"Number of Use" Indicator and its implications to Collection Schemes

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Indicators - what use are they?

1. Environmentally Sustainable Society

Main issues: Energy / Material Flow
Waste reflects Material Flows

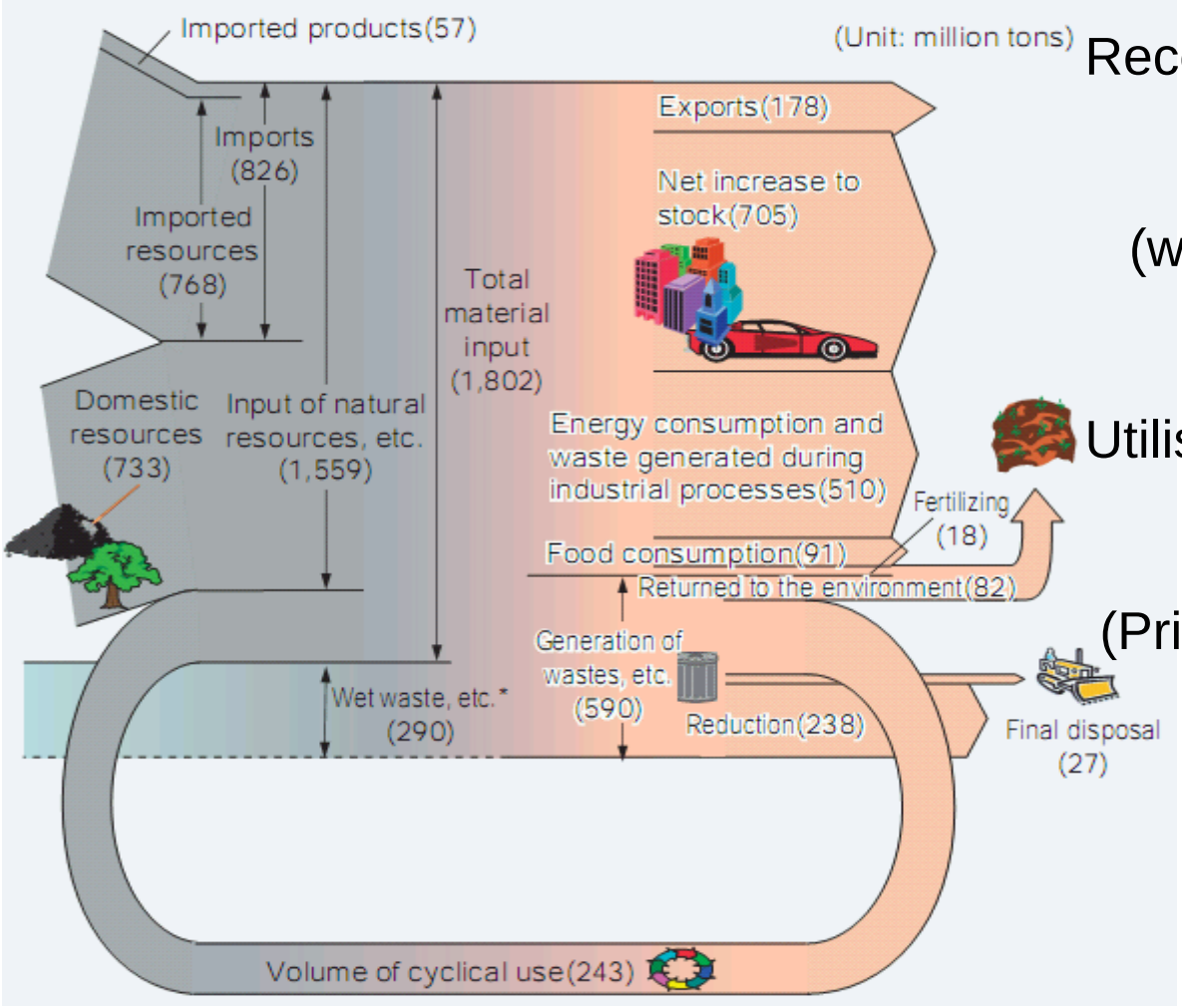
2. Environmental Administration

Indicators -> Target -> Accomplishment
No indicator, no progress?

Problem:
Waste Hierarchy: Reduce, Reuse, Recycle, Disposal
Indicators for Recycle easiest -> More Recycling than Reduce or Reuse
* Are plastic bottles a good thing as long as they are recycled?
* Waste (incl recy) increased with intro of compostables collection (St Edmundsbury, UK)
Recycling rate is "easy", but may not be the best indicator for sustainability

Recycling rates

Recovery rate and Utilisation rate (recycled content)



Recovery rate:

Amount recovered /

(waste + amount recovered)

