

Solid Waste Management - Summer term 2012

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Time and Place: Monday 14.00 – 15.30 MZ-Building (3408), Room 724
Tuesday 08.00 – 09.30 MZ-Building (3408), Room 724

Exam Type: Written Exam

Excursions: 1-day-excursion during the Whitsun holidays
(30.05 - 01.06.2012)

Downloads:

- ▶ www.uni-hannover.de
 - ▶ Students
 - ▶ eLearning
 - ▶ Stud.IP

- ▶ Password-course: **waste**

Study Trip organised by



**1-day trip during the
Whitsun holidays 2012**

Planned destination: Hamburg

Solid Waste Management, Contents I

1. Introduction, waste legislation
2. Types, amounts and composition of waste I+II
3. Collection + transport I+II
4. Processing (physical and chemical) I+II
5. Biological treatment for reuse I+II
6. Designing a composting plant (tutorial)
7. Mechanical-biological treatment (MBT) of MSW I+II
8. Immission control and treatment in MBT
9. Thermal treatment of MSW I+II
10. Municipal solid waste treatment and management

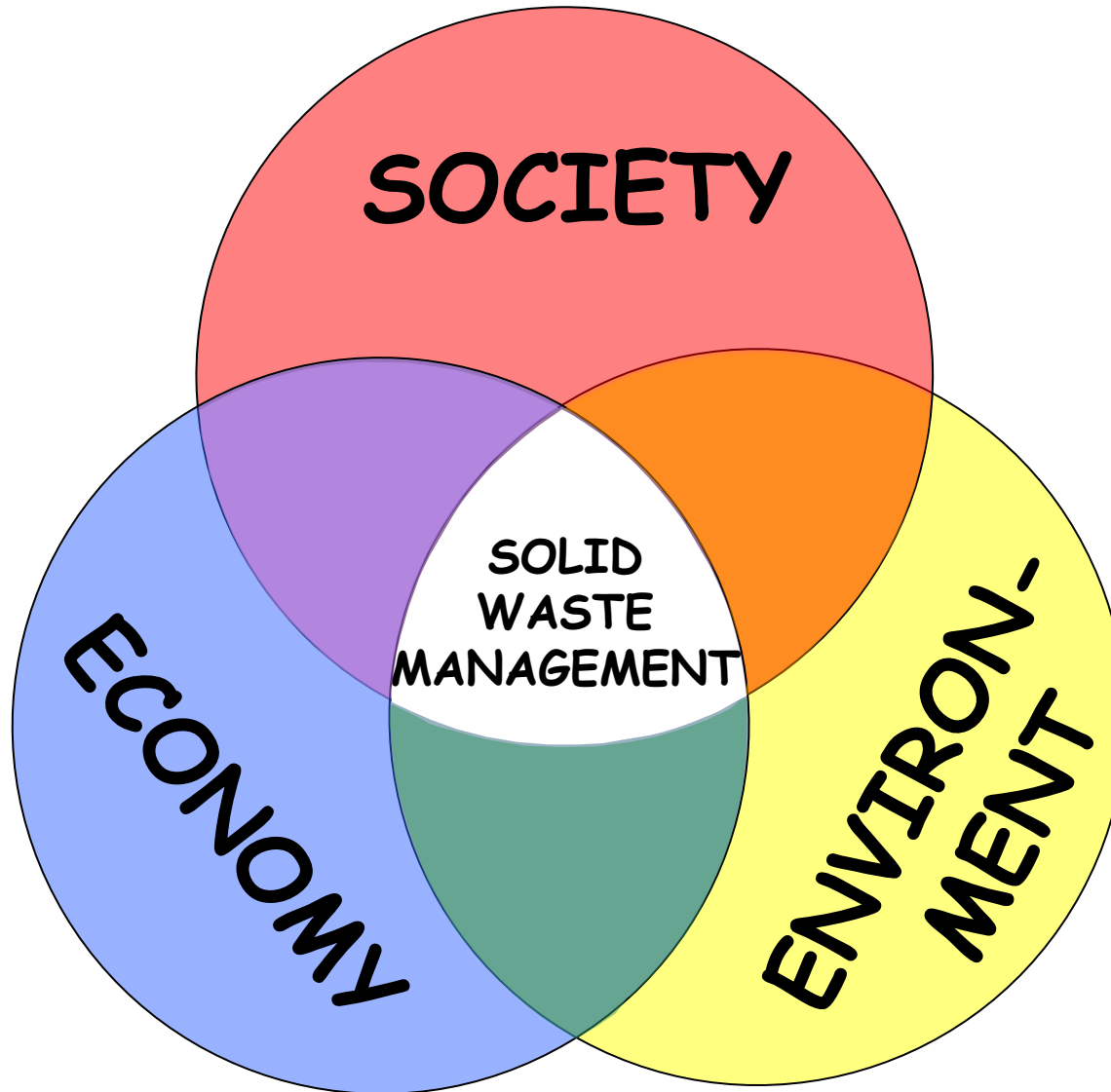
Solid Waste Management, Contents II

10. Waste disposal and landfilling I+II
11. Landfill construction and emission (Tutorial)
12. Landfill leachate treatment
13. Contaminated sites
14. Recycling and recovery I+II
15. Conclusion, preparation for the written exam

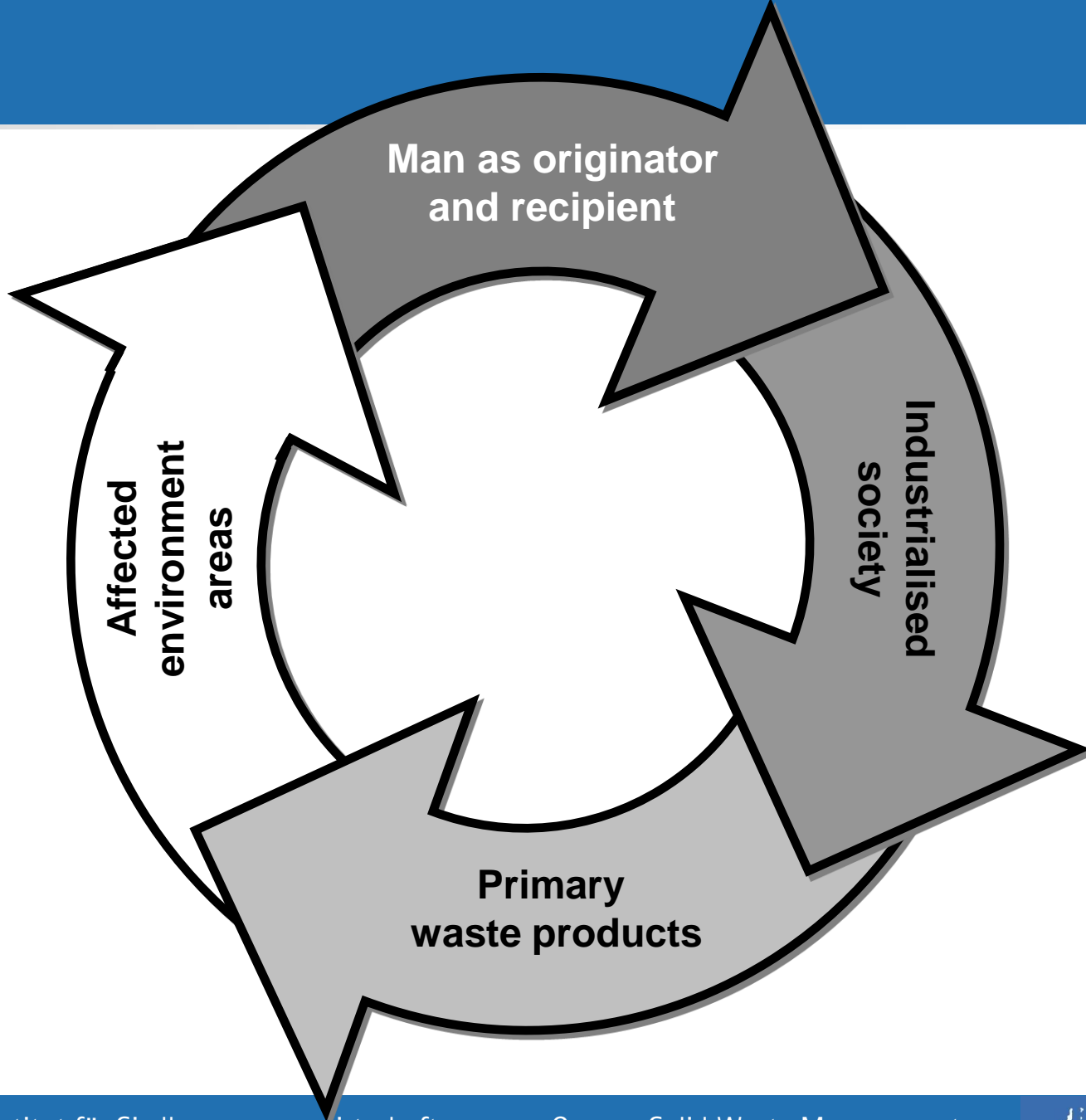
1. Introduction and waste law

Three Equal Pillars of Sustainability

Longevity



Generational
and
distributive
justice



Effective environment protection



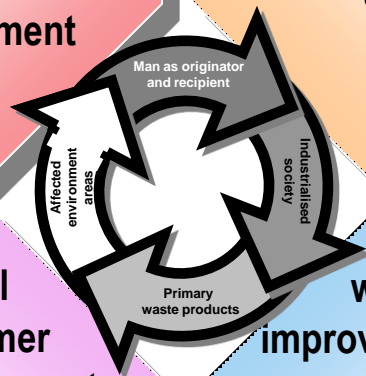
Saving of resources



Social development

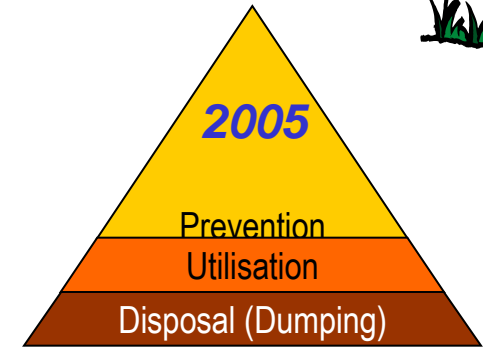


Profitable Development and employment

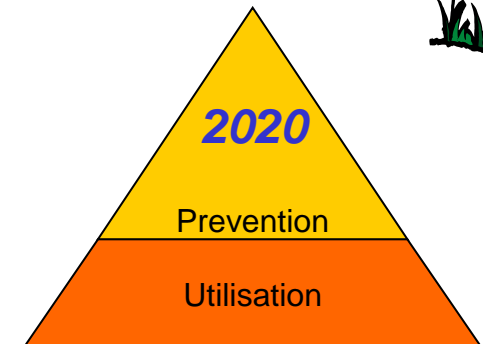


Perspectives of Waste Management

- ! Year of **2005 = Milestone** in the history of solid waste management in Germany among others: implementation of the AbfAbIV



