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Case studies of national-scale material flow assessment: the European experience

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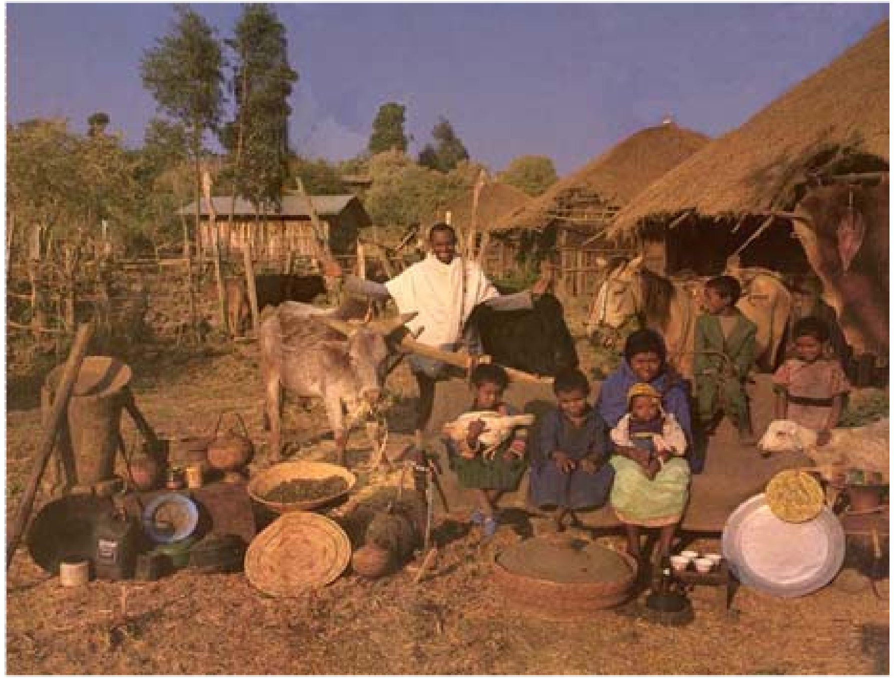
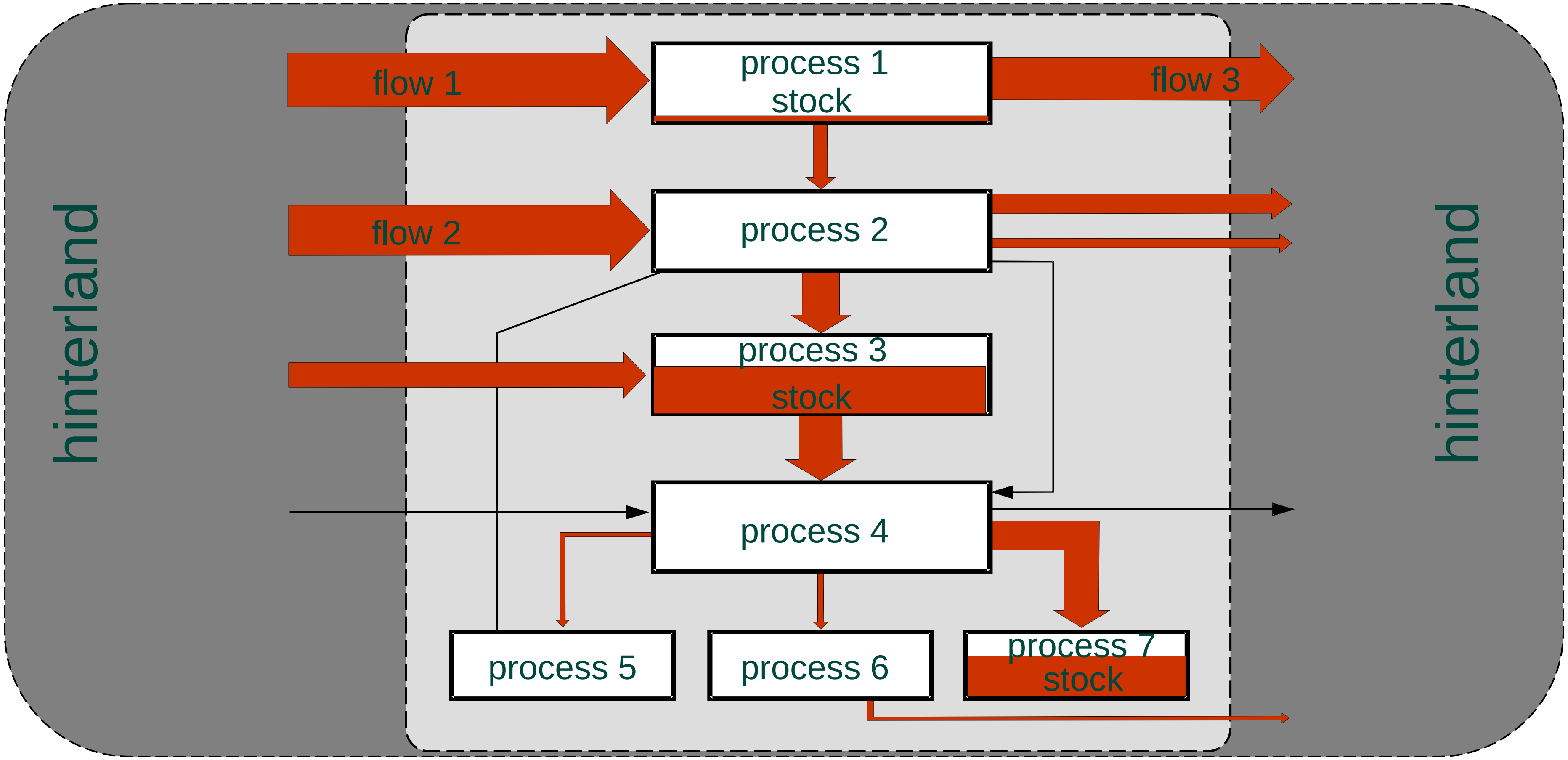
Why MFA?

- comparison of economies -> *resource efficiency, footprint*
- resource management -> *optimization, conservation, availability,*
- environmental management and waste management -> *early recognition, priorities, design of measures*



What is MFA?

