

Deploying large-scale
polygeneration in industry

D-Ploy Workpackage 4

FINANCIAL STRATEGIES

Executive Summary - D4.5

March 2009





1. D-PLOY WP4: TECHNICAL, ECONOMIC AND FINANCIAL APPRAISAL

One of the main goals of D-Ploy Project is to contrast the different financial appraisal methodologies in order to pinpoint the key divergences that undermine the implementation of industrial polygeneration projects and hence increase the understanding of project financing and risk management in corporate environment. Polygeneration projects are appraised in a structured manner, regardless of the country in which the installation is located.

First and foremost, since these installations are here to support an existing or new process, the technical assessment has to be positive. If the technical potential is recognized and the project is deemed feasible, then the project undergoes a second phase, focused on the economic assessment of the project¹. The economic assessment draws on the study of framework conditions in the host site (e.g. financial incentives for polygeneration, 'spark-spreaders', etc.). Finally it is the responsibility of the investors to carry out a financial appraisal of the project, incorporating key factors such as opportunity costs and risk evaluation.

Technical aspects have been fully covered in WP2 of D-Ploy project, legal and market aspects are covered in detail in WP3 and now WP4 has focused on financial appraisal and risk management tools.

Financial factors have long been overshadowed by project economics and were therefore not considered by engineers and installation operators when investing in polygeneration. It has however become absolutely essential that the financial dimension of new polygeneration projects be assessed with great care, as early as possible. From conversations with industry representatives, it is apparent that financial appraisals have superseded techno-economic studies as the main decision making clinchers. The impact such projects can have on the credit rating of the company is often cited as an issue: it is vital to understand how financial analysts view such large investments and look into strategies (financial or other) to mitigate the adverse effect large investment in industrial processes can have on the financial situation of the company.

Contrast the financial project appraisal methodologies used by industry, energy service companies, utilities and financial institutions. All D-Ploy partners contributed to this task.

¹ Sometimes the technical and economic potential studies are carried out simultaneously.

Techno-economic drivers of polygeneration industrial projects



Figure 1: Flowchart detailing the steps an industrial polygeneration project goes through before being given the go-ahead by a company.

Following discussions and interviews within the D-Ploy team, we can conclude that the first stages of a polygeneration project will focus mainly on technical and economic dimensions and should show that the project is economically feasible, but the go-ahead includes also financial appraisal and looking into financing options.

The process is initiated by a first contact done either with the internal department of the company, a private developer, consultant company, an ESCO, a utility, etc. Then there is a rough calculation based on the useful heat demand and comparison with other technologies. Authorizations and connection studies are also discussed before the 'feasibility study'.

At the end of the day, the decision is always a compromise between the risk and return. We will try to address in the next few sections how the estimation of the return is evaluated through Cash flow estimation (the investment estimation and Operation). Then we will dig further into the financial evaluation, identifying the best practices for ESCOs, Industrials, Utilities, Financing institutions. Finally we will assess which is the acceptance criteria the different stakeholders are using and discuss risk analysis and mitigation by identifying the types of risks attached to a polygeneration project (Legislative risks; Operation risks; Economic risks).



The aim of WP4.2. is to contrast the financial project appraisal methodologies used by industry, energy service companies (ESCOs), utilities and financial institutions. All D-Ploy partners have contributed to this task. A questionnaire was prepared and circulated through the D-Ploy team, the Advisory Committee and via national associations in order to understand the different methodologies. This questionnaire reviews: General information, Economic appraisal, Financial appraisal, Risk assessment.

The questionnaire was answered by ESCOs, Industrials and Utilities (but NO Financing institutions) located in Austria, Belgium, France, Spain, UK , who are working in power ranges between 0,5 MW to 500 MW, covering all the industrial sectors (chemical, food, refinery and paper, which fall into the scope of D-Ploy were covered).

The economic value of a proposed cogeneration system typically is determined by predicting a series of future cash flows and then evaluating these cashflows according to an agreed-upon set of criteria or indicators (figures of merit). Here we will review the financial parameters and acceptance criteria most used by the polygeneration stakeholders that were interviewed.

2. WP4.1. Economic appraisal of a polygeneration project. Cash flow estimation.

The economic aspects of a polygeneration project have been reviewed. Both the investment needed in a polygeneration plant and the operational costs, which together will determine the cash flows have been discussed.

Project cost

Different methodologies for the estimation of the cost of the polygeneration project were identified, pointing out at the importance of the grid interconnection cost estimation. Barriers to interconnect and difficulty when trying to estimate its cost has been identified by the D-Ploy partners as one of the critical points to approve polygeneration projects.

