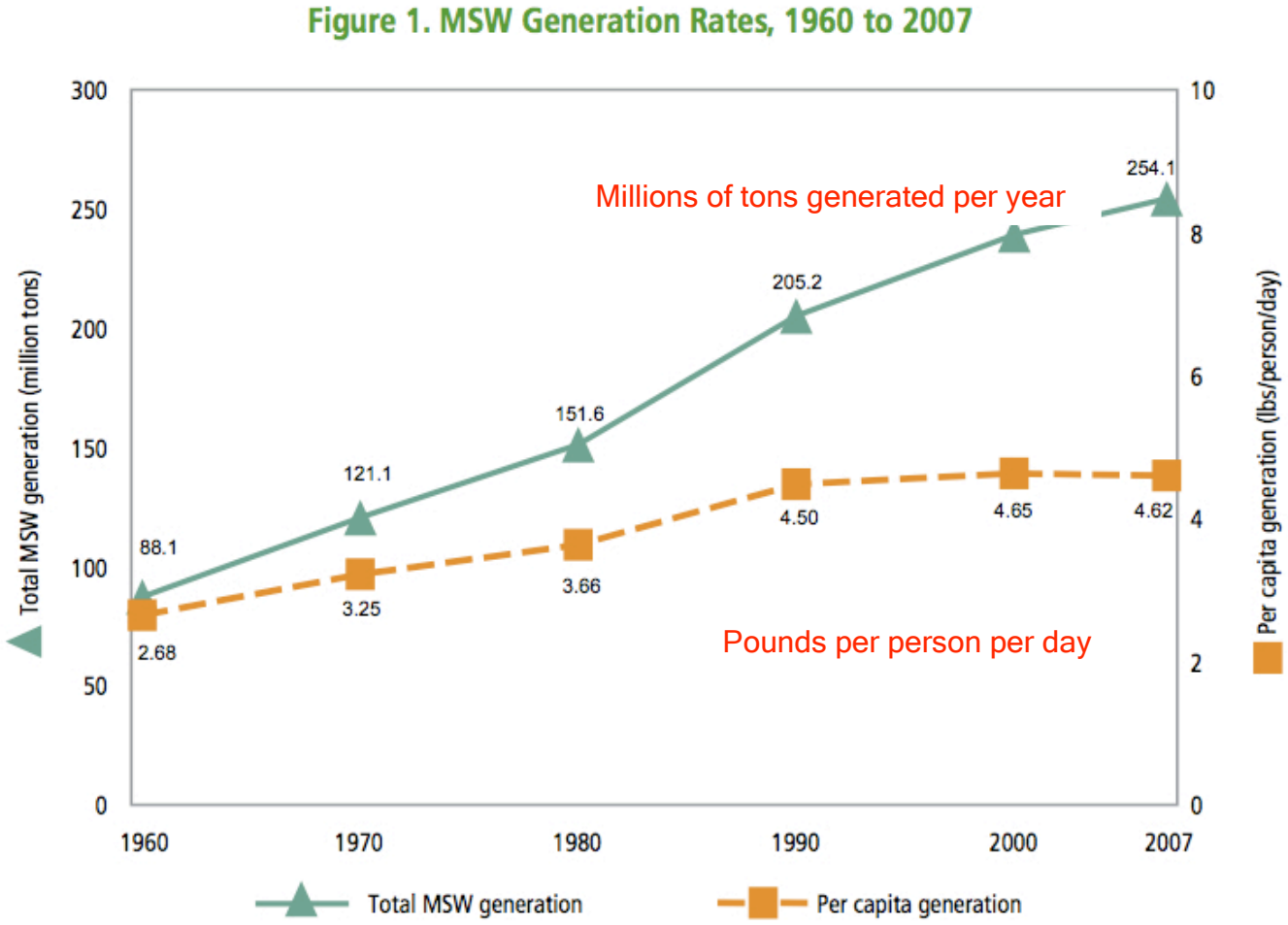
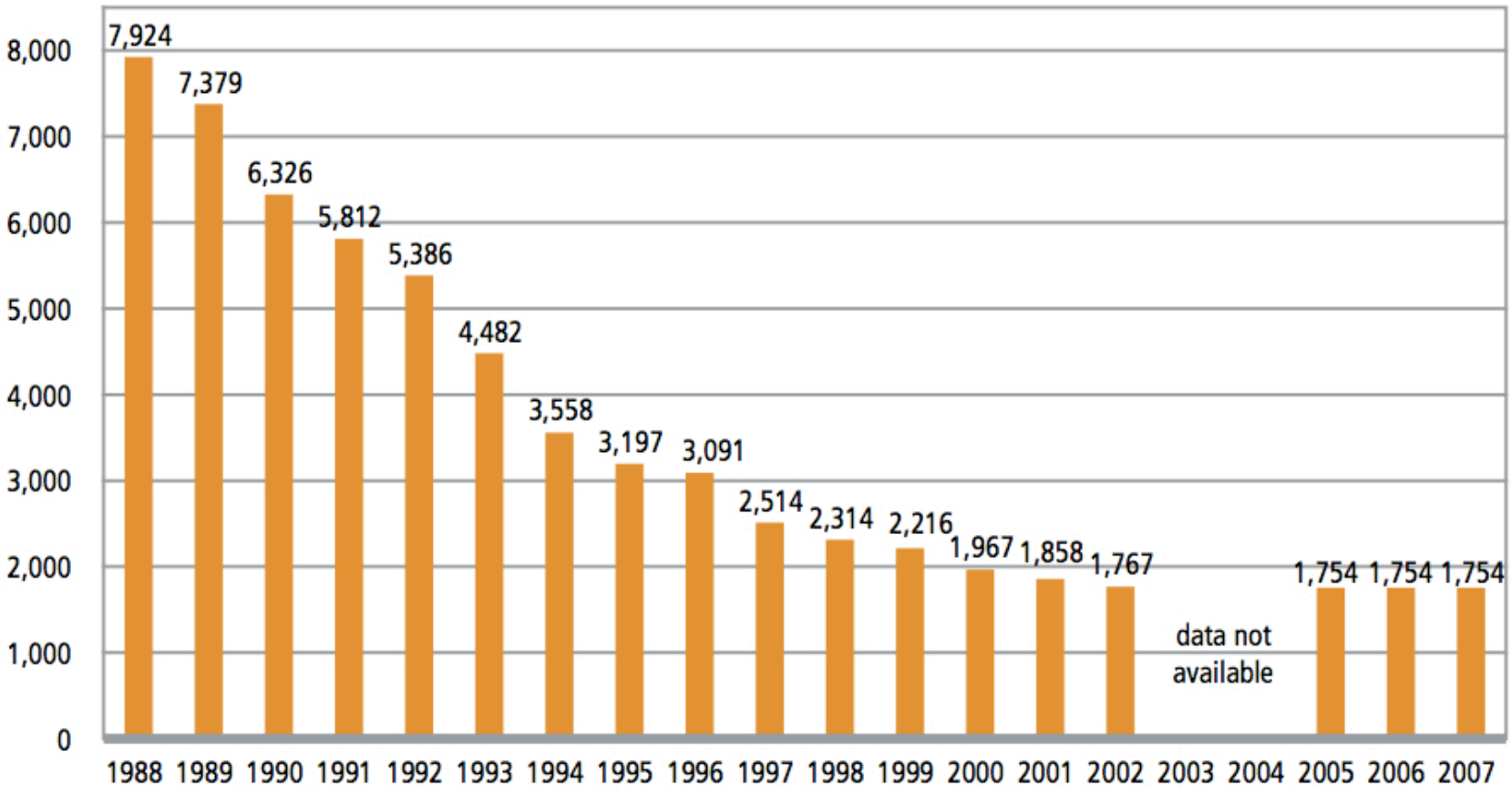
Modular Approach: Thermal Conversion of MSW

