High Efficiency Tankless Coil Boilers and Mini-Split Integration

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Technical Workshop
Sept. 14, 2016

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Background

- In 2015, in response to NYSERDA PON 2606, NORA submitted a proposal for a cost-shared project to develop two Best Practices Guides;
- One of these is focused on how to achieve the highest possible efficiency with tankless coil boilers;
- The second is focused on best practices for the integrations of high efficiency, mini-split heat pumps with existing oil-fired boilers;
- The proposal was accepted but NYSERDA requested this be split into two separate projects;
- The contracting process between NORA and NYSERDA is nearly complete and the project will formally start.

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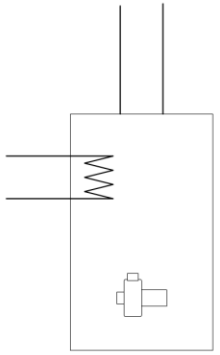
Tankless Coil Boilers



- A popular, low cost oil-heat option;
- Low annual efficiency as boiler must remain hot during non-heating season;
- Prior tests at BNL have shown common tankless coil boilers to have very high idle losses, leading to really poor annual performance;
- Over time, the heat transfer performance of coils decreases leading to the need for higher setpoints to meet DHW needs;
- One older tankless coil boiler removed from the field had an idle loss in the 4% range and a summer domestic hot water production efficiency in the 25% range;
- Poor performing tankless coil boilers often have significant uninsulated surface area;
- Some manufacturers produce tankless coil boilers with much lower idle loss but have no means to market the benefits of this.

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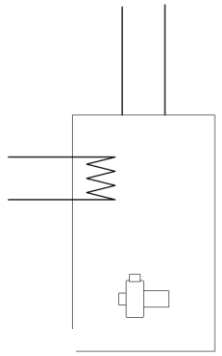
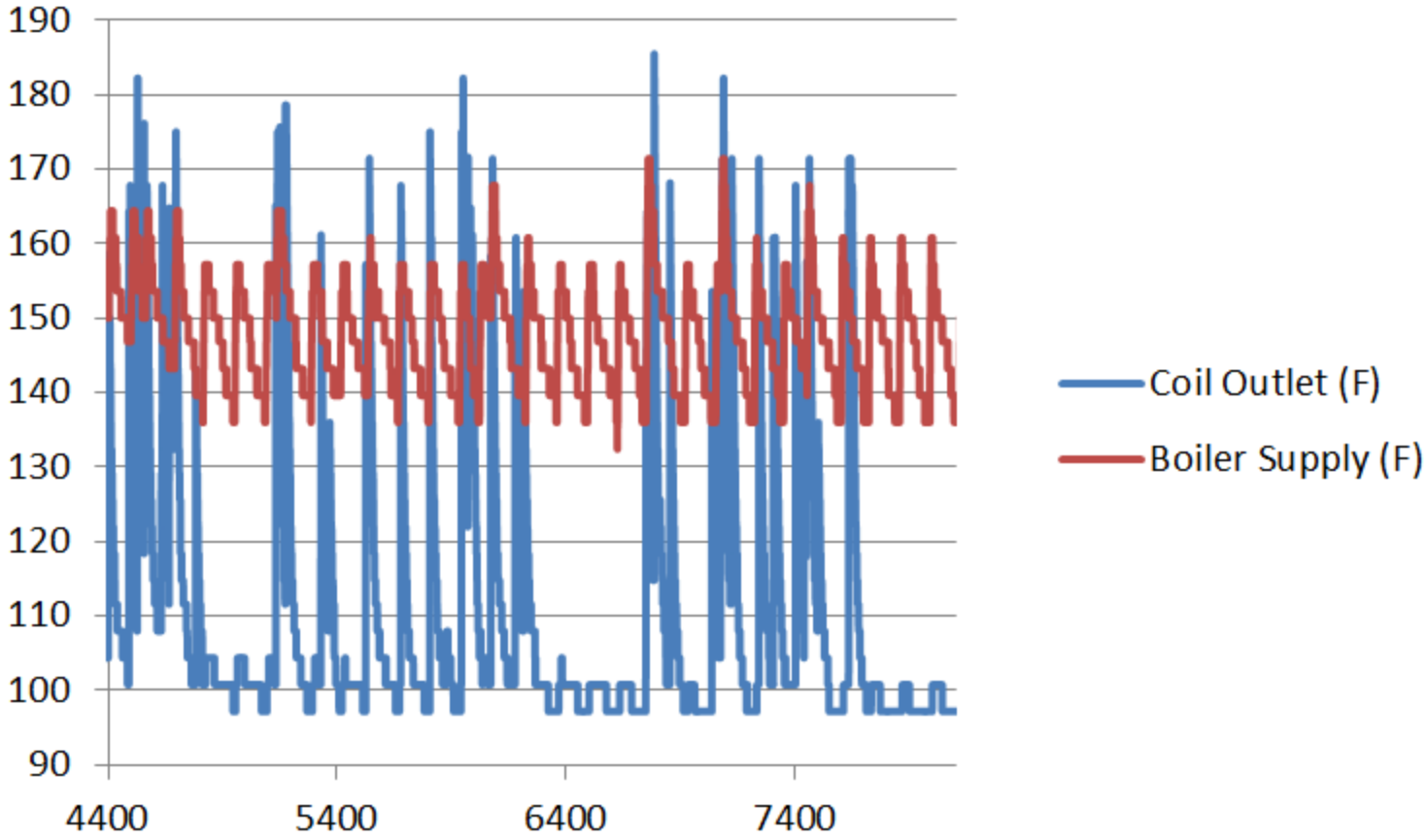
Tankless Coil Boilers

