NOTTINGHAMSHIRE
Fire & Rescue Service
*Creating Safer Communities*

Nottinghamshire and City of Nottingham
Fire and Rescue Authority
Finance and Resources Committee

# INVESTMENT IN SUSTAINABLE ENERGY TECHNOLOGIES

Report of the Chief Fire Officer

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**Agenda Item No:**

**Date:** 08 July 2011

**Purpose of Report:**

To bring to the attention of Members, a report prepared by the Estates and Procurement Manager, setting out his recommendations for investment in sustainable energy technologies and to seek approval for changes to be made to the capital programme to enable the Authority to realise the benefits of such investment.


**CONTACT OFFICER**

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|---|---|
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## 1. BACKGROUND

1.1 The Fire Authority has shown commitment to the carbon reduction agenda in recent years by the appointment of an Environmental and Sustainability Manager and signing up to the Nottingham Declaration on Climate Change. Both of these initiatives were acknowledgements of central government encouragement to reduce carbon emissions and environmental impact.

1.2 A number of initiatives for carbon reduction have been implemented such as the replacement of windows at HQ, the application of BREEM principles to new design work, low emission engines on appliances and the installation of Automatic Meter Readers and water usage improvements.

1.3 The Environmental Manager left the Authority recently and it was decided to delete his post as a budget saving for 2011/11. Nevertheless he provided the authority with a legacy of ideas and strategies to improve environmental impacts going forward.

1.4 This requirement for budget reductions has caused the Service to think creatively about how to make savings whilst at the same time looking to reduce environmental impacts. This paper proposes a series of investments which will both reduce costs and at the same time reduce environmental impacts and carbon footprint.

1.5 The full report from the Estates and Procurement Manager is given as Appendix A to this report.

## 2. REPORT

2.1 Over the two years 2009/10 and 2010/11, expenditure on energy across the authority has been fairly stable at about 4.1% of the non-pay revenue budget. That is to say £530k and £544k respectively. As budgets fall and wholesale energy prices rise this percentage can therefore only rise and begin to consume resources that could be better utilised on service provision.

2.2 There are now a number of factors to consider that may have the potential to reduce the impact of future energy costs to Nottinghamshire Fire and Rescue Service (NFRS); these are the renewable heating incentive (RHI) announced in March 2011 and the Feed in Tariff (FiT) for electrical generation.

2.3 The Estates and Procurement Manager's report recognises that whilst improvements can be made through energy reduction discipline and improved building design further improvements can be made by investing in sustainable energy technologies.

2.4 The government offer incentives for the production of renewable energy in the form of tariffs which can be used to offset the cost of energy usage and also allow surplus power to be "sold" to the grid.

2.5 Time is of the essence to take full advantage of these tariffs as they are quite high for 2011 but will reduce in 2012. It should be noted that the rate paid is fixed from when generation of power first occurs.

2.6 Focus Architects have carried out a high level evaluation report to identify the potential and suitability of these technologies and have concluded that on the 16 sites least likely to be affected by the Fire Cover Review outcomes technologies such as Photovoltaic cells (PV), Wind Generators and Ground Heat Pumps are the most viable and they have prepared estimates of the likely costs and paybacks of investments in such technologies.

2.7 The sites concerned in order of priority are:

- The Headquarters NFRS
- The Service Development Centre Ollerton
- Station 1 Mansfield Fire Station
- Station 29 Highfields Fire Station
- Station 13 Tuxford Fire Station
- Station 5 Ashfield Fire Station – Sustainable technologies may also be included within the refurbishment project
- Station 27 Carlton Fire Station – There may be limited scope due to the existing sedum roof and the use of the training building roof for access training
- Station 2 Blidworth Fire Station – Sustainable technologies may also be included within the refurbishment project
- Station 10 Harworth Fire Station
- Station 11 Misterton Fire Station
- Station 14 Southwell Fire Station
- Station 28 East Leake Fire Station

The sites prioritisation is based upon the energy efficiency and potential for savings/generation

2.8 There is little doubt, if the potential for power generation is as estimated by Focus, the potential for investment would quickly outstrip the Authority's available funds, nevertheless it is probably worth ringfencing such funds as are available to pursue this initiative.

2.9 The capital programme for property in 2010/2011 as agreed by the Authority at the budget meeting in February totalled some £1,080,000 and of this some £450,000 is allocated to the refurbishment of Blidworth Fire Station. Other

elements within this budget were to a large extent dependent upon the outcomes of the Fire Cover Review both in terms of whether they are pursued or not and in terms of which financial year they fall into.

2.10 It is clear therefore that there is approximately £530,000 available within the property capital rogramme that will not be spent in 2010/2011.

2.11 The scheme for sustainable energy generation and usage is unlike any other capital scheme in the programme in that it is designed specifically to save money and therefore has a payback period. More importantly it can potentially generate immediate budget savings when compared with the revenue cost of funding the project.

**Implications for Revenue Budgets**

2.12 The typical impact on the future revenue budget in terms of the Minimum Revenue Provision (MRP) and assumes that the project is funded from borrowing.

2.13 Typically payback periods for this type of investment are about 10 years but of course financing will be from borrowing, meaning that there will be small revenue savings generated immediately and every year.

2.14 It is estimated broadly that for every £100,000 invested in these technologies just over £10,100 will be generated at 2011 prices. These prices of course will rise whereas the cost of power generation will remain constant.

2.15 The savings are not significant but should nevertheless not be ignored. Any project which can serve the two objectives of reducing carbon emissions whilst saving money should be given due consideration.

**Implications for Capital Budgets**

2.16 The £530,000 predicted underspend in this current year could be carried forward and used to support the capital programme going forward. This would in effect be the same as doing nothing and taking the consequent revenue savings from not pending the capital allocation at all. This could be estimated as approximately £42,000 per annum. This compares poorly to the £50,500 which would be generated from the investment but nevertheless shows that £42,000 could be saved.

2.17 If the investment is made then it could be argued that, if the capital budget is capped overall by the 8% limit, then it would put pressure on the Authority's credit ceiling albeit this is self imposed.

2.18 Capital funds are fairly tight but again it must be considered that this scheme is not typical in that it generates real savings.

**Conclusions**

2.19 There is no doubt that this scheme presents a real opportunity to invest in a project which will reduce costs and contribute in a significant way to reducing the carbon footprint of the Authority at a time when government are seeking to achieve national targets by 2020.

2.20 It is suggested that the Committee may wish to ringfence up to £500,000 of capital for this project that this should be divided into three tranches as follows:

| | |
|---|---|
| Tranche 1 | 250,000 |
| Tranche 2 | 150,000 |
| Tranche 3 | 100,000 |

The reason for this is to enable experience from tranche one to inform tranche two and so forth. As neither costs nor configurations can be fixed without considerable cost being incurred it is important that the opportunity to learn as we go is not missed.

2.21 Irrespective of the tranches being ringfenced and dealing to some extent with unknown configurations no single project is allowed to progress without meeting at least the expected savings outcomes set out above.

## 3. FINANCIAL IMPLICATIONS

The financial implications are set out within the body of the report.

## 4. HUMAN RESOURCES AND LEARNING AND DEVELOPMENT IMPLICATIONS

There are no specific human resources or learning and development implications arising from this report.

## 5. EQUALITY IMPACT ASSESSMENT

There are no equalities issues arising from this report.

## 6. CRIME AND DISORDER IMPLICATIONS

There are no crime and disorder implications arising from this report.

## 7. LEGAL IMPLICATIONS

There are no legal implications arising from this report.

## 8. RISK MANAGEMENT IMPLICATIONS

There are clearly some risks attached to this proposal in that the returns and the useful lives of equipment are presently based on estimates. However the estimates of returns are fairly conservative and the lifespan information is as accurate as it can be.

## 9. RECOMMENDATIONS

That Members decide whether to support this initiative and allocate £500,000 in three tranches as set out above.

## 10. BACKGROUND PAPERS FOR INSPECTION (OTHER THAN PUBLISHED DOCUMENTS)

None.

Frank Swann
**CHIEF FIRE OFFICER**

NOTTINGHAMSHIRE
Fire & Rescue Service
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## Corporate Management Board

# INVESTMENT IN SUSTAINABLE ENERGY TECHNOLOGIES

Report by the Estates and Procurement Manager

**Date:** May 2011

**Purpose of Report:**
To seek approval from CMB to introduce and fund a programme of spend to save measures related to sustainable technologies.


**CONTACT OFFICER**

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## 1. BACKGROUND

1.1 It is well known that the trend for energy prices will most likely continue to rise each year; this will effectively increase the pressure on future revenue budgets. Revenue income due to reductions form CLG and the freeze on Council Tax will mean a fall in real terms over the next four years and possibly beyond.

1.2 Expenditure on energy across all our 27 sites over the previous two financial years were:

- 2009 / 2010 – £530,000, this figure accounted for 4.1% of the non-pay budget (non-pay budget of £12.86M)
- 2010 / 2011 – £544,000, this figure accounted for 4.1% of the non-pay budget (non-pay budget of £13.31M)

1.3 The energy figures shown as a percentage above correlate to the annual increase to the overall base budget between the two financial years.

1.4 NFRS have no control over the energy prices when purchasing from the wholesale energy market and are only able to obtain the best possible price through the Buying Solutions energy framework. This in turn is subject to the global energy prices at the time the energy is purchased.

1.5 Based on the use of energy over the previous two years this percentage compared to the non-pay budget will increase in future years. The two factors driving this are the reduction in the overall base revenue budget and the predicted increase in future energy costs.

1.6 There are now a number of factors to consider that may have the potential to reduce the impact of future energy costs to NFRS; these are the renewable heating incentive (RHI) announced in March 2011, the Feed in Tariff (FiT) for electrical generation and the recent capital grant provided to NFRS by CLG.

## 2. REPORT

**INTRODUCTION**

2.1 This report seeks approval to invest capital funds in sustainable technologies (also known as Low Zero Carbon technologies) for the generation of electrical power and the provision of renewable heating.

2.2 In order to minimise the impact of future energy price increases NFRS must take a number of actions, these include the following:

2.2.1 Seek to reduce the energy used by the building users

2.2.2 Increase the energy efficiency of our building stock including the building fabric and the energy efficiency of the mechanical and electrical equipment installed

2.2.3 Invest in sustainable energy technologies to take advantage of the UK Government's financial incentives such as the FiT and RHI and in doing so become less reliant on the global wholesale energy market price

2.3 The reduction of the energy used by the building users will be dealt with outside of this report.

2.4 The increased efficiency of the buildings and premises is being carried out during station re-builds, refurbishments and where the opportunity exists to upgrade buildings or elements of buildings (HQ double glazing and lighting project as examples). This will continue and form part of the future property strategy.

