(1)

[redacted]

From: [redacted]
Sent: 22 June 2012 10:42
To: [redacted]
Cc: [redacted]
Subject: TRIM: GIB Business case for biomass power

Attachments: GIB Biomass Power business case V5.doc
TRIM Dataset: M1
TRIM Record Number: D12/1277534
TRIM Record URI: 13333958

[redacted] copy [redacted]

This is an updated version of the evidence paper produced by DECC on the case for GIB in the biomass sector. It is not in the standard template format we asked them to use and it's not clear that it addresses each of the specific issues identified in the template. I will ask DECC whether they propose to send something else in that other format but it does not seem likely. This paper (plus the first Vivid report) may represent the best information available for us to make our argument for biomass to be within the GIB's scope. Looks like an argument could be made but it doesn't look overwhelming. Grateful for your thoughts on how to use this material in the revised notification document.

[redacted]
5514

From: [redacted]
Sent: 21 June 2012 21:43
To: [redacted]
Cc: [redacted]; [redacted]; [redacted]
Subject: RESTRICTED: GIB Business case for biomass power

GIB Biomass Power business cas...

[redacted]

Please find attached what I consider to be the final version of the business case you requested. I'm sorry for the delay in completing the work. I have tried to make sure that we have a coherent story in relation to the recent developments in the biomass sector. I think the key things to note here is that the Government response to the RO banding review has not yet been finalised, but decisions taken as part of that process should be taken to be the best reflection of biomass power policy available. As well as the expected Government response we are drafting an additional follow-up consultation which relates to some of the key conclusions of the UK Biomass Strategy. This could include tightening sustainability standards, and restricting the use of dedicated biomass power. Nothing is set in stone yet, so I suggest that the document is updated in about 6 months time. This point will also hold true as the electricity market reform policy is rolled out.

As the Government response has not yet been agreed, we have not updated the numbers contained in the business case. [redacted] has left his post, but we may be able to update the numbers in this document as the RO Government response is finalised.

[redacted]

[redacted]
Area 4a, 3-8 Whitehall Place,
London SW1A 2HH

expand on.

[redacted]

From: [redacted]
Sent: 11 July 2012 15:51
To: [redacted]
Cc: [redacted]
Storage); [redacted]
Subject: GIB Sector evidence text

Dear all

I attach draft text for inclusion in the GIB state aid notification setting out the case for GIB investment in the following sectors:

- Biomass power
- Low Carbon heat
- Marine energy
- CCS
- Biofuels

A bit more work to do but this is largely what we plan to say in the state aid notification on these sectors. Could you all review the relevant part of the text and let me have any comments **by midday tomorrow**. Silence will be taken for consent.

[redacted] can you answer the query at para 1.31 (ii) as to the date of the HMG meeting with potential CCS financiers (2011 rather than 2001?).

Thanks for all your help with this process.

[redacted]
GIB Team ShEx
[redacted]

<< File: GIB - Biomass Biofuels section from draft notification 512487870_1.DOC >>

(2)

[redacted]

From: [redacted]
Sent: 02 July 2012 14:18
To: [redacted]; Griffiths Oliver (ShEx); [redacted]
Cc: [redacted]
Subject: RE: Biofuels sector paper
Attachments: EC State Aid application, Biofuels -3.doc

We have added in some more wording on the finance gap in biofuels - modelled to be ~£5bn over the decade to 2020 in the UK. There is one obvious catch in the assumptions, which is the assumption that the UK needs to be self-sufficient in biofuels production. Unlike many renewable sectors, this is one area where the UK could import its fuel, and so the market for biofuels is at least European, if not global.

I still think we should try to make the argument as there is a general interest in countries being able to self-supply (reduces radical imbalances across Europe). We just need to be aware of where there could be push back.

thanks

[redacted]

[redacted]

I Green Investment Bank Team I Department for Business, Innovation & Skills I 1 Victoria Street, London, SW1H 0ET [redacted]
www.bis.gov.uk

From: [redacted]
Sent: 29 June 2012 18:08
To: [redacted]; Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: RE: Biofuels sector paper

Attached is a sector paper on biofuels prepared by the UKGI team (many thanks to Paul and Dorothee for their work on this). A couple of points to note on this:

- The market failures section could be lengthened in similar manner to the biomass paper - however this raises a question of the balance of the length of the paper and the best means to present these market failures in the Notification. There is probably enough content here to produce a draft along the lines of the biomass paper - but do come back if you need more
- We may be able to estimate a little more the extent of the finance gap - will come back on that.

Thanks

[redacted]

[redacted]

| Green Investment Bank Team | Department for Business, Innovation & Skills | 1 Victoria Street, London, SW1H 0ET | [redacted]
www.bis.gov.uk

From: [redacted]
Sent: 29 June 2012 17:46
To: [redacted]; Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: Biomass sector paper

Attached is the biomass sector paper which [redacted] has primarily worked on and I have added to.

In it you will see a bottom-up estimate of the finance gap for the sector. Other points to draw to your attention are:

- We have given a detailed explanation of the market failures, including mapping these to the formal market failures introduced at the start of the Notification - i.e. not just the "symptoms" such as lack of finance, but the causes such as information asymmetry etc. This approach and similar wording could be used in each of the other sectors.
- There is an attempt to explain the market failures behind the structural changes in the banking market. Much of this text could be applied generically to all the sectors.
- There is also an attempt to answer the Commission's question below around comparing green sectors to non-green sectors with similar growth/ technology profile. The answer, around different capital intensity, novel technology and regulated economics could be applied to any of our green sectors, and this may be the better way to deal with this point in the final notification.

  (i) comparative analysis with non-green emerging sectors such as technology sectors with a similar growth and technology uncertainty profile

Many thanks

[redacted]

| Green Investment Bank Team | Department for Business, Innovation & Skills | 1 Victoria Street, London, SW1H 0ET | [redacted] | www.bis.gov.uk

---

From: [redacted]

Sent: 29 June 2012 12:31
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: RE: GIB state aid call agenda

[redacted]

Attached is a paper summarising the finance related market failures for the new sector of Community Renewables. It is completed in the format of the Commission questions, so hopefully it answers the key issues.

Also attached are two *supporting* reports, although note the Arup report was prepared for UKGI, not GIB and this might raise a few unnecessary flags. If we wanted, we could probably have it reissued to UKGIB.

thanks

[redacted]

[redacted]

I Green Investment Bank Team I Department for Business, Innovation & Skills I 1 Victoria Street, London, SW1H 0ET [redacted] www.bis.gov.uk

---

From: [redacted]
Sent: 21 June 2012 13:24
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: GIB state aid call agenda

CONFIDENTIAL EMAIL FROM SLAUGHTER AND MAY - THIS EMAIL AND ANY ATTACHMENT MAY BE PRIVILEGED

All

We have the following items for discussion on today's 2pm call. The list is quite lengthy but I should have thought that each agenda item could be dispensed with quite quickly. Please let me know if there are any further items you would like to add.

- Timing on work streams for Level 2 questions
- Discount rates
- DECC input on level 1 evidence
- Waste: Scope of non-aided waste and evidence for aided and non-aided waste categories
- Analysis on EUR7.5m aid caps
- Scheme Parameters (see second part of attached email)

- Commission timing re: summer vacation
- Next draft of notification

Speak with you all at 2pm.

Best regards

[redacted]

[redacted] Associate | EU & Competition

SLAUGHTER AND MAY

One Bunhill Row
London
EC1Y 8YY

Direct [redacted]
Mobile [redacted]

Secretary: [redacted]

Admitted as Barrister and Solicitor in New Zealand

GREEN INVESTMENT BANK

Proposed Templates for responding to Commission Level 1 questions

BIOFUEL PRODUCTION

1. Detailed definition of the sector:[1]

(i) set out the scope of the technology the GIB intends to invest in (with reference to the specific different types of technology):

"Biofuel" is a generic term for any liquid or gaseous fuels obtained from vegetable or animal matter. The most commonly used Biofuels are "Biodiesel" and "Bioethanol". Biodiesel can be produced from rapeseed, sunflower, palm oils, animal fat and waste oils. Bioethanol can be produced from corn, wheat, sugar beet and other crops (generically, the "feedstock").

Biodiesel can be used alone or mixed in any ratio with fossil diesel. Depending on the Biodiesel share in the blend, Biodiesel mixtures are called B100 (pure, 100 % Biodiesel), B5 (5 % Biodiesel and 95 % fossil diesel), B20, etc. No engine modifications are necessary to use blends below B20.

European Bioethanol is most commonly blended with gasoline in a proportion between 2% to 5% (E98-E95) as an oxygenate additive (octane enhancer). Bioethanol can be blended with gasoline to create E10 or higher Bioethanol blends. However, blends above E10 require special engine cars and infrastructure (pumps).

Biodiesel and Bioethanol produce between 50-95% and 10-100% less CO_2 respectively than their respective mineral fuel equivalents, depending on blends. Biofuels use well known and relatively simple production processes and technologies which have been in place for over two decades of utilisation.

Biodiesel is a fuel made through a chemical process called transesterification whereby the glycerine is separated from the fat or vegetable oil through a chemical reaction using methanol as a catalyst. Bioethanol is an alcohol-based fuel produced by fermentation and distillation of starch crops.

Biofuel plants have an average size of 150 million litres p.a., although they can range between 50-400 million litres p.a. Average construction costs are in the range of c. £0.65-0.75/litre. The average construction period is 1.5 – 2 years and average asset life is 20-25 years.

and confirm the inclusion of any of:

(a) infrastructure

(b) ancillary / complementary technology (for example, radar for offshore wind projects)

Typical developments utilise unused "brownfield" sites and comprise a main central processing area and smaller satellite areas to provide Biofuel storage and road tanker loading facilities. The sites are typically joined by interconnecting pipelines and cables. Further pipelines are required to connect the site to necessary utilities such as gas,

[1] This needs to describe to the Commission exactly what is in and what is out of the sector scope, with reference to the various types of technology/projects.

electricity and water. The infrastructure and associated activities in the main process area for a Bioethanol plant typically include: wheat unloading and storage; wheat milling; an ethanol processing area (comprising liquefaction, fermentation, distillation, dehydration, evaporation and DDGS drying, pelletising and storage).

Technology specificity to feedstock-input is considered low. Current Biofuel technology and plants are largely designed to run interchangeably on a variety of feedstocks (i.e. all oils and seeds) and the choice of feedstock is mainly based on price/cost.

Developers are currently working on new technologies that will run on cheaper and more abundant feedstocks like cellulose i.e. 2nd Generation Biofuels. Cellulose is a biological substance most commonly found in plant products with a high fibre content, such as straw, pulp, green waste e.g. residues from sugar cane mills, cotton stalks, rice husks, wood industries and forest plantation). Existing Biofuel plants will not be able to run on these "new generation" of cellulosic feedstocks.

(ii) details of the industrial structure of the sector / specific subsectors, including:

(a) supply chain overview; details of the components to the projects within the GIB scope

For biodiesel the process starts with the crushing of rapeseed (or other oilseeds) to extract the oil. Subsequently the oil is refined and transformed into biodiesel via a process called transesterification. The by-product from the oil extraction process is rapeseed meal, primarily used in animal feed. During the transesterification process, the glycerine alcohol in the oil is replaced by methanol in order to decrease the viscosity of the fuel. Biodiesel can be distributed in various forms either through truck fleets, independent petrol stations or through oil companies' distribution network.

The production process for ethanol comprises 3 steps: fermentation (transforming sugars to alcohol), distillation (concentrating the alcohol to 45% by removing water) and rectification (transforming the alcohol to pure alcohol and removing any remaining water and other impurities). Specific pre-treatment may be required for extracting the sugars from certain raw materials, in the case of starchy crops like maize and wheat, an enzyme is required to transform the starch into glucose. Sugar rich crops like sugar cane and beet are treated to produce a sugar reach fluent that can be further concentrated

(b) details of the suppliers active in the various aspects of the sector and technology (referenced back to (i) above)

[I need to revisit this]

Feedstock e.g. Cargill, Sudzucker, ADM, Bunge, Glencore, etc

Integrated players e.g. Abengoa, Vogelbusch (ethanol)

BDI, Energea Environmental Technologies, Lurgi AG (biodiesel)

2. Identification and provision of details of market failures:

(i) details of the type(s) of market failure(s) encountered in the sector and each subsector/technology[2]

The adoption of a Directive in 2003 set up guidelines for adopting Biofuels in all transport fuels used in the EU. These targets, of a 2% inclusion rate by the start of 2006 and 5.75% by 2011 were voluntary. A proliferation of finance into the sector prior to the financial crisis coupled with significant inflows of Biofuels from international markets in the US and Brazil has resulted in existing Biofuels capacity operating at levels well below capacity.

The adoption of the Renewable Energy Directive ("RED") in 2009 has replaced aspirational targets with a mandated commitment of using 10 per cent by energy content (as opposed to overall volume) of renewable transport fuels by 2020. The introduction of increased EU import tariffs, a removal of tax subsidies for US exports and burgeoning domestic demand has created an opportunity to significantly decrease the volume of imports flowing into the EU and create a self sustainable market opportunity in the the EU (including the UK).

However, the operational challenges, capital losses and debt write downs at a significant discount to par on recently commissioned large scale assets such as Ensus coupled with uncorrelated increasingly volatile feedstocks and associated offtake price risk in a nascent market has resulted in a limited appetite to finance new build in the UK and Europe.

Commercial lenders are sceptical of financing new build Biofuel Plants as a result of historical losses, current capital constraints and allocations to projects driven by relationship strength and perceived risk in more mature sectors utilising project finance. For example a mid-sized project in the UK known to the Department for Business which benefits from conservative gearing and ECA backed commercial and political risk insurance for a substantial portion of the senior debt funding requirement is currently having difficulty gaining traction in the market.

(ii) details on the causes of such market failures

Market failure has been driven by a number of factors including:

- Currently limited appetite from large industrial players for new build resulting in a requirement to attract project finance sector from an increasingly capital constrained commercial banking market.
- Embryonic market driven by recent legislative changes across global markets. Exposure to increased implied volatility for a range of feedstocks and an inability to hedge or contract output in relatively illiquid markets over a period of time suitable for project financing.
- Despite the relatively well proven underlying technology, scaling up of technological solutions to meet the levels of production required by the RED has resulted in increased production costs and other significant operational challenges.

---

[2] The Commission require that market failures put forward are specifically linked to the sub-sectors of the sector that they can be evidenced for. For example, for biomass this might involve some market failures applying particular types of feedstock. If market failures actually apply across the sector then evidence to this effect is required. At present we have a short list of market failures for each of these sectors but they are not especially well substantiated.

- There is a reduced number of large international and a large number of small local feedstock suppliers. The former provide short-term, volume and price fixed contracts but long-term fully fixed contracts are not common.

(iii) comparative analysis with non-green emerging sectors such as technology sectors with a similar growth and technology uncertainty profile

[See arguments deployed in the Biomass paper which can be easily translated to this sector]

- Other growth markets don't tend to be as capital intensive, which leads to larger financing needs and require more risk taking

- Other growth markets are not substantially regulated in their growth trajectory

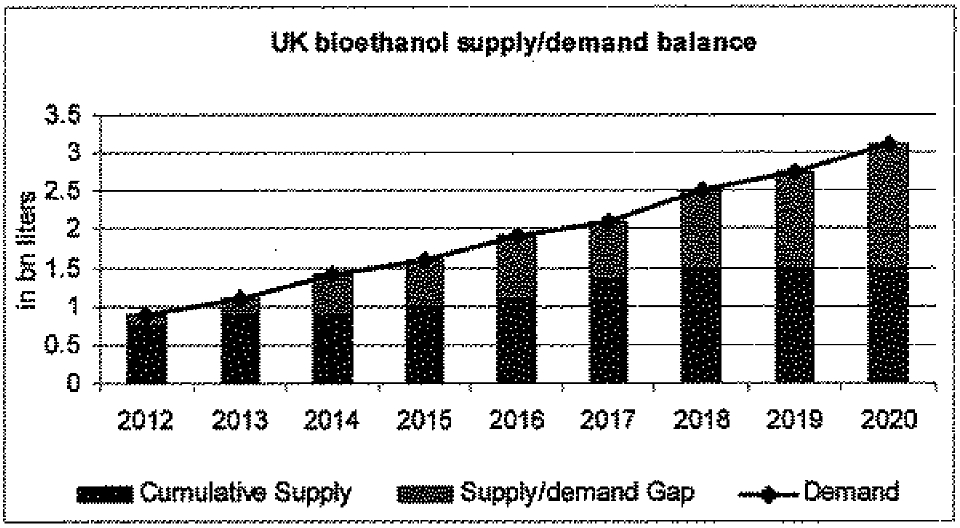
[This seems quite difficult. As an alternative way of establishing the same point, we suggest the GIB demonstrates that the market failures identified are not just common to all emerging sectors. Could we demonstrate how other Green sectors have received MEIP investment in the past to overcome 'Green' market failures?]

