# Waste Management Scenarios for the Next 25 Years

FORWAST Final Meeting
Copenhagen, November 25, 2009

**Paul H. Brunner**
**Edi Munawar**
Institute for Water Quality,
Resources and Waste Management
Vienna University of Technology

TECHNISCHE UNIVERSITÄT WIEN
Vienna University of Technology

# Goals

FORWAST project:

- Material stock and expected amount of wastes
- Life-cycle wide environmental impacts from different scenarios of waste prevention, recycling and treatment

Delivery 5-4 :

- Environmental pressures for each relevant combination of waste and treatment (process modules and report)

# Procedure

0. Review former WM scenarios
1. Define scenarios for economic scenarios
2. Establish a model for WM policies
3. Determine TK for waste treatment processes
4. Define input into the model using  3 WM systems and 3 economic scenarios as well as I/O tables
5. Calculate output of the model for the 9 scenarios

*(6. Evaluate the scenarios and conclusions regarding waste hierarchy)*

# Review of Waste Management Scenarios

1. Optimising waste management scenario in the Netherland (Dornburg and Faaij, 2006)
2. Evaluation of Waste Management Options in View of Long-Term Maintenance-Free Landfills in Austria (Döberl et al, 2001).
3. Comparison of ecological effects and costs of communal waste management systems in Austria (Beigl and Salhofer, 2004).
4. Conservation of energy and natural resources by recycling building waste in Sweden (Thormark, 2001).
5. Flow analysis of metals in a municipal solid waste management system in Japan (Jung et al, 2005)
6. Recycling of construction and demolition waste materials in Italy (Bianchini et al, 2005).
7. An assessment of the current and future options for domestic waste management in Kaunas, Lithuania (Wade et al, 2006).
8. Environmental and economic modeling: A case study of municipal solid waste management scenarios in Wales (Emery et al, 2007).
9. Life Cycle Assessment of Packaging Waste Management in Victoria, Australia (Grant et al, 1999)
10. Environmental assessment of MSW scenarios (JRC, 2007)

# Conclusion of review about WM Scenarios

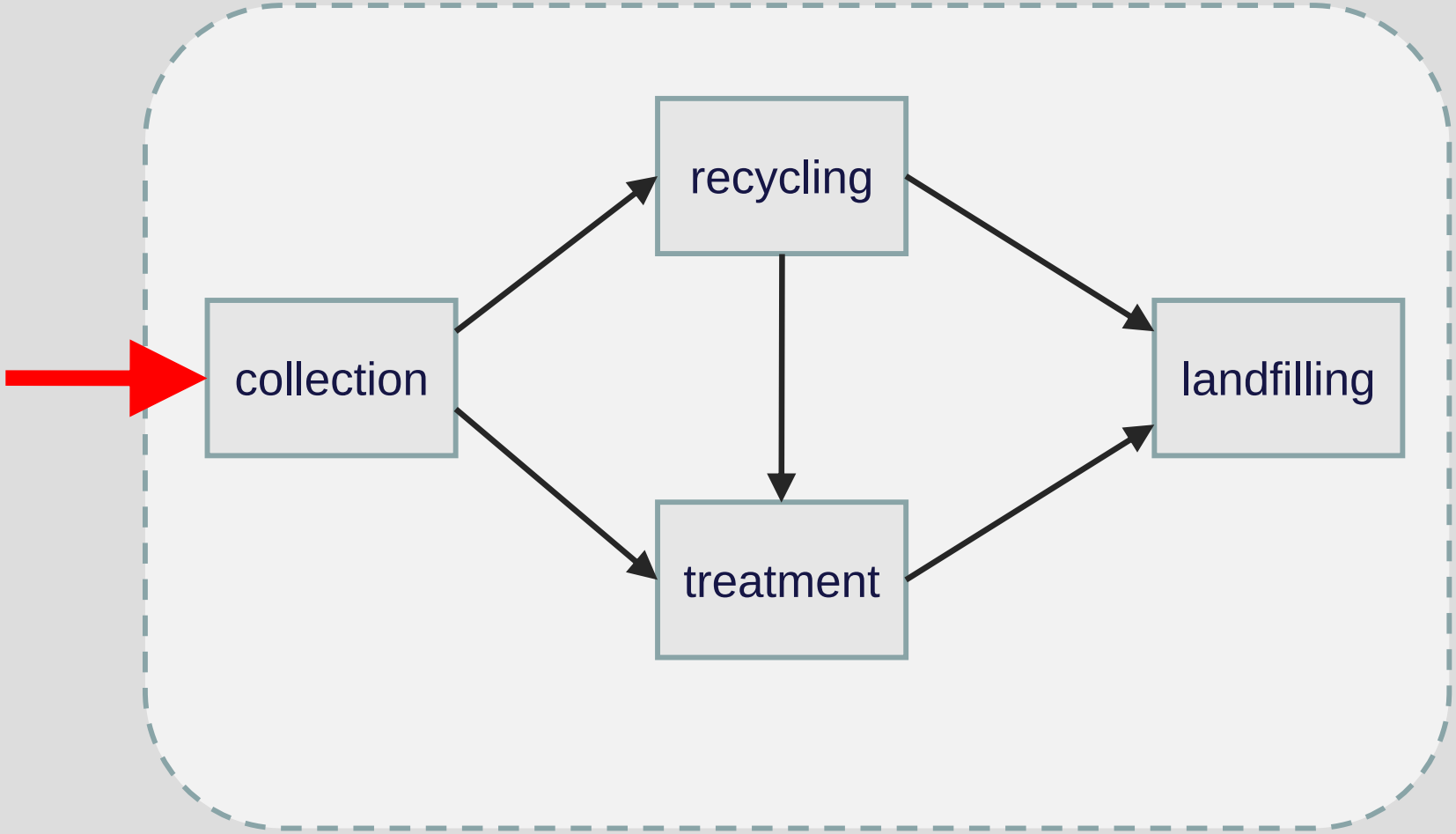
1. In general conflicting and contradictory results due to:
   - assessment methods
   - criteria

