Sustainable value chain and material use in road construction

Marit Fladvad, SINTEF Community
Lillian Mathisen, SINTEF Community

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Outline

- Introduction:
  - Marit & Lillian
  - SINTEF
- The *Sustainable Road Construction* project in general
- Road material research in the project
- Sustainability considerations in the project

Photo: Marit Fladvad, SINTEF

About us

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Marit Fladvad

- Research scientist at SINTEF Community
- 10 years experience from the Norwegian Public Roads Administration
- MSc in Civil Engineering - Highway engineering
  - Thesis on compaction of unbound granular materials
- PhD in Geology and Mineral Resource Engineering
  - Thesis on utilisation of unbound crushed aggregates for road construction

Lillian Mathisen

- Senior advisor at SINTEF Community
- 20 years in the Norwegian asphalt industry
- MSc in asphalt
  - Recycling
  - Frictional properties
- PhD in Unbound Granular Base materials
  - Deformation properties
  - Thaw weakening
  - Mineralogy

SINTEF

ONE OF EUROPE'S LARGEST INDEPENDENT RESEARCH ORGANISATIONS

367,5 million
EUR turnover

2200
employees

6400
projects

3300
customers

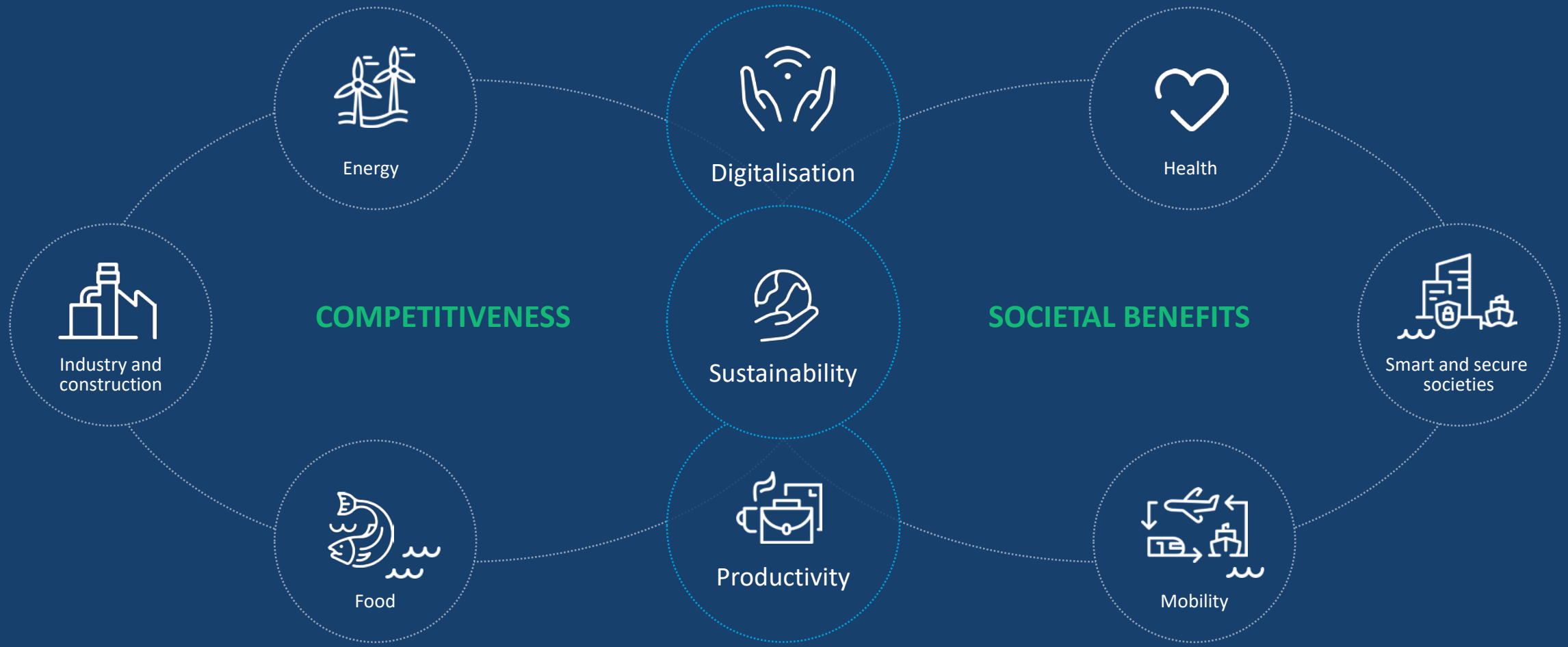
INTERNATIONAL
70,7 million EUR

NATIONALITIES
80

PUBLICATIONS (INCL. DISSEMINATION)
6200

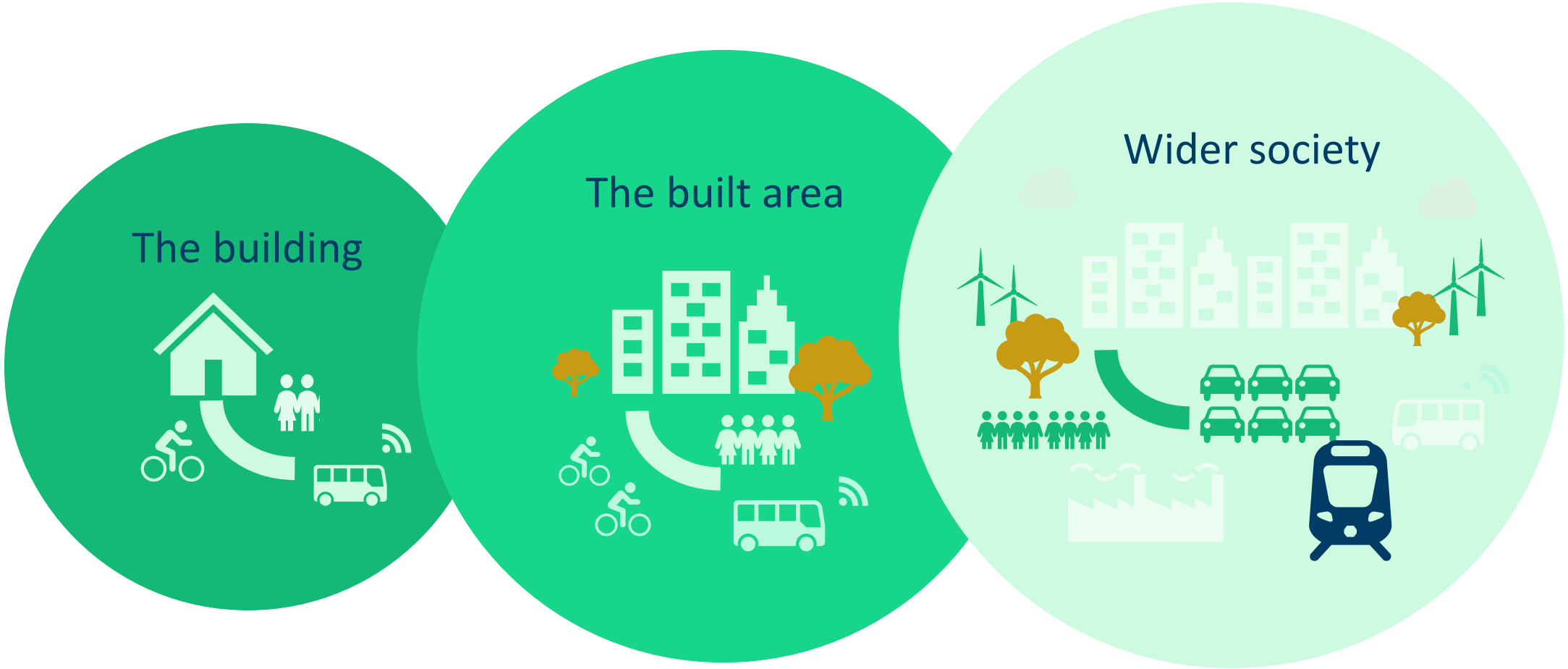
CUSTOMER SATISFACTION
4,6 / 5

Vision:
Technology for a better society



SINTEF Community

We develop future solutions for the built society



Sustainable value chain and material use in **road construction**

2023 - 2025

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Funded by
The Research
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Innovation
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Nye
Veier

B&G

eramet

FOAMROX

FUTURE
MATERIALS
NORWEGIAN
CATAPULT
CENTRE

Norconsult

NTNU

acron
INFRA

RYGENE
NORWAY

Cemonite

SINTEF

SKANSKA

Statens vegvesen

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I AGDER

VEIDEKKE

VELDE

VIA

Project goal and milestones

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Main goal

Develop new Norwegian sustainable technology and expertise with a large export potential, which contributes to Nye Veier reaching the goal of reducing greenhouse gas emissions from the construction phase of road projects by 50% by 2030