(iv) assessment on whether those market failures are estimated to be temporary or not

3. GIB's intervention may help stimulate investor interest in and appetite for opportunities in the biomass power sector in the UK. **Precise quantification of the current and expected funding gap and investment trajectory (with/without GIB intervention) for each sector and technology backed by data**

The UK Bioethanol market is currently short of supply and imports nearly all of its Bioethanol needs. This situation is likely to be exacerbated over the period to 2020 as there has not been any new UK plant announcements made due to difficulties in global credit markets and demand driven by the EU 2020 mandate.

The following chart illustrates the possible UK Bioethanol supply/demand gap over the period to 2020. It shows that UK would need to invest an additional c. 5bn GBP by 2020 in order to invest additional capital to make up the gap between anticipated supply and demand to be self sufficient. This can be considered to be equivalent to the finance gap that would otherwise occur without additional stimulation of investment by a GIB.



Supply and demand assumptions used to derive the capital expenditure requirements were provided by market consultant Nexant. Supply going forward has been assessed according to UK current capacities (including know pipelines Ensus and Vivergo), capacities under construction and possible plants coming online (announced by strong sponsors) taking into account some reasonable operating assumptions to allow for construction time and ramp up. Capital expenditure price assumptions were derived from the actual capital expenditure of the UK Vireol Bioethanol project whose construction will be starting in October 2012.

It is also worth noting that Nexant's implied demand forecasts used for the estimation of the capital expenditure requirements are based on an even split between Biodiesel and Bioethanol. It is important to note that Biofuels are not homogenous as they differ in terms of application (Bioethanol for gasoline blending and Biodiesel for diesel blending), technology and feedstock (cereals, sugarcane for Bioethanol and vegetable oil for biodiesel). The UK is a major net exporter of wheat, whereas feedstock for Biodiesel would need to be imported as UK is short of vegetable oils. Accordingly, the UK Government believes that Bioethanol may have to account for a significantly greater proportion of the overall EU 10% blending mandate over the period to 2020.

The involvement of the GIB in the UK Bioethanol market would stimulate investor's interest in the sector which is seen as essential to meet the forecasted capital expenditure requirements for the UK market to be self sufficient over the period to 2020.

4. Compare the funding gap with other sectors and technologies with a similar growth profile (inter alia comparison growth rate/ growth rate of financing) and with other geographical areas, etc.

[Ignore this question – to be answered separately]

[This seems a difficult request. Suggest use specific micro and macro examples to illustrate the gap and how intervention accelerates the closing of the gap. Again, are there any more developed Green sectors we can use as previous examples of investment gap and trajectory with/without intervention? Vivid/Oxera may be able to assist here]

③

[redacted]

From: [redacted]
Sent: 02 July 2012 20:22
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: Re: Biofuels sector paper

I think it will be sympathetic, as its general approach to renewables is to require each country to take its fair share of the burden of infrastructure roll-out.

Thanks

[redacted]

From: [redacted]
Sent: Monday, July 02, 2012 02:42 PM
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: RE: Biofuels sector paper

When you say "general interest" is the commission likely to sympathise with this view? In energy security cases emphasis is placed on to what extent security needs can be served by energy supply from other countries.

From: [redacted]
Sent: 02 July 2012 14:18
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted])
Subject: RE: Biofuels sector paper

We have added in some more wording on the finance gap in biofuels - modelled to be ~£5bn over the decade to 2020 in the UK. There is one obvious catch in the assumptions, which is the assumption that the UK needs to be self-sufficient in biofuels production. Unlike many renewable sectors, this is one area where the UK could import its fuel, and so the market for biofuels is at least European, if not global.

I still think we should try to make the argument as there is a general interest in countries being able to self-supply (reduces radical imbalances across Europe). We just need to be aware of where there could be push back.

thanks

[redacted]

[redacted]

| Green Investment Bank Team | Department for Business, Innovation & Skills | 1 Victoria Street, London, SW1H 0ET | [redacted]
www.bis.gov.uk

From: [redacted]
Sent: 29 June 2012 18:08
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: RE: Biofuels sector paper

Attached is a sector paper on biofuels prepared by the UKGI team (many thanks to Paul and Dorothee for their work on this). A couple of points to note on this:

- The market failures section could be lengthened in similar manner to the biomass paper - however this raises a question of the balance of the length of the paper and the best means to present these market failures in the Notification. There is probably enough content here to produce a draft along the lines of the biomass paper - but do come back if you need more
- We may be able to estimate a little more the extent of the finance gap - will come back on that.

Thanks

[redacted]

[redacted]

| Green Investment Bank Team | Department for Business, Innovation & Skills | 1 Victoria Street, London, SW1H 0ET | [redacted]
www.bis.gov.uk

From: [redacted]
Sent: 29 June 2012 17:46
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: Biomass sector paper

Attached is the biomass sector paper which Amit has primarily worked on and I have added to.

In it you will see a bottom-up estimate of the finance gap for the sector. Other points to draw to your attention are:

- We have given a detailed explanation of the market failures, including mapping these to the formal market failures introduced at the start of the Notification - i.e. not just the "symptoms" such as lack of finance, but the causes such as information asymmetry etc. This approach and similar wording could be used in each of the other sectors.

- There is an attempt to explain the market failures behind the structural changes in the banking market. Much of this text could be applied generically to all the sectors.
- There is also an attempt to answer the Commission's question below around comparing green sectors to non-green sectors with similar growth technology profile. The answer, around different capital intensity, novel technology and regulated economics could be applied to any of our green sectors, and this may be the better way to deal with this point in the final notification.

(i) comparative analysis with non-green emerging sectors such as technology sectors with a similar growth and technology uncertainty profile

Many thanks

[redacted]

[redacted]

I Green Investment Bank Team I Department for Business, Innovation & Skills I 1 Victoria Street, London, SW1H 0ET |[redacted] www.bis.gov.uk

---

From: [redacted]
Sent: 29 June 2012 12:31
To: [redacted]; Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: RE: GIB state aid call agenda

[redacted]

Attached is a paper summarising the finance related market failures for the new sector of Community Renewables. It is completed in the format of the Commission questions, so hopefully it answers the key issues.

Also attached are two supporting reports, although note the Arup report was prepared for UKGI, not GIB and this might raise a few unnecessary flags. If we wanted, we could probably have it reissued to UKGIB.

thanks

[redacted]

[redacted]

I Green Investment Bank Team I Department for Business, Innovation & Skills I 1 Victoria Street, London, SW1H 0ET |[redacted] | [redacted] | www.bis.gov.uk

---

From: [redacted]
Sent: 21 June 2012 13:24
To: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Cc: [redacted]
Subject: GIB state aid call agenda

CONFIDENTIAL EMAIL FROM SLAUGHTER AND MAY - THIS EMAIL AND ANY ATTACHMENT MAY BE PRIVILEGED

All

We have the following items for discussion on today's 2pm call. The list is quite lengthy but I should have thought that each agenda item could be dispensed with quite quickly. Please let me know if there are any further items you would like to add.

- Timing on work streams for Level 2 questions
- Discount rates
- DECC input on level 1 evidence
- Waste: Scope of non-aided waste and evidence for aided and non-aided waste categories
- Analysis on EUR7.5m aid caps
- Scheme Parameters (see second part of attached email)
- Commission timing re: summer vacation
- Next draft of notification

Speak with you all at 2pm.

Best regards

[redacted]

[redacted] | Associate | EU & Competition

SLAUGHTER AND MAY

One Bunhill Row
London
EC1Y 8YY

[redacted]

Secretary: [redacted]

Admitted as Barrister and Solicitor in New Zealand

www.slaughterandmay.com

(4)

[redacted]

From: [redacted]
Sent: 12 July 2012 14:14
To: [redacted]
Subject: RE: Biomass and Biofuels for Transport evidence

Attachments: GIB - Biomass Biofuels section from draft notification 512487870_1 (2)_BD_F.doc

Dear all,

Please find attached the biofuel section updated with my comments. Note that I have sent my comments on the Quantitative market failure section directly to Chris yesterday. I believe that Chris will circulate the updated section.

Please let me know if further updates are required.

Many thanks,

[redacted]

[redacted]
UK Green Investment Team | Department for Business, Innovation & Skills | Upper Ground, Orchard 1 | 1 Victoria Street | London SW1H 0ET | [redacted] Mob: [redacted] Email: [redacted]

GIB - Biomass Biofuels section...

From: [redacted]
Sent: 12 July 2012 11:27
To: [redacted]; [redacted]
Cc: [redacted]
Subject: RE: Biomass and Biofuels for Transport evidence

My comments attached. A couple of quick highlights:

- Biomass sector needs to be focused specifically on biomass power, as heat and biofuels dealt with separately. Appropriate cross-referral of the introductory landscaping is fine.
- Biomass power - some small triangulation issues on the finance gap which need ironing out with Oxera
- As discussed, we should focus on renewable heat only and leave low carbon heat for ee. we should also ensure that district heating is part of the definition of NDEE (infrastructure).
- Marine - there appeared to be no financing gap pre 2020 in wave/ tidal, which didn't seem good - Oxera graph needs updating
- CCS - did not see reference to Gov't £1bn fund - has this received separate state aid application and how in broad terms does this relate to UKGIB?
- Biofuels - Dorothee has sent across the biodiesel perspective and numbers. There are some gaps that need completing around current investors etc. **Dorothee** - could you take a look at this asap and pass back comments to Chris - should be v. quick.

thanks

[redacted]

<< File: GIB - Biomass Biofuels section from draft notification 512487870_1 (2)_BD_F.doc >>

From: [redacted]

Sent: 12 July 2012 10:15
To: [redacted]
Cc:
Subject: Biomass and Biofuels for Transport evidence

[redacted]

Some helpful comments from DECC on the Biomass section. Plus some good comments on the section dealing with the sector that apparently should be described as "Biofuels for Transport". They have forwarded the text to DfT for comment but I do not expect to receive anything from them until tomorrow so let's proceed on the assumption they are content until told otherwise. I believe Bruce had already consulted them in preparing the material on biofuels so it should be OK.

[redacted]

From: [redacted]
Sent: 11 July 2012 22:23
To: [redacted]
Cc: [redacted]
Subject: RE: RESTRICTED: GIB Sector evidence text

[redacted] << File: GIB - Biomass Biofuels section from draft notification 512487870_1 KH comments.DOC >>

I think the biomass power bit looks good, but I have made a few comments. A couple of things you may want to be aware of:

- You have included some heat only references in the biomass power section, so there is a bit of duplication with the heat section.
- I have highlighted some areas that are slightly inconsistent with the policies that will be forthcoming in the RO Government response to the banding review consultation, and the planned additional consultation on biomass sustainability. I am not suggesting you necessarily change the text for the state aids rules, but when you consider projects, you need to take these into consideration.

On the transport biofuels bit:

- I notice that there was not a DfT representative on the copy list, so I have copied in Rob, as it is important that DfT signs of that section. DECC does not lead on the biofuels policy but I have been involved in biofuels policy from a DECC perspective. It surprises me that the focus is on first generation biofuels; particularly that of biodiesel. DfT have highlighted the sustainability risks of biodiesel made from vegetable oils, and DfT have not yet signalled to industry that they intend to increase the biofuel obligation from its current level.
- There is however a high level of consensus that advanced biofuels will continue to play a role in the medium to long term, and is key to achieving the kind of carbon savings necessary to achieve our 2050 greenhouse gas reduction targets. For this reason I am really surprised that the GIB is not intending to support them. Some of these technologies are near commercial; much more so than marine and CCS technologies, and the UK is investing time and money to supporting the industry to move towards commercial realisation, through the bioenergy strategy work, TINAS (technology needs innovation assessment), and all the work we are doing to leverage EU money for advanced bioenergy (ERANET+etc).

I am not in tomorrow, but happy to discuss on Friday if there is anything you want me to

Biomass **[isn't this biomass power – given that we tackle biofuels and heat separately? Most of the emphasis is on biomass power and that was the way the source material was written]**

Overview of UK biomass sector

1.1 Biomass boilers generate heat energy through the burning of organic matter. Sources include wood, straw, energy crops, manure and the biomass portion of municipal and commercial solid waste; such fuel can be obtained domestically or imported. Biomass feedstock can be a highly versatile with considerable potential to contribute to all forms of renewable energy, including transport biofuels, heat and power.

Deleted: ;

1.2 At the end of 2010, biomass generated 2.5 GW of electricity capacity, contributing 12 TWh of electricity; the single largest contribution to the renewable energy targets. This section focuses on the biomass power sector, with biomass for heat covered under renewable heat and biomass for liquid transport fuels covered under biofuels. Biomass power can also involve the export of heat as a bi-product.

Formatted: Bullets and Numbering

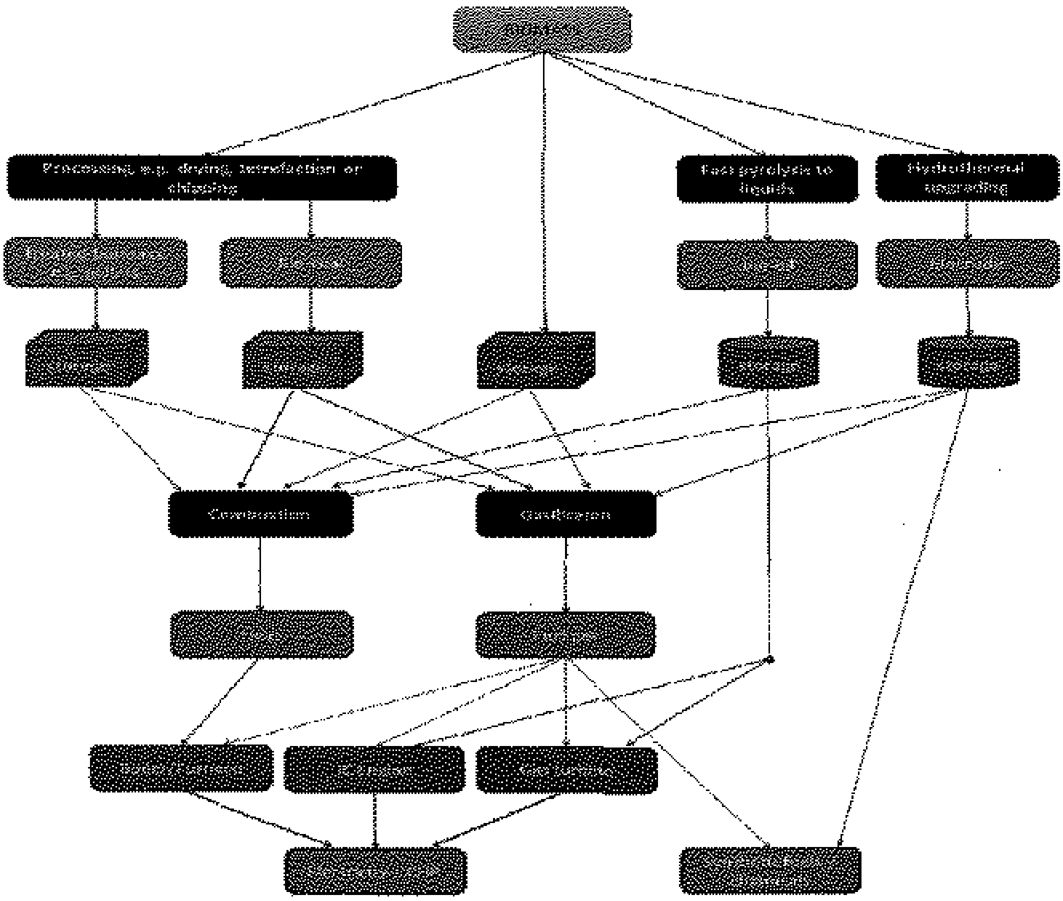
1.3 The figure below demonstrates some of the ways in which biomass can be converted into a fuel and used to generate power:

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

Figure 1.1: Biomass supply chain



Source: DECC paper 29 July 2012

1.4 Broadly speaking, the supply chain for the biomass power sector comprises four stages:

(i) **Fuel sourcing and preparation:** processing raw biomass matter for the production of feedstock (typically pellets) for use as fuel in the power generation process.

