Small-scale renewable energy generation: the provision of performance information to consumers in the heat technology sector

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I: What are standards for?

Compliance with MCS standards is a demonstration of good industry practice as defined by the relevant MCS Technical Working Groups. MCS standards aim to protect consumers and promote the sector by ensuring that companies:

- perform to a minimum standard of good technical practice;
- conform to safe practice;
- give customers defined technical, performance and operational information about the generator; and,
- give customers pre-contract performance information so they can make technical comparisons and, therefore, informed decisions.

For companies involved in the small-scale renewable energy generation supply chain, MCS standards are 'an agreed way of doing something.'[1] They are designed to help companies improve their performance and reduce risk. They create a level playing field so that rogue companies do not cut corners or mislead consumers, and thereby protect honest companies. MCS standards describe the technical information that should be given to consumers at different stages of the journey, including before the contract is signed, and, where relevant, define the values that should be included. The MCS Certification Bodies[2] are accredited by UKAS to assess installers to MCS Standards and this includes the pre-contractual performance information.

The Renewable Energy Consumer Code (RECC) is backed by the Certified Trading Standards Institute (CTSI) as part of the Consumer Codes Approval Scheme (CCAS). The Code is designed to ensure high standards of service before, during and after a contract with a consumer is agreed. Importantly, these high standards include ensuring that consumers are not subjected to poor marketing and sales practice. The Code requires its members to comply with MCS standards generally and this includes the provision of MCS-compliant performance information specifically.

II: What is information for?

Information is vital to ensure that any competitive market operates efficiently. Fundamental to the performance information issue discussed in this paper is the wider *principle* of consumer access to information. It is important to highlight this principle for two main reasons.

- Firstly, information provision is a fundamental consumer right. Consumers make better choices when they are well-informed. They are far more likely to be able to make appropriate decisions if they are given the information they need to do so.
- Secondly, consumers are more likely to make a purchase in a market in which they can confidently make comparisons. In short, there is a wealth of research showing that ***consumer inertia is more likely when consumers do not have adequate knowledge.*** Serious information asymmetries damage markets and can lead to market failure.

[1] British Standards Institute. http://www.bsigroup.com/en-GB/standards/Information-about-standards/what-is-a-standard/

[2] http://www.microgenerationcertification.org/mcs-standards/certification-bodies

The information a consumer receives *before* the contract is signed is the most important information of all. Consumers cannot base their purchasing decisions on information provided to them at completion stage.

Consumer Contracts Regulations and Consumer Rights Act

It is worth stressing the issue of risk in relation to standards. Standards should help companies reduce risk by helping them avoid practice that may be unsafe or unlawful for example. It is within this context that consumer protection legislation is relevant.

The critical nature of pre-contractual information is recognised in law in the *Consumer Contracts (Information, Cancellation and Additional Charges) Regulations 2013 (the CCRs)* and in the *Consumer Rights Act 2015*. The CCRs state that the trader must give the customer information about the 'main characteristics' of the goods *before the contract is agreed*. This is reinforced by the *Consumer Rights Act 2015* as this confirms that the 'main characteristics' of the goods must form part of the contract between the trader and the customer. Furthermore, if the goods don't comply with the 'main characteristics' as described then the trader will be in breach of the *Consumer Rights Act* and, therefore, the customer will be able to pursue a relevant statutory remedy.

It is important to note that the *Consumer Rights Act 2015* changed the law related to pre-contract information: all verbal and written statements made by a company about the company or its services are now binding if that information influences the consumer's decision when deciding to enter into the contract or when making a decision about the service after entering into the contract. In other words – misleading statements can now be seen in law as contractual terms.

While performance estimates for small-scale renewable generation installations cannot be precise and are not an absolute guarantee of actual performance, they do need to be *reasonable, rational and based on realistic assumptions*. If they are not, and consumers rely on them, they may be able to seek legal remedy.

III: What is the information problem?

The evidence from RECC's research set out in this report shows that many customers and potential customers are receiving confusing, misleading and potentially damaging information from small-scale renewable energy generation installers. There is evidence this is causing consumer harm.

RECC auditors examine the interface between consumers and installers in detail. More than 200 in-depth audit site-visits were carried out in 2013, a further 170 carried out in 2014 and 160 in 2015. Some auditors have audited more than 100 installers. In relation to performance estimates specifically, these audits reveal a growing dislocation between installer obligations as laid down by the industry through the MCS standards and actual practice for the three heat technologies; heat pumps, biomass and, to a lesser extent, solar thermal. RECC has grown increasingly concerned about the quality and reliability of performance information for these technologies.

Other indicators are consistent with the evidence reported by auditors:

- pre-contractual information given to consumers is the most frequent area of non-compliance found during RECC audits;
- non-compliance usually relates to the quote document and/or the performance estimate;
- more than 70 per cent of installers who are being audited are found to be non-compliant in their approach to pre-contractual information; and,
- there has been a significant increase in the number of complaints about the three heat technologies – there are now significantly more complaints about all three heat technologies than there are about Solar PV (expressed as a percentage of total domestic installations).

Complaints can be complex and involve as much as two months of mediation. Around 1 in every 5 complaints leads to the independent arbitration process.

IV: Analysis of performance estimates

With a view to understanding these issues more clearly, RECC initiated a long-term project to examine the performance information being given to consumers of heat technologies at the pre-contractual stage. This involved:

- a review of the obligations on consumer performance information within the MCS standards MIS 3001, MIS 3004 and MIS 3005;
- the development of three technology-specific compliance tools to help RECC auditors make a consistent appraisal of performance estimates given to consumers by installers;
- an analysis of nearly 50 actual performance estimates given to consumers by installers collected during routine RECC audits and other compliance monitoring activities;
- a review of research evidence available on the actual in-situ performance of the three heat technologies in the UK domestic setting; and,
- the development of specific recommendations to improve the information given to consumers.

Our analysis of nearly 50 actual performance estimates has allowed us to shed light on the adequacy of the compulsory technical information given at the pre-contractual stage. It is important to note that because most companies deploy template documents, each proposal analysed is likely to reflect typical practice for that whole company. In other words, the performance estimates examined represent an analysis of the performance templates used by the companies and therefore reflect the business models deployed by the installers and the broad experience of the customers served by these companies during that period. The most significant top-level results of our analysis are summarised below.

Note on methodology.
The procedure used by RECC to select companies for audits and spot checks is risk-based which means that the companies included in this report are not a random sample of RECC members. However, companies selected for audit tend to be larger and some very large installers are included in the analysis. This means that the research does reflect the experience of a significant proportion of domestic customers.

Heat Pump Performance Estimates – 9 analysed in detail:

- seven out of the nine estimates were not clear or accessible;
- one estimate gave no figure for overall heat demand, while two others gave information contradicted by very different values in alternative estimates with no explanation;
- three out of the four estimates for GSHPs did not give the required technology-specific design information included in MIS 3005 (4.4.24);
- in only three estimates were the main performance values consistent (for example, as described in the methodology set out in Appendix E of MIS 3005);.
- in five estimates the main values were significantly misleading; and,
- all the three estimates that included 'alternative estimates' (based on an alternative methodology) were presented in a non-compliant way and were misleading.

Solar Thermal Performance Estimates – 8 analysed in detail:

- four out of the eight estimates offered reasonably good information but the other four were not clear or accessible;
- one estimate gave no figure for overall hot water demand and another gave confusing information about demand;
- the estimated annual fuel saving is one of only two values that are compulsory yet five installers either failed to include this figure or the information was not adequately clear;
- financial forecasts were not fully compliant in five estimates and were misleading in one other; and,
- the main values were not consistent in two estimates and only partially consistent in one other.

Biomass Performance Estimates – 14 analysed in detail:

- only three of the fourteen estimates gave a seasonal efficiency figure, and, of those, only one estimate included the correct value;
- half the estimates did not state the calorific value of the fuel, and only two estimates gave the MCS value of the fuel in kWh/kg while the value stated for pellets ranged from 4.4kWh/kg to 5.4 with most stating it as 4.8;
- four estimates did not include the MCS disclaimer;
- twelve estimates were not clear or accessible because they did not include the key data required, such as an estimate of fuel mass needed;
- ten estimates did attempt to indicate an estimate of fuel use but seven of those significantly underestimated the fuel needed as detailed in MIS 3004;
- four estimates did not include **any** of the following values related to performance:
    - seasonal efficiency
    - mass of fuel required
    - volume of fuel required
    - performance figures consistent with demand indicated
    - fuel specification
    - calorific value of fuel in kWh/kg;
- most of the boilers were not in the PCD, and, of the three that were, none used the PCD seasonal efficiency figure.

V: Research on Performance In-Situ

Many of the performance estimates RECC examined as part of this research revealed very poor practice. Yet this would be less damaging if other, third-party empirical evidence demonstrated a good correlation between actual in-situ experience and expected performance of small-scale renewable heat generation systems. The reality is very different however. This paper describes the relevant research (with references) in in *Section 2* and the main findings are summarised below.

Heat Pumps

The UCL Energy Institute Analysis of Heat Pumps Installed via the RHPP Scheme – completed in December 2014[3]

This field trial monitored several hundred domestic installations supported by the Renewable Heat Premium Payment (RHPP) grant scheme. The top-level findings show a mean SPF H4 of 2.3 for ASHPs and 2.48 for GSHPs for the Sample C UKSET. Overall, however, the authors place stress on the SPF H2 results and conclude that while more than 90% of installations have resulted in some carbon savings, more than 40% of ASHPs and more than 20% of GSHPs in the study operate below the threshold used by the European Commission to classify as renewable – SPF of 2.5. DECC's recent RHI impact assessment is blunt:

> *"The latest RHPP evidence concludes that heat pump performance across the whole RHPP stock monitored averages 2.3 (ASHP) and 2.75 (GSHP). It also concludes that only a portion of the total heat pump stock operate at an SPF of 2.5 or greater; 53% (ASHP) and 77% (GSHP)."*[4]

This stark contrast between these field trial results and the marketing claims made for heat pumps represents a serious challenge for the industry and its regulators. The underperformance is severe and immediate action should be taken to improve the actual performance of the technology in-situ. *A first and critical step* is through the provision of better information to enable end users to make informed decisions.

The EST Phase I (completed 2010) and Phase II (completed 2013) Trials –

The Phase I trial revealed that most heat pumps were not performing as well as expected as the median *system efficiency* for air source heat pumps (ASHP) was found to be just 1.83 with the highest 2.2. The median for ground source heat pumps was 2.31 with the highest over 3.0. The detailed analysis of the field trial led directly to the revised MCS Standard MIS 3005 that came into force in 2012.

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[3] Detailed analysis of data from heat pumps installed via the Renewable Heat Premium Payment Scheme. DECC, February 2016: https://www.gov.uk/government/publications/detailed-analysis-of-data-from-heat-pumps-installed-via-the-renewable-heat-premium-payment-scheme

[4] Consultation Stage IA: The Renewable Heat Incentive: A reformed and refocused scheme IA No: DECC0211. March 2016. Annex 4.

Phase 2 of the field trial study was carried out between 2010 and 2013. This Phase II study is widely misunderstood as a 'stand alone' trial involving a new sample of installations. In fact, the phase II 're-set' the Phase I trial with 38 of the original installations selected for a range of interventions in an attempt to improve their performance. Those interventions ranged from major re-sizing to minor modifications. Six new sites were also included and installations carried out in accordance with the new MCS standard. Performance improvements were modest - average SPFs reported were 2.82 for GSHP and 2.45 for ASHPs.

Solar Thermal

Energy Saving Trust field trial 2010 - 2011

One large-scale field trial carried out by the Energy Saving Trust from 2010 to 2011 collected data from 88 domestic installations throughout the UK and Ireland. The median amount of hot water provided by the solar thermal systems as a percentage of hot water used was 39%. The best performing systems provided 60% and the lowest 9%. Typical savings for a well-installed and properly used system were estimated to be £55 per year when replacing gas and £80 per year when replacing electric immersion. EST continues to quote similar savings in its current advice on Solar Thermal.

Installers frequently claim that solar thermal installation can 'typically' provide 60% (or more) of a household's hot water needs. There is little evidence from reliable and impartial research on UK systems to support this claim. A well-designed and installed system may provide 60% of hot water needed but this is the best in-situ performance identified in the relevant field trial.

Biomass

DECC-commissioned desk-based study

There is very little published data on in-situ domestic biomass efficiency in the UK. A recent DECC-commissioned review of evidence identified one study of biomass installations in Wales. The trial, which included domestic installations, was carried out in 2010 and reported disappointing results with very few systems operating as designed. The main problem was found to be boiler over-sizing leading to poor efficiency.

A more recent DECC-commissioned desk-based study of more than 100 (mostly non-domestic) installations reported significant underperformance with average *in-situ* efficiencies of 66%.[5] That study prompted DECC to commission a large field study of domestic boilers that is due to commence in the first quarter of 2016 and will last for one year.

DECC-commissioned methodology for field trial and analysis of non-domestic RHI data

The study described above led directly to a DECC proposal for a biomass field trial designed to obtain empirical data about domestic biomass boiler efficiency. In 2015 KIWA (in partnership

[5] Review of Biomass Performance Standards, 2014. A Desk-Based Review of Performance and Installation Practices of Biomass Boilers for DECC. June 2014.

with Amec Foster Wheeler and BRE) published their methodology[6] for such a field trial; this proposal was agreed by DECC and the trial is due to start in April 2016. Preliminary research for the trial and published by KIWA[7] shows that low Utilisation Factors (UFs) are one likely cause of low in-situ efficiencies. The *non-domestic RHI data* examined for this report shows that boilers are operating below a 15% UF for six months of the year i.e. an average of only 9 minutes in every hour. The authors of the above study consider it probable that low UFs are also likely to be common among domestic installations.

KIWA piloted its proposed field-testing methodology on a *domestic* boiler by measuring variations in boiler efficiencies under different loads. The study found that the boiler efficiency decreased dramatically as UFs decreased and it concluded that this is a trend it expects to see in boilers of all sizes. Overall, KIWA report that biomass boiler efficiencies fall dramatically when UFs fall below 30%. A UF of 5% corresponds to an efficiency of 25% and a UF of 28% gives an efficiency of just over 70%. The report states:

> *"These low values are believed to be little known (and certainly not discussed) in the biomass industry."*

The authors of both DECC-commissioned reports[8] [9] comment on widespread confusion among manufacturers, suppliers and installers regarding the difference between:

- 'nominal' or 'manufacturer's specified' efficiency; and,
- *in-situ* efficiency.

Those conclusions are consistent with the RECC analysis of performance estimates. In fact, DECC now assumes that in-situ performance of domestic biomass boilers will be significantly lower than the efficiencies as stated in the Products Characteristics Database (PCD).[10]

Given the absence of reliable field trial data, the actual evidence available suggests that installers should adopt a cautious approach to forecasting efficiency and, therefore, predicted fuel requirements. The reality, however, is very different. The two DECC-commissioned reports are right to suggest that there is widespread confusion about biomass efficiency for the following reasons (see *2.4.1e* below):

- there is a widespread assumption among installers (and among stakeholders generally) that nominal efficiency is shorthand for system or boiler in-situ efficiency;
- companies frequently and wrongly refer to the 'nominal' or 'manufacturer's' efficiency as the likely actual performance that will be achieved;
- boiler combustion efficiencies are sometimes used to calculate consumer fuel requirements; and,

[6] A Methodology for Evaluating the In-Situ Performance of Sold Fuel Biomass Boilers – KIWA July 2015
[7] Much of the KIWA report represents an analysis of the data collated under the domestic and non-domestic RHI for more than 6,000 installations – with the vast majority of those installed in 2014. KIWA also used the MCS certified biomass boilers list, the HETAS Database and the RHI Eligibility List.
[8] A Methodology for Evaluating the In-Situ Performance of Sold Fuel Biomass Boilers – KIWA July 2015, page 1 and report introduction.
[9] Review of Biomass Performance Standards, 2014. A Desk-Based Review of Performance and Installation Practices of Biomass Boilers for DECC. June 2014.
[10] Consultation_Stage_Impact_Assessment_-_The_RHI_-_a_reformed_and_refocussed_scheme. Page 79.

- installers frequently advertise system efficiency levels of over 90% (see *section 2.4.1f*) and even refer to *Seasonal Efficiency rates of over 90% in Compliance Certificates* (for boilers not in the PCD).

All of the above issues are compounded by further confusion regarding the energy content of fuel and other important values specified in the MCS standard. It is RECC's view that, as a result of this confusion and poor practice, consumers are being given misleading information and that this is causing significant consumer harm. This harm is obvious from the case study information detailed in *Section 2* as fuel requirements are grossly underestimated.

VI: Executive Summary – Conclusion

The evidence reported by RECC auditors and the performance estimate analyses described above (and in *Section 2* below) suggest that many installers appear to regard the MCS standards related to performance information as optional. Some may consider the relevant standards to be 'guidelines' and, therefore, not compulsory. Some installers are clearly confused by the rules. *Pre-contract* performance information does not appear to be the subject of inspections carried out by the Certification Bodies. Installers are frequently surprised when RECC auditors insist that specific values be included in formal pre-contract performance information. Others argue with auditors about the inclusion of figures that are clearly required by the MCS standard.

The contrast between the research evidence on performance and what consumers are actually told is not sustainable. Very good evidence shows that a significant number of renewable heat technology installations are badly designed and are underperforming. This, coupled with a lack of good pre-contract information, will lead to adverse publicity, customer inertia and distrust. An obvious repercussion is the impact this is having on installers that do actually comply with MCS rules – many of those audited by RECC are frustrated by companies that clearly operate outside the MCS standards.

