Current Recycling Technologies for Plastic Waste in Japan

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Contents

1.Law for Recycling of Containers and Package

Figure1

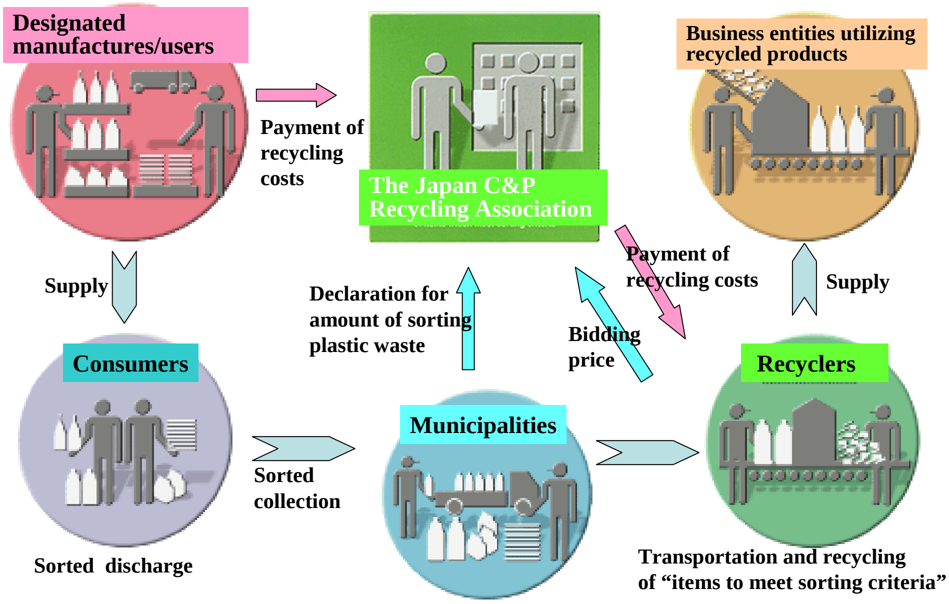


Figure2

Actual performance related to plastics other than PET bottles

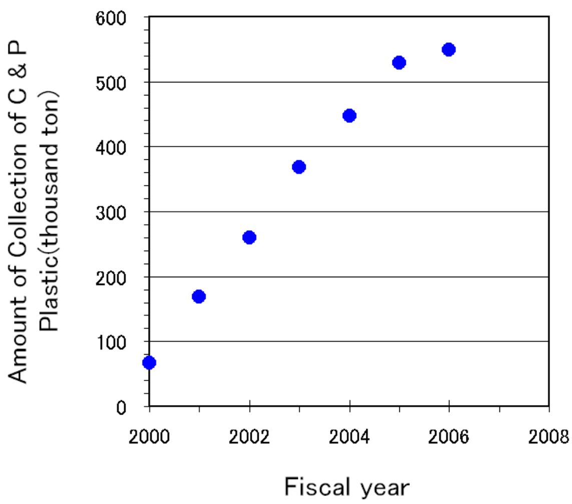


Figure3

Trends in bidding for the various recycling methods for plastics other than PET bottles

