

# New Test Methods

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# Outline

- Current Test Method
  - Equipment based on
  - Key aspects
- Advanced Wood Boilers
  - Technical features
  - Issues testing with current method
- Test Method Developed
  - Goals
  - Key aspects of test procedure
- Observations about Performance
  - Different parts of operating cycle
  - Slumber and oversizing
  - Cold start and traditional boilers
  - Whats missing in our test methods?
- Future Plans

# Common “Outdoor” Wood Boilers

- Weatherproof enclosure;
- Buried piping to home;
- Large combustion chamber – store wood charge for multiple days – 200 lb wood;
- Large internal water volume – 150 gallons;
- “Cycling” units – under low loads air flow cycles on and off to match the output;
- Typically very much oversized;
- Older units were upflow, natural draft;
- Current new products often down flow, gasification with fans;
- Cold start only once per year?

Source: VT DEC with permission

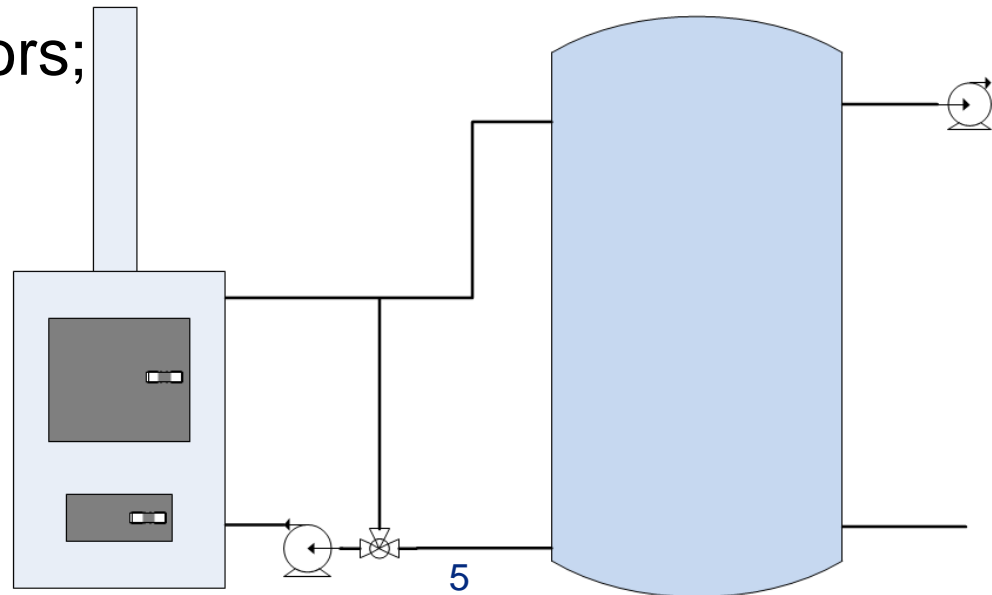


# Wood Boiler Test Procedure

- EPA Voluntary Program, Adopted by States;
- Four load categories;
- “Hot-to-hot”;
- In lowest burn rate category, operate in a cyclic mode – external thermal storage not considered in test procedure;
- Whole cycle averaged numbers;
- Crib wood.

# Advanced Wood Boilers with Storage

- Two-stage, downdraft gasification;
- Induced draft;
- Low water volume;
- Relatively small chamber;
- Must have external thermal storage;
- Cold start regularly;
- Advanced controls / sensors;
- Modulation?



# Example - Fröling Boiler



# “Partial” Thermal Storage

- Full storage refers to a system where the storage can absorb all of the heat in a full charge of wood.
- Full storage is considered too expensive for widespread useage;
- With partial storage, cycling can be dramatically reduced or eliminated if operated properly.

# Problems with Test Method and these Advanced Wood Boilers

- Current test procedure does not allow for storage;
- Without storage, these units will cycle and slumber, leading to very high emissions;
- Since they cannot be sold or installed without storage, this is a market acceptance barrier;
- With storage, cold start operation is more common and needs to be included.



