2012/2013 MARIN COUNTY CIVIL GRAND JURY

Garbology in Marin: Wasted Energy

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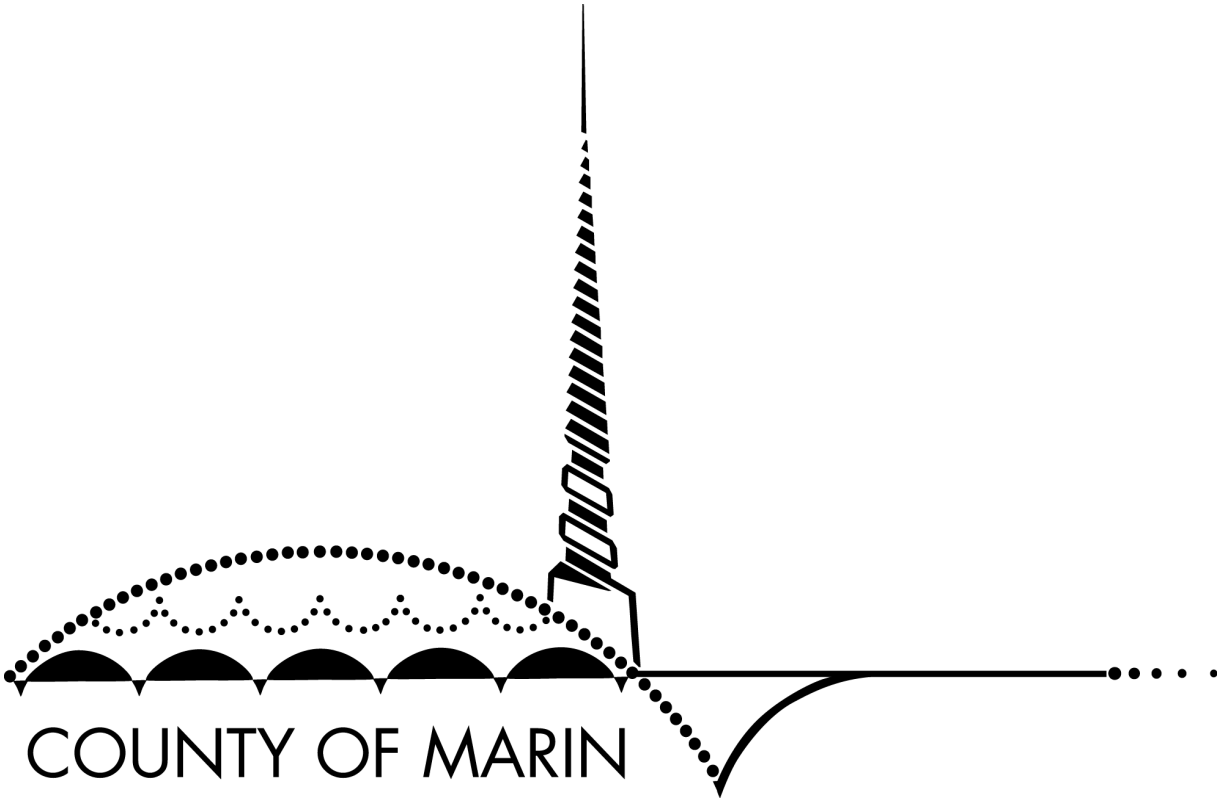


GARBOLOGY IN MARIN: WASTED ENERGY

SUMMARY

Redwood Landfill Inc. (RLI), Marin County's only solid waste landfill, is nearing the end of its useful life. Based on a 2008 Environment Impact Report (EIR), the landfill applied for and received a new Solid Waste Facility Permit in 2008 (the 2008 PERMIT), but the validity of the EIR and the 2008 PERMIT were successfully challenged in court. If the appeal currently pending is denied, the landfill will be forced to operate under its 1995 PERMIT, thereby reducing the maximum allowable disposal, which could force its closure within 7-9 years, (2020-2022).[1]

Depending on the outcome of the appeal, these are the three alternative outcomes:

1) If the landfill appeal is denied, a new EIR will be required for RLI to receive an updated permit. This process could take years to complete - the 2008 EIR, which was the basis for the 2008 PERMIT was started in 2003. RLI could take on this process, although it has expressed no certainty that it will do so.

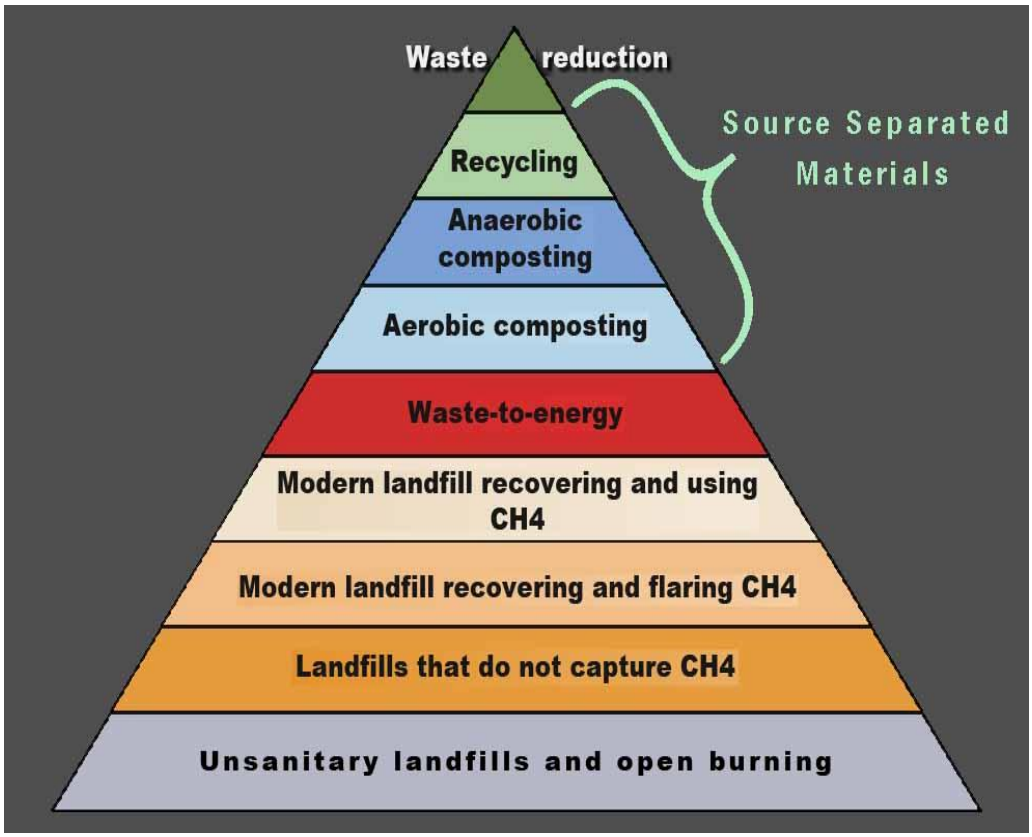
2) If the landfill appeal is denied, RLI could decide not to pursue a new permit, and simply close the landfill when it reaches the maximum disposable amount under the 1995 PERMIT. In that event;

   - Marin will need to find another landfill, a problematic issue since County officials have stated that it will be impossible to find an alternate site within the County. Not finding an alternate site in Marin County means our trash becomes another county's problem and increases our carbon footprint.

   - Marin would also lose RLI's proposed landfill gas-to-energy plant. Such a plant could possibly create enough electricity to supply approximately 6,000 to 8,000 Marin County homes with renewable green energy.

3) If RLI prevails in its appeal and the life of the landfill is extended, the 2008 PERMIT would extend the useful life for a minimum of approximately 19 years (to 2032). In addition, if RLI were to build the proposed landfill gas-to-energy plant, the landfill could also move up one tier in the "Hierarchy of Waste Management" (see illustration below) by producing energy from landfill gas.

[1] The final date would be determined by waste settlement and compaction.



Waste to Energy Research and Technology Council (WTERT)

The pyramid illustrates a spectrum of ways to deal with waste from the least to most desirable. Marin County is striving to reach a landfill diversion rate of 94% (i.e. transporting only 6% of waste to the landfill while 94% is diverted to resource recovery facilities) by 2025[2]. With measures in place, and others outlined in the 2008 PERMIT implemented, RLI could substantially help the County achieve that goal if it wins its appeal.

At the current time, Redwood Landfill is a "modern landfill recovering and flaring CH4" (Methane Gas) - the third tier from the bottom in the above diagram. As part of its operation, the landfill also composts yard waste and converts construction rubble into reusable construction material. The landfill has committed to moving up to the fourth tier by constructing a landfill gas-to-energy facility if the lawsuit appeal is granted.

There are additional ways of extending the useful life of the landfill by:

- Constructing a waste-to-energy (WTE) facility

[2] *Final Draft Zero Waste Feasibility Study* Presented by R3 Consulting Group December 2009

- Exploring possible other biomass conversion (e.g., Anaerobic composting) in sufficient quantities to contribute to Marin's renewable energy needs. Were this implemented, the landfill would move up even further on the waste pyramid.

The Marin County Civil Grand Jury supports the extension of the landfill's life regardless of the outcome of the legal proceedings and hopes that we will not end up with Wasted Energy.

BACKGROUND

Marin County's one remaining landfill originated in 1958 on property owned by Jordon Smith (for whom Smith Ranch Road received its name). Between 1972 and 1998 many significant events occurred relating to the landfill and the handling of solid waste, which are detailed below:

Historical Events

1972	In 1972, California enacted The Solid Waste Management and Resource Recovery Act (Chapter 342, Statutes of 1972) and established the Solid Waste Management Board to create policies for solid waste handling and disposal. Each of the 58 counties was given the task of developing and submitting its long-term solid waste management and resource recovery plans to the Board by January 1, 1976.
1976	The Legislature created a permitting and enforcement program for solid waste facilities to be overseen by local enforcement agencies (LEAs).
1978	Redwood Landfill received its first Solid Waste Facility Permit (PERMIT) to accept sludge and solid waste.
1989	With the threat of running out of landfill space, Californians saw the enactment of AB 939 in 1989. This Act mandated goals of 25 percent diversion of each city and county's waste from disposal by 1995 and 50 percent by 2000. With this legislation the board was reconstituted and named the California Integrated Waste Management Board (CIWMB). This new board regulated landfills and the law required significant investments by operators to meet the new standards.
1990	In 1990, realizing that it would be mutually beneficial to jointly prepare the Integrated Waste Management Plan, Marin's cities and towns and the County entered into a Memorandum Of Understanding (MOU). http://zerowastemarin.org/who-we-are/about-the-jpa/
1991	Jordon Smith sold Redwood Landfill to Sanifill, Inc.

