Energy from Waste

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Energy-from-Waste (EfW) Project Development
EPC Contractor & O&M Contractor as One-Stop-Shop?

Christophe Cord’homme

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Some essential characteristics need to be understood to implement a project for municipal solid waste treatment with Energy–from-Waste (EfW) plants. Because of the widely accepted principle: *The polluter pays*, municipal solid waste treatment is normally under the responsibility of the public entities dealing with the city utilities. Therefore, the municipalities responsible of public affairs in the city are normally in charge of the collection and disposal of household waste produced by each citizen and/or public waste produced along the town daily life.

This local public responsibility is a major and rather unique point to take in consideration to understand Energy–from-Waste industry. This business could not be handled as standard *Business-to-Business* (BtB) projects as it could be the case for other energy production facilities construction. In BtB standard case, one industrial company, the client is looking for a technical solution to its problem at the best conditions. After a private tender to its suppliers and some discussion, he is choosing the best offer answering his requirements at the best price.

Several differences are important to notice. First, EfW projects are dealing with local public entities, which are strictly constrained by public market rules to apply before contracting. This is therefore more complex and less flexible compared with contracts between industrial companies in BtB scheme.

Another point is concerning a more long-term approach for public market compared with BtB. An EfW facility is designed and built to provide a continuous public service for several decades of waste disposal and energy production at full load. This mission is representing the top priority. It could modify the financial perception to a long-term perspective. The economical calculation on the return on investment could be done on decades instead of years or even months nowadays in industrial business.

Finally, because of the nature of the municipal waste as a fuel, it needs to build a tailored technical solution with high flexibility and reliability. The variability of this fuel is also meaning that predictions are a matter of experience.

The development, design, construction and operation of such plants require specific know-how and means. These infrastructures require an important investment to realize and to manage them under the responsibilities of high-skill competences. The making of such a project needs to be carefully undertaken.

While choosing how the plant will be financed, designed, built and operated, the client will have to choose which of these steps will be undertaken by private or public actors. In fact, it is meaning whether the plant or the related services will be bought or made. By settling the terms of the different contracts, the client will acknowledge what the risk sharing balance between public sector and private companies will be. The client could choose among various options: Lots, EPC (Engineering Procurement Construction), Public or Private Operation, Public financing or BOT (Built Operate Transfer) or even merchant plants with project development.

This Paper will review the basics of the Energy from Waste markets along with the different types of topics involved in the realization of such contracts. It will then assess
Energy-from-Waste Project Development EPC Contractor & O&M Contractor as One-Stop-Shop?

various types of procurement from public to private, underlining the differences between countries. Finally, it will consider the advantages of contracting with companies such as CNIM gathering the experience in the complete value chain from design to operation in that field.

1. *EfW* not an industrial business as usual

Energy from Waste plants are large infrastructure projects dealing both with the Municipal Solid Waste (MSW) management, but also with the energy production. Nevertheless, they are not relevant of standard *Business-to Business* power plants contracts. Let us see some specific characteristics.

1.1. Public involvement

This fundamental point is concerning the *Municipal Solid Waste* ownership and responsibility. Because of the widely accepted principle: *The polluter pays*, municipal solid waste treatment is normally under the responsibility of the public entities dealing with the city utilities. Therefore, the municipalities responsible of public affairs in the city are normally in charge of the collection and disposal of household waste produced by each citizen and/or public waste produced along the town daily life. If this point is not clear by law, there is in fact no client, who is responsible and in position to sign a contract and to pay the service of the waste treatment. Such EfW facility is then quite impossible to build.

This is also meaning that:
- rules of public market tenders are applied,
- strict and changing legislation is concerning this public service and
- management of external interferences has to be done: permitting process, political issues, public opposition etc.

This local public responsibility is a major and rather unique point to take in consideration to understand Energy-from-Waste industry. This business could not be handled as standard *Business-to-Business* (BtB) projects as it could be the case for other energy production facilities construction. In BtB standard case, one industrial company, the client is mainly looking for a technical solution to its problem at the best conditions. After a private tender to its suppliers and some discussion, he is choosing the best offer answering his requirements at the best price.