- MFA -> systematic analysis of material flows and stocks
- materials accounting: -> routine MFA based on key flows and stocks



system boundary including the hinterland

MFA system boundary (space, time)

The difference between MFA and SFA

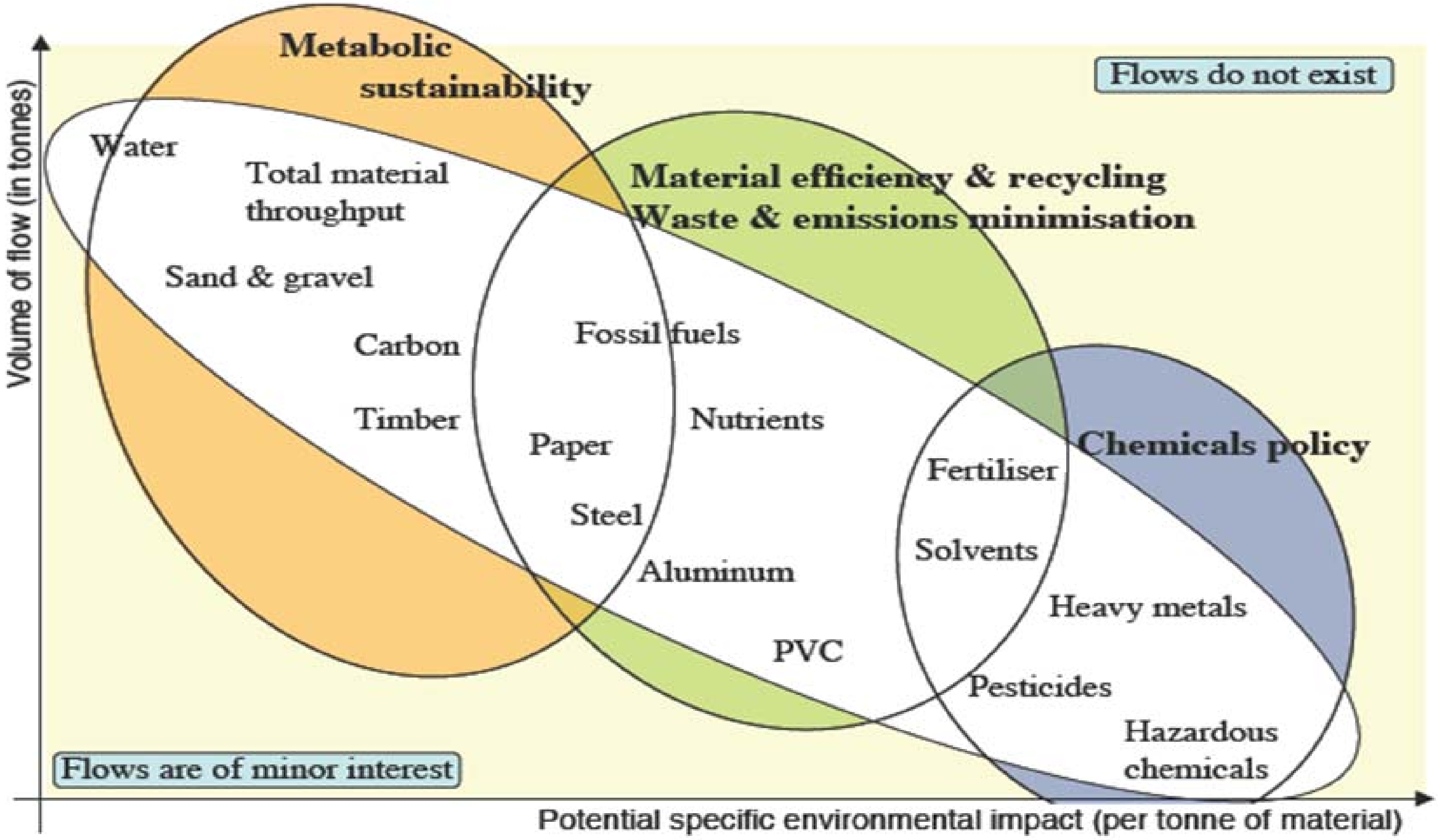
- "good" (= "product") as economic entity: car, steel, rice…
  -> data availability o.k. (national statistics etc.)

- "substance" (= "element" or "compound" in goods) are relevant for resources and environment: C, N, Cd, Nonylphenol…
  -> few data, measurement necessary
  -> high uncertainty
  -> expensive

- "material" stands for both "goods" and "substances"

MFA and SFA have different fields of application

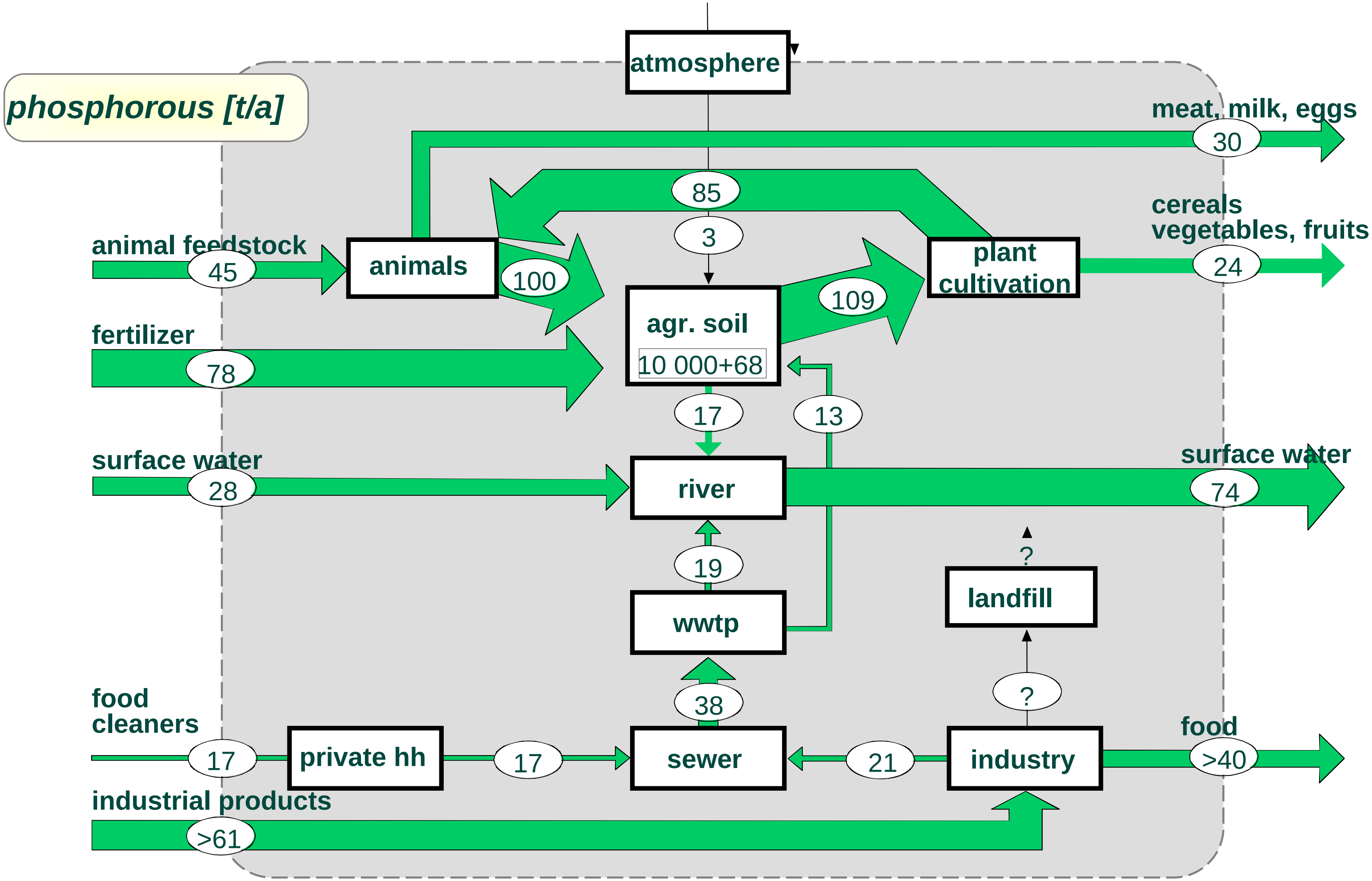
(bulk) MFA: **Dematerialization, „Factor 4“**
SFA: **analysis and optimization for r-, e-,w- management**



