Department for
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& Industrial Strategy

Combined Heat and Power – Project Development

A detailed guide for CHP developers – Part 1

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Any enquiries regarding this publication should be sent to us at:
chpfocus@ricardo.com

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1 Introduction

The development process requires a significant commitment in terms of time and special and multidiscipline expertise, thereby incurring both cost and effort. Proper management of the process is important if the proposed CHP plant is to maximise the potential benefits to the company. The instigator and manager of the development procedure will need to ensure that the necessary managerial skills are made available and applied effectively.

The development process for a CHP project depends on scheme's complexity and therefore this section has been broken down into separate sections;

- Packaged CHP.
- Custom CHP.

2 Packaged CHP

In this section the guide takes you through the project development process of the packaged CHP in a step-by-step fashion concentrating on those topics that are of particular importance. The Packaged CHP project development flow-sheet (see Appendix 1) provides a simple step by step representation of the issues to consider at particular points in the project development process. The two main issues of concern are:

2.1 How to determine project feasibility

The main purpose of a feasibility study is to identify whether or not the project is suitable for development. It is important to do this at the earliest possible stage so that the feasibility of a project is known before significant effort or resource is committed to the project.

Assessing feasibility is the first step in the project development process once the initial decision to investigate the potential for CHP has been agreed.

The basic steps for assessing the feasibility of a CHP scheme can be summarised as follows:

- Determine Site heat and power demands.
- Select CHP plant of an appropriate rating and type.
- Assess operating costs/savings when using the CHP plant.
- Determine where/how the CHP unit will be installed and connected to fuel, heat and power systems.
- Assess the capital costs of installation or the energy supply costs if an energy supply contract is being considered.
- Assess the economic, energy and environmental benefits of the installation.
- Assess the nature of other relevant issues, e.g. permits or consents.

The economics of small-scale CHP plant normally do not allow for the major use of consultants or in-house staff and Suppliers will normally offer some form of turnkey project. In practice, any assessment will require some in-house effort even if most of the work is undertaken by consultants or suppliers. In-house staff will need to evaluate these proposals and the assumptions on which they are based to see if they match expected business needs. The financial aspects and the legal aspects will require in

2.2 Project implementation procedures

Once an appropriate rating and configuration for the CHP plant has been agreed, the next step is to convert the findings of a positive feasibility study into an operational plant. This will involve several steps: unit specification, invitations to tender, tender analysis, contract placement, plant installation and commissioning. In the following sections these steps are considered in further detail.

2.3 Unit Specification

An appropriate specification of CHP will pay dividends with all projects. It is important to remember that the specification should focus on the outputs to be delivered rather than on how delivery of those outputs will be achieved. An enquiry specifications should cover the following issues:

- Preferred conditions of contract.
- Guarantees, liquidated damages.
- Quality.
- Health and safety.
- Insurance.

2.4 Invitations to Tender (ITT) for the equipment and its installation

The companies to which ITT will be issued should be selected carefully. Pre-selection may be by a formal pre-qualification exercise or by informal means. In either case the objective is the same, to establish companies that have:

- Relevant experience.
- An appropriate standing as regards finance, insurance, quality assurance and health and safety.
- The capacity to carry out the work required.

It is important to specify a date by which completed Invitations to Tender must be returned. The timescales set should not be too short, nor should deadlines be set for contract signature: failure by either party to give full consideration to all the issues involved may result in a contract that is unsatisfactory

2.5 Tender Analysis

Completed tenders should be examined carefully for:

- Compliance with the Invitation to Tender.
- Assumptions made.
- Inclusions.
- Exclusions.
- Commercial issues.
- Price/tariffs.
- Programme.
- Payment schedules.
- Guarantees, after sales service and maintenance.
- On the basis of the tenders received, it should be possible to rerun the initial feasibility study to revise/confirm project viability and value.

2.6 Contract placement

Contract placement, particularly where contracts are of significant value, as is the case with a CHP installation, will often be the responsibility of a purchasing group within an organisation. The purchasing group may be unaware of the nuances of CHP but very familiar with contracting.

It is essential, therefore, that the CHP Project Leader and the purchasing group work closely together to ensure that all commercial and technical matters are fully closed out before the contract is placed.

2.7 Plant installation

For packaged CHP, the major installed item is the ‘box’. However, the installation programme may also include:

- Removal of redundant equipment.
- Relocation of retained equipment.
- Preparation of CHP foundations.
- Preparation of access routes.
- Interconnection to a gas supply.
- Interconnection to electrical services.

- Interconnection to heat services.
- Installation of flue systems.
- Installation of heat rejection equipment.

During installation, appropriate note must be taken of Health and Safety issues, particularly:

- Construction (Design and Management) Regulations.
- Electricity at Work Regulations.
- Gas Safety (Installation and Use) Regulations.
- Noise at Work Regulations.
- Confined Space Regulations.

A reputable supplier/installer will explain the installation process and confirm that it is acceptable to the client. The supplier, like the client, wants the process to be swift and trouble-free.

2.8 Commissioning & Handover

Commissioning the CHP plant is normally simple. An important point in the case of small-scale packaged CHP is that the packaged unit should have been extensively tested at the factory, thereby reducing the time and risk involved in testing on-site. Nonetheless, a significant amount of testing is still required prior to handover.

For each item or system, the commissioning sequence should be built up from:

- Installation checks to confirm that all items installed are as specified in the drawings.
- Static system checks:
    - Flushing and pressure testing of pipe systems.
    - Electrical line checks.
- Dynamic running checks of individual equipment/systems:
    - Tests of all control and safety devices.
    - Generator and switchboard performance and safety trials.
    - Tests of all normal and alternative modes of operation.
- Plant performance and reliability trials.

All tests and trials should be planned in advance to determine:

- The purpose of the test or trial.

