From:	Paget Fulcher
To:	Hutchinson, Peter
Cc:	Mark Cockburn; Patrick Taylor; McCutcheon, Joanne; Connolly, Samuel; Stewart, Susan
Subject:	CEPA model
Date:	08 June 2011 19:58:49
Attachments:	RHITM model guide 020611.docx DETI RHITM model 080611.xlsm

Dear Peter,

Please find attached the CEPA Renewable Heat Incentive and Take-up Model. I have also attached a model user guide that provides an overview of how it works and instruction on how to use it.

Please note that the recorded information has been removed from the Report Output and Saved Run sheets as these outputs may need to change following our response to DETI's comments.

As previously requested I am available to provide a training session on the model next week via video conference. Would a session starting at 2pm next Tuesday be suitable?

Regards,

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RENEWABLE HEAT INCENTIVE FOR NORTHERN IRELAND

A REPORT FOR THE DEPARTMENT OF ENTERPRISE, TRADE AND INVESTMENT (DETI)

May 2011

Northern Ireland Renewable Heat Incentive and Takeup Model (RHITM) Model guide

Submitted by:

Cambridge Economic Policy Associates Ltd and AEA Technology

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CONTENTS

1. INTRODUCTION

1.1. Purpose of the project

CEPA and AEA were commissioned by the Department of Enterprise, Trade and Investment (DETI) in Northern Ireland to produce a recommendation on the most appropriate form of a Renewable Heat Incentive (RHI) for Northern Ireland. This RHI would help to deliver the target of having 10 percent of heating in Northern Ireland from renewable sources by 2020. Our analysis revisits the cost of delivering renewable heat, by sector, but also considers the cashflow implications and other potential barriers to deployment in more depth.

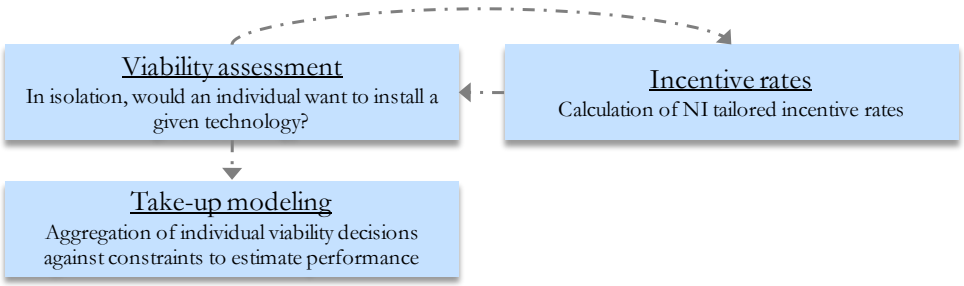
A key part of the project was the development of a detailed economic model. This is described in more detail below, with particular reference to operation and use of the model.

1.2. Model overview

CEPA has created the *Northern Ireland Renewable Heat Incentive and Take-up Model (RHITM)* a stylised model developed in Excel to calculate, under a range of assumptions, potential take-up and incentive rates in the context of achieving renewable heating targets.

The model performs three complementary functions as shown in Figure 1.1 below.

Figure 1.1: RHITM functions



RHITM is based on Northern Ireland-specific data and stylised heating market breakdown provided by AEA to tailor analysis to the specific conditions of Northern Ireland.

The foundation of the model is a large number of "viability assessments," examining the decisions that groups (such as rural households using oil) make about installing heating technologies over time. In particular, it allows us to see how much support would be needed for a given installation type, or if the levels of RHI or grant support we allow would be sufficient for them to install a renewable technology.

The "incentive rates" function of the model uses market characteristics to develop cost-based RHI rates that can be fed back into the viability assessments.

The "take-up modelling" function aggregates individual viability decisions across all groups and over time to examine take-up of renewable technologies under a view of how competing demands are prioritised under technical constraints.

