

# Quantitative / Qualitative Approach towards the Assessment of Sustainable Building

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# Quantitative / Qualitative Approach towards the Assessment of Sustainable Building

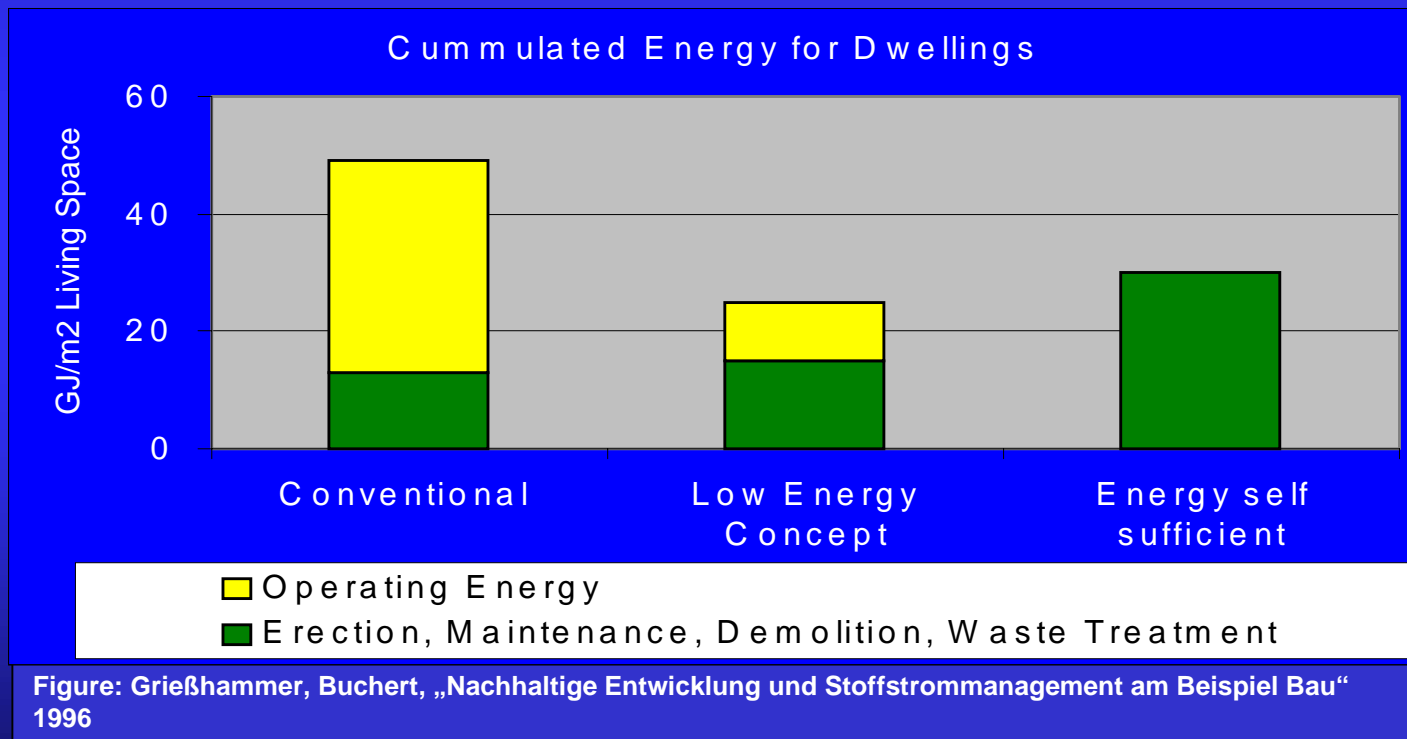
- Objectives
- Assessment Tool
- Sustainability Analysis of Floor Elements
- Conclusion



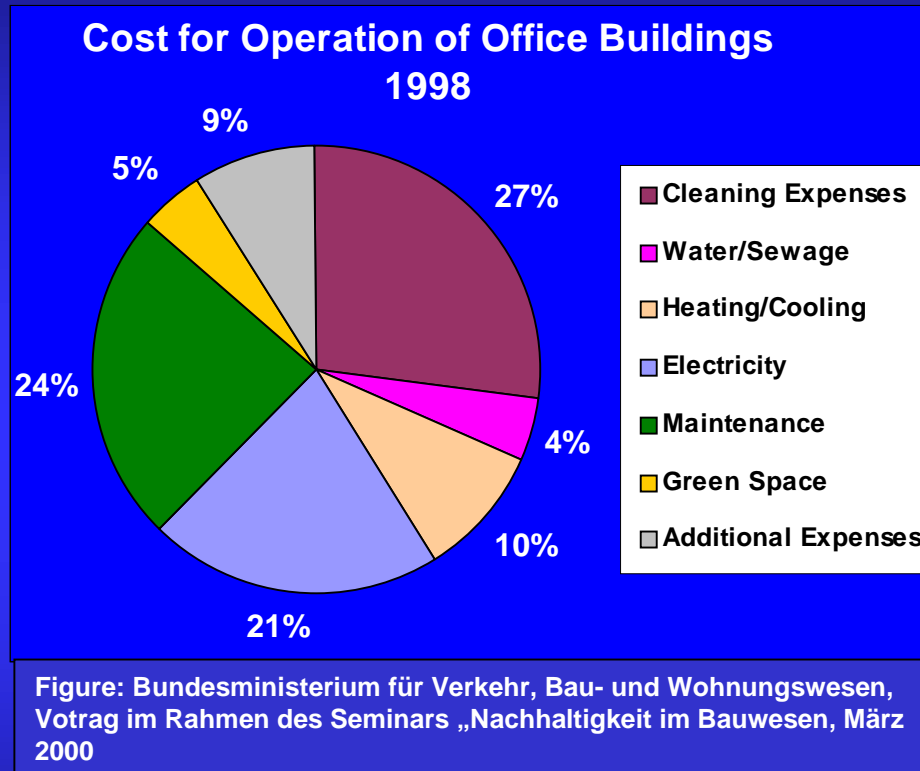
# Sustainable Development

## Main focus of research in Europe

- Decrease of operating energy (Heating/Cooling)
- Life cycle assessment of building material



# Sustainable Development



Natural Resources  
are buried in our  
buildings and  
usually end as  
landfill

➔ **Changing Regulations for Waste Treatment**

# Sustainable Building

## Objectives of New Waste Regulations

➔ Reduction

➔ Recycling and Reuse

➔ Application of demountable elements, e.g. prefabricated parts for building services

➔ Application of separable connections between adjacent material layers

Transparent description of advantages and disadvantages?

