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# Reuse and waste reduction in the construction sector – ongoing research projects

Lilo Henke, Research scientist, SINTEF Community

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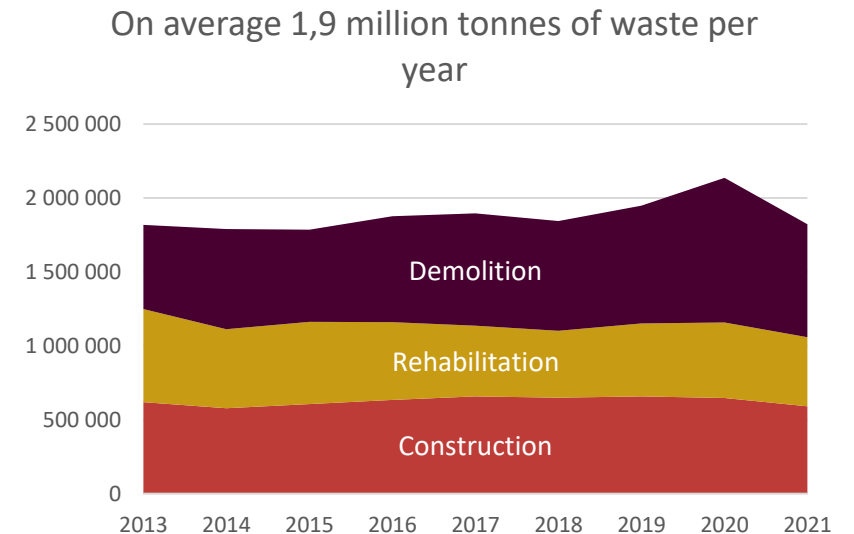
Teknologi for et bedre samfunn





# Why do we care about reuse and waste reduction on construction sites?

- **Materials** account for **70%** of the carbon footprint associated with building and construction activities<sup>1</sup>
- In Norway, the **construction industry** accounts for around **25%** of waste<sup>2</sup>
- The EU Directive requires that **70%** of waste must be **recovered or reused**, Norway is at approx. **45%**<sup>2</sup>
- Requirements in the Technical Regulations (TEK17, chapter 9) - on waste plan, final report for actual disposal of waste and **sorting** requirements **70%**
- Recent **shortages of building materials** and **increases in material costs** can force various players to consider new or better waste reduction measures.



<sup>1</sup>Hertwich, E.G. 'Increased Carbon Footprint of Materials Production Driven by Rise in Investments'. Nature Geoscience, 2021, 1–5. <https://doi.org/10.1038/s41561-021-00690-8>.

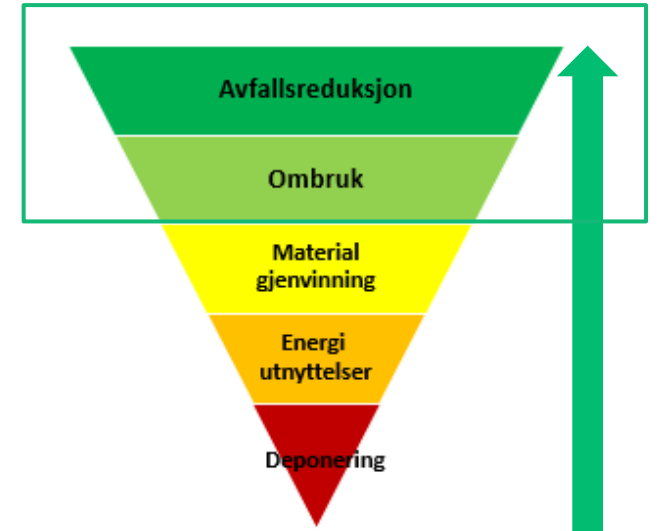
<sup>2</sup>SSB. 'Table 09247: Generated waste amounts (tonnes), by contents, activity, material and year 2013-2021.' Statistisk sentralbyrå (SSB) Statistics Norway, 2022



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# Challenges

- Today's focus is on **sorting rate** and **amount of waste**, but
  - we need to focus more on **moving up the waste hierarchy**
  - we should prioritise **design choices** and take **measures in production** that reduce the waste going to the lower levels.
- **Prefab** and **pre-cut** can be good measures both for efficiency improvement and reduction of waste, but
  - one must look at the **total amount of waste** that occurs on the construction site and the processes beforehand.
- The industry's path to increased resource efficiency depends on **communication** and **collaboration** across the value chain.





