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654-C N. Santa Cruz Ave., No. 305, Los Gatos, CA 95030-4360

Phone: Sacramento 916.508.3837 Silicon Valley 408.399.9081

www.mightycomm.com

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From: Mightycomm on behalf of Remediation Earth, Inc.



REMEDIATION EARTH, INC.

4607 Lakeview Canyon Rd, #438

Westlake Village, CA 91361

805-455-8111 mobile

805-522-9100 office

805-522-9199 fax

www.RemediationEarth.com

Via e-mail: DOCKET@energy.state.ca.us

**Subject: Making Diesel Substitute Fuel Oil
by Harvesting California's Waste Plastics**

Summary

This document is a brief summary of waste-to-fuel-oil technology being submitted for consideration for funding under the California Energy Commission's AB 118 Alternative and Renewable Fuel and Vehicle Technology Program. Specifically, this document is aimed at the 2011-2012 Investment Plan category informally titled "Diesel Substitutes."

Contact: Peter Kokiousis, REI
Daniel Moscaritolo, REI

Remediation Earth, Inc. (“REI”) Technology Overview

Alternative Feedstock – “Harvested Municipal Solid Waste” Why?

We believe that harvesting various fractions of municipal solid waste (“MSW”) is a far more cost-effective alternative fuel feedstock – in terms of environmental sustainability and greenhouse gas reduction – than harvesting purpose-grown crops. Harvesting waste plastics from California’s MSW stream would help reduce California’s petroleum dependency, develop low-carbon fuels and reduce greenhouse gases from vehicle tailpipes and municipal landfills. The benefits of using waste plastics as the new “fuel feedstock,” are outlined here:

	Purpose-grown Crops	Mixed Plastics from MSW
Water consumption	High	Very minimum
Land use	Large (production capacity requirement dependent)	Minimum (for building facility only)
Growth/supply projection	Limited (weather & soil conditions dependent)	Unlimited* (predictable)
Annual planting requirement	Yes	No
Cost of planting	High	NONE
Harvesting schedule	Seasonal	Daily*
Impact on food & fiber production	High (limited resources)	NONE
Economic impact on food & fiber	High (high price due to limited supply)	NONE
Carbon footprint generated by transportation, off-road equipment, etc.	High	Low

Table 1: Sustainability comparison between purpose-grown crops and MSW

NOTE: * According to U.S. EPA’s Municipal Solid Waste analysis report from 2008, American generated about 250 million tons of trash – about 4.5 lb of MSW per person, per day¹

Harvesting California’s waste (about 40 million tons generated in 2008, according to California Recycle²) as a feedstock to generate fuel and power, is an effective solution to addressing the state’s oil dependency. The U.S. EPA’s 2008 report on MSW pointed out that the MSW recycling rate was about 33.2%, of which only 7.1% of the plastics, which have the best fuel and power generation properties, were recovered and recycled. Therefore, MSW is an under-utilized fuel feedstock.

¹ <http://www.epa.gov/osw/nonhaz/municipal/pubs/msw2008rpt.pdf>

² <http://www.calrecycle.ca.gov/Publications/General/Extracts/2009023/Summary.pdf>

REI's Superior Waste to Energy Conversion Technology

REI's Pyrolysis I technology, a commercially proven thermal conversion process used for over 18 years in Japan, generates fuel, carbon black and electric power from various components found in waste materials. The Pyrolysis I process is NOT incineration because there is little or no oxygen in the system. As a result, this technology has superior emissions results, as shown in Figure 1 below:

REI's EMISSIONS
↓

Pollutant	Emission Limit Values		Measured Value
	EU	US	
Dioxins & PCB concentration Toxicity	0.2 ng-TE/m ³ 0.1 ng/m ³ N	13 ng/dscm	0.00006 ngTEQ/m ³ N
Oxygen	11%	N/A	Calculated with 11%
Particulates	10 mg/m ³	24 mg/dscm	1.0 mg/m ³ N
Sulphur oxide	5 mg/m ³	29 ppmv	Below 3.57mg/m ³ N
Nitrogen dioxide	400 mg/m ³	180 ppmv	84.4 mg/m ³ N
Hydrogen chloride	10 mg/m ³	29 ppmv	6.7 mg/m ³ N
Carbon monoxide	10 mg/m ³		Below 1.39 mg/m ³ N
Water			10.2%
Emission gas temperature			178°C
Emission gas flow rate	(Wet)	-	1270 m ³ N/h
	(Dry)	-	1140 m ³ N/h

Figure 1: 3rd party emissions results for mixed plastics

Figure 2 outlines critical processing steps for Pyrolysis I as a closed-loop and self-sustained system. Figure 3 illustrates its simplified process flow diagram, showing the key system components. REI's Pyrolysis I represents a direct slow pyrolysis process which produces high-quality liquid fuel and carbon black; the same level of quality cannot be achieved with a fast pyrolysis process, implemented by others.

Table 2 summarizes primary waste feedstock for REI's pyrolytic process, and the amount of liquid fuel and carbon black generated per ton.

