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Construction Issues in Biomass Projects

Introduction

Biomass is without a doubt one of the most hotly-talked about 'carbon-neutral' energy sources of the minute. As many jurisdictions aim to increase their use of renewable energy but are faced with an existing stock of thermal plants, resistance from lenders to fully embrace the wind market and with wave and tidal technologies still being in their infancy, replacing the use of fossil fuel in existing and new thermal power plants with biomass is certain to provide a big part of the solution over the coming years and in the longer term. Consequently many developers are taking a renewed interest in biomass projects. Whilst, on the face of it, biomass projects may appear more expensive than their fossil fuel equivalents, once the load factor of the power and government incentives are taken into account, biomass is in fact one of the most economical of all renewable technologies.

Key issues

- One of the key components for any biomass project is the boiler. The choice of technology impacts not just on economic viability of a project but also on other matters such as strategy for the supply of biomass fuel.
- Dedicated biomass projects can be procured on an EPC or an EPCM basis. If a project is being procured on an EPCM basis and the project is planned to be project financed, developers should structure to mitigate the interface risk between the various contracts.
- Regardless of the choice of procurement strategy, most sizeable biomass projects will inevitably involve a series of construction contracts (for example, the construction of a dock, or improvement works of an existing dock) for the delivery of biomass fuel and off-take of by-products.
- Establishing the performance guarantees in an EPC contract (or contracts) is key for a biomass project.
- Developers will need to ensure that an adequate strategy is in place for the operation and maintenance of the plant which takes account of the long term supply of spare parts, qualified technical support and relevant performance guarantees to cover the period after commercial operation.

Developers and lenders in the sector are having to consider a variety of technologies and procurement strategies, and this briefing aims to give a basic outline of the various construction-related issues that will also need to be considered when developing or funding biomass projects. For further information on regulatory issues in the UK or issues relevant to feedstock and sustainability please refer to our related briefings entitled "Regulatory Issues in UK Biomass Projects" (March 2012) and "Fuel Supply and Sustainability Issues in Biomass Projects" (March 2012).

Types of biomass project

With advances in biomass technology since the 1970s, developers have an ever-widening array of technologies to choose from, depending on the scale of the project and the incentives available. The four types of biomass project which currently receive government support are:

- ***Dedicated biomass (or direct firing)***: These are usually new plants which solely burn one or a mixture of different types of biomass fuels (sometimes with more traditional fuels used as back-up). Given the incentivisation offered in some jurisdictions, larger scale dedicated biomass plants are now economically viable for development. In addition, increasing the size of the plant above 100MW allows the use of larger and more efficient steam turbines and therefore increases the overall efficiency of the plant, improving the economic viability of the project.
- ***Co-firing***: Co-firing involves burning biomass along with a base fuel (usually coal). Since most coal plants operate at a much higher efficiency than direct fired biomass plants, co-fired projects will benefit from (1) any carbon credits or other incentives received as a result of using renewable sources of energy; and (2) in the UK, gate fees for accepting biomass from councils/waste sites who might otherwise have to pay landfill charges to dispose of their combustible waste, all without losing the efficiency of a coal-fired plant. In the UK, the government has encouraged the development of co-firing plants by offering substantial incentives by way of Renewables Obligation Certificates.
- ***Conversion***: This involves converting an existing power plant (generally coal but sometimes gas) to burn biomass only. This may be an attractive option for existing plants which may otherwise face decommissioning due to an inability to meet emissions requirements. Depending on the existing technology and equipment utilised in the power plants as well as desired heat output, limited conversion can be undertaken to an existing power plant without significant capital expenditure. It is also worth noting that, according to technical studies, up to 2% biomass can be added to the coal in a coal-fired power plant without any conversion being required and therefore become a co-fired plant as discussed above. The fuel is simply mixed with the coal in the plant fuel processing system before introduction to the boiler. Above 2%, modifications such as a dedicated biomass fuel processing system as well as modifications to one or more of the boilers would be needed to deal with the biomass once it has been reduced to fine particles.
- ***Combined heat and power (CHP)***: As would be the case with a modern fossil-fuelled plant, heat and/or steam produced as a by-product of burning biomass to generate electricity can be used by the generator or sold to adjoining or nearby industrial users. Many dedicated biomass projects are either factoring in the development of an adjoining CHP facility or at least developing the dedicated plant on a "CHP-ready" basis so as to allow future CHP development once off-take arrangements and revenue streams are more certain. In contrast with dedicated biomass power plants, developers will need to factor in any loss of power generation output in order to create the steam needed for CHP, as the steam is not necessarily "freely" created.

