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Waste Management Industry: an Overview

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AG April 27, 2017

Outline

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1. The Technical Cycle and the Biological Cycle
2. The Technical Cycle Related SWM Businesses
3. The Biological Cycle Related SWM Buisnesses
4. Concluding Remarks

1. The Technical Cycle and The Biological Cycle

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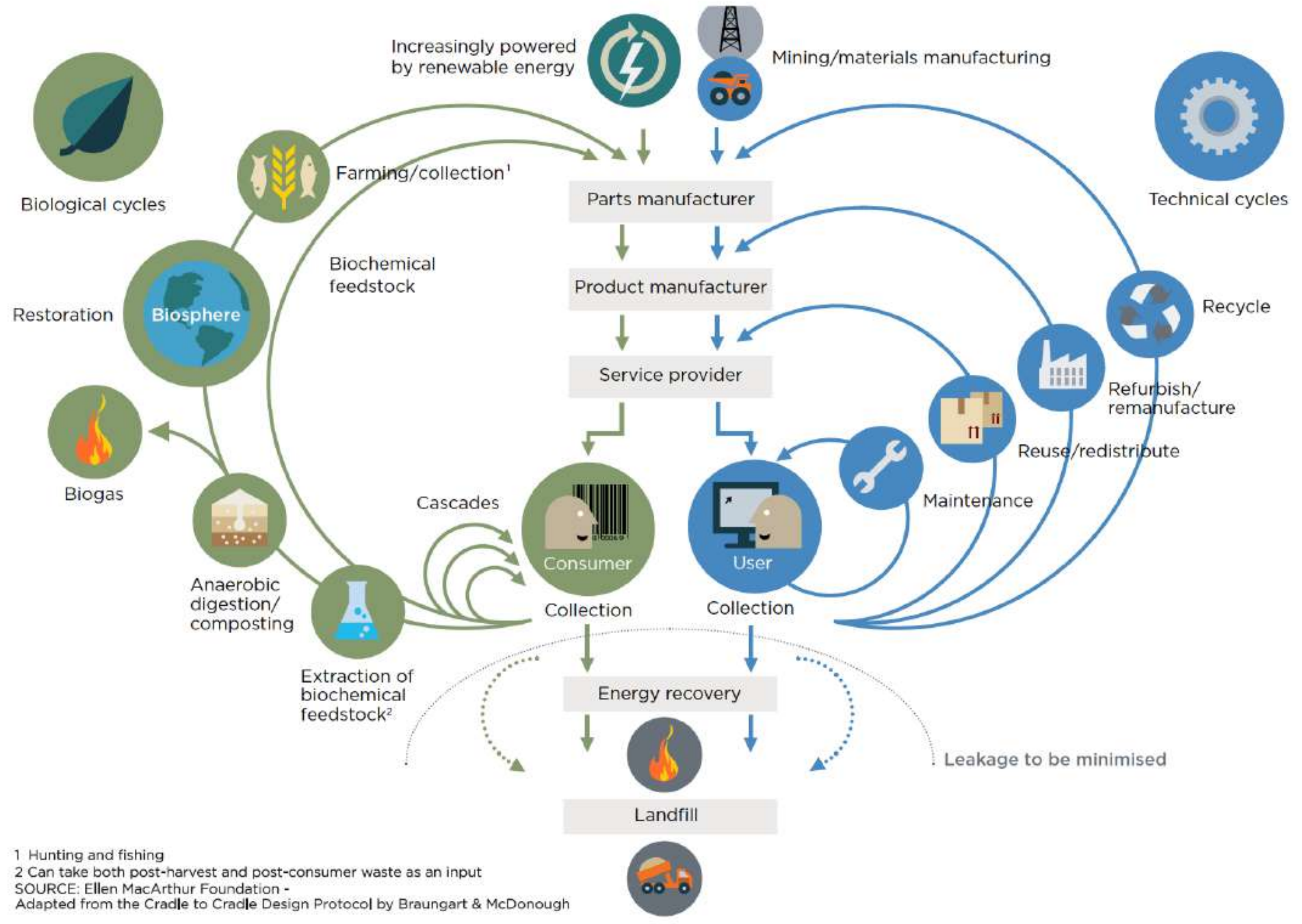
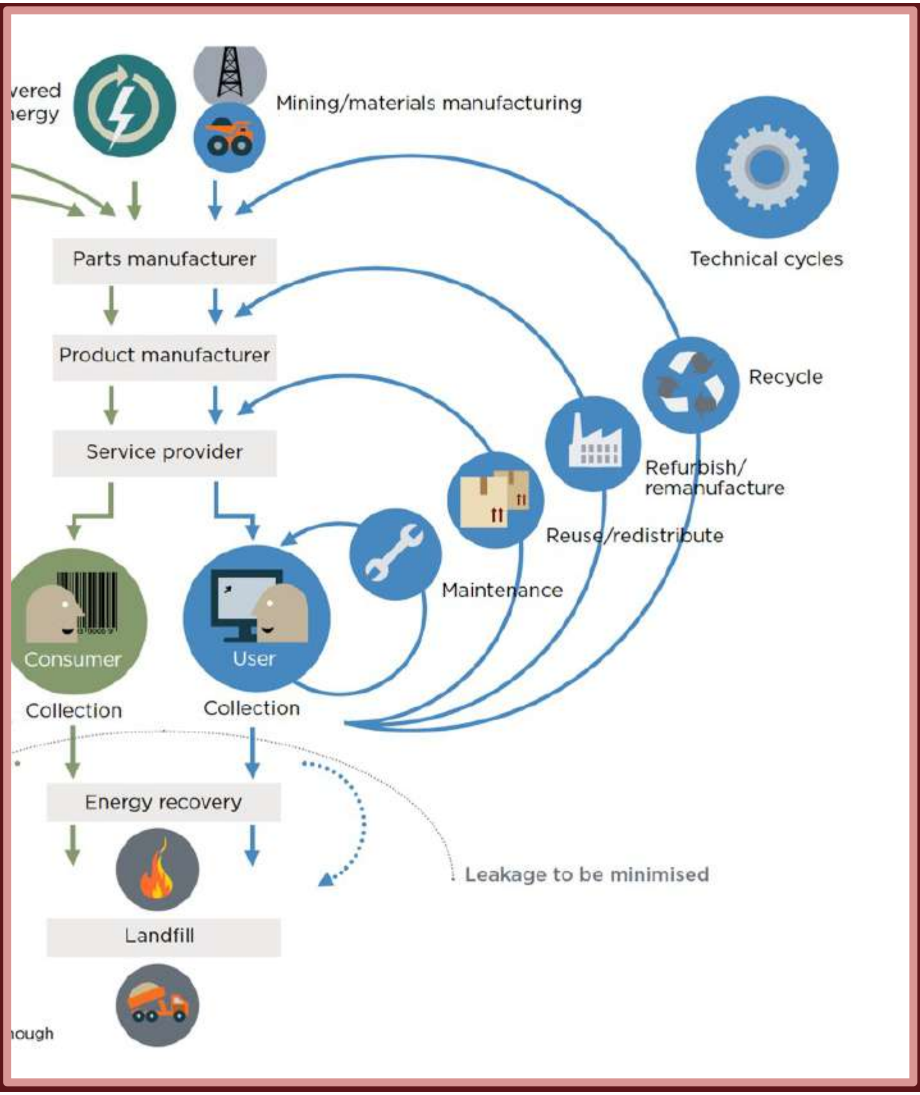
- The Biological Cycle and the Technical Cycle shown on the Figure are over-simplification of reality.
- Waste is generated at all steps in the life-cycle of materials and products, in procuring the raw materials through agriculture or mining, manufacturing the materials and the products, and distribution and retail, not just when the consumer discards a product at End-of-Life (EOL)
- In the circular economy, these wastes from each step can also enter numerous feedback loops, or be utilized for energy recovery, or go to landfill.

