



## **Coatings for Sustainable Buildings**

### **Requirements of coatings**

**with regard to sustainability,**

**health, environment, quality**

**and life cycle**



## Coatings for Sustainable Buildings





## Coatings for Sustainable Buildings

- What is „green“ ?
  - The concept of sustainability
    - Building certification
      - Criteria for products: PCF, LCA, EPD ...
        - Criteria for products: RMI concept
          - Future development: Individual concepts
            - Summary and discussion

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## What is „green“ ?



### ■ Living in the nature / with the nature?

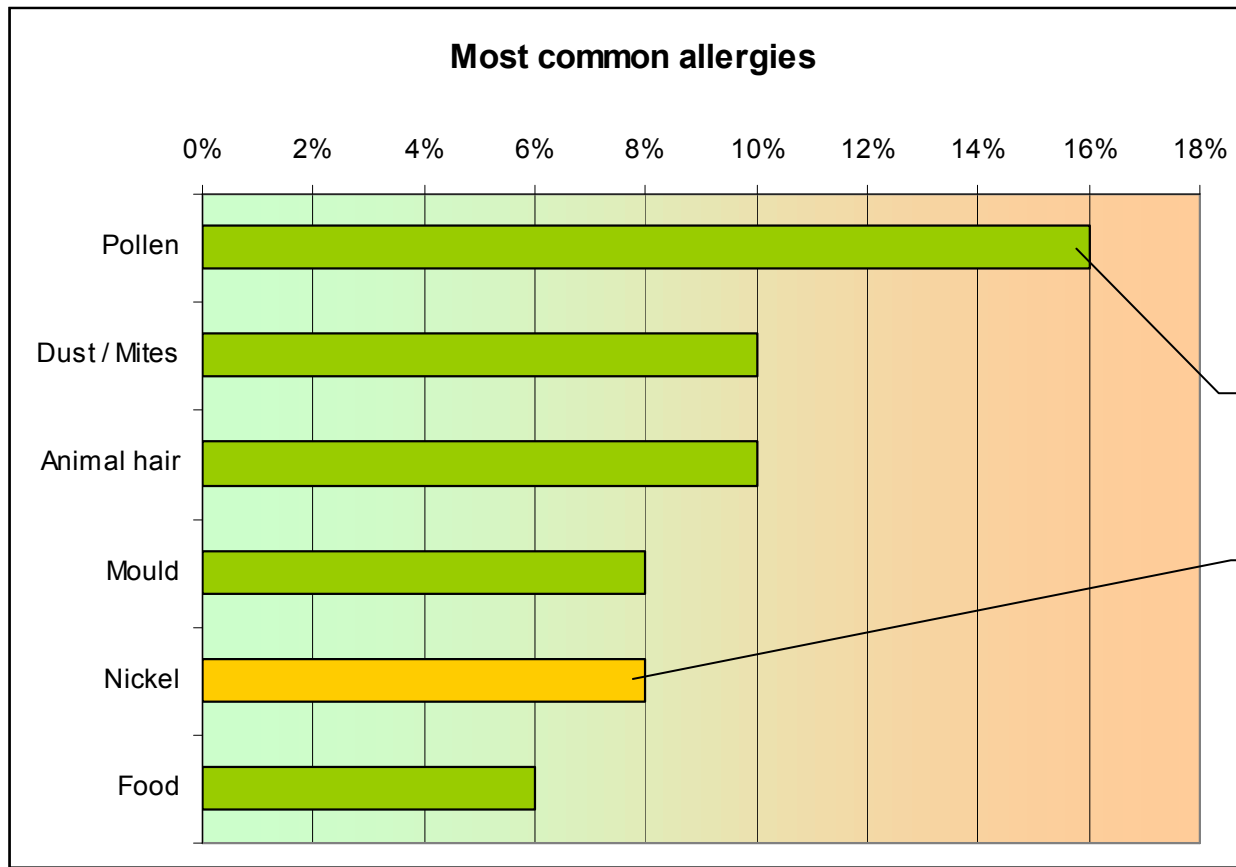




# What is „green“ ?



## ■ Using natural materials ?



„natural“

„chemical“



## What is „green“ ?



- Minimizing energy consumption ?

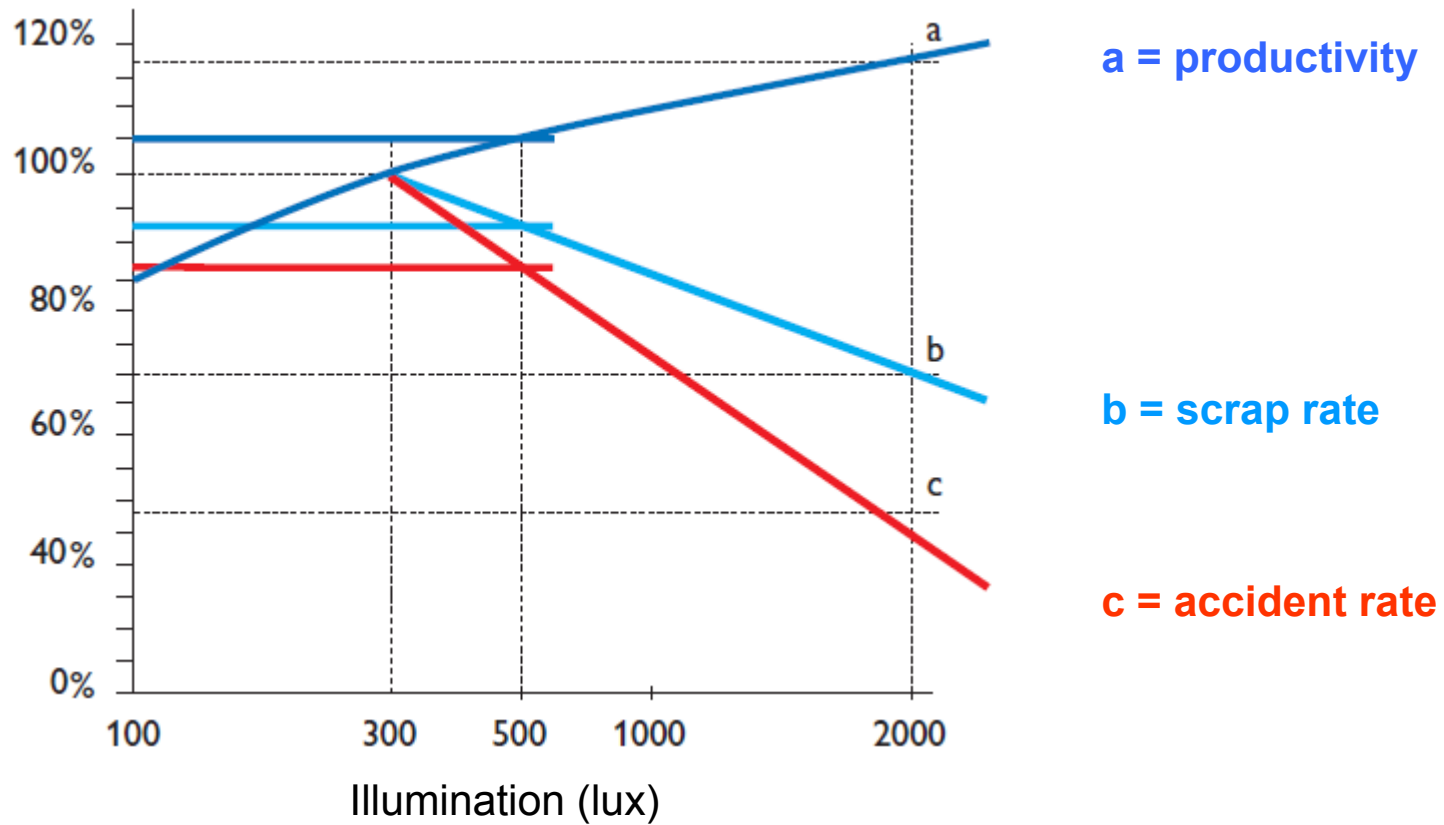




# What is „green“ ?



## ■ Minimizing energy consumption ?







## What is „green“ ?



### Conclusion:

**„Green“ is an incomplete description  
for what is expected  
from the performance  
of modern buildings.**

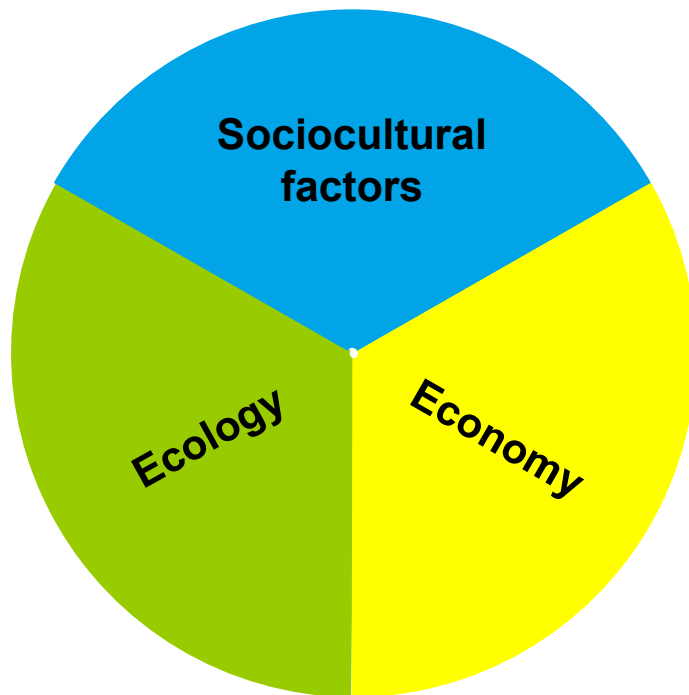


## Coatings for Sustainable Buildings

- What is „green“ ?
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## What is the meaning of sustainability?