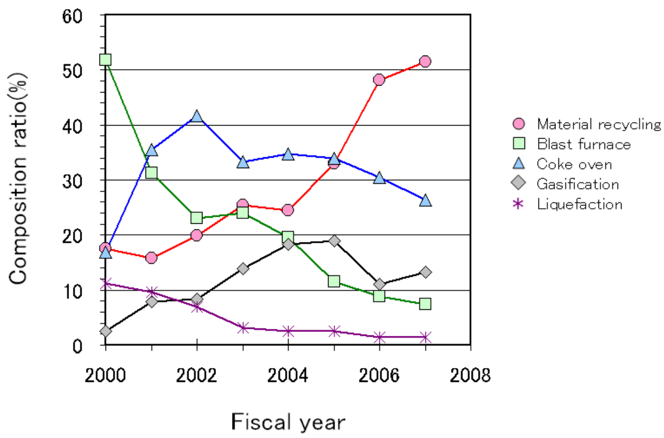


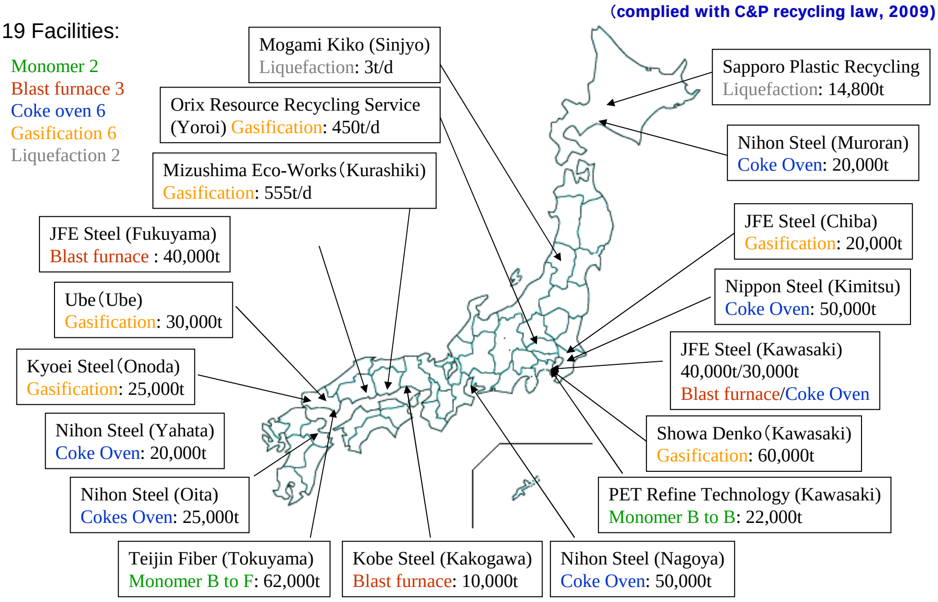
Figure4

Large Scaled Chemical Recycling Facilities

(complied with C&P recycling law, 2009)

19 Facilities:

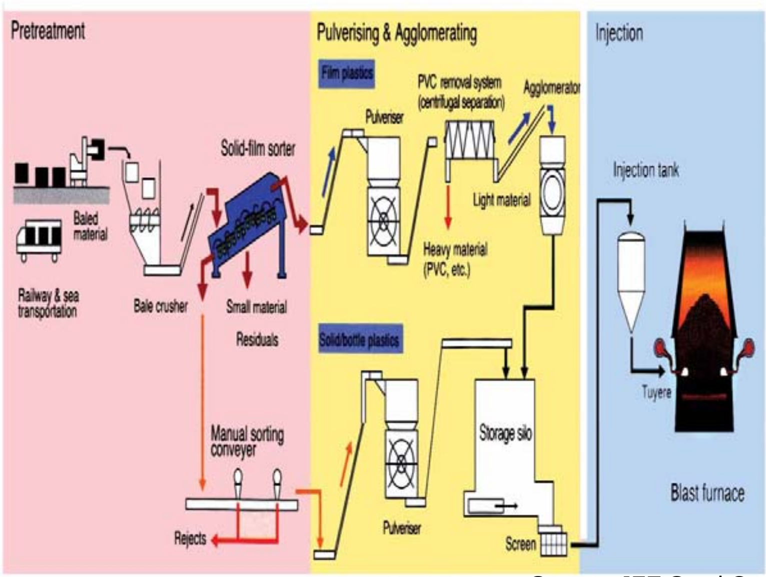
Monomer 2
Blast furnace 3
Coke oven 6
Gasification 6
Liquefaction 2



Withdraw from B to B (F: Fiber)