Milestone 1	Milestone 2	Milestone 3
Develop research-based knowledge about optimal solution choices and design to reduce greenhouse gas emissions in road construction	Test, verify, pilot and industrialize a **minimum of 10** new climate-friendly and resource-efficient solutions with large export potential based on reuse of materials and by-products from industry	Build a strong **value chain** across disciplines, technology areas and competence environments to reduce barriers and identify effective incentive schemes that accelerate the journey from idea to market nationally and internationally

Project organizing

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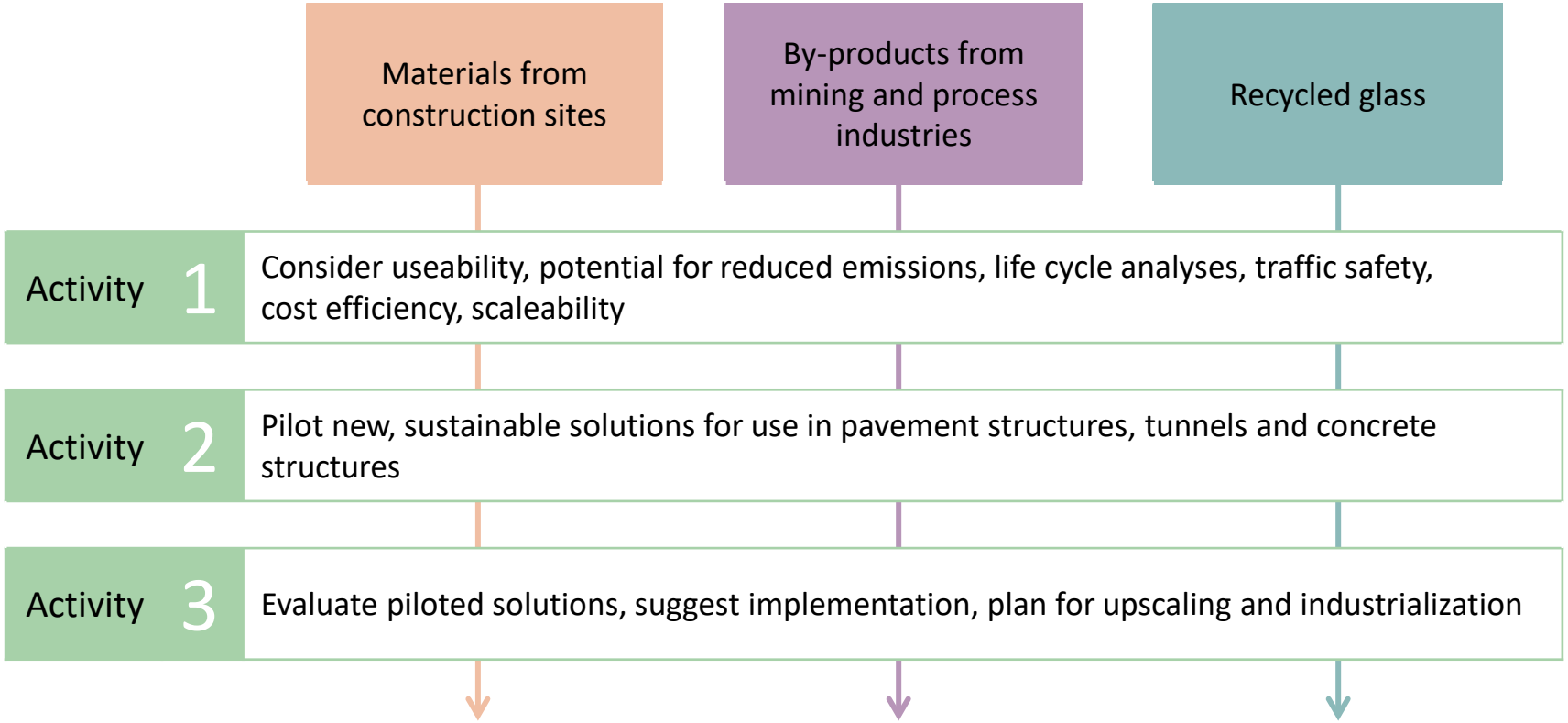

