

State Leadership in Clean Energy

CESA SLICE Award Webinar #2

New Hampshire PUC Woody Biomass Heating

and

Presentation by Ellen Burkhard, NYSERDA,

Residential Wood Boiler Technologies, Emissions
Measurements, and Observations of Wood Smoke in
Rural and Urban Communities in New York State

November 19, 2012

Housekeeping

- All participants will be in listen-only mode throughout the broadcast.
- You can connect to the audio portion of the webinar using your computer's speakers or USB-type headset. You can also connect by telephone. If by phone, please expand the Audio section of the webinar console to select "Telephone" to see and enter the PIN number shown on there onto your telephone keypad.
- You can enter questions for today's event by typing them into the "Question Box" on the webinar console. We will pose your questions, as time allows, following the presentations.
- This webinar is being recorded and will be made available after the call on the CESA website at

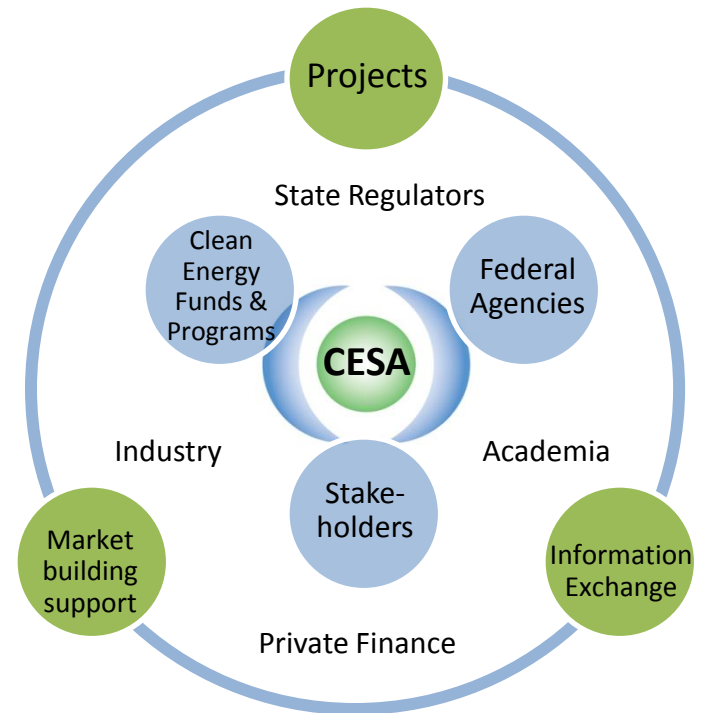
www.cleanenergystates.org/events/

About CESA

Clean Energy States Alliance (CESA) is a national nonprofit organization dedicated to advancing state and local efforts to implement smart clean energy policies, programs, technology innovation, and financing tools to drive increased investment and market making for clean energy technologies.

What We Do

- Multi-state coalition of clean energy programs cooperating and learning from each other, leveraging federal resources
- CESA state members have nearly \$6 billion to invest in next 10 years
- Members have supported nearly 130,000 renewable energy projects from 1998-2011 with state-based dollars
- Nonpartisan, experimental, collaborative network
 - Information exchange & analysis
 - Partnership development
 - CESA projects: solar, wind, RPS, fuel cells, energy storage, program evaluation, national database



SLICE: State Leadership In Clean Energy

CESA's SLICE Awards recognize state programs that are most effectively accelerating adoption of clean energy technologies.

SLICE Award winners have:

State Leadership
in Clean Energy

- Funded and supported innovative programs
- Established funds that provide critical capital investment for clean energy projects
- Collaborated effectively with industry partners, utility commissions, and local governments

How Winners Are Chosen

Projects are nominated for SLICE awards by CESA member organizations from across the U.S.

2012 winners were chosen by a panel of six distinguished judges, including representatives of the U.S. Department of Energy, the National Renewable Energy Lab, the National Conference of State Legislatures Energy Program, DSIRE, the American Wind Energy Association, and the Solar Energy Industries Association.

The 2012 SLICE Award Winners and Webinar Schedule:

- NYSERDA's Clean Energy Business Incubator and On-Site Wind Market Development Programs (November 15 – Recording available)
- The New Hampshire Public Utilities Commission's Residential Wood-Pellet Boiler Rebate Program: **November 19, 2 p.m. Eastern**
- The California Energy Commission's University of CA, San Diego Microgrid and Synchrophasor Research and Development Programs: **November 27, 2 p.m. Eastern**
- Connecticut's Clean Energy Finance and Investment Authority's (CEFIA) CT Solar Lease Program: **November 29, 2 p.m. Eastern**
- The Massachusetts Clean Energy Center's Commonwealth Solar Hot Water Pilot Program: **November 29, 2 p.m. Eastern**

A briefing report on the winning programs and links to sign up for webinars are available at

<http://www.cleanenergystates.org/projects/state-leadership-in-clean-energy>

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Pellet Heating System Rebate Program

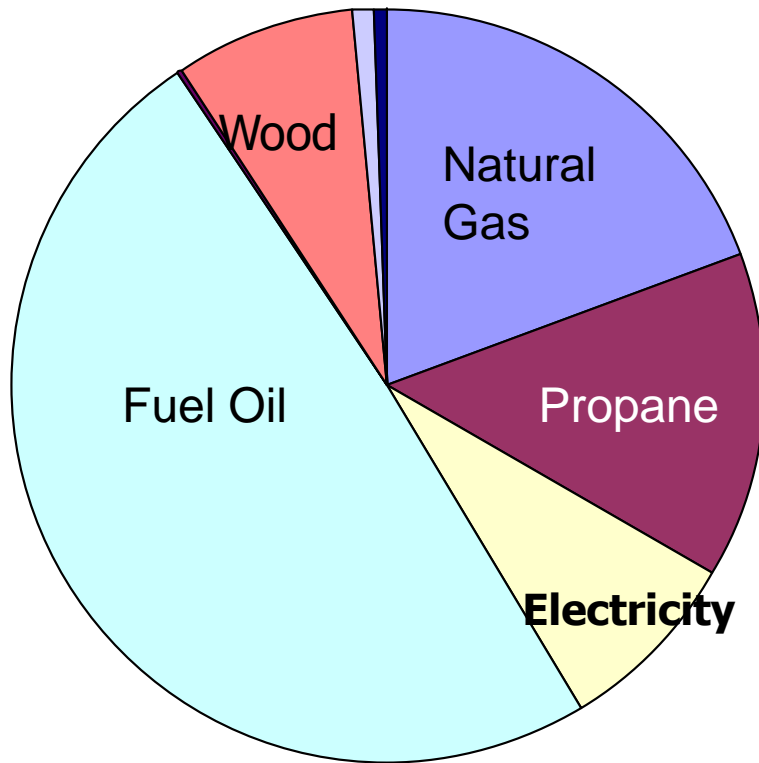
CESA WEBINAR
November 19, 2012

Barbara Bernstein
New Hampshire Public Utilities Commission
Sustainable Energy Division



NH's Residential Heating Fuel Use

NH Home Heating Types



- 100,857 Utility Gas 19.57%
- 70,863 Bottled, Tank or LP Gas 13.75%
- 41,909 Electricity 8.13%
- 253,772 Fuel Oil, Kerosene, etc. 49.23%
- 416 Coal or Coke 0.08%
- 40,272 Wood 7.81%
- 85 Solar Energy 0.02%
- 4,752 Other Fuel 0.92%
- 2,505 No Fuel Used 0.49%

