Government Actuary's Department

Quality Assurance of Ofgem RIIO-2 Financial Models

Price Control Framework Models

02/02/2021

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Contents

At GAD, we seek to achieve a high standard in all our work. We are accredited under the Institute and Faculty of Actuaries' Quality Assurance Scheme. Our website describes **the standards** we apply.

1 Introduction

Background

The Government Actuary's Department (GAD) has been commissioned by the office of Gas and Electricity Markets (Ofgem) to perform a quality assurance, using the Ofgem Model Quality Assurance Checklist, for the draft Licence Model (LiMo) and Price Control Framework Model (PCFM) for RIIO-2 (GD, T and ESO), for the four sector models (GD, ET, GT and ESO), at three different stages, as follows:

1. Publication of RIIO-2 LiMo as part of draft determinations (DD) – July 2020;

2. Publication of RIIO-2 LiMo as part of final determinations (FD) – December 2020; and

3. Publication of the final RIIO-2 PCFM as part of the statutory licence modification – February 2021.

This report has been prepared by GAD to provide details of the quality assurance at the PCFM stage (February 2021).

Scope

The full scope of this stage of the review is described in the checklist provided by Ofgem (Appendix B). The prime focus of the complete review (up to stage 3 above) is on the accuracy of the calculations, the integrity of the model and compliance with best practice in modelling.

To facilitate this review Ofgem provided GAD with a copy of each of the models and limited draft documentation for previous versions of the models (RIIO-1) . This documentation does not cover the full model at present but does provide some useful guidance concerning some sections of the calculations.

At draft determination and final determination stages our review was limited to those aspects of the models and calculations that are used as part of the draft and final determinations respectively. For the PCFM stage we have expanded our review to consider how well the models comply with best practice modelling.

The review is based on the calculation formula included within the published models; however, it is possible that changes to the numerical inputs used could be made after our final review.

Models

The models are Microsoft Excel based financial models.

The models reviewed at PCFM stage are:

I. GD PCFM Model
II. ET PCFM Model
III. GT PCFM Model
IV. ESO PCFM Model

Appendix C of this report provides full details of the final versions of the model checked by GAD.

GAD approach

We have performed a desk top review of the model to look at the formula and calculations on a line by line basis. We have also used software to assist with checking the integrity of models.

A more detailed description of the GAD approach to model quality assurance is provided in Appendix A of this report.

At each stage of the review we have shared the issues logs with Ofgem and after they have considered the findings, they have advised their proposed actions. We have also asked specific questions in relation to the operation of the model and calculations in order to help verify that the approach taken is as intended.

2 PCFM report

Overview

We have provided Ofgem with detailed issues logs and each issue has been classified into one of the following headings:

I. Calculation & Data Integrity
II. Documentation
III. User Interface
IV. Model Standards

This project has been ongoing throughout each of the three stages outlined in the background section of this report. Ofgem have addressed many of the issues we have raised and incorporated many of the recommendations made as the models have developed. It is not expected that all our recommendations (other than those in respect of calculation accuracy) will have been implemented at the PCFM stage as some of these are suggestions for future improvements to the models, rather than essential to the model at this stage.

Calculations for PCFM

At PCFM stage we have not identified any issues in respect of the accuracy of calculations that have not either been resolved, or a satisfactory explanation provided as to why this issue would not affect the PCFM.

This assurance on the accuracy of the calculations is subject to the limitations below.

I. Our assessment is based on the model being used by members of the relevant Ofgem team or authorised users, who have detailed knowledge of the operations of the model. At this stage, given the absence of final user documentation there are risks the model could be mis-used if the user does not have detailed knowledge of the model.

II. We have been provided with some draft documentation of previous versions of the model and licence; however, this does not cover all aspects of the calculations in the model as it applies to RIIO-1 rather than RIIO-2. In this respect we verified that the calculations follow a logical approach and relied on assurances from Ofgem that the calculation approach is as intended. However, until the license and documentation is finalised, there remains risks of inappropriate use / audit trail.

III. We have identified some formula that are correct for the RIIO-2 calculations but if the models were to be extended to cover future price controls would need to be amended. We have identified these points to Ofgem to help them future proof the models. This point specifically relates to checking for full depreciation of an assets value.

3 Key recommendations

Documentation

The documentation within the model itself is very limited. We would like to see a more detailed explanation of what each worksheet does (and each section of the worksheets). We have been advised that a model handbook and licence are being prepared which will help users to understand the calculations. These items are not within scope of our review and their production should reduce this concern.

Best practice documentation of models is intended to assist both users of the models and those who may be asked to develop the models in future. We encourage Ofgem to make sure that both these aspects are covered in the documentation that is to be produced.

Model structure

Best practice modelling dictates that models should follow a one way flow of information from left to right and top to bottom. This applies both to the model as a whole and within the individual worksheets. We have identified several places in the models where this approach has not been adopted. In some cases, this is due to the nature of the calculations but there are also examples where we believe a one way flow of information could have been adopted.