**INVESTMENT IN SUSTAINABLE TECHNOLOGIES**

2.5 In order to meet their promises to reduce the emission of greenhouse gases by 2020 the UK Government offer financial incentives to domestic users and more recently to industry and organisations including the Fire Service for the production of renewable energy. These incentives are in the form of tariffs payable by the Government for the production of renewable energy specifically electricity and heating.

2.6 The tariffs, and these vary subject to the method of sustainable energy production, will be payable for periods between ten to twenty five years and are set at the point at which the energy starts to be produced.

2.7 The effect of these tariffs is that they will offset the cost of the energy the Service uses over these periods and in the case of photovoltaic panels this will be for 25 years. The tariffs will be payable regardless if NFRS use the energy and in the case of electrical generation if it is exported to the national grid.

2.8 It should be noted that the tariffs are subject to digression in that the rate set for the lifetime of the tariff will reduce depending on the year in which the organisation starts producing energy. This means there is an imperative in some cases to start producing energy in this financial year if NFRS are to harness the full benefit of the higher rate tariff. This is covered in greater detail later in the report.

2.9 Focus consultants have been commissioned to produce a high level evaluation report to identify the potential and the suitability for the use of sustainable technologies by NFRS, this report is at Appendix A.

2.10 This report provides guidance to the suitability of the different sustainable technologies for use by NFRS and the potential financial and carbon reduction benefits.

2.11 The report covers sixteen sites within the property portfolio, these are sites are those that may have little or no impact from the outcomes of the Fire Cover Review, however the majority of the information contained could be

transposed or applied to any of the sites owned by NFRS with only a few exceptions.

**COMMENTARY OF ELEMENTS OF THE FOCUS REPORT**

2.12 The following provides some commentary on elements of the Focus report for clarity and to relate the information within a Fire Service context; the text refers to the paragraph numbers of the Focus report.

2.13 **Paragraph 2.11** – The generation tariff would be the income for electricity produced and used by NFRS, the rate payable is that detailed in Table Appendix C of the Focus report. The rate is subject to digression over three financial years and to the scale of power produced.

2.14 The export tariff is a fraction of the generation tariff and is the electricity fed back into the national electricity grid if there is any surplus electricity not used under the generating tariff.

2.15 **Paragraph 2.1.3** – As an example when comparing the 1st and 2nd route for the amount of electricity generation, using photovoltaic (PV) panels as the generating medium in order to produce 50kW of electricity this requires approximately 350 square metres of PV surface area.

2.16 **Paragraph 2.3** – As detailed in the Focus report there are three FiT technologies that could be suitable, the wind and the hydro generation will need to be subject to further studies and the measurement of wind and river flow data over a period of at least six month to confirm the viability.

2.17 The suitability of PV is more certain for all the sites assessed and it has been assumed that these would be roof mounted collector panels. Table 3 in Appendix A of the Focus report shows the maximum potential PV area that could be accommodated on each of the sites; this assumes full coverage of the roof. However the following considerations will apply when determining the surface area of PV collectors:

2.17.1 The affordability of the installation

2.17.2 Structural capacity of the roof to accept any additional load

2.17.3 The safe area needed for access to clean and maintain the PV collector panels

2.17.4 The roof areas in shade from adjacent structures, trees and the like

2.17.5 The areas of the roof used for access or egress for the maintenance of other roof mounted equipment

2.17.6 The areas of roof used for other technologies such as solar thermal collector panels

2.17.7 Roof areas used for fire training purposes

2.18 The actual useable roof area available will need to be assessed on a site by site basis.

2.19 **Appendix A, Table 2** – This table shows that the use of wind to generate electrical power has a relatively short payback period subject to the wind speed for the site. This as described in the main text will be subject to a wind speed study which is likely to be in excess of six months in order that sufficient data is recorded.

2.20 **Appendix A, Table 3** – This table shows the maximum estimated area of PV that could be accommodated on the individual sites, however as detailed above in paragraph 2.17 the practical area available is likely to be less than that stated. The second factor is that of affordability and the scale of the PV installation for a given site. It should be noted that there is a direct correlation between the PV area, the cost of installation and the estimated FiT over 25 years in that if the PV area is increase or reduced then this will have a similar impact on the installation cost and the FiT. The only constant (in approximate terms) will be the payback period, this remains at around 10 years. This is demonstrated between Harworth and Stapleford, Stapleford being half the potential PV area.

**PROGRAMME AND TIME RESTRAINTS**

2.21 There is clearly an imperative to have as much of the works complete within this financial year in order to obtain the higher feed in tariffs and heating tariffs before they are reduced in the future financial years.

2.22 It should be noted that the payback periods are based on the current financial years tariff rates, however this assumes a payback on capital monies invested. The savings to the revenue budget would start. The revenue savings will be that we would be buying less energy from external suppliers. The actual savings will be determined on the actual size of the PV we install and its location in gaining the maximum efficiencies for electrical generation.

2.23 In order to have works completed within the current financial year there is a requirement to start some activities straight away in order to ensure the works are complete the end of year, an outline programme is at Appendix B showing the estimated high level activities and durations.

**CAPITAL FUNDING**

2.24 The current property capital allocation for financial year 2011 / 2012 is £1,080,000; this is shown at Appendix C. Of this circa £450,000 is allocated to the refurbishment of Blidworth Fire Station under the heading of Refurbishment of Fire Stations.

2.25 The estimated cost for land purchase at Ollerton of £330,000 will most probably not be spent within the year (if it was decided by the Authority to buy land); this is partly attributable to the outcomes of the FCR which are not due to be release until later in the year. This means the time left within year for the Authority to approve the purchase, to find suitable land and then to physically buy the land would probably preclude spending this money in the current financial year.

2.26 The estimated expenditure in this current financial year for the refurbishment of Ashfield is not expected to exceed £100,000.

2.27 If the £330,000 earmarked for land purchase were to be used in this financial year for other capital projects and then the cost of land purchase taken out of subsequent financial years (if it were needed) then this would provide a balance of £530,000.

**SITES AVAILABLE IN THE CURRENT FINANCIAL YEAR**

2.28 There are a number of sites that will be relatively unaffected by the recommendations of the FCR (see Report on the Interim Capital Property Programme strategy dated 26th April 2011). These sites provide the most potential for the inclusion of sustainable technologies within the current year and until the outcomes of the FCR are known. These sites are (in the following priority):

2.28.1 The Headquarters NFRS

2.28.2 The Service Development Centre Ollerton

2.28.3 Station 1 Mansfield Fire Station

2.28.4 Station 29 Highfields Fire Station

2.28.5 Station 13 Tuxford Fire Station

2.28.6 Station 5 Ashfield Fire Station – Sustainable technologies may also be included within the refurbishment project

2.28.7 Station 27 Carlton Fire Station – There may be limited scope due to the existing sedum roof and the use of the training building roof for access training

2.28.8 Station 2 Blidworth Fire Station – Sustainable technologies may also be included within the refurbishment project

2.28.9 Station 10 Harworth Fire Station

2.28.10 Station 11 Misterton Fire Station

2.28.11 Station 14 Southwell Fire Station

2.28.12 Station 28 East Leake Fire Station

2.29 The priority above is based on the energy efficiency of the buildings based on the following criteria:

2.29.1 The full time occupation of the building and therefore the ability to utilise the energy produced

2.29.2 The score achieved on the display energy certificates in the energy efficiency of the site

2.29.3 The ability and suitability of the building to accommodate the sustainable technology

**SITES AVAILABLE IN THE NEXT FINANCIAL YEAR**

2.30 Once the outcomes of the Fire Cover Review have been released then planning for next financial year can be carried out.

**SUMMARY**

2.31 The cost of wholesale energy is expected to increase in the future and will have a detrimental effect on the revenue budget each year.

2.32 With the introduction of the FiT and the RHI the use of sustainable forms of energy production the reliance on the wholesale energy market can be reduced and in doing so reduce the impact on the annual revenue budget.

2.33 There are a number of sustainable technologies suitable for use at NFRS sites the most suitable being PV and ground source heat pumps, the other technologies require data collection over a period of time to confirm their viability.

2.34 The most benefit will be achieved from those sites that have a high level of usage by staff, these include Wholetime stations, the NFRS Headquarters and the Service Development Centre where the heating and generation tariff can be best utilised.

2.35 There is the potential to use circa £530,000 from the existing capital property programme budget in the current financial year to fund the installation of sustainable technologies.

## 3. FINANCIAL IMPLICATIONS

3.1 There are potential cost savings arising for the future annual revenue budgets, the magnitude of these saving will be subject to the affordability, scale and type of sustainable technologies fitted on the individual sites.

3.2 The reallocation of the money earmarked for land purchase of a potential site at Ollerton to fund the installation of sustainable technologies.

## 4. HUMAN RESOURCES AND LEARNING AND DEVELOPMENT IMPLICATIONS

4.1 There are no known implications to the Human Resources and Learning and Development

## 5. EQUALITY IMPACT ASSESSMENT

5.1 There are no equality implications arising directly from this report.

## 6. CRIME AND DISORDER IMPLICATIONS

6.1 There are no known implications relating to crime and disorder arising from this report.

## 7. LEGAL IMPLICATIONS

7.1 There are no legal implications arising directly from this report.

## 8. RISK MANAGEMENT IMPLICATIONS

8.1 Availability of suitable contractors.

8.2 Lead-in times the for manufacture of the equipment

8.3 Structural capabilities of the buildings to accommodate the additional roof loadings

8.4 Planning permission

8.5 Outcomes of the Fire Cover Review

## 9. RECOMMENDATIONS

9.1 It is recommended that £530,000 of capital funding be used for the current capital property programme as detailed in the report for the installation of sustainable technologies at existing NFRS sites.

9.2 It is recommended that the funding be split between the sites considering the priorities listed paragraph 2.29 and be weighted to the buildings or site that will achieve the most benefit.