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# Research projects



## REBUS - REUse of Building materials - a User perspective

### Aim



- New knowledge that will enable wider and more efficient implementation of reusable building materials from user perspective.

### Development

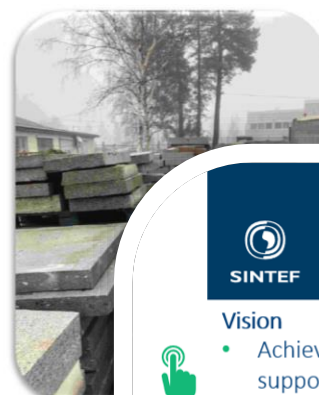


- Analyse user awareness knowledge, needs, social practice
- Develop methods for assessing technical performance and content of hazardous substances
- Methods for life cycle sustainability assessment
- Pilot testing
- Network strategies

### Organization



- Broad, interdisciplinary composition of the research team



Programme:  
Project type:  
Duration: 4 y  
<https://www.rebus.no/>



## ConZerW – Construction site Zero Waste



### Vision



- Achieve waste-free construction by developing a process toolbox that support collaboration between partners in planning, purchasing and in logistics activities associated with the construction site.

### Development



- Define the level of ambition for waste-free construction sites, identify and choose solutions
- Develop optimization methods
- Develop evaluation methods for waste reduction, economic effects and environmental savings
- Test and demonstrate a full-scale solution and communicate results

### Organisation



SKANSKA

/OPTIMERA/



Skanska Husfabrikken



Project type: IPN  
Duration: 2020 – 2023  
<https://www.sintef.no/projectweb/conzerw/>

# REBUS - REuse of Building materials - a User perspective

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## Organization



- Broad, interdisciplinary composition of the research team



Programme: MILJØFORSK  
Project type: KPN/samarbeidsprosjekt  
Duration: 4 years (2020 – 2023)  
<https://www.sintef.no/projectweb/rebus/>



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# User perceptions - interviews



## Objective

**To get an overview of practical challenges, barriers, and success factors related to the reuse of construction products in pilot projects**

- capture perceptions of the different target groups about reuse of construction products



## Target groups

**Actors with professional interest in reuse and/or involved in pilot projects**

- Manufacturers (3)
- Architects (4)
- Building owners/contractors (4)
- Reuse/environmental consultants (7)
- Public institutions (3)



## Main themes

- Mind-set and knowledge
- Reuse infrastructure
- Business framework
- Procurement & legal framework





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# Different actors experience different barriers and success factors



Group of actors \ Barrier	Business framework						
	Lack of reuse experts	Need for redesign	Lack of reuse R&D	Linear/fragmented business model	Lack of market	Lack of incentives	Financial risks
Manufacturers							
Architects							
Building owners/contractors							
Environmental/reuse consultants							
Public institutions							

Group of actors \ Success factor	Business framework						
	Including reuse experts in the value chain	Innovative reuse	Creativity and innovation capacity	Circular business models	Customer demand	Financial incentives for reusing in the value chain	Funding schemes for reusing in the value chain
Manufacturers							
Architects							
Building owners/contractors							
Environmental/reuse consultants							
Public institutions							

Colour code	0%	1-25%	26-50%	51-75%	76-100%

Group of actors \ Barrier	Mindset and knowledge				
	Conservative way of thinking	Lack of collaboration	Reluctant to take/share risk	Lack of best practices	Lack of knowledge
Manufacturers					
Architects					
Building owners/contractors					
Environmental/reuse consultants					
Public institutions					

Group of actors \ Success factor	Mindset and knowledge				
	Awareness and change of culture	Cooperation and communication	Risk sharing	Pilot projects	Knowledge
Manufacturers					
Architects					
Building owners/contractors					
Environmental/reuse consultants					
Public institutions					