1992	In November 1992, Marin County Environmental Health Services was re-designated as the solid waste Local Enforcement Agency (LEA)[3] for Marin County by the eleven cities and County of Marin and subsequently certified by CIWMB. CIWMB became known as CalRecycle effective 2010.
1995	Sanifill received a new PERMIT, incorporating the changes required by AB 939.
1996	The Marin County Hazardous and Solid Waste Management Joint Powers Authority (JPA), was formed to help ensure the County's compliance with AB 939 and now oversees the disposal of solid waste and hazardous materials in Marin County. The JPA is comprised of the County of Marin and the cities and towns of Belvedere, Corte Madera, Fairfax, Larkspur, Mill Valley, Novato, Ross, San Anselmo, San Rafael, and Tiburon. During the same year, USA Waste of California purchased Sanifill, Inc. and the ownership of Redwood Landfill was included. With the new ownership, Redwood Landfill (RLI) instituted additional diversion activities including composting of yard waste, grinding of concrete and asphalt for base rock and gravel, and setting aside metals and appliances delivered by self-haulers for recycling.
1998	Waste Management, Inc. (WM) merged with USA Waste and became the current owner and operator.

Unfortunately, the landfill sits on a 600-acre parcel of land that is surrounded on three sides by the Petaluma River Estuary and Marsh. When RLI requested a new Permit in 1999 to allow for increased landfill capacity and operational changes, the LEA prepared an environmental impact report (EIR). An initial study concluded that substantial changes proposed in 1995 concerning issues related to the proximity of the landfill to water sources and other issues had not been addressed. Once these items had been rectified, a draft EIR was prepared in 2003 and the initial final EIR approved in 2005. The final EIR was twice amended and finally completed in October 2008. With CalRecycle's concurrence, a new Permit was issued to RLI boosting capacity by 9.3 million cubic yards to a total of 26 million cubic yards and allowing continued operation for at least another 19 years.

The NO WETLANDS' Petition

In June 2008, an organization called No Wetlands Landfill Expansion (NO WETLANDS), filed a petition for a writ of mandate not only claiming the right to appeal the EIR certification to the County Board of Supervisors (BOS) but also claiming the EIR was inadequate. The Superior Court issued a judgment in March 2011 on the first issue directing the BOS to hear an administrative appeal. The First Appellate Court reversed

[3] See Appendix A for duties and responsibilities of the LEA

that decision in March 2012 saying the LEA was a legal entity distinct from the county and the BOS had no authority to approve or disapprove the project. By not ruling on the other issues brought forth by NO WETLANDS, the lawsuit was heard by Judge Duryee who ruled in favor of NO WETLANDS on December 11, 2012. RLI, joined by County Counsel, has filed an appeal.

If RLI is unsuccessful in overturning the ruling, the permit from 1995 will remain in force. What this means to the residents of Marin County is the following:

- The landfill may choose not to proceed with plans to build a methane gas-to-energy plant, which can substantially reduce current greenhouse gas admission and may provide enough electricity to power 6,000-8,000 Marin County homes.
- Under the 1995 permit, the landfill is allowed 19 million cubic yards; as of March 2012 the landfill had 2.2 million cubic yards remaining. At the current rate, RLI could be forced to close within seven to nine years, thus requiring Marin County solid waste to be trucked out of county and increasing rather than reducing our carbon footprint and making our waste some other county's problem.
- According to County officials, siting a new landfill in Marin will be impossible.

Marin's Diversion Rate

In 2008, SB 1016 was enacted to make the process for measuring disposal compliance simpler by changing from a diversion-based indicator to a per capita disposal rate (with 50 percent of generation as the goal). For 2007, the JPA had a disposal target of 7.6 pounds per person per day. The actual result was 4.9 pounds. This is the equivalent of 68 percent diversion. For 2011, the result was 3.8 pounds, or the equivalent of 75 percent diversion. The JPA's stated goal was to achieve 80 percent diversion by 2012 and reach zero waste by 2025. [4] Essentially, zero waste means that approximately 94 percent of waste will be diverted, but that there will still be residual waste after diversion processing. While the size of the annual waste stream is decreasing due to recycling efforts and the recent downturn in the economy, there is just one landfill in Marin County and it may reach capacity and close as early as 2020 if the pending appeal is denied. Several actions, if taken, can extend the useful life of the landfill, namely: reduce the amount of waste deposited, increase the recycling rate, increase the allowed capacity of the fill area, and convert the materials at the fill into alternate forms (such as green waste into compost and methane into electricity).

There are some indications that the JPA goal of 80% diversion by 2012 might not have been achieved. If so, this failure may be due to all of the following:

- A planned residential food waste implementation took longer than expected due to a lack of regional composting facilities such as RLI

[4] The 2012 actual results will be available in the JPA's Annual Report due in August.

- A planned joint project between Marin Sanitary Service and Central Marin Sanitation Agency for processing of commercial food scraps through anaerobic digestion to produce methane generated energy has been delayed
- The lack of other facilities for processing commercial food scraps - one potential facility being RLI
- The JPA's new Construction and Demolition (C&D) Ordinance has not been approved by all municipalities, and
- RLI has postponed its planned construction and demolition facility due to the lawsuit

The Grand Jury is concerned about the potential loss of the landfill and its ability to help Marin County achieve its desired 94% diversion rate. In addition, the potential loss of the proposed methane gas-to-energy plant means that we would lose the ability to provide renewable energy to 6,000-8,000 Marin County homes.

The purpose of this report is twofold: 1) Review the current diversion programs in place, and 2) examine ways of converting waste to energy that might help the County achieve zero waste by utilizing the remaining 6 percent residual, thus reducing stored waste and extending the life of the landfill.

APPROACH

The Grand Jury began its investigation by touring Redwood Landfill and conducting interviews with RLI, County Counsel, the LEA, and the JPA. In these interviews, we discussed the pending appeal, the impact if the appeal is not granted, the tonnage currently going to RLI and the possible alternatives if the appeal is denied. In addition, we interviewed Marin Clean Energy to verify the viability of using methane gas-to-energy as a renewable energy source.

Following our initial interviews, we arranged a tour of the Marin Sanitary Service complex where we observed their current resource recovery operations and received information regarding their anaerobic digestion joint venture with Central Marin Sanitation Agency, which should be operational by early 2014. In addition to our interviews, we reviewed the 2008 EIR report, the 2008 PERMIT, the NO WETLANDS lawsuit and Judge Duryee's ruling. We reviewed articles on landfill use, waste-to-energy technologies, current and past Marin County waste tonnage reports and greenhouse gas emission standards.

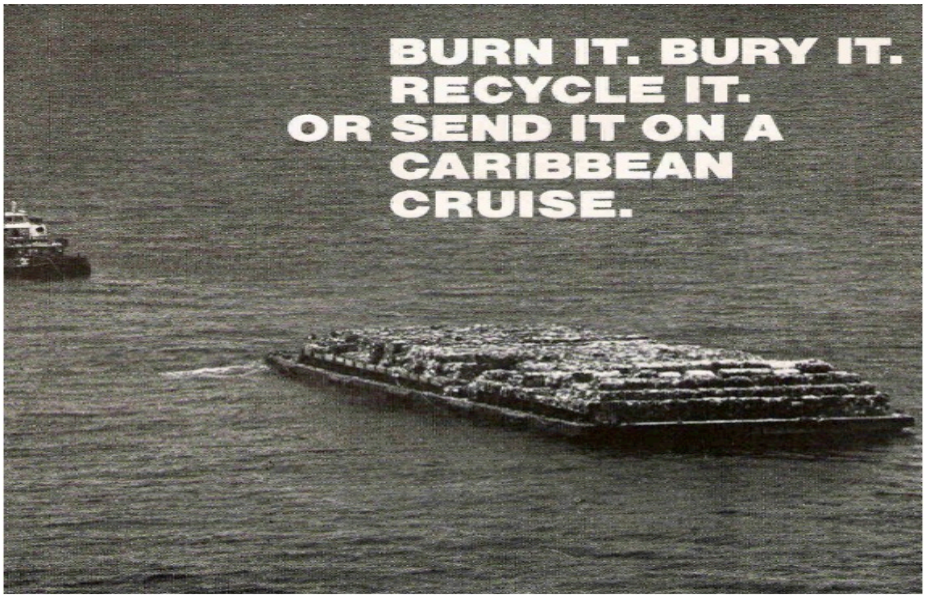
DISCUSSION

Trash is not a typical dinner party topic. Dumping the leftovers in the trashcan and placing it at the curb, or even having it conveniently picked up in the backyard by the friendly garbage man was a way of life for most Americans by the end of WWII. Who cared where it ended up; it wasn't our collective problem. It was out of sight and no

thought was given to the consequences of mounds of garbage growing in the local landfill.

A Short History of Garbage Disposal

The ZeroWasteMarin website states that for most of the first half of the twentieth century, as a nation, we recovered for reuse about 75 percent of the waste generated. In the 1970s that figure had dropped to 7.5 percent. Concerns were raised about landfill shortages. The 1987 "garbage barge", which left Long Island, New York in search of a final disposal site, became a rallying cry that shifted the national focus to Municipal Solid Waste (MSW) management.



