NTNU – Trondheim
Norwegian University of
Science and Technology

Evaluation and Decision Process for Greener Asphalt Roads

NaDim
01.12.2016

Sara Anastasio

CEDR

Conférence Européenne
des Directeurs des Routes

Conference of European
Directors of Roads

EDGAR

Evaluation and Decision Process for Greener Asphalt Roads

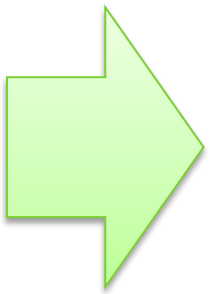
https://www.ntnu.edu/edgar

Period: 15/04/2014 -14/04/2016 (2 year)

Call 2013:
Energy Efficiency: Materials and Technologies
(funded by Austria, Germany, the Netherlands, Norway, Slovenia, UK)

Project leader:	BRRC (Be)	Joëlle De Visscher Johan Maeck Stefan Vansteenkiste Ann Vanelstraete
Partners:	TRL (UK)	Matthew Wayman James Peeling
	EPFL (CH)	Nicolas Bueche Bastien Schobinger
	NTNU (N)	Inge Hoff Sara Anastasio

Evaluation and Decision Process for Greener Asphalt Roads



Utvikle en metodikk for å hjelpe vegmyndigheter å evaluere og velge mest bærekraftig asfalt materialer / teknologier til vegnettet

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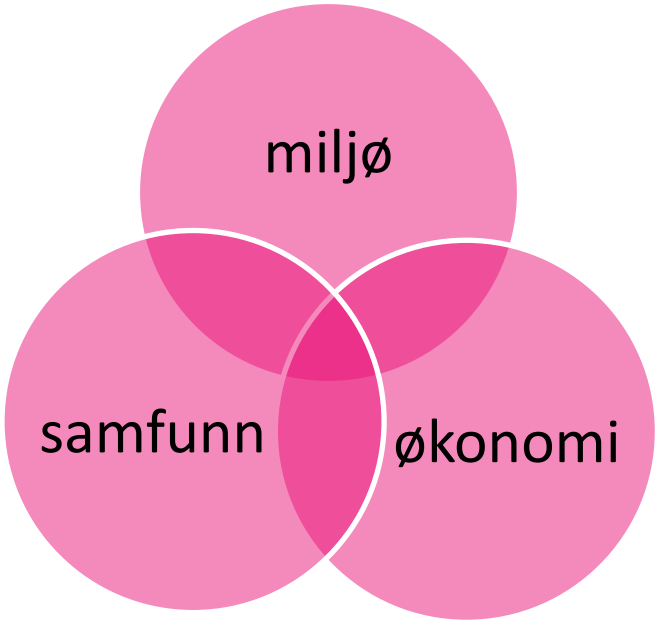
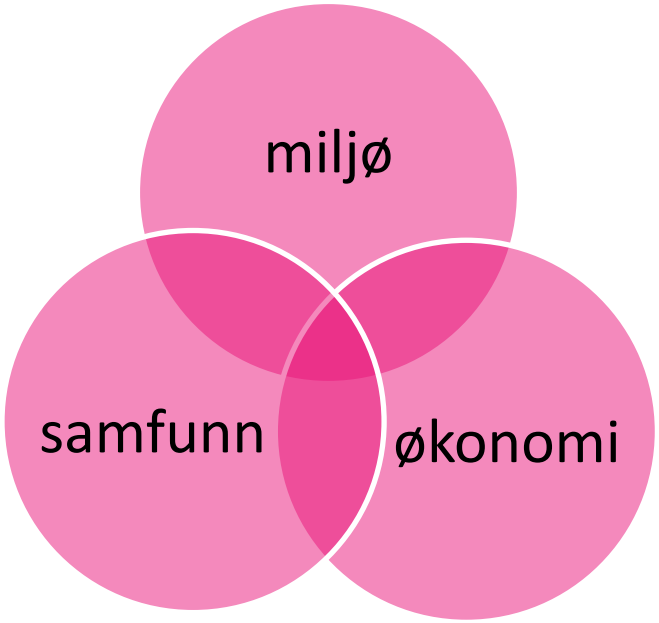
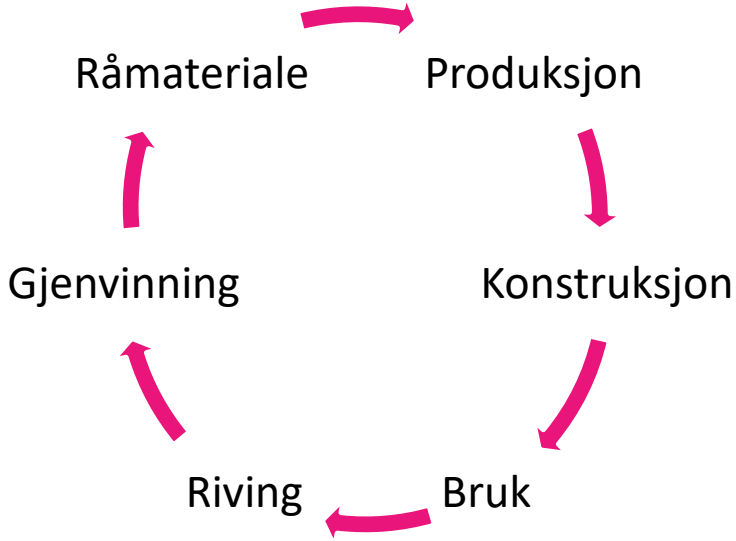


Evaluation and Decision Process for Greener Asphalt Roads

* over HELE livet

Utvikle en metodikk for å hjelpe vegmyndigheter å evaluere og velge mest bærekraftig* asfalt materialer / teknologier til vegnettet





Hva har vi nå?

