Preliminary Findings from State of Minnesota's Condensing Boiler Efficiency Assessment

Actual Boiler Efficiency Has Long Been An Issue

"What is the actual overall seasonal efficiency that an engineer can expect from a relatively new and efficient natural gas-fired steam boiler plant?"

Real World Seasonal Efficiency
of Gas Fired Steam Boilers

ASHRAE Journal Sept. 1994

IDEA - 1914 Proceedings

"In several cases people have brought up with us the question of the relative economy or advantage of heating from their own steam as against district heating; and in every case we have asked them to take into consideration the actual cost to them by operating their own system."

Condensing Boilers

- Lower natural gas prices, aggressive utility rebates and the promise of exceptional efficiency is encouraging use of condensing boilers

Condensing Boilers vs. District Heating

- Condensing boilers
  - Consume firm natural gas.
  - Specialized repair for electronics
  - No back-up unless installed separately
- District Heating
  - Interruptible gas and other fuels (biomass, fuel oil, coal, solar thermal).
  - Simplified interface - one heat exchanger, one control valve (typ).
  - Inherent reliability - multiple boilers and fuel sources

Acknowledgements

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MINNESOTA DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

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How Condensing Boilers Outperform Conventional Boilers

- Conventional Boilers
  - All “steam” goes out the vent
  - Safety factor to prevent condensation limits efficiency

- Condensing Boilers
  - A portion of the steam is used for heating
  - No safety factor

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System and Load Affects on Condensing Boiler Efficiency "Boost"

- Outdoor reset control
  - Lower return water temperature = condensing boiler efficiency improvement
  - Reduces load from overheating and pipe heat loss
- Lower flow (e.g. pump VSD & 2-way valves)
  - Pump energy savings
  - Low return water temperature = condensing boiler efficiency improvement

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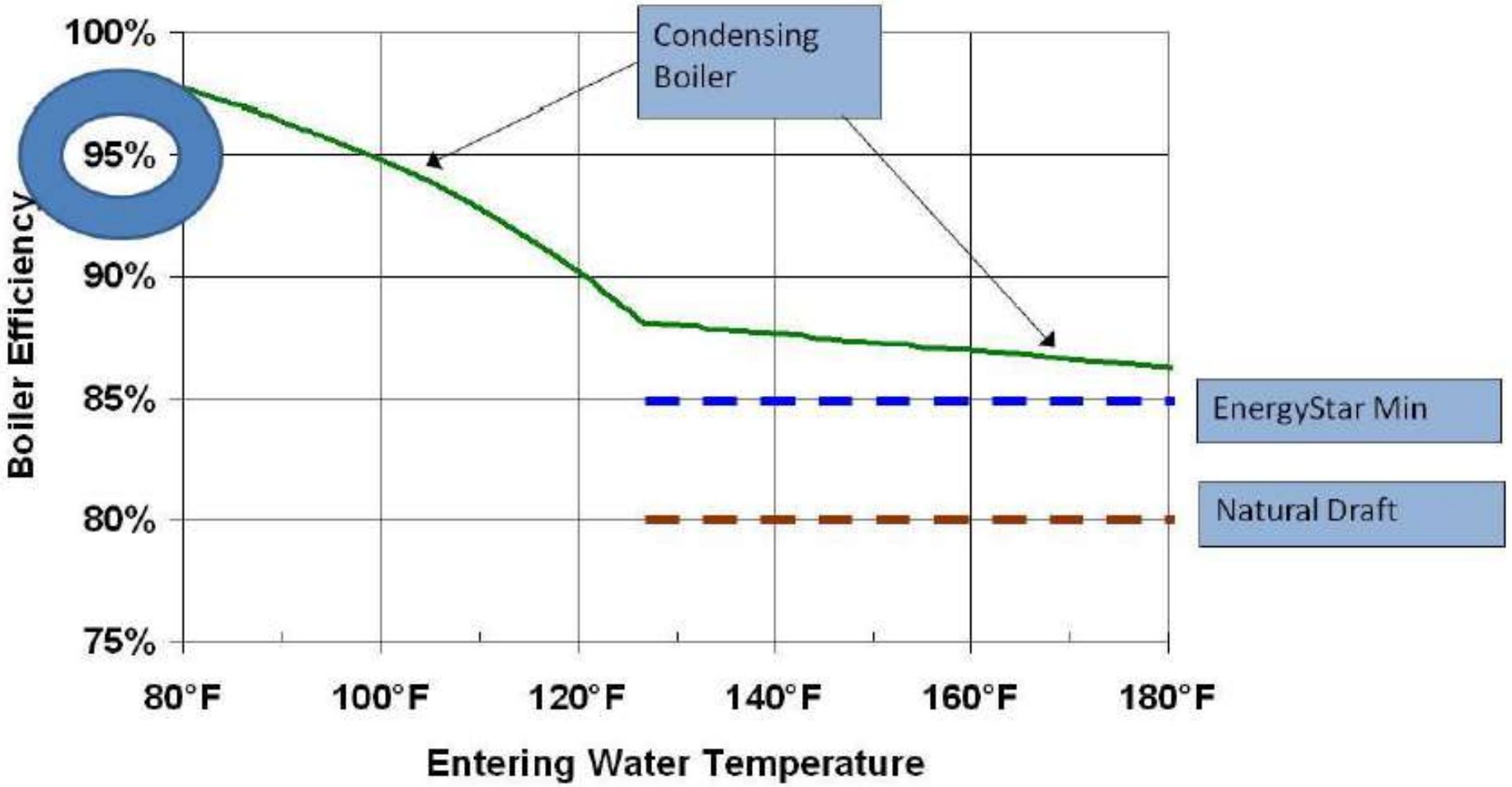
Getting The "Rated" Efficiency Boost Out of Condensing Boilers (>90% Efficiency)



