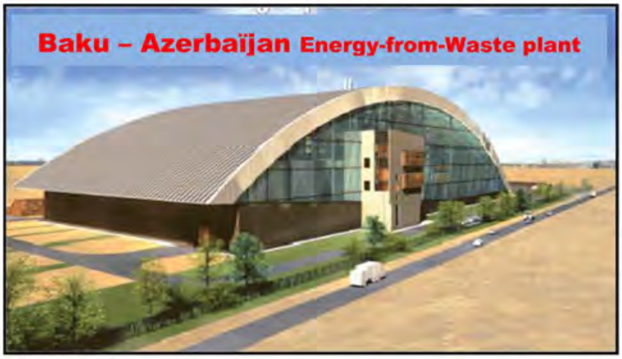
Environmentally friendly waste recovery



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Experiences of a General Contractor in Turnkey Plant Construction

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1. Energy from Waste market characteristics

Energy from Waste management has some important characteristics to take into account.

This activity is dealing with the public service of waste treatment generally under the responsibility of the public sector. It is based on a large scale infrastructure project which is very capital intensive and requires high skill competences for building and operation. Technically the know-how involved is very similar to the one required for a power plant but even more sophisticated because of the poor quality and the variable composition of the peculiar fuel, which is the waste.

The success of Energy from Waste (EfW) plants depends on several parameters such as the supply of suitable waste, the adopted technology but also the framework of the institutions in charge of the management of municipal wastes.

This organization is a fundamental condition to give the possibility to control efficiently the waste flow for its treatment by an optimum way.

The main different actors are public authorities, waste management sector and energy sector. A balanced risk sharing between these actors is determinant to allow a stable and fruitful situation.

A cost-effective and on time delivery of this important infrastructure is required to avoid a shortage in the needed waste treatment capacity.

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.

2. Public complex procurement approach

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. 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 are the following:

- Project scale – this is involving many different trades and skills to coordinate and implement through several linked procurements or one general contractor business;
- 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 demanded by the client, should integrate elements coming from site conditions, architecture, process requirements for the compliance with standards and regulations, connections with existing infrastructures;
- Extensive, very stringent and continuously changing legislation and regulations;
- 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 in novel 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 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 – to complete the project within fixed budget and time schedule is some time really challenging.

3. Risk distribution and management

Almost all investments that the public sector is making involve in one way or another, the private sector. When the municipalities are buying a complex infrastructure, the private sector may be involved simply as a supplier of goods to an input-specified project managed by the public sector. The private sector may also be involved in designing the project to respond to the public sector's performances specification.

All infrastructure projects are subject to risks. There are, for example, risks that the realization of the project will cost more than anticipated and there are risks associated with its operation and maintenance, as well as with the possibility that it may be used by fewer *consumers* than planned.

Project risks should be borne by the parties who are the best able to manage them and to face them. In general, the risks could be allocated only to the users of the infrastructure, the taxpayers through the authorities or private companies (in case of sub contracting or privatization). Risks are not disappearing through contractual structuring. They are simply allocated in different manners.

Appropriate risk allocation and associated contractual conditions are essential for cost-effective and efficient project delivery for the public sector.

Risk management is important in the process of reducing the likelihood of under-performing projects. The following chapters describe how changes have recently led to such a process integration project for risk reduction.

4. Impact of the public/private approach in waste management

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

Generally speaking 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 are exercising a sovereignty attributed by the law 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 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 with a sub-contracting of the design and construction to private companies (Municipal ownership and management with private design and construction competences);
- Public ownership 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 and operation. In general in this case, a public sector entity obtains a service for a fixed price rather than investing, building and owning assets. A private sector contractor funds 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), for example in the case of Delegation of Public Service to a private waste management company, or definitive like in a full concession with financing (Private ownership, responsibilities and management).

The diagram attached hereafter shows the differences of the development of private involvement for the municipal waste treatment. This figure shows the public-private market shares in different European countries based on the municipal solid waste volumes treated in 2009.