Project organizing

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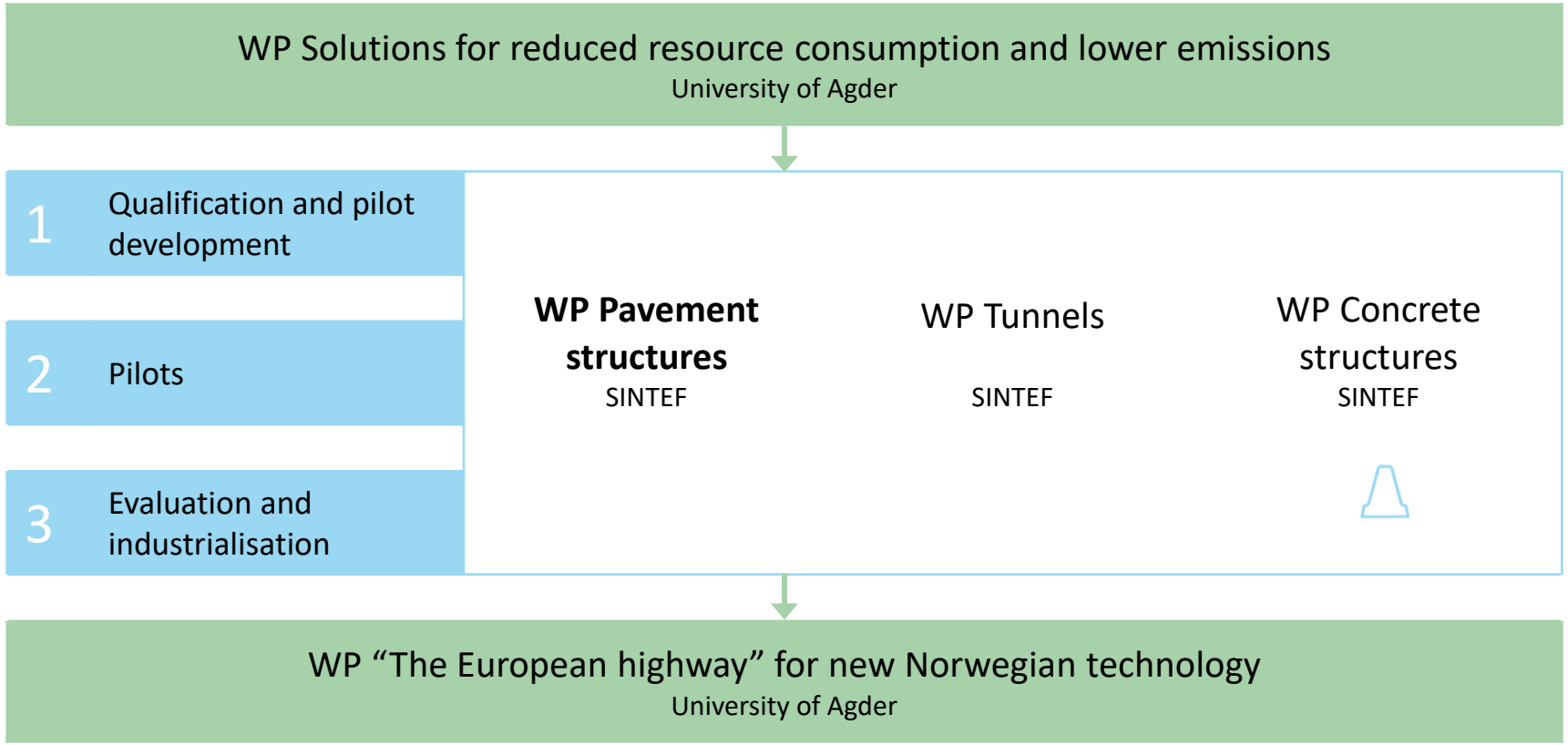

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WP Tunnels

Piloting of:

- sprayed concrete with recycled aggregates and reduced cement content
- tunnel elements made of recycled glass
- prefabricated technical buildings made of recycled glass
- rock injection materials with reduced cement content

Photo: Helene Strømsvik, SINTEF

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WP Concrete structures

Piloting of:

- Concrete with aggregates from recycled concrete
- Concrete with recycled aggregates from other sources
- Concrete with reduced cement content, slag as concrete binder

Photo: SINTEF

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WP Road construction

Piloting of:

- more environmentally friendly asphalt materials based on recycled and alternative materials
- optimalisation of material production at construction sites to increase the use of local materials
- secondary materials – recycled excavation materials and by-products from process industry – to replace crushed rock