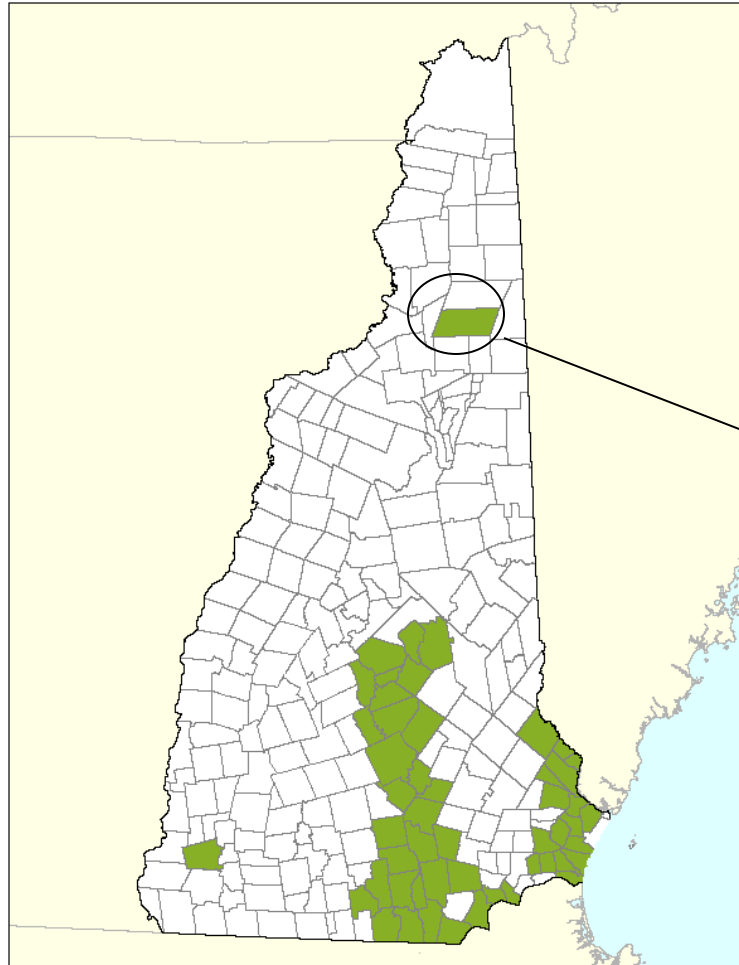
Source: 2010 United States Census Data

NH's Fuel Cost Calculator- October 2012

Fuel Type	Fuel Unit	Fuel Price Per Unit (dollars)	Fuel Heat Content Per Unit (Btu)	Fuel Price Per Million Btu (dollars)
Fuel Oil (#2)	Gallon	\$3.95	138,690	\$28.48
Propane	Gallon	\$3.46	91,333	\$37.88
Kerosene	Gallon	\$4.06	135,000	\$30.07
Natural Gas	Therm	\$1.77	100,000	\$17.70
Wood (Pellets)	Ton	\$249.00	16,500,000	\$15.09
Wood (Cord)	Cord	\$210.00	20,000,000	\$10.50
Electricity	Kilowatt-hour	\$0.150	3,412	\$43.96

Source: NH Office of Energy and Planning, www.nh.gov/oep

NH Towns with Natural Gas



= Town has Access to Natural Gas, but not necessarily everywhere

Berlin, NH – natural gas for one large commercial site

Source: NH Public Utilities Commission, www.puc.nh.gov

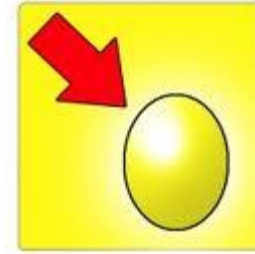
Chicken and Egg Scenario

- Consumers won't invest in new systems if they don't think the infrastructure is ready or stable
- Infrastructure won't get built until there is demand for the product
- Incentive Programs validate systems and fuel leading to validation by insurance companies, lenders, appraisers, and real estate professionals



The Egg Came First

- American Recovery and Reinvestment Act of 2009
- NH received \$25,800,000 in State Energy Program funds
- NH carved out \$500,000 for a Residential Wood Pellet Central Heating System Rebate Program to start market transformation



Goals of the program

- Stimulate economic development through market expansion of local fuels and manufacturing
- Create and retain jobs in a clean-energy field
- Expand the market for these heating systems
- Develop a stable and competitive bulk-fuel delivery infrastructure
- Reduce fossil-fuel use and emissions for home heating

Pellet System Rebate Overview

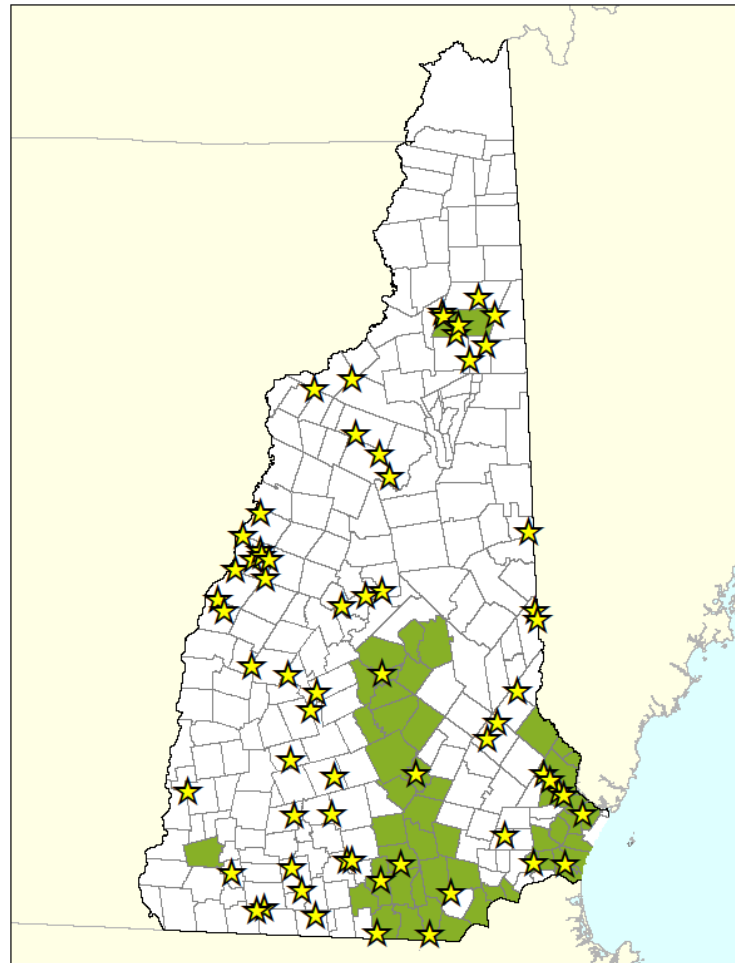
- Rebate: 30% of system cost + labor, capped at \$6,000
- Bulk-fed – 3 ton minimum
- Central heating systems only
- First come, first served - First in the Nation Program




Pellet System Rebate Overview, as of 09-30-12

- Two-Step Application Process through the NH PUC
- 103 applicants, 95 systems successfully installed,
- In April OEP provided the program with an additional \$100,000. Obligated by the end of May. And by the end of September we closed the program with less than \$100.00 in funds unspent for rebates.
- Approximately 30 installers – small and medium sized firms – have participated in the program with eight different system types having been installed.

