
Frank Werner

Life cycle inventories of wood in ecoinvent version 3.2



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Coverage of the update

- Forestry
- Sawn timber and sawn timber-based boards
- Other wood-based boards
- Wood preservation
- Wood combustion
- Municipal waste incineration

General remarks

- **Structural changes throughout the wood chain**
 - forestry process modelled as 1 process (not 3), explicit modelling of different assortments
 - differentiation of sawmilling products (laths, boards, beams)
 - allocation of sawmilling processes based on sub-division and considering technological aspects
 - wood preservation per kg of preserving agent and technology

General remarks

- Further aspects

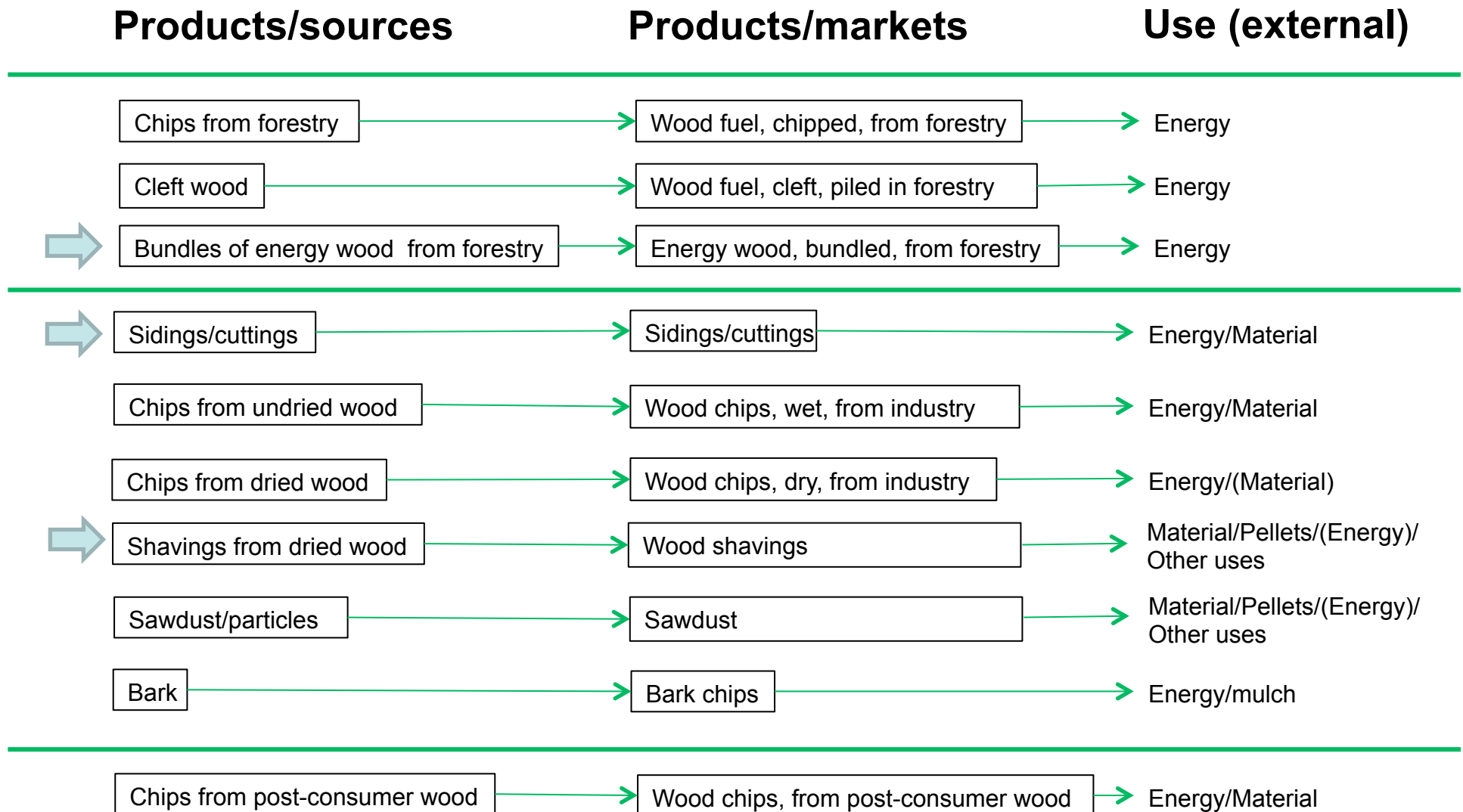
- modelling with real densities
 - apparent wood density (wet mass/wet volume)
 - basic wood density (dry mass/ wet volume)
 - dry wood density (dry mass/dry volume)