Choice of Technology

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).

- ***Direct Combustors***: These use one compartment to heat, dry and combust the fuel and are the most common combustors, found in several varieties, including:
  - ***Fixed bed boilers***: Air is supplied through the grate from below, and initial combustion of solid fuel takes place on the grate along with gasification. This allows for secondary combustion in another chamber above the first where air is added. Fixed bed boilers are commonly used in co-firing biomass plants, given that the process of suspended combustion is usually the basis of the technology already utilised in the existing coal-fired plant.

- ***Fluidised bed boilers***: Fuel is burned by adding it to a continually stirred bed of heated material (such as sand) which is agitated by passing air through it under pressure so that it behaves much like a fluid. These boilers are highly efficient, but have a higher capital cost than fixed bed boilers. There are two types of fluidised bed boiler:
  - A bubbling fluidised bed ("**BFB**") boiler involves dropping fuel down a chute into a combustion chamber. This type of 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.
  - A circulating fluidised bed ("**CFB**") boiler allows much more stable combustion with air velocity increased above that in a BFB boiler. However, the capital expenditure for a CFB boiler is much higher than with a BFB boiler and also the fuel size must be very small, which may lead to issues in running the plant at partial load. As a result, CFB boilers may only be economically viable on the larger biomass projects (i.e. capacities greater than 50MW).

  Whilst many of the dedicated biomass plants being considered for development at present have a larger capacity than some plants already in commercial operation, it is thought that these new plants will utilise the proven fluidised bed combustion technology, which has been in use since the 1970s. As with any technology, technical advice should be obtained to verify its use for a particular project.

- ***Gasifier or Pyrolysis Combustors***: These combustor types involve the heating of biomass fuel with either very limited quantities of or no oxygen, to convert the raw fuel into syngas. Syngas is a fuel which burns cleaner than fossil fuels, biomass, char or other by-products. Although considerably more efficient than combustion technologies, gasification and pyrolysis suffer from high development costs and technology risk. However, as these processes borrow heavily from coal gasification and petrochemical technologies, they should benefit from any parallel advances.

Given the focus on developing dedicated biomass projects, the remainder of this briefing concentrates on procurement strategy and other key contractual considerations for a dedicated biomass project.

Procurement Strategy

EPC v. EPCM basis

As with any project, a range of procurement strategies may be considered. Dedicated biomass projects are generally either procured on:

- a full EPC basis with all design, engineering, construction and procurement services being provided and "wrapped" in a single agreement (with FEED also included in this wrap); or
- a disaggregated (generally EPCM) basis, with specialist firms being appointed to provide proprietary process equipment and others to provide the balance of plant and other equipment.

Whilst the procurement strategy for a biomass plant depends on its size and the type of technology, the current financial climate has led to a softening of the contracting market in this sector with contractors becoming more willing to provide turnkey EPC contracts, wrapping the design and technology risks. However, the choice of procurement strategy may not change the requirement for the boiler to be procured from a particular vendor or a limited list of proposed vendors. The following factors should be taken into consideration in deciding upon the appropriate procurement strategy:

- ***Technology Risk***: As developers and lenders become more comfortable with the technology used and/or the scale of the projects in commercial operation increases, they may well be less likely to seek a complete EPC wrap of the technology risk, seeing instead the financial benefits of avoiding the risk premium charged by the EPC contractors.
- ***Boiler Procurement Strategy***: The boiler(s) may be procured as long lead items by the developer or left for the contractor to procure, depending upon the time constraints for the particular project (including any need to fast-track procurement so that the project has a greater chance at more enhanced incentives from the relevant government).

- ***Price***: Developers may be more willing to accept the greater level of interface risk involved with an EPCM strategy, rather than pay the interface risk premium which would be included as part of the contract price on an EPC basis. Lenders may require additional comfort such as contingency funds to be included as part of the financial model if the project is procured on an EPCM basis.
- ***Developer Resources***: An EPCM approach generally involves a much higher level of commitment in terms of resources and personnel on the part of the developer. Developers without access (internally or externally) to such resources should prefer an EPC approach.
- ***Level of Sponsor Support***: Greater levels of equity participation may allow developers greater leverage in their choice of procurement strategy.

