Technical Report – Energy Savings from the Addition of a TPI Room Thermostat and TRVs to a Domestic Heating System

June 2014

About These Tests

The Energy House

The University of Salford Energy House is a traditional 1900’s end terrace two bed-room property that sits inside an environmentally controlled chamber. It has solid brick external walls (with lime plaster internally), a mixture of brick and plasterboard internal walls, single glazed sash windows, timber boarded floors and lath & plaster ceilings. The loft of the house is insulated with 100mm Knauf Insulation Eco Roll mineral wool (of the type available with government subsidy for DIY fitting). The house is fully decorated, furnished and functional.

An adjoining property is also present to one side of the Energy House. This is an empty insulated space that is used as a conditioning void.

The Energy House is fitted with numerous sensors and monitoring devices (see page 2 for list of sensors included in this test). These are polled at one minute intervals.

Central Heating System

The EH is heated by a standard water filled radiator system. Heat is provided to the system by a wall mounted gas fired condensing boiler - rated output up to 28 kW*1, which is attached to the rear wall of the property in the kitchen. A TPI room thermostat manufactured by one of the BEAMA Heating Controls members is fitted in the living room on the internal wall to the left of the door to the hall at standard height.

There is a single radiator in each room of the house with the exception of the hall / landing which has one on the ground floor at the bottom of the stairs & one on the first floor at the top of the stairs. Each radiator is fitted with a TRV manufactured by one of the BEAMA Heating Controls members.

The central heating system has been balanced by a Gas Safe registered heating installer.
Standard Test Conditions

The following conditions are standard to all tests described in this document.

- Boiler thermostat set to maximum (82°C)
- Boiler timer set to a typical ‘twice a day’ schedule:
  - ON at 06:30
  - OFF at 09:00
  - ON at 15:30
  - OFF at 23:00
- External temperature (chamber) set to average temperature of 5°C
- Internal doors shut (but not sealed)
- Neighbouring property set to an average of 21°C
- ‘One day’ of testing is a 24hr period starting at 00:00
- Settings / heating pattern maintained before test started to reach repeatable state

Data Included in Tests

Air Temperature at Geometric Centre of Room:

- Bathroom
- Bedroom 1
- Bedroom 2
- Hall
- Kitchen
- Living Room
- Loft
- Chamber Front
- Gable Chamber
- Chamber Rear
- Conditioning Void Ground Floor
- Conditioning Void First Floor

Radiator Surface Temperature:

- Bedroom 1, Radiator 1
- Bedroom 2
- Bathroom
- Living Room
- Kitchen
- Hall, Radiator 1
- Hall, Radiator 2
Wall Surface Temperature:
- Gable Wall Internal
- Gable Wall External

Heating System:
- Boiler Gas Consumption
- Boiler Electric Consumption
- Heating Flow Temperature
- Heating Flow Rate
- Heating Return Temperature
- Air Temperature at Thermostat

Additional Data Included for Reference

(Not Graphed)

Three Height Temp Sensors:

Strings of sensors at three heights (just below ceiling, mid height in room & just above the floor) at five points (each corner and geometric centre of room) in each room.
Test 1

Test Conditions

Heating system under control of the boiler thermostat.

- TRVs removed from all radiators
- Living room thermostat disconnected from boiler
- Boiler thermostat set to maximum (82°C)
Test 2

Test Conditions

Heating system under control of the boiler thermostat and living room TPI thermostat.

- TRVs removed from all radiators
- Living room TPI thermostat set to 21°C
- Boiler thermostat set to maximum (82°C)
Test 3

Test Conditions

Heating system under control of the boiler thermostat, living room TPI thermostat and TRVs in all rooms except living room.

- Living room TPI thermostat set to 21°C
- TRVs set to maintain temperature of 18°C in all other rooms
- Boiler thermostat set to maximum (82°C)
### Collected Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Gas Used</th>
<th>Electric Used</th>
<th>Totals</th>
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<tbody>
<tr>
<td></td>
<td>kWh*1</td>
<td>£*2</td>
<td>kWh</td>
</tr>
<tr>
<td>1</td>
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<td>6.29</td>
<td>1.22</td>
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<tr>
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<td>4.24</td>
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<tr>
<td>3</td>
<td>68.29</td>
<td>2.92</td>
<td>0.81</td>
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</tbody>
</table>

*1 - Calculated using [http://www.energylinx.co.uk/gas_meter_conversion_meters.html](http://www.energylinx.co.uk/gas_meter_conversion_meters.html) with default settings (Correction Factor = 1.02264, Calorific Value = 40.0)


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