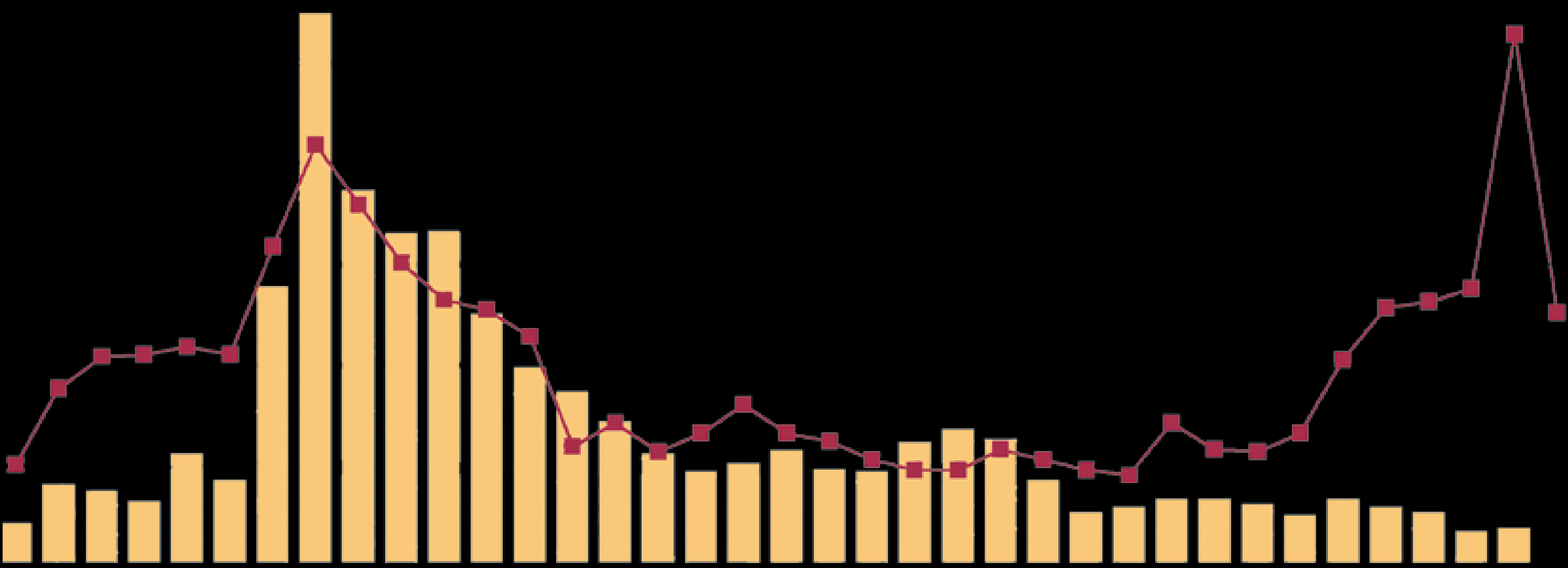
The Renewable Heat Incentive:

Risks and Remedies



The Renewable Heat Incentive:
Risks and Remedies

Renewable Energy Forum

For Calor Gas Ltd

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About Renewable Energy Forum and this Study

Calor Gas Ltd has commissioned Renewable Energy Forum to review the proposed Renewable Heat Incentive (RHI) with a view to assessing its cost-effectiveness and impact on consumers.

Renewable Energy Forum Limited (REF Ltd) is a wholly-owned subsidiary of Renewable Energy Foundation, a UK registered research and education charity.[1] Through its consultancy work REF Ltd aims to generate income to support the Foundation in its charitable objectives.[2]

REF Ltd has obtained further advice to supplement its own views from Cambridge Economic Policy Associates.[3] REF Ltd, however, is responsible for all the opinions expressed here, and for any errors of fact or interpretation.

The study reviews relevant aspects of the large body of work conducted on renewable heat and the proposed RHI over the last few years for the Departments of Business, Enterprise and Regulatory Reform (BERR), and the Department of Energy and Climate Change (DECC), and assesses and reinterprets this work in the light of other experience and from a different perspective than that of the commissioning departments.[4]

The study has been conducted and written for REF Ltd by Dr John Constable and Dr Lee Moroney.

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1 See www.ref.org.uk

2 See www.forum.ref.org.uk

3 See www.cepa.co.uk

4 See Bibliography, page 43.

1 Summary Conclusions

1.1 Government should be urged not to proceed with the Renewable Heat Incentive (RHI) in its present form, for the following reasons:

1.2 The RHI policy is an expensive leap into the dark relying on a major deployment of renewable heat technologies that are new to the UK and untested in the UK context.

1.3 The many studies of the RHI commissioned by DECC are explicitly based on a variety of unstable assumptions that reveal fundamental uncertainties ranging over supply, costs, and real world performance of the technologies, and the rate and scale of uptake.

1.4 Consequently, neither the overall cost of the proposed Renewable Heat Incentive nor its benefits can be estimated with any satisfactory degree of precision.

1.5 The government's own figures for its lead option for the RHI are a range of costs between £9.6bn to £21.1bn (NPV, Net Present Value) by 2030, or £10.7bn to £22.2bn including ancillary costs. These are very broad bands and in themselves suggest that the RHI and its impact are not sufficiently well understood to justify legislation based on the current proposal.

1.6 The uncertainties as to the scale of the realizable benefits from the RHI result in a range for the lead option of £7.7bn to £8.4bn.

1.7 As a result of these combined uncertainties DECC's estimates of the net benefit (benefits minus costs) are consistently negative and range from minus £1.2bn to minus £13.4bn (or minus £2.3bn to minus £14.5bn if ancillary costs are included).

1.8 Unsurprisingly, the Government acknowledges in their Impact Assessment that '*the RHI as a whole fails to pass the cost effectiveness test*'.[5] Nevertheless, it is unclear whether it does so by a large or a very large margin.

1.9 The Government's *Impact Assessment* also notes that the costs of the emissions savings (namely £57/tCO_2 saved in the traded sector and £75/tCO_2 in the non traded sector by 2045) are well above the cost effectiveness indicators (£20/tCO_2 traded and £39/t CO_2 non traded).

1.10 However, this calculation is made on the basis of dividing the NPV of the renewable heat incentive by the tonnes of CO_2 abated, and we suggest that it is equally important to look at the scheme from the point of view of the direct cost to the consumer, i.e. the subsidy cost, which is over £200 per tonne of CO_2 abated. While this compares favourably with the Feed-In Tariff (at over £440 per tonne), it is nearly double that of the Renewables Obligation (ca. £100 per tonne), which is itself widely regarded as an unreasonably costly measure.

1.11 It is useful to put the projected emissions saving from the RHI in national context. The government's consultants estimate that 16.7 million tonnes CO_2 would be saved by the scheme in 2020 at a subsidy cost of £3.4bn.[6] UK domestic emissions in 2008 amounted to 533 million tonnes of CO2,[7] so the savings in 2020 from the RHI are equivalent to 3% of current emissions. This is a small saving for a large and uncertain cost.

1.12 We conclude, therefore, that the actual costs and outcomes of the proposed Renewable Heat Incentive are so uncertain that it would be irresponsible to proceed in the current form, since it will expose the subsidizing consumer to high costs without adequate assurances of compensating benefit.

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5 DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), 20.

6 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy & Climate Change*, URN 10D/544 (February 2010), v, 17.

7 http://www.decc.gov.uk/assets/decc/statistics/climate_change/1_20100202104722_e_@@_ghgnatstats.pdf

1.13 Furthermore, there is reason to be concerned that the RHI might actually be counterproductive to encouraging long-term development of the renewable heat sector.

1.14 Evidence from Japan shows that government-driven, rapid growth in the solar thermal heating sector resulted in the installation of sub-optimal technology, consequent consumer disenchantment, and a collapse in the annually installed capacity of that technology (nearly 2.75 million square meters in 1980, but only 0.25 million square meters today). The Japanese solar thermal market has yet to recover, in spite of a return to higher oil prices, as can be seen in the following chart:

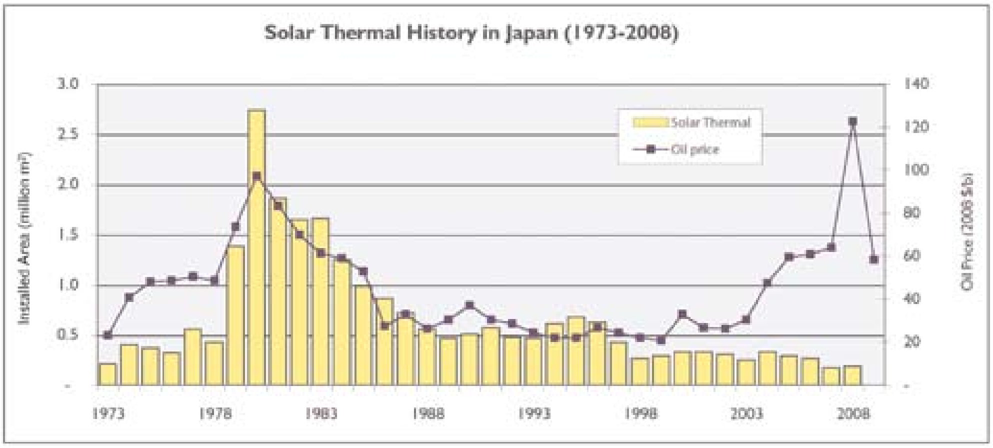

Figure 1: The annually installed capacity (m^2) of solar thermal technology in Japan, charted against oil price. Source: Redrawn from ISEP, 2009.[8]

1.15 On the basis of the fundamental uncertainties revealed by government's own studies, and what the Japanese themselves call the "Solar Tragedy",[9] it seems that the RHI is unlikely to create a viable renewable heat industry and may even be harmful to its prospects.

1.16 In this connection it is relevant to observe that the EST's recent study of UK heat pump performance revealed a very wide spread of results, with Co-efficients of Performance ranging between 1.2 and 3.2, and a disappointingly low general level, confirming the view that this sector is immature. The risk of premature adoption and consumer disenchantment is clearly real, thus raising the spectre of a UK heat pump tragedy parallel to that of solar thermal energy in Japan. Heat pumps are a genuinely promising technology and the high risk of such an outcome should be avoided.

1.17 The low efficiencies revealed in the EST study mean that many of the heat pumps currently installed will probably fail to comply with the minimum standard set in the EU Directive on renewable energy, and thus their output could not be counted towards the UK renewable energy target. This highlights another flaw in the design of the RHI, in that Government plans to 'deem' the output of such installations (i.e. assume rather than measure the output) and runs the risk that subsidised heat installations will both fail to deliver the emissions savings anticipated, or contribute renewable energy towards the EU target.

8 Redrawn from Tetsunari Iida, "Japan: New Policies to Spark Growth?", Institute for Sustainable Energy Policy, Presentation to estec2009 (Munich, Germany, 25-26 May 2009), 2. See also Tetsunari Iida, "Solar Thermal Policy and Market in Japan" (Institute for Sustainable Energy Policy: Tokyo, 20 June 2007), 2.

9 Institute for Sustainable Energy Policy (ISEP), Japan, Tetsunari Iida, "Solar Thermal Policy and Market in Japan" (Institute for Sustainable Energy Policy: Tokyo, 20 June 2007).

1.18 Regardless of the version and type of RHI that is introduced it should only be implemented with the clear proviso that it will be reviewed at specific intervals to ensure that value for money is being provided to the subsidising consumer or taxpayer. This review program should include the identification of monitoring mechanisms so that the trajectory towards meeting targets and costs incurred is transparent to all.

1.19 It is important that the rules governing these reviews should also be transparent from the outset, otherwise they will introduce uncertainty and its attendant costs.

1.20 The funding mechanism for the RHI is as yet undetermined, with the options being either a levy on fossil fuel sold for heat, or a direct draw from general taxation.

1.21 We conclude that a levy on fossil fuel would be very likely to increase fuel poverty, perhaps particularly in the rural areas, since government is, arguably, unduly optimistic about the degree to which such fuel poor and rural heat consumers will be able to invest in RHI eligible technologies.

1.22 Government's own estimates show that the RHI would increase the average domestic gas bill by 14% (£94 a year) by 2020, and the gas bill for an average medium sized commercial gas consumer by 19% (£86,000) by 2020.

1.23 These are very substantial increases, and also subject to considerable uncertainty.

1.24 No estimates have been made of the impact of the RHI on large industrial consumers of gas, which is a serious omission and needs to be rectified before any properly informed decision can be made on the proposal's future application.

1.25 In the domestic sector the RHI, if funded from a fossil fuel levy will be a regressive measure, with the proceeds flowing from poorer consumers, who cannot afford to adopt renewable heat technologies, towards richer consumers who can do so.

1.26 DECC has estimated that the impact of energy and climate change policies on combined gas and electricity bills will cause a 1% increase in 2020, but this assumes very large improvements in energy efficiency. DECC's own figures show that in the absence of such efficiency improvements the energy and climate change policies will cause a 21% increase in gas and electricity bills in 2020.

1.27 Indeed, DECC's estimates show that if energy efficiency measures fail to deliver, the impact of the RHI alone could account for a 7.5% increase in gas and electricity bills in 2020.

1.28 Close examination of DECC's projections of the impact of their predicted 1% rise in domestic energy bills on the UK's households suggests that they expect a disproportionate effect on the lower income deciles.

1.29 Applying this scaling effect, as inferred from DECC's own charts, it seems that funding the RHI alone might consume around 2% of the annual income of the poorest households in 2020, funds which will go towards reducing the bills of the richest households, who are able to benefit from the Renewable Heat Incentive subsidies, as shown in the figure on page 8.

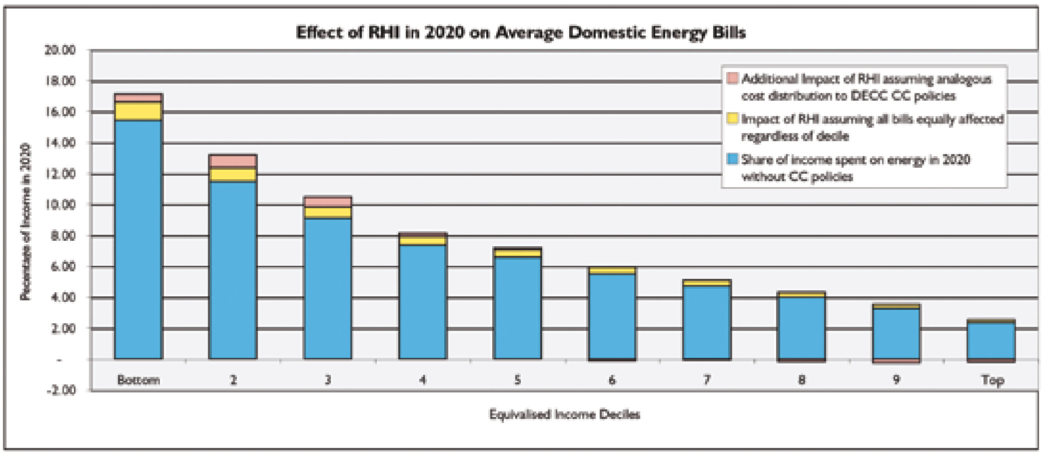

Figure 2: Effect of the RHI on household energy expenditure in 2020.[10]

1.30 Our attempt to infer DECC's assumptions regarding this skewed distributional effect suggest that the lower three deciles may on average see RHI impacts of £135 to £184 on their bills, as opposed to the £94 which they might see if the costs were imposed equally across all income bands. The upper four deciles all seem to pay less than £94, with the upper two deciles actually on average deriving income from the RHI. These are very striking outcomes, and while we acknowledge that our inferences may be to some degree inaccurate, DECC's published data strongly suggests that some such effect would obtain. We presume that the department can clarify this matter, and call on it to do so.