We understand from discussing this point with Ofgem that the users of the model are very familiar with the structure used and it would cause more confusion to make a change this at this stage. We understand this point and thus put this recommendation forward as something that Ofgem may wish to consider in future model development.

Separation of inputs and constants from calculations

At present there are instances where variable inputs and constants are entered into sheets that also contain calculations. This is particularly the case for the ESO model. Not all inputs/constants are entered on the same sheets which adds to the risk that some fields may not be updated correctly.

We understand that the user handbooks will make clear all cells that need to be updated and as above we accept that a major change to the structure of models that users are familiar with would not be beneficial at this stage.

The full extent of this issue has been considerably reduced during this review with Ofgem adopting our recommendations where it was deemed appropriate at this stage. We encourage Ofgem to seek to split out all inputs and constants from the calculation sheets in future model development.

Model checks

We have encouraged Ofgem to use many checks within the models to make sure that all inputs tie up and provide a double check on calculations. This recommendation has been adopted in many places within the model. At present there is no central indicator to confirm that all checks are as

expected. We recommend that this should be incorporated into future versions of the model and ideally placed on the user interface worksheet to make sure that any issues are apparent to a user when running the model.

Cosmetic changes

The final versions of the model that we reviewed contained a few minor cosmetic issues. Examples of these points include text colour not being consistent with the scheme outlined in the cover sheet. We have made Ofgem aware of these issues.

4 Next steps

Our model QA has been finalised based on the models that Ofgem will publish in February 2021. We understand that due to ongoing discussions it is possible some minor changes to the PCFM could be made after this date. Our model QA will not consider any subsequent changes made to the models.

5 Limitations

GAD does not have expertise in Gas and Electricity Markets and the advice does not cover any of the model's capabilities in this area.

In preparing this report, GAD has relied on data and other information supplied by Ofgem as described in the report. Any checks that GAD has made on this information are limited to those described in the report, including any checks on the overall reasonableness and consistency of the data. These checks do not represent a full independent audit of the data supplied. In particular, GAD has relied on the general completeness and accuracy of the information supplied without independent verification.

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02 February 2021

Appendix A: Quality assurance process

Our model QA process splits our findings across four areas: Calculation & Data Integrity, User Interface, Documentation and Model Standards, which are described further below.

Calculation & Data Integrity

This encompasses the following areas:

- Reasonable protection of the user against erroneous input (e.g. cell validation, cell checks)
- Input locking with audit trail for confidence in pre-completed inputs
- Direction of data flow in model
- Appropriate level of accuracy for outputs
- Sensitivity of outputs to inputs

Documentation

Documentation is part of the model standards, however as it is an important area we have separated it out for the purpose of this QA.

GAD's scope in reviewing the documentation was limited specifically to the wording and use of the model itself, and the model's compliance with calculations as set out by the Licence and model handbook. We didn't assess if all good practice documentation was in place and review any other documentation (e.g. model change control logs).

User Interface

This encompasses the following areas:

- Layout of the model and data
- Colour coding of cells and worksheets
- Model functionality
- Clarity of outputs
- General usability

Model Standards

We have included checks against GAD modelling standards and spreadsheet best practice in this section as this largely overlaps with the model standards.

Essential

- Model summary containing: Model name, Model purpose, Scope and specification, Creation date, File location, Owner/Contact, Version number, Link to QA log, and Link to assumptions log
- Model map
- Sheet descriptions

Recommended

- Structure diagram showing the links between specific inputs, calculations, and outputs
- Formatting and colour coding to illustrate cell/worksheet function
- Glossary of acronyms/abbreviations and technical terms

Consider Using

- Tables and named ranges (for robust referencing)

Spreadsheet Best Practice

- Plan a model structure before starting to build
- Aim to move data from left to right and top to bottom through the workbook
- Try to keep formulae consistent across columns or rows
- Avoid complex nested formulae (break them down across columns)
- Use meaningful headings
- Keep inputs, calculations, and outputs on separate worksheets (it can be appropriate to have outputs on inputs pages for real time testing)
- Avoid external links; include source data in its raw form in the workbook
- Avoid circularity (worksheet A refers to worksheet B so worksheet B should not refer back to worksheet A)
- It’s intuitive to scroll vertically so aim to use more rows than columns
- Aim for consistency between worksheets (heading text, column and row positioning)
- Avoid duplication
- Keep it as simple as possible to do the job