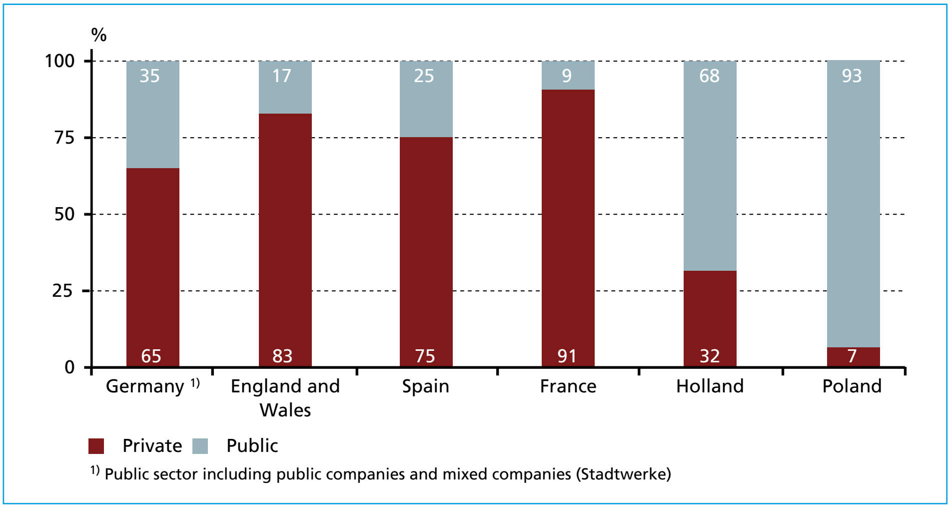

Figure 1: Public-private market shares in different European countries based on the municipal solid waste volumes treated in 2009

Source: Suez Environnement/BIPE 2010

A lot of 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 full responsibility is usually handled by the private sector. The treatment is then realized by private facilities (merchant plant). But 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 costs.

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

5. Examples of EfW market organization in different countries

In France, there is a strong and technical public organization and a traditional extensive public service concept. The cities are responsible for the collection and the treatment of the household and other municipal wastes whereas the responsibility for the commercial and industrial wastes remains in the hands of the producers. The public structure is often able to define the needs and the technical solutions for the treatment of its municipal waste. Typically the French EfW plants are owned by the municipalities, often gathered in inter-municipal associations called *Syndicats inter-communaux*. But almost all of them (85 %) have subcontracted the operation of these facilities to private companies. Some cities have also conceded to the private sector the public service of the treatment through contract for the Delegation of Public Service for a long but limited period (typically 20 years). A transfer of the units back to the public sector is planned at the end of the contract;

In UK, the choice of the complete privatization of this sector has been made through the Private Finance Initiative (PFI) procedure. That's why almost all the EfW facilities are now owned by private companies coming mostly from the waste sector. They are taking care of the financing, building and operation of these plants. One should notice that due to the British principle of public law (common law), it is necessary to clarify in the contractual documents any possibilities of any events which could occur with a low probability but with a high level of impact on the economy of the project such as *force majeure*, changing law or acts of government etc. This is radically different from the written French law which is providing the fundamental principles of legislation with consideration of the administrative case law (jurisprudence);

In Denmark, the municipalities have the responsibility of treatment of the household wastes, but also since 1989 of all the other types of wastes including industrial and commercial. This legislation obliges the private waste generators to use the facilities proposed by the municipalities. This is allowing a public control of the flows of all the wastes. Therefore a large majority of the EfW plants are owned and operated by the public municipal companies without any profit, the design and construction are normally contracted to private companies. Some other laws have also promoted heat and power supply delivered by these plants. The other Scandinavian countries have a similar approach;

In Poland, a new law about the waste has just been adopted by the Polish Parliament in May 2011. It is planning to transfer to the municipalities the ownership of the municipal wastes, which was not the case up to now. This clarification is fundamental to have a clearer institutional framework which could enable to limit the risk of the waste supply for Public Private Partnership.