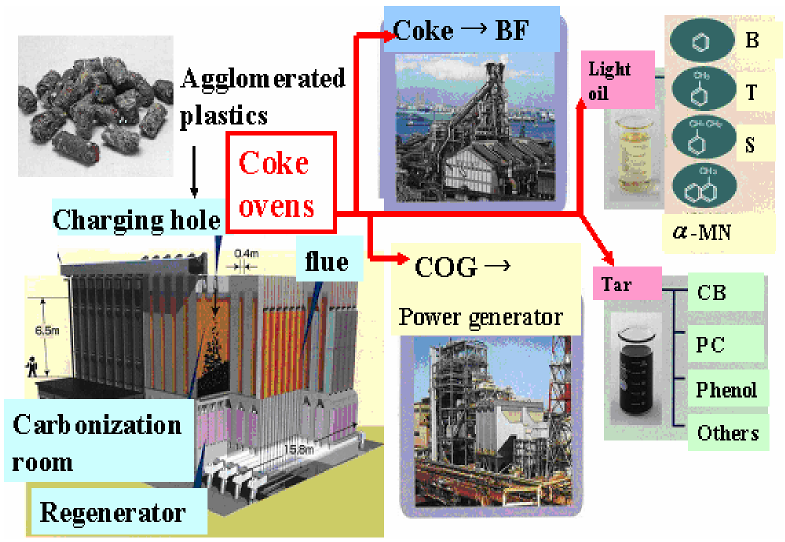
2. Recycling technologies

Figure5 **The flow seat of utilization for blast furnace reducing agents**



Source: JFE Steel Co.

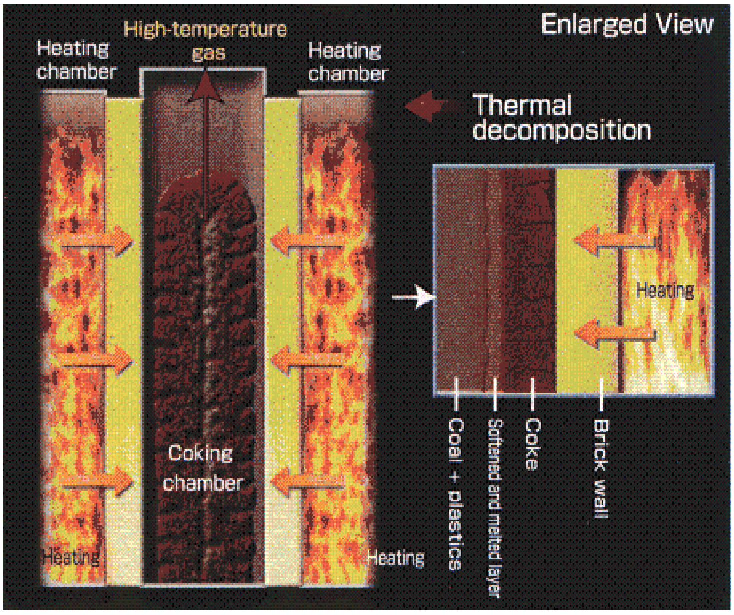
Figure6 **The flow seat of utilization for coke oven fuels**



Source: Nippon Steel Co.

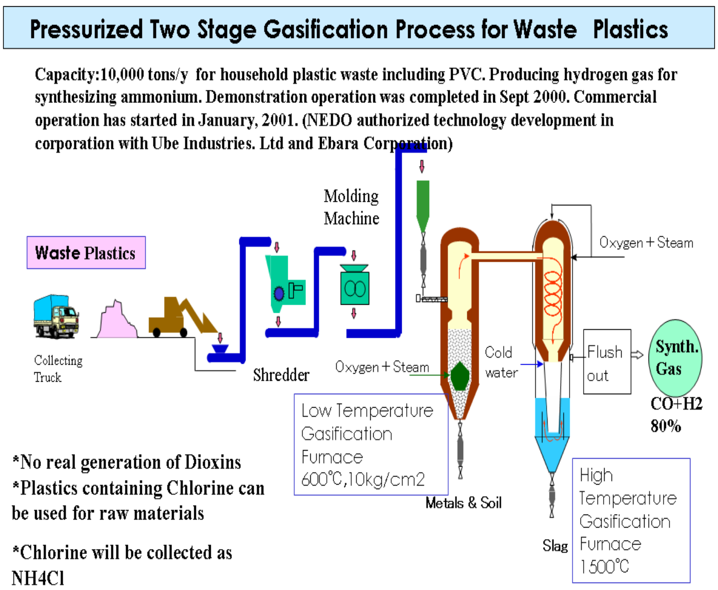
Figure7

Carbonization room



Source: Nippon Steel Co.