2. Clear results for specific wastes such as “recycling of building waste” and “recycling of metals“:
   - conservation of energy and natural resources
   - protection of the environment.

3. To set up the scenario is not the problem, the following assessment step is crucial (method, criteria, weighting)

# Waste prevention scenario

- Sole focus on waste prevention
- No change in recycling rate and waste treatment



# Waste prevention scenario

- Sole focus on waste prevention
- No change in recycling rate and waste treatment
- 2 periods: 2010-2015 and 2015-35
- Waste reduction 1. period:

# Waste prevention scenario

**Procedure:**

- Identify most important waste flows
- Identify the activities resulting in the waste flows
- Apply relevant information about prevention strategies on waste generation activities (eco-design, producer responsibility, service versus products, changes in attitude, substitution etc.)
- Assess resulting waste streams

**Relevant waste streams:**

- C&D wastes
- Excavation and soil material
- Wood waste
- MSW
- Service and production sector
- and others (see report)

| FW code | Waste prevention for categories | Reduction [%] |
|---|---|---|
| 1-3 | Cattle and Dairy (manure) | 15 (meat consumption) |
| 4 | Crop | 0 |
| 7-8 | Forestry and fishery | 0 |
| 9-10 | Coal and oil | 0 |
| 11-14 | Metal mining | 0 |
| 15-17 | Mining and quarrying | 0 |
| 18-25 | Food and beverages | 0-15 (individ.) |
| 26 | Packaging of Beverages | 10 |
| 28-30 | Textiles, shoes and leather | 6 |
| 23-35 | Paper | 8 |
| 36-42 | Chemicals (refined and others) | 6 |
| 52 | Retailers | 2 |
| 62 | Metal processing | 6 |
| 63-69 | Vehicles, machinery, equipment | 6 |
| | C&D waste | 14 |

