

# BNXS24: Overview of the Heat Replacement Effect

Version 7.3

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis form part of the Evidence Base created by Defra's Market Transformation Programme.

## 1 Summary

The 'Heat Replacement Effect' refers to the contribution to heating made by lighting and appliances in heated living space, and is fully described in Briefing Note BNXS05. This Briefing Note lists the main events in development of the topic, including consultation meetings and effects on energy saving policy.

## 2 Introduction

This short Briefing Note reports the work done by the Market Transformation Programme (MTP) to establish consensus on the Heat Replacement Effect (HRE) listing the main events (see chronicle below) and relevant documents.

HRE is a term for the consequential effect of improving the energy-consuming products installed in heated buildings. It distinguishes between gross and net savings, the former being obtained by considering the product *in isolation*, whereas the latter are those achieved *after installation*, allowing for heat replacement to maintain the same internal temperature within the building. Estimates have been developed for the numerical factors to be applied when converting one to the other.

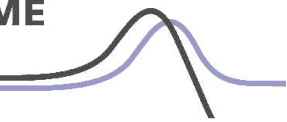
## 3 Policy implications of HRE

When prioritising policy measures according to their impact on carbon emissions, the HRE may change the forecast of benefits and ranking of measures.

One aim of the MTP is to ensure that a fair consensus is derived and reflected in published MTP policy scenarios. As with all MTP material, the results will be used to help inform Government decisions.

## 4 Use of HRE in policy decisions to date

Policy decisions based on energy models of building behaviour implicitly take account of HRE, as estimation of adventitious heat gains is usually incorporated in the modelling methods.



The MTP policy scenarios for products (lights and appliances) have not yet taken HRE into account, though it is intended to adjust the MTP projections to allow for HRE. This will have the effect of reducing the savings in energy and carbon attributed to developments in the individual product sectors.

HRE has been taken into account in the EEC-2 and EEC-3 programmes, in SAP 2005 (for lighting), and in the modelling of efficiency measures for lighting and appliances undertaken for Defra's Global Atmosphere Division by BRE.

## 5 Background

Improvements to the performance of lights and appliances are quoted as energy and carbon savings based on measurements of the product in isolation. However, that over-estimates the achievable savings when the products are installed in heated buildings.

Most lights and appliances are installed in heated living space, where some of the energy they consume contributes to the warmth of the building. If the heat emitted by them is reduced through design improvements, the temperature inside the building can be maintained only by adding heat from another source, and it is this effect that is known as the HRE. HRE occurs automatically if the heating system is thermostatically controlled.

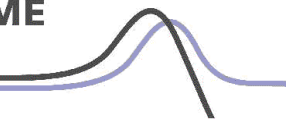
The heating contribution of lights and appliances is recognised in models based on building behaviour, where it is treated as an adventitious heat gain. However, it is usually ignored in the stock models that look at energy consumption of specific products. Factors are therefore needed to convert gross savings (measured as improved product performance) to net savings (achieved after the product is installed in a heated building). Such factors depend on the characteristics of the appliance, when and where it is used, and the type of heating system that provides the replacement heat.

The MTP Briefing Note BNXS05 explains the concept in greater detail and develops initial values for these factors. Other references quoted below provide views from other organisations, and details of progression towards consensus.

The Defra Workshop held on 22 January 2004, decided the most promising way forward for lighting was to carry out a thermal modelling simulation exercise. This modelling work was subsequently carried out, in two batches, and MTP Briefing Note BNXS29 explains the results and develops new factors for domestic lighting and some appliances.

In August 2004 Defra commissioned Professor Jake Chapman as an independent expert to review the work relating to the modelling of HRE. His review confirmed that the results of the modelling are valid and can be used with confidence. In addition, he produced a note about the heat replacement effect with regard to set top boxes, explaining in more detail a point raised in the last paragraph (17) of the review.

In October 2004, the MTP Briefing Note BNXS24 was updated to report on the second set of results from thermal simulation modelling. This replaced the earlier

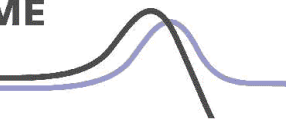


version, and extended the set of factors to include additional appliances (those which dispose of heat to air within the home, and which are used at approximately the same rate throughout the year). BNXS05 was updated to correspond to BNXS24, in particular to substitute thermal modelling results for the initial estimates of the heat replacement factors and beneficial savings factors for lighting and appliances in dwellings.

In February 2007, Lighting Association Laboratories published their study '*Energy efficient lighting – Practical heat replacement effect tests*'. This was based on practical experiments undertaken on a monitored test room. It concluded that the HRE factor for lighting in BNXS05 should be reduced dramatically. However, there were flaws in the method used. Most significantly, the external temperature of the test room varied from experiment to experiment, meaning that it was not possible to draw valid conclusions from the different amounts of heating required.

