Ask the Right Questions First

Marc J. Rogoff, Ph.D., Bruce Clark, P.E. and Jose Davila

How to decide if that new waste disposal technology IS REALLY WHAT YOU NEED.

COMPANIES REPRESENTING NEW TECHNOLOGIES to process solid waste in an environmentally conscious manner have been actively promoting their systems to governmental agencies worldwide. Systems employing technologies or processes such as anaerobic digestion, gasification, plasma arc and pyrolysis are becoming commonplace. Because the systems are new and there are few successfully operating commercial-scale plants, there is a certain amount of risk and uncertainty experienced by officials who must weigh the merits of the technology, the resources and experience of these companies, and how it would ultimately benefit the public. This article provides some definitive questions and background that officials can use in their due diligence assessment of these new technologies.

A Hypothetical Situation

At a hypothetical monthly governmental council meeting, two proposals are presented about the municipal landfill. One of them could make drastic changes in the direction and fate of the municipal waste management system. The other proposal continues the landfill only until a new, privately owned waste-to-energy technology can be developed. The latter presentation will catch many of the council members off guard.

Continuing the hypothetical story, the surprise presenter is the president of a new technology company and he is describing his company's process of "eliminating waste by thermally converting it to useful products and energy." The "evolutionary technology" would take garbage, even hazardous wastes, and turn it into useful products in a pollution-neutral, totally-enclosed facility that would employ up to 200 local people in "good, long-term jobs." The company would not ask for tax abatements and would pay local property taxes on its plants and improvements. Furthermore, it would provide its own AAA-rated cash bond to ensure that the facility would be constructed. The president only asks that the Council provide about 200 acres for construction of the plant and endorsement of the final financing package to take advantage of federal tax savings, and a contractual agreement to provide him all of your waste for 20 years.

Under these circumstances and with limited information provided during the presentation, what are Council decision makers to do? The deal presented to the Council is very intriguing; it's hard to say no since economic times are tough, and this seems to have little risk, a huge upside potential in lots of jobs, base economic growth, postitive media exposure and no more expensive landfill to operate. The scenario briefly outlined above is taking place in local governments across the U.S. and many international venues as well. Hard pressed with paying for the increasing cost of landfill disposal and more restrictive environmental regulation, many agencies are looking to new and innovative, but often commercially unproven technologies. These technologies promise to turn municipal solid waste into an asset that produces energy, usually either electric power, vehicle fuels and/or heat, and generate useful by-products that can be turned into consumer products, building materials or soil conditioners for agriculture.

How should political decision makers decide the best way to go forward with such a proposal? What additional information and data is needed to formally vet this proposal? In our opinion, due diligence of the Council should include evaluation of the following important issues as briefly discussed below. Normally, much of this information can be summarized in a pre-feasibility analysis undertaken by an independent, third party reviewer. The paragraphs below briefly describe the "Top Ten" issues that have been found from feasibility assessments of some two dozen different "new" waste conversion technologies in recent years. We believe that these are of the most concern to officials charged with making such waste disposal decisions.

#1: Does the Technology Work?

Clearly, the technical veracity of the technology proposed by the vendor is the most critical issue that must be resolved at the outset. Since the risks associated with waste-to-energy technology can be substantial, it is critical that the following considerations be used to assess the relative risk of a particular technology:

- *Actual Plant Operating Experience*—Some

The newly started 10 ton per day GS Platech MSW conversion plant in South Korea. It uses plasma gasification to produces syngas for electrical production.
Photo courtesy of David Ross, SCS Engineers.

technologies may only have been tested in very small pilot or even laboratory operations, or with raw feedstock materials other than municipal solid waste (MSW). Many of these experimental units have not been operated continuously over a significant period of time to gauge reliability, and the quality and characteristics of intermediate and final outputs. MSW is a non-homogenous, ever-changing mix and this complicates the design of basic conversion processes relative to treating; for example, a single material such as saw mill residue.

• *Scale-Up Issues*—Past history suggests that some companies without significant experience on their own prototype or pilot plant that attempt to construct and operate at full-scale may experience significant startup issues that could significantly delay full capacity operation or result in total failure. To manage/reduce the scale-up issue and associated inherent costs and extended time frame, vendors are producing smaller capacity "modules" that can be combined to meet the client's capacity and expansion requirements. This has some positive advantages, like mechanical redundancy. However, it increases the complexity of the plant and will require more maintenance. Many of the technologies are borrowed from the chemical industry where they operate quite well with a single chemical or related family of chemicals. There is no shortcut to the scale-up issue with a new technology, as a comparison, the high reliability of conventional WTE plants has evolved through operating commercial plants over a span of more than three decades.

• *Need for Pre-Processing of the Waste Stream*—MSW often contains materials that are not necessarily desirable in the treatment process or in the final residues that may be re-used somewhere. These include glass because it is very abrasive and contaminates other more valuable materials. Metals take energy to melt and often form a slag for which there is no widespread proven market for reuse. If pre-processing is desirable to remove these contaminants, then the extra cost must be included in the financial package. Typically, a material recovery facility (MRF) is used for this purpose. Depending on their complexity and capacity, MRFs can cost multi-millions of dollars and incur high maintenance costs.