(ii) **Fuel transportation:** transportation of biomass pellets or chips from the production site to generation facilities. National and international logistics companies typically provide these services. Dedicated train wagons, trucks and ships may be required for large scale operations. The Committee on Climate Change's Bioenergy Review of 7 December 2011 anticipates that approximately 90% of all biomass feedstock used in the UK will be imported and this was supported by the Government's Bioenergy Strategy of April 2012.

(iii) **Fuel handling and storage:** Biomass fuel has a lower energy density than coal and biomass heat/power generation facilities therefore require significantly

Deleted: heat/

Formatted: Bullets and Numbering

Deleted: heat /

Deleted: pellets

Deleted: ve

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

larger fuel storage facilities, which have high operating costs. In addition, many biomass products must be carefully handled to avoid spontaneous combustion. Biomass dust is highly flammable and many forms of biomass, if wet, can start of ferment, increase in temperature and then combust.

(iv) **Combustion:** The primary combustion methods used for power and heat generation from biomass rely on well-established technology. However, although technology is established, large scale commercial operation has not yet taken place on a dedicated basis. With the exception of RWE's 750MW converted plant completed at Tilbury in early 2012, plants built to date in the UK have all been relatively small scale (up to 50MW capacity). Biomass combustion can be undertaken in three different ways:

(a) Co-firing: combustion of a small amount of biomass materials (initial co-firing trails used about 5-10% biomass) with coal in an existing coal-fired power station. This practice is used by certain coal-fired generators in the UK such as Drax, RWE and E.On;

(b) Conversion of existing coal-fired plants to biomass: several major coal power station owners are considering converting their coal fired power stations to biomass. Tilbury (RWE NPower) was the first biomass conversion of its kind in the UK, which became operational in early 2012; This plant has suffered some difficulties, including the outbreak of a fire in the fuel handling process, demonstrating the difficulties of large scale biomass operations.

Comment [vi1]: DECC – we understand this plant suffered fire damage earlier this year. Is there any evidence to demonstrate that it has been successful?

(c) Greenfield dedicated biomass plants: most capacity will be provided by larger plants (capacity greater than 50MW) which are likely to be heavily dependent on imported biomass. The UK Government is aware of a number of projects currently in development; Scottish and Southern Energy (SSE) owns one medium scale renewable combined heat and power plant and RWE and E.On are building a new plant; a number of VIUs are developing new dedicated biomass stations - E.On owns and operates the UK's largest dedicated biomass plant; [redacted]

Comment [vi2]: Vertically integrated utilities?

Comment [D3]: [redacted]

Comment [D4]: [redacted]

Comment [D5]: [redacted]

Scope of GIB biomass intervention

1.5 The scope of GIB's investment in biomass power will include technologies which use biomass materials as the primary fuel for power generation (sometimes with heat), or the co-firing of biomass materials with conventional fossil fuels, including the following ancillary activities:

Formatted: Bullets and Numbering

Deleted: heat or

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1639110712:1205

(i) Harvesting/bailing: specialist machinery is needed during the production of some forms of biomass such as miscanthus and short rotation coppice;

(ii) Chipping, pelletising, briquetting, torrefaction and drying facilities: convert solid biomass such as wood and non-food energy crops into a form which is suitable for electricity generating stations;

(iii) Fuel handling, transportation and storage of fuels in specialist equipment to maintain the fuel qualities of the biomass and avoid fires

(iii) Crushers, filtration systems: used in the production and treatment of vegetable or used cooking oil;

(iv) Co-firing stations: direct combustion or steam cycle electricity generation;

(v) Conversion of coal power station to biomass;

(vi) Dedicated biomass power stations (at all scales): either with or without with the application of Carbon Capture and Storage.

(vii) Renewable combined Heat and power (at all scales): capture "usable" heat and tend to increase the overall efficiency of the engine.

(viii) Gasification, Pyrolysis and pyrolysis upgrading: convert biomass into a gaseous, solid or liquid form, which can be injected into the gas grid or burned for power.

(ix) Milling; and

(x) Combustion.

[redacted]

Market failures affecting biomass

1.7 There are a number of market failures that affect the supply of capital for large scale biomass infrastructure projects:

(i) Limited balance sheet capacity by traditional investors: traditionally, development and construction of large scale power facilities in Europe has largely been financed either by utilities, using internal and external sources, or

Formatted: Normal, Indent: First line: 0 cm, Tabs: Not at 0 cm

[redacted]

Deleted: <#>Waste treatment plants: produce solid recovered fuel;

Deleted: <#>¶

Formatted: Bullets and Numbering

[redacted]

Deleted: Combined Cycle Gas Turbines, Syngas fuelled engines,

Deleted: provide dispatchable power directly or provide baseload or peakload power to the electricity grid. Peakload power may increase in importance to balance the increasing proportion of intermittent renewable energy sources over time, particularly if used

Deleted: in combination with

Deleted: [redacted]

Deleted: [redacted]

Formatted: Bullets and Numbering

Deleted: 120712:1403

Deleted: 120712:1133

Deleted: 110712:1638110712:1205

by independent power project developers providing equity and securing long term financing from banks and insurance companies. As set out below, independent power producers and utility companies are no longer able to raise significant amounts of capital due to the credit rating constraints on their balance sheets:

> *"Strong business risk profile offset by a significant capex program (...) [one-third of which] has been earmarked for renewables projects (...) We believe that the capex program will result in negative discretionary cash flows through the period, and consequently, higher debt levels."*[1]

> *"[SSE's] large investment programme of £8bn over the 2010-2015 period, with significant focus on renewables (...) carries execution and financial risks. (...) Moody's sees no potential for upward pressure on ratings given the group's limited financial flexibility."*[2]

This issue is exacerbated by information asymmetries leading to principal-agent distrust; despite the potential for significant returns from biomass, shareholders or debt providers are concerned about potential investors' motives to raise capital. This creates the need to introduce new investors, such as the GIB.

(ii) Structural changes in bank and insurance markets leading to a lack of long term financing: the infrastructure sector has largely been financed by long term debt (up to 20 years), typically in the form of project finance from commercial banks. However, entrenched changes to financial markets has had the effect of a semi-permanent systematic tightening of credit worldwide. The introduction of the Basel III bank regulations, has also reduced liquidity and banks are required to de-lever, or at least to not increase their lending. As a result, few banks will now provide medium to long-dated debt i.e. debt with terms longer than seven years. Additionally, regulators may be introducing incentives, through the EU's Solvency II, for insurers in Europe to reduce their exposure to banks and impose higher capital charges for lower-credit-quality and longer-dated financial instruments. With banks no longer providing the scale of financial intermediation required between such asset owners and investment projects, the dramatically increased investment needs of the Green economy (as detailed in §**Error! Reference source not found.** And involving an increase from around £9 billion of annual investment in 2010 to £30-50 billion by 2020) mean that in the Green sector more than others new intermediaries are required. However, market failures are preventing the formation of such new intermediaries at the scale and pace required.

[1] S&P on E.ON, 28 July 2010

[2] Moody's on SSE, 19 December 2011

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

[redacted]

(iii) Risk aversion due to limited commercial development: there are currently only a small number of fully operating dedicated biomass power generation plants globally and few of these are large scale; only very few dedicated biomass power plants operate over 50MW globally, and none so far in the UK. Construction is considered to be the riskiest stage in a project (in terms of additional costs or delays to the project) so lenders are unwilling to invest or are looking to offset potentially over-priced investment risk through increased requirements on EPCs (engineering, procurement and construction costs), increased risk premiums and the requirement for long term feedstock contracts

[redacted]

These conditions can render it [redacted] to obtain sufficient finance, in particular for smaller projects which are subject to higher relative capital costs, have higher relative risk premiums and higher relative EPC costs, leading some financiers to overestimate the risks. Further, banks are unwilling to lend sufficient money on viable terms to scale-up operations because there are few examples of large scale (100MW and above) biomass power projects including large scale dedicated biomass, biomass conversion, CHP and co-firing (those looking to increase the proportion of co-firing higher than 15%). These conditions are currently inhibiting the development of pyrolysis and gasification technologies. However, given the number of large scale electricity plants currently in planning or awaiting the outcome of the RO banding review (approximately 2.5GW), banks expect a significant take up once there are one or two plants generating successfully. The injection of GIB capital on commercially viable terms would therefore be likely to act as a catalyst to further private investment.

[redacted]

(iv) [redacted] although there is some private investment in the sector, investors' lack of understanding of the technologies used in the sector is leading to a mispricing of risk which is constraining the injection of sufficient capital into the sector. Concerns about technology viability are particularly problematic for investment in technologies which have been newly applied to biomass, such as early stage combustion technologies including gasification and pyrolysis. This is in part due to a lack of reference plants for investors to base key decisions upon. These projects can gain a lower rate of return and are higher risk than conventional biomass to power technologies, and are therefore more difficult to fund. Funding offered to the sector is therefore insufficient to allow the sector to grow to meet renewable energy targets. The GIB offers potential for funding the development of plants which would allow for the development of track record in the sector. This should

[redacted]

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

have the effect of overcoming potential investor's misperceptions of the risk which will fuel further private sector investment.

(v) Risk aversion due to concerns around fuel pricing: feedstock accounts for 50% to 75% of the full generation costs[3] and concerns over price fluctuations may therefore deter investment in the sector. These may result from foreign exchange risk (for imported biomass) and because biomass prices remain exposed to seasonality, location and availability of supplies. As a result, it is difficult for biomass developers and generators to hedge their positions. Combined with little correlation between fuel costs and power prices, this can subject developers to significant feedstock price risk. This market failure affects all technologies which require a high volume of biomass that needs to be sourced. It is expected that it will take time before the financing market is sufficiently confident about the nature and risks involved in biomass supply contracts to support significant investment in biomass power projects.

Deleted:

Deleted: with

Deleted: of

Deleted: the

(vi) Risk aversion due to concerns around security of fuel supply: as there is no central, stabilised market equalising supply and demand across regions, the uncertainties and risks related to biomass supply are larger than lenders in energy markets expect from existing fossil fuel supplies. As a result of constrained supply, prospective investors have demanded multiple contracts of five to seven year duration with bioenergy suppliers across different geographical regions. This has been challenging to achieve and has affected investment in small and large scale dedicated biomass, CHP, pyrolysis and gasification. Oxera notes that, smaller, non utility developers may, in particular, find it harder to obtain long term-feedstock contracts:[4]

> *The availability of a viable, long-term, bankable wood fibre supply contract for non-utility takers is by no means certain.*

There is therefore a role for the GIB to provide commercial funding to enable the development of early supply.

Oxera notes that if a supply chain contains small players, or is sufficiently immature that there is a limited number of such counterparties, project development may only be possible with vertical integration into feedstock supply. This would restrict project development to large VIU players with sufficient financial strength to invest. For example, EDF has acquired its first biomass pellet manufacturing plant in Germany. In these circumstances, there would be a role for the GIB to invest into projects where such large players are capital constrained, namely due to their constrained balance sheets.

---

[3] Morgan Stanley [redacted]

[4] Reuters (2012), 'Analysis: UK bets on biomass in move away from coal', May 25.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

(vii) Risk aversion due to uncertainty of demand: Banks, which are experiencing a constrained ability to lend, have demonstrated a reluctance to invest until electricity generation stations are in place. However, all links in the biomass supply chain (production, storage, transport and processing) need to be in place in advance of the electricity generating station and the biomass supply chain will not be invested in until there is a high level of certainty that demand will justify such investment. Specifically, generators are being hindered by the lack of suitable infrastructure and are unable to plan effectively for long term contracts with high volumes of biomass. This has lead to a lack of willingness to invest in infrastructure until the supply of biomass is significant. The failure affects all listed infrastructure and ancillary technologies.

(viii) The lack of a track record in long-term consistent government policies in the biomass sector: As Green investments generally rely on government policies, which must be in place long-term to ensure a return to the project, uncertainty in future policy support has lead to a perceived risk to investors. Eventually, market failures affecting information asymmetry of the technology and market for biomass and the associated policy uncertainty should reduce as the technology is further deployed, markets scale-up and policy stabilises. The UK Government believes that GIB investment in biomass technologies will accelerate investment in the sector by demonstrating that Government policy is strongly in support of biomass and commercial investments in biomass are now viable on a long term basis.

1.8 As demonstrated by the market failures above, there is an acute need for additional sources of capital on market terms to meet renewable energy targets. GIB investment could contribute to these objectives in the following ways:

Formatted: Bullets and Numbering

(i) from a purely financial perspective, GIB commercial investment in the sector could replace funding previously provided by traditional investors but which is no longer available due to long term structural changes in the market; and

(ii) a number of the additional failures broadly arise from a lack of information or imperfect information and are expected to beover-come with time; once one or two examples have demonstrated commercial success, similar technologies should be deemed lower risk. GIB investment in early-stage projects would demonstrate the commercial success of preliminary projects. This would have the effect of overcoming potential investors' misperceptions of risk and would therefore accelerate long term capital intermediation from new classes of private sector investors in the sector.

Deleted: cured reasonably quickly

Deleted: will

Deleted: ing

Quantification of market failures affecting Biomass

1.9 Substituting grid electricity and fossil fuels for, with biomass stands to make a significant contribution to decarbonising energy and heat generation. Biomass power is considered essential to meeting renewable energy targets. The UK Bioenergy Strategy of April 2012 indicates scenarios for the biomass power sector with the potential to deliver, by 2020, 20-40TWh, equivalent to 5-11% of the UK's total power generation. Analysis set out in the Renewables Energy Roadmap indicates that in central range

Formatted: Bullets and Numbering

Deleted: heating oil

Deleted: for

Deleted: 120712:1403

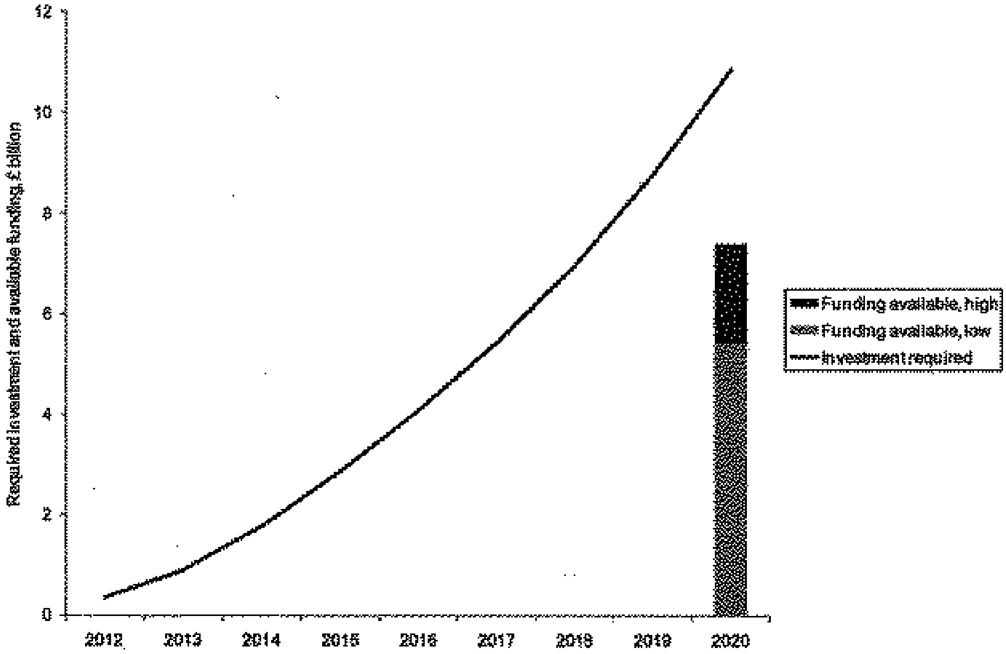
Deleted: 120712:1123

Deleted: 110712:1636110712:1205

scenarios, the biomass heat and power sector has the potential to deliver 68-100 TWh, equivalent to 30-43% of the UK's renewable energy targets. Oxera has calculated that the finance gap could lie in the range of £3.4 billion - £5.4 billion by 2020 (and as illustrated at Figure 1.2, below):

Comment [D11]: Note some inconsistency as finance gap here is for biomass heat and power – does this then relate to the below figures (£3.4/5bn gap)?