Colour code	0%	1-25%	26-50%	51-75%	76-100%

Group of actors \ Barrier	Reuse infrastructure					
	Lack of functioning market	Costs for extra efforts	Timeline	Lack of storage facilities	Lack of testing framework and infrastructure	Demolition practices for reuse
Manufacturers						
Architects						
Building owners/contractors						
Environmental/reuse consultants						
Public institutions						

Group of actors \ Success factor	Reuse infrastructure	
	Establish infrastructure	Digitalisation and standardisation
Manufacturers		
Architects		
Building owners/contractors		
Environmental/reuse consultants		
Public institutions		

Colour code	0%	1-25%	26-50%	51-75%	76-100%

Group of actors \ Barrier	Legal framework			
	Lack of supporting regulations	Lack of technical documentation	Lack of early planning	Rigid contract/procurement process
Manufacturers				
Architects				
Building owners/contractors				
Environmental/reuse consultants				
Public institutions				

Group of actors \ Success factor	Legal framework			
	Reuse-friendly regulations and stricter requirements for reuse	Responsibility for documentation; certification agencies	Setting ambitious and achievable goals in early planning phase	Reuse focused collaborative procurement process
Manufacturers				
Architects				
Building owners/contractors				
Environmental/reuse consultants				
Public institutions				

Colour code	0%	1-25%	26-50%	51-75%	76-100%

# Main findings and recommendations

- Increase **knowledge** to increase acceptance
  - Change the conservative mindset and overturn negative associations
- Establish better digital and physical **reuse infrastructure**
  - Digitalisation can play an important role
- Get **manufacturers** on board
  - Financial incentives, clear market demand
- Reuse should be supported by **regulations**
  - Set legal requirements for reuse

*"We need to rethink the way we collaborate and work in different project phases – as the current practice leads us to postpone decisions that the system (focusing on reuse) would require us to take in an early stage."*  
- Environmental consultant

Collaboration, communication and exchange along the value chain is key!





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journal homepage: [www.elsevier.com/locate/jclepro](http://www.elsevier.com/locate/jclepro)



## Barriers, success factors, and perspectives for the reuse of construction products in Norway

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### ARTICLE INFO

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### ABSTRACT

Reuse of construction materials and products has great potential to reduce the environmental footprint of a building. However, the way buildings are designed and constructed rarely considers closed loop materials systems and the implementation of reuse in building projects is associated with many hurdles. Various professionals might experience different challenges or might be affected to different degrees. The objective of this paper is to provide an insight into experiences and perspectives of professional actors involved in projects with a focus on reuse in Norway. A series of interviews with manufacturers, architects, contractors, environmental consultants, and public institutions was conducted to (i) identify barriers and success factors for reuse in pilot projects, (ii) capture the issues that seem most pressing for different actors, (iii) identify which actors in the value chain need to be more included into reuse processes, and (iv) define and prioritise necessary actions to advance reuse in Norway. The results suggest that reuse in Norway could be greatly advanced by more communication and cooperation between different actors in the value chain. Especially manufacturers can play an important role and need to be more involved in reuse processes. Planning for and practical execution of reuse will benefit from well-functioning research infrastructure. However, legislation needs to be adjusted in favour of reuse. Currently being one of the greatest barriers as experienced by most actors, it has the potential to become the greatest enabler for the reuse of materials and products in the Norwegian building sector.

### 1. Introduction

The Norwegian building and construction industry is responsible for approximately 26% of the total national waste stream (Statistics Norway, 2021). From 2018 to 2019, the amount of waste from construction, rehabilitation, and demolition further increased by 5.6%. Less than half

by 20% in the Nordic construction sector resulting in greenhouse gas emission (GHG) savings of approximately 900 000 tons CO<sub>2</sub>equivalents (Høiby and Sand, 2018). At the same time, it can create social and financial benefits for private companies equating to 1.7% of the annual growth rate (Høiby and Sand, 2018).

The concept of design for deconstruction (DfD) has been introduced



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## Publications and resources

Here you can find relevant publications, projects and links related to REBUS and reuse in the construction sector.

[REBUS publications](#) lists all reports, papers and articles that came out of the REBUS project.