Of equal concern is the belief that the values included in the standards can be adjusted and defined as the installers wish. This is most evident with biomass where there is little or no consistency in values such as the energy value of fuel (per kg) and how boiler 'efficiency' should be defined and presented. Values are clearly manipulated to predict system efficiency as high as possible and fuel requirement as low as possible – *even when the figures are clearly incorrect*. Heat pump installers often see no problem in supplying two completely contradictory estimates (one based on MCS methodology and another using calculators supplied by manufacturers) with no explanation for differences in results. Other installers simply ignore the MCS requirements completely and, instead, give consumers non-compliant predictions of RHI income.

The evidence shows that, because so many installers deploy non-compliant practice, customers currently cannot approach the formal performance estimate with confidence that the figures are *reasonable, rational and based on realistic assumptions*. Installer practice must improve in this respect. Better and clearer rules about what customers should be told are an important way to help customers identify good (and bad) practice and have confidence in the systems they are being offered.

VII: Recommendations

This section contains 'generic' recommendations for consideration by MCS Management and sections VIII, IX and X include the sector-specific recommendations for consideration by the MCS Technical Working Groups.

Generic Recommendations

In addition to the technology-specific recommendations below, RECC has a series of generic recommendations applicable to all heat technologies or to the approach taken by MCS on the subject of consumer pre-contract performance information.

Recommendation 1

MCS initiate a review of the way installer obligations on performance information are being assessed as compliant with MCS Standards. This review should investigate whether the Certification Bodies check for compliance and how compliance is tested. This review should also investigate how often installers are found to be non-compliant and what sanctions are imposed. MCS should assess whether the current arrangement can ensure compliant practice related to performance information in the long term or whether these installer obligations should be monitored using a different mechanism.

Recommendation 2

MCS revise the standards for all three heat technologies to introduce clearer performance information that is easier for customers to compare at the pre-contractual stage using a compulsory format that includes a compulsory set of performance values. Recommendations for each technology on this issue are included in sections VIII, IX and X.

Recommendation 3

MCS should consider incorporating permanent expert consumer protection representation on the MCS Technical Working Groups.

Recommendation 4

MCS and RECC should consider the development of formal consumer guides to the heat technology standards to give customers better information about the performance forecasts they are given. One source of funding for this could be the MCS Charitable Foundation.

VIII: Heat Pump Recommendations

Core Performance Values

MIS 3005 does require installers to provide comprehensive performance information to the customer in the form of the Compliance Certificate – but this is provided *after* the installation is complete.[11] Industry representatives have questioned the need for the Compliance Certificate and have argued that is should be replaced with a 'voluntary' Commissioning Checklist.[12]

[11] MIS 3005 – 6.1.

[12] BEAMA Heat Pump Installer Workshop Report (June 2015) (FINAL) RECC version

It is RECC's view that robust performance information is vital if consumers are to make an informed decision about a heat pump installation and to help avoid costly disputes. But it is clear that installers are confused about what information should be provided.

Heat Pumps Recommendation 1
The pre-contract design and performance information given to customers must be improved. This information must be given to customers in a consistent manner using standard terminology. MIS 3005 should be changed to incorporate a compulsory set of defined values that should be presented to the customer in a standard format. To this end, RECC proposes that a revised Appendix E (excluding the section on RHI values) of the current MIS 3005 should be made compulsory for this purpose.

There is widespread confusion within the industry about when the full technical survey can be carried out in relation to the contract agreement. Some installers claim the contract can be agreed based on a rough estimate of performance with the full technical survey taking place later. In fact, the intention of the MCS standard is clear - the technical heat loss assessment must be carried out before the contract is agreed[13]. For this reason, our *Recommendation 1* should not impose any additional burdens on installers who currently comply with the standard. Installers must carry out a formal technical survey to draw up a compliant design before contract agreement, therefore all of the information necessary to populate the current Appendix E should be available at the pre-contract stage.

Some industry representatives have recently argued that installers should be free to agree contracts *before* formal heat loss assessments and, instead, should be allowed to base performance and cost estimates on agreed models or preliminary estimates.

Heat Pumps Recommendation 2
RECC strongly recommends that MCS resist pressure to allow formal contracts to be agreed before technical survey stage for the following reasons:

- MCS and RECC rules currently allow preliminary estimates (that are not based on full technical surveys) to be given to customers as long they make clear that the formal performance estimate may change after the technical survey. However, the formal quotes and estimates based on full technical surveys must be given to the customer *before the contract is agreed.*
- Current RECC rules allow installers to charge consumers for full technical surveys prior to contract agreement. These charges must be reasonable.
- The installer must carry out a room-by-room heat loss calculation to make sure that the system will perform with an SPF of at least 2.5 and – after March 2016 – the installer will need the technical survey results to determine the exact SCOP. It is critical consumers are given this information prior to contract agreement.
- Formal contracts agreed prior to full technical survey stage are not consistent with the principles of consumer protection and access to information.
- If installers are allowed to agree contracts before the full technical survey is carried out then RECC would predict an increase in disputes for several reasons:

[13] MIS 3005 – 4.2.12-17

- rough estimates are more likely to be incorrect (they may wrongly show the SPF to be above 2.5 for example);
- contract agreements before formal site surveys are more likely to be used as a sales tactic by companies that sell in the home; and,
- pressure selling is much more likely where the formal MCS-compliant technical survey is not available.

- Allowing contract agreement before the formal performance estimate is available will not give consumers the information they need to help them avoid poorly designed and inefficient installations.

Design information

From March 2016 all installers have had to comply with the *Energy Related Products Directive* and will obtain the SCOP data from spreadsheets available from MCS. Some installers have argued that this move to heat pump SCOP information places too much emphasis on the efficiency of heat pump and this risks giving the wrong signal to customers about system use and efficiency.

It is RECC's view that the new requirements under the Directive do not carry this risk as long as the heat loss and emitter design information is provided to customers in a compliant manner before the contract is signed. As detailed below (*2.2.2 - MCS Obligations*) MIS 3005 already states that – before contract agreement – all customers must be given: specific room heat losses; emitter choice and sizes; and information about the Heat Emitter Guide. Our evidence shows that this information is often excluded from performance estimates or is not provided in an adequate, clear and accessible manner. Only one performance estimate discussed in Section *2.2.3* below included the information about heat losses and emitters in a compliant way. Five omitted this information entirely.

Heat Pumps Recommendation 3

The design information on heat losses and emitters[14] should be defined more clearly and given to customers before contract agreement *using standard terminology and in a standard compulsory format*.

Again, this recommendation does not impose extra obligations on installers. Instead, it will require installers to fulfil an existing obligation in a different way.

Design and performance information - timing

As described below (*2.2.2 – MCS obligations*) the MIS standard is not totally clear about when the performance and design information should be given to customers.

Heat Pumps Recommendation 4

The standard should explicitly state that the design and performance information should be provided *before* the contract is signed. All references to *'at or before'* contract agreement should be deleted from the standard. These changes should include all of the obligations related to information provided that relates to:

- Alternative estimates
- Overall design and demand
- Hot water demand

[14] MIS 3005 – 4.2.12-17

- Specific room heat loss information and emitter selection
- Design for Ground Source Heat Pumps
- System Performance
- Running costs

Alternative Estimates

As with MIS 3001(Solar Thermal) and MIS 3004 (Biomass), MIS 3005 (heat pumps) includes a general requirement that any estimate using an alternative methodology must clearly describe and justify the approach. Furthermore, any alternative estimate must not be given greater prominence than the MCS estimate and, where the results vary significantly from the MCS estimate, it must be accompanied with a warning that it be treated with caution.

RECC's analysis of estimates shows that the provision of 'alternative estimates' is a key source of confusion. These estimates using alternative methodologies are frequently given more prominence and the results often directly and significantly contradict the formal MCS values (see *Section 2.2.5* – Case Studies). This problem is further compounded by the fact that the MCS estimate carries the MCS disclaimer *but there is no obligation on the installer to include a similar disclaimer on the alternative estimate*. The customer is therefore given the erroneous impression that the MCS estimate is given 'as guidance only' and may be incorrect – while the other estimate is therefore more reliable.

The provision of standard design and performance information in a standard format should go some way to mitigate problems associated with alternative estimates. It is RECC's view however that MCS should introduce new rules to prevent further confusion.

> **Heat Pumps Recommendation 5**
> All alternative estimates must include a prominent disclaimer stating that alternative estimates using non-MCS methodology should be treated with caution. Furthermore, the disclaimer should state that it is the MCS performance estimate that should be used when making income and cost assessments and that the alternative estimate has not necessarily used a methodology approved by MCS.

IX: Solar Thermal Recommendations

Core Performance Values

As discussed in section 2.3.2, MIS 3001 currently requires installers to provide *only two* performance values before contract agreement.

It is RECC's view that robust performance information is vital if consumers are to make an informed decision about a solar thermal installation and to help avoid costly disputes. RECC will need to carry out more analysis to determine why the level of formal complaints about solar thermal installation is the highest out of all the heat technologies. Given that formal complaints represent the 'tip of the iceberg' (as detailed above), the fact that nearly 5% of all installations result in a formal complaint to RECC is not sustainable.

There is some confusion among installers about what information should be provided. This confusion is probably leading to some inaccuracies in some estimates. Overall, however, installer practice related to solar thermal pre-contract information appears to be better than practice evident for the other two heat technologies. Even so, comparisons with the estimates for heat pumps and biomass is not a high bar; half of the Solar Thermal estimates we examined did not offer information that could be properly used by the customer to make an informed choice.

> **Solar Thermal Recommendation 1**
> The pre-contract design and performance information given to customers must be improved. This information must be given to customers in a consistent manner using standard terminology. MIS 3001 should be changed to incorporate a compulsory set of defined values that should be presented to the customer in a standard format before the contract is signed. To this end, RECC proposes that the full TSPEC calculation should be made compulsory for this purpose.

There is widespread confusion within the industry about when the full technical survey can be carried out in relation to the contract agreement. Some installers seem to think the contract can be agreed based on a rough estimate of performance with the full technical survey taking place later. In fact, MIS 3001 is unequivocal on this issue and clearly states that the technical calculation must be carried out before the contract is agreed[15]. For this reason, our recommendation (as above) should not impose any additional burdens on installers who currently comply with the standard. Installers must carry out a formal technical calculation to draw up a compliant design and proposal before contract agreement, therefore all of the information necessary to populate the TSPEC (MCS 024) should be available at the pre-contract stage.

X: Biomass Recommendations

Seasonal Efficiency and Manufacturer's Specified Efficiency

Our analysis of performance estimates (and supported by anecdotal evidence from auditors) has found that a significant proportion of installers do not refer to the Seasonal Efficiency of the boiler in their performance estimates and do not use the SE figure in their performance calculations. Instead, many installers refer to the Manufacturer's Specified Efficiency.
The 'manufacturer's specified efficiency' is often referred to as:

- 'nominal efficiency' (as it is termed in the Compliance Certificate); or,
- 'boiler combustion efficiency'.

There is no question that installers using 'nominal' or 'manufacturers' specified efficiency' values in performance calculations to estimate fuel levels required are either knowingly or unknowingly exaggerating potential performance. Our analysis found that these practices mean consumers are being given very misleading advice – this is summarised in **Table 1** below.

[15] MIS 3001 – 4.5.5

Table 1: Key examples of misleading advice found in analysis of performance estimates.

Value given in performance estimate by installer	Correct value as calculated by RECC according to MIS 3004
14460kg/yr fuel required	22764kg/yr
6500kg/yr fuel required	11000kg/yr
£920/yr cost of fuel required	£2500/yr
£1137/yr cost of fuel required	>£2000/yr

The authors of the DECC commissioned report *Review of Biomass Performance Standards, 2014* report that some installers give customers confusing and misleading information about efficiency. They note that the MCS standard MIS 3004 *"stipulates that biomass boilers are CE marked and achieve a certain level of boiler combustion efficiency, and EN303:5 2012 (the EU standard for testing solid fuel heating boilers up to 500kW) also makes reference to the boiler combustion efficiency of biomass boilers. These standards are often taken as the system efficiency, whereas the boiler combustion efficiency is only one part of the overall system efficiency of a biomass installation."*

They added: *"some installers appear to be overstating the likely performance standards of Systems (at 85% and higher) by presenting boiler combustion efficiency as part of the sales process."*[16]

Performance calculations should be based on *in-situ efficiencies*. In essence, from the customer's perspective, references to 'nominal efficiency', the Manufacturer's Specified Efficiency or the boiler combustion efficiency are not useful as they cannot be used to predict fuel requirement.

Section 4.4.1(i) of MIS3004 states that the seasonal efficiency of the boiler should be obtained from the Products Characteristics Database (PCD) or the default value from Table 4a of SAP – currently 65% (or 60% if the boiler is located outside the dwelling). Despite this clarity, there appears to be confusion about what is intended by paragraph 4.4.1(i) and many installers either ignore the obligation deliberately or are confused by it.

Biomass Recommendation 1
MCS take immediate action to prevent installers from using boiler nominal (or the Manufacturer's Specified Efficiency) to predict fuel quantities required in MCS Performance Estimates. MIS 3004 should state *explicitly* that the nominal efficiency figure (or the Manufacturer's Specified Efficiency figure) should not be used in the performance calculation and that *any calculations based on those values to predict fuel use will invalidate the performance estimate.*

Biomass Recommendation 2
The MCS Biomass Working Group should initiate a review to decide on the best way to ensure that realistic efficiency levels are used in performance estimates. DECC assumes that actual in-situ efficiencies achieved are significantly lower than those stated in the PCD. MCS should adopt a cautious approach to efficiency at least until results from the 2016 field trial are known.

[16] DECC. Desk-Based Review of Performance and Installation Practices of Biomass Boilers. June 2104.

Biomass Recommendation 3
MIS 3004 should include a requirement that a standard template of values (see template proposal below) should be given to customers pre-contract and this template should include a prediction of fuel use that is based on one of the following values only:

- the default SAP figure as identified in MIS 3004 4.4.1(i)
- some other reasonable estimate of in-situ efficiency to be identified by the MCS Working Group (as Recommendation 2 above).

Biomass Recommendation 4
If the Seasonal Efficiency values from the PCD are to be used in formal MCS performance estimates then the MCS disclaimer should be adjusted to state explicitly that the estimate of efficiency is not included to indicate a 'minimum'. The disclaimer should explain that the in-situ boiler performance might result in an efficiency that is significantly lower.

2.4.5(b) – The energy content of fuel
There is no one standard value for the calorific energy content of biomass fuel. The MCS biomass calculator, however, includes the following default values:

- 4.4kWh/kg pellets
- 3.8kWh/kg logs

The problem here is obvious – some installers manipulate this value to make system proposals appear more efficient. In the estimates we examined the value stated for pellets ranged from 4.4kWh/kg to 5.4. Most stated the value as 4.8. There is clear confusion among installers about what the standard says about energy content of fuel. While some installers believe the MCS calculator values are compulsory, others think they have every freedom to give values that they choose. There is no level playing field - which gives installers an incentive to exaggerate the energy content of the intended fuel.

Biomass Recommendation 5
MIS 3004 should contain explicit obligations on energy values for intended biomass fuels. Installers should be required to refer to specific values when calculating performance estimates and those values should be included in a template of pre-contract information. The standard should state that the performance estimate *will be invalid* if the installer does not refer to the correct energy values for fuel.

2.4.5(c) – Information Template
Our analysis of performance estimates shows that while the majority of installers appear to give customers reasonable information about energy demand, most give very poor or vague information about performance. It is clear that installers are confused about what information should be provided. The performance information we have examined reveals that pre-contract information can be: misleading; inconsistent and therefore confusing; and, can lack important values.

Biomass Recommendation 6
The pre-contract design and performance information should be given to customers in a consistent manner using standard terminology. MIS 3004 should be changed to

incorporate a compulsory grid of defined values that should be presented to the customer before contract agreement in a compulsory format. To this end, RECC proposes that a revised Appendix C (excluding the section on RHI values) of the current MIS 3004 should be made compulsory for this purpose with two changes:

- Firstly, this standard template should include a specified value for the Energy Content of the Specified Fuel specified in kWh/kg and the MCS Working Group should specify compulsory default values.
- Secondly, the section on 'estimated running costs' should be included as compulsory.

As with Heat Pumps, there is some confusion within the biomass installation sector about when the full technical survey can be carried out in relation to the contract agreement. Some installers seem to think the contract can be agreed based on a rough estimate of performance with the full technical survey taking place later. In fact, MIS 3004 is completely clear on this issue as it states that the technical heat loss assessment must be carried out before the contract is agreed[17]. For this reason, the Biomass Recommendation 5 should not impose any additional burdens on installers who are currently in compliance with the standard. Installers must carry out a formal technical survey to draw up a compliant design before contract agreement, therefore all of the information necessary to populate the current *Appendix C* should be available at the pre-contract stage.

As with heat pumps discussed above, RECC recommends that MCS resist pressure to allow formal performance estimates to be provided after contracts are agreed.

[17] MIS 3004 – 4.4.1(d)

1. Introduction – What is the Problem?

1.1 Background

"I haven't seen one heat pump performance estimate that is compliant." RECC Auditor, 2015.

RECC auditors regularly examine the interface between consumers and installers in detail. More than 200 in-depth audit site-visits were carried out in 2013 and a further 170 carried out in 2014 and 160 in 2015. Some auditors have audited more than 100 installers. In relation to performance estimates specifically, these audits reveal a growing dislocation between installer obligations as laid down by the industry through the MCS and actual practice for the three heat technologies; heat pumps, biomass and, to a lesser extent, solar thermal.

Anecdotal evidence from auditors about installer practice related to pre-contractual performance information has included:

- confusion among many installers about what information should be given to customers;
- high levels of non-compliance with obligations related to performance;
- difficulty in assessing member compliance due to complex and non-standard ways of presenting performance information;
- extreme examples of non-compliance;
- examples of 'confusion marketing'; and,
- very few examples of good practice.