Figure 1.2: Funding gap in the biomass sector (2011/12 prices)



Source: Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, p.57 and Oxera analysis.

1.10 The current pipeline of potential projects exceeds the UK's Renewable Energy Roadmap target to build an additional 750 MW to 2,750 MW of biomass capacity by 2020, primarily though the conversion of existing coal plants and the building of Greenfields plants. However, the majority of projects are subject to investor approval and only a small proportion have reached financial close. Oxera estimates that the overall pipeline of plants currently being considered by developers is around 3,300MW; however only 400MW have either reached financial close or is expected to reach financial close shortly.[5]

Formatted: Bullets and Numbering

1.11 To date at least five dedicated biomass power project developers with 600MW projects under development have approached the UK Government seeking funding assistance. These projects are estimated to require over £1 billion for construction. Similarly,

[5] [Oxera to provide reference]

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

sponsors of 4GW of operating coal power capacity have approached the UK Government for funding assistance for the conversion to biomass plants or increased levels of co-firing of biomass. [redacted], it could be estimated that at least 50% of the required target investment could manifest as a "finance gap" requiring GIB intervention to mobilise further private finance into Biomass.

[redacted]

Deleted: and low carbon

Renewable heat generation

Deleted: *and low carbon*

Overview of renewable heat generation sector

1.12 The production of heat (both heat in buildings and heat in industry) currently accounts for approximately 40% of UK CO_2 emissions. There are a number of technologies which can produce low carbon or renewable heat, including, for example, heat pumps, biogas, condensing boilers and district heating. The development of such projects is essential if the UK is to meet targets to decarbonise its economy; however, current deployment levels are low.

Formatted: Bullets and Numbering

Scope of GIB's renewable and low carbon heat generation intervention

1.13 The UK Government intends that GIB investment in the sector will primarily involve investment in renewable heat deployments within industry and buildings, either on a standalone basis or as part of a range of measures including energy efficiency. Renewable heat could also be combined with the installation of district heating. District heating is the distribution of heat to a number of buildings or homes from a central heat source, or multiple heat sources, through a network of pipes carrying hot water or steam.

Formatted: Bullets and Numbering

Deleted:

Deleted: Some local authorities and businesses have already established heat networks and are realising the benefits of such investment; better resource efficiency, creation of new jobs, lower energy bills and a reduction in "fuel poverty".

1.14 There are a number of types of renewable heat sources which GIB could invest in:

Deleted: compatible with heat networks

(i) Bio-CHP: Combined Heat and Power that utilises renewable fuels such as biomass, biogas, bioliquids and the bio-element of waste allows for low carbon generation of heat and electricity, however it is more expensive to develop than conventional gas CHP.

Deleted: <#>Fossil fuel Combined Heat and Power (CHP): Gas CHP is currently the most cost-effective means of developing a heat network. There are strong synergies between district heating and gas CHP; gas-CHP engines can be employed quickly to serve existing or new district heating networks, delivering relatively low carbon heat as well as electricity as a revenue stream. ¶

(ii) Biomass boiler: Boilers running on woodchips and wood pellets are being used in heat networks in the UK at present.

(iii) Biomass co-firing: this involves supplementing existing fossil fuel based CHP plants with biomass feedstock.

(iv) Deep geothermal: Geothermal energy originates from heat retained within the earth from radioactive decay of minerals. Heat is extracted via wells roughly 1500 meters deep.

Deleted: <#>Conventional gas boilers: Boilers fired by natural gas.¶

(v) Large heat pumps: Heat pumps utilising one larger heat pump or multiples of smaller controlled heat pumps.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

(vi) Heat recovered from industrial processes: heat which has been used once and is expelled through a chimney or cooling tower. This is especially the case for high temperature industry, whose discarded heat can provide a low-carbon alternative to the direct use of heating fuels for low temperature users. In Gothenburg and Rotterdam for example, recoverable heat from industrial processes (rather than from electricity generation) provides the main source for the local district heat networks.

(vii) Heat recovered from thermal power generation: these can include thermal power stations which use coal, gas (i.e. fossil fuel CHP), nuclear, energy from waste and biomass. In the future this could include power stations fitted with carbon capture and storage.

(viii) Heat from incinerating biodegradablewaste (this is included in the waste sector).

Deleted: non-recyclable

Deleted: .

A series of low carbon heat technologies can also reduce CO2 emissions. These are included as part of the scope of the energy efficiency sector and include:

Formatted: Normal, Indent: First line: 0 cm, Tabs: Not at 0 cm

(i) Fossil fuel Combined Heat and Power (CHP): Gas CHP is currently the most cost-effective means of developing a heat network. There are strong synergies between district heating and gas CHP: gas-CHP engines can be employed quickly to serve existing or new district heating networks, delivering relatively low carbon heat as well as electricity as a revenue stream.

Formatted: Normal, Indent: First line: 0 cm, Tabs: Not at 0 cm

Formatted: Bullets and Numbering

(ii) Efficient conventional gas boilers: Boilers fired by natural gas

(iii) Conversion of electricity to heat when electricity is in plentiful supply: the future electricity generation mix is expected to result in more occasions when the electricity price is low, such as when the wind is blowing and demand is also at a low level. At these times of high supply, electricity can be stored as heat in a tank or in the system and used when needed in order to take advantage of the lower electricity price.

Market failures affecting renewable and low carbon heat generation intervention

1.15 Several market failures are constraining the provision of sufficient finance for the development of renewable and low carbon heat technologies, including as follows:

Formatted: Bullets and Numbering

Risk aversion due to concerns around security of fuel supply: As set out at paragraph 1.7(vi), security of fuel supply is a key hurdle to sufficient investment in the green sector. This is due to market concerns that low carbon heat sources may not be available in the long term. Unless security of supply concerns can be addressed, potential investors will invest in alternative projects for fear of investing in a stranded asset. As a pre-requisite to providing funding, investors are commonly requiring a project to have secured long term supply contracts with suppliers with strong credit ratings. Some companies are working to overcome these hurdles to ensure sufficient commercial investment

Deleted: 1.7(vi)

Deleted: 1.7(vi)

Deleted: 1.8(vi)

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

in the sector. Oxera has advised the UK Government that there is a role for GIB funding to invest in the development of large and experienced credit-worthy feedstock suppliers. GIB investment may also accelerate and help establish a track record in equipment supply and downstream project developers which utilise such equipment. GIB commercial investment in technologies throughout the supply chain would allow large operators to vertically integrate to ensure security of supply.

> **Comment [D13]:** This is relevant to power only, not heat
>
> **Deleted:** For example, Drax's strategy is to:[6] ¶ <#>*Contract with suppliers where a robust operational plant and logistics infrastructure is already in place…[and] work with new suppliers to help develop such infrastructure.*
>
> **Deleted:** <#>¶
>
> **Formatted:** Bullets and Numbering

(i) Disincentives to invest in capital intensive projects: although renewable energy offers good returns on investment and offers the prospect of lower cost, less volatile long term supplies of fuel, it is more capital intensive and there is evidence that private sector investors either cannot access sufficient funding or do not rationally allocate capital to such investments. Most renewable heat technologies are significantly more capital intensive than their fossil fuel counterparts, involving greater upfront investment, but lower long term running costs. For example, whilst a traditional industrial gas boiler may cost ~ £[300,000] per MW, a biomass boiler with associated fuel handling and storage could cost up to three times as much[7]. There is evidence that such investments receive little management attention within businesses, due to shorter term performance measurement and reward incentives, and that capital budgets are diverted towards output capacity, rather than reduction in costs via energy efficiency. There is therefore little short term incentive for businesses to invest in the sector. Landlords are similarly disincentivised from making capital investments in the renewable energy for a building given that long term fuel cost benefits accrue to tenants. The GIB may overcome this failure by demonstrating the long term savings that will accrue from initial capital injections. This would have the effect of overcoming a misperception by potential investors and their stakeholders that short term capital costs outweigh the medium to long term benefits of such an investment.

> **Deleted:** will lead to long term cost savings, t
>
> **Deleted:** energy efficiency
>
> **Deleted:** s
>
> **Deleted:** performance of a
>
> **Deleted:** operating

(ii) Risk aversion due to uncertainty in demand for large scale renewable heat projects: as above, renewable heat projects require significant upfront capital.[8] These costs make renewable district heat business model particularly sensitive to volume (or off-take) risk which could potentially leave the asset under-utilised and stranded. Off-take risk inherent in district heating schemes may be sufficient to deter investment:[9]

> **Deleted:** the

---

[7] [To provide source]

[8] A scheme of similar size to that in Vienna, serving over 270,000 people, may cost in the region of £1.5bn to construct and connect, in addition to any costs of the heat plant itself - Poyry (2009), 'The potential and costs of district heating networks', report prepared for the Department of Energy and Climate Change, April, p.43.

[9] Poyry (2009), 'The potential and costs of district heating networks', report prepared for the Department of Energy and Climate Change, April, p.45.

> **Deleted:** 120712:1403
>
> **Deleted:** 120712:1123
>
> **Deleted:** 110712:1698110712:1205

In order to procure private sector investment, the revenue stream of the project will need to be secure as possible... Achieving a satisfactory base load demand will be risky if it relies upon securing commitments from a large number of private sector users (both residential and commercial) to switch from their current heating systems to a district heating network. With the exception of large new private sector developments, there will be high costs of marketing and substantial inertia to overcome.

Commercial investment by the GIB in this sector would demonstrate that the projects are commercially viable based on current levels of demand. It would also demonstrate a strong UK Government commitment to the sector, which should encourage further investment by private sector investors.

(iii) A lack of information or imperfect information leading to risk aversion: some heat technologies (such as deep geothermal heat) are yet to be commercially deployed. Such technologies are likely to require additional commercial investment in the early stages of deployment, during which they are likely to be regarded as high risk due to their novelty and lack of commercial track record. In particular, renewable heat technologies which only produce heat intermittently and in a source that cannot be stored are perceived as "high risk".

Formatted: Bullets and Numbering

1.16 The GIB could become involved in addressing market failures by supplying funds in circumstances which would tip the balance between a viable project proceeding and halting where financing is nearly in place but additional financing is sought. The GIB could additionally become involved in the supply chain; it could simultaneously invest in the supply of feedstock to help develop large and experienced creditworthy suppliers, and accelerate and help establish a track record in equipment supply and the downstream project developers involved in the various stages of the supply chain. Its involvement in this respect would allow alternative lenders to gain experience while freeriding on the GIB's sectoral experience. The GIB could then later withdraw, leaving the banks to provide a full service to the supply chain.

Quantification of market failures

1.17 Analysis by DECC estimates that £112 billion of investment may be required in the UK across heat and electricity sectors by 2020.[10] Oxera estimates that, if the £55-75 billion finance that may be available[11] were allocated across sectors in proportion to sector requirements, this would imply that the funding gap in the renewable heat (non-

Formatted: Bullets and Numbering

[10] Department of Energy and Climate Change (2011), 'Planning our electric future. A White Paper for secure, affordable and low-carbon electricity', July.

[11] Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, p.40.

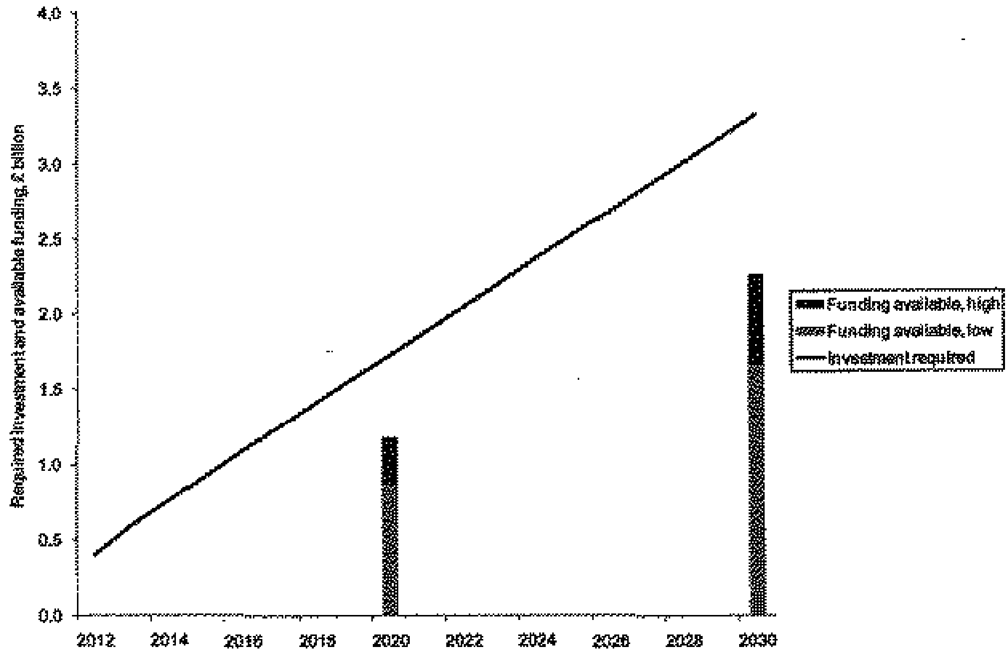
Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

domestic) sector could lie in the range £0.6—0.9 billion by 2020, increasing to £1.1—1.7 billion by 2030, as set out at Figure 1.3, below.[12]

Figure 1.3
Funding gap in the renewable heat (non-domestic) sector (2011/12 prices)



Source: *Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, pp. 58-59 and Oxera analysis.*

Marine energy generation

Overview of marine energy sector

1.18 The main marine energy generation technologies are:

Formatted: Bullets and Numbering

(i) wave power, which is generated by harnessing the energy produced as the wind passes the sea surface;

(ii) tidal stream (shallow and deep) power, which uses the energy of water flows; and

[12] The domestic sector has not been considered because Vivid Economics states that the GIB is likely to finance non-domestic investments only. See Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, p.59.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

(iii) tidal range (barrage) power, which extracts the energy produced by the changes in the height of the tide.

1.19 Vivid reports that, in 2010, there were 33 companies active in the UK marine energy sector:[13]

Formatted: Bullets and Numbering

(i) There are a number of firms involved in the development of marine technologies in the UK including Acquamarine Power Ltd, Pelamis Wave Power Ltd, OpenHydro Sit Development Ltd, Atlantis Resources Corporation Pte Ltd, Neptune Renewable Energy Ltd and Marine Current Turbines Ltd;

(ii) Utilities involved in marine energy include SSE, Scottish Power (Iberdrola), E.ON, Npower, Statkraft, EDF and International power; and

(iii) Large technology suppliers include ABB, BAE Systems, Rolls Royce and Siemens.