There are essentially three ways the investment estimation can be performed: in a *project basis*, which involves requesting for offers in order to define a final budget. For feasibility analysis purposes, at least offers for main equipment should be carried out; through a *rough estimation*, which can be done at a preliminary stage according to the polygeneration type of cycle as shown by the table below; or based on *historical databases* and using *analytical curves* per system as a function of their power. Despite this should be a highly reliable method, we often find that results are not highly accurate and we face the difficulty of having to cope with many different offers that have been requested throughout many years, their values being difficult to compare.



Cogeneration (2-30 MW)	
Simple cycle with gas turbine	800 k€/MW
Simple cycle with engine	700-800 k€/MW
Combined cycle with gas turbine	1000-1100 k€/MW
Biomass	2000-3000 k€/MW
Trigeneration (2-30 MW)	
Simple cycle with gas turbine	1000 k€/MW
Simple cycle with engine	900 k€/MW

Operational costs

Operational Income will depend on the electricity sold to the grid; electricity sold to the customer; premiums and feed-in tariffs (depend on national supporting schemes); Heat sold to the client and Operational Costs will depend on Fuel; operation personnel; specialized maintenance; backup electricity; other maintenance; general expenses and assurances.

Emphasis has been made in the price estimation of electricity sold to the grid, which is a key point in the economy of a polygeneration project. This can be easily estimated in the case of feed-in tariffs (foreseeing increments and adjustments due to inflation with respect to present guaranteed tariffs) but it becomes more sophisticated when we try to estimate pool prices to which one will need to add special premiums and efficiency complements, depending on each national regulation to estimate the full price per kWh that a cogeneration will perceive.

In the case of some countries where there is significant participation of combined cycles we have proposed an estimate of pool prices based to a large extent on gas prices (and therefore spot Brent prices) and referenced to the global efficiency of the combined cycle (which is stated to be Ref E=52,5 % in the European Directive). Therefore:

$$\text{Electricity pool Price} = \text{Price natural gas/Ref E} + \text{O\&M} + \text{CO}_2$$

where O&M stands for operation cost and maintenance, which is of the order of 5 €/MWh; and CO₂ associated costs, which is of the order of 8 €/MWh. Natural gas prices and Brent prices are highly correlated and therefore electricity pool prices can be finally estimated as a function of Brent.

At this point, we then need to determine which is the expected Brent price, which is not straightforward given the large volatility it has shown in the last months.



International forums discuss sustainable prices for Brent (which would guarantee the coverage of present cost structures and ensure the required capacity to increase production once economies recover from the present situation), that should oscillate around 80 \$/barrel. However there is no doubt that there is large uncertainty on the volatility and evolution within the framework of a global recession.

3. Figures of merit and acceptance criteria

We identified that the most widely used figures of merit, and the acceptance criteria used by the interviewed companies are the following:

- **Net Present Value.** All the interviewed stakeholders use NPV as an assessment tool in 100% of the cases.
- **Internal Rate of Return (IRR).** The results from our questionnaire point out that requested IRR on equity plus funding is ranging between 9 % and 12 % depending on the risk of the project. Engineering companies point out to similar values, from 10 % to 12 %. A specific study carried out in UK reveals that expected IRR range between 20% and 35% for chemical and food industries.
- **Payback period.** Stakeholders request a payback period in agreement with a minimum IRR. A research carried out in UK points out payback periods below 3 to 5 years required to launch a CHP project within the chemical or food industry.
- **Profitability ratio.** Only one of the interviewed companies was using it.
- **ROCE.** Only one of the interviewed companies was using it.

All the standard figures of merit are described in detail in the text.

Other insights

Other interesting insights for our questionnaire revealed:

- Polygeneration promoters describe a **weighted average cost of capital (WACC)** between 7 % and 9 %.
- Regarding **depreciation**, by default linear amortization is used, while 1-year amortization is often used in preliminary calculations. It is to be noted that promoters usually link depreciation to life time of project or to Power Purchase Agreement (PPA). In Spain, for instance, the maximum allowed coefficient to be applied is an annual 8 % if no civil work is involved. The proportional part of civil work is to be depreciated with an annual 3 %. This leads to linearly depreciate during 10 years.
- **Preferred way of financing.** ESCOs prefer to use own equity up to 15% to 25% and cover the rest SPC with bank debt. They also use project finance, sometimes stating that they embrace this option for large projects (100 M€). Engineering companies point out that operating lease or capital lease are preferred options.



4. WP4.3. Industrial Polygeneration Risk Management issues and options

As in any other kind of investment, the return expected by investors that get engaged into a polygeneration project is linked to the perceived risk of the project. The D-Ploy team has carried out a research in order to identify the main risks linked to a polygeneration project and the importance the different types of promoters are attaching to each of them.