- The condition of the test or trial, how and by whom.
- The timing of the trial, time of day or night and duration.
- Recording and witnessing arrangements.
- A list of defects, if any, should be raised at every stage of the commissioning process. For any defect raised its resolution should be identified by the responsible party. In some cases, correction of a defect is essential before the next stage of the trial can commence. In other instances, the defect can be allowed to remain until a general defect rectification period.
- Commissioning will culminate in plant handover. Handover, which may constitute a significant milestone for payment, should be agreed only if accompanied by all the appropriate documentation, for example:
    - Plant operation and maintenance manuals.
    - Drawings.
    - Commissioning records.

3 Custom CHP

Although the principle of CHP is relatively straightforward, the development process for any given CHP installation consists of a number of separate steps. These steps are covered by three key groups initial consideration, project feasibility and implementation. Each step is an essential component of the whole development procedure and must be competently and thoroughly undertaken if the project is to be successfully designed and installed, and then operated effectively throughout its lifespan.

The development process requires a significant commitment in terms of time and special and multidiscipline expertise, thereby incurring both cost and effort. Proper management of the process is important if the proposed CHP plant is to maximise the potential benefits to the company. The instigator and manager of the development procedure will need to ensure that the necessary managerial skills are made available and applied effectively.

3.1 Initial Considerations

For a site to support a successful CHP installation, it will typically need to meet certain initial criteria:

- There should normally be heat and power requirements for at least 4,500 hours/year, although CHP can sometimes be cost-effective with fewer operating hours. In general, the greater the annual period of demand, the higher the potential cost savings.
- Future requirements for heat and power should be anticipated, preferably over the lifetime of the CHP plant.
- The company must be able to make the long-term commitment that is associated with a CHP installation.

These criteria apply to both existing and new-build sites.

Any new industrial or commercial development can gain substantially by incorporating CHP as an integral part of the energy supply arrangements rather than installing it as a retrofit option at a later date:

- The design and development team will be able to plan the production and utility systems as a single operation.
- The disruption incurred during retrofit installations is avoided.
- There is less likelihood of redundant plant than with a retrofit option.
- Site energy supply costs are minimised from Day 1.
- There is enhanced security of energy supply from Day 1.

CHP is a significant investment in the utility infrastructure of a site. This is an area where some companies have relatively little expertise or experience available within their core activity resources: this may limit their ability to handle CHP projects that are large and technically complex.

Before final approval is given for implementing a capital project such as CHP, a company will probably need to address a number of strategic issues, either to ensure agreement or to define its corporate views. Several of these issues are potentially significant. They should be addressed and agreed in principle at the earliest possible stage of the project to avoid delays and minimise wastage of time and resources later in the development process. Among the questions that the company will need to consider are the following:

- Do you have a clear view of the future of the site and its business? In particular, given your plans for future site activities and working procedures, do you know what your future energy consumption is likely to be?
- Are you using energy efficiently at present? Are there any cost-effective measures that can be taken to reduce existing energy waste?
- How do you see your energy costs changing during the lifespan of a potential CHP plant?
- Are you able and willing to make a long-term investment in CHP?
- To what extent do you wish to retain the responsibilities and benefits associated with a CHP project? How would you feel about passing responsibility for and control of a key component of site activities to a third party, and what performance guarantees and sanctions would you require?
- How does the implementation of a CHP plant influence the financial aspects of your business – credit risk, balance sheet, assets and liabilities?
- Can the company, its management and its workforce successfully control and benefit from a CHP plant? Are infrastructure projects with long-term benefits, like CHP, accorded a higher priority in terms of time and resources than other issues and projects?
- Do you have imminent plans to replace site energy plant? If so, can your plans be incorporated into plans for a CHP project?
- Do you wish to improve the security of site energy supply?
- Are you about to develop a new site? If so, could you incorporate CHP as an integral part of the energy arrangements?

Each of these points is a key issue in its own right. Discussing these issues at an early stage is an effective means of focusing the attention of the relevant people on what the task ahead may entail. However, although any one issue can represent an initial hurdle in the CHP evaluation process, it is very likely to be surmountable.

3.2 Development Options

Conventional wisdom suggests that the installation of a CHP plant will require significant amounts of time, effort and money, and a company that lacks these resources may see no benefit in evaluating the potential for CHP. However, there are ways in which a company can obtain the necessary resources and assistance that will allow it to resolve these issues. It is therefore important, from the start, to have a clear idea of the various options available for the purchase, installation and on-going operation of a CHP plant.

Essentially there are three broad approaches:

- Design and manage
- Turnkey contract
- Energy services contract

Each of these has various options within it, and each involves a different level of responsibility and reward.

3.2.1 Design & Manage

If a company wishes to maximise its involvement in the design, procurement and installation of a CHP plant, it may opt for a ‘design and manage’ project in which the company is fully involved in every aspect of plant design, installation and management.

- Advantages to the company
- Greater control over plant selection and engineering detail.
- Control over interfaces with existing site systems and services.
- Involvement of site operational staff in plant design, installation, commissioning and testing, which helps to ensure:
- Achievement of the required levels of plant performance and availability.
- Levels of staff capability and ownership that are reflected in standards of plant operation, management and maintenance.
- Direct contractual dealings with contractors and equipment suppliers – more detailed specification of contractual requirements; easier to ensure that they are met.
- All of the cost savings achieved by the CHP plant are retained.

Other implications for the company

- The company must have the financial resources to purchase the plant and manage the design and procurement procedure.
- The company owns and manages the plant.

- The company retains the long-term responsibility for plant operation and performance (even when consultancy assistance is sought for design and tendering) unless it elects to appoint a contractor to operate and manage the plant on its behalf.

This approach demands a high level of both resources and operational and management expertise (in-house or specialist consultant). At the same time, it offers important advantages relating to equipment selection and installation, staff involvement and contractor management. On completion of the project, the company owns the plant and is responsible for its operation and performance. It also retains all the cost savings achieved.

3.2.2 Turnkey Contract

Advantages to the company:

- Limited responsibility for ensuring that all plant items work together and meet the requirements specified.
- Limited input of time and resources into plant design and installation procedures.
- All of the cost savings achieved by the CHP plant are retained.

