Urban Metabolism and Waste Management

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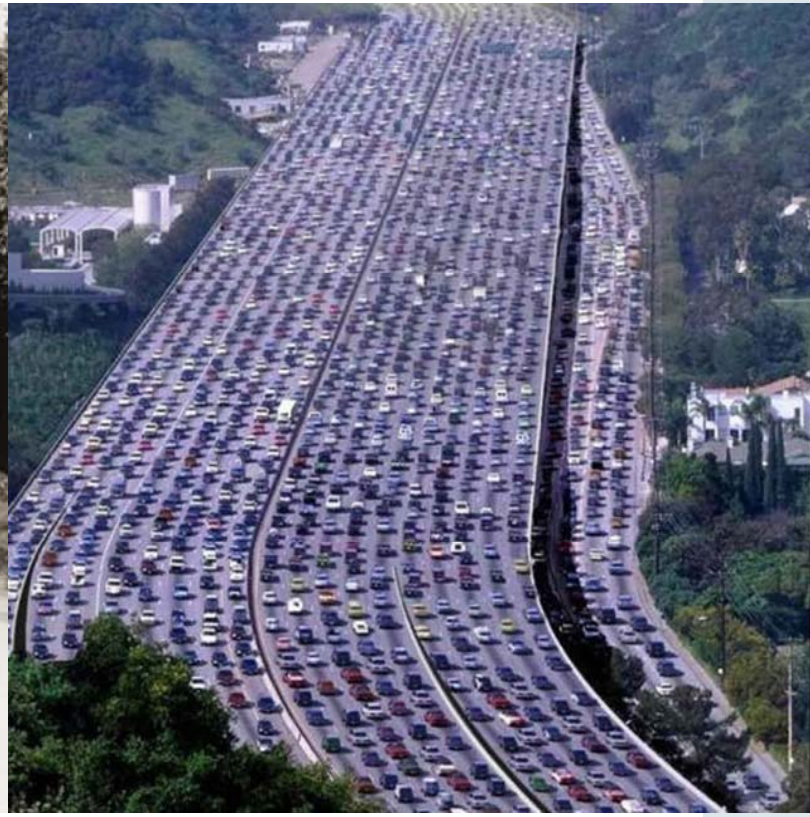
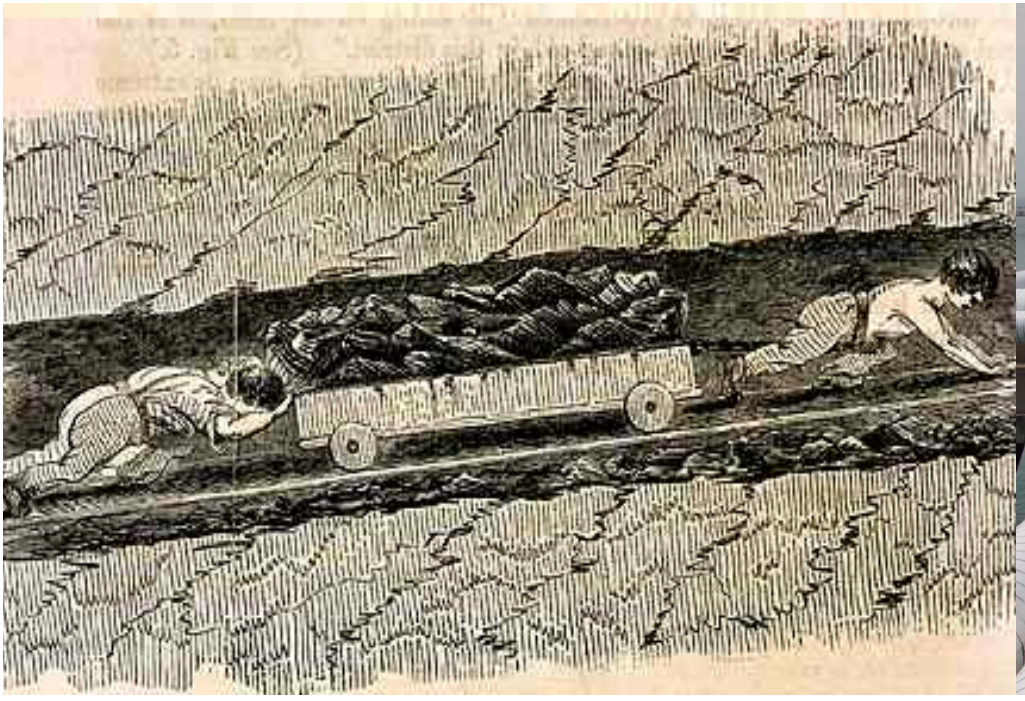
The last 100 years: unprecedented growth in materials …

Germany 1920



Japan 2010

… and energy flows!