1.31 This analysis suggests, and suggests that government is already aware, that the RHI alone would be responsible for very significant increases in fuel poverty, and for a sharpening of the effect amongst those already in fuel poverty.

1.32 We cannot believe that it was the intention of the previous government to expose the population to this risk, and we do not believe that the Coalition would wish to implement a program with such consequences, and on this ground alone there is good reason to exclude domestic consumers from the RHI at this stage.

1.33 Furthermore, it appears from close analysis of DECC's information and charts that the department's underlying models already anticipate such iniquitous distributional effects arising from the RHI, and possibly other energy and climate change policies. It is in the public interest that these models should be released, so that debate as to the impact of the RHI and the distribution of winners and losers from the program can be clearly understood.

1.34 To drive home the importance of this disclosure it need only be emphasised that in the event that fossil fuel prices rise, consumers unable to adopt RHI-eligible measures would not only pay that cost, but would also be paying for price increases resulting from the RHI levy, a levy which would be protecting the better off from rising fossil fuel increases. This would be a bizarre and manifestly unjust outcome.

1.35 The release of the department's underlying model of uneven distributional effects will also shed light on the winners and losers from other climate change policies, such as the Feed-in Tariff and the Renewables Obligation.

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10 The ten deciles represent equivalised household income, and the vertical axis shows the percentage of household income that is spent on energy. The blue bars represent the expenditure without energy and climate change polices, the yellow bar is the addition anticipated from the RHI if the costs are spread evenly over all deciles. See main text for account of our chart's construction.

1.36 Funding from general taxation could avoid these problems if correctly designed, and would have the additional benefit of transparency, since it would require that the measure would be put before Parliament for review.

1.37 However, even if the scheme were funded from general taxation, it seems that it would be prudent not to lean too heavily on the domestic sector, since the technical potential in that area is very poorly understood, and also because the subsidy cost of small scale renewable heat generators is high, while the additional renewable resource to be gathered is small.

1.38 In addition, renewable heat technologies are relatively novel, and there are only limited independent tests of their efficacy. As a consequence, early adopters run the risk of under-performance such that the RHI does not compensate for the costs incurred. Conversely, it is clear that some adopters will be over-rewarded, which is wholly unsatisfactory for the subsidising public.

1.39 These problems are less likely to occur in the industrial and commercial sector, though here too government should proceed with caution, since much industrial heat load is process specific, and may not be suitable for renewable substitution.

1.40 In view of the many problems facing the RHI, pilot studies both in the commercial and in the domestic sector are preferable to hasty and precipitate attempts to control a market sector that is poorly understood. As the EST's recent work on heat pumps shows, it is important to discover how to realize the potential, and how renewable heat compares with energy efficiency in cost effectiveness.

1.41 In summary, while renewable heat deserves encouragement:

- On the Government's own calculations, the costs of the Renewable Heat Incentive exceed the benefits by a wide margin.
- The RHI fails the Government's own tests for cost effectiveness in saving carbon.
- The Government calculates that the RHI will increase average domestic gas bills by 14%.
- If funded by energy consumers the RHI will be a regressive measure with a transfer of wealth from the poor to the better off.
- There are large uncertainties in the estimates of the RHI's effects, costs and benefits, and even some questions over whether certain supported technologies will qualify as compliant with the EU Renewables Directive.
- There is good evidence that rushing the deployment of renewable heating measures in the domestic sector can lead to unsatisfactory consumer experience and consequent disenchantment, which could prejudice the future success of domestic renewable heat.
- Taken in aggregate these points suggests that a more measured, taxpayer funded, learning approach would make more sense, with pilots specifically designed to assess effects, costs and benefits.
- Since the most promising applications are in the commercial and industrial sectors, the initial emphasis should be on these sectors.

2 Background: The EU Climate Change Targets

2.1 In March 2007 the EU's leaders committed Europe to transforming itself into an energy-efficient, low carbon economy and set a series of demanding climate and energy targets to be met by 2020, namely:

(i) 20% of EU final energy consumption (FEC) to come from renewable resources

(ii) A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels

(iii) A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency

Collectively these are known as the 20-20-20 targets.

2.2 The combination of the three targets precludes some obvious, perhaps cheaper, options for reducing CO_2 emissions. For example, if a member state were to opt for a combination of substantial nuclear power build and improvements in energy efficiency, the individual country's greenhouse gas emissions might fall well below 20% of 1990 levels, but that state would still be obliged to finance and build sufficient extra renewable energy to meet that 20% target.

2.3 The first of the targets described above is covered by the EU Renewable Energy Directive of 2008, which proposes that the member states as a whole should derive 20% of Final Energy Consumption (FEC) by 2020 from renewable energy sources. Final Energy Consumption is the energy consumed as measured at the point of final consumption, for example in a domestic gas boiler, or in an electric light, or in an automotive engine, i.e. net of transmission and conversion losses prior to delivery to the consumer.

2.4 The EU has assigned differing burden shares to the various member states, with the UK having the task of achieving a 15% target - an increase from approximately 3% at the present time and one of the largest proportional increases of any major European state.

2.5 In spite of Government assertions that such a target is feasible, very few analysts believe that it is so, and fewer still believe that the costs will be reasonable and tolerable, or that they would provide emissions reductions at lowest cost.

2.6 An indicative problem with the target is that it is specified as a percentage of Final Energy Consumption in the year 2020, a quantity that is not only unknown, but significantly uncertain. In previous comments, Renewable Energy Foundation has drawn attention to the fact that government's calculation of the target magnitude is grounded in the assumption that the UK will be using less energy in 2020 than it does today, which is a surprising assumption against a background of increasing population and what is widely hoped will be a return to economic growth.

2.7 Specifically, government has estimated that FEC up to 2020 will be stable and even show some signs of decline.

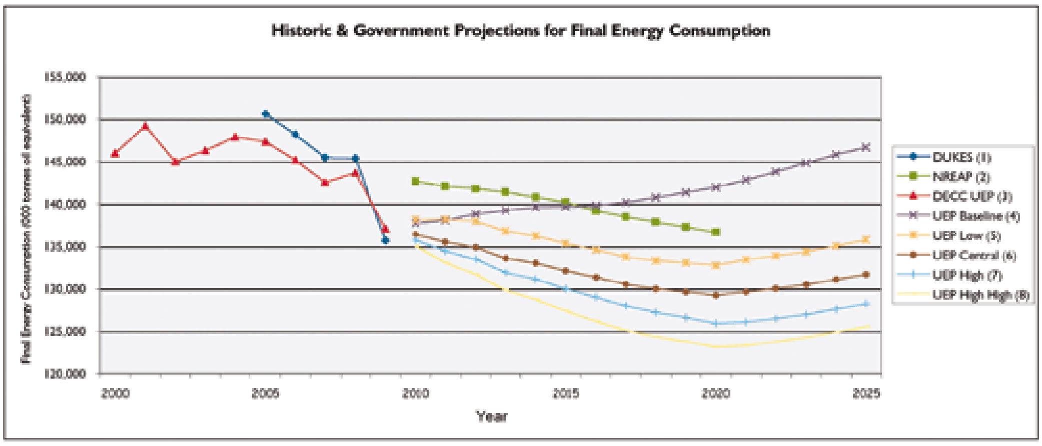

Figure 3. UK Final Energy Consumption: Historic data, and Government projections to 2025. *The chart shows a range of plots from various Government sources,. The methodologies employed by these sources are not consistent:*

i. Digest of UK energy statistics Chapter 7 Tables 7.7[11]
ii. UK National Renewable Energy Action Plan Table 1[12]
iii. DECC Updated Energy Projections (UEP) [13]
iv. UEP excluding Low Carbon Transition Plan Measures
v. UEP assuming low global energy demand for fossil fuels
vi. UEP assuming moderate demand for fossil fuels
vii. UEP assuming high demand for fossil fuels
viii. UEP assuming high demand and supply constraints for fossil fuels

2.8 A consistent methodology for quantifying Final Energy Consumption would be desirable in order that progress toward meeting the target can be observed. From Figure 3 we observe (i) the sharp decrease in energy consumption with the current economic downturn; (ii) that Government is anticipating in its projections a continued reduction in energy consumption to 2020, but an increase thereafter.

2.9 Overall, government expects that there will be very significant improvements made in energy efficiency.

2.10 While such improvements are in themselves highly desirable, their delivery is extremely uncertain. Furthermore, and this is critical, there is reasonable ground for expecting a rising population and a return to economic growth, both of which would be sufficient to cause a rise in consumption even if efficiency improvements were delivered.

2.11 Given these uncertainties, the assumption of stable energy use resulting from efficiency gains seems arbitrary, and it appears to be invoked as a free parameter to give the appearance of feasibility to what is in fact unrealistic in the EU Directive.

2.12 Similar uncertainties appear to lie behind government assignments of burden sharing within the UK energy sector. The following figure illustrates the increase required in each sector to reach the 15% target, with the Government planning a twelve-fold increase in the renewable heat sector between 2010 and 2020 in order to meet the 15% UK renewable energy target.

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11 www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

12 DECC, *National Renewable Energy Action Plan for the UK* (2010). See: www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/ored/uk_action_plan/uk_action_plan.aspx

13 www.decc.gov.uk/en/content/cms/statistics/projections/projections.aspx

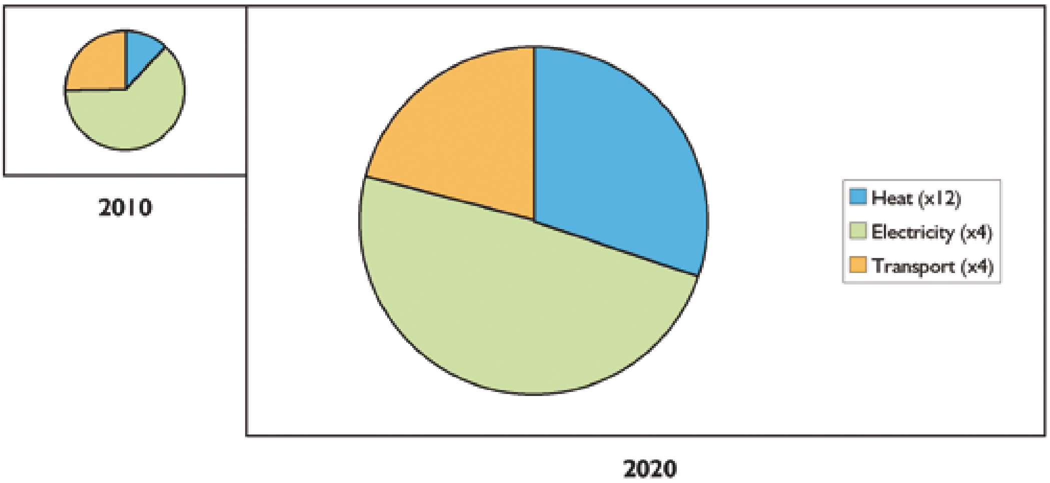

Figure 4: UK Renewable Energy in 2010, and the EU Renewable Energy Target of 2020.

2.13 The graph above shows that it is anticipated that renewable electricity will fulfil nearly 50% of the renewable energy target. However, this entails that the share of total *electricity* taken by renewable sources would increase to approximately 30%. It is now well known that there are difficulties in the introduction of high levels of renewable electricity if generated by uncontrollable sources such as wind power. Furthermore, there are concerns with regard to the sustainability of renewable transport fuels, and consequently this is restricted to the minimum level specified by the EU Renewable Energy Directive, namely 10% of all transport energy (which is in any case a high percentage for that sector).

2.14 In point of fact there are further doubts about both these figures, particularly that for electricity, since it is unlikely that the total renewable capacity required for such a proportion can be financed and constructed in the timeframe, and even if built whether it can be managed conveniently on the UK grid.

2.15 Even granting that such figures are realistic, the resulting burden suggested for renewable heat is extremely high, and represents a very rapid and dramatic increase, from around 1% of all heat today to 12% by 2020.

2.16 It is clear that the rapidity and scale of such a change entails poorly defined uncertainties in feasibility and cost.

2.17 Such uncertainties are evident in the very large range of negative Net Present Values (NPVs) described in the government's own *Impact Assessment* for the RHI, and are in themselves a cause for deep concern.

2.18 These concerns are compounded by the fact that the costs proposed arise from attempts to attain a specific quantity that appears to have only arbitrary justification.

2.19 Although there are no targets for specific renewable heat technologies, some assumptions have been made about growth rates for particular technologies in the modeling carried out in order to quantify the subsidies required to incentivise uptake of low carbon technologies. The following charts demonstrate the extent to which Government anticipates a very substantial growth in technologies currently under-developed in the UK, including air source heat pumps (ASHP), ground source heat pumps (GSHP), and the injection of biogas into the gas grid.