FEEDSTOCK (per ton)	#2 Fuel Oil / Syn-diesel	Carbon Black
Mixed Plastics (45% PP, 40% PE, 15% PS)	160 gallons	160 lb
Tires (100 tires per ton)	80 gallons	640 lb
Medical Waste	110 gallons	120 lb

Table 2: Liquid fuel & carbon black generated from different waste streams

Initially, REI will process "non-recyclable curbside residual plastics," i.e. materials that are normally landfilled. According to the U.S. EPA, in 2008 only 7.1% of plastics were recovered from MSW. REI's pyrolytic technology can process most of the remaining plastics.

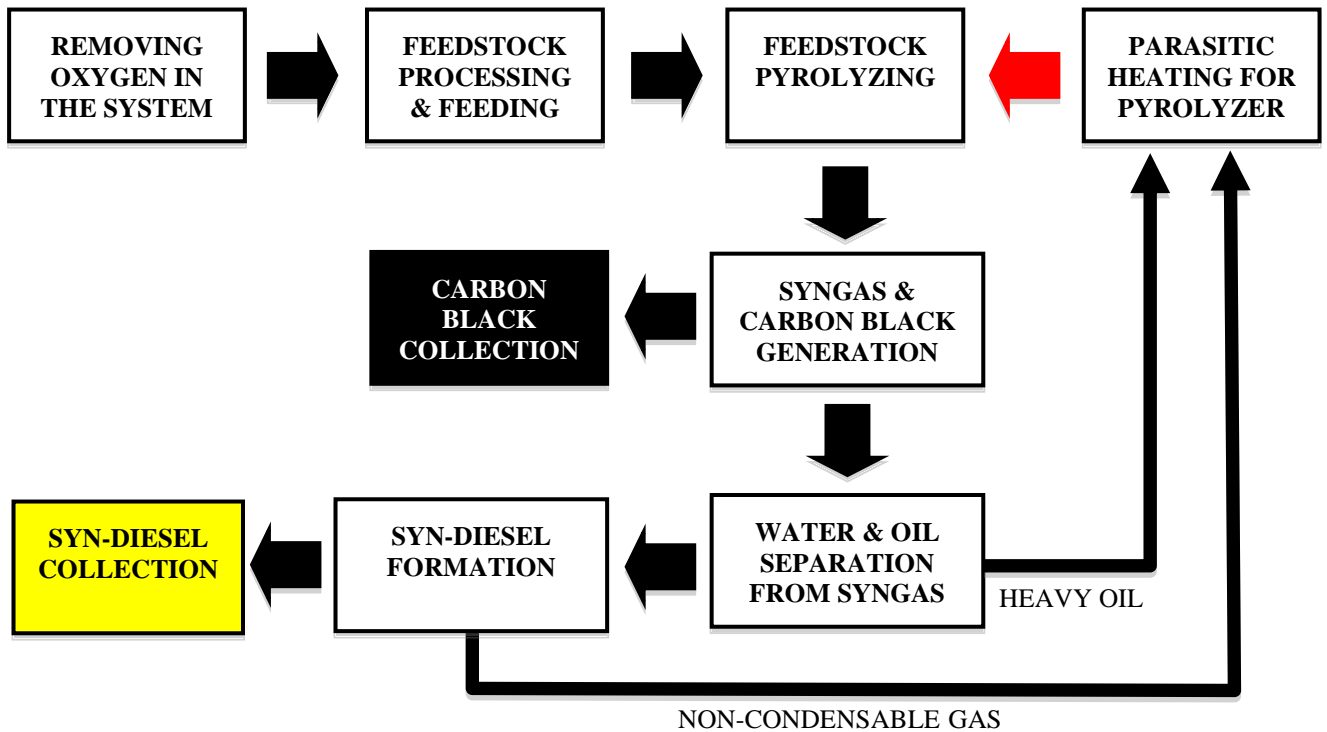


Figure 2: Flow diagram for Pyrolysis I

DIRECT SLOW PYROLYSIS SYSTEM (SIMPLIFIED PROCESS FLOW)