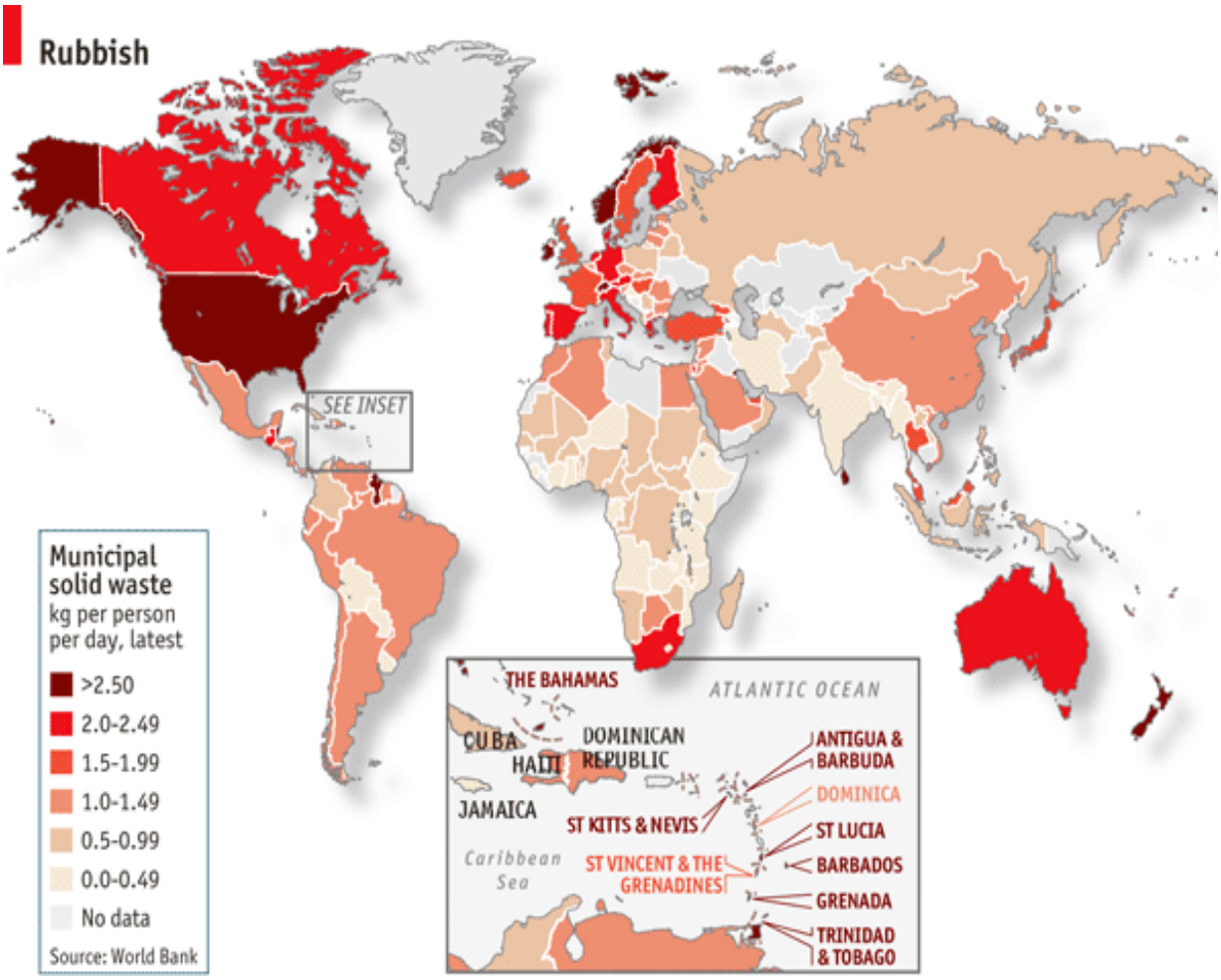
The Islip, N.Y., garbage barge spent much of Spring, 1987 toting 3,128 tons of smelly refuse from state to state and country to country. The town's dump was full, and Florida, North Carolina, Alabama, Mississippi, Louisiana, Texas, Mexico, Belize and the Bahamas refused to take delivery.[5]

In his book, Garbology, Our Dirty Love Affair with Trash, Edward Humes says "*Americans make more trash than anyone else on the planet, throwing away about 7.1 pounds per person per day, 365 days a year.*[6] *Across a lifetime that rate means, on average, we are each on track to generate 102 tons of trash. Each of our bodies may occupy only one cemetery plot when we are done with this world, but a single person's 102-ton trash legacy will require the equivalent of 1,100 graves*."

[5] http://articles.orlandosentinel.com/1990-07-29/news/9007290361_1_barge-garbage-islip

[6] "This calculation is derived from the most recent and most accurate data on America's annual municipal waste generation, the biannual study by Columbia University and the journal BioCycle, which put the nation's trash total at 389.5 million tons in 2008. The population of the country was put at 301 million that year by the U.S. Census, which yields a daily waste generation amount of 7.1 pounds per day."

Humes goes on to state, "*Americans have 'won' the world trash derby without really trying, making 50 percent more garbage per person than other Western economies with similar standards of living (Germany, Austria and Denmark, among others), and about double the trash output of the Japanese*."



The Rubbish Map- Jun 7th 2012, 15:51 by The Economist online

A more recent calculation in 2012, illustrated above by The Economist, would put the U.S. at 5.5 pound per person per day, a reduction of 1.6 pounds since 2008. As discussed in the Background section above, Marin County has achieved a much greater reduction than the national average, showing 3.8 pounds per person for 2011.[7] Several factors contributed to the changes in volume of trash headed to landfills:

- Prior to about 1960, Garbage haulers were known as scavengers because they sorted through the trash and removed bottles, cans, rags, etc. for recycling. With

[7] This calculation is based on JPA data using 2011 Marin County population of 253,512 and 175,810 tons of Marin County waste equaling 0.6935 tons equaling 1,387 pounds per person per year, or 3.8 pounds per person per day.

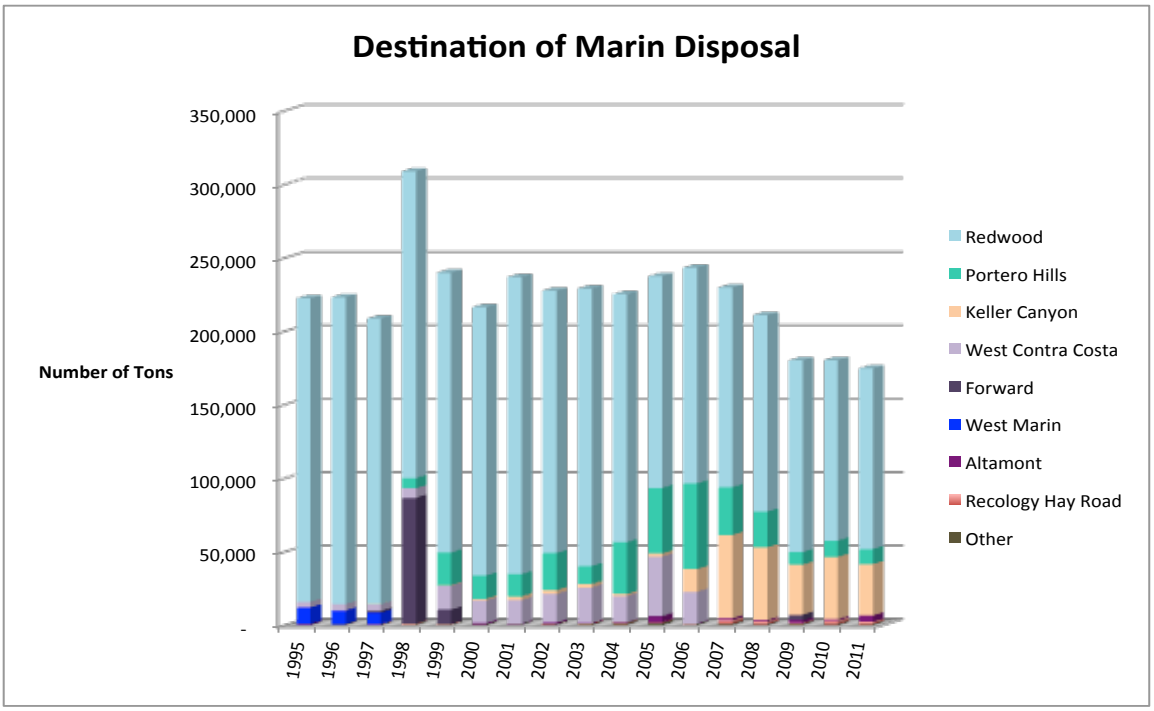
the advent of the compacting garbage truck, this was no longer possible, and everything ended up in the landfill.

- As a result of The Clean Air Act of 1970, the backyard incinerator was banned.

Marin County's awareness of the need to divert tonnage going to the landfill began even before the advent of AB 939 in 1989. Curbside recycling was instituted in the mid-'80's with bottles, cans, paper and cardboard, then progressed to green waste and household food waste and now, mandatory commercial recycling,[8] including commercial food waste.

A certain amount of the reduction in waste tonnage can be attributed to the recent economic downturn. However, the Marin JPA's policies and procedures, outlined in a 2009 Zero Waste Feasibility Study, prepared by R3 Consulting Group, have set the County on a course for reaching the desired 94% recovery rate. Exhibit 1 illustrates the 27% decline in Marin County tons disposed between 1995 through 2011. Destination of disposal is determined by the landfill contracts negotiated by the local haulers. Most of Southern Marin's waste is taken to out-of-county landfills.

Exhibit 1



California Department of Resources Recycling and Recovery (CalRecycle) Disposal Reporting System (DRS)

[8] "With the passage of Assembly Bill (AB) 341, businesses and public entities that generate four cubic yards or more of waste per week and multifamily units of five or more are required to recycle. Businesses are required to recycle on and after July 1, 2012."