Hva har vi nå?

- EPDs (Environmental Product Declarations - Miljødeklarasjoner)

CERTIFIED

EPD Transparency Summary

Spray Polyurethane Foam Alliance

Building Envelope Insulation

Closed-Cell, Medium-Density Spray Polyurethane Foam Insulation

Closed-cell, medium-density (2.0 lb/ft3) spray polyurethane foam insulation. Spray polyurethane foam is made on the jobsite by combining methylene-diphenelene diisocyanate (MDI or A-side) with an equal volume of a polyol blend (B-side).

Building Envelope Thermal Insulation

ULE 2011

10/10/2013 – 10/10/2018

13CA29310.101.1

LIFECYCLE IMPACT CATEGORIES

The environmental impacts listed below were assessed throughout the product's lifecycle – including raw material extraction, transportation, manufacturing, packaging, use, and disposal at end of life.

ATMOSPHERE | WATER | EARTH

Global Warming Potential refers to long-term changes in global weather patterns – including temperature and precipitation – that are caused by increased concentrations of greenhouse gases in the atmosphere.

Ozone Depletion Potential is the destruction of the stratospheric ozone layer, which shields the earth from ultraviolet radiation that's harmful to life, caused by human-made air pollution.

Photochemical Ozone Creation Potential happens when sunlight reacts with hydrocarbons, nitrogen oxides, and volatile organic compounds, to produce a type of air pollution known as smog.

Acidification Potential is the result of human-made emissions and refers to the decrease in pH and increase in acidity of waters, lakes, rivers, and streams – a phenomenon that pollutes groundwater and harms aquatic life.

Eutrophication Potential occurs when excessive nutrients cause increased algae growth in lakes, blocking the underwater penetration of sunlight needed to produce oxygen and resulting in the loss of aquatic life.

Depletion of Abiotic Resources (Elements) refers to the reduction of available non-renewable resources, such as metals and gases, that are found on the periodic table of elements, due to human activity.

Depletion of Abiotic Resources (Fossil Fuels) refers to the decreasing availability of non-renewable carbon-based compounds, such as oil and coal, due to human activity.

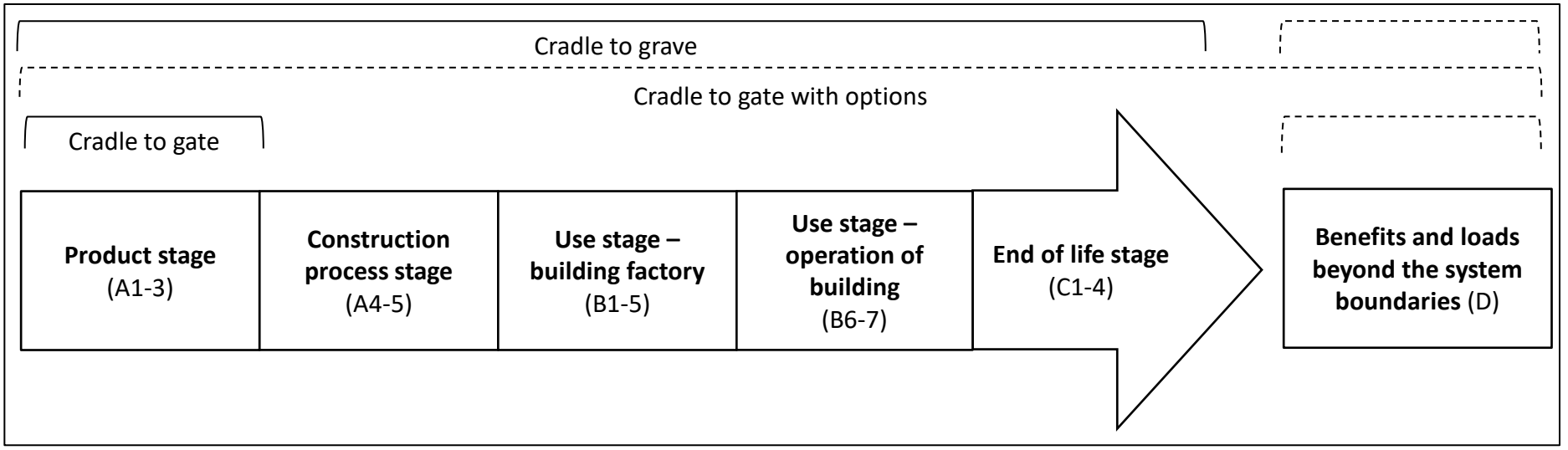
TRACI	37.0 kg CO2-Equiv.	1.10E-06 kg CFC 11-Equiv.	0.18 kg O3-Equiv.	0.70 mol H+ Equiv.	8.96E-04 kg N-Equiv.	

FUNCTIONAL UNIT: The functional unit of the product is 1 m2 of insulation material with a thickness that gives a design thermal resistance RTB = 1 m2 K/W and with a building service life of 60 years. Material Contents refers to B-side chemicals. The A-side is made from a blend of polymeric methylene diphenyl diisocyanate (pMDI).

