RICARDO-AEA

Assessment of the risks associated with certain biomass fuel sourcing scenarios

Proposal for DECC

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Note: In November 2012, Ricardo plc acquired the assets and goodwill of AEA Technology plc and formed a new company, Ricardo-AEA Ltd. The entire capability and resources previously represented by AEA Technology plc were transferred Ricardo-AEA, as were all employees. Consequently, where specific projects or track record referenced in this proposal were undertaken and completed prior to the acquisition, for contractual reasons, these continue to be identified as AEA Technology plc.

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1.1 Understanding and policy context

DECC has policy leadership on measures that will influence biomass as a renewable energy source in the UK. Working with other departments and agencies, DECC sets the overall direction for renewable energy policy and specific measures that influence the development and operation of biomass power plants (e.g. Section 36 consents, CfDs, sustainability criteria). Investors have responded, making significant investment at Drax and Lynemouth power stations.

Sustainability of biomass for power generation has attracted significant attention and many studies have been conducted on this (for example, Ricardo-AEA reviewed these studies for Defra in 2014[1]). This particular issue is complex, as many supply chain options are involved and the evidence is not always robust. This complexity, and the established position of some observers, has created an atmosphere in which developing a consensus is particularly hard. To inform the consideration of this key issue, DECC commissioned the development of scenarios using the Biomass Emissions and Counterfactual Model (BEAC Model) to characterise a wide range of supply chains for pellets for import to the UK in North America. This project will build on this work, collecting evidence and assessing the likelihood of the scenarios.

This work therefore needs to provide robust and unbiased conclusions. We have included in our proposal:

- A team of experts in the USA and Canada - with close contacts in the forestry sector
- A stakeholder survey and literature review - to gather established and up to date evidence from academic and commercial sources
- A methodology to assess the strength of the evidence gathered
- Development of a likelihood assessment, using models of forestry supply and demand that have already been validated
- A team experienced in gathering evidence and developing policy tools for DECC and other UK policy makers

This approach will demonstrate the robustness of the evidence and by extension provide potential investors the confidence they need and inform the implementation of efficient policy measures.

1.1.1 Context of the project

This project follows up the DECC 'BEAC[2]' report, which looked at the GHG emissions intensity & energy input requirements of a series of scenarios for North American woody biomass supply for electricity generation in the UK. In particular, BEAC aimed to account for the impacts omitted by the EU RED methodology, including emissions or sequestration from carbon stock changes on the land, foregone carbon sequestration and indirect impacts.

Scenarios were constructed to represent current wood feedstocks used for pellet production and feedstocks that could be draw into the market if demand rises. These included some scenarios that the authors themselves admit may not necessarily be likely: the intention of the analysis was to shed light on what potentially would be satisfactory in terms of GHG intensity and energy input requirements and what would not, in order to guide and justify future policy decisions. This proposal is aimed at providing an evidence base to help understand the likelihood of the scenarios that BEAC defined as "not likely to be satisfactory". These were:

- Scenarios 10-13: Increased harvest of naturally regenerated forests
- Scenarios 19-21: Displacement of non-bioenergy wood uses i.e. US pulpwood going to the UK instead of the US paper industry
- Scenario 14: Change in the use of wood grown in intensively managed pine plantations from non-bioenergy to bioenergy uses
- Scenarios 4-7: Forest residues that would otherwise have been left in the forest being used in pellet production

[1] Ricardo-AEA (2014) Review and synthesis of bioenergy and biofuels research, http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=19177

[2] Mackay D J C and Stephenson A L (2014) Life cycle impacts of biomass electricity in 2020: Scenarios for Assessing the Greenhouse Gas Impacts and Energy Input Requirements of Using North American Woody Biomass for Electricity Generation in the UK

- Scenario 26: New plantations on abandoned agricultural land; additional wood from the conversion of abandoned agricultural land that was previously ploughed to a short rotation coppice (SRC) hardwood plantation

These scenarios are based on assumptions on the way in which biomass could be supplied for pellets, i.e. through increases in harvest of naturally-regenerated forests, changes in the management of intensively managed plantations (and in the use of the product), the use of forest residues otherwise left in the forest and the development of new plantations on naturally re-generated forest land or abandoned agricultural land.

Understanding these scenarios and the variables that create them is of key importance to assess the evidence and the likelihood that they will occur. Variables likely to be crucial to this include quantitative variables e.g. price, costs, market economics (i.e. the impact of non-bioenergy demand and non-UK bioenergy demand), and qualitative factors e.g. what is technically and logistically feasible as well as policy constraints (particularly important in the case of Canada). This understanding needs to go beyond the variables to the 'levers' that are pushed and pulled as a result of pellet demand and the market reaction to these, including non-bioenergy demand. For example, if pellet demand pushes prices up sufficiently to enable more pellet production, it is important to understand where the feedstock is likely to come from, whether other wood products are displaced by the use of this feedstock, and what the short and long term reactions to these changes are (these could be greater harvest or residue removal in the short term; a shift in the demand for other products to other areas and more planting in the long term). To understand these changes it is important to have a good understanding of the North American forestry and non-bioenergy wood products sectors.

