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Comparison of three approaches how to deal with cumulative LCI data in a unit process database

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Challenges

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- Quality guidelines for ecoinvent require
  - Full transparency (at least for data generator)
  - Data on a unit process basis (at least for data generator)
  - Full range of elementary flows
  - Full linkage to background data
  - Standardized assumptions on infrastructure, transports, waste models, allocation, etc.

- Problems with inventory data published in a cumulative format
  - Important modelling questions cannot be harmonized
  - No possibility to use standard background data,
    e.g. for transports, electricity use
  - No update in case of new developments,
    e.g. emission control for lorries

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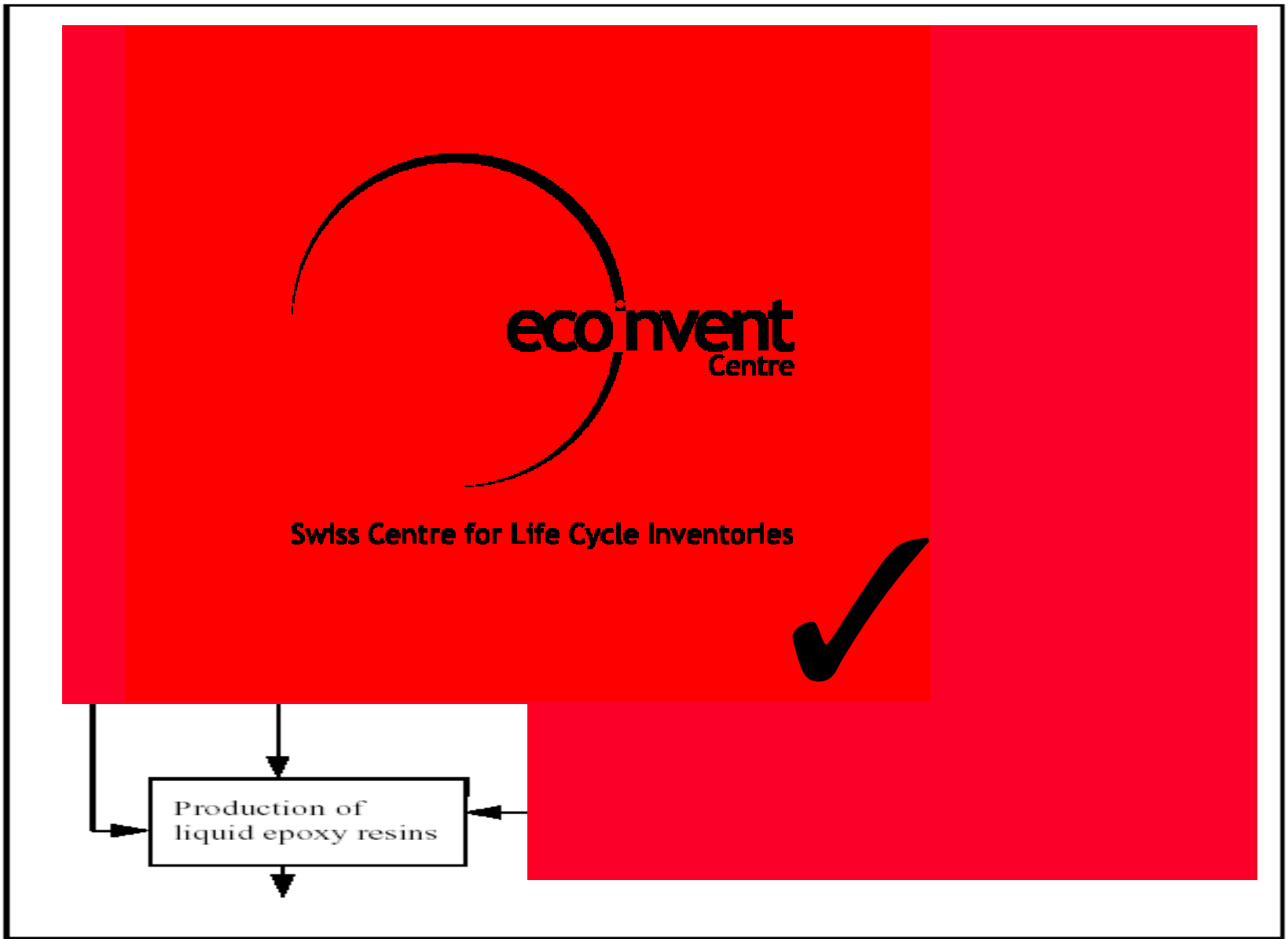
Product system of epoxy resin