Source: Bringezu after OECD (2005) based on Steurer, A. (1996) as developed with Radermacher, W. in 1995 Wuppertal Institut SBr-05/25e

Case studies - the regional example: phosphorous

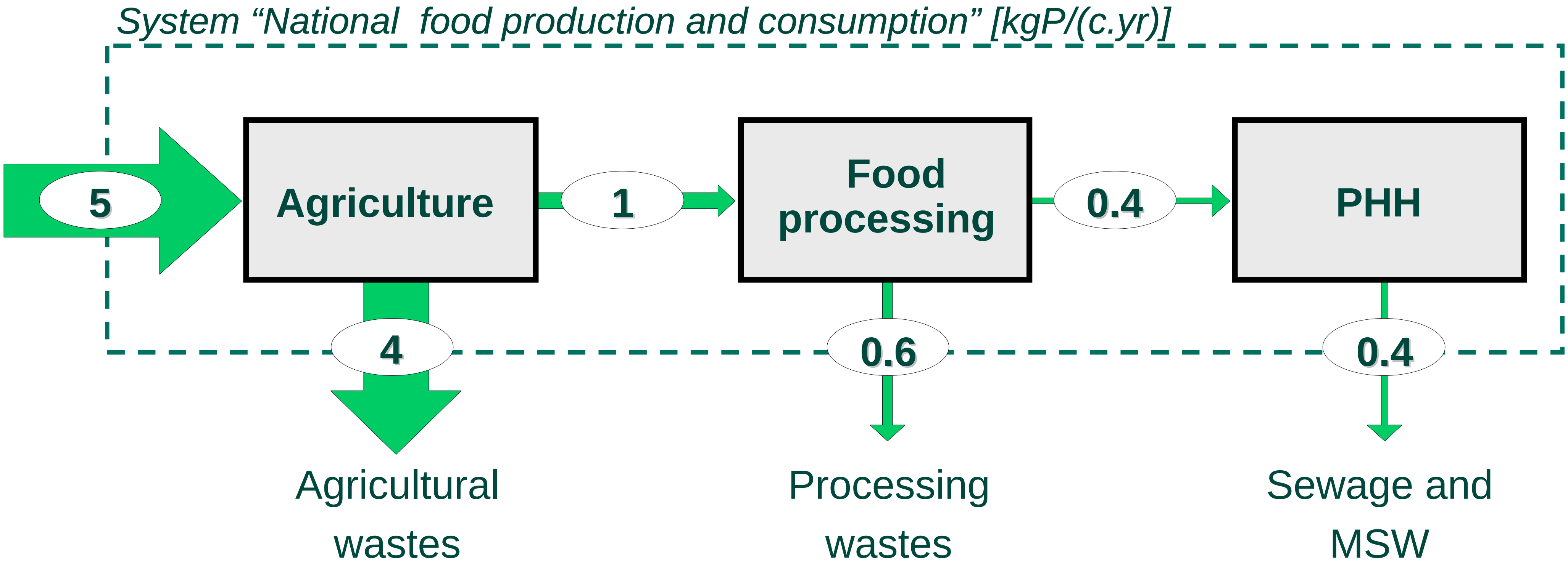
import = 230 t/a **stock 10.000 + 70 t/a** **export = 170 t/a**



Region Bunzvalley, 1985

Case studies - the national example: phosphorous

MFA as a decision support tool for waste and resources management



System "National food production and consumption" [kgP/(c.yr)]