1.3. Structure of this guide

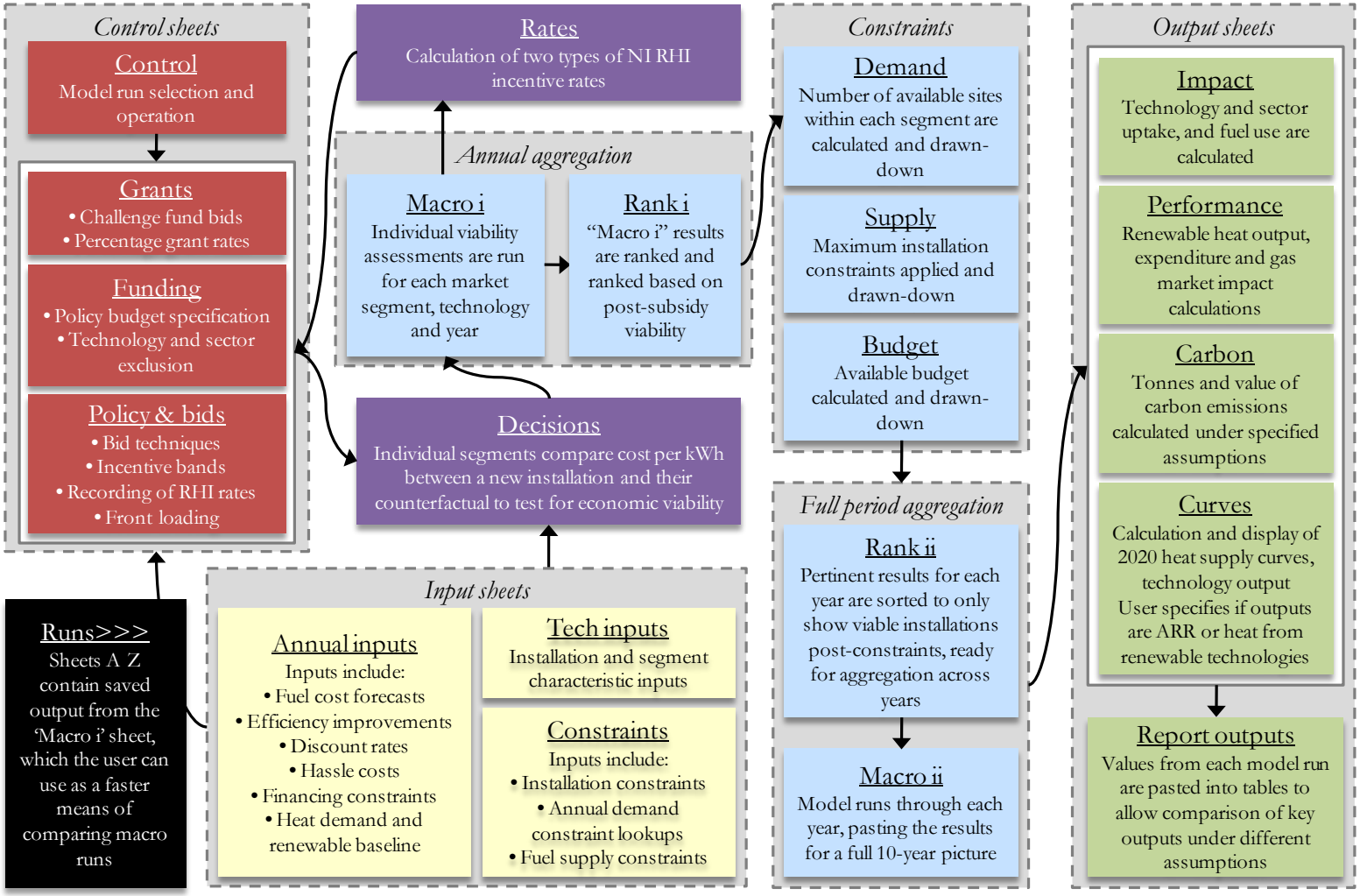
This guide provides a brief overview of the content and operation of RHITM.

- Section 2 uses a flow diagram to show the content and information flows between the parts of the model; and
- Section 3 provides instruction for common operations and the steps required in the model.

2. CONTENT GUIDE

This section provides a commentary on the function and content of the main sheets in the model.

Figure 2.1: RHITM content guide



Core macros

RHITM performs viability assessments for up to 181 technology / market segment pairs for each of the ten years examined in the model. Simultaneous calculation of 1,810 viability assessments and ten annual take-up optimisations would result in a large file size and make the model slow to run. To avoid these issues, the model has been designed so only one live viability assessment and one take-up allocation calculation is required in the model.