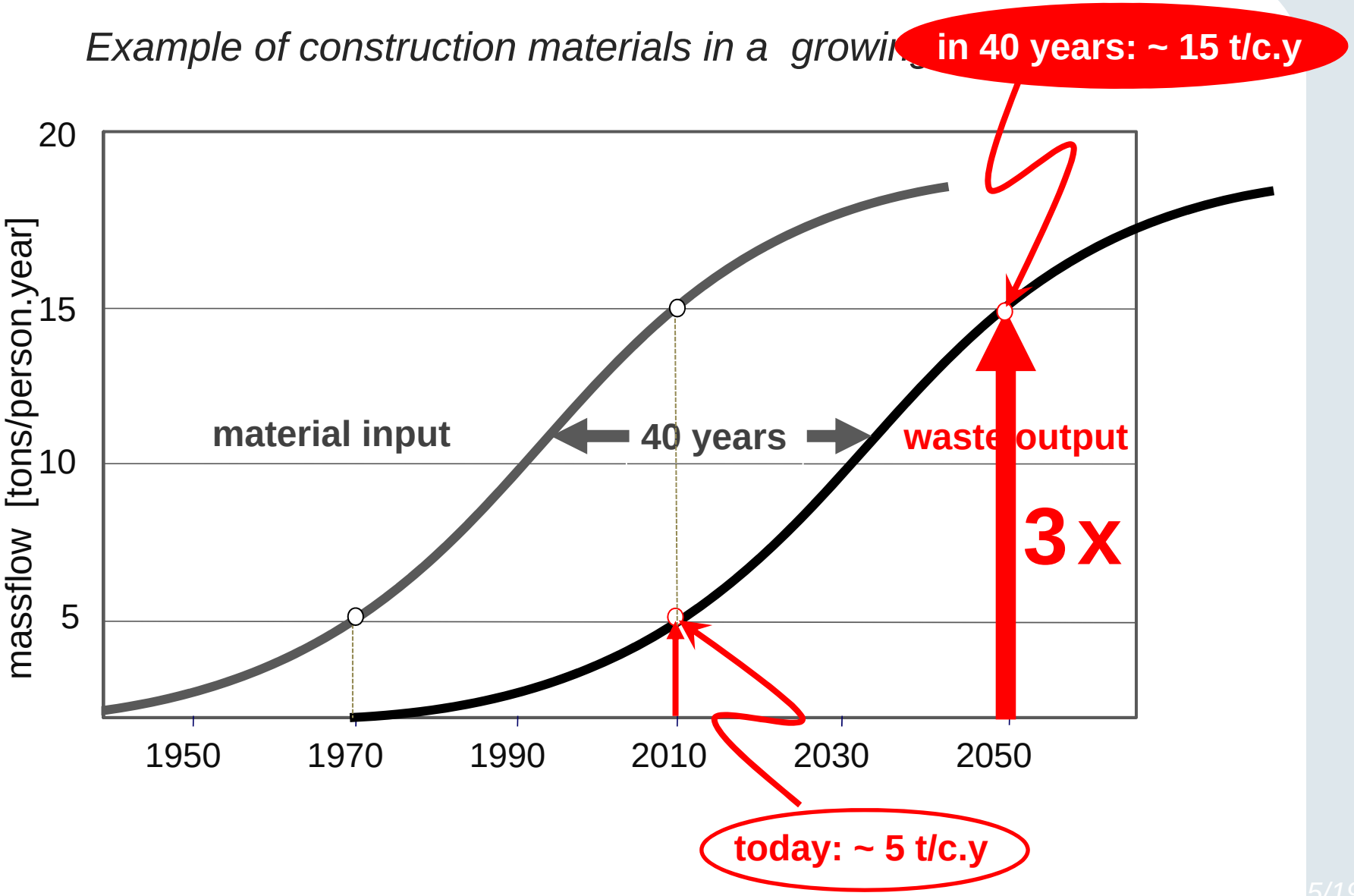
England 1840

China 2010

Large and growing material stocks

Today´s stocks are tomorrow´s wastes

Example of construction materials in a growing

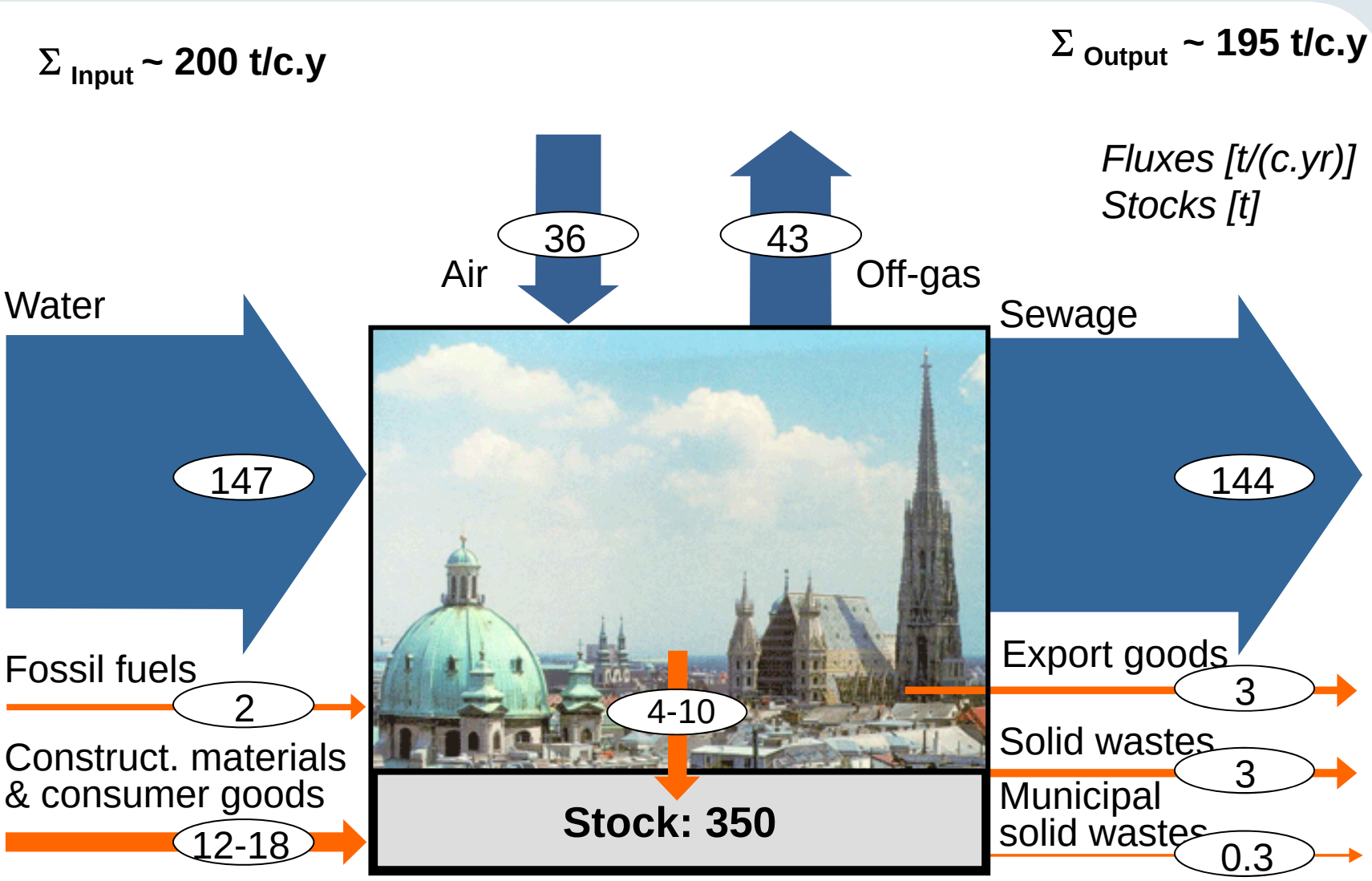


Household metabolism: Key activities and material flows

Activity	Input	Output			Stock
	[t/c.y]	Sewage	Off gas *[t/c.y]*	Solid residues	*[t/c]*