9.3 The above are authorised in time to complete all the works within the current financial year.

## 10. BACKGROUND PAPERS FOR REFERENCE

Ian Pritchard
Estates and Procurement Manager

| CAPITAL PROGRAMME 2010/11 TO 2012/13 | Pre Fire Cover Review | | | | | Post Fire Cover Review | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2011/12 As per submission | 2012/13 As per submission | 2013/14 As per submission | 2014/15 As per submission | | 2011/2012 | 2012/2013 | 2013/2014 | 2014/2015 | |
| | - | | | | | - | | | | |
| PROPERTY | | | | | | | | | | |
| Station Improvements & Refurbishments | | | | | | | | | | |
| Highfields Fire Station | | | | | | | | | | |
| Southwell Fire Station Phase 2 | 0 | | | | | | | | | |
| Ashfield Fire Station | | | 150,000 | | | | | | | |
| Ashfield Fire Station RTC Compound | | | 17,000 | | | | | | | |
| Mansfield Station former BTS | | | | | | | | | | |
| East Leake Fire Station | 0 | | | | | | | | | |
| Bildworth Fire Station | 360,000 | | | | | | | | | |
| Misterton Fire Station Refurbishment | 0 | | | | | | | | | |
| Worksop Fire Station | | | 66,000 | | | | | | | |
| Worksop Fire Station External works | | | 550,000 | 13,500 | | | | | | |
| Collingham Fire Station Rtc Compound | | | 16,200 | | | | | | | |
| Retford External works | | | 97,500 | | | | | | | |
| Stocknill Fire Station Roof & SA Prep Room | 0 | | | | | | | | | |
| HQ Occupational Health | | | | | | | | | | |
| Tuxford Fire Station | 0 | | | | | | | | | |
| Newark Fire Station | 0 | 132,000 | | | | | | | | |
| Bingham Barn | 0 | | | 168,750 | | | | | | |
| Eastwood Fire Station | | | 330,000 | | | | | | | |
| Arnold FS Refurbishment | 475,000 | 6,000 | | | | | | | | |
| Bingham Fire Station Refurbishment | 385,000 | 11,000 | | | | | | | | |
| | | | | | | | | | | |
| Strategic New Build Projects | | | | | | | | | | |
| Major Rebuilds - Carlton (include fees at this point in time) | 90,000 | | | | | | | | | |
| Sale of Carlton House | | | | | | | | | | |
| Carlton Project - other costs | | | | | | | | | | |
| Hucknall Fire Station (Include fees at this point in time) | 1,000,000 | 1,000,000 | | | | | | | | |
| Central (include fees at this point in time) | | 500,000 | 1,000,000 | | | | | | | |
| New build Retained Station TBC (possibly Retford) | | 600,000 | | | | | | | | |
| | | | | | | | | | | |
| Estate Wide Projects | | | | | | | | | | |
| | | | | | | | | | | |
| Fixtures & Fittings | 50,000 | 50,000 | | | | | | | | |
| Battery Chargers 110 volt | | | | | | | | | | |
| Battery Chargers 24 volt upgrade | | | | | | | | | | |
| Fuel Tanks | | | | | | | | | | |
| Retentions 2.5% of total capital expenditure | 57,750 | | | | | | | | | |
| Professional Fees | | | | | | | | | | |
| Refurbishment of Stations | | | | | | 750,000 | | | | |
| Purchase of Land in Ollerton | | | | | | 330,000 | | | | |
| Purchase of Land elsewhere | | | | | | | | 467,600 | | |
| Refurbishment and Rebuilds | | | | 2,000,000 | | | 2,200,000 | 2,200,000 | 2,200,000 | |
| | | | | | | | | | | |
| | 2,417,750 | 2,299,000 | 2,186,700 | 2,182,250 | | 1,080,000 | 2,200,000 | 2,667,600 | 2,200,000 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Capital Receipts Assumed | | | | | | | | | | |
| - Collingham | | | | | | | | -212,600 | | |
| - Warsop | | | | | | | | | -265,000 | |
| - Edwinstowe | | | | | | | -280,500 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

# Display Energy Certificate

## How efficiently is this building being used?

HM Government

Nottinghamshire Fire & Rescue Service
**Nottinghamshire Fire & Rescue Service**
**Training Centre, Main Road**
**Boughton**
**NEWARK**
**NG22 9JE**

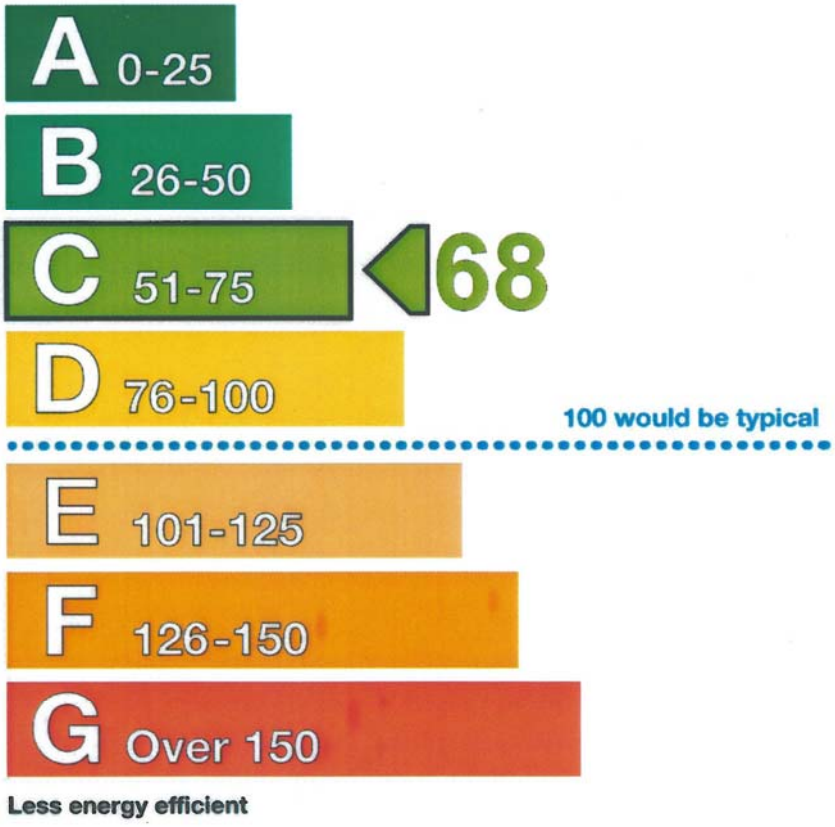
**Certificate Reference Number:**
0963-1034-0415-0900-6491

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

## Energy Performance Operational Rating

**This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.**

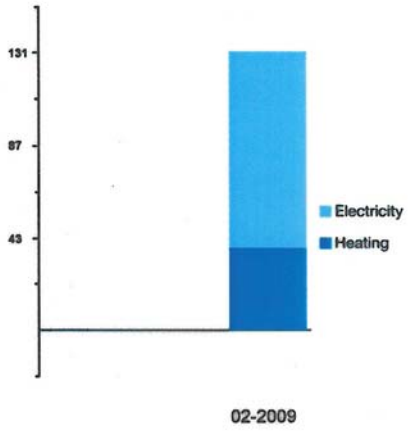
**More energy efficient**




**Less energy efficient**

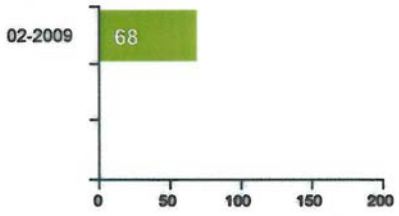
## Total $CO_2$ Emissions

**This tells you how much carbon dioxide the building emits. It shows tonnes per year of $CO_2$.**




## Previous Operational Ratings

**This tells you how efficiently energy has been used in this building over the last three accounting periods**




## Technical information

This tells you technical information about how energy is used in this building. Consumption data based on estimates.

**Main heating fuel:** Natural Gas
**Building Environment:** Heating and Natural Ventilation
**Total useful floor area ($m^2$):** 1614
**Asset Rating:** Not available.

| | Heating | Electrical |
|---|---|---|
| **Annual Energy Use (kWh/$m^2$/year)** | 124 | 103 |
| **Typical Energy Use (kWh/$m^2$/year)** | 418 | 70 |
| **Energy from renewables** | 0% | 0% |

## Administrative information

This is a Display Energy Certificate as defined in SI 2007/991 as amended.

| | |
|---|---|
| **Assessment Software:** | ORCalc V2-00-02 |
| **Property Reference:** | 935449360000 |
| **Assessor Name:** | James Garner |
| **Assessor Number:** | STRO000455 |
| **Accreditation Scheme:** | Stroma Accreditation |
| **Employer/Trading Name:** | Focus Consultants (Uk) Ltd |
| **Employer/Trading Address:** | 101 Princess Road East, Leicester, Le1 7La |
| **Issue Date:** | 08-09-2009 |
| **Nominated Date:** | 07-02-2009 |
| **Valid Until:** | 06-02-2010 |
| **Related Party Disclosure:** | not applicable |

Recommendations for improving the energy efficiency of the building are contained in the accompanying Advisory Report.

# Display Energy Certificate

## How efficiently is this building being used?

HM Government

Nottinghamshire Fire & Rescue Service
**Nottinghamshire Fire & Rescue Service**
**Fire Service H Q Bestwood Lodge, Bestwood Lodge Drive**
**Arnold**
**NOTTINGHAM**
**NG5 8PD**

**Certificate Reference Number:**
0680-0311-9750-0294-3002

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

## Energy Performance Operational Rating

**This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.**

**More energy efficient**

A 0-25
B 26-50
C 51-75
D 76-100

**100 would be typical**

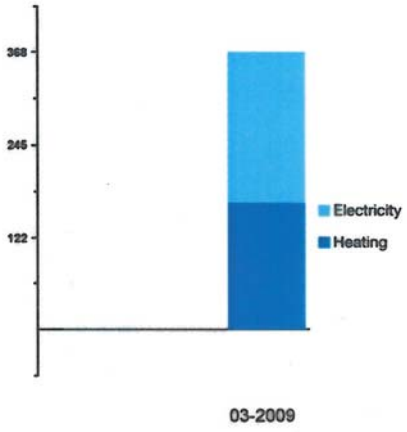
E 101-125
F 126-150
G Over 150

**184**

**Less energy efficient**

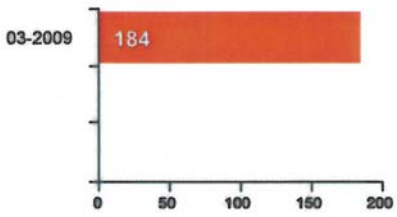
## Total $CO_2$ Emissions

**This tells you how much carbon dioxide the building emits. It shows tonnes per year of $CO_2$.**




## Previous Operational Ratings

**This tells you how efficiently energy has been used in this building over the last three accounting periods**




## Technical information

This tells you technical information about how energy is used in this building. Consumption data based on estimates.