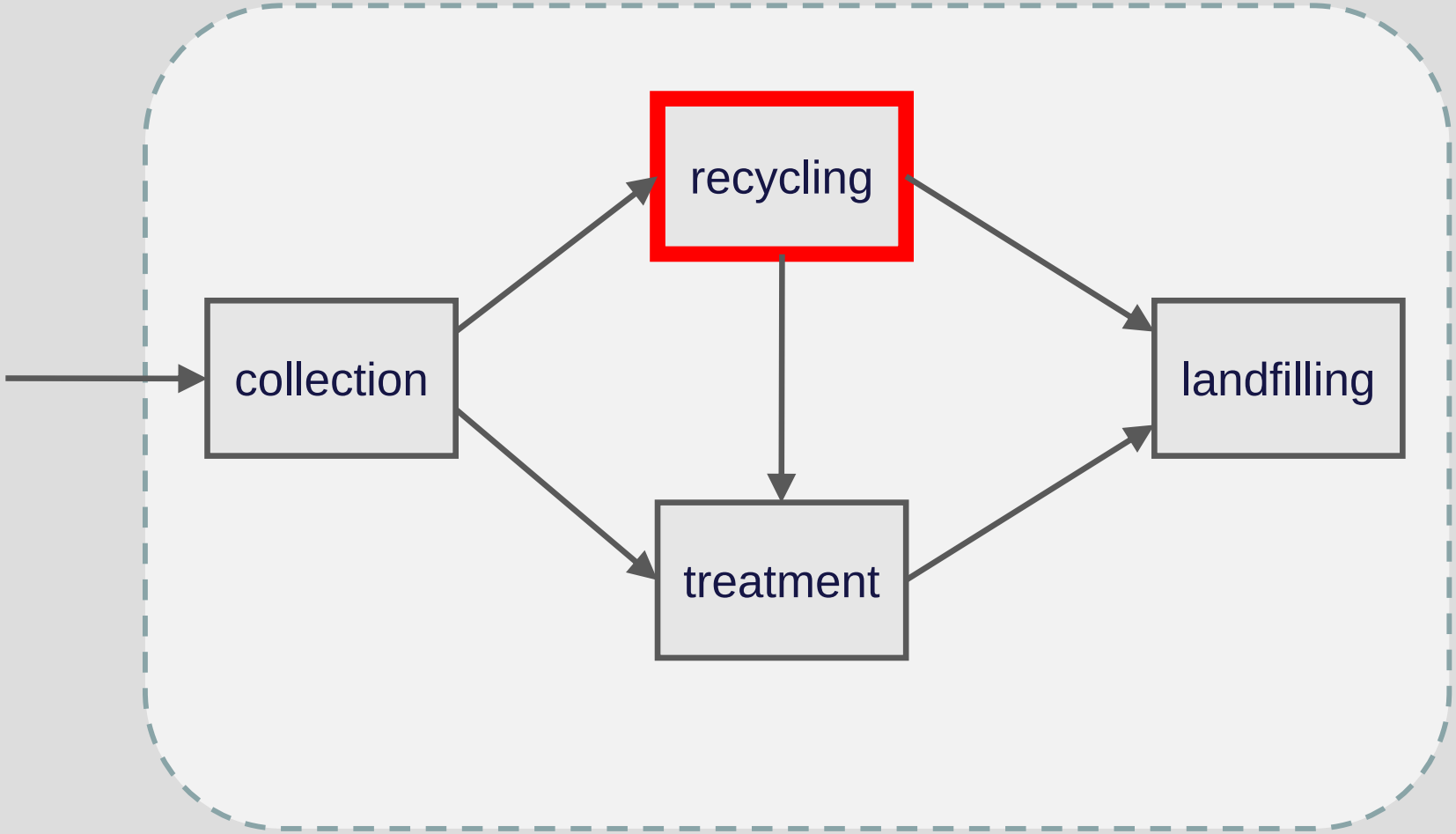
# Waste prevention scenario

- Sole focus on waste prevention
- No change in recycling rate and waste treatment
- 2 periods: 2010-2015 and 2015-35
- Waste reduction 1. period:
- Waste reduction 2. period: + 25 % of reduction of 1. period

# Waste prevention scenario

- Input data from I/O model and Delivery 5-3 (% prevention)
- WM system design from 5-4
- TK  (emission data) from 5-4 (and I/O tables ?)
- Calculation of outputs by using input data, WM system and TK of waste treatment processes

# Waste recycling scenario

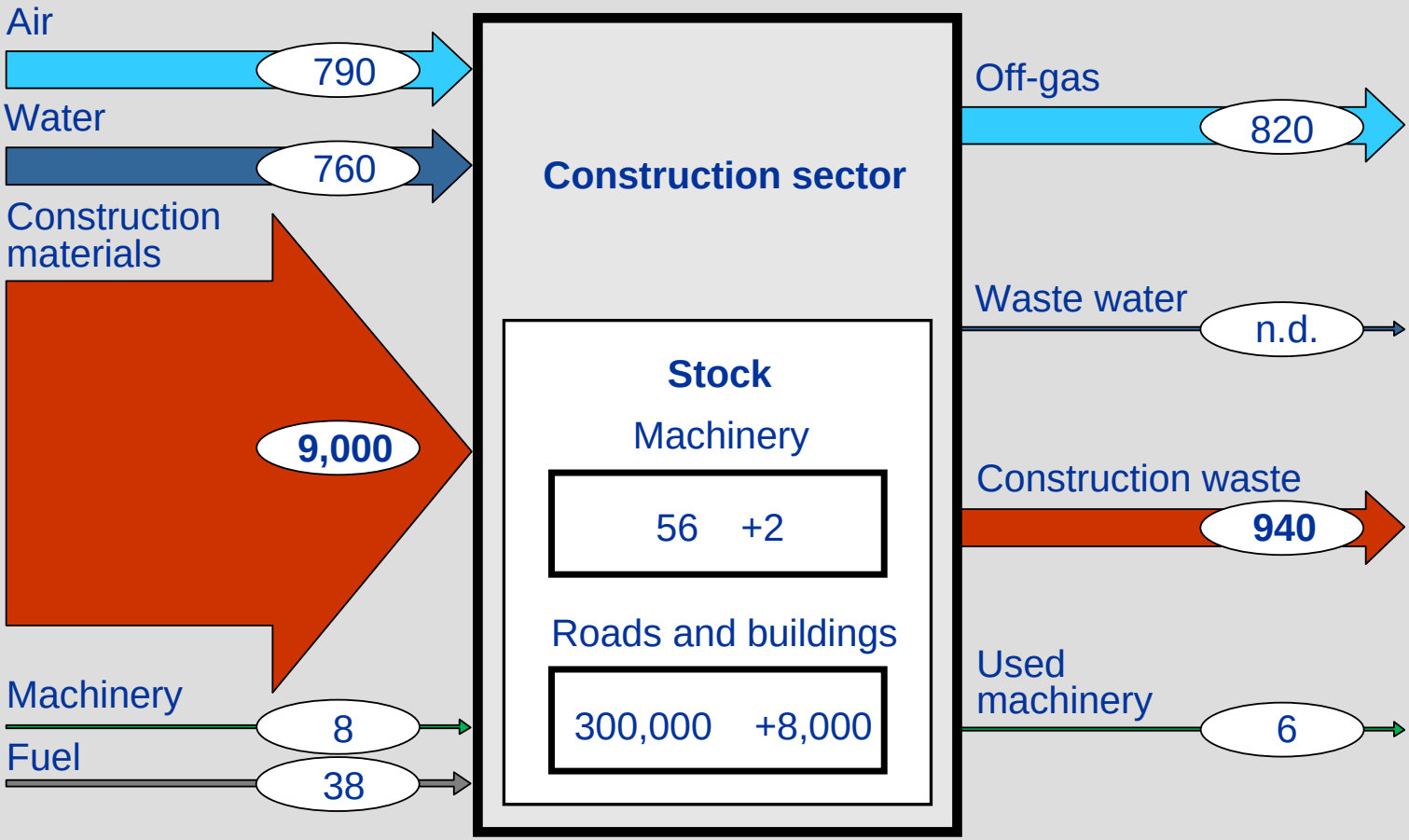


# Waste recycling scenario

Key variables:

