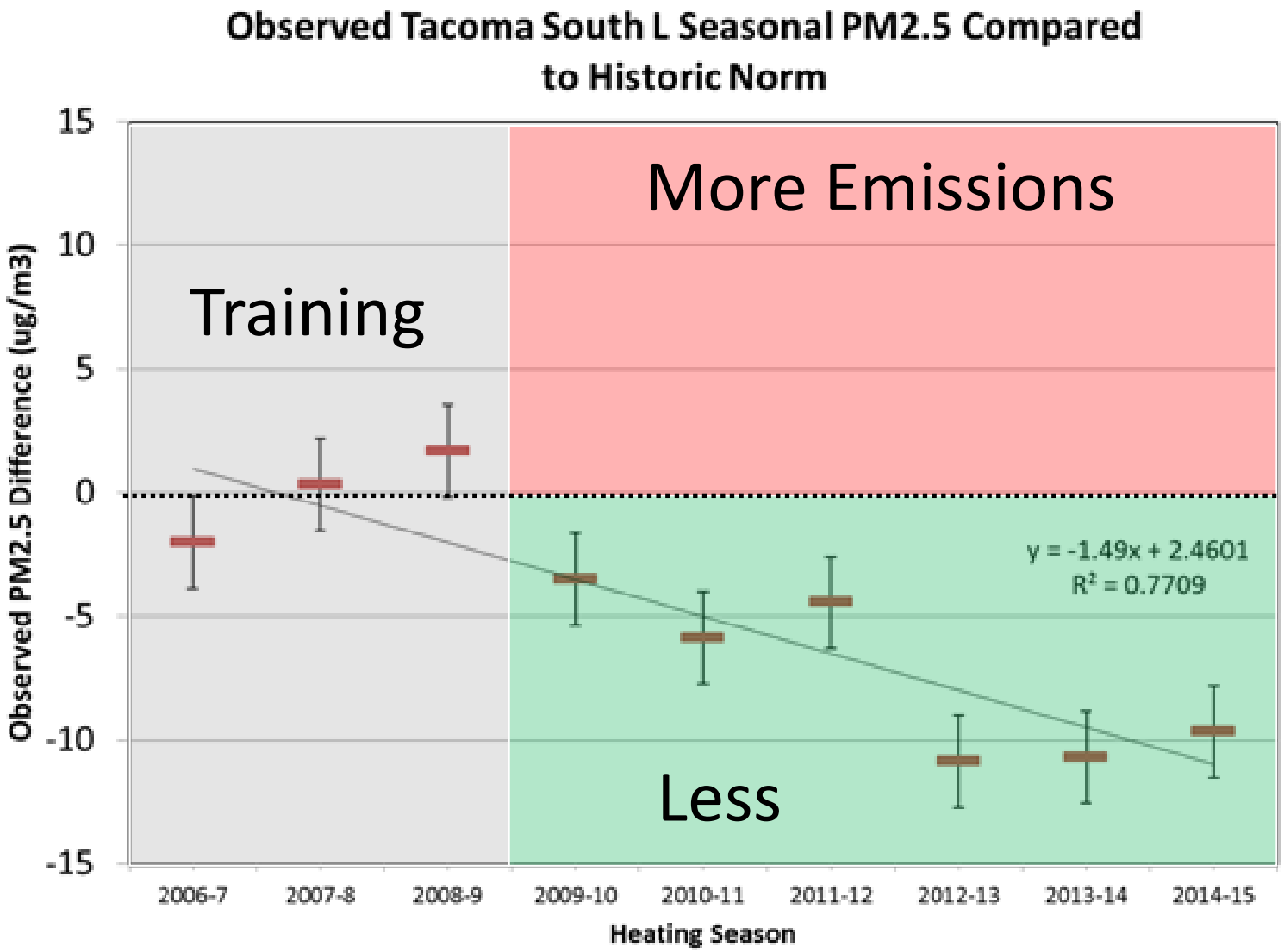
DID WE REALLY SOLVE THE PROBLEM?