"Macro i" leverages calculations on the "Decisions" sheet to perform all viability assessments required for the model in a relatively lean manner. The macro cycles through all of the technology / market segment pairs and years, performing these calculations in one location and recording the outputs required for the rest of the model in the "Macro i" sheet.

The annual take-up allocation processes in the model read off output from the "Macro i" sheet for the given year examined. To avoid replicating this calculation ten times, once for each year, the "Macro ii" macro runs the process for each year sequentially, recording outputs in the "Macro ii" sheet, and picking up outputs that feed through to subsequent years such as budget availability.

As highlighted below in this guide, users of RHITM will need to take care to ensure that these two macros are used at all appropriate stages to account for changes to either viability assessments or the coordinated allocation of installation and budget capacity over time.

3. OPERATION

This section provides an overview of how to operate the RHITM model. In particular, this guide provides instruction on how to:

- operate the model from the "Control" sheet;
- examine individual segment calculations;
- modify the model following amendments to inputs;
- use the model to calculate tailored RHI rates; and
- complete a full model run update.

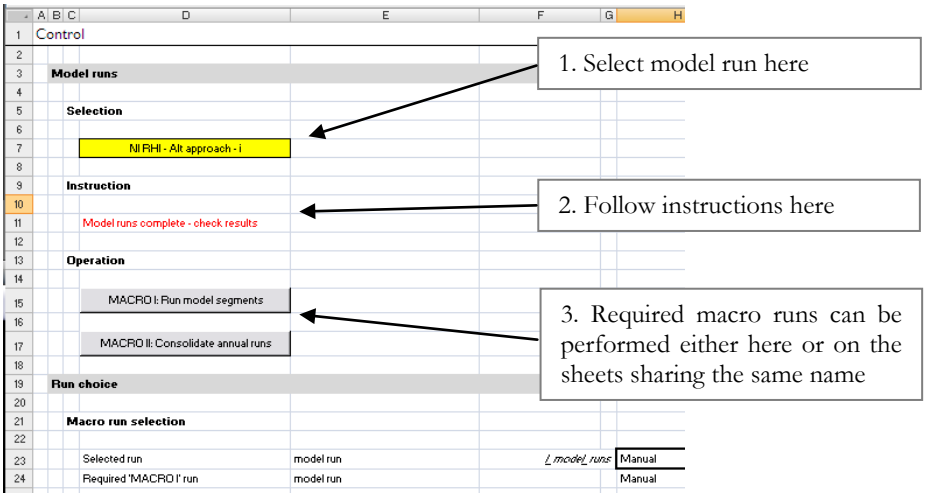
3.1. Using the control sheet to select and operate model runs

Each "model run" is a basket of assumptions or policy decisions, with the main assumptions defined in the "Control" sheet. These include assumptions regarding scenarios on costs, discount rates, barrier variations and policy options, such as the type of RHI or grant funding available. Fine tuning is also possible by modifying input assumptions on the other input sheets (those from "Policy & bids" to "Constraints"). This makes the model highly flexible and able to model the impact of a wide range of assumptions and policy choices.

Preset runs

The model contains 33 preset model runs, which can be run as shown in Figure 3.1 below.