• *Reliability to Dispose of Municipal Solid Waste*—The technology selected must be capable of disposing of solid waste in a reliable manner without frequent mechanical downtimes resulting in diversion of such waste to landfills. Early years of plant operations may require constant adjustments or modifications to systems to improve operating performance. The timeframe for adjusting the initial operation is referred to as the "shakedown" period.

#2: What Is the Strength of the Company?

Once the question of plant technology is addressed, it is important to ascertain the strength of the company proposing the technology of your project. Does this company have the basic business strength to secure the required capital for the project and to be able to work through and appropriately fund in a timely manner the normal plant operational hiccups during the first few years of plant shakedown? Furthermore, does the company have the intellectual property and patent rights for the technology? Are these rights reflected in the projected capital and operating costs for the project? All of these questions and more need to be answered so your agency can be assured that the company proposing the plant has the resources to meet the operating challenges.

Again, this waste conversion market is rapidly evolving with new players entering the marketplace. Many of these are very large corporations with strong balance sheets able to either provide parent guarantees on plant performance or have become significant investors in these technologies.

#3: Does This Project Fit In with the Current Solid Waste Program?

Solid waste management has evolved over the past several decades to one that emphasizes integrated solutions to management of solid waste including waste reduction, waste recycling, collection and transport and waste disposal. This can be easier for large regions to achieve but not practical for smaller regions. Consequently, it is important to assess realistically how this alternative technology may fit in the community's long-term, solid waste plan. It is critical to assess how current waste collection and recycling programs mesh with the proposed facility. Will the waste collection contract or franchise agreement need to be changed if the disposal location is modified? Is a transfer station needed if the proposed facility location is somewhat more distant than the current disposal location? Lastly, do the changes require a modification of the exsiting plan and a subsequent regulatory submittal to a State agency?

#4: Can You Provide Waste Supply for the Plant?

The president of the hypothetical company indicated that his company would begin operation by using the daily garbage generated within the municipality including hazardous materials, used tires and construction materials. Trucks would roll up to the doors of the plant and dump their loads into a hopper. As an added bonus, buried waste would eventually be "mined" from the local landfill enabling the site to be used for other uses or sale.

The scenario assumes that the community has the legal waste flow authority to direct waste generated in the community to the proposed facility. Will agreements need to be secured with other haulers? Furthermore, does the community have enough waste to support the projected needs for the plant? Will waste have to be imported from outside the community? These issues can be politically-charged questions that could take some time to resolve, especially if flow-control rules need to be enacted.

#5: What Are the Siting Needs for the Facility?

As the president indicated, his firm wants the community to provide several hundred acres at no cost to construct and operate the plant. Does the Council have this amount of land available that is properly zoned for the proposed facility? Further, what other community facilities would be needed such as an electrical transmission tie-line, wastewater connection, water supply, paving, etc., and who would pay for these costs, which can be substantial? The feasibility assessment of the project must take into account a clear understanding of what is provided by each party and what costs are involved. Also, as with most solid waste projects, there could be an adverse reaction from neighbors in the area of the plant. You will have to be able to convince the neighbors that this will not adversely affect their health, safety or property values.

#6: What Kind of Permits Will Be Needed?

While the president's presentation indicated that the proposed plant would be "pollution neutral and totally-enclosed", experience with similar waste conversion technologies suggests that most facilities of this type will require a significant amount of environmental permitting. At the bare minimum, a wastewater permit would be necessary if discharge water cannot be reused or if the system is installed at a location that will requires upgrades to the community's wastewater treatment system. There may be a need to treat the water prior to discharge, which might add to the plant's capital costs.

Depending on the jurisdiction, it is usual to expect that some form of air permitting might be necessary to address air emission or discharges of fugitive dusts. For example, the use of internal combustion engines fueled by waste-derived syngas to produce electrical power will normally trigger an air emission permit, which, because of the source of the syngas, will likely require extra review time. Lastly, there may also be issues with land use permits or conditional use plants if the technology is not clearly defined in local or State regulations.

#7: Are Markets Available for the Products and Energy?

These newer technologies can potentially produce several by-products or residues: a rock-like slag, heavy oil, ash, sulfur compounds and metal slag. Ultimately, the composition of the by-products depends on the composition of

the waste put into the conversion system and the specific processing technology and operating conditions. More syngas will be theoretically generated if the waste stream contains more carbon-based material (organic). More slag will be generated with a waste stream that contains more inorganic material.

The synthesis gas (syngas) from the plasma arc process typically has a low Btu value and can potentially be used to generate electricity, or used as an alternative fuel source for gas-fired industrial burners and boilers. Due to many variables in processes, including waste composting, relying on data provided by the vendors may not be sufficient to applications in all cases. Syngas that has been produced from other biomass sources has the chemical building blocks to create many of the products and chemicals currently generated in the petrochemical industry and can potentially be used as an intermediate building block for the final production (synthesis) of various fuels such as synthetic natural gas, methanol and synthetic fuels (i.e., ethanol, diesel and jet fuel, and gasoline).