Other indicators reflect anecdotal evidence reported by auditors:

- pre-contractual information given to consumers is the most frequent area of non-compliance found during RECC audits;
- non-compliance usually relates to the quote document and/or the performance estimate;
- more than 70 per cent of installers are found to be non-compliant in their approach to pre-contractual information;
- there has been a significant increase in the number of complaints about the three heat technologies – there are now significantly more complaints about all three heat technologies than there are about Solar PV (expressed as a percentage of total installs). See Table 2 below.

Table 2: Formal complaints received by RECC as a % of installations (not including those registered with certification bodies unless joint). Solar PV indicated for reference. These figures exclude:

- all technical complaints sent only to the certification bodies;
- all complaints directed only to the installers; and,
- all complaints where the customer has sought a legal solution without first involving RECC.

	Complaints 2013	**Complaints 2014**	**Complaints 2015** (first full year of RHI)	**2015 Complaints as a % of total installs**
Heat Pumps:	80	120	135	
ASHP only	64	103	107	**2.68**
GSHP only	16	13	28	**3.13**
Solar Thermal	37	40	48	**4.81**
Biomass	45	61	160	**3.86**
Solar PV	937	754		**0.8**

To help members address practice related to estimates, RECC continues to provide model documents including quotations and pre-contractual information for each technology. These include model performance estimates that are available to members free of charge and have been developed in order to comply with the requirements of the Code, MCS standards and relevant consumer protection legislation. There is also in-depth detailed guidance on the presentation of this information.

1.2 What are Standards For?

Compliance with MCS standards is a demonstration of compliance to good industry practice as defined by the relevant MCS Technical Working Groups. The MCS standards describe what technical information should be given at the pre-contract stage and, where relevant, define the values that should be included. The Certification Bodies are accredited by UKAS to assess installers to MCS Standards.

The Renewable Energy Consumer Code (RECC) is backed by the Certified Trading Standards Institute (CTSI) as part of the Consumer Codes Approval Scheme (CCAS). The Code is designed to help consumers get advice on generation solutions without being subjected to negative marketing/sales tactics, and to ensure high standards of service before, during and after a contract with a consumer is agreed. Importantly, these high standards include ensuring that consumers are not subjected to negative marketing/sales tactics. The Code requires its members to operate compliantly with the MCS standards generally and to provide consumers with MCS compliant pre-contract performance information specifically.

Generally, standards are 'an agreed way of doing something.'[18] They can perform many functions but fundamentally they help disseminate good practice and therefore help companies improve their performance and reduce risk. MCS standards describe the technical information that should be given to consumers at different stages of the journey, including before the contract is signed, and, where relevant, define the values that should be included. The MCS Certification Bodies are accredited by UKAS to assess installers to MCS Standards.

[18] http://www.bsigroup.com/en-GB/standards/Information-about-standards/what-is-a-standard/

Within the context of the domestic microgeneration sector the MCS standards protect consumers by ensuring companies:

- perform to a minimum standard of good technical practice;
- conform to safe practice;
- give customers defined technical, performance and operational information about the generator; and,
- give customers pre-contract performance information so they can make technical comparisons and, therefore, informed decisions.

While the standards appear to offer concise and clear guidance on the technical practice expected, our research shows that the way the standards define the pre-contractual information that should be given to customers is not always clear.

Our examination of the obligations related to pre-contractual performance information and actual practice shows that there is considerable confusion among installers about their obligations. The rules are often ignored and consumers given pre-contractual information that cannot be used to make properly informed decisions.

1.3 What is information for?

Information is vital to ensure that any competitive market operates efficiently. Fundamental to the performance information question discussed in this paper is the wider *principle* of consumer access to information. RECC believes it is important to highlight this issue for two main reasons.

- Firstly, information provision is a fundamental consumer right. Consumers make better choices when they are well-informed. They are far more likely to be able to make appropriate decisions if they have the information they need to do so.
- Secondly, consumers are more likely to make a purchase in a market in which they can confidently make comparisons. In short, there is a wealth of research showing that there is more likely to be ***consumer inertia when customers do not have adequate knowledge.***

A microgeneration installation is an example of a complex one-off, long-term purchase when the customer depends on:

- market intervention to ensure good technical standards and good practice; and,
- the expertise and good judgement of the installer.

All markets function best when consumers can exercise choice effectively. Other examples of complex purchases where there is access to regulated information includes the financial sector and the motor industry. Those markets are not perfect, but the consumer's right to vital and comparative information is recognised as beneficial and protected.

The importance of good consumer access to information in the energy sector is widely recognised. Last year Ofgem commissioned a report on the changing information landscape that is enabling consumers to access information about energy tariffs. That report was generally positive about how consumers can access new tariff comparisons but it warned about information asymmetries:

> *"There are many circumstances where one party can use superior knowledge/expertise to gain advantage by causing confusion blinding the other party with science. In addition, many consumers are very aware these information asymmetries exist. This can fuel a*

generalised sense of distrust and undermine consumers' confidence that they can tackle an issue effectively. This helps create inertia."

The same arguments can be deployed within the microgeneration sector. Serious information asymmetries damage markets and can lead to market failure. It is RECC's view that there is a real danger that the markets for heat pumps and biomass are being damaged because of confusion and information asymmetries – the information many people are being given is not reliable or reasonable.

1.4 The Consumer Rights Act

It is worth stressing the issue of risk in relation to standards. Standards should help companies reduce risk by helping them avoid practice that may be unsafe or unlawful for example. It is within this context that the *Consumer Rights Act* is relevant.

The information a customer receives *before* the contract is signed is the most important information made available. Consumers cannot base their purchasing decisions on information provided to them at completion stage.

The critical nature of pre-contractual information is recognised in law in the *Consumer Contracts (Information, Cancellation and Additional Charges) Regulations 2013 (the CCRs)* and in the *Consumer Rights Act 2015*. The CCRs state that the trader must give the customer information about the 'main characteristics' of the goods *before the contract is agreed*. This is reinforced by the *Consumer Rights Act 2015* that states that the 'main characteristics' of the goods must form part of the contract between the trader and the customer. Furthermore, if the goods don't comply with the 'main characteristics' as described then the trader will be in breach of the *Consumer Rights Act* and, therefore, the customer will be able to pursue a relevant statutory remedy.

The new Act that came into power in October 2015 not only consolidates and updates existing laws, it also implements new consumer rights. Two rights within the Act are worth highlighting within the context of a discussion about performance estimates.

Firstly – consumers have three 'implied terms' under the Act and one of those core rights is that goods must be 'as described' by the trader. The goods must be what the customer expects.
Secondly – and perhaps more importantly – the Act includes a significant new consumer protection: verbal or written statements, made by the company, about the company or the company's services will be binding if that information influences the customer's decision to enter into the contract.

This new provision is very important because misleading statements are now contractual terms and consumers now have the right to raise a breach of contract against a trader. Prior to this new provision, customers had to raise an 'action of misrepresentation'. Experts consider breaches of contract as easier to prove than actions of misrepresentation. Customers may now be able to claim a breach of contract if they are given misleading or inaccurate performance information.

While performance estimates for small-scale renewable generation installations cannot be precise and are not an absolute guarantee of actual performance, they do need to be

reasonable, rational and based on realistic assumptions. If they are not, and consumers rely on them, they may be able to seek legal remedy.

In reality, companies will need to be very careful about all of the pre-contractual and point-of-sale information given to customers – this includes flyers, performance estimates and all verbal information given by sales agents and other company representatives. The standards attempt to define how performance estimates should be deployed but our research shows that not only are a significant proportion of performance estimates non-compliant, some are extremely misleading.

1.5 Methodology

Our research is described in *Section 2*.

Section 2 describes our examination of a sample of formal performance estimates for each technology. This section also includes: a summary of this analysis; the top-level findings; and, relevant information about complaints made about specific technologies. ***Section 2*** *also* describes specific case studies to illustrate why specific performance estimates were found to be non-compliant.

Note on methodology.

Nearly 50 formal performance estimates were examined for this report and over 30 selected for analysis and included in the tables below. Most were obtained at formal audit or from spot checks carried out by RECC auditors. The procedure used by RECC to select companies for audits and spot checks is risk-based which means that the companies included in this report are not a random sample of RECC members. However, companies selected for audit tend to be larger and some very big installers are included in the analysis. This means that the research does reflect the experience of a significant proportion of domestic customers.

Furthermore, it is important to note that each proposal analysed is likely to reflect typical practice for that whole company. In other words – the performance estimates examined represent an analysis of the performance templates used by the companies and their approach to the performance calculations. The performance estimates described in this report therefore reflect the business models deployed by the installers and the broad experience of the customers during that period.

2. Heat Pumps, Solar Thermal and Biomass – Context, Standards and Analysis

2.1 Performance estimate analysis

To better understand the problems identified by RECC auditors, RECC developed compliance tools for the three heat technologies. The tools include all RECC and MCS installer obligations to provide pre-contractual performance information and how that information should be presented. The tools were then used to assess compliance by analysing a sample of actual performance estimates for each technology. The results are described below using the following content headings for each technology:

- **Context** – describes relevant research or reports on relevant performance issues.
- **MCS Obligations** – includes a description of the significant requirements related to pre-contractual performance information in the three technology standards – MIS 3001 (Solar Thermal), MIS 3004 (Biomass) and MIS 3005 (Heat Pumps).
- **Our analysis and top-level findings** – includes more information about our methodology, a table detailing the results for each technology and a description of the main findings.
- **Complaints** – describes information from the RECC complaints team relevant to each technology. This also includes relevant case studies.
- **Case studies** – The case studies illustrate how the assessments were made in the performance estimate analysis described. They also illustrate the consumer impact of poor practice.

2.2 Heat Pumps

2.2.1 – Context

Several studies based on empirical research have examined the performance of heat pumps in UK domestic settings. This is in contrast with the published research on biomass that is almost exclusively restricted to small studies, desk-based research and efficiency modelling (those reports are described in section 2.4.1).

The UCL Energy Institute Analysis of Heat Pumps Installed via the RHPP Scheme – February 2016[19]

This field trial monitored several hundred domestic installations supported by the Renewable Heat Premium Payment (RHPP) grant scheme. The monitoring concluded in December 2014 when the data was handed to the research consortium for analysis and the eventual sample used for the research included slightly fewer than 500 installations. As with the two field trials described above, the main outcome measures examined were the Seasonal Performance Factors (SPFs) at various system boundaries (including H2 and H4), under standard UK weather conditions.

The results are extremely disappointing because they do not demonstrate improved performance compared to the EST and DECC Phase II study cited below[20]. The authors state that

[19] Detailed analysis of data from heat pumps installed via the Renewable Heat Premium Payment Scheme. DECC, February 2016: https://www.gov.uk/government/publications/detailed-analysis-of-data-from-heat-pumps-installed-via-the-renewable-heat-premium-payment-scheme

[20] Detailed analysis of data from heat pumps installed via the Renewable Heat Premium Payment Scheme. DECC, February 2016. Page 20.

these new results are actually consistent with the DECC Phase II findings. Performance efficiency was also found to be lower than a smaller scale preliminary study of RHPP monitored heat pumps that was based on data from just one month (published in 2014).

The study sample was split into several sets for analysis and one of those (Sample C: UKSet) examined performance adjusted to a set of standard external weather conditions chosen to match temperatures used in the Standard Assessment Procedure (SAP) as closely as possible. The analysis of this set found only 55% of ASHPs and 79% of GSHPs met the SPFH2 ≥ 2.5 criterion defined in the EU Renewable Energy Directive.[21] Commenting on this specific finding the authors state: 'the results here indicate that a large proportion (between a third and just under a half) of ASHPs and just over 20% of GSHPs were not operating with sufficient efficiency to be classified as renewable sources of energy.'

The authors describe certain caveats related to the methodology and these include a discussion regarding the extent to which the RHPP sample is representative of the UK domestic market for heat pumps. They also state that there may be an overestimation of heat pump output (and therefore SPF) due to the presence of antifreeze in some primary heat distribution circuits. These and other caveats are described in the report – page 20.

Despite those limitations the authors conclude that the top-level finding show a mean SPF H4 of 2.3 for ASHPs and 2.48 for GSHPs for the Sample C UKSET[22]. Overall, however, the authors place stress on the SPF H2 results and conclude that while more than 90% of installations have resulted in some carbon savings, more than 40% of ASHPs and more than 20% of GSHPs in the study operate below the threshold used by the European Commission to classify as renewable.

DECC has recently made several comments about research on in-situ performance.

> DECC's recent RHI impact assessment states:
> *"The latest RHPP evidence concludes that heat pump performance across the whole RHPP stock monitored averages 2.3 (ASHP) and 2.75 (GSHP). It also concludes that only a portion of the total heat pump stock operate at an SPF of 2.5 or greater; 53% (ASHP) and 77% (GSHP)."*[23]

These results should be of serious concern to the industry, DECC and MCS. Since its launch, the RHI is not eligible for installations predicted to achieve a SPF of less than 2.5. These results clearly indicate that a significant proportion of domestic customers (possibly just under one half of those with ASHPs) are now using systems with an actual efficiency that:

- does not classify as renewable under EU law; and,
- would not qualify for the RHI had the performance forecast been more reliable.

The Energy Saving Trust (EST) has published two study reports on heat pump performance:

[21] Detailed analysis of data from heat pumps installed via the Renewable Heat Premium Payment Scheme. DECC, February 2016. Table 3.
[22] Detailed analysis of data from heat pumps installed via the Renewable Heat Premium Payment Scheme. DECC, February 2016. Table 2.
[23] Consultation Stage IA: The Renewable Heat Incentive: A reformed and refocused scheme IA No: DECC0211. March 2016. Annex 4.

The EST Phase I Trial

The first field trial was completed in 2010 and the results revealed that most heat pumps were not performing as well as expected as the median *system efficiency* for air source heat pumps (ASHP) was found to be just 1.83 with the highest 2.2. The median for ground source heat pumps was 2.31 with the highest over 3.0.[24] The system efficiency figures were lower than those monitored in similar field trials held in other European countries. The detailed analysis of the field trial led directly to the revised MCS Standard MIS 3005 that came into force in 2012.[25]

The EST and DECC Phase II Trial

Phase II of the study was carried out between 2010 and 2013. This Phase II trial is widely misunderstood as a 'stand alone' trial involving a new sample of installations. In fact, phase II 're-set' the phase I trial with 38 of the original installations selected for a range of interventions: from major re-sizing to minor modifications. Six new sites were also included and installations carried out in accordance with the new MCS standard.

The *EU Renewable Energy Sources Directive* requires heat pumps perform to a minimum Seasonal Performance Factor (SPF) (H2) of 2.5 to be classified as renewable. When assessed using that SPF (H2) measure - 20 out of 21 GSHPs in Phase II met or exceeded that criterion. The equivalent figure for ASHPs was 9 out of 15. Five out of the six newly installed heat pumps met the criterion. However, both DECC and the EST consider SPF (H4)[26] to be the most useful measure of performance for householders because it takes into account all of the electricity used by the heating system. According to that assessment the average performance was 2.82 for GSHPs and just 2.45 for ASHPs. Eleven out of 15 ASHPs achieved an SPF (H4) of less than 2.5. Industry representatives have criticised the methodology used in this Phase II study.

The EST concluded that performance 'has the potential to improve as the UK market continues to evolve and adopt more rigorous installer standards'[27] and that, as the installations were not fully installed under the MCS standards put in place in 2012, then it expected better technical performance and customer satisfaction in the future. RECC welcomed the introduction of the revised MIS 3005 standard in 2012. That standard (and later revisions) includes installer obligations related to the performance information that must be given to customers and those obligations are described below in 2.2.2.

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[24] The Heat is On. Energy Saving Trust. Page 18.

[25] https://www.gov.uk/government/publications/analysis-from-the-first-phase-of-the-energy-saving-trust-s-heat-pump-field-trial

[26] SPF H2 is a system boundary that only includes the electricity used by the heat pump itself (and the source fans or pumps) in the calculation. SPF H4 includes all the electricity supplied to the heat pump, all fans or pumps and electricity delivered to any incorporated auxiliary heaters used to boost space heating, and immersion heaters used to provide extra hot water. Electricity used by any other fans or pumps included in the building's heating and hot water system is also included. The calculation used for SPF H4 is the same as for SPF H2, but due to the larger system boundary the extra heat produced and electricity used is included. The Heat is On. Energy Saving Trust. Page 23.

[27] The Heat is On. Energy Saving Trust. Page 34.

The DECC Policy Framework

According to DECC, heat pumps will continue to have an important role to play in contributing to fuel poverty milestones and in reducing the carbon associated with domestic heat technologies – *as long they operate efficiently and as expected*.[28] DECC is proposing to maintain subsidy income available for heat pumps but is also aiming to identify *new ways to incentivise better in-situ performance.* Commenting on current evidence for in-situ performance DECC states that 'there is increasing evidence that design performance of heat pumps is not well correlated with their in-situ performance' and that some heat pumps are 'unlikely to be providing significant bill savings to the user and are providing less renewable heat than expected.' As a result, DECC is considering removing the link between design performance and payments and wants to ensure better value for money by incentivising better in-situ performance. They propose to do this by offering a 'base' tariff using a default SPF with 'higher payments available to those that can demonstrate better performance.'

2.2.2 – MCS obligations

MIS 3005 contains detailed installer obligations on the provision of pre-contract performance information. Those obligations cover both the design and the performance of the system and fall under the following headings:

- Alternative estimates[29]
- Overall design and demand
- Hot water demand
- Specific room heat loss information and emitter selection
- Design for Ground Source Heat Pumps
- System Performance
- Running costs

A possible source of confusion among installers is that the relevant paragraphs that describe the information that they are expected to give consumers are distributed throughout sections 4.2.1 to 4.3.4 of MIS 3005. For example requirements related to information about **demand** are contained in paragraphs 4.2.1, 4.3.2(a), 4.2.2 and 4.2.10 – all of these relate to total demand and the possible need for compulsory metering.