1.1.2 Understanding of the sector

As highlighted earlier, the project needs to be based on robust evidence and insights into the North American forestry sector, as well as a deep understanding of the conversion to pellets and the economics for use in power generation in the UK. Hence our team includes leading experts in the USA and Canada complementing Ricardo-AEA's expertise in evidencing and analysing biomass policy.

Our experts have previously reviewed the literature on North American forestry and its potential to produce biomass for a series of clients on a number of projects over the past decade. [redacted] Our team has considerable experience of North American forestry: two of the experts ([redacted]) have over 25 years' experience of US and Canadian forestry; the third key member of this team ([redacted]) has over a decade of experience. Our conclusions to this background shows:

1. That the literature resources are good, but are not aimed at the scenarios developed by BEAC and therefore there are important evidence gaps. In addition the literature does not provide a clear vision of whether or not a scenario is likely, just that it could be possible (or for some, probably not possible). There is little sense of 'likelihood': the literature is more focused on resources, where resources may arise; and how prices would impact the level of resources or costs. This may be linked to sustainability and indirect impacts, which is useful for this study, but there is often a sense that it would be useful to discuss the results with the authors or other forestry experts, because:
    a. The literature indicates uncertainty and controversy relating to the data on feedstock used for pellet production. Whilst there are data about the feedstocks used by pellet mills, these can be disputed; and the definitions of some sources (e.g. wood 'residues') are unclear
    b. There is a lack of empirical data (e.g. a historic data set) on the impact of demand for pellets and the price range at which it is viable to supply wood to pellet mills
    c. Some of the data required is confidential, so achieving certainty is not always possible, particularly regarding prices at the mill and power station gate.
    d. Other factors influence the production of wood pellets in North America, such as the increase in conversion of previous agricultural land to new forests and increasingly efficient wood processing (both noted in the BEAC report). In addition support for building mills is available from some US State administrations. The profitability of these mills will be dependent on

many factors, including the value of European incentives for biomass power, currency exchange rates, the impact of sustainability requirements on feedstock costs and the cost of transport.

2. Modelling of the economic situation in the USA is important because of the ability of the US private forestry and pellet production sectors to react quickly to market conditions
3. Modelling of the Canadian economic situation is not so important because the major players influencing changes in Canadian forestry are the Provincial Governments (>90% of Canadian forest is owned by the Crown and regulated by the Provinces). Each has its own legislation, regulations, standards and programmes through which it allocates logging rights and management responsibilities under a "tenure" system, which places strict controls on harvest of timber and forest management. Forest Licenses allow the right to harvest an allowable annual cut. Tenure and licences require management plans to be adhered to. This means that the body pulling the levers and controls in Canada is the Province Forest Administration and reaction to market conditions can be a lot slower than in the USA
4. To understand how the US and Canadian Forestry and pellet production sector will react to increased pellet demand it is important to talk to these sectors rather than just rely on literature. In addition it is important to balance their views by talking to other key stakeholders such as the paper and pulp sector, panel board sector and NGOs who understand local forestry and to support this with information from the literature and modelling. We understand through our US and Canadian contacts that this study is already known to a number of key stakeholders, who are eager to participate.

Furthermore, in order to understand the likelihood of the BEAC scenarios it is important to understand the variables that will influence them and the likelihood of these coming together in a way that promotes the scenario assumptions.

1.1.3 Understanding the approach

We have discussed these scenarios with experts in the US and Canada. From these discussions it seems that some scenarios are highly unlikely to happen. Considering all of this has led us to develop an approach that:

1. Is pragmatic, cost and time effective for the budget and timescale proposed
2. Involves key US and Canadian experts. [redacted]
3. Gathers evidence from a number of sources in order to provide the necessary cross checks against bias and lobbying. This includes a literature search, a survey of key experts from different sectors, modelling using Bob Abt's forestry economics model and expert comment on the results
4. Provides an evidence base and tool, allowing DECC to use the outcomes to understand if the scenarios are likely to happen and which policy options may be used to address this.

We have incorporated all of these points in the methodology. We offer a particularly powerful combination of expertise. As well as the North American forestry knowledge and modelling capability, Ricardo-AEA offers over two decades of bioenergy experience, statistical and economics support, a proven track record of multi-criteria analysis and development of policy tools that have been used in the development of Government renewables and biomass policy and a flexible, experienced team with considerable experience of international work.