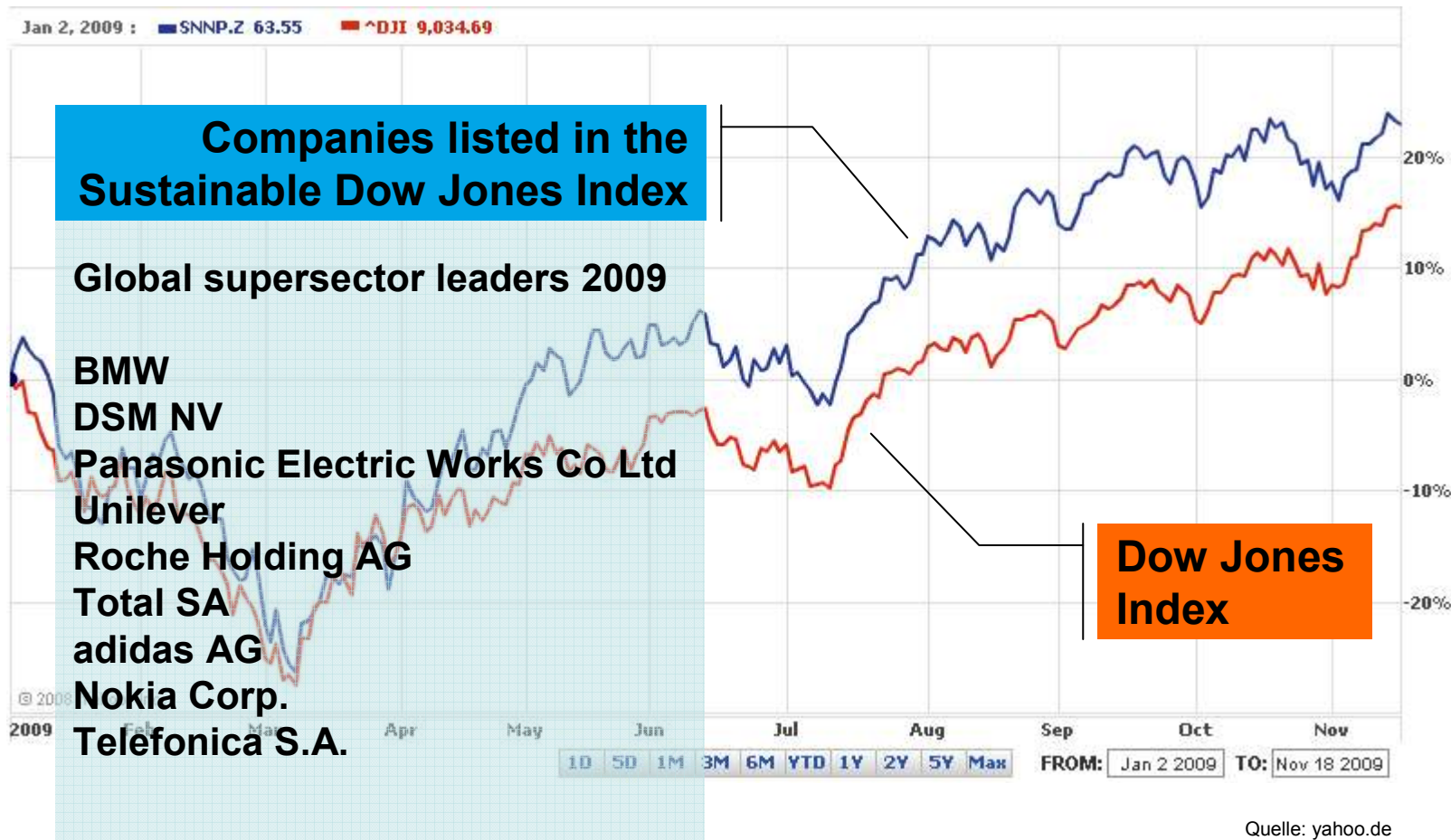
If you plan for a year, you should seed grain,  
If you plan for a decade, you should plant trees,  
If you plan for a lifetime, you should educate humans.

*Guan Zhong (ca. 650 AC)*





# The concept of sustainability



## Coatings for Sustainable Buildings

- What is „green“ ?
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## Building certification



### Motivation for building certification

- **Comparability**
- **Value stability**
- **Image improval**
- **Legal certainty for contracting parties**
- **Possibility of governmental influence**





## Sustainability certification systems for buildings:



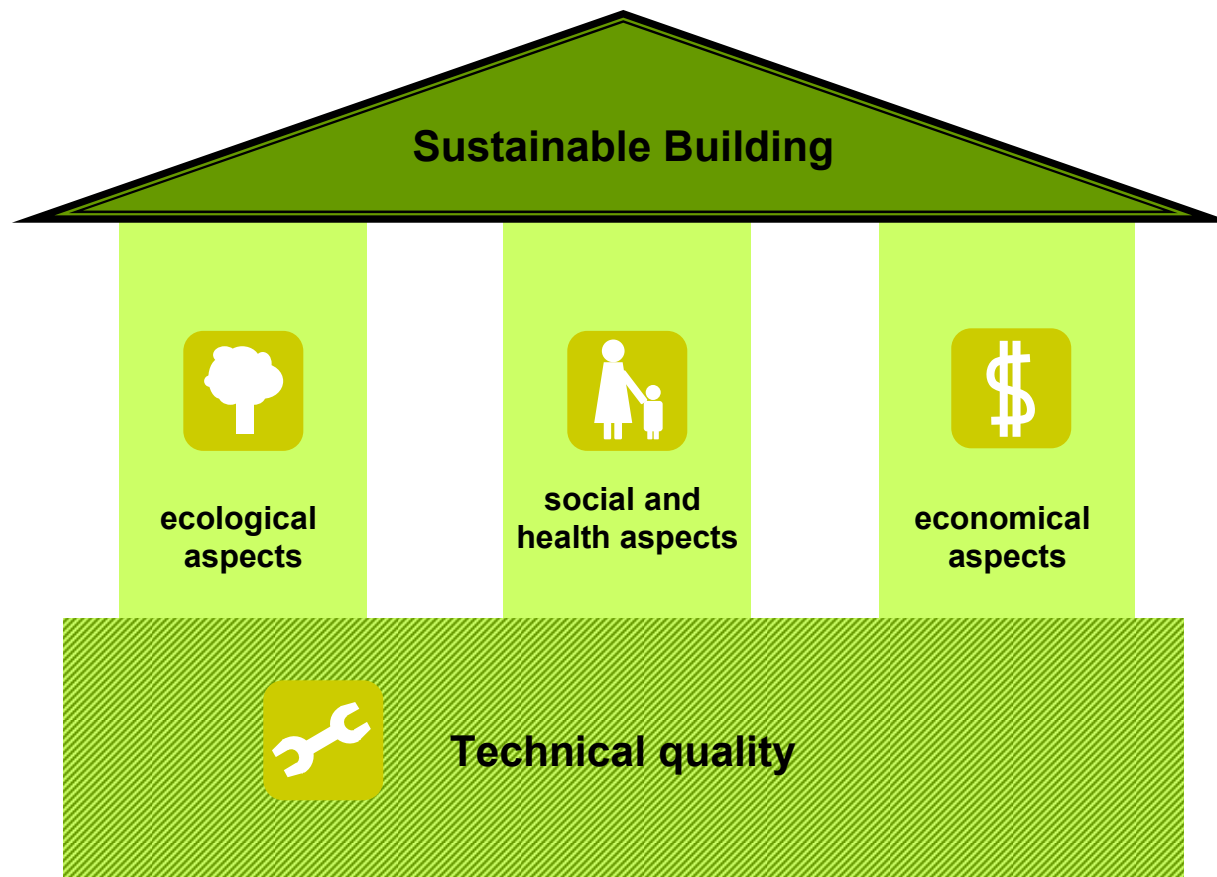
- **BREEAM (UK)**  
since 1990  
> 100.000 certified buildings
- **LEED (USA)**  
since 1998  
> 4.000 certified buildings
- **DGNB (GER)**  
since 2007  
rapidly growing