Environment

Skulle være basert på
PCR (Product Category Rules)

EN 15804 - Bærekraftige byggverk - Miljødeklarasjoner
Grunnleggende produktkategoriregler for byggevarer



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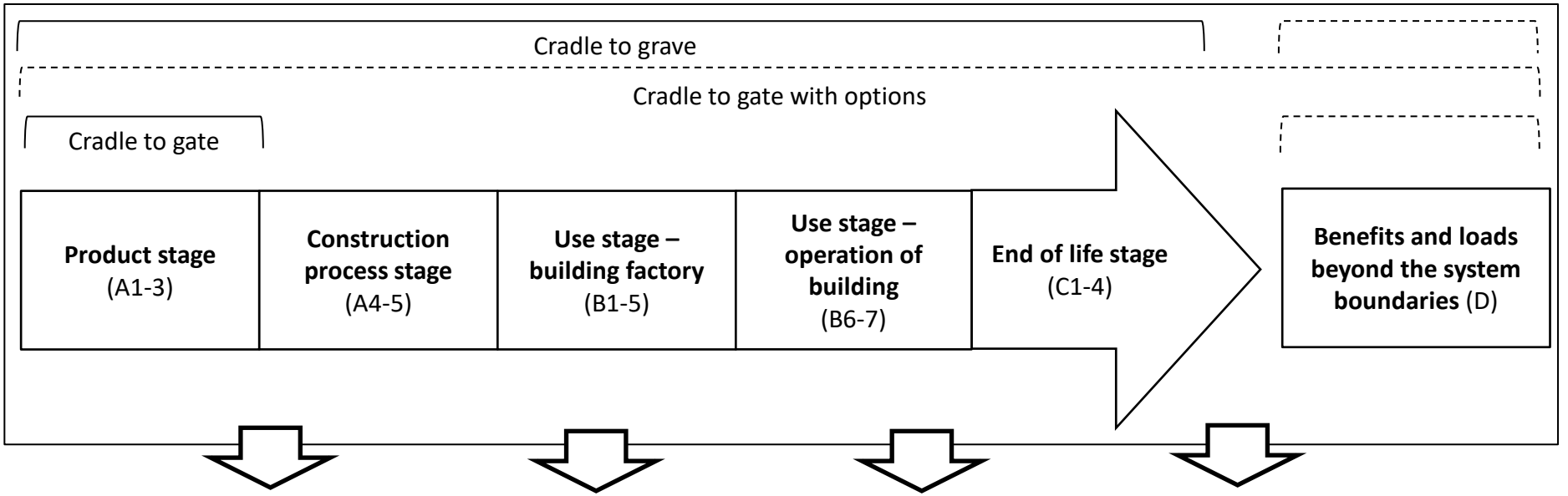

Environmental impacts
Depletion of abiotic resource elements
Depletion of abiotic resource fossil fuels
Acidification for soil and wat
Ozone depletion
Global warming
Eutrophication
Photochemical ozone creatic

Resource use
Use of renewable primary energy excluding energy resources used as raw material
Use of renewable primary energy resources used as raw material
Total use of renewable primary energy resources
Use of non-renewable primary energy excluding energy resources used as raw material
Use of non-renewable primary energy resources used as raw material
Total use of non-renewable primary energy resources
Use of secondary material
Use of renewable secondary fuels
Use of non-renewable secondary fuels
Net use of fresh water

Waste Categories
Waste disposal: hazardous
Waste disposal: non-hazardous
Waste disposal: radioactive

Output flows
Components for re-use
Materials for recycling
Materials for energy recovery
Exported energy

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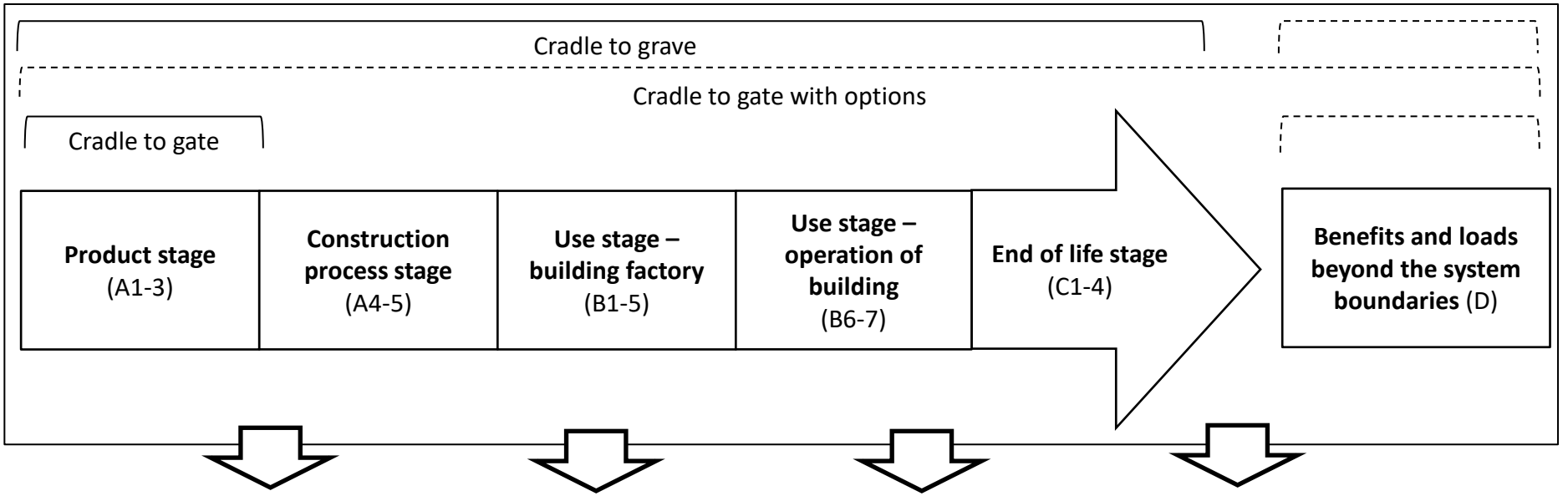

