Biomass installation contracting guide

Practical procurement advice
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1. Introduction

This guide explains a range of different options for setting up contracts for the installation of biomass boilers and associated equipment. It has been prepared under the Carbon Trust’s Biomass Heat Accelerator programme intended for thermal biomass installations up to approximately 3MW boiler output.

Historically biomass has developed outside the mainstream construction and building services engineering industries and a number of specialist installation companies have been established, often directly or indirectly associated with a particular manufacturer of plant. As a consequence of these origins, many biomass projects have been installed in the UK using less rigorous contractual approaches than might be applied in mainstream construction. Under normal circumstances the installation and operation may proceed without difficulty. However, a lack of defined contractual responsibility may very often leave the client facing unnecessary additional costs and unable to resolve any performance issues within the installed system.

Within this guide it is assumed that the general approach within Carbon Trust’s Biomass Heating Guide (CTG012) is being followed. This guidance note amplifies and builds on the advice in section 3.3 of CTG012 on procurement and implementation, although the guidance given could be used as a basis for development to fit other scenarios not explicitly covered in CTG012.

It is assumed that a detailed feasibility study (section 3.2 of CTG012) has been completed by an engineer with suitable qualifications and experience in the delivery of biomass plant and the results of that study submitted to the client in the form of a comprehensive report. The client is now looking to implement the findings of that report.
2. **Scope of guide**

This contracting guide explains the process of procuring a biomass scheme. It is intended to inform clients of the options available to undertake their biomass installation, and give awareness of the risks involved in any given approach.

It is not intended to give a definitive solution for every set of circumstances, and is not intended to be a substitute for appropriate professional advice.

Within mainstream construction and contracting, the management of risk is well understood and contracting is well evolved and rigorous. Where an installation is taking place within this environment the risks will be managed by the contracts process of the organisations involved.

An example of biomass as a small part of a project is when a new school is being constructed with a biomass boiler. The client will have a contract with the main contractor for the school, the main contractor will have a sub-contract with the mechanical subcontractor for the heating within the school, and the mechanical subcontractor will have a subcontract with the biomass boiler supplier. The client may therefore not have direct control over the boiler installation and may very well have to resolve any issues arising from the biomass installation or operation through the main contractor. The key issue from the client’s perspective is the definition of adequate boiler performance which is required to meet the client’s environmental and carbon emission targets. Some form of contracted performance measurement is essential.

Where the biomass installation forms the core project (and virtually all retrofit of biomass boilers to existing systems will fall within this category) the contracting chain will be much shorter. It will simply involve a direct contract with a boiler supplier. It is these biomass driven projects that can benefit from the use of more effective contracting used for smaller projects in the construction industry.
3. Definitions

Definitions of terms used throughout this guide:

**Client** – the ultimate person or organisation procuring the biomass plant. In construction industry contract documents, they are frequently referred to as ‘the Employer’ or ‘the Purchaser’. They can sometimes be referred to as ‘the Owner’ or ‘the User’. Carbon Trust Guide CTG12 often uses the term ‘User’; in this document the term ‘Client’ is preferred.

It should be noted that the Construction (Design and Management) Regulations 2007 (CDM) place Health and Safety duties upon the Client.

**Client’s Engineer** – a chartered professional engineer, or a consulting engineering organisation, with appropriate skills and knowledge, appointed by the Client to lead the biomass project. It is usual to appoint the professional engineer who undertook the feasibility study to perform the role of Client’s Engineer during the implementation.

The Client’s Engineer will undertake the necessary design work and produce technical specifications and contract documentation sufficient for tendering purposes. During the subsequent course of the Contract Works, the Client’s Engineer will monitor the execution of the Works, ensure that installation is in accordance with the contract, and keep the Client fully informed. (Note that the Client’s Engineer is not directly responsible for the performance of the Main Contractor or their subcontractors, or directly for the quality of the Contract Works which is the responsibility of the Main Contractor).

Depending on the nature and extent of the Works, the Engineer will frequently undertake the roles of ‘Project Manager’, ‘Contract Administrator’, ‘Technical Advisor’ and ‘Employer’s Agent’, which in a large building contract might be carried out by another construction professional.

**Contract Administrator** – A person or organisation named in the contract that will administer the contract, process variations, and receive, check and approve the Contractor’s applications for payment. In the context of small biomass projects this would usually be undertaken by the Client’s Engineer.
Employer’s Agent – A person or organisation, appointed by the Client to represent them, and take a lead role in implementing the project. The term is more commonly used with design and build contracts, and the role will generally encompass project management, contract administrator and CDM co-ordinator. Whilst a Client can use an agent to implement the project, they cannot abrogate their responsibilities as a Client under the CDM regulations by such an appointment. In the context of small biomass projects this would usually be undertaken by the Client’s Engineer.

Package Contractor – where the work has been broken down into a series of individual packages, usually based on trades/disciplines and let as separate contracts, each package is undertaken by a Package Contractor.

(Main) Contractor – Where the Works are let as a single contract, the Main Contractor is the firm/organisation charged with the task of executing the work needed to create the biomass plant. The Main Contractor is often referred to more simply as ‘the Contractor’. Because of the variety of contracts discussed in this document the term (Main) Contractor will be used to refer to this role. The (Main) Contractor can divide the work up to suit their own supply chain, and will usually operate in conjunction with several subcontractors. In turn, these subcontractors will operate in conjunction with various suppliers, including the biomass boiler supplier. The (Main) Contractor is ultimately responsible for the delivery of all works by their supply chain. The (Main) Contractor will seek to ensure that their own sub-contracts reflect the liability that they carry under the main contract. Where the project involves further detail design, or requires a degree of technical expertise, the (Main) Contractor may appoint their own professional engineer as a subcontractor to enable them to fulfil the contract successfully.