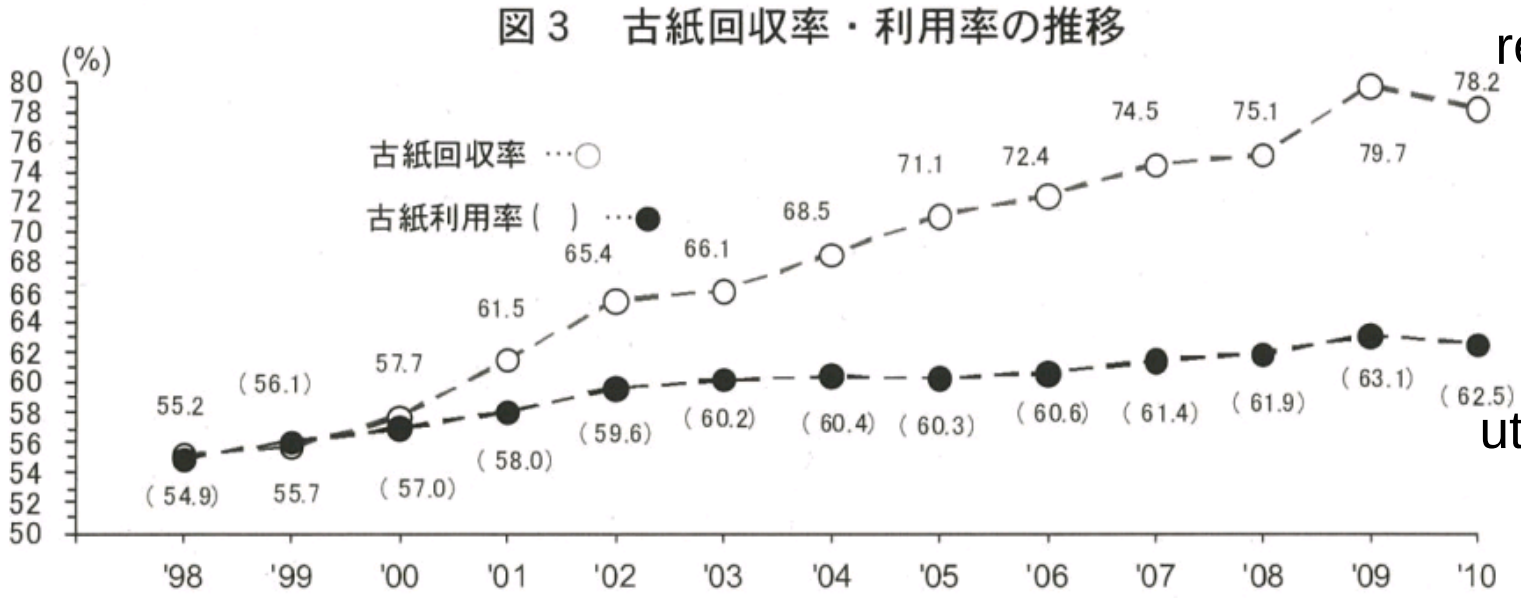
Utilisation rate:

Secondary material /

(Primary + Secondary material)

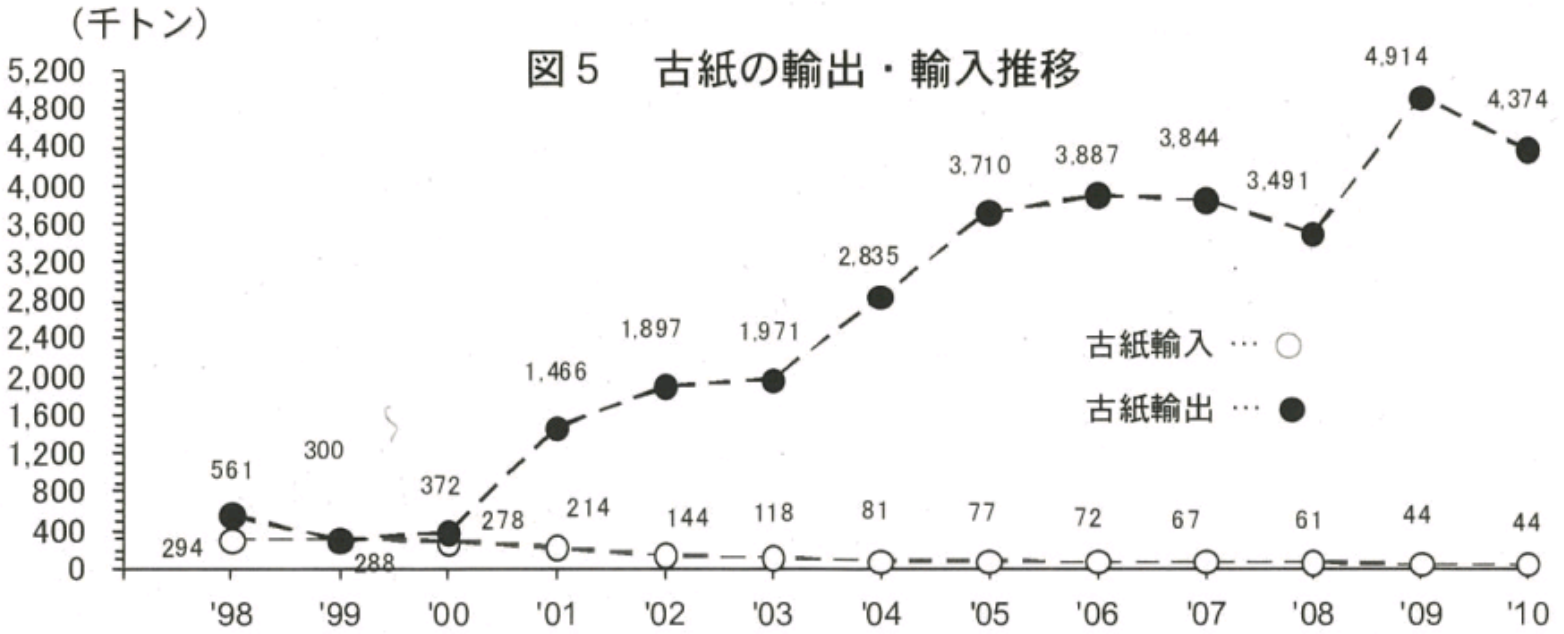
Total Material Flow of Japan (2007 - source: Ministry of the Environment, Japan)