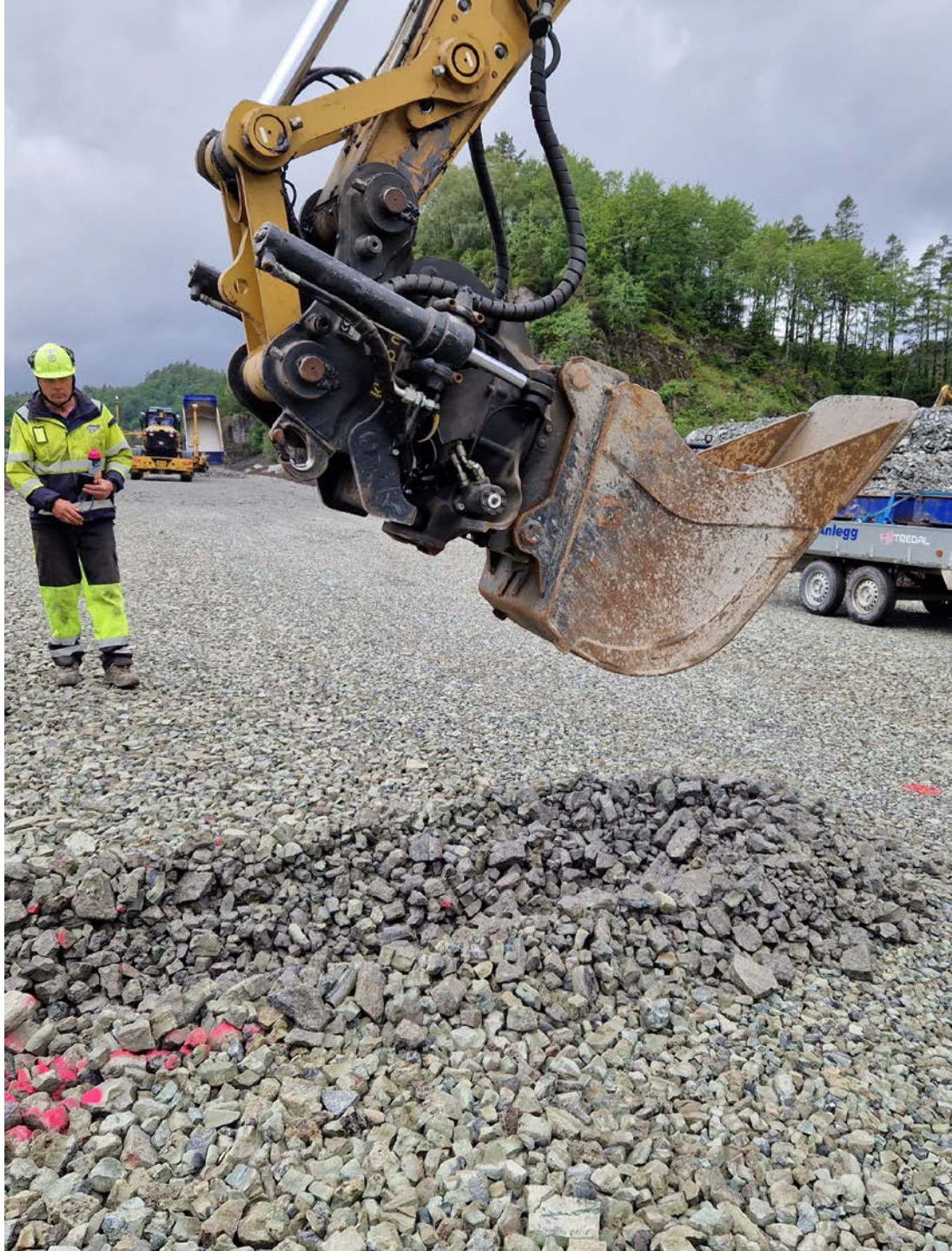

Photo: Marit Fladvad, SINTEF

Relevant subjects for WP Road structures

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Pilot 3

Pilot 2

Additives in asphalt

Pilot 3

Asphalt with high share of reuse

Pilot 1

Slag as unbound material

Slag in asphalt

Recycled excavation material as road construction material

Pilot 3

Mass balance when producing crushed rock at the construction site

Tunnel surplus materials

Aggregate quality based on MWD data

About SiMn slag from Eramet

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- Manganese is an alloy used in steel production
- Eramet Norway produces 180 000 tonnes silicomanganese (SiMn) at their smelting plant in Kvinesdal
- This results in 220 000 tonnes of slag by-product marketed as Silica Green Stone (SiGS)
- Eramet is exploring many different areas for making new products from their surplus by-products

Photo: Eramet Norway

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SiMn slag production and quality

