European Market Development - Solid Recovered Fuel from MBT plants

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Abstract
This paper reviews the growth in volume and liquidity of the European market for Solid Recovered Fuel (SRF) and discusses the development of SRF as a tradable commodity. It considers the drivers and barriers that are in place and describes the potential opportunities and threats for this method of managing waste and generating energy.
When considering the production of products (as opposed to disposing of waste) it is important to understand the needs of the customer; In this respect SRF production is no different. If SRF/RDF production is to make a significant contribution to increasing the material resource efficiency of the economies of Europe it will be necessary to meet the needs of users, and demonstrate that these kinds of substitute fuels can achieve the correct technical and economic performance. SRF produced by MBT processes is not exempt from this basic economic reality. The paper describes the use of SRF from a fuel user's perspective including an evaluation of an SRF-fuelled power project.
Keywords
SRF, RDF, Solid Recovered Fuel, Refuse Derived Fuel, MBT

1 Introduction

Mechanical Biological Treatment (MBT) is a technique for managing mixed Municipal Solid Waste (MSW) that is finding favour across Europe. The installed capacity of MBT plants is increasing; as municipalities and private sector waste companies invest in new technology to process the residual fraction of MSW that remains in an unsorted state.

Essentially MBT can be considered to be a pre-treatment that enables resource recovery or final disposal to occur in a way that is consistent with market forces or technical regulation. MBT is not a self-contained waste disposal method: this is simultaneously an advantage and an obstacle to future growth in its use. To put this comment into context (from a waste management perspective), much of the waste management industry sees MBT as risky, unnecessary and an expensive step in managing waste. On the other hand, supporters of MBT see it as a flexible, pragmatic and more acceptable method for the efficient recovery of utility from waste. Undoubtedly the debate will continue and it must be recognised that there is no "one size fits all" solution to managing waste. Each problem has unique characteristics that mean that all factors must be considered. However both sides of this debate should realise that the fuel users are neutral on waste technology; they care much more about the fuel and its relative merits in comparison to other fuels they can use.

MBT processes typically can produce five different types of output (not counting water):

- Solid Recovered Fuel or Refuse Derived Fuel[1]
- Compost like material
- Stabilised waste for landfilling
- Metals
- Dense materials (stone, glass, ceramics)

Most technologies are usually configured to produce either fuel, compost like material or stabilised waste. The recovery of the remaining fractions is then influenced by this primary selection.

This paper discusses the market for Solid Recovered Fuel in Europe and discusses the state of the current market for SRF, the factors that will encourage and inhibit SRF use and the position of MBT-derived SRF in the market.

2 Background

2.1 Drivers

The drivers for SRF use are the combination of forces from the waste management sector looking to manage waste through to “final disposal” and the major energy using industries looking for more sustainable routes for the supply of energy to their processes. The combination of these legislative and market forces conspire to “push” waste out of the traditional methods of waste disposal and “pull” substitutes for fossil fuels into the energy supply chain.

From the perspective of the EU waste management sector the adoption of the Landfill Directive has limited the amount and type of waste that can be sent to a landfill. In countries that have heavily relied upon landfill (e.g. UK, Ireland, Finland, Portugal) this has meant the wholesale renewal of waste infrastructure in these states. Even in those countries that have had a more balanced approach (i.e. a greater use of recycling and traditional “energy from waste” plants) the Landfill Directive has required new invest-

[1] The difference between SRF and RDF relates to the degree of processing and conformity with specification. SRF is the term used for more highly processed fractions and is used in the forthcoming technical standards.

ment. As a consequence the cost of waste management has risen, and will continue to rise until the entire infrastructure is in place.

The last few years has simultaneously seen a dramatic rise in the cost of fossil fuels. Even after allowing for inflation, this increase has still been significant, as shown in the figure below; the price of crude oil over the past six years has increased by approximately five times. .