The term Principal Contractor is sometimes used to describe a (Main) Contractor. The Principal Contractor has a specific meaning and set of duties under the CDM regulations, and the term should only be used in the context of those regulations. Whilst the (Main) Contractor in a contract chain is usually the Principal Contractor for Health and Safety, this is not always so, especially where the site is operated by a large facilities management contractor.

Subcontractor – a subcontractor is an individual or firm which works under the direction of the (Main) Contractor and is wholly responsible to the (Main) Contractor. A subcontractor is contracted only to the (Main) Contractor and has no direct contract with the Client. In turn, the subcontractors may themselves have suppliers.

Biomass boiler supplier – The specialist who will supply, install and commission the biomass boiler itself (but not usually the connecting pipework which will be installed by a mechanical contractor or subcontractor). The biomass boiler supplier may be either a package contractor with a direct relationship to the Client, or a subcontractor to the (Main) Contractor.

Technical Advisor – where a Design and Build method of procurement has been used, a technical specialist who remains on the Client’s side of the contract to provide appropriate advice to the Client, review the contractor’s proposals, and monitor progress on site. In the context of nearly all biomass projects, such advisory tasks would be undertaken by the Client’s Engineer.
**Fuel Supplier** – a separate contract will be let with a fuel supplier of either wood chip or pellet fuel for the installation. While this is not a part of the construction contract, there are interfaces between the fuel supply contract and construction in terms of quality of fuel, delivery load sizes and means of charging for fuel, which in turn influence the design of the overall installation. All these aspects must be carefully considered and co-ordinated. This guide is not intended to address fuel contracts.

**The Works** – In some contract documentation this can be referred to as ‘the Contract Works’. The Works are the scope of works identified and described in the contract documents (which include the specification and drawings), which the contractor is required to execute. Where there is one main contract, this will include the scope of all subcontractors; it is for the main contractor to divide the scope as they see fit. Where a package contract route has been chosen, each package will have its own definition of ‘the Works’, with the sum of all of the packages forming the overall biomass scheme.

**Associated Works** – In schemes where biomass is the main driver, then the mechanical services and biomass plant works will dominate the scope of work. The remaining works to support the installation are usually limited and are referred to in this document as ‘Associated Works’. More detail is given in section 5.3.
4. Historical issues caused by poor procurement arrangements

A review of experience from biomass installations has indicated a number of issues that could have been resolved, or avoided altogether, by improved contracts procedures:

- Limited scope of work leads to poor performance.
  Sometimes, where a contract has resulted from acceptance of a proposal from a biomass boiler supplier, the only documentation will be a list of standard items which are supplied. Correct integration of the biomass boiler into the system, particularly the interaction with fossil fuelled plant, is crucial to success. This can be beyond the skillset of an organisation focused on the biomass boiler and so can be overlooked. If integration has not been undertaken correctly, the installation is likely to perform badly.

- Higher costs caused by gaps in the scope.
  The completeness of the scope should be rigorously examined at the tender stage before the contract is let. If gaps in the scope are discovered later, these will cost more to address as a variation than if they had been included in the original scope.

A change introduced later in a project has more impact as it may affect works already completed or material already ordered. In addition the competitive element has been lost from the pricing.

- No provision for performance measurement.
  Biomass boilers which have not been correctly integrated into the system, or have been incorrectly commissioned, are unlikely to yield the carbon or energy performance claimed by the suppliers. If performance criteria have not been laid down beforehand, and subsequent monitoring is not undertaken, poor performance in operation may not be identified.

- No proper provision for clients to address underperformance.
  When performance criteria are agreed, the performance clauses should lay down the remedy that the client has against the contractor. It may be that despite the best efforts of the contractor and/or biomass boiler supplier, the performance specification cannot be met. There are circumstances where this could result in direct financial loss to the client (for example in loss of RHI payments) and the client may wish to address this in the contract.

- Risk held inappropriately leading to additional costs.
  Contacts are about the placement and management of risk. Wherever a risk is placed in the supply chain by the contracts, there will be a price attached to it. The passing of a risk from the client to the contractor will result in a higher price as the risk is taken into account. Where a contractor does not understand a risk fully, the price will be increased to give protection to the contractor. As a result, if a particular risk is not placed on those who understand it and can easily manage it, the cost of the project will rise.
5. Influences on contract method and approach

There are a number of factors which will influence the choice of procurement route and contract that will be appropriate for a given biomass scheme.

Each of the following items presents a potential project risk which will be managed via the contract procedure. The Client must consider these risks in determining the most appropriate choice of contract. This may involve engaging professional support at an early stage to help with the further evaluation of the project risks and assist with design and procurement.

5.1 Project size

A large project will pose a proportionately larger commercial risk and so will justify additional effort in setting up the contracts. This provides protection to both the Client and the contractor.

5.2 Technical complexity

Biomass boilers behave differently to established gas and oil plant in their responsiveness to load changes, and their start up and shut down processes. Where a biomass boiler is being connected to an existing system, the biomass boiler must not be considered in isolation, but must be carefully integrated into the existing system. In addition to the appropriate hydraulic connections, it will be necessary to modify the overall system controls. This is crucial to ensure that maximum benefit is gained from the biomass boiler investment. Poor hydraulic and controls system integration is one of the major causes of underperformance of biomass boiler plant. Complications may arise as a result of water quality and operating pressures of the existing system.
When installing a biomass boiler in a new facility, there may be a need for associated civil engineering works to alter the building or a need to check load bearing capacity on existing floors. Such considerations increase the complexity and number of contractual interfaces.

Size of project is only loosely related to complexity. It is possible to have small installations that have very complex integration issues, and large ones that are relatively straightforward. An installation with any degree of complexity will benefit considerably from professional engineering input at the design stages to ensure that all the aspects are adequately covered.