1.2. Not a standard fuel

The fuel for EfW has specific characteristics with an important impact for the design of EfW plants. MSW is a poor-quality fuel, with heterogeneity, variable composition and high contents of pollutants. Its calorific value or energy content is rather low, similar to fresh wood.

Yet compared to standard fossil fuel power plants, the required technical skills for EfW building and operation are more sophisticated, mainly because of the nature of this specific fuel, plants the household waste.
Its origin is local, with the advantage of reducing energy dependency from foreign countries. Nevertheless, it is also diffuse, requiring consequently synergies between municipalities for the MSW treatment. The goal is to mutualize the treatment in a common facility to reach a critical size regarding technical and economic aspects.

The high flexibility of standard mass burn EfW technology is also meaning that the fuel supply could be extended to other types of acceptable wastes, such as wastewater sludge. Commercial and Industrial waste (C&I), clinical waste.

1.3. Not a standard power plant technical solution

EfW plants are large infrastructure projects with tailored technical solutions. They are similar to a conventional Power Plant on a number of points such as:

- the technical principle (combustion, energy recovery by a steam boiler, flue gas treatment and power production by a steam turbine),
- the energy efficiency concern (to produce more power with less fuel) and
- the availability concern, especially for a base power production.

In fact, this EfW technology is even more complex because of:

- the MSW fuel quality regarding its low energy content, its heterogeneity, its variability in composition and its pollutants content,
- the MSW fuel variability in terms of quantity with daily, weekly and seasonal changes (Waste treatment is required 24/7/365),
- the regulation to fulfil, which is stringent and in evolution. (this sector is a flagship concerning pollution control and environment concern compared to other industrial sectors) and
- the public tender process, which is requiring a significant and serious feasibility study and know-how. This is not standard Business to Business between industrials clients and suppliers and this is usually tailored made.

Finally, this EfW system needs technologies, which fit to purpose. You are not buying only equipment or a device, but you need also a performance, such as Treat x tons of MSW per year with the lowest environmental impact and in safety with a consumption of y tons of reactive agents per ton of fuel, exporting z kWh of power per ton of fuel during n days/year. From time to time, one should find out some fashion victims in this market looking after the miracle solution, which is appearing first as an alternative technology with no default, but finally as a technological mirage.

1.4. Not a standard Business-to-Business solution

Similarly to Power Plants, the interfaces in terms of adaptation to the site, physical environment, architectural design and technical parameters are quite complex with tailored solution in general. Nevertheless, the best is to install these EfW close to the city center to reduce waste transports and optimize the energy reuse in district heating for example.
As well as for classical Power Plants, the preliminary studies phase and the construction time for EfW is quite long (several years in total) and the delivery risks are significant concerning delay, budget and performances. A cost-effective and on time completion with the performances fulfilment of this important infrastructure are required to avoid there a shortage in the essential waste treatment capacity.

Finally, these EfW units are also quite capital intensive with long-term investment return and energy efficiency concern. Nevertheless, contrary to the conventional combustion technologies for power production, EfW technologies’ economic performance is positively affected by the input MSW fuel prices. Waste has a negative price: the waste producer or owner has to pay a gate fee or tipping fee at the entry of the EfW plant. This is forming the basis of major source of income for the EfW plant owners. The major costs associated with these EfW plants are the investment technology costs, linked to the characteristics of this particular fuel. Apart from this, generation of electricity and heat is another source of income. Of course, the objective is to minimize this gate fee for this waste treatment service. One should understand the importance of availability and performances to reach this cost optimum. However, in the waste treatment hierarchy, this EfW process is the most economical way to treat the MSW when excluding waste disposal by landfilling, which should be avoided according to the European directives.

The development of alternative technologies such as gasification or pyrolysis is also subject to this cost reduction goal. Some systems might be proven, but are often not reliable or cheap enough to compete with classical mass burn combustion. Some others are science fiction.