NH's Residential Pellet System Rebates



 = Town has Access to Natural Gas, but not necessarily everywhere

 = Rebated Residential Bulk-Fed Pellet Systems

Source: NH Public Utilities Commission and NH Office of Energy and Planning



Model Neighborhood Project

Keeping heating dollars
at home in the Northern Forest

Market Transformation

- Initially 2 systems qualified, now 9 systems qualify
 - Froling, OkoFen, WoodPecker, WoodMaster, EcoHeat, Central Boiler, EcoChoice, Pella, *and just added --* Windhager
- Approximately 30 Installers Certified by the manufacturer/distributor who have participated in the program
- Inquiries from entrepreneurs interested in the pellet delivery and pellet manufacturing business
- Inquiries from other states interested in launching their own programs

Market Transformation

- \$2 million+ invested (to date)
- Over \$1.6 million invested by individual homeowners
- Approximately 69,000 gallons of home heating oil displaced with a renewable resource
- New employment opportunities



Industry Challenges for Wood Pellet Boilers & Bulk-Delivery of Wood Pellets

- Awareness/marketing and creating demand
- Expensive upfront system costs and financing hurdles
- Expensive delivery trucks – need to keep them active
- Replacement of broken FF heating systems often urgent
- Standardizing systems, delivery trucks, fuel quality, etc.



Challenges in the Rebate Program's Development & Implementation

- Marketing
 - If we build it, they may come, *but not without some marketing*
- Public Awareness of the product

Attention
New Hampshire Residents:

Heat Your Entire Home With... **Make the Switch!**



Local Wood Pellets

The NH Public Utilities Commission
Is sponsoring a
Wood Pellet Boiler
Rebate Program
30% on installed cost up to
\$6,000!

For More Information Contact:
Barbara Bernstein
603.271.6011
barbara.bernstein@puc.nh.gov www.puc.nh.gov

Paid Commercial Advertisement

Challenges in the Rebate Program's Development & Implementation

- Qualifying systems
- 3rd Party testing
- Home Re-sale
- CO emissions



Next Steps

- PUC has set aside an additional \$450,000 for the program to continue as of October 2012
- Modifications to the new program include recommendations for
 - thermal storage
 - review of warranties
 - use of premium wood pellets
- CO monitor a requirement
- *3rd party testing of boilers*





Thank you!

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Residential Bulk-Fed Wood-Pellet Central Boilers and Furnace Rebate Program

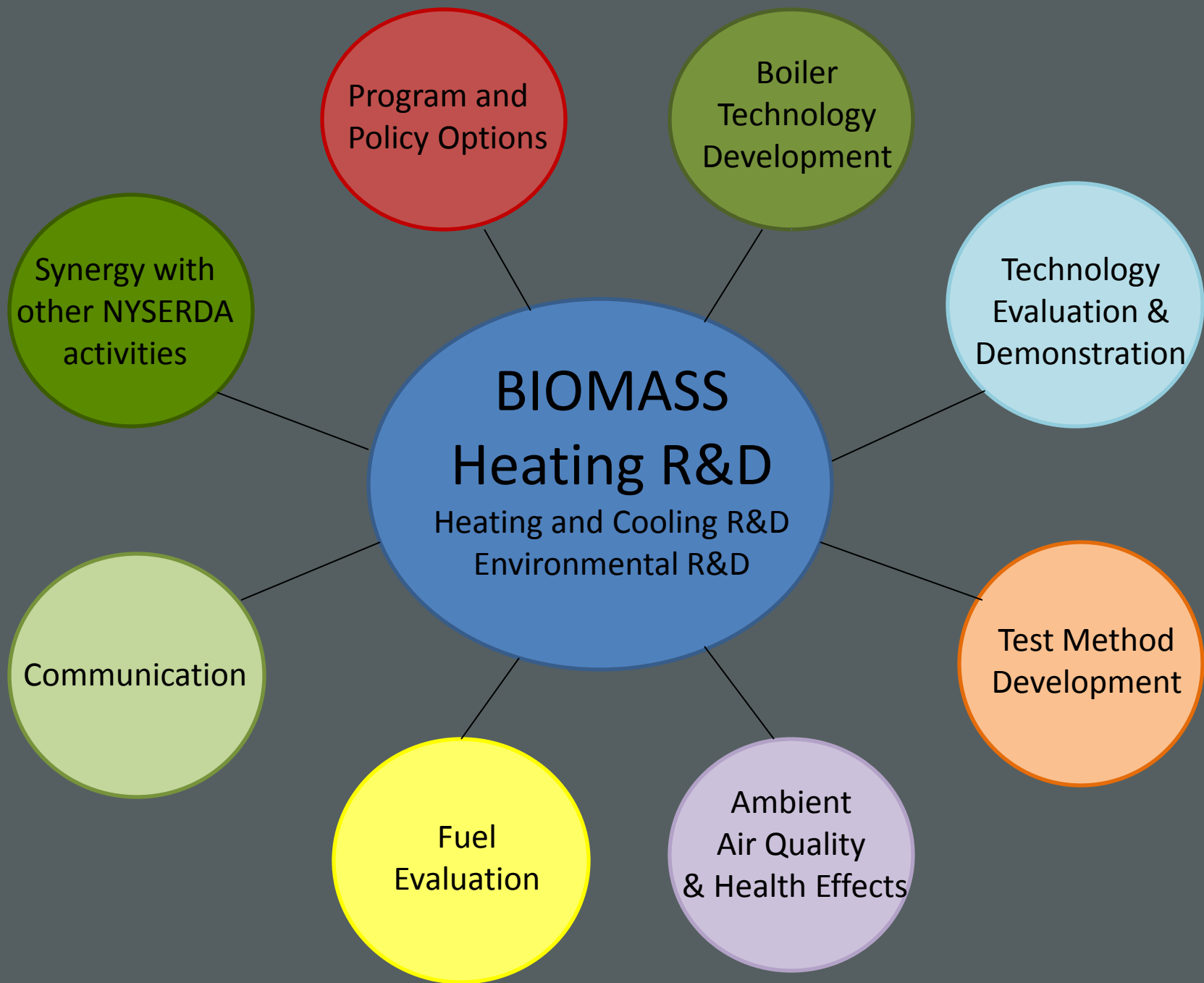
<http://www.puc.nh.gov/Sustainable%20Energy/RenewableEnergyRebates-WP.html>

Residential Wood Boiler Technologies, Emissions Measurements, and Observations of Wood Smoke in Rural and Urban Communities in New York State

Clean Energy States Alliance webinar
November 19, 2012

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Energy. Innovation. Solutions.