Within the whole procurement chain, one party must take responsibility for the design integration. This may be the Client’s Engineer in a full design traditional contracting approach, or the (Main) Contractor or one of the Package Contractors in a performance specification and design and build scenario.

### 5.3 Associated works

The installation may require various items of associated work. These associated works may be as simple as a power supply and a few concrete plinths to support the plant or as complex as a building extension to accommodate the plant and bunkers. Any of the following associated works might be required in a project:

- Removal and safe disposal of existing plant.
- Plinths for new plant.
- Water supply.
- Internal power supply.
- Changes to lighting and emergency lighting.
- New power supply from statutory authority.
- New control panel.
- Hardstandings for manoeuvring of delivery vehicles.
- Changes to road access.
- Internal building alterations.
- Extension to building.
- Bunker construction.
- Hydraulics and fuel handling system.

The discipline (building, civils, mechanical and electrical) and quantity of associated works will determine the number of internal project interfaces that have to be managed to deliver the project. Each of these interfaces poses a risk to the delivery and the project cost.
5.4 Client capability

In any project there will be project management, cost monitoring and programming tasks. The nature and extent of these tasks will vary between projects.

For example, there can be a benefit in having a (Main) Contractor to manage the interfaces between the disciplines and carry the associated financial risks, but there will be a higher cost associated with this.

Rather than contracting another party to undertake these project related tasks, the Client may consider undertaking some of these themselves. This approach will reduce the initial headline costs, but if things go wrong the Client would be directly exposed to the financial consequences, which could more than offset the saving made.

The Client will need to consider their own capability realistically, and their appetite for risk/reward, in determining which tasks to undertake themselves and which to place on the Contractor. This will be discussed further in section 6.

5.5 Forms of contract

There are a number of forms of contract that are commercially published. It is recommended that one of these be adopted for biomass projects. In the event of a dispute, these forms of contracts are reasonably well understood by the legal profession and the courts. Other, bespoke, forms of contract do exist. However, it should be noted that such bespoke contracts have generally been drafted to favour the party presenting them and they will not have the same degree of established legal precedent.

The published types of contracts suitable for biomass boiler installations are described in section 7.

5.6 Familiarity with form of contract

If the Client has an in-house procurement team, or has appointed a consultant engineer to assist them with the project, these people may have experience of at least some of the forms of contract. In most cases, there is a benefit in opting for a form of contract which is well understood by the Client’s professional team.

The familiarity of the Contractors with the contract should also be considered. For example Contractors from mainstream construction will have familiarity with the JCT and NEC families of contracts, but not the MF/1 form. Those with a plant engineering background would tend to have experience of the MF/1, which is promoted for such installation work. Where Contractors face unfamiliar forms of contract, they can perceive this as added risk and inflate their price to cover this.
6. Types of procurement process

The Carbon Trust’s Biomass User Guide (CTG012) discusses approaches to installation and procurement of a biomass heating plant. Five different approaches were listed. The following sections of this guide focus on procuring a biomass heating system as using options 1, 2 and 3 from the guide. Section 6.4 considers procuring the installation only of a biomass heating system as the first step in option 4 of the guide.

It should be noted that CTG012 makes use of the phrase ‘User’s Engineer’. In this document, the person or organisation undertaking that role is identified as the ‘Client’s Engineer’.

Contracts to install the biomass system:

Option 1 – In house design, installation and commissioning.

Advantages:
- Potentially lowest cost as interface management is by the Client.
- Direct link to all Package Contractors may suit technically able Client.
- The Client retains control of the design.

Disadvantages:
- If a problem occurs, all package costs associated with rectification or delays will fall on the Client.

Option 2 – In house design, with third party installation and commissioning.

Advantages:
- The (Main) Contractor will manage all interfaces.
- Interface issues and delays do not fall to the Client.
- The Client retains control of the design.

Disadvantages:
- Pricing of risk and management by the (Main) Contractor will add to initial headline costs.
Option 3 – Third Party design, installation and commissioning (Turnkey approach).

Advantages:
- Contractor manages all facets of biomass project with limited involvement of Client.
- Greater cost certainty as the Contractor must price risk and provide a turnkey price.
- A well written contract provides the benefit of long term performance guarantee and mitigates the risk arising from latent defect.

Disadvantages:
- The requirement for the Design and Build contractor to accept and manage risk may add to initial headline costs.

Contracts to install and operate the biomass system or to provide heat:

Option 4 – Third party design, installation and commissioning (turnkey approach) with separate operating contract.

Option 4 is essentially the same as option 3 at construction stage, but involves the Client handing over the operation of their plant to a third party using an operating contract rather than operating it 'in house'. This guide covers the contracting of the installation and commissioning of option 4, but not the subsequent operating contract.

Option 5 – Third Party design, installation and commissioning and operation with agreement to supply heat (Energy Supply Company (ESCo) model).

The long length of the contract and the inclusion of life cycle operating costs of the boiler plant, as well as the installation costs, make this a much more complicated arrangement. The higher set-up costs associated with this approach usually constrain it to large installations such as those serving a factory, estate or district heating system. The preparation, tender and evaluation of such contracts, to demonstrate that they represent value for money, requires specialised knowledge. Professional assistance must be used for such contracts, and guidance on them is beyond the scope of this guide.
6.1 Option 1 – In house design, installation and commissioning

The Client takes on the responsibility for overall delivery of the project, and runs a series of small package contracts to cover the various aspects of the work. One of these package contracts is often directly with a biomass boiler supplier.

A common variation of this where the Client engages the services of a professional engineer as the ‘Client’s Engineer’. In this case, it is usual for the professional engineer that undertook the feasibility study to continue to provide this service. The ‘Client’s Engineer’ will act on behalf of the Client in designing, tendering and organising the packages of work that are required.