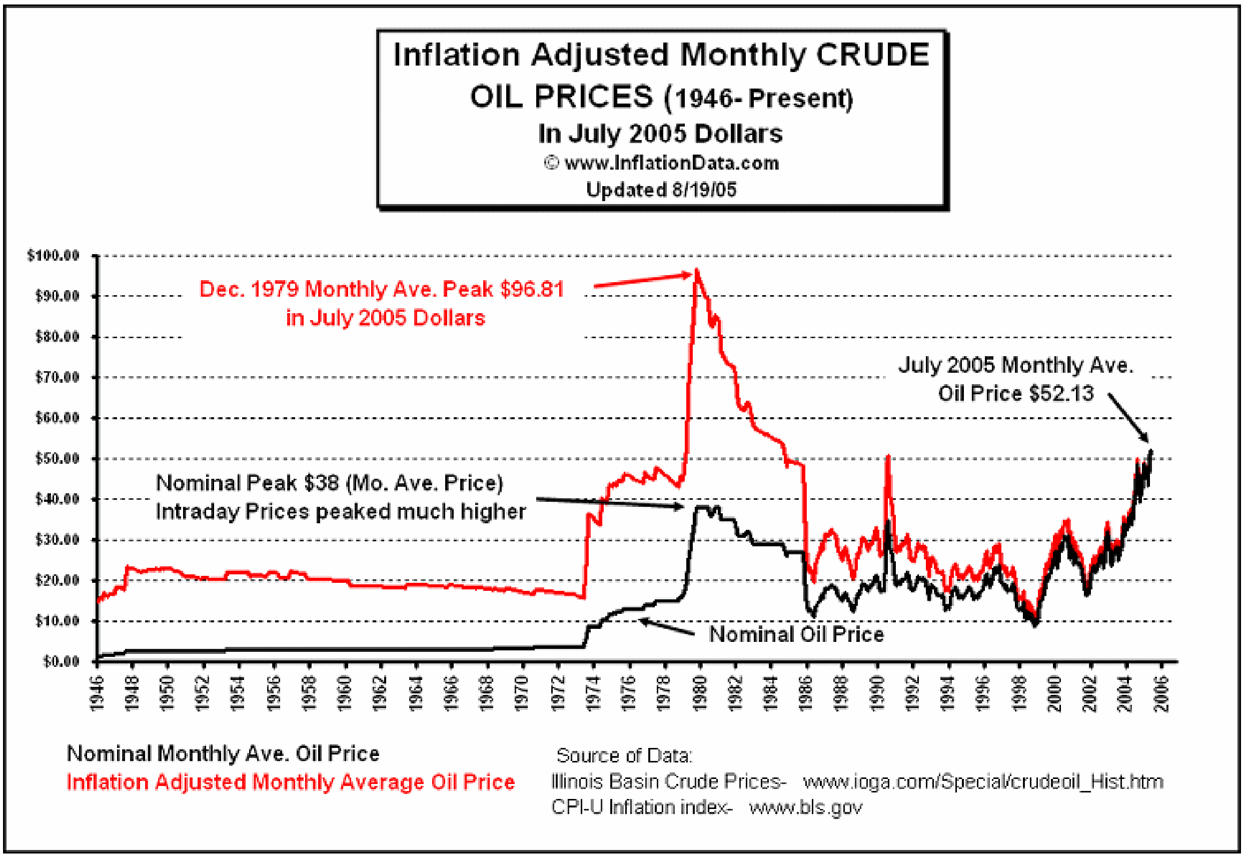

Fig 1 Price of crude oil 1946 - 2005

For the major energy using industries (e.g chemicals, refining, cement, paper and iron and steel) this has created significant cost pressures to their businesses that they are not always able to pass on to their customers. Many of these European industries are already under pressure from competing businesses located in parts of the world with lower costs and when a major investment decision has to be made, some have concluded that it is preferable to re-locate their operations to lower cost economies. The cost and availability of secure supplies of energy is an important consideration that is factored into their decision making.

Over-arching these issues are the other policy directions of the European Union in respect of climate, environment and energy that are intended to create Europe-wide conditions for the operation of business, the actions of its citizens, and their impacts on the environment.

For example the EU Emissions Trading Scheme[1] now places limits on the carbon dioxide emissions of major industrial processes. The ETS is being phased in so that from 2005 operators of industrial processes will operate in a "cap and trade" market for CO_2. If operators reduce their CO_2 emissions they have the right to sell their surplus allocation of emission allowances. Conversely any operator that cannot meet their allocation has to buy allowances in the market. Failure to comply will incur a fine of up to €100/te $_{(CO2)}$. For some operators this could have major implications for the profit and loss accounts of their businesses, but what is also becoming clear is that ETS will also become a measure of pollution potential that will be used by investors and become visible on the balance sheets of companies as it represents a potential liability to the business. The market price of CO_2 when this paper was written was over €20/tonne and it has risen from an initial price of €5/tonne in 2003.