3.2.3 Other implications for the company:

- The company must be able to specify initial requirements but otherwise has limited influence over plant selection and optimisation.
- The company must have the financial resources to purchase the plant and manage the design and procurement procedure.
- The company retains the long-term responsibility for plant operation and performance unless it elects to appoint a contractor to operate and manage the plant on its behalf.

A turnkey project is one in which a single contractor – sometimes, but not necessarily, an equipment supplier – assumes responsibility for implementing the whole project, from detailed design, through purchasing and installation, to commissioning and testing. The company has less influence on plant selection and optimisation, and responsibility for ensuring that all plant items work together rests with the contractor.

On completion, the plant is handed over to the company; the company pays for it and thereafter owns it. In many cases, the company will operate and manage the plant itself, thereby assuming responsibility for plant performance and reliability, and also retaining all of the cost savings. In some cases, the company will appoint an integrated energy services company (ESCO) to operate and manage the plant on its behalf.

3.2.4 Integrated Energy Serves Contract

Advantages to the company:

- No significant input into plant design and procurement activities particularly important if there is lack of internal expertise.
- No need for capital expenditure on non-core business plant – particularly important if there is lack of resources or if a company does not want the capital costs of a project of this scale to appear on its balance sheet.
- No responsibility for financing and managing the installation or for operating the plant thereafter.

Other implications for the company:

- The detailed and site-specific nature of the contract requires a significant managerial and legal input.
- The cost savings associated with the project must necessarily be shared with the ESCO and are, therefore, lower than could be achieved by retaining responsibility for plant operation.

The scope of the ESCO option can vary widely. In some instances, the company will set up a contract with an ESCO by which the latter designs, installs, finances, owns, operates and maintains a CHP plant on the company's site, providing the company with metered electricity and heat. In other cases, the company subcontracts the operation and management of a CHP plant that has been installed by other contractors under a design and manage or turnkey option.

The ESCO may also be responsible for fuel purchase, the operation and maintenance of boilers and other on-site energy plant, the operation and maintenance of site energy distribution systems, the purchase of imported electricity when required, and the export and sale of surplus electrical power.

Adopting the ESCO option allows the company to benefit from CHP while limiting its financial outlay to the managerial and legal input required in setting up the necessary contract. The detailed and site-specific nature of such a contract means that it must cover the quantity, condition and reliability of energy supplies; systems for metering those supplies; and the charges to be paid and variations to these charges with time and circumstances. It will also need to cover a range of issues relating to tenancy of the land and buildings, access to the plant, the use of common facilities, and various site-specific conditions. In some cases, there may be provision for the secondment or transfer of staff between the organisations involved.

Because the ESCO is responsible for finance and on-going plant operation, the net savings to the company are lower than if the company were financing and operating the plant itself.

Although it is not essential to make a firm decision on these options before starting CHP evaluation, any indications as to the preferred option can help to focus the evaluation procedure on specific topics. In particular, it is worth identifying any of the options that are definitely not acceptable, to avoid unnecessary wastage of effort and resources.

4 Project Feasibility

The importance of a properly managed and resourced evaluation and development process should not be underestimated. An inadequate approach can give rise to incomplete and misleading results, and may result in decisions (usually against CHP) being taken on the basis of poor information or presentation. Evaluating a project's feasibility follows these steps:

- First Steps
- Initial Feasibility Study
- Feasibility study review
- Detailed Feasibility Study
- Detailed Feasibility study review
- Implementation & Finance options
- Decision Making

4.1 First Steps

Any decision to proceed with a CHP evaluation must have the encouragement and support of senior management so that there is a proper process of team selection and resource provision and a proper investigation of CHP potential. Senior managers must be involved in regular reviews of the evaluation and development process; they must prevent the process from stalling for lack of resources or priority; and they must make the decisions as to whether or not the process proceeds to the next stage.

The importance of a properly managed and resourced evaluation and development process should not be underestimated. An inadequate approach can give rise to incomplete and misleading results, and may result in decisions (usually against CHP) being taken on the basis of poor information or presentation.

In some cases it is perceived to be easier to say ‘No’ to CHP, than to evaluate its true value effectively. Furthermore, it is not uncommon for a CHP evaluation to be put ‘on hold’ because of uncertainties over particular aspects of the site and its future operating conditions. If this happens, it is important to ensure that the evaluation is restarted once the effect of any planned changes has been assessed.

4.1.1 Investigation of CHP Potential

Initiating a CHP evaluation is a decision that requires careful consideration. Key aspects of this part of the process are as follows:

- There must be a belief that the evaluation can lead to a viable project, together with a determination to take the matter seriously.
- The evaluation must be properly planned.
- It must be recognised that the evaluation will require investment in terms of both time and resources.
- No CHP evaluation should be initiated until the site management is confident that all of the straightforward, short payback, energy efficiency and conservation measures that can be undertaken have been completed. A CHP plant must never be justified as a means of meeting wasteful energy demands.

4.1.2 Team Selection & Resource Provision

A company that has decided to proceed with CHP evaluation will need to assemble a project team to manage both this procedure and, if appropriate, subsequent implementation. The team will need access to a wide range of skills and experience, at least some of which may be available from in-house staff. Examples are:

- Team co-ordination and management abilities.
- Mechanical engineering skills, with experience of prime movers and combustion plant.
- Electrical engineering skills, with experience of interconnecting generating plant, its protection and control.
- Site services engineering skills and operational experience.
- Structural engineering skills.
- Energy and financial evaluation abilities.
- Equipment procurement experience.
- Legal and contractual skills.

Sometimes, the team leader possesses several of these skills: it is unusual for more than one team member to work on the CHP evaluation on a full-time basis.

The CHP evaluation process tends to develop over time, the results of one stage defining the needs of the next. Hence, it is difficult to predict accurately the skills required. The initial feasibility study can often be completed with relatively low levels of overall input, although it is important from the outset to nominate the sources of expertise that the team leader can call on. The requirement for skilled resources generally increases as the evaluation moves forward to the detailed feasibility study and beyond.