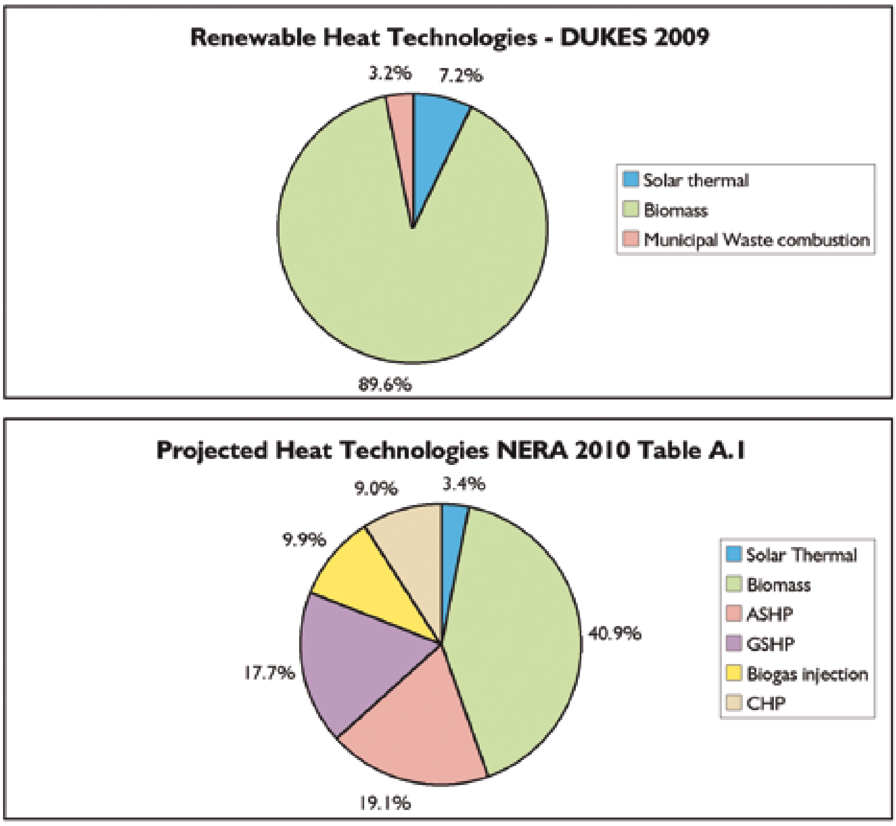

Figure 5: Comparison of the contribution of current renewable technologies to the 2009 renewable heat total compared with the projected 2020 breakdown of renewable heat technologies.

2.20 With the arguable exception of biogas injection into the grid, all these technologies can be regarded as, to a degree, proven in the abstract. However, specific applications of these technologies are very variable in character, with the result that an abstract proof of concept may be a poor guide to actual out-turns in the real world. The results from the UK's currently installed Air Source and Ground Source Heat Pumps, discussed below, is a case in point.[14]

14 Energy Savings Trust, *Getting Warmer: a field trial of heat pumps* (Energy Savings Trust: London, 2010).

3 The Renewable Heat Incentive: An Outline with Commentary

3.1 The RHI is designed to incentivise consumers to switch from fossil-fuelled heating to a specific set of renewable technologies. The set of supported technologies at this stage includes ground source heat pumps, air source heat pumps, biomass boilers, solar water heating, onsite biogas combustion, biogas injection into the gas grid, and the combustion of bioliquids.

3.2 The incentive aims to overcome the additional costs of switching to renewable heating, namely (i) the extra capital cost of the new heating system over the ongoing costs of the old system (making assumptions about reasonable costs and sizes of equipment required); (ii) the extra running costs, assuming that the fuel for the renewable heat system tends to be more expensive than the fossil fuel displaced, which is assumed to be gas; (iii) compensation for the inconvenience of any building and redecoration work required; and (iv) an investment return at the rate of 12% for all technologies excepting solar thermal, which would receive an investment return rate of 6%.

3.3 The incentive payments are planned to be spread out over a number of years, though government has yet to decide on how long this would be. One proposal is for the annual or quarterly payments to be linked to the life of the technology (10 to 23 years depending on type), another that payments should be compressed into a shorter time period.[15] Payments for small and medium scale generators would be made on the basis of the annual amount of heat generated (kWh), with these quantities being "deemed" (i.e. "assumed") rather than metered. This is to a degree understandable since metering heat is difficult and expensive, while the alternative, "deeming", involves using a Government-endorsed methodology that sets in advance the level of annual payments to the owner of the renewable heat equipment on the basis of the estimated reasonable heat requirement of the building being heated, and the technology being used.

3.4 A specific example would be a homeowner with existing oil-based central heating switching to a ground source heat pump. The expectation would be that over the specified number of years the consumer would receive sufficient payments to cover the extra cost of the ground source heat pump, the capital cost of digging the required trenches and installing the pipe work, and the extra running costs of the ground source heat pump over what would be expected to be paid for an equivalent conventional gas-fired boiler. In total the payments would guarantee the average consumer a 12% per annum return on the investment.

3.5 This is all predicated on the hypothetical householder's situation being identical to the benchmark assumed in calculating the terms of the RHI. In fact, in this example, it would be likely that the householder could do rather better than this, because the level of RHI reward assumes that the displaced fuel is gas, which is cheaper than the oil displaced in this example. However, if the consumer does not already have under-floor heating, which appears to be a pre-requisite for an effective ground source heat pump, the costs of converting may be significantly more than the benchmark cost on which the RHI level is derived. Similarly, if the insulation in the house is not of a high enough standard, heat losses might mean the electricity running costs could be significantly higher than assumed in setting the RHI level.

3.6 Thus, there will be some adopters who discover that the final costs are such that the rewards of the RHI do not adequately compensate for changing their heating source, while there will be other adopters who profit significantly more than the average. Investing in renewable heat will remain something of a gamble, in spite of the RHI's apparent generosity, because of the inherent uncertainties in any specific case.

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15 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (February 2010), 40.

3.7 Many of these uncertainties and risks stem from the scheme's originality. As the Government's own *Consultation* text admits the RHI is a scheme almost without international or domestic parallel.[16]

3.8 While groundbreaking ambition of this kind may seem laudable, it is also a reason for extreme caution, and makes it all the more surprising that when this adventurous scheme is notionally only months away from implementation the details of the tariffs and indeed the funding source remain undecided.

3.9 This is largely the result of the extraordinary haste with which the previous government pushed forward with the RHI. While powers were taken in the Energy Act of 2008 to place a levy on fossil fuels, as late as the *Consultation* of February 2010, government had still not decided how to fund the RHI, and promised to make a further announcement in the Budget 2010.[17]

3.10 This promise was not fulfilled by the then Chancellor, The Rt Hon. Alistair Darling, perhaps because he and his cabinet colleagues feared to announce further tax and cost increases ahead of the election, but in any case it remains unfulfilled by the coalition government.

3.11 Unfortunately, the principal documents relating to the scheme are not specific in their description of the likely eventual character and it is difficult to form a view of what method government will ultimately prefer.

3.12 The 2010 *Consultation* describes the proposal as a "*clean energy cash-back*"[18] intended to provide a Guaranteed Rate of return for those adopting renewable heat technologies. With regard to the source of these subsidy funds, the *Consultation* states only that the RHI powers in the Energy Act of 2008 "*enable the introduction of* a *new levy on fossil fuel suppliers who supply fossil fuel to consumers for the purpose of generating heat*."[19]

3.13 However, it is obvious that such a levy would necessarily be a pass-through cost for fossil fuel suppliers, and that the cost of the RHI would thus fall on consumers, as it does with other measures such as the Renewables Obligation.

3.14 The *Consultation* admits that that "*conserving heat (eg. Insulation) will be the first and often most cost-effective step in the control of energy demand*", but goes on "*if we are to meet our targets to reduce carbon emissions and ensure continued energy security*" we must find new sources of heat.[20]

3.15 This willingness to sacrifice consumer interest, which would be better served by conservation policies, to the fulfillment of targets is indicative, and confirms the distorting effect of such targets on the spontaneous process of discovery and experiment that would otherwise obtain in an undistorted market.

3.16 However, the *Consultation* authors are clearly aware of the implied costs and concerned by them, since they observe that: "*Financial support will allow more people to afford renewable heat, and, by expanding the market, help bring down costs more quickly*".[21]

3.17 This is wishful thinking, but, if granted for the sake of argument, begs the question as to why the scheme does not incorporate a mechanism to avoid imposing undue burdens on the subsidising consumer should technology and running costs begin to fall, in themselves and relative to fossil fuels.

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16 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (2010), 9.

17 Ibid. 4.

18 Ibid. 3.

19 Ibid. 13.

20 Ibid. 8.

21 Ibid. 8.

3.18 Similarly, Government is concerned to avoid undue rewards to certain technologies, and therefore proposes to exclude "*wood burning stoves, air heaters, open fires and similar applications*".[22] This is, perhaps, not unreasonable, but does highlight the oddity of the RHI, which will function to disadvantage these low cost renewable heat applications, that are well understood and known to work, in favour of applications that are comparatively experimental and expensive. For example, a rural dweller who coppices his own trees to burn in a stove is excluded from the RHI, and indeed, depending on the final funding mechanism, may even be expected to subsidise (via the RHI levy on any fossil fuel he consumes for heating or via a tax) the consumer who ships in wood pellets, which have possibly travelled considerable distances, to burn in a pellet boiler.

3.19 Effective monitoring will be difficult, particularly in the case of domestic consumers. For example, payment on the basis of assumed, or "deemed" renewable heat generated is clearly problematic. The justification for this approach is that "*Paying the tariffs on a metered basis could have the undesirable effect of encouraging the generation of surplus heat in order to obtain more RHI support*".[23]

3.20 This may well be true, but it might from some perspectives be better interpreted as a fundamental problem with the RHI, rather than an argument in favour of "deeming". The converse situation has apparently not been considered: i.e. that deeming may encourage the installation of renewable heat technologies that are then neglected while the household returns to conventional heating. It is conceivable, for example, that a rural, off-gas-grid consumer, perhaps on a low income, would be shocked at the increase in electricity bills following installation of an air source heat pump, and might resort instead to a coal fire to heat one or two rooms.

3.21 In addition, there are concerns with regard to the potential for fraud. Ofgem's response to the RHI *Consultation* remarks: "*We are concerned about the potential for inaccuracy and fraud in the deeming process. If the vendor of the equipment is also responsible for determining the subsidy level there would be* a *temptation to exaggerate the property's heat requirement to make the deal more attractive*."[24]

3.22 Ofgem endorse government's suggested use of an independent assessor,[25] but it is clear that the potential for corruption and misrepresentation will remain. This is further evidence suggesting both that "deeming" is unwise, and that the domestic renewable heat sector is unsuitable for this type of support.

3.23 At the very least, it is extremely surprising to find government resistant to the measurement of a quantity which is central to monitoring the success of the policy, and thus to an evaluation of the value returned for the subsidies expended.

3.24 By contrast, as Government itself observes, the industrial sector, which would be metered, will be less likely to over-generate heat, because the RHI will only be one of many commercial considerations determining whether the system should operate or not.[26]

3.25 On this latter ground alone, it would appear that that the commercial sector is a better place to experiment with renewable heat than the domestic sector, though clearly experiment is needed in both.

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22 DECC, *Renewable Heat Incentive: Consultation* (2010), 31.

23 Ibid. 41.

24 Ofgem, *Ofgem's response to DECC's RHHI consultation* (2010), 10.

25 See DECC, *Renewable Heat Incentive*, 44.

26 Ibid. 42.

4 The Renewable Heat Incentive in the Context of Other Policies

4.1 The RHI would exist in a policy sector that is already densely populated with other initiatives. The following table lists those referred to in the RHI *Consultation* document, and adds those climate change policies included in DECC's recent analysis of the impact of these policies on energy prices and bills.[27]

Table 1: Climate Change and Energy Policies

1	Carbon Emissions Reduction Target (CERT)
2	CERT extension
3	Community Energy Saving Programme (CESP)
4	Voluntary Reporting Guidance (VRG)
5	Carbon Reduction Commitment Efficiency Scheme formerly known as Carbon Reduction Commitment (CRC)
6	Zero Carbon Homes
7	Zero carbon new non-domestic buildings
8	EU ETS
9	Renewables Obligation & Extended RO
10	Feed in Tariffs (FiT)
11	Climate Change Levy
12	Future Supplier Obligation (SO)
13	Better Billing
14	Smart Metering
15	Products Policy
16	Security Measures
17	Carbon Capture and Storage (CCS)
18	Climate Change Agreements (CCA)

4.2 Anticipating the potential conflicts and disadvantages in detail is beyond our scope here, but we note that the *Consultation* makes no attempt to consider this matter, and it must be a very considerable concern.

4.3 However, experience of the Renewables Obligation suggests that this would be essential before proceeding, since it is known that investors in renewable electricity have been subsidised for the same tranche of energy under several different mechanisms, which, whilst legal, is contrary to commonsense and the spirit of the policy, and the consumer interest.

27 DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), Table A1. For convenience this table is reproduced as Appendix 2 to this document.

5 Scale and Fossil Fuel Cost Sensitivities

5.1 Against this background it is at least worth considering whether it would not be better, for the industry, and for long-term attempts to reduce emissions, to allow rising fossil fuel prices to drive innovation. Whether this would actually materialize is uncertain in the target time frame, but we note that the government's own consultants remark of their scenario modeling of high fossil fuel prices that such prices cause very significant reductions in annual renewable heat resource costs from £2.1bn to £940 m.[28] Indeed, the resource cost of large biomass boilers actually becomes negative; in other words large biomass boilers would become spontaneously attractive.[29]

5.2 However, the scale of subsidies required does not fall by such a large extent, only declining from £3.3bn to £2.8bn, indicating that the economy must bear both high subsidy costs and rising fossil fuel prices.

5.3 The fact that subsidies typically exceed costs is well known, and acknowledged by government in the RHI *Impact Assessment*: "*In a world of perfect information financial support mechanisms should be perfectly designed to match the true costs of renewable heat technologies (resource costs). However, information failure (e.g. in terms of "hidden" costs) and administrative complexities mean that subsidy payments from governments often need to be in excess of what is required to make the take up of renewable technologies financially viable. This gives rise to 'economic' rents These rents represent a transfer from those paying for the RHI to those who benefit from it by undertaking renewable heat projects*."[30] This latter point will touched upon again in section 6 below.

5.4 That subsidy in excess of resource should be contemplated by government is entailed by the need to meet the 15% renewable energy target in 2020. The subsidy needed to drive adoption to that level in the time frame is relatively insensitive to the surrounding economic context, in large part due to the non-linear cost of the incremental MWh of renewable heat needed to meet the target. By contrast, rising fossil fuel prices would automatically focus experimentation on low cost options such as energy efficiency and large scale renewable heat.

5.5 We note with interest that the think tank, Policy Exchange, has recently taken data calculated for government by NERA Consulting and suggested that the ambition of the RHI should be scaled back from 12% renewable energy to 8.5% on the grounds that it would reduce costs by between £7 and 14bn.[31] Table ES.2 in NERA 2009 shows that scaling back to 8.5% would save £2.5-£4.5 billion per annum in 2020. In other words, it suggests that it would be many times more costly per percentage point of renewable heat beyond a penetration of 8.5%.

5.6 There is much to support this view, not least the fact that, as NERA themselves indicate, "*under the higher growth rate scenario the 8.5 percent share could be achieved almost entirely through large-scale biomass boilers and air-source heat pumps (with some contribution from biogas injection), requiring only a small contribution from the domestic sector*", with very desirable consequences

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28 In this context, 'resource cost' is defined as the extra cost incurred in adopting renewable heat technologies which arise from the difference in up-front and ongoing costs between renewable heat and conventional heat. This includes an allowance for barrier costs such as the inconvenience of digging up a garden to install a ground source heat pump.