- When the melted and separated ore cools down, the result is a “new” rock with the same mineral content as the ore minus silica and manganese.
- The slag generation and cooling process was monitored by a student during the summer of 2023.
  - Quality assessment by road construction standards
- Targeted material production based on the best quality slag
  - Refinement through crushing and screening
  - New quality assessment by road construction standards

Photo: Eramet Norway

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Pilot 1: SiMn slag as unbound aggregates

SiMn slag was tested as a subbase layer at E39 in Lyngdal (June 2024)

22/125 mm material produced through screening (not crushing)

Successful pilot – all quality requirements were met

Photo: Marit Fladvad, SINTEF

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Denne steinen kan revolusjonere norsk vegbygging

Steinen heiter Silica Greenstone og kan bidra til ei meir berekraftig vegutbygging. Men førebels er det forbode å bruke han.

Tom Nicolai Kolstad
Journalist

Publisert 22. juni kl. 13:37

Ein ny type stein kan bidra til at vi kan spare fjell og berg når vi bygger nye vegar.

Faksimile: NRK 22. juni 2024

NRK:
“This rock can make a revolution in Norwegian road construction”

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Pilot X: SiMn slag as asphalt aggregates

Next step: Testing SiMn slag as aggregates in asphalt

Challenges:

- Higher quality requirements for aggregates
- Compatibility with binder
- Adhesion between aggregates and binder

Hopefully a new pilot for 2025

Photo: Marit Fladvad, SINTEF

Pilot 2: Local wood fiber in asphalt mixture

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- Fiber is added to asphalt to improve adhesion between aggregates and binder
- Traditionally, fibers are made from cellulose from recycled paper
  - Contains contaminations and fillers from the recycled paper
  - Pellets using traditional asphalt binders
  - Imported to Norway
- Rygene-Smith & Thommesen has developed a wood fiber designed specifically for use in asphalt
  - Origin: Saw mill chips
  - Pellets using green binder (bio binder)
  - Norwegian producer

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Pilot 2: Local wood fiber in asphalt mixture

- Fiber is added to asphalt to improve adhesion between aggregates and binder
- Comparing two wood fiber pellets to a common fiber type
- Tested at E39 in Møre og Romsdal with Veidekke as the asphalt contractor

Photo: Bjørn Ove Lerfald, Veidekke

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Pilot 3: 100 % circular asphalt mixture

A combination of several solutions into one asphalt mixture:

- Recycled aggregates
- High content of recycled asphalt
- Recycled bitumen
- Bio binder

Goal:

- An asphalt with no addition of new quarried rock materials or new oil-based bitumen