The Renewable Energy Supply Directive encourages the EU to increase the proportion of renewable energy in the mix of supply, in order to facilitate the EU's compliance with its Kyoto target of 8% of reduction of emissions of greenhouse gases by 2012. The RES-E Directive has a target of 22.1% by 2010. These measures have been incorporated into national policy in many states by adoption of financial instruments to encourage production of renewable power. In the UK this is known as the Renewable Obligations Order and pays the generator a minimum of £32/MWh(e) in addition to the value of the wholesale electricity for power produced by renewable sources. The eligibility of waste derived fuels to attract this "green premium" varies across Europe: in Italy all of the generated power qualifies for the premium, in the UK only the biomass fraction of qualifies (only if used in a prescribed process), whereas in Germany there is no market support.

The European Commission has sponsored the development of technical standards by the European Standardisation body (CEN). The Commission has promoted the development of technical standards in order to remove barriers to the trade and subsequent use of SRF across Europe including the ability to trade SRF across national boundaries. The driving force for this activity is to increase the resource efficiency of Europe by ensuring that where possible waste materials are recovered and not disposed in a landfill. The standards are being developed by technical and trade groups from across Europe using the organisation of national standards bodies in order to produce documents that will help establish a common framework for the production, trade and use of SRF. The work of the committee (CEN/TC 343) is progressing well and will result in technical specifications being published in 2006 that will cover fuel classification, specification, quality management, sampling and testing. It is important to note that these specifications will provide a common framework for producers and users to use. They do not prescribe the fuel quality that is required by any particular installation. Any transaction that uses these specifications will still require a knowledgeable and willing buyer and seller, but they will be able to use commonly agreed terms and methods to able to describe the transaction. It should be noted that SRF is already being traded across state boundaries and is permitted under the Trans Frontier Shipment Regulations[3].

2.2 Barriers

The most obvious barrier to the use of SRF is that it remains classified as waste, which requires the combustion plant to operate in conformity with the Waste Incineration Directive (2000/76). The emission limits required by the WID are tighter than most combustion processes but the difference is becoming less pronounced for large plant (>50MW) as the Large Combustion Plant Directive is implemented.

The ability to de-classify SRF as waste is under discussion in the Commission but is part of a much wider debate around the Waste Framework Directive and the Commission's Thematic Strategy for Waste. It is being argued that if wastes can be made into a product that meets an agreed specification then it should be possible to de-classify them as waste in order to encourage recovery. Environmental protection would be assured through the permitting process (IPC authorisation) which would determine the appropriate emissions standards and operating procedures for any installation that wished to use these fuels. It is expected that the views of the Commission on this matter will become clearer in 2006[2].

3 Country Review

The data for SRF production does not always distinguish between the manufacturing methods used to produce it. Whilst this is an issue for parties who have a specific interest in one manufacturing route (such as MBT) it is of lesser importance to the fuel user who is interested more in the technical properties and the behaviour of the supplier.

It is estimated that there are over 80 MBT plants across Europe[3] with a combined treatment capacity of 8.5 million tonnes per year. In addition, there are 43 new projects in progress. Two thirds of this capacity is installed in Germany, Italy and Spain. The same study estimates that approximately 1.3 million tonnes per year will produce a fuel fraction.

The majority of SRF is currently traded as a commodity on short and medium term contracts, usually for co-combustion in plants that simultaneously fire other fuels. It can be argued that MBT derived SRF will be competing with other substitute fuels and will find its place in a "merit order" of fuels. The factors that will influence the position on the merit order will include:

- Price expectation of user and producer
- Volume and term availability
- Calorific Value (CV)
- Quality and consistency
- Biomass content
- Supplier behaviour and experience
- User experience
- Availability of substitutes

The merit order will vary across region & country, by end user and industry sector. It will be the user that will determine the merit order. A few examples will illustrate this point:

An operator of a traditional waste to energy plant (i.e. can burn un-processed MSW) will tend not to value a fuel with a high CV as it will use more of the thermal capacity of the plant. Therefore the EFW plant operator will want to charge a higher gate fee than for un-processed MSW to compensate for this effect. Equally the EFW plant is not interested in biomass content unless local regulations enable a green power premium to be received.