Figure 3.1: Preset model run operation

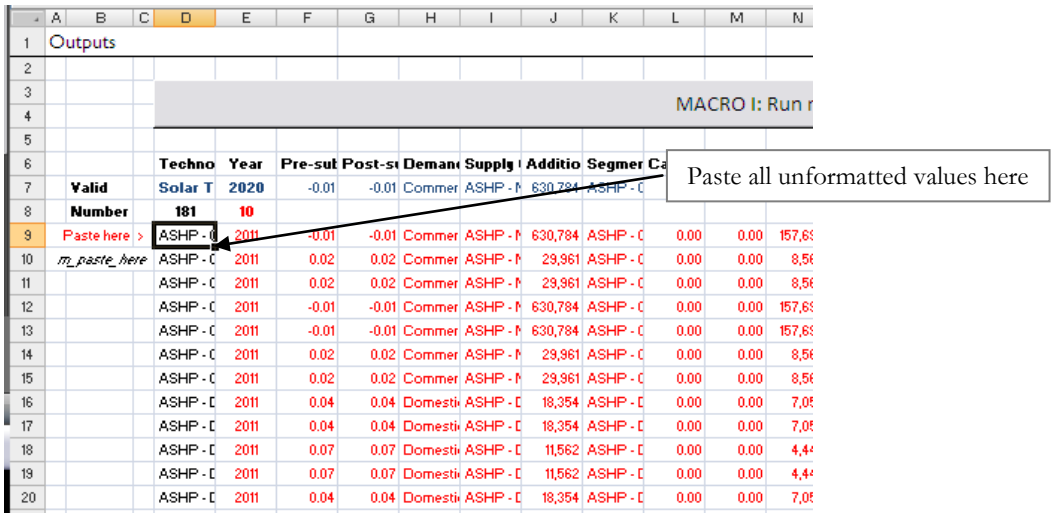


The first two runs are for RHI rate calibration, followed by 18 runs calibrated to runs examine policy options under different budget scenarios. Ten preset runs are included for sensitivity analysis as well as runs to test the impact of excluding Solar Thermal and the "Do nothing" option.

When the user is required to run Macro i, they will be reminded that they may be able to run the model using output from a lettered sheet. For example, if the user wished to test the "GB RHI i" run, they will be directed to sheet "G" where three is pre-calculated Macro i output that can be

used an alternative to running the macro, which can take over ten minutes to complete in some cases. To use this data, select all the values in the lettered sheet and then paste the values into cell D9 on the "Macro i" sheet as shown in Figure 3.2 below.[1]

Figure 3.2: Using saved model runs



Once the values have been pasted, the user can then continue to follow the instructions on the "Control" sheet.

Manual runs

The user can also select their own "Manual" run from the model run drop-down box, allowing them complete control over the assumptions rather than being limited to the pre-defined runs. The assumptions for the manual run are set in the bright yellow cells in column H. The user can then follow instructions on the sheet just as with the saved runs.

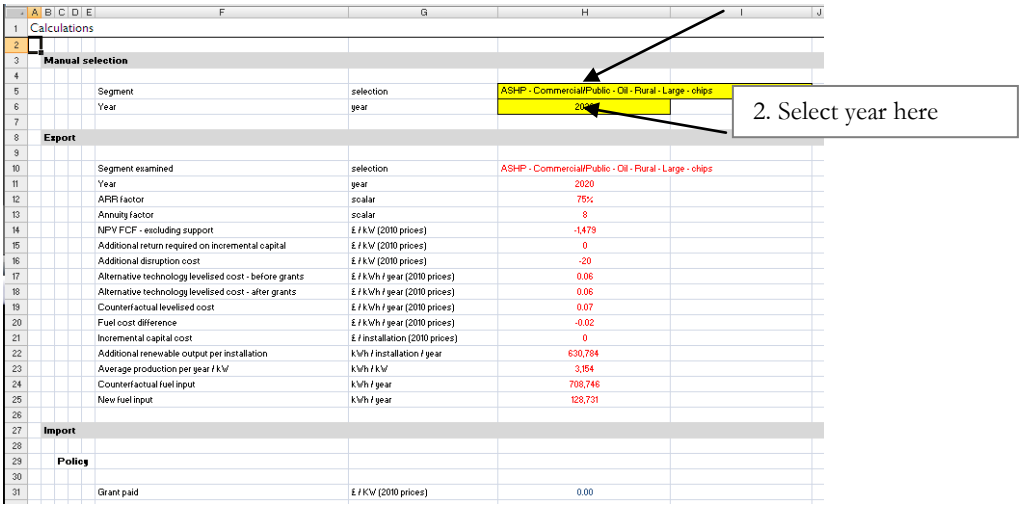
3.2. Individual segment runs

All sheets in the model up to "Macro i" look up information for just one segment. The user can examine each segment in isolation by selecting a segment from Cell H5 and year from H6 on the "Decisions" sheet as shown in Figure 3.3.

Figure 3.3: Individual segment inspection on the "Decisions" sheet

1. Select segment here

[1] This cell is also named "m_paste_here" in the model.



Each segment is defined based on six characteristics:

- Technology examined;
- Domestic, commercial/public or industrial investor;
- Counterfactual technology;
- Investor location;
- Investor size / type; and
- Access to biomass chips or pellets.

Solar thermal segments have an additional characteristic, where they are noted as being complementary technologies, rather than system replacements.

