



Los Angeles County Conversion Technology Evaluation Report

~
Phase II



*Converting Waste
into Renewable Resources*



October 2007

LOS ANGELES COUNTY CONVERSION TECHNOLOGY EVALUATION REPORT – PHASE II

October 2007

Prepared for

**The County Of Los Angeles
Department Of Public Works**

And

**The Los Angeles County Solid Waste Management
Committee/Integrated Waste Management Task Force's
Alternative Technology Advisory Subcommittee**


Prepared by



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*On the Cover: Representative images of the five
conversion technologies evaluated in Phase II of the County's project.*

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**CONVERSION TECHNOLOGY
EVALUATION REPORT – PHASE II**

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Appendix E: December 2006 Holland & Knight Memorandum - Funding Opportunities
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**EXECUTIVE SUMMARY
LOS ANGELES COUNTY
CONVERSION TECHNOLOGY EVALUATION REPORT
PHASE II**

October 2007

1.0 OVERVIEW

Background

Conversion technologies refer to a wide array of biological, chemical, thermal (excluding incineration) and mechanical technologies capable of converting post-recycled residual solid waste into useful products and chemicals, green fuels such as hydrogen, natural gas, ethanol and biodiesel, and clean, renewable energy such as electricity. In addition to the production of locally-generated renewable energy and green fuels, the use of conversion technologies in Southern California could effectively enhance recycling and beneficial use of waste, reduce pollution such as greenhouse gas emissions, and reduce dependence on landfilling and imported and domestic fossil fuels.

Conversion technologies are successfully used to manage solid waste throughout Europe, Israel, Japan, and other countries in Asia, but are not yet in commercial operation in the United States. While there are and have been pilot demonstrations of conversion technologies in the United States, the absence of larger scale demonstration facilities and commercial facilities in this country is an obstacle to demonstrating the benefits these technologies can offer. In addition to lack of U.S. experience, specific development hurdles for conversion technologies in California may include: cost, especially when compared to the current, relatively inexpensive cost of landfill disposal; the lack of a clear permitting and regulatory pathway; a lack of diversion credit, renewable energy credit, or other incentives for the development of emerging technologies; and misconceptions regarding the performance of these technologies.

For nearly a decade, the County of Los Angeles has been a consistent supporter of conversion technologies for their ability to manage post-recycling residual waste materials in an environmentally preferable manner and their potential to assist jurisdictions in meeting the State's waste diversion mandate. For example, the County has supported legislation and worked with State and local governments and other key stakeholders to advance research and development of conversion technologies.

County Role

Pursuant to AB 939, counties have the added responsibility of preparing and administering the Countywide Siting Element and the Countywide Integrated Waste Management Summary Plan. The Summary Plan describes the steps that will be taken by local agencies, acting independently and in concert, to achieve the 50 percent waste diversion mandate. The Countywide Siting Element, which was adopted by a majority of the cities in

the County of Los Angeles encompassing a majority of the cities' population, the County Board of Supervisors, and the State, is the current long-term planning document which provides for the County's solid waste disposal needs for the residual waste remaining after undergoing all recycling and other waste diversion efforts. Currently, residents and businesses in Los Angeles County generate over 24 million tons of trash each year, of which approximately 12 million tons, equivalent to over 40,000 tons of trash each day, must be properly disposed.

Meeting the mandates of AB 939 is especially challenging in Los Angeles County. The County of Los Angeles includes 88 cities and 134 unincorporated communities with a combined population in excess of 10 million. The County of Los Angeles has the largest and most complex solid waste management system in the country, with over 140 permitted waste haulers, 28 large transfer stations/material recovery facilities, 11 municipal solid waste landfills, 11 inert waste landfills, 2 waste-to-energy facilities, 43 construction and demolition debris recycling facilities and 350 recyclers. Each year, Los Angeles County residents and businesses generate approximately 24 million tons of materials, with approximately 50% being diverted through source reduction and recycling away from disposal. However, 12 million tons of trash remains each year, equivalent to approximately 40,000 tons which must be safely and properly disposed on a daily basis. This presents a challenge in not only protecting the public health and safety and the environment through effective solid waste management on a daily basis but also continuing to expand waste reduction, resource recovery, and recycling programs and policies.

The Los Angeles County Board of Supervisors is the legislative and executive branch of County government. The Board of Supervisors have been steadfast advocates of alternatives to landfills, and provided the leadership needed to advance the development of these emerging technologies. The Board of Supervisors have designated the Department of Public Works as the lead County agency advising the Board of Supervisors on waste management issues and responsible for the County's compliance with AB 939 mandates. This includes the waste diversion mandate for the unincorporated areas as well as Countywide solid waste planning responsibilities, in concert with the cities and the Task Force.

As part of its continuing efforts to evaluate and promote the development of conversion technologies, the County incorporated into the land use permit for the Puente Hills Landfill a condition requiring the owner/operator of the landfill, the County Sanitation Districts of Los Angeles County, to provide up to \$100,000 in funding each year for the remainder of the landfill's lifespan, in order to study conversion technologies, and requires the Sanitation Districts consider funding a pilot conversion technology facility, should a suitable technology be identified. The land use permit approved by the County Board of Supervisors also requested the Los Angeles County Solid Waste Management Committee/Integrated Waste Management Task Force (see description below) form the Alternative Technology Advisory Subcommittee (Subcommittee), a multi-stakeholder group whose mission is to thoroughly evaluate and promote the development of conversion technologies.

Continuing this model, the County adopted a land use permit for the Sunshine Canyon landfill, owned and operated by Browning-Ferris, Industries, which included a condition for

providing \$200,000 per year in funding for 10 years. This funding will continue the work of the Subcommittee, the Task Force and the Department of Public Works in implementing the recommendations of this Report and advancing the vision of the Board of Supervisors to some day make landfills obsolete.

To further this goal in the near term, the County of Los Angeles Department of Public Works is collaboratively working with the Task Force and the Subcommittee to facilitate development of a fully operational conversion technology demonstration facility in Southern California. The goal of the County's project is to demonstrate technical, environmental and economic benefits of conversion technologies through design, construction and operation of a facility in Southern California, in order to forge permitting and legislative pathways for conversion technologies and promote development of future projects. This demonstration project is the first implementation resulting from the combined efforts to evaluate the feasibility of conversion technologies in Southern California, including a broad evaluation in Phase I and a more detailed evaluation in Phase II. A brief description of the Phases is included below, with a more detailed explanation in Sections 2 and 3 of this Report.

Pursuant to Chapter 3.67 of the Los Angeles County Code and AB 939, the Task Force is responsible for coordinating the development of all major solid waste planning documents prepared for the County of Los Angeles and its 88 cities. Consistent with these responsibilities, and to ensure a coordinated and cost-effective and environmentally-sound solid waste management system in Los Angeles County, the Task Force also addresses issues impacting the system on a Countywide basis. The Task Force membership includes representatives of the League of California Cities-Los Angeles County Division, the County of Los Angeles Board of Supervisors, the City of Los Angeles, the waste management industry, environmental groups, the public, and a number of other governmental agencies.

In 2004, as requested by the County, the Task Force established the Alternative Technology Advisory Subcommittee to evaluate and promote the development of conversion technologies. The Subcommittee's membership includes municipal officials, regulators, consultants, industry, environmental and community representatives, all experts in the field of conversion technologies and solid waste management.

Phase I – Initial Technology Evaluation

Beginning in 2004, the County contracted with URS Corporation to conduct a preliminary evaluation of a range of conversion technologies and technology suppliers, and initiated efforts to identify material recovery facilities (MRFs) and transfer stations (TSs) in Southern California that could potentially host a conversion technology facility. A scope beyond just Los Angeles County was considered important as stakeholders in the Subcommittee extended beyond Los Angeles County, and the implications of this effort will have many regional impacts.

In August 2005, the Task Force adopted the Subcommittee's *Conversion Technology Evaluation Report*. As more fully described in Section 2 of this report, Phase I resulted in identification of a preliminary short list of technology suppliers and MRF/TS sites, along with development of a long-term strategy for implementation of a conversion technology

demonstration facility at one of these sites. The Department of Public Works and the Subcommittee intentionally pursued integrating a conversion technology facility at a MRF/TS site in order to further divert post-recycling residual waste from landfilling and take advantage of a number of beneficial synergies from co-locating a conversion facility at a MRF.

Phase II – Facilitation Efforts for Demonstration Facility

In July 2006, the County contracted with Alternative Resources, Inc. (ARI) to further advance its efforts to facilitate development of a conversion technology demonstration facility (Phase II). The ARI team included multi-disciplined expertise, including Clements Environmental Corporation, Facility Builders and Erectors, Holland & Knight, and UltraSystems Environmental. Key Phase II services provided by the ARI team included:

- an independent evaluation and verification of the qualifications of selected technology suppliers and the capabilities of their conversion technologies;
- an independent evaluation of candidate MRF/TS sites, to determine suitability for installation, integration and operation of one of the technologies;
- a review of permitting pathways;
- identification of funding opportunities and financing means;
- identification of potential County incentives (i.e., supporting benefits) to encourage facility development amongst potential project sponsors; and
- negotiation activities to assist these parties in developing project teams and a demonstration project.

This report describes progress to date on Phase II of the County's project to facilitate development of a conversion technology demonstration facility in Southern California, and represents a culmination of approximately one year of work conducted by the County and Subcommittee in conjunction with the ARI team.

Phase III – Long-Term Development of Conversion Technologies

As described previously, Los Angeles County residents and businesses generate approximately 24 million tons of materials, with approximately 50% being diverted through source reduction and recycling away from disposal. This results in over 12 million tons of trash left for disposal every year, a number that is expected to continue to grow, despite waste reduction and recycling programs, due to continued population and economic growth in the region. With the certainty that in-County landfill capacity will run out in the long term, and will be substantially diminished in the short term, the County of Los Angeles recognizes the imperative to develop technically, economically and environmentally feasible alternatives to landfills within Los Angeles County.

The goal of the County's demonstration project (Phase II) is to forge permitting and legislative pathways for conversion technologies and promote development of future projects. Building on the experiences gained after the successful development of one or more demonstration projects in Phase II, the next logical step is a focus on development of commercial scale facilities using proven technologies within Los Angeles County. To facilitate this goal, future, Phase III activities may include the following:

- Re-evaluating the marketplace of conversion technologies to consider new and emerging developments and continue to pursue development of the most technically and environmentally effective technologies, focusing on the identification of potential sites within Los Angeles County, including key potential sites identified in Phase II;
- Developing partnerships with local cities within Los Angeles County interested in the development of conversion technology facilities within or adjacent to their borders; and
- Facilitating development of commercial-scale conversion technology facilities designed to manage Los Angeles County's waste stream.

These activities can occur concurrently with the continued development of the Phase II demonstration projects.

Public Outreach

In January 2007, the County initiated efforts to develop and implement a public outreach and education plan for development of conversion technologies in Southern California. These public outreach efforts have been occurring integrally with the evaluations described in this report. This report is not intended to address the details of the public outreach plan. However, the findings presented herein are intended to be shared through the public outreach program, to facilitate the development of a conversion technology demonstration facility.

The County's Role as a Project Facilitator

The County is promoting the development of a conversion technology demonstration facility by serving as a project facilitator. In this role, the County is effectively using its resources to promote project development in a variety of ways. In the work completed in Phase I and Phase II, the County has utilized the expertise of Department of Public Works staff, the Subcommittee, and its consulting teams to disseminate a wide range of information regarding conversion technologies, potential host locations, and project development activities. Overall, the County is providing a framework to bring technology suppliers and MRF/TS site owners and operators together for development of a project.

As the County continues to support and promote conversion technologies and works to achieve development of a demonstration facility in Southern California, its role of facilitator is likely to evolve. Each technology supplier and MRF/TS site owner/operator may have

different needs and priorities for facilitation of project development. As a facilitator, the County can consider discrete actions along with invested public and private partners, such as County Sanitation Districts Board of Directors and BFI, it can take and specific incentives it can offer to promote project development. There are a wide range of potential opportunities for County facilitation and support of a conversion technology demonstration facility. Some of these are essential support activities, such as providing for public waste supply agreements or for public "backing" of private waste supply agreements for the term of financing. Others are support activities that would facilitate project development, such as developing and sharing technology and site information, and promoting beneficial use of products. These potential opportunities for County support of a conversion technology demonstration facility are further addressed in this report.

2.0 SCOPE AND METHODOLOGY OF PHASE II STUDY

Phase II activities began in July 2006, and progressed steadily through the development of this report. The scope of Phase II work has consisted of implementation of key activities identified in the Phase I strategic action plan, including: verification and evaluation of technology supplier qualifications and technology capabilities; evaluation of candidate MRF/TS sites and verification of their ability and willingness to partner with a technology supplier; and other activities aimed at promoting and facilitating development of a conversion technology demonstration facility. The scope and methodology of the Phase II study is summarized below.