29 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy & Climate Change*, URN 10D/544 (February 2010), 36.

30 DECC, *Impact Assessment of the Renewable Heat Incentive scheme for consultation in January 2020* URN 10D/547 (February 2010), 13.

31 Robert McIlveen et. Al., *Greener, Cheaper* (Policy Exchange: London, 2010), 11. For NERA's work see *The UK Supply Curve for Renewable Heat* (July 2009), v-vi.

for cost and subsidy cost. Indeed, NERA calculates the cost of the subsidy would be halved if the target was reduced to 8.5 percent and was met largely by large-scale rather than domestic projects.[32]

5.7 In other words, by reducing the ambition of the RHI the scheme would be focused on the industrial sector, where costs are probably much lower.

5.8 In this connection we note NERA's observation that there is further uncertainty about the rate at which renewable heat can be deployed, and that these variable rates have cost implications: "*The rate at which supply capacity for renewable heat technologies can grow is very uncertain, and this will have a significant impact on the costs of delivering a specific share of renewable heat.*"[33]

5.9 In other work NERA grants that even with great costs the outcome is uncertain: "*Overall, the modelling suggests that the proposed RHI subsidies may achieve just over 70 TWh of additional renewable resource from heat by 2020* [ie to achieve the required renewable heat share of approx 4.5% of the total UK renewable energy target]. *The findings are sensitive to a number of assumptions. Important uncertainties include the feasible expansion in renewable heat supply, and whether the proposed policy is sufficient to achieve the gradual establishment of renewable heat technologies as the dominant choice in large parts of the UK heat market. The subsidies required are sensitive to fuel prices, consumer discount rates, and other factors.*"[34]

5.10 That is to say, the outcomes are uncertain, and largely because of a fundamental doubt as to the implicit discount rate that consumers will apply.

5.11 As NERA put it in an earlier study: "*There is considerable uncertainty about the discount rate that would be used by households when considering purchases of renewable heat technologies. As a lower bound on plausible discount rates, some households have access to savings and borrowing (including mortgage) rates at relatively low levels, in the region of 5 percent. At the other, empirical estimates of discount rates for energy-related purchases, as well as survey evidence, suggest significantly higher rates, with estimates in excess of 30 percent not unusual.*"[35]

5.12 This leads to a general lack of precision in predicting what scale of expansion is realistic in the timescale. NERA concludes: "*An important message in our previous research on the supply curve for renewable heat was that the feasible future expansion in supply is uncertain*".[36]

5.13 The case of Solar Thermal is relevant here, and underlines the apparently arbitrary nature of government's views. DECC has specified that a rate of return of 6% on capital is to be used for solar thermal technologies. NERA note that: "*It is highly uncertain what proportion of the population might evaluate solar thermal using a discount rate at this level, and as noted in section 2.5, we are not aware of any empirical evidence that could be used to inform this issue. The uptake of solar thermal associated with this scenario therefore is highly uncertain.*"[37]

5.14 While the wish to avoid over-rewarding for certain technologies is entirely understandable, the lack of an evidence base for the specified 6% return is symptomatic of a tendentious quality that appears to permeate much of government's thinking on this subject. NERA scrupulously draws attention to this matter, but is constrained by the government's remit and can do no more than indicate that problems may arise as a consequence.

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32 NERA Consulting & AEA, *The UK Supply Curve for Renewable Heat* (July 2009), v.

33 Ibid. i.

34 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy & Climate Change*, URN 10D/544 (February 2010), viii.

35 NERA, *UK Supply Curve for Renewable Heat*, 22.

36 NERA, *Design of the Renewable Heat Incentive*, 39.

37 Ibid. 7. See also page 38.

5.15 A similar problem occurs in the discussion of banding or uniform subsidy, where the consultants have been asked to evaluate these two options, but do not appear to have been given the liberty to recommend against both.

5.16 However, NERA's work shows that both banding and uniform subsidy have major drawbacks: "[…] *the use of banding has both advantages and disadvantages. Its advantages include the reduction of rents,*[38] *and the ability to bring forward more expensive technologies without overpaying less costly options. […] Against this, banding typically drives up the cost of the renewable heat options deployed. This is because some cost-effective ways of adding to the renewables target are excluded by setting some bands lower than others.*"[39]

5.17 Elsewhere NERA notes that a banded system would be very inflexible in response to changing circumstances: "*Banding adds another layer of complexity […] as total renewable heat output depends not just on a single subsidy level, but on multiple support levels and the interactions between them. In a situation where the output that results from the policy is falling short of the target level, it is more difficult to determine which bands are set at the 'wrong' level, and which ones should be increased so that rents remain as low as feasible while also delivering the target. Similar difficulties would arise where targets appear to be over-shot.*"[40]

5.18 Thus, while NERA's study recommends banding over uniform subsidy, the latter having overwhelming objections on the ground of cost, one possible conclusion from a careful examination of their work is that neither a banded nor an unbanded subsidy is, in the last analysis, acceptable, since both have overwhelming disadvantages.

5.19 Indeed, we would suggest on the basis of the evidence and reasoning presented by NERA that the renewable heat sector is so disparate, so disaggregated, that it cannot be reasonably controlled through one market instrument such as the RHI.

5.20 Whether it should be controlled at all is a further question.

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38 'Rent' in this context is the overpayment of subsidy so that the owner of the renewable heat technology is rewarded beyond the costs of the installation and so profits from the subsidy. That it is possible for some to make such profits is a corollary of the design of the RHI.

39 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy & Climate Change*, URN 10D/544 (February 2010), 30.

40 Ibid. 65.

6 Renewable Heat Incentive Impacts on the Consumer

6.1 Regulatory Impact Assessment of Costs

6.1.1 The Government's own calculations in the *Impact Assessment*[41] show that the RHI is expected to be very expensive, with costs far exceeding benefits, including monetised climate change benefits (i.e. the calculated money value to society of avoiding the emission of a quantity of CO_2).

6.1.2 For example, the "Lead" RHI scenario proposes subsidies which will guarantee a 6% rate of return on the investment for adopters of solar thermal technology, and a 12% rate of return for all other technologies. For this scenario, the *Impact Assessment* estimates the total cost to the consumer up to 2030 to be in the range of £9.6bn to £21.1bn (£10.7bn to £22.2bn including ancillary costs), with an estimated annual cost in 2020 of between £2.2 and £2.6bn, implying the heavy back-loading of costs.

6.1.3 These need to be compared with the estimates of benefits to 2030, which comprise savings by avoided fossil fuel use and carbon taxes, and are substantially less than the costs. They range from £7.7 to £8.4bn. Thus, the Net Present Value (NPV) of the scheme ranges between minus £1.2bn and minus £13.4bn.

6.1.4 It must also be emphasised that these are probably conservative estimates. Indeed, the government's own consultants, NERA, state: "[…] *if consumers are less willing (than is assumed in the Lead scenario) to incur up-front costs against the prospect of future RHI subsidies, then both the cost of the policy and the subsidy levels required could increase substantially*".[42] NERA also point out that "*With lower discount rates (which imply less concern about up-front costs) the cost can drop by about 40 percent, whereas higher discount rates could increase costs by a similar amount or more*".[43]

6.1.5 Bearing this extreme sensitivity in mind, the reader should regard the *Impact Assessment*'s best estimate of Net Present Value of the RHI, which is minus £10.5bn, as being simply indicative of general scale and sign rather than a precise estimate. That is to say, taken in context with NERA's work, the *Impact Assessment* tells us that the RHI has very high and very uncertain costs.

6.1.6 Furthermore, these costs are not rewarded by a compensating climate change benefit. This is demonstrated in the Government's *Impact Assessment* where the "cost effectiveness" of the RHI policy is determined. "Cost Effectiveness", in this context, is defined as the net social cost per tonne of greenhouse gases reduced as a result of the policy. The RHI states that "*0% on an average basis of the carbon savings projected to occur through the RHI are cost effective*", and consequently concludes that "*the RHI as a whole fails to pass the cost effectiveness test*".[44]

6.1.7 But the simple scale of the cost is not the only major problem to which we would draw attention. There is also the very large range of the potential costs (£10.7bn to £22.2bn), an uncertainty which shows how poorly understood the field is, how little can be

41 DECC, *Impact Assessment of the Renewable Heat Incentive scheme for consultation in January 2010* (February 2010), 2.

42 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy & Climate Change*, URN 10D/544 (February 2010), vii. See also, for confirmation, *NERA Economic Consulting & AEA The UK Supply Curve for Renewable Heat: Study for the Department of Energy and Climate Change*, URN 09D/689 (July 2009), vii, and Table A.5 and Table A.6.

43 NERA, AEA, *The UK Renewable Heat Supply Curve* (2009), vii.

44 DECC, *Impact Assessment of the Renewable Heat Incentive scheme*, 20.

confidently predicted about the results of government excursion into this market, and how unclear it is that the transfers of wealth that are contemplated will be justified by the results in the renewable heat sector.

6.1.8 There are further concerns as to whether the wealth transfers between adopters and non-adopters will function as a regressive tax that is directed to the benefit of higher income earners (a point we take up in some detail below).

6.1.9 It is also interesting to ask whether there are problems for inter-regional equity. That is to say, whether the costs in a region will be returned as benefits in that region, or whether they will function as wealth transfers to other regions.

6.1.10 For example, the *Consultation* notes that heat constitutes 50% of energy demand in Scotland, a significantly higher proportion than elsewhere.[45] In the event of a levy on fossil fuels this would have a considerable effect on prices and bills for Scottish consumers, for example high rise apartment dwellers in the urban central belt, who might not able to take up RHI technologies.

6.1.11 Indeed, it is at least conceivable that there will be a transfer of wealth from poorer Scottish consumers to richer English consumers who have the space and financial resources to adopt RHI eligible technologies. It seems unlikely that this is the Government's intention.

6.1.12 These inter-regional questions do not appear to be answerable at present, and we will instead focus our attention on transfers of wealth between income classes.

6.1.13 Since the RHI *Consultation*, DECC has released its *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), which provides the clearest evidence yet of Government's own estimates of the impacts on the consumer of its energy and climate change policies.[46]

6.1.14 The impacts of the RHI are included, assuming that the mechanism is funded by a levy on fossil fuels, principally natural gas. These amount to £6 a MWh in 2020, on a base gas price of £41 per MWh.[47]

6.1.15 DECC estimates, in tables annexed to the study, that the RHI will cause a £94 per annum increase in the average domestic gas bill in 2020, an increase of 14%.[48]

6.1.16 The impact on non-domestic retail gas prices is estimated to be £6/MWh on average prices without policies of £30/MWh. Government estimates that an average medium sized non-domestic user's gas bill will rise by £86,000 annually due to the RHI, a rise of approximately 19%.

6.1.17 It is striking to note that DECC makes no estimate of the impact on large industrial consumers of gas. This is a major omission and should be rectified as soon as possible. Without this information it is impossible for government to make a properly informed decision on the design and implementation of the RHI.

6.1.18 The reader should note that DECC's study claims that these price increases will have only a 1% net impact on average domestic gas and electricity bills overall, since it is assumed

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45 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (February 2010), 77.

46 DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010).

47 Ibid. 27.

48 Ibid. 30.

that efficiency measures, which are expected to reduce electricity bills significantly, will reduce total consumption of both gas and electricity.[49]

6.1.19 However, the efficiency measures on which this net effect is dependent are highly speculative and optimistic, and, unfortunately, DECC's study does not provide sufficient data about each policy to enable assessment of their individual impacts aside from any hoped for effect in combination. This is particularly important since there is a clear risk that the costs are more likely to be realized than the savings.

6.1.20 Furthermore, even if we accept DECC's thinking with regard to the probability of counterbalancing efficiency savings, it is important to realize that the effects of only a 1% rise in average bills is highly significant, not least because, as the Department itself admits, "*the impact of policies on average domestic gas and electricity prices and bills masks significant distributional impacts across households*."[50] If the savings are not realized to the degree anticipated, and the average bill increases by more than 1%, this effect becomes still more significant.

6.1.21 An individual treatment of the policies, the RHI amongst them, would have enabled DECC to discuss in detail the significant distributional effects of the policies one by one, and permitted analytic comparisons.

6.1.22 However, the evidence so far published by government does permit a limited indicative investigation, and in what follows we attempt to gain insight into the distributional impact of the costs of the RHI on average domestic bills in 2020 by analysing tables and charts presented by DECC in their examination of the impact of all climate change policies on income.

6.1.23 These inferences are dependent on assumptions of varying strengths, and we expect the value of our conclusions to be more in their indicative value than in their precise quantification.

6.1.24 We begin our analysis with the following chart, which shows the anticipated proportion of income spent by each decile (ten percent grouping) of UK households, ranked according to equivalised income.

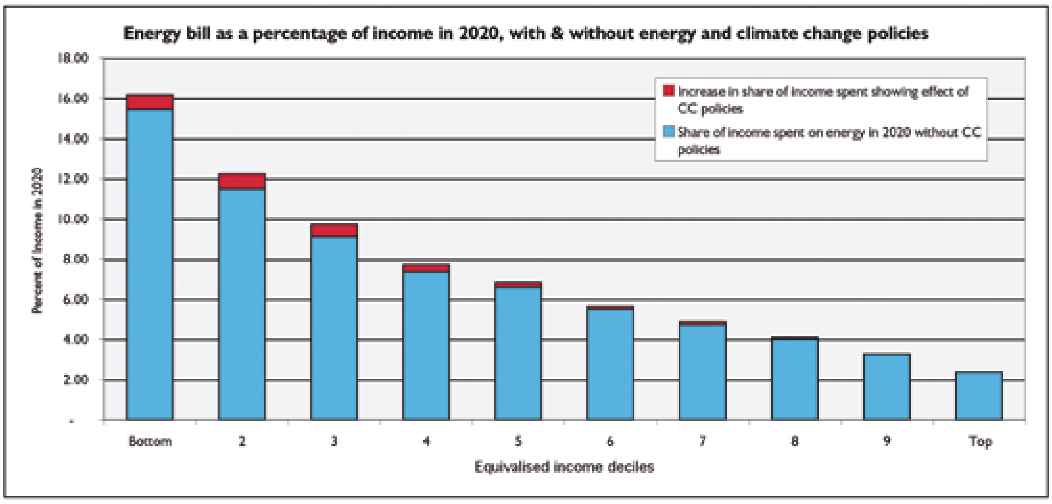

Figure 6: Energy bill as percentage of household income in 2020, with and without energy and climate change policies. Source: Redrawn from DECC 2010.[51]

49 DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), 6.

50 Ibid. 13.

51 Ibid. 15.

6.1.25 This chart denotes the distributional effect of a 1% rise in combined average gas and electricity bills in 2020 as a result of climate change policies; specifically, a rise of £13 on a bill without the impacts of climate change policies of £1,226.