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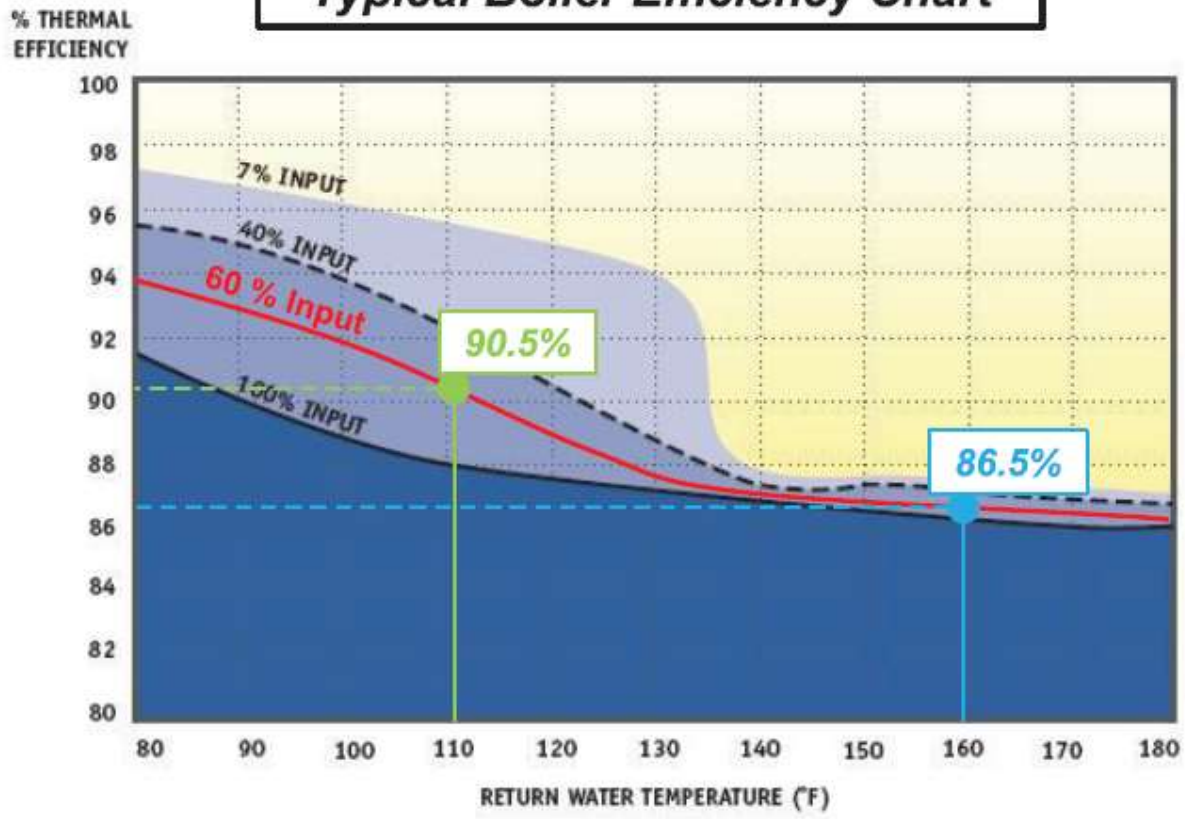
Boiler System Efficiency Details