➔ Assessment Tool with an emphasis on the analysis of maintenance, demolition and waste treatment



# Functional Unit of an Assessment

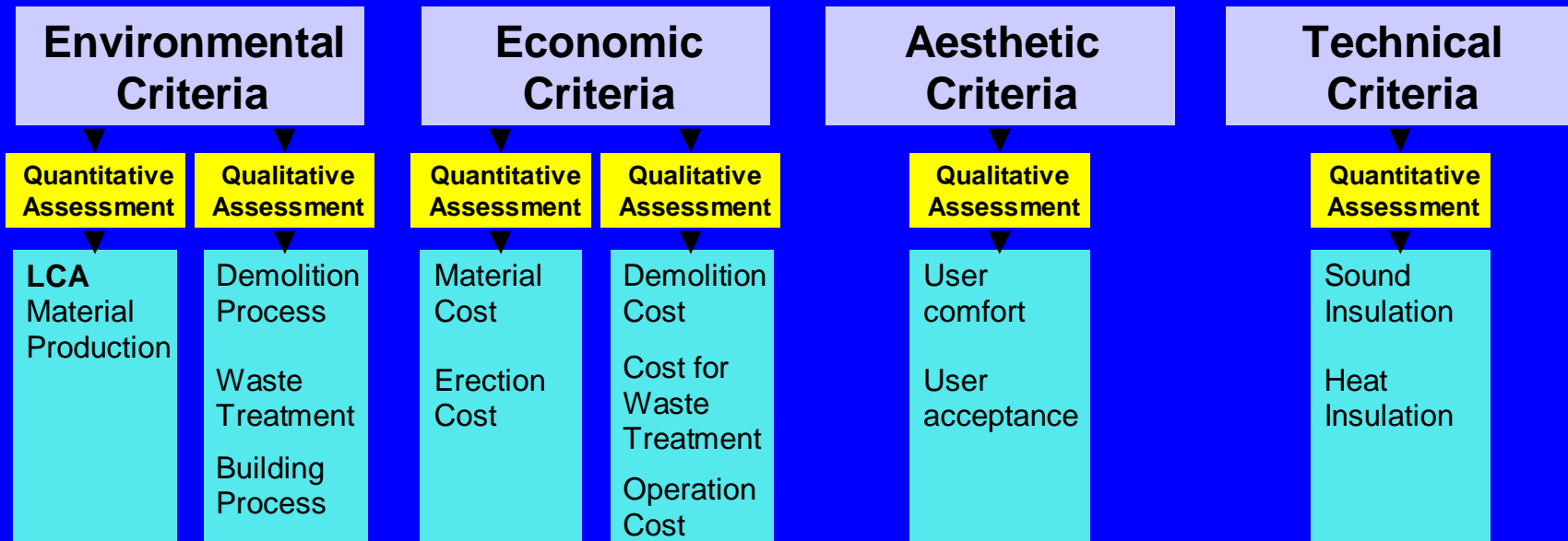
Functional Unit	Objective of Analysis	Example
Unit Mass of Material	Weak-Point-Analysis and optimization of material production	kg Cement
Unit Volume of Waste Material	Weak-Point-Analysis and optimization of waste treatment	m <sup>3</sup> Building Rubble
Unit Area of Building Element	Optimization of Elements (Materials, Connections, Maintenance, Waste Treatment)	m <sup>2</sup> Floor Element
Building	Optimization of Building Elements Optimization of Operating Energy	Building with e.g. 120m <sup>2</sup> Living Space