Determining Landfill Life

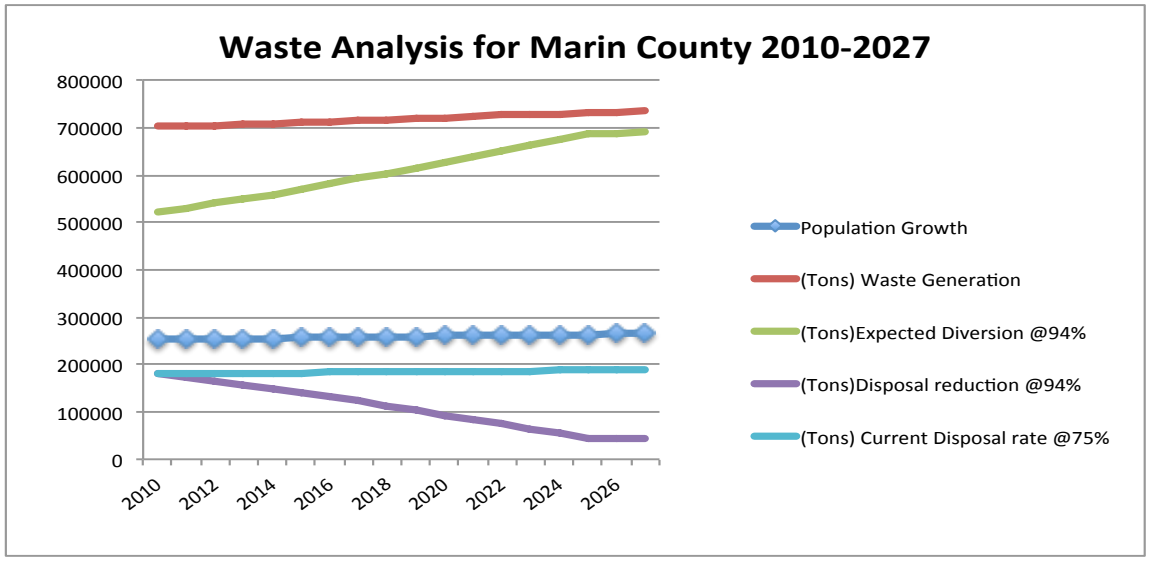
Of major concern to the JPA is the potential impact if the pending appeal of the NO WETLANDS lawsuit is denied and RLI has to revert to its 1995 PERMIT. The JPA, along with the LEA, monitors the anticipated "site life" of the landfill as part of statutory and regulatory requirements.[9] One requirement is the siting of a new landfill if there is less than 15 years of site life.

As of March 2012, under the 1995 PERMIT, RLI has available capacity for another 2.2 million cubic yards (CY). Between April 2011 and March 2012 RLI took in 263,000 CY, or about 231,500 tons of Municipal Solid Waste (MSW), meaning that at the current rate, which is one-half of their allowed yearly capacity, the landfill will reach capacity in 2020-2022, or a little more than 7-9 years from now. This means that the County would need to immediately look for alternate disposal sites.

The JPA retained Environmental Science Associates (ESA) to prepare an analysis of the landfill's site life in 2012. Their analysis, based on the 2008 PERMIT, and the County's achievement of 94% diversion rate by 2025, concluded that there would be 3.1 million tons or 3.5 million CY of capacity remaining in RLI by 2027 (15 years).[10]

In the study prepared by ESA, many factors were used to determine the landfill closure scenarios, including expected population growth, waste generation, diversion at expected 94%, disposal reduction at 94% diversion and disposal at current 75% diversion. Exhibit 2 illustrates the expected results.

Exhibit 2



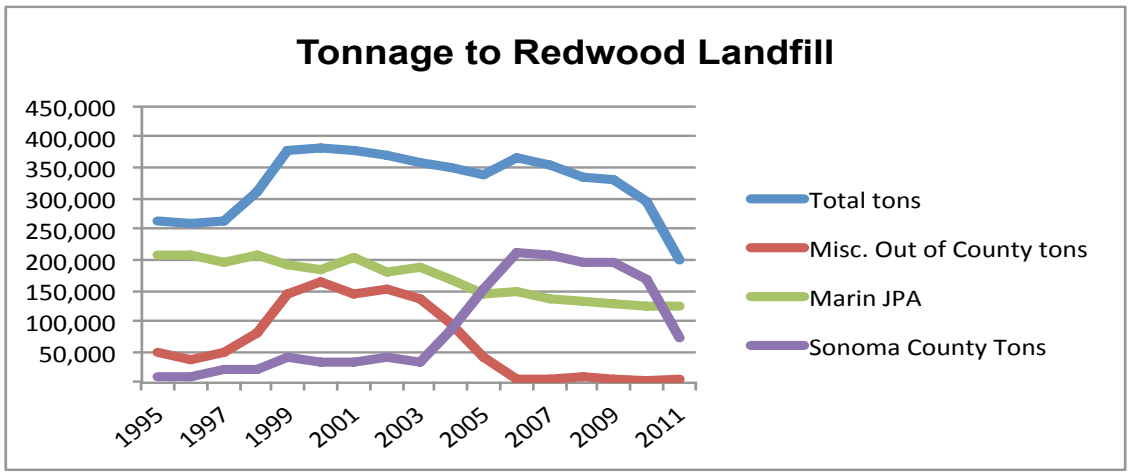
Prepared by ESA for the Marin County Hazardous and Solid Waste Management Joint Powers Authority 2/09/12

[9] PRC Sections 41700-41721.5 and 14CCR Section 18755-18756.7 -See Appendix B

[10] County Counsel has advised the JPA that RLI should operate under the 2008 PERMIT until the appeal is heard.

Since early 2000, the total tonnage going to RLI has diminished, particularly during recent years. As shown in Exhibit 3 below, there was a spike in disposal at RLI in 2005 when the Sonoma County Landfill reached capacity. In 2011, the Sonoma County landfill reopened, reducing the MSW going to RLI.

Exhibit 3



California Department of Resources Recycling and Recovery (CalRecycle)
Disposal Reporting System (DRS)
Note: above chart excludes "Alternate Daily Cover" (ADC), which amounted to 31,234 tons in 2011

If RLI prevails in the appeal, the allowable capacity under the 2008 PERMIT would leave nearly 9.3 million CY of capacity or a closure date of approximately 2049, based on the current rate of disposal. If the landfill's maximum fill rate is attained each year, then the landfill would reach capacity in 2032.

Exhibit 4 represents the year the maximum landfill capacity will be reached under the 1995 permit and under the 2008 permit with three scenarios: 1) maximum allowed fill rate per year, 2) current fill rate per year, and 3) fill rate if 94% diversion is attained.

What the Exhibit clearly illustrates is that our one landfill, despite all interventions, has a finite life, based on its current usage.

Exhibit 4

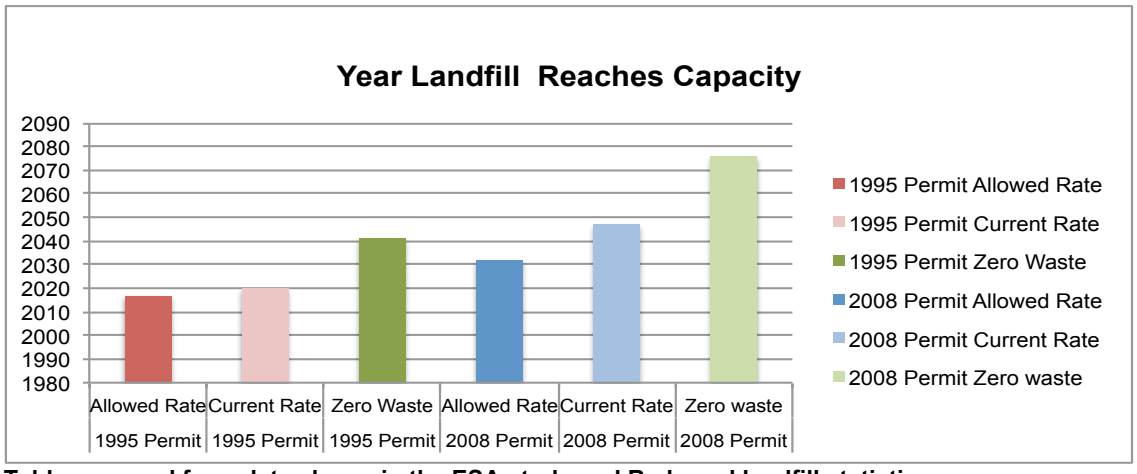


Table prepared from data shown in the ESA study and Redwood landfill statistics

Comparing 1995 PERMIT vs. 2008 PERMIT

In 2003, 180 acres of the original 600-acre site were restored to wetland status in partnership with the Marin Audubon Society. The 1995 PERMIT permitted footprint covers 210 acres of the remaining 420 acres and limits the total landfill capacity to 19,000,000 CY, which will be reached within the next 7-9 years at current rates. Of major concern to the NO WETLANDS group is the fact that the Petaluma River Estuary and Marsh surround the landfill on three sides. Although RLI has made significant improvements to levees to control leachate,[11] NO WETLANDS believes there is still a major threat of leakage into the estuary if there is a 100-year flood or an earthquake.[12] The 1995 PERMIT does not address waste diversion programs, which RLI wants to implement, nor does it address the issues raised by NO WETLANDS.

The 2008 PERMIT expands the capacity to 26,077,000 CY and limits the permitted area to 222.5 acres for disposal and 7 acres for composting. Extending the slope of the landfill mound (see illustration below) rather than adding to the footprint while maintaining the current maximum elevation will achieve the pertinent disposal expansion requirements.

As stated previously, over 10 years were spent developing the 2008 PERMIT with many adjustments and concessions on the part of RLI. The LEA's requested changes to the permit request, - "Mitigated Alternatives", are outlined in the 2008 approved EIR[13].

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[11] **Leachate** is any liquid that, in passing through matter, extracts solutes, suspended solids or any other component of the material through which it has passed. Leachate is a widely used term in the environmental sciences where it has the specific meaning of a liquid that has dissolved or entrained environmentally harmful substances, which may then enter the environment. It is most commonly used in the context of land-filling of putrescible or industrial waste. http://en.wikipedia.org/wiki/Leachate

[12] Bruce Baum, chairman of No Wetlands Landfill Expansion's board of directors, said, "*Our concerns continue around the lack of a liner and inadequate levees*."
Marin judge finalizes ruling voiding new permit for Redwood Landfill *Richard Halstead Marin Independent Journal*

[13] The fundamental basis for the Mitigated Alternative is stated in the description of this alternative on page 5-31 of the FEIR: [Under the Mitigated Alternative,] Redwood Landfill would shift its emphasis from waste disposal to material and energy recovery. Instead of placing emphasis on increasing waste disposal capacity, Redwood Landfill would develop processes and methods aimed at increasing diversion of materials from landfill, and increasing energy production at the site. This would result in several benefits, including preservation of landfill capacity; increasing diversion and reducing landfilling of wastes in this environmentally sensitive location; reducing the need for certain project mitigation measures described in the analysis; providing justification for Overriding Considerations for significant unavoidable impacts of the project; helping to counterbalance or avoid altogether the significant unavoidable effects of the proposed project; maximizing consistency with County Integrated Waste Management Plan policies and County energy policies; and providing long-term protection of the environment in accordance with California Public Resources Code (PRC) § 440127.