# PTS Test Method Developed by BNL

- Cord wood based;
- Full-load hot-to-hot;
- Low load cold-to-cold;
- Allows for reduced testing;
- Manufacturer defines minimum storage volume;
- Captures different parts of firing cycle.



# PTS Test Method Developed by BNL

- Accepted by NY DEC;
- Rigorous attempt to match the field operation of these units;
- Less costly test to run but captures critical cold start and burn-out periods.

# Acknowledgements -Sponsors

- New York State Energy Research and Development Authority
- U.S. EPA

Special thanks – Scott Nichols, TARM USA – for use of boiler, storage tanks, auxiliary equipment for year+ test program.

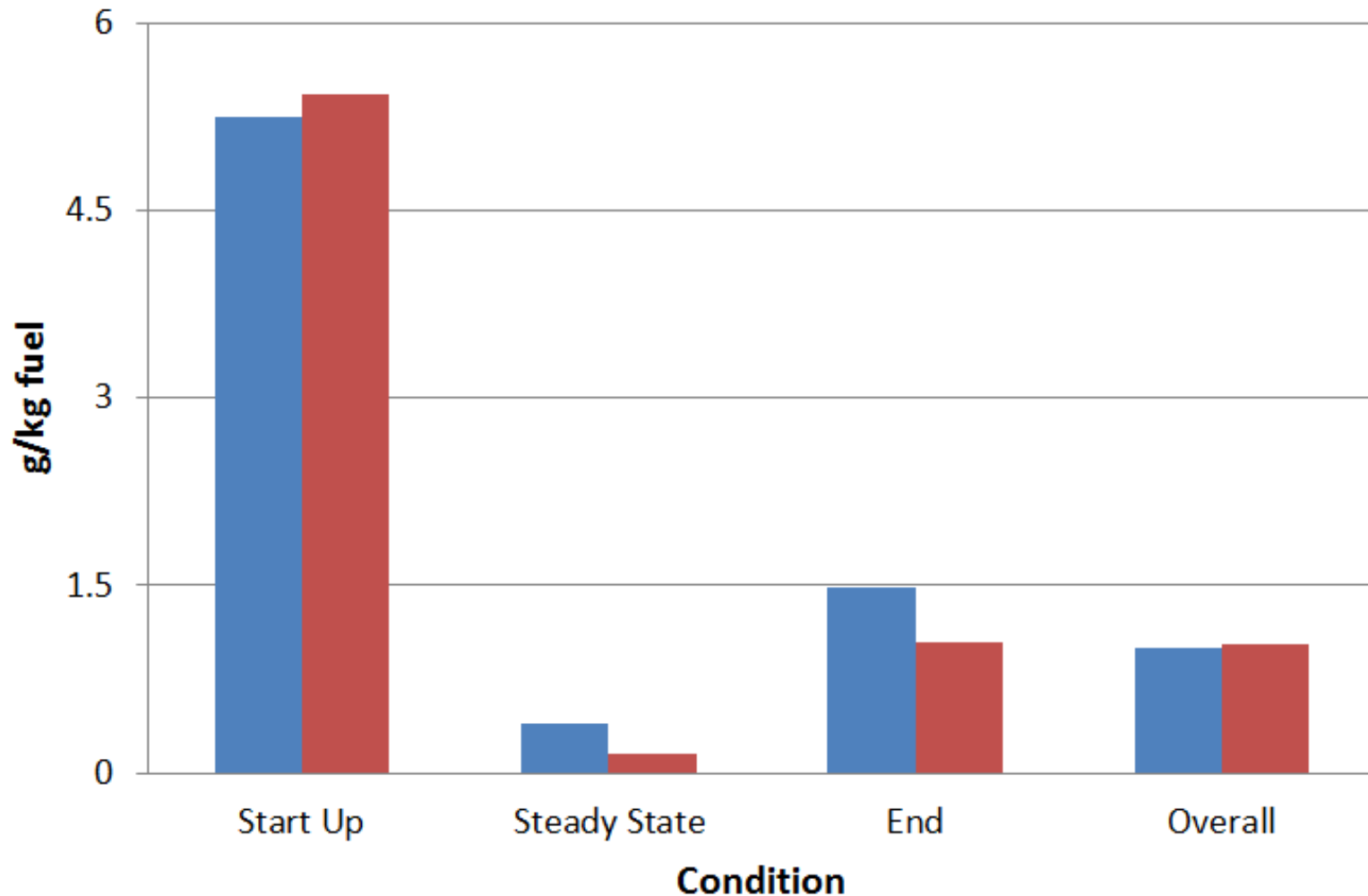
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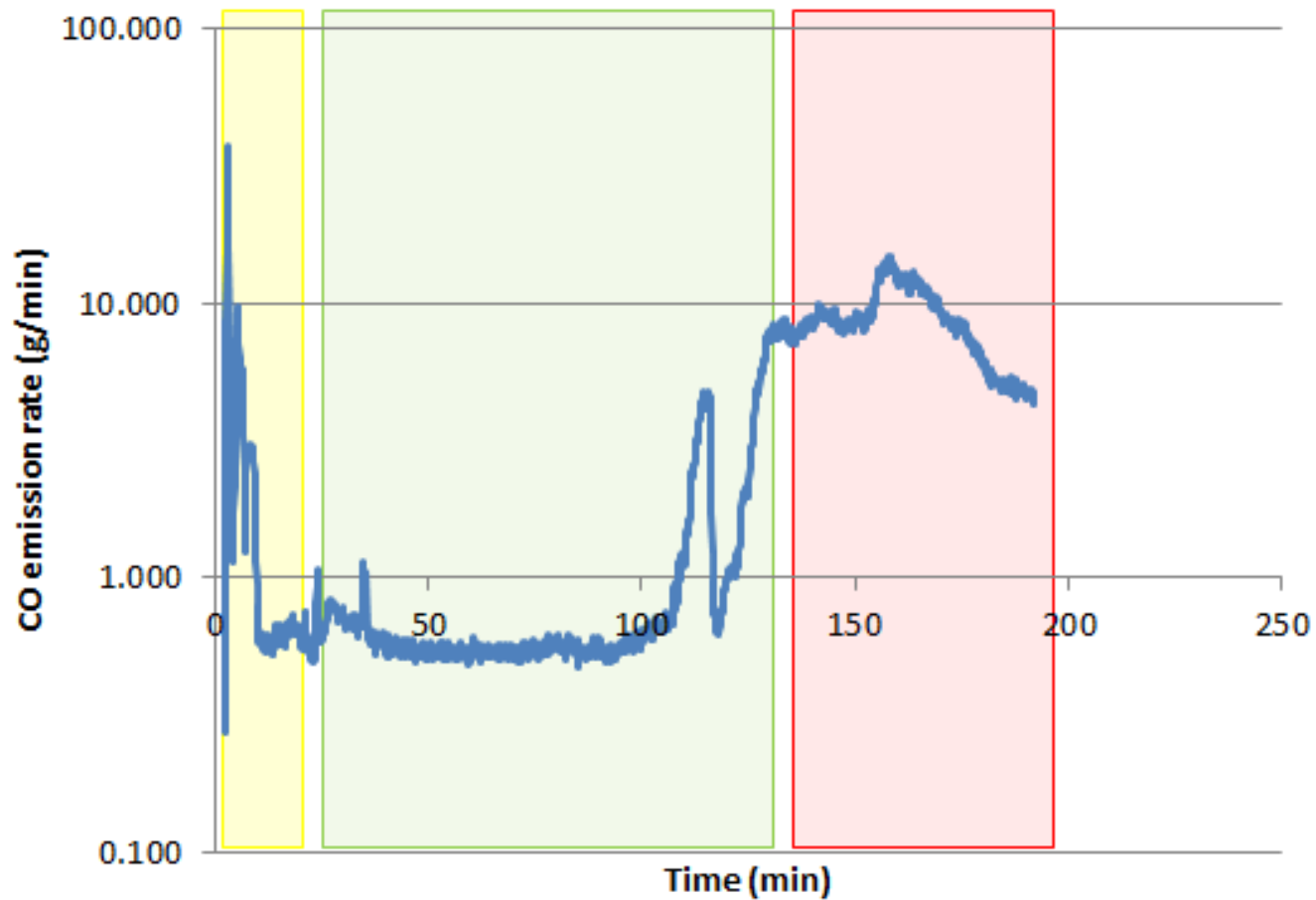
# Acknowledgements -Supporters