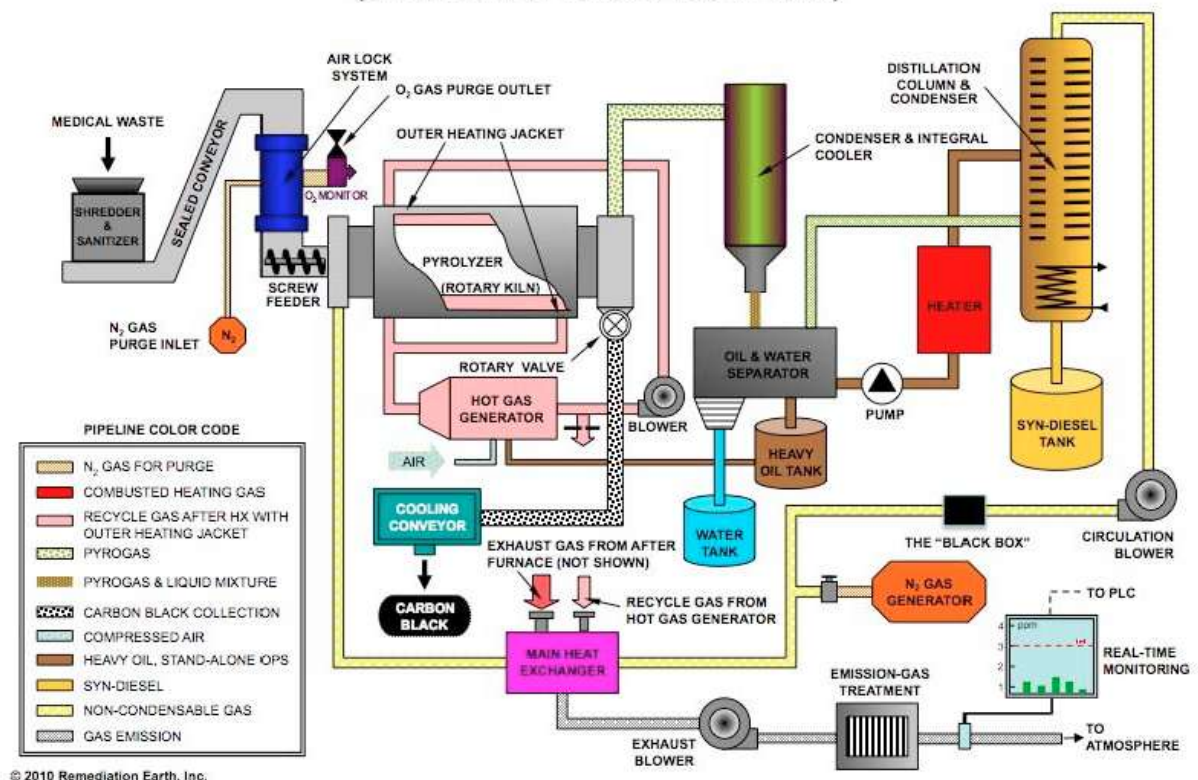


Figure 3: Flow diagram for Pyrolysis I

Medical Waste – Another Sustainable Fuel Feedstock

Today medical waste is typically burned in fossil fuel-fired incinerators or treated in autoclaves and dumped into MSW landfill sites. As a result, toxic chemical emissions and particulate matter generated from incineration, as well as chemical breakdown within landfill sites, are released into the atmosphere. REI's Pyrolysis I technology can convert these non-recyclable hazardous wastes into fuel and electric power, providing a dual solution for California: reduction in both environmental pollution and energy dependency on crude oil. According to the California Department of Public Health, the total reported medical waste treated in 2009 was approximately 53,800 tons, excluding on-site treated medical waste. Based on the conversion number listed in Table 2, REI's pyrolytic process can generate over 6 million gallons of #2 fuel oil / syn-diesel, and over 3,500 tons of carbon black from the 53,800 tons of medical waste. (Note: not all medical waste compositions can be used as fuel feedstock.)

REI's Pyrolysis I Output Applications

The main output of REI's pyrolysis technology is high-quality #2 heating oil / syn-diesel, which can also be used as a fuel feedstock and supplied to refineries as mid-distillate for upgrade to higher-value products such as jet fuel. These liquid fuels are produced by condensing the synthetic gas (i.e. syngas) that is generated from pyrolyzing feedstock inside the rotary kiln, as illustrated in Fig. 3. If not processed to form liquid fuel, this syngas can be redirected and fed into a specially modified reciprocating generator, solid oxide fuel cell ("SOFC") or like-system to produce electricity. This power generation application fits well with the distributed generation infrastructure, for example supporting electric car charging stations because of its small system footprint. Furthermore, this model improves energy efficiency by generating combined heat and power ("CHP") on-site or at near-by locations to minimize power loss through transmission.

Carbon black is a valuable by-product from the pyrolytic process. It has excellent thermal conductivity such that it absorbs and releases heat very rapidly without significant loss. One of its applications can be its use in roof tiles to collect solar energy for heating or cooling water and structures. Carbon black also has high electrical conductivity, and has been applied in battery and fuel cell development, especially when used in nano particulate form. The carbon black can be upgraded to activated carbon using REI's proprietary module.

Economic Benefits of REI's Waste-to-Fuel ("WTF") Technology

REI's first WTF facility will be located within its JV partner's, Inland Empire Environmental ("IEE"), Material Recovery Facility ("MRF") in San Bernardino, CA. IEE will provide all required unrecyclable plastics to process and produce liquid fuel and carbon black. This first WTF facility will create significant employment opportunities, requiring up to 50 people for the construction and installation, 24 permanent positions to run the facility with 6 additional people for ancillary jobs. Based on this model, a network of multiple WTF facilities located near each waste collection site can create more jobs, making California a leader in waste-to-fuel technology.

The City of San Bernardino is one of 42 Enterprise Zones under the 'Enterprise Zone Program' that "targets economically distressed areas in California with special state and local incentives which encourage business investment and promote the creation of new jobs. The Enterprise Zone program provides tax incentives to businesses and allows private sector market forces to revive the local economy."³ Some of these benefits include a 'hiring tax credit' to stimulate local job creation and a 'sales or use tax credit' to attract new businesses and potential investors.

³ <http://www.caez.org/About-Enterprise-Zones/index.html>