- Market price
    - Primary resources
    - Secondary products
- Legal framework
- Product qualities
- Demand for secondary resources (depending on economic conditions)

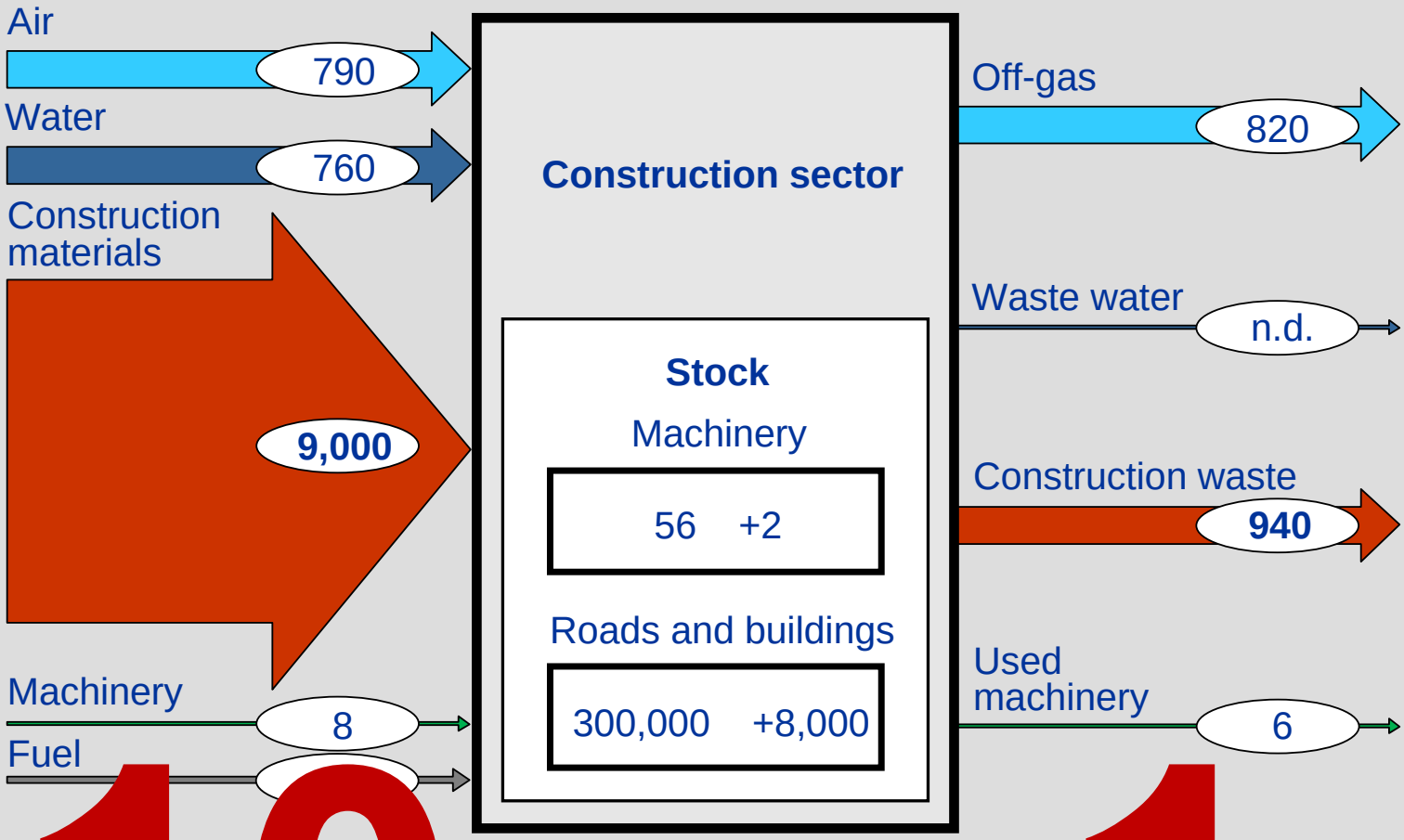
# Market demand for secondary construction materials




Source: T. Lahner, 1993

*Flows [kg/(c.yr)]*

# Market demand for secondary construction materials




*Flows [kg/(c.yr)]*

**10 : 1**

Source: T. Lahner, 1993

| FW code | Waste recycling C&D Wastes | Rate [%] 2015 | 2025 |
|---|---|---|---|
| | C-Oil | 7 | 14 |
| | C-Fibre | 20 | 40 |
| | Metals | 85 | 95 |
| | Soil and clay | 40 | 70 |
| | Sand gravel stone | 40 | 80 |