Example: Paper recycling rates and export in Japan



recovery

utilisation



export

import

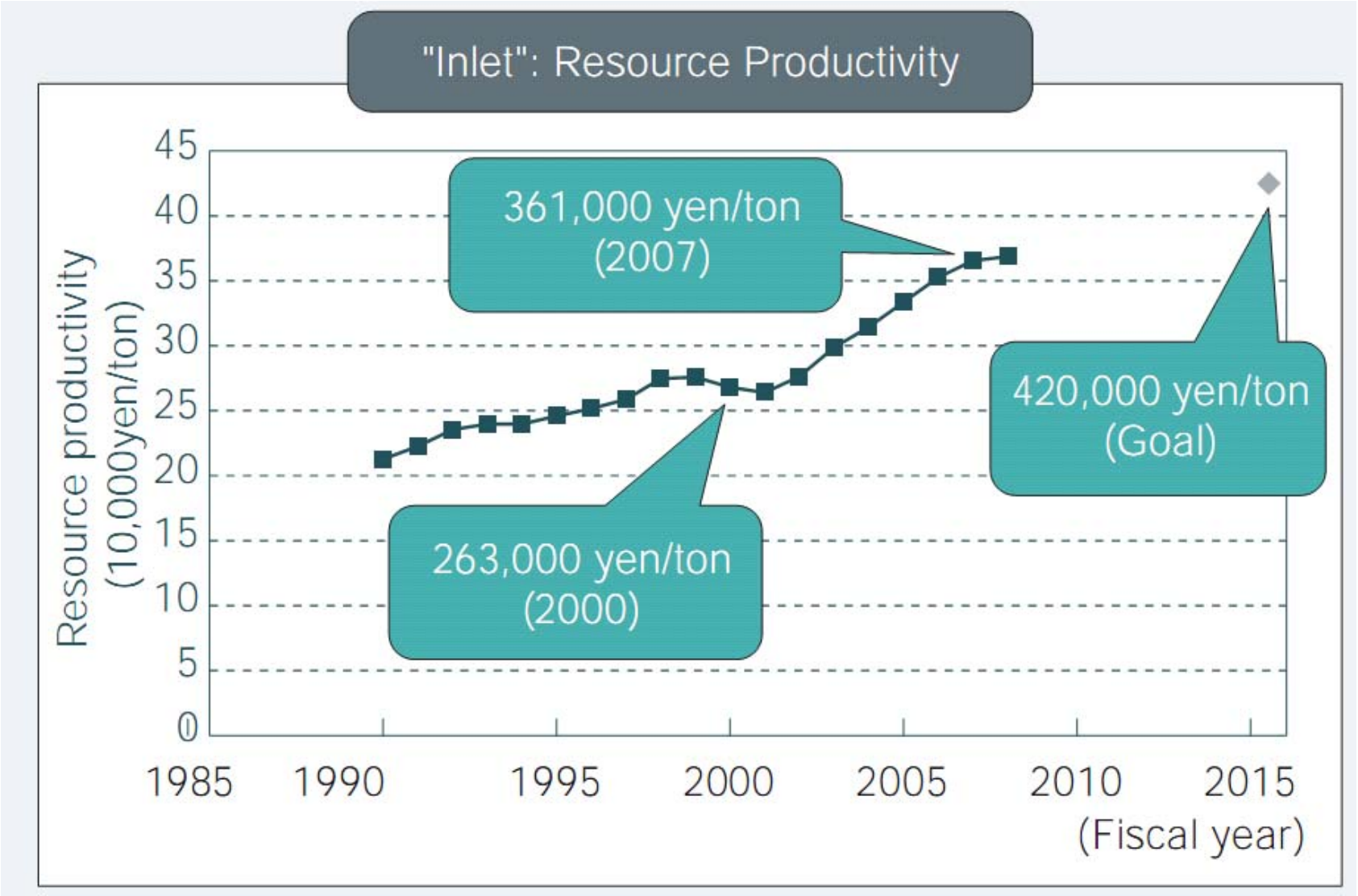
Use of Utilisation Rate
- Targets in Japanese Policy

the Fundamental Plan for Establishing a Sound Material-Cycle Society (revised 2008)