A cement kiln operator is interested in the CV because this has a direct effect on the combustion conditions within the kiln, which in turn in has an effect on product quality. However because cement kilns can burn a wide range of wastes, the availability of substitutes is an important consideration for this industry and does influence their commercial behaviour. The cement industry is dominated a few large multi-national groups with centralised functions and it is common practice for them to compare performance and operational behaviour across their many sites. Therefore they tend to trust technologies and suppliers that they know and have had direct experience of. The biomass content of fuels is becoming important as the industry seeks to manage its cost exposure to the EU ETS. The impact of this has changed the merit order for waste plastics when compared with other fuels with substantial biomass content. The cement industry has consumed substantial quantities of Meat and Bone Meal (MBM) as this fuel has been available in significant quantities with a high gate fee price. However, as European governments manage the stocks of this material as a consequence of overcoming the BSE problem that resulted in large quantities of MBM being available for immediate disposal, its use is now declining as it drops down the merit order due to its reducing gate-fee price and availability.

Therefore it can be seen that there is not a single homogenised market for SRF across Europe; it varies by region and user industry and with time. It is an important for fuel users and producers to understand the market conditions before they are committed to long term transactions.

However there is another important dynamic in the market; bi-lateral long term contracts between user and producer. As the impact of higher fossil fuel prices is felt by major process industries an increasing number are now looking to build new facilities that use SRF as the principal fuel. In this situation the merit order is likely to change because fuel availability/security and long-term pricing stability becomes more important, and as these industries become less keen to procure their fuels on the “spot” market. Such schemes are being developed because they offer producer and user greater certainty, both parties accept that they are willing to exchange this for short term price advantage. We discuss an example of one of these schemes in section 4. In this respect MBT derived SRF can be well positioned because it is easier to describe the origin, pricing and security issues with a fuel that is normally supported by a contract with a local authority compared with other waste streams that are not as commercially secure.

3.1 Austria

There are 16 operational MBT plants in Austria most of which produce an RDF/SRF fraction. A further two plants are in construction which will bring waste treatment capacity to approximately 900 000 tonnes/yr. Most of the SRF/RDF is combusted in incineration plant but an increasing proportion is going to use in the industrial sector, particularly in paper, cement and steel production.

3.2 Belgium

Currently there are no operating MBT plants that produce fuel in Belgium. One project is under construction that will produce approximately 70 000 tonnes/yr. There are two producers of non-MBT derived SRF and there is a strong market in liquid fuels to serve the cement industry.

3.3 Denmark

Denmark has no MBT capacity producing currently producing fuel. A well developed energy from waste infrastructure has meant that MBT has not established a presence.

3.4 France

France has no reported MBT capacity that produces fuel. There is now some production of SRF to meet the demands of the cement kilns.

3.5 Finland

There are no MBT plants in Finland producing SRF, but there is an extensive production of SRF produced from packaging, commercial and MSW by mechanical processing.

3.6 Germany

Germany has over 31 plants that produce SRF and has 18 MBT plants most of which are producing SRF/RDF. The market for SRF/RDF has been estimated at 1.7 million tonnes/yr of which MBT is likely to produce between 30% to 40%. The German market is growing rapidly as cement makers, power generators and paper mills start to use SRF. The German cement industry trade body has indicated that its members could expand consumption of SRF up to 2.9 million te/yr.

3.7 Italy

Italy has over 100 producers of SRF with a total output in excess of 2.8 million te/yr, of this volume it is estimated that the 17 reported MBT plants contribute approximately 20% of this output. The cement industry is already using SRF, and there are trials in progress at a large coal fired power station. There are also several dedicated SRF combustion plants that serve one or more MBT facilities and enjoy the benefit created by Italy's liberal interpretation of renewal energy support mechanisms.

3.8 Netherlands

The Netherlands has 3 MBT plants which produce RDF/SRF. There are another 6 plants known to be producing SRF in Holland, some of which is exported to Scandinavia and Germany, the remainder is used in conventional incineration plant.

3.9 Sweden

No MBT plants are reported to be producing SRF in Sweden but there are several SRF producers making fuel from commercial and domestic waste by mechanical processes.

3.10 United Kingdom

There is one MBT process in the UK currently operating with another two plants in construction and several more in the planning stages. The plants under construction will produce in excess of 200 000 tonnes/yr of SRF. Unlike the rest of Europe the UK has not created significant SRF capacity using other feed-stocks, and so the MBT derived fuels will represent the majority of the UK's SRF capacity. Currently the cement industry is leading the uptake of this fuel but there are several projects in development on industrial sites to provide steam and/or power.