Example field data – low limit set at 180 F





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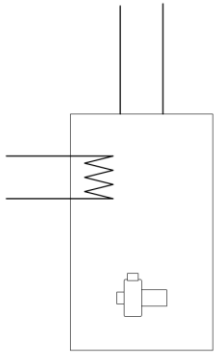

Major Project Tasks

1. Technology Review – meet with manufacturers, identify technologies for lab testing;
2. Lab Performance Testing – idle loss, steady state full load, emulated summer and winter operating periods.
3. Analysis and best practices guide

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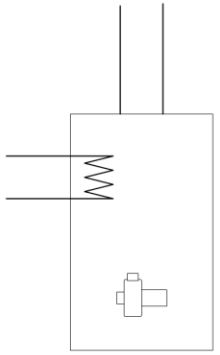

Current thinking – how to economically achieve high efficiency

1. Increased heat exchanger surface area to enable lower setpoints;
2. Improved boiler jacket insulation;
3. Controls which allow idle operation at low temperature and higher temperature only during periods of DHW demand;
4. Low boiler mass to enable rapid response to DHW demand;
5. Modulating or High/Low fire to enable low temperature idle with fast response.

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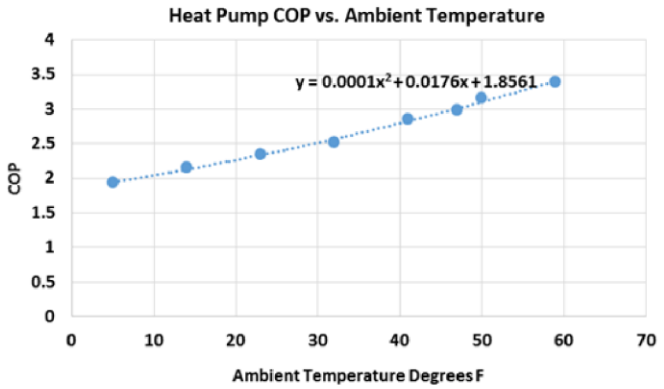
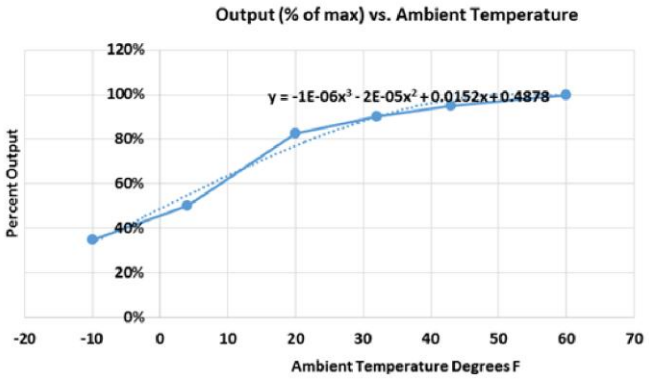
Integrated Hydronic and Mini-Splits

Background

- Modern, low-ambient mini-split heat pumps can achieve high COP's for heating under colder outdoor conditions;
- Installed primarily for cooling, these may be able to economically take some of the heating load;
- There is interest in this approach as an approach toward achieving regional greenhouse gas reduction goals;
- The installation and control details vary and actual achieved cost and emission savings are very site specific.