Another point is concerning a more long-term approach for public market compared with BtB. An EfW facility is designed and built to provide a continuous public service for several decades of waste disposal and energy production at full load. This mission is representing the top priority. It could modify the financial perception to a long-term perspective. The economical calculation on the return on investment could be done on decades instead of years or even months nowadays in industrial business.

1.5. Not standard industrial actors

The main typical actors for EfW are the following:

a) Public entities (municipalities or public companies in charge of the waste management) acting directly or through private companies under a waste disposal contract,

b) waste management or power production private industry taking care (when required) of providing waste management and/or energy production services to the public entities

c) plant constructors providing to a) or b) the entire plant on turnkey bases (EPC contract) or systems thereof

d) operation and maintenance (O&M) companies ensuring to a) or b) the O&M services when they do not perform it directly.
Some other actors are very important and active or reactive in this market, such as:
• power industry recovering produced energy (electricity, district heating, steam),
• investors, banks, lenders,
• advisors, consulting engineers,
• permit and Control authorities and
• public, neighbors and associations.

Therefore, the success of Energy from Waste plants depends on several parameters such as the supply of the waste, the adopted technology but also the framework of the different organizations involved in the realization of the EfW facility and the contractual relations established among them.

This organization is a fundamental prerequisite to give the possibility to control efficiently the waste flow in order to treat it by an optimum way. A balanced risk sharing between these actors is determinant to allow a stable and fruitful situation. As this infrastructure deals with public service, it has to follow the rules of the public market tenders with the legally binding public procurement notices. The impact of the public/private approach in waste management is therefore very important.

2. EfW not an industrial procurement as usual

Usually, public sector is buying a wide range of goods and services, from the purchase of standard and low value products to highly complex infrastructure and services.

2.1. Public market constraints

Procurement processes, techniques and issues differ a lot in this range. For the simplest, the buyer knows precisely what he wants to buy and can clearly specify the required product. There is a competitive market that can meet the requirement with available items. At the other extreme, buying an asset such as Energy-from-Waste plant is considerably more complex and requires appropriate skills and expertise, suitable governance structures and advanced procurement tools and processes.

Sources of complexity in this type of procurement for EfW plants are the following:
• rules of public market tenders: this is often leading to costly tender process requiring significant know-how on both sides (client and supplier);
• project scale this is involving many different trades and skills to coordinate and implement through several linked procurements or one general contractor contract;
• project duration: the contract after the signature, leads to more than to 2 or 3 years of relationship between the owner and the supplier as opposed to a simple and almost immediate delivery;
• Internal interfaces: for example the project, in addition to comply with the technical specifications required by the client, should integrate elements coming from site conditions, architecture, process demands for the compliance with standards and regulations, connections with existing infrastructures;

• extensive regulations: very stringent and continuously changing legislation, regulations and norms, which are often based on international directives in Europe and implemented in national and local laws and rules;

• external interfaces: the project is exposed to market risks, political opposition or interfaces with existing waste management, public involvement or other contingencies such as planning or permit granting conditions;

• solution and scope: while it is not always possible to define in full details the technical solution up front as it requires the development of tailored solutions; the use of unproven technology or proven technology under new circumstances could increase the complexity;

• financial structure: because of the size and long-term return of the investment, the financial structure is not easy to settle without a detailed feasibility study up stream;

• competition situation: due to the high level of know-how required and to the costs of tenders elaboration, the numbers of competent suppliers interested by an inquiry could be excessively reduced if a project has not been seriously prepared or if the contract conditions require the assumption by the supplier of unacceptable risks;

• delivery risks: completing the project within fixed budget and time schedule is some time really challenging.

2.2. Market organization between public and private

The legal frame conditions of the MSW treatment in a country have an impact on the organization and the sharing of responsibilities between the different involved actors.

In Europe, the most common situation is that local public sector organizations, such as cities, districts or associations of towns, have, by law, collection and treatment obligations for the household and other municipal wastes. These local authorities bring this power attributed by the law into effect over their territory to recover the wastes from the waste producers, which are the citizens. An essential key driver is that these territorial entities come together to achieve the size needed to avoid the fragmentation of the waste management system depending on the local municipal structures organization.