To nourish	5,7	0,9	4,7	0,1	< 0,1
To clean	60	60	0	0,02	0,1
To reside	10	0	7,6	1	100 + 1
To transport	10	0	6	1,6	160 + 2
Total	86	61	19	2,7	260 + 3

Material flows into stocks equal the amount of solid residues

Urban metabolism: the case of Vienna

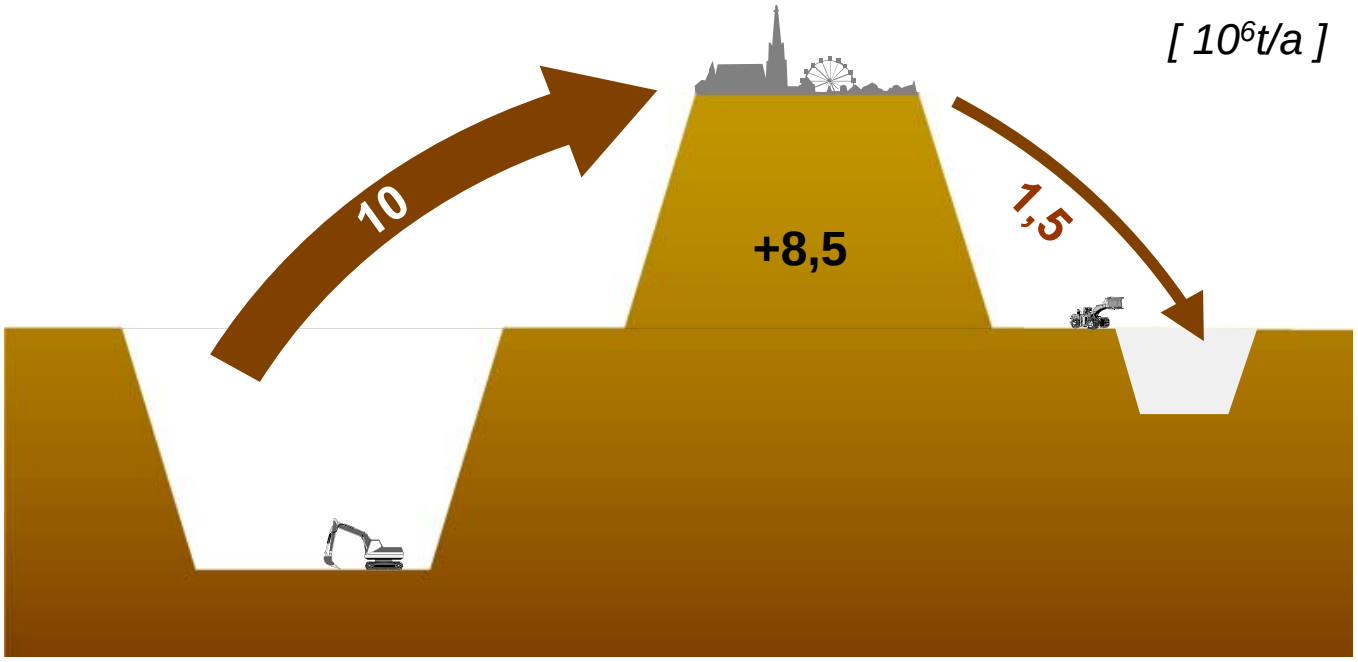


Source: Daxbeck et al. 1996 (updated)