1.2 Methodology

We will bring together an understanding of US and Canadian forestry practice through forestry experts and other stakeholders in forestry in North America and a US forestry economics model. We will gather information through literature review to gain an indication of the variables of importance in the development of

the BEAC high GHG intensity scenarios, their relative importance and how likely they are to occur. This data will provide our evidence database. We will use a multi-criteria methodology to develop a Tool to analyse this evidence and provide an overall likelihood that each scenario will occur. This Tool will be provided to DECC to allow it to analyse future policy options.

1.2.1 Overview of methodology

The aim of the research is to deliver a qualitative and quantitative assessment of the likelihood of the selected BEAC biomass sourcing scenarios associated with the highest greenhouse gas emissions, occurring at any point between now and 2030, as a result of increased demand from the UK biomass electricity sector. The scope of this work is the use of biomass by the UK biomass electricity sector. However, we will consider the development of heat and transport fuel from biomass in North America when modelling future demand, and the price of North American feedstock and how this might impact on future management practices.

Whether or not the BEAC high GHG emissions scenarios happen results not just from an interaction between supply and demand, but will also be determined by other factors that influence the forestry sector in North America such as increased demand for pellets and the price that can be afforded by UK generators. The reaction of the forestry sector will depend on number of drivers or constraints. For example, increased price will make the production of feedstock for pellets more attractive, but constraints such as lack of appropriate equipment may make the production of feedstock less likely. The interactions between price and affordability of equipment will also be important, because affordability is increased as price increases. However, pressures on price will also be important: in the UK the price the biomass electricity generators are willing to pay is limited by the level of incentives. In addition there may be interaction between the scenarios, which may be mutually dependent or exclusive or impact on each other in different ways.

In the early stages of the work we will identify the variables that influence each scenario. We will define the probable ranges for each variables and the links/dependencies between them using expert opinion, literature and modelling. We will then will analyse the chain of variables and links that result in the scenario and whether or not these are likely to happen. The results will be exposed to expert opinion and revised if necessary. We have divided the work into three Tasks, related to the Phases as described below:

Task 1 will finalise the methodology and prepare the ground for Phase 2 by defining the fundamental questions required for the evidence gathering, and agree with DECC the stakeholders to be consulted. This Task will provide the deliverables requested in Phase 0 on page 17 of the invitation to tender (ITT).

Task 2 is the data gathering phase. Data will be gathered from key stakeholders in North America and Europe, from literature and up to three runs of a US model of supply/demand in the Southeast USA. This Task will deliver an evidence database presenting the results of the data gathering exercise, including the variables defined, the probable ranges for each variable and links between them. This Task will provide part of the deliverables required for Phase 1 and Phase 2 of the ITT.

Task 3 is the data analysis stage. We will use a multi criteria methodology to analyse the likelihood of the scenarios happening. This Task will provide part of the deliverables for Phase 1 and 2 of the ITT.

Task 4 is the results presentation phase. The results will be presented in two phases as requested in the ITT. Each phase will include a publishable report assessing the likelihood of the relevant BEAC scenarios. We will also provide an Excel Tool, a completed QA log and a publishable, cleaned and de-attributed dataset for Phase 1 and 2.

1.2.2 Task 1 Finalisation of methodology and approach to the research questions

This Task finalises the methodology including the approach to modelling, the QA plan and the research questions. It comprises three sub-tasks:

- Task 1.1: A detailed methodology plan will be presented to DECC at the inception meeting for discussion and comment. A revised methodology plan will be submitted to DECC within one working week
- Task 1.2 will define the questions required in Task 2 by:
  - ⇒ Defining the key issues for each scenario, including changes in assumptions or definitions required (e.g. whether or not the length of rotation may be increased; whether or not harvest would be increased) to ensure that the questions in the consultation address the core assumptions that result in the scenarios. This will need an understanding of:
    - i) Key quantitative and qualitative variables influencing decisions for all actors in the bioenergy-pellet-power station supply chain

ii) Those variables that will constrain or enable biomass supply (e.g. price and distance)

iii) The decision chain that results in scenario happening.

⇒ Examining the questions listed in the table on page 12 of the ITT to ensure that any secondary questions arising from the primary questions are also included.

⇒ Ensuring that the questions will provide an unbiased evidence base, both by capturing the views of a range of experts from all sectors concerned with forestry and by ensuring that the questions are carefully phrased to reduce the potential for bias.

This list of questions will be discussed with DECC at the kick off meeting and will be updated at the start of Task 2.

- Task 1.3 will identify the stakeholders for Task 2. The box below provides an indication of the sort of stakeholders we will approach in the USA and Canada. A list of Stakeholders will be presented to DECC for discussion at the kick off meeting. We will also set up a web site to provide background detail on the project.