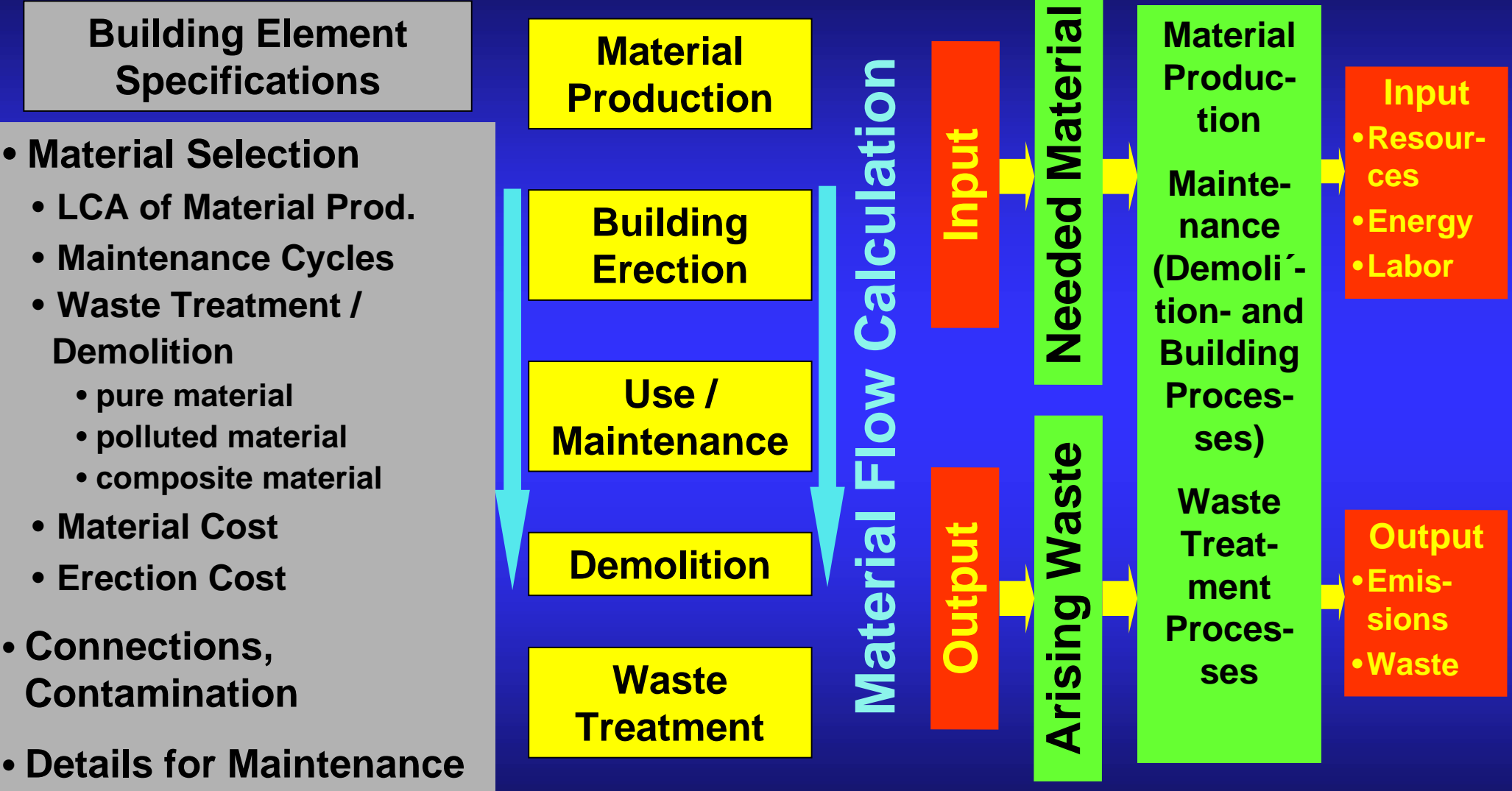
# Assessment of Building Elements

## Development of an Assessment Tool

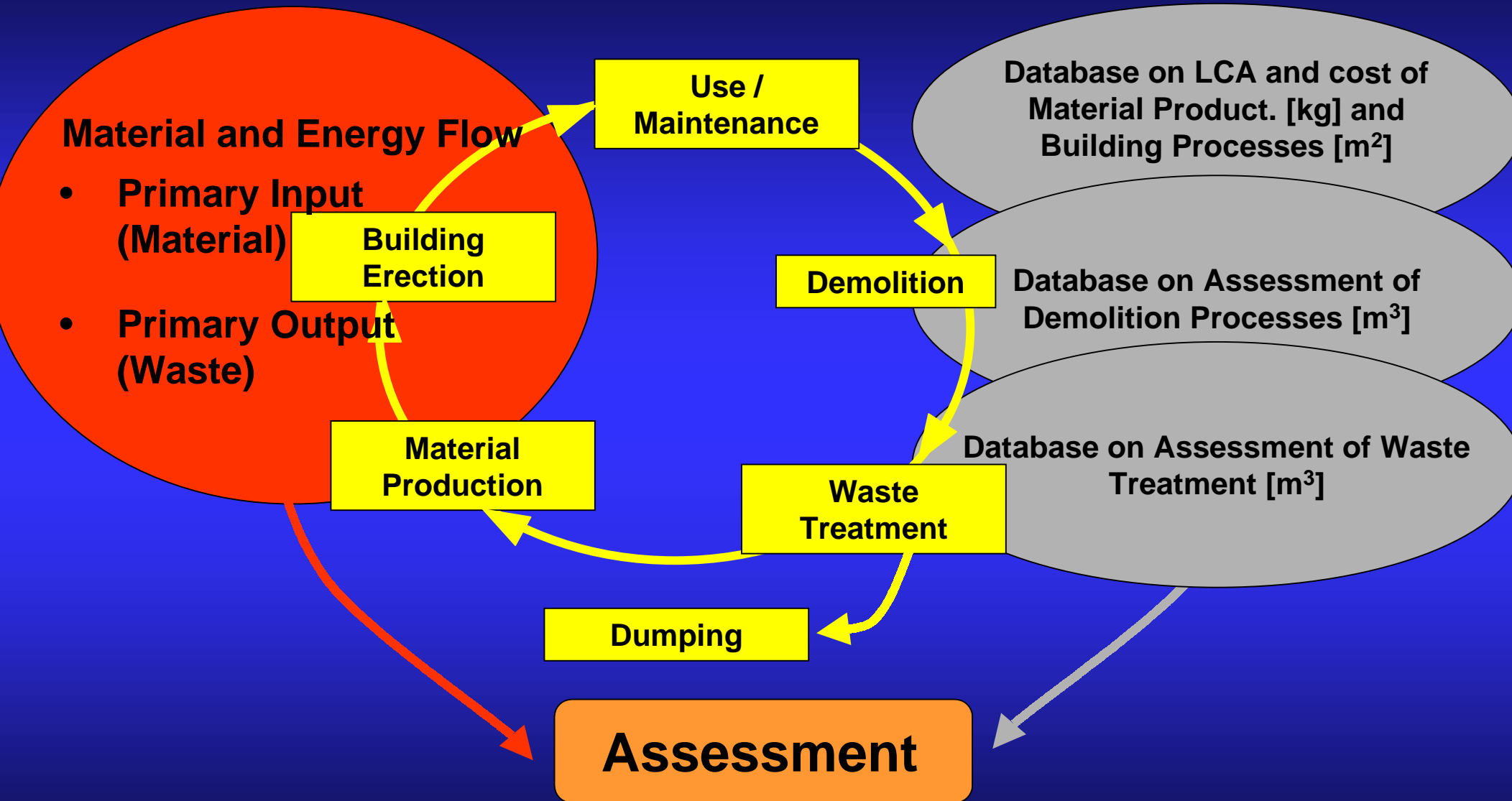
### Evaluation of Sustainable Building



# Assessment and Analysis Tool (Building Element Level)



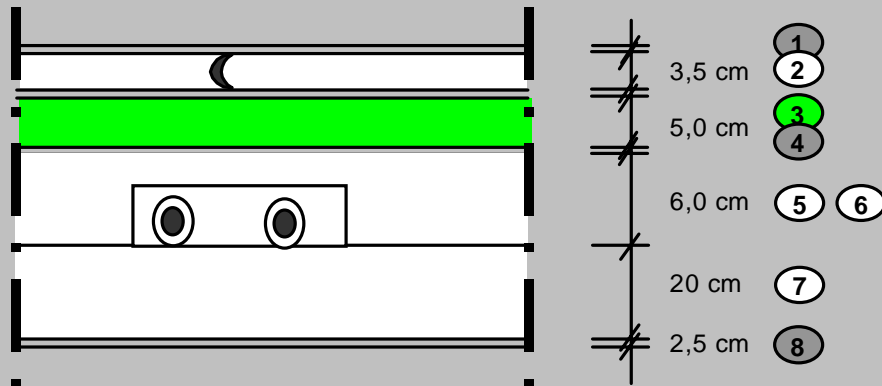
# Connection of Material Flow and Database



# Assessment of Floor Elements

Floor Assembly F1 (Conventional Floor Assembly)