## Building certification



## Criteria for certified buildings





## Criteria for certified buildings: Example DGNB

■ Ease of cleaning and maintenance

■ Quality of contractors



■ Indoor air quality

■ Visual comfort



■ Acoustic comfort

■ Global warming potential



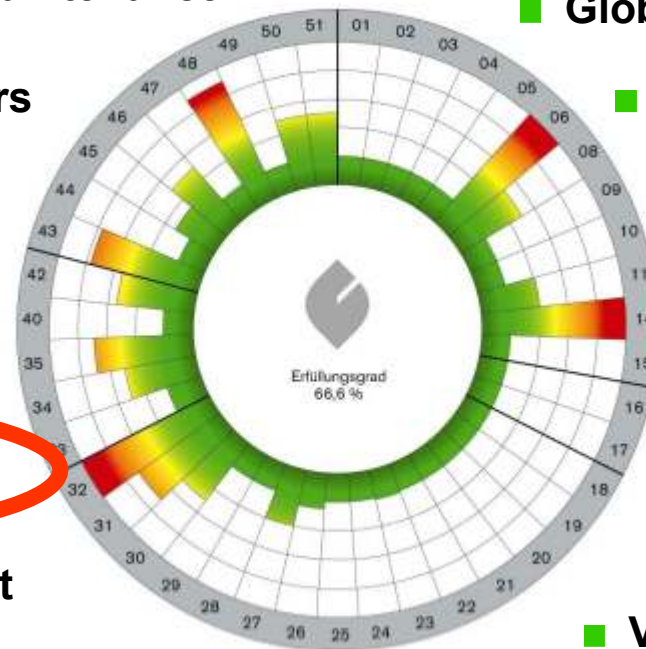
■ Ozone depletion potential

■ Risk to the environment

■ Energy consumption

■ Life cycle costs

■ Value stability



### Criteria for certified buildings: Example DGNB / Indoor Air Quality



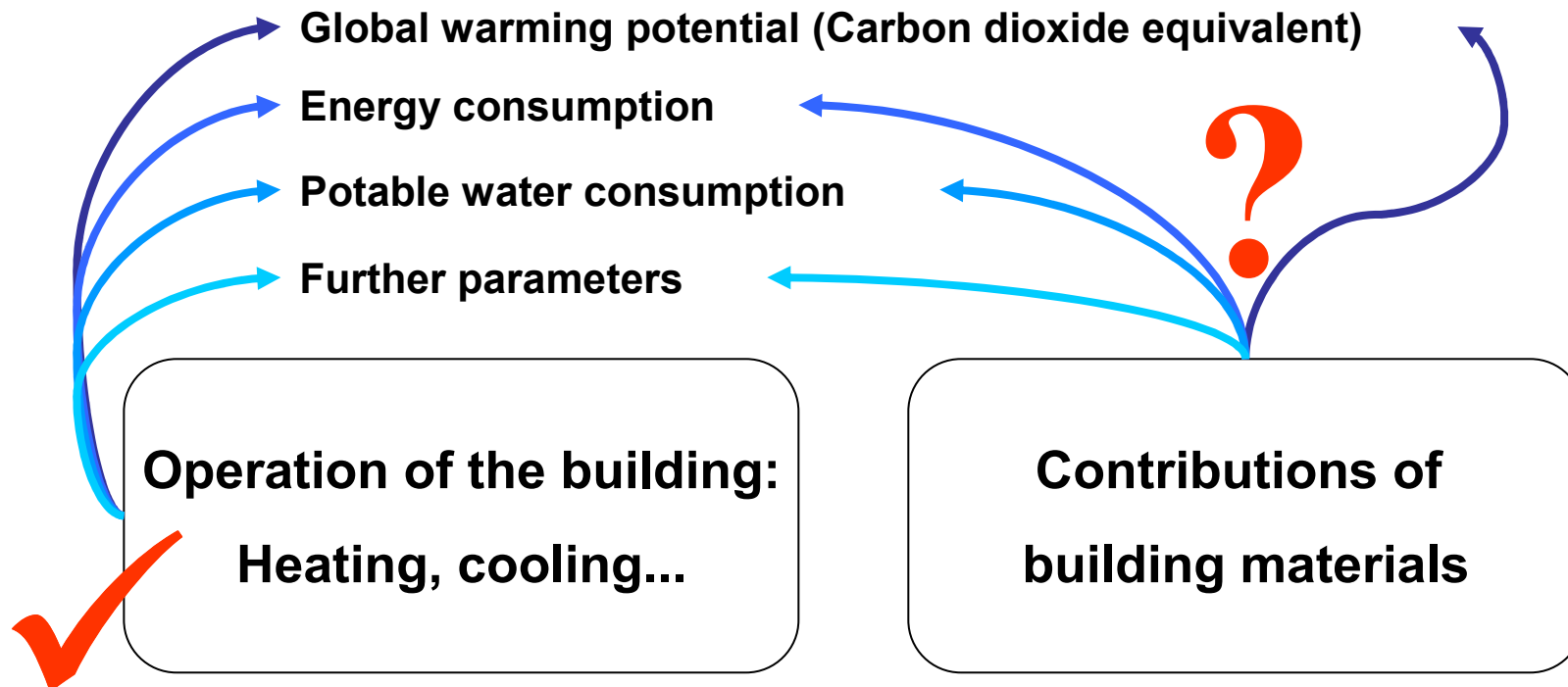
- No criteria for construction products
- Indoor air analysis as acceptance test
- Recommendation: Low emitting products
- Responsibility at architect / designer
- Uncertainty about final results
- Need for input from producers

## Coatings for Sustainable Buildings

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## Building certificates: Life cycle analysis (LCA)

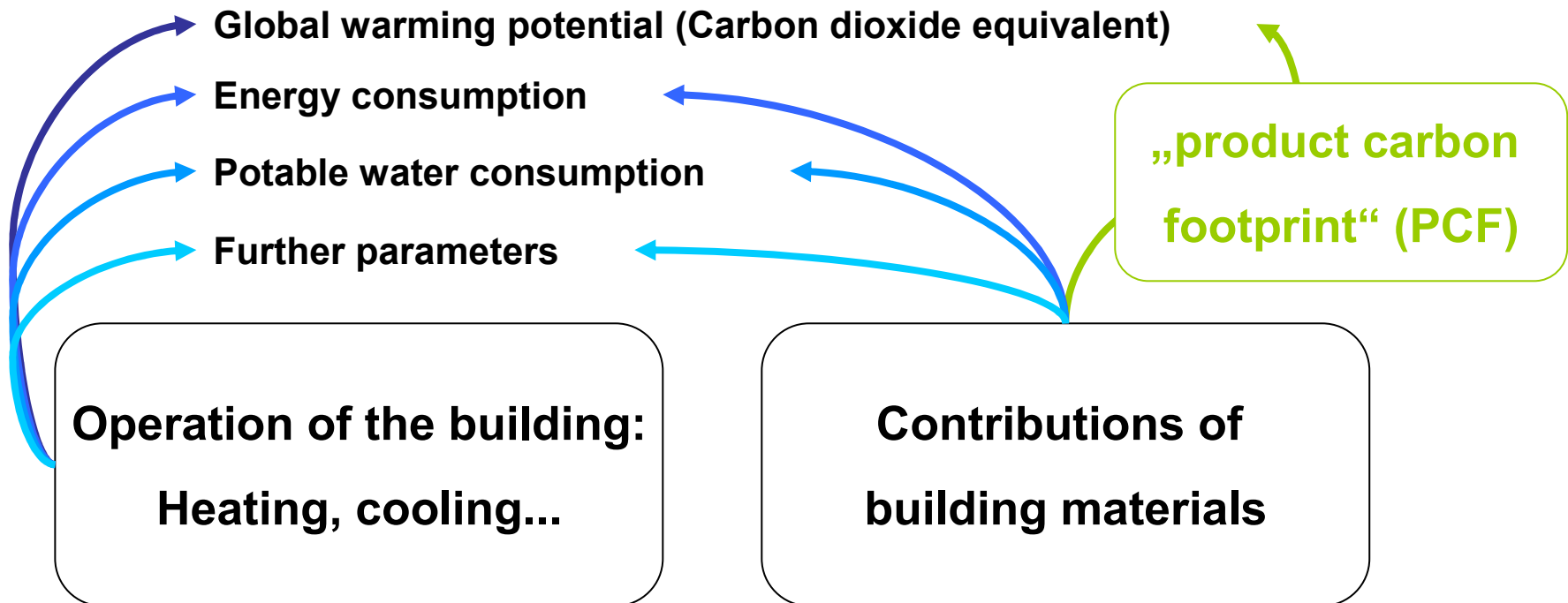
- Important criterion for sustainability: Life cycle effects on environment





## Building certificates: Life cycle analysis (LCA)

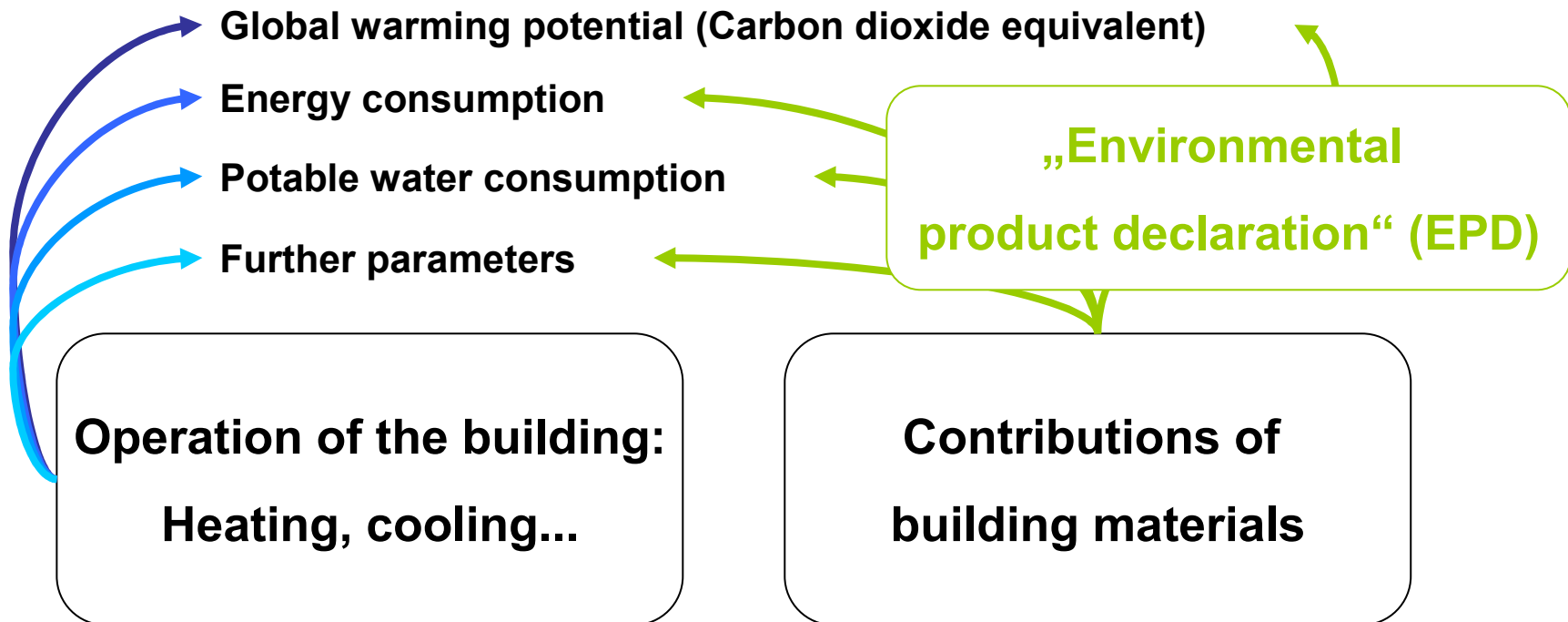
- Important criterion for sustainability: Life cycle effects on environment