Fine Particle Levels in Tacoma and Federal Daily Standard

(Daily PM2.5 [1-year 98%ile] and Design Value [3-year mean of Daily])



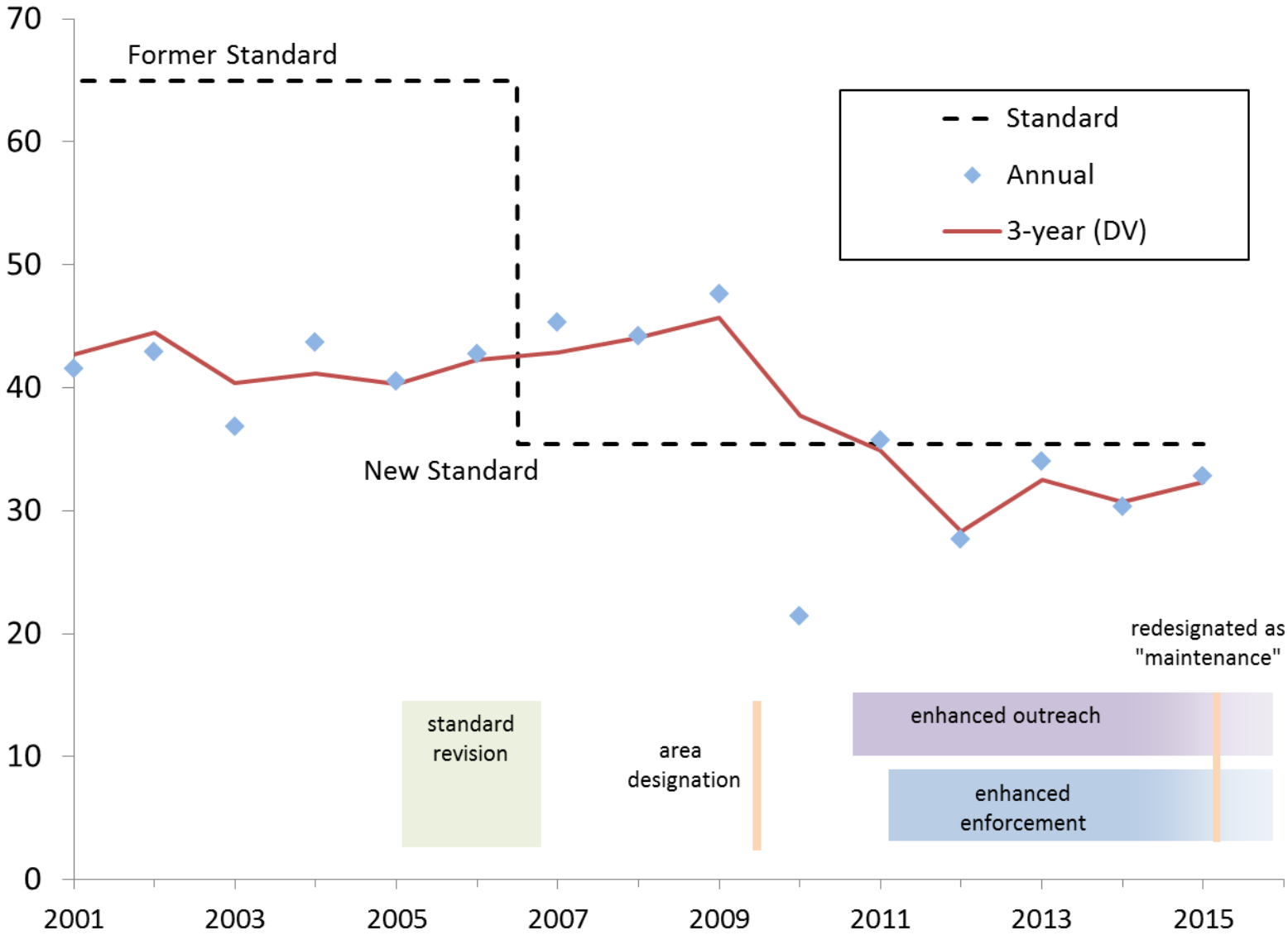
Weather corrected PM2.5 trend:



The end of the story (almost):

- **Feb 2015, was re-designated as "maintenance area"!**

2016 update to Tacoma PM2.5



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Other strategies and long-term: What about retrofits?

- replacement of wood stoves is ~$2,000-5,000 (w options & installation)
- retrofits start as low as $600
- could retrofits give similar result for lower cost?
- would also provide another option for NOASH or others who really like existing stove
- Well after Tacoma, we received a grant to seek and test emerging retrofit technologies