K-Value: 0,49 W/m<sup>2</sup>K

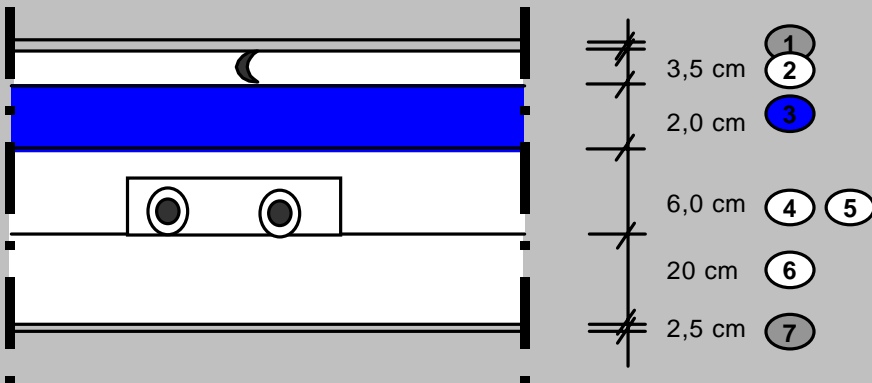


## Connections

①	Sealing (Epoxy)	(4)
②	Parquet Flooring (Wood) / Adhesive	(4)
③	Levelling Render (Cement)	(3)
④	Foil (PE-Membrane)	(1)
⑤	Insulation (Glasswool)	(1) (3)
⑥	Ducts, Heating Ducts (Copper) (1,5%)	(1) (3)
⑦	Refabricated Concrete	(4)
⑧	Plaster (gypsum)	(4)

Floor Assembly F2 (Demountable Floor Assembly)

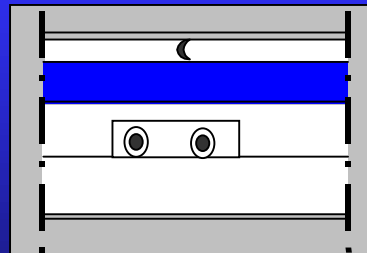
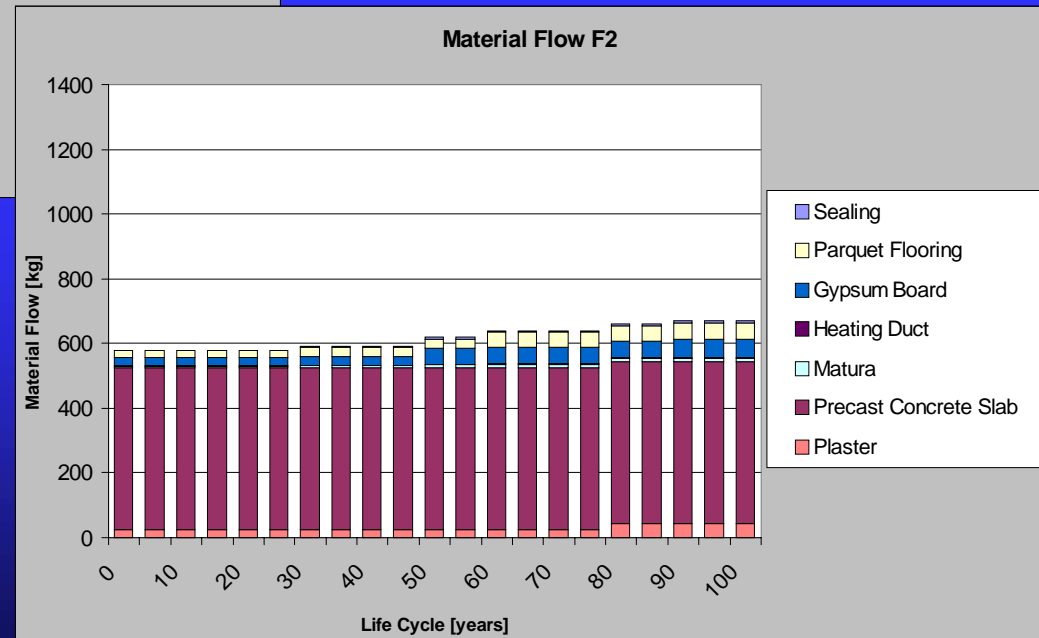
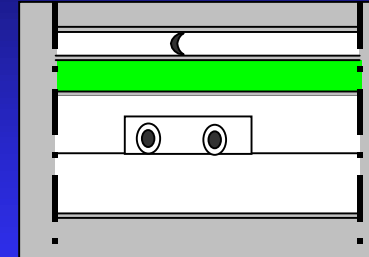
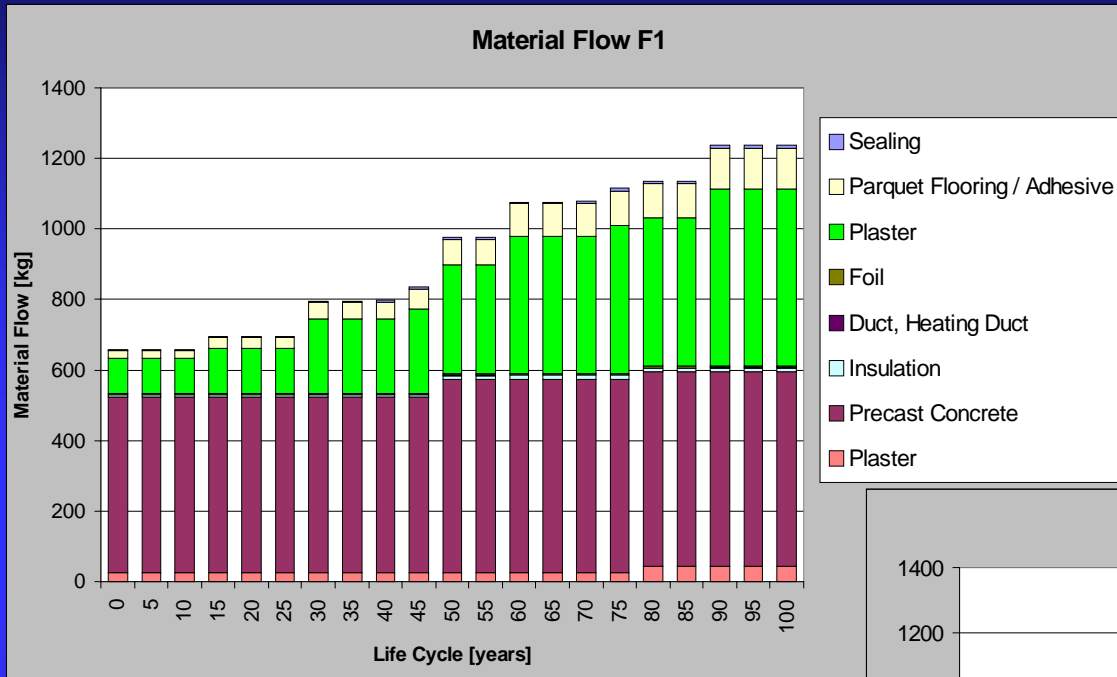
K-Value: 0,48 W/m<sup>2</sup>K