- ! Year of **2020 = thorough and complete utilisation of waste** (political vision)



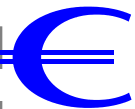
Perspectives for Waste Management

Improvement of the economic frame conditions

Even better utilisation technologies



- **The ratio in the prime costs between primary and secondary raw materials has shifted**
 - ⇒ **Improvement of the economic frame conditions for better utilisation technologies**
(for instance Refues Derived Fuel (RDF) processing, sorting accuracy, PVC)
 - ⇒ **Substitution of primary energy carriers and raw materials**
- **Renewable Energy Law (EEG, KWKG and TEHG):**
 - ⇒ **lucrative basis for the supply and energetic utilisation of biomass and secondary fuels**
(however: lack of capacities or quality)



(EEG and TEHG)



preparation and energetic reuse of biomass and RDF

Perspectives for Waste Management

Improvement of the economic frame conditions

Even better utilisation technologies

- **Development and provision of more efficient methods to produce higher quality recycling products and energy**
 - ✓ Improvement of the energetic
 - ✓ Fuel production from biomass
 - ✓ Energy production from fermentable waste
- **Cooperative acting together of waste management, agriculture, energy sector, and industry**
- **Exploration of the international waste management market**
- **Landfill aftercare and usage**
- **Change of paradigm with collection and transport?**
=> from disposal to provision?



(EEG und TEHG)

Provision and energetic utilisation of biomass and secondary fuels

Political Frame Conditions

2003, EU Commission

Thematic strategies for the sustainable utilisation of natural resources
(Central Aspect: LCA)

23.03.2005, Council of the EU, Precedency Conclusion

EU heads of government decide to strive for growth and employment also through „eco-innovation“ and sustainable resource management.

10/2005, SRU Statement No.9 (SRU: German Council on Environmental Advisors)

Towards a European resource strategy: „**Orientation through a concept for substance-specific environmental politics**“

2008, EU Commission

Amendment of the Waste Framework Directive No. 75/442/EWG

Substance-Specific Environmental Politics

- Resource utilisation with more eco-efficient technologies
- Changes in the consumption and usage patterns **Prevention**
- Lower utilisation of a particular resource if cost-free and feasible alternative options are available

Revision of the EU Waste Framework Directive:

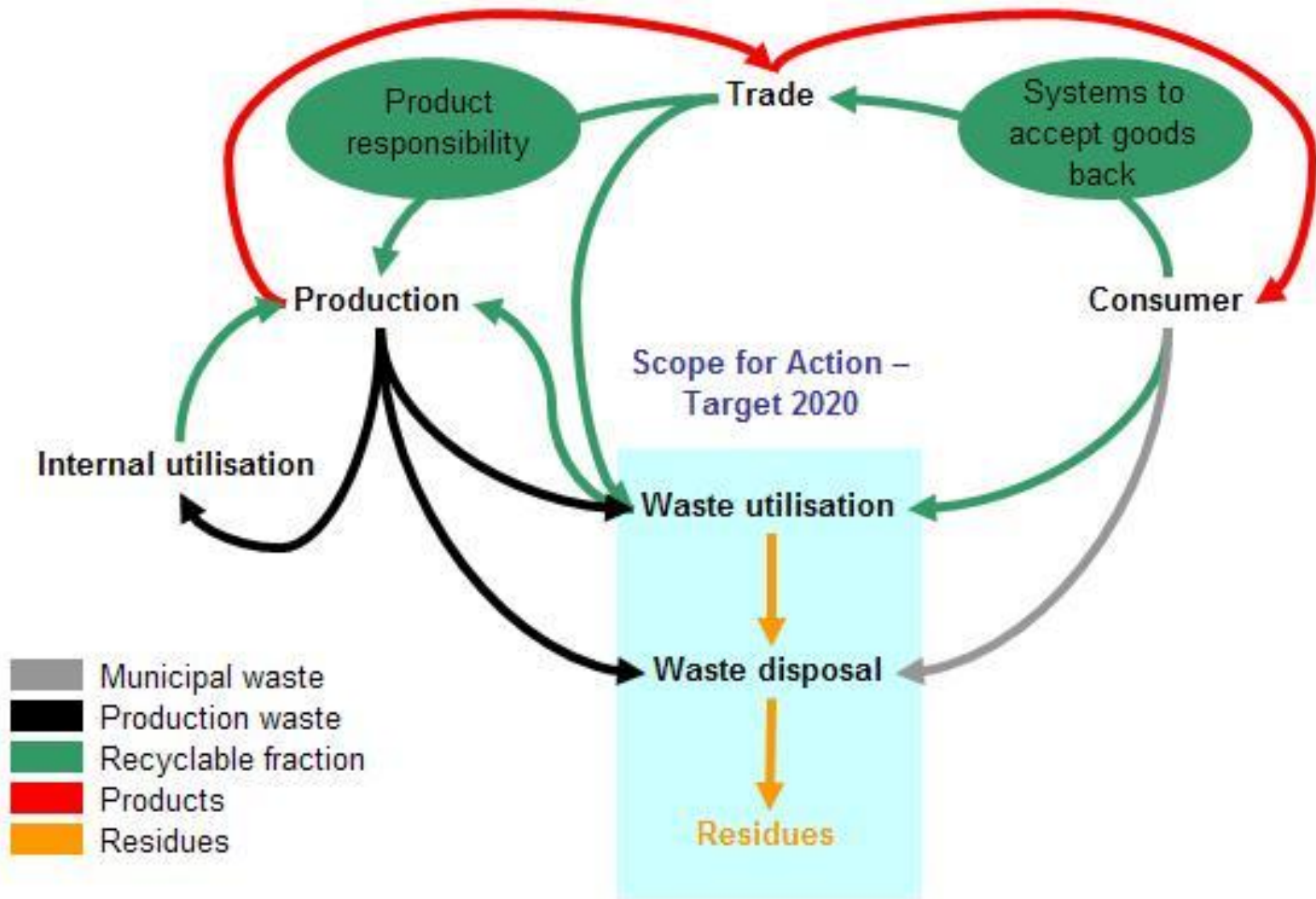
substitution

~~Complementing the waste hierarchy~~

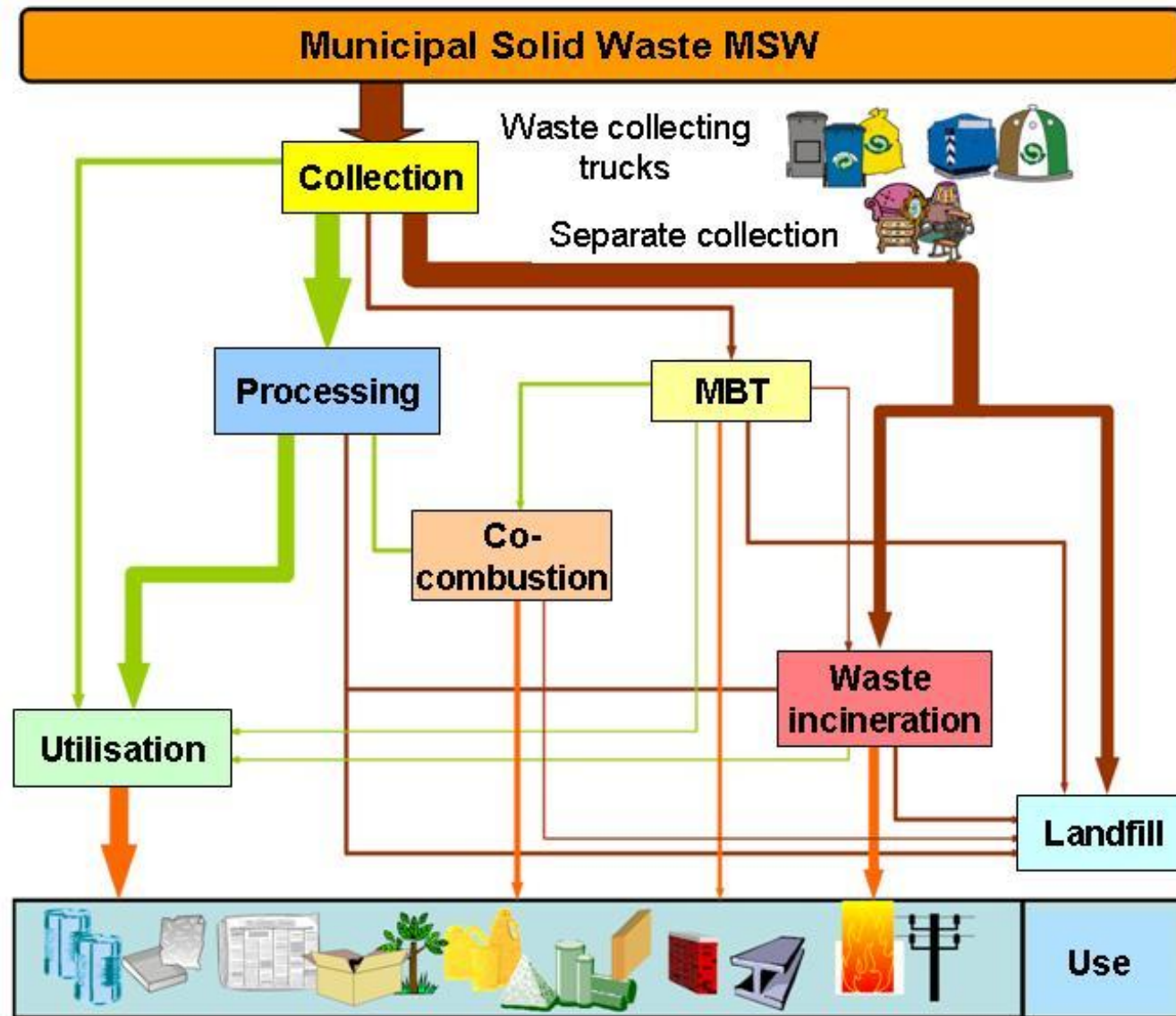
- ~~Prevent~~
- ~~Utilise~~
- ~~Dispose~~
- LCA*

