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DEPARTMENT OF BIOLOGICAL AND AGRICULTURAL ENGINEERING
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California Energy Commission
Re: Docket No. 03-RPS-1078
and Docket No. 02-REN-1038
Docket Unit, MS-4
1516 Ninth Street
Sacramento, CA 95814-5504

Comments by Rob Williams on the matter of
RPS Proceeding - Eligibility and Implementation Guidebooks

The Energy Commission's Renewables Committee and Energy Commission staff are to be commended for the work done to move the RPS Proceeding to this point in the span of about 1 year. As a researcher in biomass energy systems and issues and currently involved in the evaluation of Conversion Technology for MSW (through an interagency agreement with the California Integrated Waste Management Board), and as a concerned consumer of energy, I welcome the opportunity to provide comments regarding;

a). the RPS Eligibility Guidebook (Energy Commission, 2004)[1] as it applies to the consideration of municipal solid waste (MSW) as a renewable resource (includes a discussion of MSW as a renewable source in Europe).

b). Hybrid Technologies

RPS Eligibility Guidebook

It is encouraging to read in the set of RPS eligibility and implementation guidebooks that the Energy Commission is defining eligible renewable energy based on the renewable resource or fuel used rather than the specific technology

[1] http://www.energy.ca.gov/portfolio/documents/guidebooks/2004-01-27_500-04-002D.PDF Accessed 3 Feb., 2004

The Eligibility Guidebook indicates in the 'Outstanding Issues' section (beginning at page 2) that there are still fuel –specific eligibility issues related to at least small hydro, geothermal, and municipal solid waste. These comments are intended to help clarify the degree to which MSW is renewable.

For 2002, the California Integrated Waste Management Board (CIWMB) reports that 37.5 million short tons (wet basis) were disposed in regulated landfills[2]. Based on the last waste characterization study[3] of the 37.5 million tons disposed, 25.5 million tons are of biological origin, 4 million tons are plastics and textiles (assumed to be all synthetic textiles), and the remaining 8 million tons are mineral and other inorganic material (glass, metal, non wood construction/demolition waste). The plastics and synthetic components of the waste stream derive from fossil hydrocarbon sources (plastics synthesized from biomass are still developmental).

If the mixed waste stream were converted to energy, the biogenic (or biomass) material and the plastics and other synthetic carbon containing materials would contribute to the converted or generated energy. The already mineralized material would not contribute (in fact, in mass burn facilities these mineral materials can absorb small amounts of energy in ash transformation reactions). Table 1 displays a list of the disposed MSW stream (overall CA average) by component (weight) as well as an analysis of the total primary energy and the gross electricity generation potential represented by the waste stream. If this average waste stream were converted to electricity, about 70% could be attributed to renewable resources (the other 30% is energy derived from fossil fuel materials).

However, facilities that earn CIWMB conversion facility certification are likely to not use the complete post-recycled mixed waste stream (as described in Table 1) as a feedstock. Depending on the local waste stream, economics, and the requirements of the facility, the actual feedstock converted at a specific facility could range from 100% biogenic (renewable) components (e.g., non-recyclable paper and/or food and yard wastes) to nearly 100% non-renewable fossil fuel bases components (there is a proposed project that will convert only nos. 2 -6 plastics for production of gasoline and diesel. The project plans to generate its own electricity onsite from the gasoline product of the plastic conversion. This electricity would not be renewable.)

[2] http://www.ciwmb.ca.gov/LGCentral/Rates/Diversion/RateTable.htm Accessed 3 Feb., 2004
[3] Completed in 1999- a new characterization study is underway.

Table 1 California disposed waste stream characterization and potential for generation of electrical power[4].

CA disposed MSW by type, equivalent primary energy represented and corresponding electricity generation potential.	Landfilled[a] (Mt)	% of Total	Ash[b] (% wb)	Ash (Mt y^{-1})	HHV[b] (MJ/kg, ar)	HHV contribution to composite stream (MJ kg^{-1} as received)	Moisture[b] (%wb)	Landfilled (Mt dry)	HHV (MJ/kg, dry)	Primary Energy by Component (EJ)[c]	Primary Energy by Component (%)	Electricity Potential[d] (MWe)	(GWh y^{-1})
Paper/Cardboard	11.3	30.2	5.3	0.6	16	4.83	10	10.2	17.8	0.164	44	1040	9,115
Food	5.9	15.7	5.0	0.3	4.2	0.66	70	1.8	14.0	0.022	6	200	1,752
Leaves and Grass	3.0	7.9	4.0	0.1	6	0.48	60	1.2	15.0	0.016	4	73	640
Other Organics	2.6	7.0	10.0	0.3	8.5	0.59	4	2.5	8.9	0.020	5	128	1,119
C&D Lumber	1.8	4.9	5.0	0.1	17	0.84	12	1.6	19.3	0.028	8	180	1,577
Prunings, trimmings, branches and stumps	0.9	2.4	3.6	0.03	11.4	0.27	40	0.5	19.0	0.009	2	58	509
Biomass Components of MSW Total	**25.5**	**68.1**		**1.4**		**7.7**		**17.8**		**0.26**	**70**	**1679**	**14,712**
All non-Film Plastic	1.9	5.0	2.0	0.04	22	1.11	0.2	1.9	22.0	0.038	10	238	2,085
Film Plastic	1.5	3.9	3.0	0.04	45	1.75	0.2	1.5	45.1	0.059	16	376	3,298
Textiles	0.8	2.1	7.0	0.06	17.4	0.37	10	0.7	19.3	0.012	3	79	693
Non-Biomass Carbon Compounds Total	**4.1**	**11.0**		**0.14**		**3.22**		**4.0**		**0.11**	**30**	**694**	**6,075**
Other C&D	2.5	6.6	100	2.5	0	0		2.5					
Metal	2.3	6.1	100	2.3	0	0		2.3					
Other Mixed and Mineralized	2.0	5.3	100	2.0	0	0		2.0					
Glass	1.1	2.9	100	1.1	0	0		1.1					
Mineral Total	**7.8**	**20.9**		**7.8**		**0.0**		**7.8**		**0**	**0**	**0**	**0**
Totals	**37.4**	**100**		**9.3**		**10.89**		**29.6**		**0.370**	**100**	**2373**	**20,787**