[Related projects](#) gives an overview of interesting projects that also deal with circularity in the construction sector.

[Useful links](#) contains links to existing reuse guidelines, Norwegian building standards and certifications, and digital platforms where reusable building materials can be documented and traded.

<https://doi.org/10.1016/j.jclepro.2022.130494>

<https://www.sintef.no/projectweb/rebus/publications/>



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# ConZerW – Construction site Zero Waste

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## Organisation



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 **SINTEF**

**Skanska Husfabrikken**

**NG**  
Norsk  
Gjenvinning



Project type: IPN

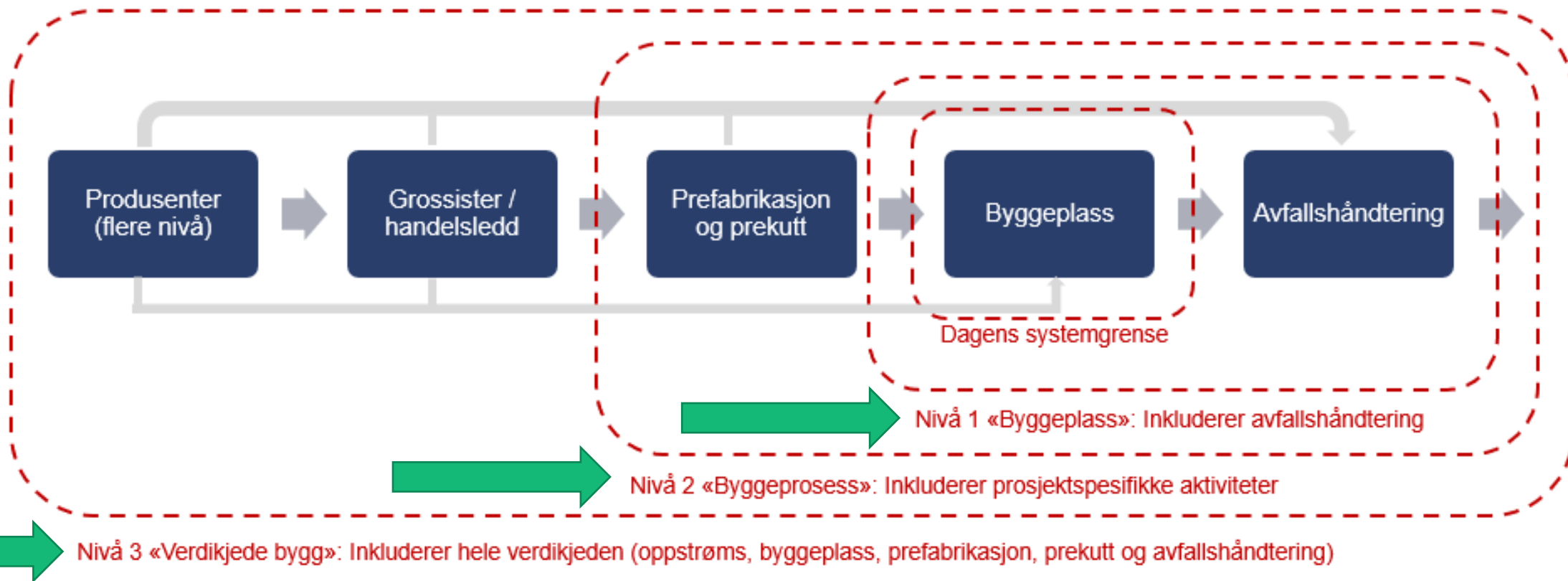
Duration: 2020 – 2023

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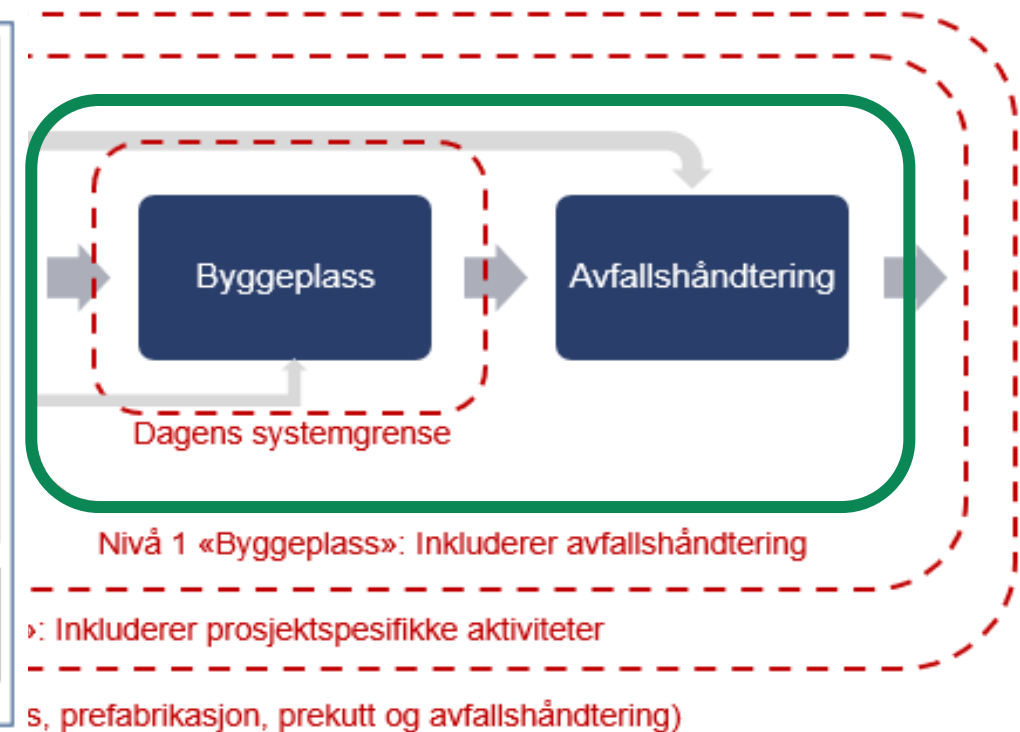
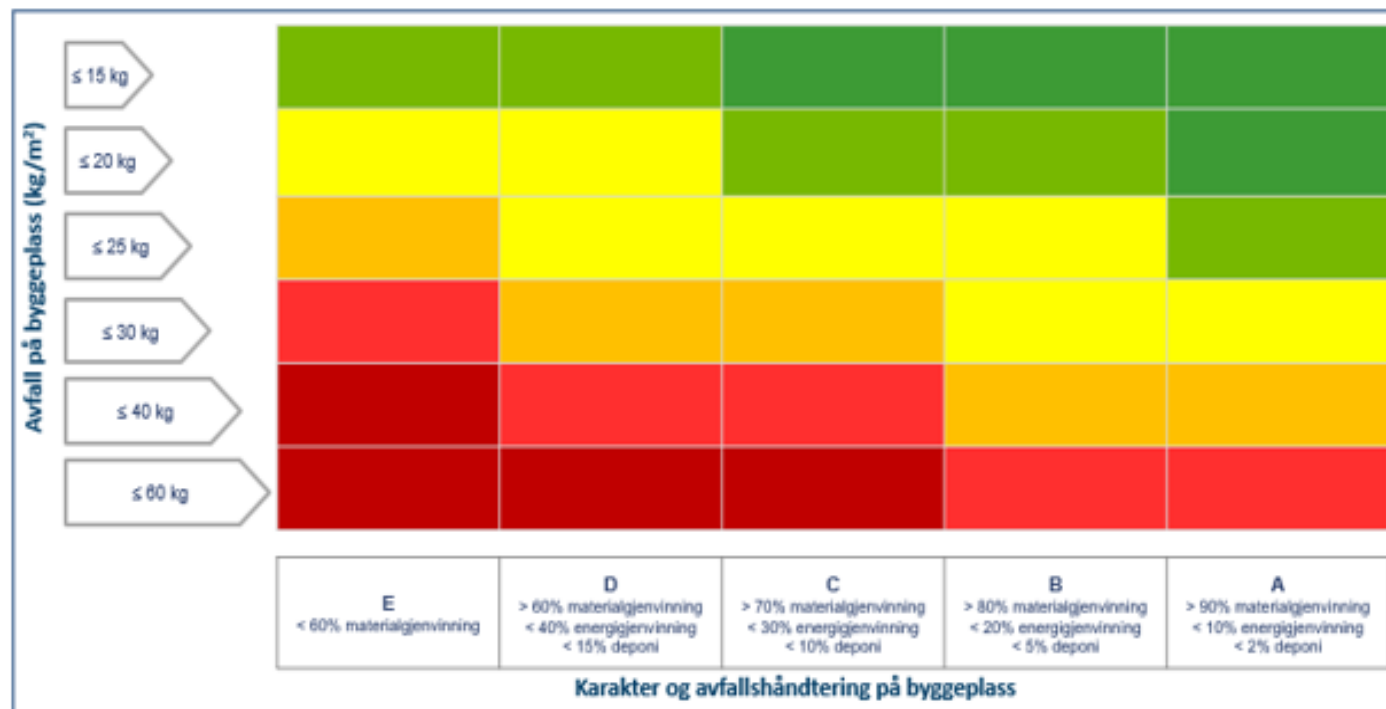
# Step-by-step expansion of ambition level for waste-free construction sites