A further source of confusion is that the standard is not always explicit about *when* the information should be provided. Some of the paragraphs in Section 4 of the standard state that the information cited must be 'communicated in writing' to the customer 'at or before the point at which the contract is awarded'. Information provided at the same time the contract is signed is not useful and this is recognised in law. The *Consumer Contracts Regulations 2013* clearly

[28] DECC. The Renewable Heat Incentive: A Reformed and Refocused Scheme. March 2016.

[29] As contained in MIS 3001(Solar Thermal and MIS 3004 (Biomass), the standard for heat pumps includes a general requirement that any estimate using an alternative methodology must clearly describe and justify the approach. Furthermore, any alternative estimate must not be given greater prominence than the MCS estimate and where the results vary significantly from the MCS estimate, then it must be accompanied with a warning that it be treated with caution.

states that where consumers do not have adequate 'time to reflect' then the agreement is defined as an 'off-premises contract' - which means that the contract is subject to special consumer rights of cancellation. The term 'at or before' is not precise and does not adequately convey the MCS intention that customers should have 'time to reflect' on the information provided *before* they are asked to sign the contract.

Other paragraphs are even less clear. For example, the standard does explicitly state that information on the heat pump *running costs* should be communicated in writing to the client, but it is not clear in paragraph 4.2.8 precisely *when* this information should be provided. This paragraphs states that the estimate of the annual running cost of the heat pump is contained within the estimate of annual energy performance, but this is not explicit in section 4.3. While 4.3.2 does describe an obligation to give the customer an *estimate of the energy needed to run the pump* – there is no mention (in 4.3.2) of a need to tell the customer *the cost of the energy.* There is a lack of precision in the standard about exactly what information should be provided *pre-contract*. We have summarized the obligations related to performance information in **Table 3** below.

Table 3: Performance Information Obligations in MIS 3005

Obligation	MIS 3005 Paragraph	When should this information be given	Comments[30]
Rules on alternative estimates	4.3.4	Applies to pre-contractual information	This warning should be clarified to state that all estimates not based on MCS methodology should be treated with caution.
Overall design and demand and information on supplementary heating	4.2.1, 4.2.2	Unclear	The information requirements in these paragraphs should be clarified.
Hot water demand	4.2.3	Unclear	Installer obligation to discuss predicted hot water demand should be clarified.
Heat Losses and Emitter Design	4.2.12-17	'At or before' contract agreed	This information is vital as it demonstrates that system efficiency depends on emitter choice. Requirements here should be clarified and standardized.
Ground Source Design	4.2.24	Unclear	Standard should define when this information should be provided.
System Performance	4.3	'At or before' contract agreed	The standard should be explicit about what values must be provided pre-contract.
Running Costs	4.2.8	Unclear	Standard should define when this information should be provided.

Installers are confused about what information they must give to customers and when that information should be given and this confusion extends to the core System Performance requirement described in section 4.3 of MIS 3005. This paragraph states:

> "An estimate of the annual energy performance shall be calculated or obtained and shall be communicated in writing to the client at or before the point at which the contract is agreed."[31]

The problem is that paragraphs 4.3.2(a)-(g) describe the calculation – *they do not describe what performance information should be given to the customer.* As the case studies in Section 2.2.5 indicate – heat pump installers interpret these paragraphs in a variety of ways and, as a consequence, the information given to customers is often vague or misleading or both. No single value can correctly encapsulate heat pump performance. Instead, customers may need all of the

[30] See section VIII – Recommendations related to these obligations.
[31] MIS 3005 – 4.3.1.

information contained in *Appendix E* of MIS 3005 before they can make a good assessment of the proposal[32] (see section VIII – Recommendations - of the Executive Summary for more on this).

2.2.3 – Our analysis and top-level findings

We examined nearly 20 estimates for heat pumps and included 9 in the analysis. This pre-contractual information was measured using the RECC heat pump performance information compliance tool as a consistent check on the performance information given to customers. Those analysed represent a wide range of 'typical' performance estimate styles such as those based on calculators provided by manufacturers, those focused on RHI income and verbose estimates that (appear to) put stress on technical detail.

Compliance with the main MCS and RECC requirements is summarized in **Table 4** below. Green indicates compliant practice; red indicates non-compliance and orange partial compliance. Compliance areas 15 and 16 were not assessed in most cases because the companies made incorrect assumptions about heat demand when calculating the RHI.

[32] See executive summary VIII – Heat Pump Recommendations.

Non compliance related to key MCS and RECC Obligations - Heat Pumps									
	Performance Estimates								
Compliance area	**PE1**	**PE2**	**PE3**	**PE4-** RECC Model	**PE5**	**PE6**	**PE7**	**PE8**	**PE9-** Easy MCS
1 Alternative estimates		N/A	N/A	N/A			N/A	N/A	N/A
2 Clear and accessible?									
3 Room x room heat loss ***(see note a)***									
4 Overall heat demand									
5 Space/water loads indicated									
6 Info on auxiliary heaters	N/A	N/A	N/A		N/A	N/A	N/A	N/A	
7 HW consumption assessed?									
8 Emitters and SPF discussed?									
9 GSHP system design info?	N/A		N/A	N/A	N/A	N/A			
10 Main values consistent? ***(see note b)***	No		No		No	No			Not fully
11 Key performance indicators:									
11a Renewable heat provided by HP (kWh/yr)	No	As 10	As 10	Not Clear	As 10	As 10			As 10
11b Electricity consumed by HP (kWh/yr)	As 10	As 10	As 10	Not Clear	As 10	As 10			As 10
11c Combined SPF (Scop/Sper)	As 10	No	No		As 10	As 10			As 10
12 Running costs clear?	Incorrect		As 10		Incorrect	No			
13 RHI Assumptions	N/A				N/A	N/A			N/A
14 RHI based on EPC?					N/A	N/A			N/A
15 Tariff rate correct ***(see note c)***									N/A
16 Correct formulae ***(see note d)***									N/A
a: Clarity regarding room-by-room heat loss.		Information included but value may be incorrect							
b: Do the key figures make sense.		Information partly complete							
c: N/A if 14 non-compliant.		Information not included							
d: N/A if 14 non-compliant (see case studies).									

Table 4. Analysis of Heat Pump Performance Estimates.

The main findings of this analysis is summarised below.

- All three estimates that included 'alternative estimates' (using an alternative methodology) were presented in a non-compliant way. All three were very misleading.
- Seven out of the nine were not clear or accessible.
- One estimate gave no figure for overall heat demand. Two others gave information contradicted by values in alternative estimates with no explanation.
- Three out of the four estimates for GSHPs did not give the required technology-specific design information included in MIS 3005 – 4.4.24.
- The main performance values were consistent in only three estimates (for example, as is shown in Appendix E of MIS 3005).
- The main values were significantly misleading in five.
- None of the estimates gave all required key performance values:
    - overall demand;
    - renewable heat provided;
    - electricity consumed by heat pump; and,
    - combined SPF.
- Four of the seven estimates that gave RHI income predictions wrongly based the figures on their own demand assessment rather than the EPC.
- The information about running costs was clear in five estimates, misleading in three and unclear in one.

The reasons why the calculations were assessed as misleading or incorrect are explained in 2.2.5.

It is worth highlighting here that the RECC requirement that estimates should be 'clear and accessible' is of critical importance. Estimates must carry the important values that enable customers to make an informed decision and the estimates must present the information in way customers can understand. Seven were not useful when measured against this benchmark. Estimates *one, two, three, seven* and *eight* carried very little information and certainly not enough to allow the customer to make a reasonable assessment of the proposal. Estimates *five* and *six* did include some useful information but almost all of this was not consistent with alternative estimates that were given greater prominence.

Estimates four and nine were reasonably compliant and contained useful information. These estimates were based on RECC or Easy MCS model documents which allow installers to input values into pre-formatted fields. Installers must fill in all necessary fields with the required information if these models are to be used in a fully compliant way.

2.2.4 Complaints

% of installations about which RECC received formal complaints (not including those registered with certification bodies unless joint):
ASHP – 2.68 in 2015 (>4,000 installs)
GSHP – 3.13 in 2015 (<900 installs)
These figures exclude:

- all technical complaints sent only to the certification bodies;
- all complaints directed only to the installers; and,

- all complaints where the customer has sought some other solution (such as legal action) without first involving RECC.

Relevant complaint case studies:

Claim of a miss-sold Air Source Heat Pump.
Installer informed complainant that he would receive RHI payments amounting to £620 quarterly. The actual RHI income being received is £160 quarterly and the shortfall over 7 years is clearly significant. The company has made two offers in return: a one-off payment of £1000 plus 5 years free servicing; or, a final offer of £1500 plus 2 years free servicing. The customer has rejected both offers. The dispute is on-going.

Inefficient Ground Source Heat Pump
This customer had a GSHP installed 3 years ago and claims the system has been inefficient and the electricity bills have been very high as a result. An independent engineer assessed the system and made technical recommendations for rectification implemented by the installer. The system is now working correctly but the consumer is seeking compensation for the 3 years of inefficiency and the cost of hiring the independent engineer. The dispute is on-going.

Very Inefficient Ground Source Heat Pump
This complainant had a GSHP installed in a second home. She believes the heat pump was undersized and was therefore miss-sold. She has installed metering to monitor the electricity used by the heat pump and has identified that it has a COP of 1. The consumer has complained and both the installer and manufacturer have visited the site. The consumer wants remedial work carried out to bring the running costs down to what was estimated before installation – roughly £80-120 per month on average. The complainant also claims that the RHI was calculated incorrectly. The installer informed the consumer she would receive £21,452 under the RHI, however the actual amount is £11,908.12, giving a shortfall of £9,543.88. The consumer is seeking financial compensation but the company states that it is not responsible for any loss incurred.

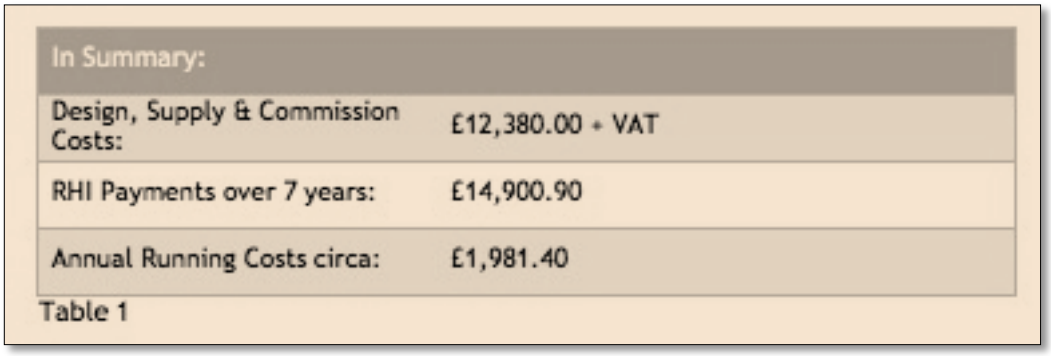
Incorrect estimate for ASHP
This customer has claimed that her ASHP has developed numerous faults and is not powerful enough to supply enough hot water. The consumer also says the system was miss-sold because the RHI was estimated at £1,582 but when she received the Green Deal Report after the sale the income was calculated at £774.The consumer was also given a payback calculation of 4.5 years which was found to be inaccurate after the contract was signed.

Incorrect Performance Claim
This customer has told RECC that a GSHP was sold as a financial package with a stated COP 3.54 and that this would ensure a financial return on the installation cost within about 10 years. The customer says that the system failed to deliver the promised performance from the outset and appears to have a COP that is about 50% of that promised level in the first year. The customer says that despite close monitoring of performance the company has failed to accept that there are performance problems. The customer said the installer eventually agreed to negotiate some joint compensation with the manufacturer but this did not materialise. The customer says that no compensation has so far been paid

2.2.5 – Heat Pumps – Performance Estimate Case Studies

The case studies below illustrate the assessments made in the performance estimate analysis described above in ***Table 4***. They also illustrate the consumer impact of poor practice.

2.2.5.1: Performance Estimate 1



In Summary:	
Design, Supply & Commission Costs:	£12,380.00 + VAT
RHI Payments over 7 years:	£14,900.90
Annual Running Costs circa:	£1,981.40

Table 1

Summary information in Performance Estimate 1 (Costs Exclude Installation)

Overview
A lengthy 9 page performance estimate in a 35 page quote for the design, supply and commissioning (installation not included) of an ASHP for a proposed large domestic new-build property.

Summary of Compliance with Obligations
The estimate is not consistent with MIS 3005 for many reasons.
Most significantly:

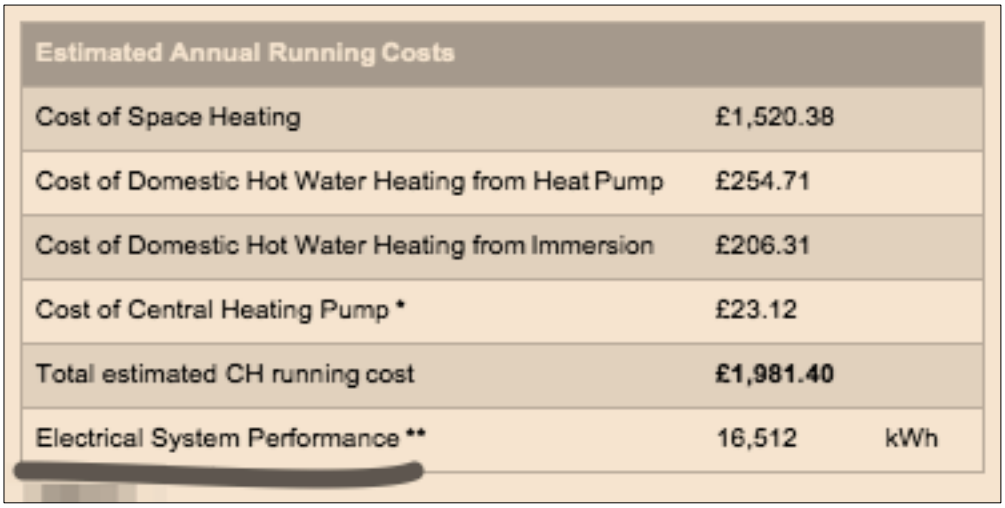
- Although there is evidence of a room-by-room heat loss assessment – no figure is given for overall heat demand in kWh.
- No figure given for renewable heat supplied by HP.
- Overall running cost per annum stated but not the assumptions used (ppkWh of electricity).
- RHI income estimates not based on EPC demand.

The company has provided the following values:

- SPF – 3
- Electricity Consumed by HP – 16,512 kWh/yr (*expressed using non-standard terminology as 'Electrical System Performance'*).
- Annual running cost - £1981.40
- RHI projected income for 7 years.

Performance Estimate Assessment:
No overall heat demand for the home in kWh.
The cost of electricity consumed is based on 12ppkWh tariff.
The RHI calculation is wrongly based on the company's own assessment of demand rather than the EPC.
Other figures given are not consistent:

- The HP energy consumption of 16512 kWh and an SPF of 3 implies a total demand of 49536kWh
- The assumed demand of 49536kWh is not consistent with the RHI income estimate of £2128.70 @ 7.3ppkWh (which is based on company's estimate of demand not the EPC).
- A reverse calculation on RHI annual income £2128 implies a total demand of 43508kWh.



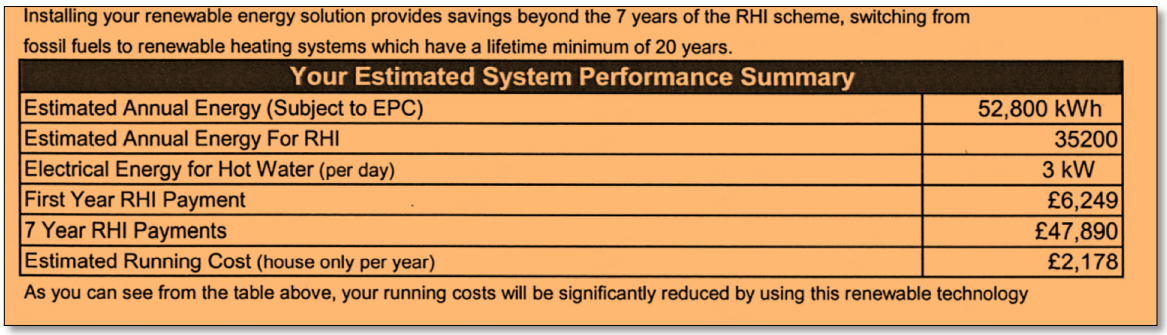
Estimated Annual Running Costs		
Cost of Space Heating	£1,520.38	
Cost of Domestic Hot Water Heating from Heat Pump	£254.71	
Cost of Domestic Hot Water Heating from Immersion	£206.31	
Cost of Central Heating Pump *	£23.12	
Total estimated CH running cost	**£1,981.40**	
Electrical System Performance **	16,512	kWh

Running Costs: Performance Estimate 1. 'Electrical System Performance' is actually electricity consumed by HP. Example of confusing, non-standard terminology.

2.2.5.2: Performance Estimate 2

Overview
This estimate contains very little performance information aside from an emphasis on the RHI. The quote/estimate is for the design, supply, installation and commissioning of a GSHP for an existing dwelling.

Summary of Compliance with Obligations
The estimate is not compliant for many reasons – mainly because it excludes most of the information required by the standard.



Installing your renewable energy solution provides savings beyond the 7 years of the RHI scheme, switching from fossil fuels to renewable heating systems which have a lifetime minimum of 20 years.

Your Estimated System Performance Summary	
Estimated Annual Energy (Subject to EPC)	52,800 kWh
Estimated Annual Energy For RHI	35200
Electrical Energy for Hot Water (per day)	3 kW
First Year RHI Payment	£6,249
7 Year RHI Payments	£47,890
Estimated Running Cost (house only per year)	£2,178

As you can see from the table above, your running costs will be significantly reduced by using this renewable technology

The company 'system performance summary' contains nearly all of the performance information offered by the installer.