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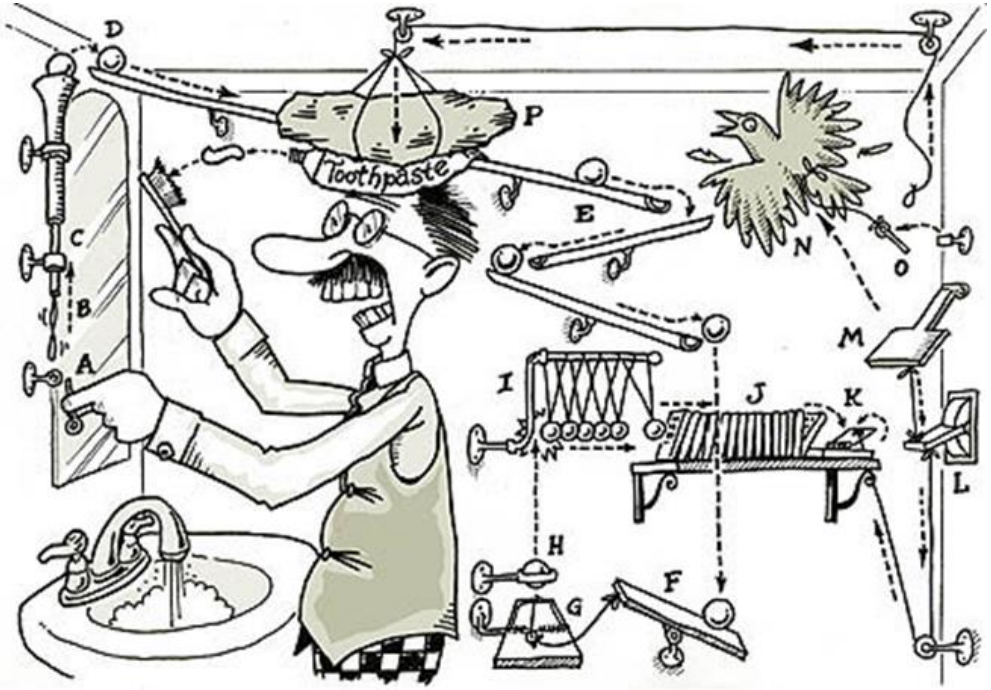
The Technical Challenge of our Challenge

- **All retrofits we <u>were previously aware of</u> have one or more of the following limitations:**



- **too expensive and complicated**
- **require significant care and maintenance**
- **have significant technical limitations that render them ineffective, unreliable, or hazardous**

The Retrofit Challenge

- With help from WA Dept. of Ecology (R.Tinnemore) obtained NEP grant to:
- Fund an open search for retrofits to reduce PAHs and fine PM
- Funded testing for finalists
- InnoCentives was contracted to promote the challenge and the open search
- It is difficult to provide financial motivation and protect intellectual property
- It is difficult to create a meaningful test protocol

Retrofit Testing

- Contracted with OMNI-Test in Portland, OR
- Two uncertified stoves, good representatives of existing stock
- Three test conditions:
  - high burn rate, high wood moisture
  - low burn rate, low wood moisture
  - low burn rate, high wood moisture
- Testing was done in two rounds, only three devices advanced to the second round
- Operated similar to official certification test method
- Also measured PAHs, CO, and temperature

Uncertified Test Stoves

Schrader (#1)

Princess (#2)