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Integrated Hydronic and Mini-Splits

Tasks

1. Host Site Selection – 6 homes with existing hybrid heat pump oil-fired boiler installations;
2. Field evaluations – document control strategy, log system temperatures;
3. Annual performance evaluation – building, heat pump, boiler system, energy cost models. Estimate annual savings in costs and emissions;
4. Best Practices Guide

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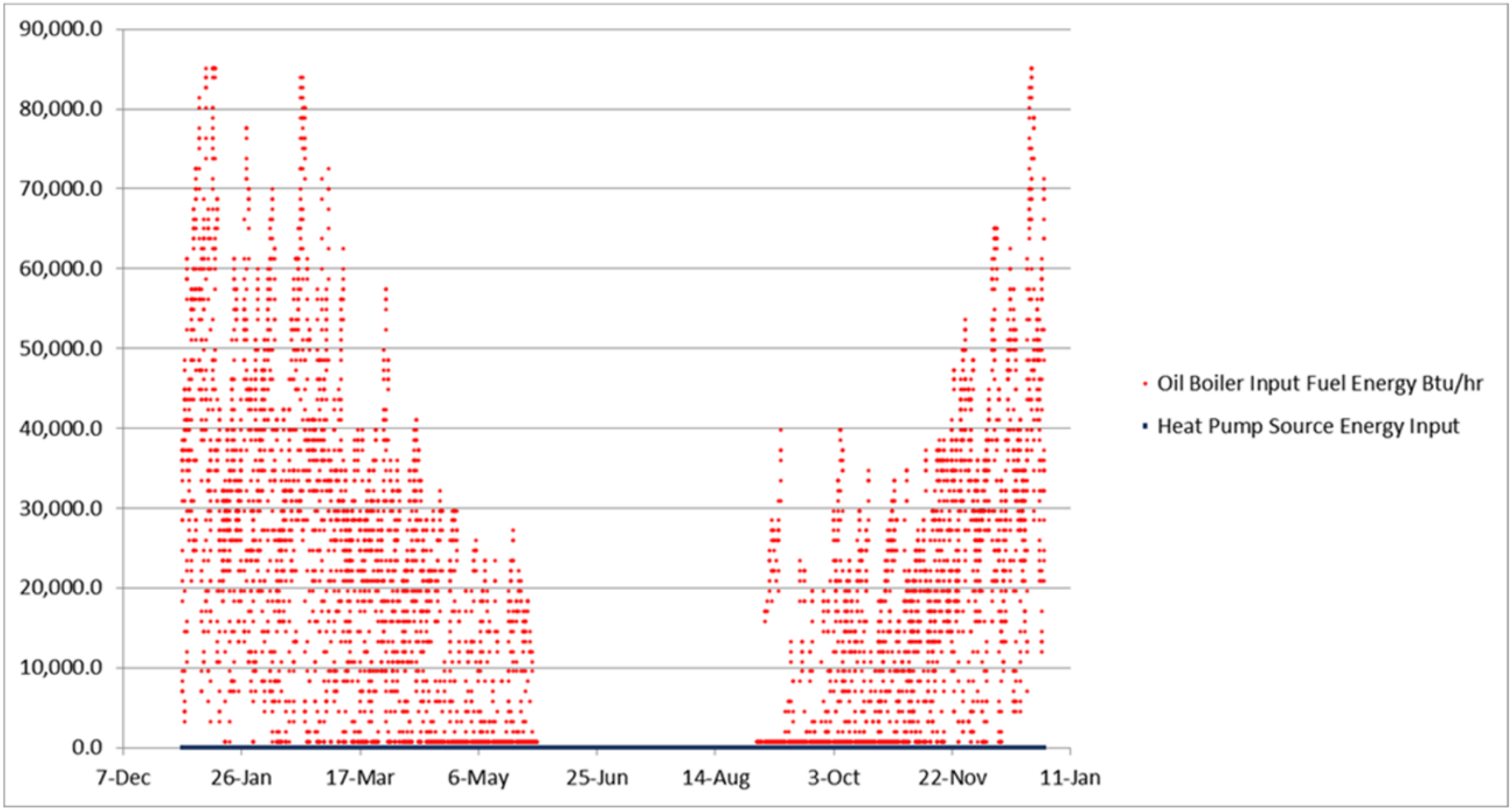
Boiler only operation