## Building certificates: Life cycle analysis (LCA)

- Important criterion for sustainability: Life cycle effects on environment





## Life cycle analysis (LCA): Contribution of coatings

- Contribution is calculated via weight of product

	Skyscraper	Small house
Weight [to]	200000	40
Effective area [m <sup>2</sup> ]	320000	200
Indoor walls [m <sup>2</sup> ]	800000	500
Outdoor walls [m <sup>2</sup> ]	80000	150
Max. painted area [m <sup>2</sup> ]	880000	650
Weight of paint [to]	105,6	0,078
<b>Ratio of paint [%]</b>	<b>0,053</b>	<b>0,195</b>





# Criteria for products: PCF, LCA, EPD ...



## Conclusion:

- Very small contribution by coatings (~ 0.1 %)
- Literature data available from databases

Umweltindikatoren			
Indikatoren der Sachbilanz			
Indikator	Richtang	Wert	Einheit
<b>Inputs</b>			
Summe Primärenergie nicht regenerierbar	Input	56,37MJ	
- Braunkohle			8,8 %
- Steinkohle			10,2 %
- Erdgas			29,2 %
- Erdöl			40,7 %
- Urge			11,1 %
Summe Primärenergie regenerierbar	Input	0,95MJ	
- Wasserkraft			50,5 %
- Windkraft			41,0 %
- Sonnennutzung (Solarenergie)			0 %
- Sonnennutzung (Biomasse)			7,9 %
Summe Sekundärbrennstoffe	Input	0,0MJ	
Wassernutzung	Input	34,30kg	
<b>Outputs</b>			
Abraum und Erzaufbereitungsrückstände	Output	7,81kg	
Hausmüll und Gewerbeabfälle	Output	1,64E-5kg	
Sonderabfälle	Output	0,0124kg	
<b>Indikatoren der Wirkbilanz</b>			
Indikator	Wert	Einheit	
Abstrischer Ressourcenverbrauch	0,0068kg	Sb-Äquivalente	
Treibhauspotenzial	1,2845kg	CO <sub>2</sub> -Äquivalente	
Ozonabbaupotential	1,0902E-7kg	R11-Äquivalente	
Versauerungspotenzial	0,0036kg	SO <sub>2</sub> -Äquivalente	
Eutrophierungspotenzial	7,339E-4kg	PO <sub>4</sub> -Äquivalente	
Bodenoxide Ozonbildung	1,842E-4kg	C2H4-Äquivalente	

**Global warming potential of 1 kg interior wall paint: 1.2845 kg CO2 equivalent**

- No individual LCA, PCF or EPD needed as input for building certification
- Need for other criteria





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## Criteria for products: RMI concept



### Demands from the building certificates

**Chasing the train**

**Chances for  
new markets**

**Contribution of paints**

- Proactive assessment of products
- Presentation of the benefits of **high quality coatings**
- Robust criteria to support architects and planners