Cities grow – implications for wm?

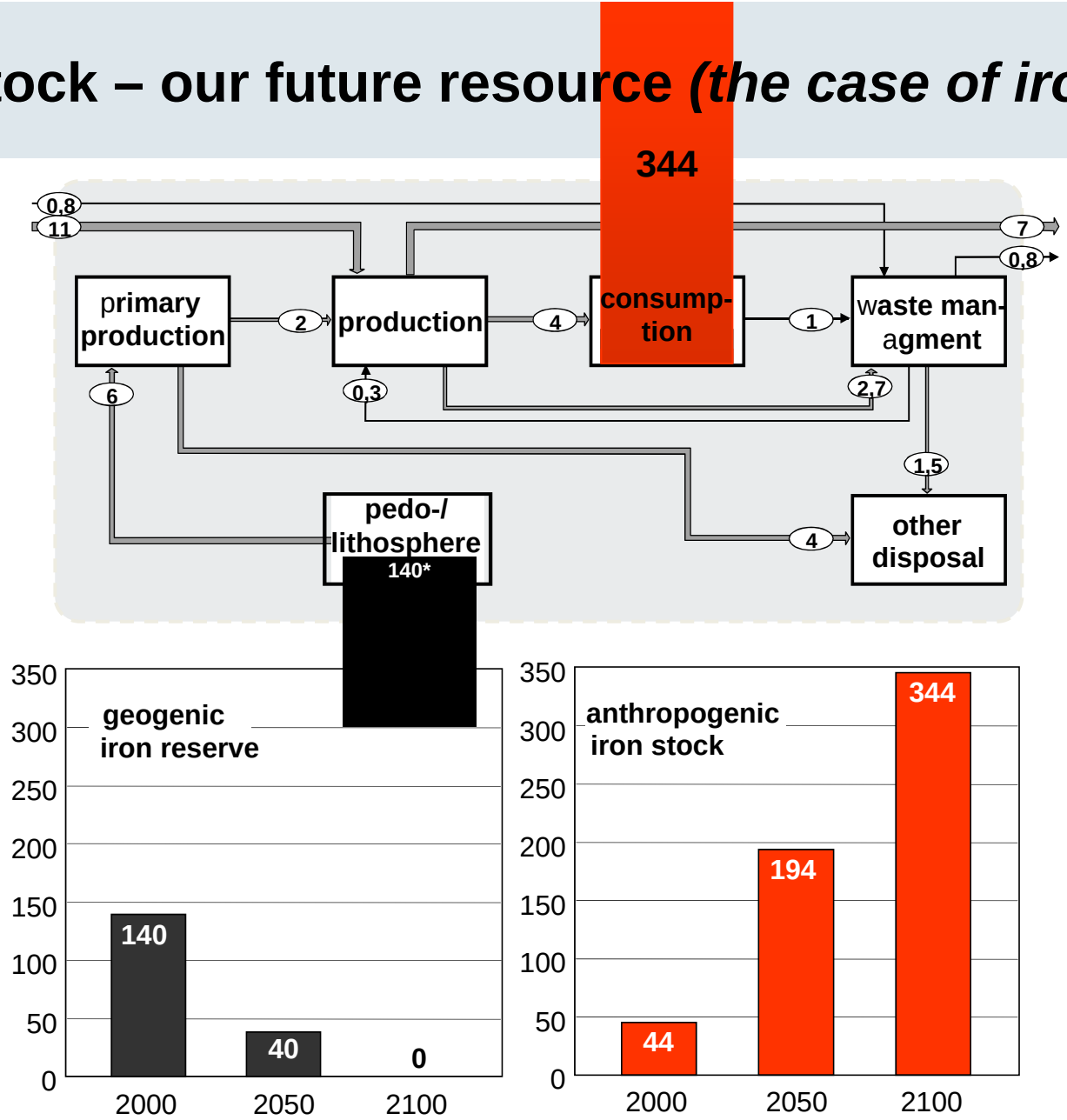
Abundance of "holes" - or scarcity of landfill space?

- the "substance" problem!