**Main heating fuel:** Natural Gas
**Building Environment:** Heating and Natural Ventilation
**Total useful floor area ($m^2$):** 2585
**Asset Rating:** Not available.

| | Heating | Electrical |
|---|---|---|
| **Annual Energy Use (kWh/$m^2$/year)** | 337 | 140 |
| **Typical Energy Use (kWh/$m^2$/year)** | 130 | 95 |
| **Energy from renewables** | 0% | 0% |

## Administrative information

This is a Display Energy Certificate as defined in SI 2007/991 as amended.

**Assessment Software:** ORCalc V2-00-02
**Property Reference:** 805733290000
**Assessor Name:** James Garner
**Assessor Number:** STRO000455
**Accreditation Scheme:** Stroma Accreditation
**Employer/Trading Name:** Focus Consultants (Uk) Ltd
**Employer/Trading Address:** 101 Princess Road East, Leicester, Le1 7La
**Issue Date:** 08-09-2009
**Nominated Date:** 01-03-2009
**Valid Until:** 28-02-2010
**Related Party Disclosure:** not applicable

Recommendations for improving the energy efficiency of the building are contained in the accompanying Advisory Report.

# Display Energy Certificate

## How efficiently is this building being used?

HM Government

Nottinghamshire Fire & Rescue Service
**Nottinghamshire Fire & Rescue Service**
**Fire Station, Rosemary Street**
**MANSFIELD**
**NG19 6AB**

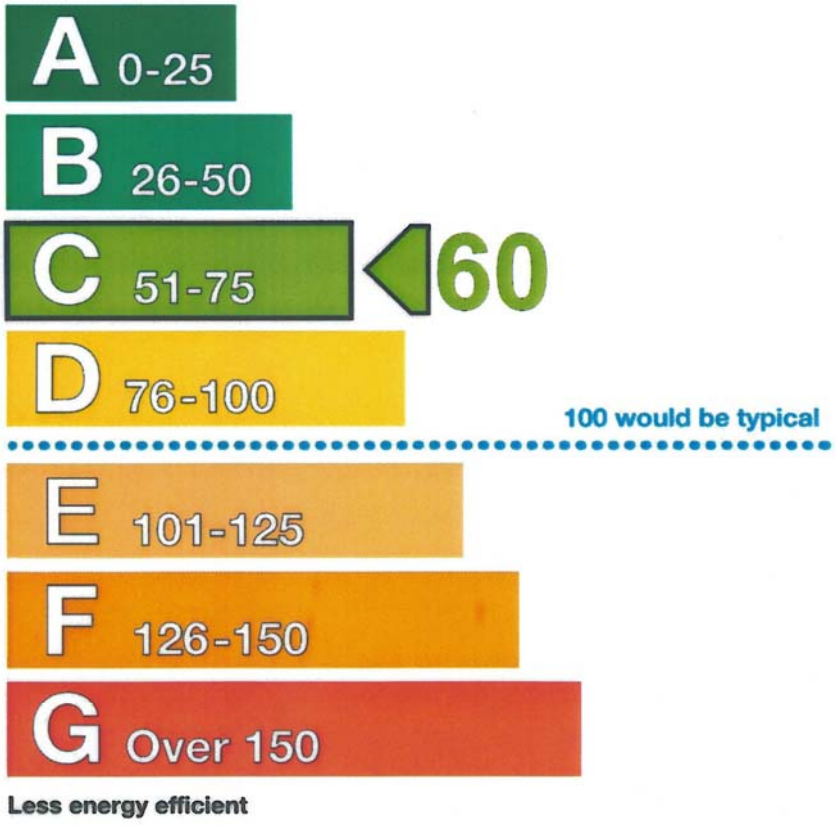
**Certificate Reference Number:**
0770-8985-0190-5070-8074

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

## Energy Performance Operational Rating

**This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.**

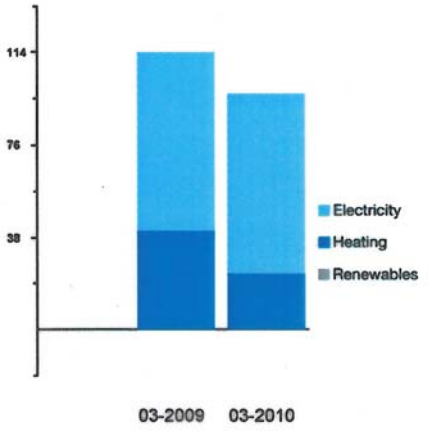
**More energy efficient**




**Less energy efficient**

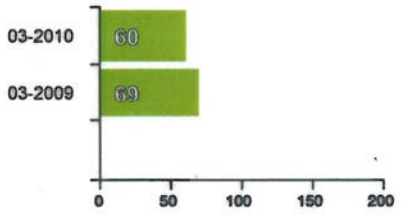
## Total $CO_2$ Emissions

**This tells you how much carbon dioxide the building emits. It shows tonnes per year of $CO_2$.**




## Previous Operational Ratings

**This tells you how efficiently energy has been used in this building over the last three accounting periods**




## Technical information

This tells you technical information about how energy is used in this building. Consumption data based on estimates.

**Main heating fuel:** Natural Gas
**Building Environment:** Heating and Natural Ventilation
**Total useful floor area ($m^2$):** 1366
**Asset Rating:** Not available.

| | Heating | Electrical |
|---|---|---|
| **Annual Energy Use (kWh/$m^2$/year)** | 87 | 98 |
| **Typical Energy Use (kWh/$m^2$/year)** | 410 | 70 |
| **Energy from renewables** | 0% | 0% |

## Administrative information

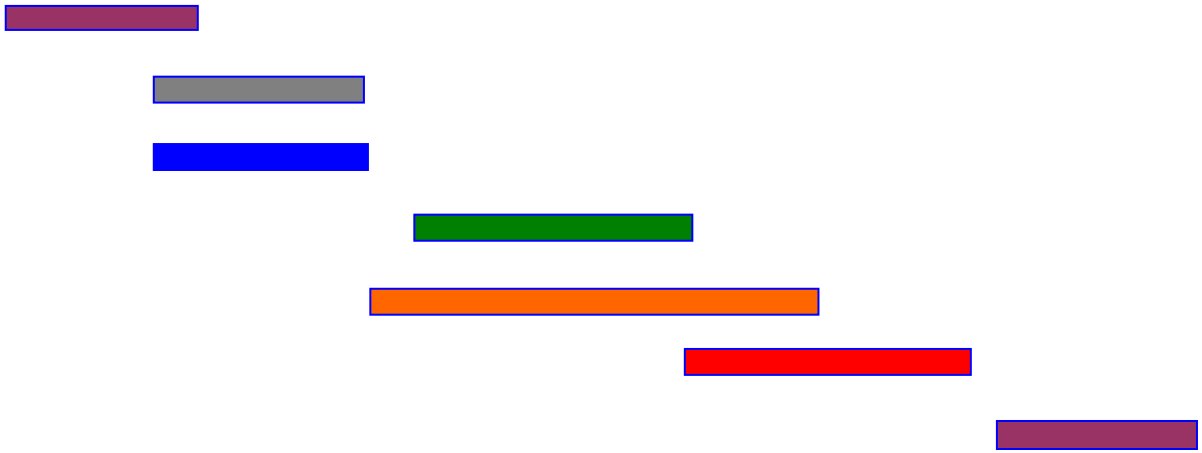
This is a Display Energy Certificate as defined in SI 2007/991 as amended.

**Assessment Software:** CLG, ORCalc, v3.0.1
**Property Reference:** 879858750000
**Assessor Name:** James Garner
**Assessor Number:** STRO000455
**Accreditation Scheme:** Stroma Accreditation
**Employer/Trading Name:** Focus Consultants (Uk) Ltd
**Employer/Trading Address:** 101 Princess Road East Leicester LE1 7LA
**Issue Date:** 30-03-2010
**Nominated Date:** 30-03-2010
**Valid Until:** 29-03-2011
**Related Party Disclosure:** Contractor to the occupier for EPB services only

Recommendations for improving the energy efficiency of the building are contained in the accompanying Advisory Report.

## Draft Outline Programme for the Retro Fitting of Sustainable Technologies

| Activity | Jun-11 | Jul-11 | Aug-11 | Sep-11 | Oct-11 | Nov-11 | Dec-11 - Mar-12 |
|---|---|---|---|---|---|---|---|
| Develop the project brief & appoint the necessary consultants | | | | | | | |
| Carry out the detailed site investigations | | | | | | | |
| Carry out the initial design | | | | | | | |
| Carry out the detailed design | | | | | | | |
| Submission of Planning Applications | | | | | | | |
| Tender the works | | | | | | | |
| Construction & installation of the works | | | | | | | |



Notes:

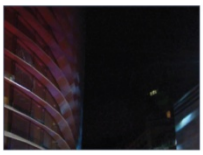
1. Planning applications are assumed as 12 weeks from submission to decision
2. Activities will need to be carried out concurrently in order to achieve completion with the current Financial Year

FOCUS

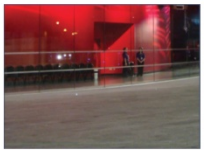
Nottinghamshire Fire and Rescue









# Feed in Tariff and Renewable Heat Incentive Evaluation

April 2011

## DOCUMENT CONTROL SHEET

| | |
|---|---|
| **Client :** | Nottinghamshire Fire and Rescue Service |
| **Project:** | FIT and RHI Evaluation |
| **Title:** | Report |
| **Authorised by:** | Jason Redfearn |
| **Position:** | Associate |
| **Signature:** | |
| **Issue:** | 1 |
| **Date:** | April 2011 |

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3.0 Renewable Heat Incentive Evaluation

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**APPENDICES**


Appendix A Assessment Tables

Appendix B Feed in Tariff rates

Appendix C Renewable Heat Incentive rate

## 1.0 INTRODUCTION

1.01 This evaluation has been produced at the request of Ian Pritchard of Nottinghamshire Fire and Rescue Service,

1.02 Focus were requested to undertake an appraisal upon 16 Sites identified by Nottinghamshire Fire and Rescue Service for suitability of the installation of Low Zero Carbon (LZC) technologies.

1.03 This report is solely for reference by Nottinghamshire Fire and Rescue Service, and should not be relied upon by any third party as a statement of fact.

### 1.1 Purpose of Report

1.1.1 This report has four main purposes, as listed below:

i. Provide an overview of each of the respective policies FIT and RHI

ii. Undertake an appraisal of each of the suitable technologies eligible under the FIT and RHI schemes

iii. Undertake a desktop assessment of each station/site for the installation of the eligible technologies

iv. Provide estimates for the budget to install, estimated energy generated, identify energy savings, carbon savings, calculate the predicted FIT and RHI income and estimated payback period.