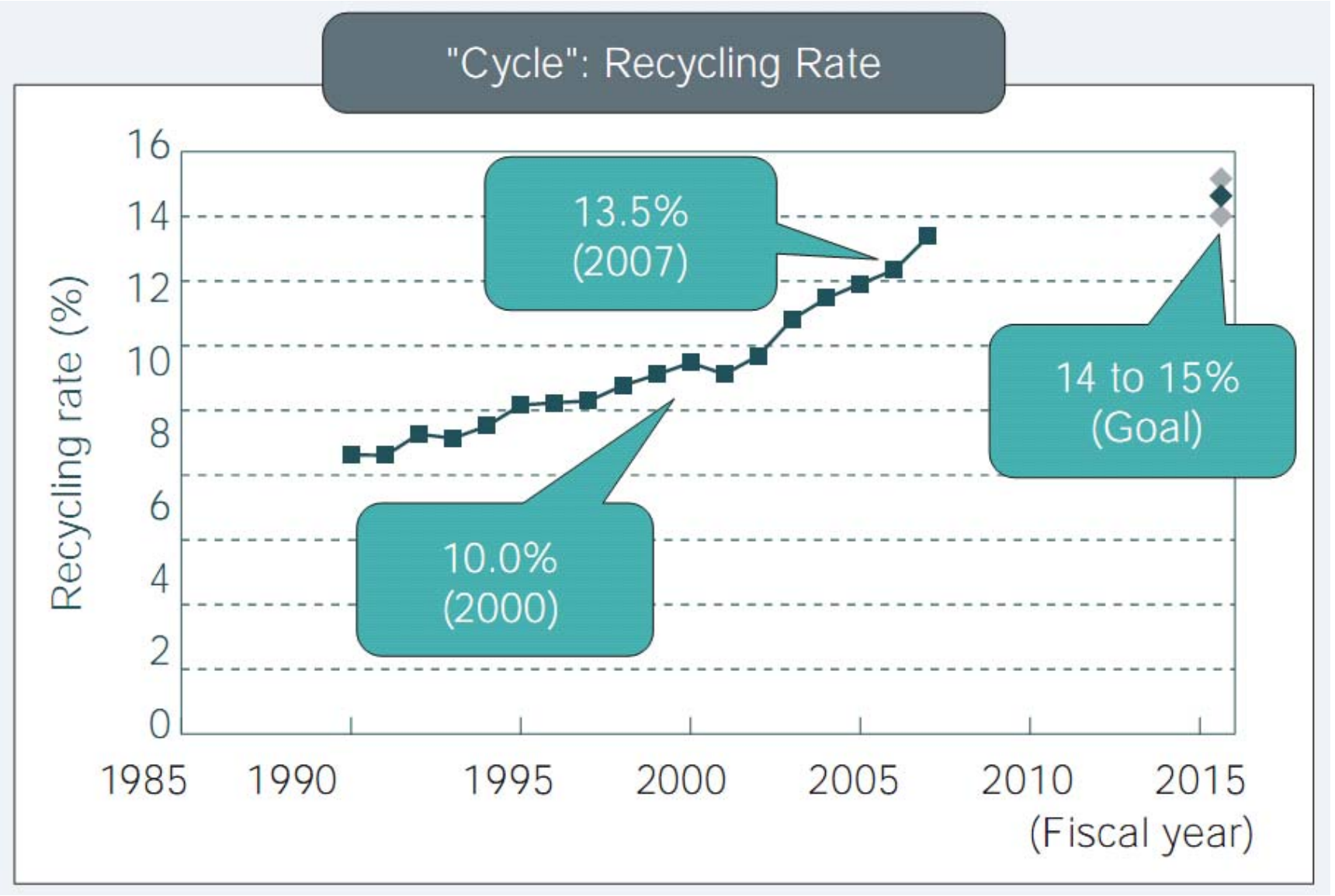
Aim: a society in which environmental burden and natural resource use is minimised through cyclical use of products

Target Indicators:
* Resource Productivity
* Recycling (Utilisation) Rate
* Amount of Final Disposal

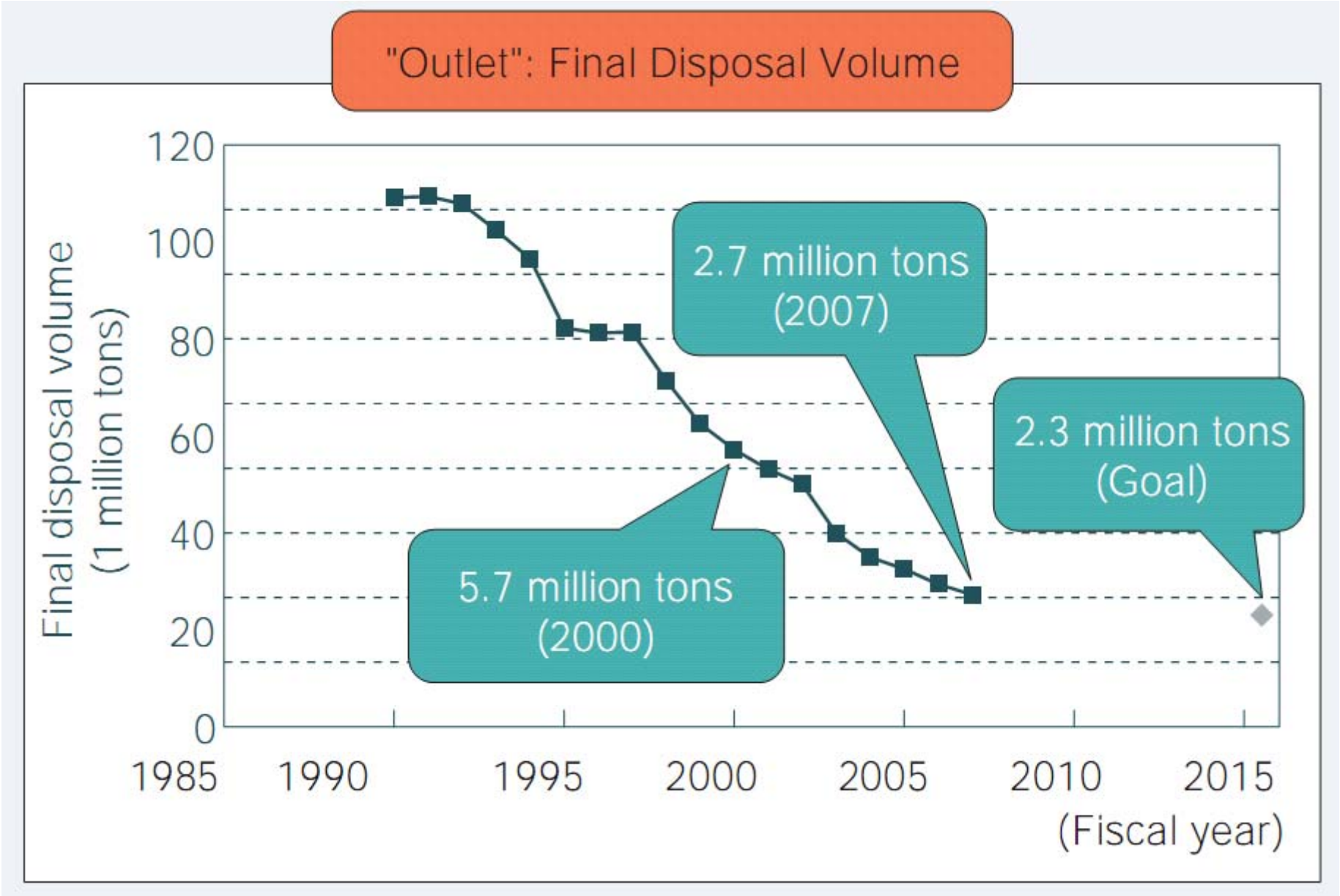
2 main laws
* Waste Management Act (prevention of pollution)
* Law for the Promotion of Effective Utilisation of Resources (promotion of 3R)