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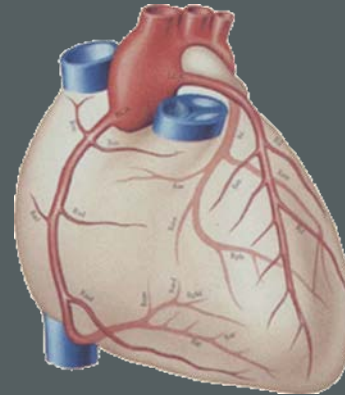
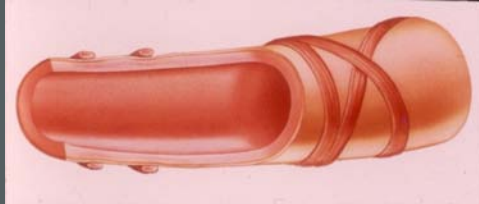
Thermo-Control



bioenergy2020+



Health Effects of PM2.5



Asthma and Increased Particle Levels	Cardiovascular Responses to Air (Particles)
Increase in Hospital Admission	Increased cardiac mortality
Decrease in Pulmonary Function	Increased hospitalizations for CVD
Increase in Asthma Exacerbations	Increased hospitalizations for CHF
Increase in Asthma Medication Use	Increased arrhythmia (Defibrillator intervention)
Increase in Pulmonary Mortality	Changes in heart rate and heart rate variability

11% asthma among children in NYS



Photo credit Phil Etter

Outdoor wood boiler



Photo credit Phil Etter



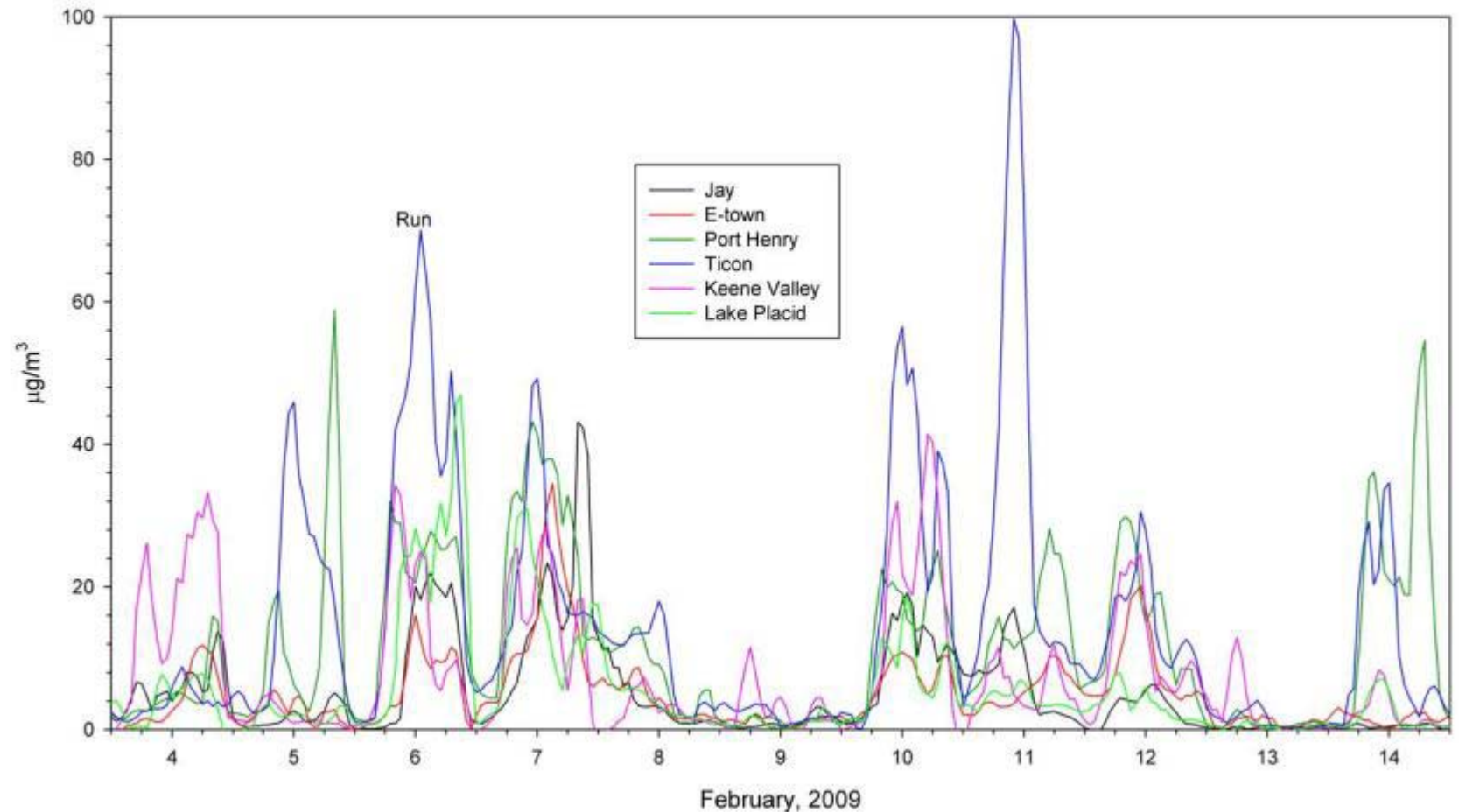
Photo credit Louis Fontain



Photo credit Gerald McDonald

“average PM” low but spikes frequently $> 200 \text{ ug/m}^3$, several over 400

Diurnal wood smoke in the Adirondacks



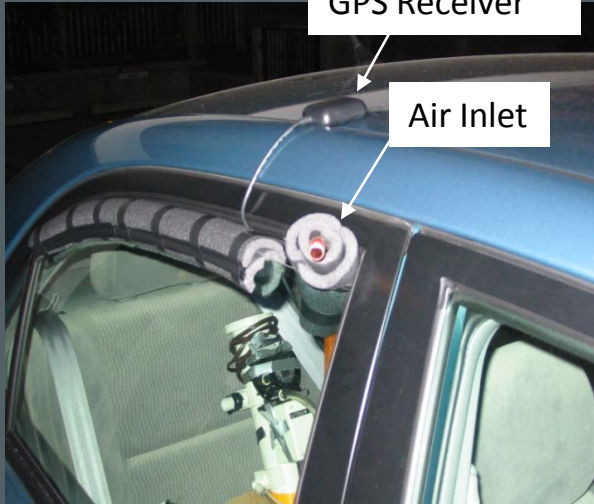
NYSERDA (2010a)