1.20 Utilities and large technology providers have become increasingly involved in the wave and tidal stream sector over the last few years. Their involvement has caused a number of consortia to form and these consortia are taking low costs steps now to position themselves advantageously for future deployment opportunities, for example:

Formatted: Bullets and Numbering

(i) Siemens is now the majority shareholder of MCT, one of the most advanced tidal companies in the UK. MCT has two pre-commercial tidal stream array projects (c.10MW capacity each) planned in the UK (Kyle Rhea in Scotland and Skerries in Wales) for which it is looking to raise the necessary finance. MCT has also secured a lease for a fully commercial 100MW tidal array in the Pentland Firth;

(ii) Rolls Royce owns TGL, which is one of the two suppliers of technologies planned to be used for the MeyGen project (which is financed by a consortium including International Power and Morgan Stanley). MeyGen has secured a lease for a 400MW tidal array in the Pentland Firth;

(iii) ABB and SSE are shareholders in Aquamarine Power. SSE has secured a lease for a 200MW wave farm using an aquamarine Oyster device in Orkney.

(iv) Vattenfall, E.On and Scottish Power are looking at developing wave projects using Pelamis device in the North of Scotland. Leases have been secured by E.on (100MW) and Scottish Power (50MW);

(v) Alstom has 40% equity share in AWS Ocean Energy. It is working with SSE and has secured a lease for a 200MW wave project in Orkney;

[13] Vivid I, pp. 57-58

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

(vi) Scottish Power Renewable are planning a pre-commercial (c.10MW) tidal array project in Islay although it is not yet known whether funding has been secured.

1.21 Although low cost investment is currently taking place in the sector, the UK Government believes that GIB investments would lead significantly to accelerated investment and a greater ability to meet renewable energy targets.

Formatted: Bullets and Numbering

Scope of GIB's marine energy intervention

1.22 The GIB would invest in the development and operation of small arrays of the most promising and well progressed marine technologies. In particular, the UK Government intends that the GIB would invest in companies which develop complete marine energy devices, and marine energy projects at pre-commercial and the first true commercial scale. Pre-commercial projects would typically involve installing devices generating 5-10MW in the sea and generating a return through energy sales. The first commercial projects are likely to install 100-400MW.

Formatted: Bullets and Numbering

1.23 In addition, it will be within the GIB's remit to invest in ancillary infrastructure and technology including:

(i) the development of vessels designed to handle marine energy devices: the UK Government considers that investment is required, particularly to support tidal stream devices. Existing vessels are not designed to operate in the extremely high energy tidal streams where tidal stream energy generation is most cost effective. Although GIB investment in developers and in early deployment projects will lead to private investment in vessels, the UK Government considers that GIB investment in the infrastructure would accelerate that process and lead to accelerated marine energy deployment; and

(ii) improving port and harbour facilities and increasing the capabilities of the existing marine renewable testing facilities (EMEC, WaveHub, NaREC, etc): The UK Government considers that such investments will support more rapid development of the sector. However, investment in ancillary infrastructure and technologies is lower priority than investing in marine energy projects.

Market failures affecting marine energy

1.24 A number of market failures, which affect the green sector generally, apply to marine energy:

Formatted: Bullets and Numbering

(i) A lack of information or imperfect information leading to risk aversion: the novelty of the technology and a lack of data in relation to these new technologies (most are still only at a trial stage) have resulted in traditional lenders demonstrating very little interest in lending large amounts of capital. This is largely due to an inability to assess the probability and severity of downside risks. This has particularly affected small to medium sized companies. With smaller companies having constrained or non-existent capital budgets, the sector has, for a number of years, therefore been reliant on grant aid for development. However, as the technology moves past demonstration

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

phase, the UK Government believes that GIB investment will play an important role in demonstrating the commercialisation of such technologies, demonstrating the commercial viability of such projects, leading to further private sector investment.

(ii) High capital costs: high industry fragmentation has meant that lending into the sector in an effective manner is difficult for traditional lenders. Small projects have particularly little appeal to traditional investors due to high capital costs and limited short term returns. For example, as venture capital funds have a lifetime of around ten years, investments will not be long-term enough to realise profits on a typical wave or tidal stream project. Forecasts for at least the next few years indicate that marine energy production will lack scale and unit costs will remain high. Until technological advancements allow for wider projects, traditional lending is therefore unlikely to provide a suitable alternative to the GIB. Given that high capital costs will not be met by the limited finance anticipated to be made available by the private sector, it is clear that there will be scope for the GIB to provide additional commercial finance.

(iii) An historic lack of track record of consistent policies: the level of revenue support for marine energy generation is currently under review; support may be increased from 2 ROCs to 5 ROCs per MWh. Whilst the industry welcomes the potential increase in revenue funding support, there is a perception that, even if ROCs support is increased in 2013, the Government may drop revenue support back to a level equivalent to 2 ROCs in 2017 under EMR proposals. There is also a perceived concern that the Government may levelise revenue support for low carbon technologies before marine energy can achieve the cost reductions needed to compete with wind power. As large scale projects will take some time to come on stream, perceived uncertainties over future levels of support are a significant barrier to investment. For example, the Scottish Marine Energy Action Plan recognised that:[14]

> *A positive and timely outcome on EMR, at least comparable with existing Renewable Obligation provisions, is critical – UK Government needs to ensure by 2013 that EMR outcome continues to incentivise investment in marine and does not create a hiatus within the industry.*

(iv) High (perceived or real) transaction costs: The process for planning and consenting marine energy arrays is not clear as no arrays have yet gone through the process. There is therefore a market concern that conservation bodies may require first movers to collect substantial environmental data (including the requirement to assess and monitor a very wide range of potential

---

14 [redacted]

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

impacts), at high cost, until they are satisfied that they have identified which environmental variables are likely to be met.

(v) Risk aversion due to technology uncertainty: As marine energy is still relatively immature, very few designs have been in the water for long enough to develop a track record on performance. The few designs that have been in the water for longer periods (the SeaGen device in Strangford Loch has been deployed since 2008) are not perceived as similar enough to other designs to give potential investors comfort to provide sufficient investment. This lack of information means that investors perceive a risk that devices may fail or maintenance costs may be higher than expected. Furthermore, the scale of finance needed for small arrays (project costs of £40m-£80m) put these projects outside the scope of typical venture capital investors. For example, the Energy and Climate Change Select Committee commented that:[15]

> *The costs and risks involved with developing wave and tidal technologies are currently too high for private investment to bear alone. Governments can help to reduce the risk by agreeing to take on some of the costs involved, for example through the provision of capital grants or infrastructure such as testing sites. This approach has worked successfully in the past for marine renewables; trade body RenewableUK estimated that every £1 spent by the public sector on marine renewables leverages a further £6 of private sector investment.*

1.25 The 'Future of Marine Renewables in the UK' report states that the UK's grid connected capacity grew from 2.9MW in 2010 to 5.6MW in 2011, an increase of over 90 per cent.[16] It is anticipated that 2012 will see the grid connection of seven new devices at the European Marine Energy Centre ("**EMEC**") and the first deployment in Ramsey Sound (Wales). If it is anticipated that the latter will double grid connected capacity to reach a total capacity of over 11MW. However, these deployments have largely been supported by public sector grant funding. It is therefore clear that capital investment will accelerate the development and deployment of commercial scale marine energy arrays which will otherwise struggle to break through the initial more costly phase into larger scale commercially viable arrays. An investigation by the industry has suggested that future GIB investment will unlock both private sector investment and enable utilities to take an equity stake in projects.[17] Although the sector is currently experiencing significant market failures leading to insufficiency of finance, it is clear that commercial investment can effectively address these failures.

Formatted: Bullets and Numbering

[15] 'The Future of Marine Renewables in the UK' (2012), para 20

[16] 'The Future of Marine Renewables in the UK' (2012), p. 10

[17] The Marine Energy Programme Finance Group - Why the Green Investment Bank should support the UK's wave & tidal energy

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

Quantification of market failures

1.26 Marine energy technologies remain, in general, at an early stage in development and not yet commercially deployed. While the short-term contribution of marine technologies is likely to be limited, there is potential for it to make a significant contribution in the medium to long term (and in particular from 2030-2050).

Formatted: Bullets and Numbering

1.27 As marine generation technology moves to commercial deployment, it will be crucial to attract sufficient initial commercial investment to demonstrate the viability of the technology as a commercial proposition. Development costs are relatively high; the deployment costs of a 5-10 MW farm are between £50 and £80 million. Total capital investment required to reach the scale up to 200-300 MW of generation by 2020[18] is therefore likely to exceed £1 billion.

1.28 Oxera analysis concluded that, if available finance were allocated across sectors in proportion to sector requirements, this would imply that the funding gap in the marine sector could equal the following:[19]

(i) Tidal range: The funding gap could lie in the range £0.6 to 1 billion by 2020, and in the range £3.9 to 6.2 billion by 2030 based on the assumption that 800 MW of capacity is required by 2020 if the UK is to remain on the path for meeting its 2050 carbon budgets. It also assumes that a further 3.6GW of capacity is required in the Severn estuary by 2030. Figure 1.4, below, sets out long term funding projections.

(ii) Wave power and tidal stream: The funding gap could lie in the range £0.7 to 1.1 billion by 2030 assuming that 4.8 GW of wave capacity and 9.4 GW of tidal stream capacity is required. Figure 1.5, below, sets out long term funding projections.

---

[18] DECC, *UK Renewable Energy Roadmap*, July 2011

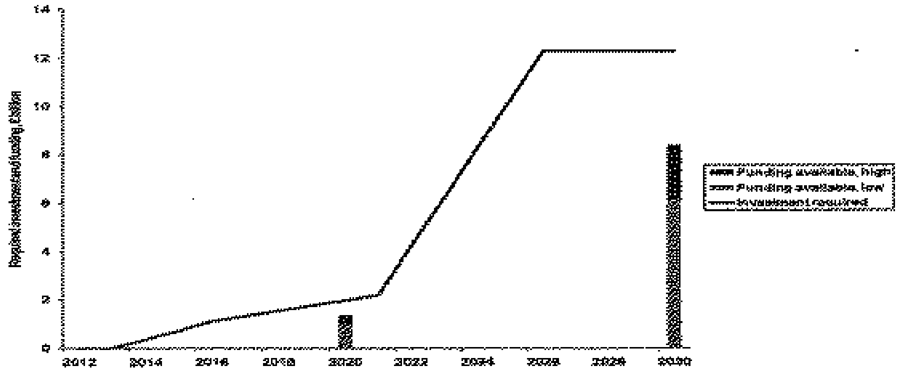
[19] The investment requirements in the sector are based on the DECC 2050 Pathways Level 3 capacity scenario presented in Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, Annex.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

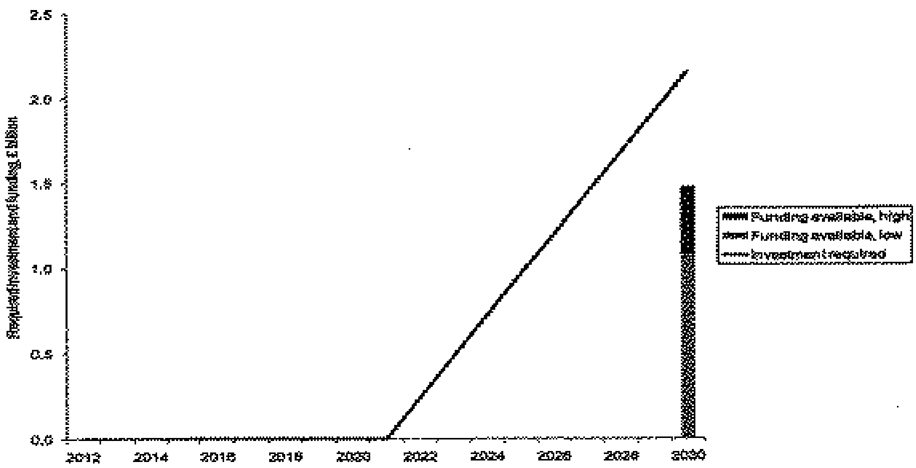
Figure 1.4
Funding gap in the tidal range sector (2011/12 prices)



Source: *Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, pp. 61-62 and Oxera analysis.*

Figure 1.5
Funding gap in the wave and tidal stream sectors (2011/12 prices)

Comment [D14]: This displays no funding gap over the period to 2030 – surely that is not helpful to the case?



Carbon Capture and Storage

Overview of CCS sector

1.29 CCS is a technology intended to prevent the release of large quantities of CO_2 into the atmosphere from fossil fuel use in power generation and other industries. The three main components of the CCS process include extracting carbon dioxide from a fuel or exhaust gas, transporting it to where it can be stored and pumping it into underground geologic storage facilities to securely store it away from the atmosphere.

Formatted: Bullets and Numbering

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1206

1.30 A typical CCS supply chain will include the following key components and suppliers:

(a) CO_2 emitter: CCS is potentially suitable for any large combustion plants; typically either a power generator (i.e. coal or gas power station) or an industrial plant (i.e. cement, aluminium, steel plant production plant). Power generators which are investing in CCS development include companies such as Vattenfall, SSE, RWE NPower and E.On. Companies in the industrial sector who are investing in CCS include Tata Steel and Total (oil refining);

(b) CO_2 capture technology provider: The capture process is the most capital intensive CCS process, however, it may also offer the greatest opportunity for cost reduction through innovation. Technology developers understood to be active in this area include Alstom, Aker Clean Carbon, Doosan Power Systems and Mitsubishi Heavy Industry;

(c) CO_2 transportation/pipeline developer and operator: This portion of the supply chain is well understood. In 2009, there were 2,400km of pipelines transporting CO_2 to more than 70 EOR projects across the world.[20] Within the UK, the main developer is National Grid; and

(d) CO_2 injection and storage developer and operator: This process is also reasonably well understood with CO_2 having been pumped underground since the 1970s. Storage developers include Shell, Statoil, National Grid, and Petrofac.

Scope of GIB CCS intervention

1.31 The GIB's investments in CCS may include highly efficient combustion plants, CO_2 capture facilities, transport pipeline infrastructure, particularly "trunk" or "oversized" pipelines which would have capacity to transport CO_2 from multiple emitters, and/or injection and storage facilities. Installation of monitoring and measurement technology relating to the storage site would also be included in the GIB's investment remit.

Formatted: Bullets and Numbering

[redacted]

[redacted]

1.32 A complete CCS project is not currently commercially deployed in the UK. It is perceived as a novel, capital intensive sector, not because the technologies which it encompasses are individually new, but because their application and commercial packaging is new.[21] For example, it is not yet known how well the technologies will perform when attached to power stations and other large combustion plants, nor the

Formatted: Bullets and Numbering

20 [redacted]

21 Vivid Economics, *The Economics of the Green Investment Bank: costs and benefits, rationale and value for money*, report prepared for the Department for Business, Innovation and Skills, August 2011, §3.12.1.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

best way to structure commercial arrangements. Further, it is unclear how the three parts of the CCS process will fit within a single business model.[22] This novelty has the potential to constrain finance since all three parts must be in place for the project to operate and be commercially successful. Uncertainty around this issue and investors' lack of familiarity with these models may deter investment or lead to an over-pricing of the risk. CCS therefore suffers from the same difficulties as many other Green technologies, namely:

(i) Perception of high risk investment due to construction risk: CCS on power plants is 'at an early pre-commercial stage in its development'. Given that there has been no large-scale deployment of CCS, there is significant uncertainty associated with the costs of power plants with CCS.[23]

> *Since there is no commercial scale application of CCS on power generation plant anywhere, estimates of costs, build time and plant performance are based on small pilot plants, engineering studies and experience from comparable technologies.*

The UNEP/SEFI guide on financing of renewable energy states that initial and secondary rounds of venture capital funding are likely to be utilised (alongside public funding and R&D grants) in order to reach commercialisation, after which private equity and bank debt may become available. The term the 'valley of death' is often used to describe the difficulties of accessing commercial finance between the initial VC investment and demonstration; or from demonstration to commercial roll-out.[24] Oxera has advised that the difficulty in quantifying and pricing these risks causes problems in identifying investment payback periods and internal rates of return (IRR), and can result in finance providers being unwilling to invest. The number of stages within the CCS supply chain, and the associated technology risks within them, can exacerbate investor caution and require commercial lenders to require performance and credit guarantees across the supply chain that limit the number of potential suppliers.