Typical Boiler Efficiency Chart



Part Load Efficiency Impact

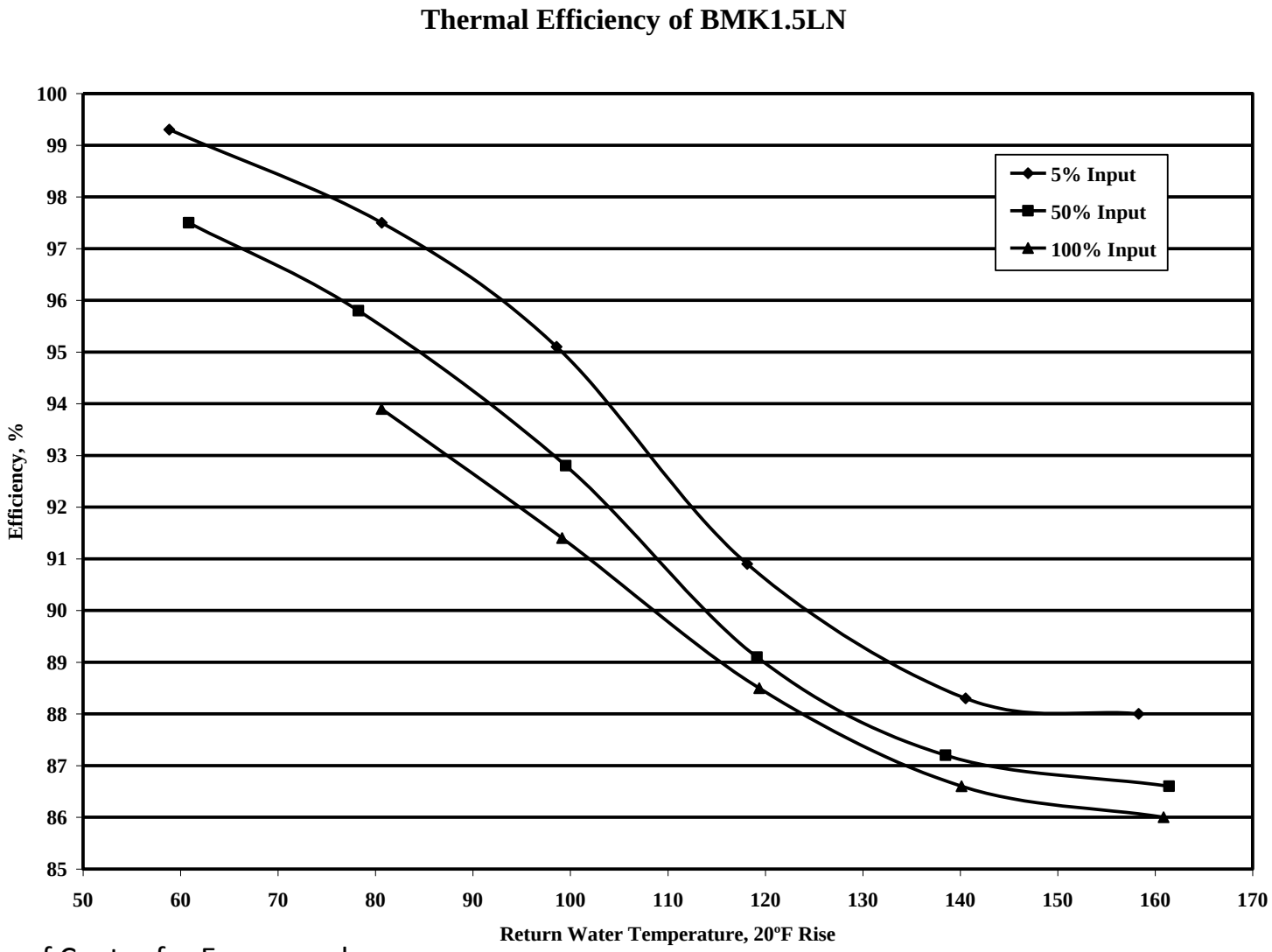


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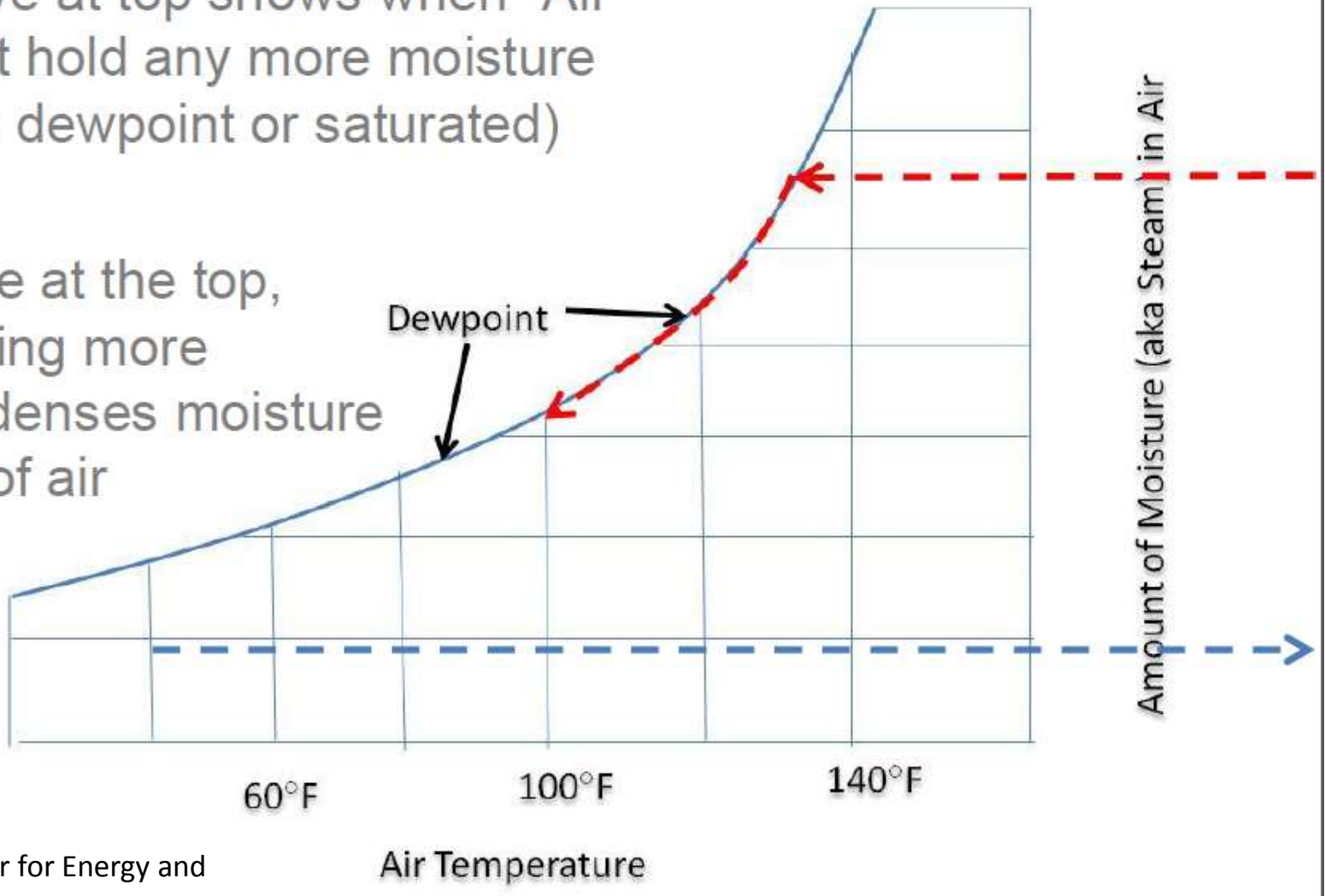
Chart for Showing Moisture in Air Issues