## Criteria for products: RMI concept



### High quality car



### Low quality car

### High quality paint



**Differentiation?**



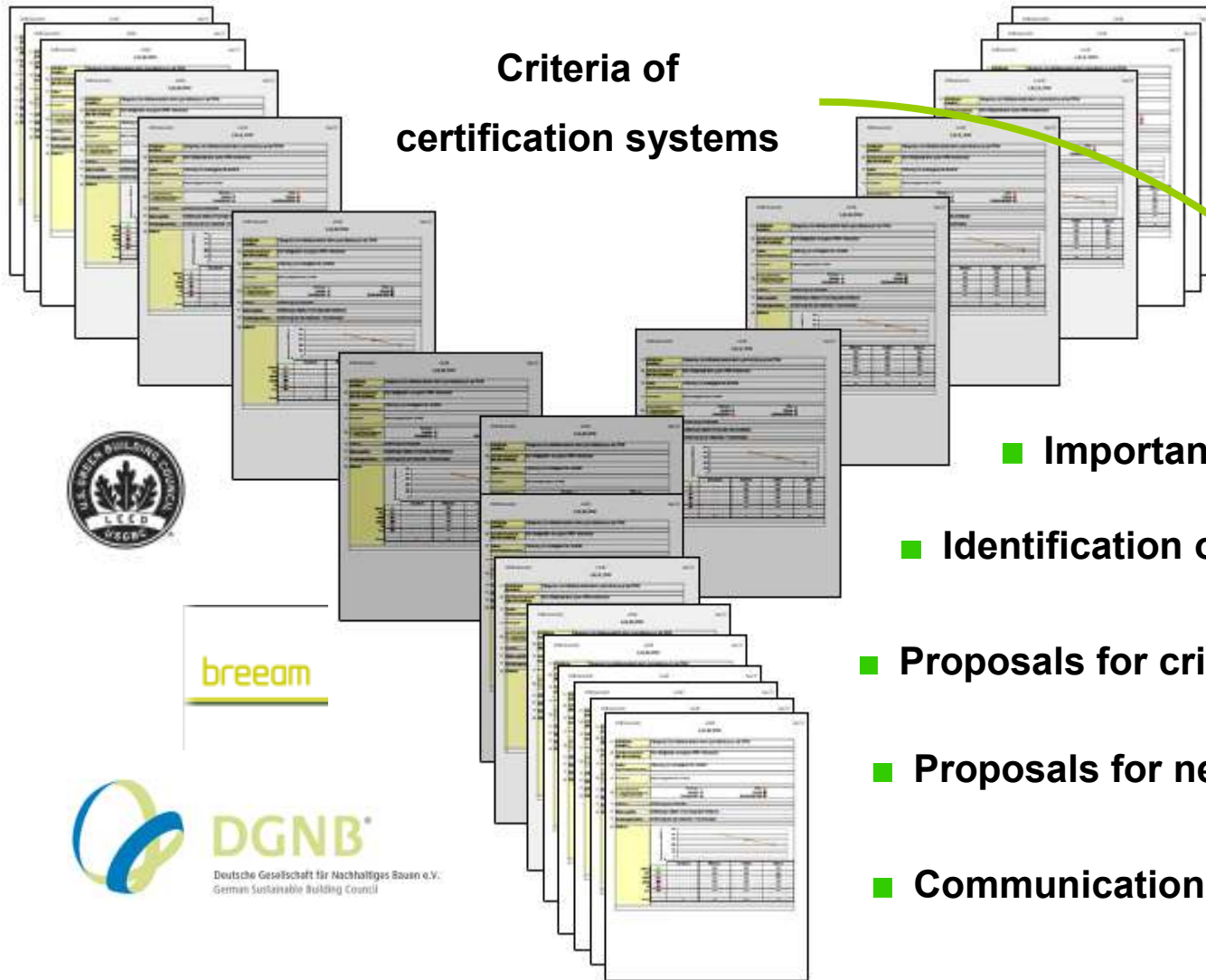
### Low quality paint



## Criteria for products: RMI concept



### Criteria of certification systems



breeam



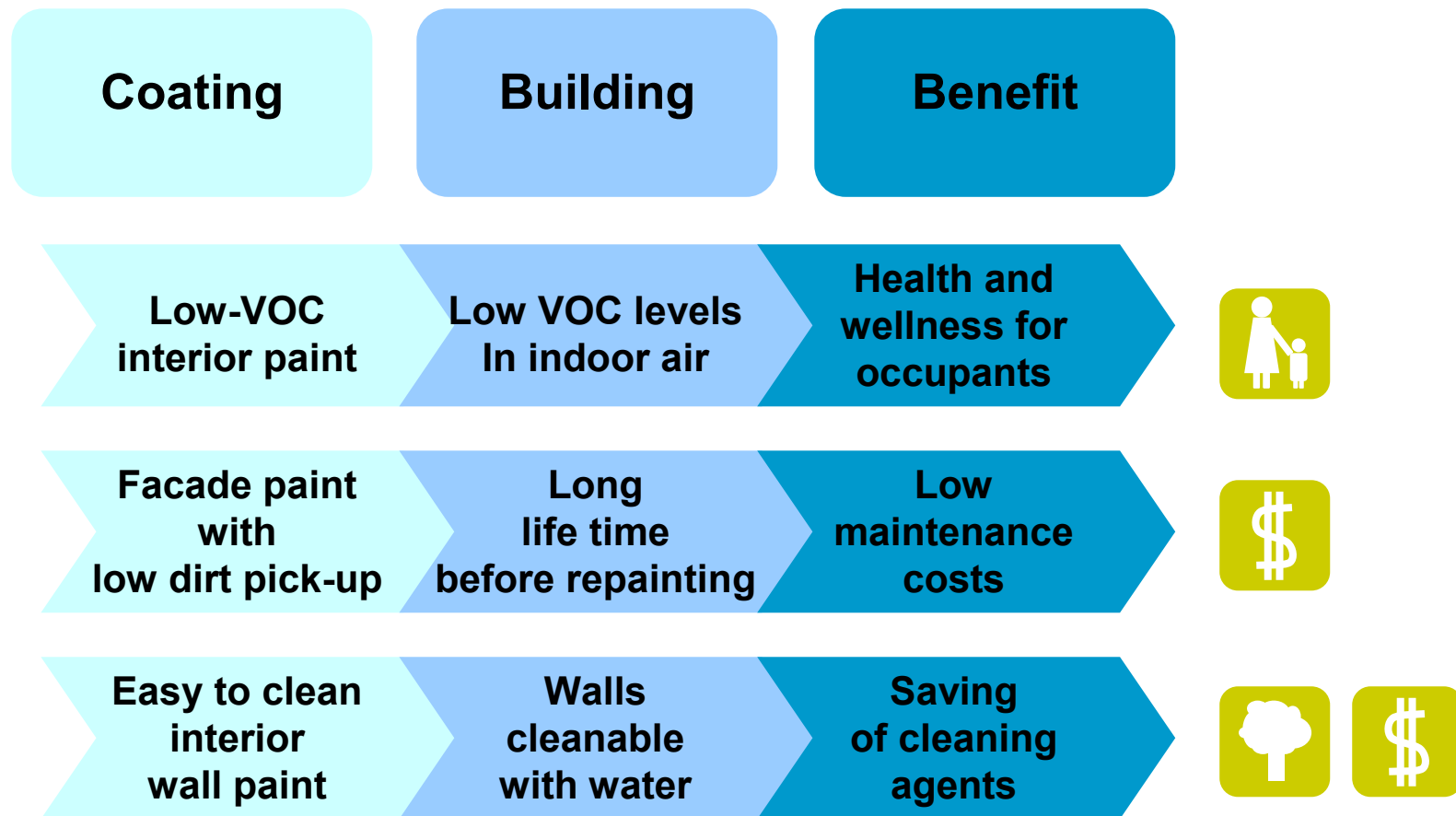
- Importance / weighting of criteria
- Identification of connections to paints
- Proposals for criteria for paints
- Proposals for new criteria in certification
- Communication of results



## Criteria for products: RMI concept



### Examples: Overview





### Example 1: Low-VOC interior wall paint

- What is „Low-VOC“?
- Lack of international standard
- Reference for LEED: California Green Seal Standard → VOC content limited
- But: consumer protection → exposition → emission testing
- Paint producers can provide the necessary information
- International standards for emission testing available: ISO 16000-9

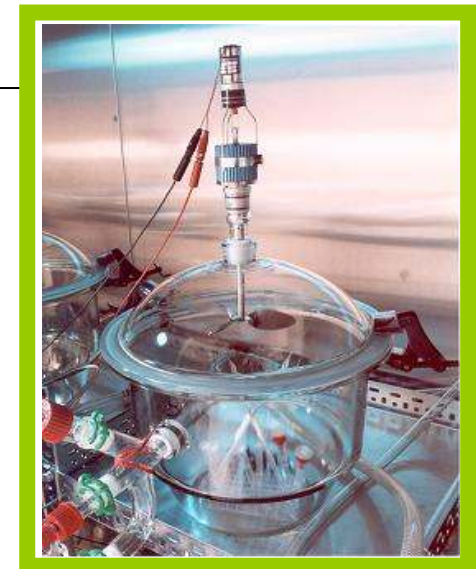


## Criteria for products: RMI concept



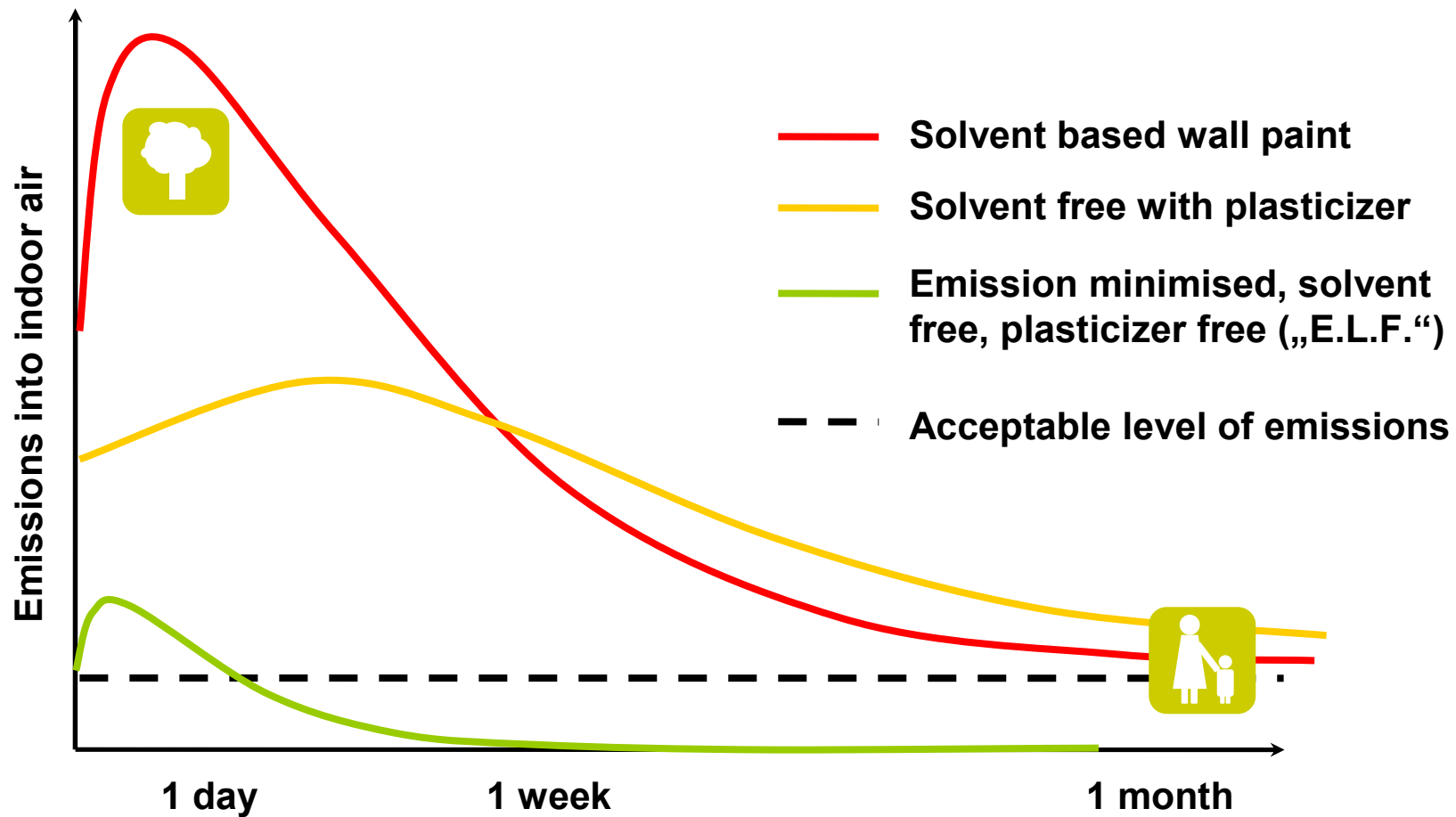
### Example 1: Low-VOC interior wall paint

- Indoor air testing (passive, active)
- Emission cell (FLEC)
- **Emission test chamber**
- Micro chamber





### Example 1: Low-VOC interior wall paint







## Example 1: Low-VOC interior wall paint

The most advanced analytical equipment:



- Odour as evidence for emissions
- Nose sometimes more sensitive than analytical equipment
- Most frequent reason for emission testing
- Odour: from quality feature to reason for rejection
- May be in future part of testing protocols