Typically a series of quotations will be obtained from suppliers (including the biomass boiler supplier) and the contracts let as a series of individual package contracts. It will be the Client’s responsibility, usually undertaken on their behalf by an appointed Client’s Engineer, to ensure that the packages match and that there are no gaps or incompatibilities in the overall project scope. This approach offers the opportunity to keep costs to a minimum by removing a Main Contractor’s overheads, but exposes the Client to greater levels of risk if one of the Package Contractors fails to deliver.

Option 1 would only be used where the project is small and the interfaces and associated works are very simple, or the in-house capabilities are significant and the risks/cost benefits are understood and accepted.

A key point when using option 1 is that someone must be appointed to integrate the overall design of the different elements of the project, and to ensure the technical compatibility of the individual package contracts. Poor integration of system components is a major cause of underperformance of biomass projects. In addition to the technical compatibility, the integrator must also ensure that the Works specified in each package match up to deliver the overall biomass project, and that there are no gaps which will lead to additional costs or delays at a later stage.

An example of a project suited to option 1 might be a boiler to serve an agricultural load such as a set of greenhouses. Typically a biomass boiler supplier would deliver a quotation for the installation, connection and commissioning of the boiler itself. The supplier would require certain other works to have been undertaken in advance (or parallel) with their installation. It is important to ensure that the biomass boiler supplier gives adequate information to enable these supporting works to be contracted elsewhere. In our example packages of work covered by individual quotations might be:

**Biomass boiler supplier**
- Supply and installation of biomass boiler.
- Commissioning of standard package of controls to thermal store.
- Possibly including chimney stack after induced draft fan.

**Builder**
- Plinths for boiler and plant.
- Modifications to the building to suit boiler/bunker.
- Roof adapted to suit stack.

**Electrician**
- New power supply to boiler plant.
- Modifications to lighting.
**Plumber/Mechanical Contractor**

- Modifications to water supply.
- Pipework connections to existing heating system.
- Controls on existing system.

Each of the four suppliers in this example will have an individual contract with the Client. The Client will carry the responsibility for overall co-ordination and programming of the four packages of work, and the associated risk.

For example, if the builder has not completed the boiler plinths when the boiler is delivered and a return visit is necessary by the biomass boiler supplier, it is likely that there would be an additional charge for the return visit. Similarly, if there are gaps in the scope of work or a technical incompatibility between the packages, this will result in additional costs, or delays, or even long term underperformance of the plant. Should one of the Package Contractors cease trading, this would cause delays and disruption which could result in legitimate claims from the remaining Package Contractors.

One of the items that can be overlooked with option 1 is the hydraulic and controls integration of the biomass boiler with the overall system. The adaption of controls is crucial to the successful use of biomass. Potentially it can be undefined by the Client, not covered by the biomass boiler supplier (whose controls quotation is usually limited to the thermal store and boiler only), and not covered by the mechanical contractor. Underperformance and operating issues are bound to follow. This risk can be mitigated by clearly allocating the responsibility to integrate the design to one party.

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**Figure 1 Example of option 1 contracting arrangement**

![Diagram showing the contracting arrangement between the client, client's engineer, boiler supplier, builder, electrical contractor, and mechanical contractor.](diagram.png)
Where the Client is experienced in running and co-ordinating contracts, or has a good understanding of biomass systems, and where the scope is not too complex, the Client may wish to pursue option 1 without assistance. Because the Client is undertaking the managing role, the Client is accepting and managing the associated financial and programme risk. The total costs from the Package Contractors would be expected to be lower than the other options. However, this cost advantage could be lost if problems occur on the project. In order to reduce this risk, the Client should conduct an appropriate level of due diligence on the experience and standing of the potential Package Contractors.

Where the Client has less experience, or the scope is more complex, and they still wish to pursue option 1, the Client will often choose to continue by appointing a professional engineer as the ‘Client’s Engineer’ to provide the technical and project support. This would usually be the same professional organisation that has undertaken the feasibility study.

In option 1, the Client’s Engineer would help assess the scope of work, prepare the specifications for Works prior to quotations and check the subsequent quotations to minimise the risk of gaps occurring. The Client’s Engineer would bring technical expertise to the management of the project and could also assist with the Client side of programming of the package works. Whilst bringing the knowledge and biomass expertise to the project, especially at the design and scoping stage, the consultants who provide the feasibility advice may not have adequate experience of the day to day management of several Package Contractors on site. This can limit the suitability of option 1 for larger or highly complex schemes with many different package and trade interfaces and programme links.

In this role in option 1, the Client’s Engineer would not have any direct contractual link with the Package Contractors, and would operate with the delegated authority of the Client.

6.2 Option 2 – In house design, with third party installation and commissioning

6.2.1 Outline

Option 2 follows the ‘traditional’ contract route used in the construction industry. The Client arranges for a detail design of the system to be completed, and then engages a (Main) Contractor to undertake the Works.

This option will nearly always take place with the appointment of a Client’s Engineer, to undertake the necessary detail design and to produce the technical specification, drawings and documents to permit a tender for the Works to take place. The consultant engineer who undertook the feasibility study is normally retained to provide the services of the Client’s Engineer. There are also a few cases where the Client has adequate relevant in-house engineering expertise themselves, and undertakes the detail design directly.

After technical and commercial scrutiny of the tender returns, a contract will be placed with the (Main) Contractor. The (Main) Contractor has the full responsibility for the execution of the Works specified in the detail design documentation to time and budget. During the construction works,
the Client’s Engineer will continue to support the Client by monitoring the Works on site, and (usually) administering the contract on behalf of the Client. In practice they will have day to day contact with the (Main) Contractor, and assist in resolving unforeseen issues that frequently occur during construction.