4 Fuel Use

4.1 Quality Issues

In respect to the different uses of SRF there is a wide range of quality-demands which influence the range of gate-fee associated with SRF. Three broad categories of SRF can be observed:

Category I:	High quality demand described by high calorific value, low heavy metal and ash-content This kind of SRF is mainly used in cement and lime industry. In some cases you get paid for the SRF. In general a small gate fee is requested.
Category II:	Medium calorific values and heavy metal content are required, but intensive fuel-preparation is needed, pneumatical feeding may be necessary.These secondary fuels are mainly used in calciners of cement-kilns or in soft-coal power-plants. The necessary gate-fee has to be considered in a mid-range.
Category III:	High-calorific fraction mainly from MBT-plants. With very low demand on fuel preparation. Based on this low fuel-preparation these SRF´s can only be used in special SRF-power-plants. The gate-fee will be in the high end of the range.

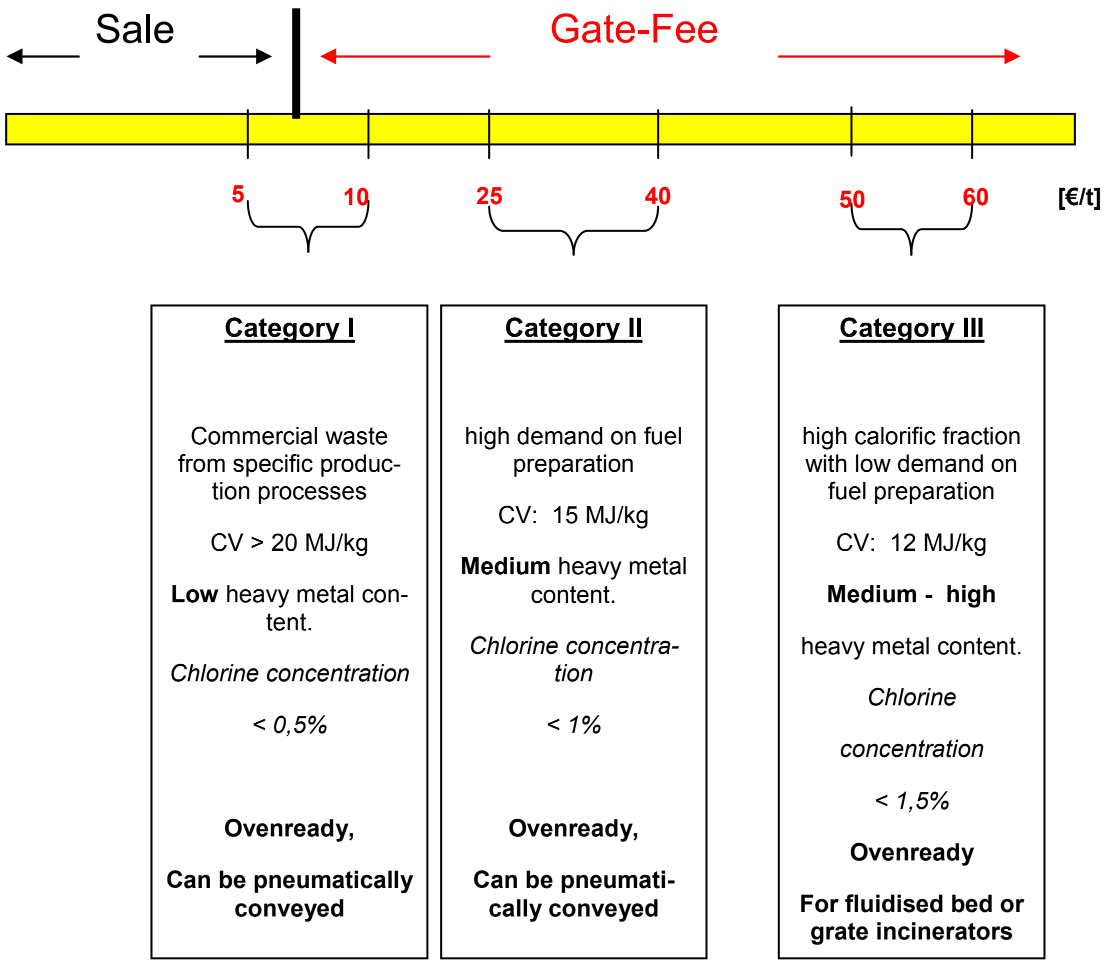

Figure 2 Quality and economical categories for solid recovered fuels

4.2 Reference Case - SCA Witzenhausen

An important reference project for SRF market development is the SCA paper mill project in Witzenhausen, Germany. SCA intends to switch energy supply totally from fossil fuel to SRF supply.