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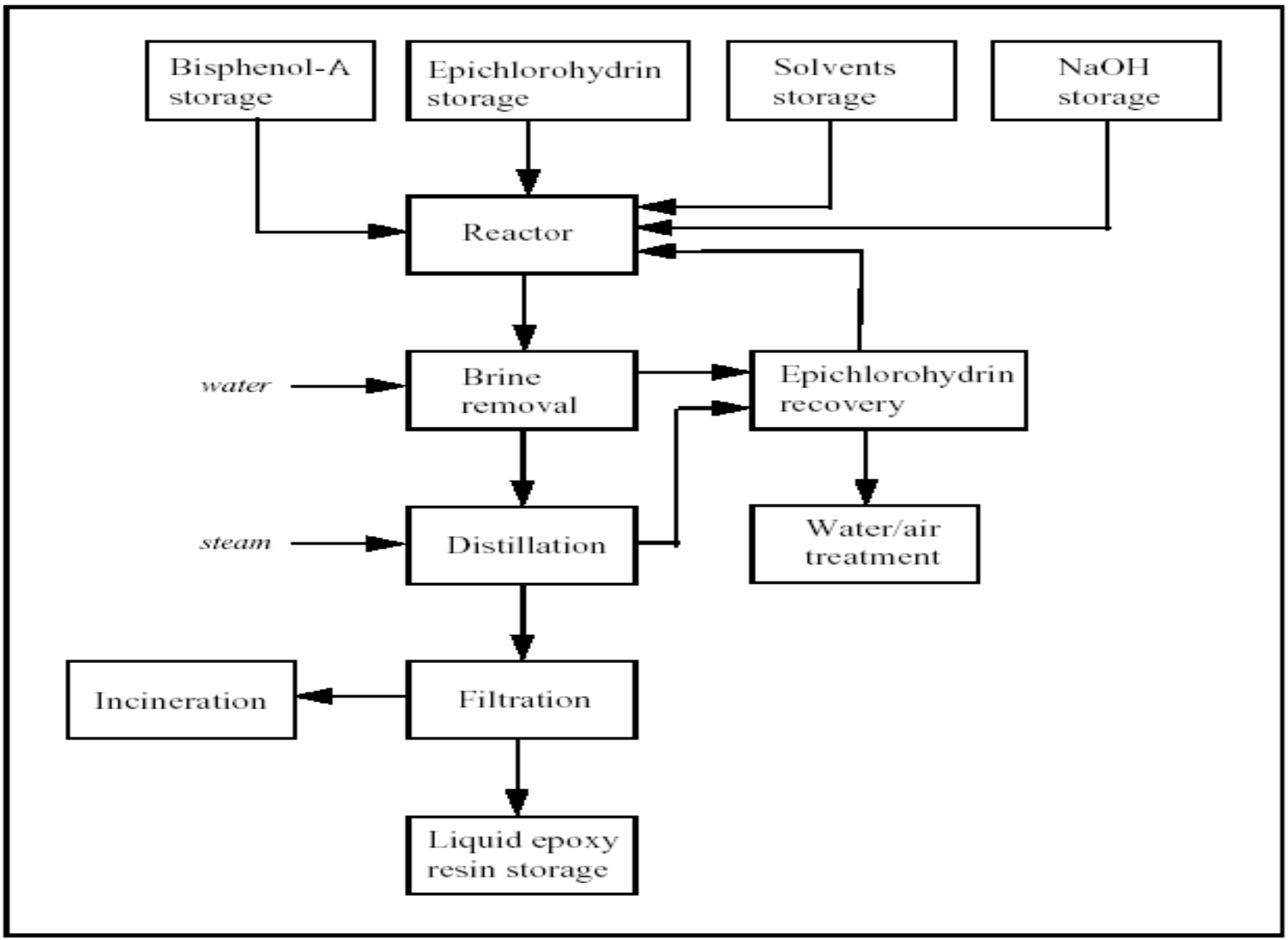
Missing process data