## 1.2 Background

To provide context to the report we examine two of the main external drivers to undertake this assessment.

### Climate Change

1.2.1 There is a lot of debate on the existence of climate change; however this report will provide a brief overview of the leading theory to its cause. Climate change is thought to be caused by a greater concentration of green house gases in the atmosphere, this causes global warming which there is evidence to suggest is affecting the earth's climate.

1.2.2 The main contributors to this increase in concentrations are thought to be Deforestation for agriculture – reduction in absorption of Greenhouse Gases and Greenhouse Gas emission through the burning of fossil fuels for energy predominately Carbon Dioxide ($CO_2$)

1.2.3 The predicted outcomes of climate change are extreme temperatures, increased risk of flooding, famine, Disease, Drought and a risk of global economic recession.

Legislation is in place to now reduce the emissions, this includes the EU Energy Performance in Buildings Directive. The European union has agreed to cut greenhouse gas emissions by 20% by 2020.

1.2.4 UK government wants to cut green house gas emissions by 34% by 2020 and 80% based upon 1990 levels by 2050

To achieve this target the UK has to look at its existing building stock and make them more energy efficient.

### Global Population

1.2.5 The global population currently stand at 6.5 billion but is projected to increase to 10.5 billion by 2050.

1.2.6 This is due to emerging countries such as China and India which will place a greater demand on global resources and fuel supplies.

## 1.3 Limitations

1.3.1 The basis of this assessment is drawings and aerial photos of each of the sixteen sites.

1.3.2 Focus Consultants 2010 LLP has not visited any of the sites.

1.3.3 No information has been provided to demonstrate the current energy demand or the age and condition of the components of the buildings.

1.3.4 No information has been provided regarding the current services available at each site.

1.3.5 This report should not form the basis for procurement and installation of each technology, it should be used to identify the potential for each site from which a more detailed assessment can be undertaken prior to commitment to install.

# 2.0 FEED IN TARIFF EVALUATION

## 2.1 Policy Overview

Introduced on 1st April 2010 under measures accepted within the Energy Act 2008 and open for 3 years. FIT is to work alongside the Renewable Obligation (RO) as a mechanism to increase the use of renewable technologies.

The scheme requires that Licensed Electricity Suppliers known as FIT Licensees pay a Generation Tariff eligible installations within Great Britain. The FIT applies for installations up to a maximum capacity of 5MW

The scheme is designed to increase low carbon electricity generation and make the renewable technology more cost effective. Tariffs are fixed for 20 years (25 years PV) please refer to the tariff table within appendix B for tariff rates.

There is an annual degression in place for FIT tariff rates which is detailed within appendix B across the three years of the policy. The government has the opportunity to pull the review forward if higher than expected deployment requires so.

### 2.1.1 Types of Tariff

Generation Tariff

A fixed rate that the generator will receive for every kW of energy produced regardless of whether the energy used is used. The generated energy must be measured by an approved Ofgem total generation meter attached to the installation.

Export Tariff

Is a payment for every kilowatt-hour (kWh) of surplus electricity your system exports to the electricity grid. This has been set in the legislation at 3p/kWhr. The generation tariff should be paid regardless of whether the installation exports back to the grid

### 2.1.2 Administration

Ofgem is responsible for administration of the scheme. FIT Licensees will be responsible for registering eligible installations, processing generation data and making payments.

### 2.1.3 Application

1st Route

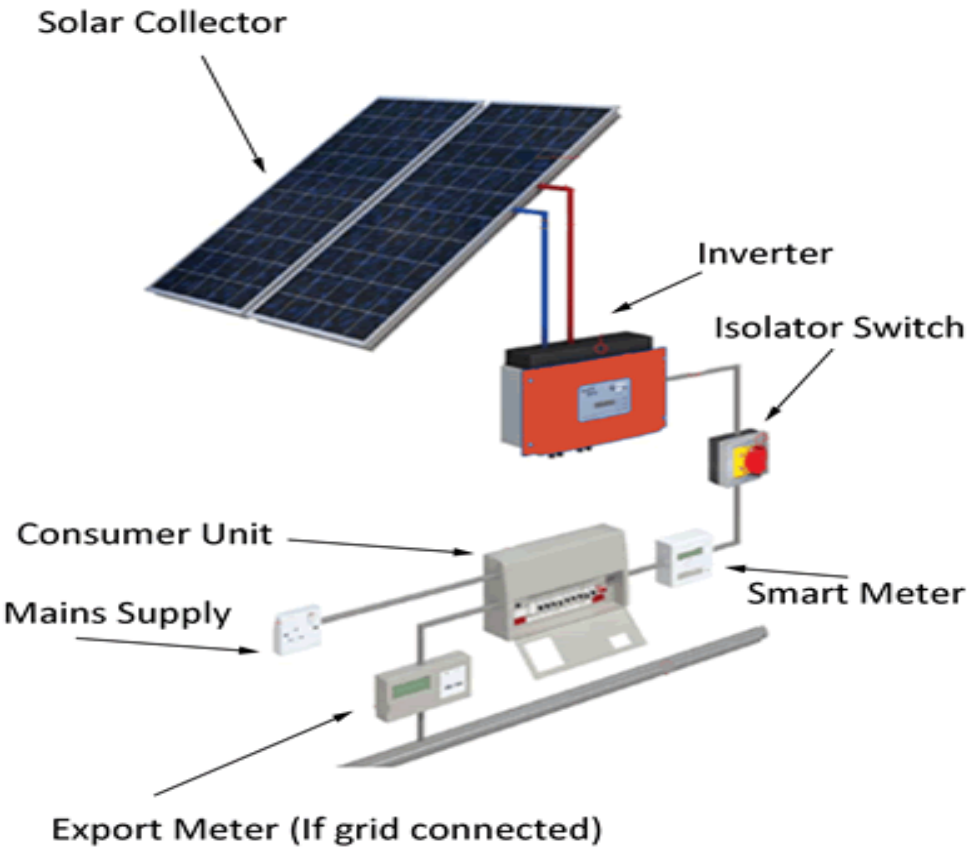
Customers using renewable technologies equal to or less than 50kW which are wind, solar PV, or hydro based will need to ensure their units are installed and accredited by Micro generation Certification Scheme (MCS) certified installations under the FIT legislation.

2nd Route

All installations that are eligible and are between 50kW and 5MW in capacity (and anaerobic digestion units of any size up to 5MW) will need to apply to Ofgem for accreditation through Ofgem's Renewable and CHP Register. Upon completion of this process, applicants will need to contact a supplier with the accreditation details.

Figure 1 below shows a typical installation for Photovoltaic and the necessary components for install and MCS compliance to enable FIT payment and metering.

**Figure 1: Typical MCS PV Installation**



The critical element of any install is the smart meter to enable accurate measurement of the generation from the complaint technology. Meter readings are typically taken at quarterly intervals.

It is suggested the meters with remote reading capability are installed, especially when managing several installations. This is to ensure readings reach FIT licensees in a timely fashion; penalties can be in place for late readings.

## 2.2 Eligible Technologies

There are five technologies that are suitable for the feed in tariff, these being:

- Anaerobic digestion
- Micro Combined Heat and Power (CHP)
- Wind turbines
- Photovoltaics (PV)
- Hydro

The first two technologies were deemed upon the first desktop analysis as not suitable for installation at the sites requested for review by Nottingham Fire and Rescue Service. The report therefore focuses on the viability of installation of wind turbines, PV and hydro at each of the sites.

### 2.2.1 Wind Turbines

Wind turbines come in different forms but the most common have three blades which are fixed to a horizontal axis which is free to rotate into the wind. The blades generally drive a generator directly however on larger installations a gearbox is utilised.

Power outputs for turbines range from 600w to 3.6Mw, however the main factor affecting the energy generation is the average wind speed. Wind turbines are less suitable for use in urban areas due to buildings causing turbulence and slowing wind speeds therefore there are very few roof mounted installations of turbines within the UK.

Advantages:

- Ability to generate onsite electricity to reduce the amount of gird supplied electricity
- Visual impact to others of the effort to reduce carbon emissions

Disadvantages

- Planning permission required
- Maintenance and inspection of the turbine to be undertaken approximately every 24 months, this is dependant of the make and model of turbines installed.
- Noise, direct drive turbines are quieter than ones with gearboxes.
- Possible vibration in the case of building mounted turbines

### 2.2.2 Photovoltaics

Photovoltaics use the energy from the sun to create electricity through the use of semi conductor cells. Modules are connected to an inverter to change the generated DC current into useable AC current. The panels supply the building they are attached to where it can be utilised any excess can be sold back to the energy supplier.

PV panels only require daylight to function, they do not require direct sunlight to generate electricity although more electricity is produced with higher levels of light.

The panels come in various forms the most common is fitted on top of the existing roof covering and appears similar to a roof light. Other types appear similar to roof tiles and are an integral part of the roof covering. Most expensively photovoltaic cells can be included within glass for atria walls.

To receive the optimum amount of energy from the sun the panels should ideally be placed between the south-east and south-west orientations at an angle of approximately 30°. Buildings that are use electricity during the day are ideally suited for a PV installation.

Advantages:

- No maintenance other than ensuring they are kept clean
- No noise generated by the technology

Disadvantages

- Required to be fitted in a southerly orientation to achieve optimum performance which may not always be available.
- Panels may be the target of vandalism
- Overshadowing of the panels will reduce performance

### 2.2.3 Hydro

Turbines can be placed within a river or stream in order to generate electricity. The amount of electricity that can be produced is dependent on the speed of the river however even a slow flowing stream can provide a useful amount of power as long as the right turbine is installed.

Consideration must be taken regarding the watercourse that the turbine is planned for in order to maintain the ecology. In order to do this it is important that only a proportion of the water is diverted to the turbine. As all watercourses are controlled by the environment agency it is likely that a license will be required for a new turbine installation.

Advantages:

- Electricity generation is largely not dependant on the weather, only serious drought will disrupt.
- Electricity is produced through the day and night

Disadvantages

- Maintenance will be required to keep the intake grills clear in order to maintain water flow
- Not all sites have an available watercourse

## 2.3 Evaluation

Each site was subject to an assessment based upon information for the scheme from existing layout drawings and aerial photographs. From this assessment the suitability of installation of photovoltaic's, wind turbines and hydro to the requested 16 sites was determined.

Although a logical approach has been taken to the practical implications of the installations of each of the technologies no physical site visits have been undertaken. Therefore should investment be considered a further detailed assessment should be undertaken before procurement.

Table one overleaf notes the suitability of the various technologies for each site. From our initial investigations all sites appear to be suitable for a PV installation be it directly to the roof or utilising a generic or bespoke stand.