Box 1: Examples of potential stakeholders in the USA and Canada

[redacted]

1.2.3 Task 2 Data collection methodology and data required

There are two aims to data collection: to provide DECC with an evidence base that answers the questions listed for each scenarios, and to ensure that it enables the development of a Tool for DECC on the likelihood of the scenarios happening. We will obtain information for these purposes through a number of sources.

Background

Our knowledge of North American literature on the impact of increased demand for wood pellets indicates that collection of data to address the likelihood of the BEAC high GHG intensity scenarios will be complicated by a number of factors. The first of these is confidentiality (particularly with regards to price and, to a certain extent, information on the destination of harvested logs). Other complexities include: preconceived notions or a lack of impartiality for some stakeholders; a lack of universally accepted definitions for terms such as 'residues'; and the difficulty in identifying the origin of some of the sources of wood for pellet production.

A number of models have been used to understand the impact of pellet demand. A recent paper by Abt et al (2014)[4] reported on the use of the Sub-Regional Timber Supply (SRTS) model to examine the impact in the

[3] SOFAC: Southern Forest Resource Assessment Consortium, http://research.cnr.ncsu.edu/sofac/

US South. This paper showed net short term and longer term responses, including increases in forest inventory, conversion of marginal agricultural land for forestry and shifts in harvest at sub-regional level and in production from traditional wood products to pellet production. The figure below shows sample results from this study.

Figure 1: South Coast projections taken from the SRTS forestry economic model with and without bioenergy removal

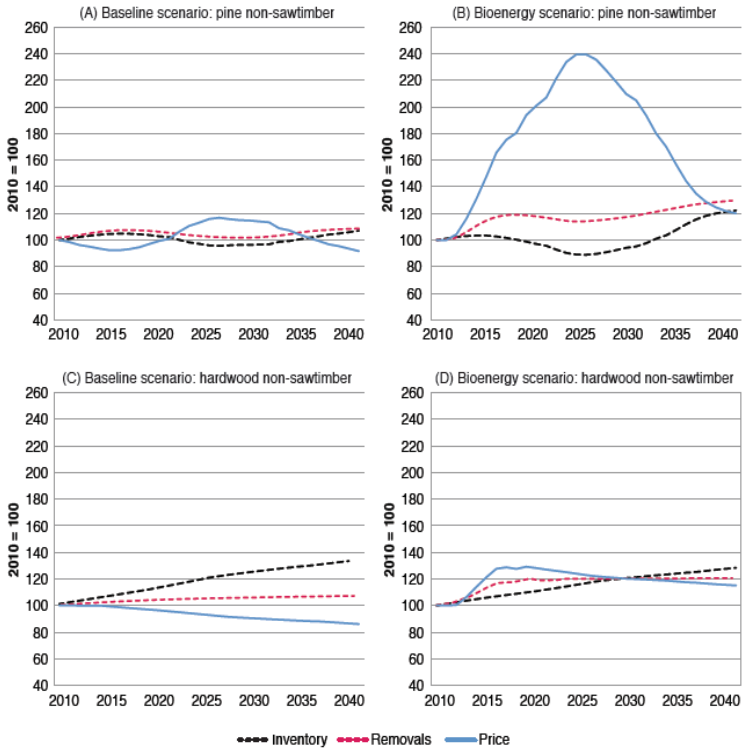


Figure 11—Southeast Coast projection results showing inventory, removals, and price indices for non-sawtimber for 2010–2040 for both the baseline and bioenergy scenarios and both pine and hardwood. A=Baseline scenario: pine non-sawtimber; B=Bioenergy scenario: pine non-sawtimber; C=Baseline scenario: hardwood non-sawtimber; D=Bioenergy scenario: hardwood non-sawtimber.

The modelling showed that if pellet demand continues, prices would remain high; but it also showed that "there would be shifts in harvest among sub-regions and shifts in production from traditional wood products to pellet production" and that timberland increase as more plantations are established on marginal agricultural land (assuming that land rents rise with increases in non-sawmill timber prices). The authors say "if we extrapolate these simulation results to a demand scenario where pellet demand continues to increase beyond 2020, we would expect the simulations to show prices remaining high or continuing to increase, and would show timberland area, harvest, and logging residue use for pellets continuing to increase". However the model also showed other short term impacts on price inelastic demand for feedstock, which result in a higher percentage change in price than the associated percentage change in quantity harvested when pellet feedstock demand increases.

Other models examine price effects[5] or the feasibility of meeting North American targets only, with results being influenced by the assumptions and scenarios used. There are studies that examine the practical ways in which biomass can be recovered from the forest[6], but these are often related to US or Canadian policy objectives and the impact from recent high levels of demand in the regions impacted by European demand is not often covered[7].