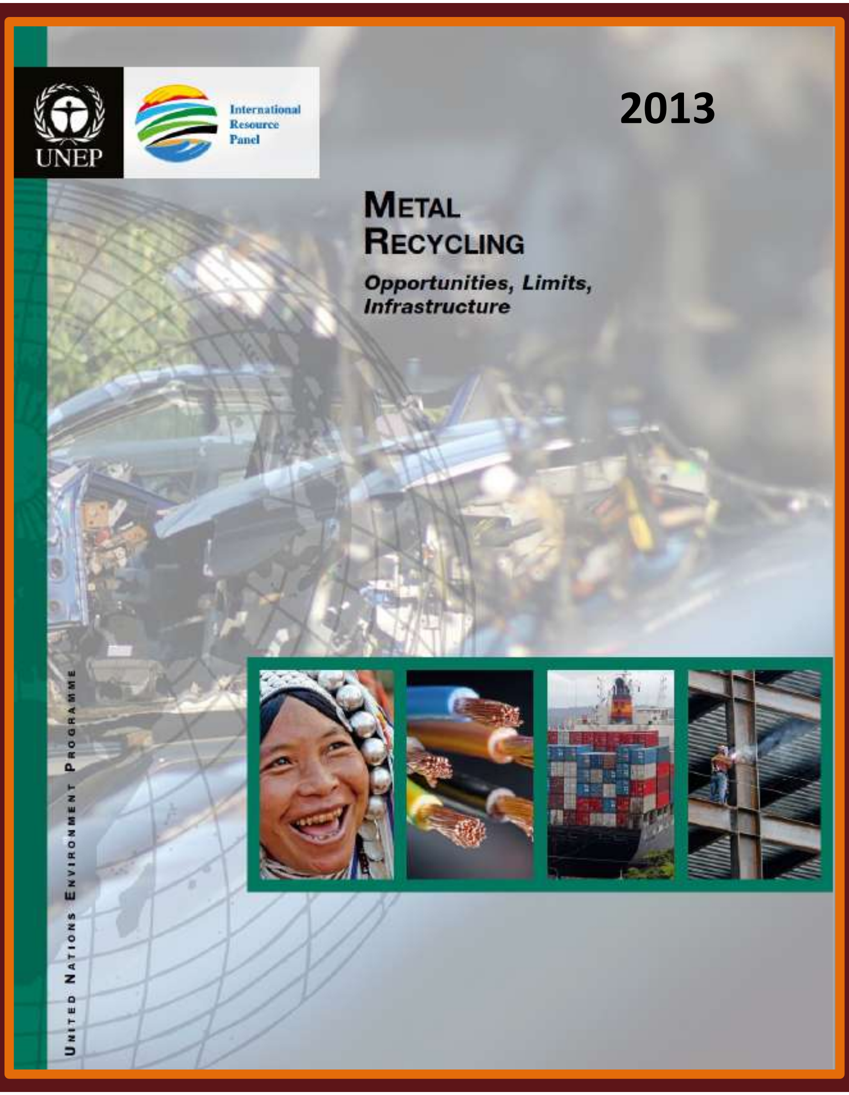


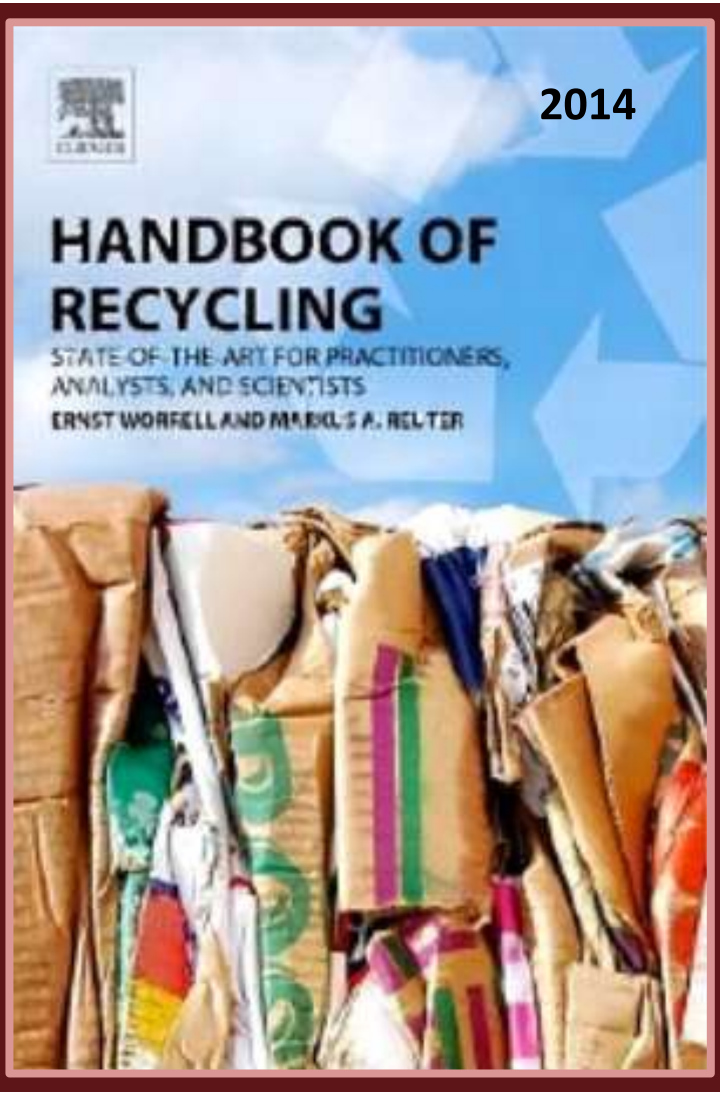
Source: Ellen MacArthur Foundation (2013) (http://www.ellenmacarthurfoundation.org/circular-economy/circular economy/interactive-system-diagram).

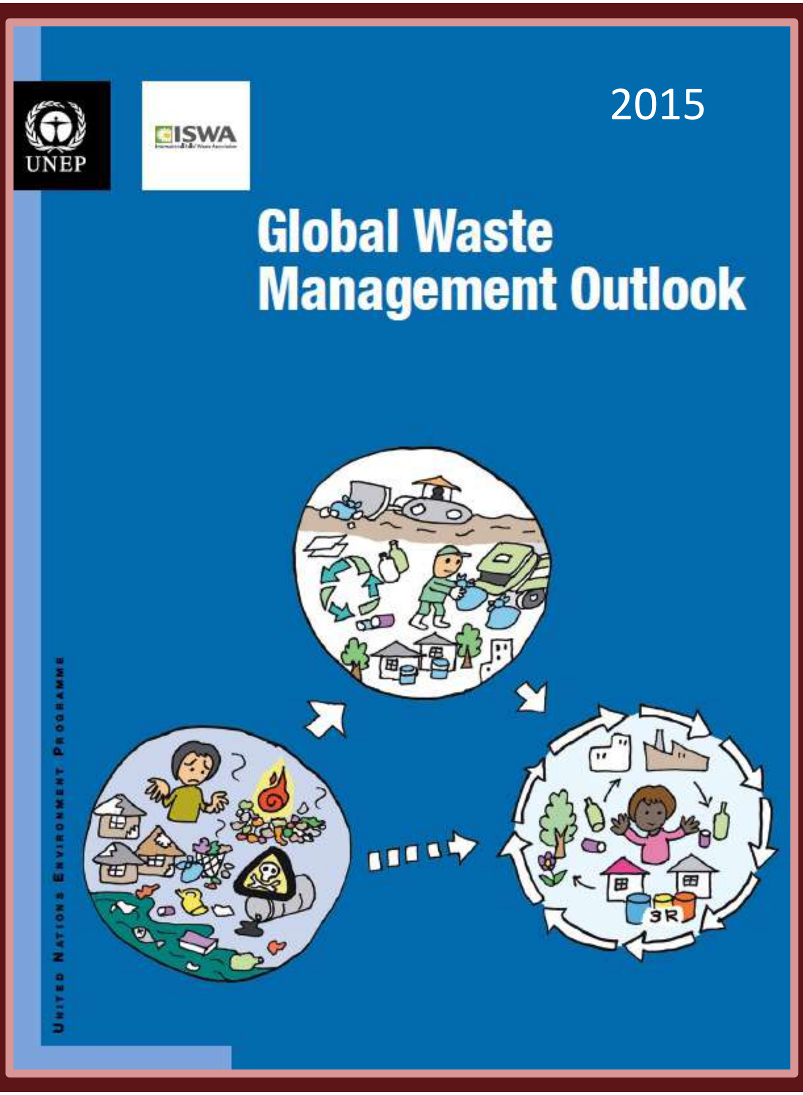
2. The Technical Cycles WM Related Businesses



Main References







2.1. Introduction

- Material consumption global average is 5 ton/person/year

- Distinction between non-renewable resources (minerals and oil) and renewable resources (e.g biomass). There is an interrelation since the second needs nutrients (e.g P and K) and micronutrients (e.g Selenium)

- Recycling is targeted for non-renewable resources as well as renewable resources. Recycling of renewable resources (such as paper) contributes to more efficient supply of resources (land, water and energy)

2.1. Introduction "cont."

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- Recycling rates differ per material recycled. According to the industry itself, the global recycling rate of paper is currently 56% (ICFPA, 2013). Europe is the leader, with a paper recycling rate of 70%.
- Recycling rates for metals vary from very high (gold) to negligible for many specialty metals, such as lithium and tellurium. Recycling rates tend to be higher when the metals are used in large quantities in easily recoverable applications (e.g. lead in batteries, steel in automobiles) or when they have a high value.
- Increasingly however, small quantities of (rare) metals are used in complex products such mobile phones.
- In this context, Porter (2002) distinguishes between economies of scale in recycling (unit costs of recycling go down when the supply of waste material increases) and diseconomies of scope (unit costs of recycling go up when the number of different recyclable materials and applications increases.

2.2. Waste Definitions

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1. Production or consumption residues
2. Off-specification products
3. Products whose date for appropriate use has expired
4. Materials spilled, lost or having undergone other mishap, including any materials, equipment, etc., contaminated as a result of the mishap
5. Materials contaminated or soiled as a result of planned actions (e.g. residues from cleaning operations, packing materials, containers, etc.)
6. Unusable parts (e.g. reject batteries, exhausted catalysts, etc.)
7. Substances which no longer perform satisfactorily (e.g. contaminated acids, contaminated solvents, etc.)
8. Residues of industrial processes (e.g. slags, still bottoms, etc.)

Waste Definitions, cont'd.

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9. Residues of industrial processes (e.g. slags, still bottoms, etc.)
10. Residues from pollution abatement processes (e.g. scrubber sludge, baghouse dusts, spent filters, etc.)
11. Machining/finishing residues (e.g. lathe turnings, mill scales, etc.)
12. Residues from raw materials extraction and processing (e.g. mining residues, oil field slops, etc.)
13. Adulterated materials (e.g. oils contaminated with PCBs, etc.)
14. Any materials, substances or products whose use has been banned by law
15. Products for which the holder has no further use (e.g. agricultural, household, office, commercial, etc.)
16. Contaminated materials, substances or products resulting from remedial action with respect to land any materials, substances or products which are not contained in the above categories.

Waste Definitions, cont'd.

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EU Examples of Relevant Waste Sources

- Households
- Municipal services
- Industries
- Agriculture/forestry
- Institutions, trade/commerce and offices
- Construction and demolition sites
- Power plants
- Mining
- Wastewater treatment plants
- Waste treatment plants

EU Examples of Relevant Waste Streams

EU Priority waste streams:

- Municipal waste
- Packaging waste
- Tyres
- Waste electrical and electronic equipment
- Construction and demolition waste
- Hazardous waste
- End-of-life vehicles
- Health care waste
- Waste oil
- Sewage sludge

Other relevant waste streams:

- Organic residues (garden waste)
- Cardboard
- Plastics
- Iron
- Other metals
- Agricultural waste
- Industrial waste
- Food and organic waste
- Paper
- Textiles
- Inert residues
- Batteries
- Bulky waste
- Mining waste

Source: European Commission, Environment DG, Preparing a Waste Management Plan, May 2003

Waste Definitions, cont'd.

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EU Classification of Local and/or Regional Waste Management System

- Collection equipment (bins, vehicles)
- Transportation schemes (transport logistics, location of treatment plants)
- Transfer/sorting facilities
- Types of treatment plants (e.g. landfills, incineration plants)
- Recycling activities - both run by authorities and private organisations (e.g. the Red Cross)
- Payment schemes
- Regulation (national as well as local)

Waste Definitions, cont'd.

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USA: Recycling Industry Company Types

- Scrap Metal Processors: Primarily handle metal scrap but also have diversified into other recyclable materials.
- End Use Manufacturers: Use recyclable materials as a feedstock to manufacture products.
- Multi-material Processors: Clean, sort, densify and process a variety of recyclable materials for shipment to end-use manufacturers.
- Recycling Collectors: Collect recyclables from homes, businesses, and industry.
- Equipment Dealers: Sell trucks, balers, and other equipment to recycling companies.
- Reuse Companies: Refurbish and reclaim laser cartridges, metal drums, and building materials.
- Oil and Chemical Recyclers: Reprocess and recycle chemicals, oils and paints.
- Textile Recyclers: Reuse or recycle textiles and fibers.
- Paper Stock Processors: Sort and bale paper and cardboard.
- Materials Brokers: Broker metal, paper, and plastic.
- Pallet and Wood Companies: Refurbish pallets and process scrap wood.
- Tire Recyclers: Retread, process or recycle tires.
- Education Groups: Provide recycling education.
- Recycling Retailers: Specialize in recycled content products.