a) California waste stream composite data (http://www.ciwmb.ca.gov/WasteChar/Study1999/OverTabl.htm), Accessed 1 Sept., 2003
b) Adapted from Tchobanalglous, G., Theisen, H. and Vigil, S.(1993),"Integrated Solid Waste Management", Chapter 4, McGraw-Hill, New York & Themelis, N. J., Kim, Y. H., and Brady, M. H. (2002). "Energy recovery from New York City municipal solid wastes." Waste Management & Research, 20(3), 223-233.
c) EJ = 10^18 J (exajoule) and is approximately equal to 1 Quad (1 Q = 1.055 EJ)
d) Electricity calculations assume thermal conversion means for low moisture stream (paper/cardboard, other organics, C&D Lumber, all plastics and textiles) and biological means (anaerobic digestion) for the high moisture components (food and green waste). Energy efficiency of conversion of matter to electricity by thermal means is assumed to be 20%. Biomethane potentials of 0.29 and 0.14 g CH4/g VS for food and leaves/grass mixture respectively are assumed for biogas production which is converted at 30% thermal efficiency in reciprocating engines. Capacity factor of 1 is used.

[4] Adapted from Williams, R.B. (2003) Solid Waste Conversion. Final Report. CIWMB interagency agreement IWM-C0172.

Since MSW conversion facilities will be individually certified, the character of the feedstock will be known with a fairly high degree of precision. It would be a simple matter to document in the certification process the proportion of electrical generation capacity that is attributable to renewable components of the waste stream (if any). Energy from facilities that convert waste tires only, should be considered renewable to the extent that natural rubber or latex is used in the tire composition (on the order of 15% in automobile tires I believe).

From a public policy perspective, it is generally a good thing to promote better utilization of waste materials rather than landfill disposal. Energy conversion can be a viable and perhaps profitable option for use of the solid waste stream. However, it should only be labeled 'renewable energy' to the extent that the fuel is derived from renewable components. This view strengthens the credibility of the program, is more defensible, and better aligns with accepted practice elsewhere.

Treatment of MSW as a renewable resource in Europe

In order to reduce green house gas emissions in attempts to comply with the Kyoto Protocol, the European Union is implementing strategies which include increased use of energy produced from renewable sources. The European Community Directive 2001/77/EC (27 September 2001)[5] contains definitions for renewable electrical energy sources;

> DIRECTIVE 2001/77/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market
>
> *Article 2*
> **Definitions**
>
> (a) '*renewable energy sources*' shall mean renewable non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases);
> (b) '*biomass*' shall mean the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste;

[5] Directive 2001/77/EC (27 September 2001). Article 2(b).
http://europa.eu.int/eur-lex/pri/en/oj/dat/2001/l_283/l_28320011027en00330040.pdf

Biomass is, of course, a renewable source. The EC Directive includes in the definition of biomass- "the biodegradable fraction of industrial and municipal waste" (although this definition appears overly restrictive depending in turn on the definition of "biodegradable" that may discount some fraction of biomass). The Directive also advises that of the electricity produced by facilities that consume both renewable and non-renewable feedstocks (mixed MSW), only that portion attributable to the renewable energy source is considered renewable electricity[6]. Electricity and heat from the **organic portion** of MSW is considered renewable in The Netherlands[7] and Switzerland. Currently, that fraction in Switzerland is 50%, based on a recent feedstock characterization for MSW combustion facilities.[8]

Hybrid Technologies

Co-firing solid biomass with coal can be the least costly means for increasing power produced from biomass. A relatively small amount of biomass injected with the coal (5-10% energy basis) can be done with minimal modifications to the power plant (perhaps separate feeding and handling facilities are required). Performance of the plant is usually not affected and in some cases, emissions may improve. Co-firing 7% (energy basis) biomass with coal in a 750 MWe facility would yield approximately 50 MWe from the biomass fuel.

If the existing coal facility happens to be near a sustainable source of renewable fuel, this option can be very attractive. There are several (smaller) coal fired facilities in California, some of which are located in the San Joaquin Valley and potentially near biomass sources.

Co-firing biogas or producer gas from thermochemical gasification of biomass are opportunities for existing natural gas fired power plants or potential new hybrid plants. The opportunities would be site-specific. Co-firing producer gas with natural gas systems are developmental (but are being investigated).

It is highly recommended that facilities that use a mix of renewable fuels (no fossil carbon content) and fossil fuels be allowed to qualify (as renewable electricity) that portion of the electricity that can be shown to come from renewable resources. This would require (at least) metering of the flows and

[6] Ibid. Article 2(c).
[7] Junginger, M., S. Agterbosch, et al. "Renewable electricity in the Netherlands." Energy Policy **In Press, Corrected Proof**.
[8] Ludwig, C. personal communication. 9 October 2003

energy contents of the input fuels. MSW conversion facilities could then be considered hybrid if their feedstocks contain a mixture of fossil fuel derived and biogenic components.

Respectfully Submitted,

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