- Curve at top shows when "Air" can't hold any more moisture (aka dewpoint or saturated)
- Once at the top, cooling more condenses moisture out of air



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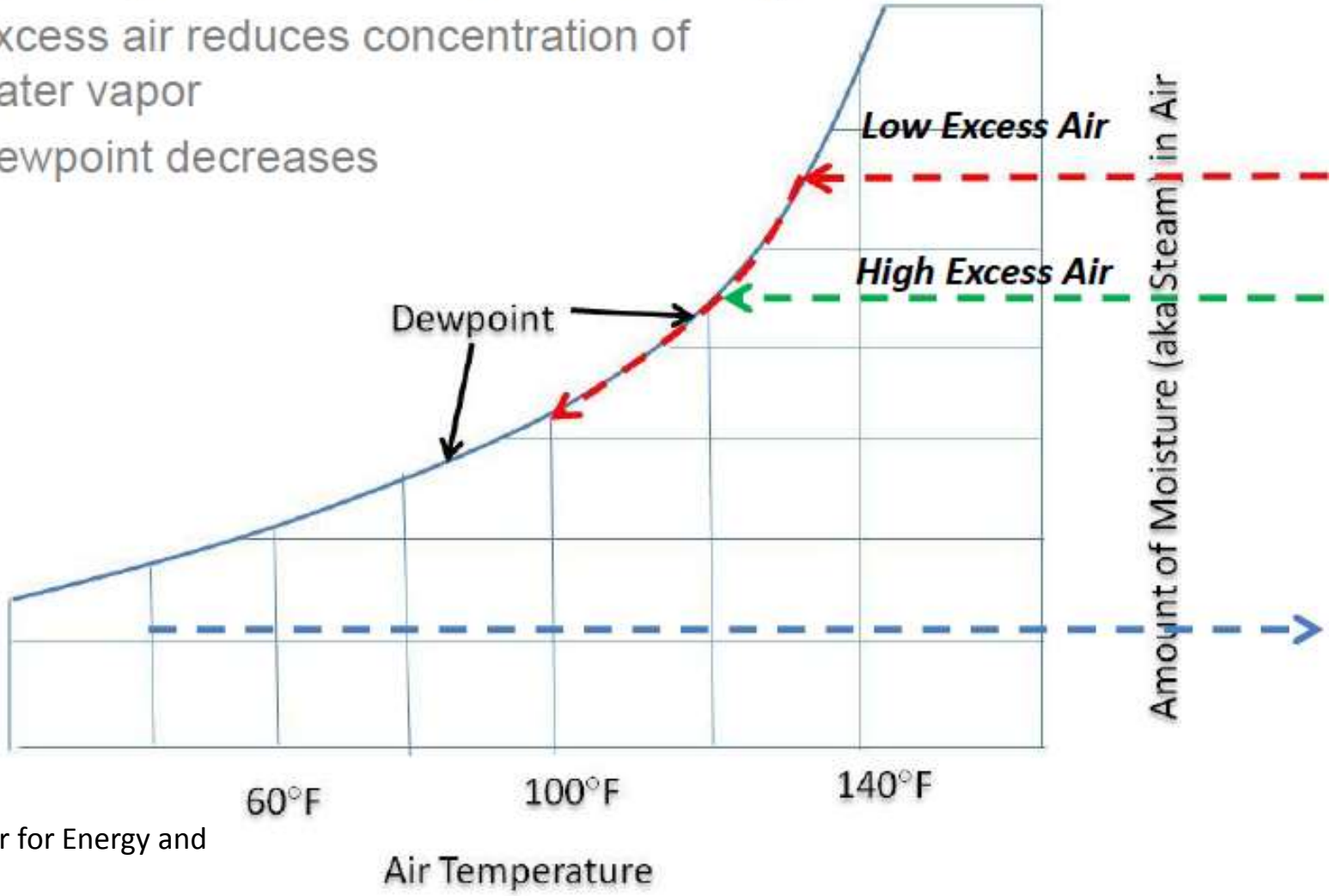
Condensing Boiler Sensitivity to Excess Air