An alternate source of information is grey literature produced by NGOs, such as Dog Wood Alliance, that include evidence such as photographs and unconfirmed reports[8]. All of these studies show that there is evidence of the impact of the effects of increased demand for pellets, but the evidence is often based on assumptions that are difficult to verify. Results can be contradictory or hampered by the lack of empirical data,

[4] Abt K L, Abt R C, Galik C S and Skog K E (2014) Effect of policies on pellet production and forests in the US South. A report for the USDA Forest Service. General Technical Report SRS-202

[5] For example Johnston C M T and van Kooten G C Global impacts of increasing Europe's bioenergy demand, in publication.

[6] For example, Evans A M (2008) Synthesis of knowledge from woody biomass removal case studies for the US Forest service say "getting woody biomass from the forest to the consumer presents economic and logistical challenges. Woody biomass is the lowest-value material removed from the forest, usually logging slash, small-diameter trees, tops, limbs or trees that cannot be sold as timber." And that "biomass removal projects tend to combine multiple objectives, such as ecological restoration, wildfire hazard reduction, forest-stand improvement, rural community stability, employment and habitat improvement."

[7] An exception is the recent work of Evans et al on the implications for wildlife habitat and biodiversity (cited in the BEAC report),which examines the type of forest local to pellet plants and the impacts of increased biomass extraction from these forests.

[8] Dogwood Alliance (2012) The use of whole trees in wood pellet manufacturing. Evidence of the use of whole trees by top wood pellet exporters from the US South to Europe. http://www.dogwoodalliance.org/wp-content/uploads/2012/11/Whole-Tree-Wood-Pellet-Production-Report.pdf

by the complexities of economic and environmental pressures on forestry in North America and by a lack of extrapolation of impacts in from one area to another. This means that evidence drawn from modelling and literature surveys is dependent on assumptions, contradictory data and high uncertainty. It will not be possible to draw out likelihood on from this information alone.

Having considered these alternatives, we concluded that the available data from literature and modelling needs completing with a survey of stakeholders in the regions most impacted by increases in pellet demand and where the BEAC report expressed concern: the US Southeast, the Canadian Pacific West and the Eastern regions of Canada (Ontario and Quebec).

Outline of method

We will use a survey methodology with a number of linked stages to obtain data from a number of different sources, each informing the evidence base and subsequent modelling in Task 3. We will also use this method to highlight uncertainties and potential thresholds in the collected evidence, as shown Figure 2.

Figure 2: Schematic of data collection methodology

The methodology for data collection is outlined as follows:

1. We will use the SRTS model of the US South to understand the variables that influence the likelihood of the BEAC scenarios. The Canadian response to new market signals may be different to that of the US South, but the variables of importance are likely to be similar, assuming that policy measures are also considered. The variables identified will be used in the modelling in Task 3

2. We will review the literature, including peer reviewed data, Government reports and grey literature. Literature will be identified by our partners in the USA and Canada. We will use a rapid evidence methodology to identify further sources of peer reviewed literature if necessary[9]
3. We will survey stakeholders in the US and Canadian pellet supply chain and UK pellet users to obtain answers to the questions outlined in Task 1.2 (and further iterated in 1 above). In addition to recording answers to these questions we will also capture the certainties and uncertainties in the evidence base and any controversy. The survey will also allow key stakeholders to comment on their management responses to increases in demand and on the whether they consider the management responses assumed in the BEAC scenarios to be practical or realistic. [redacted]
4. We will amalgamate the evidence (modelling, literature review and direct survey) into a series of key findings that are then tested/validated using forestry experts. We will examine whether this evidence points to additional potential high impact scenarios and summarise these for DECC
5. The results of this data collection will be amalgamated into a database of anonymised evidence for DECC.

Detailed methodology

The Sub-Regional Timber Supply (SRTS) model

The SRTS model is a forestry economics model, developed by Bob Abt of North Carolina State University, who is one of the team members and who will use it to perform analysis. The model is a simulation tool that provides detailed forest resource projections in response to defined demands. It is based on a routinely updated forestry inventory for the US South[10]. Demand is exogenous to the model; supply is modelled by inventory change by product, which is endogenous to the model. The advantage is that it provides a tried and tested forestry economics model based on the inventory of the US South, one of the regions key to this study. The model was also used in the BEAC analysis.

SRTS models the interaction between forest markets and forest inventory using empirical relationships from the literature[11]. It provides resource and market insight at the local (individual pellet plant) and regional (southern coastal plain) level. The impact of increases in pellet demand vary by feedstock type (hardwood, pine, residues), the age class and harvest distribution in the forest, and local wood-consuming competitors. This means that there is not one simple response to pellet demand, and scenarios have to consider each of this factors spatially and over time to assess potential impacts.

The model can be used to make future projections of forestry inventory (encompassing management responses to demand). The first 15 years of this extrapolates existing inventory data (i.e. to 2028); after that the projections reflects how the model harvests and replants the original inventory. The model works such that economic responses tend to ameliorate structural shifts in harvesting/management patterns.