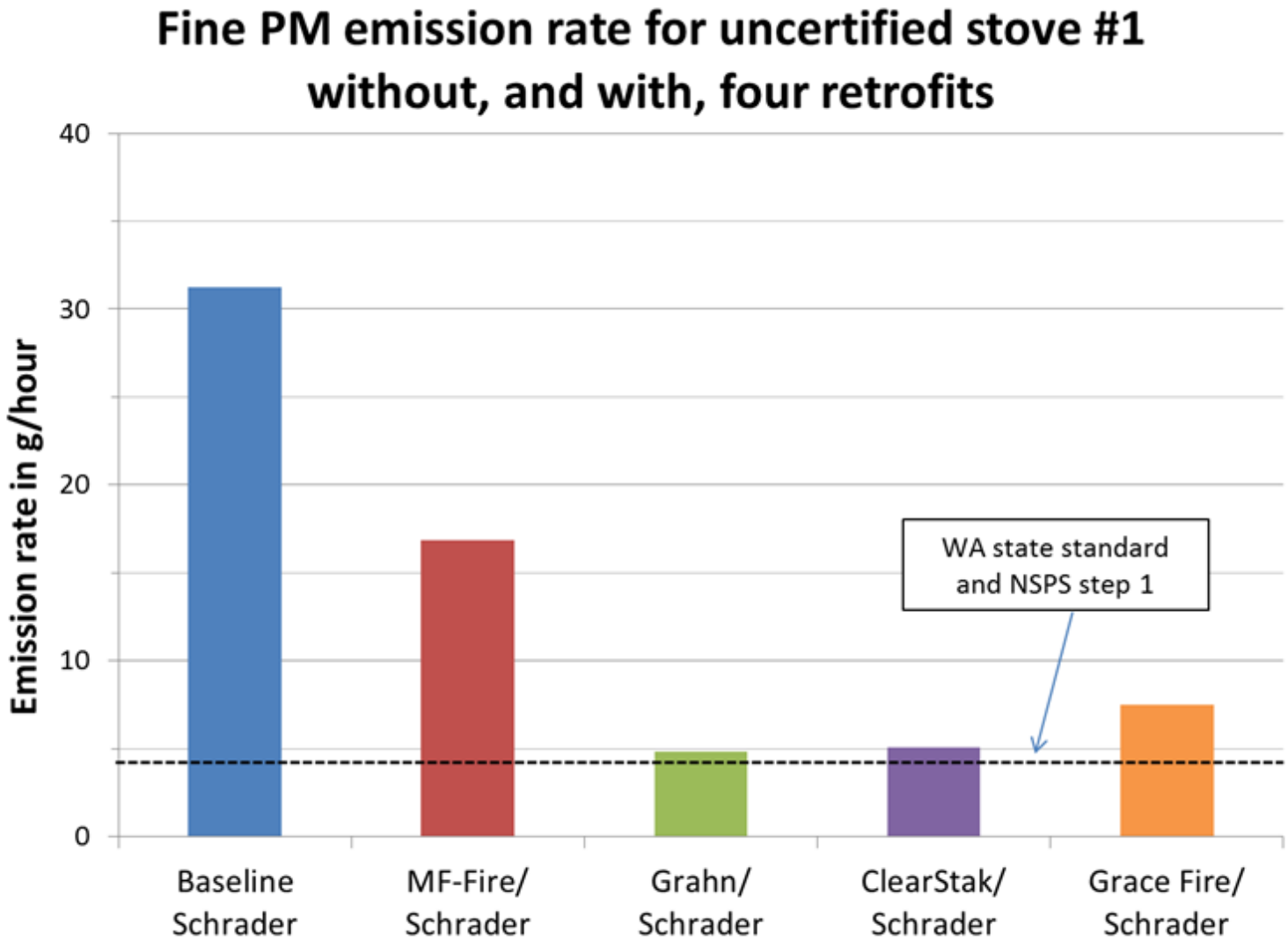
Grahn
Afterburner

GraceFire
StoveCAT

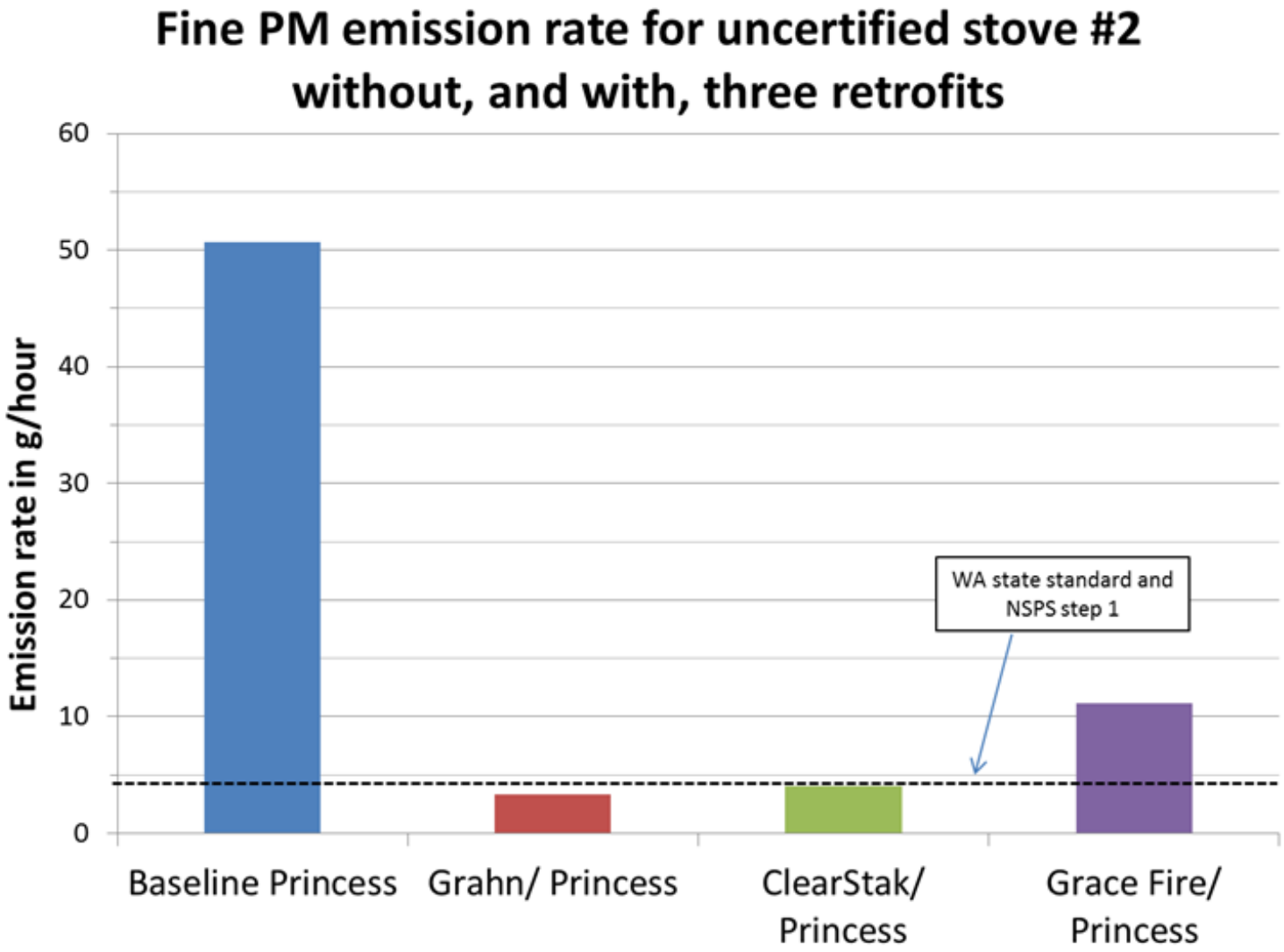
ClearStak

MF Fire

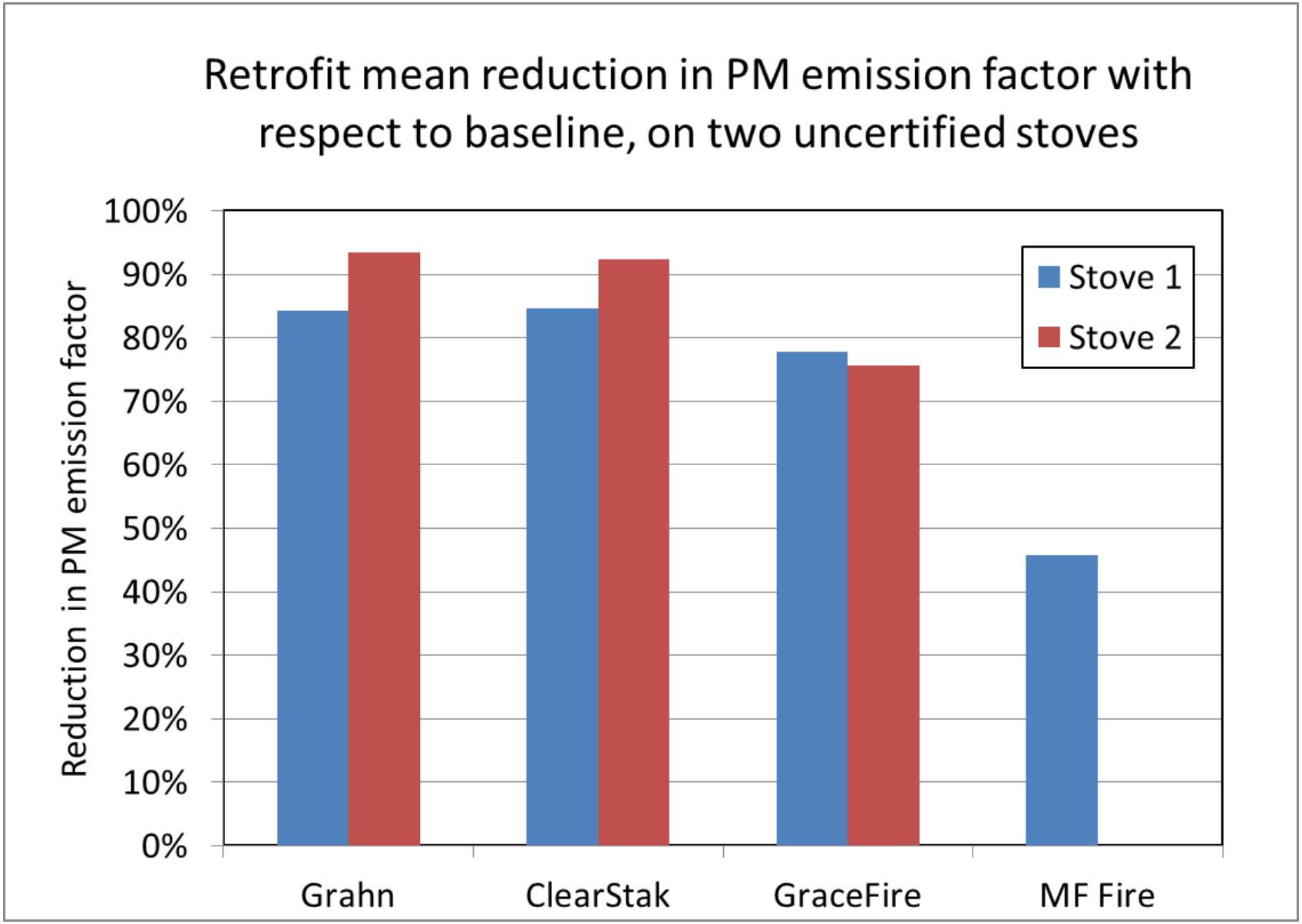
Emission Rates with & without retrofits



Emission Rates with & without retrofits



PM Reductions



Retrofit Challenge Summary

- In the end the three devices all met the Challenge criteria and were declared a 3-way tie.
- Each had unique characteristics and may work better in some situations than others and have various advantages
- We are encouraged and urge continued development and testing, hopefully some field testing…