The stock – our future resource *(the case of iron)*

[10^6 tons]



Goals and principles of waste management

General and global goals

- Protection of men and environment
- Resource conservation
- After care free wm: no export in time and space

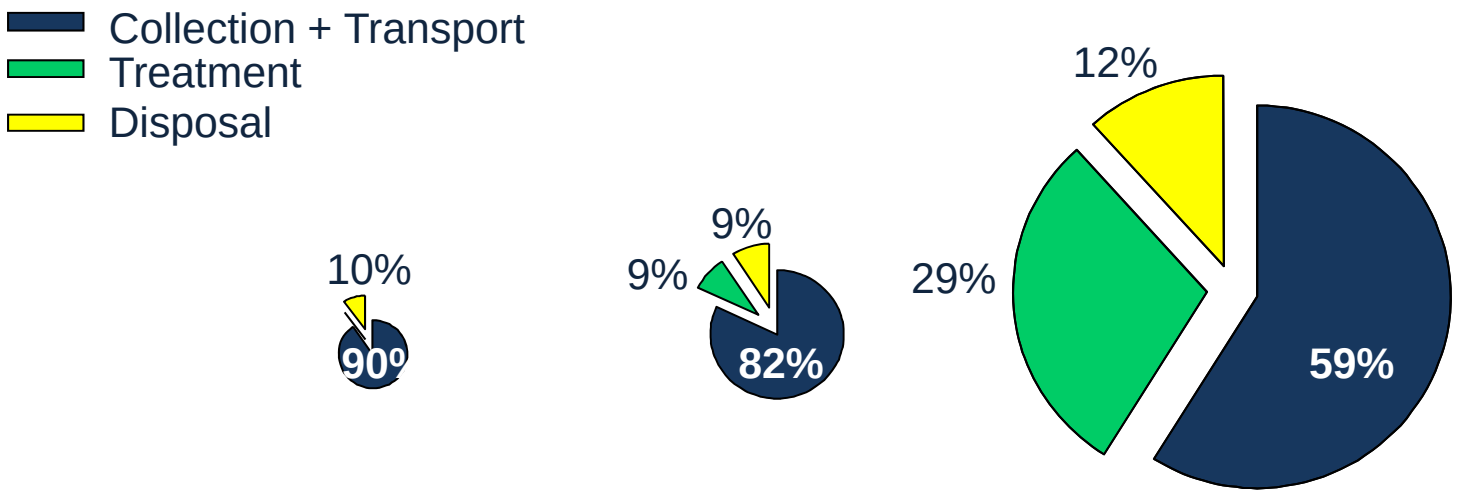
Regionally appropriate means

EU: prevention – recycling – disposal

Bangla Desh: disposal – recycling - prevention

-> means depend on GDP!