An organisation cannot always meet the CHP evaluation requirements from its available in-house resources. It is then appropriate to consider calling in external expertise to support or carry out the work. Although this may be perceived as an additional expense, it

can introduce valuable experience and expertise into the team, which reduce the overall time and costs incurred. In practice, relatively few CHP projects have been taken through to implementation and completion without some input or support from external sources.

4.2 Initial Feasibility Study

An initial feasibility study is mainly a desktop exercise designed to provide an estimate of the cost savings and financial returns that can be achieved by installing an appropriate CHP plant. The study does not need to be excessively long or complex, but it must be carried out thoroughly by someone who has the right evaluation skills and engineering knowledge. The study must also be promoted and supported by someone within the company who can ensure that the results are presented and considered effectively at the right level. An initial feasibility study also aims to consider, in outline, some of the fundamental technical aspects of installing and operating a CHP plant on the site. Above all, the study must emphasise how CHP may benefit the site: it should not simply become a list of problems with no apparent immediate solutions.

Key steps in the initial feasibility study are summarised as:

- Site Energy Demands
- Plant Selection
- Financial Assessment
- Practical Installation

4.3 Feasibility Study Review

Unless the initial feasibility study clearly indicates that a CHP plant would be economically or practically unattractive, the management review of the study should approach the findings with a view to progressing the CHP evaluation process on to its next and more detailed stage.

Specific topics that are likely to be reviewed include:

- Levels of confidence in the input data and assumptions.
- The thoroughness and reliability of the economic modelling.
- Potential hurdles that could make a project nonviable.
- Findings of the sensitivity analysis.
- Perceived risks and the extent to which they can be mitigated.

As with all capital project proposals, the better the preparation for the review, the greater the chance of the project moving forward to the next stage.

The findings of the initial feasibility study should be presented clearly and simply, and should avoid the use of jargon or other terminology that may cause confusion. While it is important to cover as much detail as possible, it is equally important not to obscure the overall findings by paying too much attention to less significant details.

The review should concentrate on whether the economic benefits of CHP are considered to be worthwhile. As a minimum, it should include indicative data to show the estimated costs and savings associated with each of the CHP options considered. It should also give some initial consideration to the method of implementation and finance that is appropriate.

Those presenting the findings must be aware, in advance, of the questions and issues that are likely to be brought up, and be ready to respond to them in as much detail as necessary. The less familiar the audience is with the concept and technology of CHP, the more important this is. The review may need to cover old ground to clarify the issues for those less familiar with the evaluation and its details.

Where the results of the study are positive, the review should not allow uncertainties about individual issues to be promoted to a level of importance that obscures these results. It is essential to remember that many issues have been seen as insurmountable hurdles at this stage of the evaluation process, but have subsequently been successfully overcome. The review should provide a list of all such areas of uncertainty, so that they can be fully addressed during the next stage of the process.

The review will normally result in one of three decisions:

- CHP appears to be a viable option and a detailed feasibility study is the next logical step.
- The option of financing or owning a CHP plant is not a viable one and the company should adopt the energy services contract approach. Moving directly to this option avoids the need for the company to undertake a detailed feasibility study.
- CHP is not a viable option for the company.

4.4 Detailed Feasibility Study

The detailed feasibility study is a more significant and thorough study than the initial feasibility study and requires a much greater degree of commitment by the company. The aim of this study is to arrive at accurate information and results that will allow the company to make firm decisions about the technical, legal, commercial and financial viability of the proposed CHP scheme.

Much of the work is similar in principle to that carried out in the initial feasibility study, and there should be no major change in the overall objective of the CHP evaluation procedure. If there have been such changes, it may be advisable to review the initial feasibility study – and even repeat it to allow for these.

To provide a meaningful result, the level of detail and accuracy must be as high as possible. To this end, most of the tasks carried out as part of the initial feasibility study must be repeated in much greater scope and detail.

4.4.1 Feasibility Study Management

The detailed feasibility study is normally carried out by a team, under the leadership of an appointed project leader. It is helpful to maintain continuity by using the same team members who were involved in the initial feasibility study. Depending on the scale of the project, it is quite common at this stage for the project leader to be occupied full time on the study for up to three months, with specialist input, as necessary, from the other team members.

The study can be approached in several ways:

- The whole study can be carried out in-house if sufficient resources and skills exist that can be dedicated to the work.
- The project leader can appoint specialist consultants to carry out the whole study. This may offer the advantage of greater accuracy and efficiency because of the consultants' experience of other CHP schemes which, in turn, may give company management a higher level of confidence in the results. This approach can mean that higher apparent costs are incurred although, in many cases, the cost of providing in-house resources is not a financial one alone.

The project team can be supplemented by the appointment of one or more consultants who can bring particular skills and experience to the team and hence optimise the study's accuracy and effectiveness. Within such a partnership arrangement, the division of responsibilities must be clearly defined and be appropriate to the skills and expertise of the team members, with the project leader appointed from within the company.

The appointment of appropriate consultants is usually carried out by inviting suitable organisations to submit their proposals against an outline study specification drawn up by the project leader. The responses should cover issues such as experience and expertise, references relating to similar work carried out, costs involved, and nomination of personnel to carry out the work.

It is unusual for a company to identify in-house all the resources and skills necessary for a detailed feasibility study: only companies that already have experience of CHP are likely to be able to carry out a full and effective study of this type without some external support. Furthermore, the time and effort required for in-house staff to acquire the necessary skills and detailed knowledge of all aspects of CHP can be more costly than recruiting external sources of the skills and knowledge.

An important management input to the detailed feasibility study is a decision on the procedure and level of detail that will be required for any financial evaluation of the CHP

options. This input will need to include company policy on issues such as discount rate, capital allowances etc.

4.5 Detailed Feasibility Study Review

The management review of the detailed feasibility study is the most important milestone in the development of a CHP project. A decision to proceed at this stage turns theory into practice and results in a commitment either to a significant capital expenditure or to the negotiation of a long-term energy services contract.