Figure8



Source: Ube Industries Ltd.

Figure9

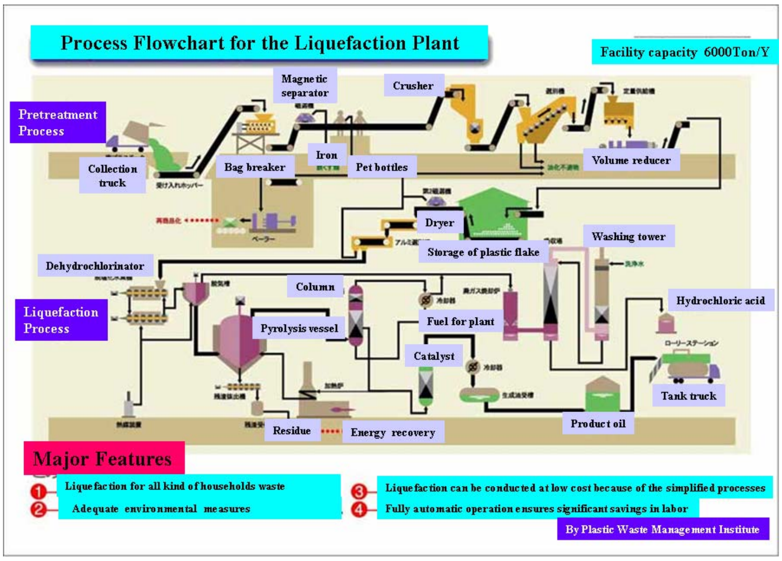
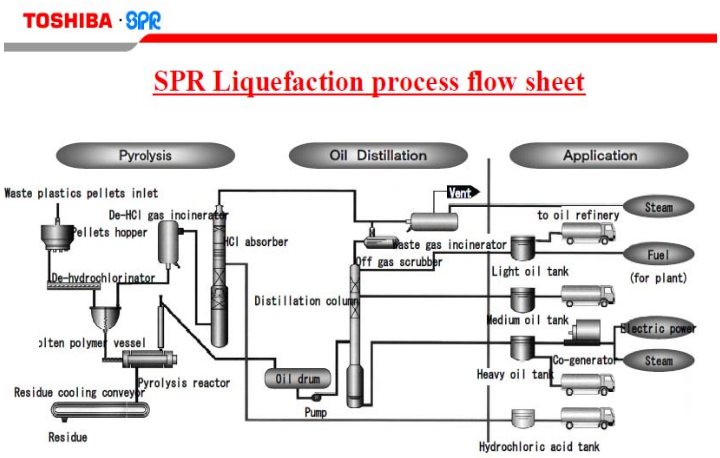


Figure10



Source: Sapporo Plastic Recycling

Figure11

Recycling under C&P Recycling Law

RPF
(Refuse Paper & Plastic Fuel)

Appearance of RPF

RPF products (diameters of 40 mm)

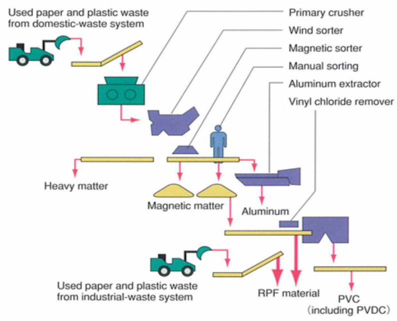
Diameter: 6 – 50 mm

Calorie: 5,000 – 10,000 kcal/kg (Can be adjusted by varying paper content.)

Ash content: 7 % max.

Application: Boiler fuel, RPF power generator, etc.