*Substance specific consideration of the entire life cycle

Overall concept of German waste policy as integral part of sustainability



General Scheme of the Disposal Ways for Municipal Solid Waste

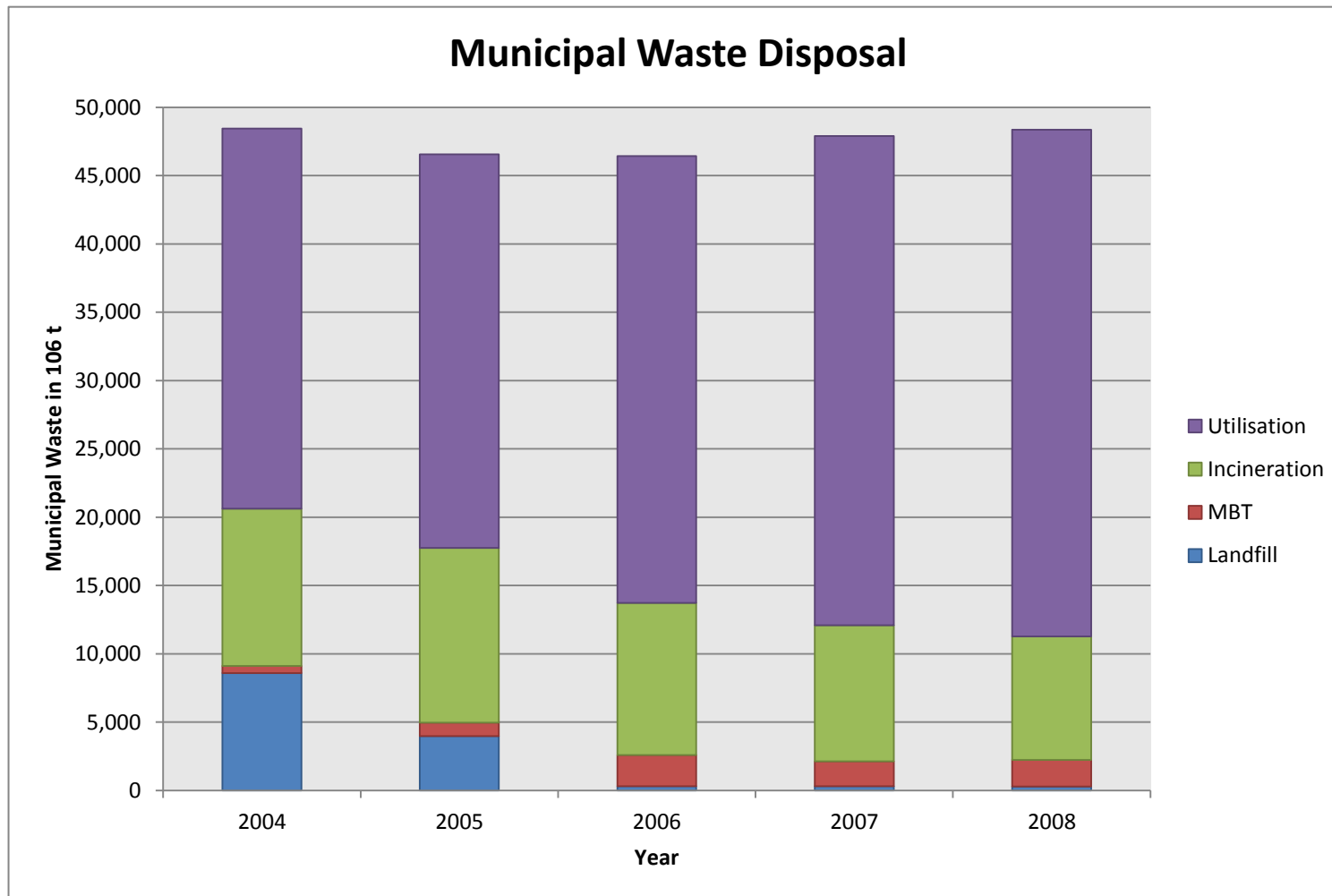


Significance of Waste Management

Waste Disposal in 2004					2006				
Method	No.	Ratio	Amount		Number	Ratio	Amount		
Landfill	346	25%	15 10^6 Mg			0	9 10^6 Mg		
MBT	51	5%	3 (7) 10^6 Mg		66	15	7 10^6 Mg		
Incineration	65	25%	15 10^6 Mg		72	39	18 10^6 Mg		
Utilisation		44%	26 10^6 Mg			46	26 10^6 Mg		
59 10^6 Mg					46 10^6 Mg				

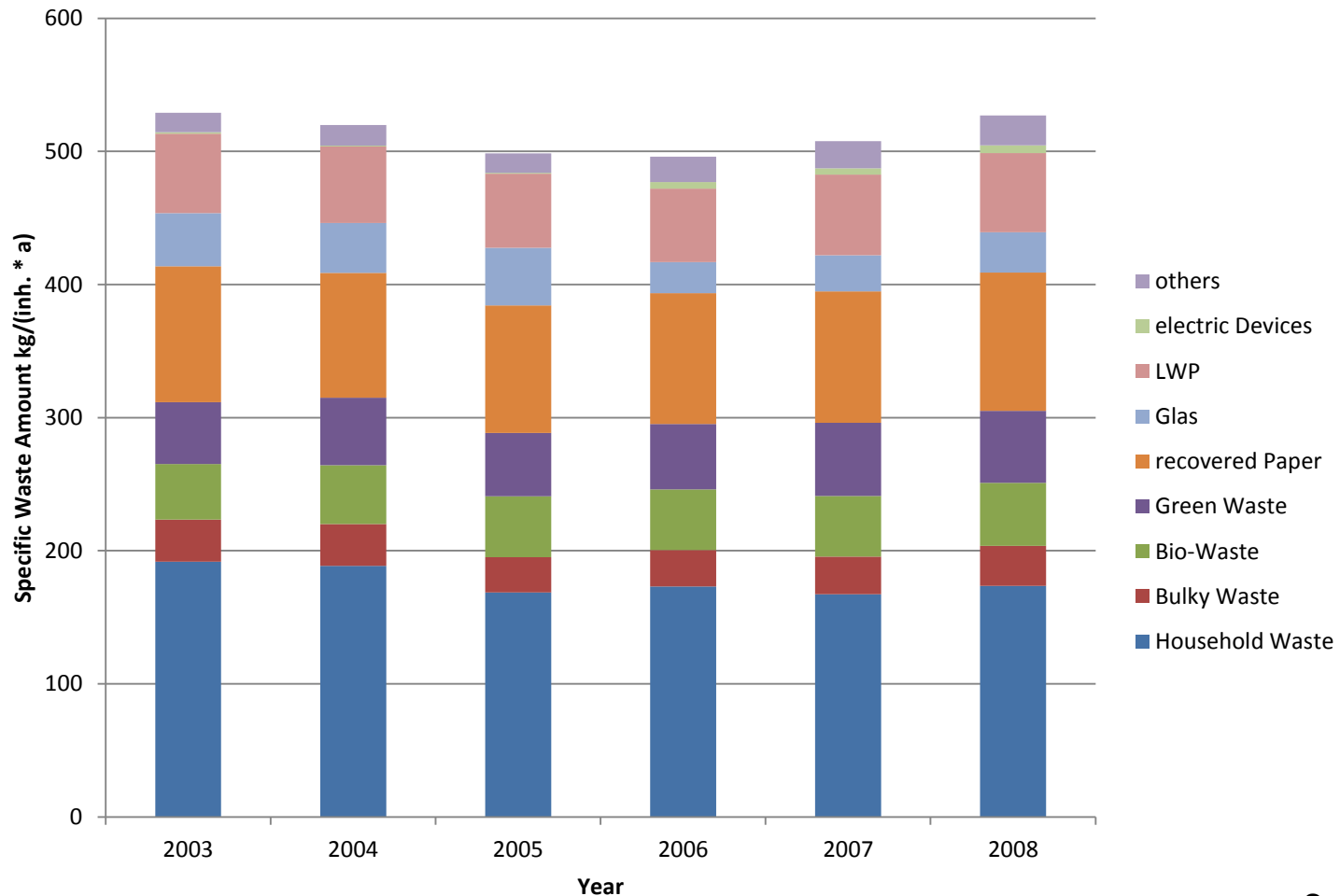
Specific Waste Amounts			
	2003	2008	
Household waste	232	212	kg/(Pers. · a)
Bulky waste	38	37	kg/(Pers. · a)
Bio-waste	51	58	kg/(Pers. · a)
Green waste	56	66	kg/(Pers. · a)
Separated	263	271	kg/(Pers. · a)
<i>recovered paper</i>	123	127	kg/(Pers. · a)
<i>Glass</i>	48	37	kg/(Pers. · a)
<i>LWP</i>	72	73	kg/(Pers. · a)
<i>electr. Devices</i>	2	7	kg/(Pers. · a)
<i>others</i>	18	27	kg/(Pers. · a)