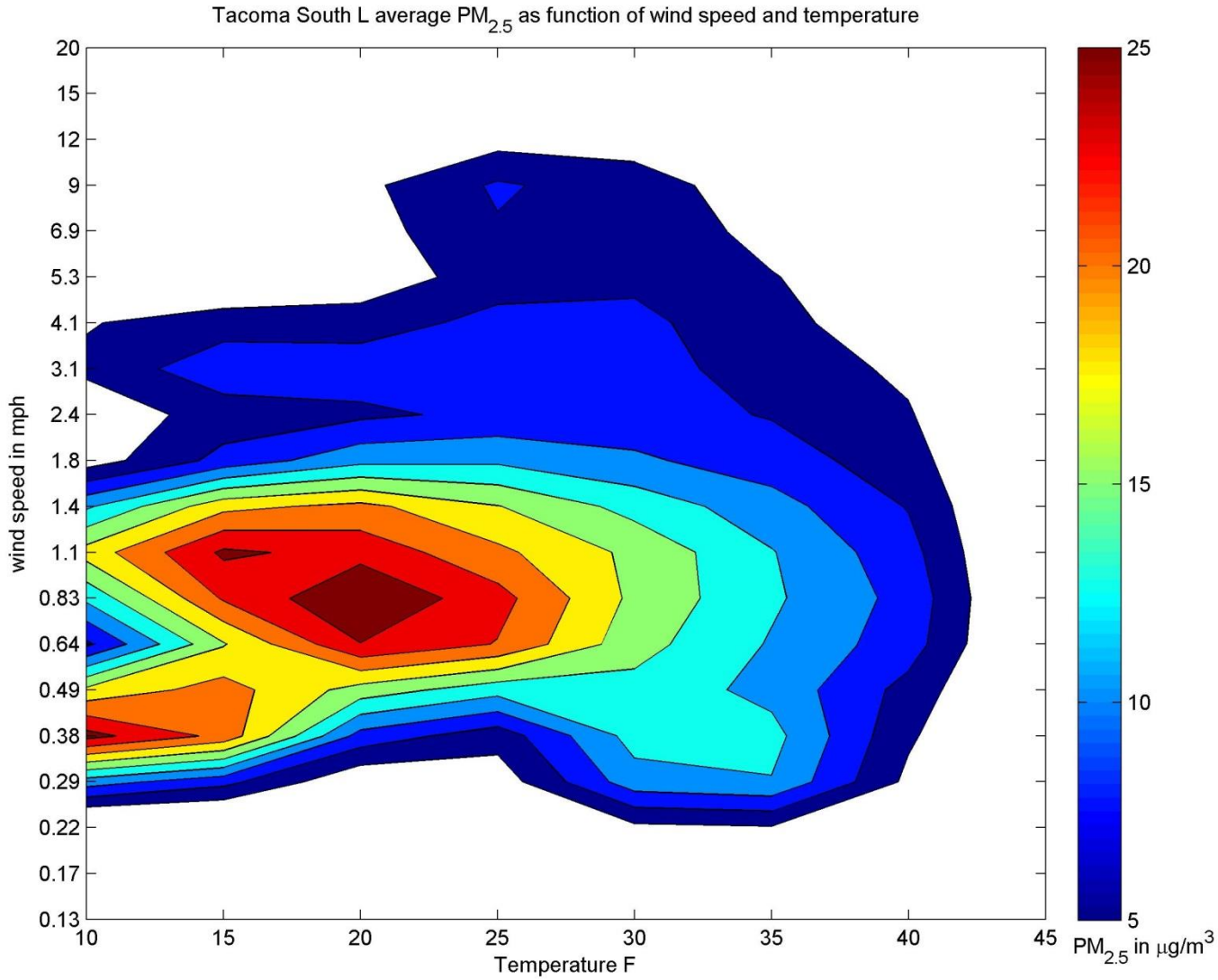
extra slides

AIR. ON THE SAFESIDE

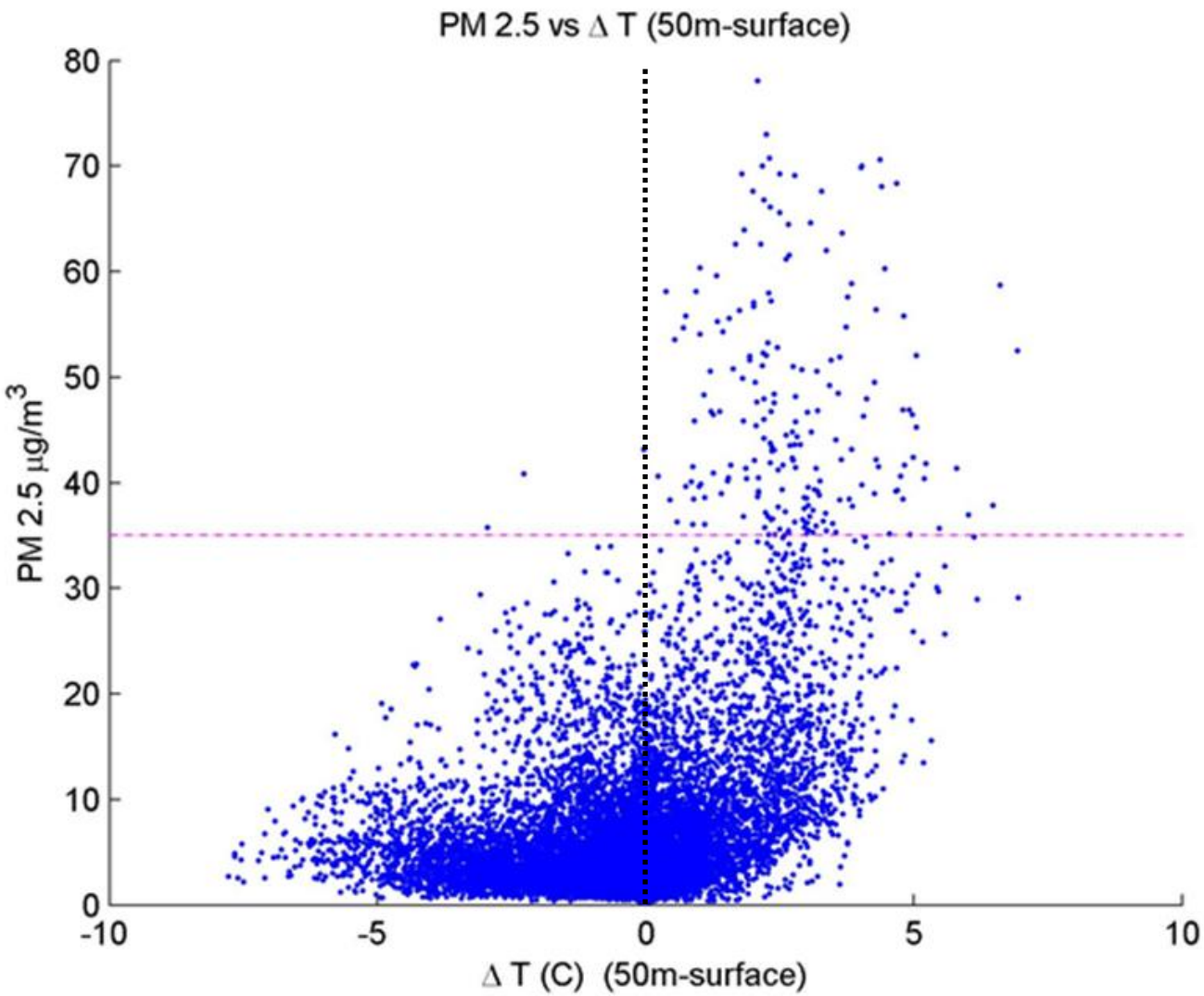
Metrics (2014 Burn Ban Ad Season)

- 10,710 Unique Visits to Webpage, 72 percent new visits
- 1100 Email Alert Sign Ups
- 1407 Text Alert Sign ups (Just over 3000 total for Pierce Co)
- 520 new Facebook followers added during burn ban season
- 665 woodstove applications completed, 363 redeemed