However it should be noted that there will be some over shading predominantly from the towers that are located on the site. This is only applies to the following sites:

- Edwinstowe
- Misterton
- Collingham
- East Leake

Overshading will significantly reduce the performance for the Photovoltaic panels and therefore any further detailed assessment should consider this issue in the final positioning of the panels.

Several stations have the potential for wind turbine installation due to their semi rural location; however as part of a detailed assessment it is recommended that wind speeds be monitored for over a period of 6 months to ascertain the average wind speed in each location to ensure the turbines will perform to an adequate level.

Consideration will also need to be given to adjoining properties due to the potential noise generated by the turbines. The four sites that have been noted as unsuitable for wind turbines this is due to their urban location.

Only one site is located adjacent to a watercourse so hydro generation is not suitable to the remainder of sites. As water courses are controlled by the environment agency an application will need to be made for a license to install a hydro turbine.

As these licences are difficult to obtain and specific data regarding the flow rate of this water course which is beyond the scope of this desktop review. Further investigation will be required to assess the suitability of generating electricity by this method.

**Table 1: Suitable FIT Technology**

| Station | PV | Wind Turbine | Micro Hydro |
|---|---|---|---|
| Mansfield | ✓ | × | × |
| Annex | ✓ | × | × |
| Ashfield | ✓ | P | × |
| Edwinstowe | ✓ | P | × |
| Warsop | ✓ | P | × |
| Harworth | ✓ | P | × |
| Misterton | ✓ | P | × |
| Tuxford | ✓ | P | × |
| Southwell | ✓ | P | × |
| Collingham | ✓ | P | × |
| West Bridgeford | ✓ | × | × |
| Stockhill | ✓ | × | × |
| Stapleford | ✓ | P | × |
| East Leake | ✓ | P | P |
| Highfields | ✓ | P | × |
| Arnold HQ | ✓ | P | × |
| Ollerton | ✓ | P | × |

✓ - Deemed Suitable

P - Potential (further investigation is required)

× - Deemed Unsuitable

## 2.4 Estimated Generation

### 2.4.1 Wind Turbines

As the wind speed for each of the sites will vary, confirming an accurate generation figure is not possible without more thorough research. However the BRE document UK annual wind speed map has been considered which predicts the average speed is between 5-6 meters per second.

Table 2 within the appendices shows the likely generation and feed in tariff that a 6kw turbine can produce. A 6kw turbine has been selected as this provides a compromise between reasonable performance and noise generation.

The table includes for the offset of energy that will no longer be required from the mains source due to the generated energy of the turbine. This is based upon 70% of the energy produced by the turbine being utilised, a default value for the electrical energy cost taken from Standard Assessment Procedure (SAP) data has been used.

The residual 30% left unused will where an export meter is installed be exported back to the grid and the agreed tariff rate, 0.03p per kWh. Tariffs will vary depending on individual energy supplier.

### 2.4.2 Photovoltaics

Based on table one, data has been collated on the potential areas that can be used for installing PV panels and the generation in kWh which those panels can provide. This information is shown in table three within Appendix A.

A number of sites have suitable locations for large installations of PV panels which will receive a lower tariff rate being above 10kw or 50kw output, consideration should be made to assess whether a smaller installation would be appropriate. It should be noted that installations above 50kw will not be eligible for FIT through the MSC certification scheme and will require a separate direct application to Ofgem for approval.

Table three within Appendix A details the maximum area identified as suitable for panel installation. The orientation for each site has been considered the assessment presumes that the installation would allow for no over shadowing and a panel elevation of 30°.

The calculations do not consider the need for multiple inverters installations or panel arrays which are split across one site. Invertors and possible bespoke mounting solutions that may be required are expected to be considered as part of a more detailed assessment. There would be an impact on the budget for installation and long term maintenance which will in turn affect the payback period.

Table three also includes data to show for the energy demand from the mains supply that the panels will offset. A theoretical value of 70% of the energy produced by the PV being used and a default electrical unit charge from SAP data is shown. If management and operation can be adapted to suit the production of energy this percentage figure will increase.

# 3.0 OVERVIEW OF RENEWABLE HEAT INCENTIVE

## 3.1 Policy Overview

The RHI is being introduced in two phases. Phase 1 for non – residential systems starts in July 2011 or soon after. Residential systems become eligible in Phase 2 in 2012, though schemes may be able to claim a one-off payment prior to 2012.

The tariff payments will be calculated by multiplying the proposed tariff per kWh by the amount of heat output of the system. This must be measured or estimated. There are two different approaches that can be used to measure the heat output of systems: metering and 'deeming'

The current proposals for non-residential systems require heat metering. It is possible that the future proposals for domestic systems will allow deeming, depending on the size of the system.

### 3.1.1 Heat metering

For phase 1 of the scheme all systems will have to meter the heat they produce and deliver. All payments will be made by calculating the metered number of kWh multiplied by the tariff per kWh.

The government has outlined the principles for metering heat, steam and biogas injection. It has also indicated how the metering should be configured in the system, calibrated, maintained and read.

The scheme administrator Ofgem is expected to produce further guidance on these aspects before its introduction.

### 3.1.2 Deeming the heat output

In the original proposals it was suggested that for small domestic systems the levels of payment would be based on a 'deemed' output based on what the installed system would be expected to deliver if the property were well insulated.

If this approach were adopted in Phase 2, the RHI would define what 'well insulated' means the consultation had proposed levels for minimum energy efficiency. The building's energy use would be assessed through the Standard Assessment Procedure (SAP). This identifies the appropriate heat demand of the building based on the assumption that the minimum energy efficiency measures will have been taken up alongside the renewable heat installation.

The tariffs last 20 years for all RHI installations, as with FIT once the installed and registered the tariff it is guaranteed for the full period.

Each year the set level of the tariffs will be adjusted pro-rata to the retail price index this follows the FIT tariffs. Ofgem the RHI administrator will publish the updated tariff levels.

The tariffs published initially are shown at 2010 levels so there will be an uplift as soon as the RHI starts in July 2011. The RHI is expected to be open for new registrations until at least 2020.

For schemes which are registered the tariffs will only change in accordance with the RPI index-link. They are not affected by reviews or degression, systems installed after April 2012 will be subject to degression tariff rates.

The RHI will be subject to detailed review by the government, the first of which is due later in 2011; the next review is in 2012. The Tariffs for RHI are listed within Appendix C.

.

### 3.1.3 Administration

As with FIT scheme Ofgem is responsible for administration. It is presumed at this stage that RHI Licensees will be responsible for registering eligible installations, processing generation data and making payments.

Meter readings as per FIT will be required to be submitted to Ofgem, this is anticipated to be quarterly as per the FIT. The heat meters to be Class 2 used for calculating the RHI will need to be the meters will need to be properly calibrated with certification. Periodic recalibration may also be required by Ofgem, this is yet to be confirmed.

### 3.1.4 Application

Applicants should use MSC certified appliances which are installed and accredited by Micro MCS) certified installations under the FIT legislation.

As noted above it is expected as with FIT that MSC certified installations will be registered with Ofgem via the schemes energy supplier.

## 3.2 Eligible Technologies

There are six technologies that are suitable for the renewable heat incentive, these being:

- Bioliquids
- Biogas on-site combustion
- Air source heat pumps – included?
- Solar thermal
- Solid biomass
- Ground source heat pumps

The initial desktop exercise and discussions with the client dismissed the first three technologies as they were deemed not suitable for installation. The RHI evaluation will focus on the viability of installation of solar thermal, solid biomass and ground source heat pumps.

### 3.2.1 Solar thermal

Solar water heating systems use the energy from the sun in order to heat water for domestic hot water use. The system utilises a heat collector normally located on the roof of a building to heat a fluid. This is then circulated to the hot water cylinder and transferred to the water contained in the cylinder via an internal coil. As with PV the collectors will still perform when the sky is overcast however the quantity of heat produced will be reduced.

There are two forms of collectors available, these being; plate type and evacuated tube. The latter being the more expensive of the two due to the manufacturing process however they are claimed to have better performance in the winter.

As with PV panels the collectors must be installed in a southerly direction. Careful consideration must also be taken to the distance between the collectors and the cylinder in order to minimise any heat losses.

Advantages:

- Limited maintenance requirements
- No noise generated by the technology
- Established technology

Disadvantages

- Required to be fitted in a southerly orientation to achieve optimum performance which may not always be available.
- Panels may be the target of vandalism
- Overshadowing of the panels will reduce performance
- Should be positioned to close to hot water storage vessel to reduce losses.

### 3.2.2 Solid Biomass

To replace the traditional fossil fuel burning heating equipment new boilers can be introduced which burn waste wood from forests, tree pruning etc however the most common type of fuel to be burnt is wood chips or pellets that are specifically made for burning in biomass boilers.

Biomass is considered to be a carbon neutral fuel as the carbon dioxide produced from burning the fuel was absorbed by the tree previously by photosynthesis also the boilers can be designed to burn smokelessly to comply with the clean air acts. Fuel is supplied to the boiler from a hopper and automatic de ashing and electronic firing is also available to prevent the need for daily maintenance. As the flue is required to discharge above the ridge height of the building planning permission is likely to be required for installation.

Advantages:

- Carbon neutral fuel
- Can be part of a planned maintenance program and replace aging fossil fuel boilers
- Not dependant on weather conditions

Disadvantages

- Boiler plant and fuel storage takes up a large amount of space
- Continuity of supply of fuel needs to be arranged
- Ash needs to be disposed of
- Regular maintenance needs to be undertaken

### 3.2.3 Ground source heat pumps

Ground source heat pumps are used to extract the heat from below ground this is then passed through a reverse refrigerator to increase the useful heat. In commercial use it is likely that a number of heat pumps be required in order to meet the required heating demand. In order to maximise the efficiency of the system it is recommended that the heat is distributed in the building via an under floor heating system as these run at lower temperatures.

There are two methods of extracting the heat from the ground, either through pipe work laid horizontally approximately two meters below ground or via boreholes straight into the ground to a depth of approximately 100m.

A horizontal system requires a large area of open ground in order to lay the pipe work which may impede on future plans for additional buildings or extensions. Vertical systems require considerably less surface area for installation and the boreholes can be placed within six meters of each other however certainty is required over the ground conditions and services that are buried below in order to confirm the viability of drilling to the required depth.