6.2.2 Design information

The detail design information prior to engagement of the Contractor will generally consist of a full analysis and calculations covering the biomass boiler and its interface with the building system, including:

- Sizing of boiler, pumps, pipes, flues and control and commissioning valves.
- Completion of plant layout drawings showing main plant and pipework locations and routes and resolution of major co-ordination clashes.
- Production of schematic drawings showing component arrangements and flows for commissioning.
- Production of a specification detailing the equipment and standards of installation; this is likely to be based upon a standard specification which covers all major components.

The Contractor will need to develop the drawings from the detail design into installation drawings for site and fabrication/workshop drawings for any components being manufactured off-site.

Some aspects of the design are usually left less developed. A typical example of this are the general controls (those other than the immediate control system of the biomass boiler itself), where only a performance specification will be issued for tender by the Client. As this is a performance specification, the Client’s Engineer will need to produce a full control strategy for the plant, as this defines how it will operate, and will indicate the location and numbers of sensors and any particular requirements of the layout and appearance of the control panel. The detail design of the controls would then be undertaken by the (Main) Contractor’s controls subcontractor.

The design of the controls of the biomass boiler and thermal store will be completed by the biomass boiler supplier but must be integrated into the overall control strategy by the detail designers of the overall controls.

Schemes of any size will often require Associated Works. The definition of these to may require the engagement by the Client of other construction professionals such as:

- Civil/structural engineer for work on slabs, plinths, hardstandings and load bearing walls.
- Building surveyor for changes to the buildings themselves.
- Electrical engineer if complex new power supplies are required.

Depending upon the nature of the Associated Works, the detail design of these elements could be placed with the (Main) Contractor in the manner of option 3. The Client’s Engineer should act as a lead consultant to co-ordinate these inputs from other design professionals and the Contractor.

6.2.3 Contracting supply chain and choice of main contractor

With option 2 the Client will enter into contract with one organisation, called the (Main) Contractor, to install the biomass boiler plant to the design that has been produced by the Client or the Client’s Engineer. It is the responsibility of the (Main) Contractor organisation to undertake all the necessary engagement of subcontractors and suppliers, co-ordination, programming and planning to ensure success of the project. The size and scope of the project will determine what contracting strategy to use, and whom to appoint as the (Main Contractor).
1. Where the project is small in size and there is only a very small quantity of Associated Works, the biomass boiler supplier may be able to act as the (Main) Contractor. It should be noted that many biomass boiler suppliers are not capable of undertaking this role and some would not wish to do so. Due diligence on their capability and track record should be undertaken by the Client or the Client’s Engineer. If a supplier inexperienced in managing the full scope of the works is selected, this could lead to much greater project risk.

*Figure 2 Example of biomass boiler supplier as (Main) Contractor*
2. Where the scope of work is primarily mechanical and electrical, including the boiler and all its interfaces, with simple to moderate building works involved, then the appointment of a Mechanical and Electrical contractor (usually referred to as an M&E contractor) to act as the (Main) Contractor would be appropriate. The M&E contractor should have the expertise to co-ordinate the engineering work on site with the limited Associated Works. The biomass boiler supplier would be a supplier/sub contractor to the (Main) Contractor. The construction risks would be placed with and managed by the M&E contractor acting as the (Main) Contractor. In selecting the M&E contractor to undertake the (Main) Contractor role, consideration must be given to the adequacy of their previous biomass experience. There are nuances to biomass installations that need to be understood by the (Main) Contractor for a successful installation. The Client’s Engineer should be able to assist and advise when considering the experience of potential candidates.

*Figure 3 Example of M&E contractor as (Main) Contractor*
3. Where the project involves moderate to extensive building works in addition to the biomass plant, such as where a significant extension or a new build boilerhouse is being constructed to house the plant, then appointment of a general builder as the (Main) Contractor could be appropriate. In general construction, multi-discipline building projects are usually led by a general building contractor, as they have the expertise to co-ordinate the building construction with the mechanical and electrical work packages.

In these circumstances, the biomass boiler is only a small part of the overall project. The biomass boiler supplier would generally be a subcontractor to the M&E subcontractor.

Figure 4 Example of builder as (main) contractor
6.2.4 Advantages and disadvantages

The main advantage of the option 2 approach is that the Client retains full control of the design either directly or through the Client’s Engineer. The design will have the benefit of being undertaken by a consulting engineering organisation that specialises in design. The Client will be able to see what they are going to get, and monitor progress to make sure it is delivered.

Where there are complex interface issues between the biomass plant and the existing system, it will nearly always prove worthwhile to reduce the technical risks by resolving these interface aspects in detail prior to tender. Option 2, with a detailed design, professionally produced prior to tender, is a good approach in such cases.

One possible disadvantage is that the complete separation of the detail design and construction phases, with an intervening period for potential contractors to submit tenders, can result in a longer project programme overall.

A further disadvantage is that any development of the design to overcome issues on site will result in additional costs as the contract has been agreed to deliver a specified installation. For example, it may be necessary to alter the layout of the plantroom to facilitate better access to plant. This may result in addition lengths of pipework for which the contractor would be entitled to payment.

6.3 Option 3 – Third party design, installation and commissioning (turnkey model)

6.3.1 Outline

This option follows what is often termed a ‘Design and Build’ contract in general construction.

The Client arranges for a performance design, which details the performance parameters of, and constraints upon, the system. These are not limited merely to plant output, but could define locations and spatial constraints and give more details of particular areas where the Client wishes to retain influence over the design.

The (Main) Contractor will develop a contractor’s proposal on how the performance design is to be met, and this will form the basis of that (Main) Contractor’s delivery. The (Main) Contractor takes full responsibility for meeting the performance parameters laid down, but has considerable freedom in how to achieve this. This option will frequently take place with the consulting engineer who undertook the feasibility study now further engaged as the Client’s Engineer to prepare the performance specification. The Client’s Engineer will support the Client throughout the evaluation of the (Main) Contractor’s proposals and the subsequent execution of the Works on site. There are also a few rare cases where the Client has adequate relevant in house engineering expertise themselves, and undertakes the performance design, and review of the subsequent contractor’s proposals directly.