The Problem: Increasing Population



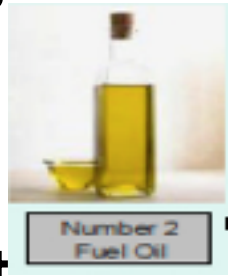
Adding to the Problem: Fewer Landfills

Figure 7. Number of Landfills in the United States, 1988 to 2007



Who is Remediation Earth, Inc. ("REI")?

- **Private Nevada Corp - June 2007**
- **Licensed, proven "non-incineration" technologies**
  - Thermo-chemical conversion; little or no oxygen
- **Remediate wastes- valuable energy products**
  - Liquid/gaseous fuels, Electricity, steam and heat
  - Carbon Black & Agri-Char (a CO_2 sequestrant)
- **Advanced Oxidation Process water treatment**
  - "AOP" is chemical free- EPA registered



20 Years Modular System Experience

Intelligent Filtration System- PEMEX Mexico

REI's Solution:

"Separate From MSW and Convert to Higher Value"

- Use proven thermal conversion technologies
  - Pyrolysis I, Hybrid-Pyrolysis II & gasification
- Gasification of MSW to power- not cost effective
  - At $0.09/kWhr, $90/ton + $40 tipping =$130/ton (2009)
- Separate plastics from MSW; > 3X profit !!
  - 160 gallons/ton syn-diesel; $320/ton @ $2.00/gal (2009)
  - 200 lbs carbon black/ton (10%); $100 @ $0.50/lb (2009)
- Smaller units; production flexibility- market need
  - Less impact from yearly scheduled Maintenance

REI: Thermal Conversion- Not Incineration

- **Incineration is combustion- many "Aliases"**
  - Waste-to-energy ("WTE"), energy from waste ("efW")
  - Advanced thermal recovery ("ATR"), "mass burn"
- **The lines are "blurred"; people are confused**
  - Incineration, WTE, efW, ATR & mass burn- ***all*** combustion
  - Pyrolysis uses little or no O_2- ***not*** combustion
  - Gasification uses sub-stoichiometric O_2- not combustion
- **Method of treating emissions is key**
  - Mass burn- can only treat ***fully combusted exhaust***
  - Thermal Conversion: intermediate step for gas cleanup
  - REI's emissions: meets worldwide standards & CA

Emission Gasses: REI's 25 t/d Pyrolysis Units
(Limit Values & Measured Values)

Pollutant	Emission Limit Values		Measured Value *
	EU	US	
Dioxins & PCB concentration Toxicity	0.2 ng-TE/m3 0.1 ng/m3N	13 ng/dscm	0.00006 ngTEQ/$m3_N$
Oxygen	11%	N/A	Calculated with 11%
Particulates	10 mg/m3	24 mg/dscm	1.0 mg/m3N
Sulphur oxide	5 mg/m3	29 ppmv	Below 3.57mg/m3N
Nitrogen dioxide	400 mg/m3	180 ppmv	84.4 mg/m3N
Hydrogen chloride	10 mg/m3	29 ppmv	6.7 mg/m3N
Carbon monoxide	10 mg/m3		Below 1.39 mg/m3N
Water			10.2%
Emission gas temperature			178℃
Emission gas flow rate (Wet)	-	-	1270 m3N/h
(Dry)	-	-	1140 m3N/h

*Actual test measurements by independent 3rd party Japanese certified lab

Technologies That Convert All These Wastes . . .