Waste Classification Systems

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J Mater Cycles Waste Manag (2014) 16:321–334
DOI 10.1007/s10163-013-0190-1

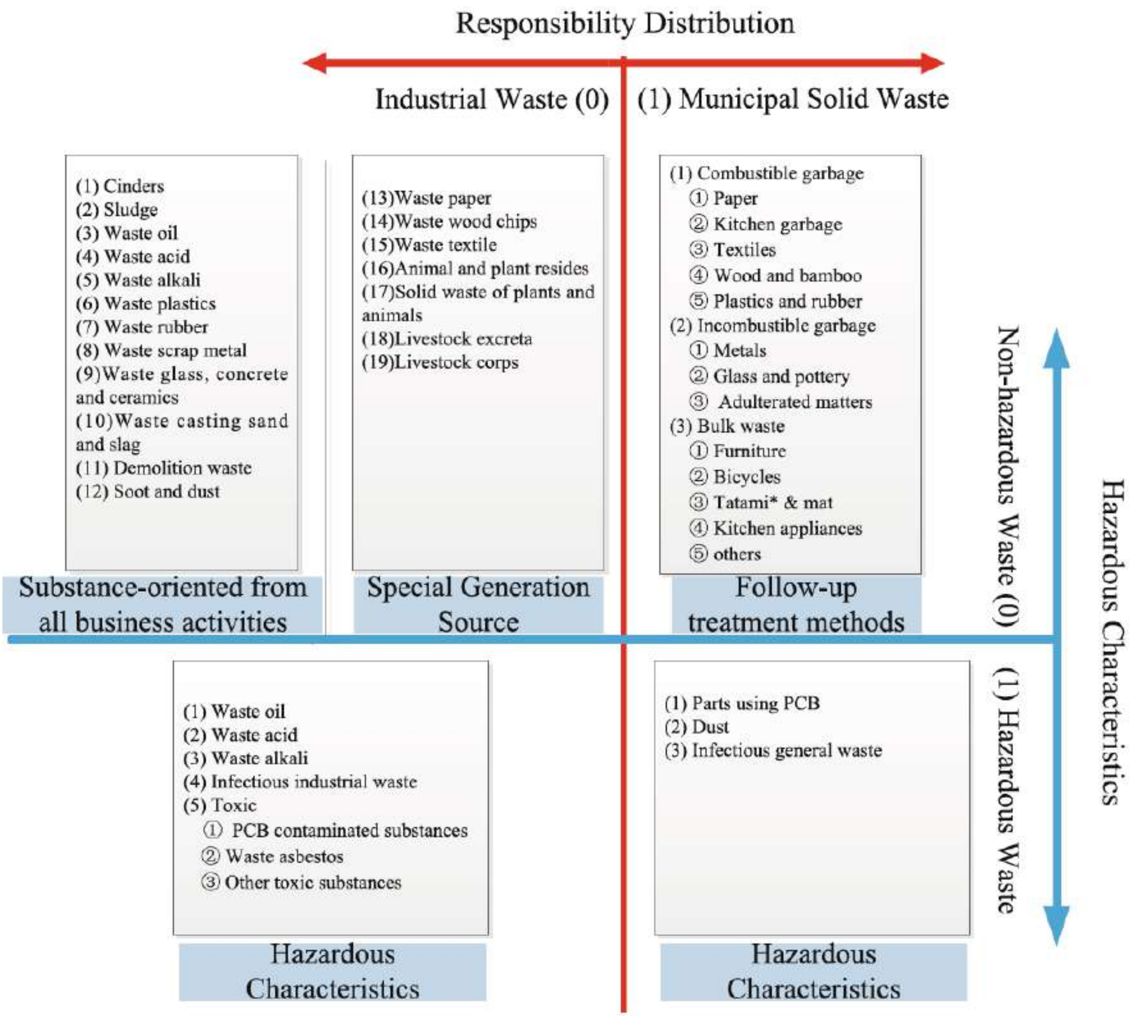
ORIGINAL ARTICLE

Comparison research on waste classification between China and the EU, Japan, and the USA

Xuefeng Wen · Qingming Luo · Hualong Hu · Na Wang · Ying Chen · Jing Jin · Yongli Hao · Guanying Xu · Fengming Li · Wenjie Fang

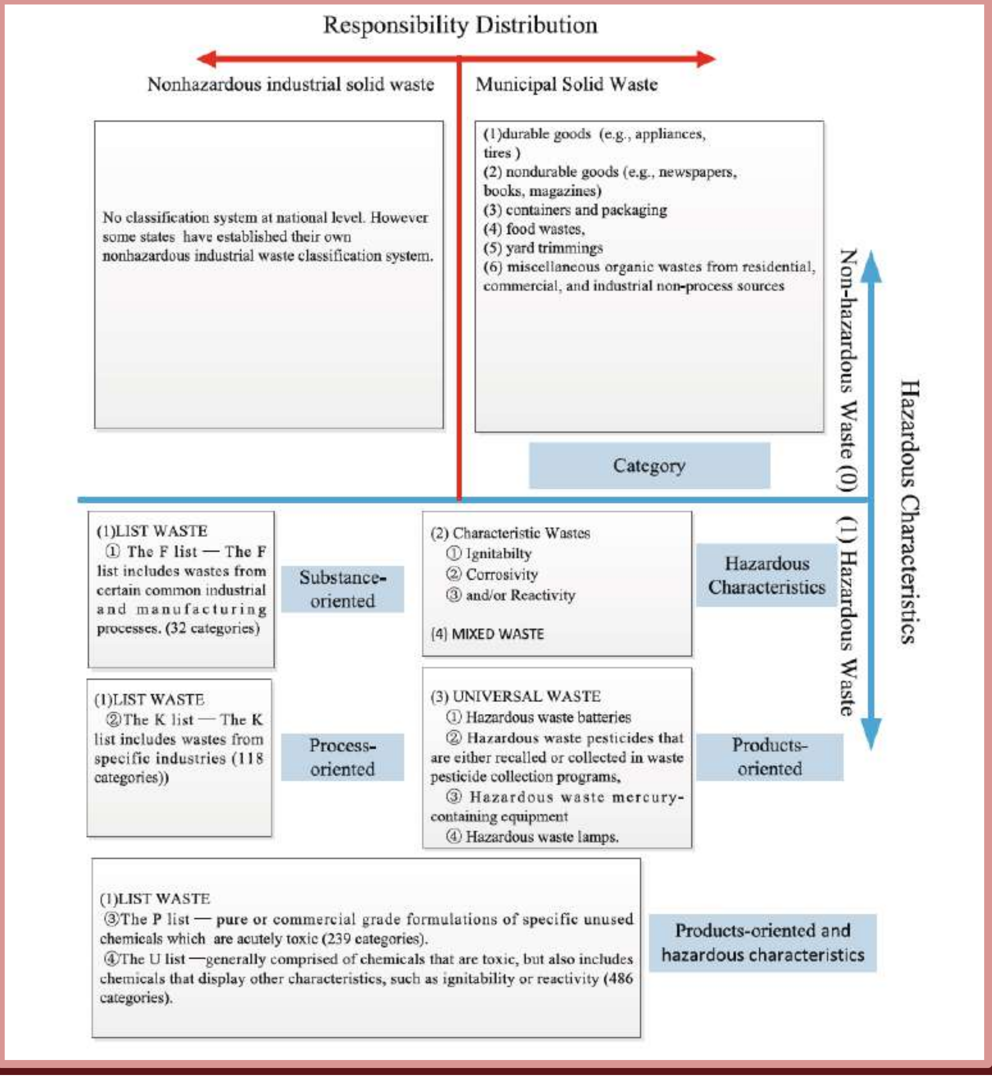
In this paper, in accordance with waste classification principles, waste classification systems in China, the EU, Japan and the USA are reviewed for collection, transportation and treatment sectors. Comparison analysis results show that waste classification methods are diversified and process-oriented classification, substance-oriented and hazardous properties classification principles are widely adopted for waste generation and transportation. For waste treatment process, all the countries and regions adopt similar classification methods based on follow-up treatment process.

Waste classification system based on environmental statistics in Japan



*: A tatami is a type of mat used as a flooring material in traditional Japanese-style rooms.

Waste categories based on environmental statistics in the USA



2.3. Secondary Materials market

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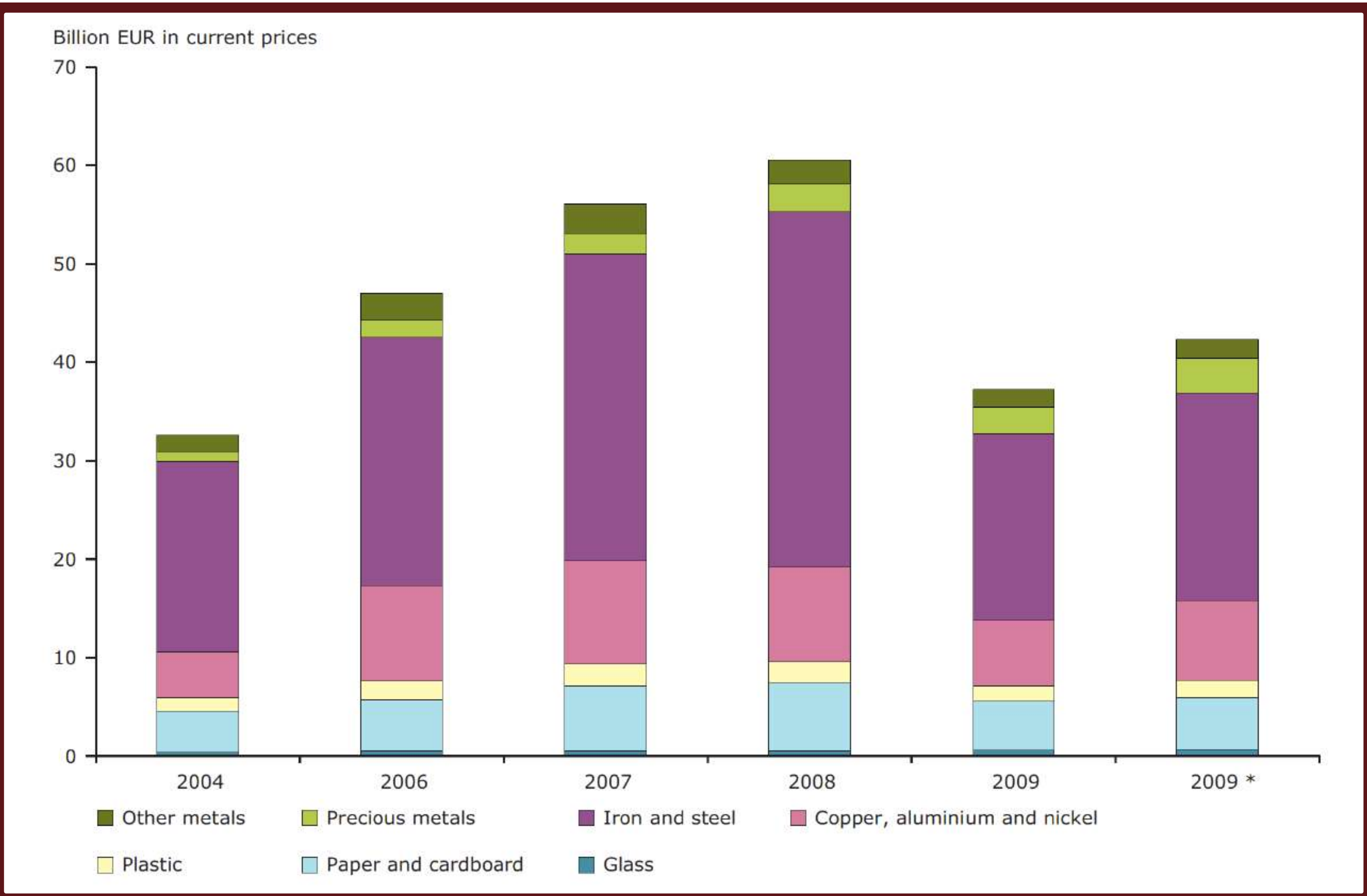
- The waste industry depends closely on the secondary materials in its local and foreign markets.
- Some markets are relatively local, for example for compost or for aggregates from C&D waste. Others may be national or regional, such as for glass and alternative fuels made from MSW
- The secondary materials which are globally traded commodities include ferrous and non-ferrous metals, paper and board (‘recovered paper’ or ‘recovered cellulose fiber’), plastics and textiles. The use of recycled materials competes with and displaces the use of primary materials and helps reduce the extraction of virgin material resources and reduce greenhouse gas emissions.
- In 2010, 700 to 800 million tons of “waste” were recycled as “secondary commodities”, derived from MSW as well as other waste streams.
- In terms of both tonnage and value, recycling markets are dominated by ferrous scrap (steel). In tonnage terms this is followed by paper and board, whereas in terms of value non-ferrous metals rank second, with aluminum and copper dominating this market.
- Only a relatively small proportion of the total 700 to 800 million tons (likely less than 25%) is traded across national boundaries.
- Asia makes up the most dynamic and arguably the most important global recycling market