Asphalt contractor: Velde

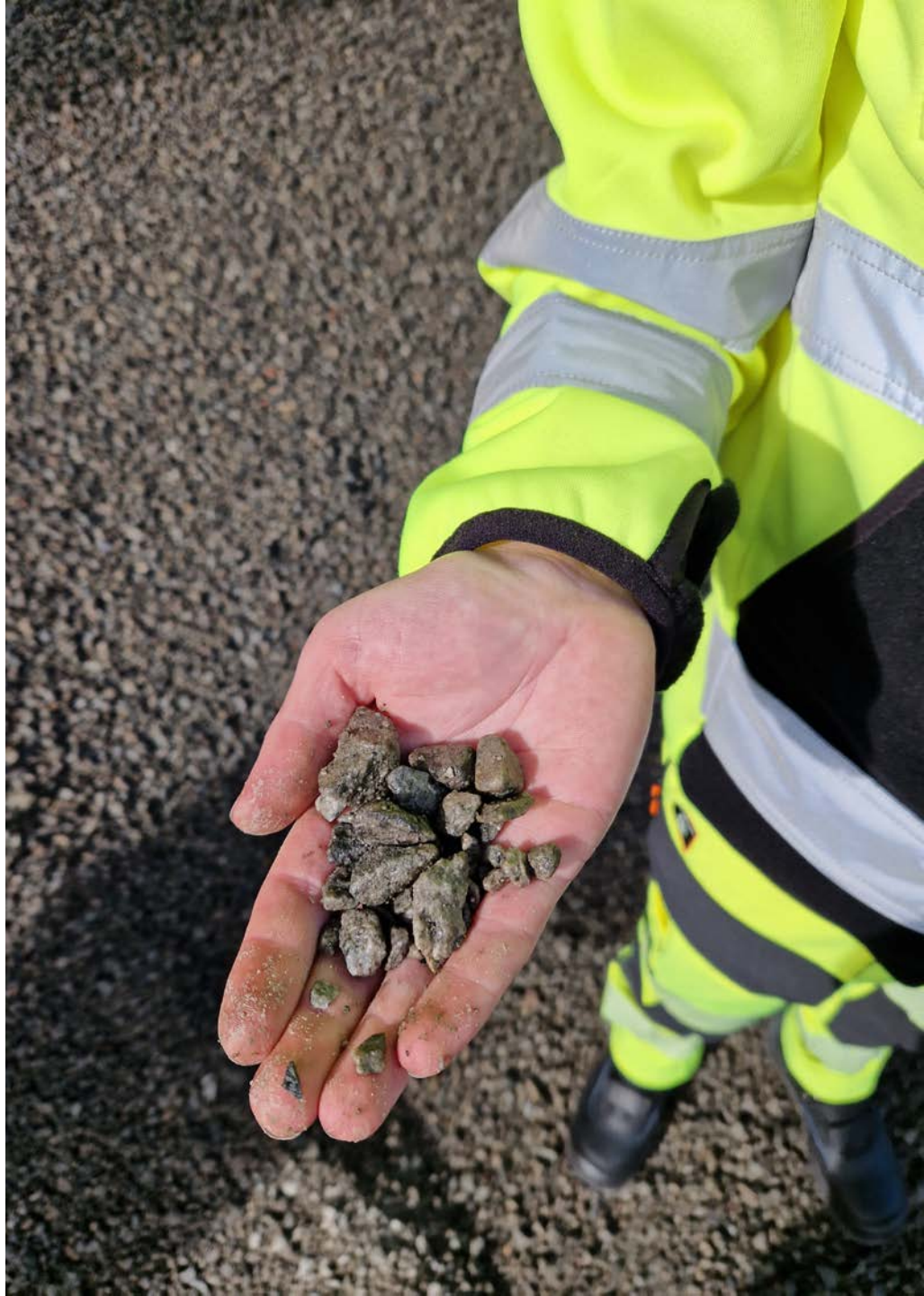

Photo: Marit Fladvad, SINTEF

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Pilot 3: 100 % circular asphalt mixture

The 100 % circular asphalt mixture will reduce CO_2 emissions, but more importantly reduce consumption of nature and resources

A balance between available materials

Under construction now at E39 in Lyngdal

- 400 m pilot section with full asphalt construction in three layers

Photo: Marit Fladvad, SINTEF

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WP Reduced resource consumption and emissions

Vision for the future circular road:

A nature-positive road

- DP 2.1: Life cycle assessment (LCA) for the pilot concepts
- DP 2.2: Circularity assessment for the pilot concepts
- DP 2.3: Optimizing concept choices – industry roadmap for better road construction choices

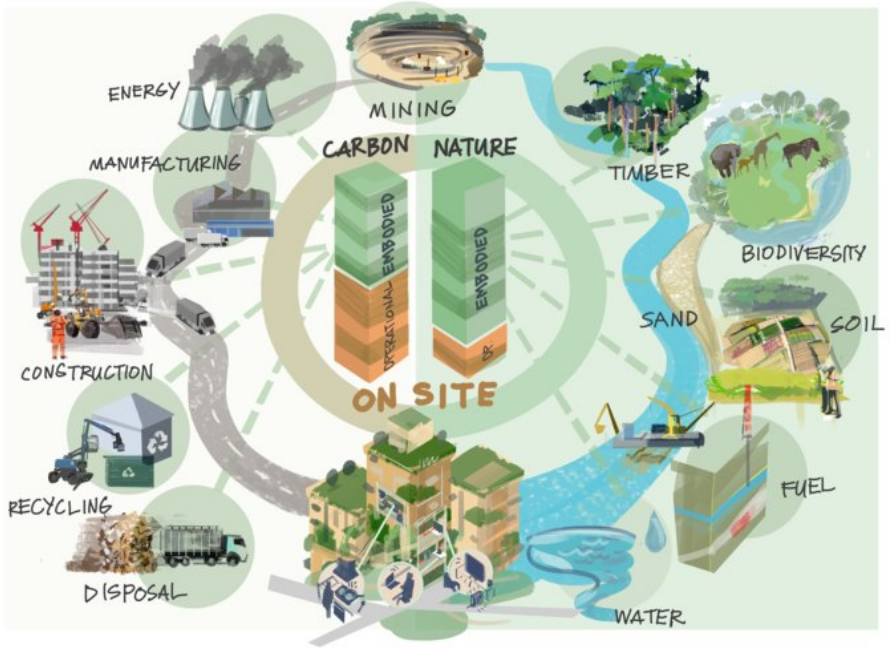

Figure: Allen-Sader et al. (2023)
https://www.wbcsd.org/news/exploring-nature-positive-buildings/

WP “European highway” for new technology

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Collecting data from

- Pilots in the Sustainable road construction project
- Tenders, contracts and business models in genereal

Questions:

- How is innovations implemented in the construction business?
- What works? What didn’t work?
- Which incentives contribute to success?
- Which obstacles were met and handled? Which obstacles were show-stoppers?