These public local authorities can then involve to a certain extent the private sector for the treatment of the waste depending on their competences and responsibilities:

• public ownership, construction and operation with a complete public management for the design, the construction and the operation of the owned Energy-from-Waste facilities (municipal ownership, responsibility and management);
• public ownership, private construction and public operation with a sub-contracting of the design and construction to private companies (municipal ownership and management with private design and construction b competences);

• public ownership and private construction and operation with a subcontracting of the design and construction to private companies and with the subcontracting also to private companies of the plant operation (municipal ownership with private design and construction and operation competences);

• private ownership (temporary or definitive), construction and operation with private financing. In general, in this case, the private sector is a service provider to the public communities, which obtain a treatment service for a fixed price rather than investing, building and owning assets.

A private sector contractor finances any required facilities and is then paid for the services actually provided by reference to pre-agreed prices. The ownership could be temporary, like in a BOT contract (Build, Operate and Transfer), such as in the case of delegation of public service to a private waste management company, or definitive like in a full concession with financing and owning (private ownership, responsibilities and management).

Many other situations are also found in public private partnership (PPP) types depending on the country legislation and the contractual and legal aspects.

For commercial and non-hazardous industrial wastes management, the private sector is usually handling the full responsibility. The treatment is then realized by private facilities (merchant plant). However, this commercial and industrial waste can also be used to complete the municipal waste treatment plants feedstock to increase their capacities and thus reduce their treatment costs.

This is adding some complexity in the waste mass flow management and is producing a panel of various situations.

2.3. Conventional public procurement for construction

In the case of public ownership, the public sector will use a conventional public procurement for the plant construction. This is generally characterized by input-based specifications, public sector funding and rather short-term contracts (3 years compared to typically 20 years for a concession).

Two main approaches could be foreseen:

• supply allotment: The public sector first realizes or procures a basic and/or a detailed design of the process and the building. Then it procures separately from the contractors to build the infrastructure, in general by lots. This approach could be used intensively for pure civil works, but it is difficult to manage for such complex process as EfW plant. This requires a very high level of technical skills in the public administration for the management of complex technical and contractual interfaces created between the lots. Because of this complexity and the specificity of each
supplier process, in general the number of lots is limited for EfW construction. EfW allotment would typically consist of a number of lots varying in general from 2 lots (civil work/process) to 5 or 6 lots (civil work/combustion/flue gas treatment/energy production/electricity/control command for example). At the end, some costs, performances and time delay risks may end up with the public sector client, for example through change orders due to interface problems. There is generally limited contractual integration with maintenance and operation phase after the plant has been delivered.

- Design and build (DB) contract with typical EPC/turnkey supplier: A design and build (DB) contract could be given to one supplier in which an integrated project team is responsible for both the design and construction of the asset. Risks are typically shared between the public and private sectors through appropriate contract terms; for example, the risk of late delivery and global performance might be transferred to the private sector. A detailed description of this typical EPC approach will be detailed hereafter. The payment of the construction is done by the public owner along the schedule of the erection. The other risks such as waste supply and financing remain supported by the public sector. These risks are not always easy to control and even to quantify. The risks for operation could remain handled by the public sector or largely transferred to the private operating company in case of sub-contracting of this scope. Nevertheless it is much more limited than in private initiative as the operation risk is only starting when the plant is commissioned, therefore has shown that it is fit to purpose.

2.4. Private construction procurement in case of concession

In case of waste management privatization, the authorities approach is to shift the risks of financing, the risks of design and build, especially for the construction costs and time delays and the risks of operation to the private sector contractor through a fixed gate fee price for the service of the waste treatment. Under this organization, the eventual additional costs to complete the project are supported by the private contractor and shared with its subcontractors in accordance with the subcontracting arrangements (and in more extreme cases by those who have provided debt finance to the concerned project). They bear risk up to their capacity or their limit of liability.