## 6 Chronicle

- 20 Dec 1999 : Topic introduced as a MTP paper
- 17 Oct 2002 : Paper reproduced as MTP Briefing Note BNDH05 (later BNXS05)
- 16 Jan 2003 : Briefing Note expanded to include definitions, factors, and initial values
- 24 Mar 2003 : Consultation with industry groups and other MTP contacts
- 04 Jun 2003 : Briefing summary prepared for Energy Efficiency Partnership (EEP)
- 21 Jul 2003 : Discussion at meeting with EEP Heating Strategy Group
- 01 Aug 2003 : Discussion at meeting with EEP Appliances Strategy Group
- 06 Aug 2003 : Discussion at meeting with EEP Insulation Strategy Group
- 18 Sep 2003 : Briefing Note expanded, taking account of comments received
- 02 Oct 2003 : "*The Heat Replacement Effect*" paper presented by Bruce Young at EEDAL '03 international conference in Turin
- 22 Jan 2004 : DEFRA workshop on the Heat Replacement Effect at DTI, London
- 01 Mar 2004 : Publication of overview Briefing Note BNXS24
- 17 Jun 2004 : Publication of Briefing Note BNXS29
- 18 Aug 2004 : Paper reviewing heat replacement effect modelling, by Prof. J Chapman
- 23 Aug 2004 : Paper on set top boxes and savings, by Prof. J Chapman
- 11 Oct 2004 : Updated versions of Briefing Notes BNXS29 and BNXS05
- 10 May 2005 : "*UK Policy on Increasing the Efficiency of Domestic Lighting, with Particular Focus on the Importance of the Heat Replacement Effect, and Its Effect on Claimed Energy Savings*" by K Lane, F Brocklehurst, and B Young at "Right Light" 6<sup>th</sup> International Conference on Energy-efficient Lighting, Shanghai, China
- 22 Jun 2006 : "*Thermal modelling of the heat replacement effect and its implications for energy saving programmes*" paper presented by John Henderson at EEDAL '06 international conference in London
- Feb 2007 : Lighting Association Laboratories publish report '*Energy efficient lighting – Practical heat replacement effect tests*'
- 16 Mar 2007 : 'Heat Replacement Effect factors in Lighting – a review of new evidence' by John Henderson, BRE
- 19 Sep 2007 : Tables in Briefing Note BNXS05 updated to use new carbon factors from Briefing Note BNXS01

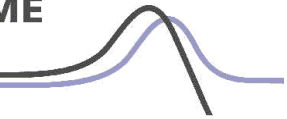


## 7 References

- MTP Briefing Note BNXS05: (formerly BNDH05) [Website document] The Heat Replacement Effect
- Summary for EEP groups [Word document] The Heat Replacement Effect - are we claiming the right savings?
- Paper for EEDAL conference [Word document] The Heat Replacement Effect
- Comparison of BREDEM and HRE factors [Word document] Heat replacement effect - comparison between its predicted magnitude in BREDEM and the MTP report
- Defra workshop: presentation by B Young, BRE [PowerPoint] The Heat Replacement Effect
- Defra workshop: presentation by J Henderson, BRE [PowerPoint] Modelling the HRE in housing
- Lighting Industry Federation Technical Statement No. 33 [Website document] The Heat Replacement Effect from using Energy Saving Lamps in Domestic Buildings
- Defra workshop: notes of meeting [Word document] Minutes of the Workshop on the Heat Replacement Effect, 22 January 2004, DTI Conference Centre, London
- Defra workshop: contribution from Insulation Strategy Group [Word document] HRE & Calculations
- MTP Briefing Note BNXS24: [Website document] Overview of the Heat Replacement Effect
- MTP Briefing Note BNXS29: [Website document] The Heat Replacement Effect - thermal simulation of domestic lighting and appliances
- paper reviewing Heat Replacement Effect Modelling [MTP Library document] Review of Heat Replacement Effect Modelling by Prof. J Chapman
- paper on set top boxes and savings [MTP Library document] Set Top boxes and savings by Prof. J Chapman
- paper on UK Policy on Increasing the Efficiency of Domestic Lighting, with Particular Focus on the Importance of the Heat Replacement Effect, and Its Effect on Claimed Energy Savings,  
[http://www.rightlight6.org/english/proceedings/Session\\_15/](http://www.rightlight6.org/english/proceedings/Session_15/)
- [http://mail.mtprog.com/Presentations/Session\\_E/E2JohnHenderson.pdf](http://mail.mtprog.com/Presentations/Session_E/E2JohnHenderson.pdf)
- Lighting Association Laboratories report: 'Energy efficient lighting – Practical heat replacement effect tests'
- 'Heat Replacement Effect factors in Lighting – a review of new evidence' by John Henderson, BRE

### Related MTP information

- Briefing Note BNXS05: The Heat Replacement Effect
  - Briefing Note BNXS29: The Heat Replacement Effect - thermal simulation of domestic lighting and appliances
  - Briefing Note BNXS01: Carbon Emission Factors for UK Energy Use
- See also "References" above



## Changes from version 7.2

- Reference to updating of BNXS05 concerning carbon emission factors

## Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email [info@mtprog.com](mailto:info@mtprog.com) quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

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