- Controlling excess air even more important
  - Excess air reduces concentration of water vapor
  - Dewpoint decreases



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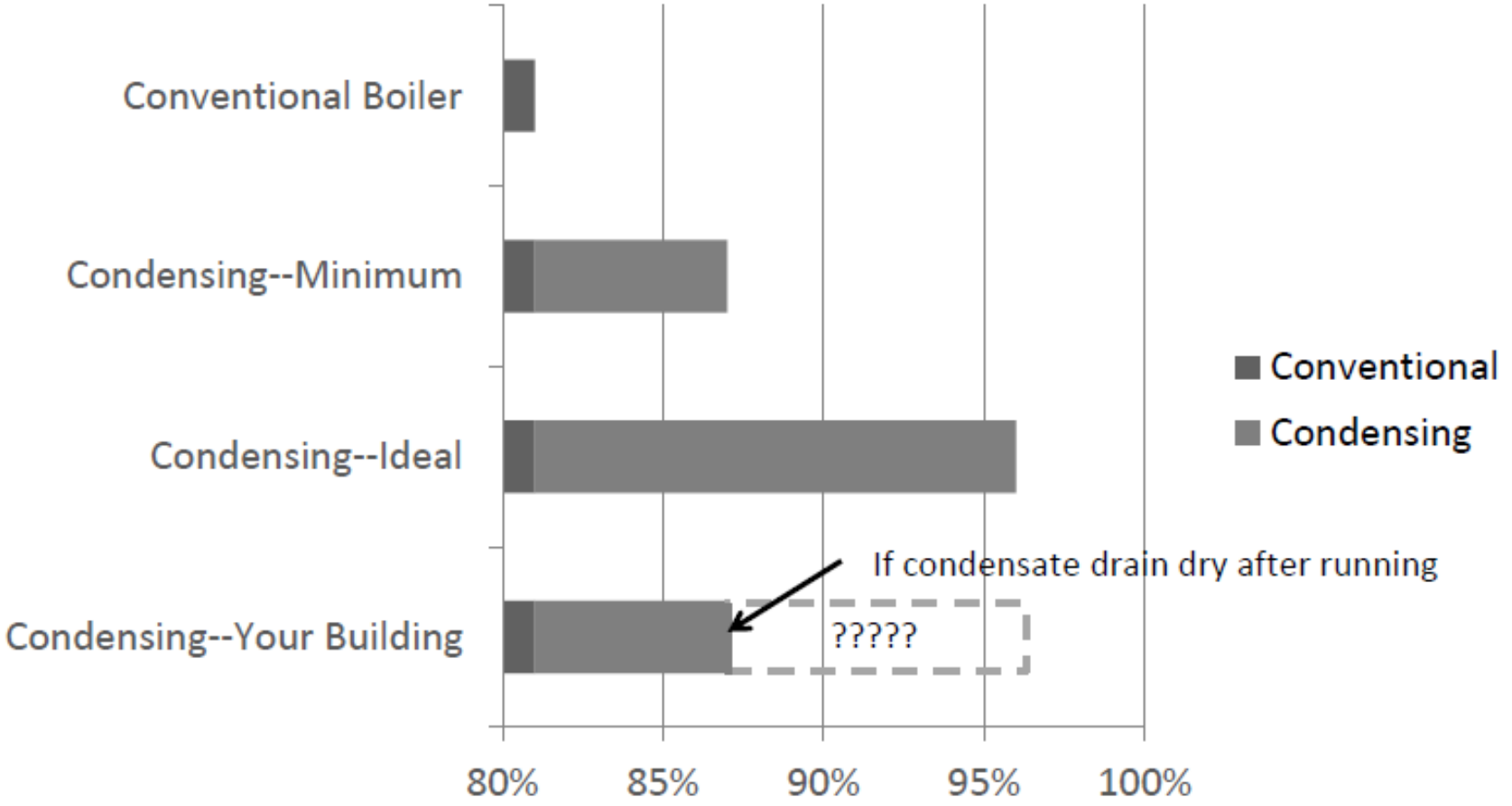
Condensing Boiler Efficiency Improvement



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Minnesota's Condensing Boiler Market: Preliminary Findings

- Condensing boilers have become the default choice
- Used in all building types that have space heating boilers
- Manufacturer's reps acknowledge often suboptimal situations
- Part-load efficiency improvements may be significantly overstated in some cases

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Project Overview: Condensing Boiler Optimization

- Market Study & Site Selection
- Monitoring & Analysis of 12 Building
  - 4 Education
  - 4 Multifamily
  - 4 Government/Office
- Industry Survey of CIP Program Options
- Dissemination