Where the Client’s Engineer performs a professional supporting role to the Client in a Design and Build context, they will sometimes be referred to in documentation as the ‘Technical Advisor’. 
6.3.2 Design information

The performance information presented to the (Main) Contractor can vary widely and will depend upon what portion of the works the Client and Client’s Engineer wish to define in detail. A specification will be prepared identifying at least the following parameters:

- Thermal load profile or details of load to be served.
- Amount of heat required from biomass as proportion of annual total heat.
- Minimum boiler and plant efficiencies.
- Spatial constraints on plant.
- Restrictions on boiler location or a defined location.
- Associated works (such as hardstandings for delivery) that must be included.
- Constraints on power or water supplies.
- Environmental constraints on emissions/discharges.
- Constraints imposed by buildings.

Within the parameters defined in the specification, the (Main) Contractor is free to develop a detail design to meet the requirements of the contract, and use their contracting skills to do this in the most cost-effective way possible.

Whilst it is possible to devolve all the detail design to the Contractor, this is likely to increase the overall project technical risk. There are certain aspects of the design (such as the integration with an existing system) that may be crucial to success, or nuances of the project which require particular solutions to be determined before obtaining tender prices. The (Main) Contractor’s design capability may not be adequate to resolve these biomass-related issues, and the overall risk to the project will be better controlled by these aspects being fully designed by the Client’s Engineer and the Client before the tender. In practice many schemes will end as a hybrid between option 2 for some parts of the design and option 3 for others.

It is important to ensure that the split of design between the Client’s Engineer and the (Main) Contractor is defined and fully understood. To assist with this the checklist in Appendix A which allows the design of each aspect to be assigned or marked not applicable. Such a table could be prepared for each project to help ensure that all aspects are covered and there are no gaps in the overall design provision.

6.3.3 Contracting supply chain and choice of main contractor

With option 3 the Client will enter into contract with one organisation, termed the (Main) Contractor. They will take the outline performance design and develop it into a fully detailed design of the plant to obtain the required performance. The (Main) Contractor will then install the biomass boiler plant to the detail design they have produced. It is the responsibility of the (Main) Contractor organisation to undertake all the necessary engagement of designers (where the (Main) Contractor does not have an adequate in-house capability) and subcontractors to deliver the project, and to provide the co-ordination, programming and planning to ensure its success. The size and scope of the project will determine what contracting strategy to use.
1. There are a few biomass boiler suppliers who will undertake the full turnkey management of projects. However, full due diligence needs to be undertaken by the Client, or the Client’s Engineer on their behalf, on the supplier’s capability. Where the project consists of the boiler installation with a few minor supporting works, then employing a suitable biomass boiler supplier in this turnkey role can be effective.

Where there are more extensive works, or complex interfaces to the existing systems, the biomass boiler supplier may not have the capability or experience to produce a full detail design or manage the installation of elements beyond the biomass boiler itself. This could result in increased risk to the project, but this can be balanced by their full understanding of the biomass plant. In setting up a direct contract between the Client and the biomass boiler supplier, the best balance of project risk should be considered. The Client’s Engineer acting as Technical Advisor can assist with this.

**Figure 5 Example of turnkey contract with boiler supplier as (Main) Contractor**
Where the scope of work is primarily mechanical and electrical, including the boiler and all its interfaces to the existing system and with only simple to moderate building works involved, then the appointment of an M&E contractor to act as the (Main) Contractor would be appropriate.

The M&E Contractor will often have in house designers, or partnerships with Mechanical and Electrical Designers, and will be able to obtain support from biomass specialists. The M&E Contractor has the expertise and experience to co-ordinate the work on site, which is mostly engineering with some associated building works. The biomass boiler supplier would be a supplier/subcontractor to the (Main) Contractor. The construction risks would be placed with and managed by the M&E Contractor acting as the (Main) Contractor. In selecting the M&E Contractor to undertake the (Main) Contractor role, consideration must be given to the adequacy of their previous biomass experience and of the detail designers they will be using. There are nuances to biomass installations that need to be understood by the (Main) Contractor and their detail designer for a successful installation. The Client’s Engineer should be able to assist and advise when considering the experience of potential candidates, but it should be noted that there can be contractual repercussions in influencing a (Main) Contractor towards a particular Subcontractor.

With (Main) Contractor designed works, the (Main) Contractor’s designers will generally not visit the site afterwards to check the installation as it progresses. It is therefore important to maintain the services of the Client’s Engineer in a ‘Technical Advisor’ role to report as to whether the quality of the installation and in-use performance meet the specified requirements. Unlike the option 2 approach, the installation is generally being conducted to the Contractor’s standards rather than the Client’s detailed specification. It should be noted that the ability of the Client and the Client’s Engineer to demand certain features is limited to those required by standards such as British Standards, or covered in the more prescriptive sections of the performance specification.

Figure 6 Example of turnkey contract with M&E contractor as (Main) Contractor
3. Sometimes the project involves moderate to extensive building works in addition to the biomass plant, for example where a significant extension or new boilerhouse is required to house the plant. The level of multidisciplinary coordination required is not usually found within the capabilities of M&E Contractors, and the best balance of risk may well be achieved by the appointment of a general (Main) Contractor experienced in building work.

In these circumstances, the biomass boiler is only a small part of the overall project, and the overall supply chain can be extensive.