- ThermoControl
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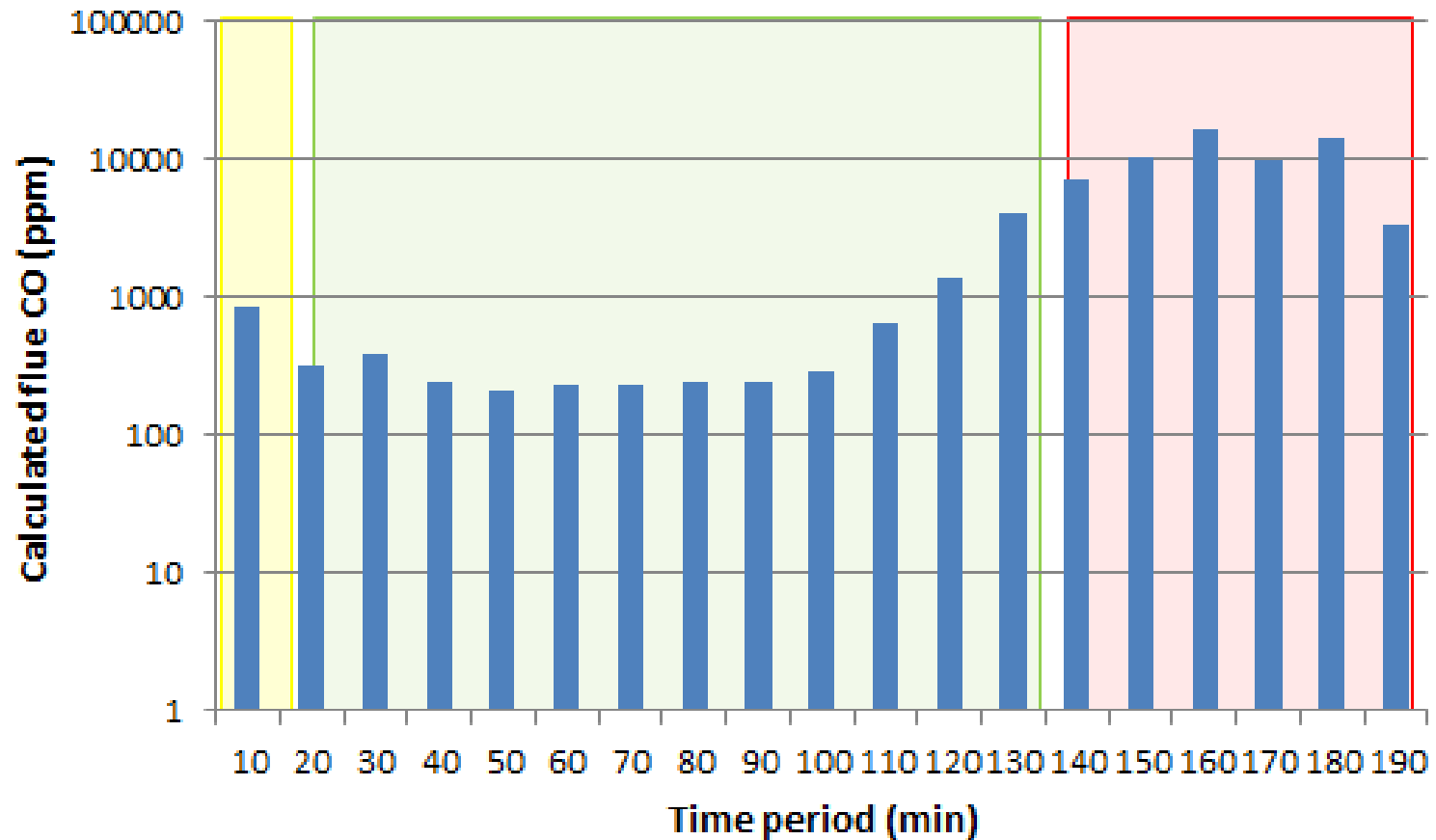
# Example PTS Test Results