Organic Waste

Hybrid Pyrolysis II - “Green” Diesel

Petroleum Product Waste

Pyrolysis I – SynDiesel

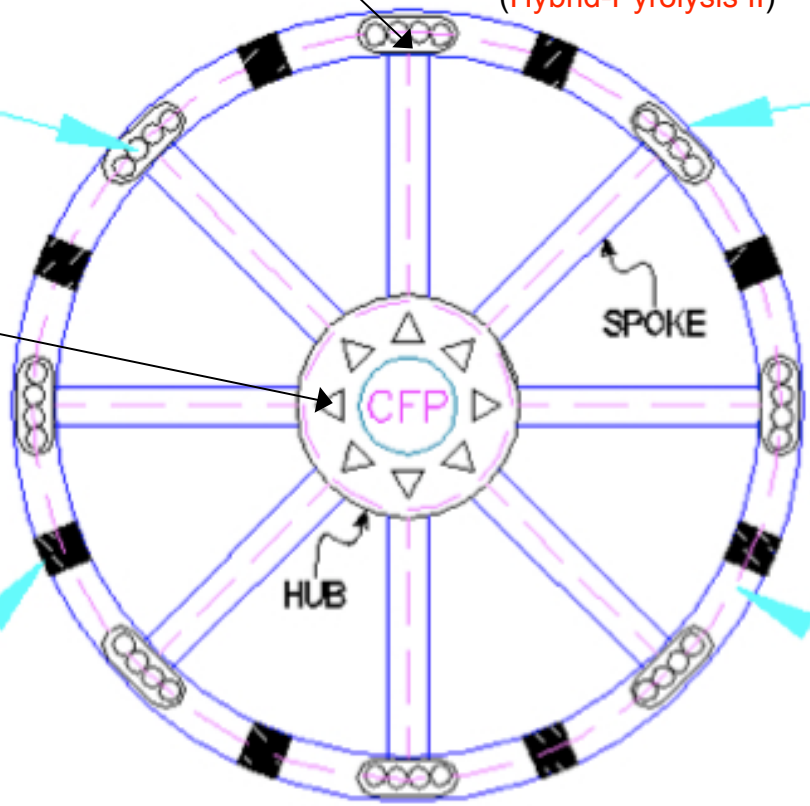
. . . Into High-Value Liquid/Gaseous Fuels and Electricity

Value-Added Products/Ton

- Tires (100 per ton) → *80 gallons #2 fuel oil
  640 lbs carbon black,300 lbs scrap steel
- Mixed Plastics
  (PP, PE, PS) → *160 gallons #2 fuel oil & synthetic diesel
  160 lbs carbon black
- Medical Waste → *110 gallons “black” #2 fuel oil, syn-diesel
  120 lbs carbon black
- e-Waste
  (Plastics with fire retardant) → *80 gallons “black” diesel
  80 lbs carbon black