Significance of Waste Management - NEU



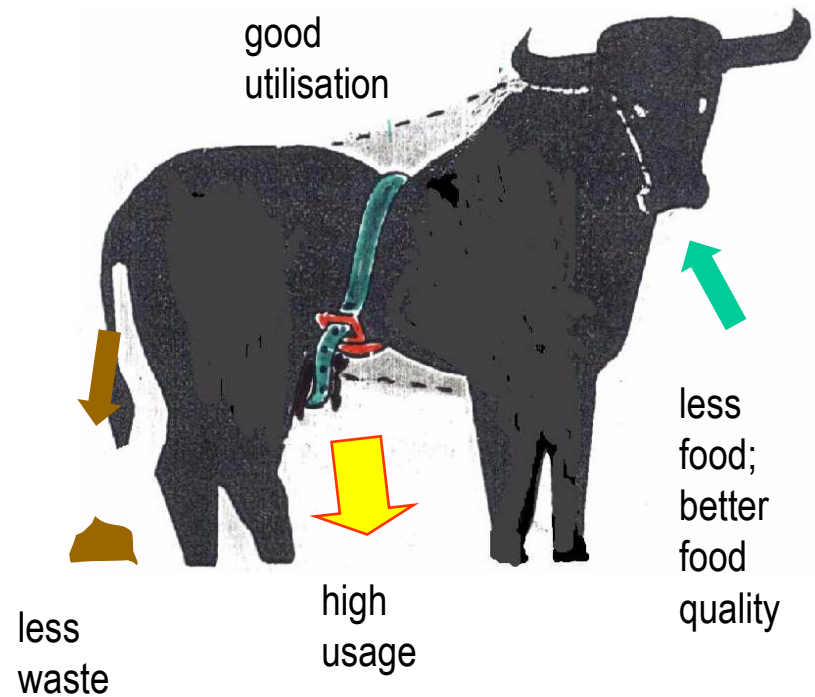
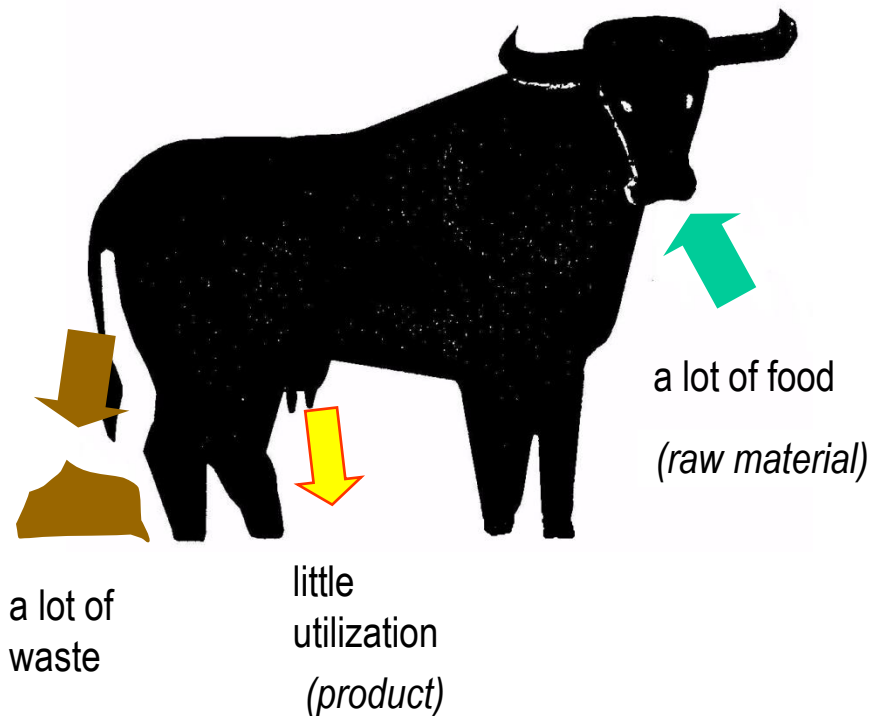
Source: UBA

Specific Waste Amount



Source: UBA

Product Input → → Waste Output



Waste amount = consumption per manufacturer or person * number of manufacturers or person

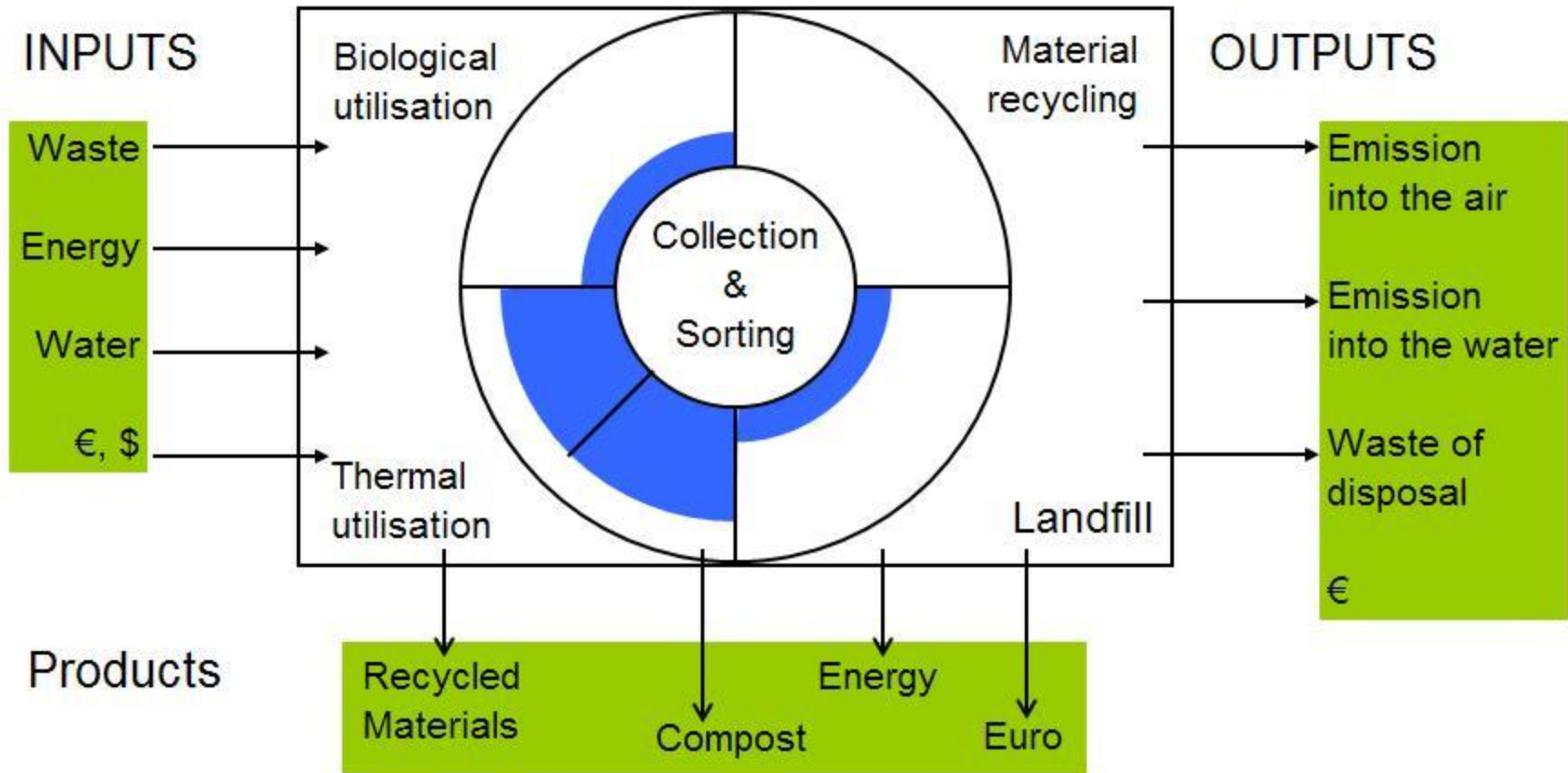
Law of Nature

- Waste cannot "be removed" ("mass preservation"), only reused, used, treated, deposited
- All such processes are associated with environmental damage (rucksack), which could technically be minimized to a large extent
 - Land consumption and ground water pollution near dumpsites
 - Air pollution through thermal and biological treatment
 - Concentration of pollutants in mass circulations
- Beforehand the application of technically high-quality "end-of-pipe" technologies must be:
 - Waste prevention (e.g. through cleaner production, renunciation of consumption, increase of recycling systems, long-lasting products)
 - Replacement and reduction of residual waste amounts (waste for disposal) by recovery of resources or energetic utilisation
 - Recover friendly products, optimized separation, separate collection, dismantling, production and the markets for secondary raw materials

Significance of Waste Management

- Production and waste management are interconnected everywhere: the **building industry** is the branch with the highest waste production amounts!
(approx. 185 million Mg/a = 56 %)
- Provision and disposal (energy, water, wastewater, waste) nowadays are increasingly in one hand => Resources management
- Interconnection between wastewater treatment and waste management
- Raw material recovery „urban mining“

Integrated Waste Management



[Reference: McDougall, 2002]

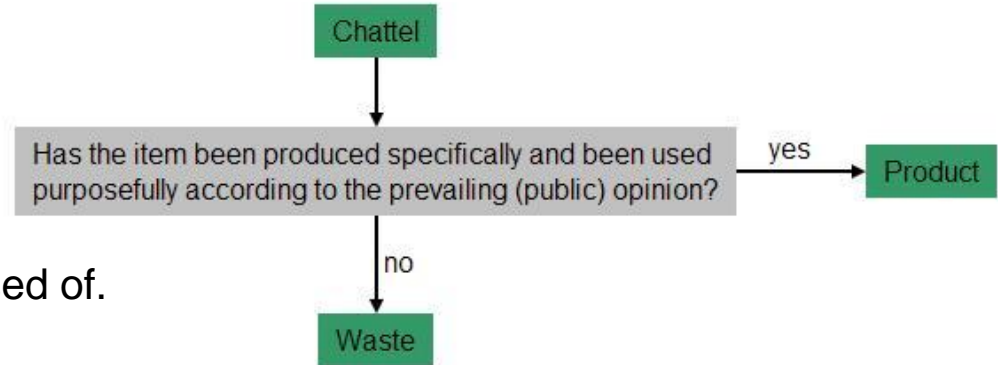
■ Energy

Waste Concepts

Waste as a Legal Term (Recycling Management and Waste Act ...KrW-/AbfG §3, Abs. 1):

Waste is defined as all chattel (mobile matter) which belong to any of the categories listed in Appendix 1 and whose owner

- gets rid of*,
- **wants** to get rid of *
- or **is obliged** to get rid of**.