Agriculture

Food processing

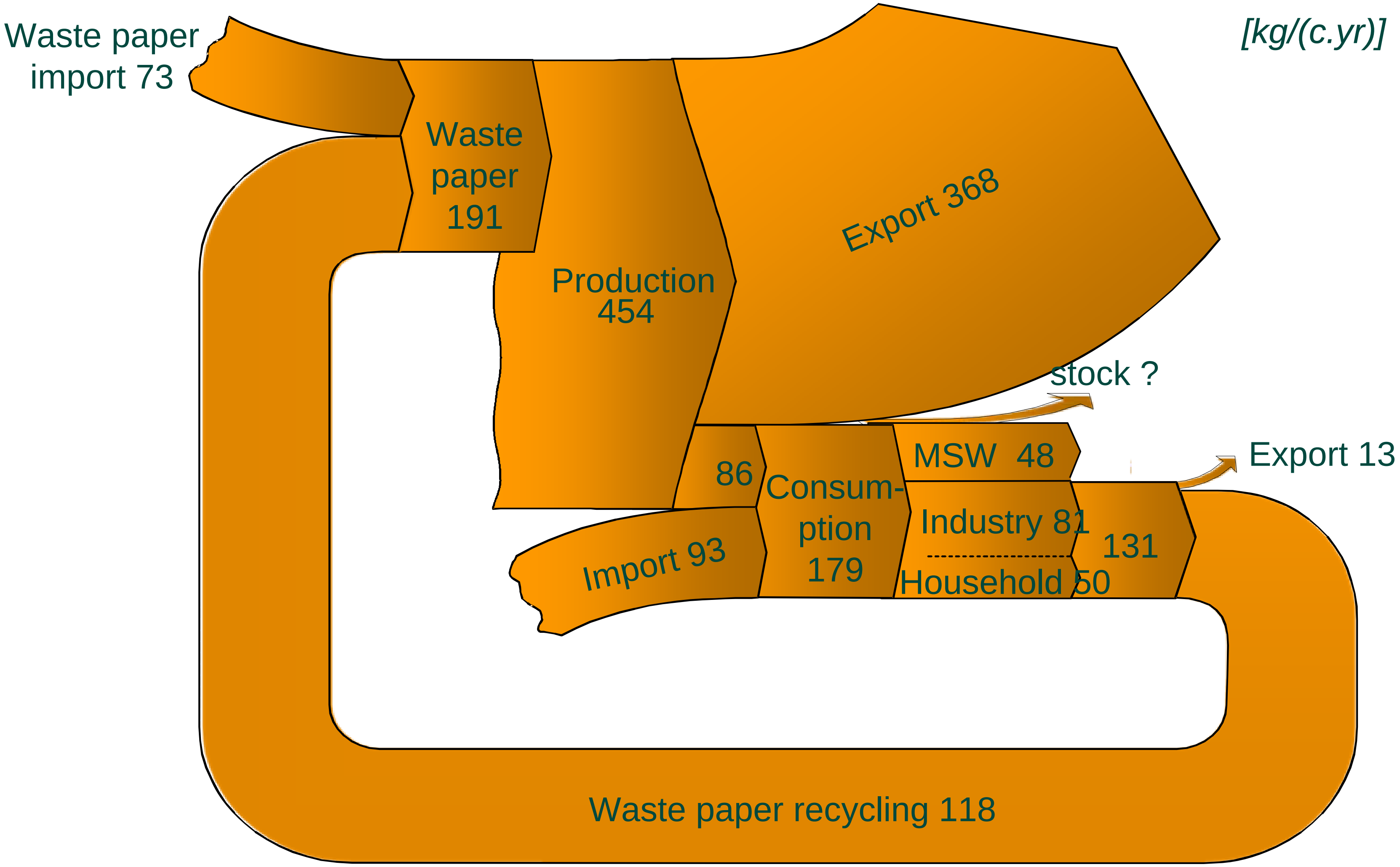
PHH

Agricultural wastes

Processing wastes

Sewage and MSW

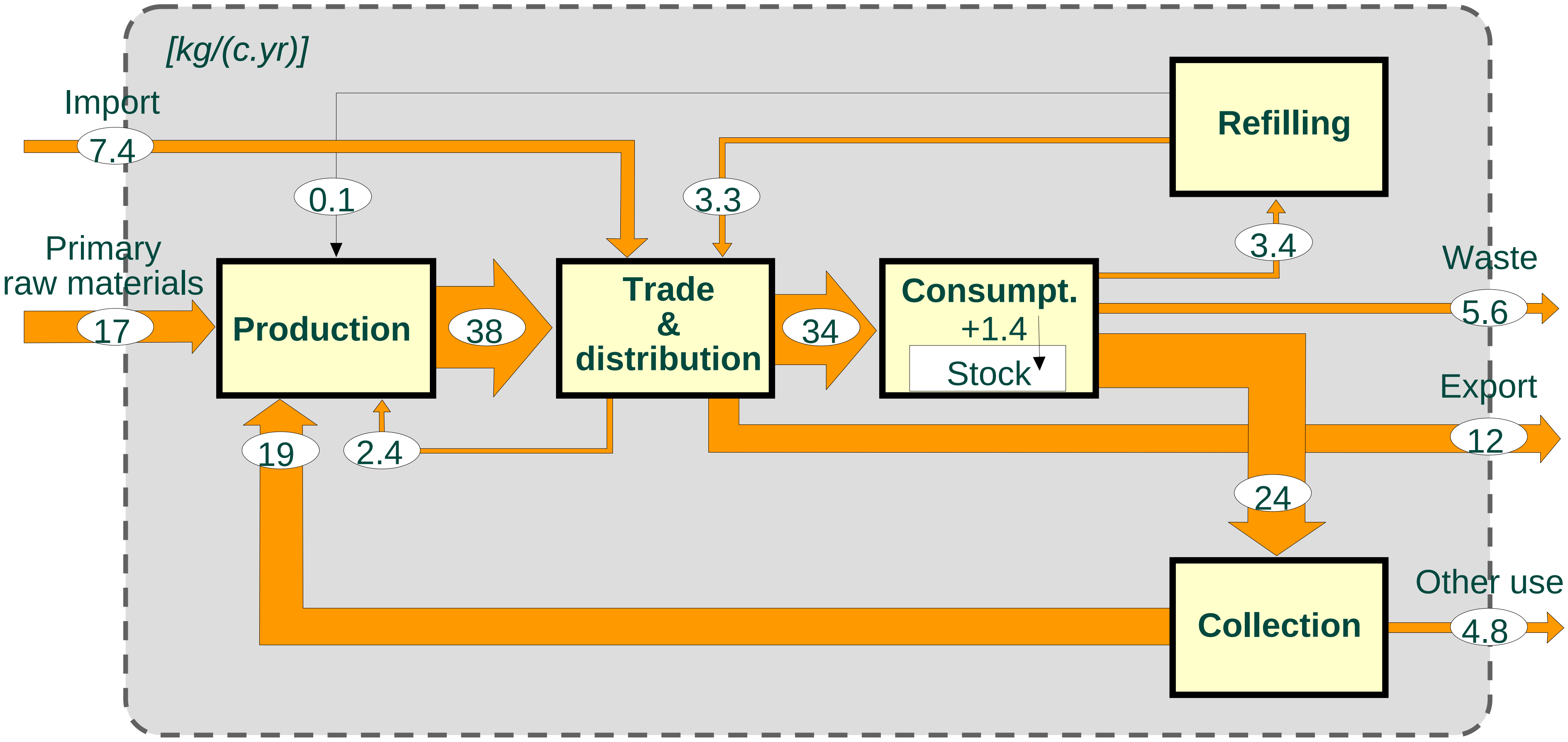
MFA of paper cycle in Austria



Data: Austrian Paper Industry, 1996

Case studies - the national example: glass

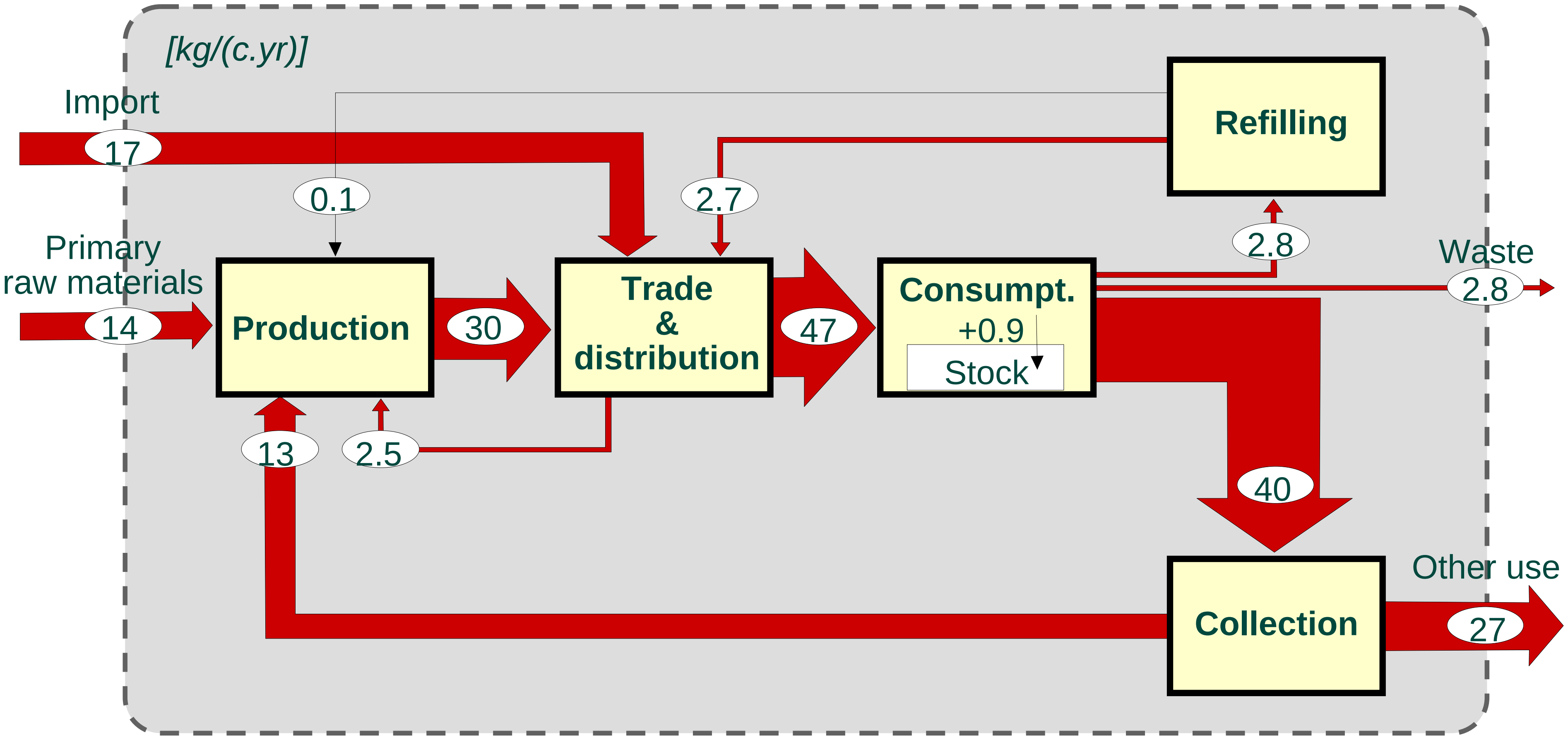
MFA of glass use in Austria



System Boundary "Austria"