RPF Production process

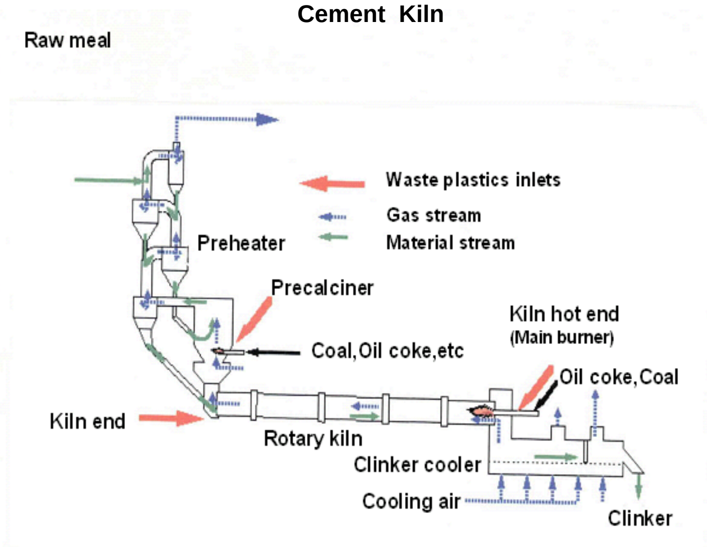


Demand for RPF	2006	1,050 Kt
	2008	1,310 Kt
Production	2006	700 Kt

Source: Japan RPF Association, The Recycling Economy Times

Figure12

Cement Kiln

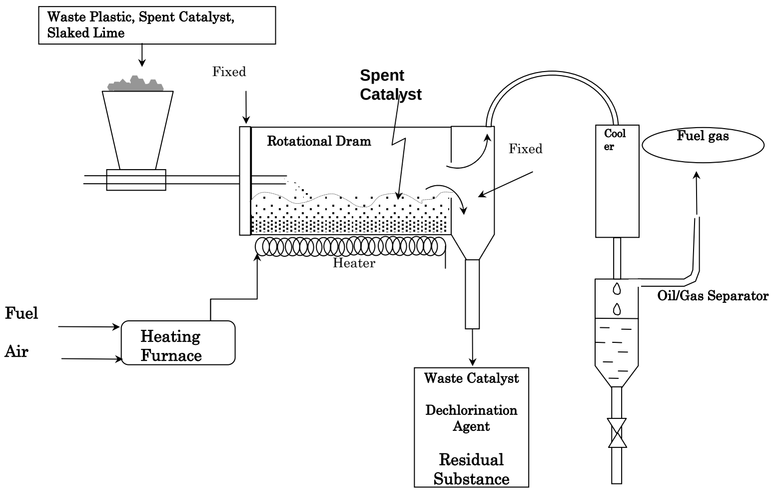


Source: Japan Cement Association

3. New recycling technologies

Figure13

Liquefaction by Catalyst Cracking using Spent FCC Catalyst

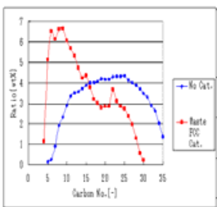


Source: The University of Kitakyusyu

Table1

Result of Catalyst Cracking by Waste FCC Cat. (PE)

Carbon No. Distribution



Composition

	NO Cat [%]	Waste FCC Cat.[%]
n-Paraffin	60	11.0
Oreffin	30	22.5
i-Paraffin	0	11.5
Aromatic	1~2	45.0

Table2

Paraffin[vol%]	19.3
Olefin[vol%]	24.7
1ring-aromatic[vol%]	41.8
2rings-aromatic[vol%]	6.6
3rings-aromatic[vol%]	7.8

Source: The University of Kitakyusyu

Figure14

Source: The University of Kitakyusyu

Figure15

Moving-bed reactor (bench plant)