Where the developer chooses to procure the project on an EPCM basis, lenders will usually seek comfort on the management of the interface risk between the various contracts. The developer may either offer one or a combination of the following mitigants:

- ***Project Management***: As mentioned above, the developer will need to prove that it is capable of managing the interface between various contractors through project planning, for example, by way of detailed timelines, responsibility matrices and interface schedules. Developers may also enter into an external contract with a construction management firm in order to manage the design and construction process. Although the construction manager would not usually accept responsibility for the works performed by the contractors, an experienced manager can greatly mitigate the interface risk by introducing adequate processes and managing the various parties.
- ***Interface Agreements***: Developers can also mitigate interface risks by requiring the various contractors to enter into agreements amongst themselves, to either provide a "wrap" of certain works, or to take on the responsibility of interacting with each other and relieving the developer of the obligation to prove that a specific contractor's work is defective. Although a developer would ideally want an interface agreement incorporating such clauses between all contractors, this may not be feasible in practice.
- ***Common contractual terms***: If an interface agreement is not feasible, there are certain provisions which can be included in the various packages which will assist in mitigating some of the interface risk (for example, each contractor being obliged to co-operate and co-ordinate with other contractors, as well as the developer, to mitigate any delays to the overall programme and to ensure compliance with a common interface schedule). Similarly, in case of disputes, developers can include consolidation provisions in each contract so as to avoid potentially conflicting decisions and to ensure that disputes with one or several contractors are all heard together.

Regardless of the choice of the procurement strategy for the main power plant, most biomass projects will involve the construction of a dock (or at least improvement works to an existing dock) for the delivery of the biomass fuel and off-take of by-products such as potash. As mentioned above, a CHP facility may be included as well. Any sizeable biomass project will therefore probably involve multiple works on a single site and therefore potentially a series of construction contracts. A developer will therefore need to prove to its lenders that it will be able to manage these contracts, even if the main development is procured on an EPC basis.

Single Stage Contracting v. Two Stage Contracting[1]

Even when EPC is the chosen procurement strategy, it may be that a further decision is to be made as to how to best procure this in the relevant jurisdiction at the time, namely whether single stage or two stage contracting will be utilised.

Two stage contracting generally involves an initial pre-construction stage governed by a separate agreement under which basic design and cost estimates are prepared and developed. Some procurement issues may be agreed and the EPC price is built up on an open book basis at this time. Upon an agreed trigger point being reached, the contract is converted into a fixed price EPC contract. In deciding whether to undertake two stage contracting rather than tendering on an EPC basis from the outset, developers need to take the following considerations into account:

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1 For further information, please see our client briefing entitled "Two-Stage Contracts".

- ***Technology risk***: As discussed above, new technologies have been developed for use in biomass projects and these are not always tested or proven (for example, biomass plants using gasification technology). An initial stage of design development, undertaken either by the eventual contractor or a specialist third party, can help mitigate these risks utilising an open book basis.
- ***Incentivisation***: A developer that appoints the contractor to develop the initial design could negotiate a pricing strategy whereby certain sections of the work carried out under the initial contract will be wrapped up in the eventual contract price (after remaining prices and other terms are agreed). This would incentivise the contractor to enter into the final construction contract. However, this potential advantage must be carefully balanced with the potential loss of competition (and competitive pricing) that early selection of a contractor entails.
- ***Speed***: As a result of the recent changes to the Renewables Obligation regime in the UK, along with the favourable political environment for biomass projects and the increasing demand for energy from renewable sources, developers may be motivated to conclude the contract arrangements at an earlier stage. Two stage contracting allows parties to mobilise the procurement process despite immaturity of the design.
- ***Lender requirements***: In the case of project financing, the developer will need to consider lender requirements in relation to price and time certainty. Utilisation of a two staged approach may require the developer to source interim funding of the activities ahead of conversion to an EPC contract.

Whilst two stage contracting may be utilised, a single stage contracting strategy under competition remains the generally preferred approach for biomass projects.

Key Contractual Considerations

From a technical perspective the one major technical difference between biomass and coal is that biomass contains virtually no sulphur. Where most coal-fired power plants require an expensive flue gas scrubbing system to remove sulphur dioxide before flue gasses are released into the atmosphere, the flue gas in a biomass plant does not require similar treatment. Other than this difference, the risks associated with constructing biomass plants are otherwise similar to those associated with the construction of traditional coal-fired plants.[2]

In addition to these more generic issues and the usual commercial considerations, some of the key concerns that developers and lenders will need to consider specifically for biomass projects are:

- ***Performance Guarantees***: Establishing the precise guarantees to be attained and applying liquidated damages if these are not achieved in order to support a project's financial model, is a challenge that will need to be addressed in the EPC contract (or contracts). Some performance guarantees will be in the form of mandatory requirements or absolute guarantees and therefore will not attract liquidated damages (for example, levels of emissions).