- MSW → *60 to 80 gallons (see Note)
  200 lbs char/ash, depending on content

Note: Amount of oil production mainly a function of % plastic
**** Deductions made for 12% -14% oil used for parasitic needs***

REI's "Wagon Wheel" Modular Approach



Clean MRF, with biomass collection center, processing 200 tons/day green waste (dry) (Hybrid-Pyrolysis II)

Four 50 ton/day pyrolysis modules = 200 tons/day

Large diesel storage tanks for blending 20% GREEN diesel & 80% black diesel (B_{20})

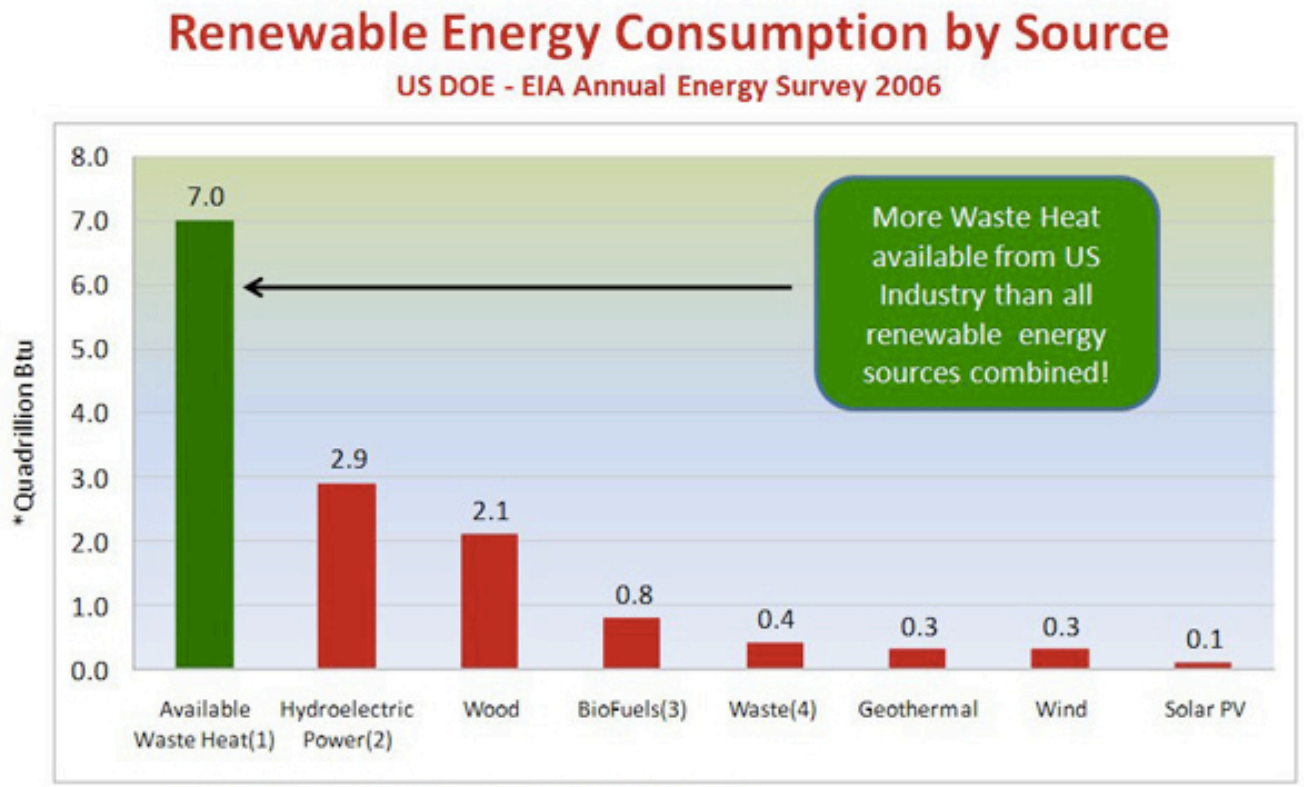
10,000 gallons/minute "AOP" water treatment with ultra-filtration = drinking water