Appendix B : Ofgem model quality assurance checklist

QA activities to be performed	Completed (Yes, No, NA)	Comment (must be provided if answer in column 2 is other than "Yes")
Structure and clarity		
Model structure		
Model logic map or flowchart	No	There is no model map or flowchart included within the models.
Are calculation flows within worksheet logical and easy to understand?	Yes	In general calculation flows are understandable but there are several occasions where the model does not use a one way flow with results referenced from latter worksheets or from further down the same sheet. Ideally a left to right and top down approach should be used. The model would also benefit from more documentation within the model or in a separate handbook to explain the flow. We understand that a handbook is being prepared.
Do similar worksheets have similar structures?	Yes	All tables related to PCFM work have the same structures.
Are similar tables laid out in similar way?	Yes	
Is the model free from anomalous calculation/label/text cells?	Yes	
Titles and labels are present, logical and accurate	Yes	
Units are indicated	Yes	
Rounding is performed in a clear and correct way	Yes	

QA activities to be performed	Completed (Yes, No, NA)	Comment (must be provided if answer in column 2 is other than "Yes")
Formula clarity & robustness		
All unique formulae have been checked for correctness	Yes	We have confirmed that calculations are sensible and consistent with provided formula to the extent possible. Since the model itself is seen as part of the licence, and hence specifies the correct calculations, we rely on Ofgem to confirm the approach is as intended but are satisfied that the calculations appear sensible.
Hardcoded values within formulae are used only when absolutely necessary	Yes	There are a few remaining cases of hardcoding within formula, but most instances have been removed.
Are formulae easily understood?	Yes	Individual formula are straightforward to understand.
Are merged cells avoided for inputs, calculations and outputs?	Yes	
Named ranges management		
Named ranges follow agreed naming convention	Yes	Named ranges are used and have clear distinct names. We are unaware of any convention.
Named ranges naming convention is meaningful and easy to understand	NA	We are unaware of any convention.
There are no corrupted names	Yes	

QA activities to be performed	Completed (Yes, No, NA)	Comment (must be provided if answer in column 2 is other than "Yes")
Verification		
Formula correctness		
None of the following errors exist in cell outputs: #NULL!, #DIV/0!, #VALUE!, #REF!. #NAME?, #NUM!, #N/A!.	Yes	
Do all formulae refer to the correct cell?	Yes	
Have formulae been copied down and across as far as they should be?	Yes	
Are all formulae which refer to named ranges calling the correct range?	Yes	
Is the data being pulled into the calculation modules correctly?	Yes	Data calls from inputs appear sensible but we rely on Ofgem for assurance that these are all as intended since the licence says that the calculations are as per the model.
Do numbers apply to the correct time period (e.g. the middle of the month/year versus the beginning/end)?	Yes	
Are financial year and calendar year data managed correctly?	Yes	
Code correctness (if applicable)		
Does the code function as intended without error, and produce the intended results?	Yes	The results appear sensible.
Are hard-coded references to cells used only when absolutely necessary?	Yes	
If they are used, are they referring to the correct values?	Yes	
External links		
Are links to external documents used only when absolutely necessary?	Yes	Links to external documents have been removed for the final versions of the models.

QA activities to be performed	Completed (Yes, No, NA)	Comment (must be provided if answer in column 2 is other than "Yes")
Are they properly documented?	NA	No external links are used
If external links are used, do they pull in the correct, up to date data?	NA	No external links are used
Can the external data be 'refreshed'?	NA	No external links are used
Open the file on a different machine to original to ensure no undocumented error messages occur	Yes	We have opened the model on GAD machines
Check the external links to ensure the most up to date data is used. This may involve requesting access to source files and engaging with owners of the data	NA	No external links are used
Validation		
Methodology correctness		
Is the methodology used sensible and fit for purpose?	Yes	We have confirmed that calculations and methodology appear sensible
Was the model methodology reviewed and agreed with relevant stakeholders?	Yes	The methodology was presented to us in the form of the model. We have challenged Ofgem on areas of uncertainty and have been satisfied with the replies on all our queries
Does the model produce "logical" outputs?	Yes	The outputs of the model appear logical. To the extent that GAD are not experts in Gas and Electricity markets we have placed reliance on assurances from Ofgem
Are they in the range of what would be expected?	Yes	The outputs of the model appear to be in the expected range. To the extent that GAD are not experts in Gas and Electricity markets we have

QA activities to be performed	Completed (Yes, No, NA)	Comment (must be provided if answer in column 2 is other than "Yes")
		placed reliance on assurances from Ofgem
Do the values change in expected direction, at an expected magnitude when inputs are changed?	Yes	Throughout our model QA we have adjusted inputs to check the validity of the calculation approaches.
Have model outputs been sense / reality checked and agreed with relevant stakeholders?	Yes	We have relied on assurance from Ofgem that outputs are as they expect as they are the key stakeholder.

Appendix C : Model versions

This appendix provides details of the final versions of the models reviewed by GAD.

Model Type	Model Name	Date received
GD	GD2 PCFM 2.7 (GAD)	02/02/2021
ET	ET2 PCFM 2.9 (GAD)	02/02/2021
GT	GT2 PCFM 2.5 (GAD)	02/02/2021
ESO	PCFM ESO v2.5 (GAD)	02/02/2021