[redacted]

The literature review

The US, Canadian and UK experts involved in this work will identify key sources of relevant information on supply, price and forest management in the US and Canada and in the UK current and future demand for biomass pellets from North America. Literature will be supplemented, if necessary, using a rapid evidence

[9] One study of note is the US 1 billion ton study, used to identify the potential US biomass resources. This may be useful in identifying the potential for Scenario 26 http://www1.eere.energy.gov/bioenergy/pdfs/billion_ton_update.pdf

[10] The Forestry inventory data is updated when FIA datasets are produced. The model currently includes the 2013 dataset, which is based on data from the previous 5-7 years

[11] Beach, R. H., Pattanayak, S. K., Yang, J. C., Murray, B. C., & Abt, R. C. (2005). Econometric studies of non-industrial private forest management a review and synthesis. Forest Policy and Economics, 7(3), 261-281; Pattanayak, S. K., Abt, R. C., Sommer, A. J., Cubbage, F., Murray, B. C., Yang, J. C., Wear, D., & Alm, S. (2004). Forest forecasts: does individual heterogeneity matter for market and landscape outcomes?. Forest Policy and Economics, 6(04-Mar), 243-260.

methodology. Information will be taken from peer reviewed journals, Government sources and grey literature. In the UK it will be supplemented by data available from Ofgem as part of their capture of sustainability data.

To understand the strength of the data by assessing of the reliability of the method and validation of the results. This will be captured as a strength "pedigree" using the methodology outlined in Table 1. Each data source will be captured on a spreadsheet that will include assessment for pedigree of data. The evidence will be summarised by region, question and scenario. For example, the literature is likely to report data on the impact of pellet demand in terms of economics and prices, forestry management changes, impacts on non-bioenergy products and in terms of non-UK bioenergy. It may provide evidence of the significance of specific variables important in determining forest management responses. It will also show where evidence is uncertain or controversial. We will aim to capture this information in a clear and concise manner.

The literature search will be used to gather evidence on pellet price/costs in order to support the survey of pellet manufacturers and users and to validate their responses.

Table 1: Example of a pedigree matrix to evaluate data and evidence for non-review reports

This methodology is taken from work we are doing for [redacted]. The pedigree of information in the literature is evaluated by scoring key elements of the underlying data between 0 and 4 on four aspects, using the framework below. Data pedigree is established from the sum of the scores of the key inputs. A combined score of 0 – 4 was poor; 5 – 8 moderate; 9 – 12 good; and 13 – 16 very good.

[redacted]

Stakeholders' survey

Data uncovered in the literature will not provide us with a comprehensive view of the management and investment sector response to increased pellet demand for all of the variables that influence this response, particularly practical or technical non-quantitative constraints. In order to gather a detailed understanding of the likelihood of the management changes happening as predicted in the BEAC scenarios, it is critical to talk to stakeholders in forestry in the regions of greatest relevance to UK pellet demand.

Our approach to surveying key stakeholders makes the best use of our partners' wide network of contacts in the forestry sector in the US and Canada. In order to gain robust data through the survey task, the survey will be distributed directly to the right individuals in the organisations which are most relevant to pellet production in the UK. Our approach to surveying is as follows:

1. Design: Questions will be carefully worded to obtain unbiased answers. [redacted]
   We will aim to keep the survey succinct to encourage a high response rate. The questions included in the survey will be cross-checked with Task 1.2 to ensure each question links clearly with a variable of interest
2. Piloting: We will pilot the survey with a small number of contacts and revise the questions if needed
3. Circulation to key stakeholders: The finalised survey will be sent via email to our partners' contacts at the relevant organisations (see Box 1 and Overview of survey respondents below). We will send the survey

to up to 60 individuals, with the objective of getting a 60-70% response rate. [redacted]

4. Follow-up: [redacted] Respondents will have the option of answering the survey questions over the phone or sending their responses in by email.

This pragmatic approach to surveying is preferable to alternative sampling approaches and will achieve the objective of collecting robust information on the likelihood of the BEAC scenarios from key stakeholders. In the time available, a larger, random sample where the survey is distributed or publicised by a junior staff member would achieve a very low response rate and the people who respond are unlikely to be the most knowledgeable individuals. In addition, political sensitivities mean that a survey publically available online, for example, could elicit a large number of responses from lobbyists or NGOs which are not necessarily representative of the forestry and pellet industry as a whole.

Overview of survey respondents

In the US South there are likely to be thousands of forest owners. However, trade groups, such [redacted] cover around 80% of the forestry products produced in the region. We will target our surveys at these trade organisations and some of the larger forest owners.

In Canada, where forestry management is controlled more closely by the Provincial Governments, we have already had promises of co-operation from key experts in Provincial Forestry Departments. We will supplement their inputs by interviewing representatives of large scale tenure agreements and key forests products and wood pellet trade associations.