Means of waste management depend on GDP

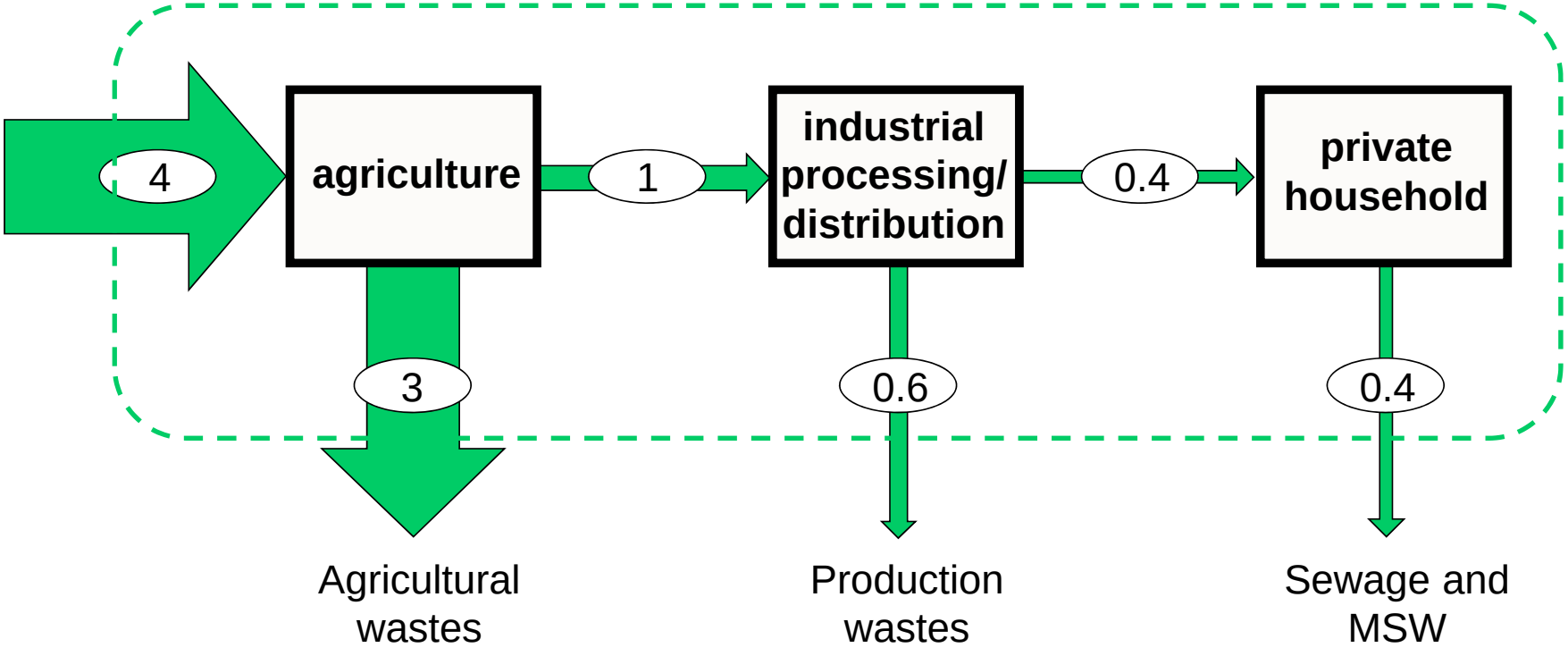


region	Dhaka (GDP 450 US$/c.y)	Damascus (GDP 1600 US$/c.y)	Vienna GDP 33‘000 US$/c.y))
WM costs [US$/c.y]	0.8	4.6	130
% of GDP	0.2	0.3	0.4

-> Globalization of EU “waste hierarchy” ?

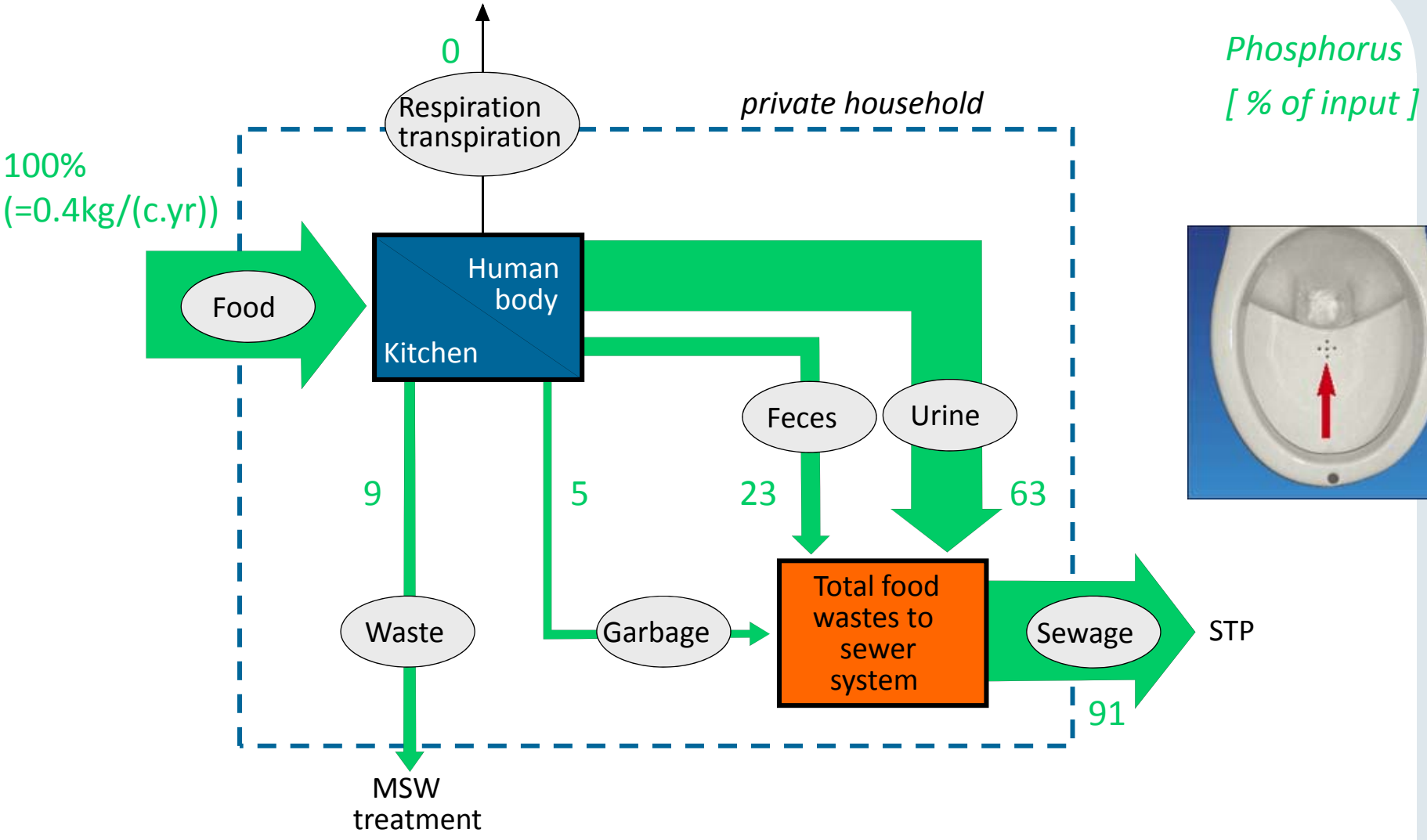
Better waste management based on metabolism

The case of Phosphorous: how to reach the goals of wm?



