CCC - Quality Assurance of Evidence and Analysis

Committee on Climate Change

January 2014

Foreword

The provision of high quality analysis is central to the function of the Committee on Climate Change under the Climate Change Act.

We have worked hard to earn an excellent reputation in this regard.

Nevertheless, we have all seen the kinds of problems that can arise in central government departments when analytical models used to inform decision-making in policy have, for whatever reason, failed to withstand scrutiny.

Given our analytical function, it is of the utmost importance that we maintain high standards, that our analysis should remain credible to those that rely on it and that it stands up to the highest levels of external scrutiny.

Last year, the Macpherson review made a number of recommendations relating to processes of Quality Assurance - and its importance - within government departments and non-departmental public bodies.

What is clear is that quality assurance should be embedded in the way that we approach, deliver and communicate analytical work.

We have a good record already. This guidance is intended to help staff further understand and deliver what is expected.

We will also publish this guidance so others can see what we expect and understand our processes. This is a necessary component of transparency; we also want to learn from others' experience.

Whilst this note formalises existing processes, this is not about creating unnecessary delay and disproportionate process around the delivery of advice. It is essential that QA is planned proportionate to the complexity of the model/analysis and the risks attached to error in that analysis. Some examples are provided by way of guidance.

For the moment, please regard this as interim guidance. We will need to keep this under review. We intend to add to user friendliness by developing a flow-chart of the steps to go through, and a number of templates for use in recording QA actions taken.

Your feedback over coming months will be welcome.

Adrian Gault

Chief Economist

1. Introduction

Quality Assurance (QA) is an on-going process about understanding, minimising, and factoring in risks around the generation and use of evidence. QA helps ensure evidence is of good quality and is fit for purpose.

It is essential that analysts in the CCC should understand the mechanics of models that are being used – these should not be a "black box". This means understanding what are the key variables and how they drive results; being able to explain results; and triangulating results with off-model evidence.

Ultimately, this reduces the risk to CCC analysis and reputation from producing, using and publishing evidence that could be incorrect, misleading or inconsistent.

Making results and methods of analysis transparent can be an effective mechanism for driving up standards of quality. This is particularly critical for the CCC, being a young organisation strongly based on evidence and high quality analysis. Transparency and robust QA will reduce the risks of reputational damage. Consistent with this, aside from any requirements arising from Freedom of Information requests, we generally expect to publish the evidence base for Committee recommendations, including commissioned consultancy work.

Coverage

Sometimes our evidence draws on approaches we would all clearly recognise as "models" (e.g. NERA heat model; DECC Energy Model; Redpoint PLEXOS power dispatch model). Model QA is included in the coverage of this note (for a definition of "model" see Box 1), and should be considered for both in-house CCC models and modelling work bought-in from outside. It should be embedded in both model development and model use (including existing models).

But our analysis goes wider, to include, for example, off-model estimation and conclusions drawn from wider reviews of evidence. QA should be thought about for our analytical approaches more generally.

So this document aims to provide guidance as to what is expected for QA of evidence and analysis, not just "models".

That is not to say that the QA requirements are the same. Where a formal "model" is being used it is likely that the requirements will be more substantial; for a few minutes work to produce a number in answer to a specific query, clearly it'll be less.

In all cases, therefore, there is a need to be proportionate. But in all cases sense-checking of findings is a minimum requirement.

Box 1: What is a model?

As set out in the Treasury's "Review of Quality Assurance", a model is:

" a mechanism for analysing or investigating some aspect of the real world. It is usually a quantitative method, system or approach which applies statistical, economic, financial or mathematical theories, techniques, and assumptions to process input data into quantitative estimates. There are typically three parts to a model:

- *Inputs – in the form of data and assumptions;*
- *a processing component – often through calculations; and*
- *outputs – the key figures as well as the risks and limitations of the models."*

Source: Review of quality assurance of government analytical models: final report (HM Treasury, March 2013)

2. The essential components of QA

The essential components of QA (Box 2) are:

1. **Plan** effectively to ensure proper QA can be done before use and publication of evidence
2. Use the expertise of appropriate people from relevant disciplines, internally and externally, to **peer review** and improve work
3. Seek **analytical clearance** of the evidence/analysis within a piece of work
4. Obtain **final approval** for publication or use of final product, taking account of risks and uncertainties in the analysis and its presentation

What CCC outputs need to have their evidence and analysis QA'd?