Case studies - the national example: glass

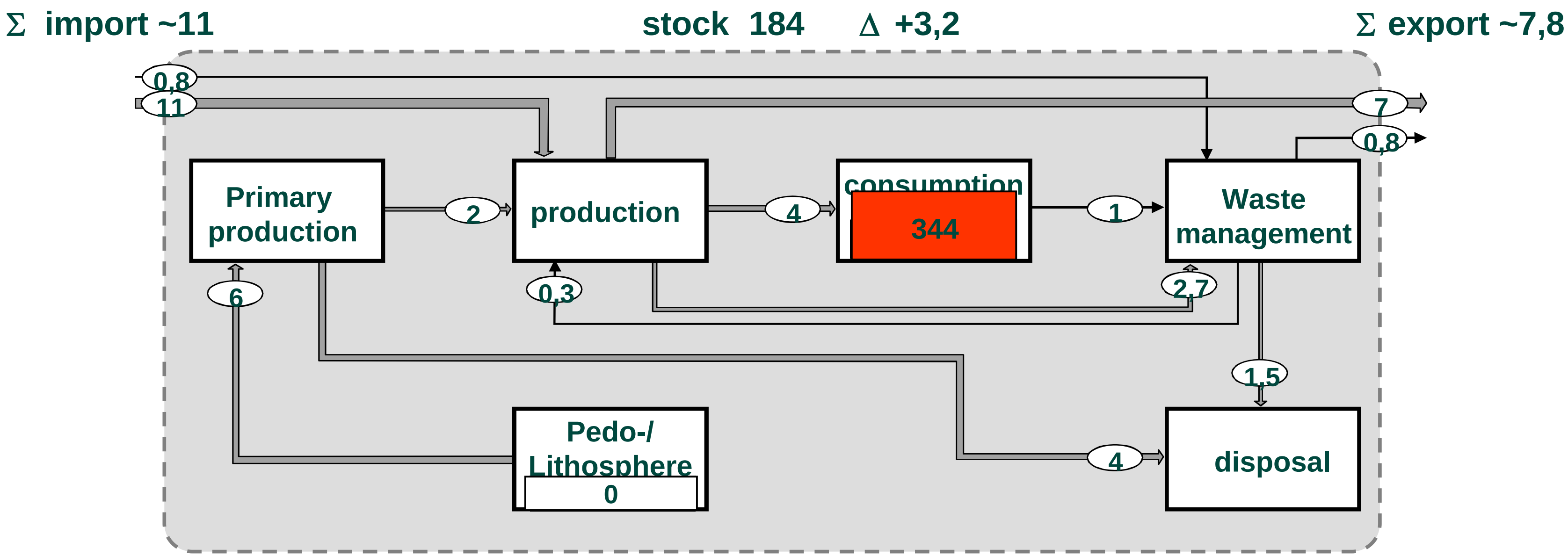
MFA of glass use in Switzerland

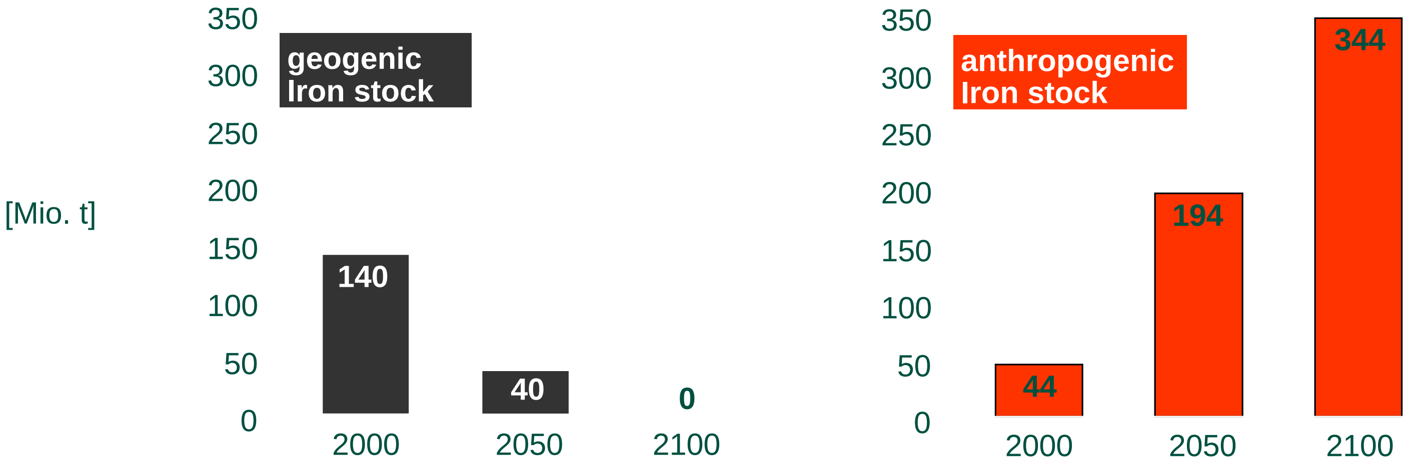


System Boundary "Switzerland"