← + 0 % Vol. | ← + 4 % Vol. | ← + 4 % Vol. | ← + 4 % Vol. |

		u>30 %	u=30 %	u=20 %	u=10 %	u=0%
Apparent density	kg/m ³	> 453	480	464	434	420
Water in wood	kg/m ³	> 111	111	77	39	0
Basic wood density	kg/m ³	370	370	386	395	420
Dry wood density	kg/m ₃	420	420	420	420	420

- parametrisation of datasets for easy update/new DS
- main products expressed in m³, by-products expressed in kg dry matter (...)

Overview of by-products

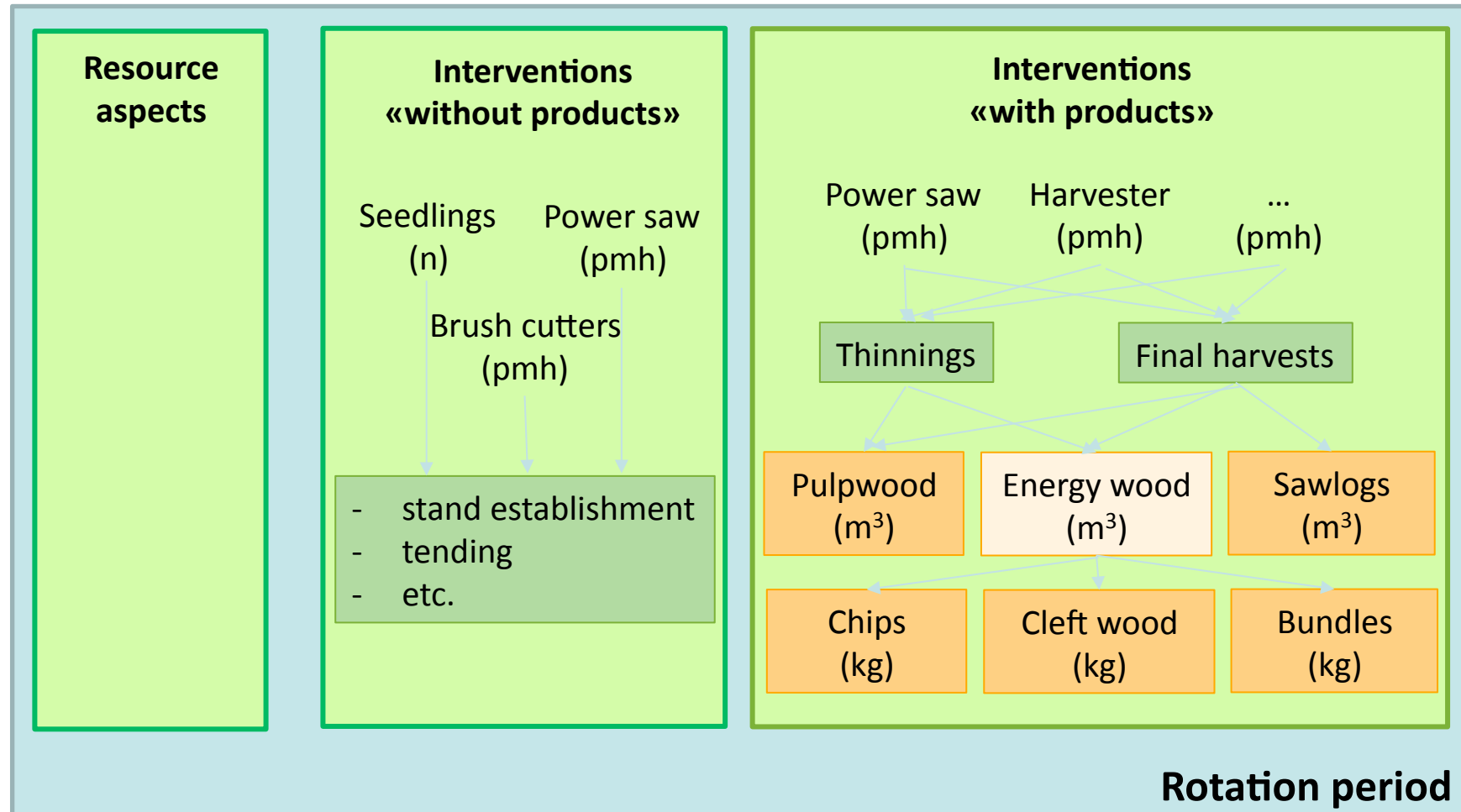


Coverage of forestry processes

- seedling production (2)
- production and end of life treatment of forest machinery (10)
- operation of forest machinery, per machine working hour (12)
- forestry processes (9)
 - Switzerland (for softwood and hardwood)
 - Germany (for beech, oak, spruce and pine)