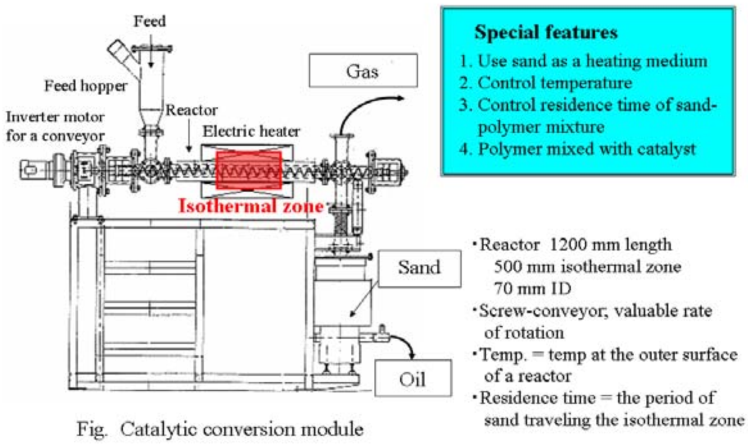


Fig. Catalytic conversion module

Source: National Inst. for Adv. Ind. Sci. & Tech. (AIST)

Table3

Comparison of the Moving-Bed Reactor with a Tank Reactor

	Moving-Bed[1)]	Tank[1,3)]
Capacity, t/d	2.4	0.9
Oil yield, wt%[2)]	99	85
Coke recovery, wt%[2)]	1	10～15
Fuel consumption, wt%[2)]	12～13	30～35
Heat-transfer area, m^2	2.09	1.93

1)Feed：Polystyrene. 2) To feed. 3) 1200mm H × 1000mm Dia.

Source: AIST

Figure16 **Tomakomai Thermal Power Station:Facility Flow for Generation of Electric Power**

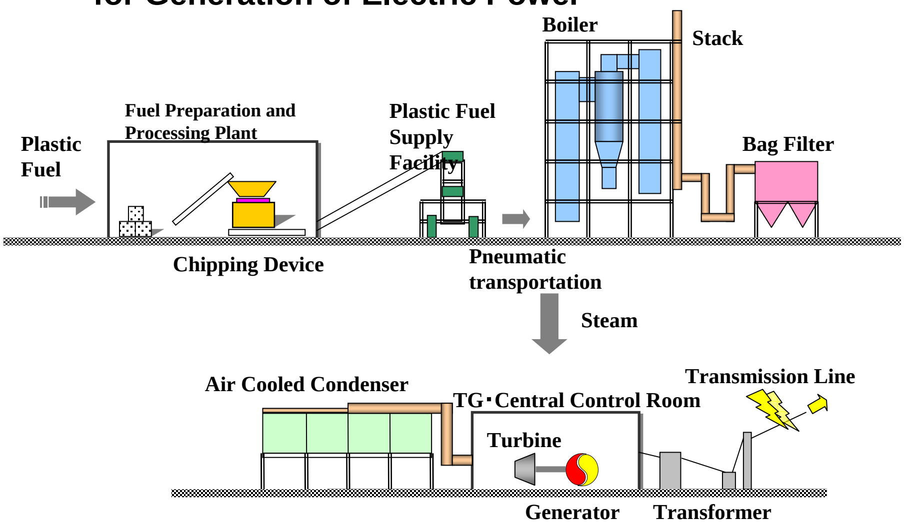
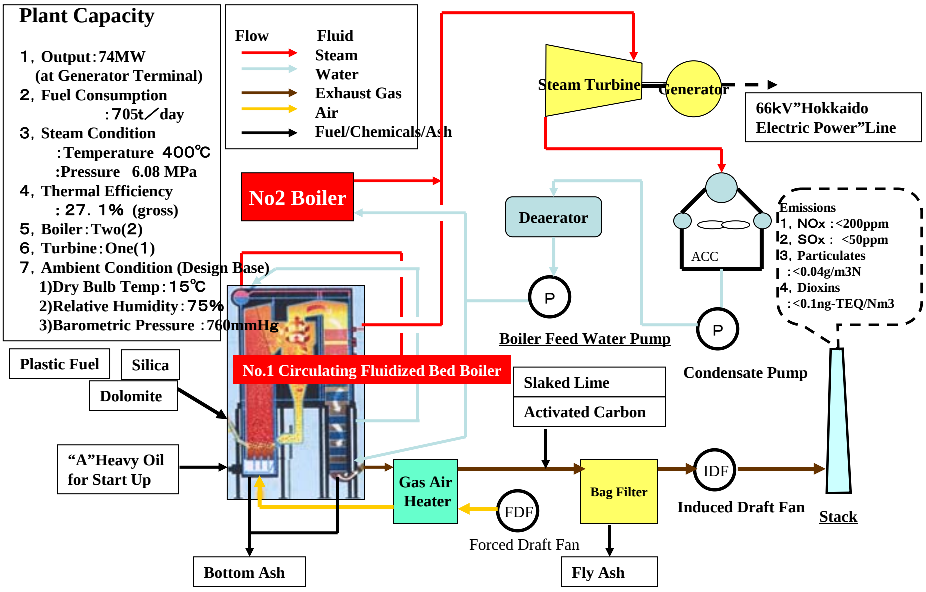