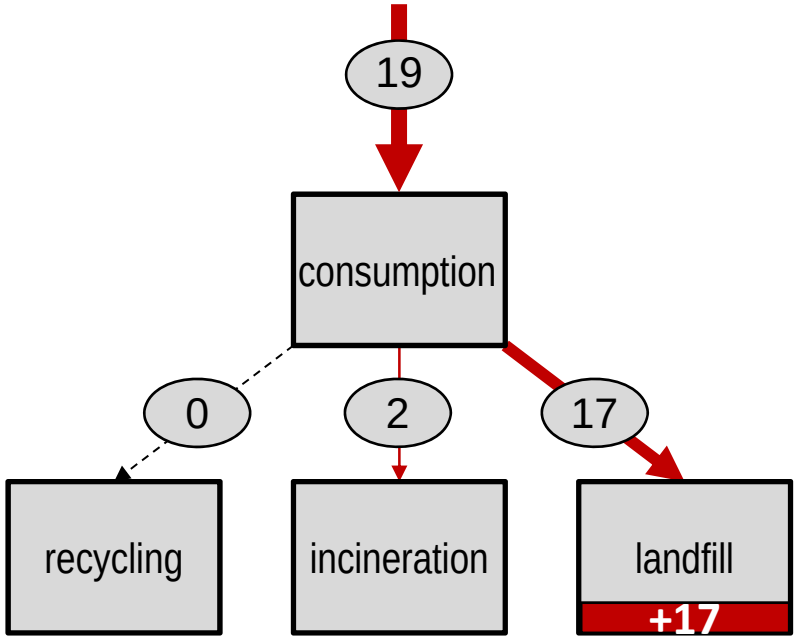
Flows [kg P/c.y]