6. Know-how and risk sharing

The choice between *Make or Buy* depends of course on some fundamental political choices translated in laws and regulations in each country but also on the competences available and on the risk sharing.

For the business in the waste treatment, we can identify 4 main levels of risks in this complex public procurement:

- The financing risks;
- The risks associated to the plant design and construction;

- The risks associated to the performances and availability during operation;
- The risks associated to the demand (waste supply guarantee, authorizations, judicial review, changing laws, electrical revenues, district heating revenues etc.).

Generally speaking, depending on the risk sharing framework, more or less risks of technical and contractual interfaces between the actors can be added to this list.

The public client (the waste owner) has to analyze how to share the risks between the actors. The objective should be to ask to the one who has the best competences for a type of risk to manage. But the client should aim for a good risk balance to avoid excessive extra-costs due to the overestimation of the risk coverage, especially for risks which are external or impossible to assess by the private sector and to allow a sufficient level of fair competition between private suppliers.

7. Conventional public procurement for the building

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:

- The public sector first realizes or procures a basic and/or a detailed design of the process and of 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 interfaces created between the lots. Because of this complexity and of the specificity of each supplier process, in general the number of lots is limited for EfW building. Typical allotment would comprise 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 cost and time delay risks may end up with the public sector through, for example, change orders due to interface problems. There is generally limited contractual integration with maintenance and operation phase after the plant has been delivered.
- A design and build (DB) contract 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 (Engineering, Procurement and Construction) approach will be detailed hereafter. The payment of the construction is paid by the public owner along the schedule of the erection. The other risks such as financing (n°1) and waste supply (n°4) remain supported by the public sector. These risks are not always easy to control and even to quantify. The risks for operation (n°3) 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.

8. Private procurement for the construction in case of concession

In case of *privatization*, the authorities approach is to shift the risks of financing (n°1), the risks of design and build, especially for the construction costs and time delays (n°2) and the risks of operation (n°3) to the private sector contractor through a fixed gate fee price for the service of the waste treatment. Under this arrangement, the eventual additional costs to complete the project are borne by the private contractor and shared with its subcontractors in accordance with the subcontracting arrangements. Ultimately, losses arising from the additional costs are borne by the investors in the contracting and subcontracting entities (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, 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, all in the frame of a PFI (Private Finance Initiative). Under these contractual organizations, the private sector is involved not only in 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.

In return for managing these risks, private sector investors expect a return result and a risk capping for this exposure. The more risky is the project, the higher is the required return. Nevertheless it is almost impossible for the private sector to cover all the risks linked to the demand (n°4) 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 account of the higher required rate of return implied. Generally speaking, 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. 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 is actually producing an economic benefit because of the increased costs relating the covering of the risks involved.

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.

This business introducing 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 in good conditions. Contracts known as EPC (engineering, procurement and construction) 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 will 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. 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.

9. EPC general contractor

The Turnkey Projects 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 Engineering, Procurement and Construction: providing a fully-equipped facility, ready for operation (at the *turn of the key*). It includes design, manufacture, delivery and installation of the overall plant, including the and the design and execution of civil work.

The EPC contract is the most appropriate answer for Municipalities or other private Clients to the challenges faced by modern complex waste management systems. 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 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, thereby creating optimal working conditions in order to complete the whole project successfully on budget and on time.

In order to meet the Owner's needs for the plant performances, large-scale project management requires integrating many different components supplied by different specialized companies in a seamless manner.

The synergies within the EPC contractor is helping to keep design and development time schedule to a minimum, particularly compared to answers to multiple call for tenders for lots, which are much more time-consuming and uncertain.

In order that the Turnkey Contract is efficient, the Contractor should be given freedom to carry out the work in his chosen way, provided the end result meets the performance criteria specified by the owner. Consequently, the owner should only exercise limited control over and should in general not interfere with the EPC Contractor's work. Clearly the Client wishes to know and to follow progress of the work to be assured that the time program is followed.