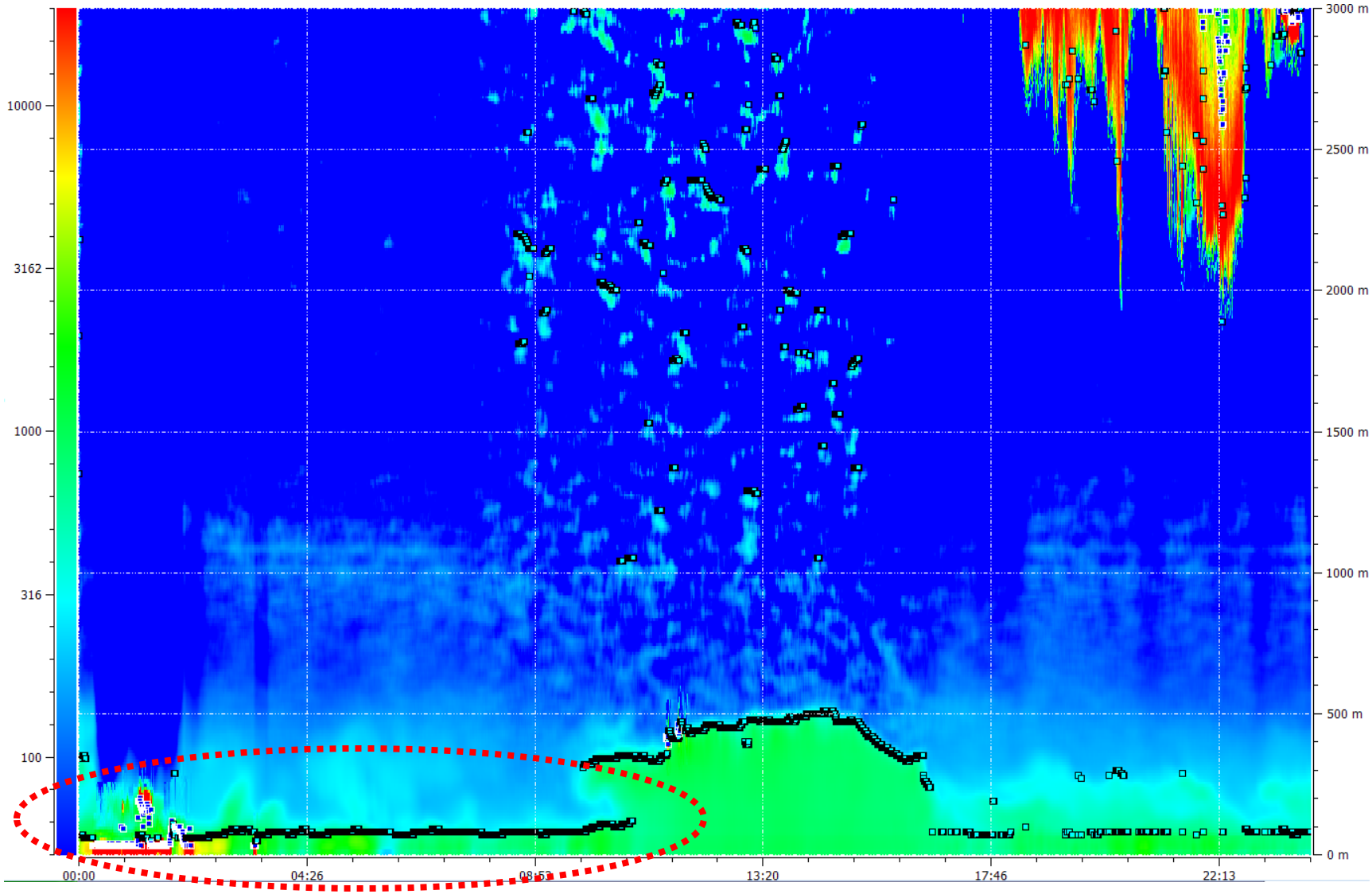
Burn Ban Forecasting: **Cold** and **Calm**
need winds < ~ 1 mph, temps < 35 F



Burn Ban Forecasting: **Calm** and **Clear** need 50m inversion > 0.5 C



Ceilometer (shown) and temp profiles helps diagnose shallow nocturnal PBL



8:45 PM Dec 7 (13 sec f/6.3 ISO 3200)

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9:20 Dec 8 (0.6 sec f/1.8 ISO 3200)

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8:53 pm Nov 27 (3 sec f/2.2 ISO 800)

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