A number of contractual structures were developed involving the private sector in project delivery and risk sharing beyond the construction phase. These structures were known by various acronyms, such as BOO (Build Own Operate), BOOT (Build Own Operate Transfer), DBMO (Design Build Maintain Operate), DBFM (Design Build Finance Maintain), DBFO (Design Build Finance Operate). In UK, these types of delivery models are in the frame of a PFI (Private Finance Initiative) and are usually involving a performance-related payment, which begins after construction and only once the project has demonstrated that it is fit for purpose and has entered into service. Under these contractual organizations, the private sector is involved in not only operating and maintaining the asset and providing the service, but it is also amortizing its
cost of constructing the plant over the lifetime of the operation, which may be 20 to 25 years. This requires the private sector contractor to raise long-term finance at risk, only allowed under bankability conditions.

In return for managing these risks, private sector investors expect a return result and a risk capping for this exposure. The more risky the project is, the higher is the required return. Nevertheless, it is almost impossible for the private sector to cover all the risks linked to the demand by a simple increase of the return interest as these risks are threatening the project bankability. If the public sector is, through the chosen contract structure, transferring some or all of the project risks, it should take into account the higher required rate of return implied. A State or public authorities are likely to be able to cover any given risks cheaper than the private sector as they might spread them to the entire population at cost without any profit. This is the same principle applied for the public self-insurance. Private sector cost of capital is also higher by essence. The public sector could also obtain cheaper financing than the private sector. Even if it is foreseen to hope to get lower operation costs through improved efficiency with private sector, it remains uncertain that private ownership and operation are actually producing an economic benefit because of the increased costs relating the covering of the risks involved. One should also consider that very long-term contracts commit often expenditure. They are often incomplete or inadequate on long period. This is meaning first a continuous public monitoring and control, but frequent renegotiation or modifications are happening by nature with a lack of competitive tendering afterwards.

Therefore, this PPP has the main _advantage_ for public entity to be an alternative to public deficits by deferring payments and debts. However, this is not an alternative source of revenues: Public entity pays at the end of the day and often more compared to a fully public solution.

Concerning the construction contract given by the private contractor, one should first notice that the same _standard_ technology is generally applied, irrespective of the structure organization. This consideration must be largely balanced by the fact that technology under development or highly innovative with little or no feedback will lead to a significant uncertainty in assessing the performances or availability. This is introducing a risk for the costs of operations and revenues. The bankability principle is encouraging to use reliable and proven technologies.

These business developers, banks, lenders and investors will want to avoid the _completion risk_. It means that once construction has started, the lenders and investors want guarantees that the project will be completed and will start operation on time and in good conditions. Contracts known as EPC or turnkey are attractive for the financial actors. Under an EPC contract, a general contractor will handle all of the tasks needed to design and build a project according to a set, pre-quoted, fixed price and will deliver the project fully operational. In these cases, because of the limitation of internal interfaces, the completion risk belongs to one company, the EPC contractor, and is secured by a performance bond. The EPC contractor is contracting with its sub-contractors and coordinates all the tasks involved.
As an alternative to this, the private owner team itself can act as the prime contractor (the role of the EPC), hiring all the engineering, procurement and construction contractors. However, it would need to demonstrate that the project would be completed on time and for the fixed price. A third choice is for the private contracting team to hire a project management firm to coordinate the project. However, this type of contract is very different from EPC. EPCM is a services-only contract, under which the contractor performs *Engineering, Procurement and Construction Management* services. Once again, over costs are needed to be taken into consideration and completion assured being this project management team not involved financially as an EPC company and a huge interface is created between the owner and the Project team.

3. EfW project in one-stop-shop

3.1. Engineering, Procurement, and Construction/turnkey general contractor

EPC is a particular form of contracting arrangement used in some industries where the EPC Contractor is made responsible for all the activities from design, procurement, construction, to commissioning and handover of the project to the end-user or owner. Other abbreviations used for this type of contract are *turnkey*, *LST* for *Lump Sum Turn Key*, and sometimes *EPCC* which is short for *engineering, procurement, construction and commissioning*.