3.3. Changing input assumptions

Care should be taken when updating input data in the model. In particular, the user should be aware that outputs will not appropriately reflect these changes without Macros i or ii being run, or even the RHI rates being recalculated in cases where different possible rates are being considered. Table 3.1 below provides an indication of the steps required following data updates. It is important to note that except for changes only requiring Macro ii to be updated, all saved macro runs in sheets A-Z may become invalid.

Table 3.1: Steps required following data updates

Data type updated	Macro i and ii rerun required	Macro ii rerun only	NI RHI rate recalibration
Additional investment returns	**Yes**	No	**Yes**
Discount rates	**Yes**	No	**Yes**
Efficiency improvements	**Yes**	No	**Yes**
Financing constraints	**Yes**	No	**Yes**
Fuel prices	**Yes**	No	**Yes**
Hassle costs	**Yes**	No	**Yes**

Data type updated	Macro i and ii rerun required	Macro ii rerun only	NI RHI rate recalibration
Subsidy band classification	**Yes**	No	**Yes**
Technical assumptions	**Yes**	No	**Yes**
Borrowing constraint	**Yes**	No	No
Calculated RHI / grant rates	**Yes**	No	No
Frontloading payments	**Yes**	No	No
Grant limit constraints	**Yes**	No	No
Percentage applicants	**Yes**	No	No
Scenario exclusion	**Yes**	No	No
Best case allocation	No	**Yes**	No
Administration costs	No	**Yes**	No
Fuel constraints	No	**Yes**	No
Funding scenario	No	**Yes**	No
Funds available	No	**Yes**	No
Installation constraints	No	**Yes**	No
Segment population	No	**Yes**	**Yes**
National heat demand	No	No	No
Carbon assumptions	No	No	No
Subsidy type	No	No	No

The broad principles behind Table 3.1 are that assumptions affecting individual viability decisions, such as fuel costs, in isolation require Macro i to be run and RHI rates to be recalculated. Variables affecting coordinated factors, such as the number of households in each segment or the subsidy budget, only require Macro ii to be run.

If in doubt, it is advisable to run both macros.

3.4. Setting RHI rates

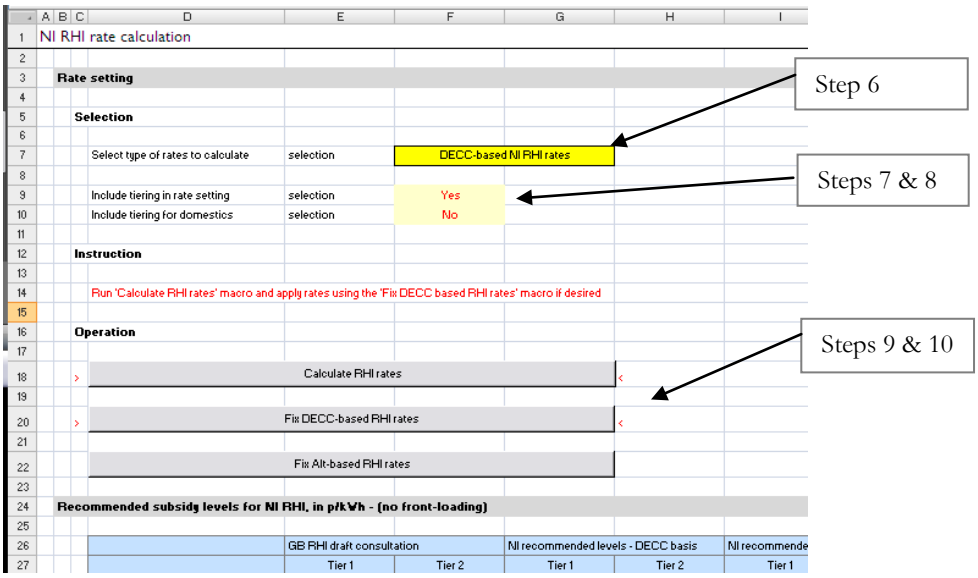
This section provides instructions for how to use the model to calculate RHI rates tailored for assumptions about the NI heat market. The model includes the option to calculate rates based on assumptions mirroring the viability assessments, or a modified methodology based on similar principles to how DECC calculate their incentive rates.