The tendering procedure has to allow discussions between the EPC contractor and the Client about technical matters and commercial conditions. The inquiry documents should describe the principle and basic design of the plant on a functional basis. The Contractor shall also carry out any necessary design and detailing of the specific equipment needed for the plant he is offering, allowing him to offer solutions more suitable to his technology and experience.

10. Fair Contracts conditions

The key to a successful completion of a complex large-scale project is a trustworthy relationship between the Owner and the EPC contractor. This can only be based upon fair contract conditions, including equitable risk sharing.

The risk sharing principles are beneficial for 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 or unexpected ground conditions, and some time what is set out in the requirements prepared by the Owner actually will result in the desired objective. If the Contractor has to carry such risks, the Owner obviously must give him the time and opportunity to obtain and consider all relevant information before the Contractor is asked to sign on a fixed contract 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.

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 for the bidder interests and the prices optimization between detailed client specifications required to ensure that the contractor is not making a deadlock 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:

- implement measures of compensation for unsuccessful bidders (this should reduce the risks of the unsuccessful inquiries, because they are realized without a serious preliminary feasibility study concerning the financing or the waste supply conditions (risks n°1 & 4);
- initiate a process of standardization of contract terms to avoid unfair and unacceptable conditions attempting to transfer risks that cannot be supported by the Turn Key contractors.

11. Project financing

More and more, the certainty of final price and of completion date is of extreme importance. The owner of such turnkey projects are ready to accept to pay more for their project if they can be more certain that the agreed final price will not be exceeded.

Among such projects can be found many projects financed by private funds, where the lenders require greater certainty about a project's costs to the owner than is allowed for under the allocation of risks provided for traditional forms of contracts. Often the EPC Contract is only one part of a complicated commercial venture. A failure of this construction project will jeopardize the whole venture.

12. Experience in the waste treatment as turnkey contractor

CNIM has been building Energy from Waste installations since 50 years and quite soon will have put in operation more than 150 Energy from Waste (EfW) plants including 270 combustion lines adding up a capacity of incineration of around 3,000 t/h of municipal waste (23 million tons/year). More than half of these installations were delivered turnkey.

The *turnkey* culture of the company is anchored in its history established in 1856, the major activity before 1982 was a leading 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 Energy from Waste sector since the beginning of the 1960s'. CNIM has bought in 2002 the design and build activity of EfW plants of Alstom Power Boilers, which itself had merged shortly before (by integrating it) with the one of ABB.

For the disposal of municipal solid waste, the firm is present in the various different types of treatments proposing the energy recovery, the material recovery and the organic treatment.

Energy from Waste plants (mostly on grate and sometimes with fluidized bed) are now an essential element of a global multi-channel structure for the waste treatment with sorting, recycling, composting or bio-gas production.

Various is the approach to the business.

Design and Construction

As a general contractor, the enterprise produces integrated turnkey solutions, from general design and engineering to commissioning, and through procurement and construction. The Group also has the skill and resources needed to perform, when required, the operation and maintenance of the plants or to provide the operators with technical assistance.

CNIM designs and builds thermal waste 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 trough the long term partnership with Martin GmbH and fluidized-beds),
- energy recovery (boiler units),
- waste-to-energy conversion (steam and water cycles),
- flue gas and residue treatment (the process of the fully owned subsidiary LAB SA).

The most sensitive equipments are manufactured in its own workshops, while other equipments 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 upgrading for compliance with new regulations of existing treatment plants.

Operation and Valorization of the recovered energy

The knowledge of the processes is fed by the non-stop feedback experience; the company is operating several plants today in France and in Great Britain with commitment on energy recovery of the facility through the sale of steam or electricity to the grid.

Project financing

This is a global waste treatment system that resembles a general concession.

The Group can also provide financing. Its references and experience in terms of financing projects of this type, notably in the United Kingdom, mean that it is a recognized actor in this domain, thus supplying a complete service for communities.

A very wide range – An overview

The references of CNIM 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): the 2 units in the plant of Ivry in the Paris region with a capacity of 50 t/h each, are the world's record of treatment capacity per line.