All analytical outputs should be subject to QA. The depth and type of QA will vary depending on the nature and scale of the analysis and risk attached to results.

What does this mean in practice?

When evidence or analysis is generated or used, proportionate checks must be made to ensure that risks and errors are identified and minimised. This means that high-risk,

complex analysis is subject to rigorous scrutiny, and low-risk products are independently sense-checked.

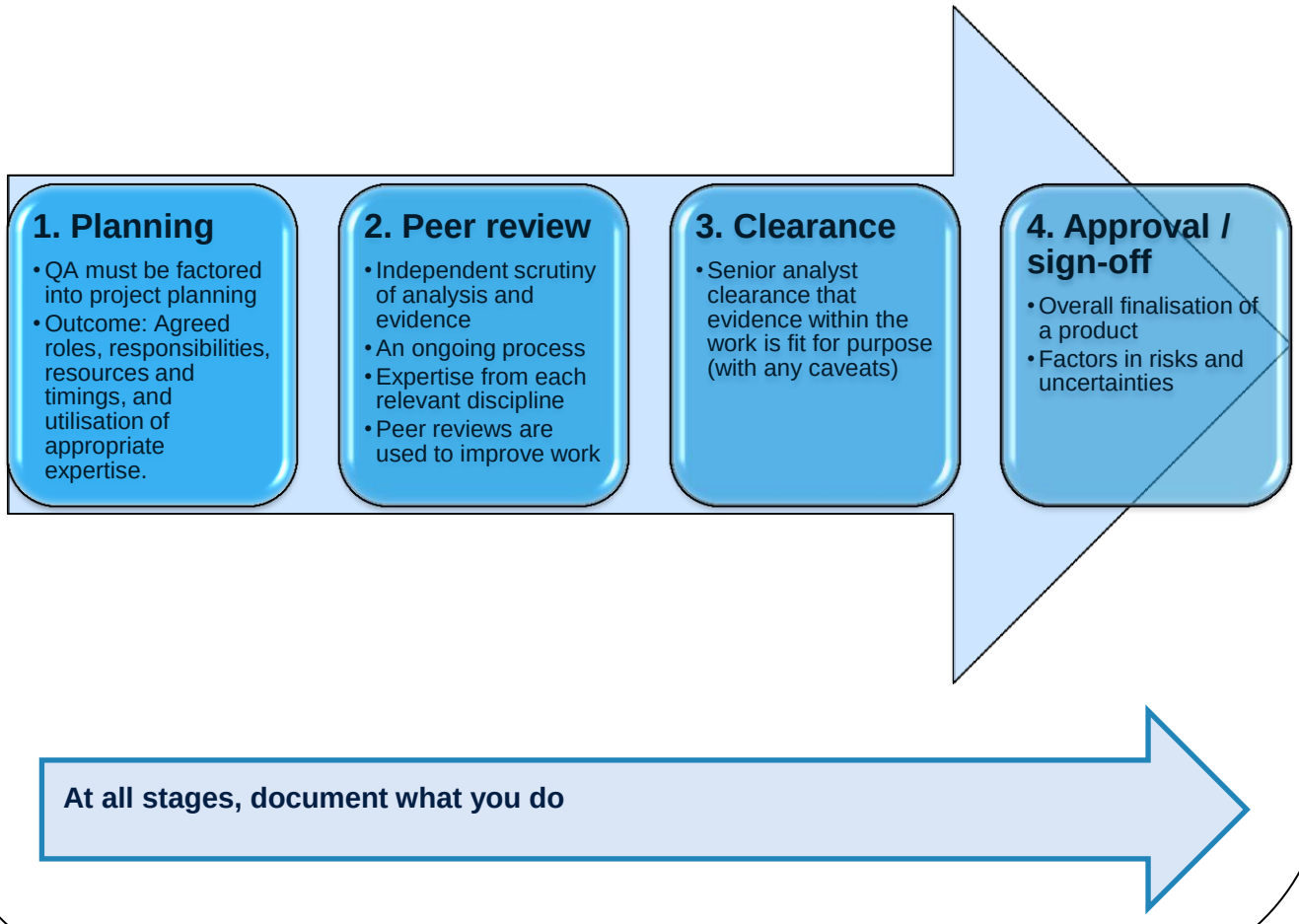
The level of assurance required should increase with the assessed impact of the results and consequences of error (see **Annex A** for an approach to assessing such impact)

The more complex or innovative the approach, the higher the risk of error, and therefore the greater the level of QA that should be undertaken (see **Annex B** for an approach to assessing complexity).