Selection of Participating Technology Suppliers

Technology suppliers were selected to participate in Phase II based on:

- (1) The results of the Phase I evaluation and ranking;
- (2) Consideration of new and relevant information regarding technology performance and development, including ancillary capabilities of technology suppliers (e.g., integrating combined heat and power or alternative fuels in project development activities); and
- (3) The ability and willingness of the technology supplier to participate in Phase II, recognizing the substantial commitment to supply detailed information that would be required on their part. In addition to having the ability and willingness to partner with one of the candidate MRF/TS sites, the minimum commitment required of the technology suppliers included disclosure of technical, environmental and cost information for the technology, disclosure of technical and financial resources of the technology supplier, and identification of an operating reference facility.

Thirty-two technology suppliers were considered for participation in Phase II, including: the six technology suppliers previously short listed in Phase I; the eight technology suppliers that passed the screening criteria and were evaluated in Phase I, but at the time were not recommended for further evaluation; and eighteen additional technology suppliers that were not evaluated in the Phase I study, but had subsequently contacted Los Angeles County and expressed an interest in the County's conversion technology demonstration project. The eighteen additional technology suppliers were evaluated using the minimum criteria established for the Phase I screening and applied to the other technologies, with a more stringent requirement for diversion potential.

Ultimately, nine technology suppliers were selected for participation in Phase II, including the six that were recommended in Phase I and three additional technology suppliers that were evaluated in Phase I but not recommended at the time (Arrow Ecology and Engineering, Ebara Corporation, and International Environmental Solutions).

After selection of the participating technology suppliers, a Request for Information (RFI) was issued to the nine selected participants. During the RFI response period, four of the nine selected technology suppliers chose to withdraw from the process for a variety of reasons on their part. The Phase II process proceeded with a final list of five technology suppliers. The suppliers and proposed projects are listed alphabetically in Table 1.

Table 1. Technology Suppliers Participating in Phase II and Proposed Projects

Technology Supplier	Technology Type	Proposed Capacity	Major Products
Arrow Ecology and Engineering (Arrow)	Anaerobic Digestion	300 tpd	Biogas (Electricity) Digestate (Compost) Recyclables
Changing World Technologies (CWT)	Thermal Depolymerization	200 tpd	Renewable Diesel Carbon Fuel Metals
International Environmental Solutions (IES)	Pyrolysis	242.5 tpd @ 58.9% moisture 125 tpd@ 20% moisture	Syngas (Electricity)
Interstate Waste Technologies (IWT)	Pyrolysis / High Temperature Gasification	312 tpd (1 unit) 624 tpd (2 units) 935 tpd (3 units)	Syngas (Electricity) Mixed Metals Aggregate
NTech Environmental (NTech)	Low Temperature Gasification	413 tpd	Syngas (Electricity)

Methodology for Technology Evaluation

Information required for the technology evaluation and for evaluation of the resources and qualifications of the technology suppliers was gathered through a detailed Request for Information (RFI). The RFI described Los Angeles County's objectives for the demonstration project, and disclosed the technical, economic, and qualifications criteria that were established for the Phase II evaluation process. The RFI also identified the candidate MRF/TS sites, provided contact information for the MRF/TS site owner/operators along with key site information, and provided waste composition assumptions. The RFI was issued in October 2006, and responses were received in December 2006. A copy of the RFI is provided in Appendix B to the report. The evaluation criteria are identified in the report, as a preface to the review of resources and financial qualifications of the technology suppliers (Section 4) and the technology evaluations (Section 5).

In January 2007, after submittal and initial review of the RFI responses, interviews and working meetings were conducted with each of the technology suppliers in Los Angeles. This direct interaction with the technology suppliers provided the opportunity to confirm

information and gather additional data and materials as needed. Throughout the review process, direct interaction and coordination with the technology suppliers continued, including visits to reference facilities from February through April 2007, to ensure the most accurate and complete information was available for review. Upon analysis of information obtained during the presentations and site visits, preliminary findings were summarized and a workshop was conducted with the Subcommittee to review and discuss the preliminary findings. Following the Subcommittee's review, the preliminary findings were shared with the technology suppliers in June 2007, to provide a final opportunity for data confirmation and input. Information in this report is current through June 2007.

Selection of Candidate Sites

The Phase I study recommended six MRF/TS facilities as preferred locations for development of a conversion technology demonstration facility. Early in the Phase II process (July 2006), the owner/operators of the six potential sites were contacted and site visits were conducted to determine interest in continued participation in the County's demonstration project. Four of the original six sites expressed a willingness and ability to participate. Two of the sites, both identified in Phase I as "second priority" sites, dropped out: the Central Los Angeles Recycling Center and Transfer Station (CLARTS), because it is a potential site for the City of Los Angeles conversion technology project, and the proposed facility in Santa Clarita, because of uncertainty regarding the approval of the entire industrial development that would have encompassed the MRF/TS. Late in the Phase II process, a new MRF was added to the project, specifically in consideration of their relationship with one of the selected technology suppliers (International Environmental Solutions). This additional MRF (Rainbow Disposal in Huntington Beach) was evaluated under this project exclusively in partnership with IES. The five MRF/TS sites evaluated in Phase II are identified in Table 2, listed in alphabetical order.

Table 2. MRF/TS Sites Evaluated in Phase II

MRF/TS Facility	Location
Community Recycling/Resource Recovery Inc.	Los Angeles County (Los Angeles)
Del Norte Regional Recycling and Transfer Station	Ventura County (Oxnard)
Perris MRF/Transfer Station	Riverside County (Perris)
Rainbow Disposal Company, Inc. MRF ⁽¹⁾	Orange County (Huntington Beach)
Robert A. Nelson Transfer Station and MRF	Riverside County (Unincorporated)

(1) The Rainbow Disposal MRF was evaluated under this project exclusively in partnership with IES.

Methodology for Site Evaluation

Criteria were established to evaluate the suitability of each facility to host a conversion technology demonstration facility. The criteria included the fundamental prerequisite of ability and willingness to partner with a technology supplier for development of a demonstration facility, along with primary criteria (e.g., space availability, feedstock quantity) and secondary criteria (e.g., ability to assist in marketing products, accessibility to major transportation routes). Information required for site evaluations was gathered through a series of site visits and meetings with each of the individual site owner/operators. The criteria that were established for the Phase II site evaluations (see Section 6 of the report) provide a template that may be useful by other entities that are similarly working on development activities for a conversion technology project.

Reference Facility Tours

Reference facility tours were an important component of the Phase II technology evaluations. The tours provided the opportunity to gather and confirm technology-specific information, and to gather valuable insight for development of a demonstration project in Southern California.

Each participating technology supplier was required to identify an operating reference facility that could be visited to observe the technology. Members of the Subcommittee, Department of Public Works staff, and representatives of the ARI team participated in the tours, which took place from February through April 2007. When possible, meetings were also held with regulators and local government officials to gather insight regarding the development and operational history of the facilities. Table 3 identifies the reference facilities that were visited. Additional information on the reference facilities and relevant findings from the tours and meetings are integrated with the technology evaluations in Section 5 of the report.

Table 3. Reference Facility Visits

Technology Supplier	Reference Facility Visited (Location)
Arrow Ecology	Hiriya, Israel
Changing World Technologies	Carthage, Missouri
International Environmental Solutions	Romoland, California
Interstate Waste Technologies	Chiba, Japan Kurashiki, Japan
NTech Environmental	York, England (pre-processing) Bydgoszcz, Poland (gasifier)

Project Economic Analysis

Planning-level cost and pricing estimates provided by the technology suppliers, including the estimated tipping fees, were independently reviewed and evaluated to determine:

- completeness and reasonableness of cost and pricing assumptions;
- consistency of estimated tipping fees with cost and pricing assumptions and technical data (e.g., annual waste throughput, quantity of products, quantity of residue); and,
- sensitivity of estimated tipping fees to outside influences.

The evaluation included economic modeling to independently estimate tipping fees.

The tipping fees estimated by the technology suppliers and confirmed by modeling as achievable fall in the range of approximately \$50 to \$70 per ton. In comparison, current waste disposal costs in the region vary considerably based on location, extent of MRF processing, and long-term disposal agreements. Current landfill gate fees for MSW range from approximately \$30 to \$40 per ton. Costs including transportation and additional processing (as indicated by gate rates at MRF/TSSs) are somewhat higher, ranging from approximately \$40 to \$50 per ton.

The Puente Hills Landfill is the largest operating landfill in the United States at 13,200 tpd, and a dominant force in setting market prices in the Los Angeles County area. The Puente Hills Landfill will close in 2013, and the Sanitation Districts of Los Angeles County, will develop a system for long haul by rail from the Puente Hills MRF, adjacent to the Landfill, in order to compensate for a fraction of the disposal capacity no longer available upon closure of the landfill on October 27, 2013. This "waste-by-rail" system is estimated to be operational by 2011 and will direct waste to the Mesquite Landfill, several hundred miles from Los Angeles. The Sanitation Districts estimate the cost for rail haul from the Puente Hills MRF at approximately \$75/ton, requiring a ramped increase before the Landfill closes in order to prevent a sudden spike in cost and provide for a levelized rate.

The Sanitation Districts projects this "levelized" gate fee (i.e., tipping fee) at Puente Hills for rail haul and disposal will be approximately \$45 per ton in 2013, which corresponds with the potential initial operating year for a conversion technology facility (\$50 to \$70). Five years thereafter (i.e., by 2018) the gate fee for rail haul and disposal is expected to be approximately \$70 per ton, and within ten years (i.e., by 2023) the gate fee is expected to be over \$100 per ton. These prices are expected to reflect overall market conditions.

The estimated tipping fees for the conversion technologies compare favorably with projected costs for haul and disposal in the immediate future, and are estimated to be directly cost competitive with landfill disposal within 5-10 years. On a life cycle basis (e.g., over 20 years of operation), the conversion technologies could be less costly than rail haul and disposal. However, in the initial years of conversion technology operation (e.g.,

up to the first five years of operation in the scenario presented above) there may be a need to "bridge" the economic gap, if any, in order to make up the difference between those new facility costs and prevailing transfer and landfill disposal prices until such time as market waste disposal fees equal those for conversion technologies.

3.0 SUMMARY OF KEY FINDINGS AND RECOMMENDATIONS

Summary of Findings

As described in this report, the Los Angeles County Solid Waste Management Committee/Integrated Waste Management Task Force (Task Force), its Alternative Technology Advisory Subcommittee (Subcommittee), and the Los Angeles County Department of Public Works have been working to facilitate the design, construction and operation of a conversion technology demonstration facility(ies) in Southern California, to demonstrate the capabilities and benefits of conversion technologies, and to forge permitting and legislative pathways for future projects. This report describes Phase II of the County's project facilitation activities. Key activities of Phase II included: (1) verification and evaluation of technology supplier qualifications; (2) verification and evaluation of technology capabilities (including technical, environmental and economic factors); and (3) evaluation of candidate MRF/TS sites and verification of their ability and willingness to partner with a technology supplier. Phase II activities also included identification of: project funding opportunities and financing approaches; financing requirements; and County incentives needed or helpful to facilitate project development. Tables 4 and 5 identify, respectively, the technology suppliers and sites recommended to participate in the next step of the Phase II process. It should be noted that the listing is alphabetic, and the ordering does not signify any ranking or preference. Key findings are as follows:

1. **Technology Readiness and Reliability.** Four of the five technology suppliers have demonstrated the technical capabilities of their conversion technologies with MSW (Arrow, IES, IWT and NTech Environmental) and are "ready" for application as part of a conversion technology demonstration project in Southern California. It should be recognized, however, that each of these technology suppliers would be incorporating one or more new aspects into its design concept, such as the unique integration of pre-processing equipment and/or other facility components. Also, specific waste characteristics, waste receiving and separation requirements, State and local regulatory requirements, and specific product markets will need to be addressed in an application of these conversion technologies in Southern California.

CWT has demonstrated its depolymerization technology with agricultural waste, but has not yet demonstrated its technology with MSW. Additional development work is necessary for application of CWT's technology to MSW (particularly for processing MRF residuals and post-recycled MSW). CWT was not recommended for further consideration for this project because its technology is not yet demonstrated for MSW, although, CWT's technology may be applicable to other waste streams. CWT's technology may be suitable for consideration in a future phase of Los Angeles County's project development activities (Phase III).

**Table 4. Technology Suppliers Recommended for
Next Step of Phase II
(Listed Alphabetically)**

Technology Supplier	Technology Type
Arrow Ecology and Engineering (Arrow)	Anaerobic Digestion
International Environmental Solutions (IES)	Pyrolysis
Interstate Waste Technologies (IWT)	Pyrolysis / High Temperature Gasification
NTech Environmental (NTech)	Low Temperature Gasification

**Table 5. MRF/TS Sites Recommended for
Next Step of Phase II
(Listed Alphabetically)**

MRF/TS Facility	Location
Del Norte Regional Recycling and Transfer Station	Ventura County (Oxnard)
Perris MRF/Transfer Station	Riverside County (Perris)
Rainbow Disposal Company, Inc. MRF ⁽¹⁾	Orange County (Huntington Beach)
Robert A. Nelson Transfer Station and MRF	Riverside County (Unincorporated)

(1) The Rainbow Disposal MRF was evaluated under this project exclusively in partnership with IES.