Proof of reliability and performance, almost all *old* units built by the firm are still working today still providing their service at full nominal load. Among the oldest, those of Ivry actually, which started in 1969, celebrate in 2011 their forty-second year of operation.

In the field of air pollution control, LAB, who installed more than 365 lines of treatment, has an extremely wide range of processes for household waste-to-energy and biomass plants, as well as for medium-power electrical power plants or district heating systems and industrial boilers.

LAB, a leading European actor in the sector, offers and controls a complete range of flue gas treatment processes that are available within the framework of the European repository BAT – Best Available Techniques in order to eliminate the pollutants that are present in combustion gases, such as dust, heavy metals and acid gases, as well as nitrogen oxide, dioxins and furans.

In addition to this energy valorization, the company has developed experience and skills in the biological mechanical treatment of waste, sorting and composting. Its installations are conceived for household waste, other municipal waste, green waste, sludge of waste water treatment plants, sanitary waste and non hazardous industrial waste.

Besides, the firm is looking after the legislative evolution, at an European level in particular, by informing itself day by day of what is going on in Brussels and in Strasbourg, but also, and especially, by assigning resources to act on the development of regulations trough an active contribution to the work of professional associations of the waste sector.

New countries

CNIM has recently delivered the Energy from Waste plant of Brno (225,000 t/year), one of the first ones in Czech Republic and is actually building the first Energy from Waste plant in Baku, in Azerbaijan (500,000 t/year) and, also, the first one of the Baltic States, in Maardu (Tallinn) in Estonia (220,000 t/year).

13. Adequacy of the tool to the needs – Supporting the municipality

Unlike an equipment supplier, the general contractor has to be able to understand and to have an overview of the necessary services for the concerned municipalities in order to accompany them in the definition of their need and the optimization of their waste disposal facilities.

Unfortunately, one still sees communities that have to adapt themselves for several years to facilities that have badly been adapted to their needs, because their project was built on incorrect assumptions. Firstly essential elements are, of course, the information relative to the waste to be treated. A good knowledge on site contains, for the various type of waste (household waste, green waste, other organic waste, sludge, commercial and industrial waste etc.), the annual tonnage, but also the distribution along the year, the composition and the calorific value (LCV), but also their fluctuations etc.

Then the questions relevant to the different waste stream and to necessary facilities for the implementation of the various waste treatment channels are coming.

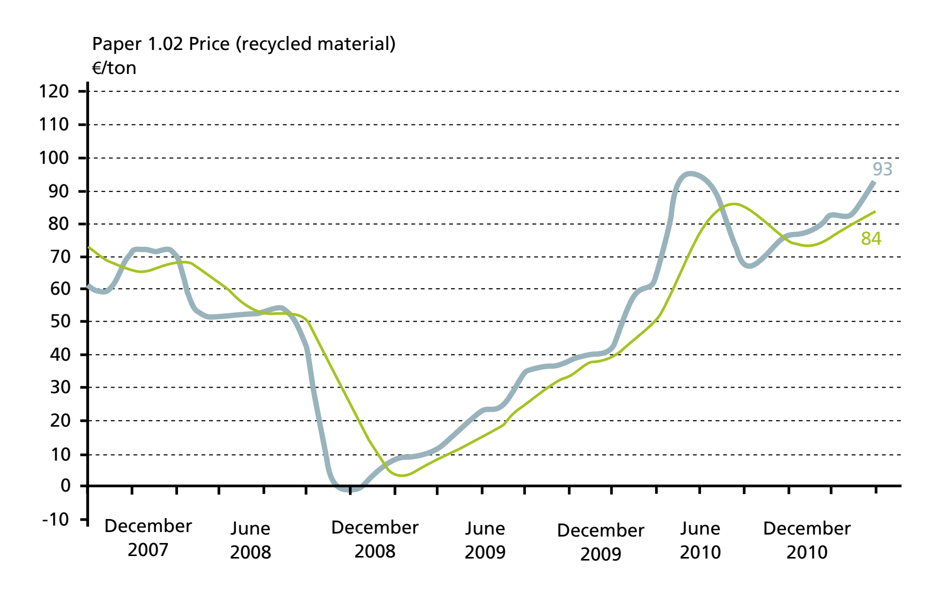

Figure 2: Paper 1.02 Price (recycled material)