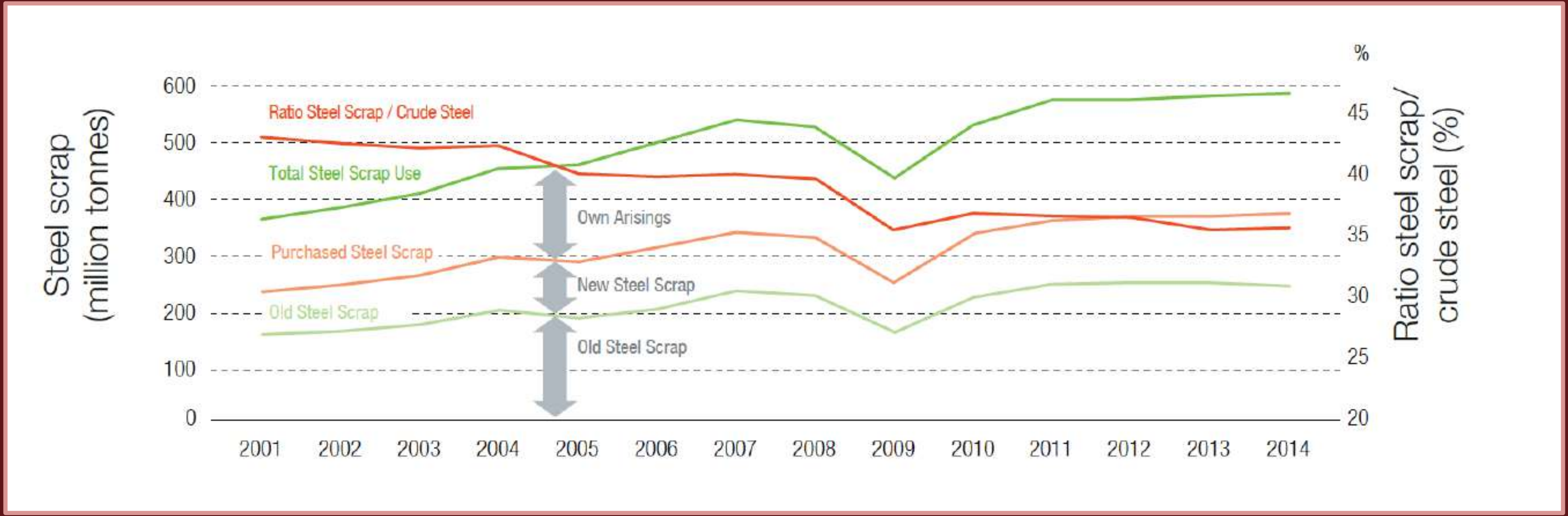
Total turnover of recycling of seven key recyclables in the EU, 2004 and 2006–2009



EEA Report, Earnings, jobs and innovation: the role of recycling in a green economy, 2011

2.3.1 Ferrous Metals

- Every ton of ferrous metal scrap that goes back into production reduces the use of iron ore by 1,400 kg, of coal by 740 kg, and of limestone by 120 kg.
- The figure shows a steady increase in scrap use from 2001-2014, By 2011-2014, total steel scrap use was approaching 600 million tpa, approximately 40% of total steel production.
- Scrap can be grouped into the three sources of (i) post-consumer (old) scrap; (ii) new scrap (e.g. production off-cuts) purchased by steel mills from industrial users; and (iii) own arising, directly recycled within the steel mills (rejects from melting, casting and rolling)



2.3.2 Non-Ferrous Metals

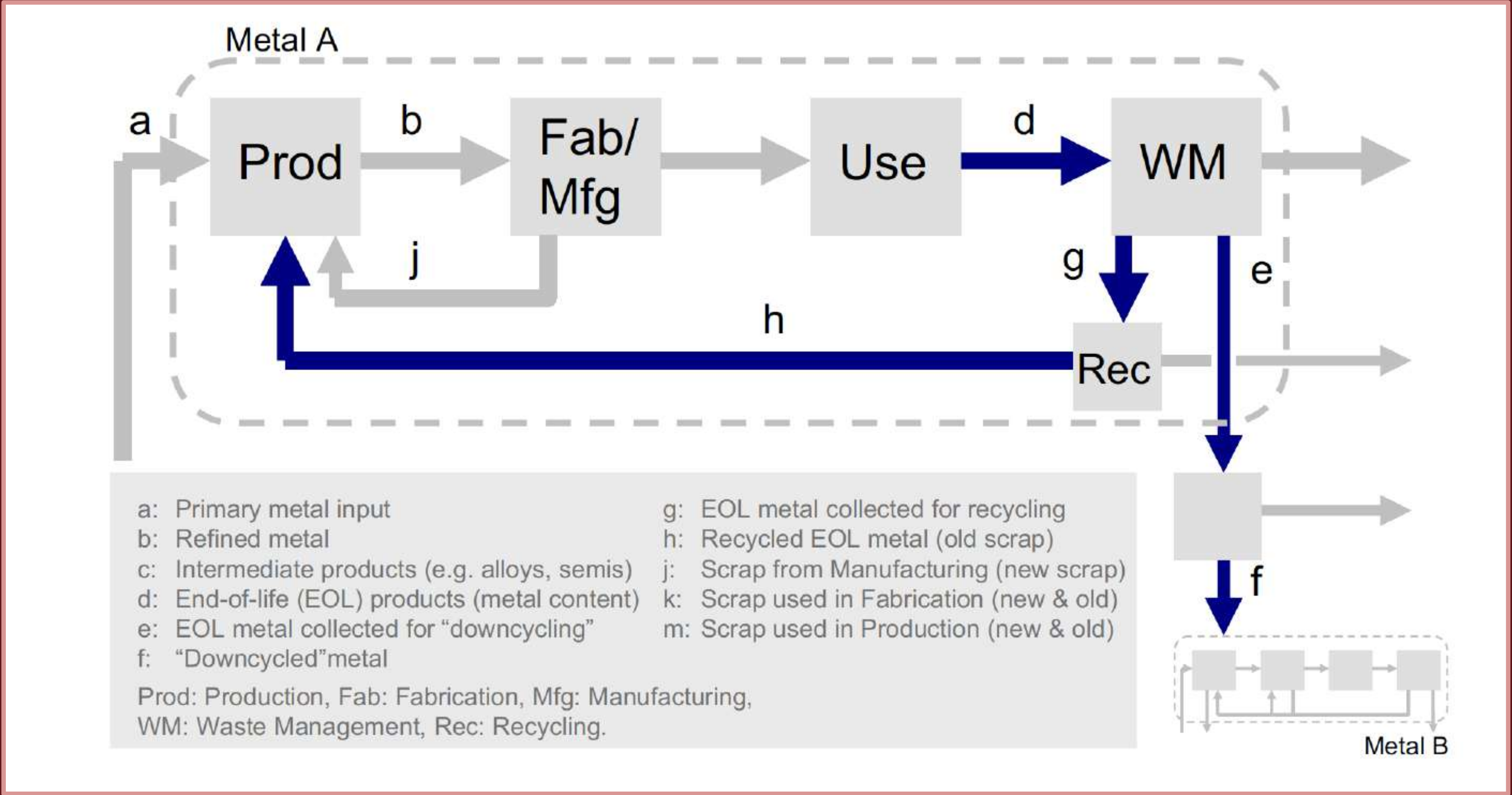
COMMODITY	GLOBAL DEMAND FOR METAL*			GLOBAL SCRAP CONSUMPTION		
	2000 (Million tonnes)	2011 (Million tonnes)	Percentage growth 2000-2011*	2000 (Million tonnes)	2011 (Million tonnes)	Percentage growth 2000-2011
Aluminium	25	45	82%	11	18	68%
Copper	15	19	30%	7.0	10	45%
Lead	9	12	30%	3.7	5.8	57%
Zinc	7	10	40%	0.8	1.1	34%
Nickel	1	1.1	10%	0.6	0.9	42%
Steel	1144 (2005 data)	1607	(40%)	401	573	43%

Global demand for primary metal has been rising quickly, as has global scrap consumption. The last row for steel is shown for comparison. The non-ferrous metal tonnages are 35 to 1,000 times lower.

Source: Bureau of International Recycling (2011). Global non-ferrous scrap flows 2000-2011. Available from http://www.bir.org/publications/brochures

Life Cycle of Metals and End-Of-Life Products

Flows related to a simplified life cycle of metals and the recycling of production scrap and end-of-life products. Boxes indicate the main processes (life stages): Prod, production; Fab, fabrication; Mfg, manufacturing; WM&R, waste management and recycling; Coll, collection; Rec, recycling. Yield losses at all life stages are indicated by dashed lines (in WM referring to landfills). When material is discarded to WM, it may be recycled (e), lost into the cycle of another metal (f, as with copper wire mixed into steel scrap), or landfilled. The boundary indicates the global industrial system, not a geographical entity (Recycling Handbook based on Graedel et al., 2011)



End-Of-Life (EOL) Recycling Rate for 60 Metals

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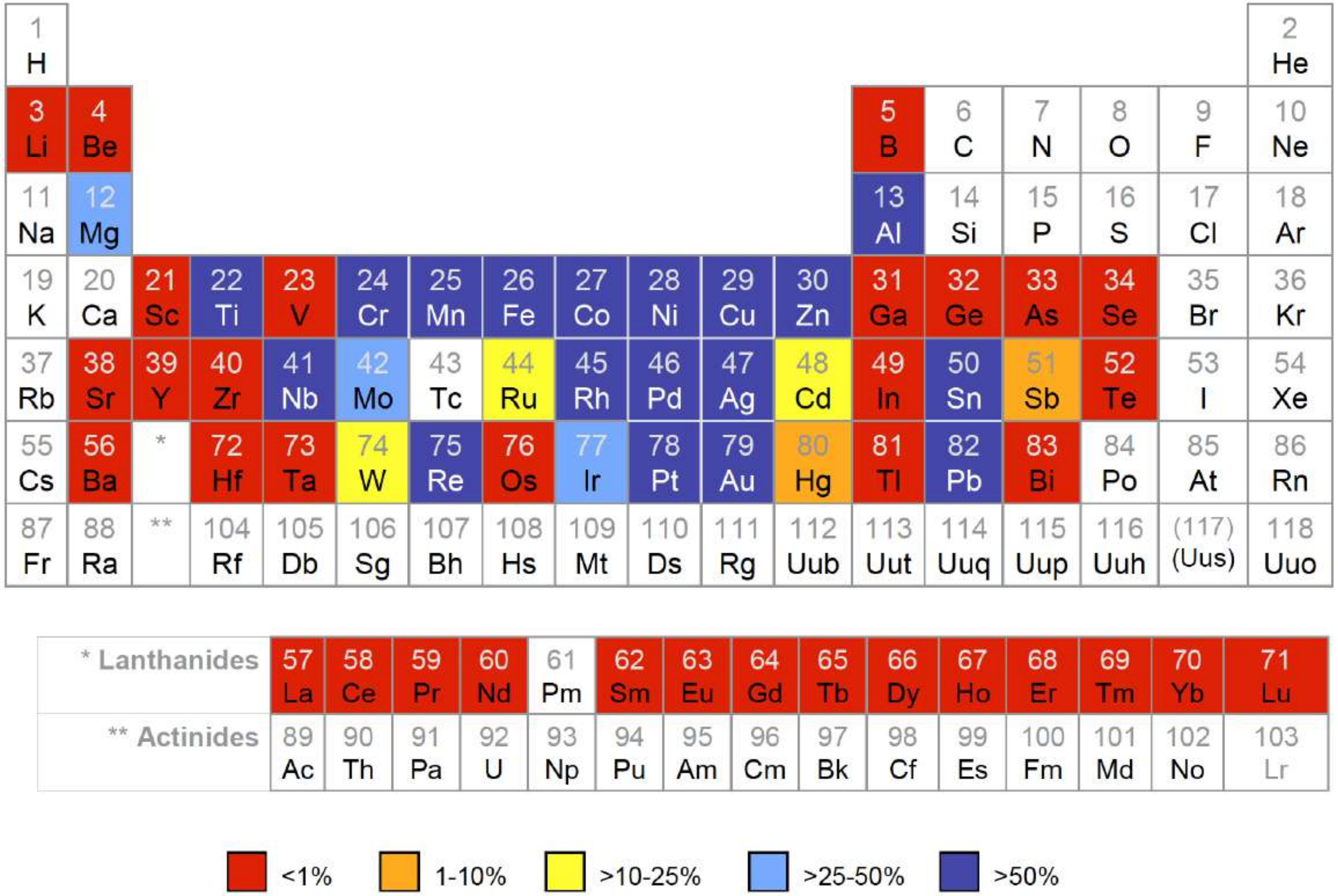
Notes:

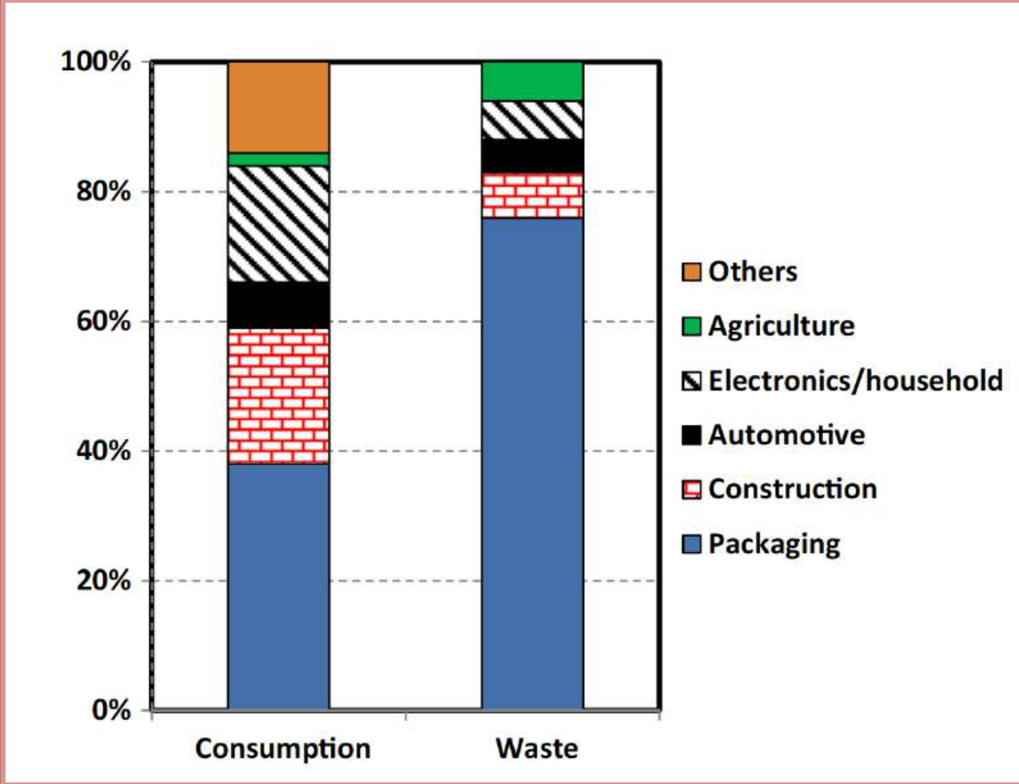
1. The figure uses the periodic table to show the global average end-of-life (post-consumer) functional recycling for sixty metals. Functional recycling is recycling in which the physical and chemical properties that made the material desirable in the first place are retained for subsequent use. Unfilled boxes indicate that no data or estimates are available, or that the element was not addressed as part of the study. These evaluations do not consider metal emissions from coal from power plants.
2. The End -of-Life (EOL) Recycling Rate (RR) relates to whatever form (pure, alloy, etc) recycling occurs.
3. Note that only 18 out of 60 metals are the EOL-RR values above 50%, another 3 metals are in the 25-50% group and three more in the 10-25% group.



Source: UNEP (2011b). Recycling Rates of Metals: A Status Report.
http://www.unep.org/resourcepanel/Portals/24102/PDFs/Metals_Recycling_Rates_110412-1.pdf

2.3.3 Plastics

- International trade in used plastics is prospering. With global production of plastics sky-rocketing, from 1.5 million tons in 1950 to 204 million tons in 2002 and 299 million tons in 2013, and a continuing shift of production from the West to Asia (more than 40% by weight of world production in 2013), the annual volume of transnationally traded waste plastics at 15 million tons represents just 5% by weight of new plastics production.
- Plastic scrap flows from Western countries with established recycling collection systems mainly to the PRC, which dominates the international market , receiving around 56% wt. of global imports. Europe (EU-27) collectively exports almost half of the plastics collected for recycling, at least 87% of which goes to the PRC.



Distribution of plastic applications in consumption and waste in the European Union.

Waste Standards

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Waste Standards:
Institute of Scrap Recycling Industries (ISRI) Guidelines

The Global Plastic Scrap Standards - ISRI Guidelines

- **ISRI – Institute of Scrap Recycling Industries**
  - Guidelines Publication: ISRI Scrap Specifications Circular 2007
- **The ISRI guidelines**
  - internationally accepted standards
  - facilitate the trading of plastic scrap commodities based on an agreement that each bale of the material will be made according to a specific recipe of material ingredients depending on the code (grade) used as the

Plastic Grade Coding System

- P 0 0 0 X X
  - The coding system for baled recycled plastic consists of a three digit number with a prefix letter "P" and a two-letter suffix. The prefix "P" designates the category of Plastics and differentiates the code from similar codes for metals and other materials. The first digit corresponds to the SPI resin identification code system and designates the primary plastic material. The second digit describes the plastic/product category. The third digit defines the color/appearance of the product. The first suffix letter indicates the type of recycled plastic. The second suffix letter indicates the source of the recycled plastic product.

Plastic Grade Coding System

P	0	0	0	X	X
Plastic	Resin Code	Product	Color	Type	Source
	0 Mixed Resins (1-7)	0—Bottles	0—Mixture	P—Post Consumer	M—Municipal
	1 PET	1—Rigids	1—Natural	R—Recovered	I—Industrial
	2 HDPE	2—Films	2—Pigment/Dyed		C—Commercial
	3 PVC	3-9 To be assigned	3-9 Designated within each category		S—Institutional
	4 LDPE				
	5 PP				
	6 PS				
	7 Other				
	8 To be assigned				
	9 To be assigned				

2.3.4 Recycled Paper

Recycled paper and paperboard (known in the industry as 'recovered paper' or 'Recovered Cellulose Fiber' (RCF) has always been a major raw material used in the paper industry. In 1990, recovered paper accounted for 40% of the total pulp used in the European paper industry, and by 2013 this had risen to 53%. At the same time total production in Europe had risen by around 50%. This increase in 'recycled content' was driven mainly by the 'rediscovery' of municipal solid waste recycling and thus an increase in recovered paper supply, but the increase in MSW recycling rates from around 8% in 1990 to approaching 50% in 2012 meant that supply was outstripping regional demand.

Unit: Million tonnes

Region	Country	Collections of recovered paper and board	Consumption of recovered paper	Net flows: positive = imports negative = exports	Regional total net flows 2012	Regional total net flows 1997
North America	United States	46.3	26.3	-20.0	-22	-6
	Canada	4.4	2.6	-1.8		
	Regional subtotal	*50.6*	*29.9*	*-21.8*		
Latin America	Brazil	4.5	4.5	0.0	**1**	
	Mexico	**3.9**	**4.8**	**0.8**		
	Regional subtotal	*12.2*	*13.1*	*0.9*		
	Germany	**15.3**	**16.2**	**0.9**	-7	-1.6
	United Kingdom	8.2	3.8	-4.4		
	France	7.3	5.0	-2.3		
	Italy	6.2	4.7	-1.6		
	Spain	**4.6**	**5.1**	**0.5**		

• 'Collections' shows national totals of recovered paper and board collected by the secondary paper industry.
• 'Consumption' shows national consumption of recovered paper by the paper industry (domestic deliveries plus imports)
• 'Net flows' shows national consumption less national collections: a positive figure denotes a net importing country (highlighted in bold); a negative figure denotes a net exporter. These figures do not total exactly zero, as some stocks are carried forward between years. Note that some countries may be both a significant importer and a net exporter. Examples include the Netherlands and Belgium, where the ports of Rotterdam and Antwerp handle exports on behalf of a number of countries.

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2.3.5 Textiles

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Used textiles have become a globally traded commodity. Focusing on the second hand clothing economy in particular, this has doubled from 1.26 billion USD in 2001 to 2.5 billion USD in 2009. Textile recyclers sort clothing into reusable garments or recycling grades, the latter including industrial cleaning cloths and reclaimed fibers. The sector has globalized as a result of the growth of supply from the global North, the relocation of sorting operations to Eastern Europe and the global South, and the development of differentiated markets for reuse.

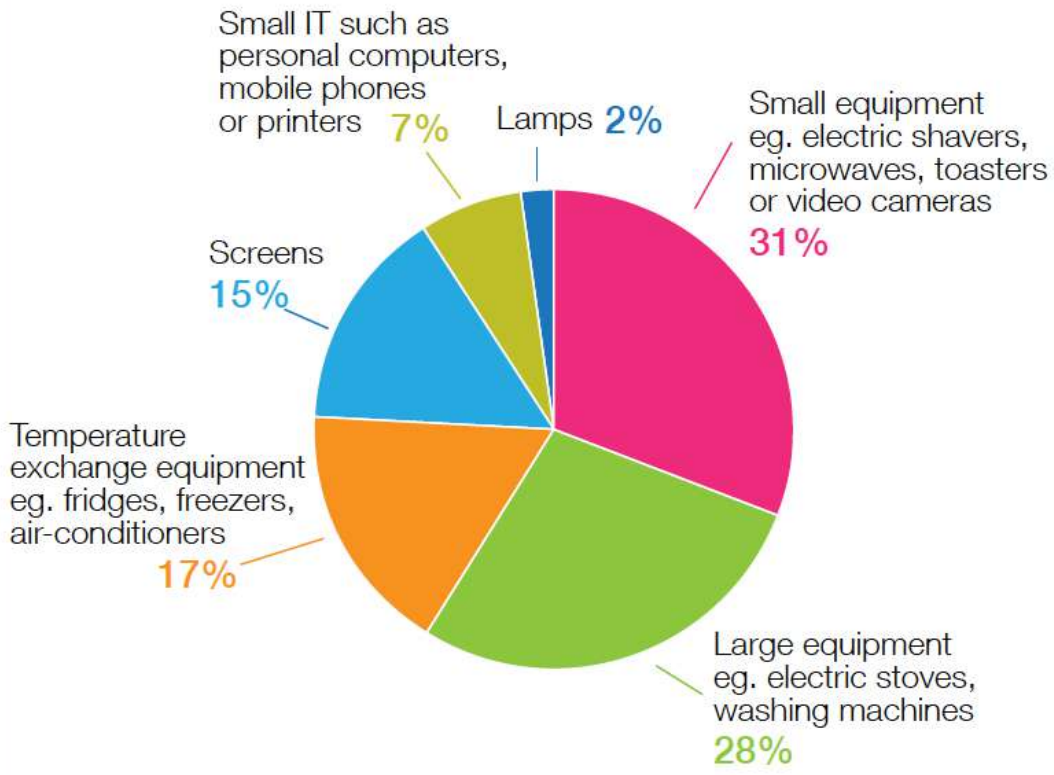
Five high-income countries (Canada, Germany, Republic of Korea, UK and U.S.) account for more than half of all exports of second-hand clothing, most of it originating as donations to charity when it reaches the end of its perceived useful first life. Charities typically select only a small percentage for domestic reuse (estimated at 20% in the UK), often for sale in their own shops. The larger part is sold on to a complex network of global traders, being sorted many times into increasingly differentiated components. Major sorting centers are located in Poland, India and Ghana. Many of the higher quality garments are sold on in Eastern Europe. Lower quality wearable items from Europe and North America tend to go to Africa, while those from Asian countries tend to go to Asian markets (matching the clothing to the users body shape). Fifteen countries account for half of all imports: Angola, Benin, Cambodia, Cameroon, Canada, Germany, Ghana, India, Kenya, Malaysia, Pakistan, Poland, Russia, Tunisia and Ukraine Many of these countries are major re-exporters of sorted fractions.