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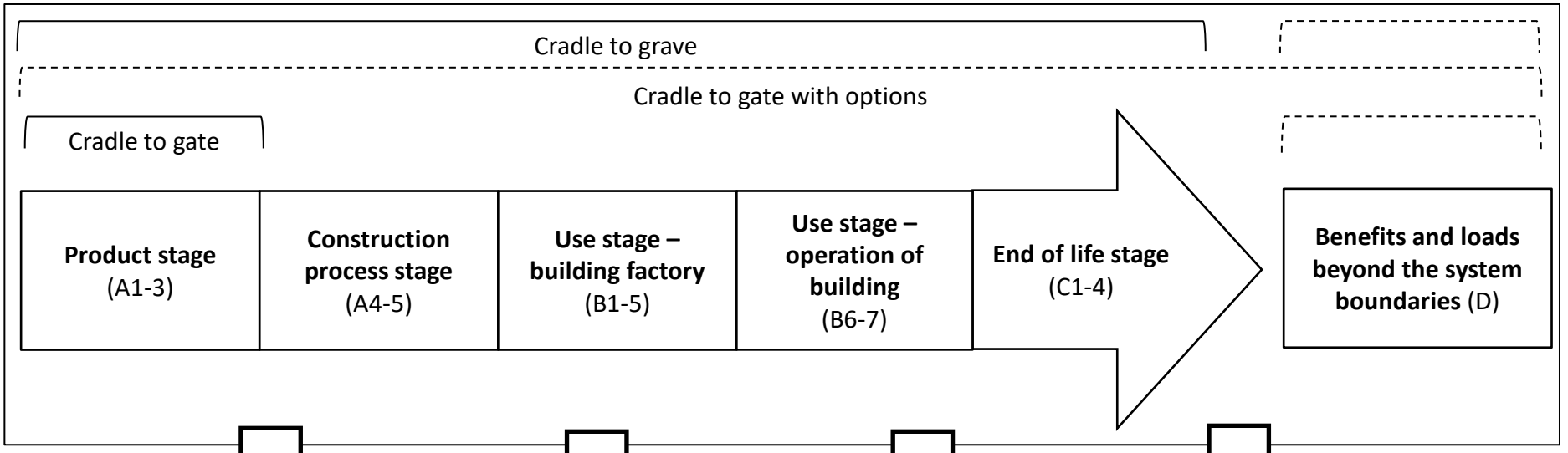

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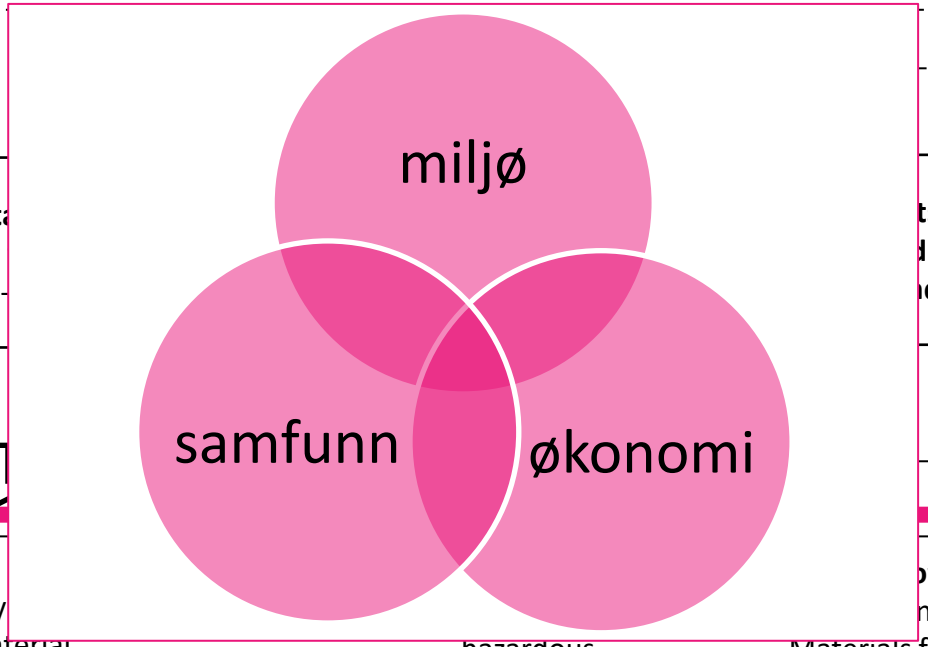
Cradle to grave

Cradle to gate

Product stage (A1-3)	**Construction process stage** (A4-5)	**Use sta building** (B1-	**ts and loads d the system daries** (D)