The slag resulting from the plasma arc process may have some potential uses in the construction industry. There are many examples of where these types of substitution have occurred in the industry, with slags generated from well-known processes, such as the steel industry. However, there are no known permitted uses of waste-derived plasma arc slag in the U.S. The only operating plant in North America, the Plasco Energy facility in Ottawa, is currently landfilling their metal and slag by-products.

#8: What Are the Costs?

All of the answers to the preceding questions can be translated into a series of projected revenues and expenses for the project. Typically, this is conducted through the use of traditional Pro Forma economic models, which can provide a series of "what if" scenarios that calculate the short-term and long-term economic impacts. These models also make conducting a "sensitivity analysis" efficient and helpful to assess the affects of varying costs and/or revenues. Key to this modeling work is obtaining accurate and realistic capital and operating costs for the proposed project. As mentioned at the outset, these data are increasingly available from pilot facilities. Clearly, it is important to review the assumptions and ensure that they accurately reflect the roles and responsibilities of the local government with respect to their project.

Some plant developers will offer the community a disposal fee (tipping fee) at the plant comparable to the government's current disposal fee. However, that fee may be based on a scenario where the new plant operates at 90 percent or greater uptime, there are no major modifications needed within the first year or two of operation, waste is imported from other regions to boost production, and the price the developer gets for the energy production does not fluctuate. Some of these factors may be overly optimistic. For example, a plant with new technology rarely operates at 90 percent uptime; it is usually lower. Also, costly modifications can be necessary after startup reveals problems in the design. The price of energy can go down. Residents of the community may object to the importation of another region's waste. These changes may force the developer to renegotiate for a higher disposal fee. The fact is that because the plant is new and may be untested at a commercial operating capacity, the real cost of disposal can't be predicted accurately and may not actually be known for a few years after startup.

#9: Will There Be Financing Risks?

There are currently a variety of project finance mechanisms, such as government loan guarantees and State credit enhancements, to improve the financability of projects with little, if any, operating history. Many vendors are also providing a significant amount of equity investments in these projects from insurance companies, pension funds and other high-yield investors. Clearly, it is important as these "deals" mature that the community understand what financial risks, if any, they are responsible for. Will the taxpayers be on the "hook" for risks of the loan? A well-seasoned financial advisor is essential to help provide the community with the advice needed to understand and negotiate these financial risks.

#10: What Happens If All Else Fails?

A lot is at stake. You are about to potentially give away one, if not the most valuable commodity your community owns—its waste. In addition, you are potentially compromising the integrity of your system by giving away control of your waste's final disposal system. If this new technology should not work and the plant is shutdown temporarily or even permanenently, can you re-open your old landfill? Where will the waste go if the plant is shut down? Who will be responsible for that and the extra costs?

Some Final Thoughts

A waste-to-energy facility is perhaps the single most complex public works project usually considered by a community. Not unlike the traditional mass burn and RDF facilities, the feasibility assessment of such projects should be undertaken in a methodical process of ascertaining the answers to key questions upfront. This will assure the public and decision makers that all relevant issues have been explored and a resolution reached before significant private and public resources are expended on such projects. If you are unwilling to take the risk, don't be the "experimental project". Stick with proven technologies that you can see in operation. Talk with your peers in communities that have the technology, and get the real story on what it costs to build and operate.

The market of new waste conversion technologies is rapidly evolving with new facilities being announced and operating data on pilot facilities being received to fill in the current gaps on plant operating history. This is beginning to make the job of assessing the claims for these technologies more efficient and accurate. These assessments, conducted by an independent third party, help decision makers by providing a clear, concise and un-biased tool that they can use in working through the decision making process. The next few years will likely see many success stories involving these new technologies. By asking the right questions, decision makers can take steps to ensure that what is being promised is what they will receive. And that is a big step to becoming another one of this industry's success stories. | WA

***Marc J. Rogoff**, Ph.D. is a Project Director with SCS Engineers (Long Beach, CA). He has extensive experience in the development of waste-to-energy projects from the initial feasibility to commercial operations monitoring. He has conducted technical feasibility studies on more than 50 waste-to-energy facilities worldwide and is the recent co-author of* Waste-to-Energy Technologies and Project Implementation*. He can be reached at (813) 621-0080 or via e-mail at mrogoff@scsengineers.com*

***Bruce Clark**, P.E, is a Project Director with SCS Engineers. He has completed more than two-dozen economic and technical feasibility assessments for alternative waste conversion plants and waste-to-energy projects within the last few years for municipalities, investors, plant developers and others. He can be reached at (813) 621-0080 or via e-mail at bclark@scsengineers.com.*

***Jose Davila** is a Project Manager with SCS Engineers. He has more than 15 years of experience in the Environmental Engineering field in areas such as air quality, environmental assessments and solid waste management. He has participated in many landfill gas energy system studies and construction projects throughout Latin America. He can be reached at (602) 840-2596 or via e-mail at jdavila@scsengineers.com.*