 - Sweden (for spruce, pine and birch)



New structure of forestry processes

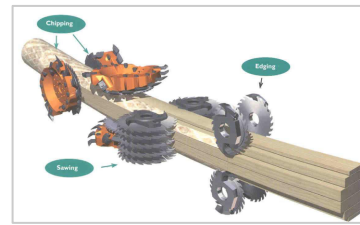


Some methodological remarks

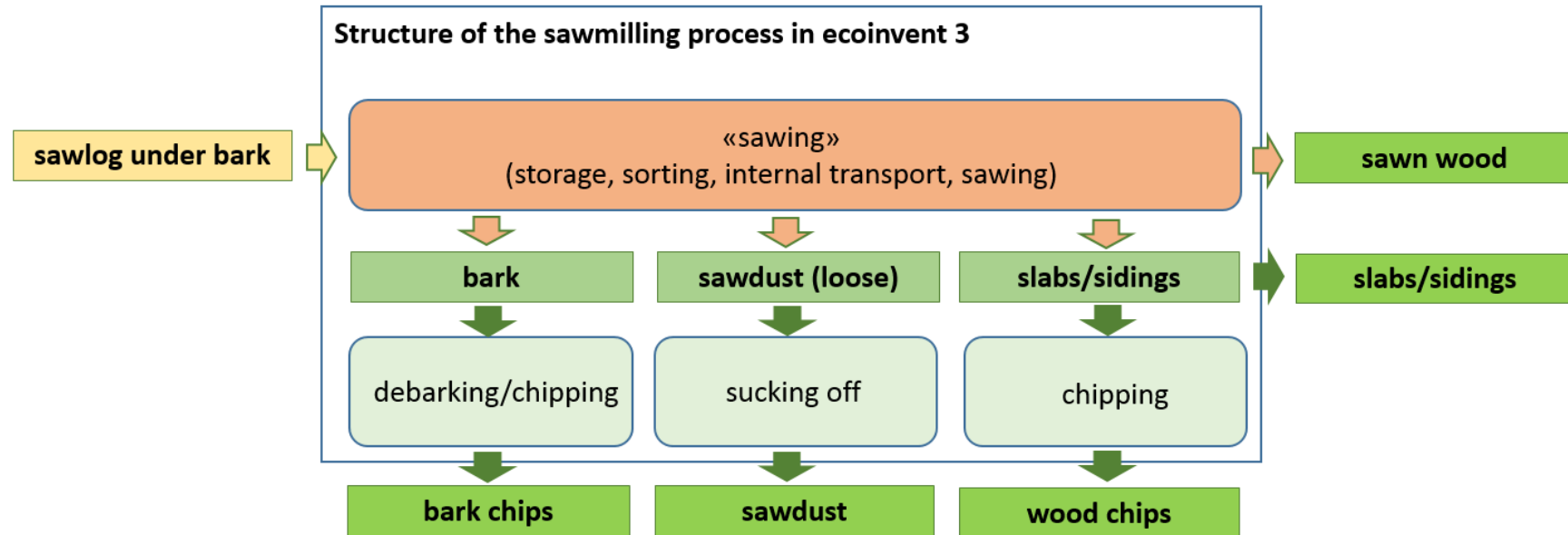
- datasets represent average mix of different country-specific harvesting methods, per m³
- assortment specific modelling of harvesting operations
- preferably modelled based on harvesting data “over one rotation period”; however, sometimes based on current statistics
- consideration of multi-functionality in the attribution of land use related elementary flows
- emissions profiles of forestry machinery dependent on base emission factor, machine power and load factor for different EURO classes
- update of emission profile for chain saws, covering aliphatic organics and PAKs