The review will need to be wide-ranging and thorough, and must involve all those senior managers who will make the final decision.

- All aspects of the detailed feasibility study will need to be examined in depth:
- Range of options considered, their engineering and technical viability.
- Assessments of capital and operating costs, and the achievable cost savings.
- Reasons for selecting the proposed CHP scheme.
- Timescale for project implementation.
- Financial returns.
- Sensitivity analyses.

If this stage of the evaluation procedure has been carried out using in-house resources only, it is often advisable to have the final report reviewed by a third party (due diligence review) with appropriate experience and knowledge of the particular CHP option that is recommended by the report.

The management review often takes the form of a presentation made by the study team to the company's senior personnel, followed by a wide-ranging and in-depth discussion which should be aimed at reaching a decision on how to proceed. This review is a key factor in the success of a CHP project, and the clear and accurate presentation of the study results is vital. The project team must be thoroughly prepared for this occasion, and the following ideas may be of use in this process:

- Produce a summary report for issue in advance of the review, to enable the key conclusions of the study to be clearly laid out.
- Establish who will be involved in the review, and what key issues or aspects of the study they will be wishing to address in detail.
- Allocate specific team members to present and discuss the different aspects of the study and its review.
- Prepare simple tables of the study results for discussion at the review.

- Prepare an agenda and objectives for the review, to prevent the review from being inconclusive and the project evaluation from stalling.
- Have a clear proposal of the next action(s) the study team would recommend, including options and cost estimates, and be ready to present and discuss this.
- If the results of the review are positive, and the company is confident that CHP can bring financial and other benefits, the decision on how to proceed then depends on two key questions:
    - Who is to own and operate the CHP plant?
    - How is the project to be financed?

4.6 Implementation & Financing Options

Project implementation and financing options are separate issues and are treated as such below. However, they are also highly interdependent – a firm decision on one issue having a significant influence on the options that are then viable for the other. In practice, the two reviews are often carried out in conjunction with each other to ensure the best overall outcome.

4.6.1 Project Implementation

There are three main implementation routes that apply to custom-built CHP plants:

- Design and manage.
- Turnkey.
- Energy services contract.

Decisions on the implementation route have more to do with risk transfer than with resource availability, and it must be remembered that risk transfer comes at a price – a reduction in the financial benefits retained by the company.

Most of the uncertainties associated with a CHP project arise during the on-going operation of the plant – where the bulk of the cash flow appears.

If the company is prepared to bear all of the operating responsibilities associated with the design and construction of the plant, as well as those involved in the long-term operation of the equipment, then an in-house route (perhaps with consultancy advice) is the preferred option.

If the company prefers to transfer plant operation by entering into a contract or partnership with another party, that party will need to have a significant say in how the plant is operated and maintained. This would mean either remote monitoring/control of the plant or, more likely, having operating staff from the other party based permanently at the CHP site.

In exchange for assuming responsibilities for plant operation, the other party would share in the overall cost savings achieved by the CHP plant.

The choice of implementation route is important to how the project is subsequently developed and should be made prior to the start of the tender and design process. There are two main benefits in doing this:

- Possible suppliers/contractors will be more likely to make a serious tender submission if they are confident that their offer is consistent with the company's preferred implementation route.
- If the implementation route is not clearly defined, the tender process will have to be broader-based, and may be unnecessarily time-consuming and, therefore, less cost-effective than it should be.

However, if there is still some doubt about the preferred implementation route, it is possible to defer this decision until receipt of tenders, later in the evaluation procedure. This deferment will require the issue of a broader-based specification of tender, which will tend to expand and prolong the tender and selection process.

4.6.2 Financing Options

The review of financing options centres around the company's attitudes to the provision of capital finance and to the ownership and status of capital plant assets. Some companies wish to retain full ownership and control of their assets and are willing to have the capital cost of those assets appear on their balance sheet. Others are content to have critical utility assets located on their site but owned and held as assets by others.

There are a number of ways of arranging the funding for a CHP project but all require a major commitment from the company. If the company does not wish the asset to appear on its balance sheet, it will need to obtain funding either through, or with the assistance of, a partner with a long-term interest in the project. This means, in effect, an operating partner. Modern accountancy and audit practice requires a substantial transfer of 'risks of ownership' if the asset – or equivalent commitment – is not to appear on the company's balance sheet.

4.7 Decision Making

The nature of the final approval will depend on the implementation route identified. Where the decision is for a design and manage or turnkey project, the approval process should largely follow established company procedures for directly funded projects. However, longer evaluation horizons are advisable for CHP projects than for projects involving market-related products, as the provision of energy to the site is a predictable on-going requirement. The plant and equipment that use the energy may change, but the need for energy is still there.

The ESCO contract, on the other hand, can be a complex one and is probably unlike other contracts that the company has experienced. The decision-making processes may, therefore, need to be significantly different from those used in other, more conventional projects. Issues of particular importance when considering this type of contract include:

- The impact of external finance.
- Security of energy supplies.
- Industrial relations.
- Default on contractual arrangements.

Furthermore, the concept of contracting out the provision of critical utility services to another organisation over which there is less direct control can be intimidating, although it will have been considered in depth earlier in the evaluation procedure. It is important for the company to have confidence in the abilities of the contractor. Furthermore, the incentives and deterrents built into the contract must be sufficient to ensure security of supply.

5 Implementation

A company that has decided to proceed with a CHP plant will need to assemble a project team to manage project implementation. The role of the team and the extent of the skills and resources needed will vary according to the implementation route selected. Key issues to be considered at this stage are:

- Implementation Team Selection
- Design & Tender Process
- Installation
- Commissioning & Testing
- Rating
- Insurance

5.1 Implementation and Team Selection

A company that has decided to proceed with a CHP plant will need to assemble a project team to manage project implementation. The role of the team and the extent of the skills and resources needed will vary according to the implementation route selected. In general, the particular roles and skills identified for determining project feasibility are also those required for the implementation stage of the project.