Robust procedures and assurance will require that more than one person should be actively involved.

Box 2: the stages of QA

There are four stages to successful analytical quality assurance, illustrated in the diagram below and explained further in section 3 of this paper.



Isn't this what we and the Committee do all the time?

Essentially, yes!

The CCC is an analytical body. We frequently use external research, combined with our own analysis and review, and test this out with stakeholders, Committee members and in Committee meetings.

In the end, the Committees have to be content with the analysis and sign-off publication.

The committee members are experts in their fields and will want to know about methodologies used, robustness and uncertainties of results, and how they have been tested. Frequently, they will pick up on results that are unexpected or look a little odd.

But it is important that we conduct good QA ourselves, and also that we have processes in place that allow us to demonstrate this is the case (for the Committees and beyond).

3. Accountabilities and responsibilities

Key accountabilities and responsibilities within the QA process are outlined below. Just who will take these roles may vary depending on the model or output. For some outputs, and given the analytical size and nature of the secretariat, it is possible that 2 of the roles here may be merged to be taken by the same person.

Analyst	• Responsible for **planning evidence and analysis QA and ensuring that it takes place.** Responsible for agreeing these QA plans with the SRO. • Identifies at an early stage who holds each role, and that they are aware of the associated accountabilities and responsibilities. • Responsible for acting on peer review outcomes and for recording, reporting and escalating analytical risks to the SRO.
Senior Responsible Owner	• Generally the team leader; may be a Senior Analyst • Holds overall **accountability** for the quality of the data, analysis and evidence for the project • Responsible for drawing risks and uncertainties, and any limitations in the QA process, to the attention of Analytical Clearance
Analytical clearance	• Frequently the team leader; may be the Chief Economiist. • Responsible for **signing-off plans for analysis**, including QA activities • Responsible for **clearing the analysis** prior to submitting to the Approving Body, including ensuring risks and uncertainties are drawn to attention of Approving Body
Approving Body	• Accountable for the decision on whether or not to **grant approval for use of an analytical output** • Responsible for factoring in considerations of risks and uncertainties

Some CCC specific examples of who might take these roles are provided at the end of the section.

3.1 Analyst – planning and peer review

Within the analyst role, there is a particular requirement to consider the role of **peer review.** The function of peer review is to *independently* scrutinise the evidence and analysis, and to help the project team improve the quality of the evidence and reduce its risks. The form of peer review may vary greatly between projects, depending on the subject, the risks and the complexity of the evidence and analysis.

Reviewing outputs of external models

When awarding research/consultancy work, the QA processes of the potential contractors will form part of the assessment of who to contract with. We need to be assured, through the response to tender and interviews (and subsequent project management) that the proposal will meet our requirements and standards.

Consideration should be given to the required output from the contract. Where possible, where contractors have to develop a modelling capability as part of the work, we generally expect to acquire that model, and user guidance, as part of the final output. Sometimes where a contractor runs their own model that may not be possible – provenance of the model and QA processes in the course of the contract are then even more critical.

During the contract, part of the role of the CCC Project Manager will be to ensure that quality standards are being met. It is likely that an Advisory Group will also feed into review of progress.