Most significantly:

- No evidence of a room-by-room heat loss assessment – and no description of a method used to assess demand.
- No Ground Source specific design information as required.
- No statement or indication of how anticipated hot water demand was assessed.
- No information given about specific room heat losses or emitter design.
- RHI income estimates not based on EPC demand.
- The formal PE is based only on the estimated annual heat demand, the RHI projection and the estimated running cost of the HP.
- No SPF indicated
- No assumptions indicated for RHI predictions

The company has provided the following values:

- Total demand – 52,800kWh
- Renewable Heat Supplied – 35200kWh
- First year RHI Payment - £6249 @ 18.8ppkWh
- 7 year RHI Payments - £47,890
- Estimated running cost - £2178 per year
- In a separate table the estimate gives a projected 20 year cumulative total income of £102,137.33 allowing for running costs.

PE Assessment –

The cost of electricity consumed is based on 13ppkWh tariff.
The other figures given are not consistent:

- The total demand minus renewable heat supplied = 17600kWh but the PE also gives kWh to run pump as 16500.
- The SPF based on 16500 is 3.2.
- A reverse calculation of the RHI income figure (not from EPC) based on the SPF of 3.2 is 48383kWh.

Conclusion. A non-expert objective assessment of the proposed installation is impossible.

2.2.5.3: Performance Estimate 4

Overview

Performance estimate for an ASHP – Glasgow; based on the RECC model document.

Summary of Compliance with Obligations

This PE does contain some compliant information within the context of the RECC model pre-contractual material. However, the installer has not used the model correctly and has failed to include some compulsory information.

Most significantly:

- There is no evidence that room-by-room heat loss assessment has been carried out and no description of a method used to assess demand.

- The estimate states that the HP will provide only 70% of hot water demand and it will be a 'combined' system but it does not make clear the implications on the RHI (metering).
- No statement or indication of how anticipated hot water demand was assessed.
- Important values are not completely consistent.
- Inconsistent information about RHI income.

The values provided include the following:

- Overall demand – 32032kWh
- 1689kWh demand for hot water
- £1636 *heat pump* running costs based on 13ppkWh
- SPF of 2.7
- EPC demand figure of 24000kWh

PE Assessment –
The cost of electricity consumed is based on 13ppkWh tariff.
The estimate gives an annual *heat pump* running cost of £1636. At 13ppkWh this represents 12584kWh. This is not consistent with the claimed SPF.
The calculated RHI based on the EPC demand appears to be accurate but is presented in a confusing way (two different values).

Conclusion – The estimate contains some useful information and the RHI is correctly calculated using the demand stated in the EPC. However, model template is not used correctly and the values included are not fully consistent. The estimate is not clear on the implications of the combined nature of the design. The customer would need more information to be able to make a meaningful comparison with other estimates.

2.2.5.4: Performance Estimate 5

Overview
Performance estimate for a ASHP. Quote for design, supply, installation and commissioning for existing dwelling.

Summary of Compliance with Obligations
This estimate is in the form of spreadsheet and report information generated by software provided by the manufacturer. One brief table of values is presented in the form of an MCS compatible summary while a 'Selection Report' represents an alternative non-MCS estimate. The presentation of both of these estimates together is extremely confusing because the terminology and values are not consistent. There is no explanation for the different values and the alternative estimate is more prominent. Confusing graphs are not explained and the financial projections in the alternative estimate are misleading.

Most significantly:

- Total heat demand obtained by adding the space heating demand to water heating demand.
- The alternative estimate is given greater prominence than the MCS summary.
- The MCS summary is not readily understandable.

- The alternative estimate carries values that appear to be unrelated to the MCS summary, use different terminology and are not explained.

The company has provided the following values:

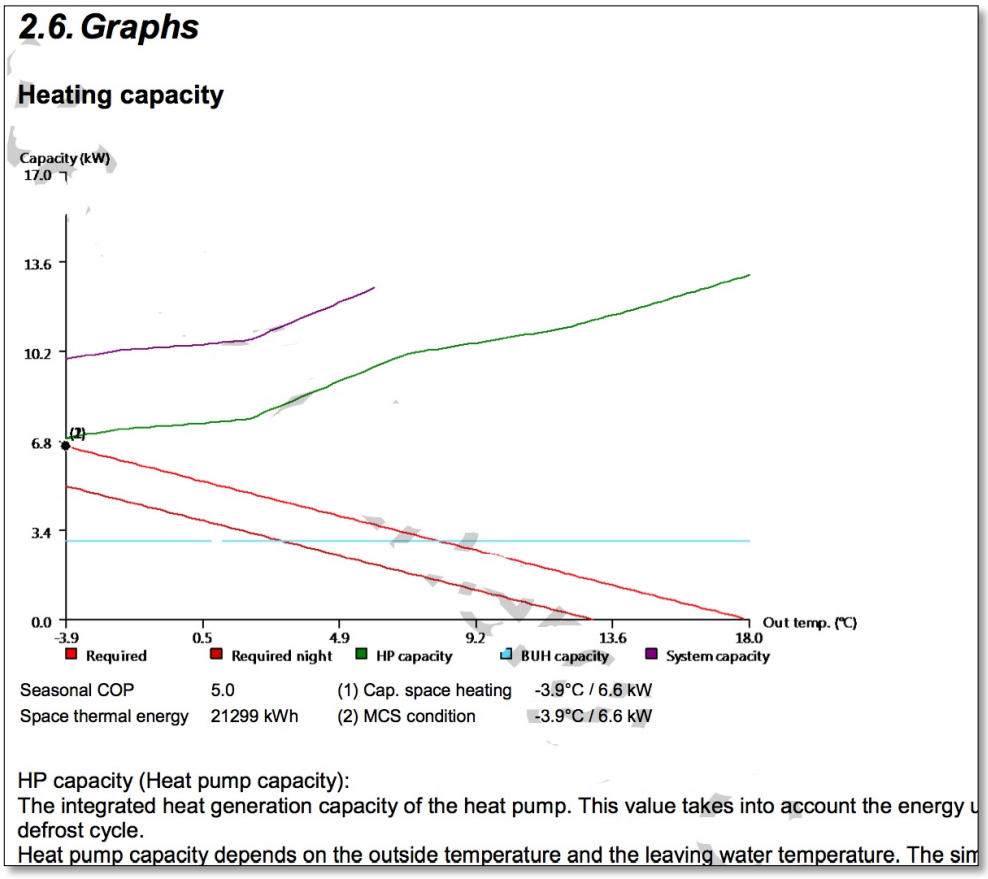
- Space heating demand – 12742kWh
- Hot water demand – 4743kWh
- SPF – 3.4
- The actual energy consumption is given as 3748kWh for space heating and 1918kWh for water heating. Combined = 5666kWh
- Estimated running cost - £498

PE Assessment –

The cost of electricity consumed is a significant underestimate because the calculation is based on the alternative estimate only and given as £498.
Total energy HP consumption is 5666kWh at 13.5ppkWh = £764
This discrepancy appears to be due to a calculation of running costs using a default split-rate electricity tariff where the 'high' cost is 13.5p and the 'low' rate is 9p. This manufacturer's 'Selection Reports' allow a split-rate tariff option and the company confirmed to RECC that the split-rate tariff option is not intended for use in the UK.

The alternative estimate also includes values that are not consistent with the summary estimate such as:

- 'primary energy use' – 10648kWh; and,
- 'yearly energy consumption' - 4259kWh.



PE5: More confusing information in the alternative estimate.

The alternative estimate carries other graphs (above) that contain other values that are not consistent with the summary MCS estimate. For example:

- 'Seasonal COP of 5'; and,
- 'space thermal energy' of 21299kWh.

Conclusion. The estimate:

- Is extremely confusing as the 'alternative' estimate is given prominence.
- The alternative estimate gives values that are not consistent with the MCS estimate.
- Misleading information is given on running costs because they are based on incorrect tariff values.
- A non-expert objective assessment of the proposal is impossible.

2.2.5.5: Performance Estimate 6

Overview

Another performance estimate for ASHP provided by manufacturer. Quote for design, supply, installation and commissioning for existing dwelling.

Summary of Compliance with Obligations

Summary sheet gives the following values:

	Annual Energy requirement	Annual Electricity requirement for the HP	Running costs £
Space	15951	4691	609
Hot Water	5337	1976	257
	21288	6667	£866
SPF	3.2		

In this example the separate *Selection Report* (the alternative estimate) states that the running costs will be £596.
The *Selection Report* also carries the following values that are not consistent with the above estimate summary but are given more prominence:

- Seasonal COP – 4.8
- 'Space thermal energy' – 21689kWh
- 'yearly energy consumption' – 4543
- 'primary energy use' – 11358kWh

2.2.5.6: Performance Estimate 7

Overview
Performance estimate for GSHP – North West England. Quote for design, supply, installation and commissioning for existing dwelling.

Summary of Compliance with Obligations
Another estimate that gives minimal information but the actual summary values appear to be correctly calculated. The installer has failed to comply with several important obligations and has provided confusing marketing information with the estimate and the RHI calculation is incorrect.

Most significantly:

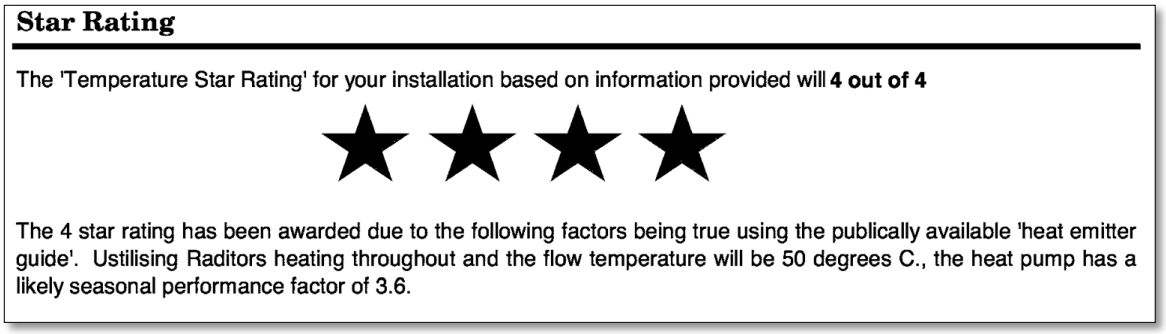
- There is no reference to a compliant room-by-room heat loss calculation.
- Demand information is not given for space and hot water separately.
- The estimate does not appear to have allowed for anticipated hot water demand.
- The full table of information for GSHP as demanded by MIS 3005 is not supplied.

The company has provided the following values:

- Annual overall demand – 28,578kWh
- Annual energy consumption – 7450kWh
- SPF – 3.6
- Renewable Heat Generated – 21128kWh
- RHI Payment First Year - £3972

PE Assessment –
The actual values provided appear to be consistent with each other but the RHI is not calculated correctly using the EPC demand which means all of the RHI forecasts will be incorrect and probably misleading. The estimate also includes confusing information about the 'temperature star rating on page 4 of the quote (below) by mistakenly suggesting that the proposal has been

‘awarded’ a ‘star rating’ of ‘4 out of 4’. This marketing terminology is extremely misleading and is not consistent with the intentions of the Heat Emitter Guide and it not compatible with the Consumer Code.



Star Rating

The 'Temperature Star Rating' for your installation based on information provided will **4 out of 4**

★★★★

The 4 star rating has been awarded due to the following factors being true using the publically available 'heat emitter guide'. Ustilising Raditors heating throughout and the flow temperature will be 50 degrees C., the heat pump has a likely seasonal performance factor of 3.6.

PE7: Misleading information about the heat emitter ‘star rating’.

Conclusion – The summary performance information contained in Performance Estimate 7 appears to be reasonable for the level of demand stated and consistent. However, the estimate lacks important information demanded by MIS 3005 and the RHI is calculated incorrectly. While it may be possible to compare the top-level summary information with another estimate, the performance information does not give the customer an adequate picture of the proposed installation.

2.3 Solar Thermal

2.3.1 – Context

One large-scale field trial carried out by the Energy Saving Trust (and funded by DECC and the devolved administrations in Wales and Scotland) was identified for this report. Carried out over 12 months from 2010 to 2011, data was collected from 88 domestic installations throughout the UK and Ireland. The study aimed to provide "an accessible overview of how solar water heating technology performs and the potential for savings on carbon and energy bills."[33]

The main performance measure recorded was the amount of hot water provided by the solar thermal system as a percentage of hot water used. The median across all systems was 39%. The best performing systems provided 60% and the lowest 9%. The EST said that the study also fund that good advice to users about effective control is essential for best performance. The study highlighted some poor installation practice such as poor insulation. Typical savings for a well-installed and properly used system were estimated to be £55 per year when replacing gas and £80 per year when replacing electric immersion. EST continues to quote similar savings in its current advice on Solar Thermal.

2.3.2 – MCS obligations

Unlike the standards for biomass and heat pumps, MIS 3001 imposes very few obligations on installers to provide customers with performance information. In fact – *the standard is only specific about two values*:

- paragraph 4.5.5 states that the **annual solar energy input to the cylinder** must be given to the customer (with disclaimer) at or before the contract is awarded; and,
- appendix A of MCS 024 states that the predicted solar output (from SAP) and the **estimated fuel saving** shall both be presented to the client at quotation stage.

An estimate can therefore remain compliant with the MCS standard in relation to information provision if it contains only two values taken from the Thermal Solar Performance Energy Calculator (introduced as part of MIS 3001 in October 2013):

- Solar input to hot water cylinder (deemed renewable heat for RHI) – 6.1 of TSPEC
- Estimated annual fuel energy saving, based on efficiency of backup heater – 7.1 of TSPEC

The RECC code however, requires the written performance estimate to be given (and any MCS calculation to be presented) in a form that is 'readily understandable'. Customers may find that a performance estimate based only on those two values (cited above) to be unhelpful if they are not given more context; for example, in the form of other values from the TSPEC calculation. *One solution would be to make the provision of the TSPEC compulsory at the pre-contractual stage (see Solar Thermal Recommendations – Section IX of Executive Summary)*.

There does appear to be some confusion about the status of the TSPEC calculation. While some installers think its provision before contract is currently compulsory, other installers not only fail

[33] Energy Saving Trust. Here Comes the Sun: a Field Trial of Solar Water Heating Systems.

to pass on the TSPEC data, they also fail to provide the two values that are essential under the standard (as described above).

Installers can use the data from the standard TSPEC to provide very informative estimates at the pre-contractual stage and some either provide the whole estimate or easily transfer the data into 'model' documents provided by RECC or Easy MCS. The existence of the TSPEC and the defined values it contains may explain why this analysis has found that a greater proportion of Solar Thermal performance estimates provide compliant information compared to those for Heat Pumps or Biomass.

2.3.3 – Our analysis and top-level findings

Our research included 14 performance estimates and eight were analysed in detail. This pre-contractual information was measured using RECC's solar thermal performance information compliance tool as a consistent check on the performance information given to customers. The results are summarised in **Table 5** below.
Green indicates compliant practice, red indicates non-compliance and orange partial compliance or where an assessment could not be made.

Non compliance related to key MCS and RECC Obligations - Solar Thermal									
	Performance Estimates								
Comp-liance area	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	RECC = RECC Template
			RECC	TSPEC		RECC	TSPEC	Easy	Easy = Easy MCS Template
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Alternative estimates
2									Clear and accessible?
3									Evidence of SDHW calc?
4									TSPEC data given to clients?
5									Overall hot water demand
6									Solar input into cylinder
7									Estimated annual fuel saving
8									Other parameters included
9									MCS Disclaimer
10		N/A							Financial forecast accuracy
11		N/A							RHI based on correct value?
12		N/A							Tariff rate correct?
13		N/A							Correct Formulae?
14		N/A							PE consistent?
		Information included					**Please note:** Compliance areas 4 and 8 are not compulsory but are included to indicate good practice.		
		Information partly complete or cannot be assessed							
		Information not included							

Table 5: Analysis of Solar Thermal Performance Estimates.

The main findings of this analysis is summarised below.

- Four of the eight estimates were not clear or accessible.
- Overall, four offered reasonably good information but four were not useful because they either lacked important information or were inconsistent.
- One estimate gave no figure for overall hot water demand and another gave confusing information about demand.
- Under MIS 3001, the estimated annual fuel saving is one of only two values that installers are required to give customers yet five installers either failed to include this figure or the information was not adequately clear.
- Financial forecasts were not fully compliant in five estimates and were very misleading in one other.
- The main values were not consistent in two estimates and only partially consistent in one other.

The reasons why some of the calculations were assessed as misleading or incorrect are explained in *Section 2.3.5 below*.

2.3.4 - Complaints

Formal complaints received by RECC as a % of installations (not including those registered with certification bodies unless joint):

Solar Thermal – 4.81 in 2015 (>1,000 installs)

These figures exclude:

- all technical complaints sent only to the certification bodies;
- all complaints directed only to the installers; and,
- all complaints where the customer has sought a legal solution without first involving RECC.

2.3.5: Solar Thermal Case Studies

The case studies below illustrate the assessments made in the performance estimate analysis described above in ***Table 5***. They also illustrate the consumer impact of poor practice.

2.3.5.1 Performance Estimate 1

Overview

This estimate contains very little performance information aside from an emphasis on the RHI. The performance estimate consists of one value – the 'estimated energy for the RHI':

Your Estimated System Performance Summary	
Estimated Energy for RHI	2,330 kWh
First Year RHI Payment	£447.36
7 Year RHI Payments	£3,427.88
Projected 1st Year Hot Water Cost Savings	£65.40
Projected 7 Year Total Savings and RHI	£3,993.85
Projected 20 Year Total Savings	£6,108.98

The company 'system performance summary' contains all of the performance information offered by the installer.