The mill produces cardboard and is one of the major plants of SCA. The input is 100% recycled paper. The capacity of the plant can be characterised as follows:

- Yearly paper production 314.000 Mg
- Paper production / day > 880 Mg
- Yearly operating hours > 8400 hours/year

The demands for the energy supply for the mills can be summarized as follows:

- Themal capacity: 124 MW_{th} –fuel
- Steam: 80 MW
- Electricity: 20 MW
- Operating time required: min. 7.900 h/a

In order to meet the availability demands of SCA the old gas-fired power plant will stay as a back-up plant.

These figures demonstrate the difference in needs when compared with a traditional incineration system. The focus is no longer incineration of waste and getting rid of the surplus heat; instead it is a supply of industrial energy. Therefore the choice of technology is important in order to be competitive with traditional fossil fuels.

4.2.1 Technology

Circulating fluidised bed combustion is the most flexible technology for burning SRF. References for this technology are already in operation for more than 4 years at the required capacity and fuel specification.

The operating experience has shown that the annual availability of such a technology will reach 7900 – 8000 hours/year and can therefore meet the demands of the paper-industry.

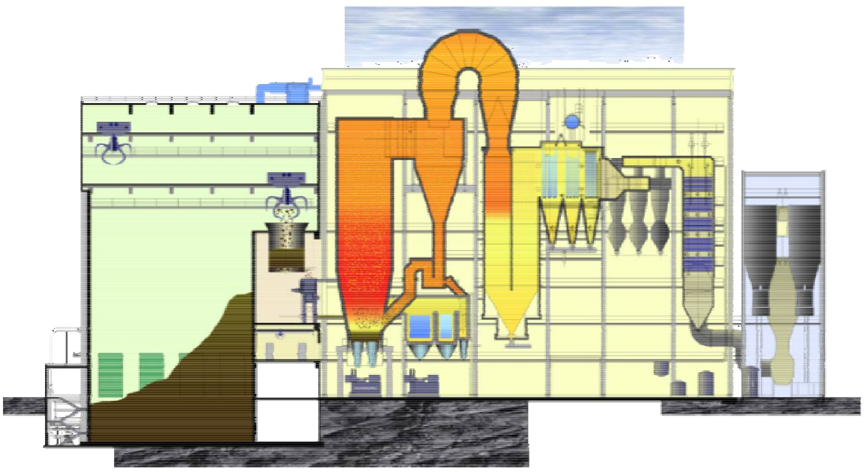

Fig 3 Cross section of a 120 MW fluidized bed energy plant for solid recovered fuels