Case studies - the national example: iron

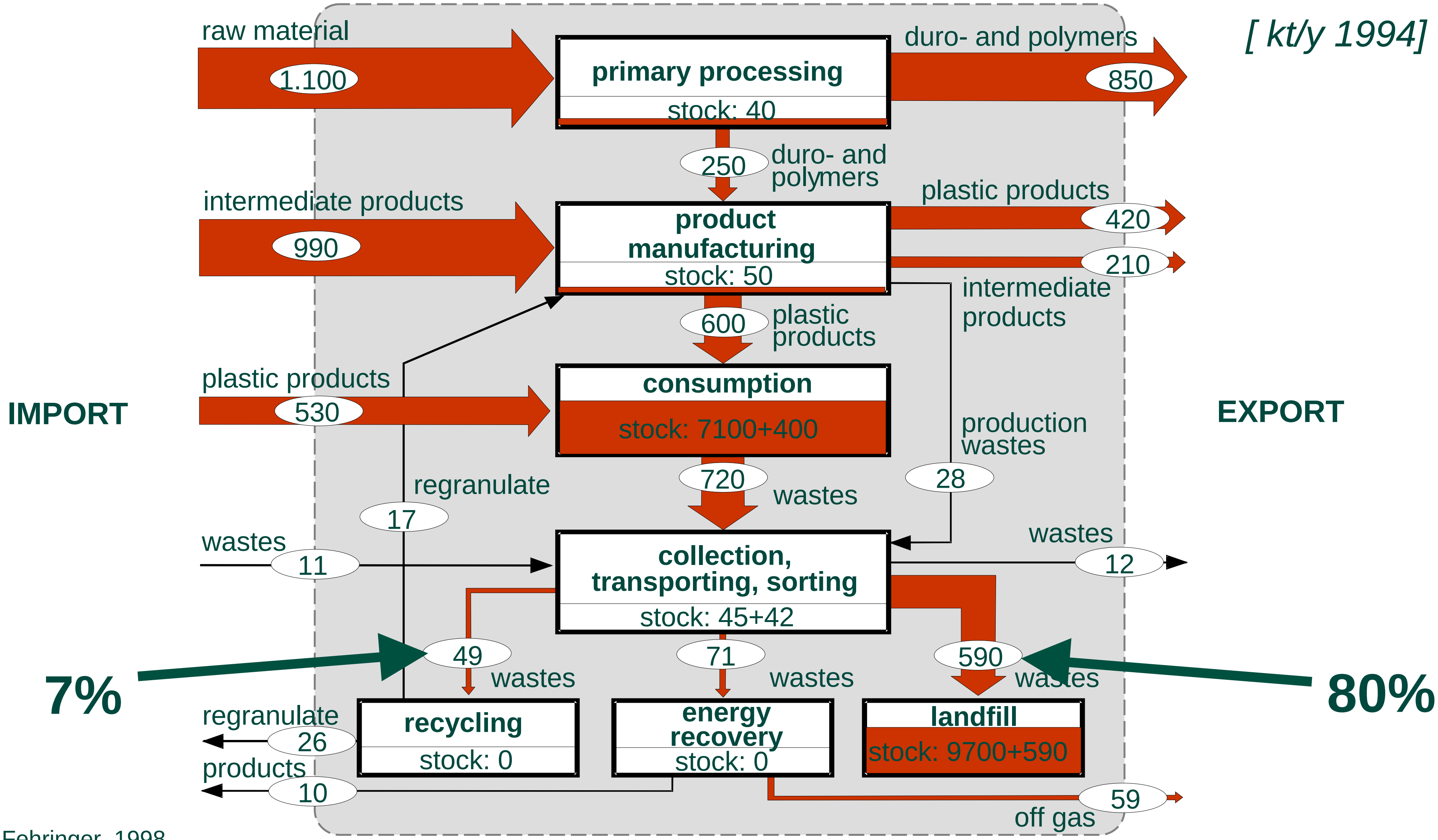
MFA of iron use in Austria





Case studies - the national example: plastics

MFA of plastic materials in Austria

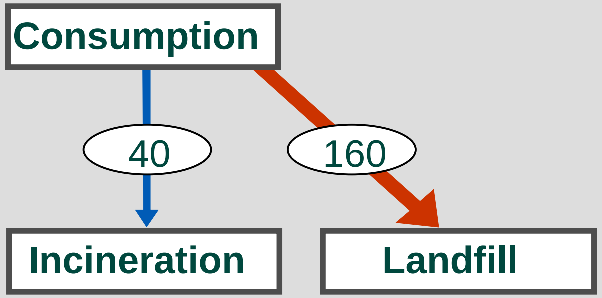


Source: R. Fehringer, 1998

MFA – a tool for decision support

Goal oriented plastic waste management based on MFA

Packaging waste view



Consumption

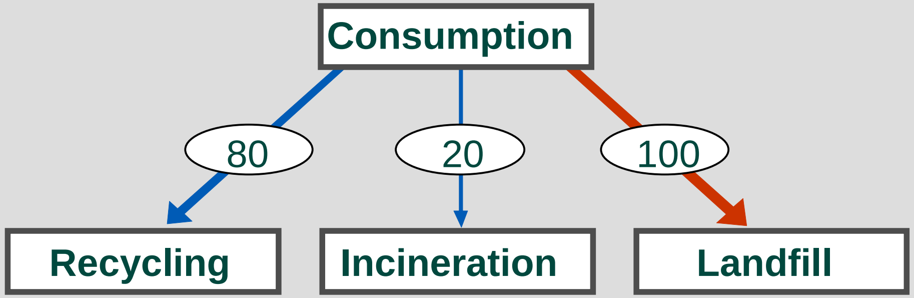
40

160

Incineration

Landfill

Impact of Packaging Waste Ordinance



Consumption

80

20

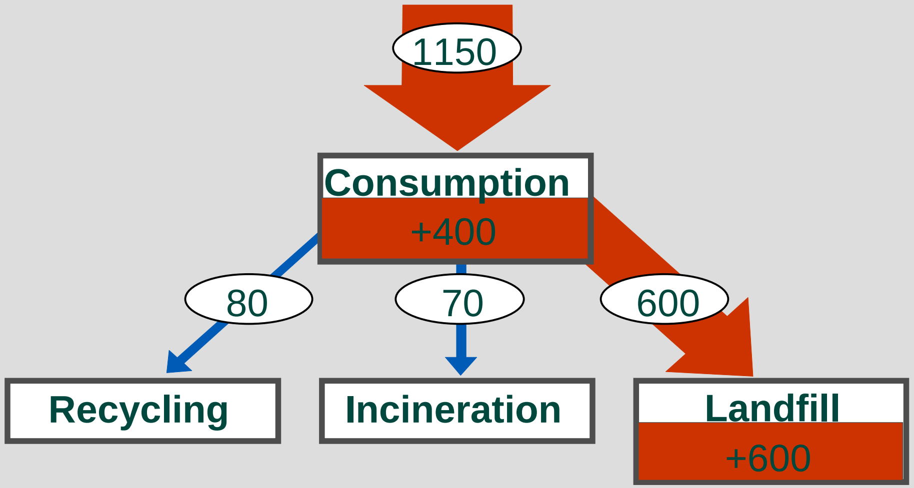
100

Recycling