Clean MRF processing 800 tons/day = 100 tons/day curbside residual (13% by wt.) + 100 tons/day "red bag" medical waste from hospitals = 200 tons/day total (Pyrolysis I)

Dash line represents interconnecting utilities: water, excess local electric power, syngas & biogas

CFP = Central Fuel Processing

Looking in all the wrong places . . .

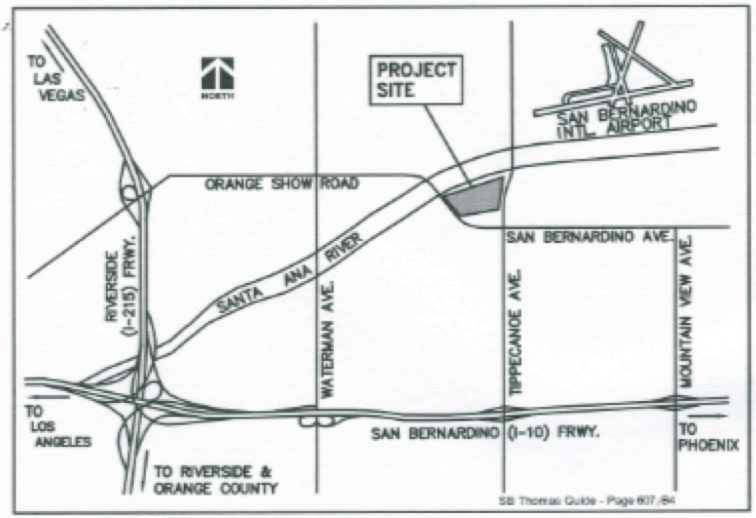


*One Quadrillion Btu is equal to one US football field 3.5 miles high of oil

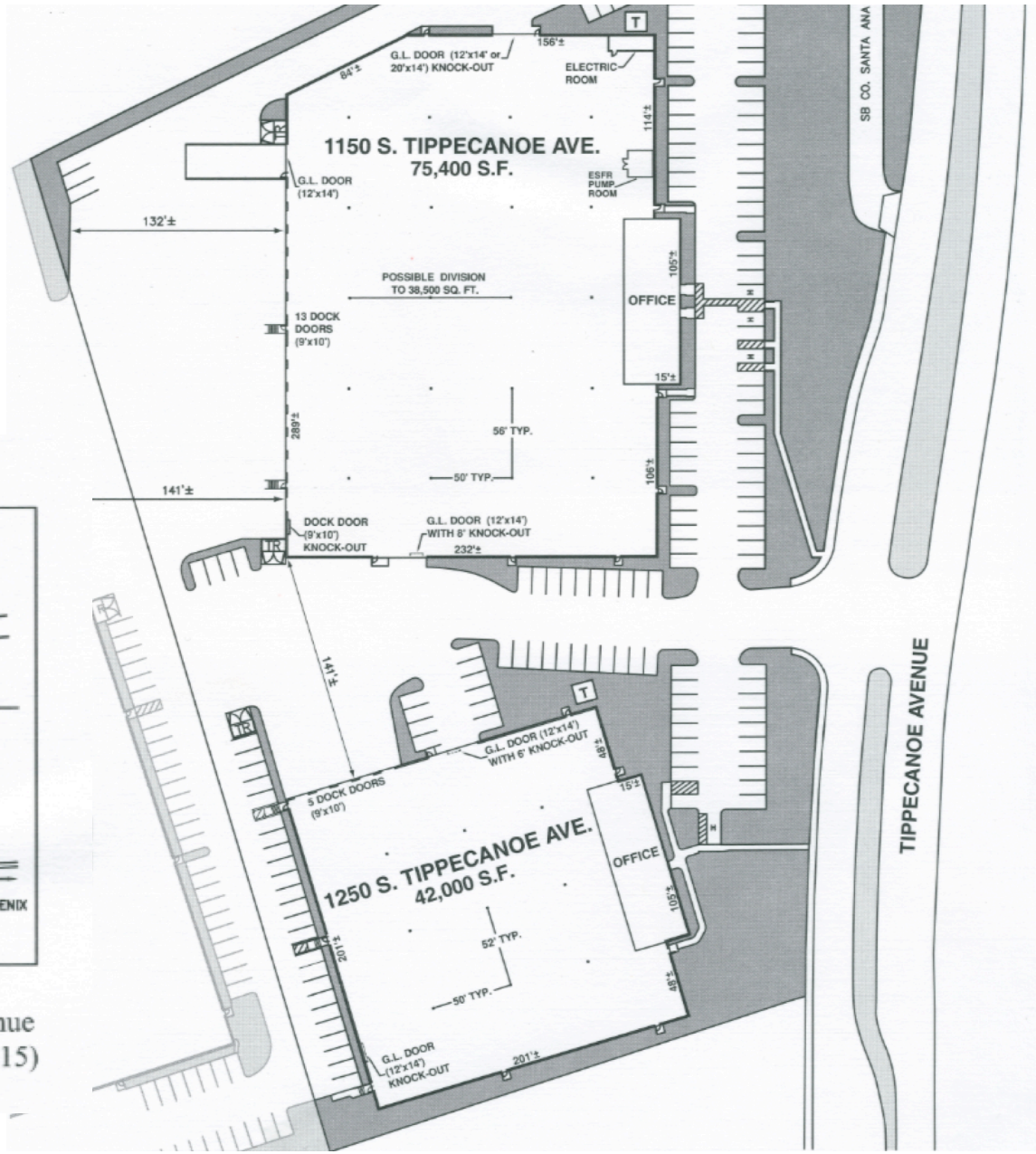
1) 24.7 Quads of energy is used by industry – of this 20-50 percent is lost in the form of Waste Heat (US DOE)
2) Conventional hydroelectric power.
3) Fuel ethanol and biodiesel consumption, plus losses and co-products from the production of fuel ethanol and biodiesel.
4) Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).

REI's San Bernardino Facility: Four 50 ton/day Pyrolysis Plants = 200 t/d

1250 S. Tippecanoe Avenue
San Bernardino, CA 92408



FREEWAY CLOSE - One mile north of the San Bernardino (I-10) Freeway via the Tippecanoe Avenue on/off ramp and two miles east of the Riverside (I-215) Freeway via the Orange Show Road on/off ramps.