Most projects are implemented with some external assistance and support, particularly for the engineering and design issues that are specific to CHP installations. Larger companies may have many of the necessary skills and resources in-house, but even these companies often prefer to use external organisations to provide the project team with the range of necessary expertise, and to ensure the required continuity of skills and resources both during project implementation and throughout the project's life.

Where a company decides to employ the services of a consultant, it will need to decide what level of expertise and input it requires of that consultant and under what terms. It should, for instance, decide whether the need is for technical advice alone, for engineering work to be carried out as part of tender specifications, or for technical advice plus help with commercial analysis. A company may use consultancy input for the tendering process alone. Others may decide to pass most of the project teamwork to a consultant, allowing him/her to manage the plant design, procurement and installation processes on behalf of the company.

In selecting a consultant, the company should take into account:

- Track record of similar work on successful CHP projects.

- The degree and regularity with which a consultant updates his/her expertise.
- Availability of experienced resources.
- Costs, and responsibilities for achieving targets and budgets.
- Flexibility to work to clients' needs.
- Personal recommendations from recent consultancy users.
- Professional indemnity insurance and recourse.

The selection of external consultancy assistance should be regarded as a process in itself. However, managed properly, it is not a major resource drain.

5.2 Design & Tender Process

Whatever the implementation route selected, the first major step involves the preparation and issue of tender documents. Each implementation route has a different tender process:

- A design and manage approach will concentrate on the specification and performance of individual units of equipment and services, each of which is an essential component of the overall CHP plant.
- Procuring a turnkey project will mean that the company needs to focus on a performance specification and on ensuring that the contractor, while competing in what is usually a capital-cost driven market, will be able to work with the long-term performance and operability of the plant in mind.
- Entering into an energy services contract requires the company to focus on the performance contract, on long-term confidence in the contractor, on whether it can work comfortably with the contractor's staff on-site throughout the contract period, and on maintaining a fair balance of financial gain between the company and the contractor in the long term.

5.3 Installation

Careful management is an essential part of the installation process. This applies not only to management of the plant's construction and installation, but also to other related issues such as health and safety, planning, minimising disruption, variation of equipment specification and contractual responsibilities.

5.4 Commissioning & Testing

Commissioning often takes longer than expected, and will inevitably reveal some defects in component performance or system design: that is its purpose.

Plant commissioning is carried out by the contractor(s) as part of completion of the installation work. Its purpose is to verify that all of the equipment functions correctly, both as individual components and within overall plant operation. The completed plant must operate correctly within its specified limits. It must respond to all automatic and manual control functions and instructions, without any malfunction, failure or cause of hazard. This must apply during full start-up and shutdown procedures, both manually and automatically initiated.

The objective of commissioning is to ensure the complete elimination of any such defects or problems, so that the plant achieves its specified design output, and its performance and reliability levels.

Where the company is purchasing the CHP plant, the plant is available for use as soon as commissioning and testing is complete, and responsibility for plant operation and management is handed over by the contractor(s). It is, therefore, essential for the specification to include details of the full range of tests that must be carried out on completion of plant commissioning to demonstrate that the plant meets the specified requirements in every respect.

Key issues to be considered are the types of tests and specific aspects CHP project testing.

5.5 Rating

The rateable value of a property represents the annual rental value based on certain statutory assumptions. It is meant to be a reasonable assessment of the rent at which a landlord and tenant would strike a bargain for the tenant to take the property on defined (statutory) terms.

CHP operators wishing to investigate exemption from Business Rating of CHP plant and machinery, should consult the CHPQA Guidance Note 43.

The purpose of this Guidance Note is to advise CHPQA Responsible Persons on the eligibility of their Scheme for exemption from Business Rating for CHP Plant and Machinery (P&M), and to provide them with step-by-step guidance on how to claim such exemption. Definitive guidance on Rating methodology and how the Rateable Value of a Hereditament is determined can only be obtained from the Valuation Office Agency (Assessors Office, Scotland). This note has been prepared in consultation with the Valuation Office Agency.

5.6 Insurance

Each CHP project will vary in its complexity, so it is recommended that an insurance adviser is consulted to provide assistance throughout the project. A proactive approach to

risk management will ensure the support of the insurance market in both the breadth of cover and the cost.

Some basic guidelines on insurance considerations are presented here in three parts: the construction phase; the operational phase; and basic information. The construction and operational phases list the risks under the headings of assets, income, and liabilities, and indicate the most appropriate types of policy. The operational phase also includes appropriate types of policy for statutory inspection and other considerations. The basic information section lists the information likely to be required by insurers.

5.6.1 Construction Phase

During the construction phase there are two possible approaches:

- A project policy specific to the scheme, covering all parties.
- Reliance on the provision of cover purchased individually or carried by each party.

Choosing the right option will depend on the circumstances of the scheme, and it is recommended that advice be taken on this issue at the earliest possible stage, and on how the contract conditions affect the insurance considerations and/or present additional risks.

Table 5-1: Risks and the appropriate insurance policy during the project construction phase

Risks & Exposures	Type of policy
Assets	
Temporary and permanent works (including building, machinery, plant) in the course of construction, erection or installation and while commissioning/testing	Contractors' All Risks
Loss or damage to buildings (including weatherproofing of roofs and/or external) walls due to an inherent defect in the aforesaid	Refer to table for operational phase (Latent and Inherent Defects).
Hired plant, equipment, temporary buildings, which are the responsibility / risk of the contractor(s)	Contractors' All Risks
Income	
Loss of future anticipated revenue, increased cost of construction and other financial losses caused by loss or	Advanced Profits

Risks & Exposures	Type of policy
Legal Liability to pay compensation to employees for death, injury, illness or disease.	Employer's liability
Legal liability arising out of error or omission in the professional advice or designs undertaken by advisors to the project	Professional Indemnity
damage to the works in the course of construction, erection or installation, but prior to completion.	
Loss of future anticipated revenue caused by loss or damage to buildings (including weatherproofing of roofs and/or external walls) due to inherent defect in the aforesaid	Refer to table for operational phase (Latent and Inherent Defects).
Liabilities	
Legal liability to pay compensation for death, injury, illness or disease, other than to employees, or property damage	Public Liability