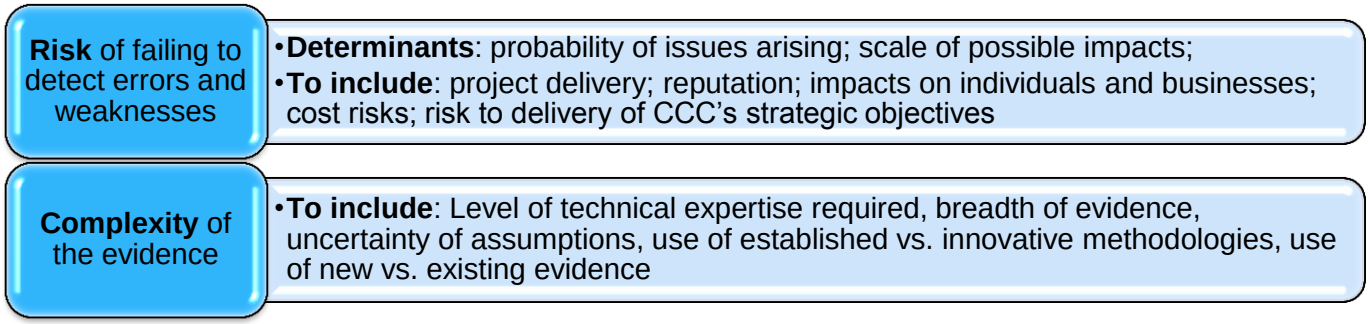
The Project Manager will clearly need to check results being received from contractors, which may include checking of model results and workings. Results provided by contractors cannot be assumed to be correct!

What type of peer review is required and who needs to peer review?

Peer review can take several forms, and will involve different expertise. The Analyst should agree with the SRO the type of peer review required as early as possible in the project, and the relevant disciplines that must be consulted.

- At the simplest level, peer review will involve sense-checking by a colleague, independent to the project.
- At a higher level, Committee Champions and/or stakeholder workshops could be drawn on.
- Where a formal model is being used, it's unlikely that Committee Champions or stakeholders are going to get into detailed checks (though they might look at broad structure). Getting a colleague to look at model calculations is an option.
- At the highest level, formal, external expert peer review might be commissioned.

The person responsible for Analytical Clearance has a role to challenge and agree the peer review activities to ensure they are sufficiently rigorous. This will be based on two considerations:



What do I do with peer review comments?

The project team should use the advice received through the peer review process to improve the evidence and analysis, reducing risks and uncertainties.

The Analyst must record details of the peer review process. They should communicate to the SRO and for Analytical Clearance:

- Scope of peer review
- Peer review findings, and actions taken or proposed to address these findings
- What risks and issues identified by the peer reviewer still remain (and why).

Note: in planning QA requirements you may want to consult the Head of Modelling in CCC

He may be able to advise on:

- Suitability of use of existing models for new projects
- Peer review
- Consistency of assumptions, use of model, etc with other modelling in CCC
- Help in evaluation of bids and choice of contractors for external projects
- Potential peer reviewers

3.2 Senior Responsible Owner (SRO)

The Macpherson review has recommended that there should be a single Senior Responsible Owner for each business critical model. We can extend this to analytical outputs more generally. Key functions for the SRO are:

- to confirm that the QA applied is appropriate;
- to ensure that the risks, limitations and major assumptions around the model or product are understood by users;

- to ensure that major uncertainties and sensitivities around results are communicated to users/clearers.

Generally the SRO in the CCC will be the relevant team leader.

3.3 Analytical clearance

Clearance is the process by which a senior analyst (generally a team leader or Chief Economist) indicates that either a) he/she views the analytical aspects of the work as fit for purpose, or b) that the work has serious risks, issues, or uncertainties that must be factored into any final sign-off or approval decision to be made with the work.

The person clearing the work is responsible for ensuring their key concerns around the evidence and analysis are accurately reported.

What do I need to do to clear analysis or evidence in a piece of work?

The clearance decision does not require full fresh scrutiny of each small detail. Instead, it should be based on comments received from the peer review process, and also follow-up challenge through discussion with the project team.

The clearance statement may be written (preferably) or, depending on the nature and risks attached to the product, may be oral.

Key aspects considered at clearance should be communicated to the approver:

- The scope, type and level of QA that has been undertaken
- The key outstanding risks, uncertainties and issues around the analysis and evidence. **Any significant remaining risks around quality must be clearly communicated to the approver.**

3.4 Approval (Final sign-off)

Approval/sign-off comes after analytical clearance, and constitutes the agreement from the relevant Committee, Champion, or other delegated approver, that the project may proceed to completion/publication.

The **Approving Body** is accountable for factoring into their decision the evidence risks that they have been advised of.

The Approving Body will vary depending on output under consideration (see Table 1 for examples).

Record keeping

The final results, together with the underlying method and analysis, records of peer reviews, clearance and approval decisions, should be filed by the Project Manager. The underlying calculations and methods should be available to share with interested stakeholders on request, so need to be clear and understandable.