(ii) A requirement for experienced commercial partners: A meeting between the UK Government and potential financiers in 2001 found that there was an interest in financing CCS, but the participants would need reassurance and clarity before making financing decisions. They expressed a preference to lend to projects which included oil majors, utilities and other large companies. This is because investors perceive that these companies would be more likely to have the capability to manage the risk associated with CCS. Similarly, a survey of 30

Comment [A16]: Should this be 2011?

Deleted: ;

Deleted: I

[22] CCS consists of three distinct processes which first extract carbon dioxide from a fuel or exhaust gas, then transport it to where it can be stored, and finally pump it into a secure geological storage facility.

[23] Mott MacDonald (2011). 'Costs of low-carbon generation technologies', May, Chapter 3, p.70.

[24] UNEP/SEFI/Bloomberg NEF/Chatham House (2010). 'Private financing of renewable energy – A guide for policymakers', January.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1206

private sector capital providers operating in Europe carried out by the Climate Group and the Ecofin Research Foundation (ERF) on behalf of the Global CCS Institute highlights that debt would be provided only if certain prerequisites are met, including that major sponsors who have successfully managed large and complicated construction projects must be involved.[25]

Deleted: likely

IGCC power stations expressed the view that it was important that serious industrial players were involved to fix problems when things went wrong. They therefore placed a premium on the involvement of the oil majors, utilities and National Grid. They stated that they would need evidence that the engineering challenges were manageable at commercial scale, stability around the long-term structure of the energy market, a mature risk allocation position with big credible companies, a joint and several liability position that gave confidence that integration risk was well managed and confidence that the economics and longer term market opportunities existed for CCS and fossil fuel plant in the future. They perceived that large utility companies could provide such security. However, as set out at §[redacted] below, the GIB will have deep institutional knowledge and experience in green investments. Commercial funding by the GIB in the sector should, therefore, demonstrate that banks are able to build sufficient know-how to invest in the sector with confidence.

Deleted: ;

Deleted: t

Deleted: confidentially

(iii) Uncertainty around the operational performance of the assets: In the event of a technical failure, the CCS plant has no means of recouping the capital cost of the chain. Further, there is a risk that malfunctioning technologies may create liabilities for investors. For example, an operator of a transport system or storage site could incur new liabilities as a result of a failure in containment of CO_2. There is no cap on the potential costs if such a liability were to materialise. While a total CCS technological failure is unlikely, there is still considerable uncertainty over the levels of reliability and efficiency of a plant at commercial scale. In particular, there are considerable risks associated with the commissioning phase, where achievement of full operation levels could be delayed, or where it may be necessary to operate outside commercially viable parameters. GIB investment in early commercial projects will demonstrate that such risk is currently misperceived and consequently over-priced. Successful commercial ventures by the GIB will lead to greater confidence in the sector and have a multiplier effect on investment.

(iv) A lack of information from previous projects leading to an inability to quantify and price risks: The fact that an integrated, commercial-scale CCS chain has not yet been demonstrated means that projects are subject to high levels of risk, making it hard for projects to attract the necessary levels of investment. Currently, there is no mechanism in the electricity generating market through

[25] The Climate Group and Ecofin Research Foundation (2010), 'Carbon Capture and Storage: Mobilising Private Sector Finance'.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1639110712:1205

which additional costs (both capital and operational) associated with the operation of a full CCS chain can be recovered. As yet, the carbon price is not sufficiently high to mitigate these funding issues. The UK Government has therefore concluded that additional support is required to bring forward projects capable of delivering sufficient contribution to development in the sector.

(v) Balance sheet constraints: A number of potential investors are experiencing significant, long term balance sheet constraints. For example, despite initial high levels of interest in the UK's re-launched CCS competition, prospective projects are not yet at the stage of making final investment decisions, and one developer has pulled out citing difficulties in the ability to secure finance:

> *We cannot proceed with the significant risk that the current power station design and fuel mix could not be funded and built in the necessary timetable following the grant of consent.*[26]

The GIB may address this failure by providing funding on market terms. Such funding may temporarily replace funding from traditional, capital constrained, investors. However, in the longer term, it is envisaged that alternative intermediaries will be encouraged by GIB success to enter the sector.

1.33 Although in time, market failures ought to remedy themselves, the need for immediate investment to achieve the required scale-up and application of CCS means the UK cannot wait for this process to take place gradually as investors come forward over time.

Formatted: Bullets and Numbering

Quantification of market failures

1.34 Forecasts by DECC and others assume CCS capacity in the UK could reach 20 GW by 2030 and 40 GW by 2050. These estimates suggest a low or mid-point estimate of 10 GW of capacity by 2030, requiring approximately seven commercial CCS coal and gas fired plants (dependent on size) to be constructed. Estimates also suggest that 38 plants will be required to reach the forecast capacity of 40 GW by 2050, as set out below:

Formatted: Bullets and Numbering

[26] Ayrshire power press release (2012), 'Ayrshire Power puts power station with CCS on hold', June 26.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

Table 1.1
Cumulative capacity of CCS installed according to scenarios presented by Poyry and DECC

Scenario	2021	2025	2030	2050
Poyry - Low[27]	2.6	4.5	10	-
Poyry - High[28]	2.6	6.5	20	-
DECC – Central Scenario[29]	-	-	10	40
Demonstrations only	1.7	1.7	1.7	-

Source: Poyry (2009), DECC (2010).

1.35 CCS projects are relatively capital intensive; the total estimated costs for a retrofit project of a relatively small plant, covering each of the three phases of retrofitting CCS are £1.3 billion. Assuming moderate cost reduction from learning, the capital requirement per 1GW plant will be approximately £1 billion. Reaching the 10 GW capacity targeted for 2030 will therefore require around £10 billion in investment capital.

Formatted: Bullets and Numbering

1.36 ERF estimates that around EUR 5 billion would be available for funding commercial CCS across Europe within the current investment cycle. However, initial analysis undertaken prior to now-cancelled Demonstrator One project, suggested that if left purely to market forces (i.e. the EU ETS market price for carbon), commercial CCS projects would not be deployed until the 2040s.

1.37 There is some evidence that, whilst certain companies may be willing to finance small scale CCS pilots/specific component development, they are unwilling and unable to singularly finance commercial scale projects given the quantum involved – around £1.8 billion capital investment for a c300MW CCS project, not including subsequent operating costs.

Comment [vi17]: How was this number calculated and how does it tie in with the above analysis suggesting £1 bn cost for a 1 GW plant?

1.38 Even significant global operators would struggle to make sufficient investment in the sector; Oxera estimates that, to invest in a 500 MW project, a utility would need an asset base greater than EUR500 billion, which is available to only around four of the

---

[27] In the Low scenario the study by Poyry assumes that the size of individual projects grows from 1GW each to up to 1.5GW due to greater commercial viability and general growing confidence in CCS operations (Poyry, 2009, p. 26).

[28] The High scenario would require the construction of two 1 GW plants per year between 2021 and 2023, and two 1.5 GW plants per year between 2024 and 2027, of which Poyry assesses as only 'just plausible, especially when the 'dash for gas' delivered 2.8 GW per year of CCGT capacity at its peak' (Poyry, 2009, p.27).

[29] Supply and demand assumptions used to derive the capital expenditure requirements were provided by market consultant Nexant. Supply going forward has been assessed according to UK current capacities (including new Ensus and Vivergo pipeline projects), capacities under construction and plants due to come online (having been announced by financially strong sponsors) taking into account some reasonable operating assumptions to allow for construction time and ramp-up. Capital expenditure price assumptions were derived from the actual capital expenditure of the UK Vireol Bioethanol project whose construction will be starting in October 2012.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

European Utilities. Alternatively, if investment in a 500MW project were carried out by a consortia of three developers, the asset base requirement would be approximately EUR 25 billion, which is held by a limited number of large utilities.

1.39 An insufficiency of funding in the sector is not unique to the UK; no operational commercial-scale CCS projects currently exist in Europe and all proposed projects, such as the ROAD project in Netherlands led by E.On, are seeking support from either or both of Government and European Commission sources.

Biofuels

Overview of Biofuels sector

1.40 Biofuels are any liquid or gaseous fuels obtained from vegetable or animal matter. The most commonly used Biofuels are "Biodiesel" and "Bioethanol". Biodiesel can be produced from rapeseed, sunflower, palm oils, animal fat and waste oils. Bioethanol can be produced from corn, wheat, sugar beet and other crops (commonly known as feedstocks).

Formatted: Bullets and Numbering

1.41 Biofuels use well known and relatively simple production processes and technologies which have been in place for over two decades of utilisation. Biodiesel and Bioethanol produce between 50-95% and 10-100% less CO_2 respectively than their respective mineral fuel equivalents, depending on blends. Both are blended with fossil fuels:

(i) European Bioethanol is most commonly blended with gasoline in a proportion between 2% to 5% (E98-E95 on account of the gasoline component being between 95% and 98%) as an oxygenate additive (octane enhancer). Bioethanol can be blended with gasoline to create E10 or higher Bioethanol blends. However, blends above E10 (more than 10% Bioethanol) require modified car engines and infrastructure (fuel pumps).

(ii) Biodiesel can be used alone or mixed in any ratio with fossil diesel. If the blend contains less than 20% Biodiesel (i.e. at least 80% fossil diesel) then it can be used to fuel a standard diesel engine without the need for any modification.

1.42 The adoption of a Directive in 2003 set up guidelines for adopting Biofuels in all transport fuels used in the EU. These targets - a 2% inclusion rate by the start of 2006 and 5.75% by 2011 - were voluntary. More recently, as noted in §**Error! Reference source not found.**, the adoption of the Renewable Energy Directive ("**RED**") in 2009 replaced aspirational targets with a mandated commitment for at least 10 percent share of transport fuels to be renewable transport fuels by 2020.

Formatted: Bullets and Numbering

[redacted] The introduction of increased EU import tariffs, a removal of tax subsidies for US exports and burgeoning domestic demand has created an opportunity to significantly decrease the volume of imports flowing into the EU and create a self-sustainable market opportunity in the EU and UK. The involvement of the GIB in the UK Bioethanol market would stimulate investors' interest in the sector which is seen as essential to meet the forecasted capital expenditure requirements for the UK market to be self sufficient over the period to 2020.

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

1.44 In terms of production:

(i) Biodiesel is made through a chemical process whereby the glycerine is separated from the fat or vegetable oil through a chemical reaction using methanol as a catalyst. For biodiesel the process starts with the crushing of rapeseed (or other oilseeds) to extract the oil. Subsequently the oil is refined and transformed into biodiesel via a process called transesterification. The by-product from the oil extraction process is rapeseed meal, primarily used in animal feed. During the transesterification process, the glycerine alcohol in the oil is replaced by methanol in order to decrease the viscosity of the fuel. Biodiesel can be distributed in various forms either through truck fleets, independent petrol stations or through oil companies' distribution network.

Deleted: called transesterification

(ii) Bioethanol is produced by fermentation and distillation of starch crops. The production process for ethanol comprises 3 steps: fermentation (transforming sugars to alcohol), distillation (concentrating the alcohol to 45% by removing water) and rectification (transforming the alcohol to pure alcohol and removing any remaining water and other impurities). Specific pre-treatment may be required for extracting the sugars from certain raw materials, in the case of starchy crops like maize and wheat, an enzyme is required to transform the starch into glucose. Sugar rich crops like sugar cane and beet are treated to produce a sugar reach fluent that can be further concentrated

1.45 Both types of Biofuels are produced at refineries dedicated to the production of either Biodiesel or Bioethanol. However, technology specificity to feedstock-input is considered low; current Biofuel refineries are largely designed to run interchangeably on a variety of feedstocks (i.e. all oils and seeds) and the choice of feedstock is mainly based on price/cost.

Formatted: Bullets and Numbering

1.46 Refineries typically utilise unused "brownfield" sites and comprise a main central processing area and smaller satellite areas to provide Biofuel storage and road tanker loading facilities. The sites are typically joined by interconnecting pipelines and cables. Further pipelines are required to connect the site to necessary utilities such as gas, electricity and water. As an illustration, the main functions in the main process area of a Bioethanol refinery typically include: wheat unloading and storage; wheat milling; an ethanol processing area (comprising liquefaction, fermentation, distillation, dehydration, evaporation and DDGS drying, pelletising and storage).

1.47 Biofuel plants have an average capacity of 150 million litres p.a., although they range in size between 50-400 million litres p.a.. Average construction costs are in the range of c. £0.65-0.75/litre, resulting in a construction cost of between £97.5 million and £112.5 million for an average capacity plant. The average construction period is one and a half to two years and a Biofuel plant has an average asset life of between 20 and 25 years.

Deleted: between

Scope of GIB Intervention in Biofuels

1.48 The scope of the GIB's commercial investments in Biofuels will cover both Biodiesel and Bioethanol. In terms of infrastructure, the GIB's scope will be limited to Biofuel refineries projects and not ancillary infrastructure such as Biofuels distribution (to filling

Formatted: Bullets and Numbering

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1838110712:1205

stations etc). GIB may also make investments in second Generation Biofuels that are being developed to run on cheaper and more abundant feedstocks such as cellulose, although some further technology development may be required.

Market failures affecting Biofuels

1.49 There are a number of market failures that affect the production (and therefore use) of Biofuels in the UK:

(i) Limited balance sheet capacity by traditional investors: traditionally, development and construction of biofuel facilities in Europe has largely been financed either by energy companies, commodity traders or high net worth individuals providing equity and securing long term financing from banks. Biofuel projects being highly capital intensive, energy companies and commodity traders are no longer able to raise significant amounts of capital due to the credit rating constraints on their balance sheets. In addition, the involvement of high net worth individuals in a project raises the questions of sponsors' credibility (is the project driven by the desire to profit from the available tax incentive rather than knowledge of the business sector?);

The combined effect of the limited finance available from both commercial lenders and industrial players has seen biofuels projects struggle to obtain financing. By way of example, a mid-sized project in the UK known to the Department for Business which benefits from conservative gearing and Export Credit Agency backed commercial and political risk insurance for a substantial portion of the senior debt funding requirement is currently having difficulty gaining traction in the market.

(ii) Perceived risks around scale-up of technology to meet increased demand: Despite the relatively well proven underlying technology, scaling up the technological solutions to meet the levels of production required by the RED has resulted in increased production costs and other significant operational challenges. For example, the Ensus bioethanol plant opened in Teesside in March 2010 closed in May 2011 – albeit temporarily – with its operator citing difficult market conditions (the plant remains closed as at July 2012 but is set to reopen in the near future). This, coupled with historical losses incurred by Biofuel refineries, has led to investor caution, with only a limited number of investors understanding the risks to the extent that they are prepared to invest in Biofuel refinery projects.

(iii) Risk aversion due to concerns around security of fuel supply: A number of investors are deterred by uncertainty of supply of feedstocks. There is a reduced number of large international and a large number of small local feedstock suppliers. The former provide short-term, volume and price fixed contracts but long-term fully fixed contracts are not common. Particularly in the case of biodiesel, as the vast majority of feedstocks are imported into the UK, even if long-term supply arrangements can be secured, these remain subject to the risk of exchange rate fluctuations.

Deleted: It is not intended that the

Deleted: will

Deleted: These technologies are still very much in development.

Formatted: Bullets and Numbering

Deleted: large scale power

Deleted: utilities, using internal and external sources, or by independent power project developers

Deleted:

Deleted: and insurance companies.