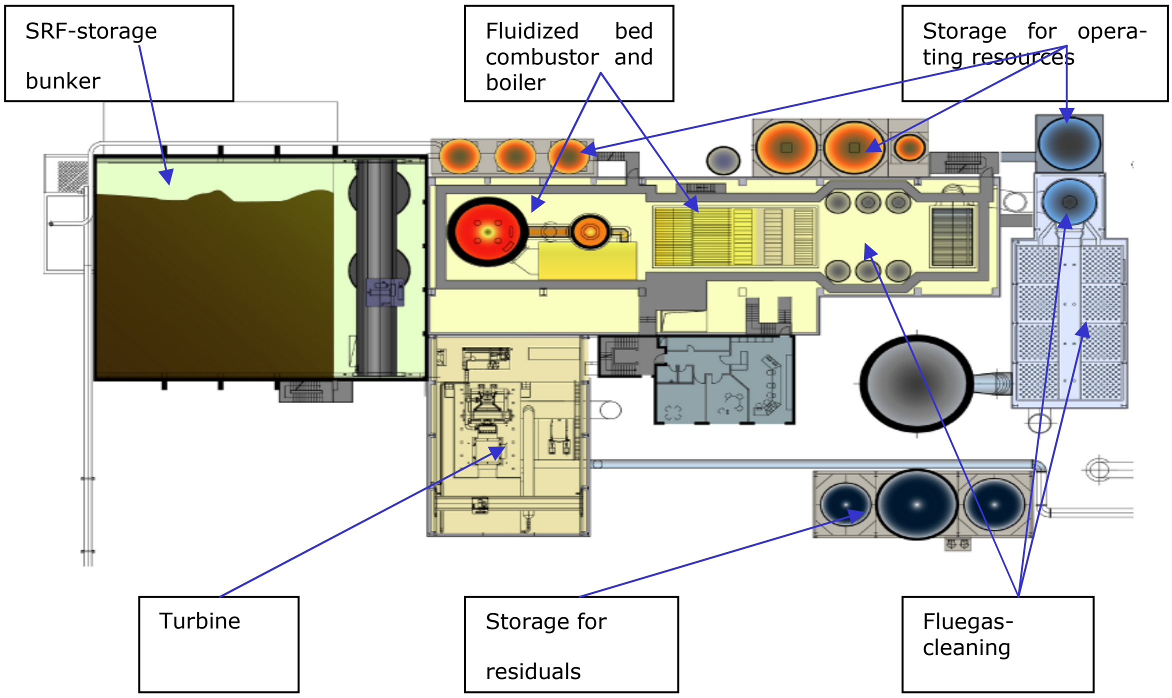

Fig 4 Plan view of a 120 MW fluidized bed energy plant for solid recovered fuels

4.2.2 Economics

The investment in the power plant needs an income stream that can provide an adequate financial return. Normally this is provided by the combined income from the sale of power and steam to the host site and from the income received from the fuel producer. In the current economic climate it is not usually possible to justify the investment based solely on the value of power and steam supply to the host site. The value of power and steam is set by the market price based on conventional energy supply. The price for SRF supply is determined by the gap in income that must be funded in order to satisfy the investor.

If the investor is the fuel supplier it may be possible to consider the return across waste management and energy supply activities and therefore arrive at different pricing than a stand alone solution. Similarly if the plant investor is the site host it will be able to consider how best to manage risk and may therefore take a different view of the project viability and risk profile than would be possible by a third party investor.

5 Future trends

MBT derived SRF will compete with other forms of SRF in a market. For the fuel producer it is important to meet the needs of the energy user in the most efficient manner. As the cost of traditional fossil fuels continues to rise the market for SRF will increase. Some of the increase will happen in co-combustion plant where substitution can occur quite rapidly in response to market movements. This market segment represents a useful tool for market development but does not necessarily represent a long-term secured future. Contrastingly the increased interest from major process industries in dedicated power plants represents a sensible and holistic approach to waste management and energy supply. By careful consideration of the needs of the waste manager and fuel producer it is possible to arrange the most appropriate combination of cost, risk and environmental impact. MBT derived SRF has some advantages and disadvantages in this context: its success in the market will be governed by the ability to match all of the needs of producer and consumer. These needs will be measured on different dimensions: fundamentally it will be necessary for the waste management industry to recognise that it is a process industry that must provide a product. By realising that it has customers that have specific needs it can then start to satisfy them and demonstrate to the wider community that it has the ability to do this. It is imperative that the benefits of this approach can be appreciated by all involved parties in order to maximise the benefit to wider society.

6 Conclusions

The use of SRF is increasing across many European states. The trend is strongest in Italy, Germany and Scandinavia. MBT derived SRF or RDF has found favour in states that has not invested to meet the total demand for dedicated waste to energy infrastructure. Germany, Italy and Austria have developed markets for MBT residues that meet a range of different needs and display different technical and commercial characteristics. Other states are developing markets for MBT, and it will be required that the fuel market is developed in parallel if growth is to match the market potential for this method waste management. Whilst the "spot" market for SRF has enabled some MBT plants to be financed there is a new type of opportunity emerging for the long term supply of fuel to dedicated industrial power plants built to high environmental standards and offering a sound and sustainable use for the fuel. This market represents an extremely good opportunity for MBT as long as the fuel producer can meet the needs of the fuel user. In this respect the development of common technical standards will assist in the promotion of knowledge and common terminology. However the waste industry (or the operator of the MBT plant) must convince the fuel user that it can meet their long-term needs in a manner that is socially and environmentally reliable and acceptable, as well as meeting the short term needs of their businesses.

7 References

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