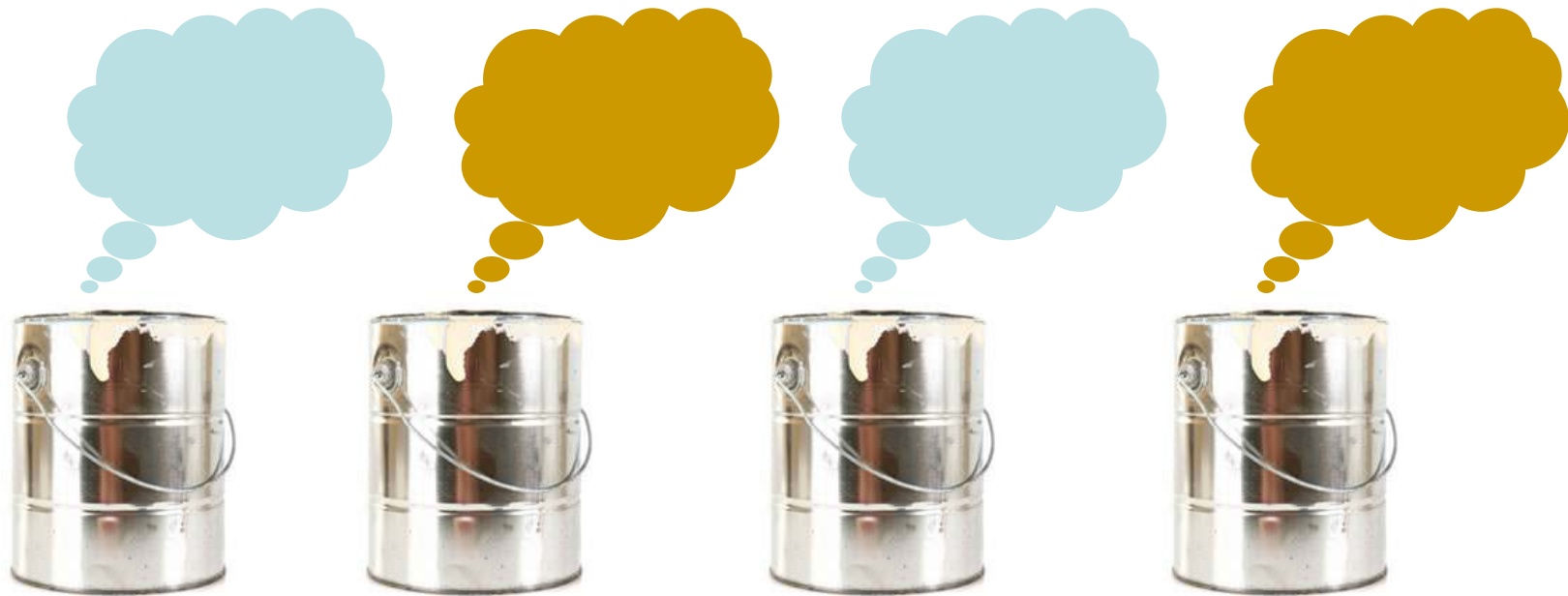
**...the nose!**



## Criteria for products: RMI concept



### Example 1: Low-VOC interior wall paint





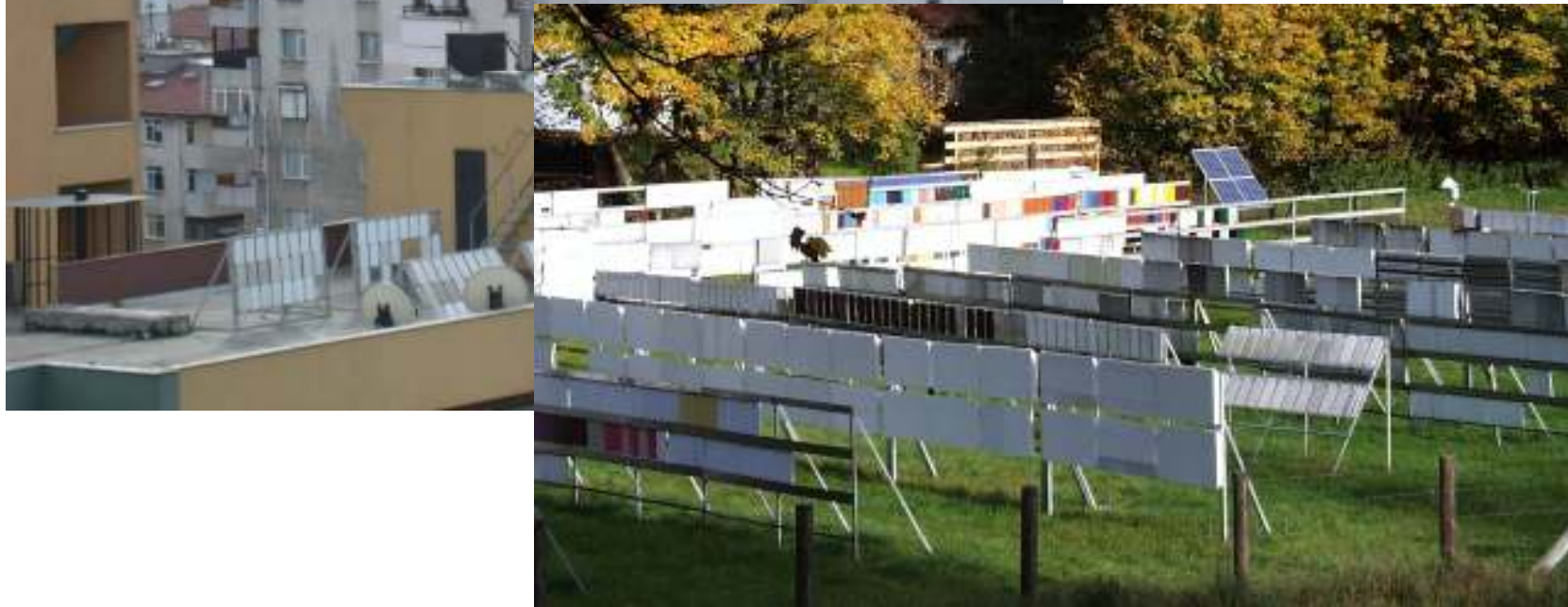
## Criteria for products: RMI concept



### Example 2: Facade paint with low dirt pick-up



- RMI weathering stations:
- 2 x Istanbul: dirt pick-up
- 3 x Germany: mould/algae

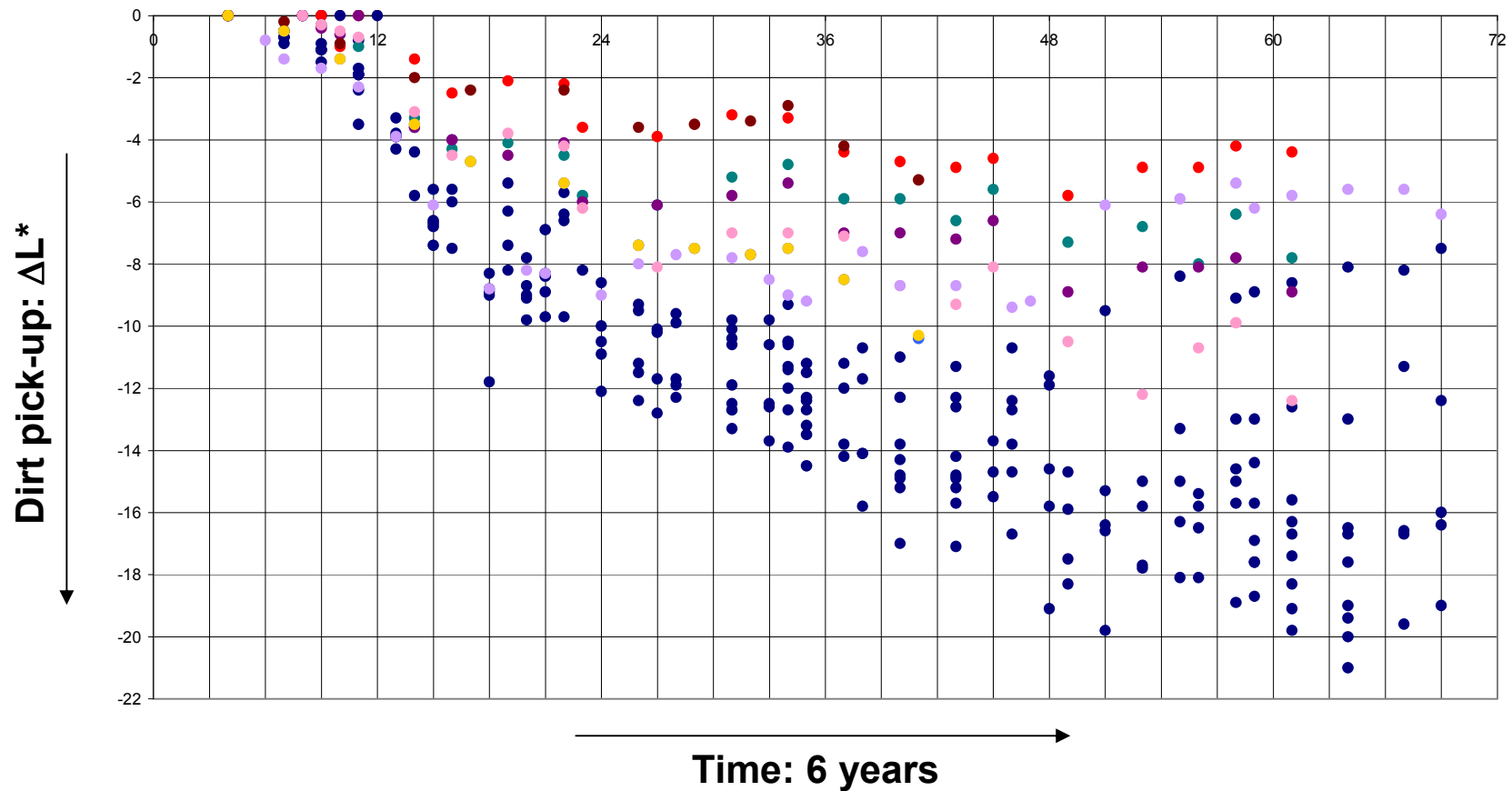




## Criteria for products: RMI concept

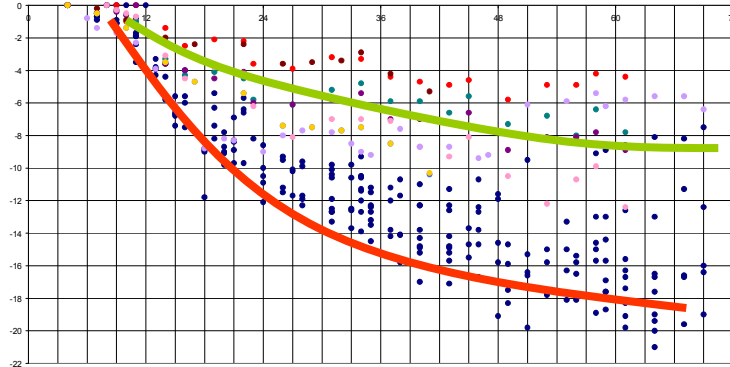


### Example 2: Facade paint with low dirt pick-up





## Example 2: Facade paint with low dirt pick-up



- Investigation of mechanisms
- Mathematical fitting of results
- Prediction of dirt pick-up behaviour
- Prediction of repainting cycles