In general construction, multi-discipline building projects are generally led by a building contractor and such contractors have the expertise to co-ordinate the design and building construction with the M&E subcontract work packages. A building contractor will generally be able to access the necessary designers of different disciplines from existing relationships with external design consultants, and from in-house teams.

As the project size increases, the biomass element reduces as a proportion of the whole, and is also further down the project supply chain. The level of understanding of biomass issues at the (Main) Contractor level can reduce, which offsets the benefit gained from reduction in construction risk from the Contractor’s multidisciplinary experience. With not only an extra tier of contract chain, but also a change of discipline, it is now more important that a due diligence investigation of the expertise and experience of the (Main) Contractor, and their proposed subcontractors is conducted by the Client and the Client’s Engineer.

In option 3, the biomass boiler supplier would usually be a supplier/subcontractor to the M&E subcontractor.

**Figure 7 Example of turnkey contract with builder as (Main) Contractor**
6.4 Option 4 – Third party design, installation and commissioning (turnkey model) with separate operating contract

Under option 4, a plant is procured and installed using option 3, or possibly a combination of option 2 and option 3. However, instead of taking on the operation of the boiler, the Client arranges a subsequent operating contract for the boiler. This may be with the installer or another contractor.

The consideration of operating contracts is beyond the scope of this document which is focused on the capital projects. The procurement of the installation project itself is identical to option 2 or option 3 as applicable.
7. Standard forms of contract

7.1 IMechE/IET model form MF/1 (rev 5)

The “Model form of General Conditions of Contract for the supply of electrical, electronic or mechanical plant – with erection” MF1 (rev 5) was last updated in 2010. It is intended for the installation of plant, and is based around the Client (Purchaser using the MF/1 terminology) providing the associated works, such as plinths, etc. as well as providing the power and water supplies to the site.

This form of contract is most suited to installations proceeding under the requirements of option 1 where the Client is providing this support and co-ordinating the associated works.

The form is designed for international use, and is used in circumstances where the Construction Act does not apply. It should be noted that a biomass boiler installation is likely to be covered by the Construction Act, and this may result in:

a) The acquisition of unintended rights by a third party under the contract.

b) Conferring a benefit upon a third party unless specifically covered by the form of contract.

The basic form of the MF/1 contract does not incorporate the clauses to prevent this, and the contract will require the insertion of wording included within the Special Conditions section.

An advantage of MF/1 for biomass plant contracts is the provision of performance testing of the plant, with the ability to assign liquidated damages for failure to achieve performance.
7.2 **JCT 2011 minor works building contract with contractor’s design (mwd)**

The JCT suite of contracts is produced by the Joint Contracts Tribunal. The Joint Contracts Tribunal has published standard forms of contract for use in the construction industry since 1931, and the contracts are well established and well understood in law.

The contracts are designed for use under English and Welsh law, but a member of the tribunal – the Scottish Building Contract Committee (SBCC) – has produced a version that is formally amended for use where Scots law applies. In Northern Ireland, adaptation schedules are published by the Royal Society of Ulster Architects.

The 2011 publication came into force on 1 October 2011 for the English and Welsh law version and 1 November 2011 for Scots law version; at December 2011, the previous 2005 version and adaptations are still in use in Northern Ireland.

More details of the JCT contracts are available at [www.jctltd.co.uk](http://www.jctltd.co.uk), including an extensive practice note: ‘Deciding on the appropriate JCT contract 2011’.

For Scottish documents further information is available at [www.sbcconline.com](http://www.sbcconline.com)

The JCT Minor Works Contract with Contractor’s Design is intended for smaller, straightforward projects. The small size of many biomass projects may make this an appropriate form of contract.

The JCT practice note states that this form of contract would be appropriate:

- where the work involved is simple in character.
- where the work is designed and the requirements for the contractor’s design of discrete part(s) are detailed by or on behalf of the employer, and where the contractor is required to design those part(s) of the work (Contractor’s Designed Portion).
- where the employer is to provide drawings and/or a specification and/or work schedules to define adequately the quantity and quality of the work.
- where an architect/contract administrator is to administer the conditions.

Typically the Client’s Engineer will produce the drawings and specification on behalf of the Client, and will frequently act in the role of Contract Administrator.

This form of contract could be suitable for Option 1, 2 or 3 depending upon the size and complexity of the project. The JCT forms of contract are well understood in the general construction industry, and would be more familiar to either an M&E contractor or a general building contractor than they would be to a biomass boiler supplier.
The JCT Intermediate Works contract is more detailed, and provides greater contractual cover than the Minor Works Contract, without including as much as the extensive Standard Building Contract. It would be a suitable form of contract for some of the larger biomass projects (up to 3MW) covered by this guide. The value of such installations is unlikely to justify the additional overhead in preparing and contracting with the more extensive Standard Building Contract.

The JCT practice note states that this form of contract would be appropriate:

- Where the proposed building works are of simple content involving the normal, recognised basic trades and skills of the industry, without building service installations of a complex nature or other complex specialist work.

- Where the works are designed, the requirements for the Contractor’s design of discrete part(s) are detailed by or on behalf of the Employer, and the Contractor is required to design those part(s) of the work (Contractor’s Designed Portion).

- Where fairly detailed contract provisions are necessary and the Employer is to provide drawings and bills of quantities, a specification or work schedules to define adequately the quantity and quality of the work.

- Where an architect/contract administrator and quantity surveyor are to administer the conditions.

- This contract is more detailed and contains more extensive control procedures than the Minor Works Contract.

The intermediate form of contract could be suitable for option 1, 2 or 3 depending upon the size and complexity of the project.
7.4 NEC3 engineering and construction short contract 2005

The NEC family of contracts are published by the Institution of Civil Engineers under their Thomas Telford brand. More details can be found at www.neccontract.com

The essence of the NEC contracts was to adopt a more collaborative approach to contracting, and they have had wide and increasing use since first published in the early 1990s. The current (third) editions were published in 2005. The aim is to get collaboration across the whole supply chain to improve the project outcomes. This is reflected in the first clause which reads “The Employer and the Contractor shall act as stated in this contract and in a spirit of mutual trust and co-operation”.