Deleted: have high

Deleted: ty and independent power producers and utility

Deleted: companies

Comment [D18]: We need to update this as this is copied paste from biomass power [redacted] - could you add here?

Formatted: Highlight

Comment [D19]: [redacted] could you define here?

Formatted: Highlight

Formatted: Highlight

Deleted: (define)

Deleted:

Deleted: ethanol

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

Quantification of market failures

Formatted: Highlight

Formatted: Highlight

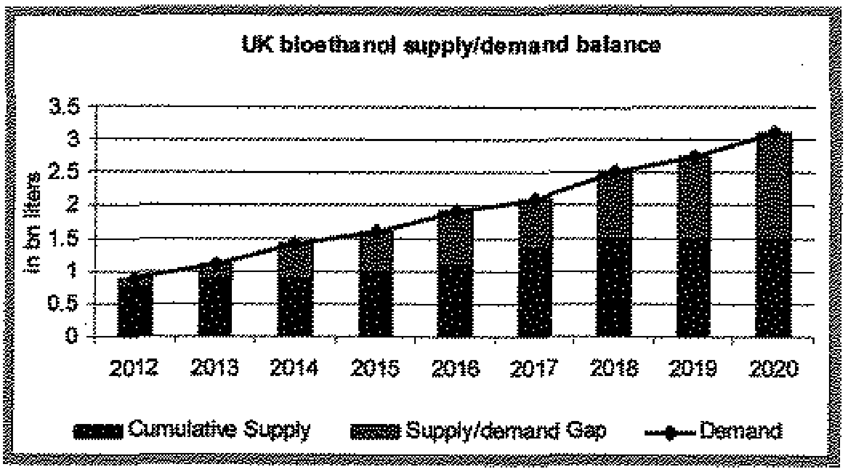
1.50 The UK does not currently produce enough Bioethanol to meet present demands and imports nearly all of its Bioethanol needs. Absent GIB intervention, over the period to 2020 this situation is only likely to become more pronounced - there have not been any new UK plant announcements in the last [3] years, due to difficulties in obtaining sufficient finance and, at the same time, demand, driven by the EU 2020 mandate, will continue to increase.

Formatted: Bullets and Numbering

Deleted: [illegible]

1.51 The following chart illustrates the possible UK Bioethanol supply/demand gap over the period to 2020. It shows that UK would need to invest approximately an additional £5 billion by 2020 in Bioethanol to make up the gap between anticipated supply and demand to be self-sufficient. This is therefore the finance gap that would otherwise occur without additional stimulation of investment by the GIB.[30]

1.52 *[Awaiting quantification of the finance gap for Biodiesel – UKGI to supply]*



[30] Specifically Articles 308 and 309 TFEU

Deleted: 120712:1403

Deleted: 120712:1123

Deleted: 110712:1638110712:1205

5

[redacted]

From: [redacted]
Sent: 17 July 2012 11:10
To: [redacted]
Cc: [redacted] Griffiths Oliver (ShEx); O'Neill Elizabeth (LEGAL B); [redacted]
Subject: FW: GIB templates (biomass, marine, renewable heat)
Attachments: Biomass template 010712.docx; Marine template 010712.doc; Low carbon heat template 010712.docx

CONFIDENTIAL EMAIL FROM SLAUGHTER AND MAY - THIS EMAIL AND ANY ATTACHMENT MAY BE PRIVILEGED

[redacted]

As discussed at this morning's meeting, attached is Oxera's final output on renewable heat (marine and biomass also attached to the same email). This was the work they were commissioned to do to respond to the Commission's Level 1 questions.

Kind regards

[redacted]

[redacted] Associate | EU & Competition

SLAUGHTER AND MAY

One Bunhill Row
London
EC1Y 8YY

Direct [redacted]
Mobile

Secretary: [redacted]

Admitted as Barrister and Solicitor in New Zealand

From: [redacted]
Sent: 01 July 2012 13:44
To: [redacted]
Cc: [redacted]
Subject: GIB templates (biomass, marine, renewable heat)

Dear [redacted]

Please find attached near final drafts of 3 of the 5 non-priority templates (biomass, marine and renewable heat).

These seek to address earlier comments from Chris and Victoria. A key issue is how to link technology novelty and investor caution (the market failures outlined at the outset in many sectors) with capital insufficiency, without arguing that existing returns are not commensurate with project risks. One way that the introduction and summary sections in the templates attempt to deal with this are to argue that:

- the novelty of the specific technology and project risks lead to mis-pricing of risk/or provision of finance only when projects can secure long-term contracts that eliminate many these risks - the range of risk perceptions across investors within a sector (highlighted by Oxera's hurdle rate analysis) means that some will invest but others may not - GIB intervention can provide funding where some but not all investors will provide finance

- the requirement for long-term contracts with experienced, creditworthy counterparties can exclude smaller technology developers, and place increased reliance on balance-sheet constrained larger utilities to control other parts of the supply chain eg, investing/partnering further up the supply chain

I hope these are useful contributions. CCS will follow, and it would be useful to understand your requirements for the nuclear template for tomorrow.

Kind regards,

[redacted]
Senior Consultant
Oxera
Direct: [redacted]
Tel: [redacted]

Oxford Brussels London

GREEN INVESTMENT BANK

Proposed Templates for responding to Commission Level 1 questions

BIOMASS POWER

2. Identification and provision of details of market failures:

(i) details of the type(s) of market failure(s) encountered in the sector and each subsector/technology[1]

Investor caution and financing constraints arise primarily from the following two industry features.

- **Feedstock supply chain risks.** There is uncertainty over biomass availability on a large scale, and in the longer term:
  - The potential for tightening sustainability criteria or air quality restrictions risk limiting supply and increasing feedstock prices—especially for wood-based products, where a number of supply alternatives may be at risk;
  - policy interventions (at a national or international level) to direct biomass feedstock to the heat sector risk limiting access to feedstock, and placing upward pressure on prices—most biomass feedstock including increasingly common wood-based products are suitable for both heat and power.
- **Project cost structure and risk profile.** Fuel price uncertainty, combined with little correlation between fuel costs and power prices can subject developers to significant power price risk.

Typically there is a finite pool of investors interested in a particular sector with a range of perceived risks and risk appetite.

The difficulty in quantifying and pricing these risks can result in finance providers being unwilling to invest unless developers can arrange long term contracts with suppliers with strong credit ratings. Where the supply chain contains small suppliers, or is sufficiently immature that there are a limited number of such counterparties, larger project development may only be possibly with vertical integration into feedstock supply—which in turn restricts project development to larger players with sufficient financial strength to invest.

(ii) details on the causes of such market failures

A) Feedstock supply chain risks

---

[1] The Commission require that market failures put forward are specifically linked to the sub-sectors of the sector that they can be evidenced for. For example, for biomass this might involve some market failures applying particular types of feedstock. If market failures actually apply across the sector then evidence to this effect is required. At present we have a short list of market failures for each of these sectors but they are not especially well substantiated.

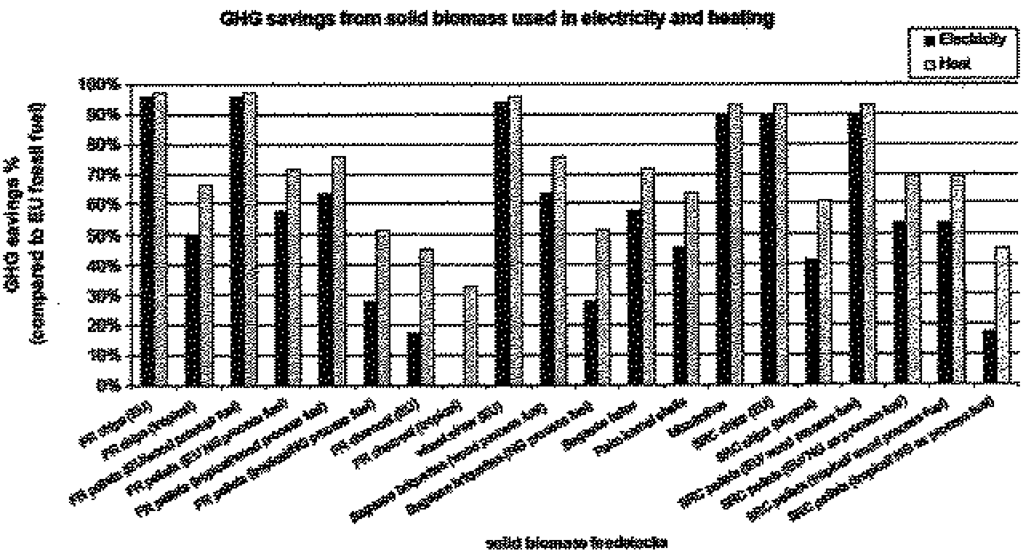
Figure 1 highlights that there are a range of biomass feedstocks available that are suitable for both heat and power. The three common types used to generate electricity are:

- Agricultural residues (by products of food production, such as straw, oat husks etc);
- Forestry products and residues (woody biomass such as bark, thinning, tree tops etc); and
- Energy crops (short rotation coppice such as willow and miscanthus).

The European Commission sustainability guidance highlights that international trade in biomass is growing, with most of the increased trade in future expected to be in the form of pellets (a type of solid biomass generally consisting of processing residues from forest-based industries).[2]

- Pellets have a number advantages as a fuel including lower moisture content, high energy intensity, clean, dry and relatively low storage requirements.[3]

Figure 1 Biomass feedstocks suitable for heat and power



Source: JRC 2009[38]

Limited number of suppliers and immature infrastructure

---

[2] European Commission (2010), 'Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling', February 25th.

[3] See for example, Forestry Commission/Biomass energy centre, 'Information sheet 1. Biomass pellets and briquettes'.

Supply risk is created by a limited number of sustainable biomass suppliers in the market. Project developers have expressed concerns over the risk of biomass supply disruptions. Investor presentations from Drax Group Plc, which undertakes biomass co-firing and is considering investment in stand-alone biomass plant, highlights that, even for relatively commonly –used wood pellets:[4]

> There are relatively few sustainable biomass suppliers in the market leading to concentration of supply risk. A supply disruption from one could impact on our generation capacity...We could fail to secure sustainable biomass supplies and logistics arrangements which meet our hurdle return rates and sustainability criteria.

Mitigating these risks where supply is limited requires developers to work with suppliers to develop supply chain reliance—Drax's strategy:[5]

> There are four strands to our fuel contracting strategy. We are looking to secure term rights to sustainable biomass through both direct contracts for delivered biomass pellets and contracts for unprocessed fibre to provide greater security over the fibre source.
>
> In order to enhance the security of supply from such contracts we are also exploring direct investment in biomass pellet plants

Fuel handling and storage risks are also prevalent, 'emphasising reliance on continuous, secure supplies while best practice in safely storing biomass is developed'. The relative novelty of storage risks is highlighted by the fire at the fuel storage area of RWE npower's Tilbury plant in February 2012, which has led to an outage of over three months. RWE has indicated that it will share lessons from this fire with the rest of industry in due course.[6]

Competing demands from the heat sector

With potential limits on the supply of sustainable biomass, investors are likely to be mindful that there is a possibility that future national low-carbon policies could act to direct biomass feedstock towards the heat sector rather than power—and depending on the economics and incentive schemes put in place to support biofuels in heat, this could adversely affect the price and availability of feedstock for early adopters of biomass power. As recommended by the UK's independent Committee on Climate Change:

> Given limits to the global supply of sustainable bioenergy, it is important that this is used in an optimal fashion... If CCS is not available, bioenergy use should be skewed towards heat generation in energy-intensive industry, and to biofuels in aviation and shipping, with no appropriate role in power generation or surface transport.

---

[4] Drax Group plc (2012), 'Preliminary results for the year ended 31 December 2011', February 21st.

[5] Drax Group plc (2012), 'Preliminary results for the year ended 31 December 2011', February 21st.

[6] npower Media Centre (2012), 'Tilbury Station Unit 8 Return to Service', June 21st.

Sustainability criteria

Sustainability criteria for biomass that can be used in power stations raises the following risks for investors:

- stringent sustainability criteria could limit the biomass sources that power stations can use
- existing generating stations may not be exempt from future changes in sustainability criteria.

The European Commission (2010 guidance) states that

> A wide variety of biomass feedstocks make it difficult to put forward a harmonised scheme at this stage. Different feedstocks present different challenges to sustainable production, greenhouse gas performance or efficient energy conversion...For these reasons, the Commission does not at this stage propose binding criteria at EU level.

However, developers have highlighted the risks of changes to biomass sustainability standards.[7]

> From April 2013, in order for the sustainable biomass we burn to qualify for support under the Government's renewables support mechanism, we will have to demonstrate that it meets pre-determined sustainability standards. Those sustainability standards may be tightened over time, and there is a risk that we may sign long-term supply contracts which meet the current standard but fail to meet a future standard.

Tightening of sustainability criteria over time from the existing levels endorsed by European guidance (as recommended by the UK's independent Committee on Climate Change)[8] could limit the number of feedstock suppliers or biomass equipment used that lenders deem acceptable in order to lend to biomass projects.

- The current EU sustainability recommendations are based on a 60% saving in greenhouse gas emissions compared to fossil fuels. The majority of forestry residue currently meets this threshold as shown in Figure 2 below.
- If the sustainability requirements were increased 72% as recommended by the Committee on Climate Change, the forestry residue suitable for use in biomass heat projects could be limited to a few sub-categories such as chips and pellets obtained from the EU, and a limited set of tropical pellets.

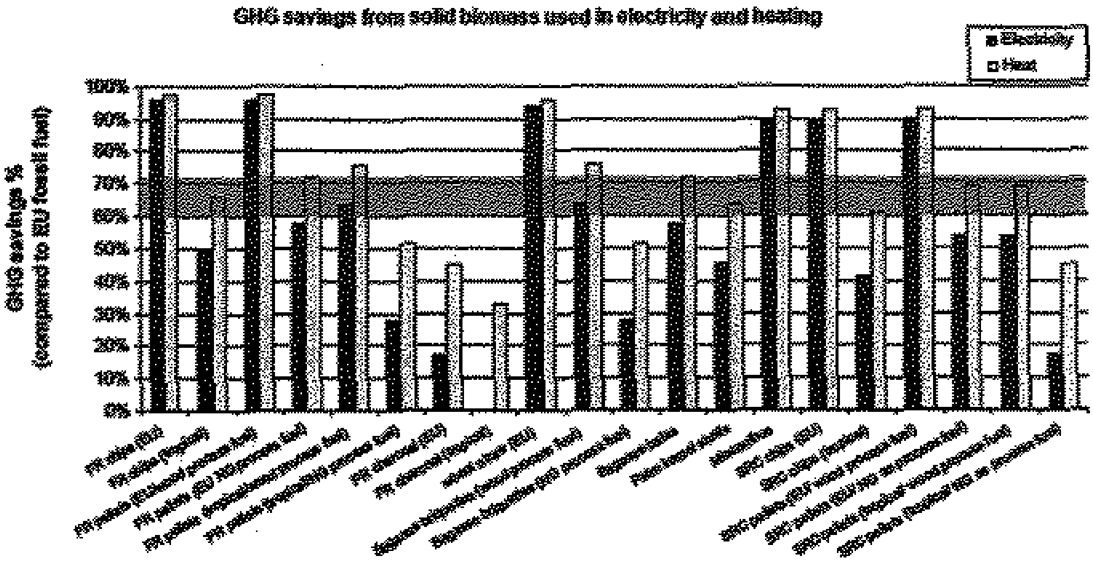
The uncertainty around future sustainability requirements is likely to limit the number of feedstock suppliers that lenders deem acceptable in order to lend to biomass projects.

---

[7] Drax Group plc (2012), 'Preliminary results for the year ended 31 December 2011', February 21st.

[8] If the emissions limits from biomass plant are reduced from 285.12 kg CO2/MWh from 200 kg CO2/MWh as recommended by the Committee on Climate Change.