*Engineering, procurement, construction and commissioning* (EPCM) is a special form of contracting arrangement, which is very different from EPC in terms of risk sharing. In an EPCM arrangement, the client selects a contractor who provides only *management services* for the whole project on behalf of the client. The EPCM contractor only coordinates all design, procurement and construction work. Therefore, his responsibility is much more limited for the risks around the plant design or construction.

EPCs are contracts where one entity is taking total responsibility for the design and execution of an engineering project. Under the usual arrangements for this type of contracts, the contractor carries out all the EPCM: providing a fully equipped facility, ready for operation (at the *turn of the key*, *Clés sur portes*). It includes design, manufacture, delivery and installation of the overall plant, including the start-up and the design and execution of civil work.

EPC is usually the most appropriate option for municipalities or other private clients. As a result, the final owner is dealing with a single entry point, which owns expertise in the wide range of knowledge and skills required for designing and developing such tailor-made projects in an effective and reliable manner.
Thanks to continually enhanced expert know-how, the turnkey contractor is used to work with different equipment manufacturers and is always seeking the most appropriate partnerships on a project-by-project basis. He thereby creates optimal working conditions in order to complete the whole project successfully on budget and on time.

3.2. EPC responsibility

In order to do so, a trustworthy relationship between the owner and the EPC contractor needs to be built. This can only be based upon fair contract conditions, including equitable risk sharing. The risk sharing principles benefit both parties, the owner is signing a contract at a lower price and is only having further costs when particular unusual risks actually happen, and the contractor avoiding pricing such risks, which are hard to evaluate.

For some projects, for example those financed by private funds, it is sometimes necessary for the contractor to assume responsibility for a wider range of risks than under the traditional practice. To obtain increased certainty of the final price, the contractor is often asked to cover such risks as the occurrence of poor ground conditions. If the contractor has to carry such risks, the owner obviously must give all relevant information and let him the time and opportunity to consider this to increase certainty of the risk estimation and therefore of the final price. The owner must also realize that asking serious contractors to price such risks will increase the construction costs and result in some projects not being commercially viable. He should also avoid unusual risks transfer, which is hard or impossible to evaluate. In any case, the owner does carry certain risks such as the risks of war, terrorism and the other risks of force majeure.

A good balance must be found in the client project definition requiring key performances but allowing contractor own specific equipment design. This has to be obtained for the bidder interests and the prices optimization with equilibrium between detailed client specifications required to ensure that the contractor is not making a dreadlock in his design and key performance requirements based on the outputs that the contractor is able to comply with according his own specific equipment design.

Some improvements should be considered to allow a fair and reasonable competition such as:

- realize a serious preliminary feasibility study concerning especially the project definition, but also the financing or the waste supply conditions;
- implement measures of compensation for unsuccessful bidders (this should reduce the risks of the unsuccessful inquiries, often caused by the lack of this serious feasibility study);
- initiate a process of standardization of contract terms to avoid unfair and unacceptable conditions attempting to transfer risks that cannot be supported by the turnkey contractors.
3.3. Avoid interface between Operation & Maintenance and Engineering Procurement Construction

As indicated in the former chapter, the EPC contracting is avoiding multiple interfaces between several lots of process in case of allotment and is limiting the risks associated with the plant's design and construction such as the completion risks corresponding to the question: *Can the project be completed on time and on budget?* The realization time should not exceed the anticipated schedule and construction costs should not exceed what was expected.

However, the standard interface between construction phase and operation phase after commissioning is introducing some weak coverage of the risks here after mainly associated with the performances and availability during operation:

- revenue risks: Will operating revenues be as projected? The performances might not be at the expected level
- operating risks: Is the project capable of operating at the projected performance level and costs? The O&M costs might exceed the ones that have been assumed, the quality of the equipment or the O&M performances might cause lack of availability and costs;
- input supply risk: Could municipal wastes or other inputs be obtained at the projected costs? The quantity or the quality of the wastes might not be as expected with fewer consumers than planned or with different energy/pollutants content.