Summary

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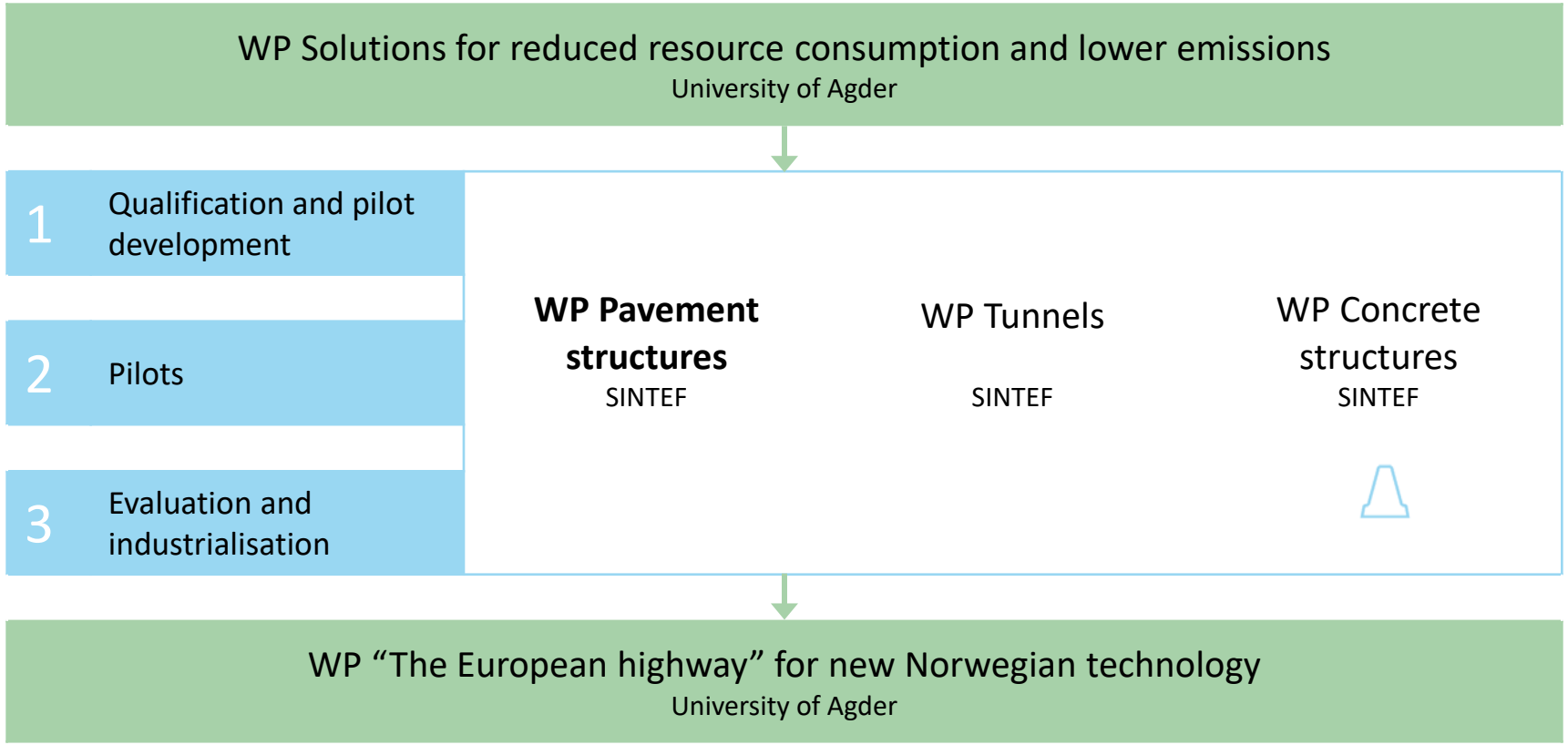

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