New design based on metabolism



WM decisions based on metabolism – the case of plastics

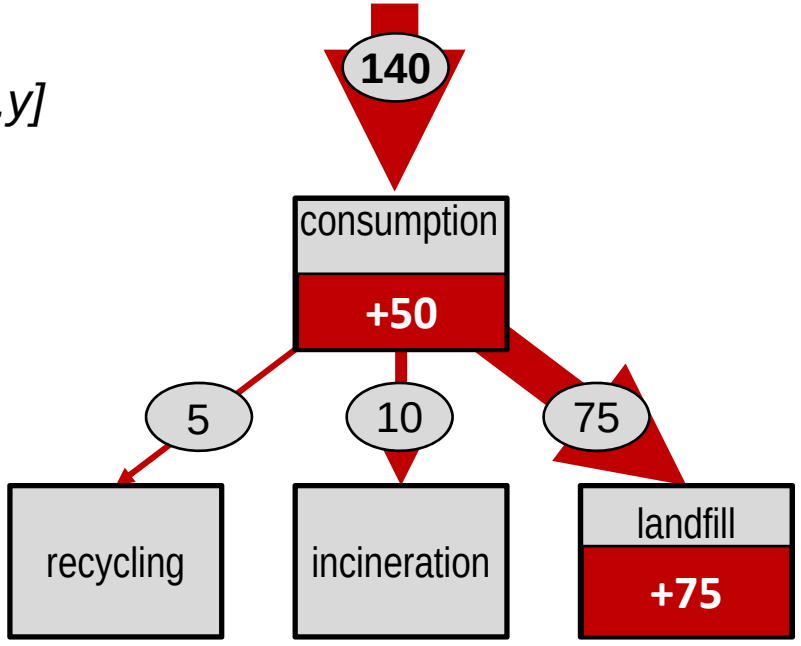
Packaging **plastic waste view**



14 %

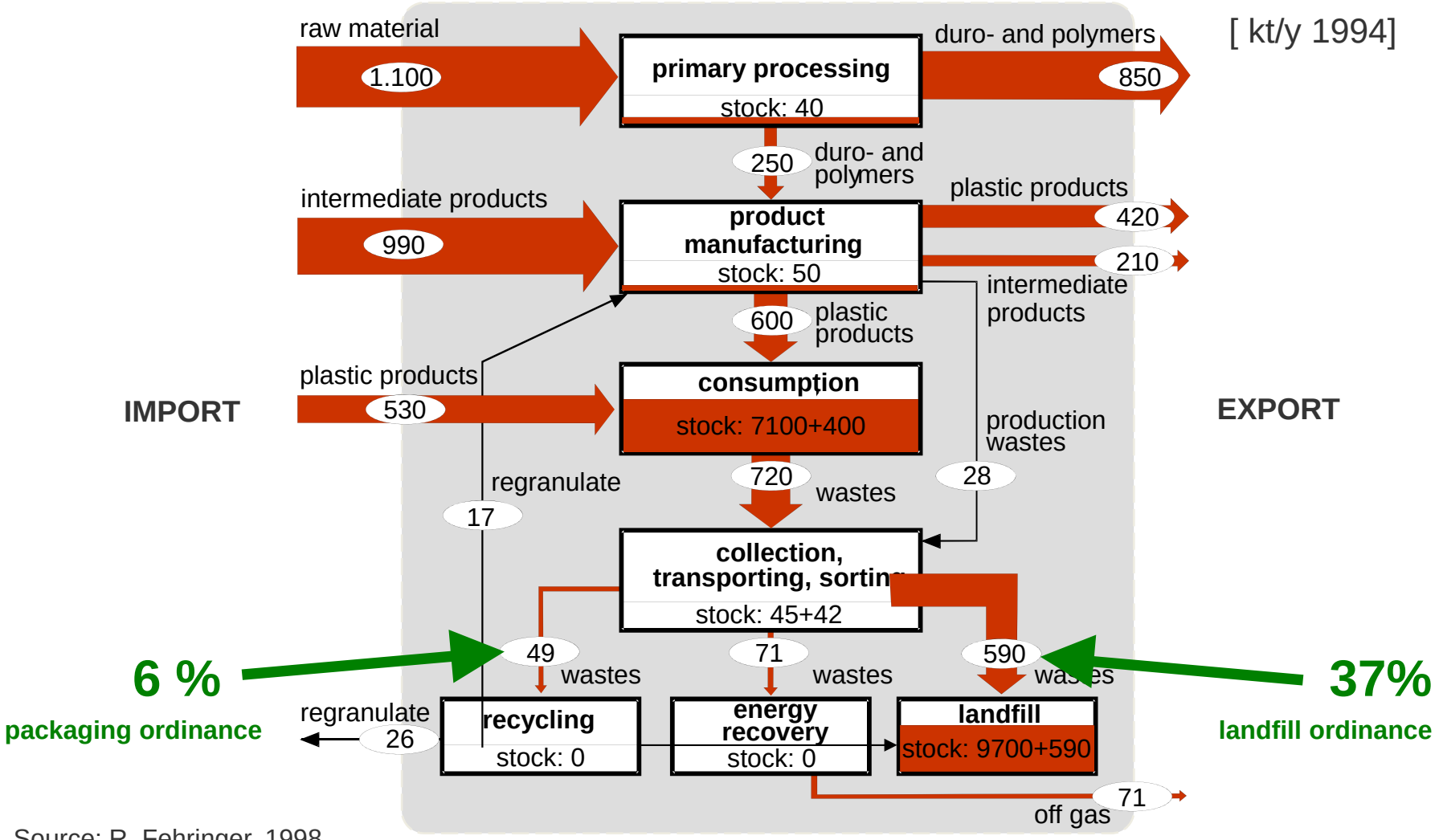
[kg/c.y]

Total **plastic waste view**



100%

Total plastic flows and stocks in Austria



Source: R. Fehringer, 1998

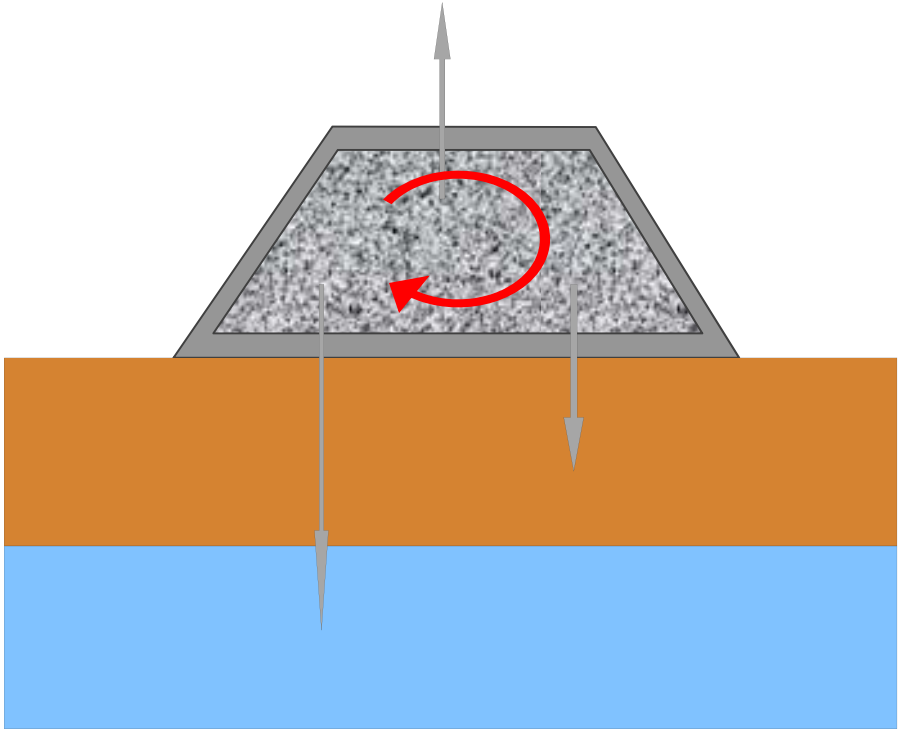
Additives are crucial for plastic recycling decisions

Material & additives	Total consumption	% in packaging material		Total stock
	[kt/yr]	[kt/yr]	[%]	[kt]
Plastics	1,100	200	18	7,100
Softeners	14	0.2	2	140
Ba/Cd- stabilizers	0.27	0.0002	<1	2.6
Pb-stabilizers	1.8	0.002	<1	18
Fire retardants	2.3	0	~0	22

Metabolism needs sinks: incinerators and landfills

objectives: - mineralization of OC
- immobilization of HM

main barrier: - waste properties
additional barriers: - natural attenuation
- monitoring



Conclusions

1. Goals of wm can be reached effectively only if total metabolism is known

2. New knowledge base needed about material flows and stocks

3. Focusing on metabolism allows:
   - early recognition of future problems
   - setting priorities
   - designing effective wm systems

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