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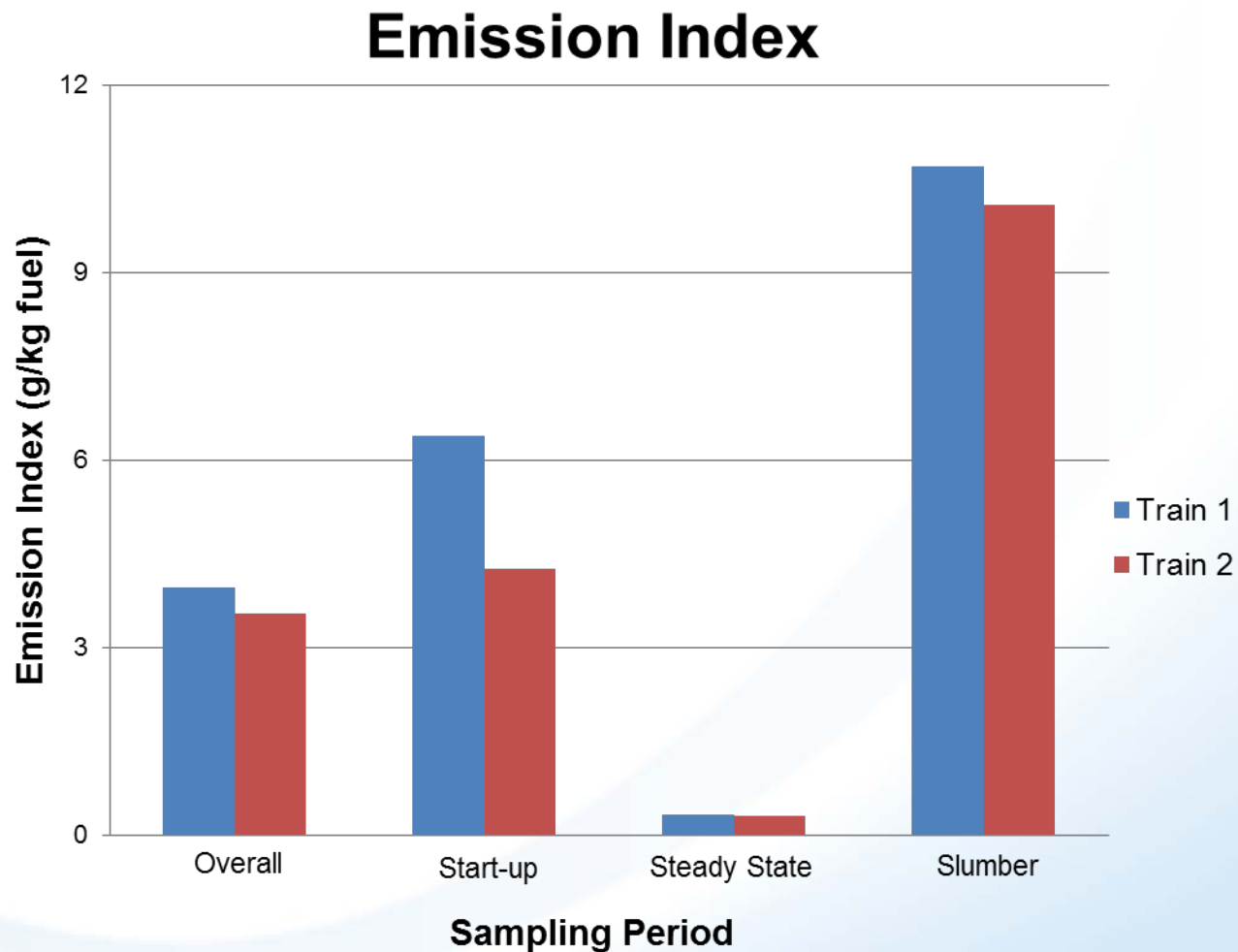