Coverage of sawmilling processes

- production of sawn timber including debarking, sawing, drying and planing processes (39)
 - sawn wood, raw
 - laths, boards, beams, raw, air-dried to 20%
 - laths, boards, beams, raw, kiln-dried to 20%
 - laths, boards, beams, raw, kiln-dried to 10%
 - laths, boards, beams, air-dried to 20%, planed
 - laths, boards, beams, kiln-dried to 20%, planed
 - laths, boards, beams, kiln-dried to 10%, planed
- production of wooden boards made from sawn timber (2)



New structure of sawmilling processes/methodological remarks



- **sub-division of sawmilling processes:**
 - chipping attributed to chips (regardless of technology)
 - debarking = bark production
 - suction/aspiration of chips, shavings and sawdust attributed as internal transport

Coverage of production of other wood-based boards

- **production of**
 - particleboard (glue-mix)
 - oriented strand board (OSF)
 - medium density fibre-boards (MDF)
 - hardboard
 - soft fibreboard (mixed technology)

in collaboration with the European Panel Fed-eration (5)

- **production of melamine-impregnated paper and coating (2)**
- **treatment of waste water from the production of wood-based panels (3)**



Coverage of wood combustion processes

- production of pellets and its corresponding infrastructure (2)
- production of particle filters for wood furnaces (3)
- heat production from
 - logs of energy wood (6),
 - pellets (8)
 - wood chips (24)
 - post-consumer wood (2)
- heat and power production as cogeneration from wood (4)
- production and end of life treatment of infrastructure for wood combustion (10)



Coverage of wood combustion processes

Category	Wood fuel	Fuel power [kW]	Efficiency	
			Average installations	Newly installed installations
Cleft wood combustion	Cleft wood	6	50%	60%
		30	70%	75%
		100	75%	80%
Pellet combustion	Wood pellets DIN-plus	9	70%	75%
		25	75%	80%
		300	75%	80%
Automated wood combustion	Wood chips from forestry / industry	50	70%	75%
		300	75%	80%
		1000	75%	80%
		5000	75%	80%
Waste wood combustion	Waste wood, untreated	2000	75%	80%

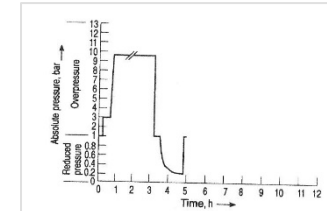
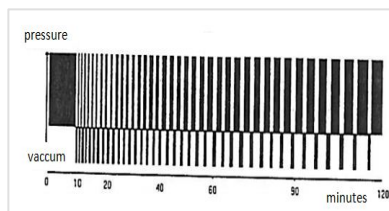
plus 2 types of CHP plants: 200 – 1000 kW_{el} and 1000 – 3000 kW_{el}

Updated emission factors for wood combustion

Fuel	Power	Wood mixed	Spruce	Beech	Wood mixed									
					NO _x	CO	CH ₄	NM VOC	Soot*	Mineral Dust	Inor-organic (salt)	PM <2.5	PM 2.5-10	UFP (PM <0.1)
	[kW _{zu}]					[mg/MJ _{zu}]								[10 ¹² /MJ _{zu}]
Cleft wood	6	80			2500	150	350	30	0	30	54	3	25	
	30	80			1250	11,4	26,6	10	0	30	36	2	25	
	100	80			1250	11,4	26,6	10	0	30	36	2	25	
Wood pellets DIN-plus	9	60			250	11,4	26,6	20	0	20	36	2	25	
	25	60			150	3,9	9,1	15	0	15	27	1,5	25	
	300	70			125	2,4	5,6	15	0	15	27	1,5	25	
Wood chips from forestry	50	120	100	130	450	7,5	17,5	8	0	72	72	4	25	
	300 ^a	120	100	130	375	3,9	9,1	1	0	24	22,5	1,25	2,5	
	1000 ^a	150	120	180	250	2,4	5,6	0,4	0	9,6	9	0,5	1	
	5000 ^{a, b}	80	80	80	100	1,2	2,8	0,2	0	4,8	5	0	0,5	
Waste wood, untreated	2000 ^a	190			100	2,4	5,6	0,2	0	4,8	5	0	0,5	