2. **MRF/TS Site Suitability.** Four sites were found to be technically and environmentally suitable for co-location of a conversion technology project: Del Norte Regional Recycling and Transfer Station (Oxnard); Robert A. Nelson Transfer Station and MRF (Unincorporated Riverside); Perris MRF/Transfer Station (Perris); and Rainbow Disposal Company, Inc. MRF (Huntington Beach). Community Recycling/Resource Recovery, Inc. MRF/TS in Los Angeles was limited by available space and is faced with an active LEA Cease & Desist Order that may pose a constriction for project development at this site. The Community Recycling site was not recommended for this project because of those constraints. However, Community Recycling has access to a larger site, which may be suitable for consideration in a future phase of Los Angeles County's project development activities (Phase III).

With only one exception, the MRF/TS sites have continued to express a willingness and ability to partner with a technology supplier and participate in Los Angeles County's conversion technology demonstration project. The only exception is the Del Norte Regional Recycling and Transfer Station in Oxnard (Ventura County), which has not yet made a commitment to continue to participate in the County's project. As the only publicly-owned MRF/TS under consideration, the Del Norte site requires a more formal and lengthier process for making a project commitment. In addition, the City of Oxnard has received and is evaluating a project offer that could result in development of the land adjacent to the MRF/TS, which was identified for location of a conversion technology facility. The future of Oxnard's participation in the County's project is uncertain.

3. **Corporate and Team Resources.** The teams assembled include technology suppliers and experienced team members in key roles such as finance, design and construction, and operations, and are capable of developing a project.
4. **Financial Resources.** Although in most cases, technology suppliers have not been in business in the U.S. market long enough to have built extensive U.S. project inventories or financial track records, the inclusion of major experienced financial, engineering and construction and/or operations team members, and their teaming with MRF/TS owners, will enhance their overall financial resources and capability, providing sufficient resources for project development and operations. In particular, these teaming arrangements will strengthen the ability to provide design, construction, operations and performance guarantees, and the taking of risks associated with these types of guarantees.
5. **Diversion Potential.** The conversion technologies have the potential of achieving significant diversion of MRF residue and post-recycled MSW from landfill disposal, ranging from approximately 87 percent to 100 percent by weight of the waste received, provided reliable markets can be identified for secondary products.

6. **Conversion Capability, Marketable Products.** The technologies have the capability of recovering recyclables, converting waste into intermediate fuel products (e.g., biogas, syngas, steam, biodiesel), efficiently using the fuel products on-site for power generation, and producing secondary material products. On-site power generation is currently the proposed alternative due to strong market demands for electricity, particularly from renewable energy sources.

7. **Environmental Soundness.** The technologies are expected to be permissible in Southern California, meeting applicable environmental standards. Appropriate air pollution controls will be required. The fuel gas (e.g., biogas, syngas) can be collected and cleaned prior to use for power generation, as necessary for permitting. Phase II addressed three key pollutants: nitrogen oxides (NO_x); dioxins; and greenhouse gas (GHG) emissions.
 - NO_x is a criteria air pollutant of concern as established by the U.S. EPA. NO_x was selected as a key indicator of environmental acceptability of conversion technologies because ground level ozone (smog) is one of the most significant pollution issues in Southern California, and NO_x is the most significant pollutant generated by conversion technologies that contributes to smog. The U.S. EPA classifies the Los Angeles South Coast Air Basin as being a severe non-attainment area for ozone, a precursor to smog. Smog poses a threat to humans because it can irritate the respiratory system and lead to severe respiratory health problems. The conversion technologies evaluated would apply control technologies to reduce NO_x emissions, and would have potential, controlled NO_x emissions that are significantly lower than the Federal requirements for large municipal waste combustors (i.e., approximately 10 times less).
 - Dioxin was selected as a key indicator of environmental acceptability of conversion technologies, because it is a toxic air pollutant of great public concern. Potential dioxin emissions from conversion technologies are expected to be very small compared to Federal requirements for large municipal waste combustors (i.e., approximately 10 to >100 times less).
 - Greenhouse gases are those gases in the atmosphere that increase global warming. Conversion technology facilities have the potential to significantly contribute positively towards the State's Global Warming Solutions Act goals. These technologies achieve significant diversion from landfill disposal and convert organic waste material into renewable energy, fuels and other products, resulting in a net reduction in greenhouse gas emissions.

- The net generation of emissions can be reduced when considering the life-cycle impact of conversion technologies. By design, conversion technologies offset emissions from other sources, including the transportation of waste to remote disposal that is no longer necessary, as well as the combustion of fossil fuels offset by the generation of renewable energy in the form of electricity or green fuels. Co-location of conversion technology facilities with MRFs maximizes this transportation reduction of residual solid waste. When factoring in diversion of materials from disposal as well as offsets from transportation and energy production, conversion technologies are likely to reduce net emissions.
8. **Estimated Tipping Fees.** The tipping fees estimated by the technology suppliers, and reviewed in this study, fall in the range of \$50 to \$70 per ton, excluding IWT's single-unit, 312-tpd project, which is not considered economically viable. Sensitivity analyses (conducted to determine the impacts on tipping fees of certain contingencies) do not result in a significant change to the overall tipping fee range.
 9. **Competitiveness of Estimated Tipping Fees.** As noted above, tipping fees needed to support a conversion technology project range from approximately \$50 to \$70 per ton. While these estimated tipping fees may be competitive with the future tipping fees associated with rail haul and landfill disposal, they are greater than current waste disposal costs in Los Angeles County. To support financing and successful project development and operation, there may be a need to "bridge" this economic gap, if any, until such time as market waste disposal fees equal those for conversion technologies.

Many alternatives could be considered to help meet this need, including one or more of the following:

- funding provided by the Sanitation Districts, consistent with the conditions of the Puente Hills Landfill C.U.P.;
- funding provided by BFI, consistent with the conditions of the Sunshine Canyon C.U.P.;
- funding provided by the cities in Los Angeles County and the County itself;
- development of public waste supply agreement (or private agreement with public "back stop") with supporting tip fees;
- increasing the amount of the project financing to provide surplus funds to "subsidize" initial tip fees being paid;

- instituting a ramped tipping fee (i.e., a structured annual increase that is kept in place until the prices charged cover the cost incurred, similar to the funding subsidy formulated by the CSD for the Waste by Rail Project);
- instituting a “green fee” to be paid by MRF/TS customers for waste processed at the conversion technology facility;
- eliminating the Solid Waste Management Fee (currently \$0.86 per ton) for waste originating in Los Angeles County going to the conversion technology facility, to provide a reduced tip fee for waste delivered to the conversion technology facility;
- increasing the Solid Waste Management Fee (currently \$0.86 per ton) imposed on each ton of solid waste being disposed to provide a dedicated funding source for promoting development of conversion facilities;
- providing tax incentives that may result in lower facility construction or operating costs; and
- successful acquisition of State and Federal grants to augment other funds as discussed above.

The level of support needed and alternatives to address needed support would require evaluation in the next step of this process, when firm, competitive offers from the project developers are made, and proposed tip fees and project-specific market conditions are known.

10. **Financing Approach.** Given the experience and corporate and team resources of the technology suppliers, and assuming waste supplies would be provided or assured by a public entity or credit-worthy private source with assignable public contracts at a sufficient tipping fee for the term of financing, the technology suppliers could structure financable projects applying customary U.S. solid waste market project financing techniques. However, specific means for providing or assuring the waste supply need to be developed, as does a means of providing a supporting tipping fee. Tax-exempt, private activity bonds would most likely be the least-costly means of private project financing. Support from the County and/or other public agencies may be needed to secure allocation of "volume cap" from the State for such financing.

State and Federal funding opportunities are limited, but could be used to assist in project development and/or project financing. Securing such funding is competitive and requires project definition.

Recommended Next Steps – Competition for Selection of Project(s)

Although substantial evaluation work has been completed, resulting in selection of acceptable technologies and sites for one or more demonstration facilities for Southern California, formal project offers have not yet been presented. As a next step, it is recommended upon approval from the County Board of Supervisors that the Task Force, Subcommittee and Department of Public Works establish a competition to solicit formal, site-specific offers from the acceptable technology suppliers in partnership with the acceptable MRF/TS sites. Such a process would establish a defined mechanism by which one or more projects would be selected to receive County support to further facilitate project development activities.

The competition would not be a formal procurement process, and it would be open only to the technology suppliers and sites identified in this report as "recommended". The process would differ from a procurement in its formality and the extent of detail requested, both of which would be streamlined. However, the competition would still require clear project definition and commitments on the part of the development team making the offer, including a tipping fee and project guarantees, and it would need to meet standards set by the Task Force, the Subcommittee and the Department of Public Works. In return, the selected project(s) would be offered County support to facilitate development activities. Potential options for support are described below, and ultimately must be selected and approved by the County before being formally offered.

The advantage of the competition is that it would allow the marketplace to establish the most beneficial pairing of sites and technologies, a process most appropriate for a privately developed project, and it would encourage the development of site-specific projects that meet the objectives of the County, the Task Force and the Subcommittee. In this way, specific offers would be evaluated to enable selection of the best project(s) as offered by a team that includes a technology supplier and site, rather than selection of a preferred technology and site for which a partnership has not yet been established or may not be possible, and a project that is not yet defined. The competition would also strengthen the County's negotiation position as a project facilitator.

The competition would be initiated with issuance of a "letter of invitation" to the recommended technology suppliers and MRF/TS sites, outlining the standards and incentives and other elements of the competition. A time limit would be set for project offers to be made. Approximately 3 to 4 months is recommended, to allow time for the technology suppliers and MRF/TS owners and operators to explore partnership opportunities and develop site-specific project offers. Upon receipt of project offers, the Task Force, Subcommittee and Department of Public Works would review, evaluate and rank the offers and select one or more projects to recommend receiving the support of the County of Los Angeles. Support activities would be negotiated with the project development teams, based on ranking and selection of project(s). As proposed, this competition would allow the County to support more than one project, perhaps with the highest level of benefits offered to the highest-ranked offer.

Standards set for the competition would include those that promote the overall objectives and goals of the project. Suggested standards could include the following:

Project Standards

- The project must be of a certain minimum size; e.g., 100 tons per day.
- The project must be capable of achieving operation by a specified date.
- The project must be capable of sustained operation at a market-competitive tip fee, if not initially, over the term of operation.
- The project must be designed to process MRF residuals and/or post-recycled municipal solid waste, and must have the potential to divert at least 75% (by weight) of this waste from landfill disposal.
- The project must have the ability to capture the gas produced and to generate electricity or a fuel product (e.g., biogas, synthesis gas, oil) and must have a defined use for the electricity and/or fuel product.
- The project must have the ability to capture and pre-clean the intermediate gas as necessary to meet permit requirements.
- The project must provide a permitting plan that demonstrates a reasonable chance of successful permitting.
- The project must provide a financing plan and assurance from the intended financing party that financing can be accomplished.
- The project must have a marketing plan for all products intended to be recovered and marketed, including power and secondary products, with provision of letters of intent to purchase from intended customers of key products.
- The project must be structured to provide for disclosure of non-proprietary project information to the County for public release, including technical, environmental and economic information, to promote the development of future projects.
- The project developer must offer a commitment to develop a “flagship facility”, to encourage and facilitate public tours, and public education programs.
- The project developer must provide assurance of its commitment to ensuring project success

The County could consider offering support to meet those needs essential to project development and other support activities that can facilitate project development. A suggested listing of such benefits is presented below. In addition to selecting specific support levels, or offering tiered levels of support based on rankings of proposed project offers, the County may wish to offer a menu of options to the facilities, and evaluate the project offers submitted based on the level of support requested in the offer.

Essential Support Activities for Private Project Development

- Provide for public waste supply agreements, or provide for public “back stop” to guarantee private waste supply agreements for the term of financing.
- Provide economic incentives in the form of a "bridge" that closes the gap, if any, between needed conversion technology tipping fees and market waste disposal fees, until such time as market waste disposal fees are sufficient to support a conversion technology project.
- In addition, if private activity tax-exempt bond financing is sought, lend County support to qualify for “volume cap” for such financing.

Other Support Activities to Facilitate Private Project Development

Develop Information, Facilitate Information Exchange

- Continue the development of information on technology suppliers and make the information available to MRF/TS site owner/operators.
- Continue the development of site information and make the information available to technology suppliers.

Funding Opportunities

- Continue to track and identify potential funding sources (e.g., grants, low interest loans, etc.) from state and federal sources to assist in payment of project development costs, construction costs and operating costs. Apply for and secure available state and federal grants (or assist project developers in doing so). Assist the facility developer in applying for and obtaining low interest loans available from the state or federal Government. Consistent with the CUP issued for Puente Hills Landfill, Public Works will request that CSD consider funding a pilot conversion technology facility.

Legislative Efforts

- Continue state legislative efforts to foster change in the solid waste management hierarchy in order to place conversion technologies within the context of beneficial uses rather than disposal.

- Continue state legislative efforts to ensure all conversion technologies that generate renewable energy are eligible to receive renewable energy credit.

Promote Beneficial Use of Products, Product Sales

- Assist site owner/operators and technology suppliers in identifying markets for products and in negotiating power or fuel sales agreements.
- Promote the use of more difficult-to-market products, such as compost and aggregate, by educating County and state departments that may use such products and integrating incentives or requirements for purchasing and use of such products into procurement practices for County and state projects. Support payment for testing services to develop engineering specifications for products and establish quality of products.