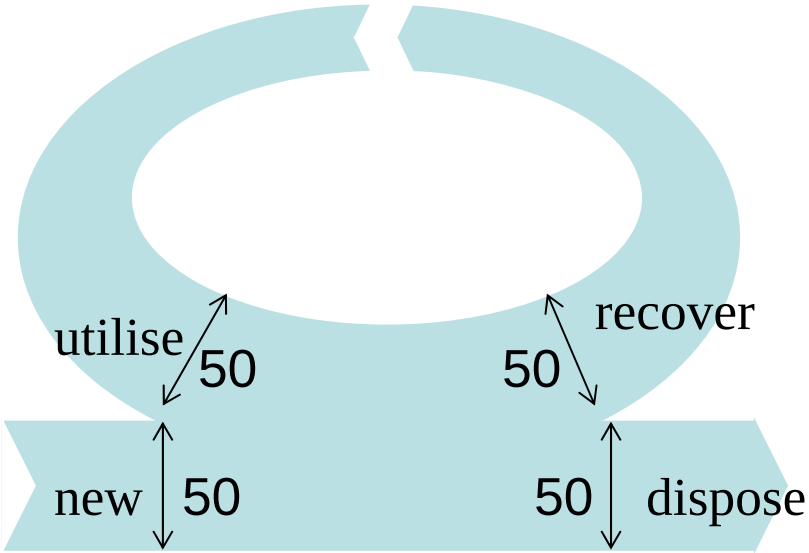
Resource Productivity: GDP/Total Material Input
"how much money you make with 1t of resource"



Recycling (utilisation) rate = cyclical use / total material input


"Outlet": Final Disposal Volume
Final disposal volume
(1 million tons)
120
100
80
60
40
20
0
1985
1990
1995
2000
2005
2010
2015
(Fiscal year)
2.7 million tons
(2007)
2.3 million tons
(Goal)
5.7 million tons
(2000)