# Example PTS Test Results

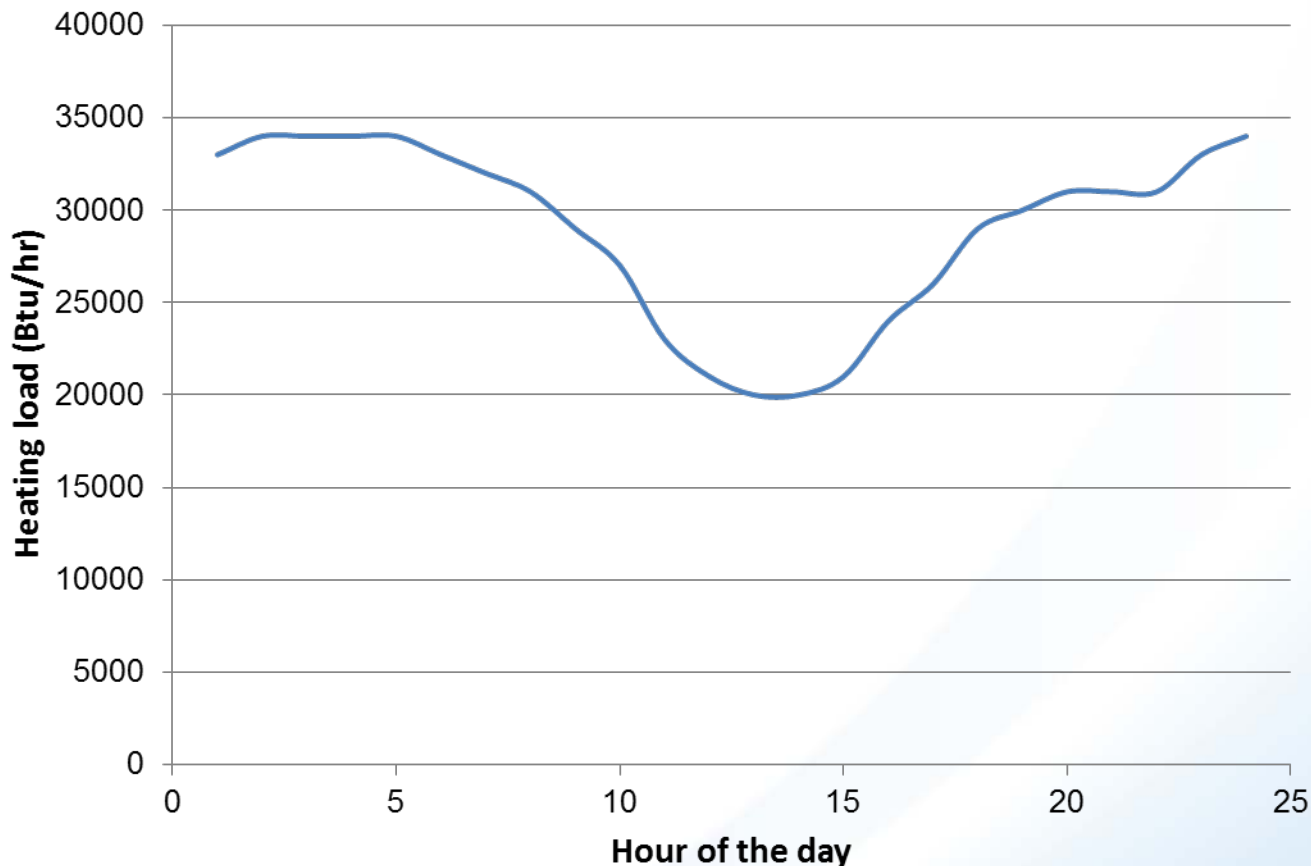




# Impact of Inadequate Storage

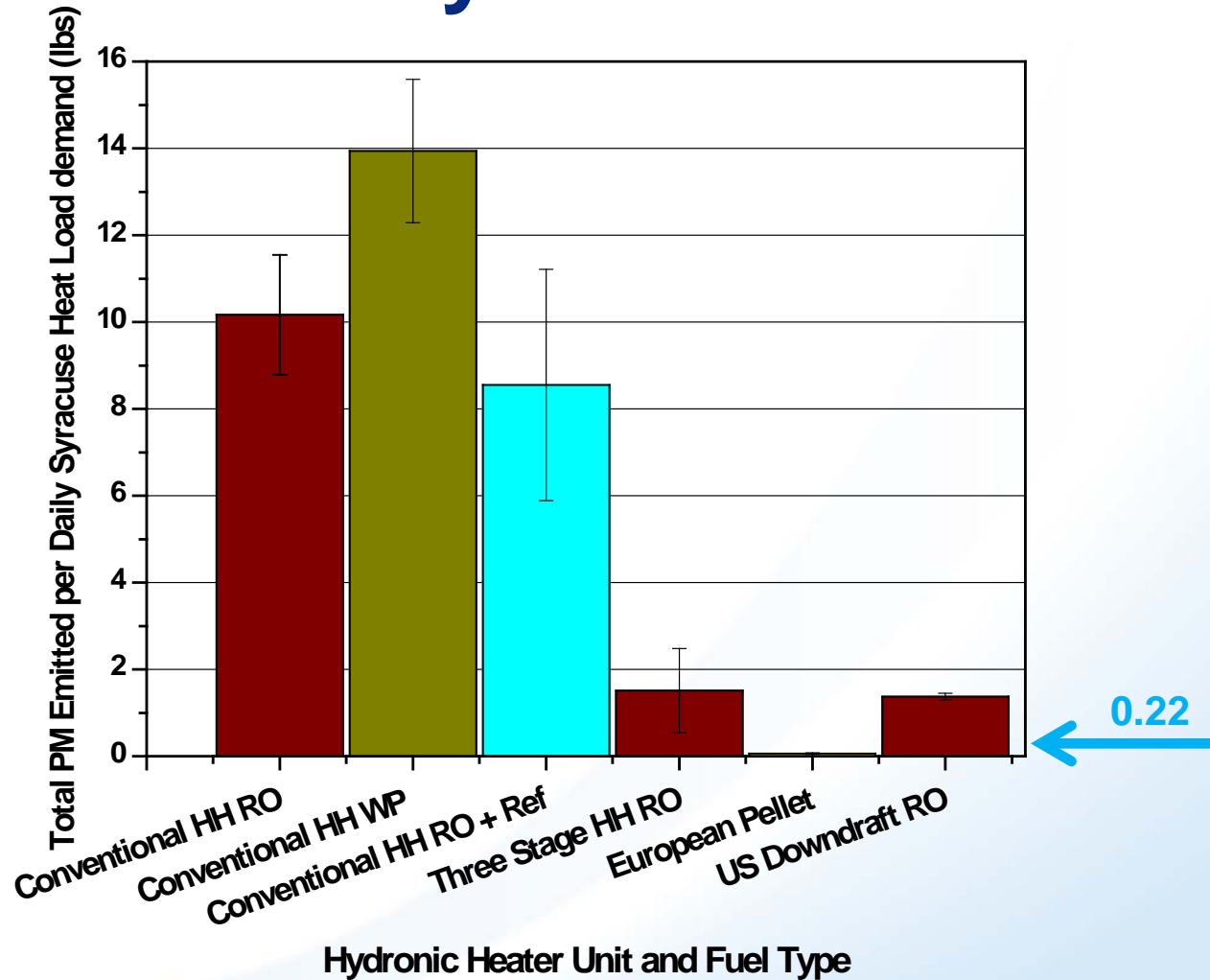


# Analysis of PM Emissions on a Typical Winter Day



Source: Environmental, Energy Market, and Health Characterization of Wood-fired Hydronic Heater Technologies, Report prepared by U.S. EPA Office of Research and Development, submitted to NYSERDA, June 2012.

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# Analysis of PM Emissions on a Typical Winter Day – Comparison with Other Fuels

- Conventional HH – 10.0 lb/day
- Pellet – 0.08 lb/day
- Oil-fired Boiler – 0.004 lb/day
- ULS Heating Oil – 0.00004 lb/day

# Next Steps

- New collaborative project with NESCAUM;
- Concepts for next generation tests method which can capture field operation in a more realistic way;
- Includes cold start for all units;
- Dramatic reduction in test burden;
- Integrates real-time PM emission rate measurements.

# Thank You!

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