A record of what steps were taken to address issues raised during peer review must be filed, together with a record of outstanding issues (e.g. the peer reviewers supported the findings of the report subject to certain caveats).

Knowledge transfer

It is essential that the outputs of all CCC research and analysis activities can be easily found, not just by the immediate project team, but across the CCC.

It is also important to avoid single person dependency by documenting all aspects of a model or analytical method and making sure formal hand over processes are in place.

Model records need to be kept up-to-date. In line with recommendations of the Macpherson review, documentation should include:

- Model scope and specification
- Purpose, limitations and risks
- Quality assurance undertaken
- Identity of model SRO with overall responsibility to ensure the model is “fit for purpose”
- That the model customer (Committee) has understood the outputs and any major uncertainties, including the results of any sensitivity analysis.

Table 1: QA responsibilities for specific CCC products

Note: Analytical clearance and approval responsibilities will in some instances be delegated. This table presents the default approach, before any delegation.

Document type	Examples	Analyst	SRO	Analytical clearance	Approving Body	*Notes*
Committee Report	*Budget recommendation, Progress Report*	**Team member (varying by topic)**	**Team Leader**	**Chief Economist**	**Committee**	
Committee letter		**Team member**	**Team Leader**	**Chief Economist**	**Committee**	
Technical Report	*The 2050 Target*	**Team member**	**Team Leader**	**Chief Economist, Champions**	**Chief Executive**	
Consultancy Report		**Team member**	**Team Leader**	**Team Leader**	**Chief Economist**	*Depends on scope. Relevant analytical disciplines need to be involved in QA of assumptions (e.g. science and economics) Committee Champions should be consulted, while external peer review likely needed for high-profile products*
Consultations	*Calls for evidence*	**Team member**	**Team Leader**	**Chief Economist**	**Committee**	
Committee presentations		**Team member**	**Team Leader**	**Chief Economist**	**Senior Analyst (Team Leader)**	
Research specifications	*ITT for external research/consultancy*	**Team member**	**Team Leader**	**Team Leader**	**Chief Economist**	
In-house (ultimately feeding into reports)	*Best use of biomass*	**Team member**	**Team Leader**	**Team Leader**	**Chief Economist**	
In-house (ultimately feeding into reports)	*ESME*	**Team member**	**Head of Modelling**	**Head of Modelling**	**Team Leader**	
Other analysis or evidence				*The principles set out in this guidance must be followed for all published outputs. Clearance and approval responsibilities will vary, but proportionate quality assurance must always be conducted and risks always need to be communicated to decision-makers.*		

4. The QA framework – processes (models)

A wide range of QA processes can be deployed. They should go beyond the simple checking of whether a model calculates without error. In particular, QA should ensure that:

- The model is securely managed, stored and operated (Model Control Environment).
- The primary data being input to the model is of good quality.
- Model is developed to perform accurately and reliably.
- Model is accurate and reliable in use.
- Appropriate governance is in place.
- Results make sense!

Where model development or use is contracted outside CCC, the tender documents should include requirements for an appropriate QA regime.

The information contained within this section is intended to provide a little more clarity around the specific processes that can be adopted. It is not intended to be exhaustive or limiting, as specific areas and model types are likely to have a greater depth of QA process than can be captured in general guidance.

4.1 Model Control Environment

Access Control

Access control is aimed at ensuring that changes are not made maliciously or accidentally by external parties.

Given the small size of CCC, this may be enacted by placing the model on our IT network, as a secure file area.

In the unlikely event that there is a need to go beyond that, then this could involve password protection with limited distribution of that password to a list of users that is logged and regularly reviewed. If such a need is identified for consideration it should be raised with a team leader in the first instance.

Change Control

Changes made to the model should be subject to a proportionate approvals process. This process should be clear to all those using or developing a model.

Local teams will want to consider what those processes should be, with what levels of delegation, appropriate to each model.

Changes should be recorded.

It is also important to consider whether controls are needed to prevent changes to the structure of the model or its inputs by, for example, the use of a read-only version.

Version Control

Version control is a simple process to embed within the development and use of a model and is fundamental to ensuring that the version in question is the one that it is believed to be. For example, a document may be circulated for comment and involve multiple comments made by a range of people simultaneously. Version control of a model acts to ensure that a record is kept of all 'comments' that have been made on the model. It is possible that there could be multiple versions of a model performing slightly different functions to different policy areas. Version control is vital to ensuring such situations are documented.