Recycling Rates and the Number of Use

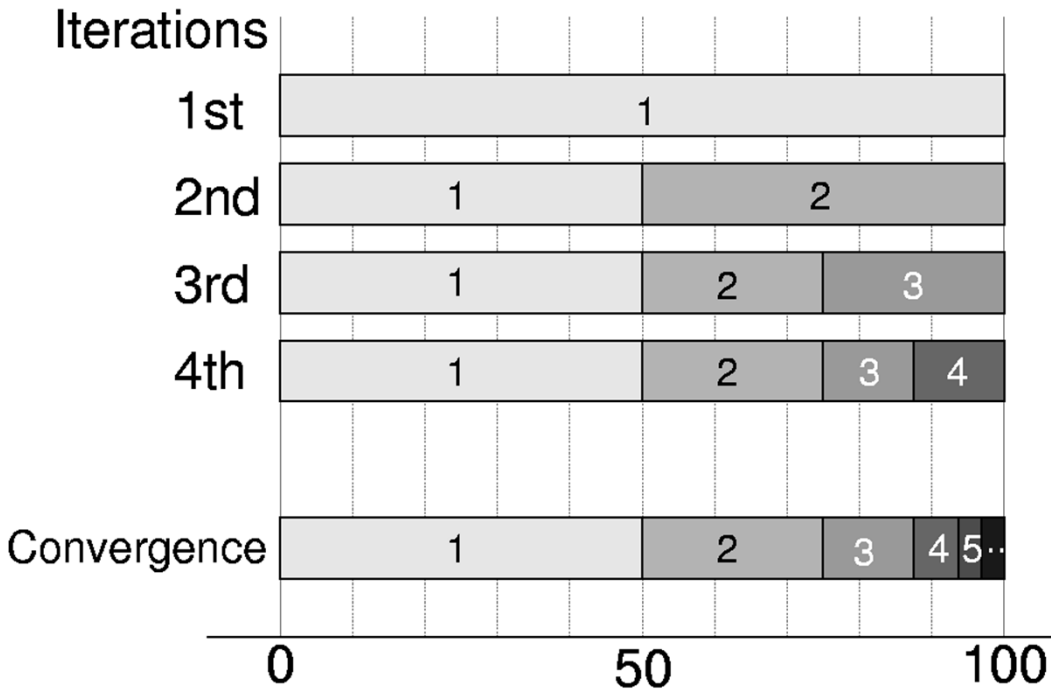


Closed loop 50% recycling

proportion of n_{th} use= $r^{n-1}-r^{n}$

average no. of use= $(1-r)^{-1}$

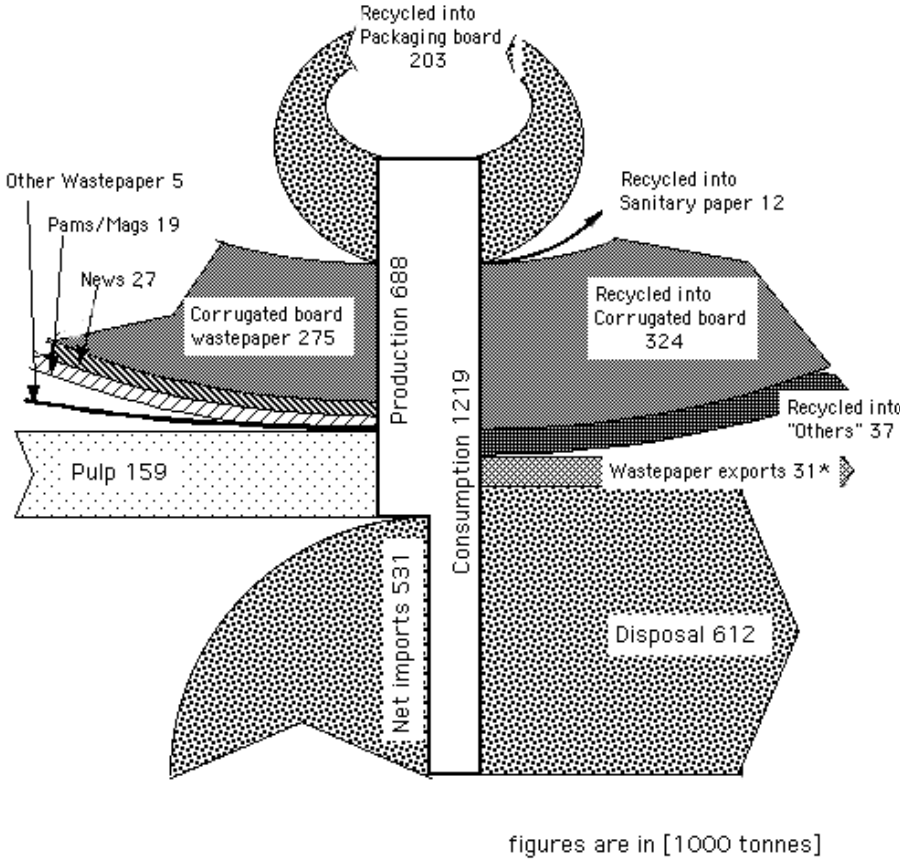
r : recovery-utilisation rate



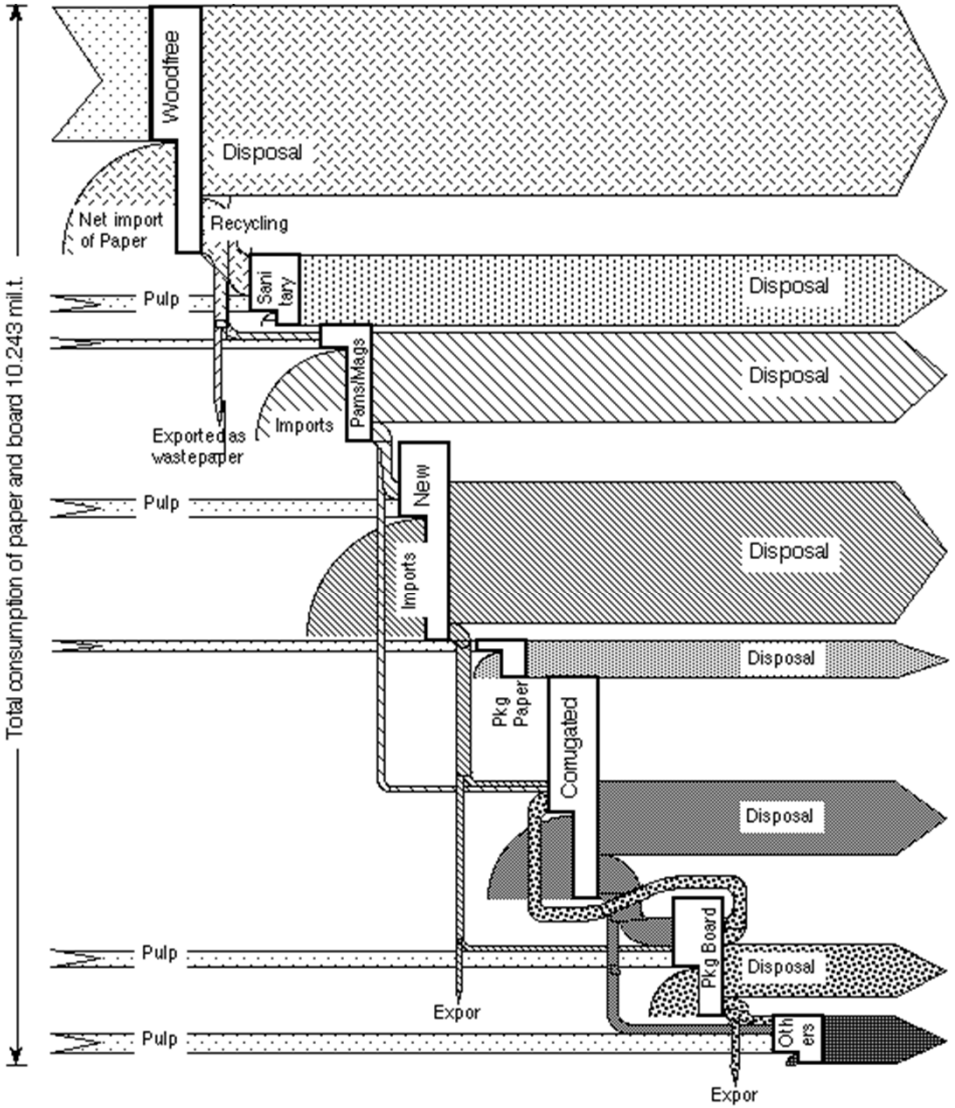
[Fig]Profile of 50% recycling rate

Things get a bit more complicated with cascading

(open loop recycling)



figures are in [1000 tonnes]



[Figure 2] The "Downcycling" of paper 500,000 tonnes /

Calculation of Number of Use in "Cascading"

Recycling Matrix = ***R***

from / to	sanitary	pams	news	pk pa	corrug	pk bd	oth
woodfree	403	176	0	27	44	4	8
pams	22	3	349	4	23	3	25
newsprint	33	3	813	6	52	6	27
pack paper	11	0	0	17	94	24	18