Summary of Compliance with Obligations
The estimate is not consistent with the provisions in the standard and the Code for many reasons.
Most significantly:

- There is no mention of a Solar Domestic Hot Water Calculation in compliance with MCS 024.
- The estimate does not give any performance values other than 'estimated energy for RHI' which is assumed to be the Solar Input into Hot Water Cylinder.
- The MCS disclaimer is not current.
- The RHI income/benefit forecast given cannot be verified because the customer's current energy spend is not included (eg: gas or electricity and ppkWh).
- No information is given on how savings are calculated to contribute to a £6,000+ projected accumulative benefit over 20 years and a £4,000 benefit over 7 years.
- No information about on-going annual costs.

Conclusion. The estimate:

- does not include important basic values – such as overall DHW demand;
- does not include on-going annual system costs;
- uses confusing terminology; and,
- cannot be used to make meaningful comparisons with other estimates.

2.3.5.2 Performance Estimate 2

Overview
This estimate contains some detail in a 'system performance' presentation but the terminology used is not consistent with the standard and important values are missing.

Most significantly:

- There is no mention of a Solar Domestic Hot Water Calculation in compliance with MCS 024 although the TSPEC is probably used.
- The estimate does give an 'annual solar input' value but no estimated annual fuel saving.
- Very little of the TSPEC data is included and the important parameters such as backup heater type are missing.
- Some of the terminology used is confusing. For example, total water demand is given as 'heat required' and solar input into cylinder is given as 'annual solar input'.
- There is no information given about hot water adjustments.

Conclusion.
Overall, the estimate is likely to give a reasonable estimate of the theoretical likely energy contribution of the proposed system but not for the specific customer. The information includes no information on the backup heater and therefore no accurate account of the estimated annual fuel saving (based on efficiency of backup heater). The customer would find it difficult to use the information to make meaningful comparisons with other estimates.

2.3.5.3 Performance Estimate 5

Overview
This estimate gives a lot of information but the values given are inconsistent which raises questions about the final financial projection. These issues are similar to those found with performance estimate 4.

Summary of Compliance with Obligations
The estimate is based on household with occupancy of *5 FTE*. The estimate values are shown in the table below.

Estimate of the amount of energy required to provide you with sufficient hot water	2537kWh
Energy Content of Hot Water	2931kWh
Hot water use adjustment	1.29
Deemed renewable heat	4539kWh
Estimated Annual Fuel Saving	5910kWh
Estimated Annual Cost Saving – Back-up Boiler Type: Gas (5910 x 4.2ppkWh)	£248.22
Annual RHI Calculated	£885.56
Cost of installation	£12360

The installer's summary of performance information and RHI calculation.

The occupancy FTE does not appear to be consistent with the energy content of hot water. Deemed renewable heat and estimated annual fuel saving appear to be too high for occupancy.

There is no information about on-going annual costs/maintenance that may have an important impact on cost saving.

Conclusion. The estimate:
- Inconsistent information makes assessment of the estimate difficult.
- Difficult to use to make meaningful comparisons with other estimates.
- Difficult to assess financial forecasts.

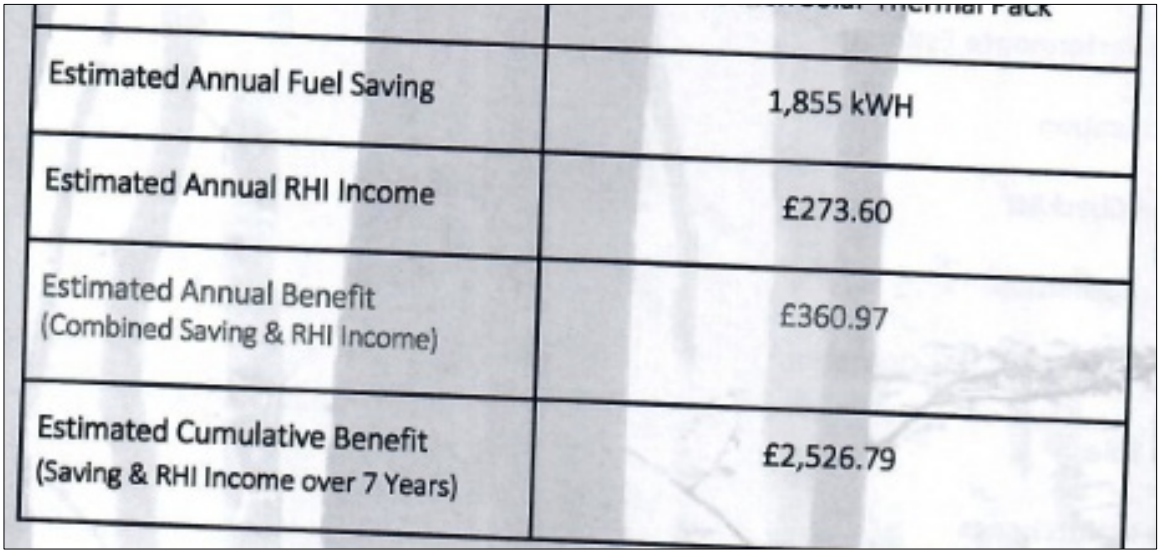
RECC has seen several other similar estimates that appear to give values for deemed renewable heat that are not consistent with the FTE occupancy. Where this is not correct, the error is then magnified through the hot water use adjustment and then the estimated annual fuel saving that is adjusted by allowing for the efficiency of the backup heater. In this case, the backup boiler is assumed to have an efficiency of 77%. While the RHI is calculated as £885, no allowance has been included in the estimate for on-going annual maintenance and electricity use.

2.3.5.4 Performance Estimate 7

Overview
A very brief estimate based on the TSPEC data sheet but including vague financial forecast information that does not include all costs.

Summary of Compliance with Obligations

This estimate is compliant with most MCS and RECC requirements simply because it includes the whole of the TSPEC data sheet. The main problem is that it includes a financial performance forecast but, like many estimates, does not explain how the net benefit is calculated or the assumptions used.



Estimated Annual Fuel Saving	1,855 kWH
Estimated Annual RHI Income	£273.60
Estimated Annual Benefit (Combined Saving & RHI Income)	£360.97
Estimated Cumulative Benefit (Saving & RHI Income over 7 Years)	£2,526.79

Performance 7 – financial forecast. RHI calculated correctly but the cumulative benefit over 7 years is not compliant.

Conclusion. The estimate:

- Includes the TSPEC which enables valid comparison with other estimates.
- Offers an accurate assessment of the first year RHI income but the information on cumulative benefit is not explained.
- Does not include any information about on-going annual costs that may exceed potential fuel savings because the displaced fuel is gas.

2.4 Biomass

2.4.1 Context

There is almost no published data on in-situ domestic biomass efficiency in the UK and very few published figures that attempt to specify system efficiency values[34]. There is, however, some DECC-commissioned research and analysis that is relevant to a discussion on expected efficiency.

2.4.1a – DECC Commissioned – Review of Biomass Performance Standards, 2014

Given this lack of information on actual efficiency in practice, DECC commissioned a literature review to identify relevant published studies and, as part of the same project, a desk-based assessment of efficiency in a sample of installations as part of a general review of biomass standards. This study[35] – *Review of Biomass Performance Standards, 2014* - was carried out between March and April 2014 and included a desk-based analysis of 106 installed (mostly non-domestic) schemes in UK.

The literature review identified only one audit of a significant number of installed systems:

> **The Wood Energy Business Scheme study:** This study – carried out in 2010 - into a biomass scheme including domestic[36] and non-domestic installations in Wales found that only 17 systems out of a sample of 63 installed between 2004 and 2008 were working properly and as originally specified. The main problem identified with the other systems was inefficiency caused by over-sizing.[37]

The literature review identified two published references to the *expected* efficiency of biomass systems in the UK:

> **The Carbon Trust.** *Biomass Heating: A Practical Guide for Potential Users'.* Published in 2008, this states that the estimated efficiency of biomass systems is likely to be in the range of 75% - 90%.
>
> **DECC. RHI Impact Assessment.** Published in March 2011 this sought to describe the costs, benefits and likely impact of the RHI scheme in the *non-dometic sector*. For the assessment DECC assumed that the biomass systems would achieve 81% efficiency performance.[38]

The desk-based analysis of 106 installed schemes (*Review of Biomass Performance Standards, 2014*[39]) was also focused on the non-domestic sector but its findings are relevant to this paper:

- The authors' central conclusion was that typical levels of actual *system* efficiency were in the range of 58% to 75%, with an average of 66.5%.

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[34] Information from Consultees – including Steve Luker Associates Ltd and KIWA.
[35] Review of Biomass Performance Standards, 2014. A Desk-Based Review of Performance and Installation Practices of Biomass Boilers for DECC. June 2014.
[36] Verbal information – Steve Luker; February 2016.
[37] Review of Biomass Performance Standards, 2014. A Desk-Based Review of Performance and Installation Practices of Biomass Boilers for DECC. June 2014.
[38] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48042/1381-renewable-heat-incentive-ia.pdf - Annex 3, 'reference installation characteristics.'
[39] Review of Biomass Performance Standards, 2014. A Desk-Based Review of Performance and Installation Practices of Biomass Boilers for DECC. June 2014.

- While the authors stressed the limitations of the study's methodology, they did conclude that the figures presented were likely to be the most accurate assessment of actual biomass efficiency in the UK. The report author told RECC that their findings may broadly apply to the domestic sector as was found in the study of Welsh installations mentioned above.[40]
- The authors also compared the actual efficiencies examined with the expected efficiencies as stated from the sources they identified in relevant standards (as above). While the expected average performance standard was 76% efficiency, systems would need to be well designed and optimized in order to reach that level of performance. The authors concluded that *actual performance* is at least 10% lower than the expected performance standards identified.

The authors made a number of other observations that are relevant because they mirror issues identified by the research carried out by RECC and described in section 2.4.2 and 2.4.3 below.

Firstly, the report places stress on the difference between 'system efficiency' and 'boiler combustion efficiency'. The report states that 'system efficiency' takes into account all losses – including those related to the boiler, the plant room and any other losses associated with delivery (such as underground pipes and accumulator tanks). The authors:

> *"…found that some installers appear to be overstating the likely performance standards of systems (at 85% and higher) by presenting boiler combustion efficiency as part of the sales process."*[41]

The report concludes that, as a consequence of this stress on boiler combustion efficiency:

> *"In simple terms, customers must know what they are buying and to what standard it will perform, but this basic requirement does not appear to be part of standard practice in the market at present."*[42]

2.4.1b DECC – Research on the Costs and Performance of Heating and Cooling Technologies – Final Report, February 2013

A further RHI Impact Assessment was published in July 2013[43] this time focused on the domestic sector. This did not refer directly to the assumptions used for the Impact Assessment but it did refer to a separate report compiled by Sweett on the use, costs and performance assumptions underpinning the RHI policy framework. The Sweett report[44] indicates that the estimated assumption for the efficiency of domestic biomass used for space heating is based on SAP at 70%.[45]

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[40] Verbal Information – Steve Luker Associates Ltd.

[41] Review of Biomass Performance Standards, 2014. Page 5.

[42] Review of Biomass Performance Standards, 2014. Page 11.

[43] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211978/Domestic_RHI_Impact_Assessment.pdf

[44] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204275/Research_on_the_costs_and_performan ce_of_heating_and_cooling_technologies__Sweett_Group_.pdf

[45] Research on the Costs and Performance of Heating and Cooling Technologies. Sweett Group. Page 53 and Table A1.6 and A1.7.

2.4.1c Proposal for field study of domestic biomass boilers – A Methodology for Evaluating the In-Situ Performance of Sold Fuel Biomass Boilers – KIWA July 2015[46]

The likely consequences of biomass boiler underperformance as reported in the DECC-commissioned study (described in 2.4.1a) are increased fuel consumption, lower reliability, increased maintenance requirements and increased pollutants with implications for the economic sustainability of installations and their impact in areas where there are air quality limits. For these reasons[47] DECC proposed a field trial to obtain empirical data about domestic biomass boiler efficiency.

In 2015 KIWA (in partnership with Amec Foster Wheeler and BRE) published their methodology for such a field trial; this proposal was agreed by DECC and the trial is due to start in April 2016. The proposed methodology report[48] published by KIWA is consistent with observations made by the authors of *Review of Biomass Performance Standards, 2014* (2.4.1a) and includes further evidence about boiler efficiency based on models developed to test the proposed methodology.

Key issues identified by the KIWA report relevant to this paper:

Utilisations factors

The KIWA report discusses *boiler utilisation* – the extent to which the installed boiler is utilised defined as the hours per year full load equivalent operation divided by number of hours per year.

KIWA was able to analyse the *non-domestic RHI data* and found that utilisation factors (UFs) were very low. For example, the analysis found that for six months in every year the boilers were operating at *below* a 15% UF - equivalent to 9 minutes in every hour. The report concludes that these low UFs could be leading to low in-situ efficiencies installed under the RHI. The authors consider it probable that typical UFs in domestic boilers are likely to be as low as those found in non-domestic boilers[49].

As low UF values cause multiple start-up and shutdowns of the boiler which are known to have a negative impact on efficiency then, KIWA explains, this 'must detract from operation.' KIWA adds:

"Suitably sized buffer tanks and thermal stores can ameliorate the situation but a high level of over- sizing will even cause these to underperform."

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[46] A Methodology for Evaluating the In-Situ Performance of Sold Fuel Biomass Boilers – KIWA July 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/458581/Evaluation_of_the_In-Situ_Performance_of_Biomass_Boilers_Final_Report_after_final_boiler_anonymisation.pdf

[47] A Methodology for Evaluating the In-Situ Performance of Sold Fuel Biomass Boilers – KIWA July 2015, page 1 and report introduction.

[48] Much of the KIWA report represents an analysis of the data collated under the domestic and non-domestic RHI for more than 6,000 installations – with the vast majority of those installed in 2014. KIWA also used the MCS certified biomass boilers list, the HETAS Database and the RHI Eligibility List.

[49] Consultation with KIWA. .March 2016.

KIWA piloted its proposed field-testing methodology on a *domestic* boiler by measuring variations in boiler efficiencies under different loads. The study found that the boiler efficiency decreased dramatically as UFs decreased and it concluded that this is a trend it expects to see in boilers of all sizes. Overall, KIWA report that biomass boiler efficiencies fall dramatically when UFs drop below 30%. A Factor of 5% corresponds to an efficiency of 25% and a utilisation of 28% gives an efficiency of just over 70%. The report states:

> *"If a continuous utilisation factor of 5% produces a gross efficiency of around 25% and a continuous 9% Utilisation factor mid 60's% then it is understandable how extended demands (especially without a buffer vessel) of less than 10% will produce very modest annual efficiencies unless the firing cycle of the boiler is carefully managed. These low values are believed to be little known (and certainly not discussed) in the biomass industry."*

There is some evidence to show that actual utilisation in domestic boilers is very low. The recent DECC RHI Impact Assessment states that the estimated average domestic heat load is just 14%.[50]

KIWA's research combined with the other available evidence indicates that there is likely to be a spread of consumer experience with a significant number of domestic boilers providing efficiencies of less than 50%.

2.4.1d DECC's Future Policy

DECC has recently announced that it wants to use the RHI subsidy tariff for biomass to more effectively target off gas grid customers in difficult-to-heat homes.[51] DECC states that biomass will continue to play an important role in long-term decarbonisation of heating but that large installations in the non-domestic sector provides better value for money to achieve this target.

It is important to highlight DECC's assumptions about domestic biomass efficiency used for these recent RHI proposals. DECC states that the source it uses for its assumptions about ***design efficiency*** is the Products Characteristics Database which includes efficiencies for a range domestic biomass boilers of between 72.5% to 90%. However, DECC states that it has also made assumptions about ***actual in-situ efficiencies*** and these are significantly lower at 62.5% to 80%.[52]

2.4.1e Context – Conclusion

As discussed above, there are almost no published studies of in-situ domestic biomass efficiency in the UK. The one field study that included domestic installations carried out in 2010 reported disappointing results. One DECC Commissioned desk-based study of more than 100 mostly non-domestic installations reported significant underperformance with average *system* efficiencies of 66%. That study prompted DECC to commission a large field study of domestic boilers that is due to commence in the first quarter of 2016 and will last for one year. Preliminary research carried out for that field trial (published in 2015) indicates that both non-domestic and domestic boilers appear to have low Utilisation Factors and that these low Utilisation Factors may partly

[50] RHI Impact Assessment – March 2016. Table A2.1.
[51] DECC. The Renewable Heat Incentive: A Reformed and Refocused Scheme. March 2016.
[52] RHI Impact Assessment – March 2016. Table A2.1.

explain evidence of very low efficiencies in installed biomass systems generally. DECC now assumes that in-situ performance of domestic biomass boilers will be significantly lower than the efficiencies identified in the Products Characteristics Database.

It is important to note that the authors of both DECC-commissioned reports stress that there is widespread confusion among stakeholders regarding boiler efficiency with the nominal figure frequently and incorrectly used as shorthand for in-situ efficiency.

There are at least five estimates or standards for boiler *in-situ (or 'real life') efficiency* in the UK context from reliable and impartial sources. Those are summarised in Table 5 below. It is interesting to note that the MCS default seasonal efficiency is the most cautious.

Table 6: Relevant standards or estimates for actual domestic system efficiency.