Coverage of wood preservation (I)

- **production of wood preservatives (9)**
 - waterborne products for use classes 1 to 3
 - solvent based products for use classes 1 to 3
 - creosote WEI Type C
 - Cr-containing wood preservative for the use class 4
 - Cr-free wood preservative for the use class 4
- **production and end of life treatment of infrastructure for the application of wood preservatives (5)**



Coverage of wood preservation (II)

- **non-pressure based impregnation processes for the inventoried wood preservative of use classes 1 to 3 (13)**
 - automated spraying/deluging
 - dipping/immersion
 - hot/cold dipping
- **pressure based impregnation processes for the inventoried wood preservative of use class 4 (6)**
 - oscillating pressure method
 - vacuum pressure method

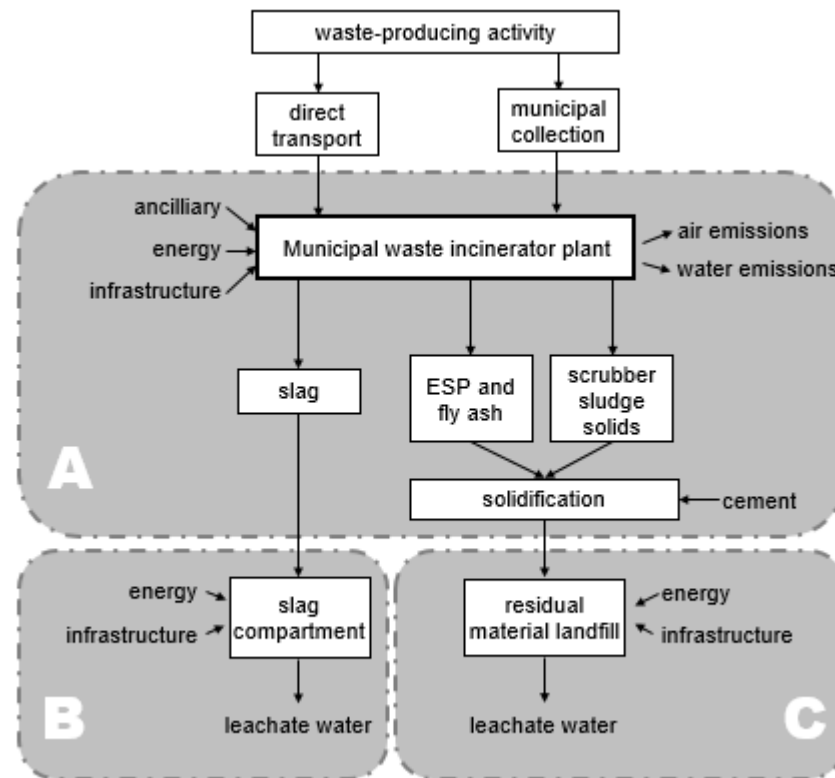
Some methodological remarks

- datasets on application contain preservative plus process
- formulations represent “ideal type” products in their use class (as provided by Empa)
- data on production of “active” ingredients mostly not accessible, though mass-% generally very small
- model-bases estimates of emissions into air, soil and water from application and storage based on OECD model (OECD 2000), based on physical properties of ingredients

=> close linkage of composition and amount of preservative, and emissions

Coverage of municipal waste incineration processes

- disposal processes for the disposal of different types of specified wastes in municipal waste incinerators (MWI) (57)
- production of heat and electricity in MWIs (2)



Some methodological remarks

- datasets (still) refer to 1 kg of wet waste
- explicit modelling of generated energy
- refinement in the attribution of heat requirements in different compartments per type of waste
- update of DeNox-Technologies (now 2007) and waste specific inventorying of thermal NOx emissions
- update of recovery of metals from slag
- update in carbon balance (organic/non-organic carbon in landfill)
- waste specific inventorying of products from incomplete combustion





Happy calculations!