Waste which is not utilised must be disposed of.

(Obligation to offer waste)

* subjective waste concept

** objective waste concept (Disposal compulsion in case of endangerment)

The judicial differentiation between product and waste is mainly decided according to the purpose of the respective item.

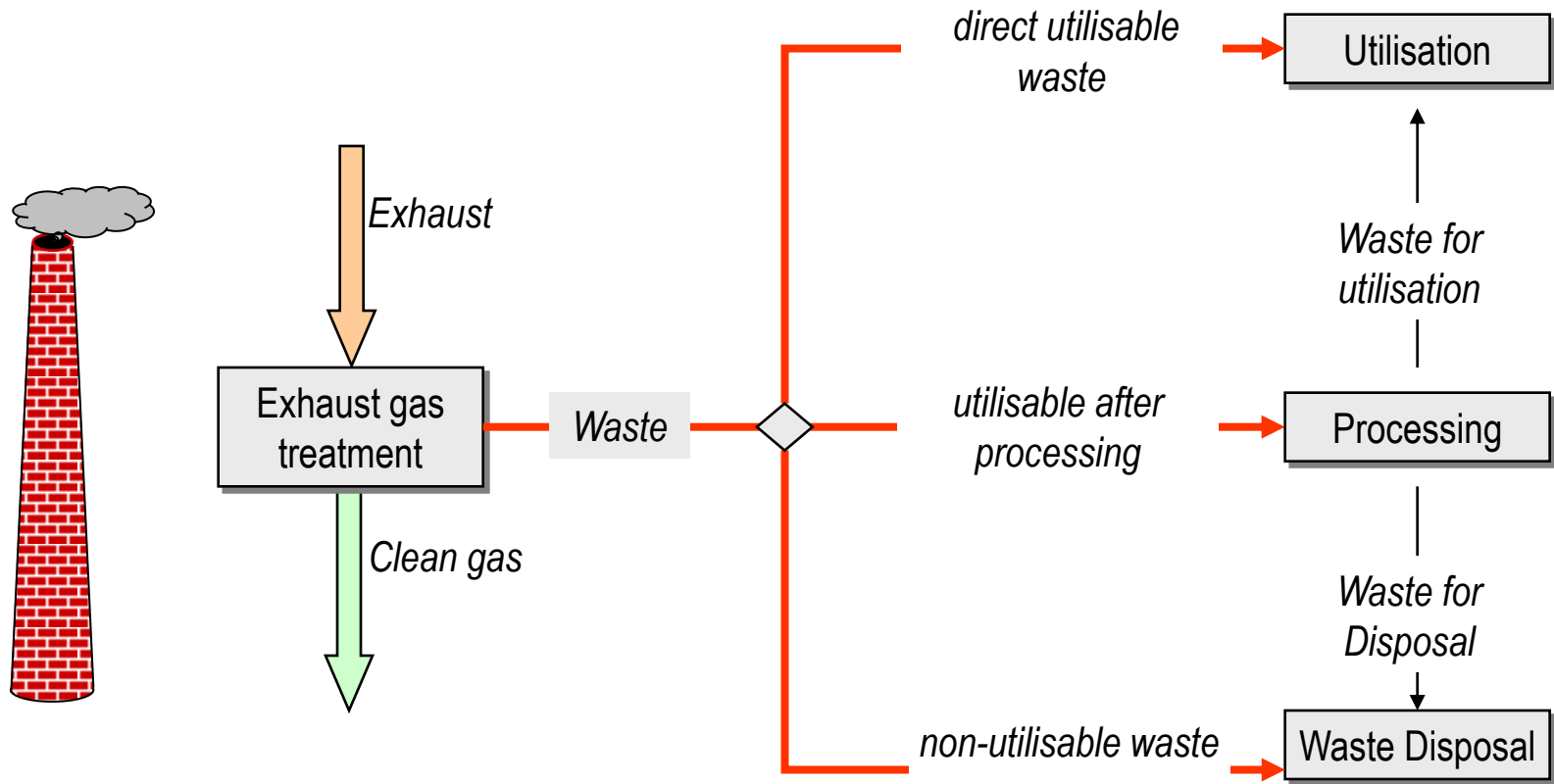
The economic differentiation between product and waste is mainly decided according to the utility value of the respective item. (Good – Not Good)

Production of Waste

Waste can be accrued

- from any product which is no longer used after differently long usage or lifetimes. For instance:
 - the daily newspaper as a short-lived product after 1 day,
 - the car or the TV set after 10-15 years, or
 - the building as durable product after 30 to 500 years,
- during the production (primary production, preliminary products, manufacturing),
- in the processing and cleaning of other environmental media, e.g.
 - sewage sludge from wastewater treatment, or
 - dusts and flue gas treatment residues from exhaust gas purification.

Minimisation of Waste from Flue Gas Treatment



Waste Prevention and Utilisation

- Waste amounts can be reduced (= **waste prevention**) through:
 - low-waste production, reduced consumption, multi-cycle systems, durable products
- Residual waste amounts (waste for disposal) can be reduced and substituted through **material or energetic utilisation**:
 - Products which are suitable for utilisation, optimised separation of waste, stripping, processing, markets and quality requirements for recyclings (secondary resources)

Mass Preservation

- Waste can not be eliminated,
but only be re-used, utilised, treated, deposited.
- All processes of this kind are bound to cause environmental loads - „load packages“ – (which can technically be minimised extensively), such as
 - land consumption for dumping grounds
 - ground water pollution loads below dumping grounds
 - air pollution through waste incineration
 - accumulation of pollutants in substance cycles
- Instead of emphasising technically high-grade end-of-pipe-technologies:
 - low-waste production
 - low-pollutant and recyclable products

Obligation Hierarchy of the Recycling Management and Waste Act

§ 4,1 KrW-/AbfG (German Wastes Act)

- Waste must be
1. predominantly prevented, particularly through a reduction of its amounts and harmfulness,
 2. secondarily
 - a. utilised materially (material utilisation), or
 - b. used for the production of energy (energetic utilisation).

§ 4,5 KrW-/AbfG
... Priority of waste utilisation waived if disposal is the more eco-friendly solution.

§ 10,1 Waste
which cannot be utilised must be excluded permanently from the recycling economy and be disposed of to warrant the common weal.

§ 22,1 KrW-/AbfG (Product responsibility)

In order to fulfil the product responsibility, products must be designed in such a way that during their production and use the occurrence of waste is reduced as much as possible...

§ 23 Bans, Restrictions and Identification

... certain products must not be put in circulation at all...