Running 3-h averages of 1-h data
Highest at night, lowest during the day

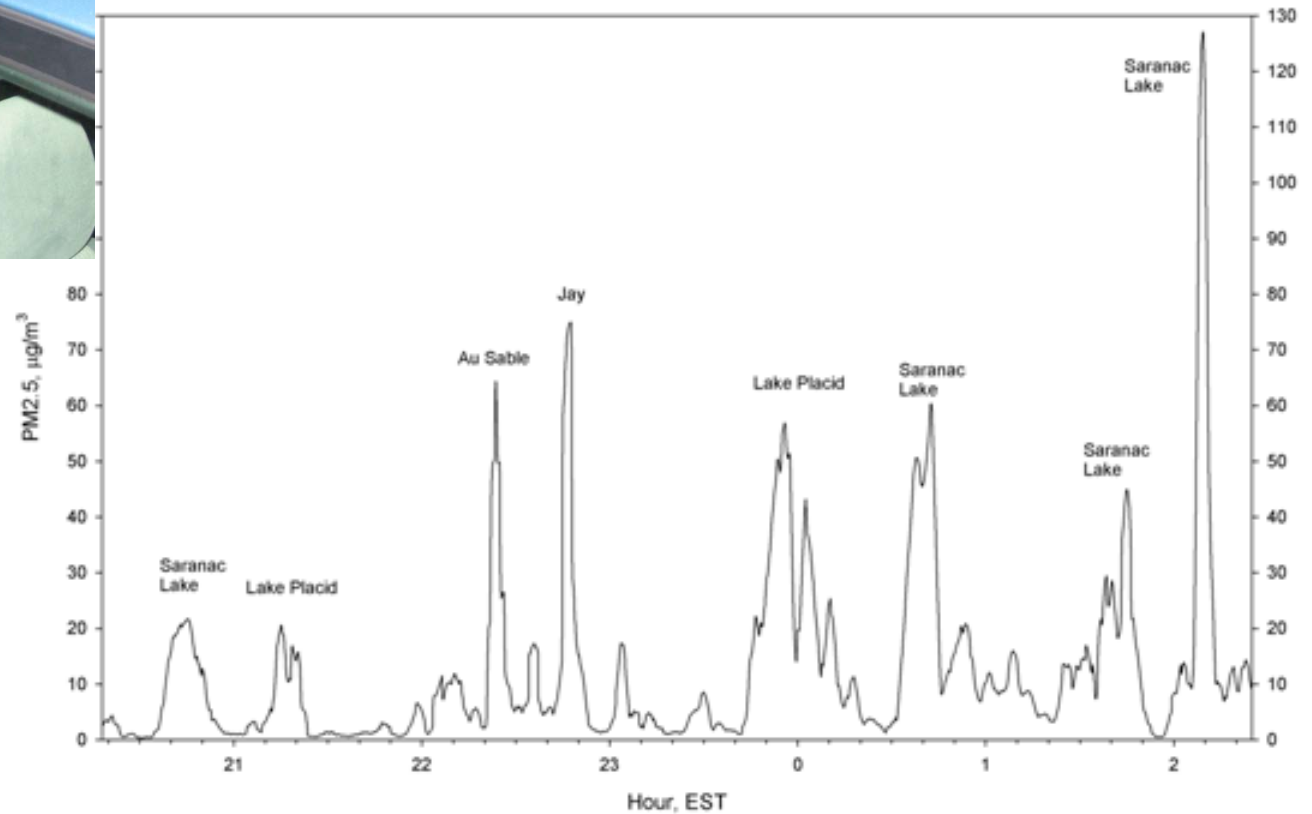
Localized high concentrations of wood smoke, “valley effect”

GPS Receiver

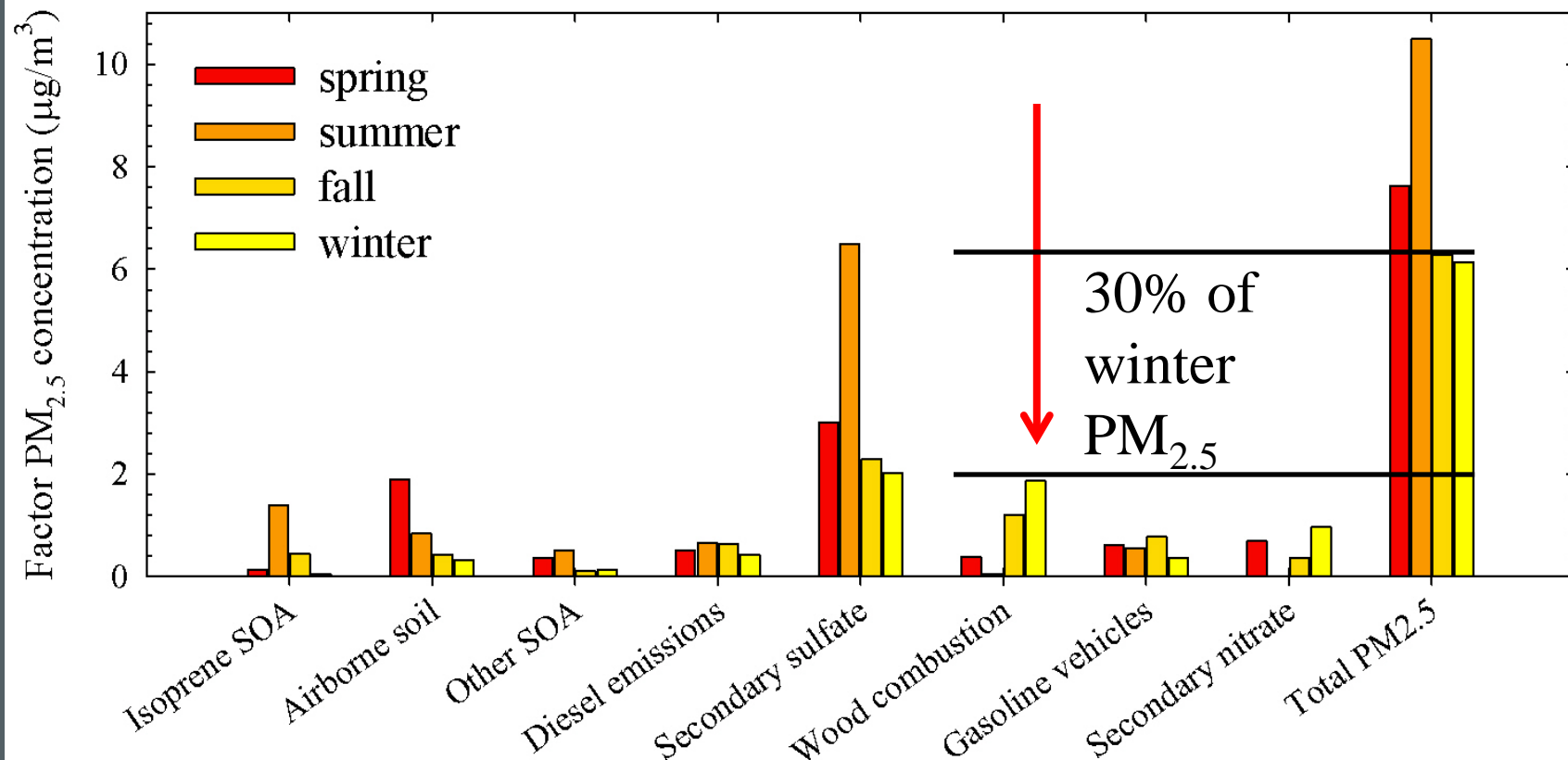
Air Inlet



24-25 Feb 2009 Mobile Monitoring, Truncated North Loop
3-Minute Running Average DR4-PM2.5



Wood smoke in Rochester, NY



Wang, Y. et al. (2012)

Monroe County housing unit heating systems:

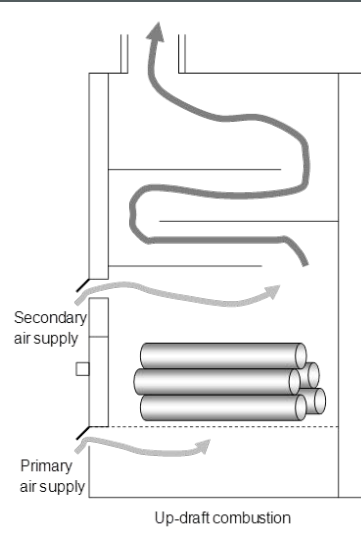
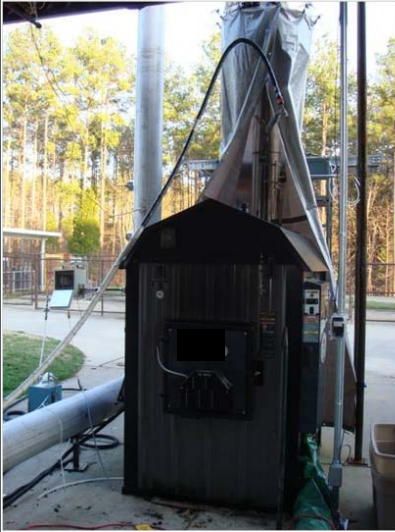
Natural gas (82.5%), Electricity (11.9%), Heating oil (2.9%), Propane (1.5%), Wood (0.5%)