6.1.26 The reader is reminded that this is a net effect, with the very substantial increases arising from, for example, the RHI and RO, being largely offset by predicted savings of around 11% arising from the Products Policy.[52]

6.1.27 It appears from the chart above that DECC expects a substantial proportion of the population to be in fuel poverty as a result of high prices, quite apart from any policy impacts, with the lower two deciles being, on average, fuel poor, i.e. spending more than 10% of income on energy.[53]

6.1.28 Importantly, even a small increase in average domestic bills over and above the 1% DECC hopes for, has a significant effect on average fuel poverty, pushing the third decile to the margin of this condition.

6.1.29 In passing we note that DECC has employed "equivalised income" in this calculation, and it should be observed that this method is to some degree controversial in relation to fuel poverty research, since it tends to understate effects on single person households, and, arguably, to overstate that on multi-person households. It would be helpful if DECC's future work on this matter were to employ "full income" data, as is recommended in the Department's *Annual Report on Fuel Poverty Statistics* (2009), or to justify the choice of equivalised incomes for the current purpose.[54]

6.1.30 Unfortunately, due to the aggregation of the policy impacts in DECC's study, it is very difficult to see what the underlying model would predict in regard to the distributional impacts of *specific climate change policies*.

6.1.31 The simple impacts on the average bill can be calculated from the tables included in the study. For example the Table E1 (reproduced here as Appendix 1), discusses the average domestic gas bill. The average bill without policies is estimated to be £688 a year. The cost impact of the RHI (+£94), the Products Policy (+£8) and Security Measures (+£1), a total increase of £103, is expected to be counterbalanced by bill reductions arising from CERT (-£18), CERT Extension (-£18), the Future Supplier Obligation (-£20), Better Billing (-£2), and Smart Metering (-£4), a total reduction of £62, the net impact being to add £39.[55]

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52 See DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), 30ff. The 'Products Policy' is defined at 18-19: "There are a number of EU Implementing Measures (minimum standards and labelling) that have already been agreed by EU Member States covering a range of household and non-domestic products, in order to improve their energy efficiency. For these 11 measures, detailed Impact Assessments have been conducted (between July 2008 and April 2009). The impacts have been recently updated, to reflect these IAs. In addition, DEFRA now have estimated impacts available on a second tranche of EU Implementing Measures that are in development led by the EU. The analysis for which is being finalised from the consultation beginning December 2009."

53 Each decile will contain households that do not spend more than 10% of income on energy; the fact a decile is on average fuel poor indicates that the average person is so, with some spending less than 10% and some much more on fuel. It must be assumed that this chart indicates that the lower deciles are preponderantly fuel poor. At present 74% of the lowest decile are fuel poor, while 32% and 14% of the 2nd and 3rd deciles are fuel poor (See http://www.decc.gov.uk/en/content/cms/statistics/fuelpov_stats/fuelpov_stats.aspx), but deciles based on equivalised income which may cause important variations in composition.

54 For discussion see DECC, *Annual Report on Fuel Poverty Statistics* (2009), 44ff.

55 Presumably due to rounding errors DECC's tables do not sum precisely.

6.1.32 Table E-2 discusses the average domestic electricity bill, estimated to be £538. The impact of the Future Supplier Obligation (+£11), the RO (+£30), the Extended RO (+£64), the EU ETS (+£30), CCS (+£15), and FiTs (+£10), totalling £160, is expected to be counterbalanced by CERT (-£37), CERT Extension (-£8), CESP (-£1), Better Billing (-£2), Smart Metering (-£9), and the Products Policy (-£130), totalling savings of £187, and resulting in a net electricity bill reduction of £26.

6.1.33 Thus we can conclude that while the headline result of DECC's study is that the department estimates the average domestic gas and electricity bill will rise by only 1% in 2020, the work in fact implies that this is only a single possible outcome out of many others.

6.1.34 It is conceivable that all the costs would be realized and none of the savings delivered in fact, resulting in a combined gas and electricity bill of £1,489, an increase of 21%.

6.1.35 Similarly, we can see that the impact of the RHI is to add 14% to the average gas bill, and 7.5% to the combined domestic energy bill.

6.1.36 What is more difficult to determine are the distributional impacts of these alternative outcomes across the population deciles, including the individual impacts of the component policies, including the RHI, which is the particular focus in this study.

6.1.37 However, DECC's own chart can be used as the basis for an estimate. We acknowledge that the model behind that chart may assume variations between the average fuel bills for each of the deciles, but we have no access to these assumptions, and any attempt to second-guess them would add arbitrary complexity to our approach.

6.1.38 Thus, for simplicity's sake let us assume that the blue bar reflects a bill of £1,226 in each case, allowing us to calculate the probable average income assumed. This results in a distribution that is sufficiently plausible for us to continue with our approach.[56]

6.1.39 Let us then assume that the RHI costs are equally distributed over all energy bills, regardless of the income on the householder, which is unlikely to be true, but will yield informative results.

6.1.40 Even with this latter assumption, the impact is necessarily greater on those in the lower income deciles. The chart below adapts DECC's chart discussed above, and applies the RHI bill increase evenly across all deciles (the yellow bar).

6.1.41 Thus, we can see that on this assumption those in the bottom decile would face an expenditure of about 1% of their income to fund the RHI, whereas those in the highest decile would face an increase of only 0.2%.

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56 The income bands calculated in this way correspond approximately to those published in Chart 5 of DECC, *Annual Report on Fuel Poverty Statistics 2009* (October 2009), 13, though these latter figures are presumably based on "full" rather than "equivalised" income.

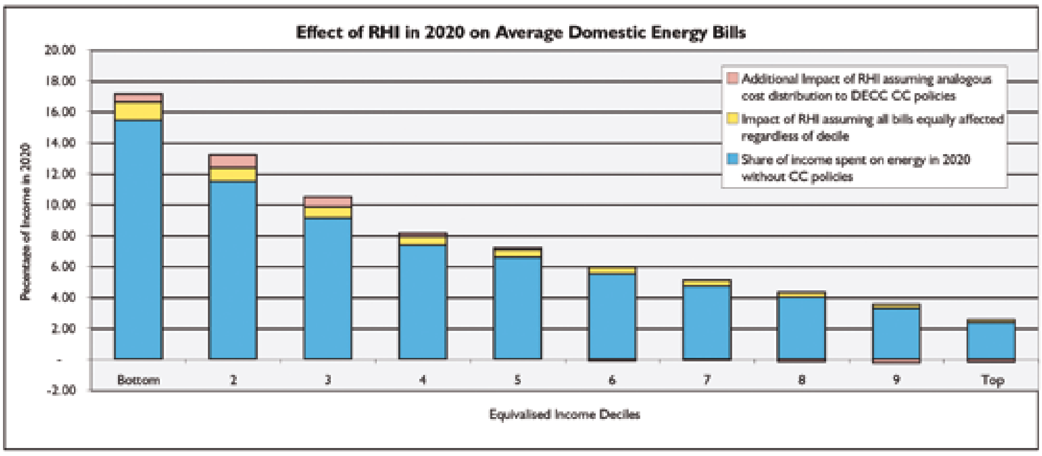

Figure 7: Effect of the RHI on household energy expenditure in 2020.[57]

6.1.42 However, this assumption would not take into account the fact that the costs and benefits of the various policies are not evenly spread over the population. As DECC itself puts it: "*Looking at the impact of polices on* ***average*** *domestic prices and bills masks significant distributional impacts across households. Policies will lead to transfers between different sections of the population.*"[58] (Emphasis added.)

6.1.43 Specifically, the RHI is likely to disproportionately benefit those who can afford to install eligible technology, as well as insulation and other energy savings or generation measures that require up-front financial investment. DECC, in their analysis of the impact of overall climate change policies recognise this phenomenon, and observe that the "*highest income deciles see a slight fall in energy bill as a proportion of income as it is assumed, under current policies, that they are more likely to take up renewable or insulation measures due to associated up front financial cost of take up*."[59]

6.1.44 Indeed, DECC notes that the 1% of households able to take up both a renewable energy and an insulation measure would thus reduce their bills by 25%.[60] It is reasonable to assume that such households would tend to be in the higher deciles, but DECC does not provide sufficient data to quantify this effect directly. However, the department does observe elsewhere that "*low income households may still find it difficult to meet upfront costs*", so they presumably do not expect proportional or even widespread adoption in these lower deciles.[61]

6.1.45 To what extent DECC has modeled such distributional effects is unclear, but it seems that they do have a model bearing on this matter, since the charted account of the 1% increase on energy bills implies a significant distributional effect that penalizes the lower income deciles.

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57 The ten deciles represent equivalised household income, and the vertical axis shows the percentage of household income that is spent on energy. The blue bars represent the expenditure without energy and climate change polices, the yellow bar is the addition anticipated from the RHI if the costs are spread evenly over all deciles. See main text for account of chart construction.

58 DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), 13.

59 Ibid. 14.

60 Ibid. 15.

61 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (February 2010), 20.

6.1.46 It would be in the public interest if the details of this model were disclosed, not least because any distributional effect expected by DECC in relation to the component policies could then be appreciated. We conclude that government should release this material.

6.1.47 In the meantime, and as an indication of the value of such a disclosure, we can attempt to infer the distributional effect likely to result in the case of the RHI in particular by pro-rating the DECC data showing the cost impact of all climate change policies on the lower deciles (the 1% increase in gas and electricity bills), and thus estimate the extra impact on the lower deciles of funding the RHI.

6.1.48 This is also shown in Figure 7 above, and is indicated by the combined yellow and pink bars. That is to say, the yellow bar indicates the extra share of income that would be paid as a result of the RHI if the costs were evenly distributed over all householders irrespective of income, while the combined yellow and pink bars includes the additional burden (pink bars) if the costs are distributed on the base of the inequalities implied in DECC's published chart.

6.1.49 Our attempt to infer DECC's assumptions regarding this skewed distributional effect suggests that the lower three deciles may on average see RHI impacts of £135 to £184 on their bills, as opposed to the £94 which they might see if the measure were imposed equally across all income bands. The upper four deciles all seem to pay less than £94, with the upper two deciles actually on average deriving income from the RHI. These are very striking outcomes, and while we acknowledge that our inferences may be to some degree inaccurate, DECC's published data strongly suggests that some such effect would obtain. We presume that the department can clarify this matter, and call on it to do so.

6.1.50 Our chart clearly shows that the distributional effect further increases the burden on the lower deciles whilst actually *reducing* the impact on the higher deciles. This is iniquitous.

6.1.51 Concerns about the scale of this effect, which results from only a 1% increase in bills, are compounded by the fact that many of the assumptions, such as the reduction in electricity bills caused by the Products Policy appear optimistic, and thus the likely increase in bills is much greater.

6.1.52 For example, regulations on the efficiency of appliances will only reduce bills by the estimated £130 a year if consumers do not increase the number of appliances they own. Such assumptions are not explicit in current government policy texts, and should be spelt out so that they can be evaluated.

6.1.53 We are similarly concerned that in the heat sector, the impact of CERT, the CERT Extension, and the still nascent Future Supplier Obligation, which are together expected to yield a substantial bill reduction of £56 annually, may fail to do so, or may underperform. Historically, part of the benefit of energy efficiency measures has been taken in increased comfort and so such measures do not always translate into reductions in bills. For example, increased comfort expectations have resulted in average household temperatures increasing from 12°C in 1970 to 18°C in 2006.[62]

62 BRE, *Domestic Energy Fact File, J.I. Utley & L.D. Shorrock* (2008).

6.1.54 Of course, it is possible that the price increases caused by climate change policies, and rising fossil fuel prices, may prevent this, so the past may not be a guide to the future. However, we think it very unwise for government to assume that efficiency measures will cushion domestic consumers against increases caused by energy and climate policies such as the RHI and the Renewables Obligation.

6.1.55 The RHI *Consultation* observes that Government aims to "keep costs under control".[63] There is much in both the *Impact Assessment* for the RHI, and in DECC's, *Estimated impacts* to suggest that the design of current policies and various assumptions with regard to mitigating factors make this much more difficult for the current government than may have been appreciated.

6.1.56 In order to facilitate public debate on this all-important topic we conclude that DECC's, *Estimated Impacts* should be rapidly supplemented with a new study that considers the policy impacts individually in detail, as well as in aggregated form.

6.1.57 Most importantly, we infer from the data and commentary so far published by DECC that the department already has more detailed projections of the distributional impacts of the policies, making explicit wealth transfers between sectors of the population. These models should be made public as a matter of urgency, since they have important implications for areas such as fuel poverty, and are strongly relevant to debate around the design of measures such as the RHI.

6.1.58 The release of the department's underlying model of uneven distributional effects will also shed light on the winners and losers from other climate change policies, such as the Feed-in Tariff and the Renewables Obligation.

6.2 Co-efficient of performance and heat pumps

6.2.1 Heat pumps extract heat from the ground or air and 'uplift' its temperature to provide heat for space heating and hot water. The efficiency of heat pumps is quantified by their co-efficient of performance (CoP) which is the ratio of heat produced per unit of electricity consumed in generating that heat. A CoP of 3 means that 3 kWh of heat are output for 1kWh of electricity used to run the pump. Higher CoP values therefore indicate more efficient heat delivery for less cost.

6.2.2 However, CoP values vary with season: the colder the ground or air, the more work the pump has to do to raise the temperature to acceptable levels for domestic heating and the more energy is consumed. Poor design and installation can also affect CoP.

6.2.3 Other aspects of performance are affected by the level of insulation and the nature of heating delivery. In very well insulated buildings with low temperature under floor heating (40°C), ground source heat pumps can be highly beneficial. Conversely, poorly-insulated buildings where the pump is required to heat high temperature radiators (60°C) and hot water (which needs to exceed 60°C to comply with Legionnaire's Disease legislation), are likely to result in significantly less compelling performance.

6.2.4 With regard to CoP, the 2009 European Directive on Renewable Energy excludes low performing heat pumps from contributing to the renewable energy targets, where it states that '*Only heat pumps with an output that significantly exceeds the primary energy needed to drive it should be taken into account*'[64] Specifically, pumps need to have a

63 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (February 2010), 36.

64 "Directive 2009/28/ec of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC", *Official Journal of the European Union*, L140/16 (05.06.09), para 31.

seasonal (average annual) CoP of greater than a quantity resulting from a complex calculation set out in Annex VII.[65]

6.2.5 While the Directive itself does not give calculated COPs, other studies do, and it would appear that the EU is implicitly requiring that heat pumps achieve a COP of 2.875 before their energy can contribute to the renewable energy target.[66]

6.2.6 The logic behind the EU's requirement for a minimum efficiency level is that replacing a fossil-fuelled heating system with a poorly performing heat pump may actually result in increased CO_2 emissions because there are emissions costs in the extra electricity requirement of a heat pump which need to be balanced against the emissions of burning a fossil fuel directly for space and water heating.