Figure17

Tomakomai Thermal Power Station:Schematic Diagram



Picture1

Source: Sanix Inc.

4. Waste to Energy

Table4

Increasing Trend Field and Future Prospect

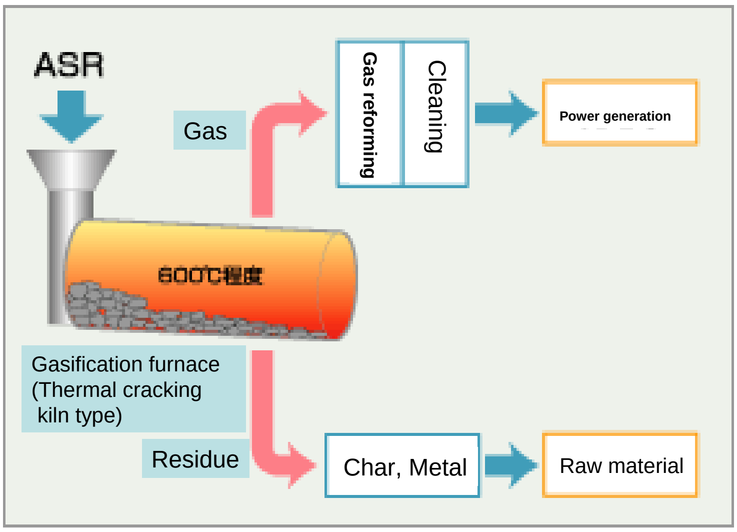
Source:PWMI

kt/y

	2001	2002	2003	2004	2005	Future
Material Recycling	1,464	1,522	1,643	1,811	1,841	++
Liquefaction	17	17	17	13	8	-
Gasification	34	35	62	98	67	±
Blast Furnace & Coke Oven Raw material	158	202	251	192	208	+
RDF+RPF	289	322	434	552	617	++
Waste Power Generation	2,065	2,043	2,164	2,151	2,315	++

Figure18

Gasification process for ELV



Source: Toyota Motor Co.

Summary of Waste to Energy

1. Trend of waste plastic treatment in Japan
   - Material recycling and energy recovery are increasing rapidly.
   - Ministry of the environment and Tokyo metropolitan make a policy that waste plastic treatment should be changed from landfill to energy recovery.

2. Relation of energy recovery to recycling laws
   - Home appliance recycling law excluding (now)
   - End of Life Vehicles recycling law including (main technology)
   - Containers and Packaging recycling law including (liquefaction, gasification, RPF)

Thinking that best available waste plastics treatment is energy recovery is expanding.

5. Conclusion

- Over 500 thousands tons waste plastics were recycled and 19 large size chemical recycling plants were operated under the Containers and Packaging Recycling Law.

- Several kind of technologies were developed such as, blast furnace reducing agent, coke oven fuels, gasification, liquefaction.

- New technologies are developing such as, liquefaction by catalyst cracking using spent FCC Catalyst, fuel oil production using a moving-bed reactor, new technology of energy recovery process for waste plastics using circulated fluid bed boiler, next generation stoker furnaces for municipal waste and so on.

- Material recycling, energy recovery as RDF including RPF and waste power generation is prospected to increase rapidly.

- Thinking that best available waste plastics treatment is energy recovery is now expanding in Japan, and all kind of recycling laws except Home Appliance recycling law are permitted to utilize energy recovery technologies.