Incineration

Landfill

Materials management view



1150

Consumption

+400

80

70

600

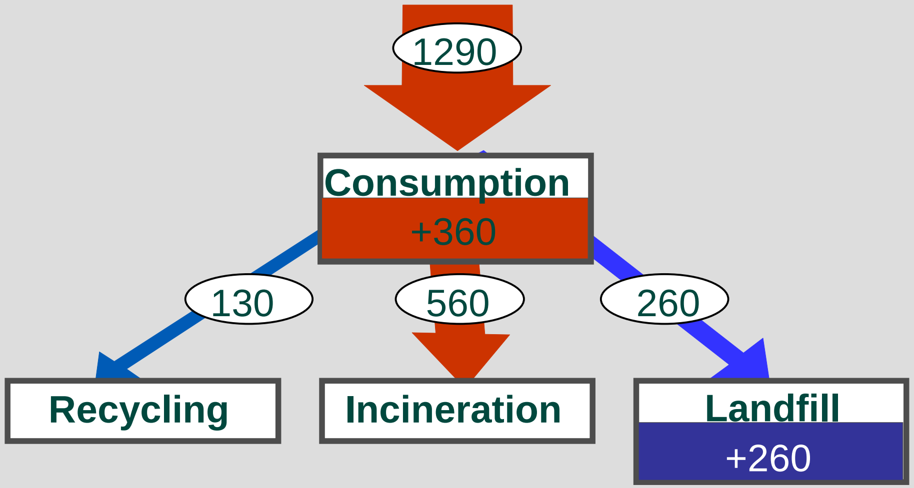
Recycling

Incineration

Landfill

+600

Impact of Landfill Ordinance



1290

Consumption

+360

130

560

260

Recycling

Incineration

Landfill

+260

Substances as key issue for plastic waste management

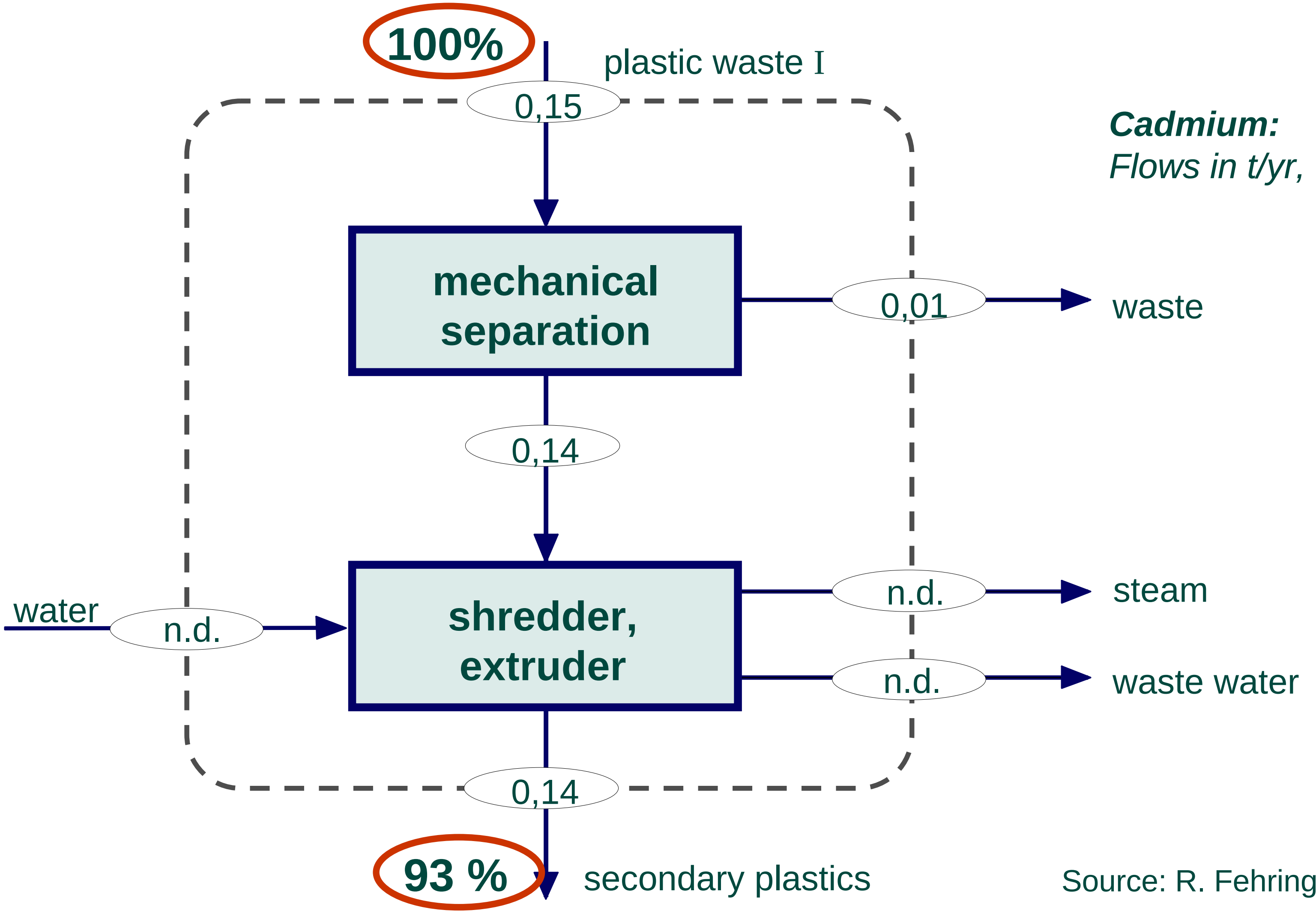
Additives in plastic materials used in Austria

Material	**Total consumption**	**Packaging material**		**Total stock**
	in kt/yr	in kt/yr	in %*	in 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**