6.2.7 There are only very limited studies of the efficiency of heat pumps as installed and used in the UK, but the most recent of these, an empirical examination of currently installed heat pump performance, was published by the Energy Saving Trust (EST) on the 8 September 2010. The study reveals that the actual performance of heat pumps installed in the UK is surprisingly poor.[67]

6.2.8. The EST data set shows that only 1 of the 22 properties with air source heat pumps achieved the implicit minimum EU Directive COP, and only 9 of the 47 sites with ground source heat pumps achieved this minimum standard.

6.2.9 The following chart redraws the EST's data in one series to facilitate overview and comparison.[68]

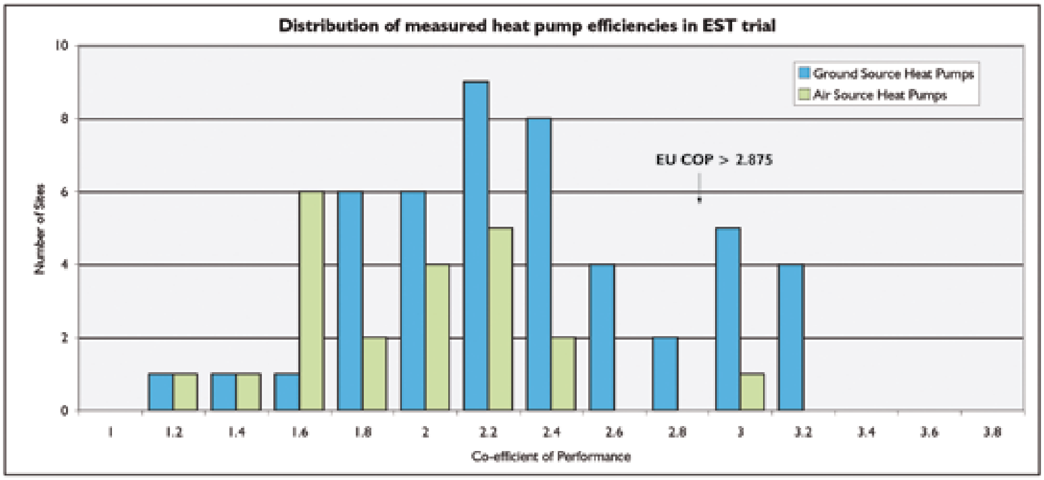

Figure 8: Distribution of measured heat pump efficiencies (Co-efficient of Performance) reported in the EST trial.

6.2.10 These results raise a number of questions. It is reasonable to ask whether heat pumps are being installed in properties that are inappropriate, possibly because the pre-existing levels of insulation are insufficient, or the temperature load is too high for the pump.

65 Directive 2009/28/ec, Annex VII.

66 Sarbu, Ioan, Sebarchievici, Calin, "Use advisability of heat pumps for building heat and cooling", *Recent Advances in Energy & Environment* (Proceedings of the 5th IASME / WSEAS International Conference on Energy & Environment (EE '10), University of Cambridge, 23-25 Feb. 2010), 106–111. Available online: http://www.wseas.us/e-library/conferences/2010/Cambridge/EE/EE-00.pdf

67 Energy Savings Trust, *Getting Warmer: a field trial of heat pumps* (Energy Savings Trust: London, 2010). Available from: http://www.energysavingtrust.org.uk/Generate-your-own-energy/Heat-pump-field-trial

68 EST, *Getting Warmer*, 15.

Furthermore, it appears possible that the level of expertise of the installers is insufficient to ensure effective installation.

6.2.11 In addition, it seems that Government may find it difficult to demonstrate compliance with the EU Directive's minimum CoP standard when the RHI proposes 'deeming' of small domestic heat pump installations. On the basis of this study, there seems a distinct risk that some heat pumps will be subsidised even though they fail to meet the minimum standard for being considered a renewable energy source. If, on the other hand, government withdraws subsidies from such installations, well-meaning householders may discover after investing heavily in a heat pump that their installations fail to come up to the required EU standard, and thus forfeit entitlement to RHI payments.

6.2.12 Another important and alarming point in the EST study is that consumer dissatisfaction with running costs is high in some sectors: '*There were many more dissatisfied social housing residents (42%) than private householders(13%)*'.[69]

6.2.13 This confirms the real possibility of consumer disenchantment leading to a backlash against the technology, an effect well-documented in Japan in relation to solar thermal hot water heating, as discussed elsewhere in this study.

6.2.14 We note that NERA's 2009 modelling for government not only assumes CoPs that are higher than those reported in the EST study, but for Air Source Heat Pumps are below that apparently implicitly required in the EU Directive.[70]

6.2.15 We further note that that NERA's work for government indicates that heat pumps are projected to receive 46% of the RHI subsidies.[71] The poor results reported in the EST's study shows that this dependence makes the RHI fragile and risk prone. We conclude that attempts to drive in heat pumps at speed, as currently proposed, are unwise, and that there is a clear need for a period of experimentation and market learning before this very promising technology can be expected to make a significant contribution.

6.3 Administration Costs

6.3.1 The administration of the RHI presents many difficulties, not least of which is that it must be effective, cost-effective, and transparent.

6.3.2 The latter point is of critical importance. There is no merit in costly monitoring if progress towards targets is not transparent to the public who are footing the bills.

6.3.3 Relevant experience is to be found in relation to the Renewables Obligation. Our judgment is that because of the increasing complexity of the scheme Ofgem is struggling to administer the RO in an effective and transparent manner, and there is every reason for thinking that the RHI will be still more difficult, not least because of the sheer numbers of installations involved.

6.3.4 In particular, we believe that it is necessary to investigate which other bodies are involved in certification and monitoring. If there is duplication of effort and costs in this area, it should be highlighted.

69 Energy Savings Trust, *Getting Warmer: a field trial of heat pumps* (Energy Savings Trust: London, 2010), 17.

70 *NERA Economic Consulting & AEA The UK Supply Curve for Renewable Heat: Study for the Department of Energy and Climate Change*, URN 09D/689 (July 2009), Table B.3, and Table B.5.

71 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), Table 4.2.

6.4 Banding

6.4.1 Work by the government's consultants confirm that an unbanded RHI would result in very high economic rents (excess subsidy), and they observe: "*relatively finely graded banded categories may be required in order to reduce rents without risking an increase in cost*", and that this has "*administrative implications*".[72]

6.4.2 In other words, the disaggregation of the sector presents simultaneous and related difficulties in both policy instrument design and administration. The heat sector, particularly in the domestic arena, involves large numbers of relatively small investments spread across a wide range of technologies installed in a variety of dwelling types, all with differing economic and technical characteristics.

6.4.3 An instrument that influences all of these decisions without undue subsidy will be fine-grained to a degree that makes consistent administration exceptionally laborious, error-prone, and costly.

6.4.4 It is unlikely that an adequate administrative arrangement will be discovered without practical experience, a point which suggests that pilot studies and a learning period for any RHI equivalent in the domestic sector would be wise, as opposed to the over-ambitious and arbitrary timescale imposed by an attempt to integrate these measures with the EU 2020 targets.

6.5 Capital, Installation, Maintenance Costs

6.5.1 The levels of subsidy support accorded to the various bands of technologies are critically dependent on a large number of assumptions about capital cost, performance (for example coefficient of performance for heat pumps), load factor, and equipment lifetime.

6.5.2 It is thus informative to observe the revisions in technology cost assumptions made by the government's consultants for their 2010 work on the cost curve, as opposed to their work in 2009.

6.5.3 These are described at page i, and include the inclusion of liquid biofuels, the inclusion of larger ground source heat pumps, the revision of solar thermal performance assumptions, demand side barriers, and consumer discount rates, the improvement in the future coefficient of performance for all heat pumps, revisions to the capital costs of biomass boilers, the update of biomass, fossil fuel, and electricity price assumptions, and the update of heat demand projections. These points are usefully summarized in Table B.2 in the 2010 study.[73]

6.5.4 As illustrations we might note that non-domestic solar-thermal energy was believed in 2009 to have a capital expenditure of £1,600 per kW, but in 2010 to be £1,300, or that in 2009 the operating expense of this plant was assumed to be £18/kW per year, but that in 2010 it was thought to be £7.

6.5.5 Other substantive variations include the view that the capital expenditure of all biomass boilers will be 10% higher than previously assumed, and that the co-efficient of performance for new heap pumps will increase by 10% per year, whereas it was had been previously thought that this would remain constant.

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72 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), 64.

73 Ibid. 46.

6.5.6 NERA doubtless had good reasons for these variations, and, indeed, fluidity in such matters is to be expected. However, the fact that such reassessments were regarded as necessary in two studies so nearly adjacent in time undermines confidence in the stability of these important parameters, and thus in the ability of government to tune the RHI subsidy to avoid over- or under-support.

6.5.7 Even assuming that the parameter data is reliable at a particular moment, which is questionable, the instability over time of inputs of this kind casts doubt on the government's ability to control costs to the consumer, and achieve its ends.

6.5.8 One conclusion which could be drawn from NERA's need to revise these assumptions is that too little is known about this sector, and that the sector is too disaggregated, to make intervention such as that of the proposed RHI feasible or wise.

6.5.9 These concerns are complicated by the fact that, as NERA note, the assumptions with regard to capital costs are necessarily based on a "*wide range of sources, and updated following stakeholder feedback*".[74] In other words, as with the Renewables Obligation, the subsidy level is set on the basis of information provided by the benefiting industries, with a risk of the overestimate of cost and consequent possibility of unreasonable profit taking at the consumer's expense.

6.5.10 NERA remarks on this problem in a footnote that deserves close reading: "*As a complication, government may face an incentive problem at the policy design (and review) stage(s) as it attempts to improve its knowledge about the true cost of technologies and thus the correct levels for bands. Given that banding levels may be based on the information supplied to government, stakeholders may have an incentive both to overstate the cost, as this may lead to a higher banded payment, and to overstate potential, as a separate band may be more important if it is thought that a particular technology or other type of project is able to make a significant contribution to the overall renewable heat target*."[75]

6.5.11 It seems unlikely that Government will be able to gather sufficient knowledge to prevent these problems.

6.5.12 Indeed, in their overall assessment of the sensitivity of systematic cost to variability in uncertain parameters, NERA emphasise that the "*experience within the UK of most of the key technologies is very limited, and the basis for estimating the feasibility and cost associated with a rapid expansion of renewable heat therefore is weaker than for many other technologies where there is significant existing experience (such as energy efficiency measures, or large-scale renewable electricity generation)*."[76]

6.5.13 While this certainly the case, it should be recalled that even in a relatively well understood and homogeneous sector, such as larger scale renewables, the Renewables Obligation has required constant revision, and is widely recognized to have produced a haphazard mixture of under- and over-reward. This does not bode well for the RHI.

6.5.14 In view of these radical uncertainties, and the high likelihood of erroneous assumptions regarding capital and operating expenditures and other such variables, government would be best advised to defer any large scale RHI, if it is not to be abandoned, pending results from a time-limited learning program of pilot studies.

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74 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), 4.

75 Ibid. 65.

76 Ibid. 63.

6.6 Over-Reward

6.6.1 Various sources of over-reward have been touched on above in relation to errors in estimating need. A sample of such problems may be cited to confirm these general concerns.

6.6.2 In the government's *Consultation* it is observed that unmetered heat providers who then install heavy insulation and thus cut heat use will not then have reduced RHI support: "*Anyone who had already installed or exceeded the minimum standard of insulation would not lose out under our proposed approach as, unlike under metering, they would not see their level of compensation under the RHI fall where they reduced their energy consumption*."

6.6.3 While we understand government's motivation for this provision, it is an admission of deadweight that reveals just how difficult a market intrusion is to control if unforeseen consequences are not to result.

6.6.4 Similarly, though perhaps more problematically, the *Consultation* observes that "*The proposed tariff structure also allows generators to retain the benefit of any future rises in fossil fuel prices. If fossil fuel prices rise, renewable energy generators will save more money compared with a situation in which they had stayed with fossil fuel heating. Conversely, if fuel prices fall, they will save less.*"[77]

6.6.5 This commitment is incompatible with the stated aim on the previous page to "*keep costs under control*". If fossil fuel prices rise, then the tariff could be reduced and thus cut the cost to the subsidizing fossil fuel consumer. Instead, under the *Consultation's* proposal fossil fuel consumers will not only face rising prices for that fuel, but as a result of that rise will also be paying needlessly high subsidies to renewable heat generators.

6.6.6 A further area of concern in relation to over-reward persists in the banded Lead Scenario, and does so in spite of the fact that banding is designed to limit excess profit-taking.

6.6.7 We agree with NERA that while an unbanded system "*can result in the dominance of one or a few technologies*",[78] (a problem familiar from the Renewables Obligation), an unbanded system can also result in enormous and unfair profits.

6.6.8 The chart illustrating this point with a hypothetical example is stark and instructive:

77 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (February 2010), 39.

78 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), 54.

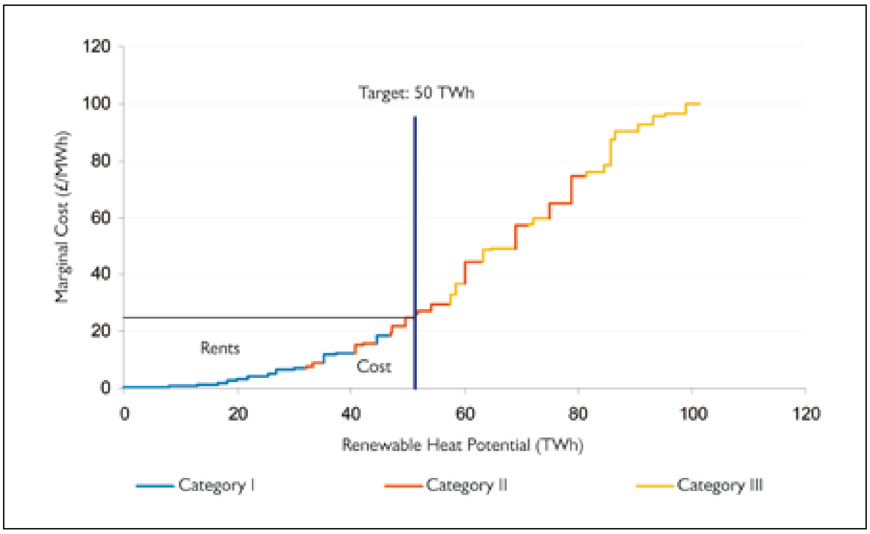

Figure 9: Illustration of unbanded subsidy. Source: NERA Economic Consulting.[79]

6.6.9 In this case a uniform subsidy is used to drive in just over 50 TWhs of renewable heat. However, in order to obtain the last MWh on the cost curve all MWhs have to be paid at the same rate, and since the cost of the marginal MWh of heat rises sharply, the uniform subsidy system creates very large over-rewards for the generators of cheaper MWhs, who enjoy significant rents (excess profits). In this theoretical case the costs to the consumer are £1.28 billion, and are made up of £380 million cost, and £890 million of rents (income in excess of need) for the fortunate owners of the cheaper generators.