## Connections

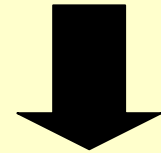
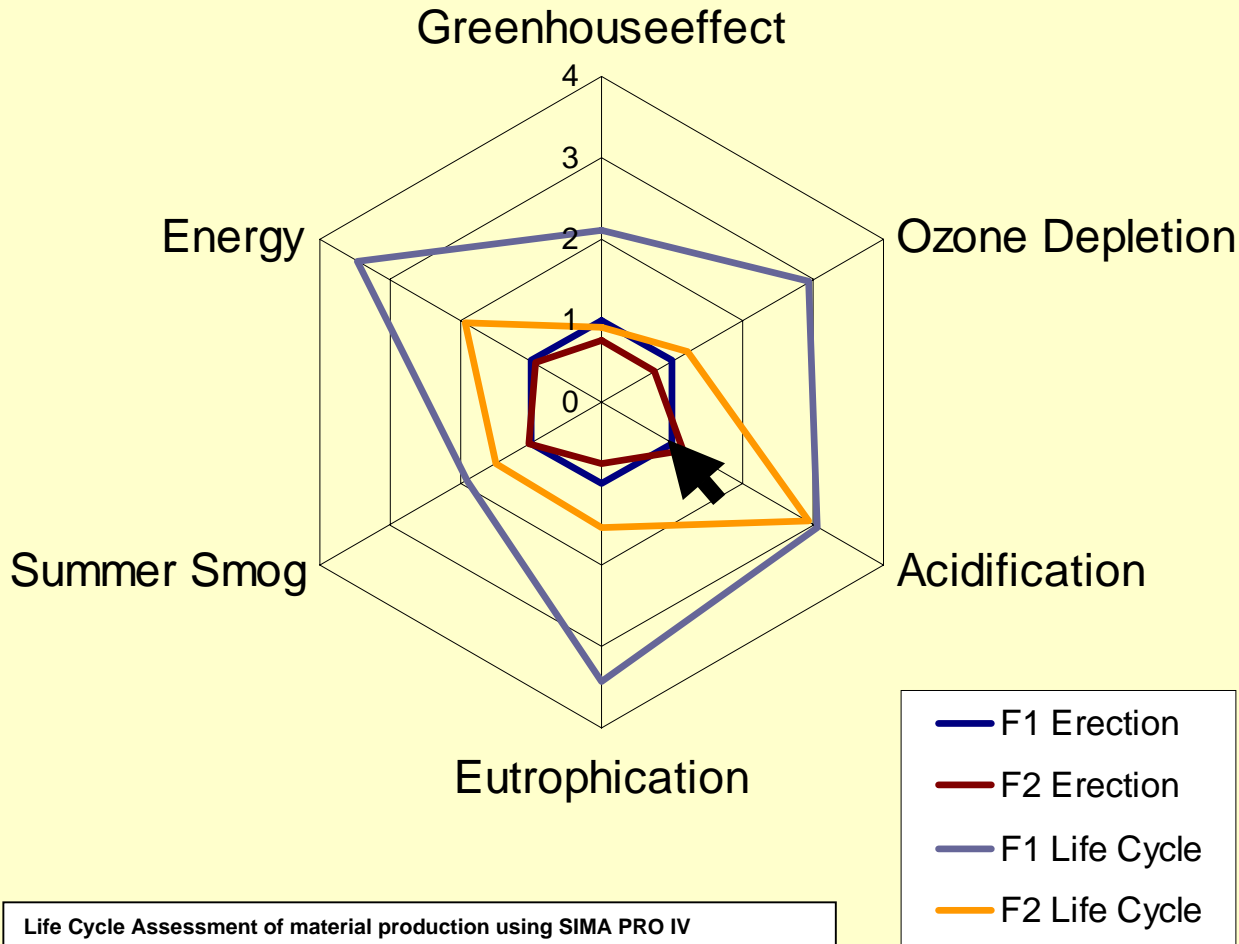
①	Sealing	(4)
②	Parquet Flooring / Adhesive	(1)
③	Gypsumboard (heavy)	(1)
④	Matura (Insulation: Glasswool)	(1) (1)
⑤	Heating Ducts (Copper) (3%)	(1) (1)
⑥	Prefabricated Concrete	(4)
⑦	Plaster	(4)