Foster Project Support with Municipal Leaders and General Public – Public Outreach

- Sponsor meetings and forums to encourage information exchange between technology suppliers, site owners/operators, municipal officials in which sites are located, State and Federal agencies, environmental and other advocacy groups and the general public to gain support for the project.
- Provide County “endorsement” of the project(s) to add credibility for purposes of public acceptance, permitting, financing, and publicity.
- Provide and reinforce public education efforts regarding the project, including publicizing the project, maintaining web and e-communications regarding the project, and seeking additional media coverage as appropriate.

Facilitate Permitting

- Assist the project in permitting efforts by:
 - making staff available to help in identifying permits needed;
 - obtaining information needed for permit applications; and
 - helping the project get priority at agencies in scheduling for permit review and receiving reasonable consideration concerning applicability/interpretation of regulatory requirements.

Facilitate Design/Construction

- During facility design, assist the project by helping to obtain design related information available at the County, and support “green” building design.
- During facility construction, assist the project in obtaining information on local suppliers of materials and services.

Support Operations and Commercialization of Technology

- Once the facility is operational, participate in facility testing and data exchange for engineering performance and environmental data.
- Continue County promotional support during facility operation to promote facility attributes and enhance public awareness. Serve as a “reference”, if requested by the facility developer, to expand the demonstration facility or to enhance the developer’s efforts to develop other facilities in or outside of the area.

Schedule

The recommendation of this report is that, upon approval by the Board of Supervisors, the Task Force, Subcommittee and Department of Public Works establish a competition to solicit formal, site-specific offers for selection of one or more conversion technology demonstration projects for County support. Upon selection of a project(s) and negotiation of associated support activities to be provided by the County, the project would proceed to permitting, design and construction, and startup. The goal is to implement a project with expedited permitting by December 2011, as summarized in Table 6. More detailed, project-specific schedules would be requested as part of the recommended competition.

Table 6. Preliminary Project Implementation Schedule

Implementation Step	Time to Complete	Projected Completion
Initiate Competition (Issue Letter of Invitation)		Fall 2007
Offers Submitted	4 months	January 2008
Review, Evaluate and Rank Offers	3 months	April 2008
Selection of Project(s) for County Support	1 month	May 2008
Negotiate Support Activities, Other Agreements	3 months	August 2008
Permitting/Conceptual Design ⁽¹⁾	18 months	February 2010
Detailed Design/Construction	18 months	August 2011
Startup	4 months	December 2011

(1) Assumes permitting can be achieved with an amendment to the existing MRF/TS Solid Waste Facility Permit and an amendment to the non-disposal facility element.

GLOSSARY OF TERMS

A Compost: Acetogenic Compost

APC: Air Pollution Control

APCD: Air Pollution Control District

ARB: (California) Air Resources Board

ASR: Auto Shredder Residue

BACT: Best Available Control Technology

Biogas: a gas produced from the biological conversion of the biodegradable, organic fraction of MSW, typically composed of methane and carbon dioxide gases. Biogas can be converted to a product such as a transportation fuel, or converted to electricity by using it as a fuel in power generating equipment such as a reciprocating engine.

BMP: Best Management Practices

BOD: Biochemical Oxygen Demand

Btu: British Thermal Unit

C: Centigrade

C&D: Construction and Demolition

CA: California

CARB: California Air Resources Board

CCGT: Combined Cycle Gas Turbine

CCNGPP: Combined Cycle Natural Gas Power Plant

CEC: California Energy Commission

CEQA: California Environmental Quality Act – regulations that mandate the assessment of the potential environmental impacts of a project and detail mitigation measures. Triggered by the need for a project to obtain a discretionary land use permit.

CH₄: Methane

CIWMB: California Integrated Waste Management Board

Glossary of Terms (Continued)

CLARTS: Central LA Recycling & Transfer Station

CO: Carbon Monoxide

CO₂: Carbon Dioxide

CT: Conversion Technology - industrial plants that use one or more noncombustion processes (e.g., biological, chemical, thermal, and/or mechanical processes) to convert MSW into green fuels, renewable energy and other products. Conversion technologies make an intermediate fuel product (e.g., biogas, synthesis gas), and have the capability to capture these gases to utilize them to make fuels such as ethanol, hydrogen, liquefied natural gas, compressed natural gas, and diesel fuel. Conversion technologies have the capability to pre-clean the gases generated in the process prior to combustion, should those gases be combusted on site to make electricity.

C.U.P.: Conditional Use Permit

Dioxin: a general term used to collectively describe a large number of chemical species making up the dioxin and furan families of compounds. Dioxin is a trace-level byproduct of combustion and some industrial chemical processes. Dioxin is a toxic air pollutant of public concern, characterized by EPA as likely to be a human carcinogen.

DWP: (City of Los Angeles) Department of Water and Power

EIR: Environmental Impact Report

EJ: Environmental Justice – an area of study and evaluation for new projects that counters the tendency in our society to place the more impactful industrial operations (prisons, wastewater treatment plants, power plants, solid waste facilities, etc.) in ethnic areas of low economic standing.

EPA: (U.S.) Environmental Protection Agency

F: Fahrenheit

FOG: Fats, Oils and Greases

gpd: gallons per day

“Greenfield Pricing”: see “Integrated Pricing”

H₂: Hydrogen

H₂S: Hydrogen Sulfide

HCl: Hydrogen Chloride

Glossary of Terms (Continued)

HF: Hydrogen Fluoride

HDPE: High Density Polyethylene (plastic)

HRSRG: Heat Recovery System Generator

Integrated Pricing: Several technology suppliers based their projected economics on “integrated pricing” that assumed use of existing scales, roads, and other site infrastructure at MRF/TS sites. This use enabled the technology suppliers to reduce project development and construction costs, since there was no need to duplicate such facilities. Other technology suppliers based their projected economics on “greenfield pricing” that assumed the use of an undeveloped site for which all ancillary infrastructure would need to be constructed. For each technology studied, the report indicates whether the pricing is based on a stand-alone, greenfield project or a project integrated with a MRF/TS through the intended use of existing, common-application site infrastructure.

IS: Initial Study

ITEQ: International Toxic Equivalents

kW: Kilowatts

kWh: Kilowatt Hours

LAER: Lowest Achievable Emission Rate

lb: pound

LEA: Local Enforcement Agency

LEED: Leadership in Energy and Environmental Design

M Compost: Methanogenic Compost

MND: Mitigated Negative Declaration

MO: Missouri

MRF: Materials Recovery Facility – an industrial facility where MSW and other materials are sorted and processed for recycling.

MRF Residual: Waste material left after MRF processing has removed recyclables.

MSW: Municipal Solid Waste

MW: Megawatts

Glossary of Terms (Continued)

MWC: Municipal Waste Combustor - also known as incinerators or waste-to-energy plants, municipal waste combustors are facilities that burn municipal solid waste at a very high temperature to generate electricity or steam power. Unlike Conversion Technology, MWCs by design do not make an intermediate product such as a synthesis gas that can be intercepted and modified (e.g., cleaned) prior to final use.

MWh: Megawatt Hours

NaOH: Sodium Hydroxide

ND: Negative Declaration

NDFE: Non-Disposal Facility Element – part of a jurisdiction’s Solid Waste Management Plan that details the facilities that handle MSW or portions thereof that are not disposal facilities (typically: transfer stations, MRFs, greenwaste chipping & grinding, composting).

NO_x: Nitrogen Oxides – generic term for a group of gases containing nitrogen coupled with oxygen in varying amounts (e.g., NO₂, N₂O). NO_x is a commonly found air pollutant (also known as a "criteria pollutant") that is formed when fuel is burned, and it contributes to the formation of ground-level ozone (smog).

NSPS: (U.S.) New Source Performance Standards as promulgated by the Environmental Protection Agency.

Off-Take Contracts: Off-take contracts are the contracts a facility would have with various parties for the sale of the energy and materials that would be produced or recovered by the facility. For example, a facility might have an off-take contract with a utility for the sale of electric power, and it may have contracts with secondary materials dealers for the sale of recovered materials such as metals, plastics or paper. Generally, energy sales contracts have terms that are coterminous with a facility’s financing and frequently have set pricing; given the nature of the secondary materials markets, materials contracts usually have much shorter terms and may include variable pricing.

OSHA: (U.S.) Occupational Safety and Health Administration

pph: pounds per hour

ppm: parts per million

PET: Polyethylene Terephthalate (plastic)

psig: pounds per square inch gage pressure

RFI: Request for Information

Glossary of Terms (Continued)

RMDZ: Recycling Market Development Zone – areas of cities and counties designated by the State of California for siting of recycling industries where tax breaks and other incentives are provided.

RPS: Renewable Portfolio Standard

RWQCB: Regional Water Quality Control Board

SCAQMD: South Coast Air Quality Management District

SCE: Southern California Edison

SCR: Selective Catalytic Reduction

SIP: State Implementation Plan for California

SO₂: Sulfur Dioxide

SWFP: Solid Waste Facility Permit

SWRCB: State Water Resources Control Board

Syngas: Synthesis gas - a gas produced from the thermal conversion of the organic fraction of MSW, typically composed of hydrogen, carbon monoxide and carbon dioxide gases. Syngas can be converted to a product such as methanol, or converted to electricity by using it as a fuel in traditional boilers with steam turbines, reciprocating engines and combustion turbines.

tpd: tons per day

tph: tons per hour

tpy: tons per year

TS: Transfer Station – an industrial facility where MSW and other wastes are transferred from smaller refuse collection trucks to large 18-wheel semi-trucks for haul to disposal sites.

TSS: Total Suspended Solids

UASB: Upflow Anaerobic Sludge Blanket

U.K.: United Kingdom

U.S.: United States

VCAPCD: Ventura County Air Pollution Control District

SECTION 1 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

Conversion technologies refer to a wide array of biological, chemical, thermal (excluding incineration) and mechanical technologies capable of converting post-recycled residual solid waste into useful products and chemicals, green fuels such as hydrogen, natural gas, ethanol and biodiesel, and clean, renewable energy such as electricity. In addition to the production of locally-generated renewable energy and green fuels, the use of conversion technologies in Southern California could effectively enhance recycling and beneficial use of waste, reduce pollution such as greenhouse gas emissions, and reduce dependence on landfilling and imported and domestic fossil fuels.

Conversion technologies are successfully used to manage solid waste throughout Europe, Israel, Japan, and other countries in Asia, but are not yet in commercial operation in the United States. While there are and have been pilot demonstrations of conversion technologies in the United States, the absence of larger scale demonstration facilities and commercial facilities in this country is an obstacle to demonstrating the benefits these technologies can offer. In addition to lack of U.S. experience, specific development hurdles for conversion technologies in California may include: cost, especially when compared to the current, relatively inexpensive cost of landfill disposal; the lack of a clear permitting and regulatory pathway; a lack of diversion credit, renewable energy credit, or other incentives for the development of emerging technologies; and misconceptions regarding the performance of these technologies.

For nearly a decade, the County of Los Angeles has been a consistent supporter of conversion technologies for their ability to manage post-recycling residual waste materials in an environmentally preferable manner and their potential to assist jurisdictions in meeting the State's waste diversion mandate. For example, the County has supported legislation and worked with State and local governments and other key stakeholders to advance research and development of conversion technologies. Below is a discussion of these efforts.

1.1.1 Assembly Bill 939

The California Integrated Waste Management Act of 1989 (Assembly Bill 939, as amended) requires each city and county to divert 50 percent of solid waste from disposal at landfills and/or transformation facilities. Failure to demonstrate achievement of this requirement may subject a jurisdiction to penalties of up to \$10,000 per day.

Pursuant to AB 939, counties have the added responsibility of preparing and administering the Countywide Siting Element and the Countywide Integrated Waste Management Summary Plan. The Summary Plan describes the steps that will be taken by local agencies, acting independently and in concert, to achieve the 50 percent waste diversion mandate. The Countywide Siting Element, which was adopted by a majority of the cities in the County of Los Angeles encompassing a majority of the cities' population, the County Board of Supervisors, and the State, is the current long-term planning

document which provides for the County's solid waste disposal needs for the residual waste remaining after undergoing all recycling and other waste diversion efforts. Currently, residents and businesses in Los Angeles County generate over 24 million tons of trash each year, of which approximately 12 million tons, equivalent to over 40,000 tons of trash each day, must be properly disposed.

Meeting the mandates of AB 939 is especially challenging in Los Angeles County. The County of Los Angeles includes 88 cities and 134 unincorporated communities with a combined population in excess of 10 million. The County of Los Angeles has the largest and most complex solid waste management system in the country, with over 140 permitted waste haulers, 28 large transfer stations/material recovery facilities, 11 municipal solid waste landfills, 11 inert waste landfills, 2 waste-to-energy facilities, 43 construction and demolition debris recycling facilities and 350 recyclers. Each year, Los Angeles County residents and businesses generate approximately 24 million tons of materials, with approximately 50% being diverted through source reduction and recycling away from disposal. However, 12 million tons of trash remains each year, equivalent to approximately 40,000 tons which must be safely and properly disposed on a daily basis. This presents a challenge in not only protecting the public health and safety and the environment through effective solid waste management on a daily basis but also continuing to expand waste reduction, resource recovery, and recycling programs and policies.