Looking at the Global Warming Potential - Net Emissions less offset, the mitigations result in a reduction of nearly 2.2 million Mg eCO2 (greenhouse gas emissions) or a reduction of 33.4 % between 1998 through 2098. [14] It should be noted that when the landfill does reach capacity and is closed, RLI is required to maintain the site for at least 30 additional years and must set aside funds for the post-closure maintenance, which includes monitoring greenhouse gas emissions. The Mitigated Alternatives also meet the requirements of the Marin County Greenhouse Gas Reduction Plan - October 2006. The final EIR dated March 2008, including responses to comments, contains 558 pages. The report includes in-depth discussions of greenhouse gas emissions, leachate control, traffic, landfill slope, and revised flood mitigation.

In the December 11, 2012 Superior Court ruling, Judge Duryee found that the 2008 EIR inadequately discussed the following:

- Cumulative effect of the Project's greenhouse gas emissions.
- The possible increased *non-cancer* health impacts from air pollutant emissions.
- Mitigation measures to reduce the impact to the Project from potential flooding and groundwater contamination.
- An alternate off-site location.

The following is taken from Will Landfill Expansion be Scrapped? Dated December 20, 2012 in the Pacific Sun, "*Rebecca Ng, deputy director of county environmental health services and the county's solid waste supervisor, says the lawsuit is the cause of stopping many protections from going into effect. In her role with environmental health services, she is the head of the LEA. The environmental report includes '60 pages plus of mitigation measures' that will not go into effect if the report gets tossed and the permit rescinded. With Judge Duryee's ruling, says Ng, the landfill will fall back to its 1995 solid-waste facilities permit. And the mitigation measures targeting greenhouse gas emissions, building a resource recovery center and a gas-to-energy plant also will fall away. 'We think the solid waste facilities permit that was issued in 2008 is far superior in terms of protecting the environment.' Ng says the county is trying to get those projects through a separate environmental review track so they might proceed.*"

A February 15, 2013 article in the Petaluma Patch entitled Landfill at Edge of Bay Pits Environmentalists against Waste Hauler, states:

"Waste Management has appealed the ruling and says opponents simply want to export their garbage out of the area.

'*This is a highly regulated site with a lot of reporting and a lot of verification going on every single day*,' *said Osha Meserve, an attorney representing Waste Management*. '*The fears that have been expressed by the petitioners are just that, they are not founded on any fact and we think they are probably based more on NIMBYism in that they would rather see their waste go to other locations than keep the waste locally*.'

[14] Mg=Million grams (1 million grams=1 metric ton) eCO2= carbon dioxide equivalent

The landfill is working to bring down its greenhouse gas emissions to pre-1990 standards and has two levees that can be raised as needed, according to Meserve. And there is no alternate site for the garbage, meaning it would have to be trucked to another county, increasing emissions and possibly rates.

Dan North is the district manager at Redwood and says the landfill has worked hard to create an operation tailored to the green future Marin leaders have envisioned. '*The county has set forth a zero waste goal by 2025 and we need to support that goal,' he said. 'So it's not just about the expansion of the landfill, which is a service that is demanded by our customers, but it's also augmenting it with more recycling and more diversion*.'

But opponents insist another site be found. They say Waste Management has plans to take in garbage from beyond Marin and Sonoma counties and is luring business by keeping prices low. They also point out that the landfill is surrounded by levees on three sides and that there are former stream channels underneath that make it easy for groundwater to get contaminated during high tides.

'*Plenty of Marin County residents drive Priuses and profess to be environmentalists,' said Brent Newell, the attorney for the group opposing the expansion. 'There is no reason they shouldn't support to pay a couple of dollars more for the proper handling of their garbage*.'"

The Grand Jury is not in a position to argue for or against the ruling. However, we do believe that Marin County citizens should be responsible for their own waste and not haul it to a landfill outside of Marin, thereby making it another county's problem.

There are three very critical aspects to the issue:

1. If the appeal is lost, RLI could close the landfill when it reaches its 1995 PERMIT capacity.

2. If RLI is nearing the 1995 PERMIT capacity, RLI may feel that they will not recover the costs of their proposed resource recovery capital expenditures. If no further 2008 PERMIT capital expenditures are made:

    - Marin loses the opportunity to have a WTE plant and RLI will simply continue to flare the landfill methane
    - Marin may lose expanded composting operations, which would change from the current windrow composting operation to Covered Aerated Static Pile (CASP) Composting. A CASP is designed to reduce methane production and volatile organic compound emissions as much as possible. This process could achieve up to an 80% reduction in emissions when compared to the current process
    - RLI will not build a proposed Reuse Center (Reusable items diverted from the scale house to charity)

- A C&D recovery operation may be lost

3. Marin's carbon footprint will increase and rates may also be raised if our waste is hauled to more distant landfills.

All of the above remains unknown until the outcome of the appeal is heard sometime next year, and until we know RLI's response if the appeal is denied. The Grand Jury hopes that RLI will continue to enhance its operations in Marin County regardless of the outcome.

Successful Diversion Alternatives

What we do know is that a currently operating landfill gas-to-energy plant is successful. The Ox Mountain Landfill in Half Moon Bay is one of California's largest renewable energy projects having a landfill gas-to-energy station that is supplying 11% of the energy needs for the City of Alameda and is projected to supply 4% of the energy needs of Palo Alto.[15] We also know that Marin Clean Energy would be very willing to purchase the energy output from RLI's proposed landfill gas-to-energy project at appropriate financial terms, which can provide renewable energy to at least 6,000 Marin County homes.

Marin County has had an exemplary record for achieving waste diversion from the landfill - reaching 75% diversion in 2011 and the expectation of reaching 80% at the end of 2012. The JPA has promoted many new programs to enhance recovery in an effort to meet or exceed the stated goal of 94% diversion by 2025. These include not only the recovery of household food waste, but now mandatory commercial recycling, including commercial food waste.

A 2009 Zero Waste Feasibility Study, prepared by R3 Consulting Group, recommended that the *"Down-stream programs include increasing the types of materials collected by haulers (e.g., food), revising franchise agreements and ordinances to reflect industry standards and establish waste reduction and diversion requirements, implement food waste digestion and composting, etc…. Approximately 56 percent or 128,000 tons of food, yard, organic waste, inerts, and mixed C&D were disposed at landfill. In order to meet the Zero Waste Goals, reduction and processing of these targeted materials is critical. However, currently there is insufficient capacity for the facilities located within the County to process these materials and it may be necessary to transport these materials to out-of-county facilities."*

Exhibit 5 breaks out the various components of waste disposed by percentages.

[15] http://www.environmentalistseveryday.org./solid-waste-management/green-waste-industry-professionals/Alameda-housing.php

Exhibit 5

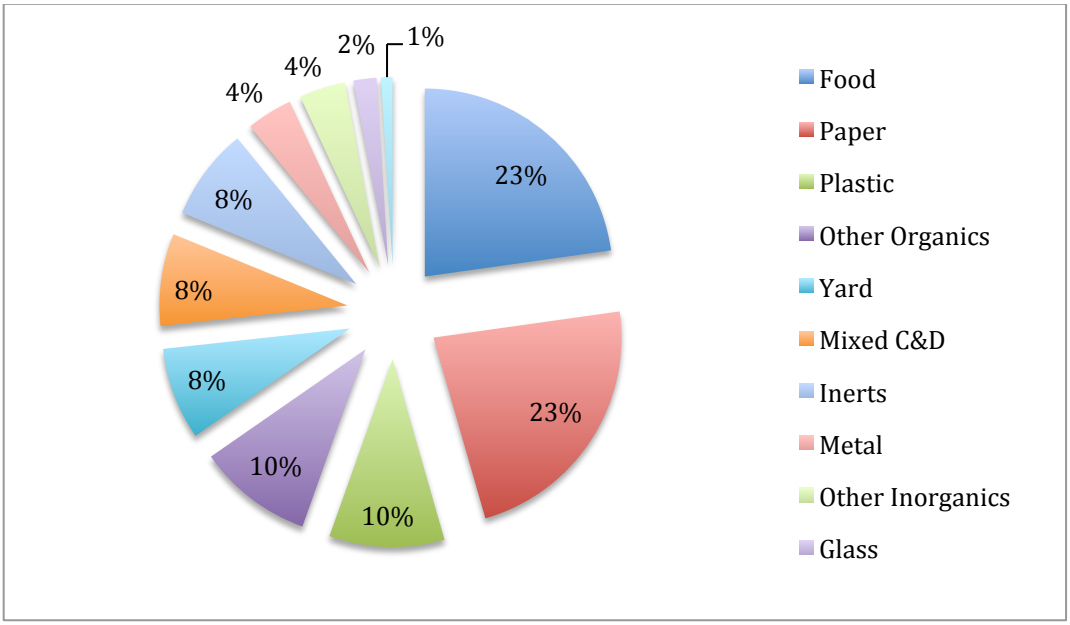


Figure ES-1-Materials Disposed- 2009 Zero Waste Feasibility Study

In addition to the potential for providing sustainable methane gas-to-energy for approximately 6,000-8,000 homes, RLI can play a vital role in helping to achieve the diversion goal if they continue with plans for an expanded composting operation, complete a C & D processing line, and possibly install an anaerobic digestion system to convert food waste to energy.