6.6.10 Clearly such a situation would be quite unacceptable, and banding, in which the cost curve is divided into sections of similar cost with each section having a different level of reward, is attractive by comparison.

6.6.11 However, banding doesn't remove the problem altogether; rather, it fragments it, since even within bands there will be cheaper and more costly technologies, all receiving the same subsidy, which will have been calculated against a "reference" technology in the centre of the band.

6.6.12 As NERA put it: "The *heterogeneity of costs within each banding segment means that a given subsidy will result in different implied rates of return for different heat consumers – with higher implied RoR for installations with costs lower than that of the reference installation.*"[80]

6.6.13 Thus "*the division into bands does not fully eliminate the variability in cost, and therefore also does not fully eliminate payment in excess of cost ('rents').*"[81]

6.6.14 And in spite of banding, these rents can be very large. NERA point out that in the Lead scenario of £3.4 billion paid in 2020, fully £1.4bn would be in excess of cost, i.e. "rent".

6.6.15 When it is considered that the RHI, overall, appears to be a regressive tax, hypothecated to the benefit of higher income groups, who have the space for and are more able to afford the qualifying technologies, this degree of profit becomes, in our view, unacceptable.

79 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), 56.

80 Ibid. 13.

81 Ibid. 22.

6.6.16 It is difficult to see how to avoid this, unless it is by accurately fine-tuned bands. These could only be specified if the renewable heat sector were better understood, which is a further argument in favour of time-limited learning programs in advance of any more comprehensive program of public subsidy for renewable heat technologies.

6.7 The Prevention of New Developments

6.7.1 There are well-known, and in the view of many, amply substantiated, theoretical reasons for viewing the relation between subsidy and technological development to be troubled.

6.7.2 Since guaranteed rates of return on capital investment effectively de-risk technologies there is a serious risk that technical advance will be truncated due to lack of incentive for market learning. This is particularly true of the "deemed" domestic technologies for renewable heat, which will be rewarded regardless of actual output.

6.7.3 It is even conceivable that the UK would become a dumping ground for underperforming domestic renewable heat products.

6.7.4 Our view, on theoretical grounds, and in view of the collapse of the Japanese solar thermal market, discussed below, is that the prospects of the renewable heat industry will not be enhanced by public subsidy.

6.7.5 On the contrary, we think that this support will fossilize the contemporary state of technology, and militate against the development of new concepts. Furthermore, there is a high risk of under-performance leading to consumer disenchantment.

7 The Funding of the Renewable Heat Incentive

7.1 We have already noted that Government is still undecided as to how to fund the RHI, whether through a levy on Fossil Fuels or via general taxation. Of the two it appears to us that general taxation is the most transparent, and the least likely to have unforeseen consequences.

7.2 That is to say, a levy on fossil fuels in addition to pipeline gas would fall on offgrid gas and oil consumers, which would almost certainly entail poorer members of society bearing a disproportionate share of the costs.

7.3 While socio-economic indicators, derived from Calor Gas's own data, suggest that many off-grid consumers are able to withstand such costs, and will actually be able to benefit from the RHI by adopting renewable technologies, careful examination of the population profile shows that a significant part of this group is either poor, or single occupants on fixed incomes. These people may not be able to withstand the levy with comfort or adopt renewable heat.

7.4 We suspect that the government's *Consultation* is mistaken in suggesting that the RHI will benefit rural communities: "*The potential benefits of the RHI to rural communities are considerable, especially those not connected to the gas grid and currently using more expensive fuels to heat their homes. The RHI would allow the households concerned to switch permanently from high cost, off-grid fossil fuel sources to renewable technologies, and thus significantly reduce heating bills. This could be of particular benefit for those households who are in or are facing the risk of being in fuel poverty.*"[82]

7.5 However, government's view is dependent on rural uptake of the RHI balancing the increased costs to off-grid fossil fuel consumers, and it is by no means certain that this would materialise.

7.6 The *Consultation* goes on to observe that 25% of all the fuel poor live off the gas grid, and that 20% of fuel poor households are in rural communities. As noted, Calor's data suggests that many rural dwellers are single person or retired households on fixed incomes, and it seems unlikely that uptake of RHI eligible technologies will be high in this group.

7.7 Furthermore, government not only admits that "*low income households may still find it difficult to meet upfront costs*" but recognises that this is so severe a problem that it will require additional mechanisms, a consultation on which was promised but as yet undelivered.[83]

7.8 This is a serious admission, and suggests that the authors of the *Consultation* text were concerned that RHI would not in practice be beneficial to the fuel poor.

7.9 In this connection it is worth returning to the footnote in DECC's, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), where it is first observed that households who adopt a renewable and an insulation measure will see a 25% fall in bills, but then conceded that: "*It should be noted that only a very small proportion of households (just over 1%) are assumed to receive both a renewable energy measure and an insulation measure as a direct result of climate change and energy policies (this does not take into account voluntary take up of measures).*"[84]

7.10 It seems likely to us, and implied in other parts of the text of *Estimated Impacts*, that such low income households will not only be unable to benefit from the RHI, but they will be shouldering the burden of paying for the benefits enjoyed by those who are able to do so.

7.11 The severity of this impact goes well beyond the simple subsidy cost.

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82 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (February 2010), 12.

83 Ibid. 20.

84 DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), 15.

7.12 Work by NERA Economic Consulting for DECC shows that the subsidy required under the RHI is relatively little affected by rising fossil fuel prices.[85] The principal cause of this is the system is optimized to meet targets, not to protect subsidizing parties against undue cost.

7.13 An example of this can be found in the RHI *Consultation*'s undertaking to maintain levels of subsidy even should fossil fuel prices rise (discussed above).[86]

7.14 This is good for those able to invest in RHI eligible technologies, but disastrous for those who are not, since they will face not only the cost of subsidising RHI investors, to a degree needlessly, but also the cost of rising fossil fuels.

7.15 We note that RHI *Consultation* has aspirations for innovative approaches to allow some low income households to benefit: "*We would like to see all households have access to the RHI. Private landlords who own the renewable heating equipment in the properties they let will be able to receive a return on their investment by claiming the RHI*".[87]

7.16 While in principle this sounds interesting it is somewhat unclear how this allows the tenants to benefit financially from the RHI.

7.17 Indeed, such an approach is curiously asymmetrical in that it gives the landlord risk free access to a, probably "deemed", RHI revenue stream, while the tenant is exposed, perhaps, to commercial biomass prices, or to high electricity prices for the heat pump, which may not perform well. The fact that the EST study found that 42% of social housing residents were dissatisfied with their heat pumps tends to suggest that this concern is well founded.[88]

General Taxation

7.18 As noted above, a Fossil Fuel levy is, in effect, a tax. Thus it might be preferable, as fairer and more transparent and open to Parliamentary scrutiny, to fund the RHI straightforwardly through general taxation.

7.19 A further advantage is that the proceeds of a Fossil Fuel levy could not be returned to the subsidizing parties should there be insufficient technology take up to consume all levy revenues, while those from general tax could in principle be redistributed as a rebate in a subsequent year.

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85 NERA, AEA, *The UK Renewable Heat Supply Curve* (July 2009), 68. Note that the subsidies totals here are not those applicable under the banded strategy, but apply to a uniform subsidy approach. However, the principal observed is applicable to the banded system.

86 DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme* (February 2010), 39.

87 Ibid. 16.

88 Energy Savings Trust, *Getting Warmer: a field trial of heat pumps* (Energy Savings Trust: London, 2010), 17.

8 Renewable Heat Incentive Benefits: Emissions Reductions and Energy Diversity

Greenhouse Gas Abatement

8.1 Regardless of source of funding, the cost of achieving emissions reductions through the RHI would be very high, and in any case the resulting benefits small. The government's consultants calculate the average cost as approximately £130/tCO_2.[89]

8.2 It must be understood that this has been calculated as: *Resource cost* divided by *CO_2 savings*.

8.3 The choice of this method is to a degree understandable from a governmental perspective, where the concern is with the impact on the overall economy, but it obscures the *subsidy* cost per tonne of emissions savings.

8.4 In other words, it obscures both the cost of the program from the perspective of the subsidizing consumer, and prevents comparison with other subsidies.

8.5 Recalculating the cost from data in NERA's study as *Annual RHI subsidy / Annual CO_2 saving* results in a figure of £204/tCO_2 in 2020.[90]

8.6 We can compare this with other schemes such as the Renewables Obligation and the Feed-In Tariff:[91]

Table 2: Subsidy Cost per tonne CO_2

Scheme	Subsidy Cost per tonne CO_2
Renewables Obligation	£105
Renewable Heat Incentive	£204
Feed-in Tariff	£443

8.7 These are, even at best, extremely high costs, greatly in excess of the EU emission trading scheme (ca. €15/cCO_2 at the time of writing, though expected to rise).

8.8 It is useful to put the projected emissions saving from the RHI in national context. NERA estimate that 16.7 million tonnes CO_2 would be saved by the scheme in 2020.92

8.9 UK domestic emissions in 2008 amounted to 533 million tonnes of CO_2,[93] so the savings in 2020 from the RHI are equivalent to 3% of current emissions.

8.10 This saving would be achieved at a subsidy cost of £204 a tonne, or £3.4 billion in total.[94]

8.11 This is a small saving at a very high price, and seems unlikely to present a compelling example to the developing world.

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89 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), vi, 17.

90 See Table 4.1 in ibid. 16.

91 Cost of Renewables Obligation calculated from Ofgem Renewables Obligation Certificate data for the seven ROC years 2002 to 2009, and on the assumption of a grid average emissions displacement of 0.43 tonnes per MWh. Renewable Heat Incentive cost calculated fromTable ES-2,in NERA Economic Consulting, Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change URN 10D/544 (February 2010), v. Feed-In Tariff cost calculated from Table 1 in DECC, *Impact Assessment of Feed-in Tariffs for Small-Scale Low Carbon, Electricity Generation* (URN 10D/536), 21.

92 NERA, *Design of the Renewable Heat Incentive*, v, 17.

93 http://www.decc.gov.uk/assets/decc/statistics/climate_change/1_20100202104722_e_@@_ghgnatstats.pdf

94 NERA, *Design of the Renewable Heat Incentive*, 16.

9 Risks of Forced Diversification

Counterproductive Outcomes

9.1 Rapid growth in any sector is risk prone, and NERA's 2009 study notes very briefly the problematic experience of heat pumps in Germany and Austria in the 1980s, where product quality was poor and there was a resulting loss in consumer confidence. Such problems are the almost inevitable consequence of Government intervention in any sector of the economy, since it creates a sheltered market without normal selective pressures.[95]

9.2 NERA's recommendation, however, which includes regulation and quality assurance standards does not necessarily address the fundamental problem, which is as much the immaturity of the sector, and the lack of market knowledge, as irresponsible vendors and installers, a point now suggested by the EST's recent empirical study of heat pump performance in the UK.[96]

9.3 The experience of Japan in driving renewable heat adoption with policy is instructive in this regard, and should be much better known, and would have usefully informed the UK government's assessment of the RHI.

9.4 In response to the first oil shock the Japanese government adopted a policy of vigorous support for solar thermal hot water heating, and by the early 1980s the annually installed capacity throughout the country amounted to just under 3 million square meters.

9.5 However, as can be seen the following chart, from Japan's Institute for Sustainable Energy Policy (ISEP), this rate was not maintained, and fell away sharply.

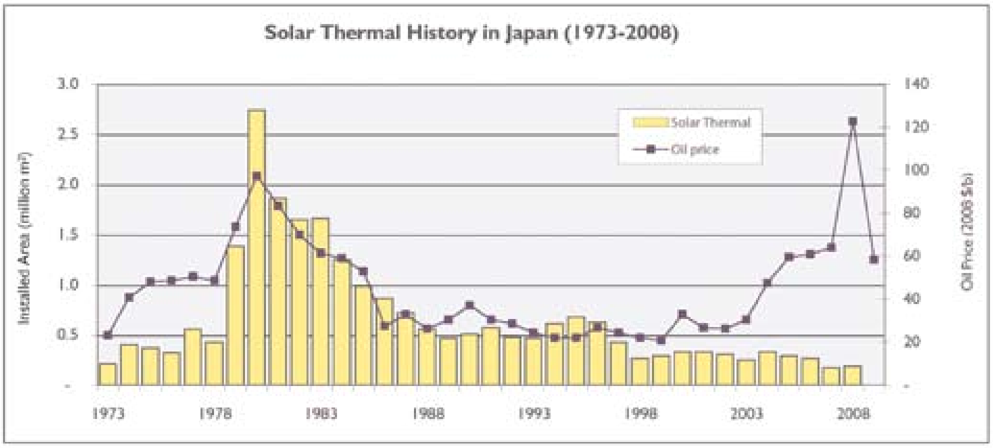

Figure 10: The annually installed capacity (M^2) of solar thermal technology in Japan, charted against oil price. Source: Redrawn from ISEP, 2009.[97]

9.6 The decline is closely correlated with the price of oil, but other factors acknowledged in Japan include weak companies (as is to be expected from a sheltered policy dependent sector), poor product quality, and what ISEP itself calls the "sales 'push' scandal".

9.7 In summary, it appears that intense government support resulted in over-rapid company growth, a lack of experimentation, and the consequent installation of sub-optimal technology, which failed or under-performed and caused consumer disenchantment.

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95 NERA, AEA, *The UK Renewable Heat Supply Curve* (July 2009), 102.

96 Energy Savings Trust, *Getting Warmer: a field trial of heat pumps* (Energy Savings Trust: London, 2010).

97 Redrawn from Tetsunari Iida, "Japan: New Policies to Spark Growth?", Institute for Sustainable Energy Policy, Presentation to estec2009 (Munich, Germany, 25-26 May 2009), 2. See also Tetsunari Iida, "Solar Thermal Policy and Market in Japan" (Institute for Sustainable Energy Policy: Tokyo, 20 June 2007), 2.

9.8 The long-term effect of what the Japanese themselves refer to as the "Solar Tragedy" is continuing stagnation in the solar thermal market, which shows no sign of recovery in spite of a return to higher oil prices.

9.9 It is at least arguable that Japan now has less solar thermal hot water heating, and a less developed and experienced industry, than it would have had had the state never become involved in the sector.

9.10 Such severely counterproductive outcomes from government support are, in our view, a very high risk of the Renewable Heat Incentive, and in themselves form a powerful argument against any scheme designed along the current lines.