1.1.2 County Government

The Los Angeles County Board of Supervisors is the legislative and executive branch of County government. The Board of Supervisors have been steadfast advocates of alternatives to landfills, and provided the leadership needed to advance the development of these emerging technologies. The Board of Supervisors have designated the Department of Public Works as the lead County agency advising the Board of Supervisors on waste management issues and responsible for the County's compliance with AB 939 mandates. This includes the waste diversion mandate for the unincorporated areas as well as Countywide solid waste planning responsibilities, in concert with the cities and the Task Force.

As part of its continuing efforts to evaluate and promote the development of conversion technologies, the County incorporated into the land use permit for the Puente Hills Landfill a condition requiring the owner/operator of the landfill, the County Sanitation Districts of Los Angeles County, to provide up to \$100,000 in funding each year for the remainder of the landfill's lifespan, in order to study conversion technologies, and requires the Sanitation Districts consider funding a pilot conversion technology facility, should a suitable technology be identified. The Puente Hills Landfill land use permit also requires the County Sanitation Districts to develop a waste by rail system for remote waste disposal, with key benchmarks, and as the largest landfill in Los Angeles County the rates at the Puente Hills landfill and, eventually, processed via the rail haul system, will establish a market benchmark with significant implications for the waste industry in Southern California. The land use permit approved by the County Board of Supervisors also requested the Los Angeles County Solid Waste Management Committee/Integrated Waste Management Task Force (see description below) form the Alternative Technology

Advisory Subcommittee (Subcommittee), a multi-stakeholder group whose mission is to thoroughly evaluate and promote the development of conversion technologies.

Continuing this model, the County adopted a land use permit for the Sunshine Canyon landfill, owned and operated by Browning-Ferris, Industries, which included a condition for providing \$200,000 per year in funding for 10 years. This funding will continue the work of the Subcommittee, the Task Force and the Department of Public Works in implementing the recommendations of this Report and advancing the vision of the Board of Supervisors to some day make landfills obsolete.

To further this goal in the near term, the County of Los Angeles Department of Public Works is collaboratively working with the Task Force and the Subcommittee to facilitate development of a fully operational conversion technology demonstration facility in Southern California. The goal of the County's project is to demonstrate technical, environmental and economic benefits of conversion technologies through design, construction and operation of a facility in Southern California, in order to forge permitting and legislative pathways for conversion technologies and promote development of future projects. This demonstration project is the first implementation resulting from the combined efforts to evaluate the feasibility of conversion technologies in Southern California, including a broad evaluation in Phase I and a more detailed evaluation in Phase II. A brief description of the Phases is included below, with a more detailed explanation in Sections 2 and 3 of this Report.

1.1.3 Los Angeles County Integrated Waste Management Task Force

Pursuant to Chapter 3.67 of the Los Angeles County Code and AB 939, the Task Force is responsible for coordinating the development of all major solid waste planning documents prepared for the County of Los Angeles and its 88 cities. Consistent with these responsibilities, and to ensure a coordinated and cost-effective and environmentally-sound solid waste management system in Los Angeles County, the Task Force also addresses issues impacting the system on a Countywide basis. The Task Force membership includes representatives of the League of California Cities-Los Angeles County Division, the County of Los Angeles Board of Supervisors, the City of Los Angeles, the waste management industry, environmental groups, the public, and a number of other governmental agencies.

In 2004, as requested by the County, the Task Force established the Alternative Technology Advisory Subcommittee to evaluate and promote the development of conversion technologies. The Subcommittee's membership includes municipal officials, regulators, consultants, industry, environmental and community representatives, all experts in the field of conversion technologies and solid waste management.

1.1.4 Phase I

Beginning in 2004, the County contracted with URS Corporation to conduct a preliminary evaluation of a range of conversion technologies and technology suppliers, and initiated efforts to identify material recovery facilities (MRFs) and transfer stations (TSs) in Southern California that could potentially host a conversion technology facility. A scope

beyond just Los Angeles County was considered important as stakeholders in the Subcommittee extended beyond Los Angeles County, and the implications of this effort will have many regional impacts.

In August 2005, the Task Force adopted the Subcommittee's *Conversion Technology Evaluation Report*. As more fully described in Section 2 of this report, Phase I resulted in identification of a preliminary short list of technology suppliers and MRF/TS sites, along with development of a long-term strategy for implementation of a conversion technology demonstration facility at one of these sites. The Department of Public Works and the Subcommittee intentionally pursued integrating a conversion technology facility at a MRF/TS site in order to further divert post-recycling residual waste from landfilling and take advantage of a number of beneficial synergies from co-locating a conversion facility at a MRF.

1.1.5 Phase II

In July 2006, the County contracted with Alternative Resources, Inc. (ARI) to further advance its efforts to facilitate development of a conversion technology demonstration facility (Phase II). The ARI team included multi-disciplined expertise, including Clements Environmental Corporation, Facility Builders and Erectors, Holland & Knight, and UltraSystems Environmental. Key Phase II services provided by the ARI team included:

- an independent evaluation and verification of the qualifications of selected technology suppliers and the capabilities of their conversion technologies;
- an independent evaluation of candidate MRF/TS sites, to determine suitability for installation, integration and operation of one of the technologies;
- a review of permitting pathways;
- identification of funding opportunities and financing means;
- identification of potential County incentives (i.e., supporting benefits) to encourage facility development amongst potential project sponsors; and
- negotiation activities to assist these parties in developing project teams and a demonstration project.

This report describes Phase II of the County's project to facilitate development of a conversion technology demonstration facility in Southern California, and represents a culmination of approximately one year of work conducted by the County and Subcommittee in conjunction with the ARI team.

1.1.6 Public Outreach

In January 2007, the County initiated efforts to develop and implement a public outreach and education plan for development of conversion technologies in Southern California. These public outreach efforts have been occurring integrally with the evaluations

described in this report. This report is not intended to address the details of the public outreach plan. However, the findings presented herein are intended to be shared through the public outreach program, to facilitate the development of a conversion technology demonstration facility.

1.1.7 Phase III (Long-Term Development of Conversion Technologies)

As described previously, Los Angeles County residents and businesses generate approximately 24 million tons of materials, with approximately 50% being diverted through source reduction and recycling away from disposal. This results in over 12 million tons of trash left for disposal every year, a number that is expected to continue to grow, despite waste reduction and recycling programs, due to continued population and economic growth in the region. With the certainty that in-County landfill capacity will run out in the long term, and will be substantially diminished in the short term, the County of Los Angeles recognizes the imperative to develop technically, economically and environmentally feasible alternatives to landfills within Los Angeles County.

The goal of the County's demonstration project (Phase II) is to forge permitting and legislative pathways for conversion technologies and promote development of future projects. Building on the experiences gained after the successful development of one or more demonstration projects in Phase II, the next logical step is a focus on development of commercial scale facilities using proven technologies within Los Angeles County. To facilitate this goal, future, Phase III activities may include the following:

- Re-evaluating the marketplace of conversion technologies to consider new and emerging developments and to continue to pursue development of the most technically and environmentally effective technologies, focusing on the identification of potential sites within Los Angeles County, including key potential sites identified in Phase II;
- Developing partnerships with local cities within Los Angeles County interested in the development of conversion technology facilities within or adjacent to their borders; and
- Facilitating development of commercial-scale conversion technology facilities designed to manage Los Angeles County's waste stream.

These activities can occur concurrently with the continued development of the Phase II demonstration projects.

1.2 THE COUNTY'S ROLE AS A PROJECT FACILITATOR

The County is promoting the development of a conversion technology demonstration facility by serving as a project facilitator. In this role, the County is effectively using its resources to promote project development in a variety of ways. In the work completed in Phase I and Phase II, the County has utilized the expertise of Department of Public Works staff, the Subcommittee, and its consulting teams to disseminate a wide range of information regarding conversion technologies, potential host locations, and project

development activities. Overall, the County is providing a framework to bring technology suppliers and MRF/TS site owners and operators together for development of a project.

As the County continues to support and promote conversion technologies and works to achieve development of a demonstration facility in Southern California, its role of facilitator is likely to evolve. Each technology supplier and MRF/TS site owner/operator may have different needs and priorities for facilitation of project development. As a facilitator, the County can consider discrete actions along with invested public and private partners, such as County Sanitation Districts Board of Directors and BFI, it can take and specific incentives it can offer to promote project development. There are a wide range of potential opportunities for County facilitation and support of a conversion technology demonstration facility. Some of these are essential support activities, such as providing for public waste supply agreements or for public "backing" of private waste supply agreements for the term of financing. Others are support activities that would facilitate project development, such as developing and sharing technology and site information, and promoting beneficial use of products. These potential opportunities for County support of a conversion technology demonstration facility are further addressed in this report.

1.3 REPORT STRUCTURE

This report describes Phase II of the County's project to facilitate development of a conversion technology demonstration facility in Southern California. The beginning sections of the report present background information and an overview of the scope and methodology of the study. This overview is followed by evaluations of the technology suppliers, technologies, and candidate sites, as well as an economic analysis of the conceptual projects proposed for Southern California and funding issues related to such projects. The final section of this report summarizes findings and presents recommendations. For reference, the specific sections of this report are as follows, with supporting information provided in appendices, as applicable:

- Section 1: Introduction
- Section 2: Overview of Phase I Study
- Section 3: Scope and Methodology of Phase II Study
- Section 4: Resources and Financial Qualifications of Technology Suppliers
- Section 5: Technology Evaluations
- Section 6: Site Evaluations
- Section 7: Permitting Pathways and Regulatory Issues
- Section 8: Project Economic Analysis
- Section 9: Project Financing and Funding Opportunities
- Section 10: Summary of Key Findings and Recommendations

SECTION 2 OVERVIEW OF PHASE I STUDY

This report, which presents the findings and recommendations of Los Angeles County's Phase II evaluation of conversion technology suppliers and potential MRF/TS host locations, builds upon the Phase I work completed by the Task Force and its Subcommittee, together with DPW and its consultant, URS Corporation, in August 2005. To provide perspective on the starting point for this Phase II Report, a brief overview of the Phase I *Conversion Technology Evaluation Report* is provided here. (The full report can be accessed from www.SoCalConversion.org.)

The County's Phase I study consisted of an identification and initial evaluation of conversion technologies that could be suitable for Southern California, including analysis, screening and ranking of technologies and technology suppliers. A large number of conversion technologies and suppliers were identified, covering a wide range of thermal, biological and chemical processes, including pyrolysis, gasification, plasma gasification, thermal depolymerization, aerobic and anaerobic digestion, hydrolysis-ethanol production, and many other technology types. The following minimum requirements were established for evaluating technology suppliers:

- **Minimum waste diversion rate** of 50%, when processing residuals from a MRF and/or TS.
- **Demonstrated processing experience** of at least a pilot scale facility, designed to process MSW or similar feedstock at approximately 5 tons per day (tpd) or greater, with at least one year of operating experience. During any one-year period, the technology must have processed at least 1,000 tons of MSW or similar feedstock.
- Capability to convert waste into **marketable products and byproducts**, other than only RDF or compost.
- **Compliance with all regulatory requirements** (i.e., air emissions) in the state of California.
- **Responsive** to the County's information request in a timely manner.
- **Willing and able to create a partnership** with the owner and/or operator of a MRF/TS in Southern California, for development of a demonstration project.
- Capability to develop a facility with a **minimum capacity to process 100 tpd of MRF residuals**.

Preliminary information was obtained from the technology suppliers using a questionnaire. Twenty-eight technology suppliers submitted a response to the questionnaire; of these, half passed the screening analysis, which incorporated the minimum criteria listed above. These fourteen technology suppliers were further evaluated and then ranked, using a matrix of weighted criteria established to evaluate the potential for the technology to meet project objectives (i.e., maximize environmental suitability, maximize technical performance, and minimize net cost).

The ranking criteria were as follows:

- Waste suitability
- Need for equipment scaling
- Marketability of products
- Expertise in system design
- Operational experience
- Economics
- Landfill diversion potential
- Supplier credibility (i.e., technical and financial resources)

The Phase I evaluation and ranking process resulted in a recommended shortlist of six technology suppliers, consisting of the four thermal technology suppliers that received the highest ranked scores and two waste-to-fuel emerging technologies that passed the screening criteria:

- Interstate Waste Technologies (IWT) - Pyrolysis/Gasification
- Primenergy LLC - Gasification
- NTech Environmental - Gasification
- GEM America - Flash Pyrolysis
- Changing World Technologies (CWT) - Thermal Depolymerization
- BRI - Gasification/Fermentation to Ethanol

The Phase I study recommended siting a conversion technology at an existing MRF/TS, because of the potential benefits of co-location (e.g., readily available feedstock, appropriate zoning, transportation avoidance, etc.). Therefore, the Phase I study also included evaluation of MRFs/TSs in Southern California, to identify sites that are compatible for partnership with a conversion technology supplier. A survey was used to identify existing facilities and gather information on key site characteristics and interest in the project. A limited number of facilities responded to the survey. Additional information was gathered from these interested MRF/TS facilities, to evaluate site characteristics against a dozen criteria generally representative of site conditions necessary for successful project development (e.g., adequate space, sufficient quantity and quality of residue for conversion feedstock, utility availability, etc.). As a result of this process, six facilities were identified as preferred locations for development of a conversion technology demonstration facility:

1st Priority Sites

- Del Norte Regional Recycling and Transfer Station (Oxnard)
- Robert A. Nelson Transfer Station and MRF (RANT) (Aqua Mansa)
- Perris MRF/TS (Perris)

2nd Priority Sites

- Central Los Angeles Recycling Center and Transfer Station (Los Angeles)
- Community Recycling/Resource Recovery, Inc. (Los Angeles)
- Proposed Santa Clarita MRF/TS (Santa Clarita)

In addition to identifying and evaluating technology suppliers and potential sites to host a facility, the Phase I study also included development of a long-term strategy for implementation of a conversion technology demonstration facility. Key steps in the strategic plan included: verification and evaluation of technology supplier qualifications and technology capabilities, including tours of reference facilities; evaluation of candidate MRF/TS sites and verification of their ability and willingness to partner with a technology supplier; and other facilitation activities, such as funding research, partnership negotiation activities, and public outreach support. These key steps in the strategic action plan were undertaken in Los Angeles County's Phase II study, and are described in this report.