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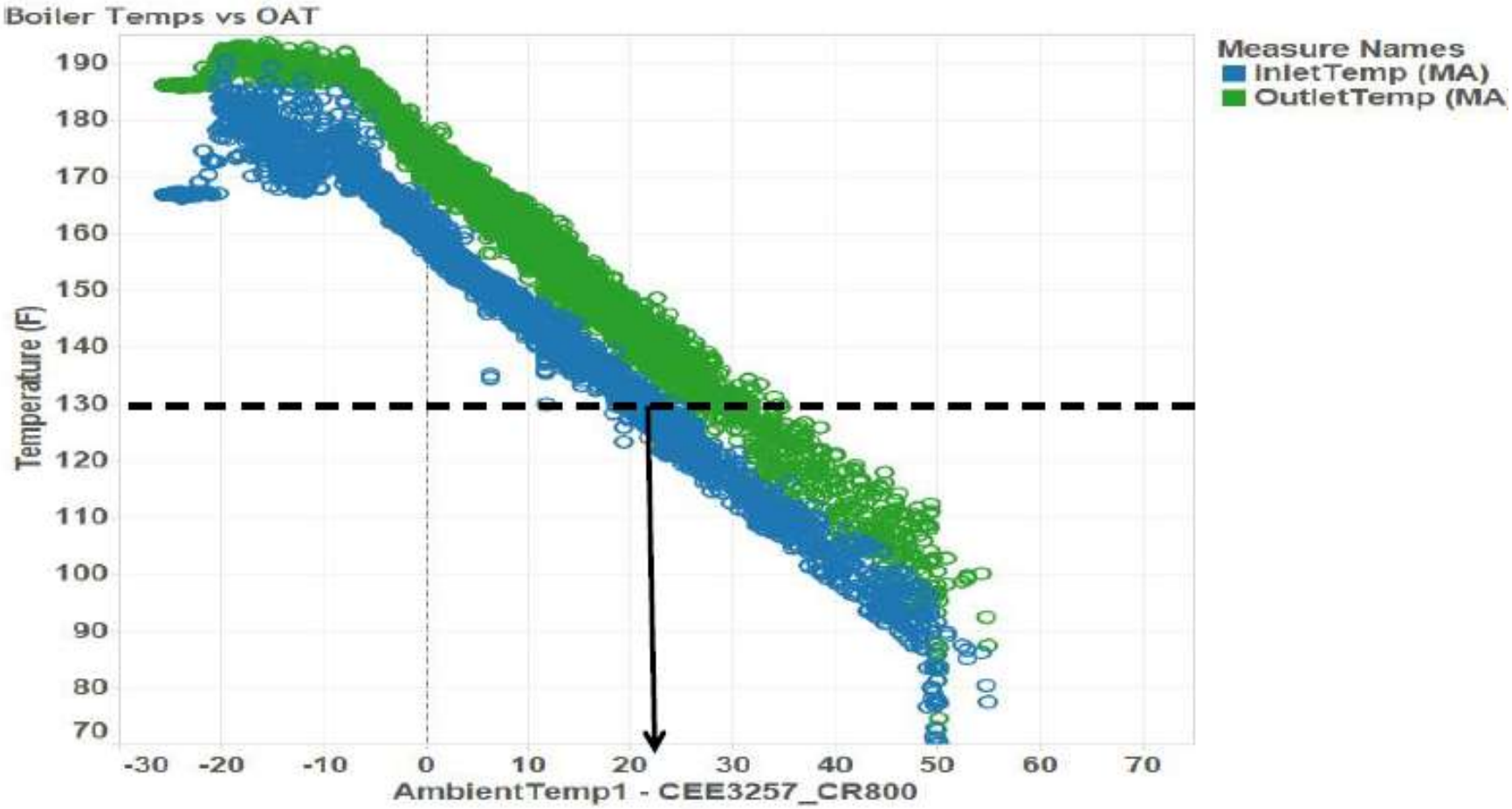
PRELIMINARY RESULTS