# Material Flow of Floor Elements

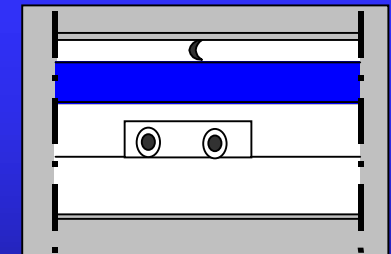


# Life Cycle Assessment (Quantitative)

Life Cycle Assessment of Material Production



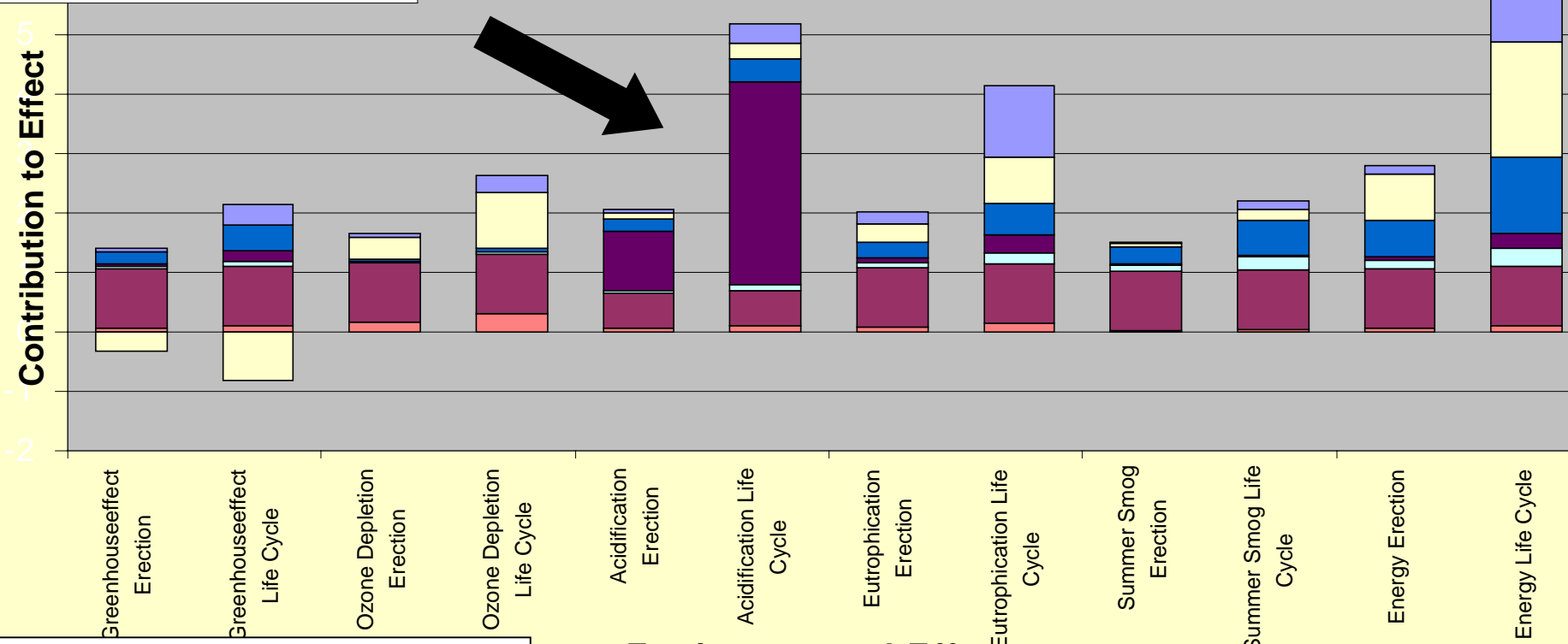
**Acidification  
Floor  
Assembly F2**



# Life Cycle Assessment Floor F2

Life Cycle Assessment F2 - Normalized Values  
(Maximum)

- Sealing
- Parquet Flooring
- Gypsum Board
- Heating Duct
- Matura
- Precast Concrete Slab
- Plaster