corrugated	15	0	0	41	1380	204	306
pack board	18	1	0	1	307	63	1

average no. of use matrix : ***C***

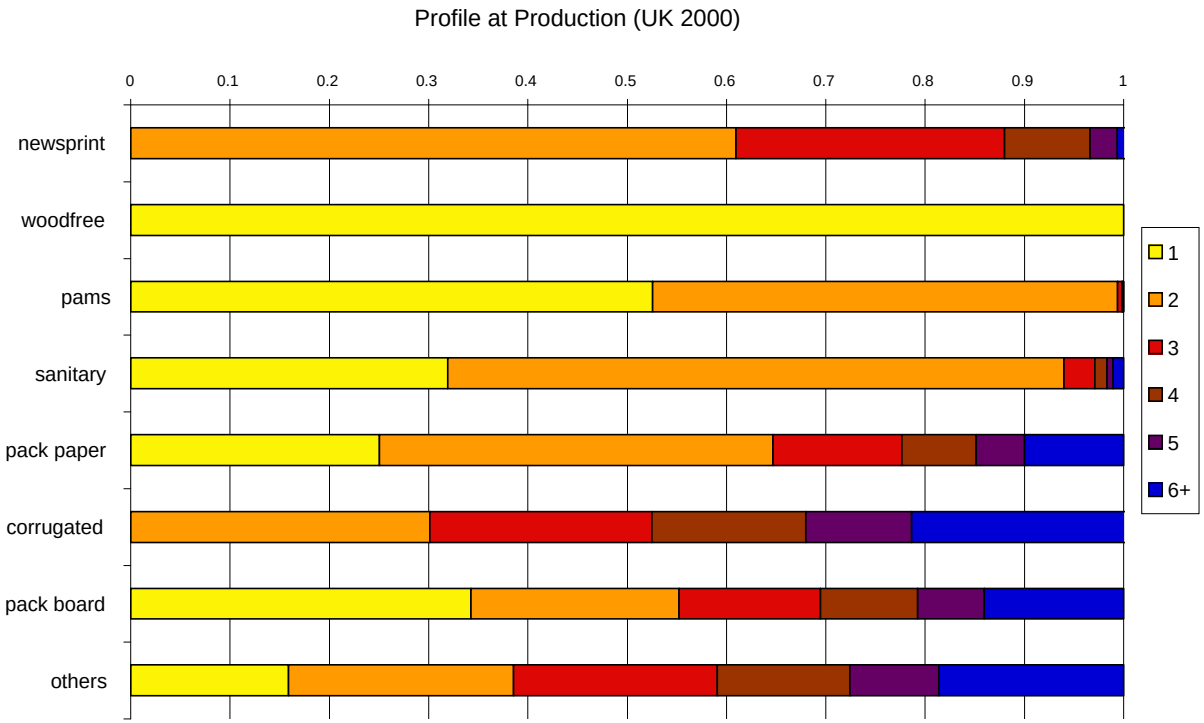
$$\boldsymbol{C}=(\boldsymbol{I}-\boldsymbol{R})^{-1}$$

Proportion of n_{th} use matrix: ***L***n

$$\boldsymbol{L}n=\boldsymbol{R}^{n}-\boldsymbol{R}^{(n-1)}$$

newsprint (UK Product)
util rate 100% av. use 2.68
corrugated (UK Product)
util rate 100% av. use 4.39

UK imports a lot of newsprint, which keeps the "age" of feedstock low



Number of use and implication to recycling

As recovery rate rises, the total flow becomes more "closed loop" and the average number of use (="age") will rise significantly

Physical quality of paper fibres, plastic polymers etc. deteriorate with "age".