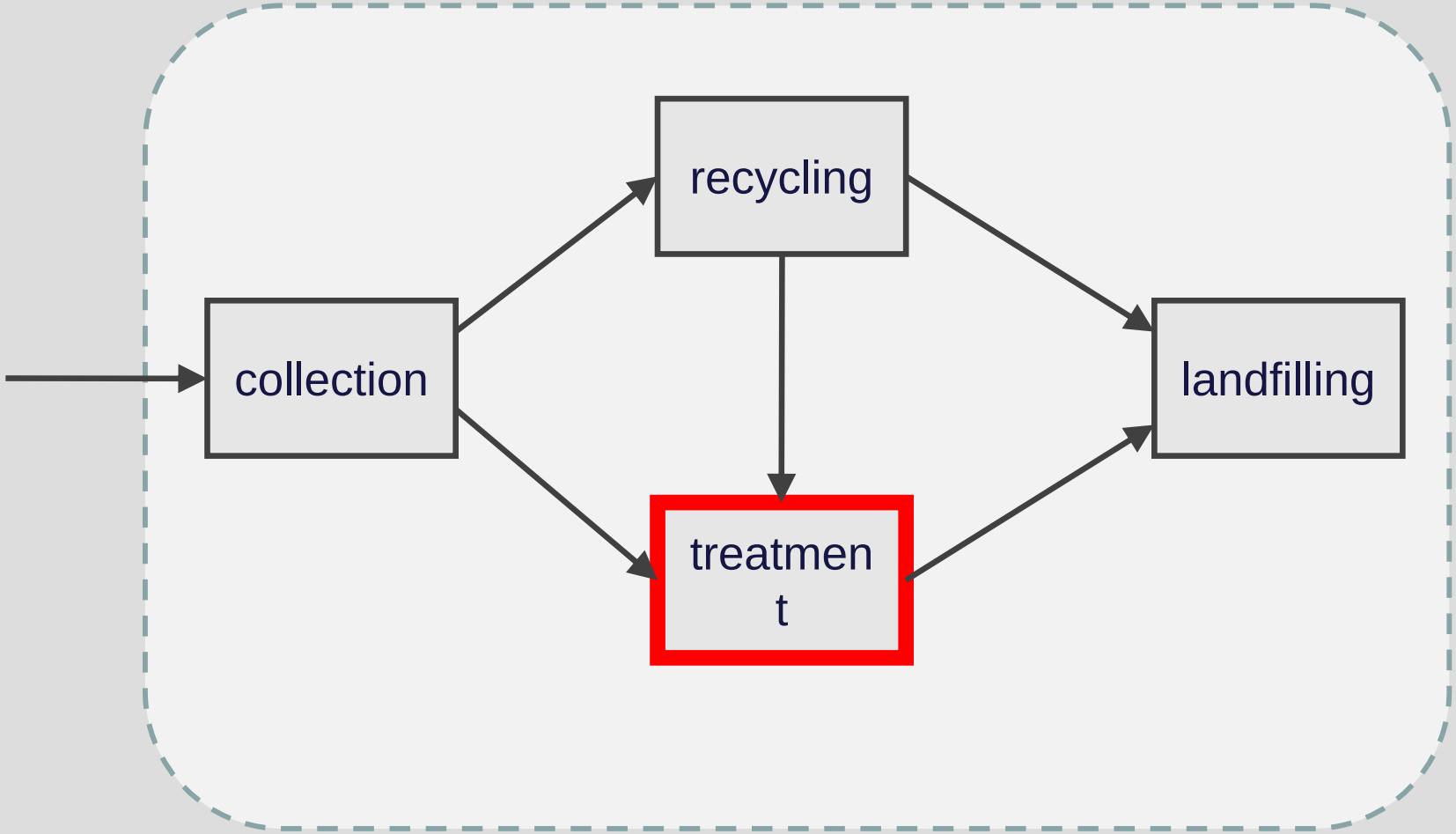
| FW code | Waste recycling beverage packages | Rate [%] 2015 | 2025 |
|---|---|---|---|
| 26 | C-Oil | 70 | 85 |
| 26 | Sand/gravel/stones | 90 | 95 |
| 26 | Paper | 30 | 50 |
| 26 | Aluminum | 80 | 90 |
| | | | |

| FW code | Waste recycling other categories (more details in 5-3) | Rate [%] 2025 |
|---|---|---|
| 4-5 | Agricultural wastes | 40 - 90 |
| 32-35 | Paper, printed matter, media waste | 67 -> 77 |
| 68 | ELV | 85 - 95 |
| 22-25 | WEEE | 40 - 85 |