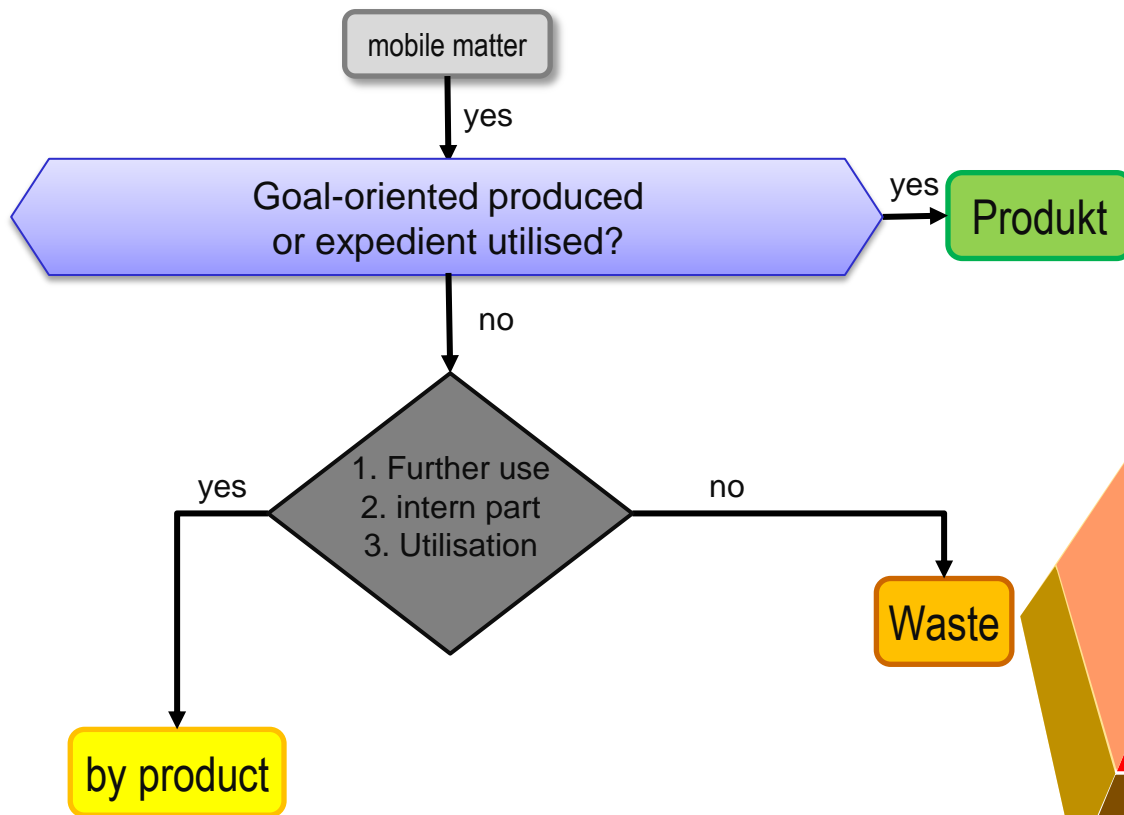


Appendix IIb, KrW-AbfG
Utilisation Methods
R1 – R13

Appendix IIa, KrW-AbfG
Disposal Methods
D1 – D15

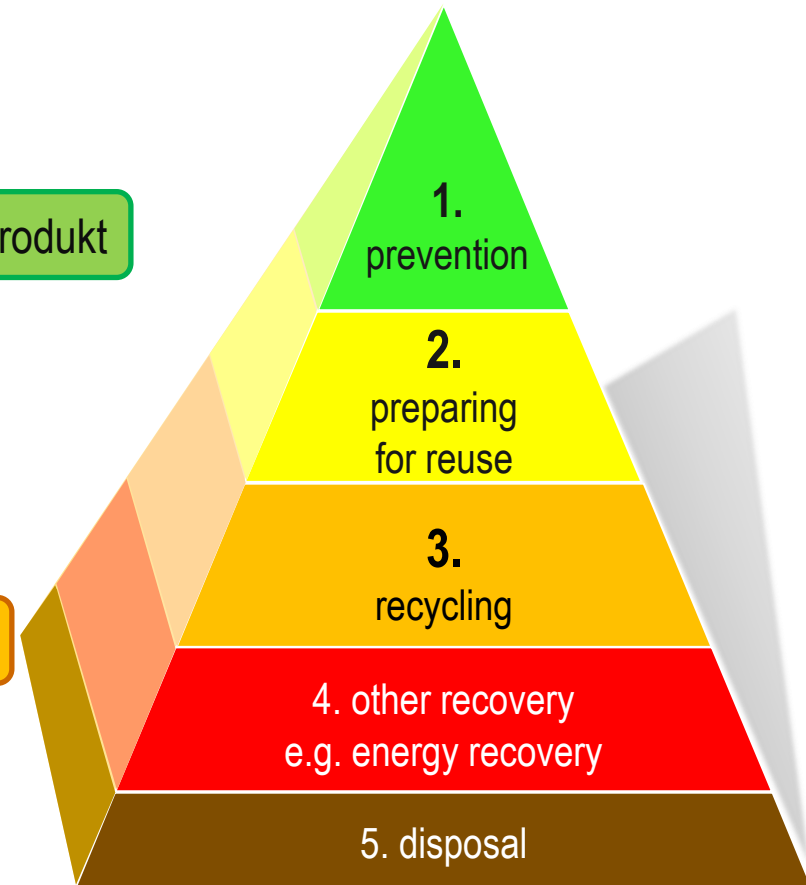
Legislation -

- Classification of the waste item-

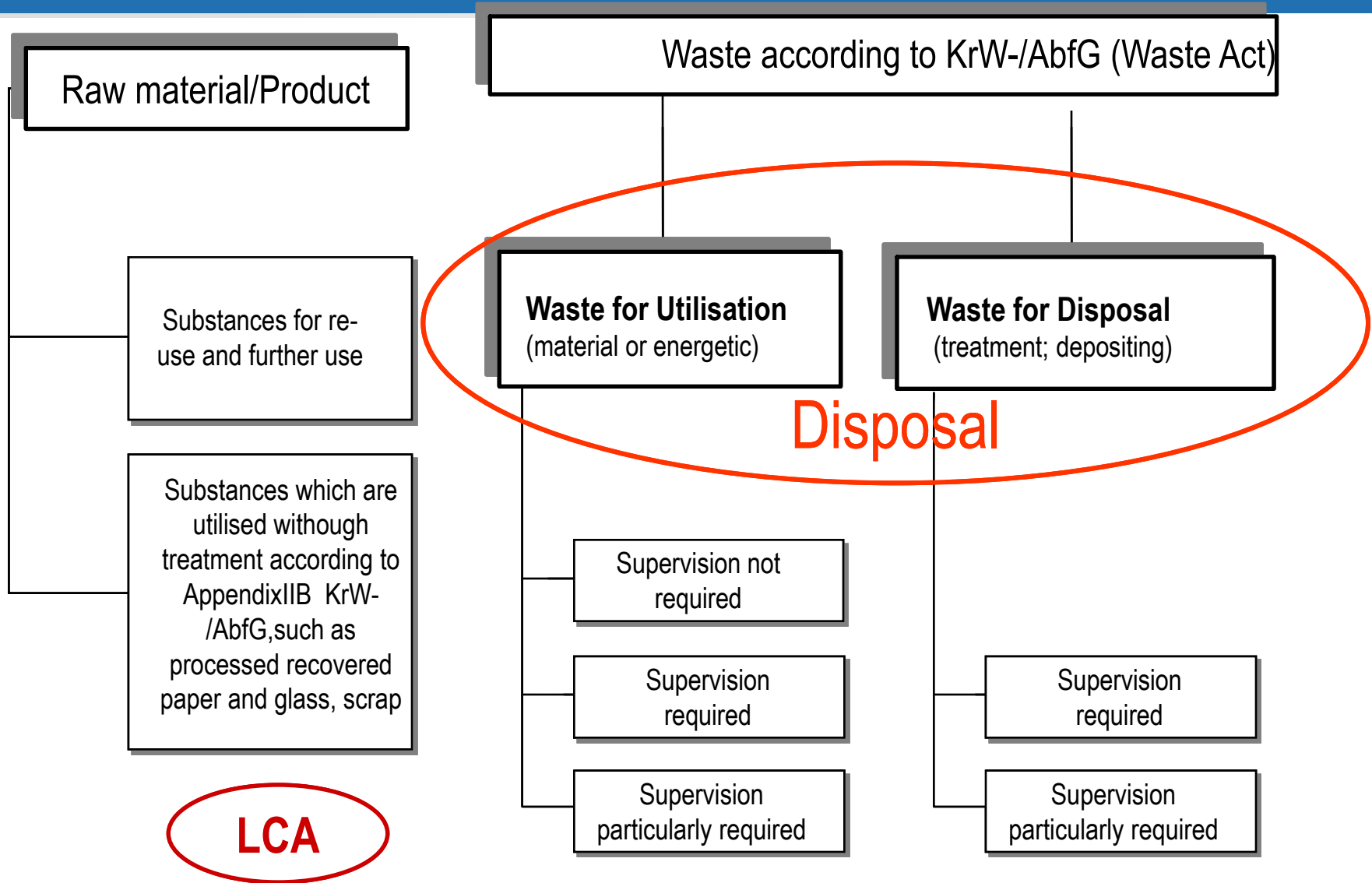


- subjective item

- waste hierarchy -



Allocation of Substances



Development of Waste Management

From a historical perspective, waste is quite a recent problem.

Primeval Society:

Man (hunter and collector) was part of the natural substance cycles. They took what they needed for food or clothes, returned utilisable substances back to Nature, and thus did not interfere in any ways that were radically different from those of their fellow creatures.

Pre-Industrial Society: Subsistence economy (self-supply)

Conscious utilisation of natural substance cycles with materials and substances which the environment could accept back and process.

However:

Initial hygienic problems were caused by faeces, animal corpses and human bodies => precursors of today's waste problems.

Development of Waste Management

Beginnings of Industrial Society:

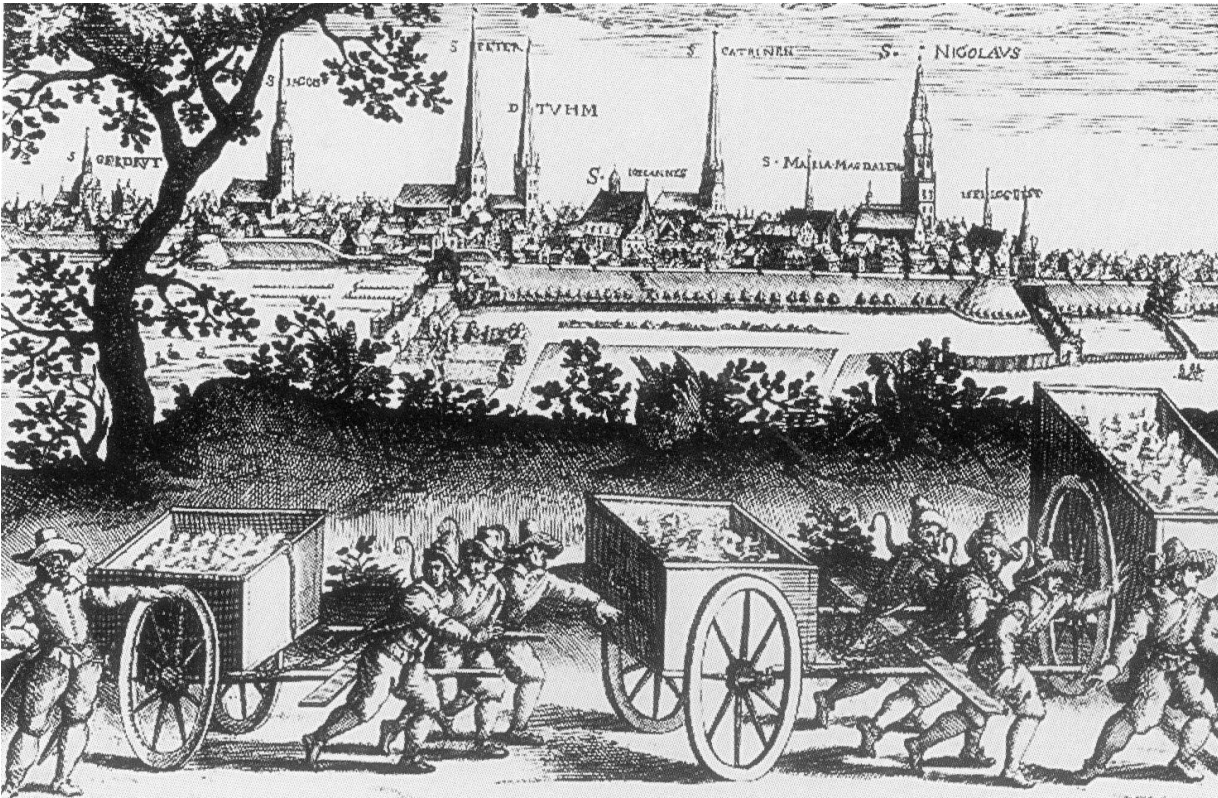
Man produces new substances in thus far unconceivable varieties and amounts.

- not only wealth and consumption option, but today's environmental problem "waste".

Waste Disposal:

In the first half of the 20th Century, waste was tipped off (hence the term rubbish tip) into old gravel or clay pits, embankments, kettle ponds (water-filled glacial period basins), and later also bomb craters.