Emissions testing of 4 wood-fired hydronic heaters by EPA ORD

- Conventional outdoor wood boiler (Red Oak, White Pine)
- Advanced outdoor wood boiler (Red Oak)
- Staged combustion (gasifier) with thermal storage (Red Oak)
- European pellet boiler (hardwood pellets)
- Each tested using the same “call for heat”

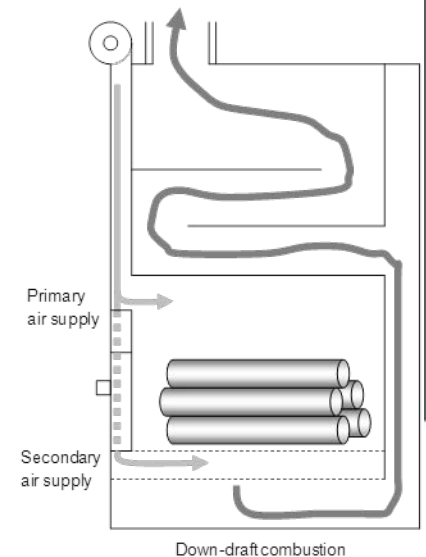


Outdoor Wood Boilers (Hydronic Heaters)



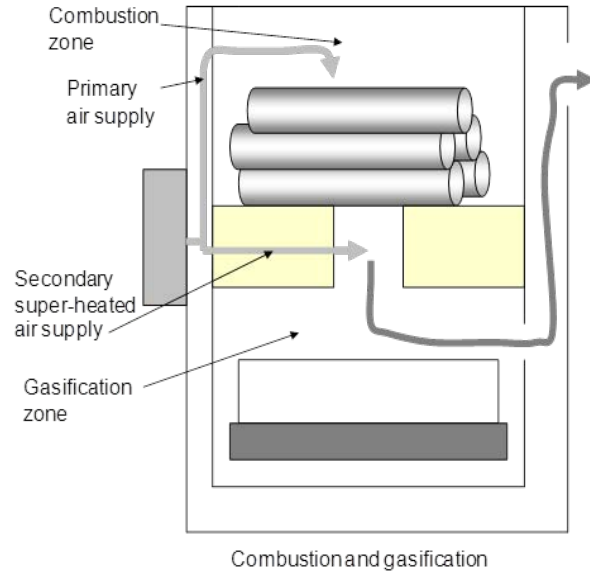
Conventional OWB
Updraft
250,000 Btu/h
196 gallons
Fuel charge: 254 lbs

Advanced OWB
down-draft
160,000 Btu/h
450 gallons
Fuel charge 200 lbs



Btu = British Thermal Unit

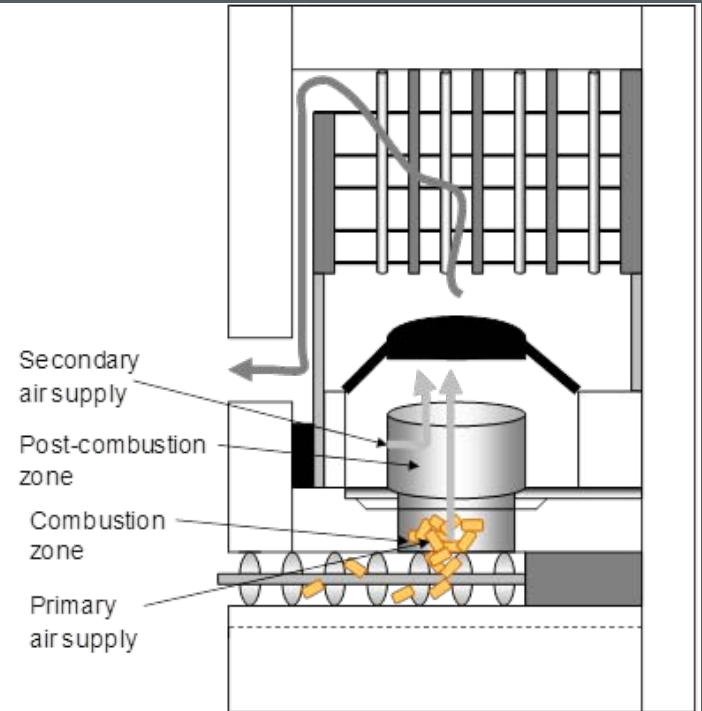
2-stage combustion (gasification) wood boiler