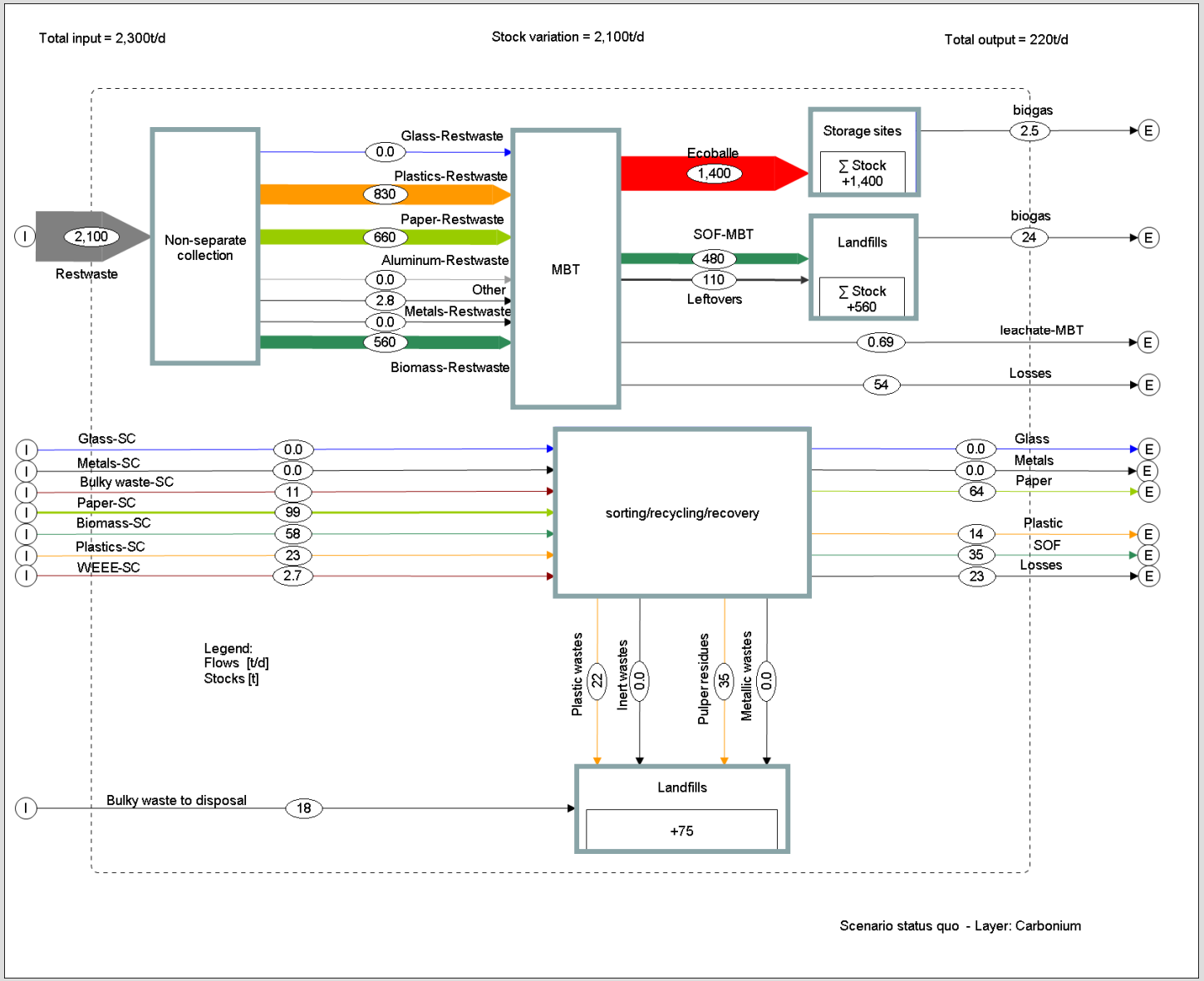
# Waste recycling scenario

- Input data from I/O model
- WM system design from 5-4
- TK from 5-4 (and I/O tables ?)
- Calculation of outputs by using input data, WM system and TK of waste treatment processes

# Waste treatment scenario



# Modelling of WM systems by MFA and STAN



# Waste treatment scenario

EU-targets for reduction of wastes to landfills:

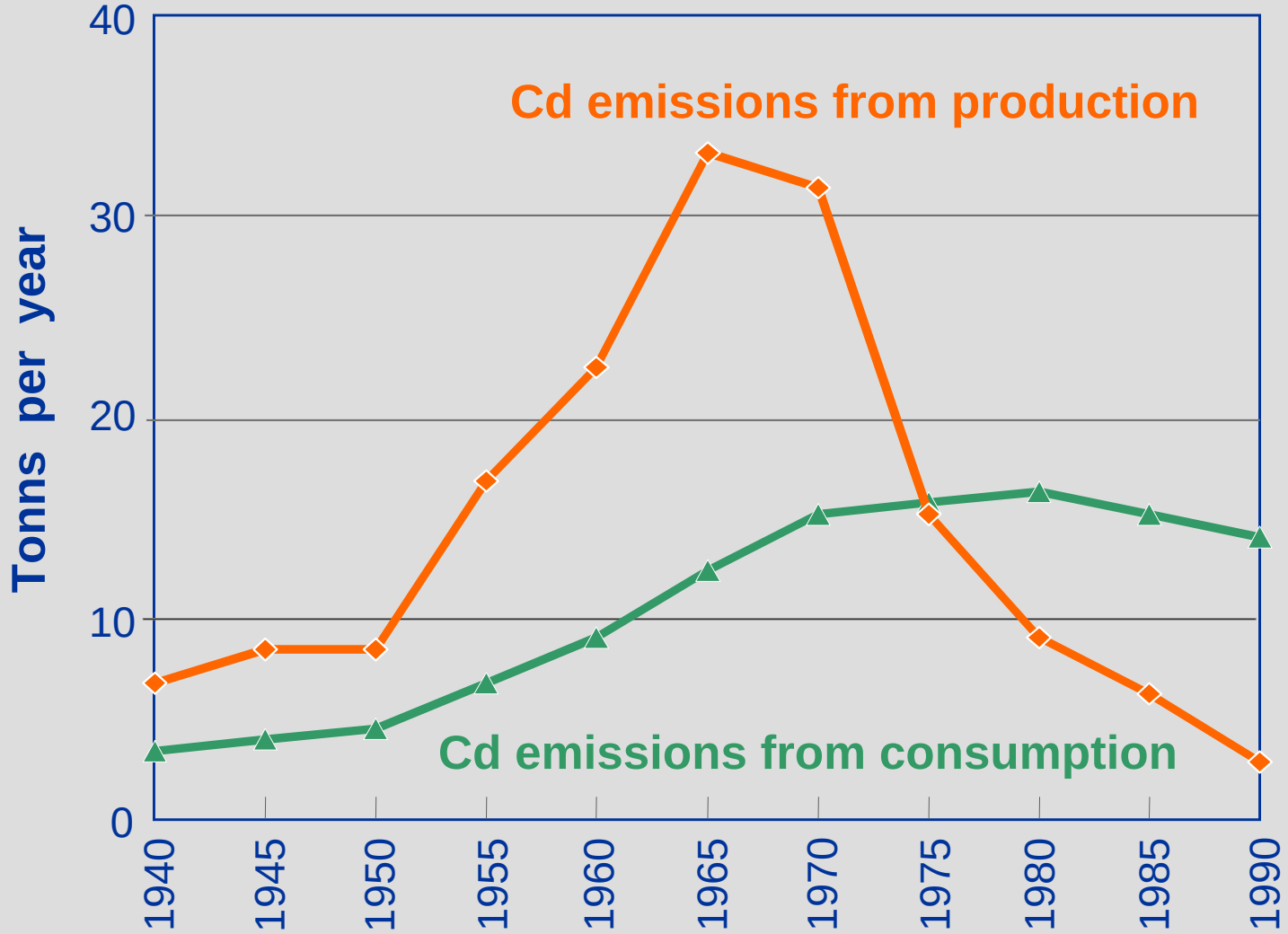
2010: - 25 %
2013: - 50 %
2020: - 65 %

Treatment (BAT!) :

- MBT
- incineration
-“landfilling”

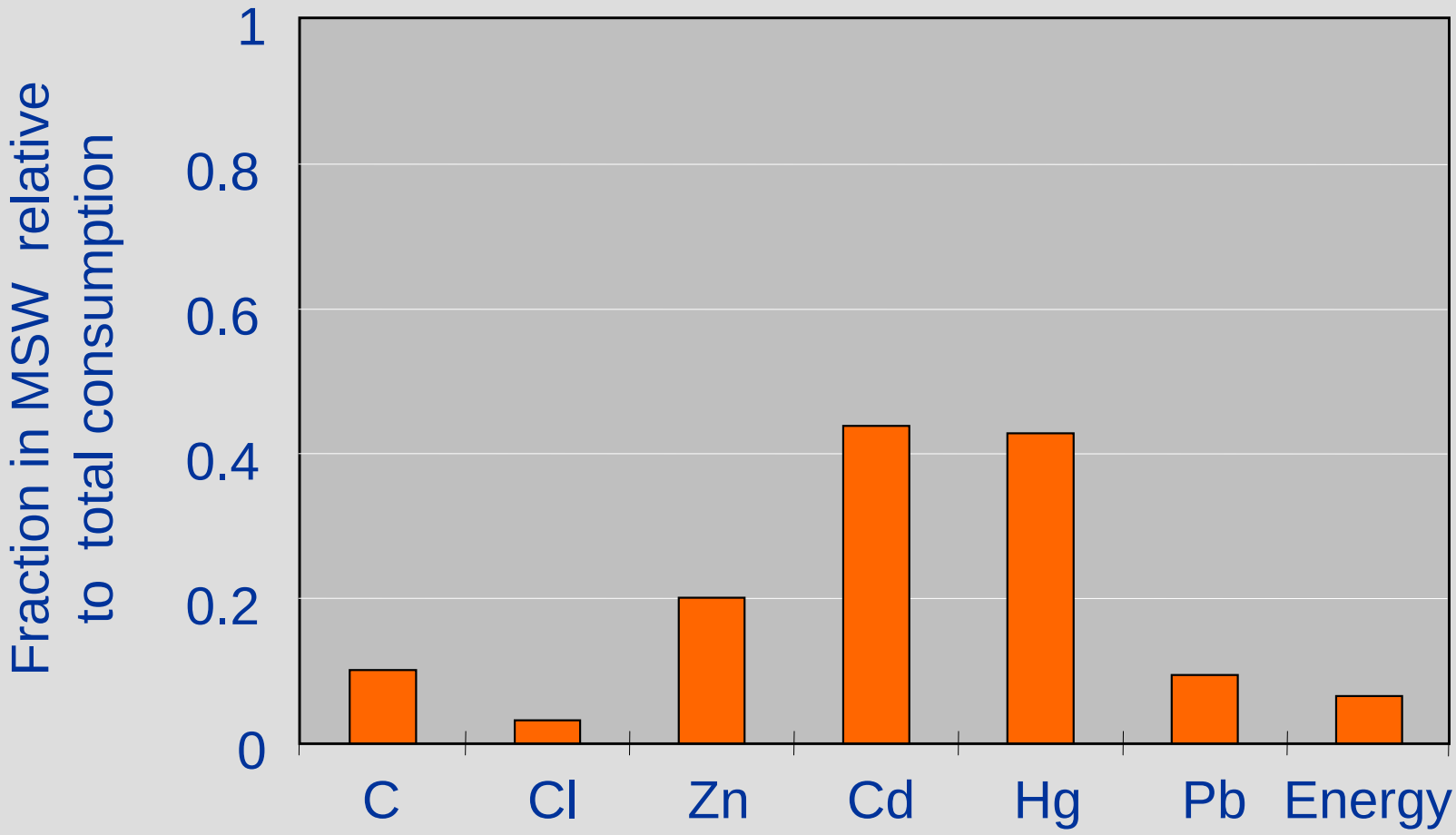
TKs and emission data for each wt-process
Focus on emissions: heavy metals -> why?