Between the end of an asset's construction and the beginning of its operation, there is a substantial transition period where most, if not all, of the professionals who designed, installed, and verified the initial condition of the asset cease to be involved. A new team of people begins to run the asset, taking on the phase with greater costs and environmental impact. This shift in personnel presents one of the greatest risks to the parties' ability to bridge the gap from construction to efficient operation.

Additionally, assets naturally could trend toward *performance decay*. This phenomenon is indicated to be responsible for as much as 30 percent in efficiency loss in the first years of operation in buildings such as hospitals for example. (note: fortunately, this is not the case in most EfW facilities.)

Today, many new assets follow a standard approach to the design and construction process, particularly with regard to the contractual agreements binding the teams and the protocols of communication between team members. Most importantly, the typical roles have not changed in a very long time, although assets are more technologically complex and are delivered in less relative time for ever decreasing fees.

In this approach, during the earliest and most critical phases of planning and design, not all members of the ideal team are present. Of particular note, the facility manager is rarely present during design discussions. Yet the person expected to manage operations and maintenance staff and effectively uphold the performance of a facility might...
have input during the design phase. In addition, the facility manager should play an important role in ensuring that the trade-offs between construction costs and operating and maintenance costs are fully considered (it may be beneficial to spend more up front on higher quality construction, as this may reduce operating and maintenance costs over the long term, or vice versa).

A further weakness in this model is that it is common for design roles to remain segregated and communication kept to a minimum with all parties — with work being pushed to be done in order to preserve profit. Everyone involved up until the completion of construction essentially leaves, turning over the facility to an entirely new group of professionals. Even assuming the facility is in top shape upon delivery, the new staff lack the history of why systems and settings were designed the way they were.

Some modern IT tools for O&M such as computer assisted production management (CAPM) or computer assisted maintenance management system (CAMM) are much more efficient and easy to implement if they are designed as soon as possible during the early study phase of the plant. This is meaning a strong coordination between the EPC contractor with its design team and the O&M contractor. These tools allow automatic calculations of relevant Key Performance Indicators (KPIs) which are available for operation, maintenance and financial reports.

Let us quote other tools such as ILS (integrated logistic support) or RAMS (reliability, availability, maintainability & safety), which are very helpful to improve the efficiency of O&M if they are designed from the beginning together with the process design.

In conclusion, combining in One-Stop-Shop both EPC and O&M to a single experienced company is allowing simplifying this complex interface.

4. CNIM experience in EfW business

4.1. EPC/turnkey experience

CNIM is building EfW installations since more than 55 years with 285 EfW combustion lines adding up a capacity of thermal treatment of around 27 million tons of municipal waste per year. More than half of these installations were delivered turnkey. For example the company has recently delivered the EfW plant of Brno (225.000 t/year), one of the first ones in Czech Republic, but also the first EfW plant in Baku, in Azerbaijan (500.000t/year) and the first one of the Baltic States, in Maardu (Tallinn) in Estonia (220,000 t/year).

The turnkey culture of the company is anchored in its history: established in 1856, the major activity before 1982 was a leading naval shipyard, which was building very large-sized ships, such as cargo boats, methane carriers or passenger ships. This type of realization requires an organization capable of handling in a limited and short schedule, a complex tailor-made project using a large number of sub-contractors for
a fixed budget. This experience is by nature the kind of turnkey projects. This skill has been used in the EfW sector since the beginning of the 1960s and reinforced with the acquisition of the ABB - Alstom Environment in 2002.

For the disposal of MSW, CNIM is present in the various different types of treatments proposing the energy recovery, the material recovery and the organic treatment. EfW plants are now an essential element of a global multi-channel structure for the waste treatment with sorting, recycling and composting on an integrated horizontal approach.

As a general contractor, CNIM produces integrated turnkey solutions, from general design and engineering to commissioning, and through procurement and construction. It designs and builds thermal waste or biomass treatment plants, that use its own processes, and carries out the detailed design of the essential elements of the installation, also using its own processes, in particular for:

- combustion (combustion grates through the long term partnership with Martin GmbH and fluidized-beds),
- energy recovery (boiler units),
- waste-to-energy conversion (steam and water cycles) and
- flue gas and residue treatment with process supplied by the fully owned subsidiary LAB.