SECTION 3 SCOPE AND METHODOLOGY OF PHASE II STUDY

3.1 INTRODUCTION

Phase II activities began in July 2006, and progressed steadily through the development of this report. The scope of Phase II work has consisted of implementation of key activities identified in the Phase I strategic action plan, including: verification and evaluation of technology supplier qualifications and technology capabilities; evaluation of candidate MRF/TS sites and verification of their ability and willingness to partner with a technology supplier; and other activities aimed at promoting and facilitating development of a conversion technology demonstration facility. The scope and methodology of the Phase II study is summarized below.

3.2 SELECTION OF PARTICIPATING TECHNOLOGY SUPPLIERS

Technology suppliers were selected to participate in Phase II based on:

- (1) The results of the Phase I evaluation and ranking;
- (2) Consideration of new and relevant information regarding technology performance and development, including ancillary capabilities of technology suppliers (e.g., integrating combined heat and power or alternative fuels in project development activities); and
- (3) The ability and willingness of the technology supplier to participate in Phase II, recognizing the substantial commitment to supply detailed information that would be required on their part. In addition to having the ability and willingness to partner with one of the candidate MRF/TS sites, the minimum commitment required of the technology suppliers included disclosure of technical, environmental and cost information for the technology, disclosure of technical and financial resources of the technology supplier, and identification of an operating reference facility.

Thirty-two technology suppliers were considered for participation in Phase II, including: the six technology suppliers previously short listed in Phase I; the eight technology suppliers that passed the screening criteria and were evaluated in Phase I, but at the time were not recommended for further evaluation; and eighteen additional technology suppliers that were not evaluated in the Phase I study, but had subsequently contacted Los Angeles County and expressed an interest in the County's conversion technology demonstration project. The technology suppliers that were considered for participation in Phase II are identified in Table 3.2-1. As described in the text following Table 3.2-1, the eighteen additional technology suppliers were evaluated using the minimum criteria established for the Phase I screening and applied to the other technologies, with a more stringent requirement for diversion potential.

Table 3.2-1. Technology Suppliers Considered for Participation in Phase II

Technology Suppliers Recommended (Shortlisted) in Phase I Report	"New" Technology Suppliers not Evaluated in the Phase I Report ⁽¹⁾
Interstate Waste Technologies Primenergy NTech Environmental GEM America Changing World Technologies BRI Energy	Allan Environmental* Arkenol/BlueFire Ethanol* Choren BTL/ANRTL, LLC Cleansave Waste Corporation* Eco Waste Solutions EnerTech Environmental, Inc.* EnviroArc Technologies/Nordic American*
Technology Suppliers Passing the Phase I Screening Criteria but not Recommended in the Phase I Report	Enviro-Tech Enterprises, Inc. Global Alternative Green Energy (GAGE)* Global Recycling Group, LLC*
Arrow Ecology and Engineering Canada Composting Ebara Corporation Geoplasma LLC Green Energy Corporation International Environmental Solutions Organic Waste Systems Waste Recovery Systems	Harold Craig Herhof GmbH* Integrated Environmental Technologies* Prime Environmental International Recycled Refuse International* Wastes Conversion Company World Waste Technologies, Inc. Zero Waste Energy Systems*

(1) The 18 technology suppliers identified as "new" were sent a questionnaire in September 2006, soliciting information on their technologies. The 11 identified with an asterisk (*) responded to the County's questionnaire.

The methodology for considering the three groups of technology suppliers listed in Table 3.2-1 is summarized below, with supporting documentation provided in Appendix A.

- In August 2006, a letter was sent to the six technology suppliers previously short listed in Phase I, to confirm their willingness and ability to participate in the Phase II process. All six technology suppliers responded affirmatively, and were recommended as participating technology suppliers.
- In August 2006, a letter was sent to the eight technology suppliers that passed Phase I screening, but were not recommended at the time. The purpose of the letter to these eight technology suppliers was to determine their interest in the Phase II process, and to provide the opportunity for disclosure and evaluation of new and relevant information regarding technology performance and development that may have occurred subsequent to the Phase I evaluation. In disclosing new information, the technology suppliers were asked to address factors that impacted their ranking in Phase I as well as specific issues unique to their technologies. Based on the responses received, three of these eight technology suppliers were recommended for participation in Phase II, due to

demonstration of further technology developments and/or confirmation of the availability of relevant new information:

- Arrow Ecology identified recent technology developments for its unique, two-stage wet anaerobic digestion technology, demonstrating it overcomes certain disadvantages of other anaerobic digestion technologies (e.g., greater diversion from landfill disposal, generation of less compost and more biogas, smaller facility footprint). Arrow Ecology also documented commencement of construction for a new facility in Australia, and demonstrated preliminary partnership activities with one of the sites on the County's Phase I list of MRFs/TSSs.
- Ebara Corporation demonstrated significant commercial experience in Japan with their TwinRec/TIFG technology, with active development activities for the next generation of the technology, which would allow for collection of the synthesis gas to enable cleaning of the gas, as applicable, and use of the gas for generation of electricity or fuels.
- International Environmental Solutions demonstrated the formation of strategic alliances with Northern Power Systems (for facility design and construction) and Rainbow Disposal (for integrating and optimizing a pre-processing system). IES also confirmed that it has made significant progress in developing and validating its technology since completion of the Phase I evaluation, include a 14-day, 24/7 test with post-MRF residuals and South Coast Air Quality Management District source testing.
- In September 2006, a letter with a questionnaire was sent to the eighteen new technology suppliers that were not evaluated in Phase I. The questionnaire established minimum criteria for participation, and requested basic information on the technology supplier and technology offered to confirm that the minimum criteria were met. The minimum criteria were based on those established in Phase I, but the diversion potential was increased from a minimum of 50% to a minimum of 75% in consideration of the experience and capabilities of the top-ranked technology suppliers. Eleven technology suppliers responded to the questionnaire. Based on the responses, none of these technology suppliers were able to fully demonstrate compliance with the minimum criteria. Most were not able to demonstrate sufficient operating experience, and many did not provide information on an operating reference facility. As a result, none of these additional technology suppliers were recommended for participation in Phase II.

Ultimately, nine technology suppliers were selected for participation in Phase II, including the six that were recommended in Phase I and three additional technology suppliers that were evaluated in Phase I but not recommended at the time (Arrow Ecology and Engineering, Ebara Corporation, and International Environmental Solutions). The nine technology suppliers that were selected for participation, listed in alphabetical order, are identified in Table 3.2-2.

**Table 3.2-2. Technology Suppliers
Selected for Participation in Phase II**

Technology Supplier
Arrow Ecology and Engineering (Arrow)
Bioengineering Resources (BRI)
Changing World Technologies (CWT)
Ebara Corporation
GEM America
International Environmental Solutions (IES)
Interstate Waste Technologies (IWT)
NTech Environmental (NTech)
Primenergy

After selection of the participating technology suppliers, a Request for Information (RFI) was issued to the nine selected participants. During the RFI response period, four of the nine selected technology suppliers chose to withdraw from the process for a variety of reasons on their part. The four that withdrew were BRI, Ebara Corporation, GEM America, and Primenergy. Therefore, the Phase II process proceeded with a final list of five technology suppliers, which are listed alphabetically in Table 3.2-3.

Table 3.2-3. Technology Suppliers Participating in Phase II

Technology Supplier	Technology Type
Arrow Ecology and Engineering (Arrow)	Anaerobic Digestion
Changing World Technologies (CWT)	Thermal Depolymerization
International Environmental Solutions (IES)	Pyrolysis
Interstate Waste Technologies (IWT)	Pyrolysis / High Temperature Gasification
NTech Environmental (NTech)	Low Temperature Gasification

3.3 METHODOLOGY FOR TECHNOLOGY EVALUATION

Information required for the technology evaluation and for evaluation of the resources and qualifications of the technology suppliers was gathered through a detailed Request for Information (RFI). The RFI described Los Angeles County's objectives for the demonstration project, and disclosed the technical, economic, and qualifications criteria that were established for the Phase II evaluation process. The RFI also identified the candidate MRF/TS sites, provided contact information for the MRF/TS site owner/operators along with key site information, and provided waste composition assumptions. The RFI was issued in October 2006, and responses were received in December 2006. A copy of the RFI is provided in Appendix B. The evaluation criteria are identified later in this report, as a preface to the review of resources and financial qualifications of the technology suppliers (Section 4) and the technology evaluations (Section 5).

In January 2007, after submittal and initial review of the RFI responses, interviews and working meetings were conducted with each of the technology suppliers in Los Angeles. This direct interaction with the technology suppliers provided the opportunity to confirm information and gather additional data and materials as needed. Throughout the review process, direct interaction and coordination with the technology suppliers continued, including visits to reference facilities from February through April 2007, to ensure the most accurate and complete information was available for review. Upon analysis of information obtained during the presentations and site visits, preliminary findings were summarized and a workshop was conducted with the Subcommittee to review and discuss the preliminary findings. Following the Subcommittee's review, the preliminary findings were shared with the technology suppliers in June 2007, to provide a final opportunity for data confirmation and input. That input is reflected in this report, as appropriate.

3.4 SELECTION OF CANDIDATE SITES

As summarized in Section 2, the Phase I study recommended six MRF/TS facilities as preferred locations for development of a conversion technology demonstration facility. Early in the Phase II process (July 2006), the owner/operators of the six potential sites were contacted and site visits were conducted to determine interest in continued participation in the County's demonstration project. Four of the original six sites expressed a willingness and ability to participate. Two of the sites, both identified in Phase I as "second priority" sites, dropped out: the Central Los Angeles Recycling Center and Transfer Station (CLARTS), because it is a potential site for the City of Los Angeles conversion technology project, and the proposed facility in Santa Clarita, because of uncertainty regarding the approval of the entire industrial development that would have encompassed the MRF/TS. Late in the Phase II process, a new MRF was added to the project, specifically in consideration of their relationship with one of the selected technology suppliers (International Environmental Solutions). This additional MRF (Rainbow Disposal in Huntington Beach) was evaluated under this project exclusively in partnership with IES. The five MRF/TS sites evaluated in Phase II are identified in Table 3.4-1, listed in alphabetical order.

Table 3.4-1. MRF/TS Sites Evaluated in Phase II

MRF/TS Facility	Location
Community Recycling/Resource Recovery Inc.	Los Angeles County (Los Angeles)
Del Norte Regional Recycling and Transfer Station	Ventura County (Oxnard)
Perris MRF/Transfer Station	Riverside County (Perris)
Rainbow Disposal Company, Inc. MRF ⁽¹⁾	Orange County (Huntington Beach)
Robert A. Nelson Transfer Station and MRF	Riverside County (Unincorporated)

(1) The Rainbow Disposal MRF was evaluated under this project exclusively in partnership with IES.

3.5 METHODOLOGY FOR SITE EVALUATION

As further described in Section 6 (Site Evaluations), criteria were established to evaluate the suitability of each facility to host a conversion technology demonstration facility. The criteria included the fundamental prerequisite of ability and willingness to partner with a technology supplier for development of a demonstration facility, along with primary criteria (e.g., space availability, feedstock quantity) and secondary criteria (e.g., ability to assist in marketing products, accessibility to major transportation routes). Information required for site evaluations was gathered through a series of site visits and meetings with each of the individual site owner/operators. The criteria that were established for the Phase II site evaluations (see Section 6.3) provide a template that may be useful by other entities that are similarly working on development activities for a conversion technology project.

3.6 REFERENCE FACILITY TOURS

Reference facility tours were an important component of the Phase II technology evaluations. The tours provided the opportunity to gather and confirm technology-specific information, and to gather valuable insight for development of a demonstration project in Southern California. Benefits of visiting the reference facilities included the ability to:

- Inspect and observe the facilities in operation, first-hand;
- Confirm the type of waste processed and compare the waste streams;
- Evaluate the generation and management of products and byproducts;
- Assess applicability and interface issues in consideration of co-location of a conversion technology at a MRF/TS in Southern California;
- Observe waste collection and handling practices;

- Observe site design and operational practices for ensuring employee occupational health safety and efficient operation;
- Observe public education practices, including facility design elements associated with educational tours;
- Observe the locational and aesthetic aspects of the facility, and its integration into the surrounding area and wider community; and,
- Meet with local regulators and other stakeholders.