Table 5-2: Risks and the appropriate insurance policy during the project operations phase

Risks & Exposures	Type of Policy
Assets	
Buildings owned or for which you are responsible, including landlord's fixtures and fittings and tenants' improvements, external walls, fences, gates, landscaping, car parks, outbuildings, yards, machinery bases and underground services.	Property
Contents of the buildings, and machinery, plant and equipment, trade and office furniture, fixtures and fittings.	Property
Loss or damage to buildings (including weatherproofing of roofs and/or external walls) due to an inherent defect in the aforesaid.	Latent and Inherent Defects
Stock and materials in trade, work completed and in progress, customers' and other goods in trust.	Property
Terrorism/subsidence.	Optional Property Cover
Leakage of sprinklers.	Property or Sprinkler Leakage
Steam boiler and pressure plant explosion.	Engineering
Accidental damage to or breakdown of computers including peripherals used in the production process or office. Also reinstatement of data, increased cost of working following breakdown or accidental damage.	Computer
Machinery, plant and equipment hired in. Property or Engineering Breakdown of machinery and plant.	Engineering Breakdown

Risks & Exposures	Type of Policy
Property while in transit within the UK. Property in Transit, or Property Vehicles and plant and machinery, including those hired in, where Road Traffic Act cover is necessary.	Motor
Money at your own premises and in transit.	Loss of Money
Income	
Loss of gross revenue and additional cost of working resulting from breakdown/failure of machinery/plant.	Business Interruption
Loss of future anticipated revenue caused by loss or damage to buildings (including weatherproofing of roofs and/or external walls) due to an inherent defect in the aforesaid.	Engineering Business Interruption
Loss of gross revenue and additional cost of working etc. following loss or damage at suppliers' or Business Interruption and customers' premises and failure of public utilities.	Latent and Inherent Defects
Reinstatement of data, increased cost of working etc. following computer breakdown or accidental damage.	Engineering Business Interruption Extensions
Unrecoverable outstanding business following loss or damage to business records.	Computer Business Interruption
Loss due to insolvency or failure to pay accounts due to default of customers to whom goods or services have been delivered or work done on credit terms.	Book Debts and Computer Book Debts
Loss of gross revenue and additional cost of working resulting from breakdown/failure of machinery/plant.	Credit

Risks & Exposures	Type of Policy
Liabilities	
Legal liability to pay compensation for death, injury, illness or disease, other than to employees, or property damage arising from the business activities, the products/services provided or the premises occupied.	Public/Products Liability
Legal liability to pay compensation for death, injury, illness or disease to employees arising from the business activities.	Employer's Liability
Legal liability to pay compensation arising from pollution (other than sudden and accidental) – first and third party.	Environmental Impairment
Liability of directors and officers.	Directors' and Officers' Liability
Legal liability to pay compensation arising out of libel or slander.	Public Liability or Professional Indemnity
Legal expenses of the company in defending or mounting an action.	Commercial Legal Expenses
Statutory inspection	
Inspection of machinery, plant and equipment where periodic inspection is required by legislation or is advisable as good risk-management practice.	Engineering Inspection

Risks & Exposures	Type of Policy

Other considerations	
Death, injury and disablement benefits for key and/or all directors/employers following accident.	Group Personal Accident Cover
Theft by employees (staff honesty).	Fidelity Guarantee
Personal accident, medical and emergency expenses and travel assistance for employees travelling abroad.	Business Travel

5.7 Basic Insurance Information

The following list represents the basic information likely to be required by insurers. While individual circumstances may require more detail, the points listed will provide a sound basis for discussion with insurers.

5.7.1 Information specific to construction

- Construction/erection/installation method statement.
- Breakdown in construction/erection/installation costs, split between civil, mechanical and electrical.
- For major items of machinery/plant: installation timescales; manufacturing timescales.
- Site layout, plant layout.
- Bar chart showing progression of work.
- Commissioning/testing periods.
- Contract conditions.

5.7.2 Common aspects

- Consideration of who needs to be covered (The Insured) at each stage and under each type of policy.
- A description of the scheme, with plans and schematics showing processes to be carried out.
- Construction/heating and use of buildings.
- Risk-management structure and responsibilities.

5.7.3 Assets – material damage

- Schedule of buildings owned by the company, or for which the company is responsible, showing location, age, reinstatement/replacement value and usage.
- Description and value of tenants' improvements (where leased property), fixtures and fittings, including sprinkler installation.
- Value of external features, e.g. yards, perimeter walls, gates and fences, plus landscaping, outbuildings and utilities.
- Schedule, for each location, of machinery, plant and equipment, trade and office furniture, fixtures and fittings (including electronic office equipment).
- Value of non-ferrous metal/precious metals at each location.
- Whether cover is required for terrorism/subsidence.
- What inflation provisions are required.

5.7.4 Book Debts

- Maximum value of outstanding debit balances.
- How accounts are rendered.
- Location where records are kept and how they are stored.
- Location where duplicate records are kept.

5.7.5 Computer

- Assessment of the impact that the loss of the computer system would have on the gross revenue.
- Whether a maintenance contract is in force, and whether it provides free parts and labour and a guaranteed call-out within 24 hours.
- Value for reinstatement of data.
- Value for increased cost of working.
- What indemnity period is required.

5.7.6 Computers and peripheral equipment

- Description, including make, manufacturer, model number and new replacement value.
- Whether both damage and breakdown cover is required.

- What they are used for, e.g. accounting, production.
- Situation, e.g. shop floor, customer's office or computer suite.
- Security of hardware and software.
- Whether a maintenance contract is in force, and whether it provides free parts and labour and a guaranteed call-out within 24 hours.
- Directors' and Officers' Liability
- Who is to be covered, including names, positions held and experience.
- Limit of indemnity required.
- Accounting projections.