The Engineering and Construction Short Contract is intended for projects which do not require sophisticated management techniques, comprise straightforward work, and impose only low risks upon the Client and Contractor.

In order to enable the approach to run smoothly through a project, other contracts from the suite can be used in the contract chain, including:

- NEC3 Engineering and Construction Short Subcontract 2005, which can be used by the main Contractor to engage their subcontractors.
- NEC3 Supply Short Contract 2009, which can be used for procurement of goods.

The contracts are written to enable their use worldwide, and the contract includes alternative clause at the end which come into use if the UK Construction Act applies.

This form of contract could be suitable for option 1, 2 or 3 depending upon the size and complexity of the project. The NEC forms of contract are well understood in the general construction industry, and would be more familiar to either a Mechanical and Electrical contractor or a general contractor than to a biomass boiler supplier.

7.5 NEC3 engineering and construction contract 2005 (with amendments June 2006)

This is a more extensive form of contract, and requires considerably more effort to prepare. This input has to be weighed against the value and risk profile of the project. It would be used when the consideration of the cost benefit given the size, complexity or risk of the project means that this is a more appropriate form of contract than the Short Contract. The size of most biomass projects would generally make this form of contract too onerous.

As with the Short Contract, there are matching accompanying contracts as part of the NEC3 family:

- NEC3 Engineering and Construction Short Subcontract 2005 (with amendments June 2006).
- NEC3 Supply Contract 2009.
8. Entering into contract

8.1 Formal contract documentation

When the contact is agreed, there will be a package of formal information prepared. This could be undertaken by the Client or the Client’s Engineer acting on their behalf. Whilst best practice is for this to take the form of a complete reference package of information to both parties, it sometimes takes the form of a signed memorandum with a full schedule of reference contract information. The same principle applies whether option 2 or option 3 is followed. The documentation included or referenced should include the following:

- Signed memorandum from the chosen form of contract.
- Full set of contract drawings.
- Full set of specifications.
- Contract preliminaries.
- CDM Risk Assessments and tender stage Health and Safety Plan.
- Other relevant information.
- Programme.
- Cost breakdown and payments schedule.
- Insurances.

8.2 Contract preliminaries

The contract preliminaries are a set of basic ‘housekeeping’ information associated with the contract and general information other that the detail works information. The contract preliminaries are prepared from a standard form such as those with the National Building Specification and give details of items such as site access arrangements, site working hours, setting down areas for equipment, welfare facilities for contractor’s staff, site agent provision and any site accommodation, site electrical and water supplies, insurance requirements, quality, safety and environment requirements, etc. They also include requirements for approvals, testing and sub-contracting.
The preliminaries will also detail the extent of detail design work that has to be undertaken by the Contractor. In developing the specification, certain items will have been taken to detail design by the Client or Client’s Engineer, whereas other items will have been left at a performance level of specification. It is important to ensure that the elements of detail design identified to be undertaken by the (Main) Contractor in this section contains all the remaining detail design work which has not been undertaken by the Client’s Engineer. The best practice of working through a preliminaries document ensures that all these requirements are picked up and recorded. With simple projects the process does not take long.

8.3 CDM risk assessments and safety plan

The Construction Design and Management Regulations 2007 identify and place certain requirements upon all duty holders in a construction project. The following are specifically identified and defined in the Regulations.

**Client** – The Client has a duty to ensure that the necessary resources are in place for the other duty holders to discharge their duties in accordance with the regulations.

**Designer** – At each stage of a design, the Designer has a duty to consider the risks in the construction, operation and future demolition of their design. Wherever possible, potential hazards are to be designed out. The Designer will transmit the residual risks in their design via a designer’s risk assessment as a formal part of the documentation.

**CDM Co-ordinator (CDM-C)** – Where the size of project is such that the site work is expected to either last longer than 30 days or involve more than 500 person days of construction work the Health and Safety Executive must be notified, and a CDM Co-ordinator (CDM-C) must be formally appointed. The CDM-C will gather together the basic Health and Safety information for the project and incorporate into a Tender Stage Health and Safety Plan.

For most small and medium sized biomass projects where the plant is the majority of the work, the CDM-C role could be taken on by the Client’s Engineer so long as they are suitably qualified and experienced.

**The Combustion Engineering Association has pushed a guide to health and safety in biomass systems.**

8.4 Insurances

The (Main) Contractor in Options 2/3, or each Package Contractor in option 1 will need to carry the following insurances:

- Contractor’s All Risks insurance.
- Public Liability insurance.
- Employers Liability insurance.

Where the (Main) Contractor in option 3/4, or a hybrid of option 2 and 3, or a Package Contractor in option 1, is also taking on design responsibility then they will also need to carry Professional Indemnity insurance.

The value required for these insurances should be set on a case by case basis proportionate to the size of the project and the risks involved. Professional advice should be sought to ensure that correct levels and extents of coverage have been requested. Copies of certificates should be available from the Contractor as proof of cover.
Appendix A – Checklist for assignment of contractual design responsibility

The following checklist can be used to assign responsibility for elements of work.

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<th>Element of Work</th>
<th>Outline Design by Client’s Engineer</th>
<th>Detail Design by Client’s Engineer</th>
<th>Detail Design by Contractor</th>
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<td>Water supply to plant</td>
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<td>Electrical Supply to plant</td>
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<td>Gas supply to plant</td>
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<td>Identify existing buried services</td>
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<td>Design of Drainage for plant</td>
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<td>Site Investigation where required</td>
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<td>Foundation design for plant or building</td>
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