# Consumption emissions > production emissions




Source: Bergbäck, 1992

# Wastes are important carriers of hazardous materials



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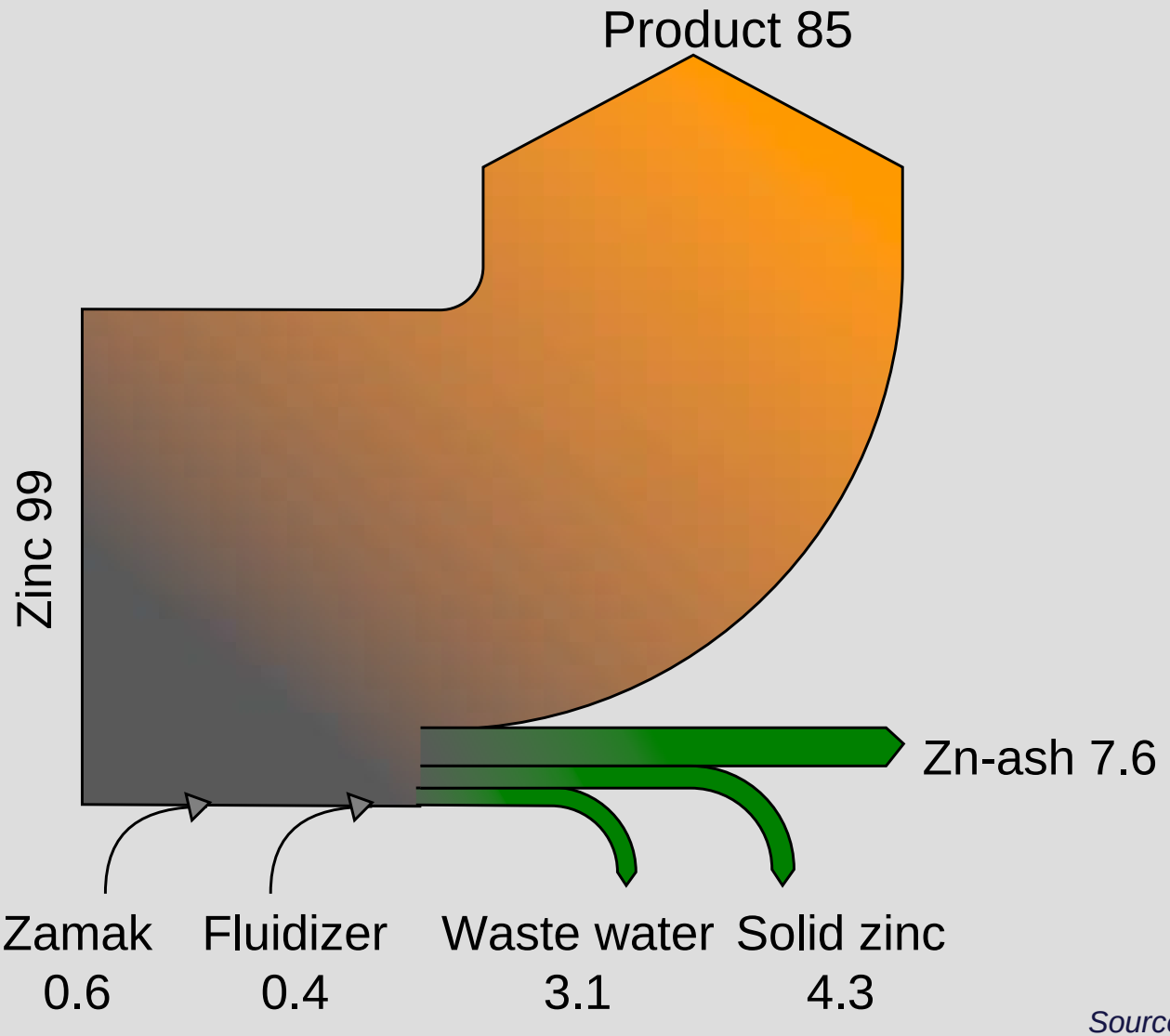


*Source: W. Enöckl, 1994*

| FW code | Waste categories | Treatment (BAT) |
|---|---|---|
| 1-7 | Agricultural wastes | Biogasification & landuse |
| 8-10 | Food, textiles, paper and chemicals | Incineration |
| 11-17, 43-49 75-77 | Mineral waste (mining, construction, etc.) | Recycling to EU-15 (2003) |
| 50-61, 62-69 | Metal processing | Recycling to EU-15 (2003) |
| | Other wastes | Incineration and MBT |

# Conclusions

1. 9 Scenarios defined
2. must be implemented and calculated by “The model”
3. *How to evaluate the results?*
    - *E.g. emissions of greenhouse gas and other harmful substances?*
    - *fraction in clean cycles and in final sinks?*
    - *WM costs (including stranded investments)?*

not

# The End