IEE's Clean Material Recovery Facility ("MRF")

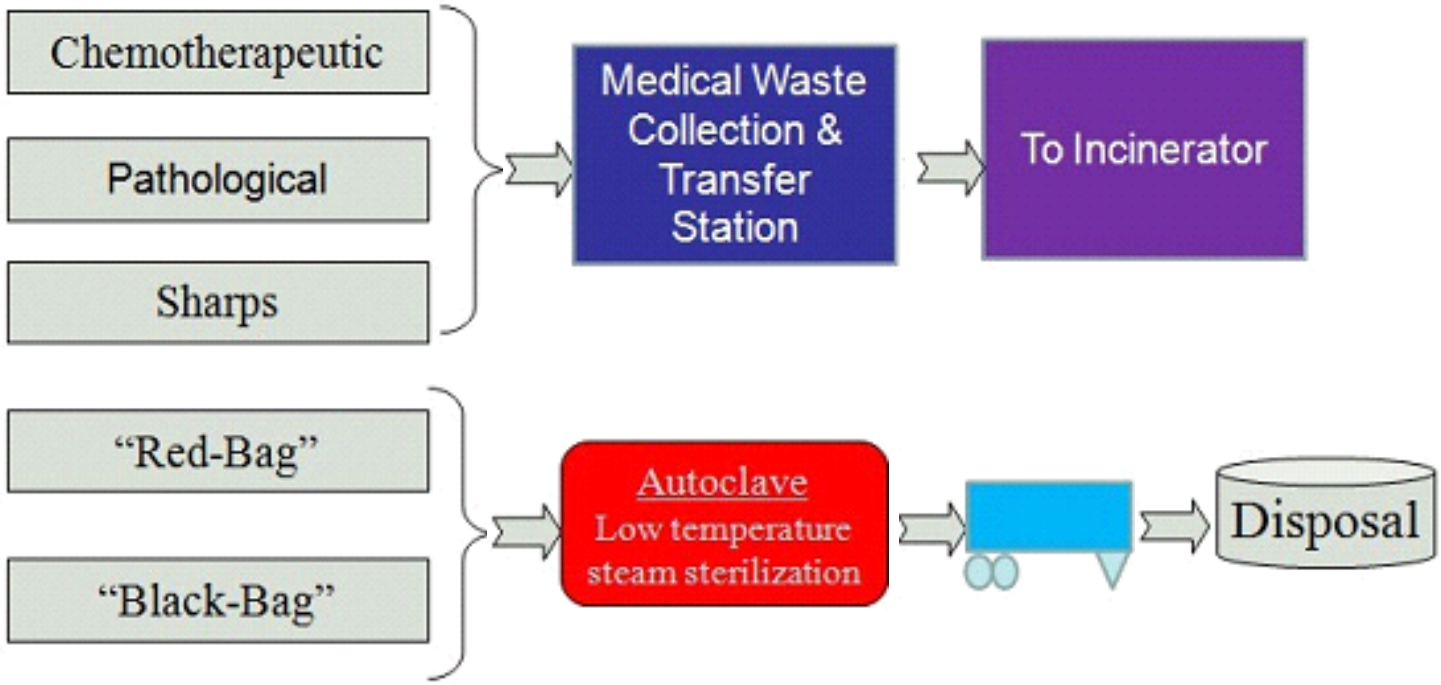
-1150 S. Tippecanoe Ave.-

PyroPOWER™

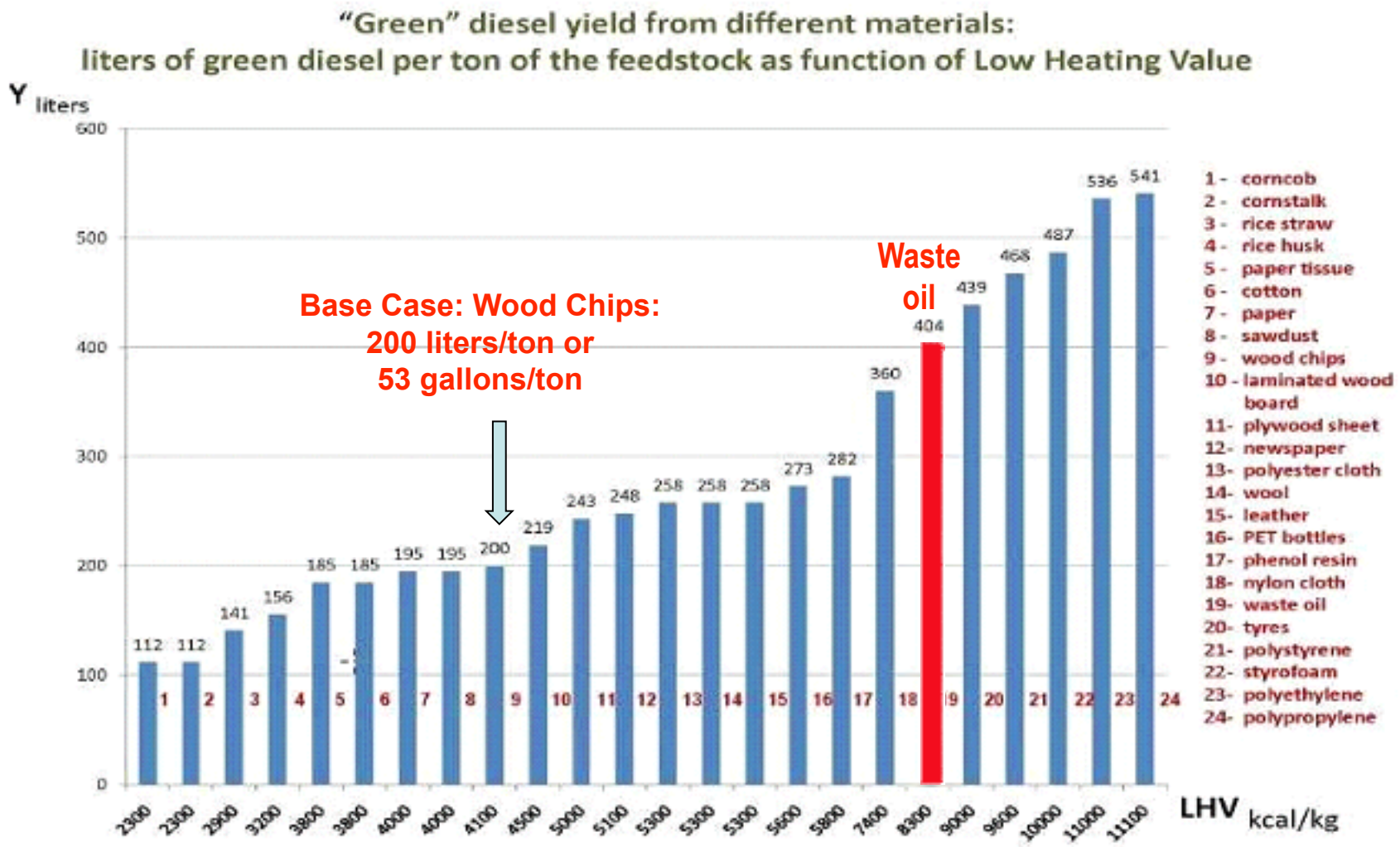
REI's New 365 kW Ultraclean PyroGas Engine Driven Electric Generator

25 Ton per Day Continuous Pyrolysis Unit

Basic Flow Diagram of Hospital/Medical Waste Process
(How most medical waste processors operate)



Green Diesel Yield



"Green" Diesel vs."Black" Diesel

Green diesel properties

Compared with a commercial diesel, green diesel has higher cetane value, lower density, and narrower boiling temperature range with lower high-boiling point. In addition, green diesel has no aromatic content that is believed to be the cause of particulate matters (PM) in exhaust. Furthermore, green diesel excels in NOx reduction and contains no sulphur and thereby expedites the PM reduction effect of oxidation catalyst.

Parameter	Green diesel	Commercial diesel*
LHV [MJ/kg]	43.5	43.5
Air-oil ratio [kg/kg]	14.9	14.6
Density [kg/m3]	763	802
Cetane number	78.4	59.9
Kinematic viscosity (at 30 C)	4.44	2.20
High-frequency reciprocating rig HFRR (μ m)	580	440
Oxygen content (mass %)	< 0.1	0
Carbon content (mass %)	84.9	87.5
Hydrogen content (mass %)	15.1	12.5
Sulphur content (mass %)	~ 0	< 0.005

*Sample parameters can fluctuate

The End


Thank You
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