The approach to version control can be relatively informal, perhaps through the use of consistent date stamping on file names.

Where models are important or complex, with lots of inter-connected files and programs, it is advisable to keep a log of all versions, complete with the date, name and time that a new version was created. That log should record what is different about the new version and perhaps how this has altered the main output.

Whether formal or informal, there should be a standard approach to version control that is consistently understood and applied by all model users.

Note: Excel Workbooks

For Excel workbooks it is recommended that standard practice should be to have a sheet for Version Control and a Welcome sheet.

The former would document the changes/comments made to the model.

The latter would cover: creator; date of creation; purpose; source inputs/assumptions; basic user guide with link to further model guidance if needed/available; example outputs/findings; spreadsheet "map"; formatting conventions.

In developing spreadsheet models it is also recommended that you:

- Avoid hard-wiring data into formula
- Keep data inputs on sheets separate to analysis.

Back-Up and Recovery

To ensure that CCC is resilient to IT or infrastructure failure, all models should be able to be restored if the primary version of the model or access to IT system on which the primary version of the model is stored is disrupted. If the primary storage area is the L: drive, there should be a back-up version elsewhere.

To enable a proper audit trail of past decision-making, consideration should also be given to the storage of previously live versions of the models, upon which recommendations were made. It also helps if subsequent errors are found, in that analysis can be completed on previous model versions to understand the size of any error. Storage of previous live versions of a model will also aid any future ex-post evaluation.

Single Person Dependency

Where the development, use or interpretation of a model is reliant on a single person, this imports a significant amount of risk into the use of analysis and decision-making based on that modelling. This may be an acceptable risk where the modelling is straightforward or of limited impact. Where it is more complex and high impact, then it is likely that the risk will need to be mitigated. Consideration should be given to building capability amongst a wider number of staff.

The second risk however, is that the use of a single developer or user, through no fault of their own, may increase that chances that errors in the model or model approach go unchallenged. This may point towards the need for higher levels of independent review when the model has been developed or is used by a single person.

User Guide and Succession Planning

Ideally each CCC model should contain either a user guide or instructions within the interface that, as a minimum, enable an ‘intelligent new user’ to produce new model runs without, or with clearly described, further input.

More comprehensive user guides can prove resource-intensive, and the precise format and content should take into account how frequently the model may be used in the future, how complex the model is to use and how wide the scope for error is in the operation or interpretation of the model. Where external contractors have been paid to develop a model, a comprehensive user guide should be seen as a way to protect that investment.

Strong QA practice would also include succession planning, where someone with the right skills and experience to take over the primary model user role is identified. Ideally this would encompass a period of handover to properly facilitate the transfer of the modelling function and capability.

Documentation Standards

There should be documentation of methods, sources and underlying reasoning which is a reference source, to allow new developers to understand the model's construction, and enable them to undertake new development work or create a new version.

All users and developers should have an understanding of what is expected. This may include formal documentation of elements such as model procedures, controls, structure and use. Model parameters and assumptions should be transparent and evidence-based.

Skills and Experience

Model developers and users should have appropriate levels of skill and experience in developing and using the model or model techniques. For complex models it may be appropriate to ensure sufficient skills internally to operate and update a model, but with external expertise used for development.

If the appropriate capability does not exists within CCC, it may be necessary to build the capability through the use of a training and development plan that formally considers the appropriate skill mix and sets out how any gaps are to be filled.

Where there are multiple models interacting, there should be at least one member of staff that understands how they all fit together and has oversight of their interaction. Currently the Head of Modelling has this role.

4.2 Primary (input) data

Model results can only be as good as the data being fed in.

Data sources and year should be recorded. Where more recent data become available, consideration should be given to updating the dataset.

Weaknesses and uncertainties in input data, for the task in hand, should be considered. They should be drawn to the attention of SRO, analytical clearer and approving body.