Source: REVIPAP

In recycling, the conditions of recovery evolve with the raw materials market which is very volatile. This could be partially compensated when a recovery guarantee mechanism exists at a national level, as in France with the Eco-Emballages, but it concerns often only a fraction of the waste amount (as Eco-Emballages intervenes only on packaging waste) and in any case for a contractually limited period.

The specifications for recycled materials must be defined according to the constraints of the moment (regulations, requirements of the buyers etc.) and with sufficient flexibility for adaptation to future evolutions. It is advisable, both at the selective collection level that of the sorting level, neither to look for excessive performances and thus too expensive, nor to produce at a low cost materials of an insufficient quality leading to loss of market opportunities.

For the compost, the question of its effective use and the conditions to this one is absolutely essential. It's indeed no useful to produce compost if at the end it must be dumped.

In case of biogas production, the difficulty lies in the estimation of the quality and the quantity variations of the biogas produced and therefore, in the management of these at an industrial scale.

The delicate subject is then to handle the appreciation topic, both in quantity and in quality, of the remaining amount after primary treatments that are sorting, recycling and organic treatment like composting. It could be heard that if these are well done, then there is nothing left! Nevertheless, for municipal waste, this residual waste typically represents from 50 % to 80 % of the initial tonnage.

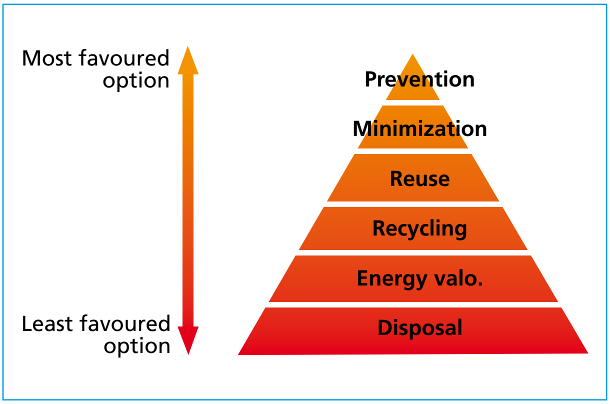

Figure 3:

Waste Flow Management Directive

According to the hierarchy of the waste treatment recommended by the waste framework directive (2008/998/CE), the energy recovery is essential for this fraction.

There also, the question of market opportunities has a big importance. If for electricity there is almost everywhere an obligation of purchase (legal or de facto), it is absolutely not the same for heat. It is nevertheless the export of all the available heat or the export of combined heat and electricity which is the most successful in the three dimensions energy, economical and environmental.

Like electricity, heat couldn't easily be stored. But unlike electricity, heat could not be transported on long distances. It is thus necessary to use it with the flow of production. However the heat consumption varies intensely between the seasons and according to the local climatic conditions, except when it is used by industrial consumers.

The geographical situation of installations is thus going to play a crucial role in the possibility of energy recovery under thermal energy form. It would ideally be necessary to built the Energy from Waste plant next to a consumer which would use the biggest possible part of the available heat all year long. The problem of the sustainability of industrial demand arises however in that case because the amortization of a Energy from Waste plant is usually more than 20 years, which really exceeds the visibility of an industrial consumer. The best would be in fact the connection of the plant to the biggest possible district heating network with regards to its production capacity. Also, the best situation is the one where the demand of the heat network at the base, that is the call for the supply of domestic hot water and for the industrial consumers, is equal to the production of the EfW plant.

The setting-up of multi-channel system installations also affects the collecting system, the possible centers of transfer and transport between the various installations.