It is also essential to obtain practical, empirical data from pellet producers on the types of feedstock that they can accept, the sources that they prefer (including specifications[12]) and their view on costs/prices going forward. In the UK we will contact [redacted] In addition we will discuss the specification of wood required for combustion to understand if there are any limits on specific types of wood in North America.

Validation of results

The evidence obtained through the three sources above will be amalgamated into a series of findings that will then be tested with key experts:

- In the USA this will comprise a discussion with key experts
- In Canada we are proposing to hold a series of workshops [redacted] We are investigating the potential for these workshops to be additionally supported by the International Energy Agency Bioenergy Agreement's Task 43. [redacted]
- In the UK we will use DECC's existing routine contacts with the Biomass sector to publicise the results and obtain expert comment.

[redacted]

Additional data

[redacted]

[12] [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

- [redacted]

1.2.4 Task 3 Analysis of the data

Data collected in Task 2 will be analysed to understand the likelihood of each scenario happening. The important steps in this analysis are:

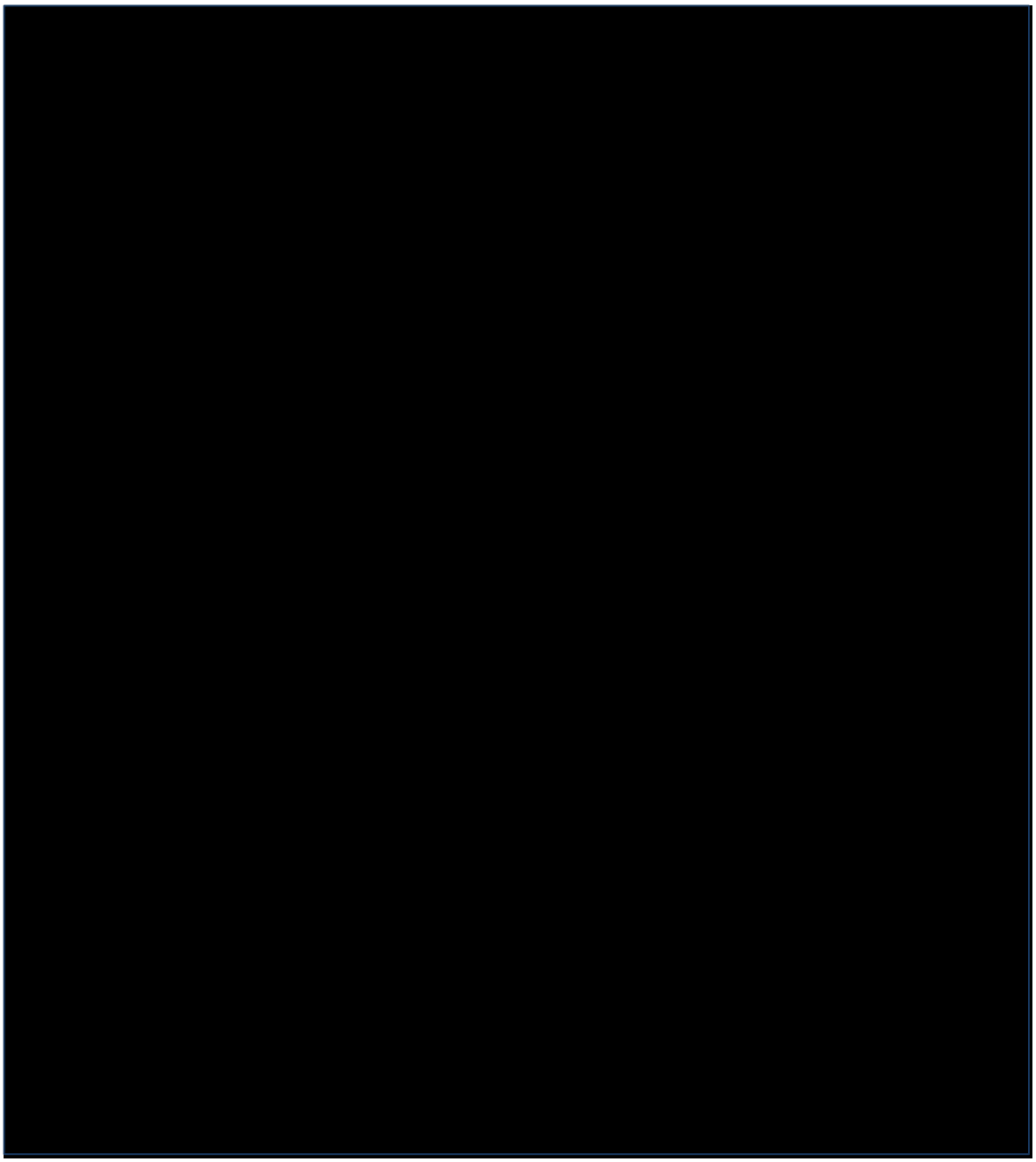
- [redacted]
- Data consolidation and evaluation: all data collected through the literature review, survey, and expert interviews will be consolidated in Excel and reviewed to see if there are any unexpected values, outliers, or a high number of missing values. An initial assessment of the range of each key variable will be made. The data will be anonymised at this stage as well
- Development of a multi-criteria tool to explore the likelihood of the scenarios happening, under different assumptions regarding key variables. This tool will incorporate probable range of values for key variables, a weighting of their relative important in influencing decisions, and an understanding of relationships between variables. We are calling this tool the "BEAC Scenario Likelihood Tool"