4.3 Model Accuracy and Reliability in development

The development of an analytical model can be thought of in three stages:

- Specification: The development of a common understanding of what the model is needed for; what questions the model will answer; what the risks and limitations around the different possible approaches are; what the timescales are and what complexity and quality is required.
- Build: During the model build stage, the model owner or developer should be ensuring that the model is developed or used in line with the agreed specification and that any deviations or problems are communicated.
- Test: The final stage in the model life-cycle comes when the outputs are tested against requirements to ensure that they answer the question that was set and that any limitations and uncertainty is understood.

Input Validation

Input validation provides assurance that the data inputs and assumptions entering into the model and upon which the model calculations are made, are accurate and reliable. By accurate, we mean that the inputs are in the correct format and do not contain any errors. By reliable we mean that they are the correct inputs for the question in hand, for example the correct measure of GDP or inflation.

As well as data inputs, the model is also likely to have parameters. These are structural properties of the model, such as elasticities, and might be fixed for many runs of the model. These parameters will also need to be kept under review as part of the input validation process.

Once data and assumptions have been entered into the model, good practice is to formally log their sign-off, perhaps in a separate register.

Developer Testing

Developer testing is a catch-all term for a wide range of processes and tests that can be undertaken to ensure that the model is reliable. This element of the QA regime may prove the most time and resource heavy part of the process. It will be for individual areas and model owners to identify the processes that are appropriate to their modelling.

Further to identifying the available range of developer tests, it is for model owners to agree the appropriate set of tests, addressing the trade-off between time, quality, cost and resulting risk that is considered acceptable.

Communication of Model Limitations and Uncertainty

The results from a particular analytical model are more often than not, only going to be one part of the overall decision-making process. For the Committee to understand the weight they may wish to place on those results, the limitations and uncertainty in the modelling need to be communicated. To inform this, consideration should be given to:

- Sensitivity testing – how sensitive are results to plausible changes in individual assumptions.
- Scenario testing – how sensitive are results to plausible changes in a group of assumptions.
- Uncertainty in the modelling – the range of statistical uncertainty that exists around a result, perhaps caused by the uncertainty in the forecasts of inputs or model parameters.

- The limitations of the model – what are the questions that the model cannot or should not be used to inform.
- Risks from the QA approach - what are remaining risks given the mix of QA that has and has not been conducted, with reference to model impact and complexity?

Independent Review

Independent review is a strong element of any model QA. The degree of independent review that is desirable should be considered at the start of an analytical project and time and resource built into the project plan to allow for it. As a project evolves, it may be that the modelling turns out to be more risky, either through complexity or profile than anticipated. In such circumstances, it is likely that the degree of independent review that is desirable would increase.

Irrespective of the type of review that is chosen, it will always make sense to include someone other than the model developer or user performing a high level sense check of the final results.

The exact nature of the review and the checks and assurance that you are seeking to achieve, should be made explicit in a Terms of Reference. It is likely that the mechanism for ensuring independent review may vary from model to model. For example:

- Internal Review - usually defined as being undertaken by someone other than the modeller or model developer, but internal to the organisation. This may range from high level sense checks, to more detailed interrogation of a model.
- External Review - External review may of itself be no more stringent than an internal review, but it is defined as being by someone outside of CCC. This could be a professional services firm, a government department or an academic institution.
- Peer Review - Peer review tends to be a sub-set of external review, usually associated with a more academic approach to testing the overall quality of the approach taken and whether it fits with accepted best practice. The review tends not to focus heavily on the checking of calculations, but may, for example, suggest whether the overall approach to is valid.
- Internal Model Audit - Internal audit is likely to perform a different function to a review and will involve the use of a professional audit firm or possibly Defra/DECC own internal audit team. Internal audit may focus more on the risks in the process for undertaking the modelling and test the controls that are in place to mitigate those risks.
- External Model Audit - External audit will involve the use of a professional external audit function. An external audit is likely to be a comprehensive test of how the model functions, with the aim of signing off the final set of results as being accurate.

4.4 Model Accuracy and Reliability in Use

Effective model use means understanding what a model can and cannot do, asking the right question and understanding why it comes up with the answer it does. That answer should then be used within its limitations, and alongside other available evidence, to inform the Committee's position. Recommendations/decisions should never simply be justified *"because the model says so"*!

Input Validation

Similar to input validation for model in development, but will be focused on ensuring the input data and parameters remain valid.