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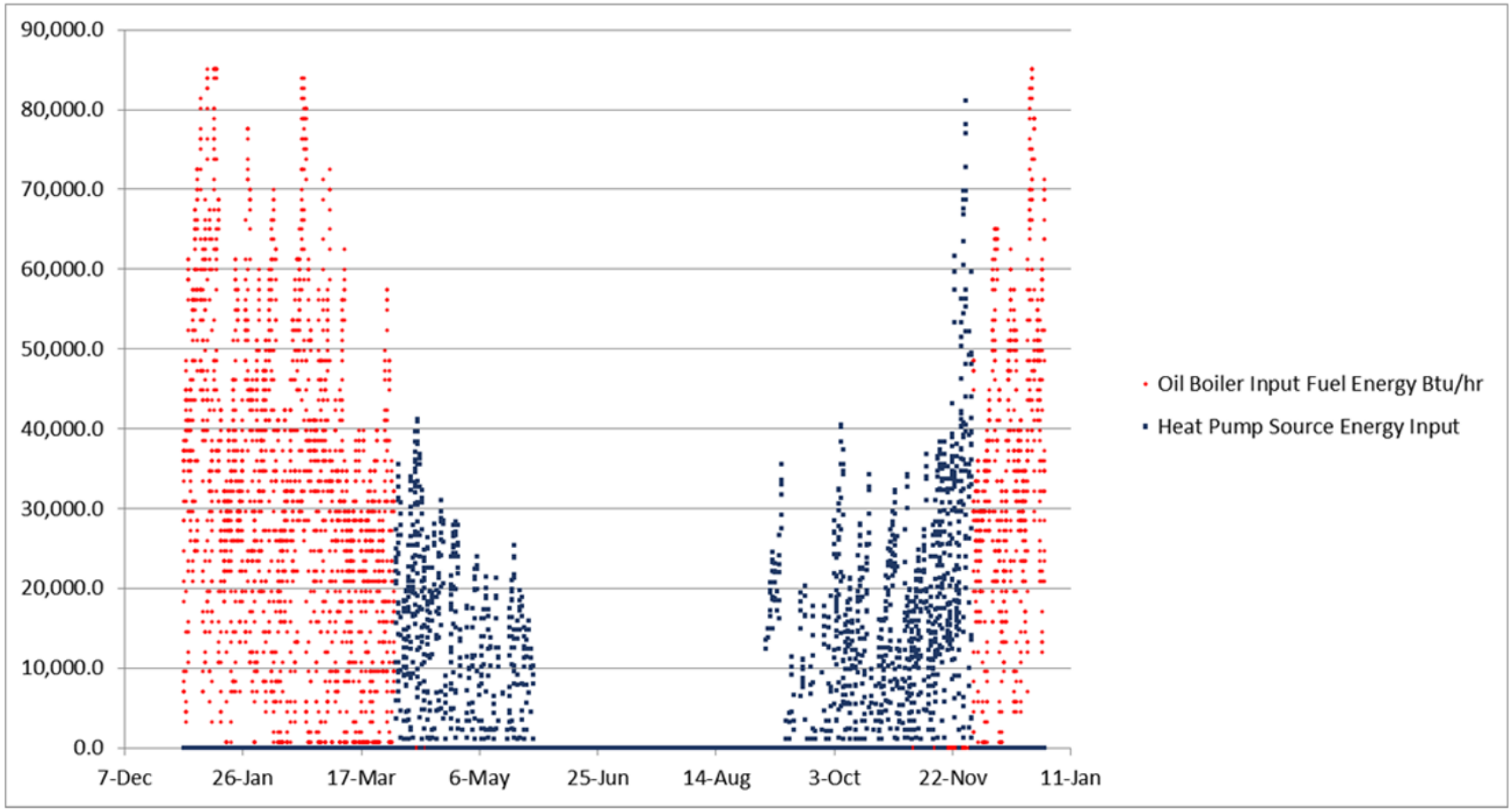
Boiler operating in winter (December, January and February) and Heat Pump Spring and Fall