Standard or Estimate	**Value**
The Carbon Trust. Biomass Heating: A Practical Guide for Potential Users	**75-90%**
DECC RHI Impact Assessment for ***Non-Domestic*** Sector	**81%**
Sweett Report for DECC RHI Impact Assessment for ***Domestic*** Sector	**70%**
DECC's most recent assumptions for **domestic in-situ efficiency** based on its best judgement[53]	**62.5% - 80%**
MCS estimate of seasonal efficiency as stated in MIS 3004 - SAP Table 4a (when boiler not listed in PCD)	**60-65%**

In the absence of reliable field trial data, the actual evidence available discussed above suggests that the MCS Biomass Technical Working Group *should adopt a cautious approach to biomass efficiency levels obtainable in domestic settings.*

The reality of installer claims about potential efficiency could not be more different. The two DECC-commissioned reports are right to suggest that there is widespread confusion about biomass efficiency for the following reasons:

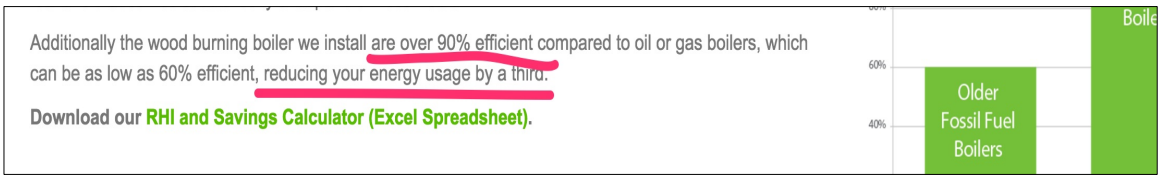
- there is a widespread assumption throughout the sector that boiler nominal efficiency is shorthand for system efficiency;
- companies frequently refer to the 'nominal' or 'manufacturer's' efficiency as the likely actual performance that will be achieved;
- 'nominal' or 'manufacturer's' efficiency is often used to calculate consumer fuel requirements; and,
- installers advertise efficiency levels of over 90% and even refer to Seasonal Efficiency rates of over 90% in Compliance Certificates (for boilers not in the PCD).

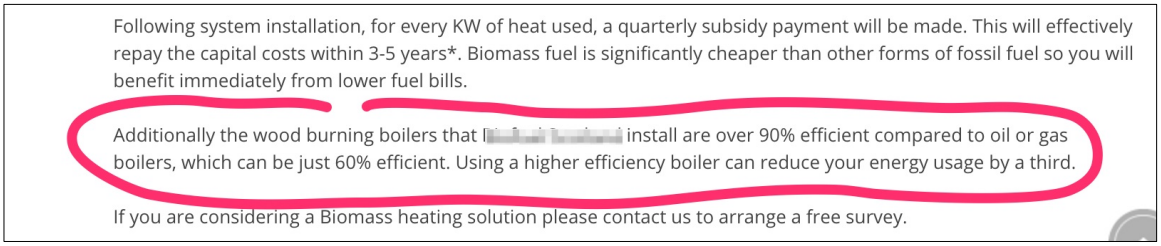
All of the above issues are compounded by further confusion (discussed below) regarding the energy content of fuel, and other important values specified in the MCS standard. It is RECC's

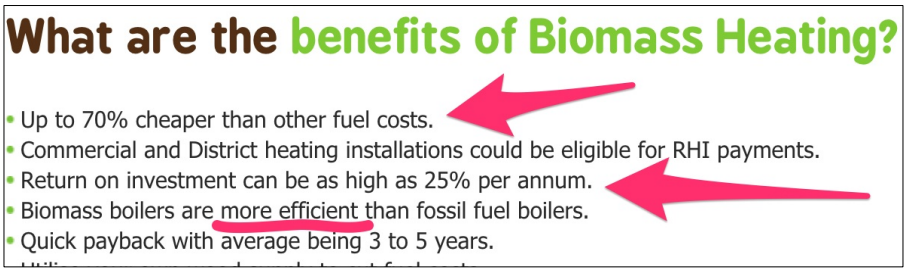
[53] RHI Impact Assessment – March 2016.

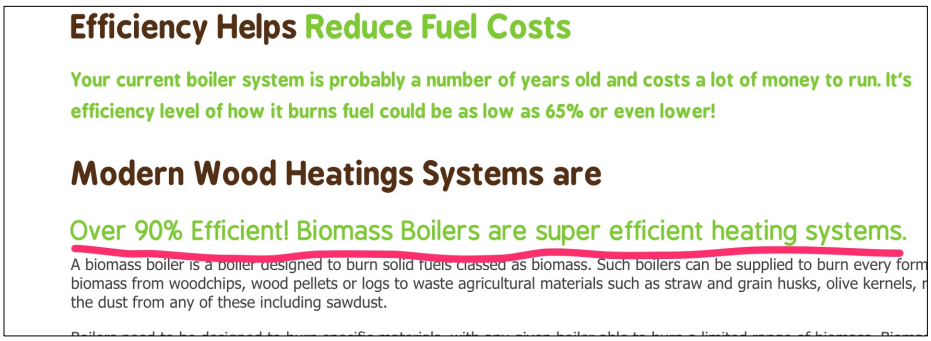
view that, as a result of the confusion and poor practice, UK consumers are being given misleading information and that this is causing significant consumer harm.

2.4.1f A few of the many misleading advertising claims identified by RECC









servicing of multiple renewable technology products, including BIOMASS boiler systems.

Modern Wood Heating Systems are over 90% efficient.

A biomass boiler is a boiler designed to burn solid fuels classed as biomass. Such

biomass heating used.

- ✔ It's good for the environment – The carbon dioxide emitted when wood is burned is the same amount that was absorbed over the time the plant was growing. The process is sustainable as long as new plants continue to grow in place of those used for fuel.
- ✔ The technology is simple but effective – Biomass heating systems are highly efficient being able to convert up to 92% of the heat energy produced during burning of the biomass fuel into usable heat. Depending on the installation locations there are different sizes available, they are relatively quiet, very easy to use, few moving parts so the systems rarely malfunction and they are economic to service

Biomass Heating Systems | Air Source Heat Pumps | Solar Photovoltaics | Solar Thermal | Ground Source Heat Pumps | Lightin

Biomass Heating Systems

Environmentally friendly heating

Sustainable heating solutions are at the forefront of our heating product portfolio. The need to increase the awareness of alternative sources of fuel to fulfil our energy needs has never been so great, not only to alleviate world reliance on fossil fuels but also to encourage more natural sources of energy supply.

Why Biomass? Wood is one of the most natural and sustainable fuel sources available, it has a carbon neutral cycle as it releases about the same amount of carbon dioxide into the atmosphere through burning, as it absorbs during growth process.

Controlled in a very similar way to an oil or gas boiler, biomass boilers have clean burn credential's and super efficiencies in excess of 90%, meaning the range is a more viable option for properties particularly in rural areas that currently have an oil or gas heating system installed.

2.4.2 – MCS obligations

As in the heat pumps standard (MIS3005) information requirements are distributed throughout MIS 3004 but most are described in detail in 4.4 – System Performance. Unlike MIS 3005, however, the biomass standard is *unequivocal* about when the information should be provided by stating that *'all of the following information in clauses 4.4.1 (a) to (k) inclusive shall be communicated in writing to the client before the point at which the contract is awarded.'* [54]

That section requires installers to give customers values that are essential so they can make an informed decision and this includes information about demand ***and*** estimated performance. That information includes (but is not restricted to) the following important values:

- annual heat demand;
- proportion of heat to be provided by BHS;
- seasonal efficiency;
- manufacturer's specified efficiency;
- annual fuel requirement in kg/yr;
- annual fuel requirement in volume m3/yr;
- fuel specification;
- gross calorific value of fuel in kWh/kg;
- bulk density of fuel in kg/m3.

The customer (or the installer) can then obtain fuel prices from various sources and use the above values to estimate running costs.

There is, however, a significant lack of clarity in the standard about some of the above values and this has led to confusion among installers. These issues are discussed below and in *Section X - Recommendations* of the Executive Summary.

2.4.3 – Our analysis and top-level findings

Our analysis included 14 performance estimates. This pre-contractual information was measured using the biomass performance information compliance tool as a consistent check on the performance information given to customers. All 14 estimates were examined in detail for this report.

Compliance with the main industry requirements on performance estimates is summarised in **Table 7** below. The table indicates practice measured against the RECC biomass performance information compliance tool. Green indicates compliant practice, red indicates non-compliance and yellow partial compliance or where an assessment could not be made.

[54] MIS 3004. Page 11.

Table 7: Results from the Biomass Performance Estimate Analysis

	PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10	PE11	PE12	PE13	PE14
					Easy MCS	Easy MCS	RECC Model		RECC Model			Eesy MCS		
Boiler Type + is it in the PCDM	Pellet - NOT IN PCD	Pellet- NOT IN PCD	Pellet - Listed in PCD as SE - 84%	Pellet- NOT IN PCD	Pellet - NOT IN PCD	Pellet - NOT IN PCD	Pellet - Listed in PCD as SE - 82.7%	**LOG - NOT IN PCD**	Pellet - NOT IN PCD	Pellet - Listed in PCD as SE - 85%	Pellet -Listed in PCD as SE - 89.5%	WOOD Chip	Pellet - NOT IN PCD	Pellet - NOT IN PCD
Alternative Estimate?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Overall - Is it Clear and Accessible?	Not enough key data	Not enough key data	Not enough key data	Not enough key data	Not enough key data	Yes	Not based on SE	Not based on SE	Not based on SE	Not enough key data	No - not enough key data	Inconsistent	Not enough key data	Partially
Demand Values														
Evidence of compliant heat loss calculation?	Yes	Yes	NK	NK	NK	Yes	Yes	Yes	NK	NK	NK	Yes	NK	Yes
Overall heat demand figure? Estimate = not based on roomxroom Actual and credible = comp	Estimate. Actual done later.	Yes	Yes	Yes	Yes	PC - not consistent (pages 1&5)	Yes	Yes	Yes	Yes but poss not on roomxroom	PC - not consistent Estimate V Comp Cert	Yes	NK	Yes
Space and water heating given and proportions provided by BHS?	Yes	Yes	PC - not proportion	Yes	PC - not proportion	Yes	Yes	Yes	Yes	PC - not proportion	Yes	Yes - space only	NK	Yes
Performance Values														
Seasonal Efficiency	No	No	No	No	No	Yes - 65%	No	No	Incorrect	No	No	Incorrect	No	No
Annual Fuel Requirement - Mass	No	Incorrect	No	Incorrect	Incorrect	Yes	Incorrect	Incorrect	Incorrect	No	Yes (not consistent with demand	Incorrect	No	Yes
Annual Fuel Requirement - Volume	No	NK	No	Incorrect	Incorrect	Yes	Incorrect	Incorrect	Incorrect	No	Yes (not consistent with demand	Incorrect	No	Yes
Are the figures compliant? (demand values consistent with Performance Values?)	No	NK	No	Incorrect	Incorrect	Yes	Incorrect	Incorrect	Incorrect	No	No	Incorrect	No	Yes
Fuel Values														
Fuel Spec or ref to relevant	No	No	No	No	No	Yes	No	No	No	No	No	No	No	Yes
Gross Calorific Value in kWh/kg?	No	No - incorrect	No	No	No - incorrect	Yes	No - incorrect	No - incorrect	No	No	No - incorrect	May be incorrect	No	Yes
Disclaimer														
Full MCS Disclaimer?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes
Financial														
Assumptions given where payback given or year on year forecast?	N/A	N/A	N/A	Yes but fuel savings incorrect.	N/A	Yes	Yes but fuel savings incorrect.	Yes but fuel savings incorrect.	Yes but fuel savings incorrect.	Yes but fuel savings incorrect.	N/A	NK as demand inconsistent	No	N/A
RHI Based on Demand from EPC?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NK	N/A	NK as above	No	Yes
Is the Calculation Correct (including the tariff rate)?	PC (as above)	Yes	Yes	NK (Nireland)	Yes	Yes	PC (as above)	NK	PC (as above)	PC (as above)	N/A	NK as above	No	NK

The above overview shows that practice related performance estimate information is often non-compliant. While most installers offer reasonable information on overall demand, the information about predicted performance is usually absent or incorrect.

- Eleven gave no seasonal efficiency figure. Of the three that included a figure, only one estimate included the correct value.
- Half of the estimates did not state the calorific value of the fuel. Only two estimates gave the MCS value for the calorific content of the fuel in kWh/kg. The value stated for pellets ranged from 4.4kWh/kg to 5.4. Most stated the value as 4.8.
- Four estimates did not include the MCS disclaimer.
- 12 were not considered clear or accessible because they did not include key data required – such as an estimate of fuel mass needed.
- 10 of the 14 did attempt to indicate an estimate of fuel use but 7 of those were assessed as significantly underestimating the fuel needed as detailed in MIS 3004.
- Four estimates did not include **any** of the following values related to performance:
    - seasonal efficiency;
    - mass of fuel required;
    - volume of fuel required;
    - performance figures consistent with demand indicated;
    - fuel specification;
    - calorific value of fuel in kWh/kg.
- Most of the boilers were not in the PCD. Of the three that were, none used the PCD seasonal efficiency figure.
- For those boilers **not** included in the PCD (11 of the 14), ony one included the seasonal efficiency figure from SAP as required .Five of the estimates used performance estimate templates from Easy MCS or RECC. However, in all but one of these examples the templates were either not deployed correctly or the installer used incorrect values.
- The biomass RHI estimates performed better than the heat pumps in terms of forecasting RHI income based on the EPC – as required.

The reasons why some of the calculations were assessed as misleading or incorrect are explained in *Section 2.4.5 – Case Studies*.

2.4.4 – Complaints

Formal complaints received by RECC as a % of installations (not including those registered with certification bodies unless joint):

Biomass – 3.86 in 2015 (>4,000 installs)

These figures exclude:

- all technical complaints sent only to the certification bodies;
- all complaints directed only to the installers; and,
- all complaints where the customer has sought a legal solution without first involving RECC.

The following are relevant complaint case studies:

Excessive fuel consumption
The consumer has a biomass boiler and believes there is excessive fuel and problems related to bad workmanship causing leaks. There was no control box or thermostats fitted. The consumer was told by the salesman the price of fuel was around £100 per tonne its actually around £260.

Limited fuel availability
Consumer states that the boiler does not work with A1 wood pellets as it should but only works with pellets supplied by the contractor which are extremely expensive. As a result the end user (a tenant) is spending far more on fuel costs than promised.

Excessive fuel and maintenance costs
The consumer claims boiler miss-sold as she was initially quoted £1522 per annum for heating costs which she states is a gross underestimate and she actually pays £260 on average every 3 weeks for pellets an annual equivalent of >£4000. She says she was not informed that about maintenance cost of £280 every 1000 hours to have the boiler serviced – which works out at 4 times a year. The consumer was also told that the boiler was low maintenance and this was not the case as it has to be cleaned every day and pellets are fed into the system twice a day over winter.

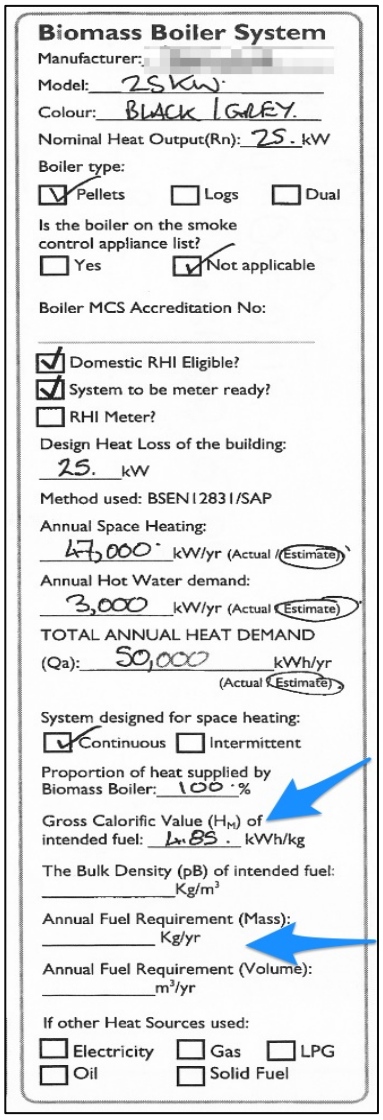
Excessive fuel costs
Consumer was told that the projected annual savings on fuel and maintenance would be £411.29. Since the installation, consumer has spent £2000 on wood pellets and £900 more per annum on fuel than forecast by installer.

2.4.5 – Biomass Case Studies

The case studies below illustrate the assessments made in the performance estimate analysis described above in ***Table 7***. They also illustrate the consumer impact of poor practice.

2.4.5.1: Performance Estimate 1

Overview
Example 1 (below) is all of the performance information provided by this company for pellet boiler. *No other estimate was provided prior to contract agreement*. Estimate provided by one of UK's largest biomass installers.



Biomass Boiler System

Manufacturer: [redacted]
Model: 25KW
Colour: BLACK / GREY.
Nominal Heat Output(Rn): 25. kW
Boiler type:
☑ Pellets ☐ Logs ☐ Dual
Is the boiler on the smoke control appliance list?
☐ Yes ☑ Not applicable
Boiler MCS Accreditation No:
☑ Domestic RHI Eligible?
☑ System to be meter ready?
☐ RHI Meter?
Design Heat Loss of the building:
25. kW
Method used: BSEN12831/SAP
Annual Space Heating:
47,000 kW/yr (Actual / Estimate)
Annual Hot Water demand:
3,000 kW/yr (Actual / Estimate)
TOTAL ANNUAL HEAT DEMAND
(Qa): 50,000 kWh/yr
(Actual / Estimate)
System designed for space heating:
☑ Continuous ☐ Intermittent
Proportion of heat supplied by Biomass Boiler: 100 %
Gross Calorific Value (H_N) of intended fuel: 4.85 kWh/kg
The Bulk Density (pB) of intended fuel: _____ Kg/m³
Annual Fuel Requirement (Mass): _____ Kg/yr
Annual Fuel Requirement (Volume): _____ m³/yr
If other Heat Sources used:
☐ Electricity ☐ Gas ☐ LPG
☐ Oil ☐ Solid Fuel

***Example 1*:** this estimate does not include a predicted value for fuel mass or volume, no seasonal efficiency and the calorific value of fuel in kWh/kg is specified as 4.85kWh/kg. This was the only performance estimate given to customer before sale was agreed.