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Example APME data

(APME - Association of Plastics Manufacturers in Europe)

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Selected gross air emissions in mg arising from the production of 1kg liquid epoxy resin

Emission (mg/kg)	Fuel production	Fuel use	Transport	Process operation
Dust	5‘500	2‘800	21	7‘100
CO_2	1‘600‘000	3‘600‘000	34‘000	650‘000
N_2O	<1	<1	-	-

First approach (1): cumulative data

Name	Location	Infrastructure	Process	Unit	*epoxy resin, liquid, at plant*
					RER
			0		
				kg	
disposal, hard coal mining waste tailings, in surface backfill	GLO	0		kg	3.00E-1
Oil, crude, in ground	-	-		kg	6.70E-1
Carbon dioxide, fossil	-	-		kg	5.90E+0
Dinitrogen monoxide	-	-		kg	5.00E-7

(...)

- All data are directly taken from the APME publication
- Data "<1" estimated with 0.5
- Only "wastes to disposal" linked to background processes on waste treatment
- No uncertainty ranges

Second approach (2): disaggregated data

Name	Location	Infrastructure	Unit	epoxy resin, liquid, disaggregated data, at plant
Location				RER
InfrastructureProcess				0
Unit				kg
electricity, medium voltage, production UCTE, at grid	UCTE	0	kWh	2.19E+0
heavy fuel oil, burned in power plant	RER	0	MJ	1.10E+1
disposal, municipal solid waste, 22.9% water, to sanitary landfill	CH	0	kg	2.98E-1
transport, lorry 32t	RER	0	tkm	6.06E+1
Carbon dioxide, fossil	-	-	kg	6.50E-1

(...)

- Linkage of data to background processes (e.g. fuel oil energy supply)
- Disposal of process specific wastes linked to background processes
- Process specific emissions from publication, other emissions from database
- Own assumptions on infrastructure and transports according to ecoinvent guidelines
- No uncertainty ranges

Third approach (3): stoichiometric calculation

bisphenol A, powder, at plant	epichlorhydrin, at plant	sodium hydroxide, 50% in H2O, production mix, at plant
RER	RER	RER
kg	kg	kg
0.83	0.33	0.14

- Use of 3 pre-products in the stoichiometric ratio
- No process specific data for: yield, emissions, energy uses, infrastructure, process wastes, etc.
- Uncertainty is assessed

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Inventory Results (excerpt)

	Unit	1 aggregated kg	2 disaggregated kg	3 stoichiometric kg
cumulative energy demand	MJ-Eq	125.0	290.0	125.9
Land occupation	m2a	0.003	0.168	0.053
Carbon dioxide, fossil	kg	5.92	15.63	4.26
Nitrogen oxides	kg	0.035	0.093	0.013

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- Cumulative fossil energy use and CO_2 emissions much higher for disaggregated data