Advantages:

- Not dependant on weather conditions
- No planning permission required
- No significant maintenance requirements

Disadvantages

- Requires a large area for installation for horizontal systems
- Not all sites will be suitable for drilling bore holes
- Ideally suited to a building with under floor heating

## 3.3 Evaluation

As per the FIT review a desk based exercise has been undertaken to ascertain the suitability of installation of solar water heating, biomass boilers and ground source heat pumps to the requested 16 sites. This exercise has utilised drawn information of the sites as well as overhead photos of the buildings. No physical site visits have been undertaken.

**Table 4: Suitable RHI Technology**

| Station | Solar Hot water | Biomass | Ground Source HP |
|---|---|---|---|
| Mansfield | ✓ | P | ✓ |
| Annex | ✓ | P | ✓ |
| Ashfield | ✓ | P | ✓ |
| Edwinstowe | ✓ | P | ✓ |
| Warsop | ✓ | P | ✓ |
| Harworth | ✓ | P | ✓ |
| Misterton | ✓ | P | ✓ |
| Tuxford | ✓ | P | ✓ |
| Southwell | ✓ | P | ✓ |
| Collingham | ✓ | P | ✓ |
| West Bridgeford | ✓ | P | ✓ |
| Stockhill | ✓ | P | ✓ |
| Stapleford | ✓ | P | ✓ |
| East Leake | ✓ | P | ✓ |
| Highfields | ✓ | P | ✓ |
| Arnold HQ | ✓ | P | ✓ |
| Ollerton | ✓ | P | ✓ |

✓ - Suitable

P - Potential however further investigation is required

× - Unsuitable

As can be seen from table four all three technologies are potentially viable at the sites. In order to quantify the eligible amount of heat generated by the technology suitable meters will need to be installed in order to measure and report the generated energy.

## 3.4 Estimated Generated Output

### 3.4.1 Solar Hot Water

From our initial investigations all sites appear to be suitable for solar hot water installation. It should be noted that this will remove some of the available area for the installation of PV panels.

Solar hot water is collected during daylight hours so is ideally suited for a hot water demand during this time. For example if there is high demand for hot water in the morning and very little is required during the rest of the day there would be little benefit from this technology.

Consideration should be made as to whether each site would benefit from the hot water generation or whether the area for the panels would be better utilised for PV.

In table five within appendix A it is assumed that through operational procedures through day at the station 70% of the energy produced by the panels will be used, reducing the demand on the existing water heater. As we have no information regarding the current water heater it has been assumed that the cost and carbon savings are based upon a gas fuel source.

It has been assumed a $4m^2$ panel array will be adequate for supporting domestic hot water, if the actual demand is deemed to be higher then a larger system can be installed, subject to a more detailed investigation.

As per the PV installation it has been assumed the panels are under optimum conditions of south facing, 30° angle and no over shadowing.

### 3.4.2 Biomass

Biomass is also a potential technology for installation however consideration should also be made as to the amount of space available for installing the plant and storage and availability of the fuel.

As no information is available regarding the specific heating demand at the identified sites no site specific quantities of heat can be generated however table 6 within the appendices notes the potential values for different sized boilers.

The size of system and capacity of fuel storage vessel will determine the frequency of fuel delivery consideration should be given to the impact of regular deliveries will have on station/site.

To reduce the impact of the fuel storage, capacity would need to be increased or boiler output reduced. Although the technology is listed as a potential technology to all sites the larger sites are considered to be best placed to adapt to storage and delivery requirements.

### 3.4.3 Ground Source Heat Pump

Ground source heat pumps appear to be viable at all the stations provided the heat is collected via boreholes rather than horizontal collectors. Some stations have a large external areas such as the Headquarters at Arnold which has an adjacent playing field, this could be utilised to lay the heat collectors horizontally across the field. Consideration however should be given to the future use of this space and the impact and disturbance to the field required for installation.

These larger stations also provide the opportunity for the drilling of vertical boreholes in a number of locations, whereas other stations have limited space for access for drilling. It is recommended that holes are not drilled within 3 meters of any buildings and they are not placed within 6 meters of each other.

Consideration will need to be made to the disturbance that the drilling of boreholes will have on each individual site, each hole will need to be connected together with pipe work and ultimately connected to a heat pump within the building. The disturbed areas will then require resurfacing and making good.

Site investigations will also be required in order to determine whether the ground conditions are suitable for the drilling of boreholes and consideration will need to be made into any potential future expansion of the buildings in order to ensure that the boreholes or associated pipe work do not cause hindrance with this.

As per the biomass calculations no data is available for this report to the level of heating demand required at each site so the identified is based on the maximum number of boreholes up to a maximum of eight. However due to the sizes of the sites Ashfield, East Leake and Arnold HQ can accommodate significantly more bore holes.

# 4.0 REPORT SUMMARY

## 4.1 Budgets for Installation

Budgets provided are based upon information sourced from current tender returns, information direct from manufacturers and suppliers and publications across the construction industry.

Should NFRS considered a large scale programme of installations, it is likely that negotiations and procurement through a competitive tender process will gain cost savings against all technologies reviewed.

## 4.2 Estimated Energy Generation

An analysis of the energy output when assessed against budget for installation indicates that for technologies which would support the existing energy demand, these being solar thermal, PV and wind turbine, solar thermal appear to offer the greatest energy generation based upon a cost of £1.50 - £1.57 per kWh (The cost per kWh is calculated from the cost of installation over the estimated energy generation amount).

This compared to £3.99 per kWh for Wind Turbine and £4.12 per kWh for PV. However, operational procedures linked to the use of DHW within stations would need to be assessed to ensure that the installation is utilised to its full advantage. Given the likely sporadic nature of the DHW use within stations, reaching this optimum use pattern is likely to be difficult; we would therefore expect the actual energy utilised to drop.

Wind turbines are heavily reliant upon the site specific elements and with mechanical parts maintenance and reliability are a key concern if energy and efficiency outputs are to be maintained. The cost implications of these maintenance elements have been considered within the report but only based upon publicised data for the standard case. The practical implications of access to the turbine may vary between sites, and therefore the cost burden should assessed on a site by site basis as part of any further evaluation study.

## 4.3 Estimated Energy Savings

The study has provided the estimated energy savings/contribution for each of the sites based upon theoretical outputs. As stressed within this report this data is based upon optimum conditions.

Further study work should be undertaken to accurately measure the anticipated energy output for each site based upon site specific data, be it technologies installed under the FIT or RHI programme.

## 4.4 Carbon Savings

The evaluation has provided with the FIT calculations anticipated carbon savings based upon published emission rates for each of the fuels. For RHI technologies the savings are more difficult to quantify. Specifically the carbon savings for GHP and Biomass should be measured against existing kWh demand and calculated carbon emissions associated with the existing fuel source.

Biomass has a very low carbon emission rate 0.026 kg/$CO_2$ per kWh so when compared to an existing gas fuelled station the carbon emissions will be significantly reduced. By comparison GHP utilises mains electricity which has a carbon emission rate of 0.544, compared with gas emission rate of 0.204 kg/$CO_2$ per kWh the emission rate may increase, however the COP/Efficiency of the Heat Pump is what provides the reduction in carbon emissions.

This clearly requires that the heat pump is maintained and operated correctly to ensure efficiency levels are maintained.

## 4.5 FIT and RHI income

The figures produced within the report are based upon theoretical outputs under optimum conditions, for both FIT and RHI. The income is subject to the prevailing tariff rate at the point of installation and lodgement with Ofgem.

When procuring the relevant technology the relevant contract should include for ensuring the system is installed, commissioned and lodged prior to the next degression, as the tariff rate could reduce if this is not achieved and income for the 25 year period and payback can be impacted.

For both RHI and Fit the income will be directly related to the maintenance of the system, some of the technologies have a greater maintenance burden than others. To maintain the kWh output of each technology and therefore the metered tariff a robust maintenance programme should be considered.

## 4.6 Payback Period.

The payback periods for each of the technologies is included within the respective tables, the calculation is a simple conversion against estimated budget, tariff income, energy saved and maintenance burden where data is available.

It is linked to several variables and on this basis should continue to be reviewed as part of any further detailed assessment of each site.

## Appendix A

**Table 2: Wind Turbines**

| Turbine | Estimated Installation Cost | Windspeed m/s | Estimated Generated Electricity (kWh) *1 | Estimated Annual FIT | Estimated carbon reduction Kg $CO_2$ Per annum *2 | Estimated Energy Bill Savings ( Based upon 70% use and £0.1269p per kWh) | Maintenance Cost Average per annum (60 year period/3 year service interval) *3 | Estimated Payback Years | Estimated FIT over 20 Years |
|---|---|---|---|---|---|---|---|---|---|
| 6kw Turbine | £27,000 | 4 | 6,765 | £1,806.26 | 3,660 | £600.93 | £236.00 | 12.44 | £36,125.10 |
| 6kw Turbine | £27,000 | 5 | 11,622 | £3,103.07 | 6,288 | £1,032.38 | £236.00 | 6.92 | £62,061.48 |
| 6kw Turbine | £27,000 | 6 | 16,900 | £4,512.30 | 9,143 | £1,501.23 | £236.00 | 4.67 | £90,246.00 |