14 [redacted]

- Use of the scoring resulting from the analysis in the tool to compare the current situation with the BEAC scenario analysis to generate a score of the likelihood of the scenarios happening
- Commentary on the strength of the data used, critical assumptions and uncertainties.

The methodology for this Task is provided in Figure 3. This shows the stages in Task 2 that provide data for the Tool.

Figure 3: Schematic of the methodology for Task 3 showing dependencies on data collection in Task 2



Development of BEAC Scenario Likelihood Tool (BSLT)

This will be an Excel based tool that uses a multi-criteria methodology to map out the likelihood of each scenario. The tool will draw on the database developed in Task 2 in order to map out the situations that would result in the BEAC scenarios.

The BSLT Tool will combine these probability tables and values for the variables that would result in each feedstock required for the BEAC scenarios. A score of likelihood will be obtained by summing the variables

taking account of their relative importance (the 'weight' applied to each variable) and their probable range of values. This score will be relative to the current situation for forestry production and within typical current price ranges; and for SRTS modelled futures to 2030. Each BEAC scenario will also be assessed for likelihood using the variable ranges provided by the stakeholders.

The likelihood of the BEAC scenarios will be judged in a number of ways:

- [redacted] Any scenarios that are judged by the consultees to be highly unlikely will not be analysed further in the Tool, but their scores and dependencies will be noted in the evidence database. In particular the variables that prevent the scenarios from occurring will be recorded. [redacted]
- For the BEAC scenarios that may occur we will note their score relative to the current situation and to the futures modelled in SRTS
- We will also provide a commentary on potential consequential actions that may happen elsewhere, outline where data is weak, detail the assumptions that have been made and where uncertainties have potential consequences for the analysis. [redacted]

The exact format of the BSLT tool will depend on the quantity and ranges of data obtained in Task 2 and also the relationships defined between variables. The tool will be composed of the underlying database, the equations that define the relationships between variables, and a user-friendly front end that will allow DECC to use the tool to explore other possible scenarios.

Validation of results

The results will be validated through feedback from key experts. [redacted]

[redacted]

1.2.5 Producing outputs required

1.2.5.1 Phase 0

The Phase 0 report, which is an inception report detailing agreed methodology, will be published as part of Task 1. It will be produced after discussion of the methodology at the inception steering group meeting.

1.2.5.2 Phase 1

The phase 1 draft report will be produced after the preliminary data analysis in Task 3 for Scenarios 10-13, 19-21 and 14 is complete. [redacted]

1.2.5.3 Phase 2

The phase 2 draft report will be produced after the Task 3 data analysis for scenarios 4-7 and 26 is completed. This will be presented in draft form to the board meeting at the end of June and comments from peer reviewers addressed in the final report, presented to the board meeting at the end of July 2015.

1.3 Management and delivery

1.3.1 Management processes

We are proposing an international team with considerable expertise to undertake this work. The team will be managed from the UK by Ricardo-AEA, who will sub-contract the work in the USA and Canada to experienced partners, as shown in Figure 4.

Figure 4: Project management structure

The team members are:

Project manager:

1.3.2 Work Plan (detailed delivery plan)

The Gantt chart below sets out our work plan, showing the timescale for each Task, meeting and reporting deadlines. We will hold expert workshops in association with the IEA Bioenergy Task 43 in early May, as described in Section 1.2.

Figure 5: Gantt chart

1.4 Skills and expertise

1.4.1 Management team

The management team expertise is shown below. The header for each person provides their role in the project.

[redacted]

1.4.2 Experts and their skills

Table 4 shows the expertise of the proposed team, covering the requirements of the project. We have provided brief summaries of each expert beneath this table, including their role in the project.

Table 3: key skills in the project team

[redacted]

[redacted]

1.4.3 Allocation of resources

[redacted]

Appendices

- Appendix 1 [redacted]
- Appendix 2 [redacted]
- Appendix 3 [redacted]
- Appendix 4 [redacted]
- Appendix 5 [redacted]
- Appendix 6 [redacted]
- Appendix 7 [redacted]
- Annex B [redacted]
- Annex C Technical Proposal

Appendix 1 Curriculum Vitae

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