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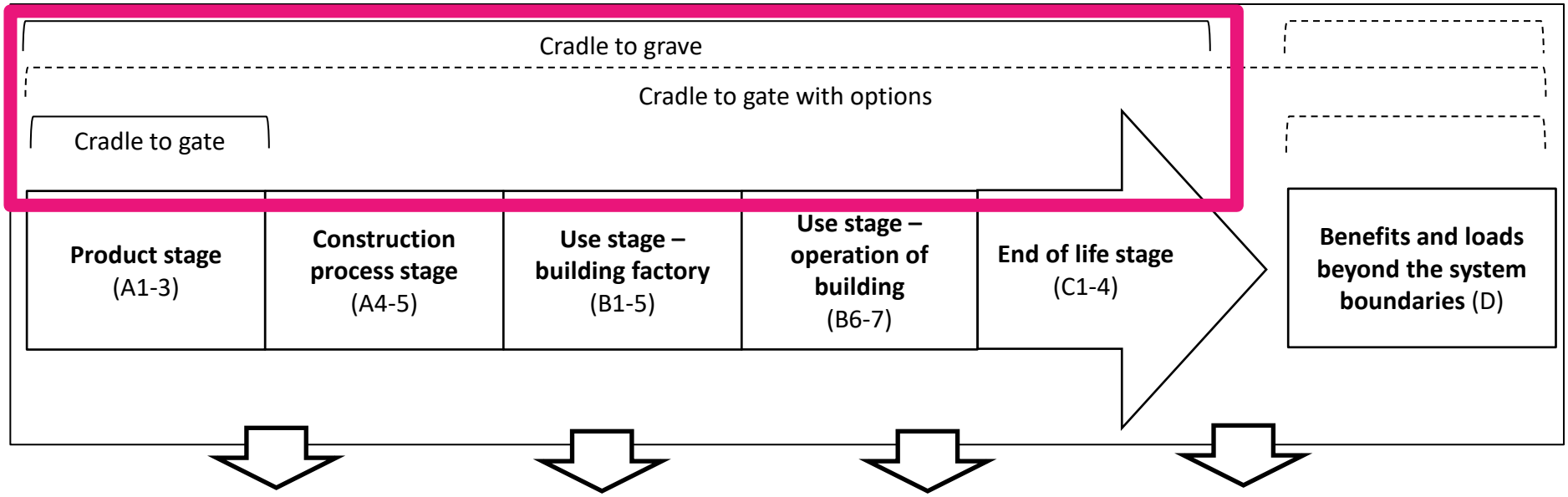

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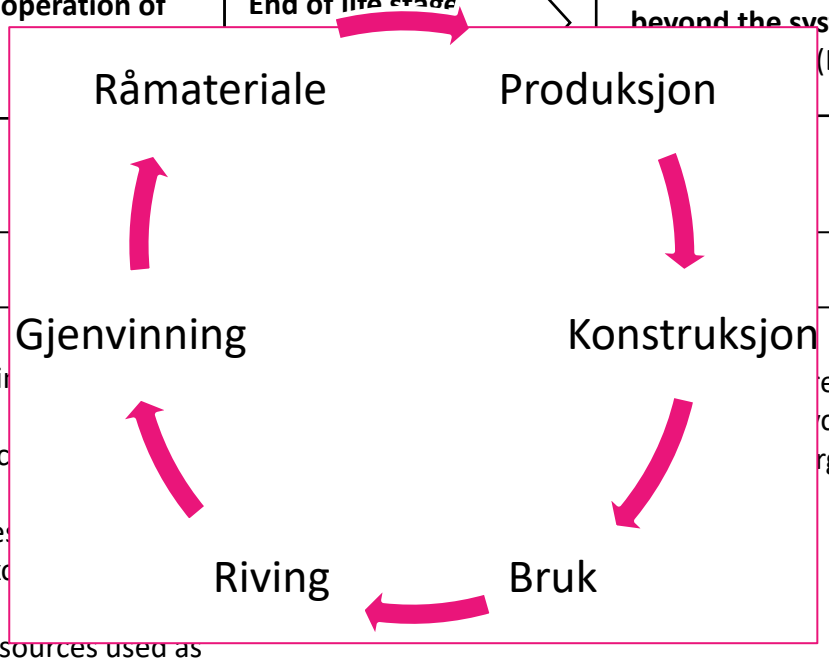
Grunnleggende produktkategoriregler for byggevarer

Cradle to grave

Cradle to gate with options

Cradle to gate

Product stage (A1-3)	Construction process stage (A4-5)	Use stage – building factory (B1-5)	Use stage – operation of	End of life stage	Benefits and loads beyond the system (D)