**Notes**

1. Integrating renewable energy into new developments: Toolkit for planners, developers and consultants

2. Based 0.541 kg $CO_2$ emission rate for electric fuel source

3. Micro-wind Turbines in Urban Enviroments: An assessment

**Table 3: Photovoltaics**

| Station/Site | PV Area m2 | Cost @ £500/m2 | Estimated kw peak | Estimated Generated electricity (kWh) *1 | Estimated carbon reduction Kg $CO_2$ Per annum *2 | Estimated Energy Bill Savings ( Based upon 70% use and £0.1269p per kWh) | Maintenance Cost Average per annum (based upon 25 year period) *3 | Estimated FIT per annum | Estimated Payback years (basic maintenance) | Estimated total FIT over 25 years |
|---|---|---|---|---|---|---|---|---|---|---|
| Mansfield | 124 | £62,000.00 | 17.71 | 15,057 | 8,146 | £1,338 | £120 | £4,954 | 10.05 | £123,845.00 |
| Annex | 125 | £62,400.00 | 17.83 | 15,154 | 8,198 | £1,346 | £120 | £4,986 | 10.05 | £124,644.00 |
| Ashfield | 164 | £82,000.00 | 23.43 | 19,914 | 10,773 | £1,769 | £120 | £6,552 | 10.00 | £163,795.00 |
| Edwinstowe | 352 | £176,000.00 | 50.29 | 42,743 | 23,124 | £3,797 | £240 | £14,062 | 9.99 | £351,560.00 |
| Warsop | 124 | £62,000.00 | 17.71 | 15,057 | 8,146 | £1,338 | £120 | £4,954 | 10.05 | £123,845.00 |
| Harworth | 296 | £148,000.00 | 42.29 | 35,943 | 19,445 | £3,193 | £240 | £11,825 | 10.01 | £295,630.00 |
| Misterton | 172 | £86,000.00 | 24.57 | 20,886 | 11,299 | £1,855 | £120 | £6,871 | 9.99 | £171,785.00 |
| Tuxford | 423 | £211,600.00 | 60.46 | 51,389 | 27,801 | £4,565 | £240 | £16,907 | 9.97 | £422,671.00 |
| Southwell | 144 | £72,000.00 | 20.57 | 17,486 | 9,460 | £1,553 | £120 | £5,753 | 10.02 | £143,820.00 |
| Collingham | 125 | £62,400.00 | 17.83 | 15,154 | 8,198 | £1,346 | £120 | £4,986 | 10.05 | £124,644.00 |
| West Bridgeford | 504 | £252,000.00 | 72 | 61,200 | 33,109 | £5,436 | £240 | £20,135 | 9.95 | £503,370.00 |
| Stockhill | 640 | £320,000.00 | 91.43 | 77,714 | 42,043 | £6,903 | £240 | £25,568 | 9.93 | £639,200.00 |
| Stapleford | 148 | £74,000.00 | 21.14 | 17,971 | 9,722 | £1,596 | £120 | £5,913 | 10.01 | £147,815.00 |
| East Leake | 172 | £86,000.00 | 24.57 | 20,886 | 11,299 | £1,855 | £120 | £6,871 | 9.99 | £171,785.00 |
| Highfields | 1540 | £770,000.00 | 220 | 187,000 | 101,167 | £16,611 | £240 | £57,409 | 10.44 | £1,435,225.00 |
| Arnold HQ | 880 | £440,000.00 | 125.71 | 106,857 | 57,810 | £9,492 | £240 | £32,805 | 10.46 | £820,128.57 |
| Ollerton | 51 | £25,600.00 | 7.31 | 6,217 | 3,363 | £552 | £120 | £2,350 | 9.20 | £58,752.00 |
| | | | | | | | | | | |
| Max 10Kw peak | 70 | 35,000.00 | 10.00 | 8,500 | 4,599 | £408 | £120 | £2,610 | 12.08 | £ 65,237.50 |

**Notes**

1. Integrating renewable energy into new developments: Toolkit for planners, developers and consultants

2. Based 0.541 kg $CO_2$ emission rate for electric fuel source

3. Estimated cost based upon annual cleaning of the panels to maintain efficiency

**Table 5: Solar Hot Water**

| Panel Type | Panel Area | Estimated Installation Cost | Estimated Metered Output hot water (kWh) *1 | Estimated carbon reduction Kg $CO_2$ Per annum *2 | Estimated Energy Bill Savings ( Based upon 70% use and £0.0424p per kWh) | Maintenance Cost Average per annum (based upon 25 year period) *3 | Estimated RHI income per Annum | Estimated Payback years (basic maintenance) | Estimated total RHI over 20 years | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plate type | 4 | £2,850.00 | 1,816 | 370 | £53.90 | £70.00 | £327 | 9.17 | £6,537.60 | £1.57 |
| Evacuated tube | 4 | £3,500.00 | 2,328 | 475 | £69.10 | £70.00 | £419 | 8.37 | £8,380.80 | |

**Notes**

1. Integrating renewable energy into new developments: Toolkit for planners, developers and consultants

2. Based 0.204 kg $CO_2$ emission rate for gas fuel source

3. Estimated cost based upon annual cleaning of the panels to maintain efficiency

**Table 7: Ground source Heat Pump**

| Station/Site | No. of Bore Holes | Estimated Installation cost | Estimated Heat Output (kWh) | Estimated carbon reduction Kg $CO_2$ Per Annum | Estimated RHI per Year | Maintenance Cost Average per annum (based upon 25 year period) | Estimated Payback Years | Estimated RHI over 20 Years |
|---|---|---|---|---|---|---|---|---|
| Mansfield | 4 | £21,000.00 | 25600 | 5222 | £1,792.00 | £120.00 | 12.56 | £41,216.00 |
| Ashfield | 4 | £21,000.00 | 25600 | 5222 | £1,792.00 | £120.00 | 12.56 | £41,216.00 |
| Edwinstowe | 8 | £37,000.00 | 51200 | 10445 | £3,584.00 | £180.00 | 10.87 | £82,432.00 |
| Warsop | 4 | £21,000.00 | 25600 | 5222 | £1,792.00 | £120.00 | 12.56 | £41,216.00 |
| Harworth | 3 | £17,000.00 | 19200 | 3917 | £1,344.00 | £120.00 | 13.89 | £30,912.00 |
| Misterton | 7 | £33,000.00 | 44800 | 9139 | £3,136.00 | £180.00 | 11.16 | £72,128.00 |
| Tuxford | 3 | £17,000.00 | 19200 | 3917 | £1,344.00 | £120.00 | 13.89 | £30,912.00 |
| Southwell | 3 | £17,000.00 | 19200 | 3917 | £1,344.00 | £120.00 | 13.89 | £30,912.00 |
| Collingham | 3 | £17,000.00 | 19200 | 3917 | £1,344.00 | £120.00 | 13.89 | £30,912.00 |
| West Bridgeford | 5 | £25,000.00 | 32000 | 6528 | £2,240.00 | £120.00 | 11.79 | £51,520.00 |
| Stockhill | 7 | £33,000.00 | 44800 | 9139 | £3,136.00 | £180.00 | 11.16 | £72,128.00 |
| Stapleford | 6 | £29,000.00 | 38400 | 7834 | £2,688.00 | £120.00 | 11.29 | £61,824.00 |
| East Leake | 8 | £37,000.00 | 51200 | 10445 | £3,584.00 | £180.00 | 10.87 | £82,432.00 |
| Highfields | 8 | £37,000.00 | 51200 | 10445 | £3,584.00 | £180.00 | 10.87 | £82,432.00 |
| Arnold HQ | 8 | £37,000.00 | 51200 | 10445 | £3,584.00 | £180.00 | 10.87 | £82,432.00 |
| Ollerton | 6 | £29,000.00 | 38400 | 7834 | £2,688.00 | £120.00 | 11.29 | £61,824.00 |

**Table 6: Biomass**

| Boiler size | Estimated installation cost | Estimated Heat Output (kWh) | Estimated carbon reduction Kg $CO_2$ Per annum | Estimated RHI per Annum | Estimated Payback Years (excludes maintenance) | Estimated total RHI over 15 years |
|---|---|---|---|---|---|---|
| 45 Kw | £35,000.00 | 10,500 | 2,142 | £683 | Beyond RHI period | £10,237.50 |
| 30 Kw | £27,500.00 | 7,000 | 1,428 | £630 | Beyond RHI period | £9,450.00 |

## Appendix B

| Renewable Heat Incentive tariff rates | | | |
|---|---|---|---|
| | | | |
| Technology | Scale | Tariff level for new installations in period (p/kWh)* | Tariff Lifetime |
| | | | |
| | | Installations registered in FIT year 2 (1 April 11 - 31 March 2012 | |
| | | | |
| Solid Biomass | ≤ 45kW | 9 | 15 |
| Solid Biomass | > 45kw - 500kw | 6.5 | 15 |
| Solid Biomass | >500Kw | 1.6 | 15 |
| Bio Liquids | ≤ 45kW | 6.5 | 15 |
| Biogas on-site combustion | ≤ 45kW | 5.5 | 10 |
| Biogas on-site combustion | > 45kw - 200kw | 5.5 | 10 |
| Ground Source Heat Pumps | ≤ 45kW | 7 | 23 |
| Ground Source Heat Pumps | > 45kw - 350kw | 5.5 | 20 |
| Ground Source Heat Pumps | >350Kw | 1.5 | 20 |
| Air source heat pumps | ≤ 45kW | 7.5 | 18 |
| Air source heat pumps | > 45kw - 350kw | 2 | 20 |
| Solar Thermal | ≤ 20kW | 18 | 20 |
| Solar Thermal | > 20kw - 100kw | 17 | 20 |
| Biomethane | All scales | 4 | 15 |

## Appendix C

| Feed in Tariff Rates | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Technology | Scale | Tariff level for new installations in period (p/kWh)* | | | Tariff Lifetime |
| | | | | | |
| | | Year 1: 1/4/10 - 31/3/11 | Year 1: 1/4/11 - 31/3/12 | Year 1: 1/4/12 - 31/3/13 | |
| | | | | | |
| Anaerobic digestion | ≤ 500kW | 11.50 | 11.50 | 11.50 | 20 |
| Anaerobic digestion | > 500kW | 9.00 | 9.00 | 9.00 | 20 |
| Hydro | ≤ 15 kW | 19.90 | 19.90 | 19.90 | 20 |
| Hydro | > 15 - 100kW | 17.80 | 17.80 | 17.80 | 20 |
| Hydro | > 100 kW - 2 MW | 11.00 | 11.00 | 11.00 | 20 |
| Hydro | > 2 MW - 5 MW | 4.50 | 4.50 | 4.50 | 20 |
| MicroCHP pilot* | ≤ 2 kW* | 10.00 | 10.00 | 10.00 | 10 |
| PV | ≤ 4 kW ( newbuild ) | 36.10 | 36.10 | 33.00 | 25 |
| PV | ≤ 4 kW ( retrofit ) | 41.30 | 41.30 | 37.80 | 25 |
| PV | > 4 kW - 10 kW | 36.10 | 36.10 | 33.00 | 25 |
| PV | > 10 kW - 100 kW | 31.40 | 31.40 | 28.70 | 25 |
| PV | > 100 kW - 5 MW | 29.30 | 29.30 | 26.80 | 25 |
| PV | Stand alone system | 29.30 | 29.30 | 26.80 | 25 |
| Wind | ≤ 1.5 kW | 34.50 | 34.50 | 32.60 | 20 |
| Wind | > 1.5 - 15 kW | 26.70 | 26.70 | 25.50 | 20 |
| Wind | > 15 - 100kW | 24.10 | 24.10 | 23.00 | 20 |
| Wind | > 100 - 500 kW | 18.80 | 18.80 | 18.80 | 20 |
| Wind | > 500 kW - 1.5 MW | 9.40 | 9.40 | 9.40 | 20 |
| Wind | > 1.5 MW - 5 MW | 4.50 | 4.50 | 4.50 | 20 |
| Existing Micro-generators transferred from | | 9.00 | 9.00 | 9.00 | to 2027 |

***Note that the government is currently reviewing the tariff rates the Ofgem website should be checked for current rates.**