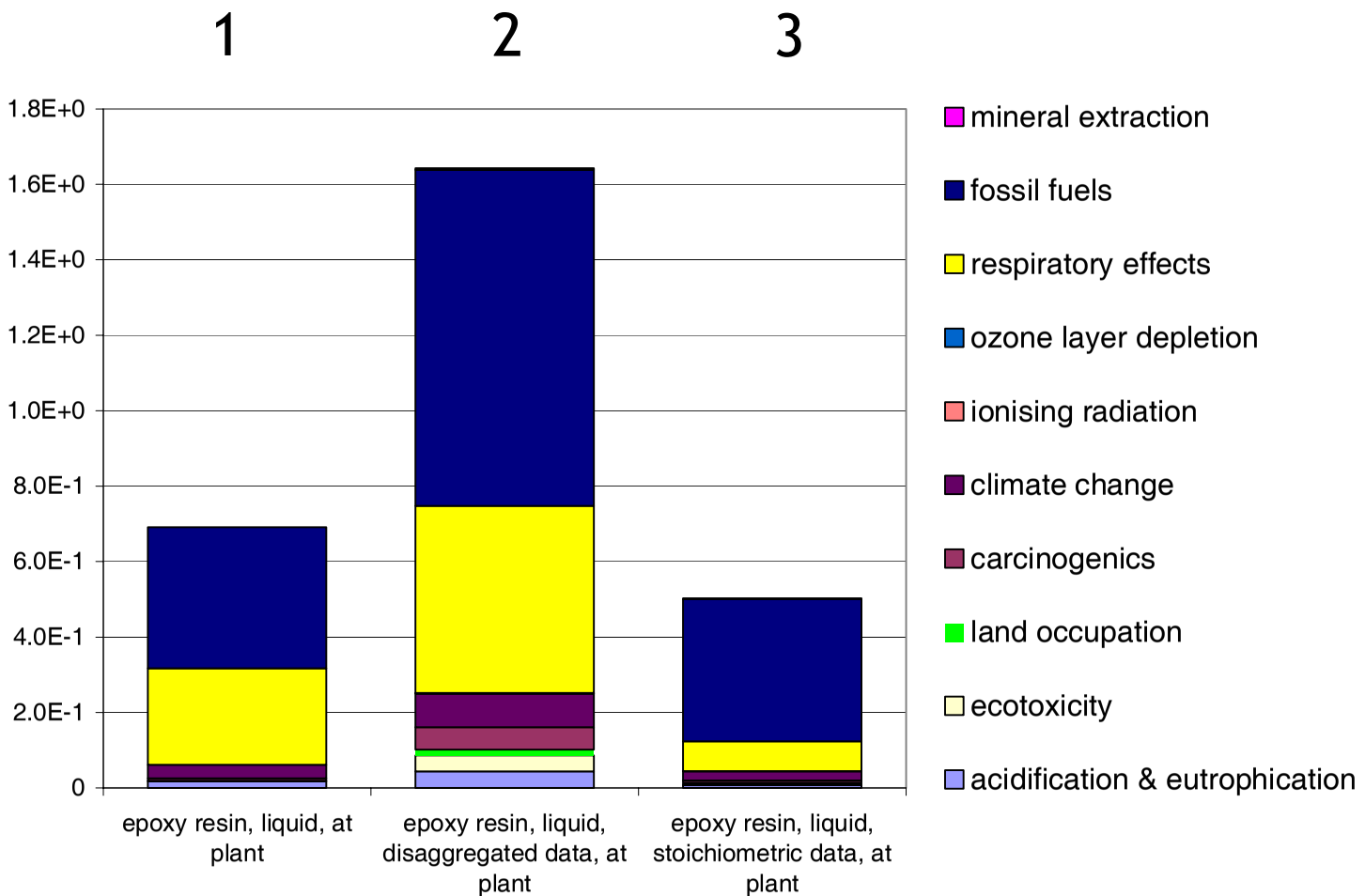
  => Lower transport distances seem to be used by APME
- Land use is much lower for aggregated data

  => Only from waste disposal, but no direct land use data in APME
- NOx emissions higher for disaggregated data

  => Emissions from transport and differing assumptions for combustion?

  => For stoichiometric calculated emissions are sometimes higher, energy is similar

Impact Assessment (EI'99 H,A)