* *% of total consumption*

MFA: base for EIS and decisions regarding recycling

Fate of Cadmium during plastic recycling

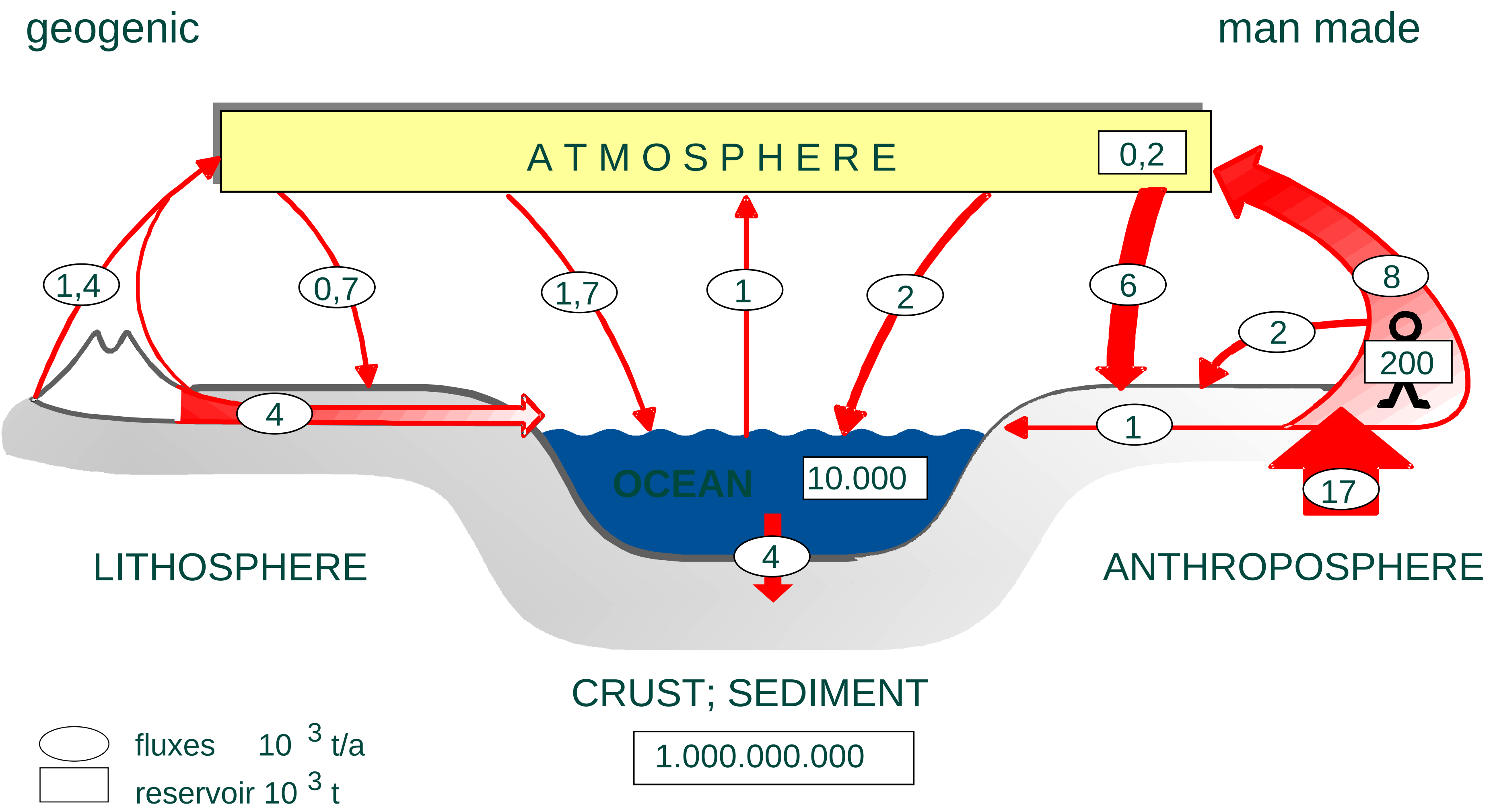


Cadmium:
Flows in t/yr, 1994

Source: R. Fehringer, 1996

Case studies - the global example: cadmium

Global cadmium flows and stocks



geogenic

man made

ATMOSPHERE

0,2

1,4

0,7

1,7

1

2

6

8

2

200

4

1

17

OCEAN

10.000

4

LITHOSPHERE

ANTHROPOSPHERE

CRUST; SEDIMENT

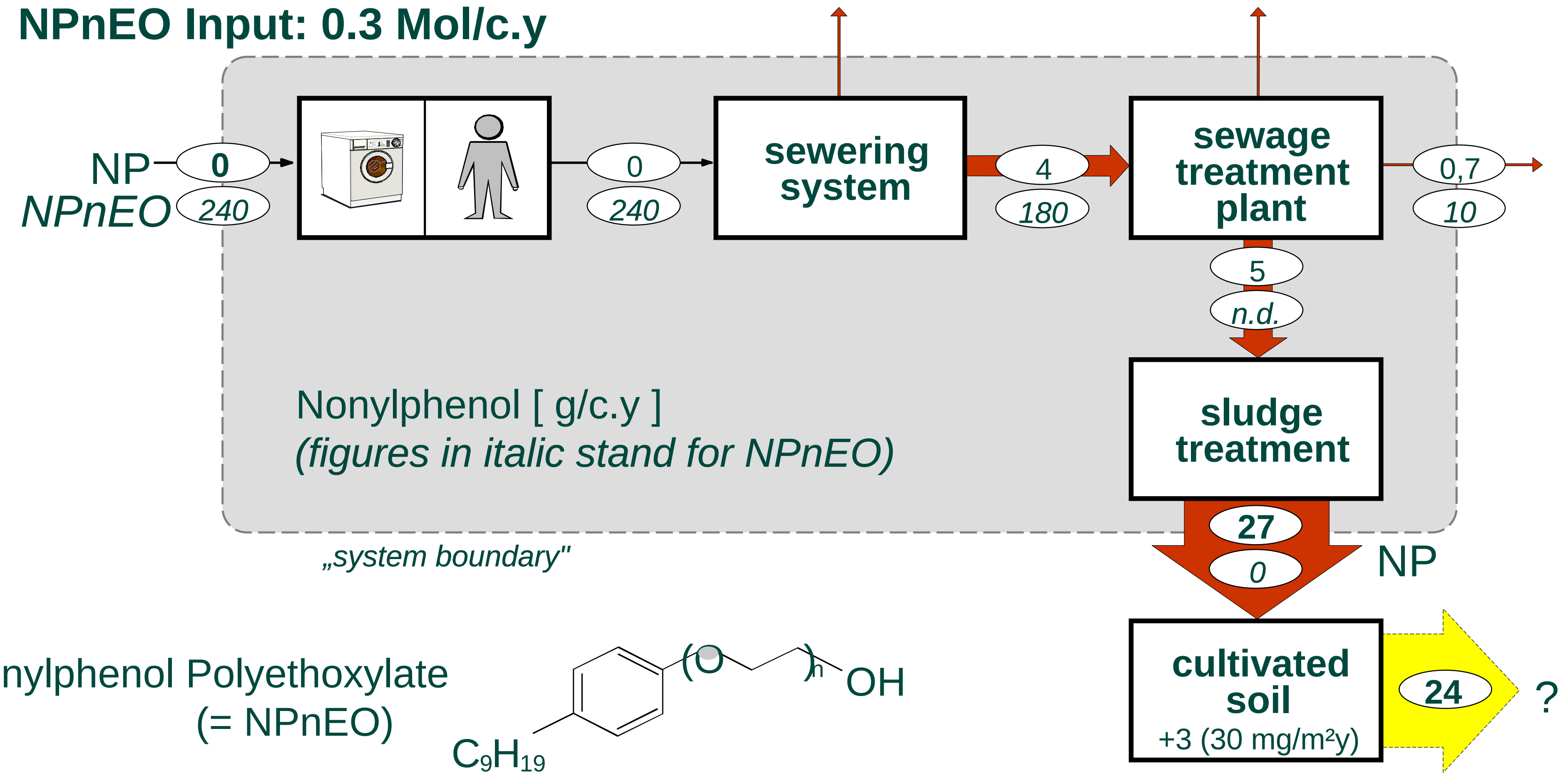
1.000.000.000

○ fluxes 10 ^{3} t/a

▭ reservoir 10 ^{3} t

Case studies - the national example: detergents

MFA of Nonylphenol Polyethoxylate in Switzerland



NPnEO Input: 0.3 Mol/c.y

NP **0**

NPnEO *240*

0

240

sewering system

4

180

sewage treatment plant

0,7

10

5

n.d.

sludge treatment

27

0

NP

cultivated soil

+3 (30 mg/m²y)

24

?

Nonylphenol [g/c.y]

(figures in italic stand for NPnEO)

„system boundary"

Nonylphenol Polyethoxylate
(= NPnEO)

NP Output: 0.12 Mol/c.y

Conclusions

MFA important for

- Resource management:
  - EU resources strategy (new resource information base)
  - Dematerialization/factor 4 (Germany, Japan)
  - Accumulation/depletion of stocks (Sweden, Austria, USA)
- Environmental management
  - Early recognition (nutrient accounting CH, global and regional Cd)
  - Priority setting (Austria NEP)
  - Filter strategy -> „life cycle thinking“ (EU, *NOT necessarily LCA)*
- Waste management
  - transparency (I=O + change in stock)
  - EIS (NRWF Germany)
  - Priority setting (WMP Austria);
  - Waste analysis (Switzerland, Austria)
  - FP7 (EU)

Thank you

Software for Substance Flow Analysis

STAN

Vienna University of Technology

Freeware, available from:

http://www.iwa.tuwien.ac.at