9.11 Risks of this kind cannot be readily accounted for in terms of a Cost:Benefit analysis, since it is hard to quantify consumer disenchantment, or the prevention of innovation in response to market learning.

Economic Risk

9.12 There is also good ground for suspecting that unduly accelerated uptake of renewable heat technologies in the UK will result in growth in overseas markets due to a transfer of wealth from UK consumers to manufacturers in other parts of the world. This raises interesting questions regarding the impact of the RHI on the balance of payments.

9.13 Development of a UK manufacturing may be desirable, but should not be regarded as inevitable. As NERA remarked in 2009, "*Because supply starts from a very low base, projections of future developments are intrinsically very uncertain*",[98] and go on to identify the need for "*significant expansion of supply capacity, including increased capacity for equipment supply, growth or creation of installer companies, training of skilled personnel, and the development of required infrastructure*".[99] Given this, it may be easier for existing overseas businesses to switch production to target the market created by the RHI, than it will be for investors to create such industries domestically.

9.14 In fact, the demands placed on the supply chain would be considerable. NERA estimates that meeting a 12 percent heat share in 2020 would entail renewable energy taking 50% of the market share by that year. There is a clear possibility, indeed a likelihood, that this would result in growth outside the UK, particularly in ASHP and GSHP, which are closely related to the air cooling industries already dominated by other countries.

9.15 Simultaneous contraction in UK manufacturing of conventional domestic heating equipment, where due to its focus on high efficiency gas boilers the UK has a developed industry, cannot be ruled out.

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98 NERA Consulting, *UK Renewable Heat Supply Curve* (2009), iv.

99 Ibid. 13.

10 Alternative policy instruments

10.1 Government aims to achieve a diversification of heating fuels and a reduction in the emissions of greenhouse gases, both of which are desirable ends.

10.2 However, it does not appear from the extant analysis that the RHI will deliver either goal efficiently or at reasonable cost to the subsidizing consumer or taxpayer.

10.3 Hasty implementation of such a program, should be avoided, and we recommend suspension pending the construction of alternative instrument designs which can be with confidence regarded as less costly and more easily controlled and modulated at need, and consequently more robust. For example:

Concentration on the commercial and industrial heat sector

10.4 In the commercial and industrial heat sectors economic benefits are conceivable, and renewable heat can certainly be delivered at much lower cost, as can be clearly seen in this cost curve chart for biomass boilers which demonstrates that more heat can be delivered for lower cost for the larger boilers:

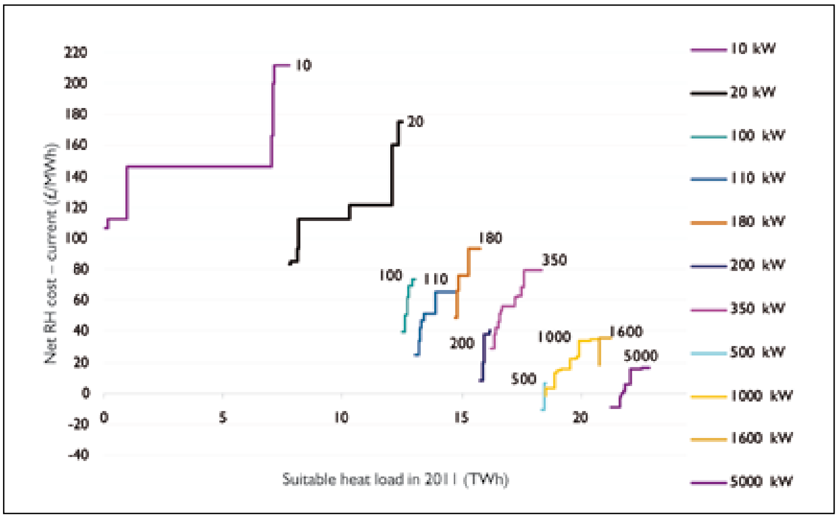

Figure 11: Market potential curves and size bands for biomass boilers.
Source: NERA Economic Consulting.[100]

10.5 Nevertheless, we remain concerned that due to the varying characters of industrial processes the suitability of biomass may have been overestimated.

10.6 It would be desirable to leave industry the freedom to apply biomass heating if it is cost-competitive. We doubt whether a target-driven policy instrument would deliver such an outcome.

Delay of any policy for the domestic sector

10.7 We have seen that even if feasible there will be many problems in applying renewable heat at the required scale by 2020, and at least in part because of these problems it seems that the domestic sector will simply not deliver in the manner projected.

10.8 At present, there is too little market experience of these technologies to make it likely that domestic consumers will rapidly adopt renewable technologies and sustain that adoption. Even

100 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), 10.

with the RHI subsidy it seems probable to us that there will be understandable, even prudent, market resistance.

10.9 However, there is an opportunity for significant market learning in the commercial and industrial sector, learning which might be of utility at a later date in the domestic sector.

10.10 We note that NERA Consulting observe in their 2009 study that: "*The industrial and commercial/public sectors generally offer the lower-cost opportunities for renewable heat than the domestic sector; depending on growth rates, the non-domestic sectors may be able to deliver most of the renewable heat required*."[101]

10.11 This remark differs, as NERA admit, from previous analysis in 2008, but in spite of this, government has remained overfocused, in our view, on the domestic sector, to the detriment of the overall project.

Explicit learning programs with Time-limited Subsidy

10.12 However, although we believe that it would be best if the successor to the RHI as currently designed were to avoid a heavy hand in the domestic sector, there is a case for a learning program that avoids prior determination of outcomes.

10.13 This might consist of pilot schemes to prove concepts before roll-out on a larger scale. While subsidies are questionable in principle, if there are to be subsidies then a time-limited program which is explicitly intended to support learning would avoid the delivery of hyperprofits and economic rent. Such an explicit policy of reducing the subsidy over time in combination with time limited learning programs might even encourage innovation.[102]

The potential for injecting biogas into the existing natural gas grid.

10.14 It is interesting to note that the injection of biogas into the existing natural gas grid has lowest cost under the current assumptions, at around £1/MWh.[103] Given the use that this would make of current infrastructure and installed heating plant, avoiding premature replacement costs, this suggestion deserves closer examination.

10.15 AEA is quoted in NERA's 2009 study as supporting large scale gasifiers sized to make best use of the high grade heat from the methanation reaction. NERA, however, note that insufficient time is available to allow for this development to contribute to the 2020 targets, and therefore do not consider it further.

10.16 That so interesting a suggestion should become a casualty of the target driven schedule is highly instructive.[104]

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101 NERA Consulting, *UK Renewable Heat Supply Curve* (2009), ii.

102 NERA Economic Consulting, *Design of the Renewable Heat Incentive: Study for the Department of Energy and Climate Change* URN 10D/544 (February 2010), 34.

103 Ibid. 20.

104 NERA, *UK Renewable Heat Supply Curve*, 5.

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Appendix 1: Impact of Energy and Climate Change Policies on Domestic Energy Bills

The following tables are found as Annex E to DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010), 27-32.

Estimated impact of energy and climate change policies on an average domestic gas bill (including VAT)

£ (real 2009 prices)	2010	2015	2020
Estimated average bill without policies	582	637	688
Bill impact of CERT	6	-18	-18
Bill impact of CERT Extension	0	-17	-18
Bill impact of CESP	1	0	0
Bill impact of Future Supplier Obligation	0	16	-20
Bill impact of Better Billing	-1	-2	-2
Bill impact of Smart Metering	0	6	-4
Bill impact of RHI	0	18	94
Bill impact of Products Policy	1	9	8
Bill impact of Security Measures	2	1	1
Estimated average bill with policies	591	651	727
Estimated impact of policies	9	14	39
% impact (on baseline)	2%	2%	6%

Estimated impact of energy and climate change policies on an average domestic electricity bill

£ (real 2009 prices)	2010	2015	2020
Estimated average bill without policies	478	511	538
Bill impact of CERT	-7	-39	-37
Bill impact of CERT Extension	0	-8	-8
Bill impact of CESP	1	-1	-1
Bill impact of Future Supplier Obligation	0	29	11
Bill impact of Better Billing	-1	-2	-2
Bill impact of Smart Metering	0	3	-9
Bill impact of the Existing RO	16	24	30
Bill impact of the Extended RO	5	21	64
Bill impact of EU ETS impact on wholesale prices	26	28	30
Bill impact of CCS	0	8	15
Bill impact of FiTs	0	6	10
Bill impact of Products Policy	-8	-81	-130
Bill impact of Security Measures	1	0	0
Estimated average bill with policies	512	499	512
Estimated impact of policies	33	-13	-26
% impact (on baseline)	7%	-2%	-5%

Appendix 2: Energy and Climate Change Policies

The following appears Table A1 in DECC, *Estimated impacts of energy and climate change policies on energy prices and bills* (July 2010).

Energy and climate change policies included in the analysis

Policy	Notes
Community Energy Saving Programme (CESP)	No changes since July 2009 price and bills analysis
Carbon Emissions Reduction Target (CERT)	The estimated bill impacts of CERT include savings accrued from measures installed as part of EEC1 and EEC2. They also allow for a comfort factor of 15% for insulation measures in the priority group. Bill impacts for CERT and the CERT extension arise from the cost to suppliers of meeting their targets and the reduced energy demand resulting from households receiving measures
CERT Extension	This is a new policy included in the analysis since July 2009. It is due to run between 2011 and 2012 with savings from installed measures expected to accrue in the years following. It therefore replaces the further supplier obligations in these years assumed in place for the July 2009 price and bills analysis. The CERT extension is a 108Mt extension to the CERT supplier target. It includes a super-priority group which must receive 15% of this target; professional insulation must receive 68% of the target; and Compact Fluorescent Lights are no longer eligible measures. Analysis allows for a comfort factor of 40% for insulation measures in the super priority group (15% in priority group) and 25% for heating measures in the super priority group (0% for priority group).
Future Supplier Obligation (SO)	There is likely to be a continuation of the CERT extension past 2012, however the detail of what form it will take is still being built up. The numbers used here are based on the Initial Assessment of Impacts published in March 2010.
Better Billing	Since January 2009, suppliers have been required to include on bills or statements comparisons between the energy used in the period covered by the bill or statement and the energy used in the same period in the previous year. This requirement, which was part of the UK's implementation of the Energy Services Directive, was designed to help customers be more aware of their energy consumption, and consequently to use energy more efficiently. The cost/benefit analysis for this policy, published by BERR in August 2007, estimated, on a central case, a total net benefit of £315 million over fifteen years, assuming energy savings of 0.25% persisting over that period
Smart Metering	The Government set out its commitment to the rollout of smart meters in its coalition programme. In July 2010, the Government published its implementation plan (the Smart Metering Prospectus), which provides an overview of analysis and proposals for implementing the smart metering roll-out to domestic and small non- domestic consumers. The impacts presented in this document refer to the expected price and bill impacts of this set of proposals.

Policy	Notes
Products Policy	There are a number of EU Implementing Measures (minimum standards and labelling) that have already been agreed by EU Member States covering a range of household and non-domestic products, in order to improve their energy efficiency. For these 11 measures, detailed Impact Assessments have been conducted (between July 2008 and April 2009). The impacts have been recently updated, to reflect these IAs. In addition, DEFRA now have estimated impacts available on a second tranche of EU Implementing Measures that are in development led by the EU. The analysis for which is being finalised from the consultation beginning December 2009.
Renewable Heat incentive (RHI)	The powers to introduce the RHI were taken in the Energy Act 2008. The intention to introduce the RHI in April 2011 and broad nature of the scheme were set out in the Renewable Energy Strategy. Detailed proposals were consulted on from 1 February to 26 April 2010. There has been no public update of the policy since the consultation proposals. The underlying subsidy costs of the RHI policy have not changed since the RHI Impact Assessment published in February 2010. However, the estimated bill impacts have fallen by around £10 since that previous publication. This is primarily because the impacts published in February corresponded to the financial year 2020/21, whereas the impacts here relate the calendar year 2020. The proposals which were consulted on this year were the first set of detailed proposals on scheme design, including eligibility and tariffs. The published costs were lower than in the LCTP due to the introduction of tariff banding by technology and size of installation.
Security Measures	This includes the costs recouped through the Ofgem price control process for security upgrades within the gas and electricity networks undertaken as part of the Government's National Security Strategy.
EU Emissions Trading System (EU ETS)	The estimated price and bill impacts of the EU ETS are based on analysis of the impact of the policy on wholesale electricity prices. The results presented assume full cost pass through of the EUA (carbon price) to end use consumers, regardless of whether allowances are allocated free of charge to generators or are purchased from auctions or the secondary carbon market. DECC published updated carbon values (EUA prices) in June 2010. These are lower than those used for the price and bills analysis in July 2009 incorporating the effect of the recession and revised estimates of industrial carbon abatement opportunities.
Existing Renewables Obligation (Existing RO)	The existing RO bill impacts are calculated as the subsidy costs of the RO following the Energy White Paper reforms, especially the introduction of technology banding, that were expected to take renewable electricity generation to around 15% of total generation in 2020.

Policy	Notes
Extended RO	The extended RO bill impacts are calculated as the additional impacts of the extended RO (through subsidy costs and balancing costs pushing up consumer electricity bills) over and above those of the existing RO. The extended RO policy package is expected to take large-scale renewable electricity generation to around 29% of total generation in 2020. The published Impact Assessments for the extended RO with the Renewables Obligation Order 2010 and the Renewable Energy Strategy 2009 included an offsetting impact on consumer electricity bills through lower wholesale prices than would otherwise have come about. The analysis in this report does not include any impacts the RO may have on wholesale electricity prices at this stage. However, this impact has been modelled separately by Redpoint, and it is estimated to reduce wholesale electricity prices by an average of around £6/MWh over the period 2010 to 2020.
Carbon Capture and Storage demonstrations (CCS)	The range of impacts is marginally higher than in the July 2009 analysis because a more detailed analysis of the costs of CCS has resulted in slightly increased estimates and a narrowing of the range. This analysis is consistent with that presented in the Impact Assessment of Coal and Carbon Capture and Storage requirements in 'A framework for the development of clean coal.'
Feed-in-Tariffs (FiTs)	Following the FiTs consultation in July 2009 the final details of the FiT's scheme were announced in February 2010 and the scheme itself was launched in April 2010. The analysis now reflects the final scheme design as announced and published in February.
Climate Change Levy (CCL)	No changes since July 2009 price and bills analysis
Carbon Reduction Commitment (CRC)	The price and bill impacts are consistent with the Impact Assessment published in January 2010.
Climate Change Agreements (CCA)	Newer data and methodological improvements since July 2009 have led to a reduction in the estimate of non-traded emissions covered by CCAs of around 50%. The analysis assumes that the new CCA scheme goes ahead as planned by the previous Government. CCA agreements are not assumed to be in place after the third carbon budget period.