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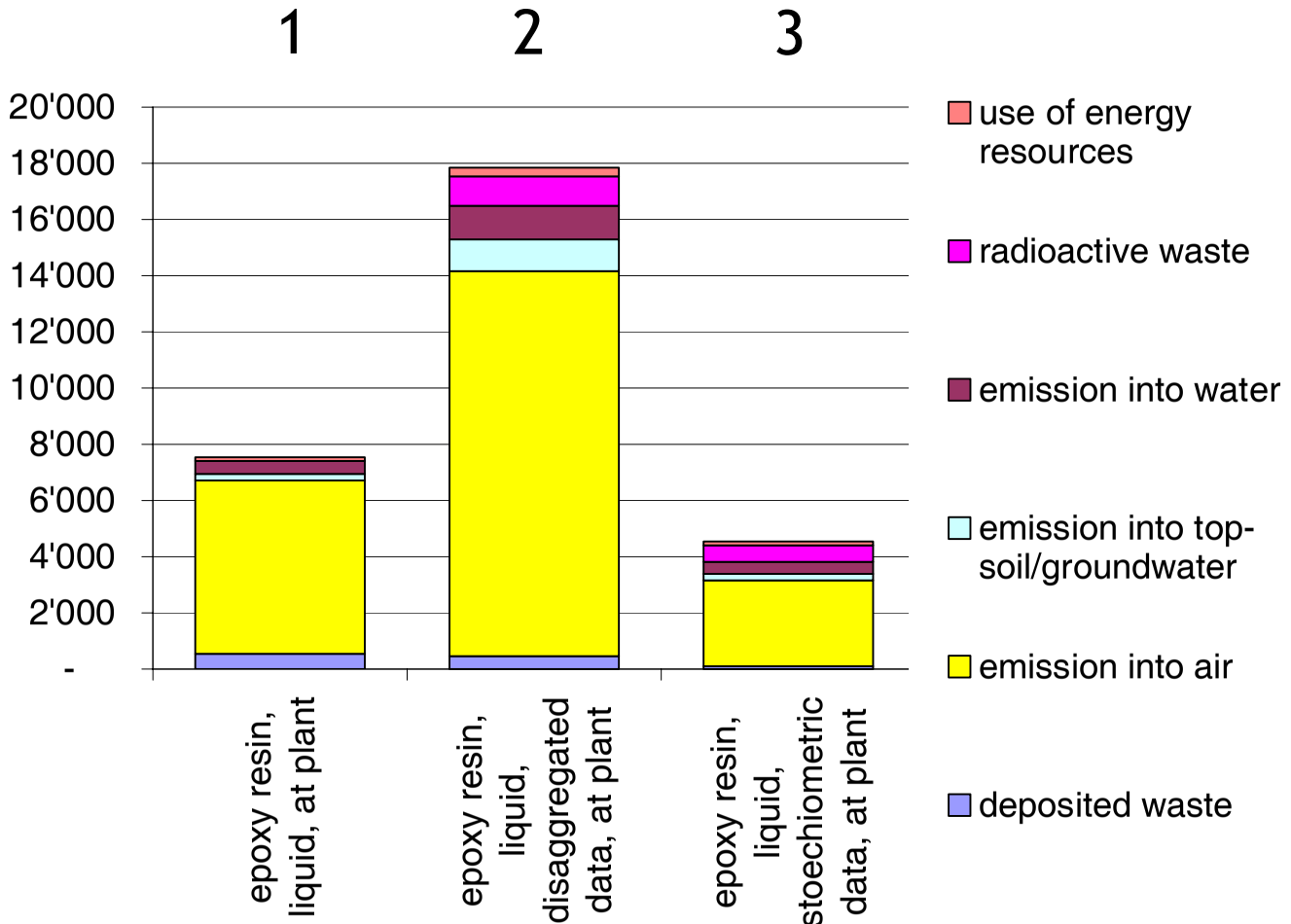
➢ Main difference: Energy use, respiratory effects (NOx)

Impact Assessment (ecological scarcity 97)



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- Main difference: NOx emissions, radioactive waste

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Summary

- **No perfect solution possible for the integration of cumulative data**
- In cumulative data certain aspects may be underestimated, neglected or inconsistent with unit process data
- Disaggregated data get a poor quality rating because important aspects like type of combustion, transport device, etc. are not known, assumptions might be inconsistent
- Stoichiometric data may miss important direct process impacts

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➢ ecoinvent Database uses the original cumulative data (first approach)

➢ It is recommended to use these as background data but not for comparison with materials investigated in detail

Outlook

- Industrial data and averages are an important and necessary part of LCI databases
- Ideally, industrial data are supplied to database operators on a unit process basis
- If necessary, confidentiality can be ensured by database operator
- Horizontal industry averages on a unit process basis are no problem
- Vertical accumulation decreases data usability and comparability and thus data quality of further LCA studies
- A good example for industrial databases is e.g. the LCI report on Aluminium published by the European Aluminium Association

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