  Contractors usually seek to limit any performance guarantees by reference to specific types of fuel used. It is therefore very important to ensure that the contractor's required fuel parameters are achievable and can be readily supplied or that the guarantees can be modified for alternate fuel supply parameters.

  Where EPCM is the chosen procurement strategy, the developer will need to ensure that the performance guarantees across the contracts not only interface appropriately with each other from a technical and timing perspective, but also provide a sufficient degree of recourse across the relevant performance criteria so that the biomass plant as a whole operates at or above the guaranteed levels despite the disaggregated procurement strategy. Where the project is project financed, the lenders will need to be assured of this both from a technical and financial perspective.

  In addition to performance guarantees in the EPC contract (or contracts), developers and lenders may be looking for the additional comfort of an availability guarantee during an initial period after commercial operation, either as part of the EPC contract (or contracts), the operation and maintenance agreement or other long term service agreements for the plant.

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2 For consideration of the issues applicable to traditional plants please see our client briefing entitled "EPC Due Diligence for Power Projects".

- ***Operation and Maintenance***: Developers need to ensure that there is an adequate strategy in place for the operation and maintenance of the plant at an early stage, as is the case with traditional power plants. The operation and maintenance strategy will depend on a number of factors including:
  - the developer's own capability and resources;
  - the choice of procurement strategy for the design and construction of the plant (for example, a disaggregated procurement strategy may have a series of operation and maintenance agreements matching some of the split of scope packages); and
  - whether the developer is a utility and/or it is intended for a utility to have a long term role in the relevant project.

  Lenders will also require, as part of this strategy, a credible assurance as to the long term supply of spare parts, appropriately qualified technical support for the key plant as well as some longer term performance guarantees to cover the period after commercial operation (including factors such as availability and degradation of output).
- ***Technology Risk***: Developers and lenders will also need to consider the appropriateness of the chosen technology and its supplier, not only in relation to whether it is proven and other commercial risks, but also whether technology is sufficiently flexible so as to utilise a mixture of biomass fuels (whether as part of the fuel supply strategy or so as to mitigate particular risks in the supply chain and transportation of such fuels from their source).
- ***Timing***: Developers and lenders will need to consider timing implications including any potential impact on:
  - the levels of liquidated damages; and
  - the financial model of the relevant project,

  should any government incentives be forecast to change at certain key dates.[3]
- ***Testing***: Depending upon the choice of technology, developers and lenders may want to see the performance of the plant measured by a longer reliability run than that for a fossil fuelled plant. The testing process will also need to take into account any government requirements in order to benefit from support or subsidies, such as the Renewables Obligation Certificates in the UK, and equivalent provisions in other jurisdictions.
- ***Fuel Source Availability***: Contractors are generally unwilling to take any risk as a result of delays in the procurement of the fuel supply during the commissioning and testing period or, post-commercial operation, in the case that availability guarantees are in operation. Developers will therefore have to ensure that adequate fuel supply arrangements are in place along with adequate amounts for storage. [4]
- ***Auxiliary fuel sources***: In addition to the main fuel supply, some biomass plants will be designed to perform on auxiliary fuel in case of temporary shortage of the main fuel source. It is important to take this into account when measuring the performance criteria and the possible impact on accreditation.
- ***Additives (including additional bed material)***: Given fluidised bed boilers require the presence of a minimum level of fuel ash content for the continued operation of the boiler, developers and lenders will need to consider the composition of fuel proposed and whether additional bed material/other additives are required.
- ***Site issues***: Given the impact on the assessment of sustainability issues, most proposed dedicated biomass plants are located around ports or industrial areas already equipped with established transportation routes. Given this requirement, contamination issues may need to be considered depending upon the site's original use and/or its proximity to other industrial properties and their associated use.

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3 For changes envisaged in a UK context please see our client briefing entitled "Regulatory Issues in UK Biomass Projects" (March 2012).

4 For further details on issues relating to fuel please see our client briefing entitled "Fuel Supply and Sustainability Issues in Biomass Projects" (March 2012).

Clifford Chance

The commercial impetus to develop biomass power projects, driven by the government incentives available, and the need to obtain energy from renewable sources means that the obstacles in developing more efficient and larger biomass power projects will be overcome.

Clifford Chance has the experience, expertise and innovative edge necessary to support the developers and financiers of these projects. Any of the contacts on the following page would be delighted to provide details of our capabilities.

Our team of acknowledged experts successfully advises on all aspects of transactions in the energy and infrastructure sector, including project structuring, tax, planning and environmental issues, construction, major acquisitions, joint ventures, asset and share sales, project and acquisition finance, privatisations, trading and marketing, disputes, regulation and market reform, competition and anti-trust and public procurement.

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