Cogeneration projects entail a complex set of relationships that need to be negotiated so that any one party obtains essentially all of the benefits or avoids essentially all of the risks. The dissatisfaction or bankruptcy of the system supplier, fuel supplier, steam host or O&M contractor may lead to lawsuits but not to economic rewards. The several contracts must then be structured to provide each party with appropriate incentives to make the project work as intended. This requires that rewards be allocated commensurate with risks and that risks, to the extent that they cannot be eliminated or mitigated, be accepted by the party best able to control or absorb them.

The main risks identified in polygeneration projects are: Greenhouse gas value risks (CO₂, NO_x); Spark spread risks (Power to fuel price); Subsidy risks; Technical risks; Country risk – legislation changes; Company risk / client risks (reduction in steam production); Legislative framework; Insurance costs; OM costs may vary; Currency rates (spare parts); and Labor costs.

The questionnaire results shows how nearly all the stakeholders point the client risk (possible reduction in steam production due to variations in the client's industrial process) and the country risk (variation in legislative framework) as the most critical factors, followed by the spark spread risks (power to fuel price variations), greenhouse gas emissions value risks (allocation procedure of CO₂ and NO_x) and technical risks. Other risks like insurance costs, OM costs variation, labor costs or currency rates variation are pointed out as secondary.

Further ideas inferred from our interviews are listed here:

- Supporting schemes in form of feed-in tariffs, premiums, CHP certificates or green certificates are implanted in all the countries and the inquiries reveal that no polygeneration project would be attractive without such subsidy, except for large plants (above 25 MW with a large heat demand and low electricity demand – high efficiency & economies of scale)
- No tax rebate is typically applicable to polygeneration projects
- All the interviewed companies rely on in-house financial experts
- No common hurdle rate is used across projects, instead risks analysis is performed on a project basis. There are some industrial sectors that appear to be more risky than other sectors since they have historically fluctuations. For instance, the paper sector is extremely risky, while the chemical industry entails some risk and food (basic products, not luxury) is less risky.
- When the sector entails high risk, only the industrial can assume financing the project
- Lack of Turnkey offers for large plants



- Engineering know-how or labor costs do not seem to be a problem, except for one country
- Equipment manufacturers are fully booked, which results in main equipment delivery time – in particular for engines
- The increase in prices during 2006-2007 seems stabilized now
- Combined cycle boom does not seem to interfere with smaller size plants
- Type of discount that is offered to the client: ESCOs mainly offer discounts in heat only, though utilities offer discounts in electricity also
- CHP projects need to compete with ‘best alternative’ that sometimes lays within the core business of the industrial

From our analysis we can estimate an average risk premium since we know that firms will require IRRs that are larger than their WACC plus a risk premium and after our analysis we can estimate the IRR that is usually required and the cost of capital (WACC). From the results shown in previous sections such risk premium is perceived to be between 2% and 3% for the interviewed companies.

5. Conclusions

This work package has focused on economic and financial appraisal of polygeneration projects, complementing technical and legislative work packages that can be found in WP2 and WP3 respectively.

The original hypothesis that many in the industry still assess the financial attractiveness of industrial projects with outdated techniques as accounting rate of return (ARR) or payback is not validated. Far from that, all the interviewed companies use cutting-edge financial tools such as net present value (NPV) and discounted cash flow techniques (CDF) to make their decisions.

Indeed, the most widely used figures of merit are Net Present Value, which is used by all the interviewed stakeholders, Internal Rate of Return (IRR) after tax (required values are numbers between 9 and 12 %), Payback periods (4 to 7 years), Profitability ratio (only one company was using it) and ROCE (only one company was using it)

In order to perform NPV evaluations, relevant cash flows are to be identified. We proposed several methodologies in order to estimate the investment needed to carry out the polygeneration project. Besides, we described all the concepts involved in operational margins, and we derived a way to estimate electricity prices as a function Brent barrel prices.

Regarding the preferred way of financing ESCOs prefer to use own equity up to 15% to 25% and cover the rest SPC with bank debt. They also use project finance, sometimes stating that they embrace this option for large projects (100 M€). Engineering companies point out that operating lease or capital lease are preferred options.

Regarding risk perception, the questionnaire results show how nearly all the stakeholders point the client risk (possible reduction in steam production due to variations in the client's



industrial process) and the country risk (variation in legislative framework) as the most critical factors, followed by the spark spread risks (power to fuel price variations), greenhouse gas emissions value risks (allocation procedure of CO₂ and NO_x) and technical risks. Other risks like insurance costs, OM costs variation, labor costs or currency rates variation are pointed out as secondary. The **risk premium** perceived for polygeneration projects is of the order of **2-3 %**.

There is only one clear advice that came out from our discussions, and which is supported by the many years of experience of the D-Ploy partners in polygeneration projects, and that is that **ONLY high efficiency polygeneration projects (high PES) resist the test of time and ensures you are intrinsically hedged against adverse evolution of the energy prices.**