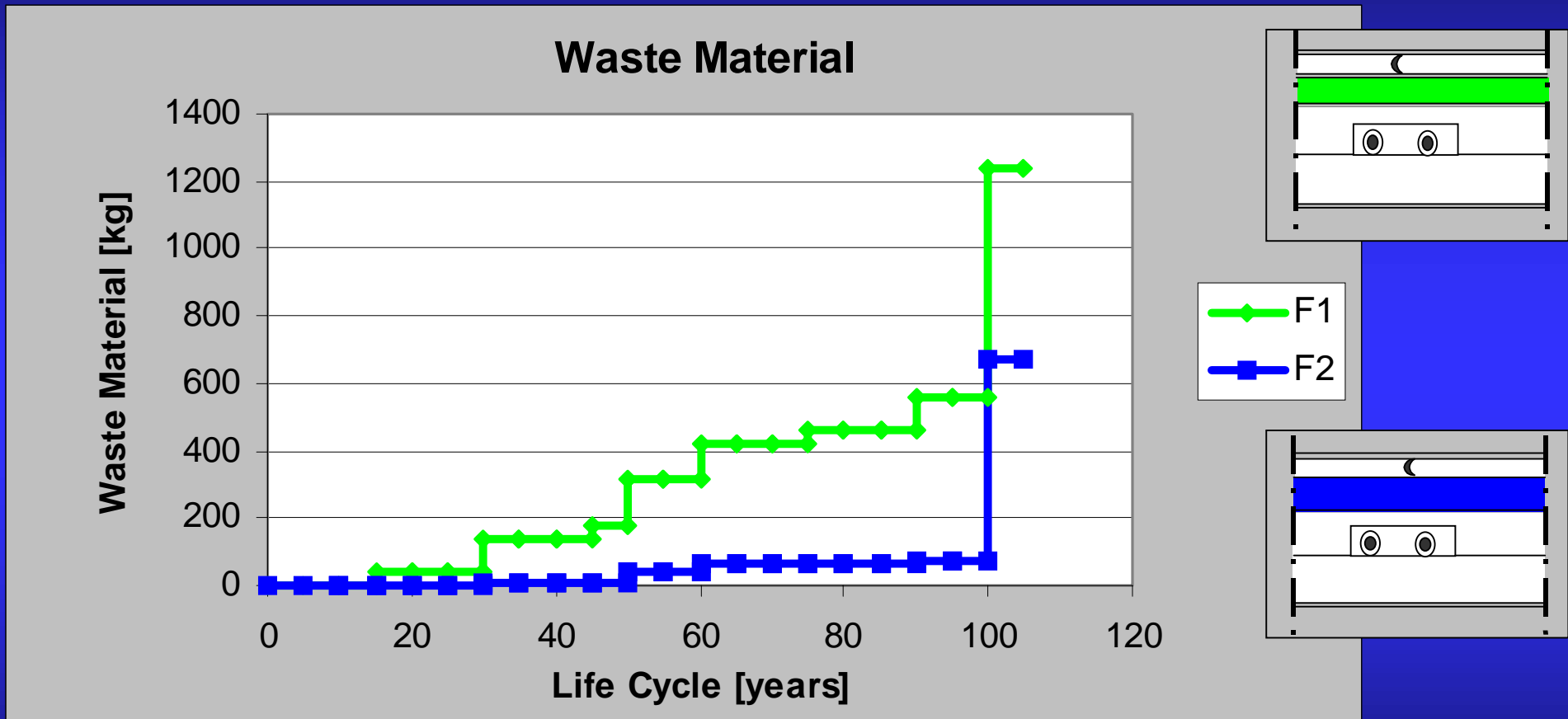


Life Cycle Assessment of material production using SIMA PRO IV

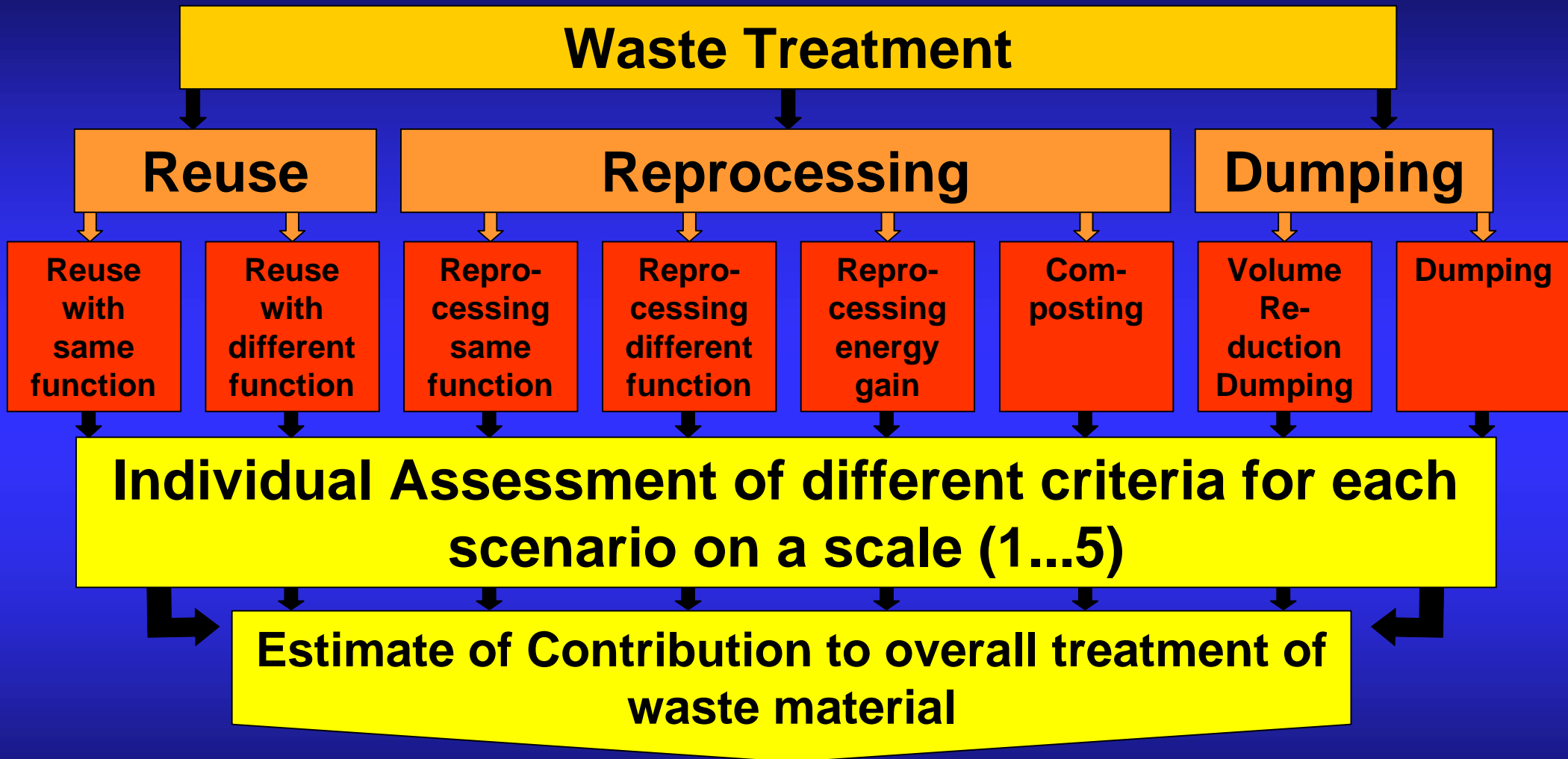
Environmental Effects



# Waste Material Flow



# Assessment of Waste Treatment



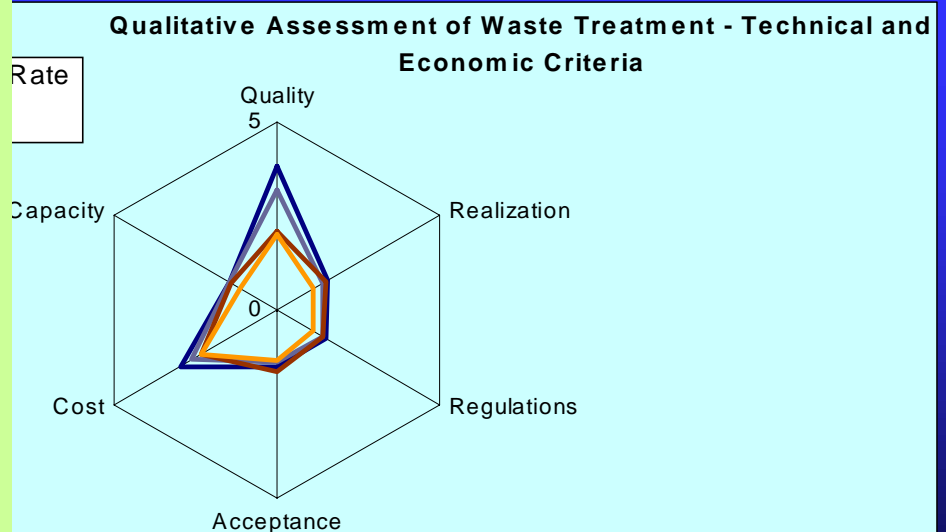
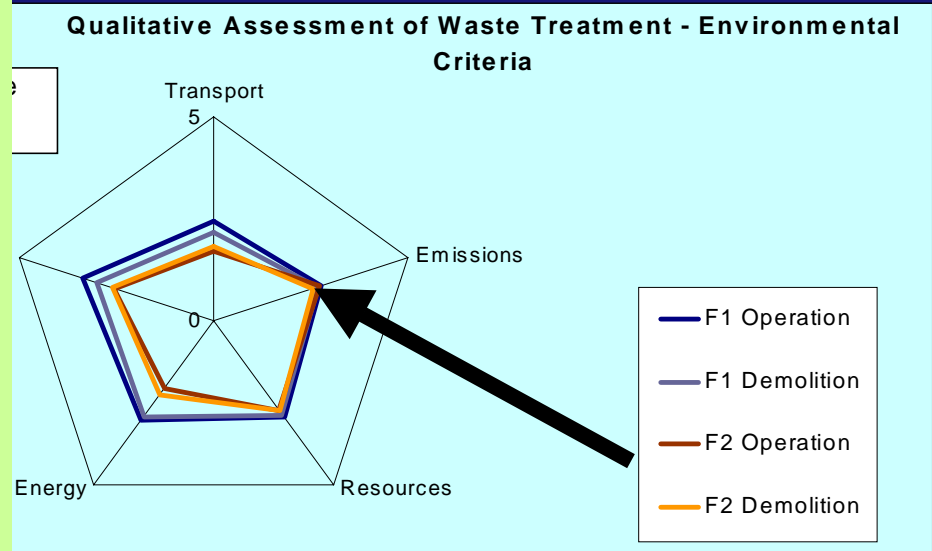
## Overall Performance of Waste Material Treatment