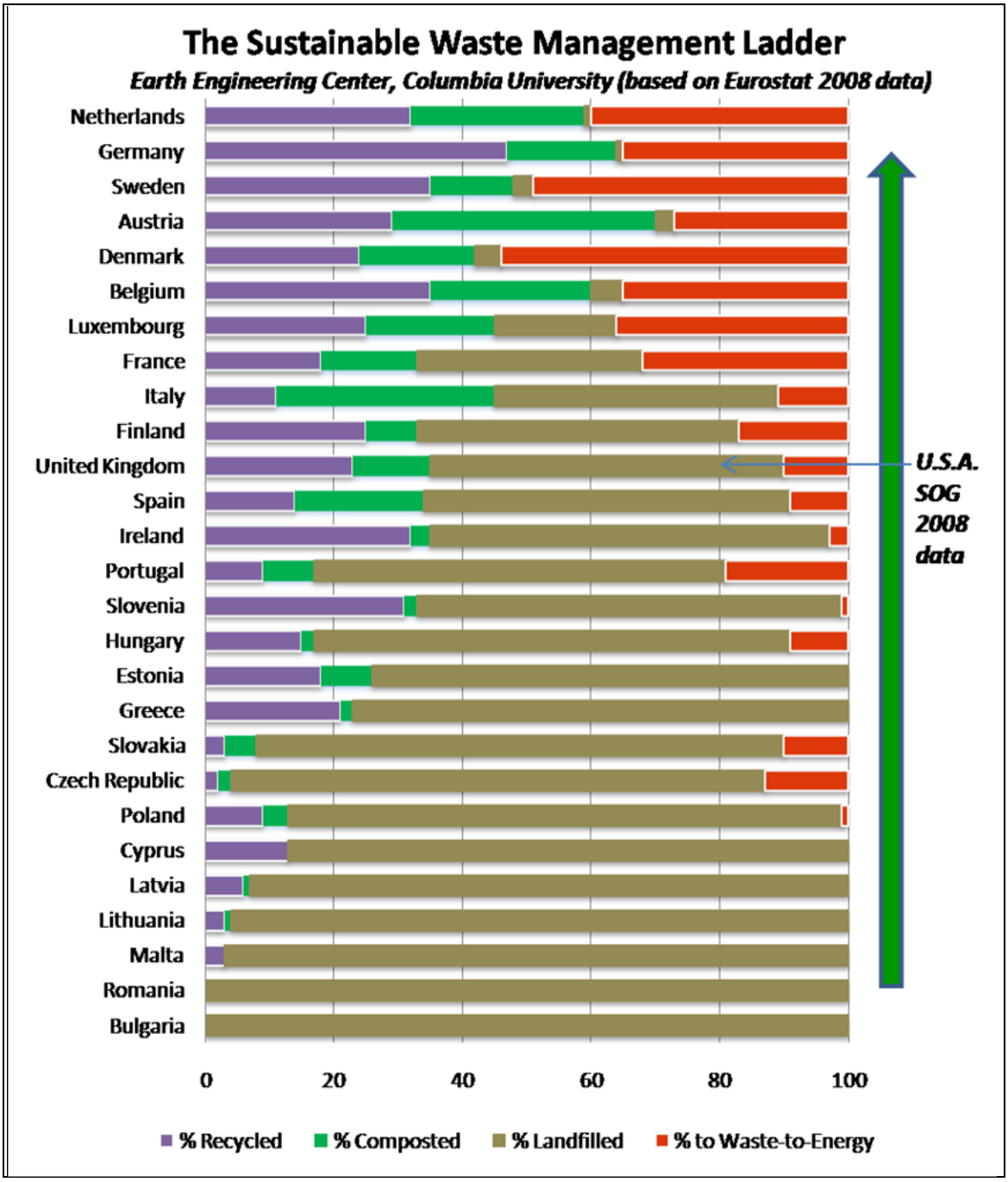
The JPA has encouraged and endorsed the Marin Sanitary Service/ Central Marin Sanitation District's Anaerobic Digestion system, called the Food to Energy (F2E) program. This program is designed to divert commercial food waste but may be expanded to include residential food waste once the public has accepted the concept. (See Appendix C)

Further Diversion Alternatives

To understand further diversion possibilities, the Grand Jury has researched methods used in other countries, which include forms of waste incineration or plasma gasification of waste. There are many dissenters when the word "incineration" is used because the immediate vision is of smoke stacks spewing a toxic stew into the atmosphere. Another argument against this approach is that people will simply not recycle if given this option.

However, that is not necessarily the case. Exhibit 6 illustrates that many countries with substantial waste to energy programs, nevertheless continue to recycle a substantial portion of their waste.

Exhibit 6



The United States is about on par with the United Kingdom according to the above diagram. The Netherlands and Germany lead the way with less than 2% of their waste being landfilled. Denmark is highly advanced in its use of waste for energy. Using Copenhagen as an example, Edward Humes states,[16] "*This city recycles trash at twice the U.S. average, its residents create less than half the household waste per capita, and the community philosophy holds that dealing with and solving the problem of trash must be a*

[16] Excerpt From: Humes, Edward. "Garbology." Avery, 2012-04-19. iBooks.

local concern, even a neighborhood concern. When it comes to waste, NIMBY (Not in My Backyard) is not a factor, as shipping trash off to some distant landfill—making it disappear for others to manage—is considered wasteful, costly and immoral. Not that such out-of-sight, out-of-mind garbage treatment is much of a consideration here: only 3 to 4 percent of this city's waste ends up in landfills, compared to the U.S. average of 69 percent….And the secret sauce for that city and the entire nation of Denmark, at least on the waste disposal front, is its mastery of turning trash into a renewable energy source.

'They are the model, along with Japan and a number of other countries in Europe,' says Nickolas Themelis of Columbia University, America's engineer-apostle of the untapped power of garbage. 'They put these waste-to-energy plants right in their neighborhoods. They become part of the fabric of the community. There's none of the fear and misinformation about waste energy that we have in the U.S. They are clean and efficient, and many of them are quite attractive. The people are proud of them.' Denmark's strategy has been to build trash-burning, power-generating plants on a relatively small scale. No behemoths burning 2,000, 5,000 or 10,000 tons of garbage a day, such as those proposed for Los Angeles in the seventies and eighties."

Humes continues his argument that burning does not diminish recycling by stating "*The cities and nations that have made trash burning a key part of their energy and waste strategies—Denmark, Germany, Austria, Japan, the Netherlands—all have robust recycling programs that not only recycle as much as or more than the amount of trash that is burned, but they all also recycle at a much higher percentage than the U.S. has been able to accomplish. It's the landfilling that diminishes when waste-to-energy becomes a strong option, not recycling. Germany, for instance, burns 34 percent of its municipal waste and it recycles the rest, an impressive 66 percent. That's not just one super-green city, like San Francisco, but an entire country of 82 million people, the powerhouse economy of Europe. Almost none of its municipal waste gets landfilled.*"

Most WTE opponents assume that only massive, expensive, utility-scale trash power plants can be used to produce energy. Currently there are 86 facilities in the United States for the combustion of MSW, all of which were built prior to 1995.[17] There are three WTE plants in California. Two are in Southern California; Long Beach and Commerce, and the other is in Stanislaus County. The Stanislaus Resource Recovery Facility began commercial operation in January 1989. This Waste-to-Energy facility, operating as Covanta Stanislaus, processes 800 tons per day of solid waste, which generates up to 22.5 megawatts of renewable energy that is sold to Pacific Gas and Electric Company.[18] But the less costly, community-based plants that Denmark is using are the most successful use of the WTE technology right now. For a description of the various forms of WTE technologies please refer to Appendix D.

Once the energy crisis of the 1980s was resolved in the United States, the public lost interest in the WTE technology. Interest has been revived as landfills reach capacity and newer methods of extracting energy from waste are being developed. One of the most

[17] Energy Recovery from Waste/Municipal Solid Waste/ US EPA
[18] http://www.covantaenergy.com/en/facilities/facility-by-location/stanislaus.aspx

promising is Plasma Gasification, which contains the waste in a sealed container, thus limiting environmental exposure. Please see Appendix E for a description of one form of Plasma Gasification. Other methods are being developed including Microwave Plasma Gasification.[19] While these methods are still very expensive due to development costs, once the technology is perfected, and demand increases, costs will decrease and they will become viable alternatives to waste disposal.

Waste Management - owner of RLI - is well aware that as the newer waste diversion techniques become increasingly more affordable, landfills will become a thing of the past, and in their 2012 Sustainability report, C.E.O. David P. Steiner wrote*:" We are committed to finding the 'next big things' or even the small profitable things — that will relegate the landfill to the last resort for waste after all possible value has been extracted. We recognize that it takes time to develop the innovative technologies necessary to derive new uses for waste streams, and we are realistic about the challenge of finding the right innovations. That is why we have invested in a portfolio of more than 30 partnerships focused on alternative energy technologies. In this way, we function as venture capitalists for entrepreneurs looking for new ways to transform waste into useful products such as fuels and chemicals. As we work together, we gain insights from what fails as well as what succeeds"*

The Grand Jury urges the LEA, JPA, and the County Public Works Department to explore additional methods for keeping Marin County waste in the county including turning the 6% residual after diversion into energy and possibly achieve 100% landfill diversion. Our hope is that we will not have any Wasted Energy.

FINDINGS

F1. Redwood Landfill's 2008 EIR is being challenged in court, thereby jeopardizing its 2008 Solid Waste Facility Permit, which has delayed the construction of the methane gas-to-energy plant and the Construction and Demolition sort line.

F2. Redwood Landfill, as currently permitted, has a finite life and therefore, alternate methods of waste diversion need to be explored.

F3. Waste-to-Energy Plants can be a solution to limited landfill space.

F4. A portion of Marin County MSW is being sent to out-of-county landfills, increasing our carbon footprint and making our waste another county's problem.

F5. Marin County waste disposal has diminished by over 27% since 1995 due to the passage of AB 939 in 1989 and public awareness.

F6. Redwood Landfill has seen a waste reduction of 24% during the same time period as a result of less out-of -county disposal in the Marin landfill and the effects of diversion awareness.

[19] http://www.waste-management-world.com/articles/print/volume-12/issue-6/features/microwave-plasma-gasification-heats-up-in-the-us.html

F7. CalRecycle statistics prove that waste diversion in Marin County is much higher than the national average due to concerted efforts by the Marin County Hazardous and Solid Waste Management Joint Powers Authority (JPA) and local waste haulers to educate the public.

RECOMMENDATIONS

R1. The Grand Jury recommends that the Marin County Hazardous and Solid Waste Management Joint Powers Authority (JPA) and Local Enforcement Agency (LEA) meet with Redwood Landfill as soon as feasibly possible to gain assurances that the landfill methane gas-to-energy plant will become a reality.

R2. The Grand Jury recommends that the Marin County Hazardous and Solid Waste Management Joint Powers Authority (JPA) and Local Enforcement Agency (LEA) ensure that Redwood Landfill completes the Construction and Demolition sort line.

R3. The Grand Jury recommends that the Marin County Public Works Department, Local Enforcement Agency (LEA) and Marin County Hazardous and Solid Waste Management Joint Powers Authority (JPA) work with Redwood Landfill to ensure the building of an anaerobic digester for food waste, the energy from which can be added to the methane gas-to-energy plant.

R4. The Grand Jury recommends that the Marin County Public Works Department, Local Enforcement Agency (LEA) and Marin County Hazardous and Solid Waste Management Joint Powers Authority (JPA) work with Redwood Landfill to explore all options for minimizing future disposal through some cost effective, least polluting form of waste gasification, such as Microwave Plasma Gasification.