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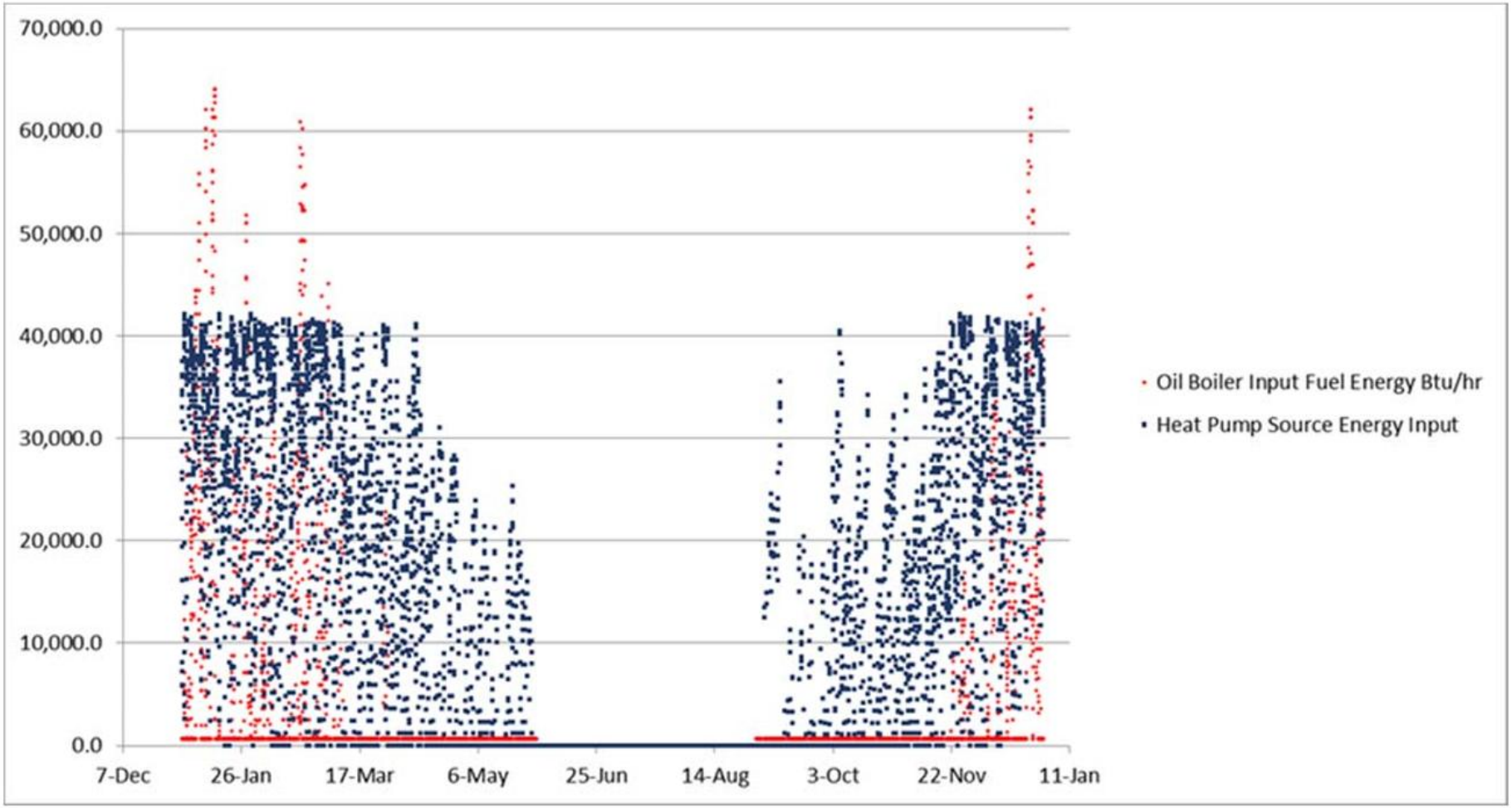
Heat Pump primary heating and Boiler Back-up when HP runs out of capacity



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Other factors:

- Preliminary assessment shows unacceptable payback periods if installed as a heating efficiency measure;
- Reduction in CO2 impact to be assessed – strong function of heating oil bio-blend level and electric power source;
- Mini-splits provide local comfort – expect a heat distribution concern;
- Heat pumps achieve best performance under spring/fall conditions which boilers achieve best performance under high winter load conditions;
- Concern over potential for pipe freezing under some conditions.

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