The most sensitive pieces of equipment are manufactured in its own workshops, while other pieces like the steam turbines are entrusted to a network of high quality subcontractors.

CNIM is active both in the production of new installations and in the renovation, extension and revamping.

The companies references in Energy from Waste cover the whole range of industrial facilities with capacities of waste treatment, from 2.5 to 50 t/h per line (20,000 to 375,000 t/year per line). Proof of reliability and performance, almost all old units built by CNIM are still working today still providing their service at full nominal load. Among the oldest, those of Paris in France with a total capacity of 100 tons of MSW per hour actually and which started in 1969, celebrate in 2018 their 49 years of operation.

4.2. O&M experience

CNIM also has the skill and the resources needed to perform, when required, the operation and maintenance of the plants, or to help the operators with technical assistance or to provide an integrated vertical approach for the project development.
The knowledge of the processes is fed by the non-stop feedback experience since 45 years; the group is operating in several plants today in France, in Great Britain, in Azerbaijan with commitment on energy recovery of the facility through the sale of steam or electricity to the grid.

These global waste treatment systems are developed through global offer contracts such as concession schemes – PPP. In such contract responsibility environment, the group can participate as a shareholder within the structuration of the deal and then co-invest in it. The groups experience in financing projects of this type, most notably in the United Kingdom, show it is a recognized actor in such a field, thus supplying a complete service for communities.

5. Conclusion

To understand Energy-from-Waste industry, one should consider that this type of large scale infrastructure is presenting some complex mechanisms in term of planning, financing, design, building and operation, involving a large range of actors, but the local public responsibility in this sector is also a major and rather unique point to take in consideration. This business could not be handled as standard capital intensive Business-to-Business projects as it could be the case for other energy production facilities construction.

This has an impact on a more long-term approach for this public market supply compared with BtB. An EfW facility is designed and built to provide a continuous public service for several decades of waste disposal and energy production at full load. This mission is representing the top priority. It could modify the financial perception on a long-term perspective. The economical calculation on the return on investment could be done on decades instead of years or even months nowadays in industrial business.

The public client as municipal waste owner has to analyze how to share the risks of technical and contractual interfaces between the actors. The goal should be to ask to the one who has the best competences for a type of risk to manage it. However, the final client should aim for a good risk balance to avoid excessive extra costs due to the overestimation of the risk coverage.

Risks should therefore be carefully allocated among public entities, waste management or power production private industry, plant constructors, operation and maintenance companies able to manage them for an efficient project delivery and operation. Engineering Procurement Construction contracts often offer best possible alternative as they externalize construction risk. Building a plant requires in fact substantial technical knowledge and should be led by specialized companies. Companies with experience both in EPC and in Operation & Maintenance could propose a very efficient offer reducing a major interface problematic occurring after the commissioning phase when the teams are changing from construction to operation. This could be proposed for standard long-term period, but also for short-term such as an assistance during the guarantee period.
With its high-skill competences and specific know-how, CNIM, specialized in the delivery of EPC turnkey contracts and also experienced in the O&M, offers a quite unique One-Stop-Shop service possibility in that realm answering the needs of its clients, while also isolating them from substantial risks. This turnkey experience combined with references in operation and maintenance allows proposing optimized services, adapted innovations and an integrated offer.

6. References


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Several plants in Germany have been provided with this technology. Figure 8 shows a plant, realised with a dry hydrator for a Ca(OH)₂ production capacity of approximately 3 t/h. As alternative there is the possibility to install the dry hydrator close to the additive can now be injected directly into the reactor without temporary storage in a silo. Figure 9 shows such a dry hydrator as well as the corresponding WtE plant.

Figure 8: RDF incineration plant EEW Premnitz / Germany

Figure 9: Dry hydrator and corresponding WtE plant.