2.3.6 E-Waste

A 2015 report by the United Nations University (UNU) estimated that 41.8 million tons (Mt) of e-waste was generated in 2014, almost 25% more than the 2010 figure of 33.8 Mt.2 The amounts of e-waste generated by type are shown in the figure .

Most of this waste was generated in Asia (16 Mt), followed by Europe (11.6 MT), North America (7.9 Mt), Latin America and Caribbean (3.8 Mt), Africa (1.9 Mt) and Oceania (0.6 Mt). However, in e-waste generation per capita, Europe has the highest figure (15.6 kg/person) and Africa the lowest (1.7 kg/person).

Estimated annual generation in the coming years are as high as 50 Mt in 2018.



2.3.7 C&D Waste

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Construction and demolition (C&D) waste is generated during the construction, renovation or demolition of buildings, roads, bridges, flyovers, subways, and so on. These activities typically generate large quantities of waste, although oftentimes data on C&D waste are not collected routinely or consistently, so most published figures are estimates which need to be interpreted with caution. Such estimates include 8211 million tons of C&D waste generated across the EU in 2012, 77 million tons in Japan, 33 million tons in China and 17 million tons in India (all in 2010), and almost 7 million tons in each of the fast developing cities of Dubai (2011) and Abu Dhabi (2013). C&D waste often represents the largest proportion of total waste generated: for example, C&D waste accounts for 34% of the urban waste generated within OECD countries. The volume of C&D waste is also sharply increasing, reflecting the pace of infrastructure development across the world.

Wood
- Used for Animal Bedding, Mulch, Diesel Fuel, Electrical Power Plants and Particle Board

Bricks, Concrete and Other Masonry Products
- Crushed and used for Fill, New Roads, Under lament for Concrete Applications

Metals (Ferrous and Non-Ferrous)
- Melted into New Products

Roofing Shingles
- Asphalt Roads

Cardboard
- Processed used New Cardboard Products

Plastic
- Made into bottles, floor tile, paneling, plastic lumber, etc.

2.3.8 Used Tyres Waste

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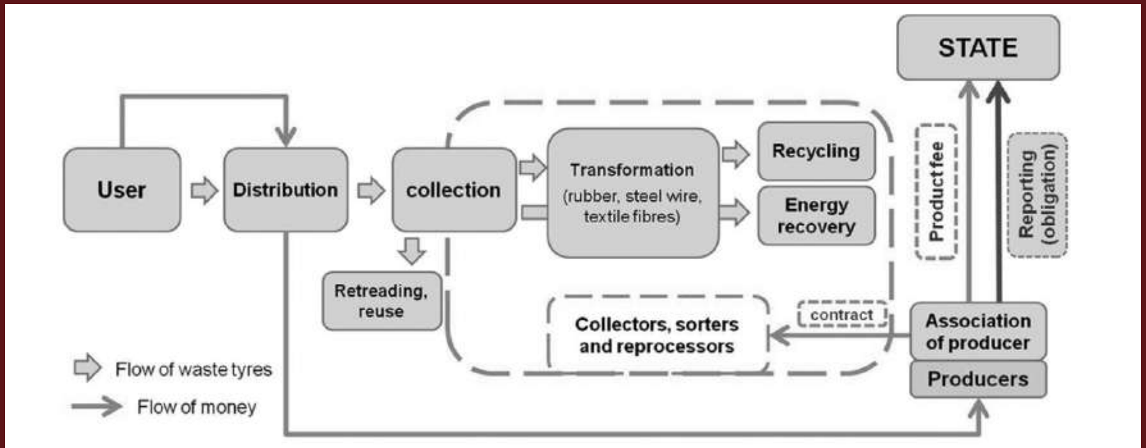
The dynamic increase in the manufacture of rubber products, particularly those used in the automobile industry, is responsible for a vast amount of wastes, mostly in the form of used tyres, of which more than 17 million tons are produced globally each year. The widely differing chemical compositions and the cross-linked structures of rubber in tyres are the prime reason why they are highly resistant to biodegradation, photochemical decomposition, chemical reagents and high temperatures. The increasing numbers of used tyres therefore constitute a serious threat to the natural environment.

The progress made in recent years in the management of polymer wastes has meant that used tyres are starting to be perceived as a potential source of valuable raw materials. The development of studies into their more efficient recovery and recycling, and the European Union's restrictive legal regulations regarding the management of used tyres, have led to solutions enabling this substantial stream of rubber wastes to be converted into energy or new polymer materials.




Waste Management 32 (2012) 1742–1751

Contents lists available at SciVerse ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

ELSEVIER

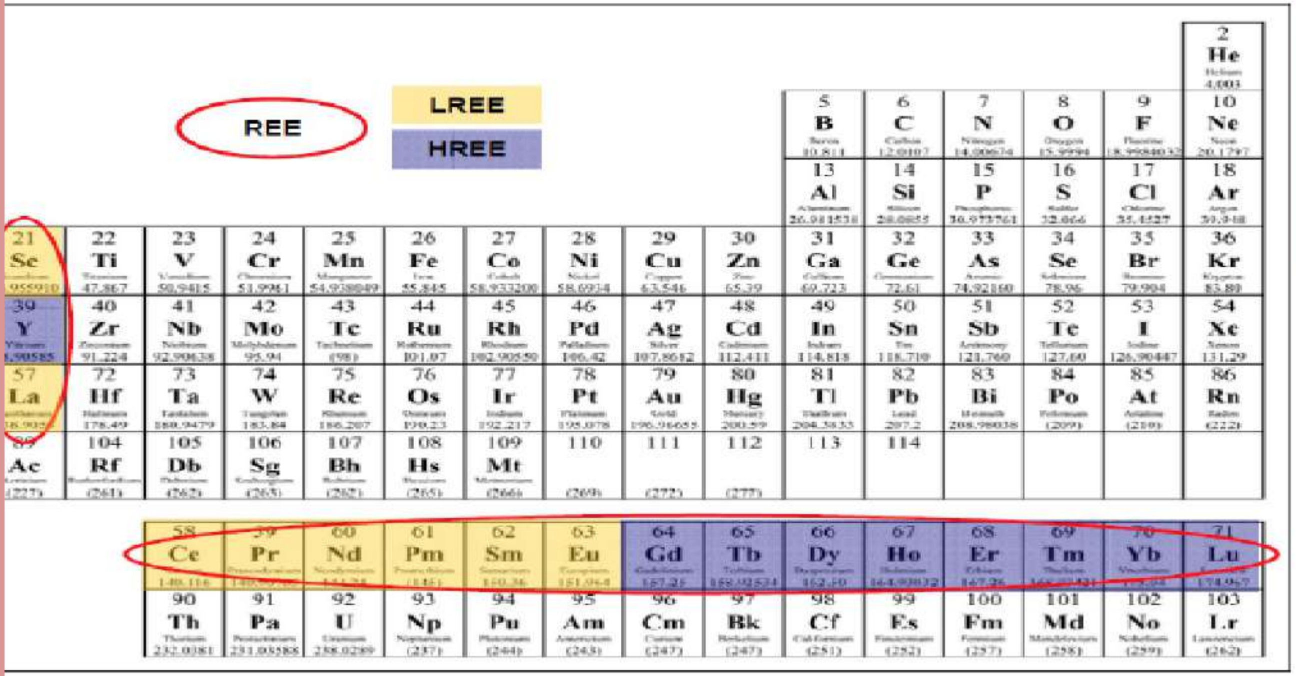
Review

Progress in used tyres management in the European Union: A review

Maciej Sienkiewicz *, Justyna Kucinska-Lipka, Helena Janik, Adolf Balas

Polymer Technology Department, Chemical Faculty, Gdansk University of Technology, Gabriela Narutowicza Street 11/12, 80-952 Gdansk, Poland

2.3.9 Rare Earth Elements (REE)



Periodic table of the elements showing the division between LREEs and HREEs (Schuler et al., 2011).

Wikipedia photo = Assortment of lanthanoide group el
Uploaded at 22:12,19 April 2006 by User:Tomihhndor
User:Tomihahndorf. Permission=GFDL.

Scandium

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Yttrium

Wikipedia photo = To
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REEs: Important Reference Material

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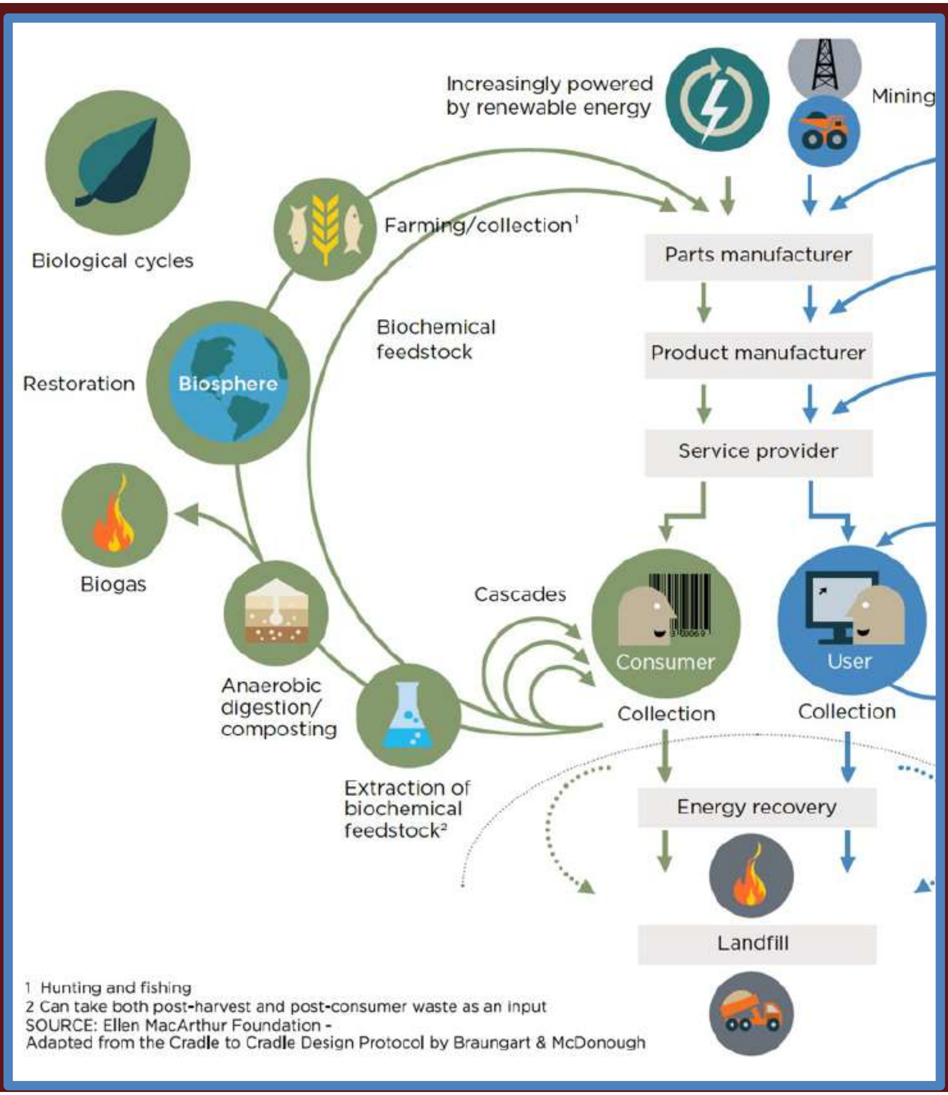
July 2009