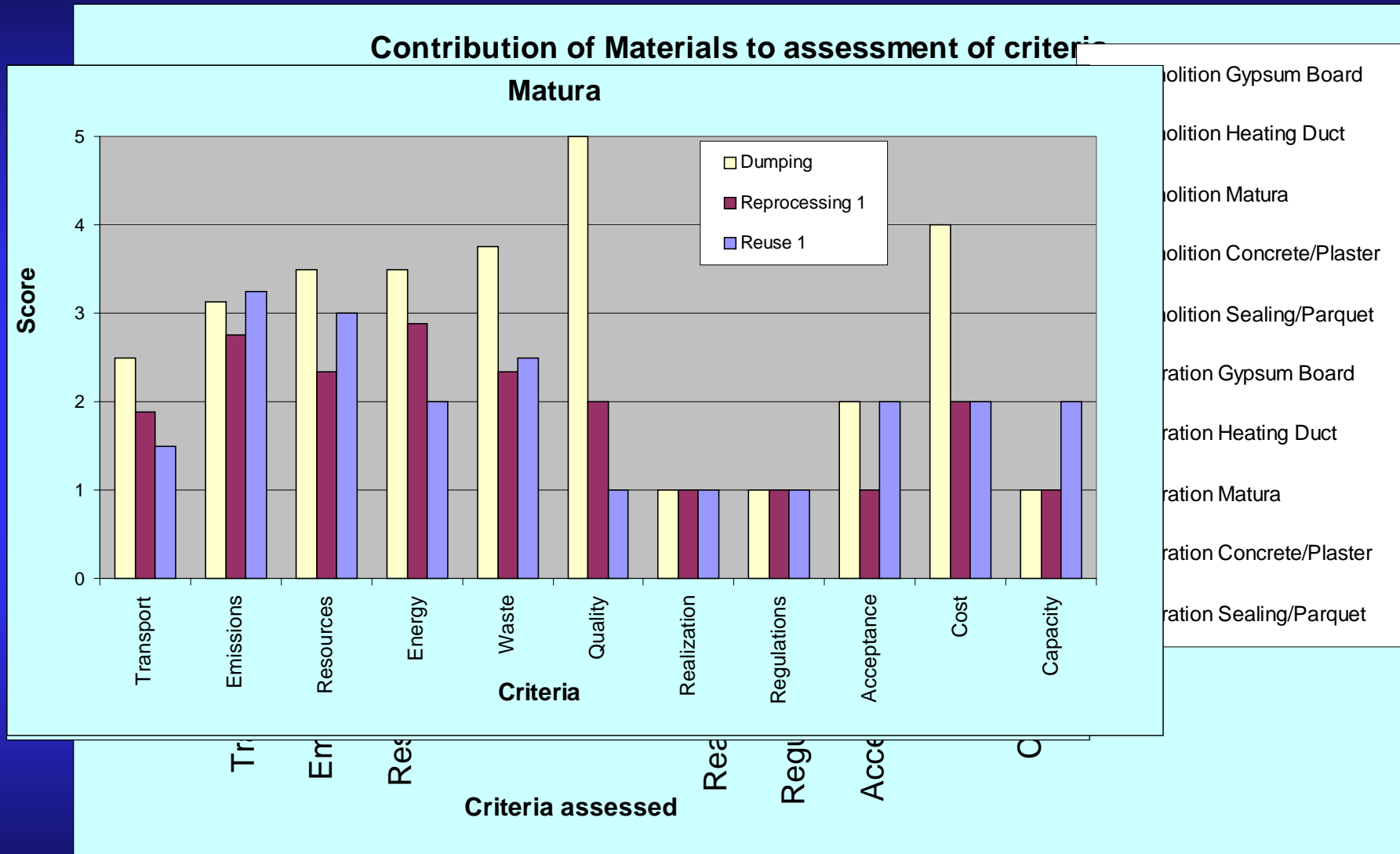
# Assessment of Waste Material

## Optimization

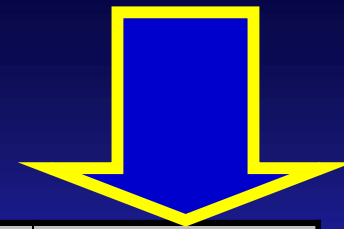
- 1) Identification of material that contributes most to a “low” ranking
- 2) Reducing the amount of that waste
  - different material
  - demountable connections
- 3) Optimization of contribution of waste treated according to different scenarios considered
- 4) Optimization of waste treatment itself.



# Assessment of Waste Material (Floor F2)



# Overall Assessment



Life Stage	Assessment	Criteria	Qualitative (X)/ Quantitative (XX)	Floor F1	Floor F2
Erection	LCA Material	Environmental	XX	0	0
	Building Process	Environmental	X	0	0
	Erection Cost	Economic	XX	+	-
Operation	LCA Material	Environmental	XX	-	+
	Building Process	Environmental	X	-	+
	Demolition Process	Environmental	X	--	++
	Waste Treatment	Environmental	X	-	+ (Vol.)
	Waste Treatment	Economic / Technical	X	-	+ (Vol.)
	Maintenance Cost	Economic	XX	-	+
	Demolition Cost	Economic	X	-	+
	Heat Transmission Coefficient	Technical	XX	0	0
	Comfort	Aesthetic	X	+	-
Demolition	Demolition Process	Environmental	X	-	+
	Waste Treatment	Environmental	X	-	+ (Vol.)
	Waste Treatment	Economic / Technical	X	-	+ (Vol.)
	Demolition Cost	Economic	X	0	0



# Conclusion

- **A comparative sustainability analysis of building elements must be based on the functional unit „Element“**
- **The consideration of the whole life cycle is substantial**
- **The completion of quantitative assessable criteria with qualitative assessable criteria (ranking) avoids problem shifting**
- **The final evaluation will be done individually**
- **The tool developed so far is useful for an optimization and analysis of structures, but at this stage can not give a „One Value“ result for the assessment of sustainability**