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re-use
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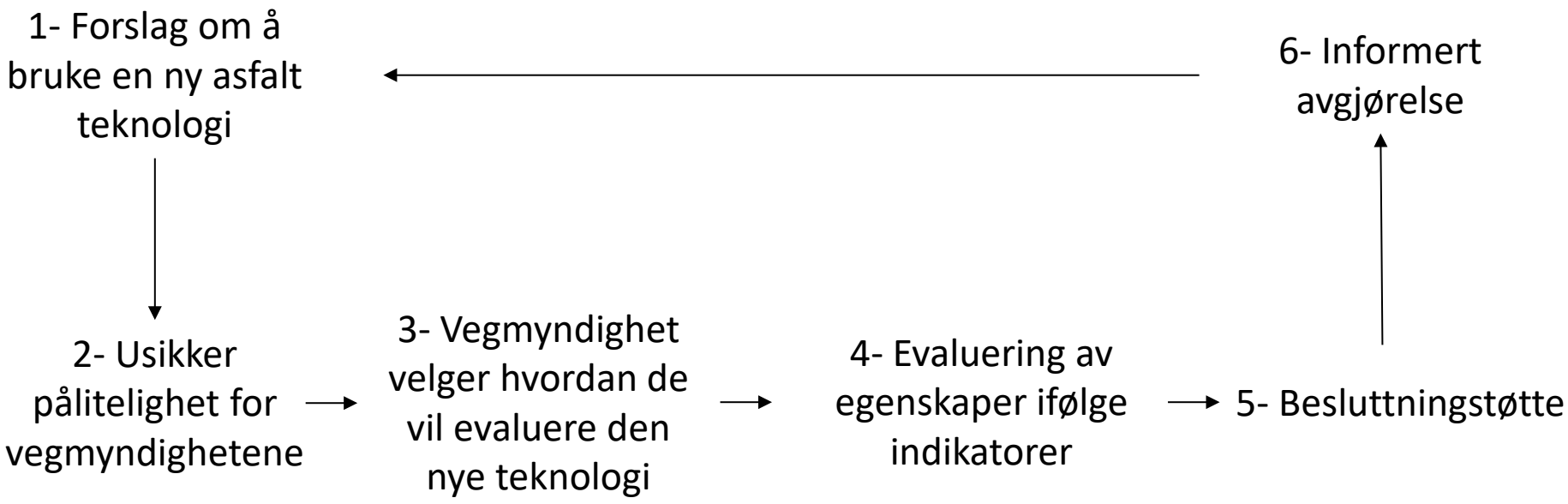
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2- Usikker pålitelighet for vegmyndighetene
3- Vegmyndighet velger hvordan de vil evaluere den nye teknologi
4- Evaluering av egenskaper ifølge indikatorer
5- Besluttningstøtte
6- Informert avgjørelse

1- Forslag om å bruke en ny asfalt teknologi

1- Forslag om å bruke en ny asfalt teknologi

2- Usikker pålitelighet for vegmyndighetene

- Bare «gode» egenskaper
- Mangel på informasjon
- Risikoer og fordeler ikke avklart

Technologies / Applicable sustainability indicator(s)	Global warming potential	Depletion of resources & waste management	Air pollution	Leaching potential	Noise	Skid resistance	Financial cost	Recyclability	Performance (durability)	Responsible sourcing	Traffic congestion
Warm and half-warm asphalt technologies											
Foam	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Organic additives	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Chemical additives	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Cold and semi-cold asphalt technologies											
Emulsion	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Foam	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Asphalt recycling											
Plant	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
In situ	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Secondary and open-loop recycled materials											
Steel slag	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Fly ash	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Crumb rubber	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Shredded roofing	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Crushed glass	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Alternative and modified binders											
Bio-binders	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Sulphur	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
PMB	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆

Positive
Negative
Nøytral
Inconclusive

1- Forslag om å bruke en ny asfalt teknologi

2- Usikker pålitelighet for vegmyndighetene

3- Vegmyndighet velger hvordan de vil evaluere den nye teknologi

- Samling av indikatorer

Indikator	Anbefalt Evaluering metode	
Global oppvarming potensial (GWP)	asPECT v4.0 MIRAVEC	kg CO_{2e}/tonne asphalt
Bruk av ressurser	Indicator MD-2 fra Greenroads v2.0	kg Sb_e/tonne asphalt
Luftforurensning	ECORCE v2.0 PaLATE	kg SO_{2e}/tonne asphalt kg $ethene_e$/tonne asphalt
Utlekkingspotensial	CEN/TS 16637 leaching tests (water)	(tool dependent)
Støyreduksjonspotensial	Laboratory drum method	dB
Gjenbruksmulighet	EDGAR bespoke methodology	%
Friksjon	Pendulum test	(tool dependent)
Responsible sourcing	BES 6001	(tool dependent)
Levetidskoatnader	LCCA Express 2.0	€
Traffikantkostnader	QUADRO	€
Ytelse	Resistance to fatigue/rutting/water sensitivity	(property dependent)

1- Forslag om å bruke en ny asfalt teknologi

↓

2- Usikker pålitelighet for vegmyndighetene → 3- Vegmyndighet velger hvordan de vil evaluere den nye teknologi → 4- Evaluering av egenskaper ifølge indikatorer

(Entrepreneurs)

1- Forslag om å bruke en ny asfalt teknologi

2- Usikker pålitelighet for vegmyndighetene → 3- Vegmyndighet velger hvordan de vil evaluere den nye teknologi → 4- Evaluering av egenskaper ifølge indikatorer → 5- Besluttningstøtte