R5. The Grand Jury recommends that Local Jurisdictions holding MSW franchise agreements mandate, through revisions to the agreements, that haulers dispose of all MSW generated in Marin County in Marin County.

REQUEST FOR RESPONSES

Pursuant to Penal code section 933.05, the grand jury requests responses as follows:

From the following individuals:

- Operations Manager, Redwood Landfill Inc. to Findings F1-F4 and F6 and all Recommendations.
- Deputy Director, Environmental Heath Services-Community Development Environmental Health Services Administration to Findings F1-F6 and all Recommendations.
- Director, Department of Public Works, to Findings F1-F4 and Recommendations R3 & R4.
- Deputy Director, Department of Public Works - Waste Management to All Findings and Recommendations.

- Program Manager Department of Public Works-Waste Management Division to All Findings and Recommendations.

From the following governing bodies:

- The Marin County Hazardous and Solid Waste Management Joint Powers Authority (JPA) to all Findings and Recommendations.
- County Counsel to Finding F1 and Recommendation R4 & R5
- Board of Supervisors to Finding F2-F4 and all Recommendations
- Marin Energy Authority to Recommendations R 1, R3 & R4
- Novato Sanitary District to Recommendation R 5
- The City Council, City of San Rafael to Recommendation R 5
- The Town Council, Town of Ross to Recommendation R 5
- The City Council, City of Larkspur to Recommendation R 5
- The City Council, City of Sausalito to Recommendation R 5
- The Town Council, Town of Tiburon to Recommendation R 5
- The City Council, City of Belvedere to Recommendation R 5
- The City Council, City of Novato to Recommendation R 5
- The Town Council, Town of Corte Madera to Recommendation R 5
- The City Council, City of Mill Valley to Recommendation R 5
- The Town Council, Town of San Anselmo to Recommendation R 5
- The Town Council, Town of Fairfax to Recommendation R 5

The governing bodies indicated above should be aware that the comment or response of the governing body must be conducted subject to the notice, agenda and open meeting requirements of the Brown Act.

BIBLIOGRAPHY

- County of Marin Greenhouse *Gas Reduction Plan,* October 2006
- Energy Recovery from Waste/Municipal Solid Waste/ US EPA
- *Final Draft Zero Waste Feasibility Study* Presented by R3 Consulting Group December 2009
- Halstead, Richard. *Marin judge finalizes ruling voiding new permit for Redwood Landfill* Marin Independent Journal December 20, 2012
- Humes, Edward. *Garbology, Our Dirty Love Affair with Trash*, Avery, 2012-04-19

- http://www.calrecycle.ca.gov/archive/IWMBPR/2008/December/54.htm
- http://www.covantaenergy.com/en/facilities/facility-by-location/stanislaus.aspx
- http://www.environmentalistseveryday.org/solid-waste-management/green-waste-industry-professionals/Alameda-housing.php
- http://www.nytimes.com/2012/09/11/*science/plasma-gasification-raises-hopes-of-clean-energy-from-garbage.html*
- http://www.waste-management-world.com/articles/print/volume-12/issue-6/features/microwave-plasma-gasification-heats-up-in-the-us.html
- *Is It Better To Burn or Bury Waste for Clean Electricity Generation*? P. Ozge Kaplan, Joseph DeCarolis, and Susan Thorneloe VOL. 43, NO. 6, 2009 / ENVIRONMENTAL SCIENCE & TECHNOLOGY 9 **1711**
- *Landfill at Edge of Bay Pits Environmentalists against Waste Hauler*, Petaluma Patch, February 15, 2013.
- No Wetlands Landfill Expansion et al., vs. County of Marin et al.- First Appellate Court District Division Four #A131651 filed 3/20/12
- No Wetlands Landfill Expansion et al., vs. County of Marin et al.- Superior Court of Marin, Case No: CV090198 RULING 12/11/12
- *Per Capita Disposal and Goal Measurement (2007 and Later*)- http://www.calrecycle.ca.gov/lgcentral/Basics/PerCapitaDsp.htm
- Redwood Landfill, Solid Waste Facility Permit: December 18, 2008
- Redwood Landfill Final Environmental Impact Report – Response to Comments Amendment ESA/ March 2008
- Siedman, Peter. *Will Landfill Expansion be Scrapped?* Pacific Sun, December 20, 2012
- The History of the California Environmental Protection Agency- http://www.calepa.ca.gov/about/history01/ciwmb.htm
- *The State of Garbage in America,* BioCycle, October, 2010
- http://zerowastemarin.org/the-2025-goal/our-mission/

Reports issued by the Civil Grand Jury do not identify individuals interviewed. Penal Code Section 929 requires that reports of the Grand Jury not contain the name of any person or facts leading to the identity of any person who provides information to the Civil Grand Jury.

GLOSSARY

C & D - Construction and Demolition

CY - Cubic Yard

EIR-Environmental Impact Report

EPA- Environmental Protection Agency

ESA - Environmental Science Associates

LEA – Local Enforcement Agency (See Appendix A for full definition)

JPA – Marin Hazardous and Solid Waste JPA (Joint Powers Authority)

MSW – Municipal Solid Waste

PERMIT – Solid Waste Facility Permit

RLI – Redwood Landfill Inc.

WM – Waste Management Inc.

WTE- WASTE-TO-ENERGY

APPENDIX A

Solid Waste Local Enforcement Agency (LEA)
Duties and Responsibilities of the LEA

Summary of Duties and Responsibilities specific to the Marin County LEA

1. Routine Landfill Inspections
   There are two landfills in Marin County, which are inspected at least monthly.
2. Routine Transfer Station/Materials Recovery Facility Inspections
   Marin Sanitary Service's transfer station and resource recovery building are inspected monthly.
3. Closed Landfill Inspection
   The LEA is required by current regulations to perform quarterly inspections at the 14 closed landfills in Marin County
4. Abandoned Site Inspections
   Abandoned sites are required to be inspected quarterly. There are no known abandoned sites in Marin County.
5. Illegal Site Inspections
   The LEA is responsible for investigation of alleged illegal dumping sites. Confirmed illegal sites are required by regulation to be inspected monthly depending abatement by enforcement action. Currently, there is one known illegal site, which has been referred to the County Counsel.
6. Compost Facility Inspections
   The LEA performs monthly inspections of the Redwood Landfill Biosolids Compost Facility.
7. Sites Exempted Pursuant to 27 CCR 21565
   Exempted sites shall be inspected quarterly. Currently no exemptions exist within Marin County.
8. Facility Complaint Inspections
   If a complaint cannot be resolved off-site, the LEA will respond by inspection
9. Demonstration Projects
   When a landfill operator proposes to use an alternative daily cover (ADC) for refuse not within one of the categories listed in 27 CCR 20690(b)(1-10), or an ADC material from one of the above categories, but used differently than specified in the aforementioned section, a site-specific demonstration project must be conducted. In such instances, the LEA may require that the project be subject to performance standards, as specified in 27 CCR 20695. Sites operating under performance standards are inspected by the LEA on a weekly basis.

10. Refuse Collection Vehicle Inspections
    There are ten recognized refuse collection service operators in Marin County responsible for approximately 105 collection vehicles. The LEA performs annual inspections of each vehicle.
11. Non-Facility Complaint Inspections
    Complaints regarding the storage, handling or disposal of solid waste at undeveloped properties, non-food related businesses, and residences other than multiple-family dwellings are investigated by the LEA.
12. Permits
    The LEA evaluates, writes and processes new solid waste facility permits and revisions of existing permits in coordination with the CIWMB. New permits are required for facilities that have never operated, facilities which did not previously required a solid waste facility permit, or facilities with a new operator. After issuance, a permit is required to be reviewed every five years. This is also done by the LEA, in conjunction with the CIWMB.

    A permit revision is required whenever a change in the design or operation of a facility is proposed that has potential for resulting in a physical change to the environment directly or ultimately. A revised permit must be reviewed by the LEA within five years of reassurance.
13. Permit Exemptions
    The LEA reviews applications and documentation to determine if proposed solid waste facilities can be exempted pursuant to 27 CCR 21565. A staff report is generated and LEA staff facilitates a public hearing.
14. CEQA Process
    The LEA reviews applications for solid waste facility permits or exemptions for completeness and accuracy. During the review, California Environmental Quality Act (CEQA) compliance must be assessed and if the project is not exempt, an Environmental Impact Report (EIR) may be required. In such cases, the LEA often acts as the lead agency for the EIR.

APPENDIX B

Siting Element References

Cal. Pub. Res. Code § 41701.
Each countywide siting element and revision thereto shall include, but is not limited to, all of the following:
(a)A statement of goals and policies for the environmentally safe transformation or disposal of solid waste that cannot be reduced, recycled, or composted.
(b)An estimate of the total transformation or disposal capacity in cubic yards that will be needed for a 15-year period to safely handle solid wastes generated with the county that cannot be reduced, recycled, or composted.
(c)The remaining combined capacity of existing solid waste transformation or disposal facilities existing at the time of the preparation of the siting element, or revision thereto, in cubic yards and years.
(d)The identification of an area or areas for the location of new solid waste transformation or disposal facilities, or the expansion of existing facilities, that are consistent with the applicable city or county general plan, if the county determines that existing capacity will be exhausted within 15 years or additional capacity is desired.
(e)For countywide elements submitted or revised on or after January 1, 2003, a description of the actions taken by the city or county to solicit public participation by the affected communities, including, but not limited to, minority and low-income populations.