Development of Waste Management and Law in Germany



Refuse removal in Hamburg through convicts with Schott's Cart 1609

- End of 19th Century: first refuse incineration
- Beginning of the 20th Century: Hygiene aspects, cleanness of the cities
- Also, from World War II to 1970: no specific waste laws; “public health and care”

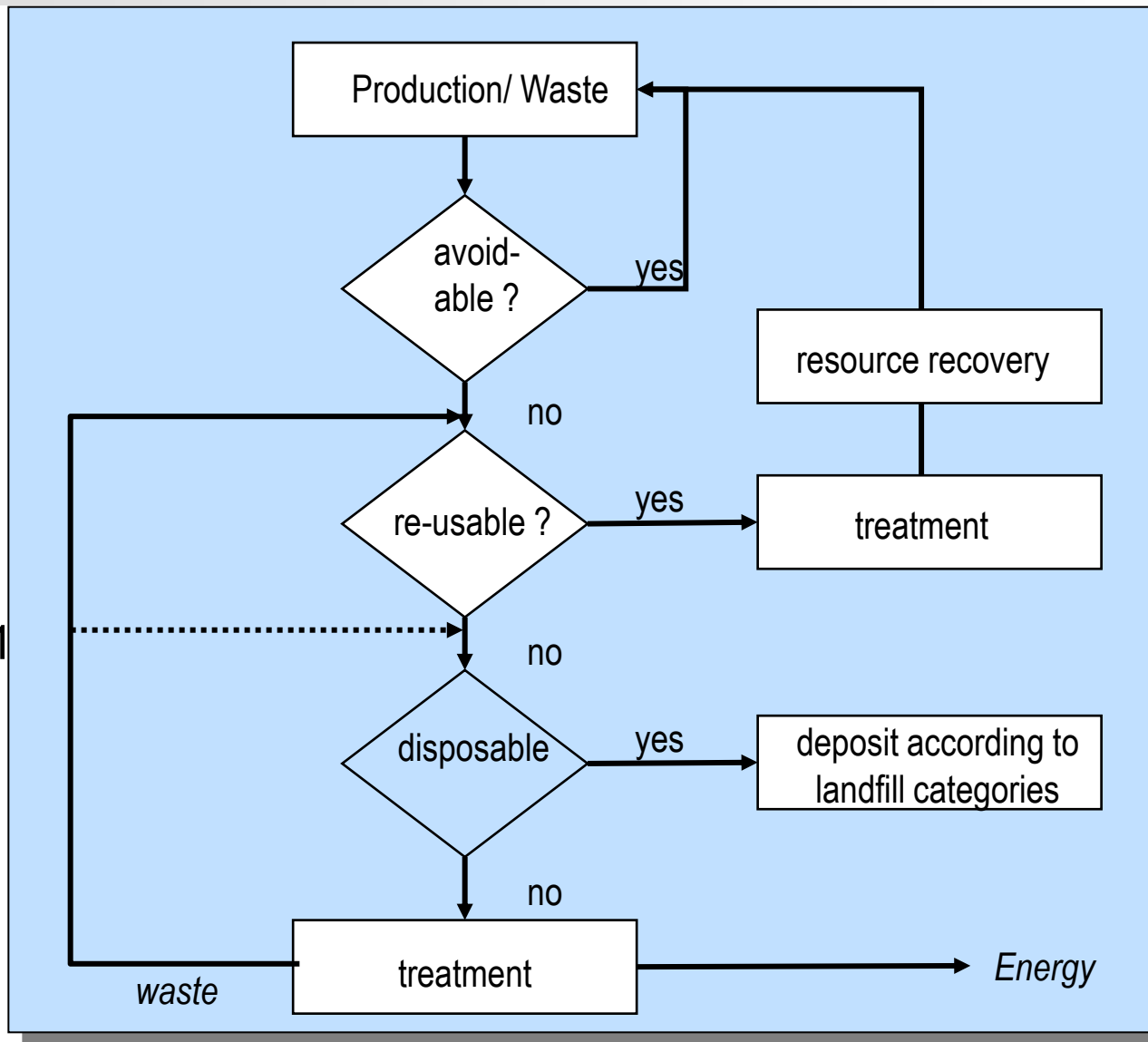
Development of Waste Management and Law in FRG

- 1972 first **Waste (-removal)-Law** (AbfG) in FRG
- 1975 **Waste Management Programm of the Federal Government with the following concepts:**
 - waste prevention
 - waste minimisation
 - waste utilisation (resource or energy recovery)
 - harmless „removal" and deposit of residual waste
- 1986 Implementation of this concept in the Waste Law.
- 1990/91 **Technical Order Waste**
- 1991 **Packaging Order**
- **1993 Technical Order Municipal Waste** for recovery, treatment and removal of municipal solid waste (MSW)

Development of Waste Management and Law in FRG

- 1972
- 1975

- 1986
- 1990/91
- 1991
- **1993**



reatment

Development of Waste Management and Law in FRG

- 1994-96 Recycling Management and Waste Act (KrW-/AbfG);
Emphasis on recovery and manufacturers' responsibility for the impact of their products
- 1998 Old car; Bio-waste; Battery
- 2001 European Waste index list;
- 2001 Waste disposal act – AbfAbIV, Abfallablagerungsverordnung) incl. emission control of the treatment
- 2002 Wood waste; Old car (Amendment 1); Used oil
- 2003 Commercial waste; Fertilizer; Handling with biological substances; Waste incineration; Bio-waste; Old car (reform 2); Waste deposit fee; Emission from incineration and co-incineration of waste
- 2004 Odour emission; green-house gas emission trading; Renewable energy; Environment Information;
- 2005 Electronics
- 2006 Waste exchange in Europe

Development of Waste Management and Waste Law in Germany

- 2004 **Amendment Recycling Management and Waste Act - KrW/AbfG**
- 2004 **Odour Emission Directive - GIRL -**
- 2004 **Greenhouse Gas Emission Trading Law - TEHG**
- 2004 **Amendment Renewable Energy Law – EEG**
- 2004 **Environment Information Law - UIG**
- 2005 **Electric and Electronic Appliances Law - ElektroG**
- 2008 **Amendment of the Packaging Ordinance - VerpV**
- 2005 **Ordinance on the Utilisation of Waste on Landfill
DepVerwV – Landfill Utilisation Ordinance**
- 2006 **Ordinance (EU) No. 1013/2006 of the European Parliament and
Council from June 14, 2006, on the Dumping of Waste**
- **2007 EU Framework Waste Directive** (DIRECTIVE 2006/12/EU OF THE
EUROPEAN PARLIAMENT AND COUNCIL from April 5, 2006, on
waste)
- **2007 REACH Ordinance (EU) 1907/2006** as of 01.06.2007
- **2008/9** Amendment of the **EU Framework Waste Directive**

- 2010 **Landfill Directive – DepV (Deponieverordnung)**
 - **replaces the existing**
 - 1990/91 Technical Order Waste
 - 1993 Technical Order Municipal Waste for recovery, treatment and removal of municipal solid waste (MSW)
 - 2001 Waste disposal act – AbfAbIV, Abfallablagungsverordnung) incl. emission control of the treatment
 - 2002 Landfill Directive
 - 2005 Ordinance on the Utilisation of Waste on Landfill DepVerwV – Landfill Utilisation Ordinance

Recycling Management and Waste Act KrW-/AbfG (1)

- 1st Part: General instructions, application range
- 2nd Part: Principles and Obligations
 - § 5, Sect. 4: Utilisation obligation if
 - technically possibly (if necessary after preliminary treatment)
 - a market is available for recovered materials or energy
 - Economically reasonable (costs not disproportionate to disposal costs))
 - § 5, Sect. 5: Priority of utilisation is waived if disposal is more eco-friendly
 - § 6, Sect. 1: material or energetic utilisation; priority for that utilisation method which is more eco-friendly (possible legal directive of the Federal Government with approval of the Federal Council)
 - § 6, Sect. 2: If no priority determined, the energetic utilisation is permitted if
 - Heating value ≥ 11.000 kJ/kg,
 - η combustion $\geq 75\%$, and
 - the emerging excess heat is used, and
 - the produced waste, such as slags, can be deposited without treatment (if it is not utilised)



Recycling Management and Waste Act KrW-/AbfG (2)

§ 2 Application Range 04 05

(1) The injunctions of this law apply to 1. the prevention, 2. the utilisation, and 3. the disposal of waste.

(2) The injunctions of this law **do not apply to**

1. those substances which must be disposed of according to the **Food and Fodder Law Code**, as far as it applies to food, food additives, cosmetic articles, commodities, and products which may be confused with food, to the Provisional Tobacco Law, to the Milk and Margarine Law, to the Animal Disease Law, to the Plant Protection Act, and to those legal directives enacted on the basis of these acts,
1. a. **animal by-products** which according to the EU Ordinance No. Nr. 1774/2002 of the European Parliament and Council from October 3, 2002, with hygiene prescriptions are not assigned for human consumption (ABl. EG Nr. L 273 S. 1) in the applicable versions, according to the legal acts enacted for their execution, to the Animal By-Product Disposal Act, or to the legal ordinances enacted on the basis of this Ordinance on the retrieval, collection, transport, storage, treatment, processing, utilisation, disposal, or putting into circulation of animal by-products,
2. **nuclear fuels** and other radioactive substances in terms of the Atomic Energy Act,
3. substances the disposal of which is regulated in an ordinance enacted on the basis of the Precautionary **Radiation Protection Act**,
4. waste which is produced during the collection, recovering, processing and finishing of resources in companies which are under supervision of the **mining authority**, with the exception of waste produced not immediately or nor commonly, but only during those activities mentioned in the first sub-clause,
5. **gaseous substances** which are not caught in containers,
6. substances as soon as they are discharged into bodies of water or wastewater treatment plants,
7. the collecting, salvaging, transporting, storing, treating, and destroying of **warfare agents**.