5.7.7 Engineering

- Details and specifications for steam boilers, power generation engines/turbines and any other major machinery and plant.
- Type of hired-in plant, estimated maximum value of any one item, estimated annual hiring charges, contract conditions applying and a sum insured for continuing hire charges liability.
- Engineering Business Interruption
- Anticipated loss of gross revenue following damage or breakdown of major items of plant.
- Where major items of plant fit into the production process and the contribution to the company's gross revenue.
- Maximum indemnity period required.
- Whether utilities (gas, electricity, water) are to be covered.
- Back-up facilities (if any) in the event of loss/damage.

5.7.8 Group Personal Accident

- Employees to be covered.
- Benefits required.
- Estimated earnings.
- Cover required, i.e. 24-hour; occupational only.
- Travel abroad? Pattern of travel.

5.7.9 Income – Business Interruption

- Whether cover is to be the same as that for property.
- Anticipated gross revenue – provide calculation.
- Uninsured working expenses, i.e. those expenses not incurred/avoided in the event of loss/damage, such as consumables.
- Percentage of gross revenue reliant on individual major customers or suppliers.
- What penalties/liquidated damages could be incurred for failure to supply.
- Details of any other income.
- Inflation provision required.
- Maximum indemnity period required.
- Whether cover is required for terrorism/subsidence.

5.7.10 Liabilities – Employer's and Public/Products Liability

- Estimated wages (split between clerical and manual) and turnover.
- Limits of indemnity required.
- Description of processes, including machinery used, materials brought in, hazardous substances used or stored, hazardous processes, waste produced and disposal methods.
- Details of work carried out at customers' or other third parties' premises and whether it involves the application of heat.
- Details of any liability assumed under contract (including copy of actual contract conditions)

5.7.11 Money

- Estimated annual carryings.
- Any one loss limit.
- Where cover is to apply, e.g. on premises during business hours, out of business hours, in transit or safe.
- Details of safe, and limits required.
- Method of conveyance – security company, employee etc.
- Security precautions taken – escorts, routing, timing, security, cases etc.
- Personal accident assault benefits required.

5.7.12 Motor

- Schedule of vehicles and plant, if licensed for road use.
- Cover required, e.g. comprehensive; third party, fire and theft; or third party only.
- Drivers' particulars, e.g. age, experience, convictions and accident history.

5.7.13 Other – Fidelity Guarantee (staff honesty)

- Limit of indemnity required per employee, per loss and in the year.
- Number of employees.
- Estimated wages/salaries paid to all employees, split between those responsible for cash, finances and stock, and those not.

6 Additional Considerations for Renewables CHP

The development process for a renewable fuel fired CHP scheme is much the same as that for fossil fuel fired CHP and comprises a number of separate steps.

There are however a number of additional considerations which are specific to renewables CHP centred around the security of supply, conversion and delivery of the feedstock.

6.1 Fuel Supply Security

Securing a supply of renewable fuel or feedstock is essential for a successful renewable CHP project. An assessment of available fuel/ feedstock supplies in the area and preliminary discussions with suppliers should take place as part of the initial feasibility study and is an important factor in determining the viability of the project.

Disruptions to fuel supply represent a significant risk to renewable CHP projects. However, there are a number of measures which can be used to mitigate this risk.

6.2 Entering into long term fuel supply agreements

This puts a contractual obligation on the supplier(s) to ensure a consistent supply and quality of fuel and on the CHP plant operator to purchase and accept delivery of the contracted supply quantity. A well crafted fuel supply agreement should protect both parties from sudden price rises but should also consider the impacts of external factors such as inflation, road transport fuel and electricity price increases. It is import to ensure fuel/feedstock suppliers are capable of supplying the contracted quantities and the contract does not place them at the limit of their capabilities prior to entering into a fuel supply agreement. Having fuel supply agreements in place can be essential criteria for securing investment for a renewable CHP project.

6.3 Multiple fuel suppliers

The security of fuel supply can be improved by sourcing fuel/feedstocks from multiple suppliers thereby reducing exposure to failure of a single supply chain. Using multiple fuel suppliers in different regions can reduce the risk of short term supply disruptions resulting from severe weather events.

6.4 Fuel Flexibility

A renewable CHP schemes that is capable of using multiple fuel types is likely to be less affected by both long and short term fuel supply disruptions due to the ability to switch fuels. Fuel flexibility can improve the capacity factor of some renewable CHP technologies and achieve a high degree of operational flexibility. For example, a renewable CHP scheme can utilise cheap fuels when available, such as agricultural residues following a harvest, and switch to more expensive fuels when necessary for maintaining power and thermal output.

6.5 Fuel Storage

It is important that a renewable CHP plant is provided with sufficient fuel storage to minimise the risk of short term fuel supply disruptions such as those resulting from severe weather events. The amount of storage capacity required for a renewable CHP is project specific but 10% to 15% of total annual supply is typical for larger schemes.

6.6 Conversion of Renewable Fuels

The type and characteristics of the proposed feedstock will influence the choice of technology selected for a renewables CHP project. Some renewable CHP systems include a process, such as anaerobic digestion or gasification, which firstly converts feedstock into a secondary fuel which can be used in higher efficiency prime mover technology, such as reciprocating engines. The development process for renewable fuel conversion plant is similarly to that of the CHP plant itself and requires a time and capital investment.

6.7 Vehicle Movements

Renewable fuel / feedstock generally have lower energy densities compared to fossil fuels and are therefore bulky in nature. This can increase the number of vehicle movements required to deliver feedstock to the plant and, is likely to be a key concern of groups that may oppose the scheme. A traffic study should be undertaken to ensure the local road network is capable of handling the volume of additional traffic without significant disruption to nearby residents or contributing to excessive traffic levels.

Appendix: Project development flow-sheet

This publication is available from: https://www.gov.uk/government/collections/combined-heat-and-power-chp-developers-guides#chp-development-guides

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