Water Temperatures: Outdoor Temperature When 130°F Reached



Preliminary Results

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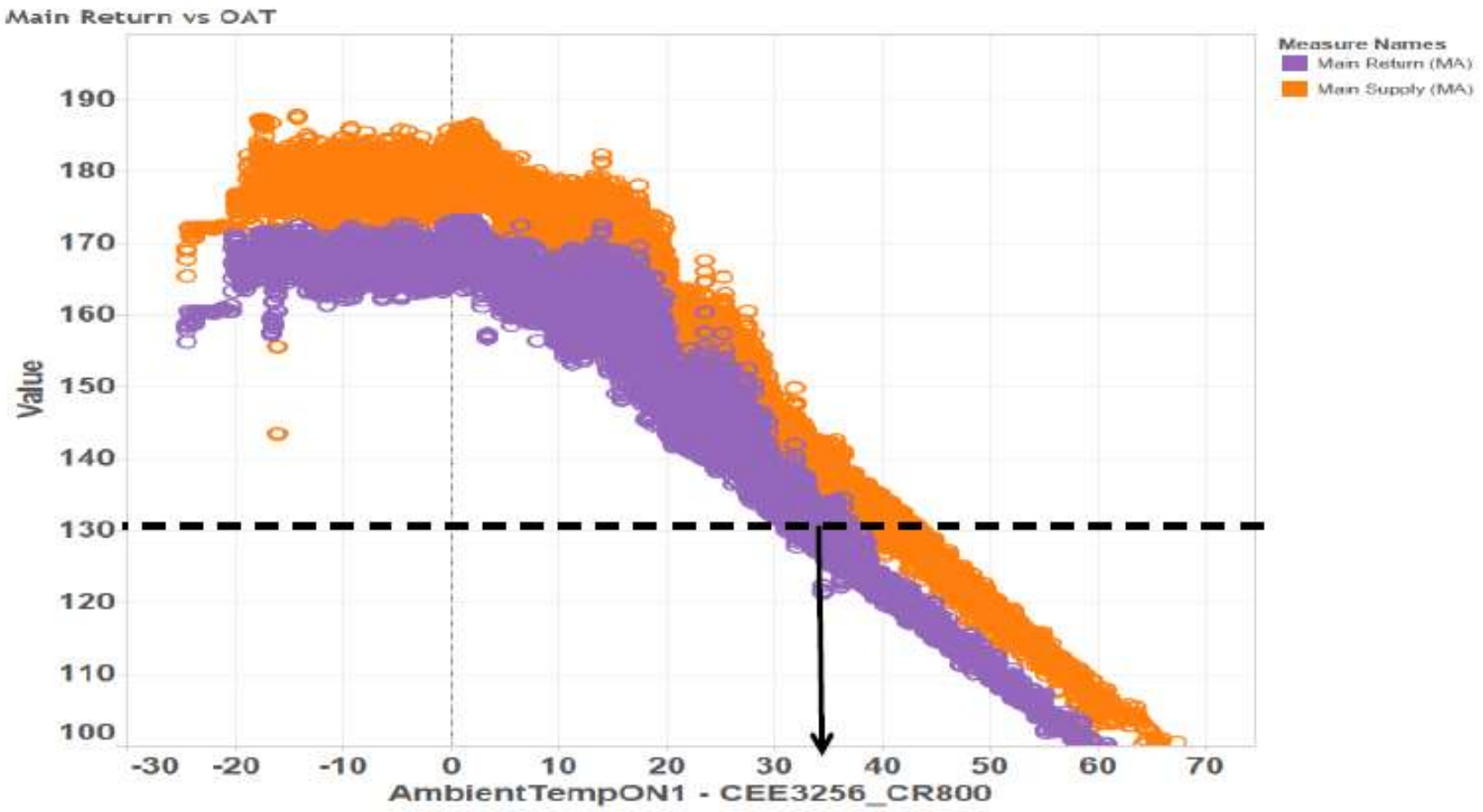

Preliminary Results

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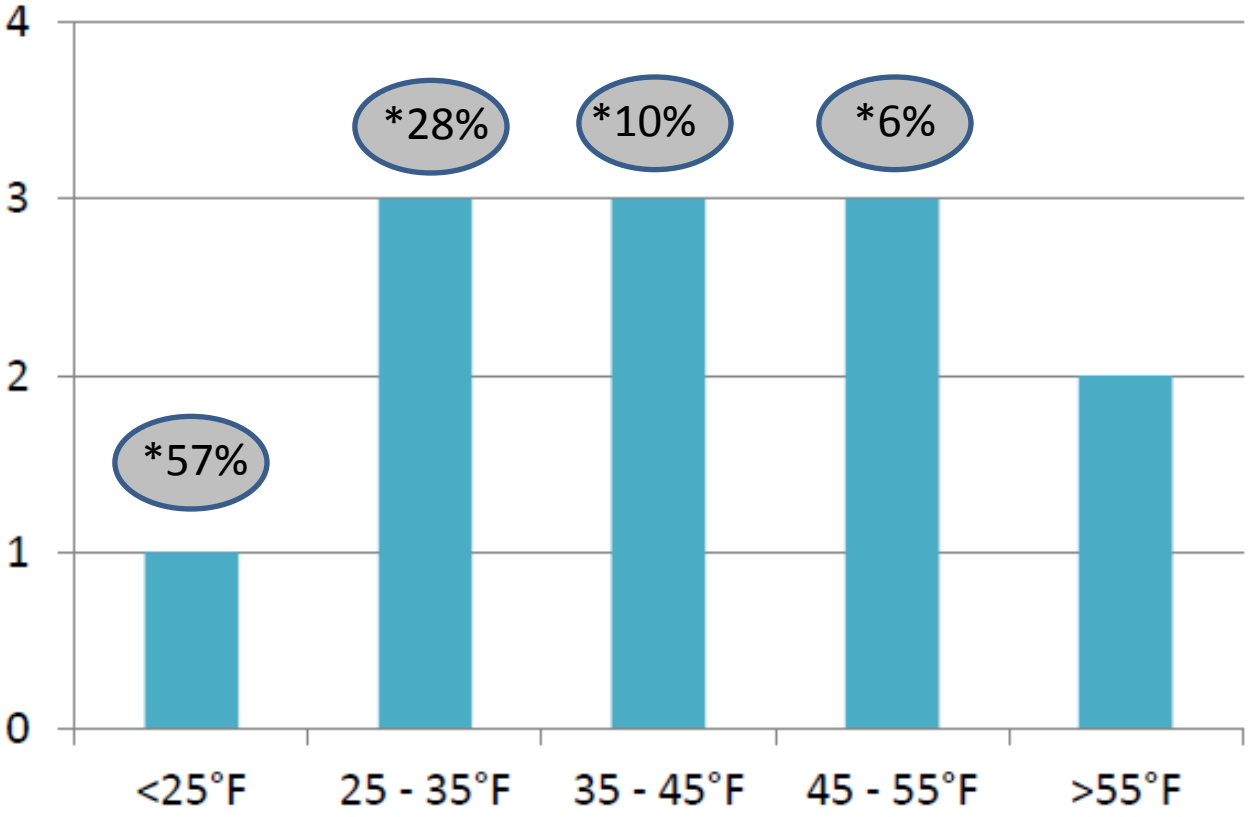