Figure 1 Typical greenhouse gas performance of solid biomass



Note: FR refers to forest residues; SRC refers to short rotation coppicing.
This figure excludes the impact of land use change, which the European Commission highlights should also be included when assessing the greenhouse gas emissions impact of biomass.
Source: European Commission (2010), 'Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling', February 25th.

Summary

Uncertainty over large scale feedstock availability for biomass power is driven by the limited number of sustainable suppliers, and threats to the availability of that supply in the medium term— caused by possible tightening of sustainability criteria, and the potential trade-offs made by national or international policymakers to divert biomass from power to heat projects.

- tightening of sustainability criteria, air quality restrictions risks limiting supply and increasing feedstock prices—especially for wood-based products;
- policy interventions (at national or international level) to direct biomass feedstocks to the heat sector risk adversely limit access or placing upward pressure feedstock prices across most biomass feedstocks, including the most common wood-based products, which are suitable for both heat and power.

Typically there is a finite pool of investors interested in a particular sector with a range of perceived risks and risk appetite.

The difficulty in quantifying and pricing these risks can result in finance providers being unwilling to invest unless developers can arrange long term contracts with suppliers with strong credit ratings. Where the supply chain contains small suppliers, or is sufficiently immature that there is a limited number of such counterparties, project development may only be possibly with vertical integration into feedstock supply— which in turn restricts project development to larger players with sufficient financial strength to invest.

B) Project cost structure and risk profile

Contracting structures and business models

The project development business models for biomass are relatively complex in comparison to those of other technologies like wind and solar.[9] This complexity places additional requirements on the financial strength of the developer, exacerbating supply chain risks.

For example, Ernst & Young has highlighted the following:

> The simplicity of wind and solar [unlike biomass] more readily gives them the characteristics of an infrastructure asset investment rather than a business investment.

There is substantial uncertainty over biomass prices, which in turn results in uncertainty over potential project returns, free cash flow, and hence financing options.

- Estimates commissioned by DECC highlight that biomass prices could range between £4/GJ and £10/GJ by [2020] depending on global biomass supply.[10]

Potential exposure to these risks places additional pressures on the financial standing (or balance sheet strength) of developers:[11]

> Wind and solar both benefit from free natural resources obtained by way of land or roof lease (with relatively modest royalties) rather than complex feedstock contracts.
>
> Consequently, banks prefer projects to have sponsors who control feedstock and waste streams or for projects to have the benefit of long-term supply agreements for at least a significant proportion of the feedstock - for a period ideally exceeding the tenor of the loan and providing known parameters for price fluctuations.

Indeed, there has been some evidence of increased vertical integration (Ernst & Young).[12]

> M&A activity...showed evidence of vertical integration as companies seek to secure feedstock supply. Utility giant, EDF is paying an undisclosed sum to acquire its first biomass pellet manufacturing plant in Germany.

However, smaller non-utility developers may find it harder to obtain long-term feedstock contracts:[13]

[9] Ernst & Young (2011), 'Renewable energy country attractiveness indices', August, p.3.

[10] DECC (2012), 'UK Bioenergy Strategy', April.

[11] Ernst & Young (2011), 'Renewable energy country attractiveness indices', August p.3.

[12] Ernst & Young (2012), 'Renewable energy country attractiveness indices', May, p.18.

> The availability of a viable, long-term, bankable wood fiber supply contract for non-utility takers is by no means certain.

If larger utilities are more able to vertically integrate and obtain long-term contracts than smaller market participants, it may be more difficult for such smaller participants to obtain bank financing.

Technology risks

A key component of a biomass project is the choice of boiler technology. A number of technologies are available (eg, fixed bed boilers, fluidised bed boilers and pyrolysis combusters).[14]

> One of the key components for any biomass project is the boiler/combustor. Developers have a choice of technologies either thermal energy (which uses oxygen) or anaerobic heating (which does not).[15]

Certain boiler types are relatively more flexible with respect to the variety of feedstock they can use.[16]

> A bubbling fluidised bed ("BFB") boiler...has two main advantages over more traditional fixed bed boilers, namely the fuel size and flexibility of fuel type, with BFB boilers able to utilise fuel with varying moisture content and particle size as well as a mixture of different biomass fuel types.

Ernst and Young adds that there is a trend towards developing projects using such boiler technologies:[17]

> As feedstocks vary by locality, there is an added degree of complexity as most technologies require relatively homogeneous inputs. This is resulting in a trend towards technologies that can run on a mixed feedstock supply.

However, the small size and limited financial strength of many biomass technology suppliers may limit their ability to offer Engineering, Procurement and Construction (EPC) wraps that are require by lenders providing project finance. According to Ernst & Young:[18]

> The biopower technology industry (other than in landfill gas) has no large players and is a collection of largely unrelated subsectors, each with many often locally or regionally based manufacturers.

---

[13] Reuters (2012), 'Analysis: UK bets on biomass in move away from coal', May 25th.

[14] Clifford Chance (2012), 'Construction Issues in Biomass Projects', March, pp. 2-3.

[15] Clifford Chance (2012), 'Construction Issues in Biomass Projects', March, pp. 2.

[16] Clifford Chance (2012), 'Construction Issues in Biomass Projects', March, p.3.

[17] Ernst & Young (2011), 'Renewable energy country attractiveness indices', August p.4.

[18] Ernst & Young (2011), 'Renewable energy country attractiveness indices', August p.4.

Consequently, many biopower technology suppliers do not always have the financial strength required by banks and specialist investment funds for project financing, with construction contractors often required to provide turnkey wraps to absorb risk. Indeed, some banks (especially post 'credit crunch') have been reticent to lend to some technologies due to some early poor performing loans - in part due to optimism bias concerning availability and efficiency, as well as difficulties arising from system scale - up or integration risk.

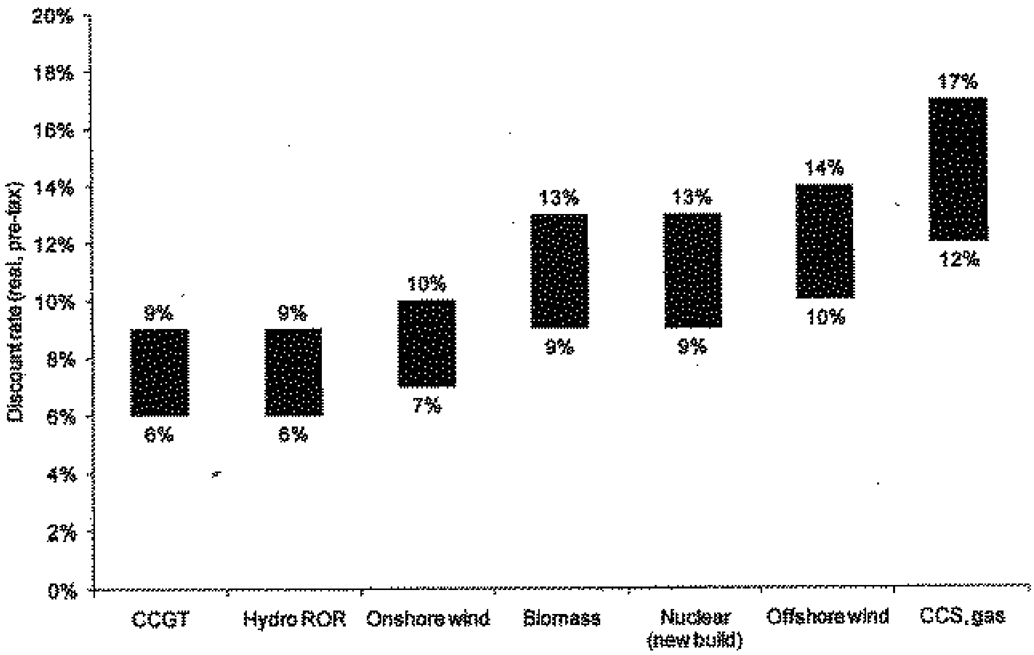
Summary

Biomass projects are relatively exposed to fuel price volatility, which exacerbates supply chain risk and can lead to bank requirements to restrict lending without control over feedstocks. This and the requirement for developers to secure EPC wraps from technology providers can require significant financial strength throughout the supply chain in order for investments to be undertaken.

In general, relatively high-risk projects might be expected to go ahead as long as expected returns are commensurate with those risks. However, the difficulty in measuring and appraising those risks for biomass projects is highlighted by a wider range of required returns from investors.

The relatively high uncertainty over biomass projects relative to other low carbon technologies is highlighted in Oxera's study on discount rates for the Committee on Climate Change. The study shows that the range of discount rates for biomass projects is wider than that of relatively mature technologies such as onshore wind.

Figure 1 Discount rate ranges for selected technologies



Source: Oxera (2011), 'Discount rates for low-carbon and renewable generation technologies', April, Figure 4.1.

3. Precise quantification of the current and expected funding gap and investment trajectory (with/without GIB intervention) for each sector and technology backed by data

The UK's Renewable Energy Roadmap set out a target of building an additional 750 MW to 2,750 MW of biomass capacity by 2020 (primarily through conversion of existing coal plant and through building new stand-alone plant).[19]

The current pipeline of potential projects exceeds this ambition, but the majority of projects are subject to investor approval, and only a small proportion has reached financial close (see Figure 3 and Table 1).[20] The information available also suggests that all of these projects intend to primarily use wood-based products for which sustainability concerns are greatest.

The risks discussed in previous sections could therefore result in a proportion of the pipeline being cancelled if sufficient funding is not made available.

- The overall pipeline of plants currently being considered by developers is around 3,300 MW.
- Only 400 MW of this capacity has either reached financial close or is expected to reach financial close shortly ie,10% of the 3,300 MW capacity in the pipeline. [to confirm capacity that has reached financial close]

---

19 [Explain derivation of range]

20 Platts (2012), 'Power in Europe', May 28th.

Biomass pipeline

Location	Developer	Capacity (MW)	Status	Feedstock (where published)
Reached financial close				
Markinch	RWE Innogy	50	Under construction	
Port of Tees	MGT Power	295	Arranging £450m of financing to start construction in August 2012	Wood chips
Avonmouth Dock	Helius Energy	100	Expects to close £300m of financing this summer	
Not reached financial close [to be confirmed]				
Port Talbot	Prenergy	350	Planning approved – no information on financing	Wood
Tilbury Docks	Tilbury Green Power	60	Planning approved – no information on financing	Wood chips and solid fuel from household waste
Ironbridge (coal to biomass conversion)	E.ON UK	450	Planning approved	
Rookery South	Convanta	65	Planning approved – no information on financing	Waste
Anglesey	Anglesey Aluminium Metal Renewables	299	Planning approved – no information on financing	Solid biomass fuel from certified forestry operations
Drax	Drax	660 conversion	Being considered by Drax	
Immingham	Drax, Siemens	299	Planning approved	
Royal Portbury Dock	E.ON	150	Planning approved, but uncertainty over subsidy delaying final investment decision	Wood
King George V dock	Forth Energy	120	Applied for planning permission	Softwood from sustainable managed projects from the UK and overseas
Imperial dock	Forth Energy	222	Applied for planning permission	
Pollington	Dalkia	53	Applied for planning permission	Wood pellet from discarded wood

Roosecote	Centrica	80	Pre-proposal, with an intention to make a planning application in summer 2012	Wood pellets (imported)
Suspended/cancelled				
South Shields	Drax/Siemens	290	Suspended in 2010, because Drax considered the support levels to be insufficient	
Stallingborough	RWE Innogy	65	Suspended, while RWE reviews investments	
Drax	Drax/Siemens	299	Cancelled	

Source: Platts (2012), 'Power in Europe', May 28th.

The funding gap for the UK power sector could be in the region of 30-50% of required investment by 2020:

- Analysis by DECC concludes that £110 billion of investment may be required in the UK electricity generation and transmission sectors by 2020.[21]
- Analysis by Vivid Economics suggests that only £55-75 billion of finance may be available (from utility balance sheets, bank debt, infrastructure funds, pension funds and insurance funds).[22]
- This implies that the overall funding gap for the UK electricity sector could be around £35-55 billion, or equivalently around 30-50% of the £110 billion of investment needed in the sector.

If available finance were allocated across sectors in proportion to sector requirements, this would imply that the funding gap in the biomass sector could lie in the range £3.4—5.4 billion by 2020 (see Figure 4).[23]

This is an indicative first approximation, and implies that there is a similar relationship between risk and return across sectors—that is, although risks and returns may differ

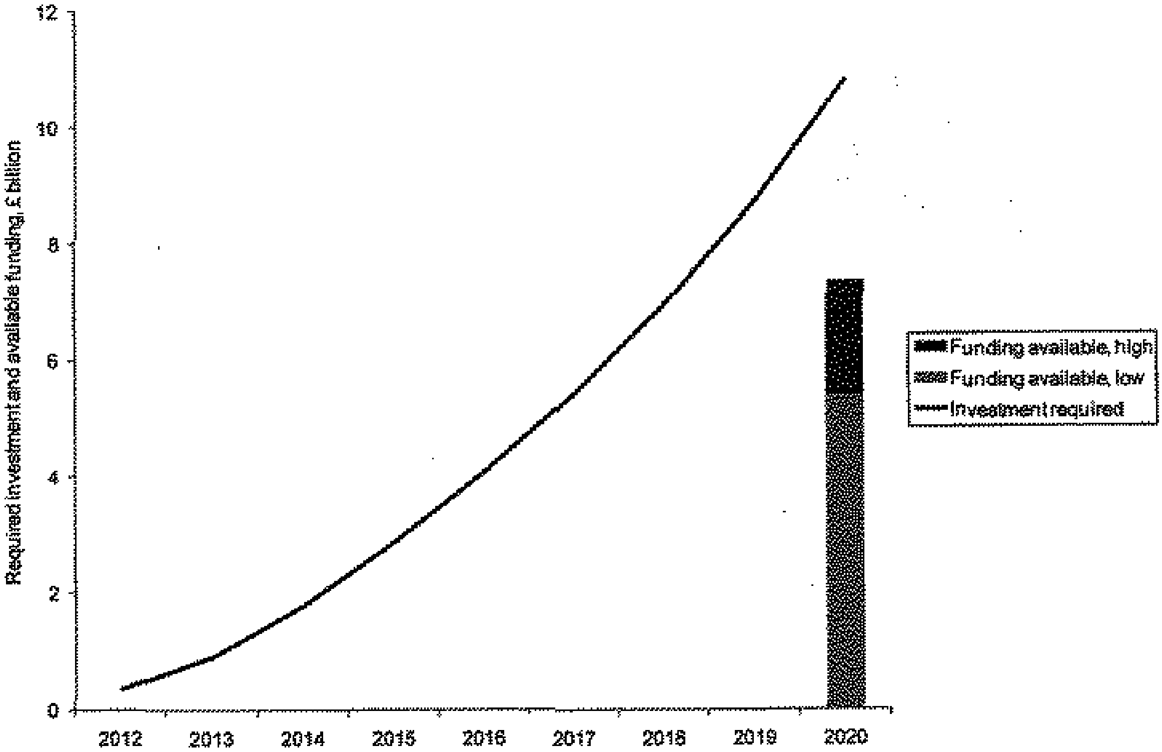
[21] Department of Energy and Climate Change (2011), 'Planning our electric future. A White Paper for secure, affordable and low-carbon electricity', July.

[22] Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, p.40.

[23] The investment requirements in the sector are based on biomass capacity projections in DECC (2010), 'National Renewable Energy Action Plan for the United Kingdom', July. The costs of these capacity projections are estimated in Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, Annex, p.57.

across sectors, risk is not priced significantly differently across them. It is likely to represent a conservative estimate, and further constraints may limit access to finance in some sectors—such as the desire for large utilities to limit exposure to a particular sector to a fixed proportion of their balance sheet, or that lenders are wary of highly levered financial structures such that not all potential debt finance can be utilised.

Figure 4 Funding gap in the biomass sector (2011/12 prices)



Source: Vivid Economics (2011), 'The Green Investment Bank: Policy and Finance Context', October, p.57 and Oxera analysis.