Each participating technology supplier was required to identify an operating reference facility that could be visited to observe the technology. Members of the Subcommittee, Department of Public Works staff, and representatives of the ARI team participated in the tours, which took place from February through April 2007. When possible, meetings were also held with regulators and local government officials to gather insight regarding the development and operational history of the facilities. Table 3.6-1 identifies the reference facilities that were visited. Additional information on the reference facilities and relevant findings from the tours and meetings are integrated with the technology evaluations (Section 5).

Table 3.6-1. Reference Facility Visits

Technology Supplier	Reference Facility Visited (Location)	Date
Arrow Ecology	Hiriya, Israel	March 12, 2007
Changing World Technologies	Carthage, Missouri	April 25, 2007
International Environmental Solutions	Romoland, California	February 15, 2007
Interstate Waste Technologies	Chiba, Japan Kurashiki, Japan	April 2, 2007 April 3, 2007
NTech Environmental	York, England (pre-processing) Bydgoszcz, Poland (gasifier)	March 7, 2007 March 9, 2007

3.7 OTHER ACTIVITIES

In addition to conducting technology and site evaluations, Phase II also included parallel activities related to facilitation of partnerships and project development. A meeting was held in January 2007 with the South Coast Air Quality Management District (SCAQMD), to discuss conversion technologies and address permitting pathways and regulatory issues (see Section 7). Project financing and funding opportunities were addressed, including research on grants and funding opportunities from private and public sources as well as the possibility of financing through the issuance of bonds or special appropriations. In addition, meetings were held in May 2007 in New York City with bankers and financial advisors associated with the technology suppliers to solicit more information on financing requirements (see Section 9). Finally, initial negotiation efforts were conducted to facilitate partnerships between the technology suppliers and site owner/operators, including discussions regarding incentives the County may be able to offer that would be beneficial to the project participants (see Section 10).

SECTION 4 RESOURCES AND FINANCIAL QUALIFICATIONS OF TECHNOLOGY SUPPLIERS

4.1 INTRODUCTION

For the purpose of evaluating technology supplier qualifications, the Phase II RFI established criteria and requested information regarding the technology supplier and its team's business structure and organization, financial information, and other similar background information. The information provided was used to develop an understanding of each technology supplier regarding the following characteristics:

- **Corporate and team resources**, including:
 - business operations, business history and ownership structure, teaming arrangements or other strategic alliances that are pertinent;
 - the capability of the technology supplier to design, permit, construct, and operate a conversion technology project, considering the management structure and organization;
 - relationship with the proposed technology (e.g., ownership and/or license arrangements, other parties involved in the technology development and ownership, etc.); and,
 - the capability of the technology supplier to finance and meet the financial risks and obligations associated with the design, permitting, construction and operation of a conversion facility.
- **Financial security and risk considerations**, including the technology supplier's experience in offering single source guarantees and other financial security techniques; and the technology supplier's risk posture on matters such as financing, construction and facility performance, and product generation and sale.
- **Financing approach**, including the demonstration by a technology supplier of its understanding of, experience with and arrangements it might bring to finance a prospective project, recognizing that formal financing would be finalized in a subsequent stage of project development.

The evaluation criteria applied can be found in Attachment 3 of the October 2006 Request for Information, in Appendix B of this report. The criteria provide a template that may be useful for future evaluations, and are available for public usage.

The objective for the evaluation of technology supplier resources and financial qualifications was to develop a profile of prospective project developers. The information requested in the RFI was consistent with this objective. It should be noted that the depth of the information provided in the RFI responses was less than what would be expected in a formal procurement. In responding to a Request for Proposals, a proposer would be required to provide a formal proposal - with a firm price and schedule for delivery of

services along with technical, environmental and financial information to sufficiently demonstrate that the service and performance requirements could be met for the prescribed terms and conditions of the contract. This typically requires sufficient design to develop firm pricing. The level of detail in the responses to Los Angeles County's Phase II RFI also reflects the nature of the emerging technologies market, with many of the technology firms in various stages of initial development in the U.S. marketplace. Several technology suppliers have, however, teamed with large firms in the U.S. experienced in the waste and energy businesses. This adds to the strength of those overall teams.

The RFI responses and subsequent evaluation assumed that any project(s) developed would be privately owned and financed. While there may be incentives and certain support that the County can provide, financability will ultimately be determined by the finance market, and the details of project structures and risk profiles may be more at the call of the market than at the County's discretion. Since these projects are likely to be private transactions, this is not necessarily an adverse condition. As privately financed, developed and managed projects, proper structuring will shift most risks to the private parties involved, lowering the County's risk.

Additional due diligence will be required in the next step of the program, when the County considers selection of one or more site-specific conversion technology demonstration projects to support. A significant portion of such information will become available as the technology suppliers and participating MRFs move forward in the development of partnerships, specific project definition and financing arrangements.

4.2 CORPORATE AND TEAM RESOURCES

The information that was requested by the RFI is important from several perspectives. First, it indicates the nature and business history of each company in the municipal solid waste business, including its experience with the offered technology. Second, it characterizes the relationship of each company with the technology (e.g., as licensee or developer/owner), which has implications regarding the availability of the technology, the permanency of the relationship and a company's long-term access to technical support. And finally, it provides an indication of each company's familiarity with and understanding of the U.S. solid waste market's standard industry practices.

4.2.1 Technology Supplier Teams

Typically, the teams assembled for MSW projects include the following key participants:

- Project developer to lead the development team, select the team members, manage and coordinate project development activities and construction and operation of needed facilities, and be the single point of responsibility to the customer (i.e., the party contracting with the project developer) for delivery of services. For the purpose of this report and the contemplated demonstration project, the project developer is considered to be the technology supplier, with the MRF/TS owner as a partner.

- An engineering, procurement and construction (“EPC”) contractor, which would be responsible for designing the facility, procuring equipment, and constructing and participating in the start-up of the facility. The EPC contractor would be at risk for and provide guarantees on construction cost and schedule. The EPC contractor would also guarantee acceptance testing and initial performance. For the purpose of this report and the contemplated demonstration project, the EPC contractor would provide these services and guarantees to the project developer.
- A facility operator, which would be responsible for operating and maintaining the facility according to contract-set requirements (which would typically include technology-specific requirements, manufacturers’ guidelines, standard industry practices, and regulatory requirements). The operator could be the project developer (i.e., the technology supplier), or an operations company that is under contract to the project sponsor. If a contract operator other than the project developer were involved, it would provide operating performance and cost guarantees to the project developer, including guarantees on the production or recovery of products such as energy and secondary materials over the contract term.
- A guarantor, which would provide the ultimate guarantee on the costs and performance of the project to the customer contracting with the project developer for services. Typically, the guarantor’s position would be supported by guarantees provided by its EPC and operations contractors, as well as by other security measures such as bonds and comprehensive insurance coverage. Bank-issued letters of credit may also be included in the overall guarantee and security package. The guarantor could be the project developer and/or a parent company of the project developer.
- An investment banker, which would be responsible for developing the financing plan for the project and for securing the financing. The investment banker would perform significant due diligence on the principal aspects of the project (such as the technology, team members, waste supply assurance, product markets and contract terms and conditions) to assure that a financable project is being configured. Typically, the investment banker included on a project team has a long-standing relationship with, and has participated in other projects with, the project developer.

Table 4.2-1 identifies the technology suppliers and their teaming partners, as of June 2007. In evaluating this project structuring, it is important to consider the qualifications and resources of the team as a whole, since each team member has a specific role in ensuring the project’s success, and in the case of the EPC contractor and operator, provides significant guarantees to the project developer. As indicated in a footnote to Table 4.2-1, the composition of individual teams could change as technology suppliers begin site-specific project development activities and identify additional development needs.

**Table 4.2-1. Technology Supplier Teams
(Listed Alphabetically)**

Technology Supplier (Project Developer)	Teaming Partners ⁽¹⁾	
Arrow Ecology and Engineering (Arrow) Development Partner: CR&R	EPC: Operator: Guarantor: Banker: Technology:	Siemens (international engineering/ construction firm with US experience) Arrow Not Specified Investec Bank Developed and patented by Arrow
Changing World Technologies (CWT)	EPC: Operator: Guarantor: Banker: Technology:	Not Specified CWT CWT Goldman Sachs Exclusive worldwide license of depolymerization technology
International Environmental Solutions (IES) Development Partner: Northern Power Systems (NPS)	EPC: Operator: Guarantor: Banker: Technology:	Northern Power Systems (diverse US energy equipment and services provider) IES/NPS Distributed Energy Systems Corp. Morgan Stanley Developed and patented by IES; Northern Power exclusive US distributor
Interstate Waste Technologies (IWT)	EPC: Operator: Guarantor: Banker: Technology:	SNC Lavalin (international engineering/ construction firm with US experience); Thermosteel will design gasification component Veolia Environment (international infrastructure facilities operator with significant number of US MSW – waste- to-energy – projects) Interstate Business Corporation (Related Company) Morgan Stanley Developed and patented by Thermosteel; IWT has license for US, Mexico, Caribbean countries
NTech Environmental	EPC: Operator: Guarantor: Banker: Technology:	EMCOR (international engineering/ construction firm with US experience) NTech Environmental Not Specified New Century Finance Ltd. All major elements under exclusive agreement or license

(1) Team make-up as of June 2007 - the composition of individual teams could change as technology suppliers begin site-specific project development activities and identify additional development needs.

Based upon the information provided by the technology suppliers, and summarized in Table 4.2-1, the following can be concluded:

- The technology suppliers have different levels of financial resources and experience in developing projects, internationally and in the U.S. Some have commercial operating facilities overseas; others do not. All have yet to develop a commercial MSW conversion technology facility in the U.S. To fill this gap, and of key importance to the success of the conversion technology project, the technology suppliers have assembled teams with experienced EPC contractors, operators and banking institutions. In addition, partnering with MRF/TS owners/operators will add technical and financial resources and important knowledge of local practices and requirements. For example, Arrow, IWT and NTech Environmental, particularly, have selected major international engineering and construction companies with U.S. experience. IES's development partner, Northern Power Systems, is an experienced energy project EPC. CWT did not identify an EPC, but its team includes an experienced investment banker, and it has represented that it has worked with a major international EPC on other projects.
- All of the technology suppliers offer the advantage of being the developers/owners, licensees or sole representatives of what can be considered to be proprietary technology (i.e., they are not simply purchasers of individual equipment components from suppliers). Familiarity and experience with the technologies and, the proprietary, integrated nature of the technologies, will help assure the technology supplier's success in planning, implementing and operating facilities.
- Because of their close relationships to the technologies, all of the technology suppliers have long-term access to technical support, which will enable them to resolve difficulties that may arise over time or to benefit from technical enhancements that may be developed in later years. Given that many of the technologies have been developed and applied outside of the United States, the ease of access to technical support from non-U.S.-based providers should be addressed prior to Los Angeles County's commitment to a technology. Techniques such as requiring U.S. resident presence by the technology owner/licensor can be effective in this regard.
- All of the participating companies appear to have invested heavily (and to continue to invest) in the development, refinement and/or marketing of their technologies.

4.2.2 Team Financial Resources

The RFI requested data for the past five years on financial performance indicators, as well as summary discussions of financial resources. Financial resources and capabilities are important because they indicate the ability of a company to finance a project and to bear the financial risks associated with project development and operation, particularly of a

privately owned and operated facility, and to provide meaningful and enforceable guarantees. The information provided by the technology suppliers is summarized in Table 4.2-2.

As shown in Table 4.2-2, when considering these financial resources, the technology suppliers are relatively small companies (assets measured in millions as compared to companies with assets of a billion dollars or more). However, the inclusion of major experienced engineering and construction firms operators and bankers, and teaming with MRF/TS owners enhances the technology suppliers overall project-related financial resources and capabilities. In structuring financings, lenders will give considerable weight to the overall capabilities of project teams and the manner in which the capabilities, resources and guarantees of individual members complement or augment those of other members.