In Europe, the IPPC directive (Integrated Pollution Prevention and Control; Directive 96/61/EC) replaced by the directive IED (Industrial Emission Directive, 2010/75/EU) imposes the implementation of Best Available Techniques with sometimes contradictory requirements. Outside Europe the use of Best Available Techniques is also very often required for its capacity to produce 'efficient energy and environmentally friendly solutions'.

To these constraints are added those that can result from the situation in the setting-up zone of the facility as for example the necessity of lowering locally the nitrogen oxides (NO_x) within the framework of the Plan of Protection of the Atmosphere (Air quality plan; cf. directive E.U. 2008/50/EC on ambient air quality and cleaner air for Europe).

An approach of Life Cycle Thinking type integrating both the costs and the profits of different possible solutions on the economic, environmental and social plans would allow to identify the optimal project.

Figure 4: From London to Torino Energy from Waste Turnkey plants

14. Summary

The design, construction and operation of modern quality Energy from Waste plants require a specific know-how and means. They could be evaluated as more sophisticated compared to the ones which are necessary for Power Plants. This is obvious on two levels, technically because of the nature of the waste as fuel (poor quality, variable composition and contents of pollutants) and institutionally because the necessity of public service of waste treatment combined with the efficiency of energy production.

These infrastructures require an important investment to realize and to manage under the responsibilities of high-skill competences. A question mark is *Make or Buy*. The risk sharing balance between public sector and private companies is often promoting the Turn-key supply of the construction of the plants by EPC general contractor (Engineering, Procurement and Construction) even in the case of privatization. Thanks to its 50 years experience, CNIM is a leader in project management requiring coordination and dialogue between different disciplines. In particular, the company is able to design and deliver effective high-performance turn-key waste management systems adequate to the needs of the primary users of the infrastructure, the citizens.

Unlike an equipment supplier, the general contractor has to be able to understand and to have an overview of the necessary services for the concerned municipalities in order to accompany them in the definition of their need and the optimization of their waste disposal facilities.

Table 1: Some Experiences of Turnkey Plants Built or under Contruction by CNIM

Plant location	Country	CNIM Client (Public/Private)	Final end customer	Order year	Capacity in tons of waste per year	CNIM supply	Contractor	Plant operation
LONDON	GREAT BRITAIN	SELCHP (Private company)	London Boroughs	1990	450,000	EPC (BOT)	CNIM	Private
BAKU	AZERBAIJAN	Ministry of Economic Development (Public)	City of Baku	2008	500,000	EPC (DBO)	CNIM	CNIM (Private)
LA COLETTE	JERSEY ISLAND	State of Jersey (Public)	State of Jersey	2008	105,000	EPC (DB)	JV CNIM/Camerons	Public
THUMAIDE L5&6	BELGIUM	IPALLE (Public municipal association)	IPALLE	2006/ 2009	200,000	EPC (DB)	CNIM	IPALLE (Public)
BRNO	CZECH REPUBLIC	SAKO A.S. (Public municipal-owned utility company)	SAKO A.S.	2007	224,000	EPC (DB)	Consortium CNIM/SIEMENS	Public
SAINT-OMER	FRANCE	SMFM (Public association of 160 municipalities)	SMFM	2007	92,000	EPC Process (DB)	CNIM	Private
MAARDU (TALINN)	ESTONIA	EESTI ENERGIA (Public national state-owned utility company)	EESTI ENERGIA	2010	220,000	EPC (DB)	CNIM	Public
TORINO	ITALY	TRM SpA (Public municipality-owned company)	TRM SpA	2010	421,000	EPC (DB)	ATI CNIM/ Unieco/Coopsette	ATI CNIM (Private)
STAFFORD SHIRE	GREAT BRITAIN	VEOLIA UK subsidiary (Private Initiative)	STAFFORD SHIRE	2011	300,000	EPC (DB)	Consortium CNIM/CLUGSTON	VEOLIA (Private)
LINCOLNSHIRE	GREAT BRITAIN	WRG Ltd (Private Initiative)	Lincolnshire County Council	2011	150,000	EPC (DB)	Consortium CNIM/CLUGSTON	WRG Ltd (Private)