Section 18744. Facility Capacity Component.
(a) For the initial SRRE the Solid Waste Facility Capacity Component shall identify and describe all existing permitted solid waste landfills and transformation facilities within the jurisdiction. This description shall contain the following:
(1) identification of the owner and operator of each permitted solid waste disposal facility;
(2) quantity and waste types of solid waste disposed;
(3) permitted site acreage;
(4) permitted capacity;
(5) current disposal fees; and
(6) for solid waste landfills, remaining facility capacity in cubic yards and years.
(b) The Solid Waste Facility Capacity Component shall include a solid waste disposal facility needs projection which estimates the additional disposal capacity, in cubic yards per year, needed to accommodate anticipated solid waste generation within the jurisdiction for a 15-year period commencing in 1991.
(1) The solid waste disposal facility capacity needs projection for the initial SRRE shall be calculated based upon the solid waste generation projection conducted in accordance with section 18722, of Article 6.1 of this Chapter.
(2) The disposal capacity needs projection for the 15 year period shall be calculated using the following equation:
ADDITIONAL CAPACITY Year
n = [(G + I) - (D + TC + LF + E)]Year n
where:
G = The amount of solid waste projected to be generated in the jurisdiction;
I = The amount of solid waste which is expected to be imported to the jurisdiction for disposal in permitted solid waste disposal facilities through interjurisdictional agreement(s) with other cities or counties, or through agreements with solid waste enterprises, as defined in section 40193 of the Public Resources Code.
D = The amount diverted through successful implementation of proposed source reduction, recycling, and composting programs.
TC = The amount of volume reduction occurring through available, permitted transformation facilities.
LF = The amount of permitted solid waste disposal capacity which is available for disposal in the jurisdiction, of solid waste generated in the jurisdiction.
E = The amount of solid waste generated in the jurisdiction which is exported to solid waste disposal facilities through interjurisdictional agreement(s) with other cities, counties or states, or through agreements with solid waste enterprises, as defined in section 40193 of the Public Resources Code.
n = each year of a 15 year period commencing in 1991. [iterative in one year increments]
(c) The Solid Waste Facility Capacity Component shall include discussions of:
(1) The solid waste disposal facilities within the jurisdiction which will be phased out or closed during the short-term and medium-term planning periods and the anticipated effect from such phase-out or closure on disposal capacity needs of the jurisdiction.
(2) Plans to establish new or expanded facilities for the short-term and medium-term planning periods and the projected additional capacity of each new or expanded facility.

(3) Plans to export waste to another jurisdiction for the short-term and medium-term planning periods and the projected additional capacity of proposed export agreements.
Note:
Authority cited:
Section 40502 of the Public Resources Code.
Reference:
Sections 41260, 41460 and 41821 of the Public Resources Code.
Section 18788. Five-Year Review and Revision of the Countywide or Regional Agency Integrated Waste Management Plan.

APPENDIX C

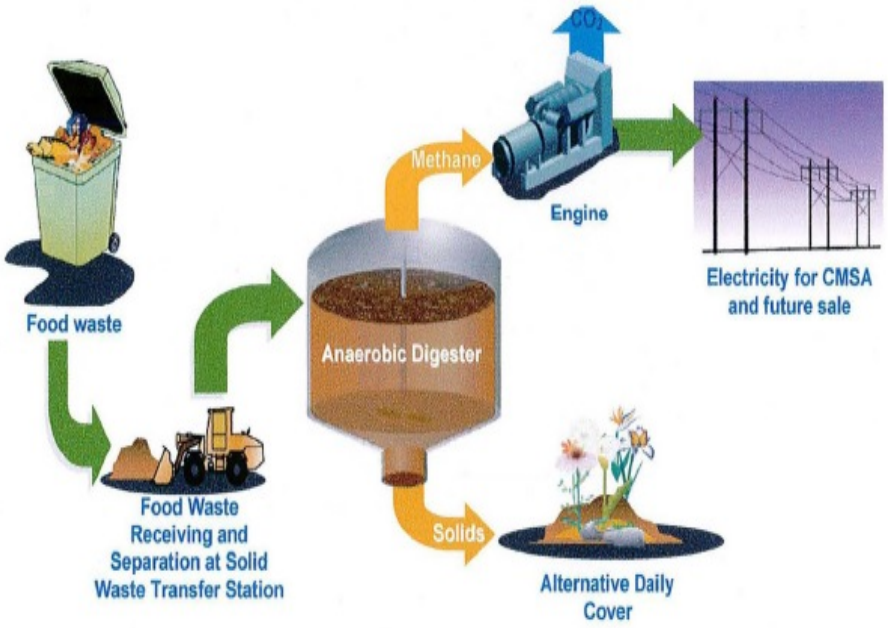
Marin Sanitary Service
CONSERVATION – OUR EARTH, OUR MISSION, OUR JOB

Central Marin Commercial Food-to-Energy (F2E) Program

CMSA

What is Anaerobic Digestion?

Anaerobic digestion (also known as food-to-energy (F2E) is the decomposition of organic solids in an oxygen-free environment. Through this technique, a natural biogas is created (consisting primarily of methane gas) which is captured and utilized as a source of renewable energy. By diverting food waste from landfills, fugitive green house gas (GHG) emissions are averted. Food waste is very biodegradable and has a much higher volatile solids destruction rate than biosolids. Therefore, residuals will only increase slightly and may be used as an alternative daily cover.



APPENDIX D

The follow describes the methods used to turn various types of waste into energy:

THERMAL TECHNOLOGIES

Gasification—uses heat, pressure and steam to convert organic or fossil-based materials directly into a gas composed mainly of carbon monoxide, hydrogen and carbon dioxide, otherwise known as syngas. Typical raw materials used in gasification are coal, petroleum-based and organic materials. The technology requires an energy source to generate heat and to begin processing. Hydrocarbon buildup, a main contributor to plant failures, is a significant problem. In addition, the cost of requirements to operate the plant has made it commercially unviable.

Microwave Plasma Gasification- plasmatron guns are strategically pointed to saturate matter with microwaves at an angle, creating an efficient vortex flow that starts the gasification process at the core, making this a more effective process.
In addition, the microwave plasma gasification reactor does not react violently with any material as feedstock, and it is not as sensitive to moisture as other technologies are. For this and many other reasons, microwaves gasification can be considered as the leading emerging technology in the waste to energy field. [20]

Pyrolysis—burns wet MSW in an oxygen and water free environment and generates substantial amounts of condensable hydrocarbons, which make operating the plant difficult and inefficient. The solids resulting from pyrolysis are highly contaminated and need further treatment. The additional process requires more energy than the original pyrolysis procedure.

Plasma Arc Gasification—uses electricity passed through graphite or carbon electrodes to convert organic materials to syngas; inorganic materials are converted to solid slag. Main disadvantages include large initial investment costs relative to current landfills, large electrical energy input, frequent maintenance of the highly corrosive plasma flame and highly toxic waste water. There are no tars or furans. At extremely high temperatures all metals become molten and flow out the bottom of the reactor. Inorganics such as silica, soil, concrete, glass, gravel, etc. are vitrified into glass and flow out the bottom of the reactor. There is no ash remaining to go back to a landfill –See Appendix E

Thermal Depolymerization—uses waste plastic, tires, wood pulp, medical waste, turkey offal and sewerage sludge to produce crude oil products as kerosene, naphtha and light crude oil. Methane, an additional byproduct, is collected and used to power turbine generators that produce electricity either for the facility or for resale.

[20] http://www.linkedin.com/groups/Microwave-plasma-gasification-vs-other-1978778.S.95759190

NON-THERMAL TECHNOLOGIES

Fermentation production—uses waste cellulose or organic material to create ethanol for use in motor vehicles. The fermentation process is the same general procedure used to make wine.

Esterification—uses recycled vegetable oil, virgin oil and/or tallow to create biodiesel. The recycled oil is processed to remove impurities and virgin oil is refined. The amount of oil in the feedstock and the transportation distance determine the effectiveness of the technology.

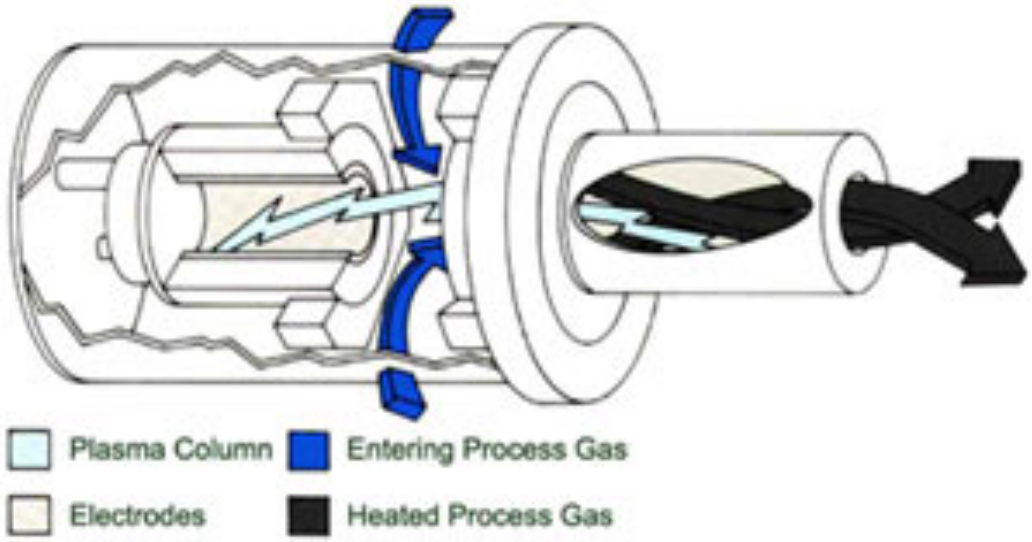
Anaerobic Digestion—uses bacteria to break down food waste and release methane gas as a byproduct that can be used for electricity/energy generation. The organic residue can be used as a soil amendment.

APPENDIX E

DISCUSSION ON PLASMA GASIFICATION

Plasma gasification is the gasification of matter in an oxygen-starved environment to decompose waste material into its basic molecular structure. Plasma gasification does not combust the waste as incinerators do. It converts the organic waste into a fuel gas that still contains all the chemical and heat energy from the waste. It converts the inorganic waste into an inert vitrified glass.

Plasma is considered a 4th state. Electricity is fed to a torch, which has two electrodes, creating an arc. Inert gas is passed through the arc, heating the process gas to internal temperatures as high as 25,000 degrees Fahrenheit. The following diagram illustrates how the plasma torch operates.



The temperature a few feet from the torch can be as high as 5,000-8000º F. Because of these high temperatures the waste is completely destroyed and broken down into its basic elemental components. There are no tars or furans. At these high temperatures all metals become molten and flow out the bottom of the reactor. Inorganics such as silica, soil, concrete, glass, gravel, etc. are vitrified into glass and flow out the bottom of the reactor. There is no ash remaining to go back to a landfill.

PROCESS FLOW DIAGRAM- Plasma Gasification
http://recoveredenergy.com/d_plasma.html