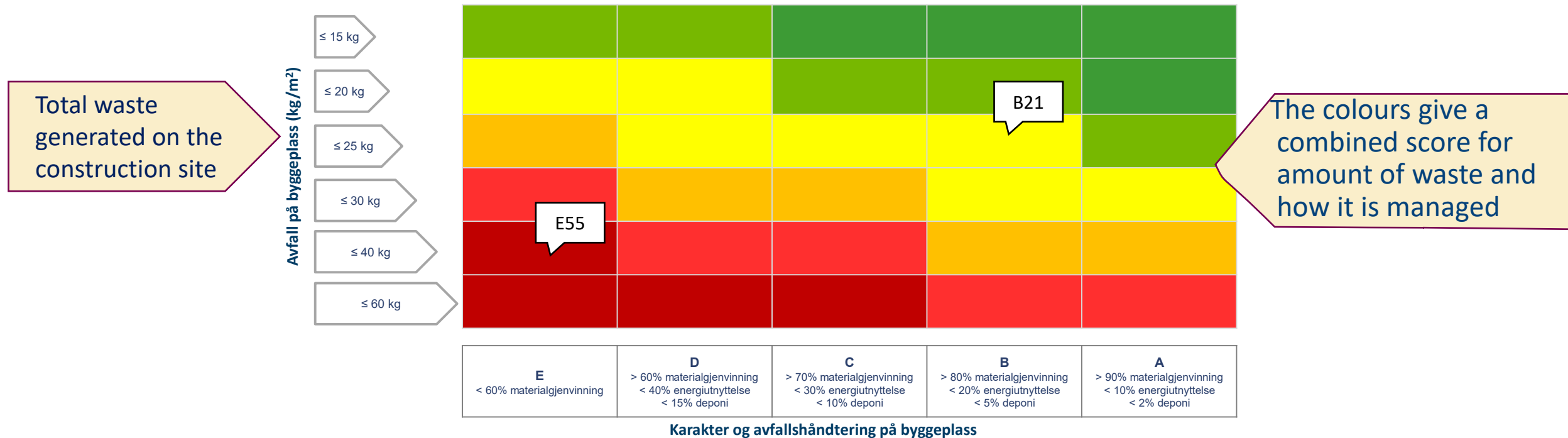


# Labelling scheme for construction waste

- A system for communicating waste reduction goals and results



# Labelling scheme for Level 1



- the grade (A-E) depends on the type of waste management of the construction waste
- higher recycling rates give a higher grade



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[https://www.sintefbok.no/book/index/1348/merkeordning\\_for\\_avfall\\_i\\_byggeprosjekter\\_definisjon\\_og\\_noekkelindikatorer\\_versjon\\_1](https://www.sintefbok.no/book/index/1348/merkeordning_for_avfall_i_byggeprosjekter_definisjon_og_noekkelindikatorer_versjon_1)

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NOTAT

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# Merkeordning for avfall i byggeprosjekter

DEFINISJON OG NØKKELINDIKATORER.  
VERSJON 1







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