Verktøy for å evaluere de forskjellige muligheter

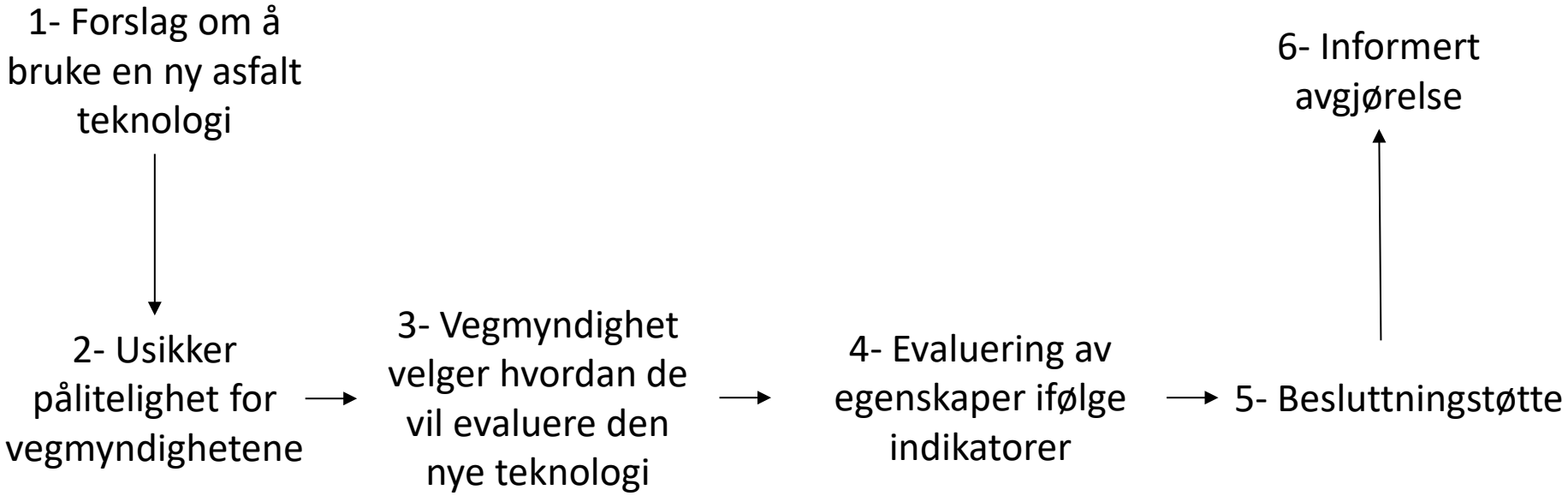
Egenskaper evaluerte ifølge indikatorer

MADM*
Multi-Attribute
Decision Making

Bærekraftighets vurdering

- Vurderer manglende data og usikkerhet
- Forskjellige vekt kan anvendes på indikatorene
- Tar hensyn av lokale eller nasjonale retningslinjer