Recycling Management and Waste Act KrW-/AbfG (3)

- 1st Part: General instructions, application range
- 2nd Part: Principles and Obligations
 - § 5, Sect. 4: Utilisation obligation if
 - technically possibly (if necessary after preliminary treatment)
 - a market is available for recovered materials or energy
 - Economically reasonable (costs not disproportionate to disposal costs))
 - § 5, Sect. 5: Priority of utilisation is waived if disposal is more eco-friendly
 - § 6, Sect. 1: material or energetic utilisation; priority for that utilisation method which is more eco-friendly (possible legal directive of the Federal Government with approval of the Federal Council)
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 - η combustion $\geq 75\%$, and
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 - the produced waste, such as slags, can be deposited without treatment (if it is not utilised)

Recycling Management and Waste Act KrW-/AbfG (4)

- 3rd Part: Product Responsibility
 - Bans; acceptance and return obligations; voluntary redemption
- 4th Part: Planning Responsibility
- 5th Part: Trade Promotion (public authorities)
- 6th Part: Information Obligations
- 7th Part: Supervision
- 8th Part: Operation Organisation/Representatives
- 9th Part: Final Clauses
- [Appendix I](#) Types of Waste
- [Appendix II A](#) Disposal Methods
- [Appendix II B](#) Utilisation Methods
- [Appendix III](#) Criteria to Determine the State-Of-The-Art

- **Ordinance on Utilisation and Disposal Documentation (Documentation Ordinance - NachwV** as of 10.09.1996, Amendment as of 26.10.2006):
 - **Documentation obligatory** for all producers of waste for which supervision is particularly required with ≥ 2.000 kg/a
 - **Documentation and documentation register** according to §42 - 47 KrW-AbfG
 - **Disposal Evidence (DE)** of the permissibility of the intended disposal method with responsible declaration of the producer, **declaration analysis** ; **statement of acceptance** of the waste disposal contractor
 - **Documentation** of the executed disposal of waste for which supervision is particularly required through
 - Covering letters on the executed disposal; six-fold carbon copy set form; as EDV-compatible as possible; keeping of documentation registers
 - Dock receipt for collective disposal
- **Ordinance on Transport Permissions (TgV, 1996)** for waste requiring special supervision through specialised contractors (cf. also § 49 KrWG-/AbfG)
- **Ordinance on Specialised Disposal Contractors (§ 52 KrW-/AbfG; EfBV, 1996)**

Data Sheet for Disposal Evidence

Begleitschein
 Beleg zum Nachweis der Entsorgung von Abfällen

Blatt ⑤ Nr.

Diese Ausfertigung (altgold) ist vom Entsorger mit seiner Unterschrift und der des Beförderers an den Erzeuger zu senden.

Barcodefeld 75x15mm

Abfallbezeichnung¹⁾

Abfallschlüssel¹⁾ Entsorgungsnachweis-Nummer Menge in t

Erzeugernummer Beförderernummer Entsorgungsnummer

Datum der Übergabe (Tag, Monat, Jahr) Datum der Übernahme (Tag, Monat, Jahr) Datum der Annahme (Tag, Monat, Jahr)

Firmenname, Anschrift Firmenname, Anschrift Firmenname, Anschrift

Unterschrift (als Versicherung der richtigen Deklaration) Unterschrift (als Versicherung der ordnungsgemäßen Beförderung) Unterschrift (als Versicherung der Annahme zur ordnungsgemäßen Entsorgung)

Frei für Vermerke / Übernahmeschein-Nummern bei Nutzung eines Sammelentsorgungsnachweis

Weitere an der Beförderung beteiligte Firmen:

Beförderernummer (1. Transportwechsel) Beförderernummer (2. Transportwechsel) Zwischenlager

Datum der Übernahme (Tag, Monat, Jahr) Datum der Übernahme (Tag, Monat, Jahr) Datum der Übernahme (Tag, Monat, Jahr)

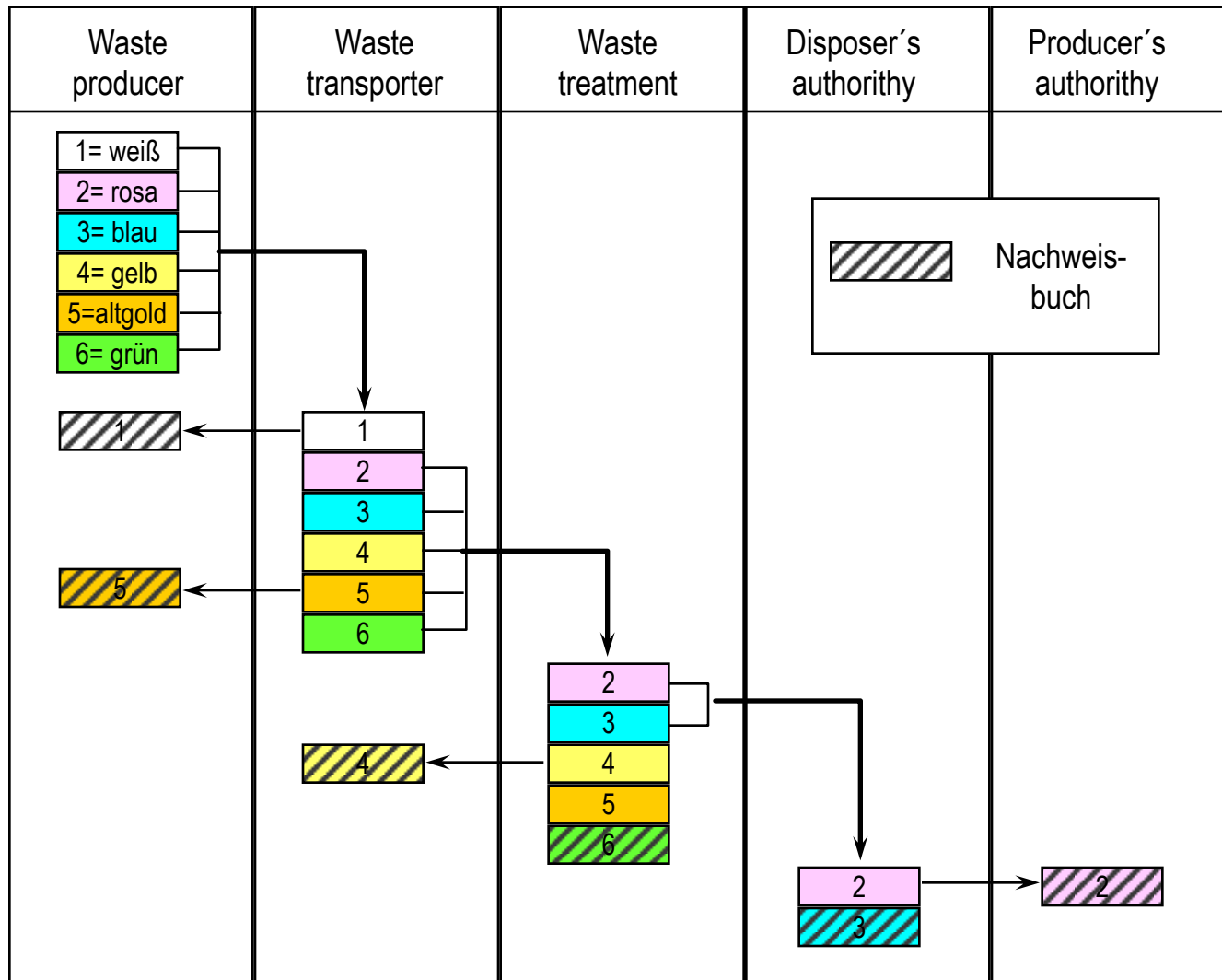
Beförderer (nur Name, Anschrift) Beförderer (nur Name, Anschrift) Beförderer (nur Name, Anschrift)

Unterschrift (als Versicherung der ordnungsgemäßen weiteren Beförderung) Unterschrift (als Versicherung der ordnungsgemäßen weiteren Beförderung) Datum der Übergabe (Tag, Monat, Jahr)

Unterschrift (als Versicherung der ordnungsgemäßen Zwischenlagerung)

1) Nach EAK-Verordnung, Bestimmungserreichung besonders Überwachungsbedürftige Abfälle, Bestimmungserreichung Überwachungsbedürftige Abfälle zur Verwertung.

How to do (§ 15 – 17)

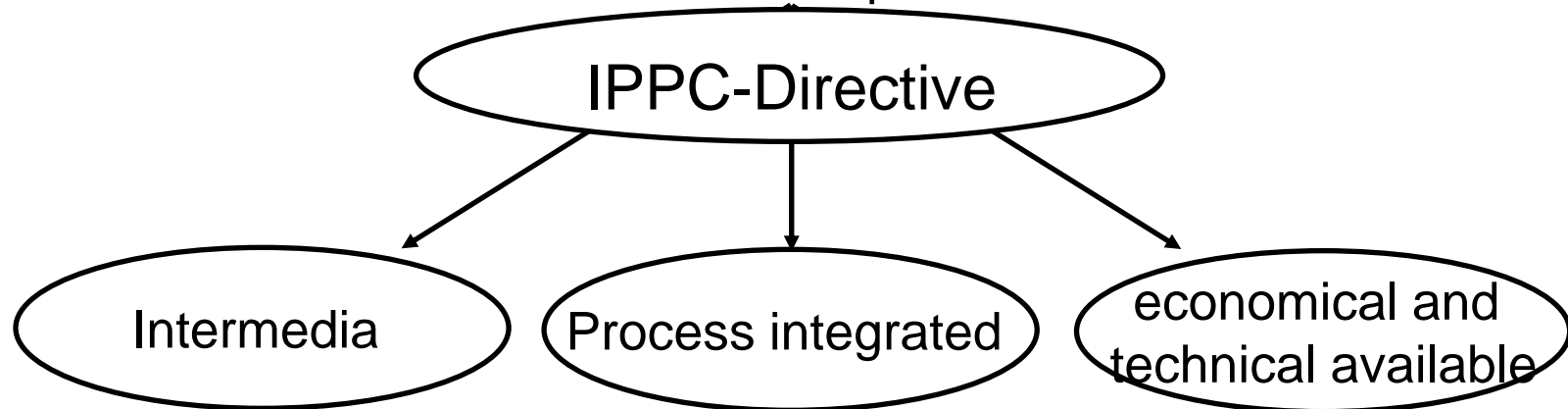


Industrial – Requirements for the industry

Directive for the integrated prevention and reduction of environmental pollution (IPPC-Directive)

National regulation: based on emission
in contrast

IPPC Directive: integrated approach for the prevention of
environmental pollution



Realisation:

Preparation of Reference Documents for **B**est **A**vailable **T**echniques (BREF)

⇒ based on the process

Idealised survey about emissions and usage in an entire process