downdraft
150,000 Btu/h
32 gallons
Fuel charge: 64 lbs



Staged combustion pellet boiler



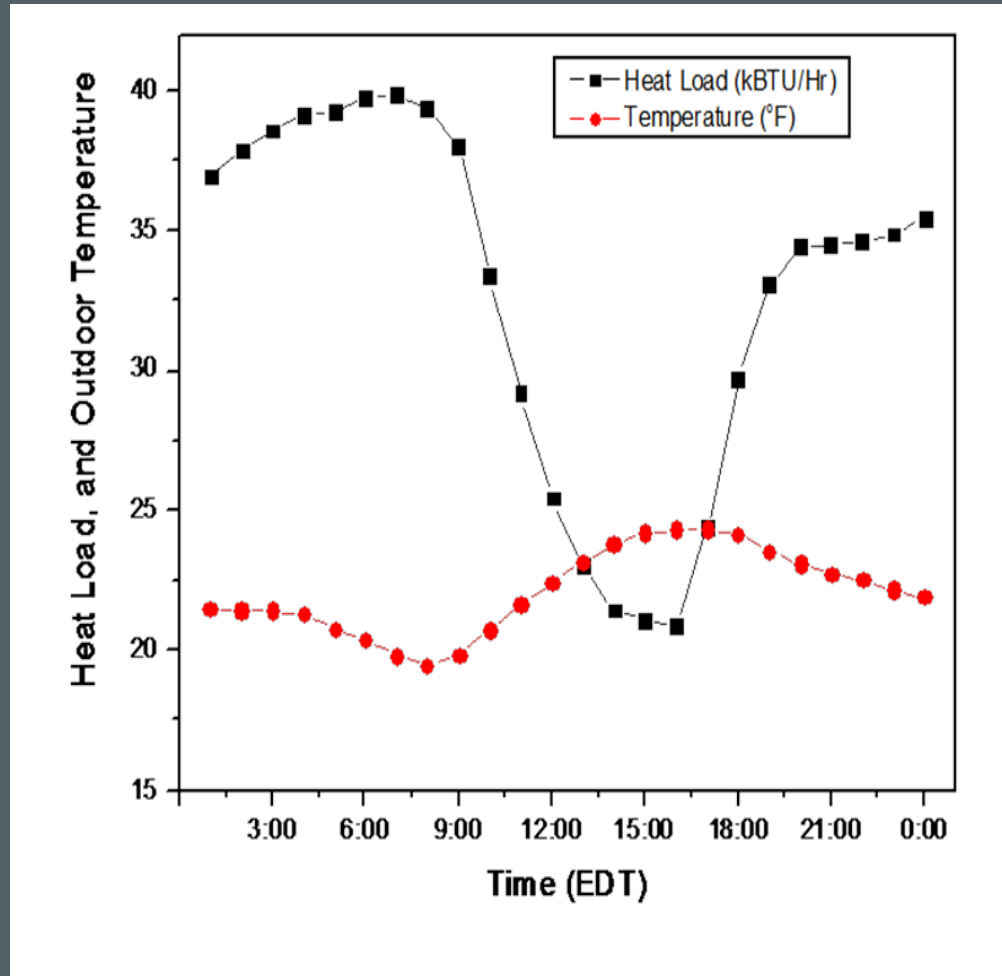
Bottom fed pellet burner

Staged combustion
137,000 Btu/h
43 gallons
pellets

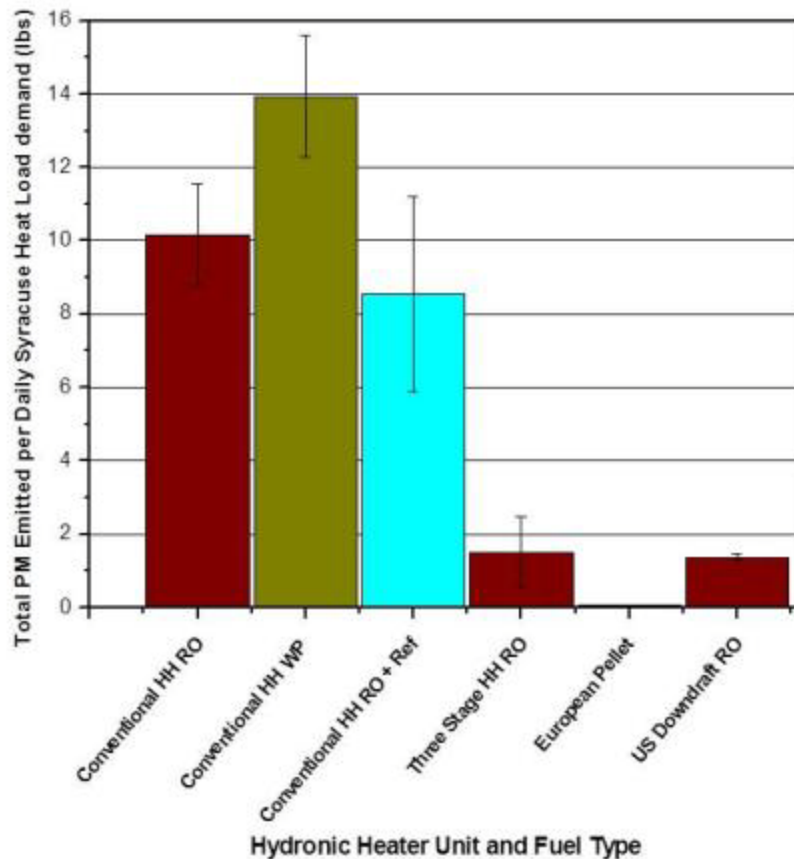
NYSERDA (2012)

Syracuse, NY heat load

Ranch-style home,
2500 ft²
R-13



EPA-ORD residential wood boiler research



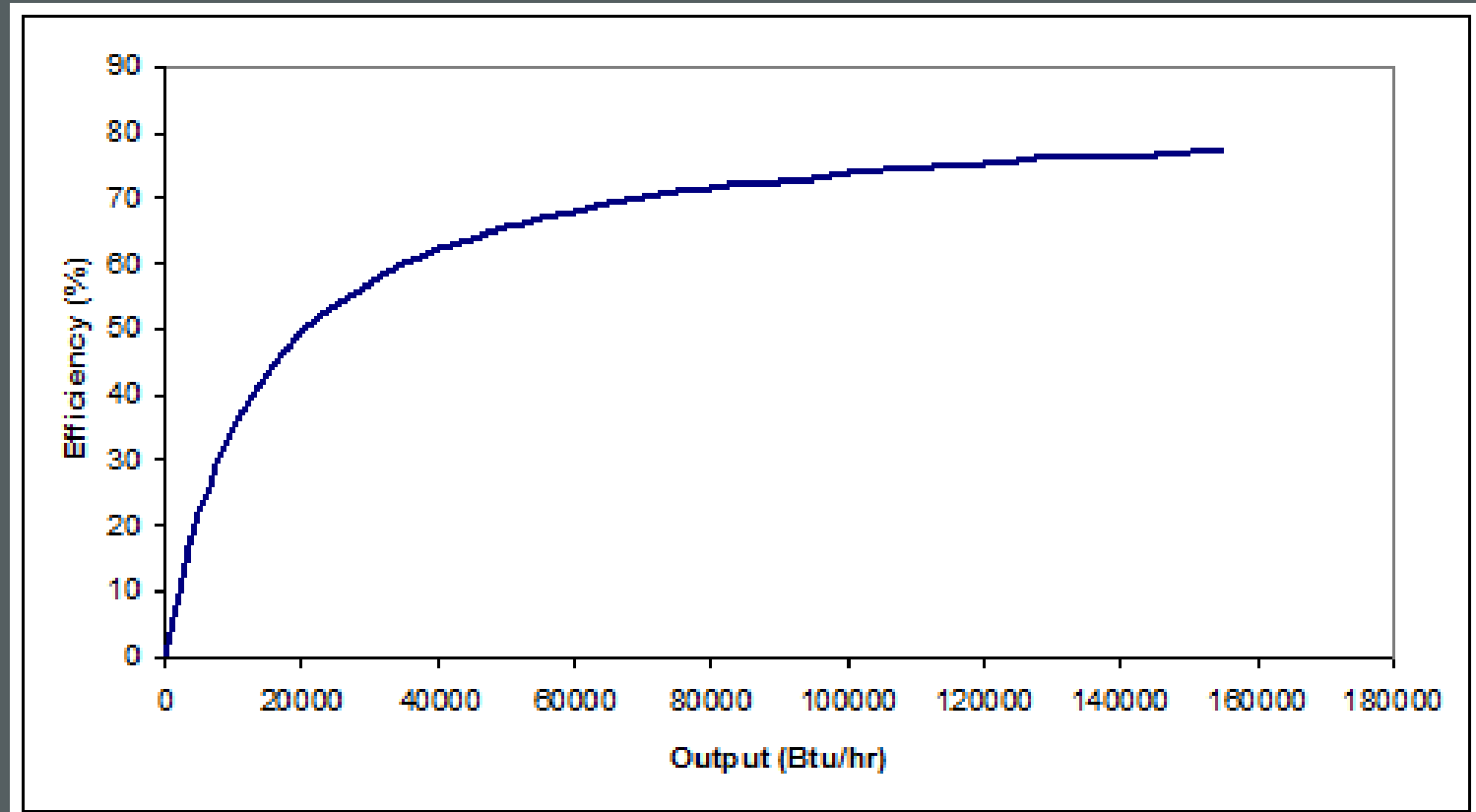
NYSERDA (2012)

All units responding to the same heat load with no thermal storage except for the US downdraft

Pellet – 0.08 lb/day
Oil-fired boiler – 0.004 lb/day
ULS HHO – 0.00004 lb/day

PM Generated per Syracuse Day for All Six Unit/Fuel Combinations.

Efficiency curve for pellet boiler



Determine the Heat Load

Method	Details	Accuracy
Manual J, Energy 10, DOE 2 etc	Insulation, solar gain, internal gains, temperature, infiltration, weather data etc	High
Square footage	How big is the house?	Low
Previous system	What was the output of the previous system?	Low

- Over sizing is very common
- NYSERDA programs require a Manual J (or equivalent) calculation to determine proper HVAC equipment sizing.