The following instructions guide the user how to calculate both options for tailored RHI rates.

1. Go to the "Control" sheet.
2. Select "NI RHI - calibration - DECC approach" in cell D7 as in Figure 3.1 above.
3. Run "Macro i" from the button in cell D15 or paste saved run A into the "Macro i" sheet as in Figure 3.2 above.
4. Wait for macro run to complete – can take upwards of 10mins.

5. Go to the "Rates" sheet.

Figure 3.4: Operating the "Rates" sheet



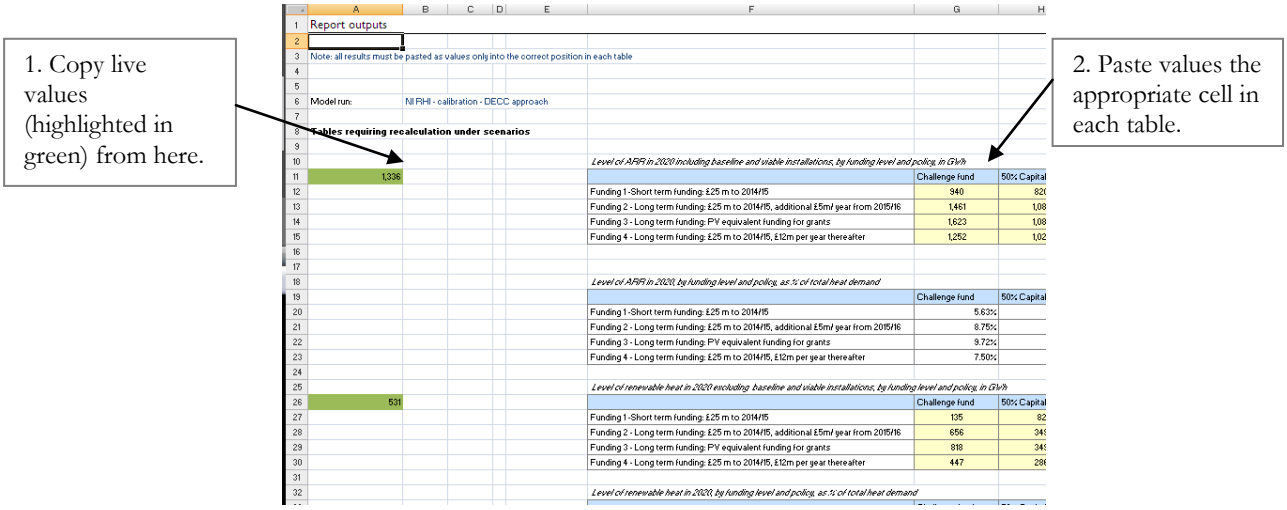
6. Select "DECC-based NI RHI rates" in cell F7 as in Figure 3.4.
7. Check whether you want to include tiered rates in cell F9 as in Figure 3.4.
8. Check whether you want to include "tiering" for the smallest scale bands including domestics in cell F10 as in Figure 3.4.
9. Run the "Calculate RHI Rates" macro.
10. Run the "Fix DECC based RHI rates" macro.
11. Complete Steps 1-9 again, but running the "NI RHI - calibration - Alt approach" run in Step 2 and then using the "Fix Alt-based RHI rates" instead of the "Fix DECC based RHI rates" macro in Step 6.

3.5. Full run

This section provides instructions on how to perform a full model run, so outputs are up to date on the "Report outputs" sheet or to update the lettered saved model runs.

1. First calculate RHI rates as above in Section 3.4.
2. Perform all model runs from "Challenge fund 1" onwards, following instructions in Cell D11 on the Control sheet. When each run is complete you can view or save the model runs in the "Report Output" sheet, as shown in Figure 3.5 below.

Figure 3.5: Saving outputs on the "Report Output" sheet



Values need to be pasted for ten separate tables for the main model runs. Below row 177 are some tables where values are only pasted for one run: "NI RHI - Alt approach – i." For the sensitivity model runs, only one value needs to be recorded for each run. This is recorded in the tables from Row 251.

3. Please note that some model runs share the same Macro i output so only Macro ii will need to be run.

4. If the full model run is being conducted because there are new input assumptions for the model, the user should save any new Macro i outputs on the "Macro i" sheet into the appropriate lettered sheet.