This installer uses a quote/order form on a single sheet with contract terms and conditions on the back – pre-contractual paperwork used by companies that sell in the home (off-premises selling). Most biomass companies do not attempt to use this 'single sheet' quote/order from.

The form includes an RHI estimate based on a estimated demand of 50,000kWh.
The **Compliance Certificate** was obtained for this install and this included the following figures:
Manufacturer's Specified Efficiency: **92%**
Seasonal Efficiency: **91% (Boiler not in PCD)**
Estimated Mass of Fuel Required: **11,000kg/yr**
Total Heat Supplied by BHS: **57,000kWh/yr**
Calorific value of intended fuel: **4.9kWh/kg**

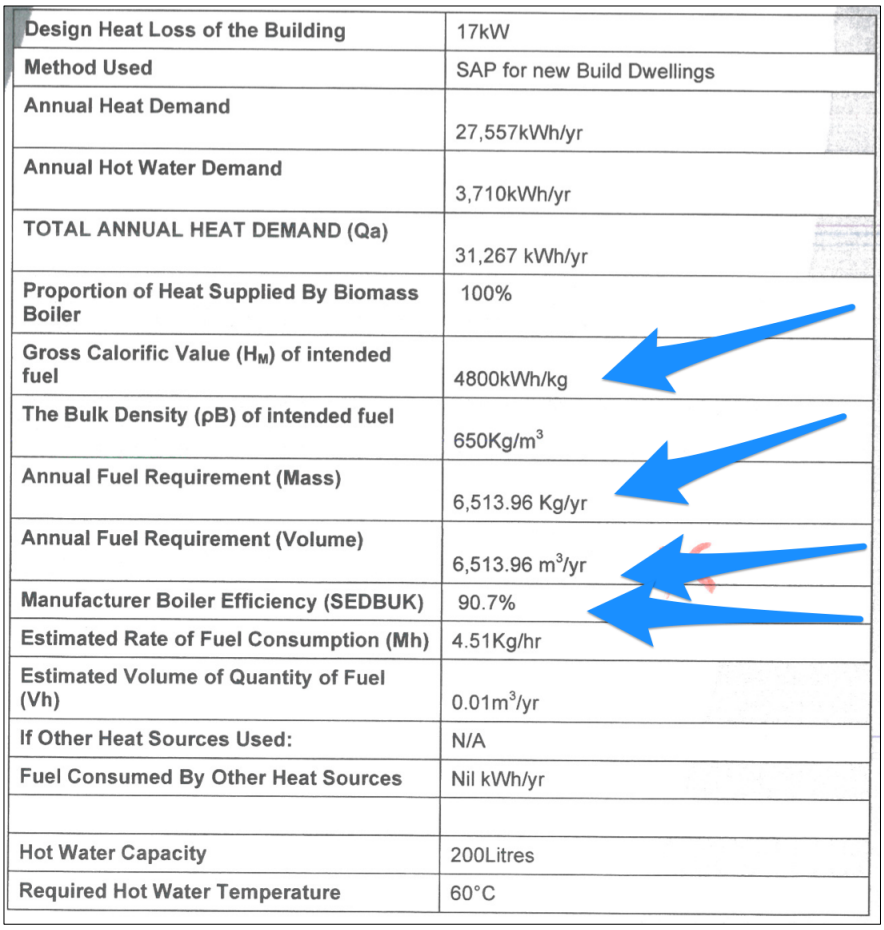
The above values imply a fuel mass of nearly 13000kg/yr. However – using MCS compliant calculations, the fuel requirement would be close to 20,000kg/yr.

2.4.5.2: Performance Estimate 2

This estimate provided the following values:
Total demand for space and water heating: **65107kWh**
Gross Calorific Value of fuel kWh/kg: **5.4**
Annual fuel requirement: **14.46kg/yr** (presumably – 14460kg)
The boiler model is not included in the PCD.

The above estimate of fuel assumes a seasonal efficiency of around **83%** and a fuel energy content of **5.4kWh/kg.**
Calculated according to MIS3004 - **65%** seasonal efficiency and a fuel energy content of **4.4kWh/kg** the fuel requirement would be: **22764kg/yr**

2.4.5.3: Performance Estimate



Design Heat Loss of the Building	17kW
Method Used	SAP for new Build Dwellings
Annual Heat Demand	27,557kWh/yr
Annual Hot Water Demand	3,710kWh/yr
TOTAL ANNUAL HEAT DEMAND (Qa)	31,267 kWh/yr
Proportion of Heat Supplied By Biomass Boiler	100%
Gross Calorific Value (H_M) of intended fuel	4800kWh/kg
The Bulk Density (ρB) of intended fuel	650Kg/m^3
Annual Fuel Requirement (Mass)	6,513.96 Kg/yr
Annual Fuel Requirement (Volume)	6,513.96 m^3/yr
Manufacturer Boiler Efficiency (SEDBUK)	90.7%
Estimated Rate of Fuel Consumption (Mh)	4.51Kg/hr
Estimated Volume of Quantity of Fuel (Vh)	0.01m^3/yr
If Other Heat Sources Used:	N/A
Fuel Consumed By Other Heat Sources	Nil kWh/yr
Hot Water Capacity	200Litres
Required Hot Water Temperature	60°C

Example 2 (above) shows all of the performance information given in this estimate. The boiler is not included in the PCD.
The overall heat demand in this scenario is **31267kWh/yr** and the company estimates that the fuel mass needed is **6,513kg/yr** with a calorific energy content of **4.8kWh/kg.** There is no Seasonal Efficiency figure and the other values given are confusing. ***The estimated fuel mass means that the company has assumed the seasonal efficiency is exactly 100%.***

If the above is calculated correctly according to MCS rules then **65%** seasonal efficiency and a calorific energy content of **4.4kWh/kg** then the fuel requirement would be **10932kg**: an actual requirement that is **50%** more than the estimate given to the customer.

2.4.5.4: Performance Estimate 10

Example 3:

You are currently paid 10.98p for each of these units, this may drop by 10% in April so I have based your figures on this. If the biomass system is your sole primary source of heating you are paid the maximum amount and the system is not metered, if you leave in your existing boiler or have a backup source then the system becomes metered and you are paid on what you use –

56,281kWh (Space Heating) + 3,081kWh (Water Heating) = Annual allowance of 59,362kWh.

As a comparison a litre of oil will give out 10kWh of heat.

Below I have inserted returns you would see –

	Size of Boiler (kW)	Heat used (kWh)	RHI rate (p/kWh)	Total income
Tier 1	25	59,362	9.88p	£5,864.97

You will have some additional costs i.e. for fuel and an annual service, and you will also have some additional savings by switching from the fuel you are currently using.

	Income from RHI	Cost of fuel	Fuel saved	Total income (£)
25kw Boiler	£5,865	£920	£1,000	£5,945

The RHI is RPI index linked, meaning as inflation rises you will also see your tariff rise. In April 2014 we saw people already registered on the scheme receive a 0.2ppkWh rise.

Example 3 above shows all of the performance information given in this estimate. The pellet boiler is **included in the PCD** with an indicated seasonal efficiency of **85%** but this seasonal efficiency value is not included in the estimate. The demand is given as **59,362kWh** but no fuel mass.
As the RHI calculation indicates that the full demand will be provided by the boiler, the fuel mass can be estimated as **15872kg/yr (**assuming a fuel energy content of **4.4kWh/kg).**

At a very conservative estimate of 4.2p per kWh (or £185 per tonne), the running costs should be well over **£2500**. The actual fuel cost indicated in the estimate is £**920**.

2.4.5.5: Performance Estimate 13

Example 4:

16	£0.06	31,601	£1,772.40	£2,372.41	£0.00	£2,372.41	258.85%	£47,755.01
17	£0.06	31,601	£1,825.57	£2,611.50	£0.00	£2,611.50	272.89%	£50,366.51
18	£0.06	31,601	£1,880.34	£2,869.51	£0.00	£2,869.51	288.41%	£53,236.02
19	£0.06	31,601	£1,936.75	£3,147.85	£0.00	£3,147.85	305.52%	£56,383.87
20	£0.06	31,601	£1,994.85	£3,447.99	£0.00	£3,447.99	324.35%	£59,831.87

Installing your renewable energy solution provides savings beyond the 7 years of the RHI scheme, switching from fossil fuels to renewable heating systems which have a lifetime minimum of 20 years.

Your Estimated System Performance Summary	
Estimated Annual Energy For RHI (subject to EPC)	31,601
First Year RHI Payment	£3,855
7 Year RHI Payments	£29,541
20 Year Fuel Savings & RHI Payments	**£59,831**

As you can see from the table above, your running costs will be significantly reduced by using this renewable technology

Example 4 above shows all of the performance information given in this estimate. The pellet boiler is **not included in the PCD**. The customer receiving this estimate has no access to any of the values used to assess running costs such as:

- assumed efficiency of boiler;
- energy content of fuel required; and,
- mass of fuel.

Demand at this level with an assumed seasonal efficiency of 65% would require a mass of approximately **11000kg/yr. At roughly £185 per tonne of pellets this would come to around £2000.** The company indicates the first year running costs to be **£1137**.

Conclusion and Summary of Recommendations

Executive Summary – Conclusion

The evidence reported by RECC auditors and the performance estimate analyses described above (and in *Section 2* below) suggest that many installers appear to regard the MCS standards related to performance information as optional. Some may consider the relevant standards to be 'guidelines' and, therefore, not compulsory. Some installers are clearly confused by the rules. *Pre-contract* performance information does not appear to be the subject of inspections carried out by the Certification Bodies. Installers are frequently surprised when RECC auditors insist that specific values be included in formal pre-contract performance information. Others argue with auditors about the inclusion of figures that are clearly required by the MCS standard.

The contrast between the research evidence on performance and what consumers are actually told is not sustainable. Very good evidence shows that a significant number of renewable heat technology installations are badly designed and are underperforming. This, coupled with a lack of good pre-contract information will lead to adverse publicity, customer inertia and distrust. An obvious repercussion is the impact this is having on installers that do actually comply with MCS rules – many of those audited by RECC are frustrated by companies that clearly operate outside the MCS standards.

Of equal concern is the belief that the values included in the standards can be adjusted and defined as the installers wish. This is most evident with biomass where there is little or no consistency in values such as the energy value of fuel (per kg) and how boiler 'efficiency' should be defined and presented. Values are clearly manipulated to predict system efficiency as high as possible and fuel requirement as low as possible – *even when the figures are clearly incorrect*. Heat pump installers often see no problem in supplying two completely contradictory estimates (one based on MCS methodology and another using calculators supplied by manufacturers) with no explanation for differences in results. Other installers simply ignore the MCS requirements completely and, instead, give consumers non-compliant predictions of RHI income.

The evidence shows that, because so many installers deploy non-compliant practice, customers currently cannot approach the formal performance estimate with confidence that the figures are *reasonable, rational and based on realistic assumptions*. Installer practice must improve in this respect. Better and clearer rules about what customers should be told are an important way to help customers identify good (and bad) practice and have confidence in the systems they are being offered.

Recommendations

The Executive Summary section VII contains 'generic' recommendations for consideration by MCS Management and sections VIII, IX and X include the sector-specific recommendations for consideration by the MCS Technical Working Groups. Those recommendations are summarised below.

Generic Recommendations

In addition to the technology-specific recommendations, RECC has set out below a series of generic recommendations applicable to all heat technologies or to the approach taken by MCS on the subject of consumer pre-contract performance information.

Recommendation 1
MCS initiate a review of the way installer obligations on performance information are being assessed as compliant with MCS Standards. This review should investigate whether the Certification Bodies check for compliance and how compliance is tested. This review should also investigate how often installers are found to be non-compliant and what sanctions are imposed. MCS should assess whether the current arrangement can ensure compliant practice related to performance information in the long term or whether these installer obligations should be monitored using a different mechanism.

Recommendation 2
MCS revise the standards for all three heat technologies to introduce clearer performance information that is easier for customers to compare at the pre-contractual stage using a compulsory format that includes a compulsory set of performance values. Recommendations for each technology on this issue are included in sections VIII, IX and X.

Recommendation 3
MCS should consider incorporating permanent expert consumer protection representation on the MCS Technical Working Groups.

Recommendation 4
MCS and RECC should consider the development of formal consumer guides to the heat technology standards to give customers better information about the performance forecasts they are given. One source of funding for this could be the MCS Charitable Foundation.

VIII: Heat Pump Recommendations

Heat Pumps Recommendation 1
The pre-contract design and performance information given to customers must be improved. This information must be given to customers in a consistent manner using standard terminology. MIS 3005 should be changed to incorporate a compulsory set of defined values that should be presented to the customer in a standard format. To this end, RECC proposes that a revised Appendix E (excluding the section on RHI values) of the current MIS 3005 should be made compulsory for this purpose.

Heat Pumps Recommendation 2
RECC strongly recommends that MCS resist pressure to allow formal contracts to be agreed before technical survey stage for the following reasons:

- MCS and RECC rules currently allow preliminary estimates (that are not based on full technical surveys) to be given to customers as long they make clear that the formal performance estimate may change after the technical survey. However, the formal quotes and estimates based on full technical surveys must be given to the customer *before the contract is agreed.*

- Current RECC rules allow installers to charge consumers for full technical surveys prior to contract agreement. These charges must be reasonable.
- The installer must carry out a room-by-room heat loss calculation to make sure that the system will perform with an SPF of at least 2.5 and – after March 2016 – the installer will need the technical survey results to determine the exact SCOP. It is critical consumers are given this information prior to contract agreement.
- Formal contracts agreed prior to full technical survey stage are not consistent with the principles of consumer protection and access to information.
- If installers are allowed to agree contracts before the full technical survey is carried out then RECC would predict an increase in disputes for several reasons:
    - rough estimates are more likely to be incorrect (they may wrongly show the SPF to be above 2.5 for example);
    - contract agreements before formal site surveys are more likely to be used as a sales tactic by companies that sell in the home; and,
    - pressure selling is much more likely where the formal MCS-compliant technical survey is not available.
- Allowing contract agreement before the formal performance estimate is available will not give consumers the information they need to help them avoid poorly designed and inefficient installations.

Heat Pumps Recommendation 3
The design information on heat losses and emitters[55] should be defined more clearly and given to customers before contract agreement *using standard terminology and in a standard compulsory format*.

Heat Pumps Recommendation 4
The standard should explicitly state that the design and performance information should be provided *before* the contract is signed. All references to *'at or before'* contract agreement should be deleted from the standard. These changes should include all of the obligations related to information provided that relates to:

- Alternative estimates
- Overall design and demand
- Hot water demand
- Specific room heat loss information and emitter selection
- Design for Ground Source Heat Pumps
- System Performance
- Running costs

Heat Pumps Recommendation 5
All alternative estimates must include a prominent disclaimer stating that alternative estimates using non-MCS methodology should be treated with caution. Furthermore, the disclaimer should state that it is the MCS performance estimate that should be used when making income and cost assessments and that the alternative estimate has not necessarily used a methodology approved by MCS.

Solar Thermal Recommendations

[55] MIS 3005 – 4.2.12-17

Solar Thermal Recommendation 1

The pre-contract design and performance information given to customers must be improved. This information must be given to customers in a consistent manner using standard terminology. MIS 3001 should be changed to incorporate a compulsory set of defined values that should be presented to the customer in a standard format before the contract is signed. To this end, RECC proposes that the full TSPEC calculation should be made compulsory for this purpose.

Biomass Recommendations

Biomass Recommendation 1

MCS take immediate action to prevent installers from using boiler nominal (or the Manufacturer's Specified Efficiency) to predict fuel quantities required in MCS Performance Estimates. MIS 3004 should state *explicitly* that the nominal efficiency figure (or the Manufacturer's Specified Efficiency figure) should not be used in the performance calculation and that *any calculations based on those values to predict fuel use will invalidate the performance estimate.*

Biomass Recommendation 2

The MCS Biomass Working Group should initiate a review to decide on the best way to ensure that realistic efficiency levels are used in performance estimates. DECC assumes that actual in-situ efficiencies achieved are significantly lower than those stated in the PCD. MCS should adopt a cautious approach to efficiency at least until results from the 2016 field trial are known.

Biomass Recommendation 3

MIS 3004 should include a requirement that a standard template of values (see template proposal below) should be given to customers pre-contract and this template should include a prediction of fuel use that is based on one of the following values only:

- the default SAP figure as identified in MIS 3004 4.4.1(i)
- some other reasonable estimate of in-situ efficiency to be identified by the MCS Working Group (as Recommendation 2 above).

Biomass Recommendation 4

If the Seasonal Efficiency values from the PCD are to be used in formal MCS performance estimates then the MCS disclaimer should be adjusted to state explicitly that the estimate of efficiency is not included to indicate a 'minimum'. The disclaimer should explain that the in-situ boiler performance might result in an efficiency that is significantly lower.

Biomass Recommendation 5

MIS 3004 should contain explicit obligations on energy values for intended biomass fuels. Installers should be required to refer to specific values when calculating performance estimates and those values should be included in a template of pre-contract information. The standard should state that the performance estimate *will be invalid* if the installer does not refer to the correct energy values for fuel.

Biomass Recommendation 6

The pre-contract design and performance information should be given to customers in a consistent manner using standard terminology. MIS 3004 should be changed to incorporate a compulsory grid of defined values that should be presented to the customer before contract agreement in a compulsory format. To this end, RECC proposes that a revised Appendix C (excluding the section on RHI values) of the current MIS 3004 should be made compulsory for this purpose with two changes:

- Firstly, this standard template should include a specified value for the Energy Content of the Specified Fuel specified in kWh/kg and the MCS Working Group should specify compulsory default values.
- Secondly, the section on 'estimated running costs' should be included as compulsory.