Boiler Sizing

- Sizing is a problem for all boilers and is especially challenging for solid fuels
- More challenging with larger fuel charge
- Auxiliary thermal storage serves as a major efficiency measure for staged combustion units resulting in lower emissions
- Pellet boilers also benefit from smaller buffer tanks

Development of test method for advanced cord wood boiler technologies with thermal storage



Thank you!



University of Massachusetts Lowell Center for Sustainable Production

Symposium held in November 2011

Focus on industrial, commercial, and institutional applications (non-residential)

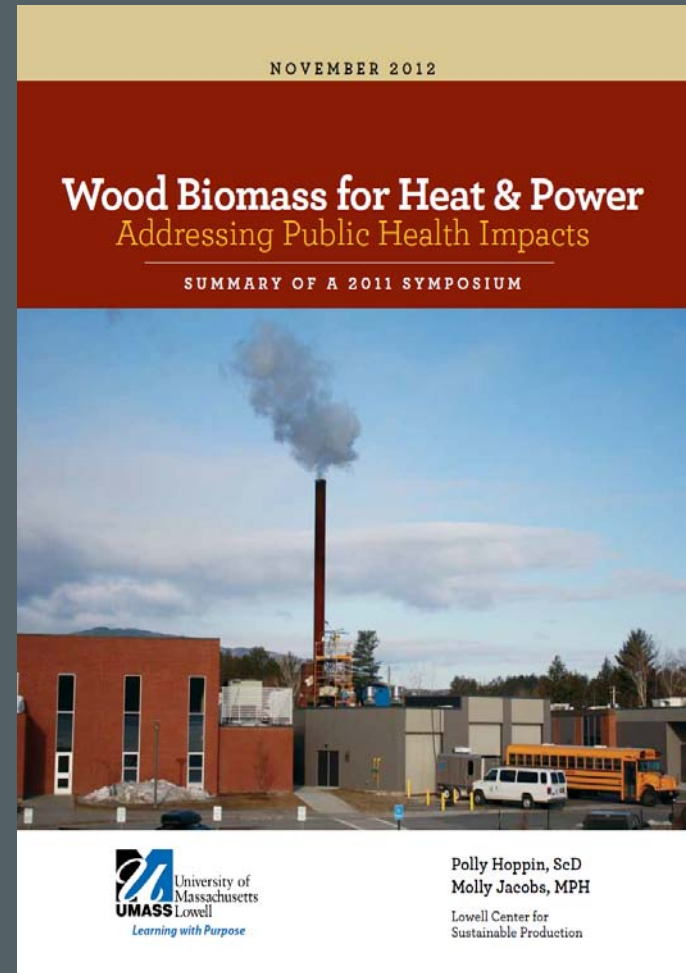
Broad stakeholder participation from 9 states:

- academia;
- state energy, environment, health, education, and forestry agencies;
- health advocacy; and
- biomass industry participants

State of the Science on Biomass Emissions and Health Effects

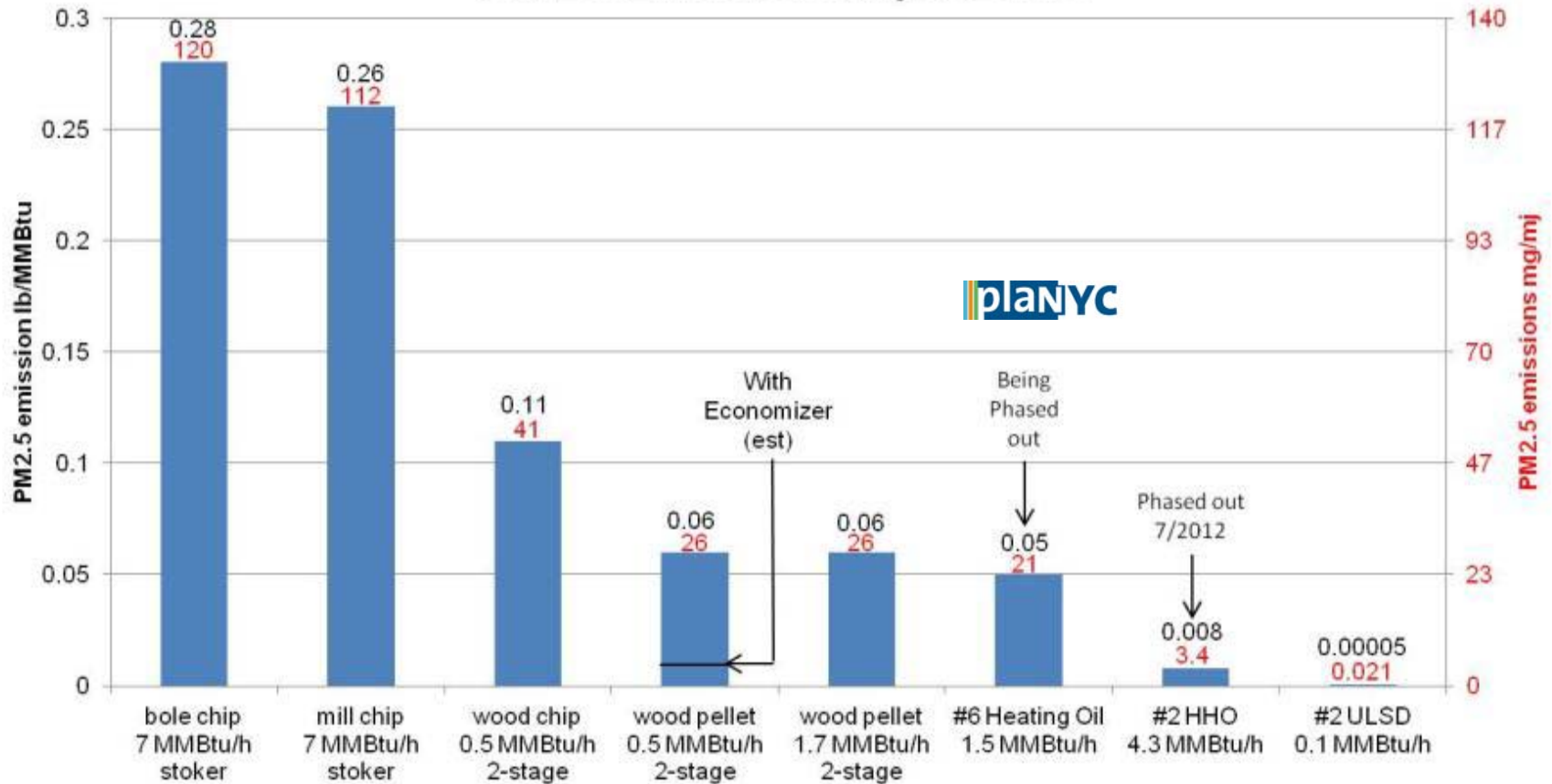
Recommendations and Priority Action Steps

<http://www.sustainableproduction.org/WoodBiomass.php>



PM 2.5 emissions on energy input basis

PM 2.5 Emissions Input Basis





NEXT GENERATION
Woodstove
DesignChallenge

The Next Generation Wood Stove Design Challenge is now underway! The Challenge seeks to promote next generation stove designs, build a community of innovators and showcase stove innovation to the public.

Popular Mechanics

ALLIANCE
FOR GREEN HEAT
clean, renewable & local



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