November 2011

Rare Earth Elements' Processing;
Current and Emerging Technologies, and evolving needs within the Manufacturing Sector

SME (NYC)
October 18,, 2011
Jack Lifton
jacklifton@aol.com

3. The Biological Cycles WM Related Businesses



3.1 Biomass utilization in developed countries

- The European energy production from biogas reached 6 million of oil equivalent (Mtoe) in 2007 with yearly increase of 20%.
- Germany has become the largest biogas producing country in the world. Number of biogas production units in operation is 7700 (2016) producing more than 8 billion cu m of biomethane as well as roughly the samr amount of “green” carbon dioxide per year (www.euroobserv-er.org).

National Biomass Strategy: a Necessity

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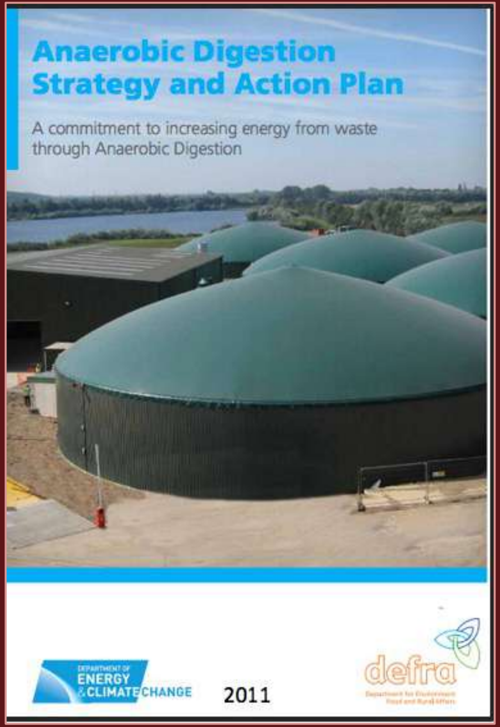
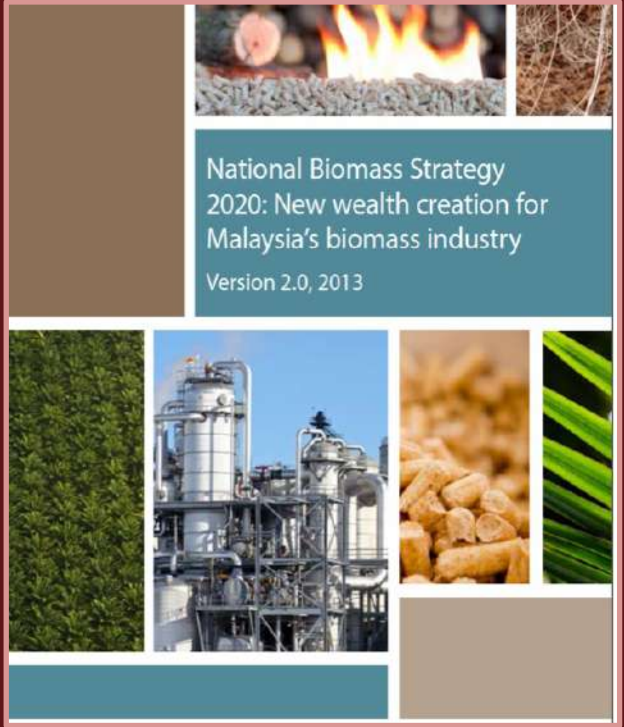
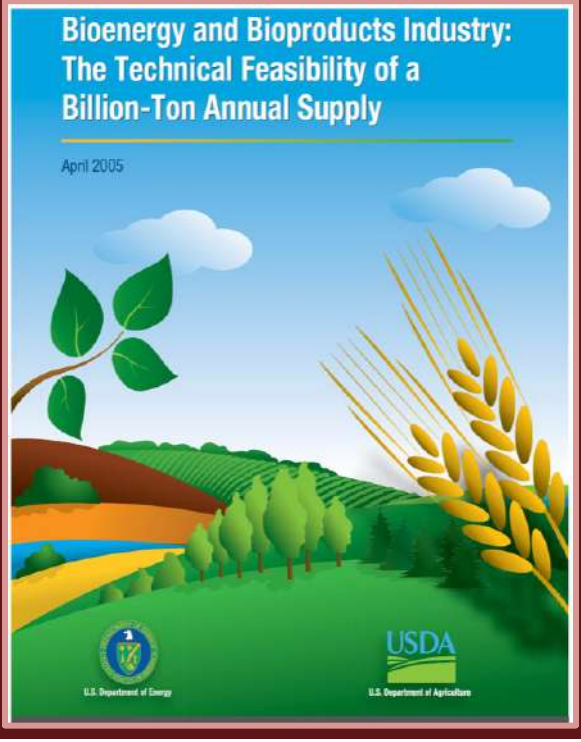
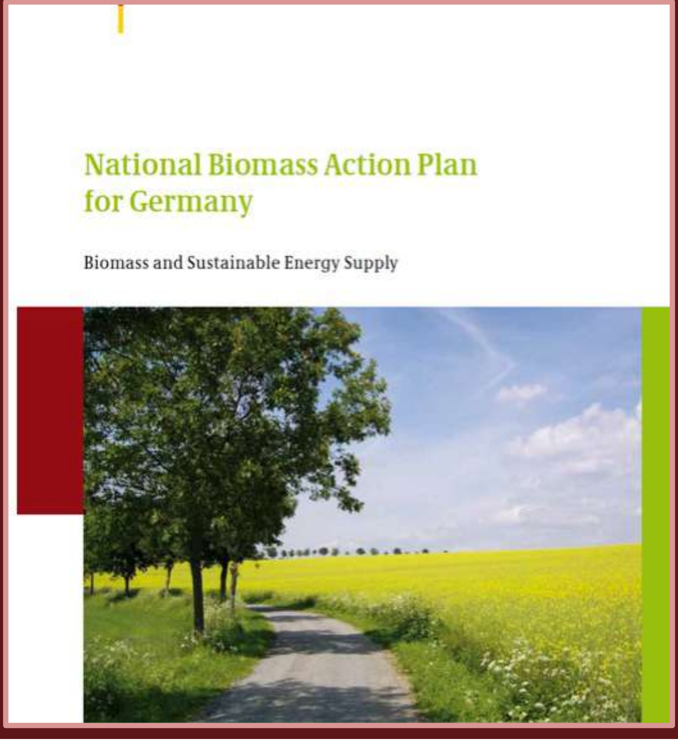
National Biomass Strategies and Action Plans, four examples:

- UK
- Germany
- Malaysia
- USA a billion ton annual supply target









3.2 Example of Related Resourceful Publications

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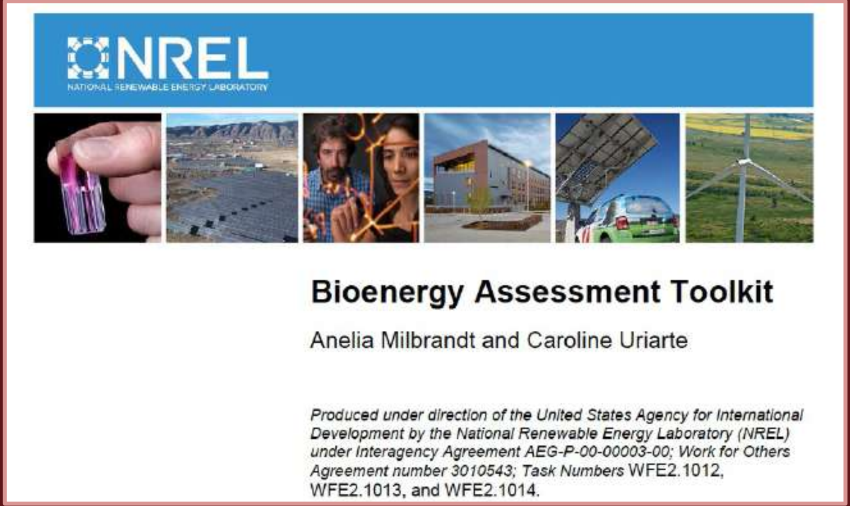

Table 2. Technology Evaluation Tools and Studies

Resource	Description	URL
Thermo-chemical conversion of biomass	This page contains a description and videos of the thermo-chemical conversion processes.	http://www.nrel.gov/biomass/thermochemical_conversion.html
Bio-chemical conversions of biomass	This page contains a description and video of the bio-chemical conversion processes.	http://www.nrel.gov/biomass/biochemical_conversion.html

Examples		
U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry	This report is an economic assessment of the current and potential biomass resources in the United States that includes projections by 2030 and a spatial county-by-county inventory of primary feedstocks. It also contains prices and available quantities (e.g., supply curves) for the individual feedstocks such as crop residues, forest residues, primary mill residues, urban wood waste, and dedicated energy crops.	http://www1.eere.energy.gov/biomass/pdfs/billion_ton_update.pdf

Biomass Socio-Economic Multiplier Model (BIOSEM)	BIOSEM facilitates existing data so that the employment and income benefits from bioenergy development and deployment in rural areas can be measured. The model simulates the interaction between agricultural crops, biomass production, energy production, and other sectors of the economy.	http://ec.europa.eu/research/agro/fair/en/uk1389.html

Assessment Tools

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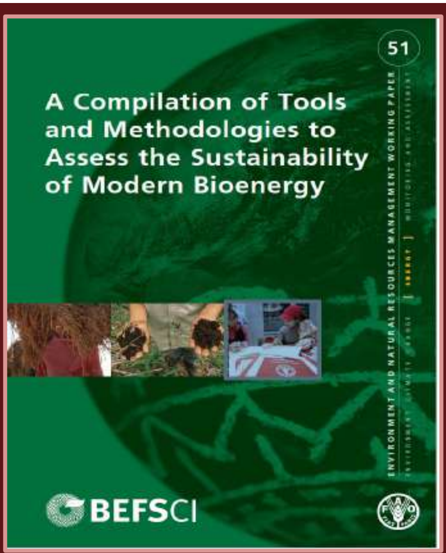


11.2 Biomass Socio-economic Multiplier[108] (BIOSEM)

Author	FAIR Programme, European Commission
Year	1997
Type	Planning
Application level/scale	Regional; National; Local; Farm
Primary users	Governments; Operators
Availability	Free
www.task29.net/assets/files/reports/Madlener_Myles.pdf	