Table 4.2-2. Corporate and Team Resources Summary

Company	Summary Information
<p>Arrow</p> <p>Developer: Arrow & CR&R EPC: Siemens Operator: Arrow Guarantor: not specified Banker: Investec Bank</p>	<ul style="list-style-type: none"> • Arrow: 8+ years experience; founded 1999 (spin-off of technology developer founded in 1974) • Arrow: Annual planned losses 2001-2005 (development mode); profitable in 2006 (Australia project), but associated net worth for 2006 not provided; low annual revenues • Arrow: reported to be negotiating new corporate funding arrangement • Siemens (EPC) is an international engineering and construction firm with US experience: \$118 billion in annual revenues • Bonds and insurance from AON, an international risk manager and insurer, with \$9 billion in annual revenues
<p>CWT</p> <p>Developer: CWT EPC: not identified Operator: CWT Guarantor: CWT Banker: Goldman Sachs</p>	<ul style="list-style-type: none"> • CWT: 10 years experience; founded in 1997 • CWT: +/- 10% owned by Goldman Sachs • CWT: Net worth +/- \$29 million • CWT: \$14 million in Federal development grants • CWT: continues to carry losses but has significant asset and net worth growth
<p>IWT</p> <p>Developer: IWT EPC: SNC Lavalin Operator: Veolia Environment Guarantor: Interstate Business Corporation (related company) Banker: Morgan Stanley</p>	<ul style="list-style-type: none"> • IWT: 15+ years experience; founded in 1990 • IWT: Significant project pursuit/development experience • IWT: Puerto Rico project moving toward closing (will add experience and revenue) • IWT: Revenues (\$2.4 million, 2005); 2005 net worth \$7.1 million • IWT: Guarantor's annual revenues +/- \$24 million, net worth \$46 million • SNC Lavalin (EPC) is an international engineering and construction firm with US Experience: \$3.5 billion annual revenues • Veolia (Operator) is an international operations form with significant US MSW projects: \$2.3 billion annual revenues • Bonds and insurance from AON, an international risk manager and insurer, with \$9 billion in annual revenues

Company	Summary Information
<p>IES/NPS</p> <p>Developer: IES/NPS EPC: Distributed Energy Operator: IES/NPS Guarantor: Distributed Energy Banker: Morgan Stanley</p>	<ul style="list-style-type: none"> • IES: 15 year investment in technology development • IES: net worth/revenues not provided • IES: first commercial unit on line Summer 2007 • IES: alliances with Rainbow Disposal (project development), Air Products (hydrogen production technology) • Northern Power: Founded in 1974 (as North Wind Power Company, Inc.) • Northern Power: wholly owned by Distributed Energy Systems Corporation (NASDAQ-traded), a 2003 combination of NPS and Proton Energy Systems – strong energy project experience/experienced EPC • Distributed Energy’s revenue doubled 2004-2005 to \$45 million, 2005 net worth of \$85 million • Distributed Energy has continuing losses due to planned investment in corporate build-out (\$3 - \$5 million/year R&D)
<p>NTech Environmental</p> <p>Developer: EPC: EMCOR Operator: Guarantor: not specified Banker: New Century Finance Ltd.</p>	<ul style="list-style-type: none"> • NTech: experienced team members/subcontractors/equipment suppliers • NTech: projects operating in UK, Canada, Germany, Mexico • NTech: merged with E Renewable Energy (principal technology partner, net assets of US \$3.4 million) • EMCOR (EPC) is an international engineering and construction firm with US experience: \$5 billion annual revenues • Bonds and insurance from AON, an international risk manager and insurer, with \$9 billion in annual revenues

4.3 FINANCIAL SECURITY AND RISK CONSIDERATIONS

Although specific transactions and contractual terms and conditions have not been formally defined yet, the technology suppliers were asked to discuss their general postures regarding project risks. As discussed below, when viewed from the perspective of established U.S. industry practice for private parties involved in MSW projects, several conclusions can be drawn based on the information provided by the technology suppliers.

- **Project Cost and Performance Guarantees.** The industry standard in the U.S. market is the provision of “single-source” or corporate guarantee, through which one entity provides all of the schedule, cost and performance guarantees to a customer. Typically, those single-source guarantees to the customer are supported by cost and performance guarantees provided by the major design, construction and operations team members to the project developer. All of the participating companies recognized the importance of the “single-source” approach to the provision of construction, operation, performance and financial guarantees. The guarantees that the partners (who are accustomed to providing such) would provide to the technology suppliers (as the project developers) would, ultimately, be significant backstops for any guarantees provided directly by the project developers.

- **Security Instruments.** As is standard in the US market, single-source or corporate guarantees are typically paired with comprehensive performance bond and insurance packages. All of the technology suppliers acknowledged the need for such customary project security, with several specifically identifying their bond and insurance providers. It should be recognized that the very ability of a project developer to provide such security arrangements is, in itself, an indicator of financial capability, since bond and insurance providers will not write policies for clients that do not meet the providers' financial standards.

- **Commercial Product Market Risks.** The U.S. industry standard is that the project developer bear the risks associated with the production of marketable products (i.e., energy and secondary materials). Customarily, this requires the developer to take the risks regarding the quality and quantity of products produced or recovered (for example, that the project will generate a guaranteed amount of electric power or that it will recover a guaranteed volume of ferrous metals). These types of risks are usually not insurable and must be borne directly by the project. In some cases, the developers take the risks that energy or materials will be sold at certain prices. In the absence of defined project structures and contractual bases, the technology suppliers indicated that specific risk arrangements would be the subject of continuing development and negotiation. However, they generally recognized the importance of their risk taking regarding the commercial product risks. Their specific responses varied, as follows:
 - Arrow did not specifically address product risks;
 - CWT indicated that its risk profile would be determined, in part, by the financial returns it could expect;
 - IES/NPS indicated that actual performance and risk issues would be determined once the MSW specification was confirmed;
 - IWT stated that it would guarantee the production of recycled products of marketable quality and would pass through revenues to its customer;
 - NTech Environmental stated that its risk posture would be determined in part through due diligence that would be conducted by its funders and insurance underwriters.

Consistent with their positions on the need for further negotiation of product risk postures, several of the technology suppliers also indicated that specific risk postures and guarantees would be conditioned on assurances regarding the availability and specific characterization of the waste streams they would be processing. This degree of specificity will be provided in the next step of project development, where technology suppliers team with MRF/TS owners and operators and integrate their system with the specific waste supply and separation systems of the MRF/TS.

- **Financial Market Considerations.** All of the investment bankers identified by the technology suppliers have experience with the financing of MSW projects. Considerable confidence can be placed in the due diligence that would be performed by potential lenders and investors who, for their own purposes, would look to structure projects as securely as is practicable. The technology supplier's bankers have indicated that they believe that most risks can be addressed at the project level, and have also indicated that they are generally comfortable regarding key risk areas as technology capabilities and performance and construction risk.

Given the responses of the technology suppliers, the key financing issues that must be resolved are waste assurance and supportable tipping fees that are market competitive (see Section 9). The technology suppliers acknowledge and intend to follow standard U.S. industry practice in structuring projects. However, as project development continues, the guarantee and risk postures required for County support of individual projects should be clearly defined.

4.4 FINANCING APPROACH AND EXPERIENCE

With the assumption that any project resulting from this process would be privately financed, owned and operated, technology suppliers were requested to discuss their experience in financing projects and their ideas regarding a prospective demonstration project.

The working assumption of private finance and ownership is founded in part on the long experience of the private financing, ownership and operation of projects in diverse public infrastructure fields, including solid waste, water and wastewater treatment, and biosolids management. Private financing techniques for infrastructure projects are well established.

MSW projects are usually funded as "project financings." In the public infrastructure market, there are two principal types of financings, "general obligation financing" and "project financing." General obligation financing is typically used when the facility being financed does not have a specific or discrete revenue source (such as a new school building), and is paid for out of general tax revenues. Project financing is typically used when the facility does have a revenue source, such as a water system (which would have user rates paid by consumers) or an MSW facility (which would levy tipping fees for the disposal of MSW and receive revenues associated with sale of energy and/or marketable products). Project financing approaches can be applied to either publicly-owned projects or privately-owned projects. Publicly-owned projects can be financed with 100% debt (i.e., all of the money needed to construct the system can be borrowed, usually with most debt through tax-exempt bond issues). Project financings for privately-owned infrastructure projects typically require that the private owner invest its own capital or equity in the project (analogous to a homeowner's down payment on a home mortgage). This is required in order to reduce the amount of money borrowed and, thus, reduce the lender's risk. The amount of equity required will depend upon the lender's analysis of the amount of risk involved in any individual project: the more risk perceived, the more equity will be required. Typically in the public infrastructure market, lenders require an equity investment (a "down payment") of between 15% and 30% of total project design and

construction costs, establishing, for example, a “debt-to-equity ratio” of 85%/15%. Private financing, with private ownership, can be accomplished for MSW projects using tax-exempt bonds, if IRS requirements can be met and volume cap (established for such purposes) is available. Private financing can also be accomplished with 100% equity financing and by commercial loan. Both of these later financing methods would have a higher lending rate than a private activity based financing. Therefore, tax-exempt, private activity project financings are likely to be the least costly means of financing, resulting in a lower tipping fee.

All of the technology suppliers acknowledged the preference for private finance and ownership. Four of the technology suppliers (Arrow, IES, IWT, and NTech) either have financed projects using customary solid waste project financing techniques, are in the process of structuring financings for projects being implemented, or are in the process of developing funding mechanisms with financial institutions. Changing World Technologies used private investment capital (equity) combined with Federal grants to fund its Carthage, MO project. The RFI did not require the submission of formal financing plans and, as could be expected, the commitment of all technology suppliers and their financial advisors to private financing and ownership was made contingent on the further definition of a project(s) and the negotiation of satisfactory waste supply, tipping fee, “off-take” (energy and materials sales) arrangements and contracts.

Every technology supplier expressed confidence in the ability to finance the project(s) contemplated, conditioned upon the type of waste supply and energy sales contractual arrangements that are customary in the US solid waste market. All of the technology suppliers are working with (or have worked with) experienced investment bankers and/or financial advisors, although two (Arrow and NTech) referenced the involvement of non-US institutions. All technology suppliers except CWT specifically mentioned the structuring of customary debt/equity project financings that would combine private investment capital with debt. The debt could be in the form of a commercial type of loan or another form, such as a bond issue. While referencing this type of financing, CWT also mentioned the potential use of 100% equity financing to finance the first, demonstration phase of its project.

Further discussions follow for the individual technology suppliers:

- **Arrow Ecology.** Arrow reported that it raised \$12 million from local partners and Israeli banks to finance the development of its Tel Aviv plant. It also reported that, working with ANZ Investment Bank (based in Australia), it was able to finance its facility in Australia. Arrow also provided a letter of interest from Investec Bank, Ltd. (Australia) to either provide or arrange for debt and equity financing, subject to credit approval, and indicated some level of partnership involvement by the MRF owner, CR&R, to be defined.
- **Changing World Technologies.** CWT has retained Goldman Sachs as its financial advisor. The company cited its success in raising corporate development funding, as well as Federal development grants. CWT stated that it is “comfortable that there are a number of different debt and equity sources that could be identified for this opportunity,” but did not provide any more

material discussion or information, and stated that no predetermined financing arrangement had been set. CWT did state that it anticipates working with Los Angeles County to obtain state and/or federal grants and to access municipal (tax-exempt) financing. CWT's Carthage, MO facility, an industrial application, was funded primarily through equity, with some grant funds applied. CWT's estimated tipping fees for a demonstration project in Southern California are based on an assumed all-equity financing.

- **International Environmental Solutions.** IES's associate, Northern Power Systems (NPS), a wholly-owned subsidiary of NASDAQ-listed Distributed Energy Systems Corp., would own the project. NPS stated that it had established a separate division and fund to fund debt and equity for its projects, with anticipated financings typically with a 70/30 debt-to-equity ratio. As an example of its capability to provide financing, the company also cited its provision of leasing arrangements to its industrial customers.

NPS reported that it is in the final stages of concluding a formal agreement with a major investment firm to establish an investment fund for these types of projects. It is intended that this fund will provide the equity for numerous projects, and NPS reports that the initial fund size will be in the hundreds of millions of dollars. NPS and this firm have executed a letter of intent for this fund, with the final term sheet to be concluded in the near future. This same firm will be providing the debt financing for these projects. NPS also stated that several other financial institutions have expressed interest in funding these projects should the first firm decline to participate.

- **Interstate Waste Technologies.** IWT's stated business plan is to privately finance, own and operate conversion technology facilities. The company reported that it is currently involved in financing a \$660 million project in Caguas, Puerto Rico (\$475 million construction, \$185 million soft costs), and had, as a part of formal proposals, offered to finance another facility in Puerto Rico and one in Collier County, FL. It characterizes the Caguas transaction as a conventional project financing based on an equity investment of approximately 13%, with the balance of funds provided by a combination of taxable and tax-exempt bond debt. Equity sources are IWT and its investors. The financing plan for the Caguas project has been completed, and closing is anticipated for the third quarter of 2008. It conceived of a similar financing structure for a prospective demonstration project in Southern California, and included a letter of interest from Morgan Stanley in placing the taxable and tax-exempt debt that would be used in a financing (Morgan Stanley is also working with IWT on the Caguas, Puerto Rico project).
- **NTech Environmental.** NTech Environmental stated that it had arranged debt financing (apparently for both corporate development and project purposes) through two institutions, RoyCap Merchant Banking Group (Toronto, ON, Canada) and New Century Finance Ltd (United Kingdom). NTech also reported that it has developed projects in the United Kingdom, Mexico, Canada and Germany. NTech provided letters of interest and support regarding project

financing from both of these groups (as could be expected, both conditioned on the need for satisfactory contractual arrangements).

A discussion of project financing requirements developed through discussions and meetings with the technology supplier bankers is provided in Section 9 of this report. The ability to satisfy such requirements will have a significant impact on the financing of the project(s) and the resulting financing costs.

Given the experience and corporate and team resources of the technology suppliers, and assuming that the types of financing requirements that are identified in Section 9 can be achieved, our analysis concluded that the technology suppliers are capable of structuring financable projects using customary US solid waste market project financing techniques.