→ Generation of robust criteria for facade paints

→ Important input for life cycle analysis of building



## Criteria for products: RMI concept



### Example 2: Facade paint with low dirt pick-up

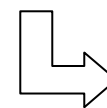




### Example 3: Interior wall paint cleanability



- Fast staining of walls
- Clean walls matter of value & image
- Cleaning or repainting?
- Need for criteria
- Wet scrub resistance
- DIN EN ISO 11998



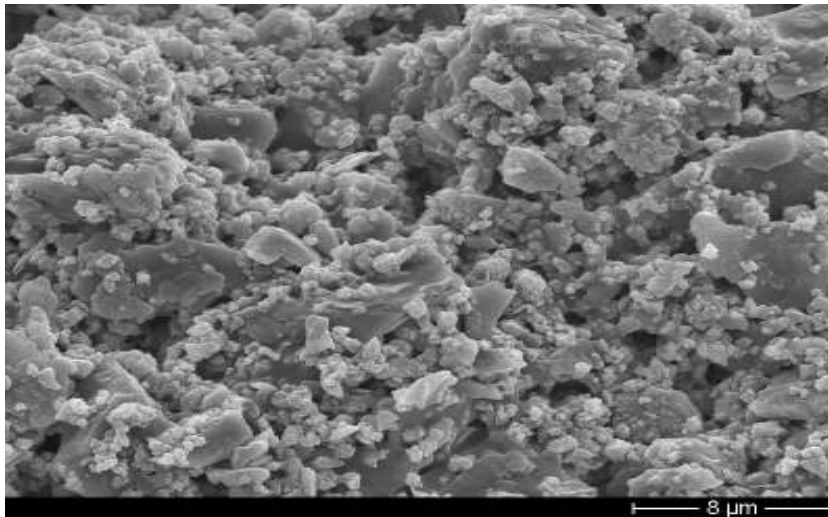
Class 1 < 5  $\mu\text{m}$

Class 2 < 20  $\mu\text{m}$

Class 3 < 70  $\mu\text{m}$

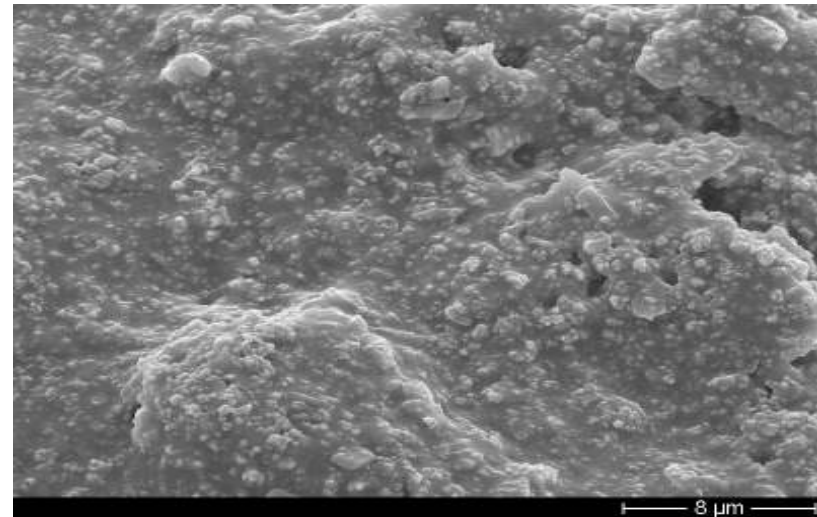
**Factor 10 !**

### Example 3: Interior wall paint cleanability



**Class 3**

- Open surface structure
- Dirt moves into porosities
- Low cleanability



**Class 1**

- Closed surface structure
- Dirt stays at surface
- Easy to clean



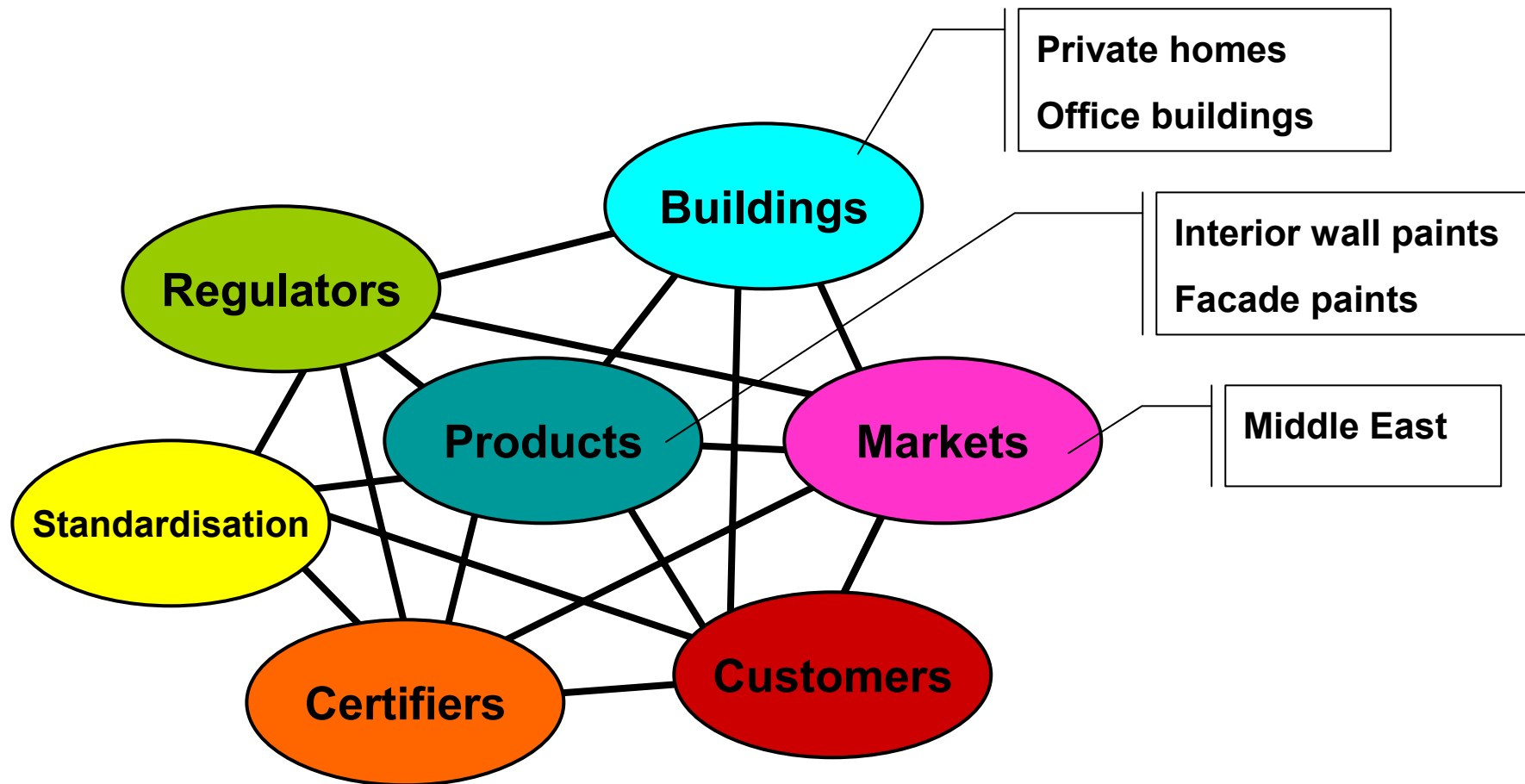


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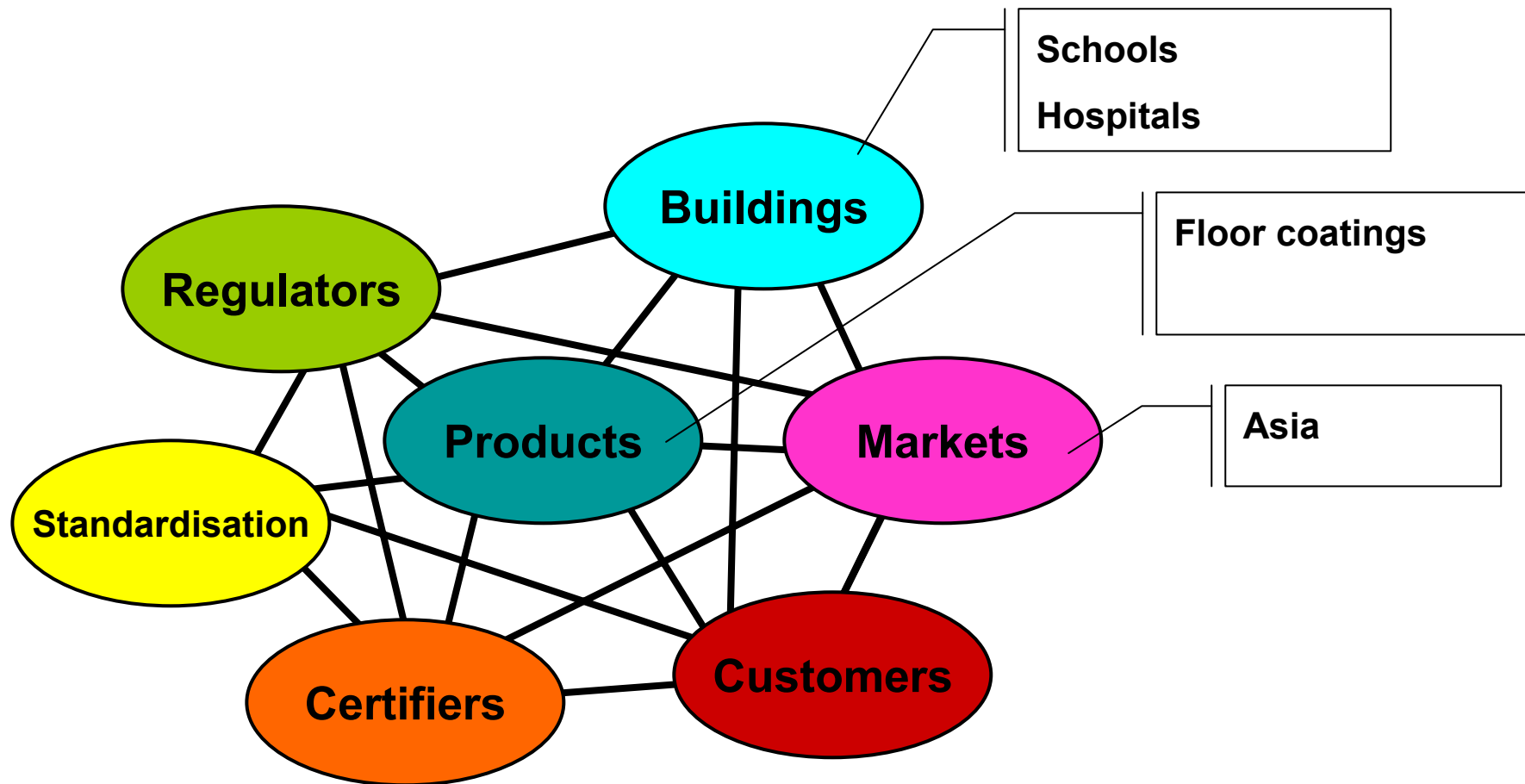


## Future development: Individual concepts



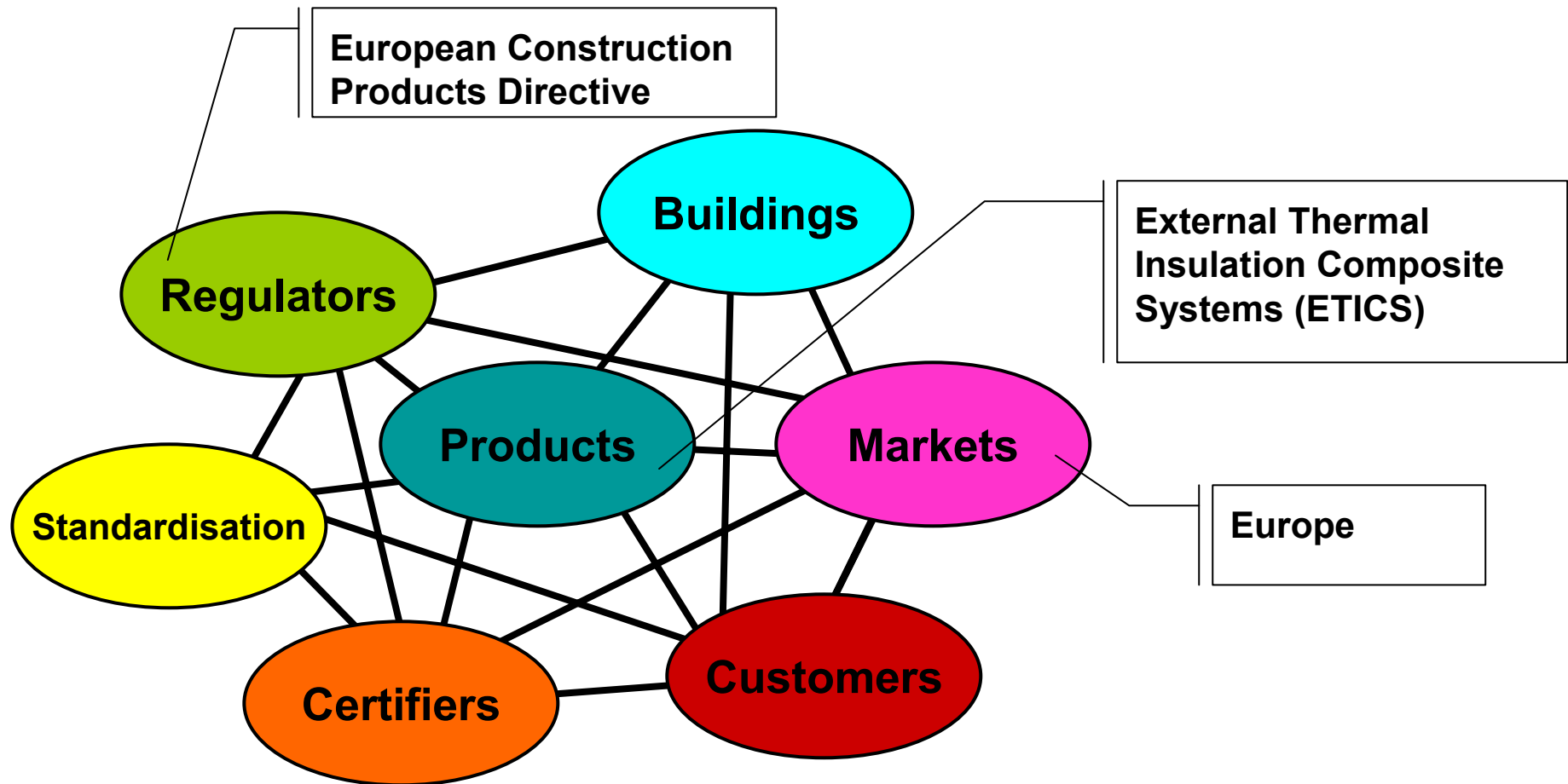