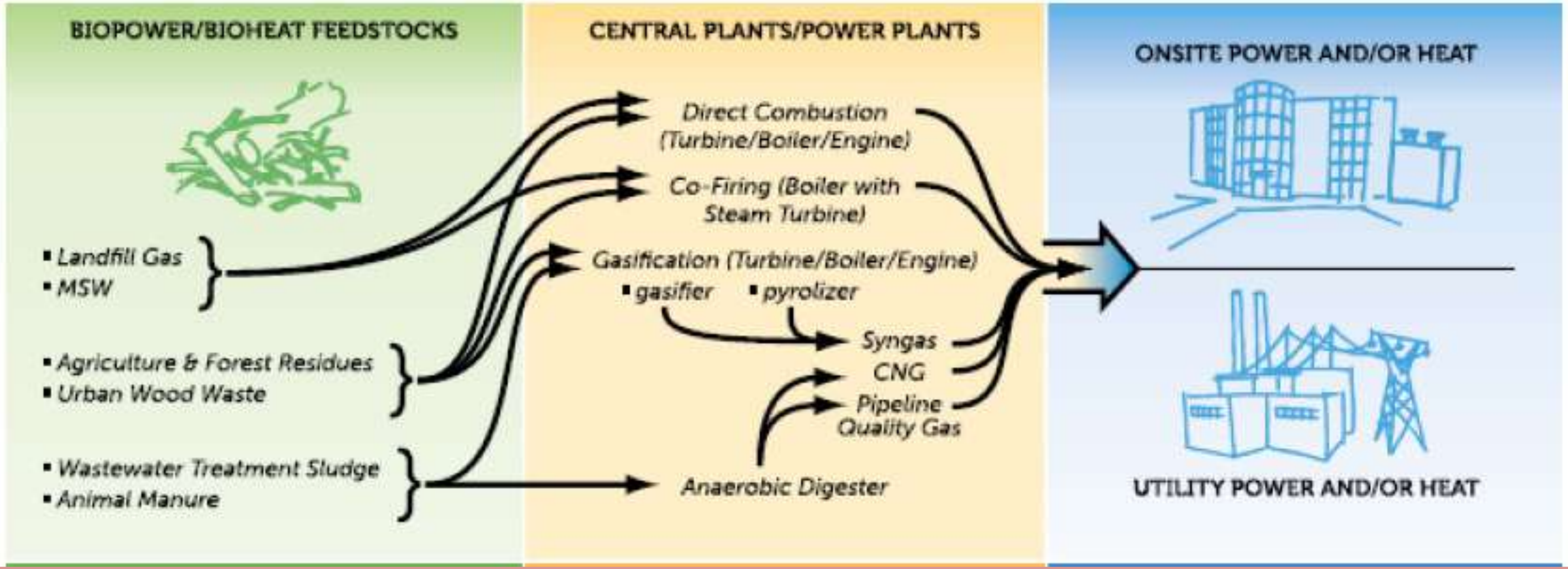
Recycling of Agricultural, Municipal and Industrial Residues in Agriculture Network (RAMIRAN)

The "Recycling of Agricultural, Municipal and Industrial Residues in Agriculture Network (RAMI-RAN)" is a research and expertise network dealing with environmental issues relating to the use of livestock manure and other organic residues in agriculture. RAMIRAN evolved in 1996 from the much smaller FAO Animal Waste Network, that had been active since 1978, and the scope was expanded to include other organic residues (industrial and municipal) which are used on land as organic manures and soil amendments. It is in principal a European network, but it is also open to interested experts from other parts of the world.

The network provides an invaluable means of exchanging ideas, information and experiences on topics that are becoming increasingly important at a national and international level. The main objectives of the network are to:

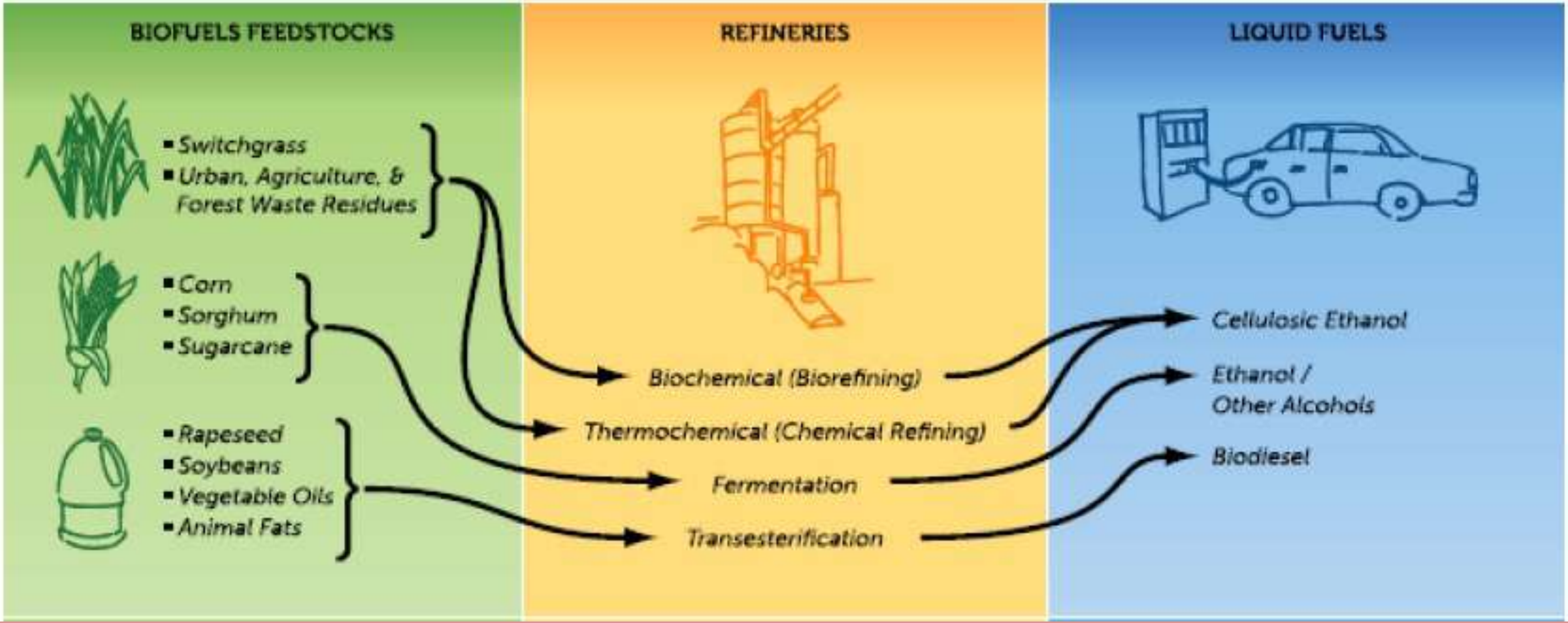
- Promote the exchange of methodologies, materials and processes;
- Progress knowledge on the environmental assessment of organic residues recycling in agriculture;
- Identify research priorities and initiate innovative collaborative activities that make use of the synergies resulting from the international network.

3.3 Biomass to Bio-Power Pathway



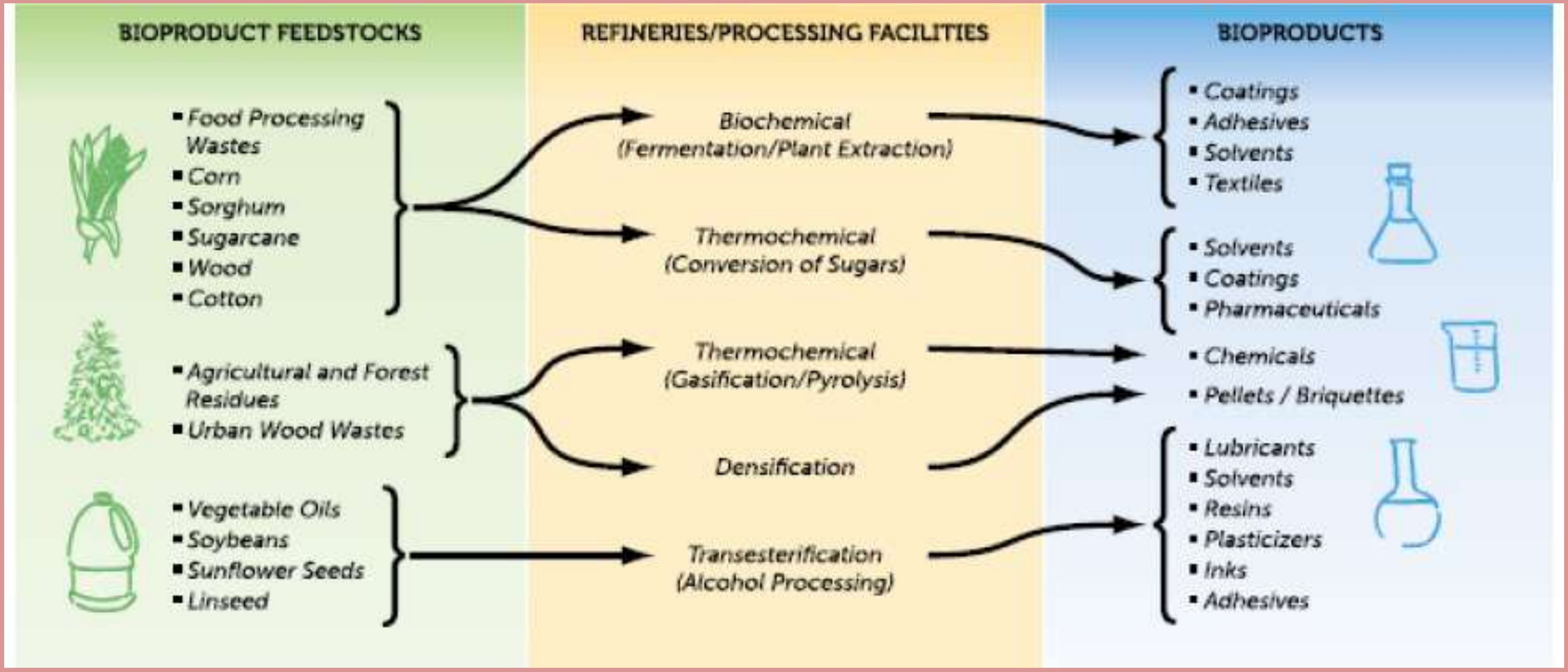
Source: U.S. Environmental Protection Agency (EPA) State Bioenergy Primer (2009) http://www.epa.gov/statelocalclimate/resources/bioenergy-primer.html

3.4 Biomass to Bio-Fuel Pathway



Source: U.S. Environmental Protection Agency (EPA) State Bioenergy Primer (2009) http://www.epa.gov/statelocalclimate/resources/bioenergy-primer.html

3.5 Biomass to Bio-Products Pathway



Source: U.S. Environmental Protection Agency (EPA) State Bioenergy Primer (2009) http://www.epa.gov/statelocalclimate/resources/bioenergy-primer.html

4. Concluding Remarks

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- There are many ways to present the WM Industry, one of which is to look at the "Technical Cycle" and the "Biological Cycle" related businesses.
- Each of the two cycles is linked to a big global industry with many sub-sectors included
- We have to understand different systems of "waste classification" and "waste definitions".
- Like all industries, WM industry has its "Best Practices", "Norms" and "Codes", " R&D" and "Occupational Standards".
- Nations had developed "Regulations" , "Strategies" and" Master Plans" to related to its WM industry
- Opportunities are tremendous !!!!

وختاما...تحية واحتراما للمدورين العظام في منشية ناصر ...!!!

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