*** Percentage of Building Load and Heating Season in Minneapolis/Saint Paul**

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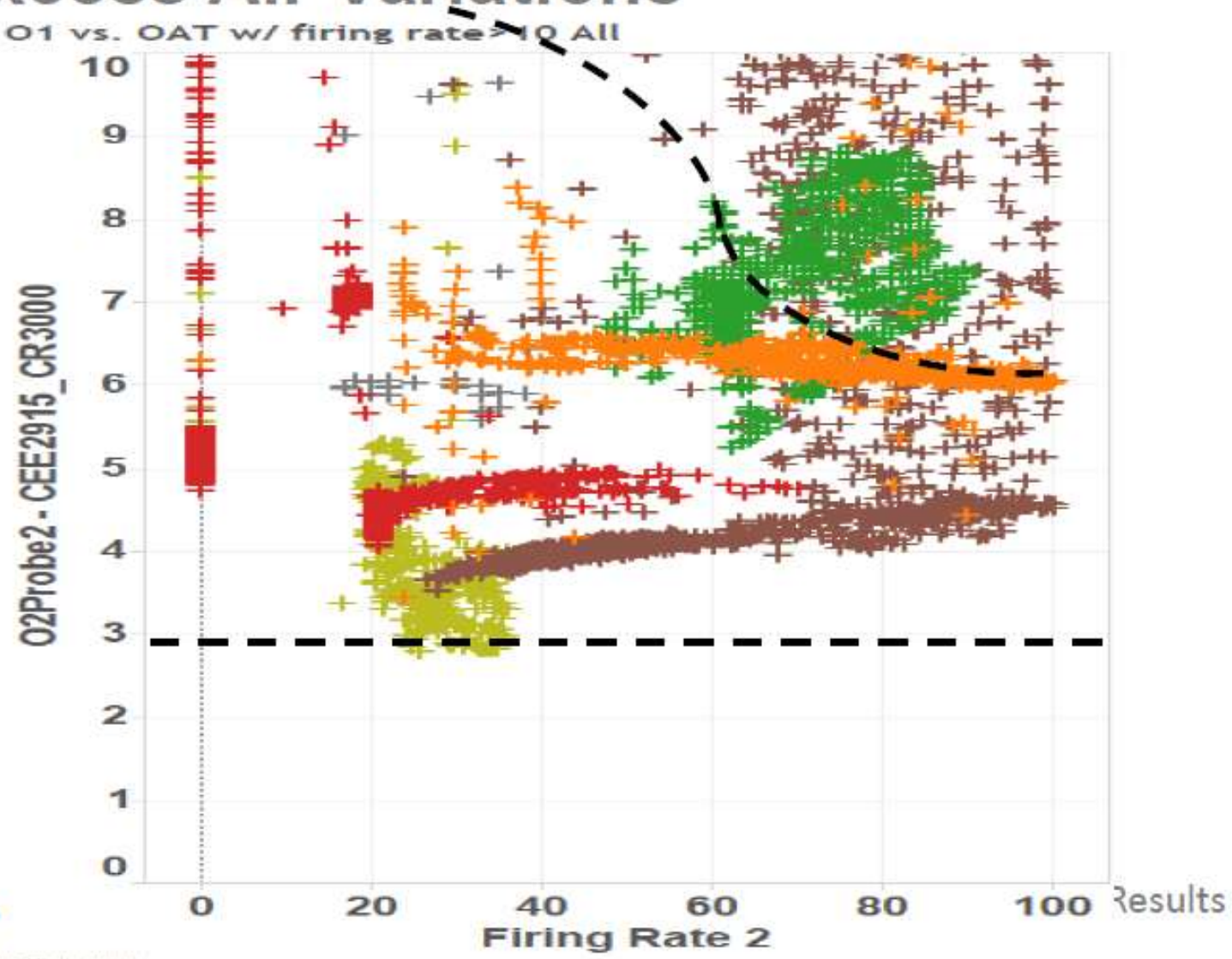
Background Slide Courtesy of Center for Energy and Environment.
Heating Season Analysis by Ever-Green Energy

PRELIMINARY RESULTS

Excess Air Variations



Results

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Next Steps

- Center for Energy and Environment will conclude analysis later this year
- Report complete early 2015
- CEE has been invited to present results at IDEA Conference in Toronto
- State of Minnesota Division of Energy Resources is interested in your feedback/questions

Questions?

Jeff Volovsek
jeff.volovsek@ever-greenenergy.com

Ken Smith
ken.smith@ever-greenenergy.com

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