## Future development: Individual concepts





## Future development: Individual concepts





## Future development: Individual concepts



**→ All different situations and markets need individual concepts, but based on the same principles:**

- **Analysis of the needs of the market**
- **Identification of possible contributions of the product group to sustainability**
- **Development of criteria based on experience and accepted standards**
- **Communication of the results to the stakeholders**

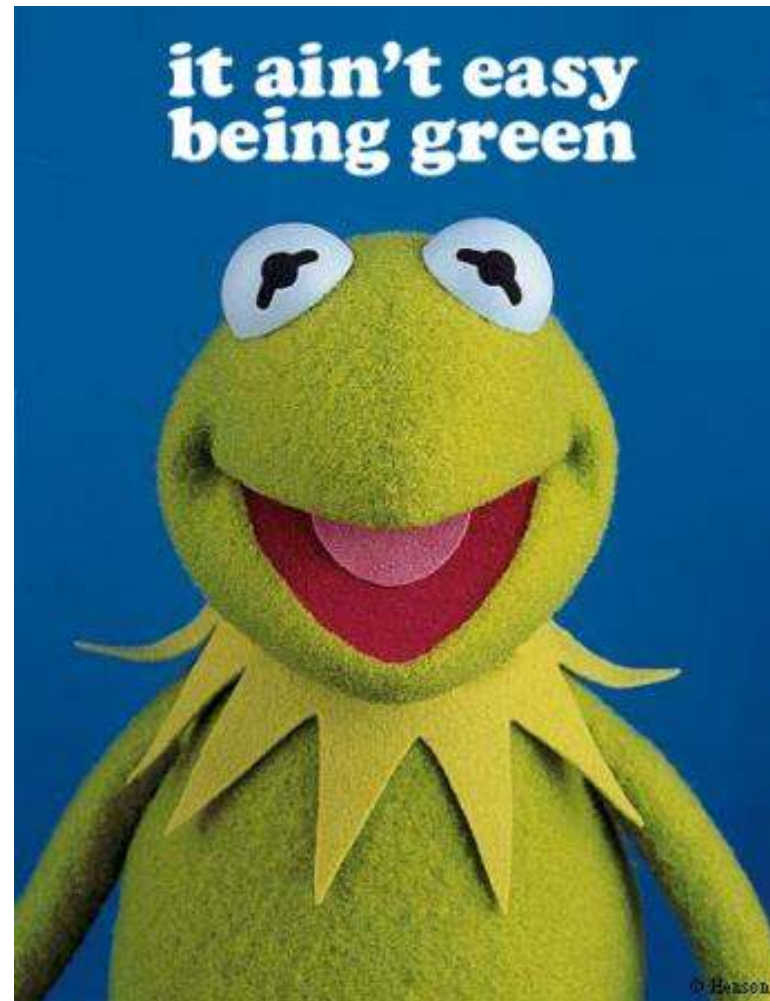
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### Summary

- „Green“ is not sufficient
  - Sustainability: ecological, economical and sociocultural aspects
    - Technical quality is basis for sustainable products
      - Ecological life cycle analysis is not appropriate for coatings
        - RMI provides robust criteria for coatings
          - Examples: low-VOC, dirt pick-up, cleanability
            - Further concepts (ETICS) are under development



**. . . but RMI will help you to find the right way !**