Testing of Model Runs

Testing covers a wide range of processes and tests that can be undertaken to ensure that the model is reliable. This element of the QA regime may prove the most time and resource heavy part

of the QA process. It will be for individual model owners to identify the processes that are appropriate to their modelling.

Communication of Model Limitations and Uncertainty

Similar to the processes used for model development, but as the model is likely to have been used in the past, it might be possible to glean more information about uncertainty by comparing past results with actual outcomes. The use of benchmarking against past outcomes and reviewing past model performance should help explore these questions in more depth.

Independent Review

Again, the main types of independent review will be the same for a model in use as for a model in development. However, if a model has been extensively tested during development it may be that stringent reviews need only take place when significant changes are made to the model. Where that is not the case, independent review is likely to focus on the interpretation of results, understanding why they have changed from one run to the next and ensuring that the approach is suitable for the question being asked.

4.5 Model Governance and Transparency

Governance

Governance is the process by which risk is managed and the appropriate QA regime signed off. Appointing a Senior Responsible Office for each model helps to drive leadership and should form part of the governance framework. The appropriate level for the SRO will be determined by the impact of the model, but for business critical models, it is unlikely that the SRO will be below team leader level.

Thinking about the three stages of model development, governance should play an important role in all three:

- Model Specification
  - Establish the appropriate QA regime taking account of the model impact matrix and the degree of model complexity.
  - Identify resources and timescales for delivery.

- Model Build (running and use of model)
  - Monitor progress towards timescales
  - Provide a forum through which risks to delivery can be raised and mitigated.
  - Consider whether the QA regime remains appropriate.

- Model Testing (signing off results)
  - Provide challenge to final outputs.
  - Establish that the QA regime was followed.
  - Communicate risk and uncertainty to decision-makers.
  - Sign-off the completion of the modelling.

Transparency

Transparency is a powerful tool for improving the quality of analytical work. It encourages those producing something for public consumption to undertake more rigorous checks. It opens up the approach and results to a wide range of external experts and can spark challenge, debate and research.

On occasion there may specific reasons which limit transparency - commercial sensitivity for example. But in general CCC expects to make analytical modelling work as transparent as possible.

4.6 Sense checking

Think about the results.

Again and again!

Annex A: Model Impact Matrix

Description	Low (1)	Medium (2)	High (3)
Role of analysis in the final decision	Model or analysis is one of many factors determining the decision and is not critical.	Model or analysis is one of the most important factors in the decision-making process	The model output is the most important factor in the decision-making process
Size of the financial allocation to which the model relates	Modelling is used to inform recommendations which bear on a small (below £100million) amount of Govt funding	Modelling is used to inform recommendations which bear on a medium (£100-500million) amount of Govt funding	Model is used to inform recommendations which bear on a large (over £500million) amount of Govt funding
Size of the wider welfare impacts	Gross welfare impact (positive or negative) <£100 million	Gross welfare impacts (positive or negative) >£100million <£500million	Wider welfare benefits or costs over £500million
Level of reputational risk	Model is only used internally	Model output is likely to inform a public statement but not explicitly stated	Model output is quoted publicly
Model is essential to business plan activities	Model has no relevance to business plan or activities	Model forms part of the reporting for business plan	Model is likely to determine success against a business plan objective
Number of times model is used	One-off single use	Used for one or two projects annually	Used frequently, for multiple projects

Annex B: Model Complexity Matrix

Description	Low (1)	Medium (2)	High (3)
Form of the Model	Simple spreadsheet, perhaps using one or two sheets with limited amount of data transformation	Complicated spreadsheet, perhaps over several worksheets with multiple sources of data and calculations.	Model is an application running through code.
Innovation	Model follows well-established techniques with a strong evidence-base	Model follows well established techniques but may involve the generation of new evidence, i.e. econometric modelling or some other forms of innovation	Model is innovative and either applies techniques in a new way or involves developing a new approach.
Interactions / Iterations	Modelling requires no iteration or interaction with other models	Modelling requires a limited amount of iterations and interactions with other models but not too complex	Model involves a high degree of iteration and interactions between models.
Scale / Visibility	Easy to gain oversight of the whole modelling process and limited amount of key information to check and report	Modelling is challenging to oversee, relying on a number of key assumptions and results to gain confidence in the output.	Modelling is very challenging to oversee, relying on oversight across a range of models and model interactions.