*Bueche N. (2011) "Evaluation des performances et des impacts des enrobés bitumineux tièdes", Thèse EPFL No 5169. Lausanne.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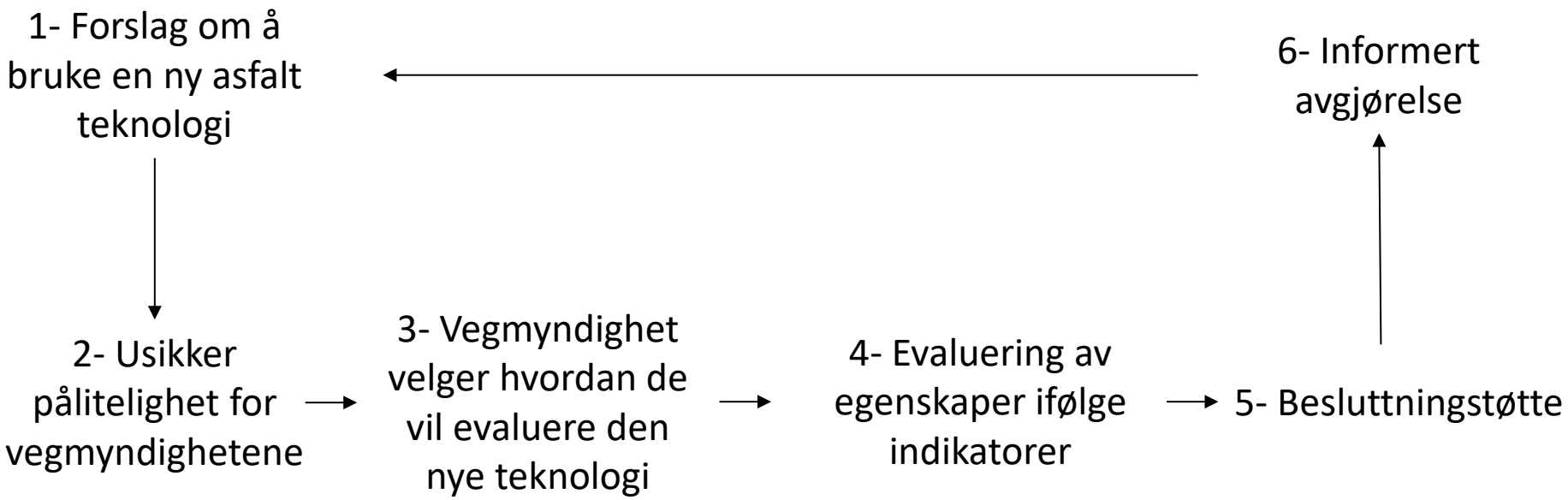
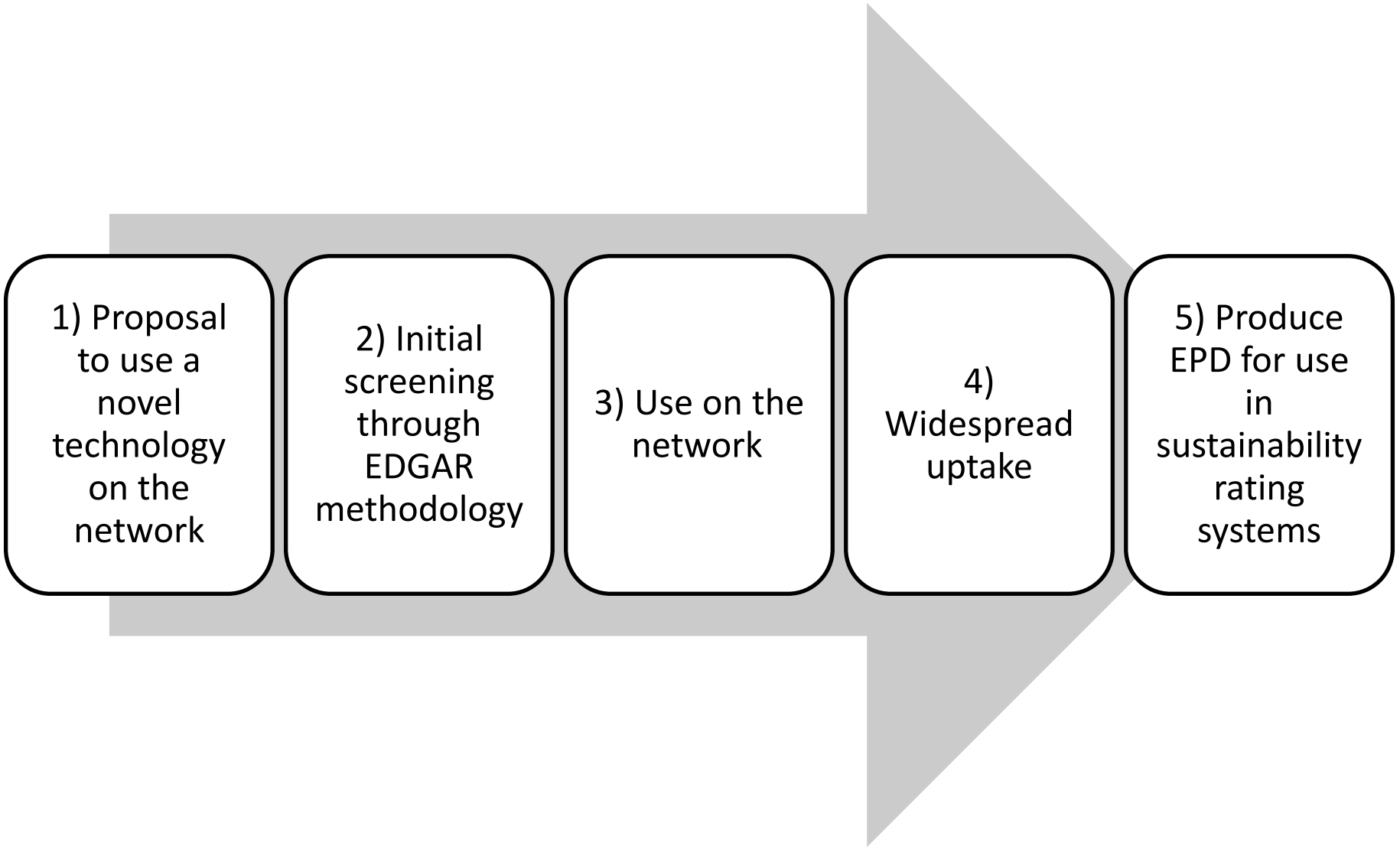


Prosessen kan iterativt gjentas når nye eller bedre data blir tilgjengelige


1) Proposal to use a novel technology on the network
2) Initial screening through EDGAR methodology
3) Use on the network
4) Widespread uptake
5) Produce EPD for use in sustainability rating systems

Virker det?

Virker det?

1. HMA ← Referanse
2. WMA (med tilsetningsstoff-syntetisk voks)
3. WMA med gjenbruk asfalt (med tilsetningsstoff-syntetisk voks)
4. Cold mix asphalt (cold in-place recycling; emulsion based)
5. HMA med stålslagg

Virker det?

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→ Evaluaering av indikatorer

→ Anvendelse av MADM

Hovedkonklusjoner

- Vanskelig å finne nøyaktige data (spesielt for CIR)
- Performance er en viktig indikator
- Bruksfasen er dominerende for GWP (rullemotstand)
- Verktøy er en avgjørelse hjelpemiddel, men krever fremdeles eksperter til å tolke resultatet
- Sensitivitetsanalyse hjelper vurdering av effekten av vekt koeffisienter og andre parametere

Resten av konklusjoner

Anvendelsen av en slik metodikk vil:

- øke bevisstheten om de grunnleggende kriteriene for å bli vurdert for asfaltveier
- oppfordre leverandører / entreprenører for å gi pålitelige data og bevis
- øke tilliten til nye "grønne" teknikker
- forbedre raskere adopsjon av de mest bærekraftige løsninger

Metodikken ble påført i en case-studie, som viser:

- sterke sider: brukbarhet, åpenhet og fleksibilitet, evne til å håndtere data usikkerhet, ...
- svake punkter: mangel på nøyaktig inndata, brukervennlighet og «idiotsikkerhet» av MADM verktøy

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EDGAR

Takk for meg!

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https://www.ntnu.edu/edgar