If the "age" of secondary materials is low, higher utilisation rate for a product is still possible with relatively low quality feedstock (there is room to allow for impurities)

As "age" rises, more stringent quality control will be required for collected materials

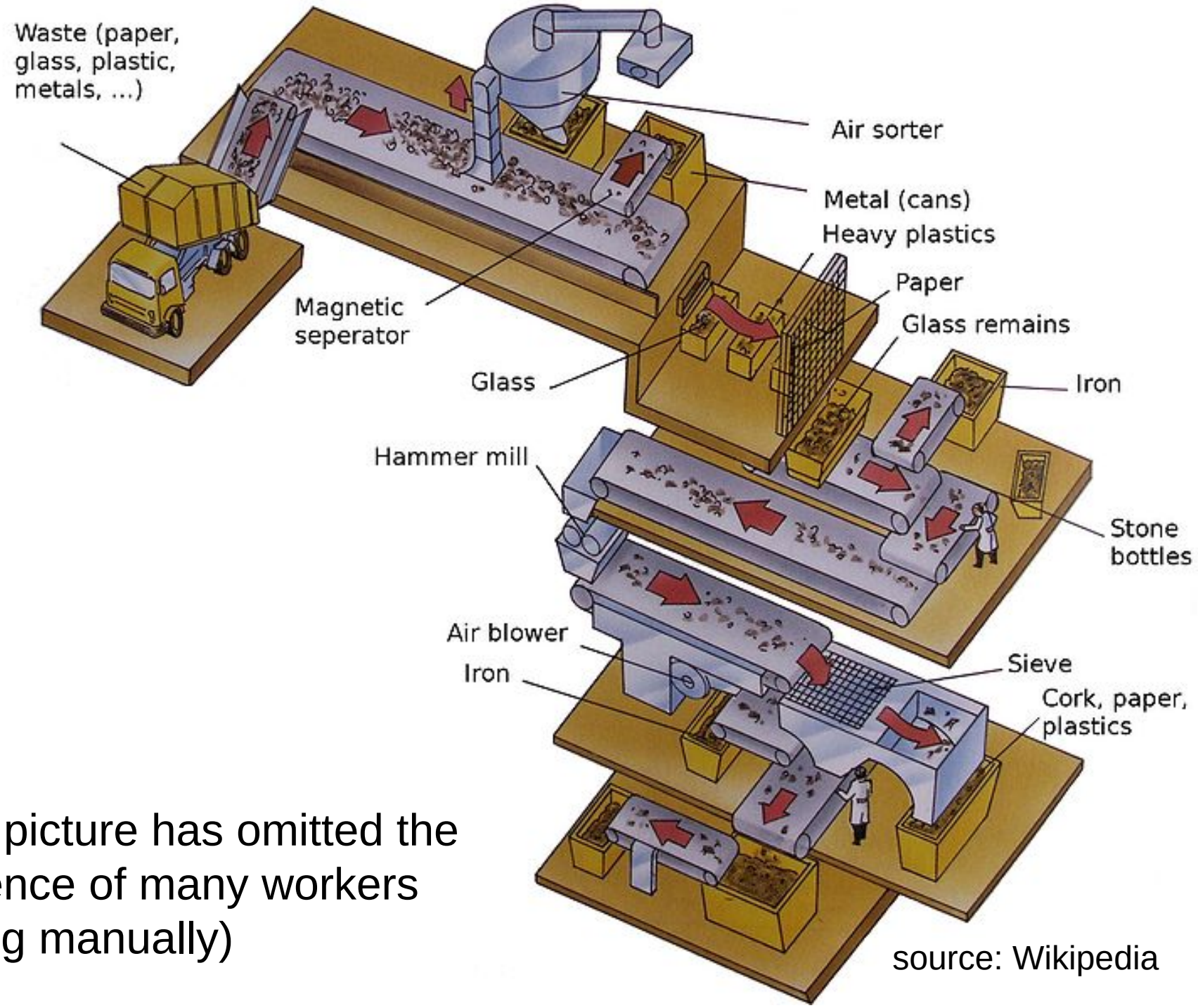
Collection Schemes are the start of "vein flow"

"Single Stream"

- Lower collection cost
- Low requirement for residents
- Requires MRF (material sorting facility)
- Lower quality of recovered materials

Separate Collection

- Higher collection cost
- Higher requirement for residents
- Recovery rate dependent on resident cooperation
- Higher quality of recovered materials



(This picture has omitted the presence of many workers sorting manually)

source: Wikipedia

Edmonton (Alberta)


5

Miharu (Fukushima)

Munakata (Fukuoka)

Wrap up

Good indicators are essential for good policy
(e.g. Japanese cyclical society policy - there may be even better indicators)

Recovery rate is not the only indicator for Recycling
(utilisation rate / number of use indicator can show different aspects)

As recovery /utilisation rate increases, higher quality will be required for secondary materials (increased number of use)

"Single stream" is possible at low overall recycling rates, but at higher rates, detailed separate collection will be required to assure the quality